

Attachment I-4: Test Data

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
 Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-62M	ND Div	1	5.5	893.1	887.6	CH	34.3	74	26	48	7314	Alluvium
09-62M	ND Div	2	9	893.1	884.1	CH	34.3	81	25	56	7314	Sherack
09-62M	ND Div	3	14	893.1	879.1	CH	46	74	36	38	7314	Sherack
09-62M	ND Div	4	19	893.1	874.1	CH	59.7	115	42	73	7314	CH
09-62M	ND Div	5	24	893.1	869.1	CH	58.4	100	38	62	7314	CH
09-62M	ND Div	6	29	893.1	864.1	CH	53.3	98	36	62	7314	Brenna
09-62M	ND Div	7	34	893.1	859.1	CH	60.8	104	38	66	7314	Brenna
09-62M	ND Div	8	41.5	893.1	851.6	CH	62.3	102	33	69	7314	Brenna
09-62M	ND Div	9	49	893.1	844.1	CH	68.2	96	35	61	7314	Brenna
09-62M	ND Div	10	56.5	893.1	836.6	CH	49.9	88	32	56	7314	Brenna
09-62M	ND Div	11	64	893.1	829.1	CH	59.1	86	33	53	7314	Brenna
09-62M	ND Div	12	69	893.1	824.1	CL	19.5	28	17	11	7314	Till
09-62M	ND Div	13	75.5	893.1	817.6	CL	18.1	30	16	14	7314	Till
09-62M	ND Div	14	83.5	893.1	809.6	CL	19	40	17	23	7314	Till
09-63M	ND Div	1	9	903.7	894.7	CH	37.2	83	29	54	7314	Alluvium
09-63M	ND Div	2	13.5	903.7	890.2	CH	47.5	110	35	75	7314	CH
09-63M	ND Div	3	19.5	903.7	884.2	CH	51.8	100	31	69	7314	CH
09-63M	ND Div	4	23.5	903.7	880.2	CH	56.3	94	31	63	7314	Brenna
09-63M	ND Div	5	28.25	903.7	875.45	CH	56.1	87	34	53	7314	Brenna
09-63M	ND Div	6	33	903.7	870.7	CH	66.4	91	35	56	7314	Brenna
09-63M	ND Div	7	38.5	903.7	865.2	CH	61.5	95	35	60	7314	Argusville
09-63M	ND Div	8	43.5	903.7	860.2	CH	52.3	87	29	58	7314	Argusville
09-63M	ND Div	9	48.5	903.7	855.2	CH	50.2	77	26	51	7314	Argusville
09-63M	ND Div	10	53.5	903.7	850.2	CL	21.7	33	17	16	7314	Till
09-63M	ND Div	11	58.5	903.7	845.2	CL	21	26	17	9	7314	Till
09-63M	ND Div	12	63.5	903.7	840.2	CL	20.2	32	17	15	7314	Till
09-63M	ND Div	13	68.5	903.7	835.2	CL	18.7	41	21	20	7314	Till
09-64M	ND Div	1	7.5	898.3	890.8	CH	31.5	80	24	56	7314	Alluvium
09-64M	ND Div	2	11.5	898.3	886.8	CH	38.9	83	31	52	7314	Sherack
09-64M	ND Div	3	13.75	898.3	884.55	SC	32.6	26	19	7	7314	Alluvium
09-64M	ND Div	4	19	898.3	879.3	CH	63.8	120	34	86	7314	CH
09-64M	ND Div	5	24	898.3	874.3	CH	56.2	105	33	72	7314	Brenna
09-64M	ND Div	6	29	898.3	869.3	CH	63.2	104	33	71	7314	Brenna
09-64M	ND Div	7	34	898.3	864.3	CH	66.7	113	32	81	7314	Brenna
09-64M	ND Div	8	39	898.3	859.3	CH	59.4	109	30	79	7314	Brenna
09-64M	ND Div	9	44	898.3	854.3	CH	67.5	107	31	76	7314	Brenna
09-64M	ND Div	10	51.5	898.3	846.8	CH	60.9	90	31	59	7314	Brenna
09-64M	ND Div	11	57.5	898.3	840.8	CH	57.8	81	30	51	7314	Brenna
09-64M	ND Div	12	64	898.3	834.3	CH	57.4	86	28	58	7314	Brenna
09-64M	ND Div	13	69	898.3	829.3	CL	20.7	30	17	13	7314	Till
09-64M	ND Div	14	72.75	898.3	825.55	SC	18.2	33	20	13	7314	Till
09-65M	ND Div	1	9	902.6	893.6	CL	19.2	34	15	19	7314	Alluvium
09-65M	ND Div	2	14	902.6	888.6	CL	27.7	42	21	21	7314	Alluvium
09-65M	ND Div	3	19	902.6	883.6	CH	31.7	78	24	54	7314	Alluvium
09-65M	ND Div	4	24	902.6	878.6	CH	31.5	70	26	44	7314	Alluvium
09-65M	ND Div	5	29	902.6	873.6	CH	36.9	80	27	53	7314	Alluvium
09-65M	ND Div	6	34	902.6	868.6	CH	53.7	111	38	73	7314	Brenna
09-65M	ND Div	7	39	902.6	863.6	CH	63.5	114	36	78	7314	Brenna
09-65M	ND Div	8	44	902.6	858.6	CH	62.4	105	39	66	7314	Brenna
09-65M	ND Div	9	51.5	902.6	851.1	CH	62.6	97	34	63	7314	Brenna
09-65M	ND Div	10	59	902.6	843.6	CH	50.2	87	32	55	7314	Brenna
09-65M	ND Div	11	64	902.6	838.6	CH	29.7	40	18	22	7314	Till
09-65M	ND Div	12	69	902.6	833.6	CL	19.5	39	17	22	7314	Till
10-66M	Fargo	1	3.5	915.157	911.657	CH	37.5	73	24	49		Topsoil
10-66M	Fargo	2	8.5	915.157	906.657	CH	38	87	29	58		brenna
10-66M	Fargo	3	13.5	915.157	901.657	CH	44.1	80	26	54		Brenna
10-66M	Fargo	4	18.5	915.157	896.657	CH	46.8	83	26	57		Brenna
10-66M	Fargo	5	23.5	915.157	886.657	CH	39	64	22	42		Brenna
10-66M	Fargo	6	28.5	915.157	880.657	CH	40	56	24	32		Brenna
10-66M	Fargo	7	33.5	915.157	876.657	CH	37.5	63	27	36		Brenna
10-66M	Fargo	8	38.5	915.157	871.657	CH	38.1	56	26	30		Brenna
10-66M	Fargo	9	43.5	915.157	866.657	CH	41.7	68	26	42		argusville
10-66M	Fargo	10	48.5	915.157	861.657	CH	38.8	67	25	42		argusville
10-66M	Fargo	11	53.5	915.157	856.657	CH	40	91	28	63		argusville
10-66M	Fargo	12	58.5	915.157	850.957	SC	31.1	27	15	12		unit "A" till
10-66M	Fargo	13	63.5	915.157	844.657	CL-ML	15.3	19	12	7		unit "A" till
10-66M	Fargo	14	68.5	915.157	829.657	CL	14.7	30	16	14		unit "A" till

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Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-71M	Fargo	1	3.5	896.571	893.071	CH	39.6	75	30	45		Topsoil
10-71M	Fargo	2	8.5	896.571	888.071	CH	36.9	73	21	52		sherack
10-71M	Fargo	3	10.5	896.571	886.071	CH	37.1	73	26	47		sherack
10-71M	Fargo	4	13.5	896.571	883.071	CH	45.6	102	30	72		Oxidized Brenna
10-71M	Fargo	5	18.5	896.571	878.071	CH	52.3	111	29	82		Oxidized Brenna
10-71M	Fargo	6	23.6	896.571	872.971	CH	54.5	107	31	76		brenna
10-71M	Fargo	7	28.5	896.571	868.071	CH	55	92	30	62		brenna
10-71M	Fargo	8	33.5	896.571	863.071	CH	67.1	118	23	95		brenna
10-71M	Fargo	9	38.5	896.571	858.071	CH	60.8	115	17	98		brenna
10-71M	Fargo	10	43.5	896.571	853.071	CH	64.5	107	28	79		brenna
10-71M	Fargo	11	48.5	896.571	848.071	CH	62.4	102	28	74		argusville
10-71M	Fargo	12	53.5	896.571	843.071	CH	50.9	91	27	64		argusville
10-71M	Fargo	13	58.5	896.571	838.071	CH	51.2	76	24	52		argusville
10-71M	Fargo	14	64.15	896.571	832.421	CL	37.6	33	23	10		unit "A" till
10-71M	Fargo	15	68.5	896.571	828.071	SC	18.5	30	15	15		unit "A" till
10-71M	Fargo	16	73.5	896.571	823.071	CL	17	28	16	12		unit "A" till
10-71M	Fargo	17	93.5	896.571	803.071	ML	37.1	45	34	11		unit "A" till
10-72M	Fargo	1	3.75	894.034	890.284	CH	35.2	81	34	47		Topsoil
10-72M	Fargo	2	6.25	894.034	887.784	CH	33.9	74	29	45		fill
10-72M	Fargo	3	9.25	894.034	884.784	CH	32.9	74	26	48		sherack
10-72M	Fargo	4	11.75	894.034	882.284	CH	35.7	60	25	35		sherack
10-72M	Fargo	5	14.25	894.034	879.784	CH	41	98	36	62		Oxidized Brenna
10-72M	Fargo	6	19.25	894.034	874.784	CH	54.5	110	40	70		Oxidized Brenna
10-72M	Fargo	7	22.25	894.034	871.784	CH	63.3	114	29	85		Oxidized Brenna
10-72M	Fargo	8	27.75	894.034	866.284	CH	56.3	103	32	71		Brenna
10-72M	Fargo	9	30.25	894.034	863.784	CH	61	98	33	65		Brenna
10-72M	Fargo	10	39.25	894.034	854.784	CH	58.5	100	33	67		Brenna
10-72M	Fargo	11	43.75	894.034	850.284	CH	63.3	115	27	88		Brenna
10-72M	Fargo	12	49.25	894.034	844.784	CH	64.8	116	35	81		argusville
10-72M	Fargo	13	50.25	894.034	843.784	CH	63.3	109	33	76		argusville
10-72M	Fargo	14	54.75	894.034	839.284	CH	54.5	105	29	76		argusville
10-72M	Fargo	15	59.25	894.034	834.784	CH	53.8	98	29	69		argusville
10-72M	Fargo	16	63.25	894.034	830.784	CH	57	90	32	58		argusville
10-72M	Fargo	17	68.75	894.034	825.284	CH	58.6	99	30	69		argusville
10-72M	Fargo	18	72.25	894.034	821.784	CH	61	84	28	56		argusville
10-72M	Fargo	19	78.25	894.034	815.784	SC	17	29	16	13		unit "A" till
10-72M	Fargo	20	88.75	894.034	805.284	CL	13.5	33	17	16		unit "A" till
10-73M	Fargo	1	2	883.857	881.857	ML	40.7	55	30	25		dessicated brenna
10-73M	Fargo	2	4	883.857	879.857	CH	46.1	109	31	78		dessicated brenna
10-73M	Fargo	3	8.5	883.857	875.357	CH	61.9	112	30	82		dessicated brenna
10-73M	Fargo	4	13.5	883.857	870.357	CH	57.7	107	35	72		dessicated brenna
10-73M	Fargo	5	18.5	883.857	865.357	CH	54.1	96	35	61		dessicated brenna
10-73M	Fargo	6	23.5	883.857	860.357	CH	69.6	112	33	79		brenna
10-73M	Fargo	7	28.5	883.857	855.357	CH	63.1	102	34	68		brenna
10-73M	Fargo	8	33.5	883.857	850.357	CH	74.4	122	35	87		brenna
10-73M	Fargo	9	38.5	883.857	845.357	CH	62.2	113	29	84		brenna
10-73M	Fargo	10	40.5	883.857	843.357	CH	67.6	120	35	85		brenna
10-73M	Fargo	11	42.5	883.857	841.357	CH	60.7	103	30	73		argusville
10-73M	Fargo	12	48.5	883.857	835.357	CH	59.2	96	29	67		argusville
10-73M	Fargo	13	53.5	883.857	830.357	CH	59.7	93	30	63		argusville
10-73M	Fargo	14	58.5	883.857	825.357	CH	63.7	87	35	52		argusville
10-73M	Fargo	15	63.5	883.857	820.357	CL	18.5	26	16	10		unit "A" till
10-73M	Fargo	16	68.25	883.857	815.607	SC	18	26	15	11		unit "A" till
10-73M	Fargo	17	76	883.857	807.857	CL	17.7	33	19	14		unit "A" till
10-73M	Fargo	18	85.5	883.857	798.357	CL	22	33	18	15		unit "A" till
10-74M	Fargo	1	1.25	880.475	879.225	CH	36.5	70	23	47		Topsoil
10-74M	Fargo	2	4.75	880.475	875.725	CH	27.4	65	24	41		Alluvium
10-74M	Fargo	3	8.25	880.475	872.225	CH	38.4	84	29	55		sherack
10-74M	Fargo	4	13.75	880.475	866.725	CH	43.1	84	27	57		sherack
10-74M	Fargo	5	19.25	880.475	861.225	CH	36.6	69	26	43		sherack
10-74M	Fargo	6	21.25	880.475	859.225	CH	44.4	101	33	68		Oxidized Brenna
10-74M	Fargo	7	24.25	880.475	856.225	CH	59	115	37	78		Oxidized Brenna
10-74M	Fargo	8	28.75	880.475	851.725	CH	55.1	107	34	73		Oxidized Brenna
10-74M	Fargo	9	32.75	880.475	847.725	CH	56.8	102	29	73		Brenna
10-74M	Fargo	10	38.75	880.475	841.725	CH	55.9	98	30	68		Brenna
10-74M	Fargo	11	43.75	880.475	836.725	CH	75.7	109	28	81		Brenna
10-74M	Fargo	12	48.75	880.475	831.725	CH	50.8	94	28	66		Brenna
10-74M	Fargo	13	53.75	880.475	826.725	CH	63.6	110	31	79		Brenna
10-74M	Fargo	14	58.75	880.475	821.725	CH	60.1	111	25	86		Brenna
10-74M	Fargo	15	63.75	880.475	816.725	CH	54.5	106	31	75		Brenna
10-74M	Fargo	16	67.75	880.475	812.725	CH	58	103	30	73		Brenna
10-74M	Fargo	17	70.25	880.475	810.225	CH	59.8	108	27	81		Brenna
10-74M	Fargo	18	74.75	880.475	805.725	CH	57	98	29	69		argusville
10-74M	Fargo	19	76.25	880.475	804.225	CH	56	89	27	62		argusville
10-74M	Fargo	20	79.75	880.475	800.725	CH	51.8	74	27	47		argusville
10-74M	Fargo	21	81.75	880.475	798.725	CH	43.9	76	24	52		argusville
10-74M	Fargo	22	87.75	880.475	792.725	CH	36.5	59	24	35		argusville
10-74M	Fargo	23	93.25	880.475	787.225	CL	20.3	26	16	10		unit "A" till
10-74M	Fargo	24	95.75	880.475	784.725	CL	10.9	29	15	14		unit "A" till
10-74M	Fargo	25	98.35	880.475	782.125	CL	11.9	22	14	8		unit "A" till
10-74M	Fargo	26	103.25	880.475	777.225	CL	20.8	35	17	18		unit "A" till
10-74M	Fargo	27	108.25	880.475	772.225	CL-ML	21.6	23	19	4		unit "A" till
10-74M	Fargo	28	113.75	880.475	766.725	CL	20.9	35	19	16		unit "A" till

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Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-75M	Fargo	1	4.5	890.601	886.101	CH	30.2	66	23	43		Alluvium
10-75M	Fargo	2	8.1	890.601	882.501	CH	34	77	26	51		sherack
10-75M	Fargo	3	9.5	890.601	881.101	CH	40	105	32	73		dessicated brenna
10-75M	Fargo	4	13.5	890.601	877.101	CH	61.5	111	36	75		brenna
10-75M	Fargo	5	18.5	890.601	872.101	CH	50.7	96	35	61		brenna
10-75M	Fargo	6	23.5	890.601	867.101	CH	49.2	88	31	57		brenna
10-75M	Fargo	7	28.5	890.601	862.101	CH	60.7	94	32	62		brenna
10-75M	Fargo	8	33.4	890.601	857.201	CH	54.3	93	35	58		brenna
10-75M	Fargo	9	38.35	890.601	852.251	CH	57.3	92	34	58		brenna
10-75M	Fargo	10	43.5	890.601	847.101	CH	63.6	110	30	80		brenna
10-75M	Fargo	11	48.5	890.601	842.101	CH	60.9	100	32	68		argusville
10-75M	Fargo	12	53.5	890.601	837.101	CH	53	90	26	64		argusville
10-75M	Fargo	13	58.5	890.601	832.101	CH	61.9	76	31	45		argusville
10-75M	Fargo	14	63.5	890.601	827.101	CH	31.3	90	26	64		argusville
10-75M	Fargo	15	68.5	890.601	822.101	CL	14.6	28	17	11		unit "A" till
10-75M	Fargo	16	73.5	890.601	817.101	CL	18.5	27	17	10		unit "A" till
10-75M	Fargo	17	85.5	890.601	805.101	CL	12.5	42	19	23		unit "A" till
10-75M	Fargo	18	95.5	890.601	795.101	CL	19	30	17	13		unit "A" till
10-76M	Fargo	1	0.25	881.646	881.396	CH	39.8	70	22	48		Topsoil
10-76M	Fargo	2	4.75	881.646	876.896	CH	28.9	60	22	38		fill
10-76M	Fargo	3	5.25	881.646	876.396	CH	29.9	62	21	41		Alluvium
10-76M	Fargo	4	9.25	881.646	872.396	CH	28.4	64	22	42		sherack
10-76M	Fargo	5	12.25	881.646	869.396	CH	39.7	76	24	52		sherack
10-76M	Fargo	6	15.25	881.646	866.396	CH	38	75	28	47		sherack
10-76M	Fargo	7	16.35	881.646	865.296	CH	38.5	88	28	60		dessicated brenna
10-76M	Fargo	8	19.75	881.646	861.896	CH	43.3	112	33	79		dessicated brenna
10-76M	Fargo	9	23.75	881.646	857.896	CH	61.5	109	36	73		dessicated brenna
10-76M	Fargo	10	28.75	881.646	852.896	CH	54.8	105	34	71		Brenna
10-76M	Fargo	11	32.25	881.646	849.396	CH	54.6	97	30	67		Brenna
10-76M	Fargo	12	37.75	881.646	843.896	CH	51.8	82	28	54		Brenna
10-76M	Fargo	13	43.75	881.646	837.896	CH	53.2	86	32	54		Brenna
10-76M	Fargo	14	48.75	881.646	832.896	CH	58.1	94	29	65		Brenna
10-76M	Fargo	15	53.75	881.646	827.896	CH	60.3	105	31	74		Brenna
10-76M	Fargo	16	58.75	881.646	822.896	CH	62.1	113	31	82		Brenna
10-76M	Fargo	17	64.25	881.646	817.396	CH	60.6	96	28	68		Brenna
10-76M	Fargo	18	69.25	881.646	812.396	CH	61.1	92	27	65		Brenna
10-76M	Fargo	19	73.25	881.646	808.396	CH	59.4	92	33	59		Brenna
10-76M	Fargo	20	74.75	881.646	806.896	CH	58	96	30	66		Brenna
10-77M	Fargo	1	3.5	912.682	909.182	CH	28.3	72	24	48		Alluvium
10-77M	Fargo	2	8.5	912.682	904.182	CH	43.1	85	25	60		dessicated brenna
10-77M	Fargo	3	13.5	912.682	899.182	CH	46.8	79	26	53		dessicated brenna
10-77M	Fargo	4	23.5	912.682	889.182	CH	48.4	76	25	51		brenna
10-77M	Fargo	5	28.5	912.682	884.182	CH	38.7	68	21	47		brenna
10-77M	Fargo	6	33.5	912.682	879.182	CH	42.3	71	24	47		brenna
10-77M	Fargo	7	38.5	912.682	874.182	CH	41.5	73	29	44		brenna
10-77M	Fargo	8	43.5	912.682	869.182	CH	44.1	63	24	39		argusville
10-77M	Fargo	9	48.5	912.682	864.182	CH	48.7	74	24	50		argusville
10-77M	Fargo	10	53.5	912.682	859.182	CH	47.8	71	24	47		argusville
10-77M	Fargo	11	58.5	912.682	854.182	CH	46.3	67	24	43		argusville
10-77M	Fargo	12	63.5	912.682	849.182	CH	44.7	72	20	52		argusville
10-77M	Fargo	13	68.5	912.682	844.182	CH	44.7	59	22	37		argusville
10-77M	Fargo	14	73.5	912.682	839.182	CL	15.8	26	15	11		unit "A" till
10-77M	Fargo	15	78.5	912.682	834.182	CL	45.8	30	15	15		unit "A" till
10-78M	Fargo	1	8.5	905.68	897.18	CH	31	64	20	44		Alluvium
10-78M	Fargo	2	18.5	905.68	887.18	CH	30.9	67	22	45		Alluvium
10-78M	Fargo	3	23.5	905.68	882.18	CH	41.1	65	19	46		dessicated brenna
10-78M	Fargo	4	28.5	905.68	877.18	CH	39.6	69	23	46		dessicated brenna
10-78M	Fargo	5	33.5	905.68	872.18	CH	43.7	68	21	47		argusville
10-78M	Fargo	6	38.5	905.68	867.18	CH	43.3	65	19	46		argusville
10-78M	Fargo	7	43.5	905.68	862.18	CH	50.3	79	29	50		argusville
10-78M	Fargo	8	48.5	905.68	857.18	CH	46.2	78	23	55		argusville
10-78M	Fargo	9	53.5	905.68	852.18	CH	44.7	75	20	55		argusville
10-78M	Fargo	10	58.5	905.68	847.18	CH	51.1	69	21	48		argusville
10-78M	Fargo	11	63.5	905.68	842.18	CH	48.1	70	15	55		argusville
10-78M	Fargo	12	68.5	905.68	837.18	CL	18	32	18	14		unit "A" till
10-78M	Fargo	13	75.5	905.68	830.18	CL-ML	9.3	15	11	4		unit "A" till
10-79M	Fargo	1	8.5	905.252	896.752	CH	30.2	56	23	33		Alluvium
10-79M	Fargo	2	13.5	905.252	891.752	CH	28.7	58	22	36		Alluvium
10-79M	Fargo	3	18.5	905.252	886.752	CH	26.3	57	18	39		Alluvium
10-79M	Fargo	4	24.5	905.252	880.752	CL	25.4	48	17	31		Alluvium
10-79M	Fargo	5	28.5	905.252	876.752	CH	38.6	60	25	35		Alluvium
10-79M	Fargo	6	33.5	905.252	871.752	CH	39.3	62	29	33		argusville
10-79M	Fargo	7	38.5	905.252	866.752	CH	42.4	72	24	48		argusville
10-79M	Fargo	8	43.5	905.252	861.752	CH	61	79	21	58		argusville
10-79M	Fargo	10	53.5	905.252	851.752	CL-ML	11.3	17	13	4		unit "A" till
10-79M	Fargo	11	60.5	905.252	844.752	CL-ML	17.1	22	16	6		unit "A" till
10-79M	Fargo	12	70.5	905.252	834.752	CL	13.6	27	16	11		unit "A" till
10-79M	Fargo	14	90.5	905.252	814.752	ML	8.6	11	10	1		unit "A" till

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH
 Date: JUL 09
 Latest Revision: 2/18/2011
 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-80M	Fargo	1	3.25	921.11	917.86	CL	29.4	48	23	25		topsoil
10-80M	Fargo	7	28.25	921.11	892.86	ML	29.9	35	27	8		Alluvium
10-80M	Fargo	8	33.25	921.11	887.86	CH	49.4	85	27	58		brenna
10-80M	Fargo	9	38.75	921.11	882.36	CH	51.2	95	25	70		brenna
10-80M	Fargo	10	43.25	921.11	877.86	CH	50	78	27	51		brenna
10-80M	Fargo	11	48.25	921.11	872.86	CH	60.5	100	34	66		brenna
10-80M	Fargo	12	52.75	921.11	868.36	CH	70.5	82	34	48		brenna
10-80M	Fargo	13	58.75	921.11	862.36	CH	50.4	79	24	55		brenna
10-80M	Fargo	14	63.25	921.11	857.86	CH	53.1	78	29	49		argusville
10-80M	Fargo	15	68.25	921.11	852.86	CL	19	26	15	11		unit "A" till
10-80M	Fargo	16	73.75	921.11	847.36	CL	21.2	29	16	13		unit "A" till
10-80M	Fargo	18	83.25	921.11	837.86	ML	8.1	14	11	3		unit "A" till
10-80M	Fargo	19	88.25	921.11	832.86	ML	8.3	13	11	2		unit "A" till
10-80M	Fargo	21	98.25	921.11	822.86	CL	23.9	43	21	22		unit "A" till
10-80M	Fargo	22	103.25	921.11	817.86	ML	21	Non-Plastic				unit "A" till
09-11M	MN Div	1	4.5	887.6	883.1	CH	32.9	74	33	41	G4127	topsoil/alluvium
09-11M	MN Div	2	9.5	887.6	878.1	CH	33	72	30	42	G4127	sherack
09-11M	MN Div	3	15.5	887.6	872.1	CH	39.5	75	29	46	G4127	sherack
09-11M	MN Div	4	19.5	887.6	868.1	CH	35.5	81	30	51	G4127	PL Sherack
09-11M	MN Div	5	25.5	887.6	862.1	CH	42.5	97	35	62	G4127	brenna
09-11M	MN Div	6	33.5	887.6	854.1	CH	57.6	104	30	74	G4127	brenna
09-11M	MN Div	7	38.5	887.6	849.1	CH	60.1	100	32	68	G4127	brenna
09-11M	MN Div	8	44	887.6	843.6	CH	56.3	87	32	55	G4127	brenna
09-11M	MN Div	9	49.5	887.6	838.1	CH	58.6	96	39	57	G4127	brenna
09-11M	MN Div	10	54.5	887.6	833.1	CH	62.8	93	39	54	G4127	brenna
09-11M	MN Div	11	59.5	887.6	828.1	CH	63.5	107	38	69	G4127	brenna
09-11M	MN Div	12	64.5	887.6	823.1	CH	65.2	112	40	72	G4127	brenna
09-11M	MN Div	13	69.5	887.6	818.1	CH	57.4	95	31	64	G4127	brenna
09-11M	MN Div	14	74.5	887.6	813.1	CH	55.5	98	35	63	G4127	brenna
09-11M	MN Div	15	79.5	887.6	808.1	CH	53.5	88	33	55	G4127	brenna
09-11M	MN Div	16	84	887.6	803.6	CH	45.5	69	30	39	G4127	argusville
09-11M	MN Div	17	89.5	887.6	798.1	CH	44.2	78	27	51	G4127	argusville
09-11M	MN Div	18	94.5	887.6	793.1	CH	47	70	25	45	G4127	argusville
09-11M	MN Div	19	99.5	887.6	788.1	CL	20.5	29	17	12	G4127	till
09-11M	MN Div	20	107.5	887.6	780.1	CL	20.7	28	16	12	G4127	till
09-12M	MN Div	1	4.5	892.2	887.7	CH	31.1	58	28	30	G4127	sherack
09-12M	MN Div	2	9.5	892.2	882.7	CH	44.8	77	32	45	G4127	sherack
09-12M	MN Div	3	13.5	892.2	878.7	ML	27.5				G4127	poplar river
09-12M	MN Div	4	18.25	892.2	873.95	ML	29	28	26	2	G4127	poplar river
09-12M	MN Div	5	22	892.2	870.2	CH	51.3	60	22	38	G4127	poplar river
09-12M	MN Div	6	25.25	892.2	866.95	CH	37.8	67	30	37	G4127	poplar river
09-12M	MN Div	7	34.5	892.2	857.7	CH	74.1	108	32	76	G4127	brenna
09-12M	MN Div	8	39	892.2	853.2	CH	72.9	103	37	66	G4127	brenna
09-12M	MN Div	9	43.5	892.2	848.7	CH	57.6	99	37	62	G4127	brenna
09-12M	MN Div	10	49.5	892.2	842.7	CH	72.7	120	32	88	G4127	brenna
09-12M	MN Div	11	54.5	892.2	837.7	CH	74.6	120	37	83	G4127	brenna
09-12M	MN Div	12	59.5	892.2	832.7	CH	68.4	113	36	77	G4127	brenna
09-12M	MN Div	13	64.5	892.2	827.7	CH	65.1	106	32	74	G4127	brenna
09-12M	MN Div	14	69.5	892.2	822.7	CH	60.6	99	33	66	G4127	brenna
09-12M	MN Div	15	74.5	892.2	817.7	CH	49.5	82	34	48	G4127	brenna
09-12M	MN Div	16	79	892.2	813.2	CH	59.9	98	32	66	G4127	brenna
09-12M	MN Div	17	84.5	892.2	807.7	CH	53.4	75	29	46	G4127	argusville
09-12M	MN Div	18	89.5	892.2	802.7	CH	44.4	66	26	40	G4127	argusville
09-12M	MN Div	19	94.5	892.2	797.7	CH	51.5	91	30	61	G4127	argusville
09-12M	MN Div	20	99.5	892.2	792.7	CH	51.8	87	29	58	G4127	argusville
09-12M	MN Div	21	104.5	892.2	787.7	CH	45.3	84	30	54	G4127	argusville
09-12M	MN Div	22	109.5	892.2	782.7	CH	44.8	76	29	47	G4127	argusville
09-12M	MN Div	23	114.5	892.2	777.7	ML	15.2	20	18	2	G4127	till
09-13M	MN Div	1	4.5	903.4	898.9	ML	31.8	48	29	19	G4127	sherack
09-13M	MN Div	2	9.5	903.4	893.9	MH	37.5	58	32	26	G4127	sherack
09-13M	MN Div	3	14.5	903.4	888.9	ML	28.8	24	23	1	G4127	poplar river
09-13M	MN Div	4	19.5	903.4	883.9	ML	28.2	26	23	3	G4127	poplar river
09-13M	MN Div	5	24.5	903.4	878.9	CH	36.1	53	27	26	G4127	poplar river
09-13M	MN Div	6	29.5	903.4	873.9	CH	42.7	97	38	59	G4127	brenna
09-13M	MN Div	7	34.5	903.4	868.9	CH	80.4	134	43	91	G4127	brenna
09-13M	MN Div	8	39.5	903.4	863.9	CH	76.3	120	33	87	G4127	brenna
09-13M	MN Div	9	44.5	903.4	858.9	CH	68.4	99	33	66	G4127	brenna
09-13M	MN Div	10	49.5	903.4	853.9	CH	66.9	98	33	65	G4127	brenna
09-13M	MN Div	11	54.5	903.4	848.9	CH	71.4	110	31	79	G4127	brenna
09-13M	MN Div	12	59.5	903.4	843.9	CH	66.3	110	27	83	G4127	brenna
09-13M	MN Div	13	64.5	903.4	838.9	CH	59.8	103	33	70	G4127	brenna
09-13M	MN Div	14	69.5	903.4	833.9	CH	57.9	93	30	63	G4127	brenna
09-13M	MN Div	15	74.5	903.4	828.9	CH	61.6	91	30	61	G4127	brenna
09-13M	MN Div	16	79.5	903.4	823.9	CH	57.2	85	26	59	G4127	brenna
09-13M	MN Div	17	84.5	903.4	818.9	CH	54.3	88	29	59	G4127	brenna
09-13M	MN Div	18	89.5	903.4	813.9	CH	54.6	94	31	63	G4127	argusville
09-13M	MN Div	19	94.5	903.4	808.9	CH	46	80	31	49	G4127	argusville
09-13M	MN Div	20	99.5	903.4	803.9	CH	44.1	80	30	50	G4127	argusville
09-13M	MN Div	21	104.5	903.4	798.9	CL	30.9	61	19	42	G4127	argusville
09-13M	MN Div	22	109.5	903.4	793.9	CH	28.8	48	21	27	G4127	argusville
09-13M	MN Div	23	114.5	903.4	788.9	CH	36.1	56	24	32	G4127	argusville
09-13M	MN Div	24	121.5	903.4	781.9	CL	13.4	23	15	8	G4127	till

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 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-14M	MN Div	1	3.75	913.1	909.35	CH	33.6	63	26	37	G4127	sherack
09-14M	MN Div	2	9.5	913.1	903.6	CH	37.1	62	21	41	G4127	sherack
09-14M	MN Div	3	14.5	913.1	898.6	CH	56.3	96	29	67	G4127	brenna
09-14M	MN Div	4	19.5	913.1	893.6	CH	47.9	92	29	63	G4127	brenna
09-14M	MN Div	5	23.25	913.1	889.85	CH	53.2	80	28	52	G4127	brenna
09-14M	MN Div	6	29.5	913.1	883.6	CH	45.7	81	33	48	G4127	brenna
09-14M	MN Div	7	33.5	913.1	879.6	CH	55.2	90	31	59	G4127	brenna
09-14M	MN Div	8	38.5	913.1	874.6	CH	49.5	91	31	60	G4127	brenna
09-14M	MN Div	9	44.5	913.1	868.6	CH	39.7	69	29	40	G4127	argusville
09-14M	MN Div	10	49.5	913.1	863.6	CH	42.9	76	28	48	G4127	argusville
09-14M	MN Div	11	54.5	913.1	858.6	CH	37.9	51	25	26	G4127	argusville
09-14M	MN Div	12	59.5	913.1	853.6	CH	42.4	52	25	27	G4127	argusville
09-14M	MN Div	13	64.5	913.1	848.6	ML	26				G4127	Elastic Silt
09-14M	MN Div	14	68.5	913.1	844.6	CL	20.3	25	17	8	G4127	Interbedded Till?
09-14M	MN Div	15	69.5	913.1	843.6	SM	21.7				G4127	Sand
09-14M	MN Div	16	74.5	913.1	838.6	SM	26.4				G4127	Sand
09-14M	MN Div	17	79.5	913.1	833.6	SM	24.8				G4127	Sand
09-14M	MN Div	18	84.5	913.1	828.6	SM	22.9				G4127	Sand
09-14M	MN Div	19	89	913.1	824.1	SP-SM	23.1				G4127	Sand
09-14M	MN Div	20	93.5	913.1	819.6	SM	22.2				G4127	Sand
09-14M	MN Div	21	99	913.1	814.1	SP-SM	19.7				G4127	Sand
09-14M	MN Div	22	104.5	913.1	808.6	CL-ML	11.7	21	17	4	G4127	till
09-14M	MN Div	23	109.5	913.1	803.6	CL-ML	12.2	23	16	7	G4127	till
09-15M	MN Div	1	4	914.9	910.9	CH	24.6	66	23	43	G4127	sherack
09-15M	MN Div	2	9.5	914.9	905.4	ML	32.2	36	29	7	G4127	sherack
09-15M	MN Div	3	14	914.9	900.9	SP-SM	19.9				G4127	poplar river
09-15M	MN Div	4	19.5	914.9	895.4	CH	68.6	123	36	87	G4127	brenna
09-15M	MN Div	5	23.25	914.9	891.65	CH	63.9	107	34	73	G4127	brenna
09-15M	MN Div	6	28.15	914.9	886.75	CH	65	111	36	75	G4127	brenna
09-15M	MN Div	7	34.5	914.9	880.4	CH	67.6	111	39	72	G4127	brenna
09-15M	MN Div	8	39.5	914.9	875.4	CH	60.1	91	31	60	G4127	brenna
09-15M	MN Div	9	44.5	914.9	870.4	CH	63.2	92	26	66	G4127	brenna
09-15M	MN Div	10	49	914.9	865.9	CH	58.2	73	29	44	G4127	brenna
09-15M	MN Div	11	54.5	914.9	860.4	CH	47.5	74	28	46	G4127	brenna
09-15M	MN Div	12	59.5	914.9	855.4	CL	40.9	46	23	23	G4127	brenna
09-15M	MN Div	13	64.5	914.9	850.4	CH	52.6	79	30	49	G4127	argusville
09-15M	MN Div	14	69.5	914.9	845.4	CH	48.5	75	29	46	G4127	argusville
09-15M	MN Div	15	74.5	914.9	840.4	CH	61.9	72	28	44	G4127	argusville
09-15M	MN Div	16	79.5	914.9	835.4	CH	45.9	64	27	37	G4127	argusville
09-15M	MN Div	17	84	914.9	830.9	CH	32.3	50	22	28	G4127	argusville
09-15M	MN Div	18	89.5	914.9	825.4	CL	34	37	20	17	G4127	till
09-15M	MN Div	19	101.5	914.9	813.4	CL	13.3	27	18	9	G4127	till
09-16M	MN Div	1	4	921.6	917.6	CH	35.7	67	31	36	G4127	topsoil/fill
09-16M	MN Div	2	9.5	921.6	912.1	ML	35.8				G4127	sherack
09-16M	MN Div	3	14.5	921.6	907.1	ML	43.1				G4127	sherack
09-16M	MN Div	4	19.5	921.6	902.1	CH	46.8	66	28	38	G4127	poplar river
09-16M	MN Div	5	24.5	921.6	897.1	CH	63.3	78	30	48	G4127	poplar river
09-16M	MN Div	6	29.5	921.6	892.1	CH	55.7	65	28	37	G4127	poplar river
09-16M	MN Div	7	34.5	921.6	887.1	CH	66.5	94	27	67	G4127	poplar river
09-16M	MN Div	8	38.5	921.6	883.1	CH	50.1	67	28	39	G4127	poplar river
09-16M	MN Div	9	44.5	921.6	877.1	CH	39.9	55	26	29	G4127	poplar river
09-16M	MN Div	10	49.5	921.6	872.1	SP-ML	21.5				G4127	poplar river
09-16M	MN Div	11	53.5	921.6	868.1	SP-ML	22.2				G4127	poplar river
09-16M	MN Div	12	58.5	921.6	863.1	SP	14.1				G4127	poplar river
09-16M	MN Div	13	64.5	921.6	857.1	CL	29.2	38	23	15	G4127	?
09-16M	MN Div	14	69.5	921.6	852.1	CL	31.5	42	24	18	G4127	?
09-16M	MN Div	15	74.5	921.6	847.1	ML	31.4	41	27	14	G4127	?
09-16M	MN Div	16	76.5	921.6	845.1	CH	41	84	26	58	G4127	?
09-16M	MN Div	17	79.5	921.6	842.1	CH	35.7	56	25	31	G4127	argusville
09-16M	MN Div	18	84.5	921.6	837.1	CH	38.3	50	25	25	G4127	argusville
09-16M	MN Div	19	89.5	921.6	832.1	CL	16.5	22	16	6	G4127	till
09-16M	MN Div	20	94.5	921.6	827.1	ML	18.6	18	15	3	G4127	till
09-16M	MN Div	21	101.5	921.6	820.1	CL	17.8	29	18	11	G4127	till
09-17M	Moorhead	1	4.5	905.03	900.53	CH	33.5	71	28	43	G4127	sherack
09-17M	Moorhead	2	9.5	905.03	895.53	CH	39.3	50	24	26	G4127	sherack
09-17M	Moorhead	3	13.5	905.03	891.53	CH	45.1	71	29	42	G4127	poplar river
09-17M	Moorhead	4	14.5	905.03	890.53	CH	46.1	102	30	72	G4127	brenna
09-17M	Moorhead	5	18.25	905.03	886.78	CH	56	108	37	71	G4127	brenna
09-17M	Moorhead	6	23.5	905.03	881.53	CH	62.9	116	39	77	G4127	brenna
09-17M	Moorhead	7	28.5	905.03	876.53	CH	56.8	99	30	69	G4127	brenna
09-17M	Moorhead	8	34	905.03	871.03	CH	38.3	80	29	51	G4127	brenna
09-17M	Moorhead	9	39	905.03	866.03	CH	31	82	27	55	G4127	brenna
09-17M	Moorhead	10	44	905.03	861.03	CH	40.6	79	30	49	G4127	brenna
09-17M	Moorhead	11	49	905.03	856.03	CH	28.9	64	27	37	G4127	brenna
09-17M	Moorhead	12	54.5	905.03	850.53	CH	33.6	66	29	37	G4127	brenna
09-17M	Moorhead	13	59.5	905.03	845.53	CH	27.7	63	27	36	G4127	brenna
09-17M	Moorhead	14	64.5	905.03	840.53	CH	29.5	65	29	36	G4127	argusville
09-17M	Moorhead	15	69.5	905.03	835.53	CH	38.9	74	32	42	G4127	argusville
09-17M	Moorhead	16	74.5	905.03	830.53	CH	39.9	74	31	43	G4127	argusville
09-17M	Moorhead	17	79.5	905.03	825.53	CH	39	69	29	40	G4127	argusville
09-17M	Moorhead	18	84.5	905.03	820.53	CH	39.4	60	23	37	G4127	argusville
09-17M	Moorhead	19	89.5	905.03	815.53	CL-ML	21.4	23	17	6	G4127	till
09-17M	Moorhead	20	94	905.03	811.03	CL	12.6	27	16	11	G4127	till

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH
 Date: JUL 09
 Latest Revision: 2/18/2011
 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-18M	Moorhead	1	4.5	885.56	881.06	CH	37.9	60	30	30	G4127	alluvium
09-18M	Moorhead	2	8	885.56	877.56	CH	34.1	61	27	34	G4127	sherack
09-18M	Moorhead	3	14.5	885.56	871.06	CH	43.2	89	29	60	G4127	brenna
09-18M	Moorhead	4	18.5	885.56	867.06	CH	44.9	95	30	65	G4127	brenna
09-18M	Moorhead	5	23.5	885.56	862.06	CH	46.1	89	30	59	G4127	brenna
09-18M	Moorhead	6	28.25	885.56	857.31	CH	46.3	92	31	61	G4127	brenna
09-18M	Moorhead	7	33.5	885.56	852.06	CH	46.2	74	31	43	G4127	brenna
09-18M	Moorhead	8	38.5	885.56	847.06	CH	43.3	72	29	43	G4127	brenna
09-18M	Moorhead	9	44.5	885.56	841.06	CH	46.4	73	30	43	G4127	argusville
09-18M	Moorhead	10	49.5	885.56	836.06	CH	43.2	67	29	38	G4127	argusville
09-18M	Moorhead	11	54.5	885.56	831.06	CH	42.2	73	30	43	G4127	argusville
09-18M	Moorhead	12	59.5	885.56	826.06	CH	44.5	63	28	35	G4127	argusville
09-18M	Moorhead	13	64.5	885.56	821.06	CH	40.2	54	26	28	G4127	argusville
09-18M	Moorhead	14	69.5	885.56	816.06	CH	31.3	51	25	26	G4127	argusville
09-18M	Moorhead	15	72.5	885.56	813.06	CL	17	34	17	17	G4127	till
09-19M	Moorhead	1	4.5	886.84	882.34	CH	37.5	55	29	26	G4127	sherack
09-19M	Moorhead	2	7.5	886.84	879.34	CH	37.2	67	31	36	G4127	sherack
09-19M	Moorhead	3	8.5	886.84	878.34	CH	50.9	102	31	71	G4127	sherack
09-19M	Moorhead	4	14.5	886.84	872.34	CH	47	109	32	77	G4127	brenna
09-19M	Moorhead	5	19	886.84	867.84	CH	57.3	100	31	69	G4127	brenna
09-19M	Moorhead	6	23.5	886.84	863.34	CH	65.6	111	34	77	G4127	brenna
09-19M	Moorhead	7	29	886.84	857.84	CH	64.3	111	34	77	G4127	brenna
09-19M	Moorhead	8	34.5	886.84	852.34	CH	57.9	82	28	54	G4127	brenna
09-19M	Moorhead	9	39.5	886.84	847.34	CH	35.2	69	28	41	G4127	brenna
09-19M	Moorhead	10	44.5	886.84	842.34	CH	36.4	72	28	44	G4127	brenna
09-19M	Moorhead	11	49.5	886.84	837.34	CH	39.8	72	29	43	G4127	argusville
09-19M	Moorhead	12	54.5	886.84	832.34	CH	32.2	64	28	36	G4127	argusville
09-19M	Moorhead	13	59.5	886.84	827.34	CH	30.4	67	28	39	G4127	argusville
09-19M	Moorhead	14	64.5	886.84	822.34	CH	31.7	59	27	32	G4127	argusville
09-19M	Moorhead	15	69.5	886.84	817.34	CH	31.3	56	24	32	G4127	argusville
09-19M	Moorhead	16	74.5	886.84	812.34	ML	17.4	19	18	1	G4127	till
09-19M	Moorhead	17	84.5	886.84	802.34	CL	18.1	28	19	9	G4127	till
09-20M	Moorhead	1	4.5	890.71	886.21	CH	32.1	70	27	43	G4127	sherack
09-20M	Moorhead	2	9	890.71	881.71	CH	47.5	101	34	67	G4127	PL sherack
09-20M	Moorhead	3	14.5	890.71	876.21	CH	48.4	101	35	66	G4127	PL sherack
09-20M	Moorhead	4	19.5	890.71	871.21	CH	50.5	93	29	64	G4127	PL sherack
09-20M	Moorhead	5	23.5	890.71	867.21	CH	46.1	87	32	55	G4127	brenna
09-20M	Moorhead	6	29.5	890.71	861.21	CH	56.1	96	31	65	G4127	brenna
09-20M	Moorhead	7	33.5	890.71	857.21	CH	51	96	32	64	G4127	brenna
09-20M	Moorhead	8	39.5	890.71	851.21	CH	49.7	80	28	52	G4127	brenna
09-20M	Moorhead	9	44.5	890.71	846.21	CH	53.5	82	30	52	G4127	brenna
09-20M	Moorhead	10	49.5	890.71	841.21	CH	55.6	90	31	59	G4127	argusville
09-20M	Moorhead	11	54.5	890.71	836.21	CH	55.3	81	29	52	G4127	argusville
09-20M	Moorhead	12	59.5	890.71	831.21	CH	53	79	29	50	G4127	argusville
09-20M	Moorhead	13	64.5	890.71	826.21	CH	47.1	69	27	42	G4127	argusville
09-20M	Moorhead	14	69.5	890.71	821.21	CH	37.2	52	22	30	G4127	argusville
09-20M	Moorhead	15	74.5	890.71	816.21	CH	41.4	67	26	41	G4127	argusville
09-20M	Moorhead	16	79.5	890.71	811.21	ML	29.4	30	25	5	G4127	till
09-20M	Moorhead	17	91.5	890.71	799.21	CL	17.2	37	19	18	G4127	till
09-21M	Moorhead	1	4	886.2	882.2	CH	39.6	77	29	48	G4127	sherack
09-21M	Moorhead	2	9.5	886.2	876.7	CH	41.2	67	27	40	G4127	sherack
09-21M	Moorhead	3	14.5	886.2	871.7	ML	41	32	30	2	G4127	sherack
09-21M	Moorhead	4	19	886.2	867.2	CH	53.6	103	33	70	G4127	brenna
09-21M	Moorhead	5	24	886.2	862.2	CH	73.5	115	33	82	G4127	brenna
09-21M	Moorhead	6	28.5	886.2	857.7	CH	68.8	111	32	79	G4127	brenna
09-21M	Moorhead	7	33.5	886.2	852.7	CH	64	106	32	74	G4127	brenna
09-21M	Moorhead	8	38.5	886.2	847.7	CH	59.7	92	30	62	G4127	brenna
09-21M	Moorhead	9	44	886.2	842.2	CH	53.6	76	30	46	G4127	argusville
09-21M	Moorhead	10	49	886.2	837.2	CH	55.3	90	32	58	G4127	argusville
09-21M	Moorhead	11	54.5	886.2	831.7	CH	56	78	29	49	G4127	argusville
09-21M	Moorhead	12	59.5	886.2	826.7	CH	52.6	67	30	37	G4127	argusville
09-21M	Moorhead	13	64.5	886.2	821.7	CH	47.4	67	30	37	G4127	argusville
09-21M	Moorhead	14	69.5	886.2	816.7	CH	50.2	76	30	46	G4127	argusville
09-21M	Moorhead	15	73.5	886.2	812.7	SM	18.9				G4127	till
09-21M	Moorhead	16	79.5	886.2	806.7	CL	14.7	26	17	9	G4127	till
09-22M	Moorhead	1	4.5	882.2	877.7	ML	41.2	47	29	18	G4127	sherack
09-22M	Moorhead	2	9.5	882.2	872.7	CH	37.7	54	27	27	G4127	sherack
09-22M	Moorhead	3	14.5	882.2	867.7	CH	54.5	100	30	70	G4127	brenna
09-22M	Moorhead	4	19.5	882.2	862.7	CH	57.5	106	33	73	G4127	brenna
09-22M	Moorhead	5	24	882.2	858.2	CH	58.7	105	33	72	G4127	brenna
09-22M	Moorhead	6	29.5	882.2	852.7	CH	58.3	105	34	71	G4127	brenna
09-22M	Moorhead	7	34	882.2	848.2	CH	61.5	99	32	67	G4127	brenna
09-22M	Moorhead	8	39	882.2	843.2	CH	56.4	96	31	65	G4127	brenna
09-22M	Moorhead	9	44	882.2	838.2	CH	49.6	80	28	52	G4127	brenna
09-22M	Moorhead	10	49	882.2	833.2	CH	50.3	67	27	40	G4127	argusville
09-22M	Moorhead	11	54	882.2	828.2	CH	48.7	81	26	55	G4127	argusville
09-22M	Moorhead	12	59	882.2	823.2	CH	55.9	76	27	49	G4127	argusville
09-22M	Moorhead	13	64.5	882.2	817.7	CH	45.3	75	28	47	G4127	argusville
09-22M	Moorhead	14	69.5	882.2	812.7	CH	42.9	67	28	39	G4127	argusville
09-22M	Moorhead	15	74.5	882.2	807.7	CH	47.5	67	25	42	G4127	argusville
09-22M	Moorhead	16	79.5	882.2	802.7	SM	14.2				G4127	till
09-22M	Moorhead	17	84.5	882.2	797.7	CL-ML	12.7	22	16	6	G4127	till

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-23M	Moorhead	1	4.5	882.9	878.4	CH	37.6	63	29	34	G4127	topsoil/alluvium
09-23M	Moorhead	2	9.5	882.9	873.4	CH	34.1	60	28	32	G4127	alluvium
09-23M	Moorhead	3	13.5	882.9	869.4	CH	39.7	53	25	28	G4127	sherack
09-23M	Moorhead	4	18.25	882.9	864.65	CH	61.6	95	32	63	G4127	brenna
09-23M	Moorhead	5	24	882.9	858.9	CH	66.3	8	33	-25	G4127	brenna
09-23M	Moorhead	6	33.25	882.9	849.65	CH	71.2	106	32	74	G4127	brenna
09-23M	Moorhead	7	38.5	882.9	844.4	CH	58.9	84	29	55	G4127	brenna
09-23M	Moorhead	8	44.5	882.9	838.4	CH	56.7	81	28	53	G4127	argusville
09-23M	Moorhead	9	49.5	882.9	833.4	CH	40.7	55	24	31	G4127	argusville
09-23M	Moorhead	10	54.5	882.9	828.4	ML	39.8	28	24	4	G4127	argusville
09-23M	Moorhead	11	59.5	882.9	823.4	ML	31.2	26	25	1	G4127	argusville
09-23M	Moorhead	12	64.5	882.9	818.4	ML	29.9	27	25	2	G4127	argusville
09-23M	Moorhead	13	69.5	882.9	813.4	ML	31.8	20	19	1	G4127	argusville
09-23M	Moorhead	14	74.5	882.9	808.4	ML	32.5	25	24	1	G4127	argusville
09-23M	Moorhead	15	79.75	882.9	803.15	ML	30.8	29	24	5	G4127	argusville
09-23M	Moorhead	16	91.5	882.9	791.4	CL	19.2	34	19	15	G4127	til
09-24M	Moorhead	1	5.5	883.7	878.2	CH	35.9	55	23	32	G4127	sherack
09-24M	Moorhead	2	9.5	883.7	874.2	CH	32.4	75	26	49	G4127	brenna
09-24M	Moorhead	3	13.25	883.7	870.45	CH	55.4	97	33	64	G4127	brenna
09-24M	Moorhead	4	19.5	883.7	864.2	CH	53.1	92	31	61	G4127	brenna
09-24M	Moorhead	5	23.5	883.7	860.2	CH	46.1	106	33	73	G4127	brenna
09-24M	Moorhead	6	29	883.7	854.7	CH	41.2	97	33	64	G4127	brenna
09-24M	Moorhead	7	34	883.7	849.7	CH	28.2	87	30	57	G4127	brenna
09-24M	Moorhead	8	39	883.7	844.7	CH	40.2	85	29	56	G4127	brenna
09-24M	Moorhead	9	44.5	883.7	839.2	CH	40	69	27	42	G4127	brenna
09-24M	Moorhead	10	49.5	883.7	834.2	CH	36.3	74	27	47	G4127	argusville
09-24M	Moorhead	11	54.5	883.7	829.2	CH	34.9	63	25	38	G4127	argusville
09-24M	Moorhead	12	59.5	883.7	824.2	CH	42.8	66	26	40	G4127	argusville
09-24M	Moorhead	13	64.5	883.7	819.2	CH	33.8	70	27	43	G4127	argusville
09-24M	Moorhead	14	69.5	883.7	814.2	CH	36.2	73	29	44	G4127	argusville
09-24M	Moorhead	15	73.5	883.7	810.2	CH	34.6	63	23	40	G4127	argusville
09-24M	Moorhead	16	79.5	883.7	804.2	CH	32.8	50	22	28	G4127	argusville
09-25M	Moorhead	1	4.5	898.7	894.2	CH	28.5	68	30	38	G4127	sherack
09-25M	Moorhead	2	9.5	898.7	889.2	CH	34.7	67	29	38	G4127	sherack
09-25M	Moorhead	3	14.5	898.7	884.2	ML	37.3	28	25	3	G4127	poplar river
09-25M	Moorhead	4	24.5	898.7	874.2	MH	36.8	56	30	26	G4127	poplar river
09-25M	Moorhead	5	29	898.7	869.7	CH	41.3	63	31	32	G4127	poplar river
09-25M	Moorhead	6	30.5	898.7	868.2	CH	47.6	90	33	57	G4127	brenna
09-25M	Moorhead	7	39.5	898.7	859.2	CH	68.3	100	35	65	G4127	brenna
09-25M	Moorhead	8	45.5	898.7	853.2	CH	63.2	103	36	67	G4127	brenna
09-25M	Moorhead	9	51.5	898.7	847.2	CH	63.7	97	35	62	G4127	brenna
09-25M	Moorhead	10	57.5	898.7	841.2	CH	59.4	101	37	64	G4127	brenna
09-25M	Moorhead	11	63.75	898.7	834.95	CH	62.1	102	36	66	G4127	brenna
09-25M	Moorhead	12	69.5	898.7	829.2	CH	54	87	33	54	G4127	argusville
09-25M	Moorhead	13	74.5	898.7	824.2	CH	50.8	81	31	50	G4127	argusville
09-25M	Moorhead	14	79.5	898.7	819.2	CH	43.6	73	29	44	G4127	argusville
09-25M	Moorhead	15	84.5	898.7	814.2	CH	45.6	71	30	41	G4127	argusville
09-25M	Moorhead	6	89.5	898.7	809.2	CH	52.2	72	31	41	G4127	argusville
09-25M	Moorhead	17	94.5	898.7	804.2	CH	48.4	72	28	44	G4127	argusville
09-25M	Moorhead	18	99.5	898.7	799.2	CH	42.2	68	27	41	G4127	argusville
09-26M	MN Div	1	4	911.5	907.5	CH	32	67	27	40	G4127	topsoil/alluvium
09-26M	MN Div	2	6.5	911.5	905	CH	27.3	65	25	40	G4127	alluvium
09-26M	MN Div	3	9.5	911.5	902	CH	34.1	63	26	37	G4127	sherack
09-26M	MN Div	4	14.5	911.5	897	CH	50.9	101	35	66	G4127	PL sherack?
09-26M	MN Div	5	18.5	911.5	893	CH	48.4	107	35	72	G4127	PL sherack?
09-26M	MN Div	6	23.5	911.5	888	CH	53.3	101	33	68	G4127	PL sherack?
09-26M	MN Div	7	28.5	911.5	883	CH	50.8	93	31	62	G4127	brenna
09-26M	MN Div	8	33.25	911.5	878.25	CH	56.9	96	29	67	G4127	brenna
09-26M	MN Div	9	39.25	911.5	872.25	CH	48.3	85	30	55	G4127	brenna
09-26M	MN Div	10	44.5	911.5	867	CH	48.2	69	30	39	G4127	brenna
09-26M	MN Div	11	49.5	911.5	862	CH	45.8	61	25	36	G4127	brenna
09-26M	MN Div	12	54.5	911.5	857	CH	49.1	62	26	36	G4127	argusville
09-26M	MN Div	13	58.5	911.5	853	CH	44.5	68	27	41	G4127	argusville
09-26M	MN Div	14	64.5	911.5	847	CH	43.3	66	29	37	G4127	argusville
09-26M	MN Div	15	69.5	911.5	842	CH	42.5	71	28	43	G4127	argusville
09-26M	MN Div	16	74.5	911.5	837	CH	45.5	59	25	34	G4127	argusville
09-26M	MN Div	17	79	911.5	832.5	CH	32.7	56	22	34	G4127	argusville
09-26M	MN Div	18	84.5	911.5	827	CH	39.3	68	25	43	G4127	argusville
09-26M	MN Div	19	88.5	911.5	823	CL					G4127	til
09-26M	MN Div	20	101.5	911.5	810	CL					G4127	til
09-34M	Moorhead	1	3.5	907.9	904.4	CH	26.4	58	25	33	G4127	alluvium
09-34M	Moorhead	2	9.5	907.9	898.4	CH	42.9	58	29	29	G4127	sherack
09-34M	Moorhead	3	10.45	907.9	897.45	MH	35	53	30	23	G4127	sherack
09-34M	Moorhead	4	14	907.9	893.9	CH	51	109	34	75	G4127	PL sherack
09-34M	Moorhead	5	17.5	907.9	890.4	CH	63.7	111	33	78	G4127	PL sherack
09-34M	Moorhead	6	24.5	907.9	883.4	CH	56.4	123	37	86	G4127	brenna
09-34M	Moorhead	7	29.5	907.9	878.4	CH	57.3	100	33	67	G4127	brenna
09-34M	Moorhead	8	34.5	907.9	873.4	CH	63.2	103	34	69	G4127	brenna
09-34M	Moorhead	9	39.5	907.9	868.4	CH	53.1	89	33	56	G4127	brenna
09-34M	Moorhead	10	44.5	907.9	863.4	CH	54.2	90	32	58	G4127	brenna
09-34M	Moorhead	11	49.5	907.9	858.4	CH	47.9	74	29	45	G4127	brenna
09-34M	Moorhead	12	54.5	907.9	853.4	CH	51.8	75	30	45	G4127	argusville
09-34M	Moorhead	13	59.5	907.9	848.4	CH	49.8	76	29	47	G4127	argusville

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH
 Date: JUL 09
 Latest Revision: 2/18/2011
 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-34M	Moorhead	14	64.5	907.9	843.4	CH	45	66	28	38	G4127	argusville
09-34M	Moorhead	15	69.5	907.9	838.4	CH	43.8	68	25	43	G4127	argusville
09-34M	Moorhead	16	74.5	907.9	833.4	CH	44.5	62	25	37	G4127	argusville
09-34M	Moorhead	17	79.5	907.9	828.4	CH	41.9	70	31	39	G4127	argusville
09-34M	Moorhead	18	84	907.9	823.9	CH	46.5	67	28	39	G4127	argusville
09-40M	MN Div	1	3.25	912.8	909.55	CL	17.1	26	17	9	G4127	?
09-40M	MN Div	2	9.5	912.8	903.3	CL	41.6	43	26	17	G4127	sherack
09-40M	MN Div	3	14.5	912.8	898.3	CH	46.7	80	33	47	G4127	sherack
09-40M	MN Div	4	18.35	912.8	894.45	CH	46.6	75	30	45	G4127	poplar river
09-40M	MN Div	5	23.2	912.8	889.6	CH	48.3	79	31	48	G4127	brenna
09-40M	MN Div	6	28.5	912.8	884.3	CH	52.5	73	31	42	G4127	brenna
09-40M	MN Div	7	33.4	912.8	879.4	CH	53.6	74	30	44	G4127	argusville
09-40M	MN Div	8	38.5	912.8	874.3	CL	26	38	28	10	G4127	argusville
09-40M	MN Div	9	43.25	912.8	869.55	ML	20.5				G4127	silt
09-40M	MN Div	10	46.5	912.8	866.3	ML	21.6				G4127	silt
09-40M	MN Div	11	49.5	912.8	863.3	ML	21.5				G4127	silt
09-40M	MN Div	12	53.5	912.8	859.3	ML	21.6				G4127	silt
09-40M	MN Div	13	59.5	912.8	853.3	ML	25.8				G4127	silt
09-40M	MN Div	14	64.5	912.8	848.3	ML	27				G4127	silt
09-40M	MN Div	15	68.5	912.8	844.3	ML	24.4				G4127	silt
09-41M	Moorhead	1	3.4	889.7	886.3	CH	36.2	64	25	39	G4127	topsoil/alluvium
09-41M	Moorhead	2	9.75	889.7	879.95	CH	30.2	66	24	42	G4127	sherack
09-41M	Moorhead	3	14	889.7	875.7	MH	31.8	53	31	22	G4127	sherack
09-41M	Moorhead	4	17.5	889.7	872.2	CH	47	103	38	65	G4127	brenna
09-41M	Moorhead	5	24	889.7	865.7	CH	47	76	28	48	G4127	brenna
09-41M	Moorhead	6	28.5	889.7	861.2	CH	48.8	75	28	47	G4127	brenna
09-41M	Moorhead	7	33.5	889.7	856.2	CH	63	70	32	38	G4127	brenna
09-41M	Moorhead	8	39.5	889.7	850.2	CH	47	67	29	38	G4127	brenna
09-41M	Moorhead	9	44	889.7	845.7	CH	48.3	58	30	28	G4127	argusville
09-41M	Moorhead	10	49.5	889.7	840.2	CH	41.5	70	27	43	G4127	argusville
09-41M	Moorhead	11	53.5	889.7	836.2	CH	45.1	69	29	40	G4127	argusville
09-41M	Moorhead	12	59.5	889.7	830.2	CL	30	35	17	18	G4127	argusville
09-53M	Moorhead	1	5.4	900	894.6	CL	25.8	40	21	19	G4127	topsoil/alluvium
09-53M	Moorhead	2	8.5	900	891.5	CL	36.7	47	26	21	G4127	topsoil/alluvium
09-53M	Moorhead	3	12.5	900	887.5	CH	34.4	54	28	26	G4127	alluvium
09-53M	Moorhead	4	14.5	900	885.5	CH	31.5	69	29	40	G4127	sherack
09-53M	Moorhead	5	19.5	900	880.5	CL	34.4	42	25	17	G4127	poplar river
09-53M	Moorhead	6	23.4	900	876.6	CH	38.9	83	28	55	G4127	brenna
09-53M	Moorhead	7	28.3	900	871.7	CH	56.4	105	35	70	G4127	brenna
09-53M	Moorhead	8	33.3	900	866.7	CH	58.6	92	33	59	G4127	brenna
09-53M	Moorhead	9	38.5	900	861.5	CH	54.2	104	37	67	G4127	brenna
09-53M	Moorhead	10	43.5	900	856.5	CH	57.1	102	35	67	G4127	brenna
09-53M	Moorhead	11	48.5	900	851.5	CH	50.8	101	36	65	G4127	brenna
09-53M	Moorhead	12	53.5	900	846.5	CH	42.3	90	31	59	G4127	brenna
09-53M	Moorhead	13	58.5	900	841.5	CH	47	81	27	54	G4127	brenna
09-53M	Moorhead	14	64.5	900	835.5	CH	51.7	81	30	51	G4127	argusville
09-53M	Moorhead	15	68.5	900	831.5	CH	53.5	77	28	49	G4127	argusville
09-53M	Moorhead	16	73.5	900	826.5	CH	50.4	72	29	43	G4127	argusville
09-53M	Moorhead	17	78.5	900	821.5	CH	46.5	74	26	48	G4127	argusville
09-53M	Moorhead	18	83.5	900	816.5	CH	48.5	67	26	41	G4127	argusville
09-53M	Moorhead	19	88.5	900	811.5	CH	55.3	78	26	52	G4127	argusville
09-53M	Moorhead	20	93.5	900	806.5	ML	15.4				G4127	till
09-53M	Moorhead	21	106.5	900	793.5						G4127	till
09-57M	Moorhead	1	3.5	881.9	878.4	CH	41.9	57	29	28	G4127	topsoil/alluvium
09-57M	Moorhead	2	8.5	881.9	873.4	CH	32.9	61	25	36	G4127	sherack
09-57M	Moorhead	3	13.5	881.9	868.4	ML	27.1	28	25	3	G4127	sherack
09-57M	Moorhead	4	16	881.9	865.9	CL	37.1	44	22	22	G4127	poplar river
09-57M	Moorhead	5	18.4	881.9	863.5	CH	42.4	89	31	58	G4127	brenna
09-57M	Moorhead	6	28.5	881.9	853.4	CH	68	102	32	70	G4127	brenna
09-57M	Moorhead	7	33.5	881.9	848.4	CH	66.7	101	33	68	G4127	brenna
09-57M	Moorhead	8	38.5	881.9	843.4	CH	66.2	102	34	68	G4127	brenna
09-57M	Moorhead	9	43.5	881.9	838.4	CH	63.1	85	32	53	G4127	brenna
09-57M	Moorhead	10	48.5	881.9	833.4	CH	49.4	66	26	40	G4127	argusville
09-57M	Moorhead	11	53.5	881.9	828.4	CH	52.1	71	28	43	G4127	argusville
09-57M	Moorhead	12	58.5	881.9	823.4	CH	49.5	74	26	48	G4127	argusville
09-57M	Moorhead	13	63.5	881.9	818.4	CH	51.6	72	25	47	G4127	argusville
09-57M	Moorhead	14	73.5	881.9	808.4	CH	43.5	61	21	40	G4127	argusville
09-57M	Moorhead	15	79.5	881.9	802.4	CH					G4127	till
09-57M	Moorhead	16	83.5	881.9	798.4	CH					G4127	till
09-57M	Moorhead	17	93.5	881.9	788.4	CH					G4127	till

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
 Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-60M	Moorhead	1	3.5	882.6	879.1	CH	33.3	62	25	37	G4127	topsoil/alluvium
09-60M	Moorhead	2	8.5	882.6	874.1	CH	38	77	29	48	G4127	sherack
09-60M	Moorhead	3	13.5	882.6	869.1	MH	42.1	54	33	21	G4127	poplar river
09-60M	Moorhead	4	18.5	882.6	864.1	MH	59.4	83	41	42	G4127	poplar river
09-60M	Moorhead	5	23.5	882.6	859.1	CL	30	27	19	8	G4127	poplar river
09-60M	Moorhead	6	28.5	882.6	854.1	ML	30.4	32	26	6	G4127	poplar river
09-60M	Moorhead	7	33.5	882.6	849.1	CL	29.6	29	20	9	G4127	poplar river
09-60M	Moorhead	8	38.5	882.6	844.1	CL	32.3	43	19	24	G4127	poplar river
09-60M	Moorhead	9	43.5	882.6	839.1	CH	42.8	100	36	64	G4127	brenna
09-60M	Moorhead	10	48.5	882.6	834.1	CH	53.3	104	33	71	G4127	brenna
09-60M	Moorhead	11	53.5	882.6	829.1	CH	49	98	31	67	G4127	brenna
09-60M	Moorhead	12	58.5	882.6	824.1	CH	49.7	87	31	56	G4127	argusville
09-60M	Moorhead	13	63.5	882.6	819.1	CH	52	98	30	68	G4127	argusville
09-60M	Moorhead	14	68.5	882.6	814.1	CH	47	68	28	40	G4127	argusville
09-60M	Moorhead	15	73.5	882.6	809.1	CH	50.4	79	31	48	G4127	argusville
09-60M	Moorhead	16	78.5	882.6	804.1	CH	48	81	30	51	G4127	argusville
09-60M	Moorhead	17	83.5	882.6	799.1	CH	44.4	78	28	50	G4127	argusville
09-60M	Moorhead	18	95.5	882.6	787.1	CL	17.3	31	17	14	G4127	till
09-63M	Moorhead	1	3.5	881	877.5	CH	40.5	63	30	33	G4127	topsoil/alluvium
09-63M	Moorhead	2	8.5	881	872.5	CH	37.6	74	30	44	G4127	sherack
09-63M	Moorhead	3	13.5	881	867.5	CH	73.4	108	40	68	G4127	brenna
09-63M	Moorhead	4	18.25	881	862.75	CH	81	115	38	77	G4127	brenna
09-63M	Moorhead	5	23.5	881	857.5	CH	72.4	120	37	83	G4127	brenna
09-63M	Moorhead	6	28.5	881	852.5	CH	75.4	119	35	84	G4127	brenna
09-63M	Moorhead	7	33.5	881	847.5	CH	64.4	105	40	65	G4127	brenna
09-63M	Moorhead	8	38.5	881	842.5	CH	67.7	102	38	64	G4127	brenna
09-63M	Moorhead	9	43.5	881	837.5	CH	62.4	96	34	62	G4127	brenna
09-63M	Moorhead	10	48.5	881	832.5	CH	62.8	84	29	55	G4127	brenna
09-63M	Moorhead	11	53.5	881	827.5	CH	49.9	72	26	46	G4127	argusville
09-63M	Moorhead	12	58.5	881	822.5	CH	51.4	73	25	48	G4127	argusville
09-63M	Moorhead	13	63.5	881	817.5	CH	55.4	82	25	57	G4127	argusville
09-63M	Moorhead	14	68.5	881	812.5	CH	47.6	73	23	50	G4127	argusville
09-63M	Moorhead	15	73.5	881	807.5	CH	45.8	60	22	38	G4127	argusville
09-67M	Moorhead	1	8.3	895.1	886.8	CH	32.3	62	28	34	G4127	topsoil/alluvium
09-67M	Moorhead	2	10.5	895.1	884.6	CH	35.1	68	25	43	G4127	alluvium
09-67M	Moorhead	3	14.5	895.1	880.6	CH	30.8	58	22	36	G4127	alluvium
09-67M	Moorhead	4	18.5	895.1	876.6	ML	27.5				G4127	poplar river
09-67M	Moorhead	5	21.5	895.1	873.6	CH	49.8	107	37	70	G4127	brenna
09-67M	Moorhead	6	28.3	895.1	866.8	CH	77	119	37	82	G4127	brenna
09-67M	Moorhead	7	33.5	895.1	861.6	CH	73.3	108	35	73	G4127	brenna
09-67M	Moorhead	8	38.5	895.1	856.6	CH	74.8	114	37	77	G4127	brenna
09-67M	Moorhead	9	43.5	895.1	851.6	CH	77.8	112	32	80	G4127	brenna
09-67M	Moorhead	10	48.5	895.1	846.6	CH	72.7	114	36	78	G4127	brenna
09-67M	Moorhead	11	53.5	895.1	841.6	CH	62.1	104	33	71	G4127	brenna
09-67M	Moorhead	12	58.5	895.1	836.6	CH	66.5	98	32	66	G4127	brenna
09-67M	Moorhead	13	63.5	895.1	831.6	CH	57.3	88	29	59	G4127	brenna
09-67M	Moorhead	14	68.5	895.1	826.6	CH	47.3	89	30	59	G4127	argusville
09-67M	Moorhead	15	73.5	895.1	821.6	CH	51.7	79	29	50	G4127	argusville
09-67M	Moorhead	16	78.5	895.1	816.6	CH	54.2	85	30	55	G4127	argusville
09-67M	Moorhead	17	83.5	895.1	811.6	CH	56.6	58	23	35	G4127	argusville
09-67M	Moorhead	18	93.5	895.1	801.6	CH	47.7	58	23	35	G4127	argusville
09-67M	Moorhead	19	98.5	895.1	796.6	CH	45.4	64	24	40	G4127	argusville
09-67M	Moorhead	20	103.5	895.1	791.6	CH	40.9	89	30	59	G4127	argusville
09-67M	Moorhead	21	105.25	895.1	789.85	ML	14.3	45	30	15	G4127	till
09-67M	Moorhead	22	115.5	895.1	779.6	CL	14.5	30	16	14	G4127	till
09-68M	Moorhead	1	3.5	879.6	876.1	CH	39.7	77	32	45	G4127	sherack
09-68M	Moorhead	2	8.5	879.6	871.1	CH	42.4	72	28	44	G4127	poplar river
09-68M	Moorhead	3	13.5	879.6	866.1	CL	63.8	45	25	20	G4127	poplar river
09-68M	Moorhead	4	18.5	879.6	861.1	CH	39.1	74	30	44	G4127	poplar river
09-68M	Moorhead	5	10.5	879.6	869.1	CH	40.4	76	32	44	G4127	poplar river
09-68M	Moorhead	6	22.5	879.6	857.1	CH	43.1	84	33	51	G4127	poplar river
09-68M	Moorhead	7	28.2	879.6	851.4	CH	78.4	120	39	81	G4127	brenna
09-68M	Moorhead	8	33.5	879.6	846.1	CH	71.8	115	36	79	G4127	brenna
09-68M	Moorhead	9	38.5	879.6	841.1	CH	69.1	109	34	75	G4127	brenna
09-68M	Moorhead	10	43.5	879.6	836.1	CH	63.2	109	38	71	G4127	brenna
09-68M	Moorhead	11	48.5	879.6	831.1	CH	55.9	100	33	67	G4127	brenna
09-68M	Moorhead	12	53.5	879.6	826.1	CH	50.2	88	29	59	G4127	brenna
09-68M	Moorhead	13	58.5	879.6	821.1	CH	53.8	86	28	58	G4127	argusville
09-68M	Moorhead	14	63.5	879.6	816.1	CH	50.4	85	31	54	G4127	argusville
09-68M	Moorhead	15	68.5	879.6	811.1	CH	54.8	88	28	60	G4127	argusville
09-68M	Moorhead	16	73.5	879.6	806.1	CH	56.6	75	27	48	G4127	argusville
09-68M	Moorhead	17	78.5	879.6	801.1	CH	44.5	66	26	40	G4127	argusville
09-68M	Moorhead	18	83.5	879.6	796.1	CH	37.3	67	25	42	G4127	argusville
09-68M	Moorhead	19	88.5	879.6	791.1	CL	20.5	29	17	12	G4127	till

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH
 Date: JUL 09

Latest Revision: 2/18/2011
 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
09-69M	Moorhead	1	8.5	878.1	869.6	CH	38.5	79	29	50	G4127	sherack
09-69M	Moorhead	2	13.5	878.1	864.6	CL	29.9	34	25	9	G4127	poplar river
09-69M	Moorhead	3	14.5	878.1	863.6	CH	35.7	61	28	33	G4127	poplar river
09-69M	Moorhead	4	17.5	878.1	860.6	CH	36.8	76	30	46	G4127	brenna
09-69M	Moorhead	5	18.5	878.1	859.6	CH	40.3	55	26	29	G4127	sherack
09-69M	Moorhead	6	23.2	878.1	854.9	CH	71.6	124	34	90	G4127	brenna
09-69M	Moorhead	7	28.5	878.1	849.6	CH	71.3	113	34	79	G4127	brenna
09-69M	Moorhead	8	33.5	878.1	844.6	CH	66.6	114	34	80	G4127	brenna
09-69M	Moorhead	9	38.5	878.1	839.6	CH	67.6	109	34	75	G4127	brenna
09-69M	Moorhead	10	43.5	878.1	834.6	CH	62.1	108	34	74	G4127	brenna
09-69M	Moorhead	11	48.5	878.1	829.6	CH	60.1	89	34	55	G4127	brenna
09-69M	Moorhead	12	53.5	878.1	824.6	CH	54.3	73	26	47	G4127	brenna
09-69M	Moorhead	13	58.5	878.1	819.6	CH	54	88	21	67	G4127	argusville
09-69M	Moorhead	14	63.5	878.1	814.6	CH	48.6	82	30	52	G4127	argusville
09-69M	Moorhead	15	68.5	878.1	809.6	MH	49	78	39	39	G4127	argusville
09-70M	Moorhead	1	5.5	878.4	872.9	CH	38.3	56	27	29	G4127	sherack
09-70M	Moorhead	2	8.5	878.4	869.9	CL	42.7	37	25	12	G4127	poplar river
09-70M	Moorhead	3	11.5	878.4	866.9	CH	38	66	29	37	G4127	poplar river
09-70M	Moorhead	4	14	878.4	864.4	CH	37.7	53	26	27	G4127	poplar river
09-70M	Moorhead	5	23.2	878.4	855.2	CH	72.1	121	36	85	G4127	brenna
09-70M	Moorhead	6	28.35	878.4	850.05	CH	70.1	116	37	79	G4127	brenna
09-70M	Moorhead	7	33.5	878.4	844.9	CH	71	118	35	83	G4127	brenna
09-70M	Moorhead	8	43.5	878.4	834.9	CH	59.3	94	28	66	G4127	brenna
09-70M	Moorhead	9	48.5	878.4	829.9	CH	54.3	83	31	52	G4127	brenna
09-70M	Moorhead	10	53.5	878.4	824.9	CH	48.6	71	27	44	G4127	argusville
09-70M	Moorhead	11	58.5	878.4	819.9	CH	54.6	80	28	52	G4127	argusville
09-70M	Moorhead	12	63.5	878.4	814.9	CH	50.9	84	25	59	G4127	argusville
09-70M	Moorhead	13	68.5	878.4	809.9	CH	52.7	89	32	57	G4127	argusville
09-70M	Moorhead	14	73.5	878.4	804.9	CH	49.8	71	26	45	G4127	argusville
09-72M	Moorhead	1	5.5	873.9	868.4	CH	36.8	76	28	48	G4127	sherack
09-72M	Moorhead	2	11.5	873.9	862.4	CH	40.3	82	31	51	G4127	sherack
09-72M	Moorhead	3	18.5	873.9	855.4	ML	33.5				G4127	poplar river
09-72M	Moorhead	4	24.5	873.9	849.4	ML	27.8	24	24	0	G4127	poplar river
09-72M	Moorhead	5	27.5	873.9	846.4	CH	39.3	69	31	38	G4127	brenna/sherack
09-72M	Moorhead	6	31.5	873.9	842.4	CH	56.9	116	39	77	G4127	brenna
09-72M	Moorhead	7	35.25	873.9	838.65	CH	68.3	108	38	70	G4127	brenna
09-72M	Moorhead	8	37.25	873.9	836.65	CH	64.1	100	36	64	G4127	brenna
09-72M	Moorhead	9	44.5	873.9	829.4	CH	62.3	92	32	60	G4127	brenna
09-72M	Moorhead	10	49.5	873.9	824.4	CH	56.8	88	32	56	G4127	brenna
09-72M	Moorhead	11	54.5	873.9	819.4	CH	61.9	91	36	55	G4127	brenna
09-72M	Moorhead	12	59.5	873.9	814.4	CH	48.7	78	27	51	G4127	brenna
09-72M	Moorhead	13	64.5	873.9	809.4	CH	49.7	78	28	50	G4127	brenna
09-72M	Moorhead	14	69.5	873.9	804.4	CH	46	75	23	52	G4127	argusville
09-73M	Moorhead	1	5.5	874.5	869	CH	34.2	72	30	42	G4127	alluvium
09-73M	Moorhead	2	9.5	874.5	865	CH	50.7	107	36	71	G4127	PL sherack?
09-73M	Moorhead	3	14.5	874.5	860	CH	55.6	109	37	72	G4127	PL sherack?
09-73M	Moorhead	4	19.5	874.5	855	CH	65.7	114	37	77	G4127	brenna
09-73M	Moorhead	5	25.5	874.5	849	CH	72	122	35	87	G4127	brenna
09-73M	Moorhead	6	35.5	874.5	839	CH	65	109	33	76	G4127	brenna
09-73M	Moorhead	7	41.5	874.5	833	CH	60.2	94	32	62	G4127	brenna
09-73M	Moorhead	8	47.5	874.5	827	CH	49	68	27	41	G4127	brenna
09-73M	Moorhead	9	54.5	874.5	820	CH	57	81	29	52	G4127	brenna
09-73M	Moorhead	10	59.5	874.5	815	CH	43.5	54	27	27	G4127	brenna
09-73M	Moorhead	11	64.5	874.5	810	CH	43.9	78	21	57	G4127	argusville
09-74M	MN Div	1	9	916	907	CL	35.5	37	22	15	7314	ML
09-74M	MN Div	2	14	916	902	CH	48.8	90	36	54	7314	CH
09-74M	MN Div	3	24	916	892	CH	68.2	112	37	75	7314	Brenna
09-74M	MN Div	4	29	916	887	CH	70.7	105	37	68	7314	Brenna
09-74M	MN Div	5	33.5	916	882.5	CH	69.7	100	34	66	7314	Brenna
09-74M	MN Div	6	39	916	877	CH	71.1	103	36	67	7314	Brenna
09-74M	MN Div	7	44	916	872	CH	65.3	95	28	67	7314	Brenna
09-74M	MN Div	8	49	916	867	CH	53.4	76	24	52	7314	glacio-lacustrine
09-74M	MN Div	9	54	916	862	CH	54.6	75	31	44	7314	glacio-lacustrine
09-74M	MN Div	10	59	916	857	CH	47.2	61	29	32	7314	CH/CL
09-75M	MN Div	1	9	925.5	916.5	CH	41.2	82	28	54	7314	CH
09-75M	MN Div	2	14	925.5	911.5	CH	36.8	80	29	51	7314	CH
09-75M	MN Div	3	19	925.5	906.5	CL	45.6	78	30	48	7314	CH
09-75M	MN Div	4	24	925.5	901.5	CH	49.4	77	30	47	7314	Brenna
09-75M	MN Div	5	29	925.5	896.5	CH	47.7	58	19	39	7314	glacio-lacustrine
09-75M	MN Div	6	34	925.5	891.5	CL	52	72	30	42	7314	CH
09-75M	MN Div	7	39	925.5	886.5	CL	36.7	46	22	24	7314	CH
09-75M	MN Div	8	44	925.5	881.5	ML	24.5				7314	ML
09-75M	MN Div	9	49	925.5	876.5	SP-SM	21.8				7314	SP

Project: Fargo-Moorhead Metro Feasibility Study
Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-76M	Moorhead	1	4.5	896.819	892.319	CH	29.6	67	23	44		Alluvium
10-76M	Moorhead	2	8.5	896.819	888.319	CH	34.4	77	34	43		sherack
10-76M	Moorhead	3	13.5	896.819	883.319	CH	38.7	85	31	54		sherack
10-76M	Moorhead	4	16.55	896.819	880.269	ML	30.4					PR-WF
10-76M	Moorhead	5	23.5	896.819	873.319	CH	48.2	48	25	23		PR-WF
10-76M	Moorhead	6	26.25	896.819	870.569	CH	49	55	30	25		PR-WF
10-76M	Moorhead	7	28.35	896.819	868.469	CH	41.6	68	24	44		PR - Harwood
10-76M	Moorhead	8	32.5	896.819	864.319	CH	47.9	102	31	71		dessicated brenna
10-76M	Moorhead	9	38.4	896.819	858.419	CH	72.6	107	35	72		brenna
10-76M	Moorhead	10	43.5	896.819	853.319	CH	65.6	107	32	75		brenna
10-76M	Moorhead	11	48.5	896.819	848.319	CH	65.6	105	37	68		brenna
10-76M	Moorhead	12	53.5	896.819	843.319	CH	72.1	118	35	83		brenna
10-76M	Moorhead	13	58.5	896.819	838.319	CH	73.6	118	34	84		brenna
10-76M	Moorhead	14	63.5	896.819	833.319	CH	60.6	103	32	71		brenna
10-76M	Moorhead	15	68.5	896.819	828.319	CH	61.3	108	29	79		brenna
10-76M	Moorhead	16	73.5	896.819	823.319	CH	59.4	93	28	65		brenna
10-76M	Moorhead	17	78.5	896.819	818.319	CH	54.6	98	24	74		brenna
10-76M	Moorhead	18	84.5	896.819	812.319	CH	55.5	84	26	58		brenna
10-76M	Moorhead	19	88.5	896.819	808.319	CH	45	64	22	42		argusville
10-76M	Moorhead	20	93.5	896.819	803.319	CH	69.7	75	33	42		argusville
10-76M	Moorhead	21	98.5	896.819	798.319	CH	40	74	24	50		argusville
10-76M	Moorhead	22	103.5	896.819	793.319	CH	46.3	74	24	50		argusville
10-76M	Moorhead	23	112.5	896.819	784.319	SM	9.8	16	14	2		unit "A" till
10-76M	Moorhead	24	130.5	896.819	766.319	CL	10.3	26	16	10		unit "A" till
10-77M	Moorhead	1	0.75	885.37	884.62	CH	33.8	67	30	37		Topsoil
10-77M	Moorhead	2	6.25	885.37	879.12	CH	29.4	69	24	45		sherack
10-77M	Moorhead	3	8.75	885.37	876.62	CH	29	65	27	38		sherack
10-77M	Moorhead	4	13.25	885.37	872.12	CH	36.9	79	35	44		sherack
10-77M	Moorhead	5	18.25	885.37	867.12	CH	38.5	70	25	45		sherack
10-77M	Moorhead	6	23.25	885.37	862.12	CH	47.3	63	23	40		sherack
10-77M	Moorhead	7	28.25	885.37	857.12	CH	50.9	99	36	63		dessicated brenna
10-77M	Moorhead	8	33.75	885.37	851.62	CH	54.5	99	31	68		Brenna
10-77M	Moorhead	9	38.75	885.37	846.62	CH	59.5	97	32	65		Brenna
10-77M	Moorhead	10	43.75	885.37	841.62	CH	56.7	93	31	62		Brenna
10-77M	Moorhead	11	48.75	885.37	836.62	CH	61.4	102	30	72		Brenna
10-77M	Moorhead	12	54.75	885.37	830.62	CH	55.2	104	32	72		Brenna
10-77M	Moorhead	13	58.75	885.37	826.62	CH	66.1	115	33	82		Brenna
10-77M	Moorhead	14	63.75	885.37	821.62	CH	62.9	116	33	83		Brenna
10-77M	Moorhead	15	68.25	885.37	817.12	CH	54.8	94	29	65		Brenna
10-77M	Moorhead	16	73.75	885.37	811.62	CH	58.3	98	27	71		Brenna
10-77M	Moorhead	17	78.75	885.37	806.62	CH	56.9	91	31	60		Brenna
10-77M	Moorhead	18	83.25	885.37	802.12	CH	52	79	28	51		Brenna
10-77M	Moorhead	19	87.25	885.37	798.12	CH	38.6	76	24	52		argusville
10-77M	Moorhead	20	93.25	885.37	792.12	CH	46.8	73	25	48		argusville
10-77M	Moorhead	21	98.75	885.37	786.62	CH	46.2	71	24	47		argusville
10-77M	Moorhead	22	103.75	885.37	781.62	CL	21.4	30	17	13		unit "A" till
10-77M	Moorhead	23	108.25	885.37	777.12	SC	20.8	32	19	13		unit "A" till
10-77M	Moorhead	24	113.75	885.37	771.62	CL	19.5	32	18	14		unit "A" till
10-77M	Moorhead	25	118.75	885.37	766.62	CL	21.2	35	18	17		unit "A" till
10-77M	Moorhead	26	123.25	885.37	762.12	SM	8.5	18	12	6		unit "A" till
10-77M	Moorhead	27	128.25	885.37	757.12	CL - ML	8.8	16	10	6		unit "A" till
10-78M	Moorhead	1	4	892.849	888.849	CH	33	64	27	37		Alluvium
10-78M	Moorhead	2	8.5	892.849	884.349	CH	37.6	80	35	45		sherack
10-78M	Moorhead	3	14.5	892.849	878.349	CH	38.7	77	33	44		sherack
10-78M	Moorhead	4	18.6	892.849	874.249	ML	41.8	39	27	12		PR-WF
10-78M	Moorhead	5	24.5	892.849	868.349	ML	35.4	31	23	8		PR-WF
10-78M	Moorhead	6	28.5	892.849	864.349	CH	41.6	61	27	34		PR - Harwood
10-78M	Moorhead	7	34	892.849	858.849	CH	48.5	100	35	65		dessicated brenna
10-78M	Moorhead	8	43.5	892.849	849.349	CH	69.5	112	32	80		brenna
10-78M	Moorhead	9	48.5	892.849	844.349	CH	66.8	105	34	71		brenna
10-78M	Moorhead	10	53.5	892.849	839.349	CH	70.9	127	34	93		brenna
10-78M	Moorhead	11	58.5	892.849	834.349	CH	67	112	29	83		brenna
10-78M	Moorhead	12	63.5	892.849	829.349	CH	62.7	104	33	71		brenna
10-78M	Moorhead	13	68.5	892.849	824.349	CH	59.9	100	31	69		brenna
10-78M	Moorhead	14	73.5	892.849	819.349	CH	59.9	92	32	60		brenna
10-78M	Moorhead	15	78.5	892.849	814.349	CH	52.9	87	27	60		brenna
10-78M	Moorhead	16	84.5	892.849	808.349	CH	45.5	74	28	46		argusville
10-78M	Moorhead	17	88.5	892.849	804.349	CH	58.2	81	29	52		argusville
10-78M	Moorhead	18	93.5	892.849	799.349	CH	42.1	75	31	44		argusville
10-78M	Moorhead	19	98.5	892.849	794.349	CH	51.5	84	26	58		argusville
10-78M	Moorhead	20	108.5	892.849	784.349	CH	42.4	69	24	45		argusville
10-78M	Moorhead	21	113.5	892.849	779.349	CL	13.2	33	15	18		unit "A" till
10-78M	Moorhead	22	123.5	892.849	769.349	CL	19.5	33	16	17		unit "A" till

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
 Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-79M	Moorhead	1	3.25	898.444	895.194	CH	31.4	64	22	42		Fill
10-79M	Moorhead	2	8.75	898.444	889.694	CH	35.4	78	29	49		sherack
10-79M	Moorhead	3	13.75	898.444	884.694	CL	41.3	46	21	25		sherack
10-79M	Moorhead	4	18.75	898.444	879.694	MH	33.7	27	22	5		PR-WF
10-79M	Moorhead	5	23.25	898.444	875.194	ML	29.3					PR-WF
10-79M	Moorhead	6	29.25	898.444	869.194	CH	37.9	75	27	48		dessicated brenna
10-79M	Moorhead	7	33.25	898.444	865.194	CH	76.8	131	37	94		Brenna
10-79M	Moorhead	8	38.75	898.444	859.694	CH	68.1	110	30	80		Brenna
10-79M	Moorhead	9	43.75	898.444	854.694	CH	63.6	100	40	60		Brenna
10-79M	Moorhead	10	48.75	898.444	849.694	CH	66.2	102	42	60		Brenna
10-79M	Moorhead	11	53.75	898.444	844.694	CH	72.3	121	34	87		Brenna
10-79M	Moorhead	12	58.75	898.444	839.694	CH	65.7	109	30	79		Brenna
10-79M	Moorhead	13	63.75	898.444	834.694	CH	61	98	29	69		Brenna
10-79M	Moorhead	14	68.25	898.444	830.194	CH	62.4	95	31	64		Brenna
10-79M	Moorhead	15	73.25	898.444	825.194	CH	48.6	88	26	62		Brenna
10-79M	Moorhead	16	78.75	898.444	819.694	CH	52.1	89	26	63		Brenna
10-79M	Moorhead	17	83.25	898.444	815.194	CH	46.1	75	26	49		argusville
10-79M	Moorhead	18	88.75	898.444	809.694	CH	51	72	26	46		argusville
10-79M	Moorhead	19	93.75	898.444	804.694	CH	61.8	81	30	51		argusville
10-79M	Moorhead	20	98.75	898.444	799.694	CH	46.9	77	21	56		argusville
10-79M	Moorhead	21	103.75	898.444	794.694	CH	46.7	89	28	61		argusville
10-79M	Moorhead	22	108.75	898.444	789.694	CH	37.8	63	22	41		argusville
10-79M	Moorhead	23	112.25	898.444	786.194	CH	43	69	24	45		argusville
10-79M	Moorhead	24	118.25	898.444	780.194	SC	33.1	27	17	10		unit "A" till
10-80M	Moorhead	1	0.25	911.24	910.99	CH	29.8	63	26	37		Topsoil
10-80M	Moorhead	2	3.75	911.24	907.49	CH	32.4	55	30	25		sherack
10-80M	Moorhead	3	9.25	911.24	901.99	CH	43.9	100	32	68		sherack
10-80M	Moorhead	4	10.75	911.24	900.49	CH	54.4	108	30	78		Oxidized Brenna
10-80M	Moorhead	5	13.75	911.24	897.49	CH	53.6	99	28	71		Oxidized Brenna
10-80M	Moorhead	6	16	911.24	895.24	CH	38.8	82	26	56		Oxidized Brenna
10-80M	Moorhead	7	18.75	911.24	892.49	CH	53.3	100	29	71		Oxidized Brenna
10-80M	Moorhead	8	23.75	911.24	887.49	CH	55	105	34	71		argusville
10-80M	Moorhead	9	28.75	911.24	882.49	CH	52.3	81	24	57		argusville
10-80M	Moorhead	10	34.25	911.24	876.99	CH	39	63	27	36		argusville
10-80M	Moorhead	11	39.25	911.24	871.99	CH	42.3	68	27	41		argusville
10-80M	Moorhead	12	43.75	911.24	867.49	CH	48.6	61	29	32		argusville
10-80M	Moorhead	13	48.75	911.24	862.49	CH	53.5	88	29	59		argusville
10-80M	Moorhead	14	54.25	911.24	856.99	CH	42.3	72	24	48		argusville
10-80M	Moorhead	15	58.75	911.24	852.49	CH	43.5	66	22	44		argusville
10-80M	Moorhead	16	61.75	911.24	849.49	CH	43.4	71	25	46		argusville
10-80M	Moorhead	17	68.05	911.24	843.19	CH	35.9	52	25	27		argusville
10-81M	Moorhead	1	4.5	907.77	903.27	CH	36.9	51	21	30		sherack
10-81M	Moorhead	2	8.5	907.77	899.27	CH	44.4	104	31	73		oxidized brenna
10-81M	Moorhead	3	13.5	907.77	894.27	CH	40.2	94	30	64		oxidized brenna
10-81M	Moorhead	4	18.5	907.77	889.27	CH	46	96	29	67		brenna
10-81M	Moorhead	5	28.5	907.77	879.27	CH	47.9	79	26	53		brenna
10-81M	Moorhead	6	33.5	907.77	874.27	CH	53.8	82	26	56		brenna
10-81M	Moorhead	7	38.5	907.77	869.27	CH	41.6	58	28	30		brenna
10-81M	Moorhead	8	43.5	907.77	864.27	CH	51.5	73	28	45		argusville
10-81M	Moorhead	9	48.5	907.77	859.27	CH	44.9	71	26	45		argusville
10-81M	Moorhead	10	53.5	907.77	854.27	CH	47.5	74	26	48		argusville
10-81M	Moorhead	11	58.5	907.77	849.27	CH	43.7	69	25	44		argusville
10-81M	Moorhead	12	63.5	907.77	844.27	CH	39.2	55	23	32		argusville
10-81M	Moorhead	13	68.8	907.77	838.97	CL	16.1	25	11	14		unit "A" till
10-81M	Moorhead	14	73.5	907.77	834.27	CL	15.1	26	14	12		unit "A" till
10-81M	Moorhead	15	83.75	907.77	824.02	CL	15.4	31	15	16		unit "A" till
10-82M	Moorhead	1	3.5	906.383	902.883	CH	24.5	68	24	44		Topsoil
10-82M	Moorhead	2	4.75	906.383	901.633	CH	28.4	54	26	28		Alluvium
10-82M	Moorhead	3	6.25	906.383	900.133	CL	41.2	41	24	17		sherack
10-82M	Moorhead	4	9.25	906.383	897.133	CH	42.2	75	28	47		sherack
10-82M	Moorhead	5	11.25	906.383	895.133	CH	32.6	67	23	44		PR-WF
10-82M	Moorhead	6	14.25	906.383	892.133	CL	25.8	30	22	8		PR-WF
10-82M	Moorhead	9	25.75	906.383	880.633	CL	43.2	42	21	21		Oxidized Brenna
10-82M	Moorhead	10	26.35	906.383	880.033	CH	39.8	68	24	44		Oxidized Brenna
10-82M	Moorhead	11	34.25	906.383	872.133	CH	70.5	105	30	75		Brenna
10-82M	Moorhead	12	39.25	906.383	867.133	CH	74.9	106	34	72		Brenna
10-82M	Moorhead	13	44.25	906.383	862.133	CH	80.6	116	29	87		Brenna
10-82M	Moorhead	14	48.75	906.383	857.633	CH	76.4	112	27	85		Brenna
10-82M	Moorhead	15	54.25	906.383	852.133	CH	62.7	95	24	71		Brenna
10-82M	Moorhead	16	58.75	906.383	847.633	CH	69.4	90	29	61		Brenna
10-82M	Moorhead	17	60.25	906.383	846.133	CH	65.3	91	24	67		Brenna
10-82M	Moorhead	18	64.75	906.383	841.633	CH	63.9	91	25	66		argusville
10-82M	Moorhead	19	68.75	906.383	837.633	CH	51.6	85	23	62		argusville
10-82M	Moorhead	20	73.25	906.383	833.133	CH	52.2	77	26	51		argusville
10-82M	Moorhead	21	77.75	906.383	828.633	CH	53.2	85	24	61		argusville

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
 Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-93M	Moorhead	19	98.5	912.374	813.874	ML	24.9	Non-Plastic				BA

Project: Fargo-Moorhead Metro Feasibility Study
 Subject: Jar Sample / Disturbed Testing Result from USACE Soil Exploration
 Tested by: Midwest Testing Laboratory, Grand Forks, ND; SET, Minneapolis, MN; SETS, Tucker, GA

Created by: KAH Latest Revision: 2/18/2011
 Date: JUL 09 By: KAH

Boring #	Location	Sample #	Mid-Depth [ft]	Top of boring Elevation [ft]	Elevation [ft]	Classification	In-Situ Moisture [%]	Liquid Limit (LL) [%]	Plastic Limit (PL) [%]	Plasticity Index (PI) [%]	Project #	Soil Formation
10-101M	Fargo	1	4.75	879.18	874.43		34.66	79	26	53		Alluvium
10-101M	Fargo	2	9.25	879.18	869.93		37.97	82	32	50		sherack
10-101M	Fargo	3	13.75	879.18	865.43		40.68	75	30	45		sherack
10-101M	Fargo	4	19.25	879.18	859.93		44.46	77	34	43		oxidized brenna
10-101M	Fargo	5	24.25	879.18	854.93		65.3	103	31	72		Brenna
10-101M	Fargo	6	29.25	879.18	849.93		57.05	95	33	62		Brenna
10-101M	Fargo	7	34.25	879.18	844.93		51.53	96	33	63		Brenna
10-101M	Fargo	8	39.2	879.18	839.98		57.58	91	34	57		Brenna
10-101M	Fargo	9	44.25	879.18	834.93		56.99	87	34	53		Brenna
10-101M	Fargo	10	49.25	879.18	829.93		60.03	106	35	71		Brenna
10-101M	Fargo	11	54.25	879.18	824.93		62.33	104	35	69		Brenna
10-101M	Fargo	12	59.25	879.18	819.93		61.37	93	35	58		Argusville
10-101M	Fargo	13	64.25	879.18	814.93		61.07	96	34	62		Argusville
10-101M	Fargo	14	69.25	879.18	809.93		60.16	99	34	65		Argusville
10-101M	Fargo	15	74.25	879.18	804.93		57.87	83	31	52		Argusville
10-101M	Fargo	16	79.25	879.18	799.93		46.31	74	28	46		Argusville
10-101M	Fargo	17	84.25	879.18	794.93		39.38	71	27	44		Argusville
10-101M	Fargo	18	89.25	879.18	789.93		20.13	27	17	10		unit "A" till
10-101M	Fargo	19	94.25	879.18	784.93		23.9	34	21	13		unit "A" till
10-101M	Fargo	20	99.25	879.18	779.93		22.6	34	21	13		unit "A" till
10-101M	Fargo	21	104.25	879.18	774.93		22.95	42	20	22		unit "A" till
10-101M	Fargo	22	109.25	879.18	769.93		30.9	NP				SM
10-101M	Fargo	23	113.25	879.18	765.93		8.13	29	16	13		unit "A" till
10-105M	Fargo	1	4.25	898	893.75		40.14	76	31	45		Alluvium
10-105M	Fargo	2	10.25	898	887.75		33.38	78	28	50		Alluvium
10-105M	Fargo	3	14.25	898	883.75		39.16	71	31	40		sherack
10-105M	Fargo	4	19.25	898	878.75		52.14	110	35	75		oxidized brenna
10-105M	Fargo	5	24.25	898	873.75		62.94	112	38	74		Brenna
10-105M	Fargo	6	29.25	898	868.75		63.51	109	32	77		Brenna
10-105M	Fargo	7	34.25	898	863.75		62.33	80	33	47		Brenna
10-105M	Fargo	8	39.25	898	858.75		63.71	102	35	67		Brenna
10-105M	Fargo	9	44.25	898	853.75		66.37	102	35	67		Argusville
10-105M	Fargo	10	49.25	898	848.75		65.01	101	33	68		Argusville
10-105M	Fargo	11	54.25	898	843.75		58.41	99	35	64		Argusville
10-105M	Fargo	12	59.25	898	838.75		51.53	80	33	47		Argusville
10-105M	Fargo	13	64.25	898	833.75		44.92	68	25	43		Argusville
10-105M	Fargo	14	69.25	898	828.75		20.61	31	18	13		unit "A" till
10-105M	Fargo	15	74.25	898	823.75		14.2	31	19	12		unit "A" till
10-105M	Fargo	16	84.25	898	813.75		8.85	33	18	15		unit "A" till
10-105M	Fargo	17	88.75	898	809.25		11.4	32	19	13		unit "A" till

1839

1821

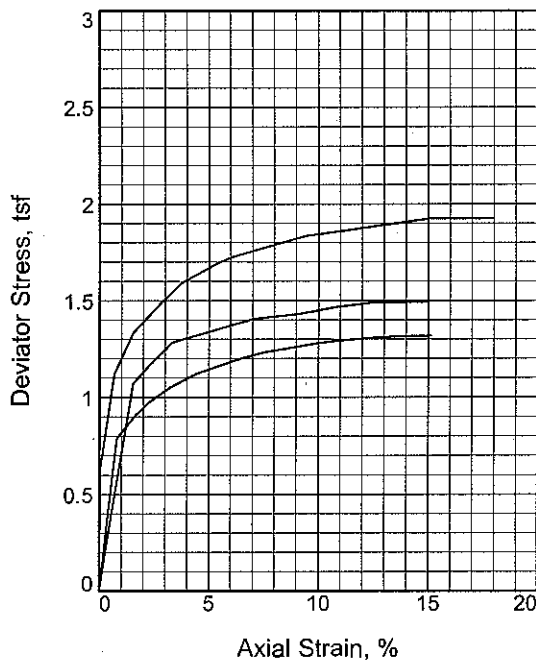
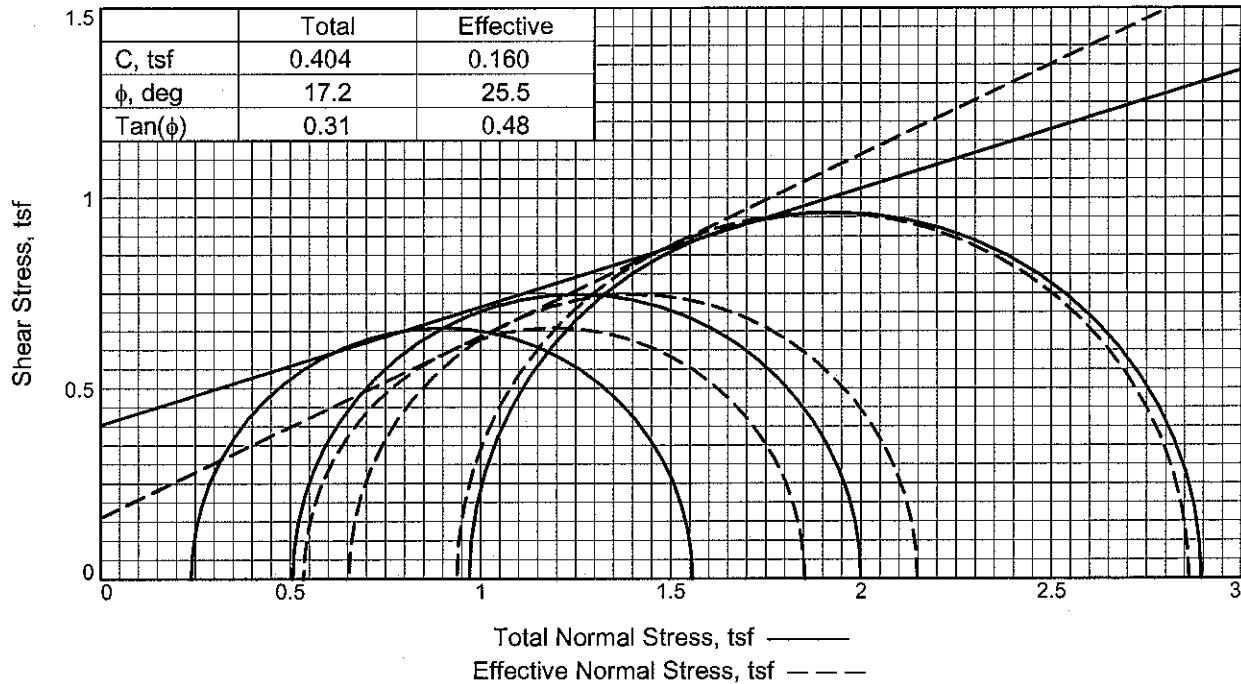
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1768

983

1839



Sample No.	1	2	3	
Initial	Water Content, %	26.3	26.0	24.9
	Dry Density, pcf	94.7	95.4	97.9
	Saturation, %	88.8	89.2	90.8
	Void Ratio	0.8131	0.8004	0.7534
	Diameter, in.	1.43	1.39	1.41
	Height, in.	2.99	2.93	2.95
At Test	Water Content, %	29.6	29.1	27.4
	Dry Density, pcf	94.7	95.4	97.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8131	0.8004	0.7534
	Diameter, in.	1.43	1.39	1.41
	Height, in.	2.99	2.93	2.95
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.24	0.51	0.97	
Back Pressure, tsf	5.51	5.46	5.52	
Cell Pressure, tsf	5.75	5.97	6.49	
Peak Deviator Stress, tsf	1.32	1.49	1.92	
Total Pore Pr., tsf	5.22	5.32	5.55	
Ultimate Deviator Stress, tsf	1.32	1.49	1.92	
Total Pore Pr., tsf	5.22	5.32	5.55	
Maj. Eff. Stress at Ultimate, tsf	1.85	2.15	2.86	
Min. Eff. Stress at Ultimate, tsf	0.54	0.65	0.94	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 68 PL= 17 PI= 51

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #1

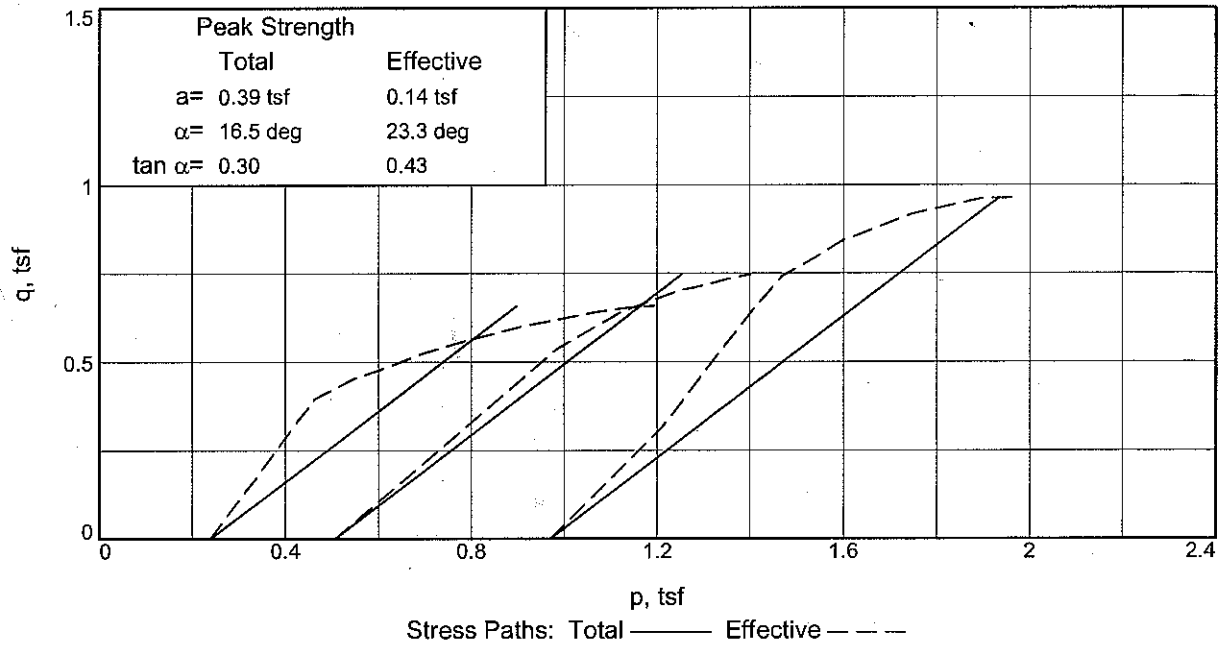
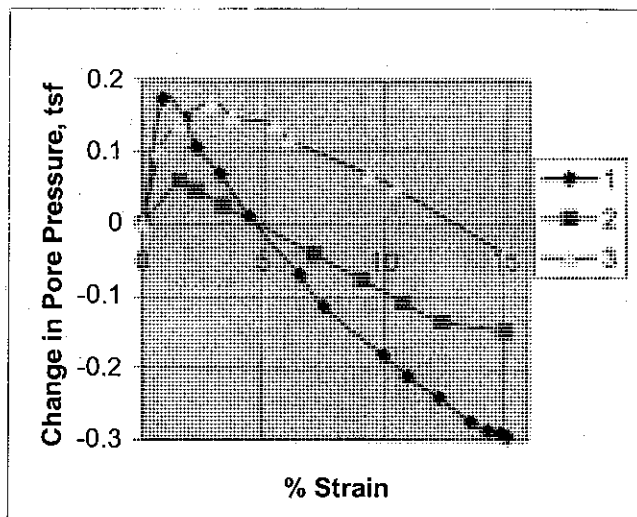
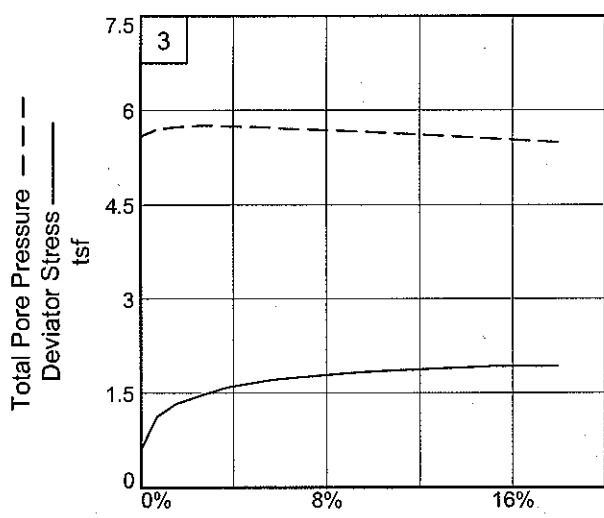
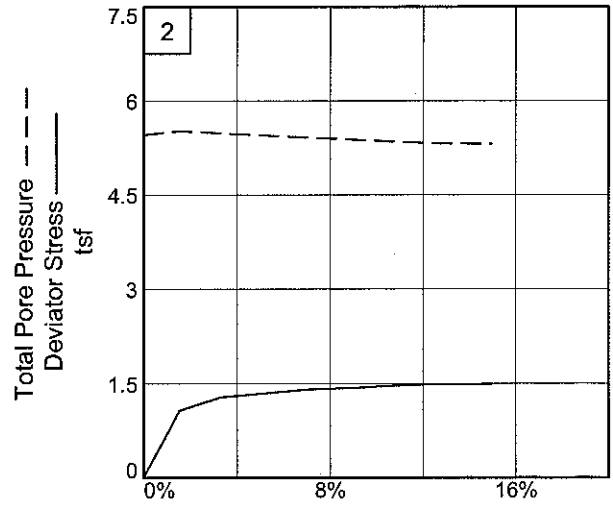
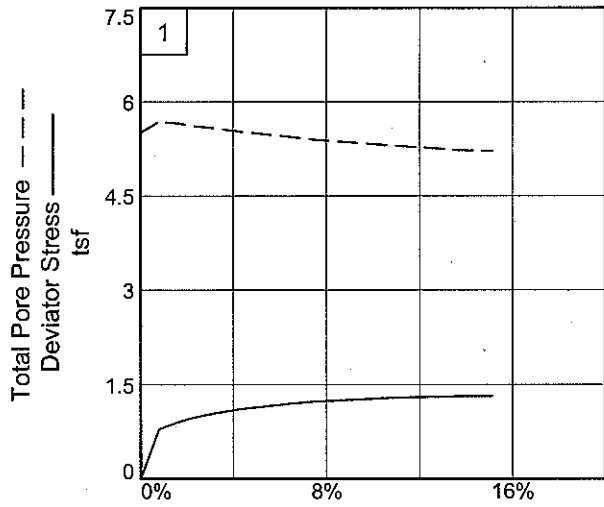
Depth: 2-4'

Alluvium

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 2-4' **Sample Number:** Boring 09-23MU, #1 **Alluvium**

Project No.: B-09-03-127 **Figure:** 27

Braun Interotec
Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

8/28/2009

12:51 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Depth: 2-4' **Sample Number:** Fargo Boring 09-23MU, #1
Description: FAT CLAY, gray (CH) **Alluvium**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**68 **PL=**17 **PI=**51
Test Method: COE uniform strain

Parameters for Specimen No. 1				
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	103.970			183.190
Moisture content: Dry soil+tare, gms.	88.690			148.690
Moisture content: Tare, gms.	30.510			30.690
Moisture, %	26.3	29.6	29.6	29.2
Moist specimen weight, gms.	149.8			
Diameter, in.	1.43	1.43	1.43	
Area, in. ²	1.59	1.59	1.59	
Height, in.	2.99	2.99	2.99	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	119.6	122.7	122.7	
Dry density, pcf	94.7	94.7	94.7	
Void ratio	0.8131	0.8131	0.8131	
Saturation, %	88.8	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 5.753 tsf
 Consolidation back pressure = 5.514 tsf
 Consolidation effective confining stress = 0.239 tsf
 Fail. Stress = 1.318 tsf at reading no. 16
 Ult. Stress = 1.318 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0671	15.200	0.0	0.0	0.000	0.239	0.239	1.00	5.514	0.239	0.000
1	0.0671	15.200	0.0	0.0	0.000	0.239	0.239	1.00	5.514	0.239	0.000
2	0.0671	15.200	0.0	0.0	0.000	0.239	0.239	1.00	5.514	0.239	0.000
3	0.0910	32.900	17.7	0.8	0.793	0.066	0.859	13.01	5.687	0.462	0.396
4	0.1170	35.700	20.5	1.7	0.910	0.094	1.004	10.68	5.659	0.549	0.455
5	0.1340	37.200	22.0	2.2	0.971	0.133	1.104	8.30	5.620	0.619	0.486
6	0.1630	39.200	24.0	3.2	1.049	0.171	1.220	7.13	5.582	0.695	0.524
7	0.2000	41.200	26.0	4.4	1.122	0.230	1.352	5.88	5.523	0.791	0.561
8	0.2620	43.700	28.5	6.5	1.203	0.310	1.513	4.88	5.443	0.911	0.601
9	0.2920	44.700	29.5	7.5	1.232	0.355	1.587	4.47	5.398	0.971	0.616
10	0.3660	46.700	31.5	10.0	1.280	0.422	1.702	4.03	5.331	1.062	0.640
11	0.3960	47.400	32.2	11.0	1.294	0.452	1.746	3.86	5.301	1.099	0.647
12	0.4360	48.200	33.0	12.3	1.306	0.481	1.787	3.72	5.272	1.134	0.653
13	0.4740	48.900	33.7	13.6	1.315	0.515	1.830	3.55	5.238	1.172	0.657
14	0.4940	49.200	34.0	14.3	1.316	0.527	1.843	3.50	5.226	1.185	0.658
15	0.5090	49.400	34.2	14.8	1.316	0.531	1.847	3.48	5.222	1.189	0.658
16	0.5200	49.600	34.4	15.1	1.318	0.535	1.853	3.46	5.218	1.194	0.659

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	73.930			171.430
Moisture content: Dry soil+tare, gms.	65.130			139.310
Moisture content: Tare, gms.	31.240			30.790
Moisture, %	26.0	29.1	29.1	29.6
Moist specimen weight, gms.	139.1			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.51	1.51	1.51	
Height, in.	2.93	2.93	2.93	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	120.1	123.1	123.1	
Dry density, pcf	95.4	95.4	95.4	
Void ratio	0.8004	0.8004	0.8004	
Saturation, %	89.2	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 5.969 tsf
 Consolidation back pressure = 5.463 tsf
 Consolidation effective confining stress = 0.506 tsf
 Fail. Stress = 1.494 tsf at reading no. 15
 Ult. Stress = 1.494 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.1820	22.240	0.0	0.0	0.000	0.506	0.506	1.00	5.463	0.506	0.000
1	0.1820	22.240	0.0	0.0	0.000	0.506	0.506	1.00	5.463	0.506	0.000
2	0.1820	22.240	0.0	0.0	0.000	0.506	0.506	1.00	5.463	0.506	0.000
3	0.1820	22.400	0.2	0.0	0.008	0.506	0.514	1.02	5.463	0.510	0.004
4	0.1820	22.400	0.2	0.0	0.008	0.506	0.514	1.02	5.463	0.510	0.004
5	0.1820	22.400	0.2	0.0	0.008	0.506	0.514	1.02	5.463	0.510	0.004
6	0.1820	22.400	0.2	0.0	0.008	0.506	0.514	1.02	5.463	0.510	0.004
7	0.1820	22.400	0.2	0.0	0.008	0.506	0.514	1.02	5.463	0.510	0.004
8	0.2270	45.000	22.8	1.5	1.071	0.448	1.519	3.39	5.521	0.984	0.536
9	0.2470	47.000	24.8	2.2	1.157	0.460	1.617	3.52	5.509	1.039	0.579
10	0.2790	50.000	27.8	3.3	1.283	0.481	1.764	3.67	5.488	1.122	0.641
11	0.3890	53.900	31.7	7.1	1.406	0.548	1.954	3.57	5.421	1.251	0.703
12	0.4490	55.200	33.0	9.1	1.432	0.584	2.016	3.45	5.385	1.300	0.716
13	0.4970	56.600	34.4	10.8	1.465	0.615	2.080	3.38	5.354	1.348	0.733
14	0.5450	57.800	35.6	12.4	1.489	0.642	2.131	3.32	5.327	1.386	0.744
15	0.6200	59.000	36.8	15.0	1.494	0.654	2.148	3.28	5.315	1.401	0.747

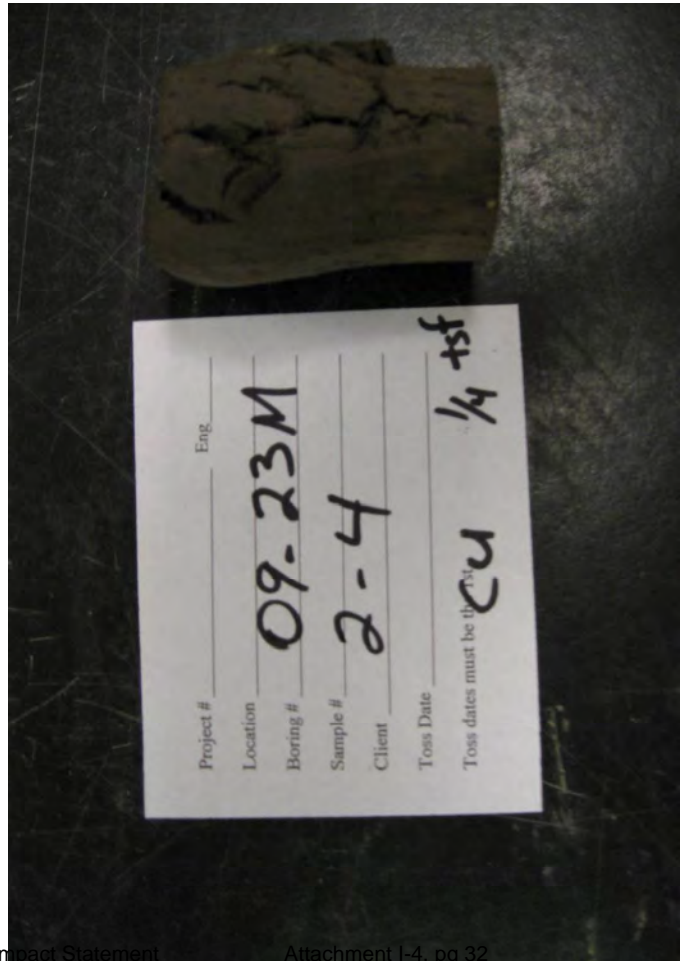
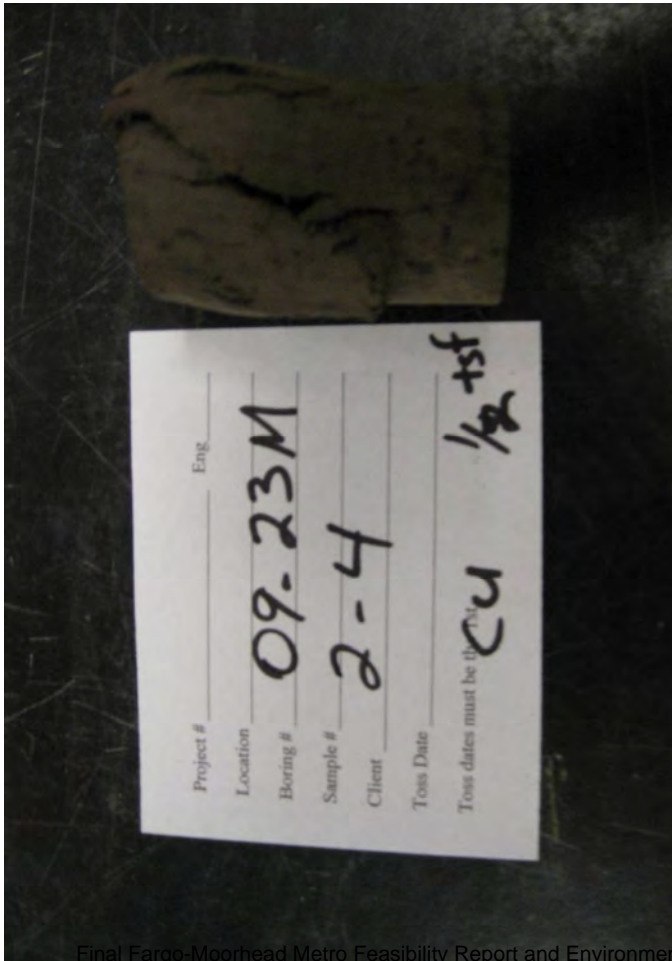
Parameters for Specimen No. 3

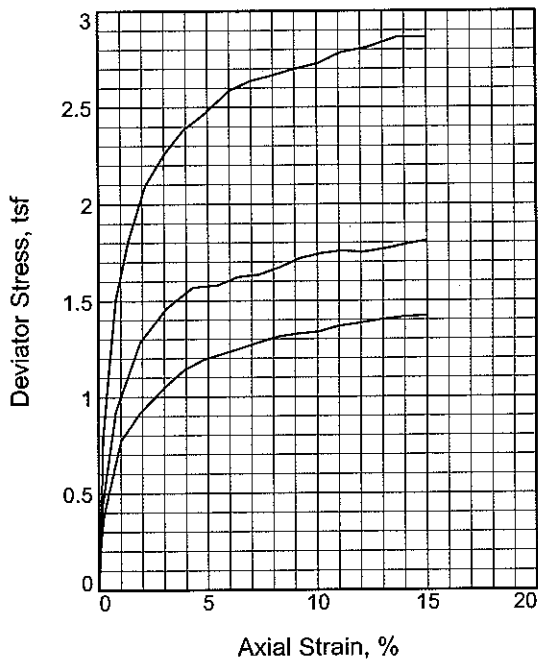
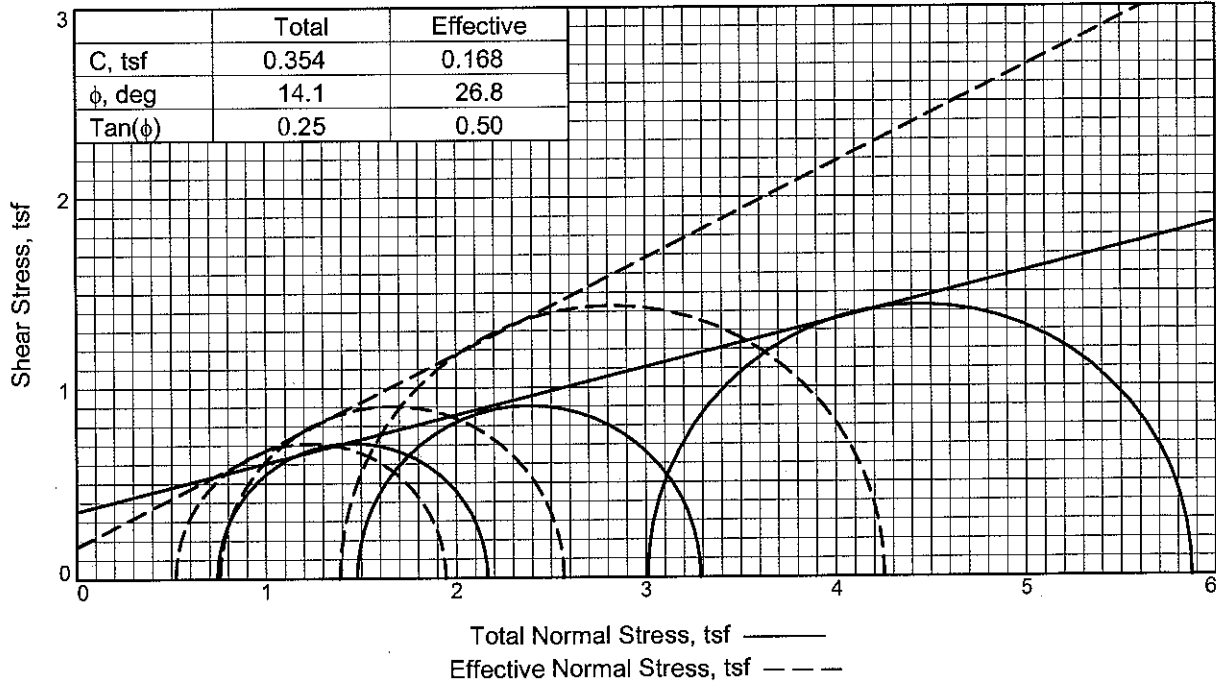
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	70.200			179.550
Moisture content: Dry soil+tare, gms.	62.250			147.630
Moisture content: Tare, gms.	30.280			30.790
Moisture, %	24.9	27.4	27.4	27.3
Moist specimen weight, gms.	148.1			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.95	2.95	2.95	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	122.3	124.7	124.7	
Dry density, pcf	97.9	97.9	97.9	
Void ratio	0.7534	0.7534	0.7534	
Saturation, %	90.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 6.487 tsf
 Consolidation back pressure = 5.517 tsf
 Consolidation effective confining stress = 0.970 tsf
 Fail. Stress = 1.925 tsf at reading no. 10
 Ult. Stress = 1.925 tsf at reading no. 10

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0959	17.200	0.0	0.0	0.000	0.970	0.970	1.00	5.517	0.970	0.000
1	0.0970	30.900	13.7	0.0	0.631	0.895	1.526	1.70	5.592	1.210	0.315
2	0.1160	41.700	24.5	0.7	1.120	0.793	1.913	2.41	5.694	1.353	0.560
3	0.1410	46.600	29.4	1.5	1.333	0.752	2.085	2.77	5.735	1.419	0.667
4	0.1780	50.370	33.2	2.8	1.485	0.726	2.211	3.05	5.761	1.468	0.742
5	0.2060	53.100	35.9	3.7	1.591	0.745	2.336	3.14	5.742	1.541	0.796
6	0.2570	56.200	39.0	5.5	1.698	0.757	2.455	3.24	5.730	1.606	0.849
7	0.2770	57.200	40.0	6.1	1.729	0.778	2.507	3.22	5.709	1.642	0.864
8	0.3740	61.200	44.0	9.4	1.835	0.827	2.662	3.22	5.660	1.745	0.918
9	0.4050	62.100	44.9	10.5	1.851	0.846	2.697	3.19	5.641	1.771	0.925
10	0.5400	66.400	49.2	15.0	1.925	0.937	2.862	3.05	5.550	1.899	0.962
11	0.6260	68.200	51.0	18.0	1.926	0.998	2.924	2.93	5.489	1.961	0.963





Sample No.		1	2	3
Initial	Water Content, %	31.1	31.5	30.9
	Dry Density, pcf	90.7	89.7	90.6
	Saturation, %	96.0	94.7	95.1
	Void Ratio	0.8921	0.9142	0.8943
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.81	2.81	2.80
At Test	Water Content, %	31.7	31.0	29.6
	Dry Density, pcf	91.7	92.6	94.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8719	0.8534	0.8140
	Diameter, in.	1.39	1.38	1.38
	Height, in.	2.80	2.78	2.76
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.74	1.48	3.00
Back Pressure, tsf		6.39	5.65	4.13
Cell Pressure, tsf		7.13	7.13	7.13
Peak Deviator Stress, tsf		1.42	1.81	2.86
Total Pore Pr., tsf		6.61	6.38	5.75
Ultimate Deviator Stress, tsf		1.42	1.81	2.86
Total Pore Pr., tsf		6.61	6.38	5.75
Maj. Eff. Stress at Ultimate, tsf		1.94	2.57	4.22
Min. Eff. Stress at Ultimate, tsf		0.52	0.76	1.39

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

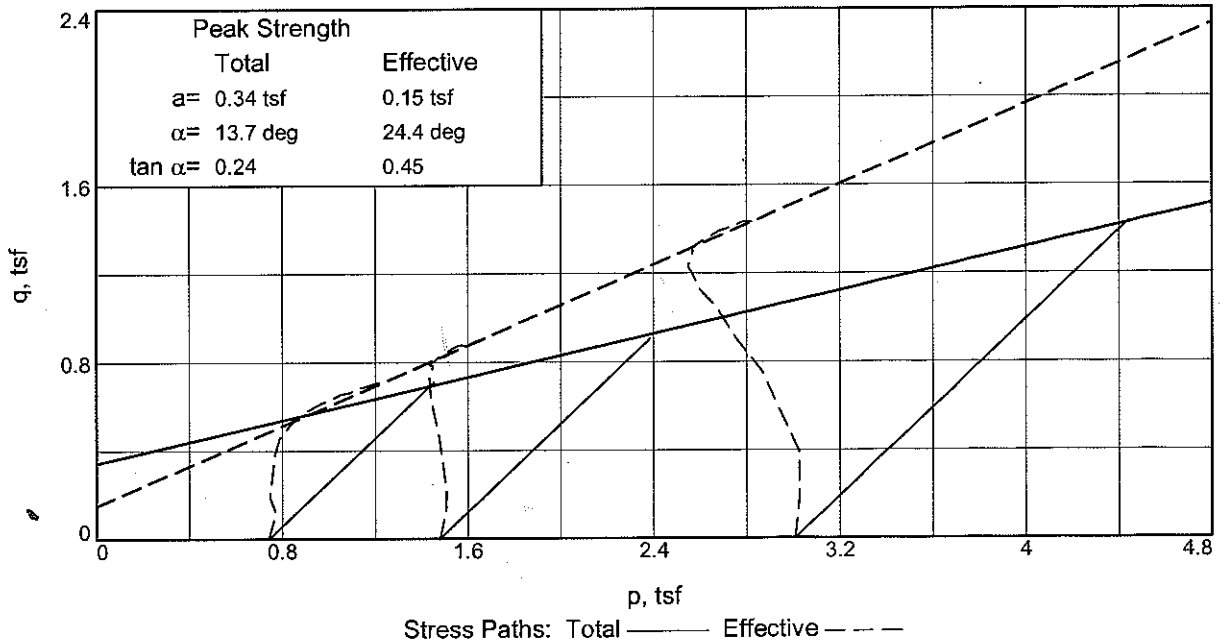
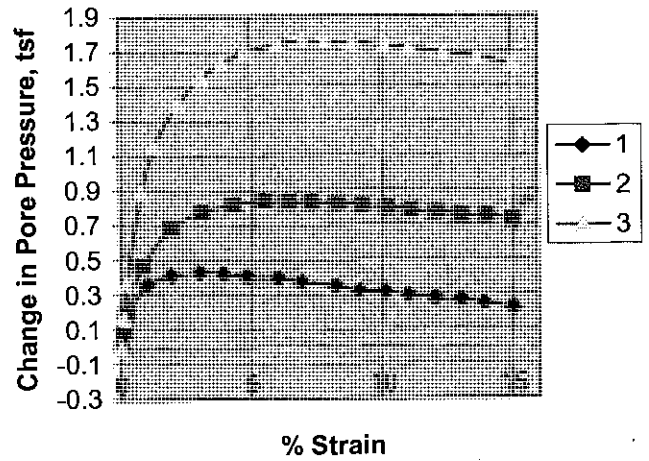
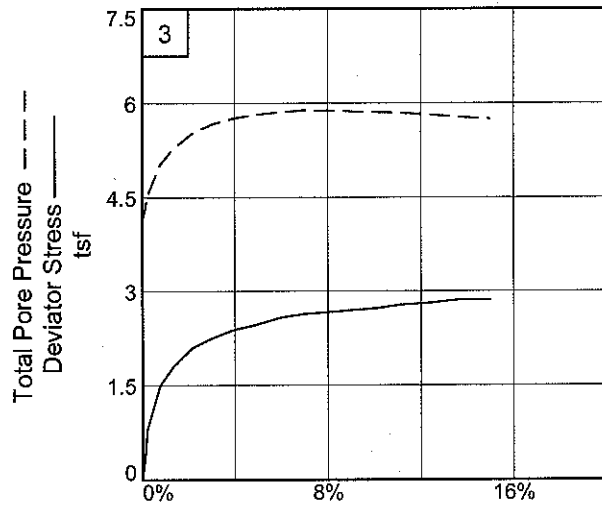
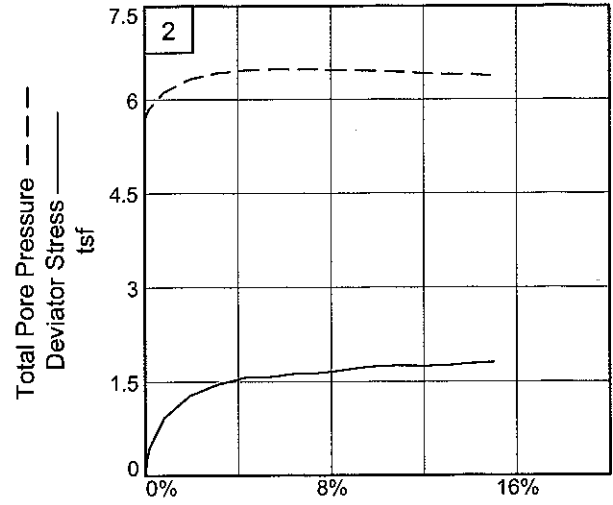
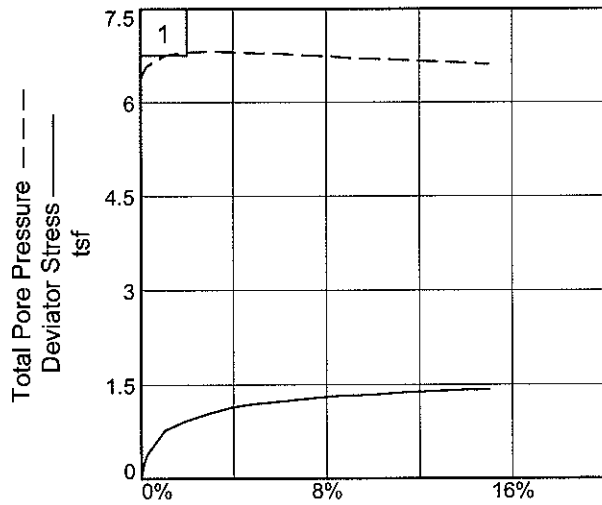
Location: SE-F-13, Fargo, Alluvium Formation

Sample Number: Boring 09-25MU, #1 **Depth:** 14-16'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-13, Fargo, Alluvium Formation

Depth: 14-16'

Sample No.: Boring 09-25MU, #1

Project No.: D-109-0127 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/9/2009

12:53 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Alluvium Formation
Depth: 14-16' **Sample Number:** Boring 09-25MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	138.810			164.560
Moisture content: Dry soil+tare, gms.	113.090			132.190
Moisture content: Tare, gms.	30.500			29.900
Moisture, %	31.1	32.4	31.7	31.6
Moist specimen weight, gms.	134.6			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.52	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	119.0	120.2	120.8	
Dry density, pcf	90.7	90.7	91.7	
Void ratio	0.8921	0.8921	0.8719	
Saturation, %	96.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.132 tsf
Consolidation back pressure = 6.390 tsf
Consolidation effective confining stress = 0.742 tsf
Peak Stress = 1.422 tsf at reading no. 17
Ult. Stress = 1.422 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0150	19.190	0.0	0.0	0.000	0.742	0.742	1.00	6.390	0.742	0.000
1	0.0179	24.250	5.1	0.1	0.239	0.654	0.893	1.37	6.478	0.773	0.119
2	0.0216	27.250	8.1	0.2	0.380	0.556	0.936	1.68	6.576	0.746	0.190
3	0.0437	35.730	16.5	1.0	0.773	0.382	1.155	3.02	6.750	0.769	0.387
4	0.0676	38.970	19.8	1.9	0.917	0.331	1.248	3.77	6.801	0.789	0.458
5	0.1003	42.200	23.0	3.0	1.054	0.314	1.368	4.36	6.818	0.841	0.527
6	0.1244	44.310	25.1	3.9	1.140	0.322	1.462	4.54	6.810	0.892	0.570
7	0.1492	45.740	26.6	4.8	1.194	0.337	1.531	4.54	6.795	0.934	0.597
8	0.1819	46.960	27.8	6.0	1.234	0.351	1.585	4.51	6.781	0.968	0.617
9	0.2088	48.030	28.8	6.9	1.268	0.374	1.642	4.39	6.758	1.008	0.634
10	0.2449	49.470	30.3	8.2	1.313	0.395	1.708	4.32	6.737	1.051	0.656
11	0.2708	50.140	30.9	9.1	1.328	0.424	1.752	4.13	6.708	1.088	0.664
12	0.2965	50.700	31.5	10.1	1.339	0.432	1.771	4.10	6.700	1.101	0.669
13	0.3228	51.750	32.6	11.0	1.369	0.448	1.817	4.06	6.684	1.132	0.684
14	0.3497	52.460	33.3	12.0	1.384	0.465	1.849	3.98	6.667	1.157	0.692
15	0.3774	53.250	34.1	13.0	1.401	0.481	1.882	3.91	6.651	1.181	0.700
16	0.4044	53.990	34.8	13.9	1.415	0.499	1.914	3.84	6.633	1.207	0.708
17	0.4340	54.590	35.4	15.0	1.422	0.522	1.944	3.72	6.610	1.233	0.711

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	153.380			161.700
Moisture content: Dry soil+tare, gms.	123.860			131.370
Moisture content: Tare, gms.	30.100			30.650
Moisture, %	31.5	33.2	31.0	30.1
Moist specimen weight, gms.	132.3			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.49	
Height, in.	2.81	2.81	2.78	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	117.9	119.5	121.4	
Dry density, pcf	89.7	89.7	92.6	
Void ratio	0.9142	0.9142	0.8534	
Saturation, %	94.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.132 tsf
 Consolidation back pressure = 5.653 tsf
 Consolidation effective confining stress = 1.479 tsf
 Peak Stress = 1.809 tsf at reading no. 17
 Ult. Stress = 1.809 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0128	19.340	0.0	0.0	0.000	1.479	1.479	1.00	5.653	1.479	0.000
1	0.0148	24.560	5.2	0.1	0.253	1.378	1.631	1.18	5.754	1.504	0.126
2	0.0179	28.560	9.2	0.2	0.446	1.283	1.729	1.35	5.849	1.506	0.223
3	0.0346	38.630	19.3	0.8	0.927	1.011	1.938	1.92	6.121	1.474	0.463
4	0.0657	46.350	27.0	1.9	1.283	0.798	2.081	2.61	6.334	1.439	0.641
5	0.0986	50.440	31.1	3.1	1.459	0.704	2.163	3.07	6.428	1.434	0.730
6	0.1323	53.220	33.9	4.3	1.570	0.663	2.233	3.37	6.469	1.448	0.785
7	0.1644	53.870	34.5	5.5	1.581	0.644	2.225	3.45	6.488	1.434	0.790
8	0.1902	55.160	35.8	6.4	1.624	0.649	2.273	3.50	6.483	1.461	0.812
9	0.2168	55.780	36.4	7.3	1.635	0.649	2.284	3.52	6.483	1.466	0.817
10	0.2438	57.030	37.7	8.3	1.673	0.659	2.332	3.54	6.473	1.496	0.837
11	0.2696	58.500	39.2	9.2	1.721	0.667	2.388	3.58	6.465	1.527	0.860
12	0.2966	59.500	40.2	10.2	1.746	0.680	2.426	3.57	6.452	1.553	0.873
13	0.3227	60.200	40.9	11.1	1.758	0.693	2.451	3.54	6.439	1.572	0.879
14	0.3484	60.450	41.1	12.1	1.750	0.710	2.460	3.46	6.422	1.585	0.875
15	0.3754	61.290	42.0	13.0	1.766	0.729	2.495	3.42	6.403	1.612	0.883
16	0.4023	62.350	43.0	14.0	1.791	0.732	2.523	3.45	6.400	1.627	0.895
17	0.4294	63.300	44.0	15.0	1.809	0.757	2.566	3.39	6.375	1.662	0.905

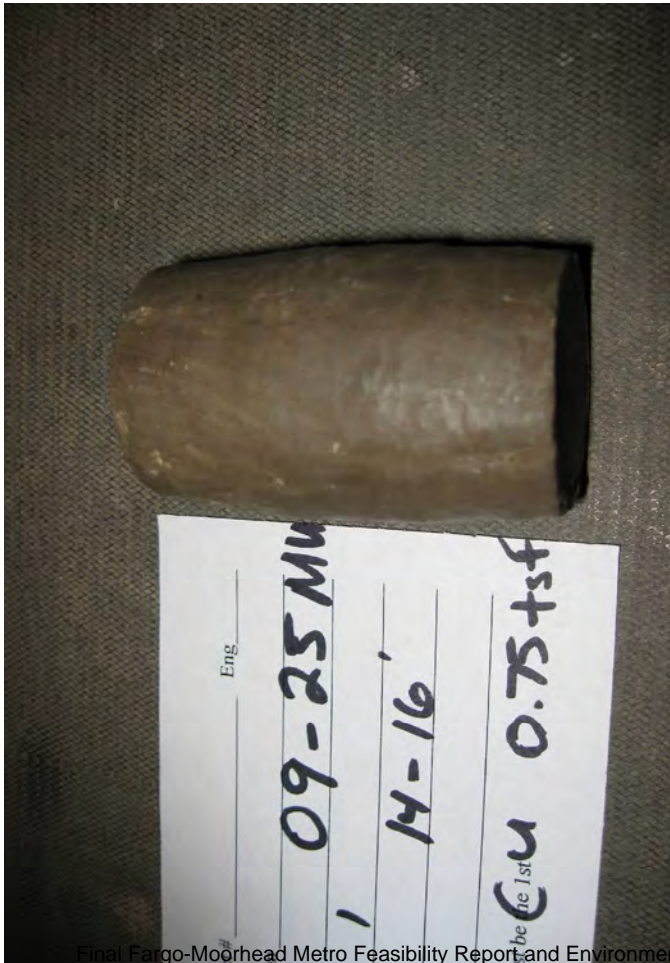
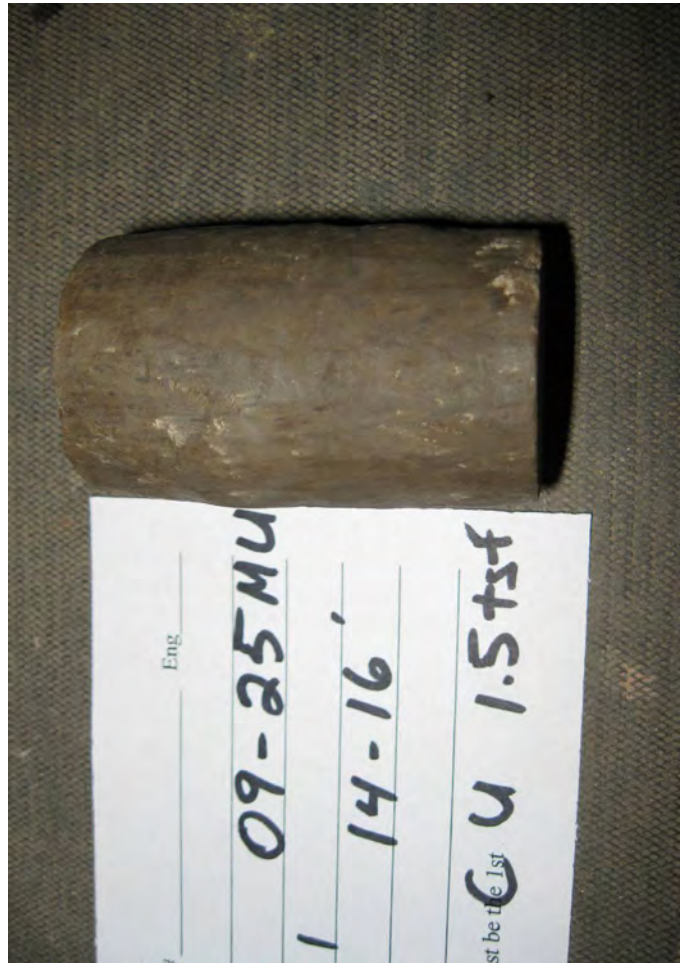
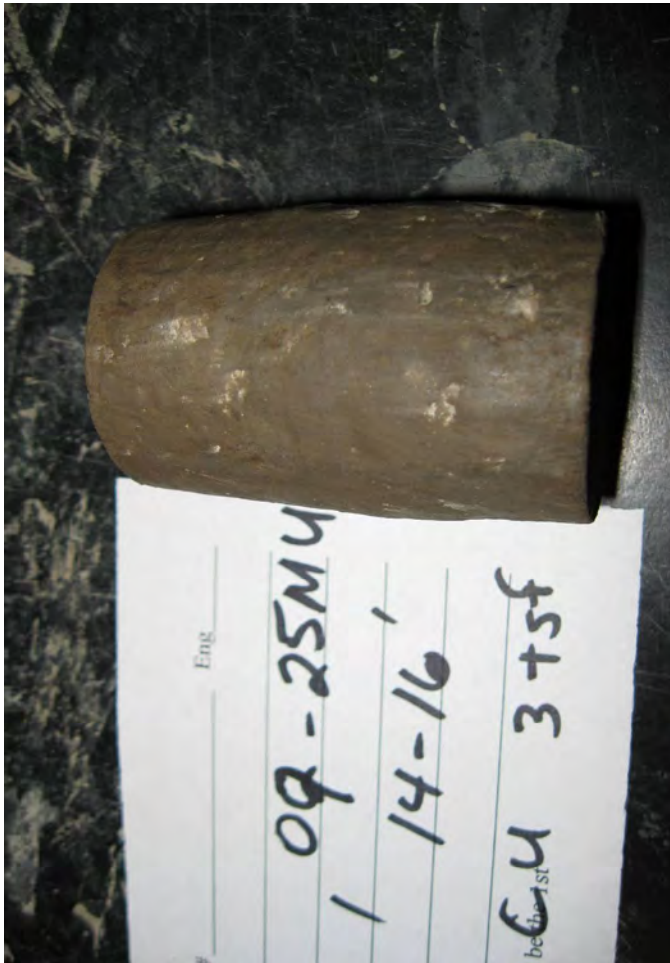
Parameters for Specimen No. 3

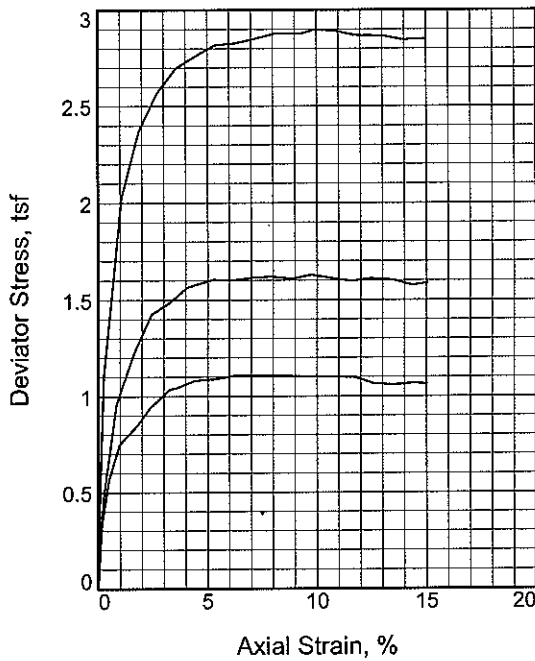
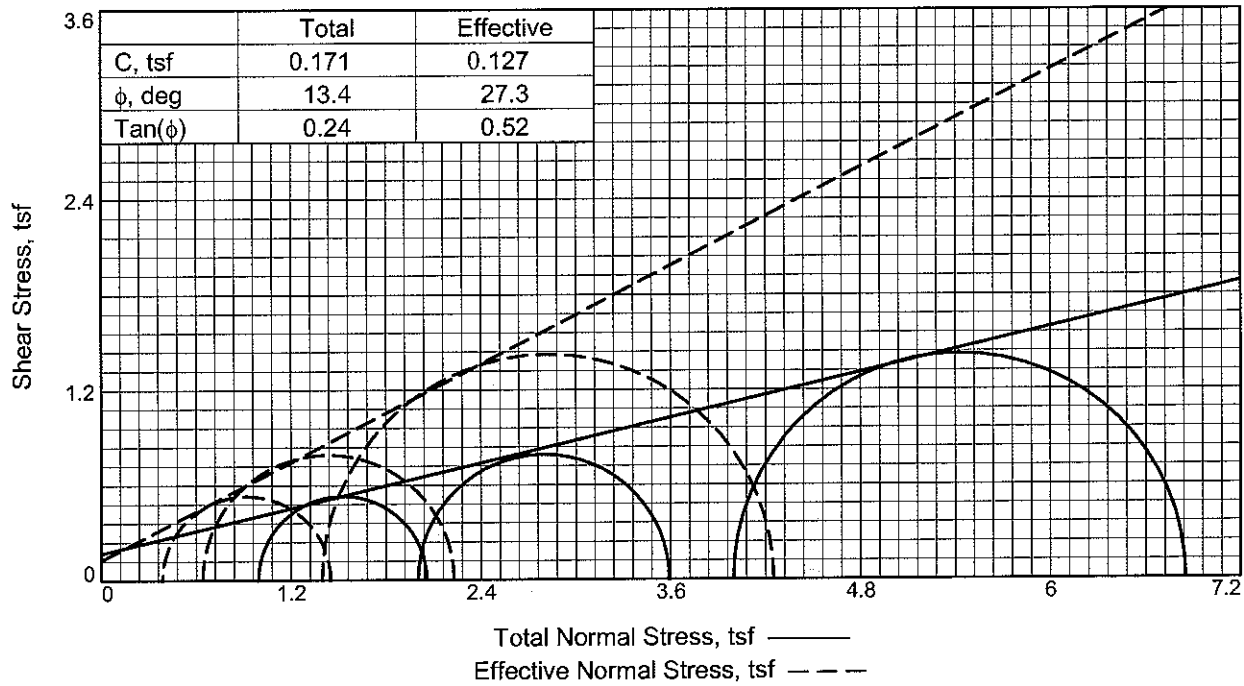
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	135.490			162.170
Moisture content: Dry soil+tare, gms.	110.710			133.820
Moisture content: Tare, gms.	30.590			30.790
Moisture, %	30.9	32.5	29.6	27.5
Moist specimen weight, gms.	134.5			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.54	1.54	1.50	
Height, in.	2.80	2.80	2.76	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	118.7	120.1	122.7	
Dry density, pcf	90.6	90.6	94.6	
Void ratio	0.8943	0.8943	0.8140	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.135 tsf
 Consolidation back pressure = 4.126 tsf
 Consolidation effective confining stress = 3.009 tsf
 Peak Stress = 2.865 tsf at reading no. 16
 Ult. Stress = 2.864 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0108	19.620	0.0	0.0	0.000	3.009	3.009	1.00	4.126	3.009	0.000
1	0.0141	27.340	7.7	0.1	0.371	2.841	3.212	1.13	4.294	3.027	0.186
2	0.0164	35.940	16.3	0.2	0.784	2.634	3.418	1.30	4.501	3.026	0.392
3	0.0321	51.080	31.5	0.8	1.503	2.118	3.621	1.71	5.017	2.869	0.751
4	0.0479	57.650	38.0	1.3	1.806	1.854	3.660	1.97	5.281	2.757	0.903
5	0.0706	64.180	44.6	2.2	2.099	1.617	3.716	2.30	5.518	2.666	1.049
6	0.0954	68.110	48.5	3.1	2.263	1.465	3.728	2.54	5.670	2.597	1.132
7	0.1194	71.200	51.6	3.9	2.386	1.378	3.764	2.73	5.757	2.571	1.193
8	0.1443	73.360	53.7	4.8	2.462	1.318	3.780	2.87	5.817	2.549	1.231
9	0.1772	76.780	57.2	6.0	2.586	1.274	3.860	3.03	5.861	2.567	1.293
10	0.2031	78.490	58.9	7.0	2.637	1.249	3.886	3.11	5.886	2.568	1.319
11	0.2291	79.680	60.1	7.9	2.663	1.255	3.918	3.12	5.880	2.587	1.332
12	0.2558	81.030	61.4	8.9	2.695	1.264	3.959	3.13	5.871	2.611	1.347
13	0.2908	82.740	63.1	10.1	2.731	1.278	4.009	3.14	5.857	2.644	1.366
14	0.3178	84.670	65.0	11.1	2.784	1.289	4.073	3.16	5.846	2.681	1.392
15	0.3527	86.300	66.7	12.4	2.813	1.320	4.133	3.13	5.815	2.727	1.407
16	0.3883	88.530	68.9	13.7	2.865	1.353	4.218	3.12	5.782	2.785	1.432
17	0.4250	89.600	70.0	15.0	2.864	1.388	4.252	3.06	5.747	2.820	1.432





	1	2	3	
Sample No.	1	2	3	
Initial	Water Content, %	48.3	48.3	48.4
	Dry Density, pcf	73.0	71.5	72.4
	Saturation, %	98.3	94.9	97.2
	Void Ratio	1.3517	1.4000	1.3707
	Diameter, in.	1.39	1.40	1.40
	Height, in.	2.81	2.83	2.82
At Test	Water Content, %	47.3	46.3	40.9
	Dry Density, pcf	74.6	75.5	80.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3018	1.2744	1.1245
	Diameter, in.	1.38	1.37	1.35
	Height, in.	2.79	2.78	2.72
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.99	2.00	4.00	
Back Pressure, tsf	6.15	5.14	3.14	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	1.11	1.63	2.90	
Total Pore Pr., tsf	6.76	6.49	5.74	
Ultimate Deviator Stress, tsf	1.06	1.59	2.85	
Total Pore Pr., tsf	6.75	6.50	5.74	
Maj. Eff. Stress at Ultimate, tsf	1.49	2.28	4.30	
Min. Eff. Stress at Ultimate, tsf	0.38	0.65	1.40	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY with organic matter(shells), gray (CH)

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.001 in/min.

Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

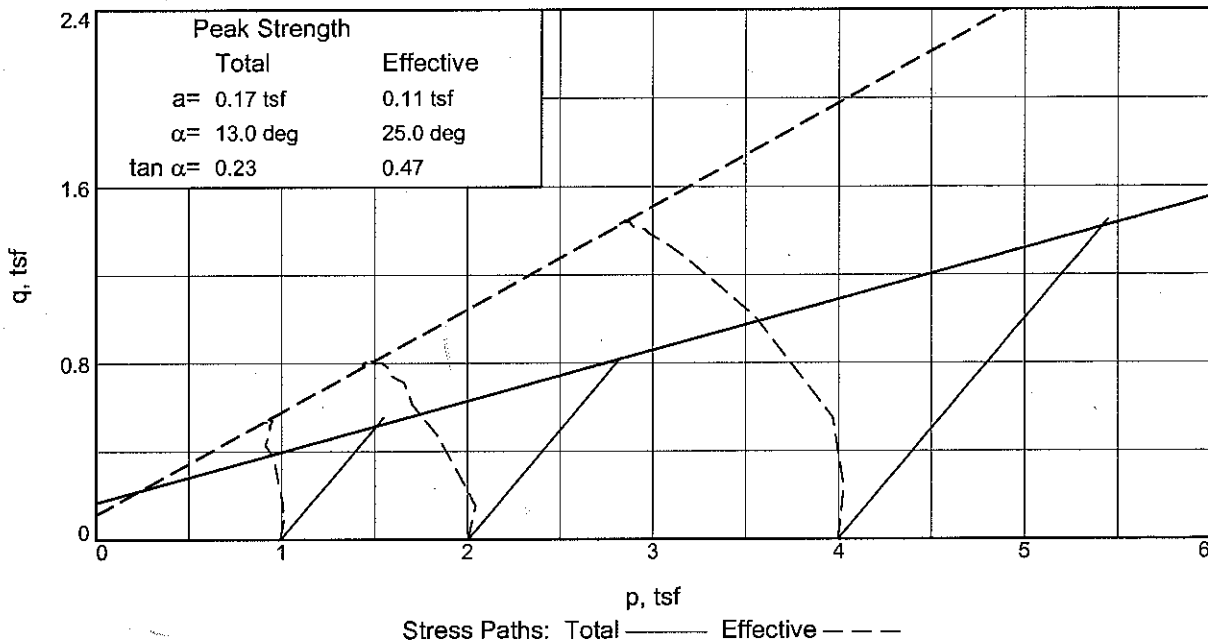
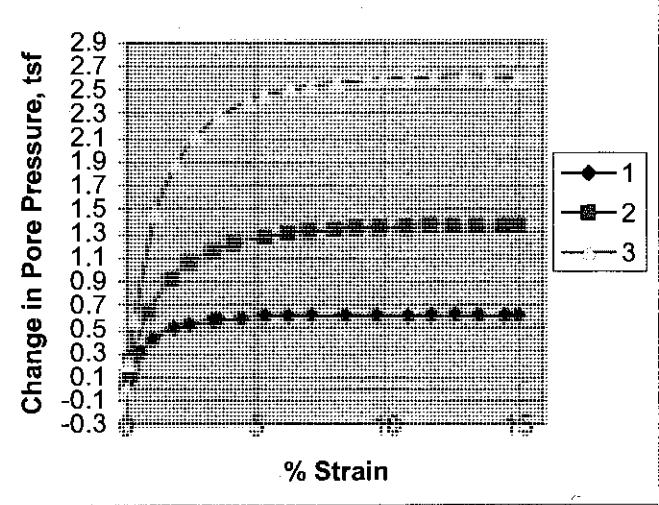
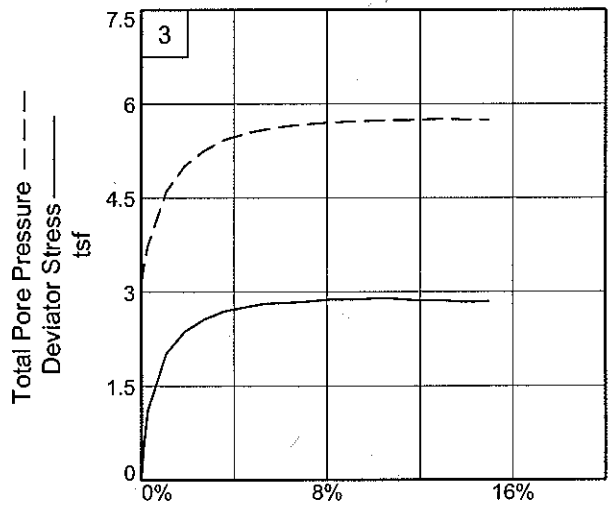
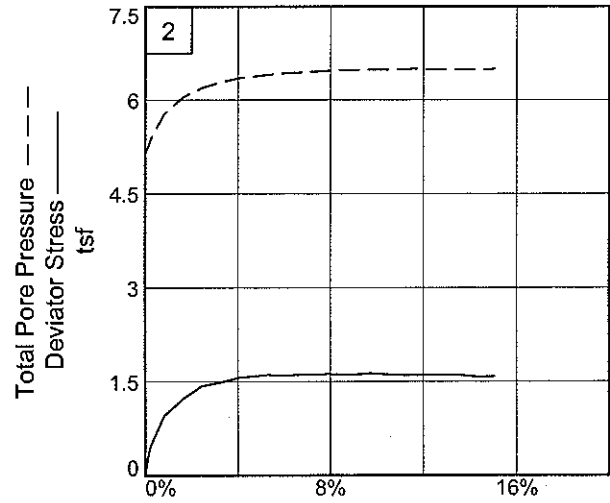
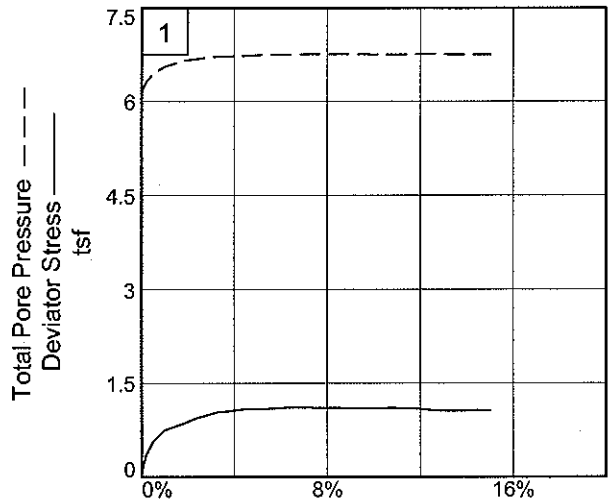
Location: SE-F-13, Fargo, Alluvium Formation

Sample Number: Boring 09-25MU, #2 **Depth:** 26-28'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN[™]
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-13, Fargo, Alluvium Formation

Depth: 26-28'

Sample No.: Boring 09-25MU, #2

Project No.: DL 09-03127 Fargo-Moorhead Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

11/17/2009

9:17 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Alluvium Formation
Depth: 26-28' **Sample Number:** Boring 09-25MU, #2
Description: FAT CLAY with organic matter(shells), gray (CH)
Remarks: The rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.880			149.640
Moisture content: Dry soil+tare, gms.	93.480			113.270
Moisture content: Tare, gms.	30.590			31.110
Moisture, %	48.3	49.2	47.3	44.3
Moist specimen weight, gms.	122.1			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.53	1.53	1.50	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	108.3	108.9	109.9	
Dry density, pcf	73.0	73.0	74.6	
Void ratio	1.3517	1.3517	1.3018	
Saturation, %	98.3	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.146 tsf
 Consolidation effective confining stress = 0.994 tsf
 Peak Stress = 1.108 tsf at reading no. 12
 Ult. Stress = 1.064 tsf at reading no. 20

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0081	18.670	0.0	0.0	0.000	0.994	0.994	1.00	6.146	0.994	0.000
1	0.0099	22.330	3.7	0.1	0.175	0.925	1.100	1.19	6.215	1.013	0.088
2	0.0129	25.750	7.1	0.2	0.338	0.836	1.174	1.40	6.304	1.005	0.169
3	0.0219	30.570	11.9	0.5	0.567	0.694	1.261	1.82	6.446	0.977	0.283
4	0.0355	34.480	15.8	1.0	0.749	0.582	1.331	2.29	6.558	0.957	0.375
5	0.0595	36.920	18.3	1.8	0.857	0.484	1.341	2.77	6.656	0.913	0.429
6	0.0748	38.840	20.2	2.4	0.942	0.459	1.401	3.05	6.681	0.930	0.471
7	0.0996	41.070	22.4	3.3	1.037	0.420	1.457	3.47	6.720	0.938	0.518
8	0.1073	41.250	22.6	3.5	1.042	0.713	1.755	2.46	6.427	1.234	0.521
9	0.1322	42.350	23.7	4.4	1.083	0.410	1.493	3.64	6.730	0.951	0.541
10	0.1566	42.720	24.0	5.3	1.090	0.387	1.477	3.82	6.753	0.932	0.545
11	0.1821	43.360	24.7	6.2	1.108	0.389	1.497	3.85	6.751	0.943	0.554
12	0.2078	43.610	24.9	7.1	1.108	0.384	1.492	3.89	6.756	0.938	0.554
13	0.2419	43.910	25.2	8.4	1.107	0.385	1.492	3.87	6.755	0.938	0.553
14	0.2758	44.130	25.5	9.6	1.102	0.385	1.487	3.86	6.755	0.936	0.551
15	0.3096	44.510	25.8	10.8	1.103	0.390	1.493	3.83	6.750	0.942	0.552
16	0.3356	44.700	26.0	11.7	1.100	0.384	1.484	3.86	6.756	0.934	0.550
17	0.3605	44.170	25.5	12.6	1.066	0.380	1.446	3.81	6.760	0.913	0.533
18	0.3865	44.290	25.6	13.5	1.060	0.386	1.446	3.75	6.754	0.916	0.530
19	0.4125	44.780	26.1	14.5	1.069	0.387	1.456	3.76	6.753	0.921	0.534
20	0.4280	44.830	26.2	15.0	1.064	0.386	1.450	3.76	6.754	0.918	0.532

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.760			145.330
Moisture content: Dry soil+tare, gms.	89.760			110.750
Moisture content: Tare, gms.	29.760			30.710
Moisture, %	48.3	50.9	46.3	43.2
Moist specimen weight, gms.	120.7			
Diameter, in.	1.40	1.40	1.37	
Area, in. ²	1.53	1.53	1.48	
Height, in.	2.83	2.83	2.78	
Net decrease in height, in.		0.00	0.05	
Wet Density, pcf	106.1	107.9	110.5	
Dry density, pcf	71.5	71.5	75.5	
Void ratio	1.4000	1.4000	1.2744	
Saturation, %	94.9	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.137 tsf
 Consolidation effective confining stress = 2.003 tsf
 Peak Stress = 1.629 tsf at reading no. 13
 Ult. Stress = 1.587 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0079	18.940	0.0	0.0	0.000	2.003	2.003	1.00	5.137	2.003	0.000
1	0.0118	25.230	6.3	0.1	0.306	1.890	2.196	1.16	5.250	2.043	0.153
2	0.0148	28.590	9.6	0.2	0.469	1.759	2.228	1.27	5.381	1.994	0.235
3	0.0309	38.690	19.7	0.8	0.955	1.357	2.312	1.70	5.783	1.835	0.478
4	0.0539	44.520	25.6	1.7	1.227	1.088	2.315	2.13	6.052	1.701	0.613
5	0.0757	48.920	30.0	2.4	1.426	0.945	2.371	2.51	6.195	1.658	0.713
6	0.0984	50.440	31.5	3.3	1.486	0.850	2.336	2.75	6.290	1.593	0.743
7	0.1214	52.430	33.5	4.1	1.566	0.788	2.354	2.99	6.352	1.571	0.783
8	0.1543	53.710	34.8	5.3	1.606	0.735	2.341	3.19	6.405	1.538	0.803
9	0.1792	53.950	35.0	6.2	1.602	0.704	2.306	3.28	6.436	1.505	0.801
10	0.2039	54.590	35.7	7.0	1.616	0.687	2.303	3.35	6.453	1.495	0.808
11	0.2291	55.050	36.1	8.0	1.621	0.670	2.291	3.42	6.470	1.480	0.810
12	0.2537	55.150	36.2	8.8	1.610	0.658	2.268	3.45	6.482	1.463	0.805
13	0.2787	55.960	37.0	9.7	1.629	0.654	2.283	3.49	6.486	1.469	0.815
14	0.3046	55.950	37.0	10.7	1.612	0.650	2.262	3.48	6.490	1.456	0.806
15	0.3296	56.000	37.1	11.6	1.598	0.638	2.236	3.50	6.502	1.437	0.799
16	0.3555	56.670	37.7	12.5	1.610	0.648	2.258	3.48	6.492	1.453	0.805
17	0.3816	56.940	38.0	13.4	1.604	0.647	2.251	3.48	6.493	1.449	0.802
18	0.4074	56.670	37.7	14.4	1.576	0.648	2.224	3.43	6.492	1.436	0.788
19	0.4263	57.250	38.3	15.0	1.587	0.641	2.228	3.48	6.499	1.435	0.794

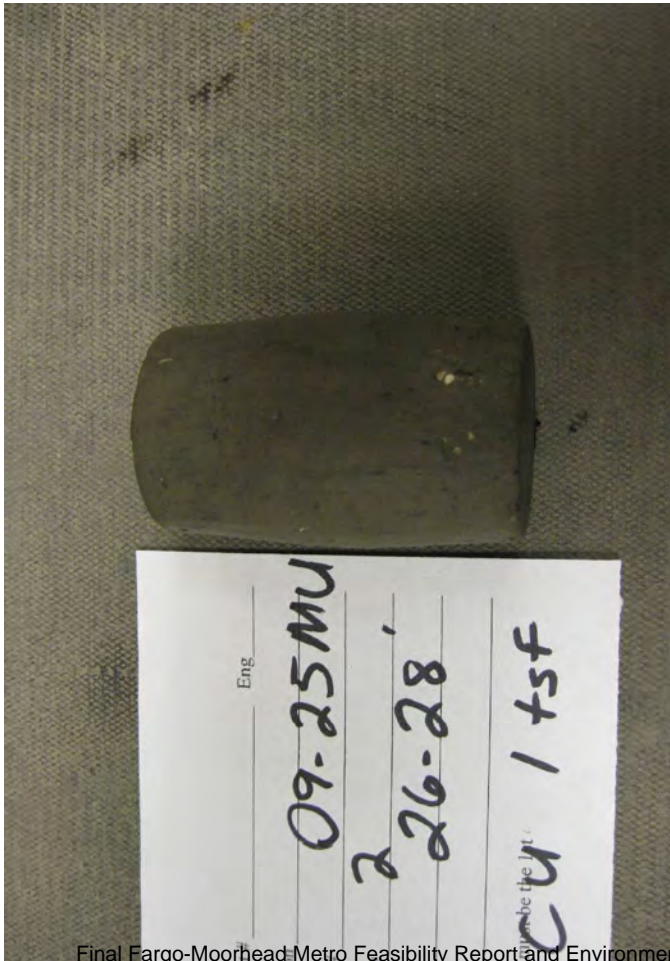
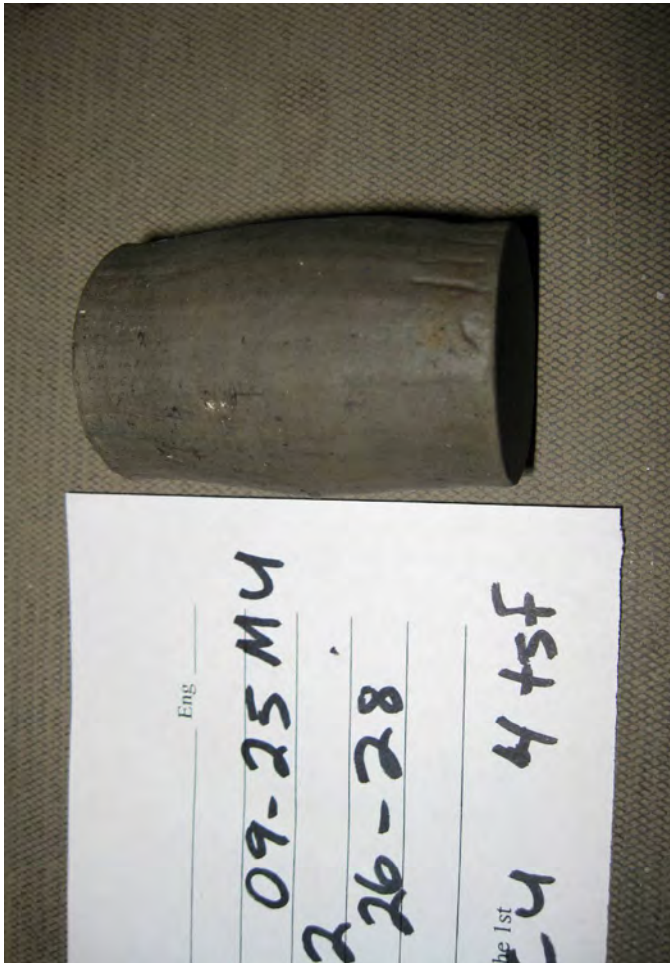
Parameters for Specimen No. 3

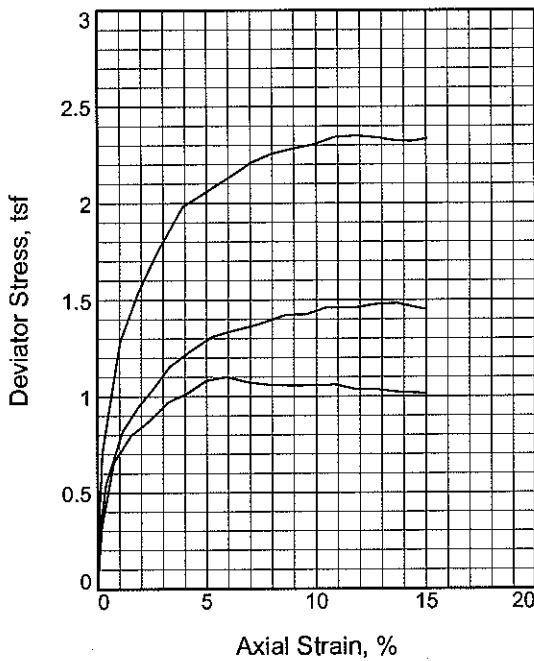
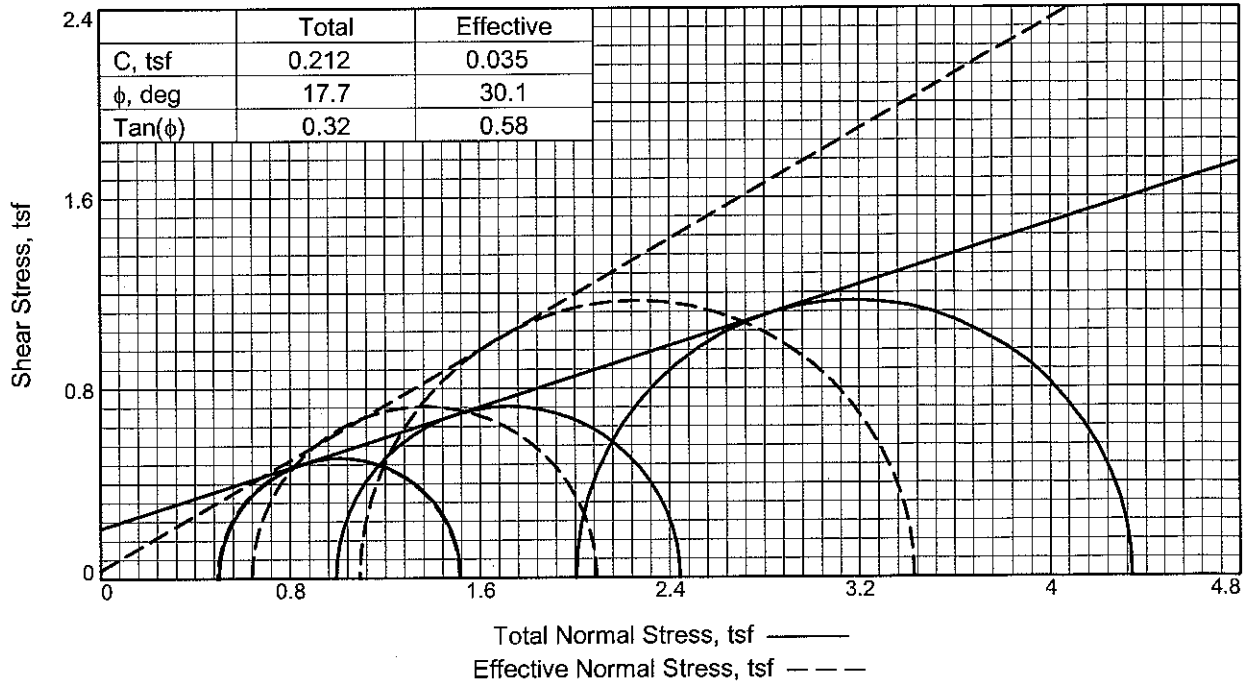
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.780			141.210
Moisture content: Dry soil+tare, gms.	97.630			112.000
Moisture content: Tare, gms.	31.260			29.430
Moisture, %	48.4	49.8	40.9	35.4
Moist specimen weight, gms.	122.5			
Diameter, in.	1.40	1.40	1.35	
Area, in. ²	1.54	1.54	1.43	
Height, in.	2.82	2.82	2.72	
Net decrease in height, in.		0.00	0.10	
Wet Density, pcf	107.5	108.5	113.9	
Dry density, pcf	72.4	72.4	80.8	
Void ratio	1.3707	1.3707	1.1245	
Saturation, %	97.2	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 3.142 tsf
 Consolidation effective confining stress = 3.998 tsf
 Peak Stress = 2.897 tsf at reading no. 13
 Ult. Stress = 2.851 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0108	18.700	0.0	0.0	0.000	3.998	3.998	1.00	3.142	3.998	0.000
1	0.0130	28.290	9.6	0.1	0.482	3.785	4.267	1.13	3.355	4.026	0.241
2	0.0179	40.710	22.0	0.3	1.105	3.415	4.520	1.32	3.725	3.968	0.553
3	0.0398	59.320	40.6	1.1	2.023	2.538	4.561	1.80	4.602	3.550	1.012
4	0.0617	66.710	48.0	1.9	2.372	2.124	4.496	2.12	5.016	3.310	1.186
5	0.0847	71.170	52.5	2.7	2.570	1.884	4.454	2.36	5.256	3.169	1.285
6	0.1079	74.280	55.6	3.6	2.698	1.715	4.413	2.57	5.425	3.064	1.349
7	0.1392	76.630	57.9	4.7	2.779	1.590	4.369	2.75	5.550	2.979	1.389
8	0.1563	77.850	59.1	5.3	2.818	1.545	4.363	2.82	5.595	2.954	1.409
9	0.1814	78.640	59.9	6.3	2.828	1.492	4.320	2.90	5.648	2.906	1.414
10	0.2050	79.670	61.0	7.1	2.850	1.462	4.312	2.95	5.678	2.887	1.425
11	0.2313	80.920	62.2	8.1	2.878	1.437	4.315	3.00	5.703	2.876	1.439
12	0.2637	81.710	63.0	9.3	2.877	1.417	4.294	3.03	5.723	2.856	1.439
13	0.2800	82.570	63.9	9.9	2.897	1.404	4.301	3.06	5.736	2.853	1.449
14	0.3053	83.130	64.4	10.8	2.892	1.403	4.295	3.06	5.737	2.849	1.446
15	0.3307	83.280	64.6	11.8	2.869	1.394	4.263	3.06	5.746	2.828	1.434
16	0.3647	84.140	65.4	13.0	2.866	1.378	4.244	3.08	5.762	2.811	1.433
17	0.3897	84.380	65.7	13.9	2.846	1.391	4.237	3.05	5.749	2.814	1.423
18	0.4175	85.300	66.6	15.0	2.851	1.397	4.248	3.04	5.743	2.823	1.426





Sample No.	1	2	3	
Initial	Water Content, %	29.7	28.7	28.7
	Dry Density, pcf	92.6	93.6	94.4
	Saturation, %	96.9	96.4	98.3
	Void Ratio	0.8328	0.8080	0.7930
	Diameter, in.	1.40	1.39	1.39
At Test	Height, in.	2.81	2.81	2.80
	Water Content, %	30.6	29.4	27.5
	Dry Density, pcf	92.6	94.1	97.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8328	0.7984	0.7453
Pore Pressure Parameter B	Diameter, in.	1.40	1.38	1.38
	Height, in.	2.81	2.81	2.77
	Pore Pressure Parameter B	1.0	1.0	1.0
	Consolidation Pressure, tsf	0.50	1.00	2.01
	Back Pressure, tsf	6.64	6.14	5.13
	Cell Pressure, tsf	7.14	7.14	7.14
	Peak Deviator Stress, tsf	1.10	1.48	2.35
	Total Pore Pr., tsf	6.87	6.53	6.13
	Ultimate Deviator Stress, tsf	1.02	1.45	2.33
	Total Pore Pr., tsf	6.64	6.50	6.05
Maj. Eff. Stress at Ultimate, tsf	1.38	2.09	3.36	
Min. Eff. Stress at Ultimate, tsf	0.27	0.61	1.01	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 75 PL= 18 PI= 57

Assumed Specific Gravity= 2.718

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

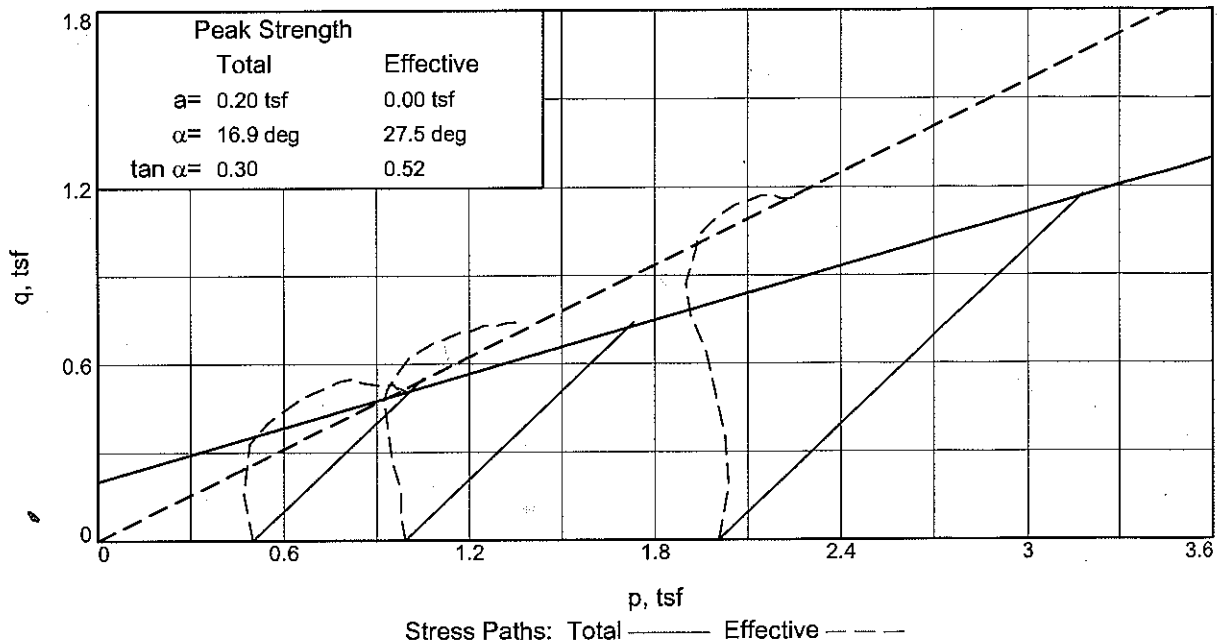
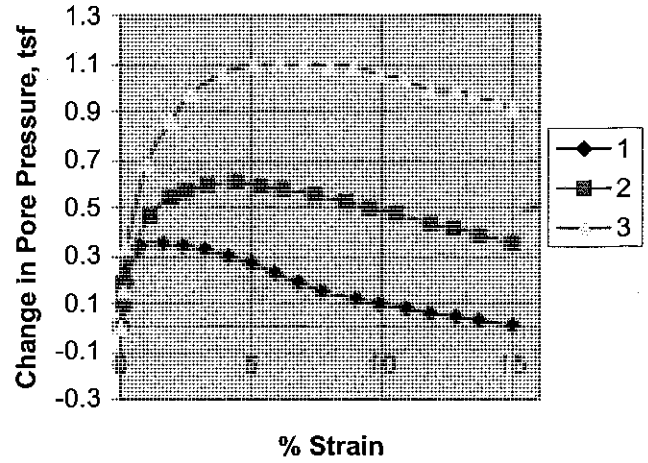
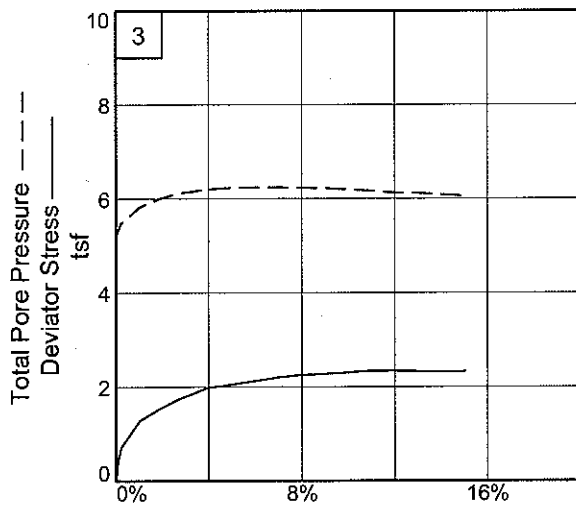
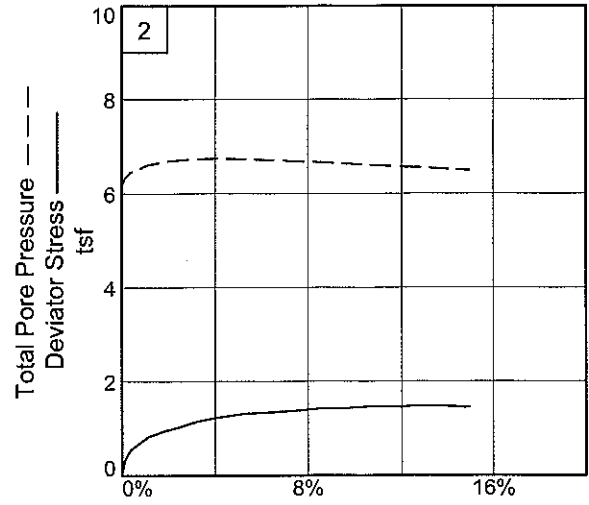
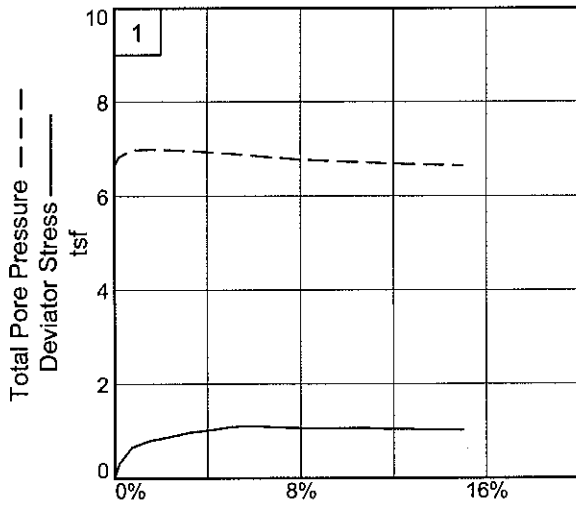
Location: SE-F-19, Fargo, Alluvium Formation

Sample Number: Boring 09-27MU, #1 **Depth:** 6-8'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Location: SE-F-19, Fargo, Alluvium Formation

Depth: 6-8'

Sample Number: Boring 09-27MU, #1

Project No. 09-0127 Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

11/9/2009

12:58 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, Alluvium Formation
Depth: 6-8' **Sample Number:** Boring 09-27MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.718 **LL=**75 **PL=**18 **PI=**57
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.640			168.320
Moisture content: Dry soil+tare, gms.	94.720			135.630
Moisture content: Tare, gms.	30.980			30.110
Moisture, %	29.7	30.6	30.6	31.0
Moist specimen weight, gms.	136.9			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	120.1	120.9	120.9	
Dry density, pcf	92.6	92.6	92.6	
Void ratio	0.8328	0.8328	0.8328	
Saturation, %	96.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.640 tsf
Consolidation effective confining stress = 0.500 tsf
Peak Stress = 1.102 tsf at reading no. 9
Ult. Stress = 1.017 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0107	18.790	0.0	0.0	0.000	0.500	0.500	1.00	6.640	0.500	0.000
1	0.0127	21.900	3.1	0.1	0.145	0.414	0.559	1.35	6.726	0.486	0.072
2	0.0158	25.630	6.8	0.2	0.318	0.312	0.630	2.02	6.828	0.471	0.159
3	0.0317	33.010	14.2	0.7	0.658	0.161	0.819	5.09	6.979	0.490	0.329
4	0.0544	36.220	17.4	1.6	0.800	0.148	0.948	6.41	6.992	0.548	0.400
5	0.0774	37.960	19.2	2.4	0.873	0.157	1.030	6.56	6.983	0.593	0.436
6	0.1014	40.270	21.5	3.2	0.970	0.173	1.143	6.60	6.967	0.658	0.485
7	0.1263	41.500	22.7	4.1	1.016	0.204	1.220	5.98	6.936	0.712	0.508
8	0.1510	43.210	24.4	5.0	1.082	0.235	1.317	5.60	6.905	0.776	0.541
9	0.1770	43.910	25.1	5.9	1.102	0.274	1.376	5.02	6.866	0.825	0.551
10	0.2028	43.540	24.8	6.8	1.076	0.313	1.389	4.44	6.827	0.851	0.538
11	0.2278	43.480	24.7	7.7	1.063	0.351	1.414	4.03	6.789	0.882	0.531
12	0.2638	43.670	24.9	9.0	1.056	0.383	1.439	3.76	6.757	0.911	0.528
13	0.2896	44.000	25.2	9.9	1.059	0.403	1.462	3.63	6.737	0.933	0.530
14	0.3168	44.320	25.5	10.9	1.061	0.423	1.484	3.51	6.717	0.954	0.531
15	0.3435	44.000	25.2	11.8	1.037	0.445	1.482	3.33	6.695	0.963	0.518
16	0.3705	44.270	25.5	12.8	1.036	0.458	1.494	3.26	6.682	0.976	0.518
17	0.3963	44.200	25.4	13.7	1.023	0.474	1.497	3.16	6.666	0.985	0.511
18	0.4322	44.430	25.6	15.0	1.017	0.495	1.512	3.05	6.645	1.003	0.508

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	112.390			165.090
Moisture content: Dry soil+tare, gms.	94.000			134.540
Moisture content: Tare, gms.	30.000			30.260
Moisture, %	28.7	29.8	29.4	29.3
Moist specimen weight, gms.	134.3			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.50	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	120.5	121.5	121.9	
Dry density, pcf	93.6	93.6	94.1	
Void ratio	0.8080	0.8080	0.7984	
Saturation, %	96.4	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.136 tsf
 Consolidation back pressure = 6.144 tsf
 Consolidation effective confining stress = 0.992 tsf
 Peak Stress = 1.483 tsf at reading no. 17
 Ult. Stress = 1.451 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0146	19.950	0.0	0.0	0.000	0.992	0.992	1.00	6.144	0.992	0.000
1	0.0167	23.610	3.7	0.1	0.175	0.889	1.064	1.20	6.247	0.977	0.088
2	0.0186	27.060	7.1	0.1	0.340	0.808	1.148	1.42	6.328	0.978	0.170
3	0.0256	31.400	11.4	0.4	0.546	0.676	1.222	1.81	6.460	0.949	0.273
4	0.0467	37.290	17.3	1.1	0.821	0.522	1.343	2.57	6.614	0.932	0.410
5	0.0682	40.250	20.3	1.9	0.954	0.447	1.401	3.13	6.689	0.924	0.477
6	0.0835	41.930	22.0	2.5	1.027	0.420	1.447	3.44	6.716	0.933	0.513
7	0.1064	44.830	24.9	3.3	1.153	0.395	1.548	3.92	6.741	0.971	0.576
8	0.1372	47.150	27.2	4.4	1.246	0.384	1.630	4.24	6.752	1.007	0.623
9	0.1621	48.820	28.9	5.3	1.310	0.402	1.712	4.26	6.734	1.057	0.655
10	0.1879	49.770	29.8	6.2	1.340	0.412	1.752	4.25	6.724	1.082	0.670
11	0.2219	50.930	31.0	7.4	1.374	0.438	1.812	4.14	6.698	1.125	0.687
12	0.2567	52.470	32.5	8.6	1.423	0.468	1.891	4.04	6.668	1.180	0.712
13	0.2827	52.860	32.9	9.5	1.426	0.493	1.919	3.89	6.643	1.206	0.713
14	0.3086	54.030	34.1	10.5	1.461	0.517	1.978	3.83	6.619	1.248	0.731
15	0.3446	54.470	34.5	11.8	1.459	0.558	2.017	3.61	6.578	1.287	0.729
16	0.3714	55.290	35.3	12.7	1.477	0.578	2.055	3.56	6.558	1.317	0.739
17	0.3985	55.810	35.9	13.7	1.483	0.606	2.089	3.45	6.530	1.347	0.741
18	0.4350	55.570	35.6	15.0	1.451	0.640	2.091	3.27	6.496	1.365	0.725

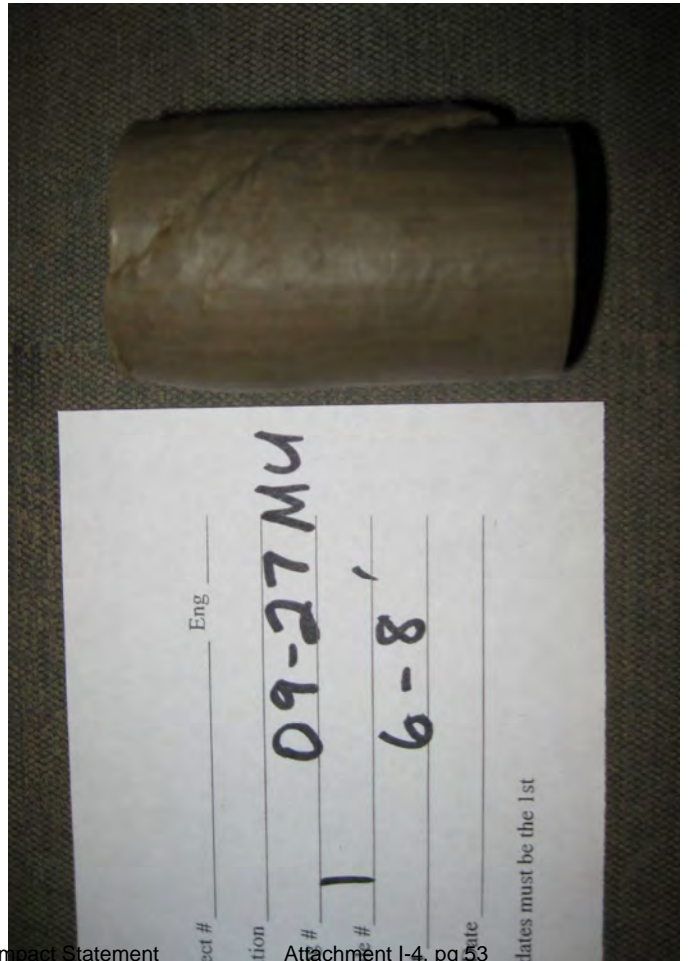
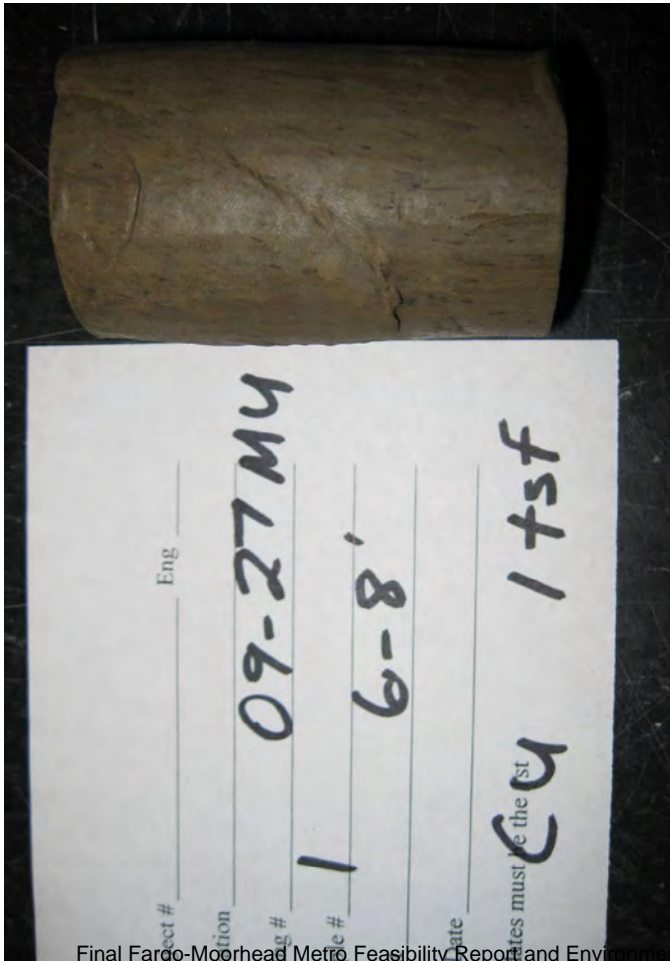
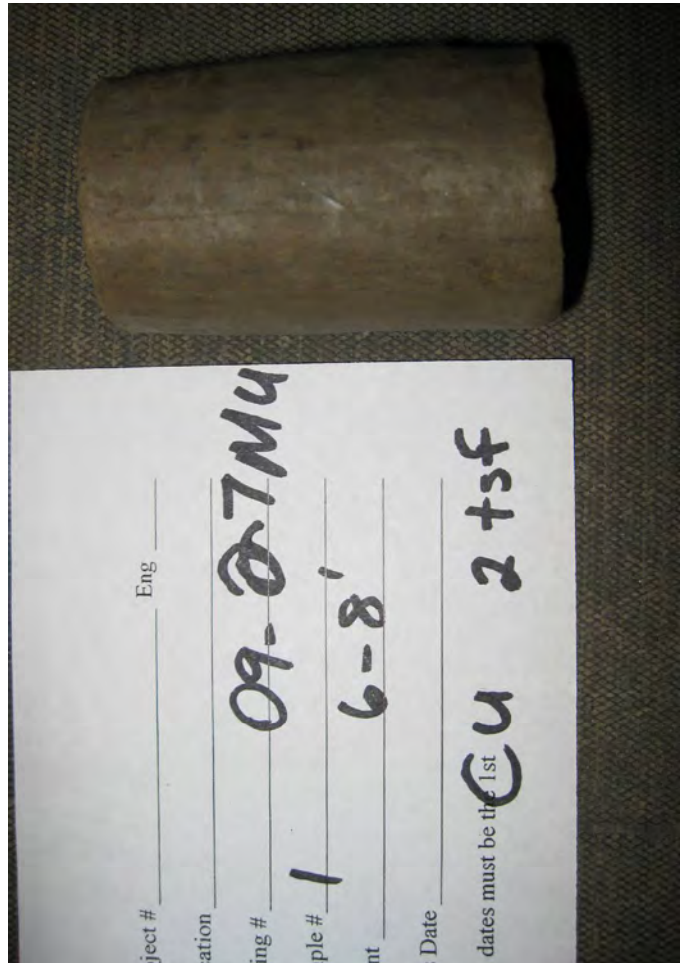
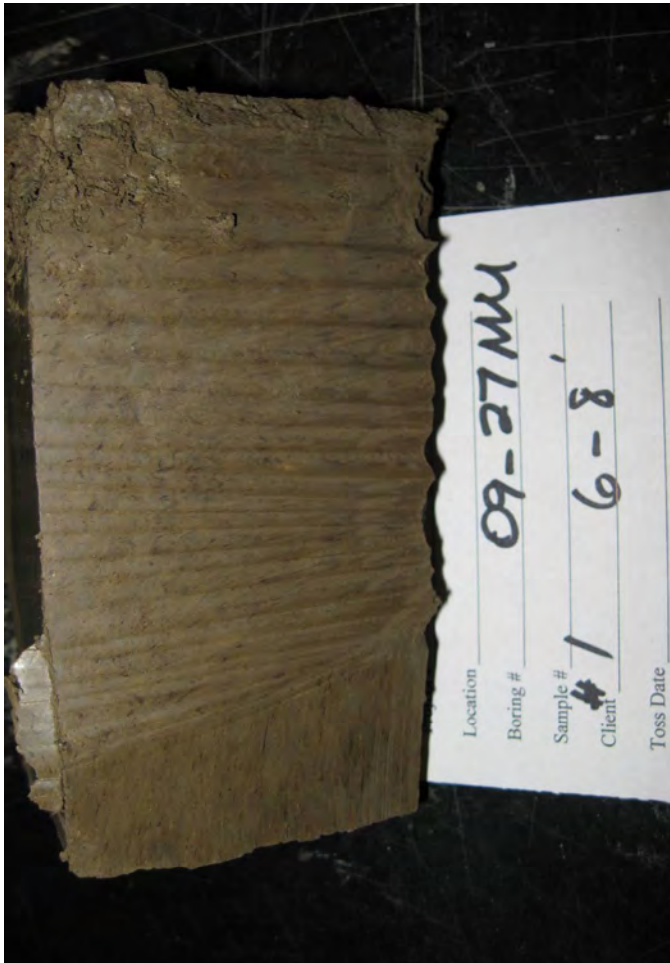
Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	99.490			165.240
Moisture content: Dry soil+tare, gms.	84.190			136.250
Moisture content: Tare, gms.	30.960			30.240
Moisture, %	28.7	29.2	27.5	27.3
Moist specimen weight, gms.	135.9			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.49	
Height, in.	2.80	2.80	2.77	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	121.6	122.0	123.7	
Dry density, pcf	94.4	94.4	97.0	
Void ratio	0.7930	0.7930	0.7453	
Saturation, %	98.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.135 tsf
 Consolidation effective confining stress = 2.005 tsf
 Peak Stress = 2.350 tsf at reading no. 14
 Ult. Stress = 2.335 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0100	19.860	0.0	0.0	0.000	2.005	2.005	1.00	5.135	2.005	0.000
1	0.0118	27.490	7.6	0.1	0.367	1.853	2.220	1.20	5.287	2.037	0.184
2	0.0160	34.540	14.7	0.2	0.706	1.672	2.378	1.42	5.468	2.025	0.353
3	0.0389	46.840	27.0	1.0	1.286	1.322	2.608	1.97	5.818	1.965	0.643
4	0.0617	52.460	32.6	1.9	1.541	1.143	2.684	2.35	5.997	1.914	0.771
5	0.0857	57.130	37.3	2.7	1.746	1.027	2.773	2.70	6.113	1.900	0.873
6	0.1185	62.680	42.8	3.9	1.982	0.942	2.924	3.10	6.198	1.933	0.991
7	0.1524	65.120	45.3	5.1	2.068	0.907	2.975	3.28	6.233	1.941	1.034
8	0.1783	67.040	47.2	6.1	2.135	0.903	3.038	3.36	6.237	1.970	1.067
9	0.2052	69.230	49.4	7.0	2.211	0.904	3.115	3.45	6.236	2.009	1.105
10	0.2313	70.770	50.9	8.0	2.257	0.914	3.171	3.47	6.226	2.042	1.128
11	0.2570	71.860	52.0	8.9	2.282	0.919	3.201	3.48	6.221	2.060	1.141
12	0.2839	72.930	53.1	9.9	2.304	0.945	3.249	3.44	6.195	2.097	1.152
13	0.3108	74.430	54.6	10.8	2.344	0.972	3.316	3.41	6.168	2.144	1.172
14	0.3386	75.190	55.3	11.8	2.350	1.012	3.362	3.32	6.128	2.187	1.175
15	0.3659	75.590	55.7	12.8	2.340	1.019	3.359	3.30	6.121	2.189	1.170
16	0.3836	75.670	55.8	13.5	2.326	1.038	3.364	3.24	6.102	2.201	1.163
17	0.4096	76.170	56.3	14.4	2.322	1.067	3.389	3.18	6.073	2.228	1.161
18	0.4270	76.900	57.0	15.0	2.335	1.092	3.427	3.14	6.048	2.259	1.167

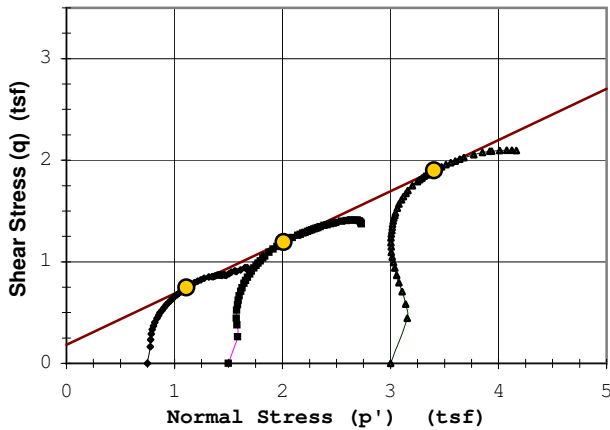
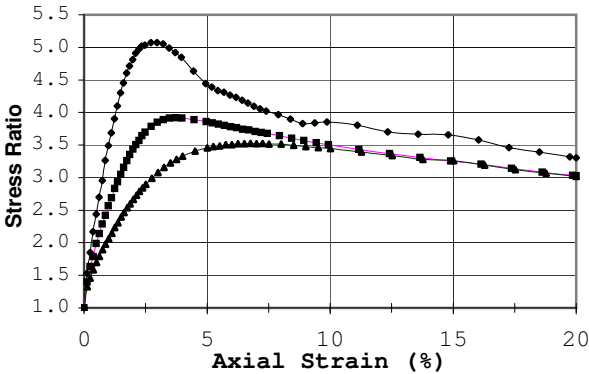
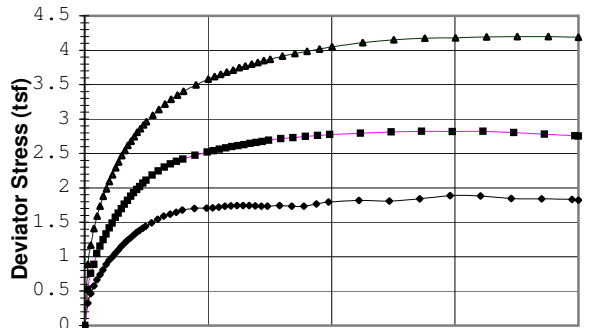
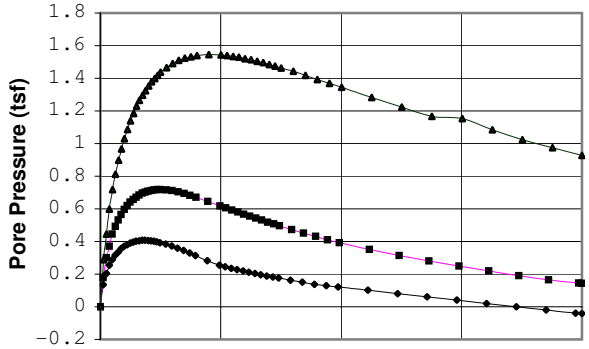


TRIAXIAL TEST ASTM: D 4767

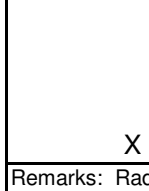
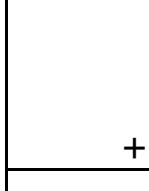
Job No. 7577

Date: 8/26/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **13-15 (Mid)**
 Soil Type: **Fat Clay w/a few laminations of silt (CH) Alluvium**



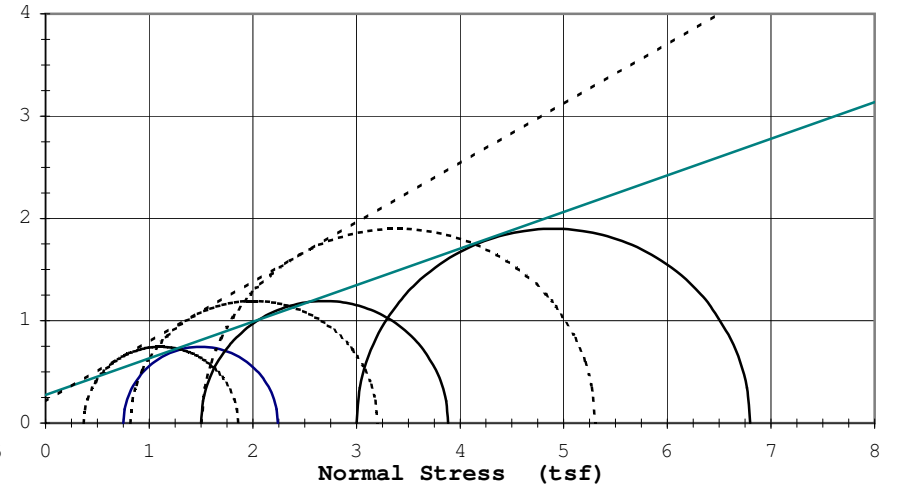
Rupture Envelope at Failure
 $\alpha = 26.7^\circ$ $a = 0.2$ (tsf)



Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 30.2^\circ$	
Apparent Cohesion, $c' = 0.21$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 55.8
Test Type: CU w/pp	Plastic Limit: 22.1
Strain Rate (in/min): 0.002027	Plasticity Index: 33.7
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.72
Before Consolidation	
	A B C D E
Diameter (in)	1.94 1.94 1.94
Height (in)	4.08 4.08 4.08
Water Content (%)	28.6 28.8 28.9
Dry Density (pcf)	94.4 94.1 93.8
Void Ratio	0.80 0.80 0.81
After Consolidation	
Diameter (in)	1.93 1.91 1.91
Height (in)	4.05 4.03 3.99
Water Content (%)	28.0 26.7 26.3
Dry Density (pcf)	96.4 98.3 99.0
Void Ratio	0.76 0.73 0.71
Back Pressure (tsf)	5.8 5.8 5.8
Minor Principal Stress (tsf)	0.75 1.50 3.00
Max. Deviator Stress (tsf)	1.89 2.82 4.20
Ultimate Deviator Stress (tsf)	1.82 2.75 4.19
Deviator Stress at Failure (tsf)	1.49 2.39 3.80
Max. Pore Pressure Buildup (tsf)	0.41 0.72 1.55
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	2.7 3.7 6.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



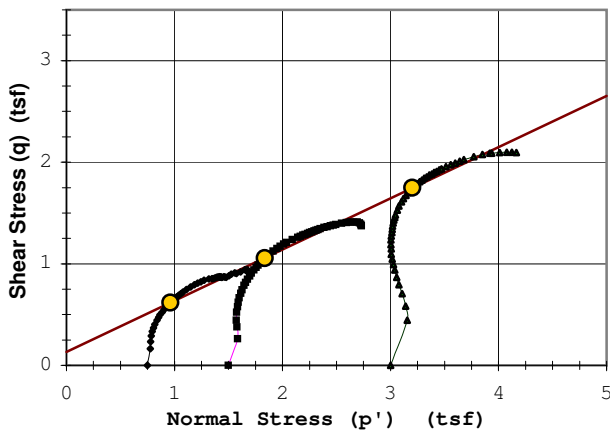
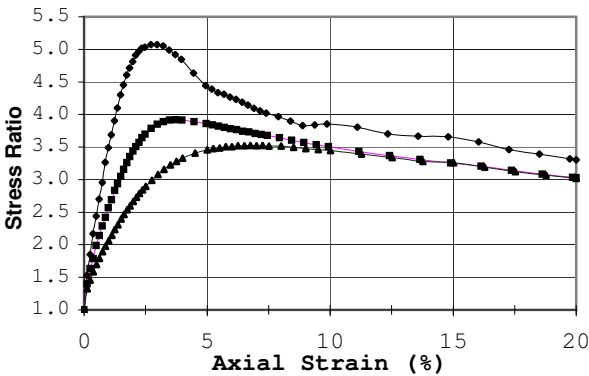
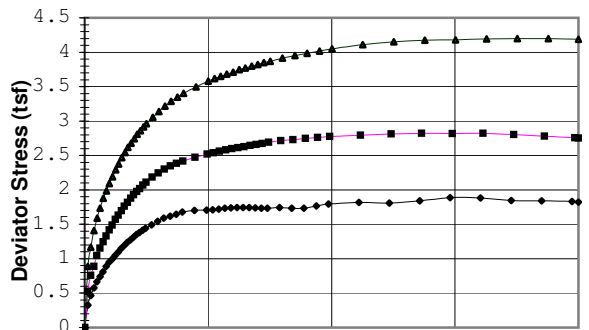
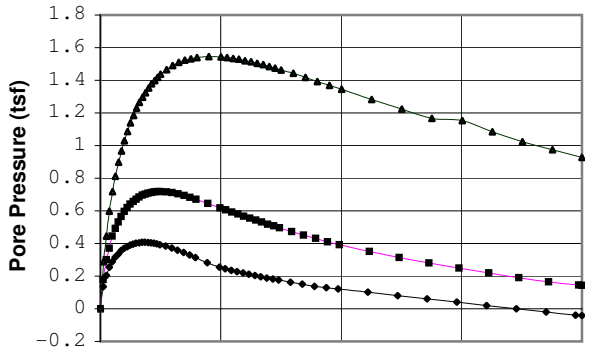
-----	Effective ϕ' : 30.2°	$c' =$ 0.21 (tsf)
_____	Total ϕ' : 19.7°	$c =$ 0.28 (tsf)

TRIAXIAL TEST ASTM: D 4767

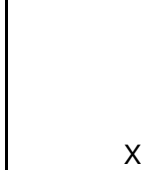
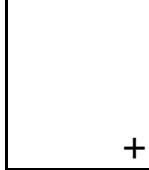
Job No. 7577

Date: 8/26/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **13-15 (Mid)**
 Soil Type: **Fat Clay w/a few laminations of silt (CH) Alluvium**



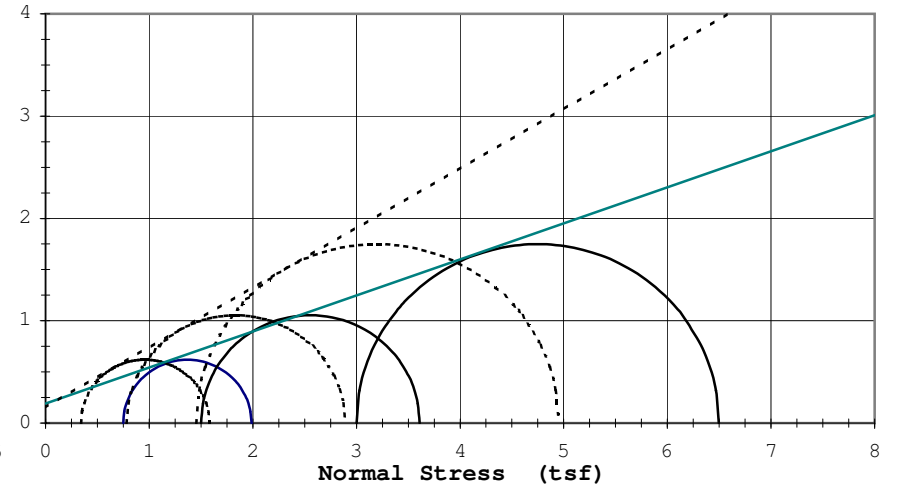
Rupture Envelope at Failure
 $\alpha = 26.8^\circ$ $a = 0.1$ (tsf)



Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 30.3^\circ$	
Apparent Cohesion, $c' = 0.15$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 55.8
Test Type: CU w/pp	Plastic Limit: 22.1
Strain Rate (in/min): 0.002027	Plasticity Index: 33.7
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.72
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94 1.94 1.94
Water Content (%)	28.6 28.8 28.9 28.9 28.9
Dry Density (pcf)	94.4 94.1 93.8 93.8 93.8
Void Ratio	0.80 0.80 0.81 0.81 0.81
After Consolidation	
Diameter (in)	1.93 1.91 1.91 1.91 1.91
Height (in)	4.05 4.03 3.99 3.99 3.99
Water Content (%)	28.0 26.7 26.3 26.3 26.3
Dry Density (pcf)	96.4 98.3 99.0 99.0 99.0
Void Ratio	0.76 0.73 0.71 0.71 0.71
Back Pressure (tsf)	5.8 5.8 5.8 5.8 5.8
Minor Principal Stress (tsf)	0.75 1.50 3.00 3.00 3.00
Max. Deviator Stress (tsf)	1.89 2.82 4.20 4.20 4.20
Ultimate Deviator Stress (tsf)	1.82 2.75 4.19 4.19 4.19
Deviator Stress at Failure (tsf)	1.24 2.11 3.50 3.50 3.50
Max. Pore Pressure Buildup (tsf)	0.41 0.72 1.55 1.55 1.55
Pore Pressure Parameter "B"	1.0 1.0 1.0 1.0 1.0
Pct. Axial Strain at Failure	1.7 2.5 4.5 4.5 4.5

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



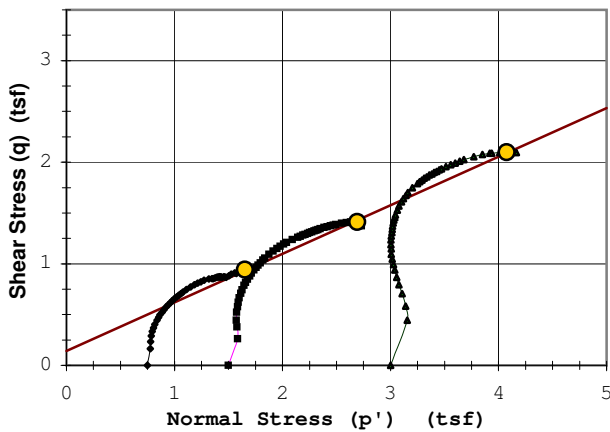
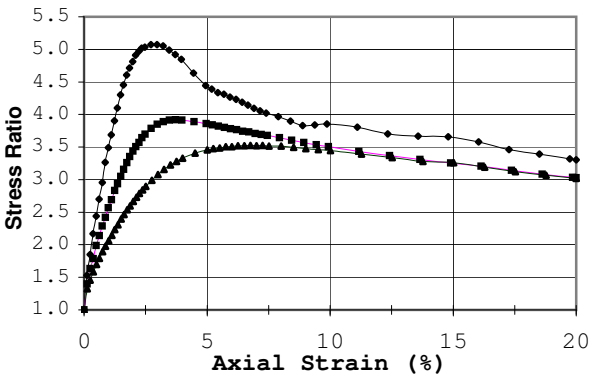
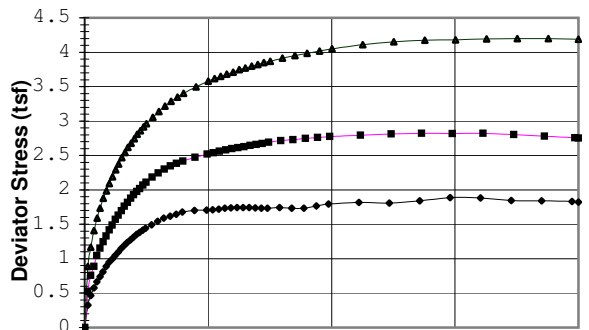
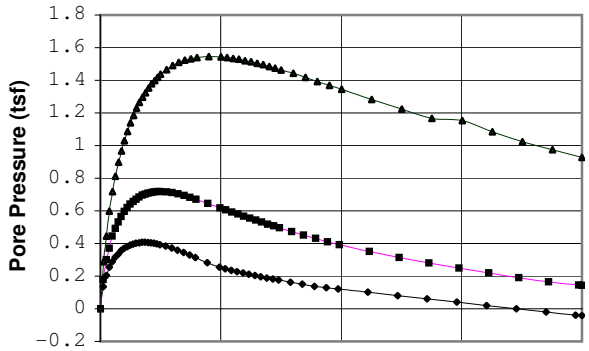
-----	Effective ϕ' : 30.3°	$c' = 0.15$ (tsf)
_____	Total ϕ' : 19.4°	$c = 0.19$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 8/26/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **13-15 (Mid)**
 Soil Type: **Fat Clay w/a few laminations of silt (CH) Alluvium**



Rupture Envelope at Failure
 $\alpha = 25.6^\circ$ $a = 0.1$ (tsf)



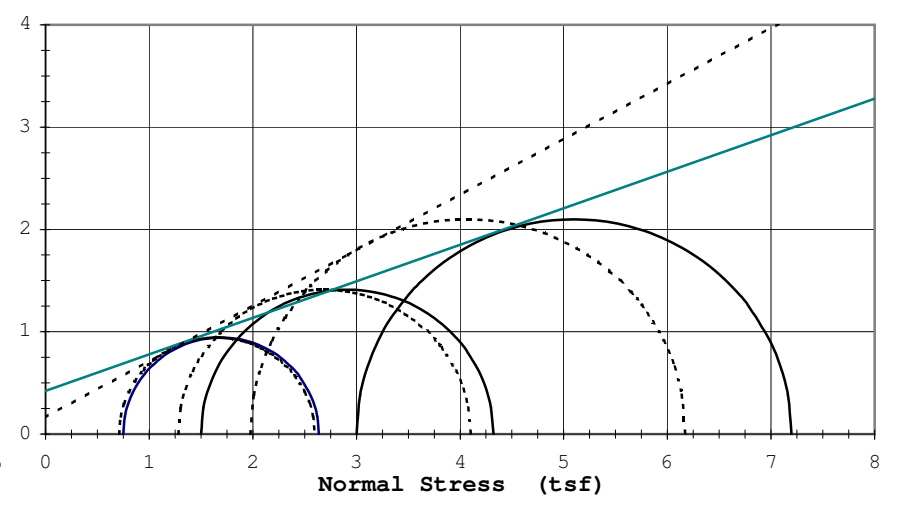
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Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 28.6^\circ$	
Apparent Cohesion, $c' = 0.16$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 55.8
Test Type: CU w/pp	Plastic Limit: 22.1
Strain Rate (in/min): 0.002027	Plasticity Index: 33.7
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.72
Before Consolidation	
	A B C D E
Diameter (in)	1.94 1.94 1.94
Height (in)	4.08 4.08 4.08
Water Content (%)	28.6 28.8 28.9
Dry Density (pcf)	94.4 94.1 93.8
Void Ratio	0.80 0.80 0.81
After Consolidation	
Diameter (in)	1.93 1.91 1.91
Height (in)	4.05 4.03 3.99
Water Content (%)	28.0 26.7 26.3
Dry Density (pcf)	96.4 98.3 99.0
Void Ratio	0.76 0.73 0.71
Back Pressure (tsf)	5.8 5.8 5.8
Minor Principal Stress (tsf)	0.75 1.50 3.00
Max. Deviator Stress (tsf)	1.89 2.82 4.20
Ultimate Deviator Stress (tsf)	1.82 2.75 4.19
Deviator Stress at Failure (tsf)	1.89 2.82 4.20
Max. Pore Pressure Buildup (tsf)	0.41 0.72 1.55
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	14.8 16.1 17.5

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Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



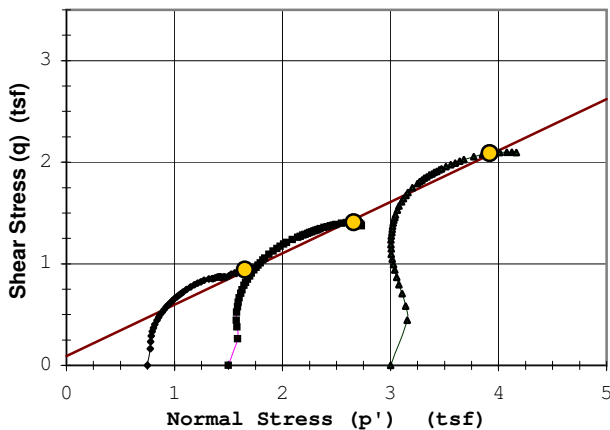
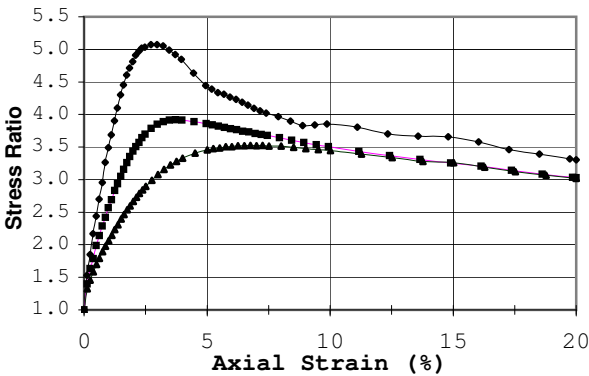
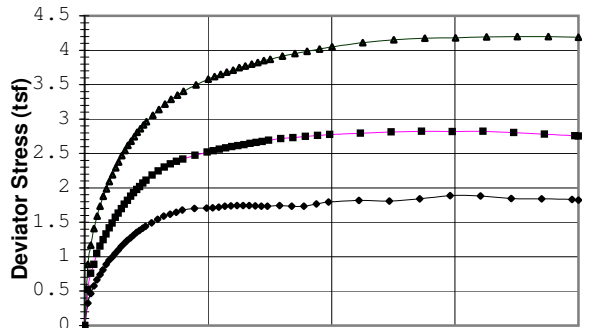
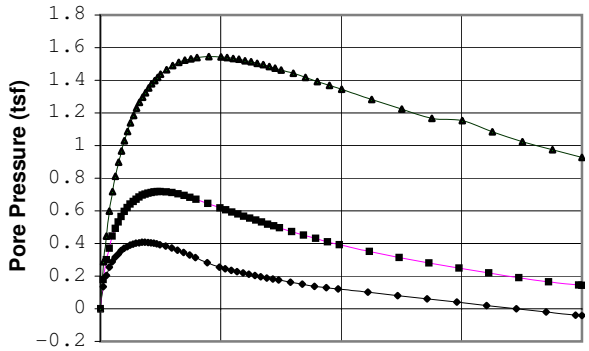
-----	Effective ϕ' : 28.6°	$c' =$ 0.16 (tsf)
_____	Total ϕ' : 19.7°	$c =$ 0.42 (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 8/26/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **13-15 (Mid)**
 Soil Type: **Fat Clay w/a few laminations of silt (CH) Alluvium**



Rupture Envelope at Failure
 $\alpha = 26.8^\circ$ $a = 0.1$ (tsf)



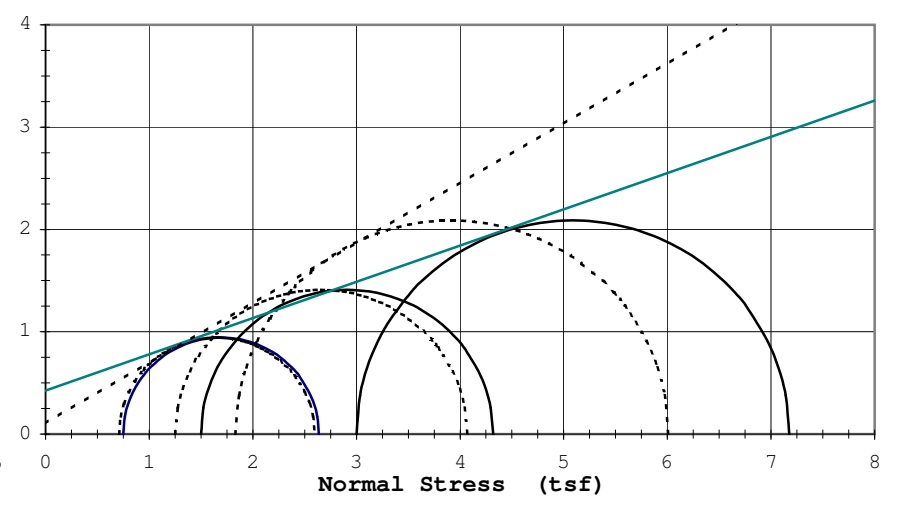
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X

Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 30.4^\circ$	
Apparent Cohesion, $c' = 0.11$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 55.8
Test Type: CU w/pp	Plastic Limit: 22.1
Strain Rate (in/min): 0.002027	Plasticity Index: 33.7
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.72
Before Consolidation	
	A B C D E
Diameter (in)	1.94 1.94 1.94
Height (in)	4.08 4.08 4.08
Water Content (%)	28.6 28.8 28.9
Dry Density (pcf)	94.4 94.1 93.8
Void Ratio	0.80 0.80 0.81
After Consolidation	
Diameter (in)	1.93 1.91 1.91
Height (in)	4.05 4.03 3.99
Water Content (%)	28.0 26.7 26.3
Dry Density (pcf)	96.4 98.3 99.0
Void Ratio	0.76 0.73 0.71
Back Pressure (tsf)	5.8 5.8 5.8
Minor Principal Stress (tsf)	0.75 1.50 3.00
Max. Deviator Stress (tsf)	1.89 2.82 4.20
Ultimate Deviator Stress (tsf)	1.82 2.75 4.19
Deviator Stress at Failure (tsf)	1.89 2.82 4.18
Max. Pore Pressure Buildup (tsf)	0.41 0.72 1.55
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	15.0 15.0 15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



-----	Effective ϕ' : 30.4°	$c' = 0.11$ (tsf)
_____	Total ϕ' : 19.5°	$c = 0.43$ (tsf)

Triaxial Plot Data Summary

Job #: 7577

Boring: 10-78MU

Sample: 1

Depth: 13-15 (Mid)

Test Type: CU

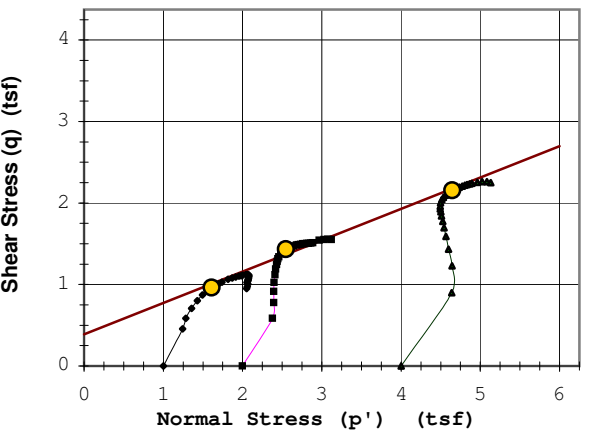
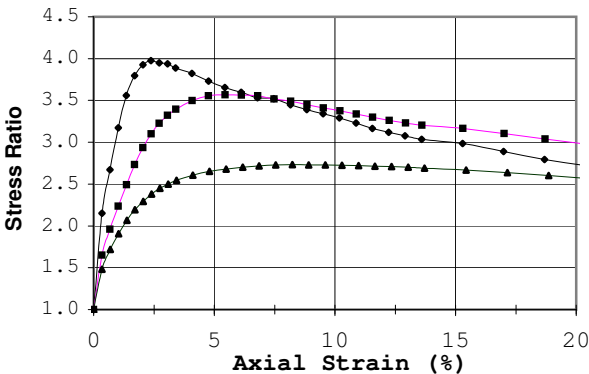
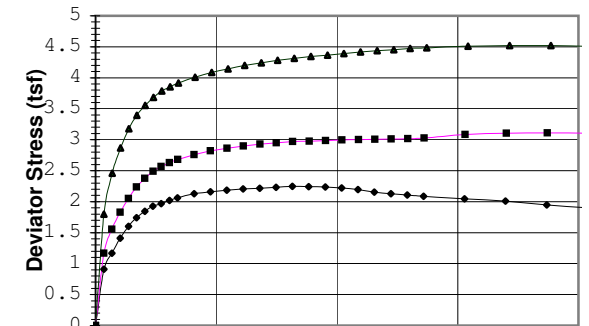
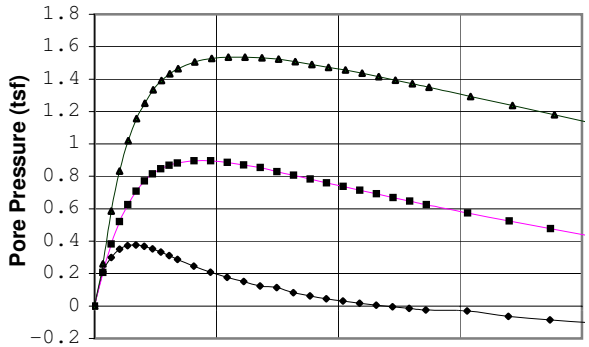
Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						
0.12	0.33	0.14	0.12	0.52	0.18	0.13	0.89	0.29						
0.25	0.47	0.20	0.25	0.76	0.30	0.25	1.17	0.44						
0.37	0.58	0.25	0.37	0.89	0.37	0.38	1.41	0.60						
0.49	0.67	0.29	0.50	1.04	0.45	0.50	1.59	0.72						
0.62	0.74	0.31	0.62	1.15	0.49	0.63	1.74	0.81						
0.74	0.81	0.34	0.75	1.24	0.53	0.75	1.88	0.90						
0.86	0.89	0.36	0.87	1.33	0.56	0.88	1.98	0.97						
0.99	0.95	0.37	0.99	1.42	0.60	1.00	2.09	1.03						
1.11	0.99	0.38	1.12	1.49	0.62	1.13	2.19	1.09						
1.23	1.05	0.39	1.24	1.57	0.64	1.25	2.29	1.14						
1.36	1.10	0.40	1.37	1.63	0.66	1.38	2.38	1.18						
1.48	1.15	0.40	1.49	1.70	0.67	1.50	2.47	1.23						
1.60	1.19	0.40	1.61	1.76	0.68	1.63	2.54	1.26						
1.73	1.24	0.41	1.74	1.82	0.70	1.75	2.62	1.30						
1.85	1.27	0.41	1.86	1.88	0.70	1.88	2.68	1.32						
1.97	1.31	0.41	1.99	1.93	0.71	2.00	2.74	1.35						
2.10	1.35	0.40	2.11	1.97	0.71	2.13	2.81	1.38						
2.22	1.38	0.40	2.24	2.02	0.72	2.25	2.86	1.40						
2.34	1.41	0.40	2.36	2.07	0.72	2.38	2.91	1.42						
2.47	1.44	0.39	2.48	2.11	0.72	2.50	2.96	1.44						
2.71	1.49	0.38	2.73	2.18	0.72	2.75	3.06	1.47						
2.96	1.54	0.37	2.98	2.25	0.71	3.01	3.14	1.49						
3.21	1.59	0.36	3.23	2.30	0.70	3.26	3.22	1.51						
3.45	1.62	0.34	3.48	2.35	0.69	3.51	3.28	1.52						
3.70	1.65	0.33	3.72	2.39	0.68	3.76	3.35	1.53						
3.95	1.68	0.31	3.97	2.42	0.67	4.01	3.40	1.54						
4.44	1.70	0.28	4.47	2.47	0.64	4.51	3.50	1.55						
4.94	1.71	0.26	4.97	2.52	0.62	5.01	3.58	1.54						
5.18	1.71	0.25	5.21	2.54	0.61	5.26	3.62	1.54						
5.43	1.72	0.24	5.46	2.56	0.59	5.51	3.65	1.53						
5.68	1.73	0.23	5.71	2.58	0.58	5.76	3.68	1.53						
5.92	1.74	0.22	5.96	2.60	0.57	6.01	3.71	1.52						
6.17	1.74	0.21	6.21	2.61	0.55	6.26	3.75	1.51						
6.42	1.74	0.20	6.45	2.63	0.54	6.51	3.77	1.50						
6.66	1.74	0.20	6.70	2.65	0.53	6.76	3.80	1.50						
6.91	1.74	0.19	6.95	2.66	0.52	7.01	3.82	1.48						
7.16	1.73	0.18	7.20	2.67	0.51	7.26	3.85	1.47						
7.40	1.73	0.18	7.45	2.69	0.50	7.51	3.87	1.46						
7.90	1.74	0.16	7.95	2.71	0.47	8.01	3.91	1.44						
8.39	1.74	0.15	8.44	2.73	0.45	8.51	3.95	1.42						
8.88	1.73	0.14	8.94	2.75	0.43	9.01	3.98	1.39						
9.38	1.76	0.13	9.43	2.76	0.41	9.52	4.02	1.37						
9.87	1.79	0.12	9.93	2.77	0.39	10.02	4.05	1.35						
11.11	1.82	0.10	11.17	2.80	0.35	11.27	4.11	1.28						
12.34	1.81	0.08	12.41	2.81	0.31	12.52	4.15	1.22						
13.57	1.84	0.06	13.65	2.82	0.28	13.77	4.18	1.17						
14.80	1.89	0.04	14.90	2.82	0.25	15.03	4.18	1.15						
16.04	1.88	0.02	16.14	2.82	0.22	16.28	4.19	1.08						
17.27	1.85	0.00	17.38	2.80	0.19	17.53	4.20	1.02						
18.51	1.84	-0.02	18.62	2.78	0.17	18.78	4.20	0.97						
19.74	1.83	-0.04	19.86	2.75	0.15	20.00	4.19	0.93						
20.00	1.82	-0.04	20.00	2.75	0.14									

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid-Top)**
 Soil Type: **Fat Clay w/a few Laminations of Silt (CH) Alluvium**



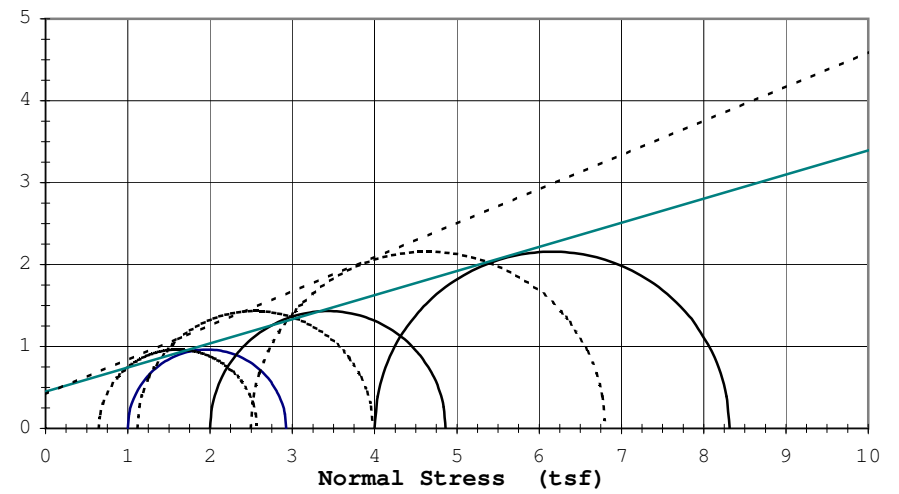
Rupture Envelope at Failure
 $\alpha = 21.1^\circ$ $a = 0.4$ (tsf)



Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 22.6^\circ$	
Apparent Cohesion, $c' = 0.42$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 51.8
Test Type: CU w/pp	Plastic Limit: 20.5
Strain Rate (in/min): 0.0039	Plasticity Index: 31.3
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.70
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	26.3 26.6 26.1
Dry Density (pcf)	96.3 95.2 95.3
Void Ratio	0.75 0.77 0.77
After Consolidation	
Diameter (in)	1.44 1.42 1.42
Height (in)	2.94 2.94 2.92
Water Content (%)	26.4 25.3 24.2
Dry Density (pcf)	98.4 100.2 102.0
Void Ratio	0.71 0.68 0.65
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	2.25 3.11 4.52
Ultimate Deviator Stress (tsf)	1.90 3.10 4.50
Deviator Stress at Failure (tsf)	1.93 2.86 4.31
Max. Pore Pressure Buildup (tsf)	0.38 0.90 1.54
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	2.4 5.4 8.2

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



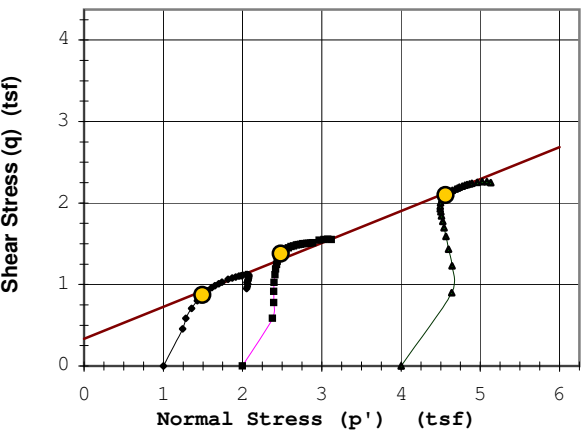
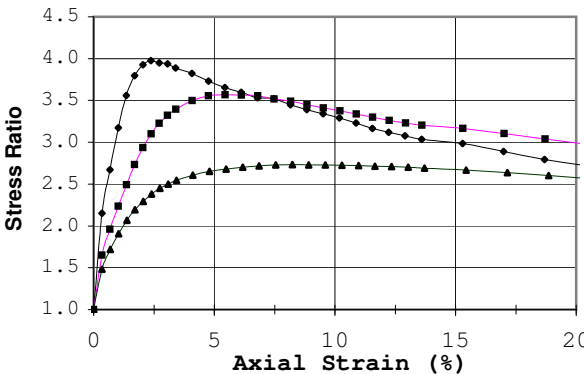
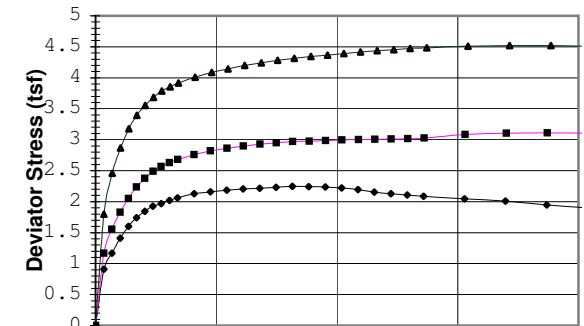
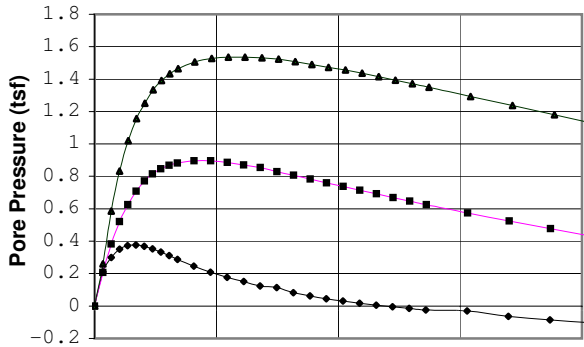
----- Effective ϕ' : 22.6° $c' = 0.42$ (tsf)
 _____ Total ϕ' : 16.4° $c = 0.45$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid-Top)**
 Soil Type: **Fat Clay w/a few Laminations of Silt (CH) Alluvium**



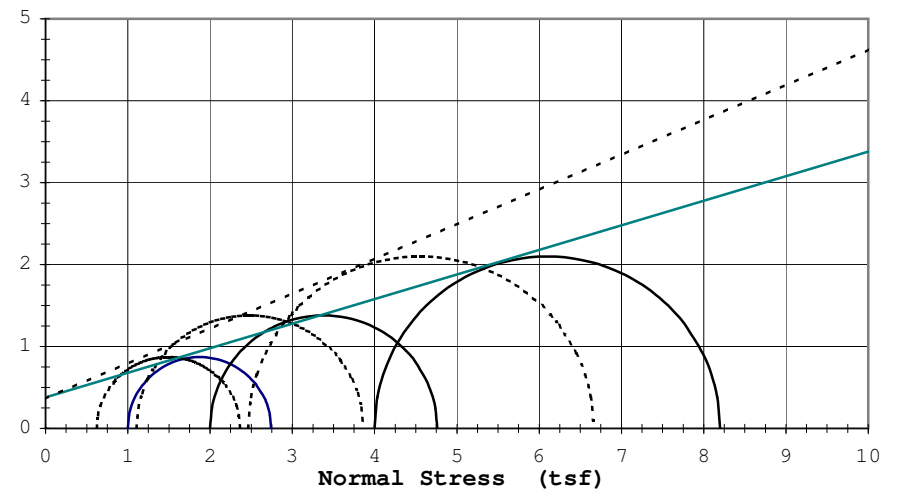
Rupture Envelope at Failure
 $\alpha = 21.4^\circ$ $a = 0.3 \text{ (tsf)}$



Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 23.1^\circ$	
Apparent Cohesion, $c' = 0.36 \text{ (tsf)}$	
Test Date: 8/12/10	Liquid Limit: 51.8
Test Type: CU w/pp	Plastic Limit: 20.5
Strain Rate (in/min): 0.0039	Plasticity Index: 31.3
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.70
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	26.3 26.6 26.1
Dry Density (pcf)	96.3 95.2 95.3
Void Ratio	0.75 0.77 0.77
After Consolidation	
Diameter (in)	1.44 1.42 1.42
Height (in)	2.94 2.94 2.92
Water Content (%)	26.4 25.3 24.2
Dry Density (pcf)	98.4 100.2 102.0
Void Ratio	0.71 0.68 0.65
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	2.25 3.11 4.52
Ultimate Deviator Stress (tsf)	1.90 3.10 4.50
Deviator Stress at Failure (tsf)	1.74 2.76 4.20
Max. Pore Pressure Buildup (tsf)	0.38 0.90 1.54
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	1.7 4.1 6.2

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



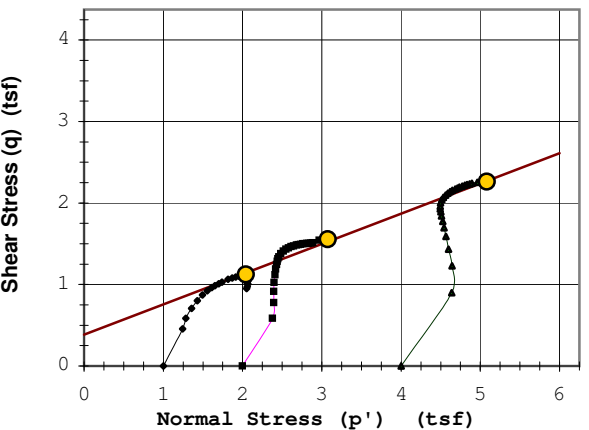
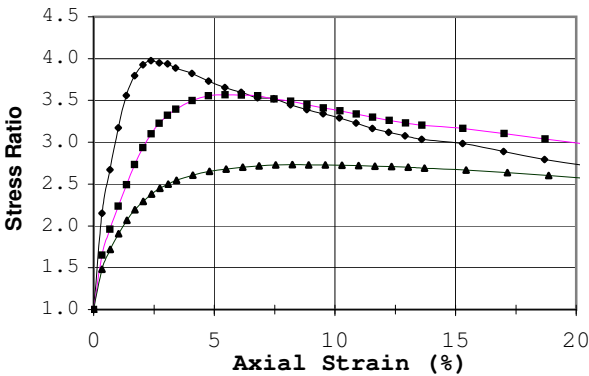
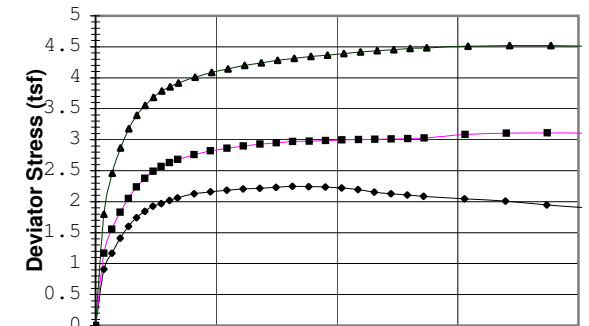
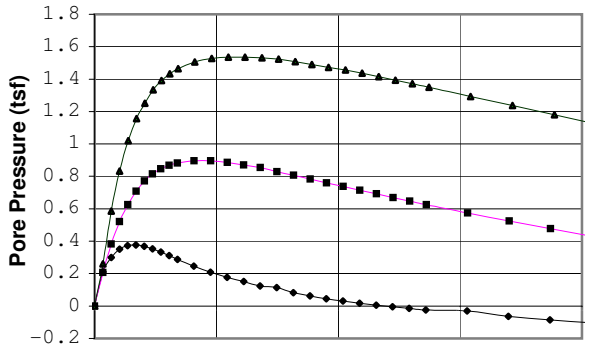
-----	Effective ϕ' : 23.1°	$c' = 0.36 \text{ (tsf)}$
_____	Total ϕ' : 16.7°	$c = 0.38 \text{ (tsf)}$

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid-Top)**
 Soil Type: **Fat Clay w/a few Laminations of Silt (CH) Alluvium**



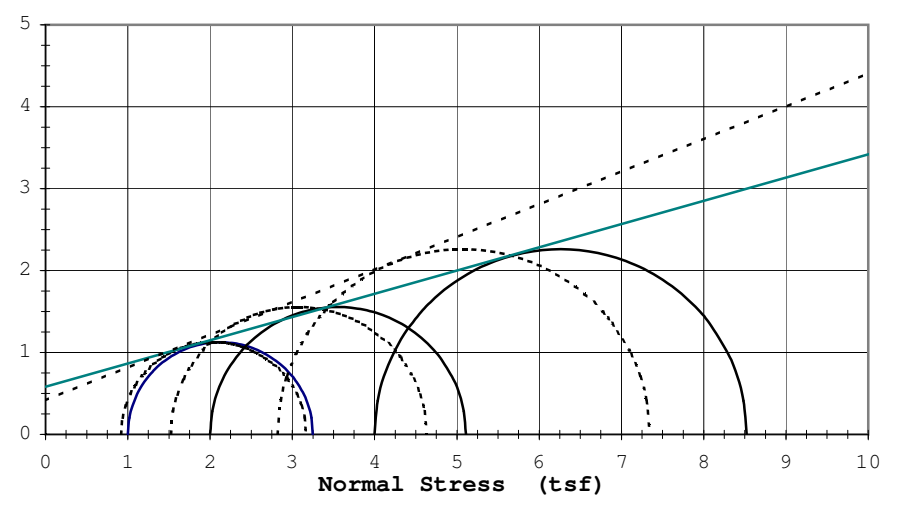
Rupture Envelope at Failure
 $\alpha = 20.4^\circ$ $a = 0.4$ (tsf)



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 21.8^\circ$	
Apparent Cohesion, $c' = 0.41$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 51.8
Test Type: CU w/pp	Plastic Limit: 20.5
Strain Rate (in/min): 0.0039	Plasticity Index: 31.3
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.70
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	26.3 26.6 26.1
Dry Density (pcf)	96.3 95.2 95.3
Void Ratio	0.75 0.77 0.77
After Consolidation	
Diameter (in)	1.44 1.42 1.42
Height (in)	2.94 2.94 2.92
Water Content (%)	26.4 25.3 24.2
Dry Density (pcf)	98.4 100.2 102.0
Void Ratio	0.71 0.68 0.65
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	2.25 3.11 4.52
Ultimate Deviator Stress (tsf)	1.90 3.10 4.50
Deviator Stress at Failure (tsf)	2.25 3.11 4.52
Max. Pore Pressure Buildup (tsf)	0.38 0.90 1.54
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	8.2 18.7 18.9

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



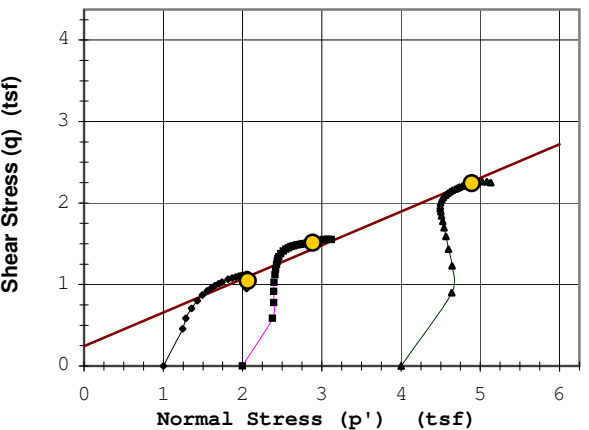
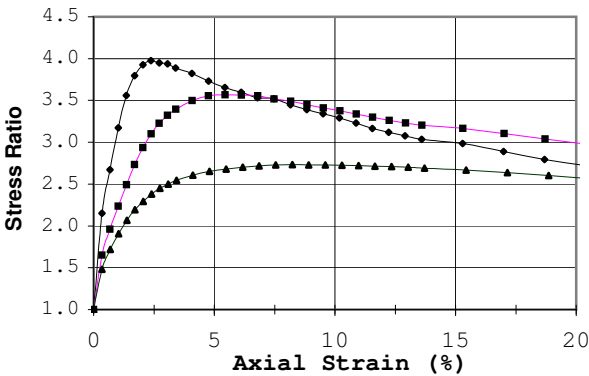
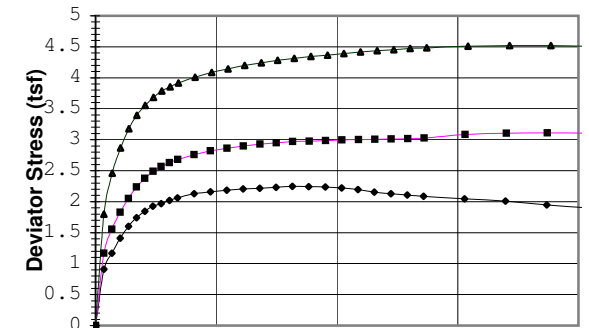
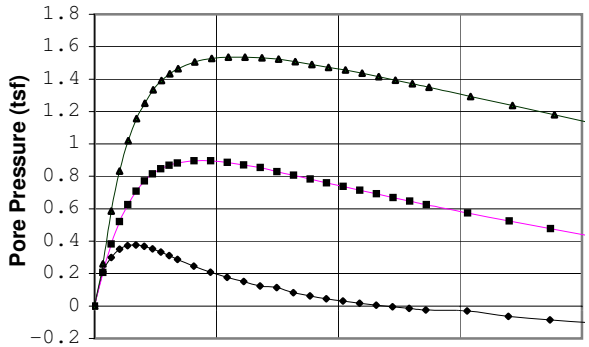
----- Effective ϕ' : 21.8° $c' = 0.41$ (tsf)
 _____ Total ϕ' : 15.8° $c = 0.58$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid-Top)**
 Soil Type: **Fat Clay w/a few Laminations of Silt (CH) Alluvium**



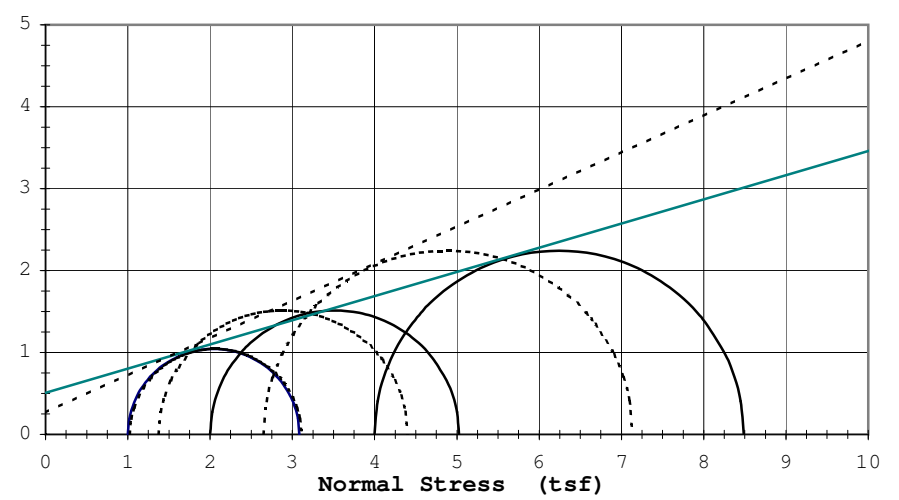
Rupture Envelope at Failure
 $\alpha = 22.5^\circ$ $a = 0.2$ (tsf)



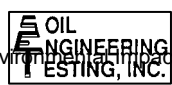
Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi' = 24.4^\circ$				
		Apparent Cohesion, $c' = 0.27$ (tsf)				
Test Date:	8/12/10	Liquid Limit:	51.8			
Test Type:	CU w/pp	Plastic Limit:	20.5			
Strain Rate (in/min):	0.0039	Plasticity Index:	31.3			
Strain Rate (%/min):	0.132	Spec. Gravity (Assumed):	2.70			
Before Consolidation		A	B	C	D	E
Diameter (in)	1.45	1.45	1.45			
Height (in)	2.99	2.99	2.99			
Water Content (%)	26.3	26.6	26.1			
Dry Density (pcf)	96.3	95.2	95.3			
Void Ratio	0.75	0.77	0.77			
After Consolidation						
Diameter (in)	1.44	1.42	1.42			
Height (in)	2.94	2.94	2.92			
Water Content (%)	26.4	25.3	24.2			
Dry Density (pcf)	98.4	100.2	102.0			
Void Ratio	0.71	0.68	0.65			
Back Pressure (tsf)	5.76	5.76	5.76			
Minor Principal Stress (tsf)	1.00	2.00	4.00			
Max. Deviator Stress (tsf)	2.25	3.11	4.52			
Ultimate Deviator Stress (tsf)	1.90	3.10	4.50			
Deviator Stress at Failure (tsf)	2.09	3.03	4.49			
Max. Pore Pressure Buildup (tsf)	0.38	0.90	1.54			
Pore Pressure Parameter "B"	1.0	1.0	1.0			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 24.4° $c' = 0.27$ (tsf)
 _____ Total ϕ' : 16.5° $c = 0.51$ (tsf)



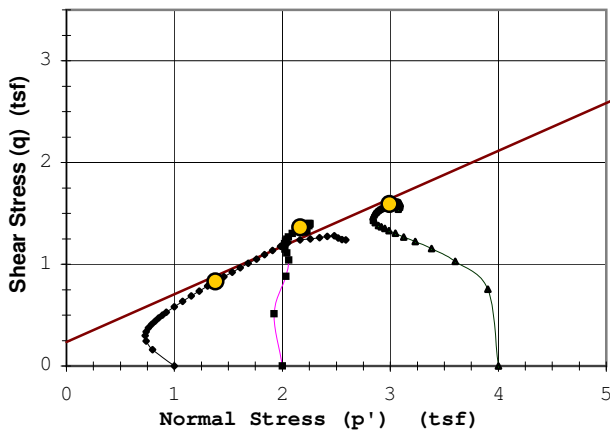
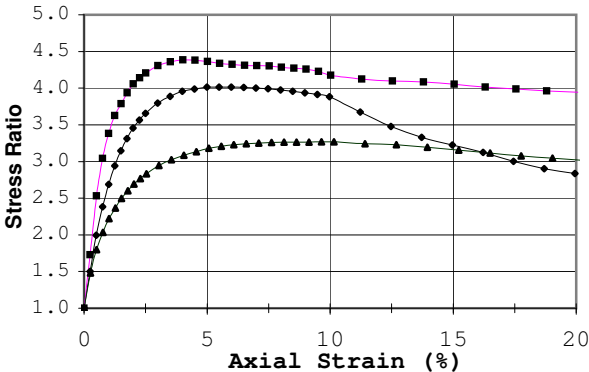
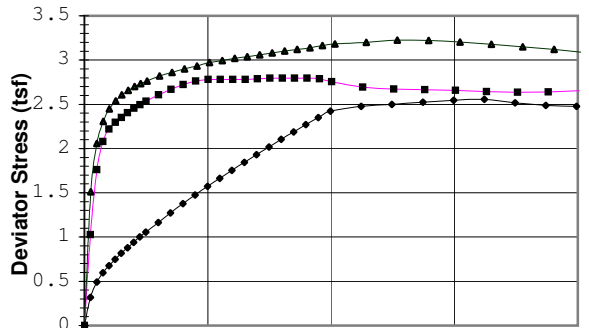
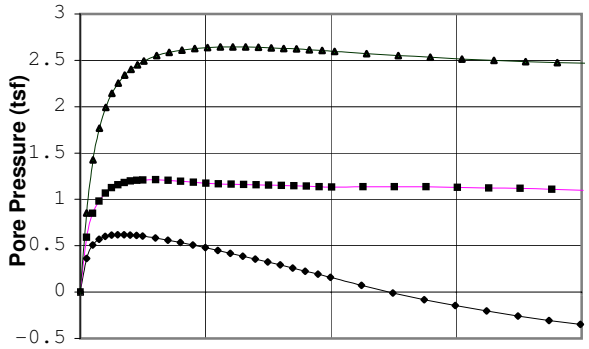
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.34	0.91	0.21	0.34	1.17	0.21	0.34	1.80	0.26
0.68	1.17	0.30	0.68	1.55	0.38	0.69	2.46	0.59
1.02	1.41	0.35	1.02	1.83	0.52	1.03	2.87	0.83
1.36	1.60	0.37	1.36	2.05	0.63	1.37	3.18	1.02
1.70	1.74	0.38	1.70	2.24	0.71	1.72	3.40	1.16
2.04	1.85	0.37	2.04	2.38	0.77	2.06	3.55	1.25
2.38	1.93	0.35	2.38	2.49	0.81	2.40	3.68	1.33
2.72	1.97	0.33	2.72	2.57	0.85	2.74	3.78	1.39
3.06	2.02	0.31	3.06	2.63	0.87	3.09	3.85	1.43
3.40	2.06	0.29	3.40	2.68	0.88	3.43	3.92	1.46
4.08	2.13	0.25	4.08	2.76	0.90	4.12	4.01	1.51
4.76	2.16	0.21	4.76	2.82	0.90	4.81	4.08	1.53
5.44	2.18	0.18	5.44	2.86	0.89	5.49	4.14	1.53
6.12	2.21	0.15	6.13	2.90	0.87	6.17	4.20	1.54
6.79	2.22	0.12	6.81	2.93	0.85	6.86	4.24	1.53
7.47	2.23	0.11	7.49	2.95	0.83	7.55	4.28	1.52
8.15	2.25	0.08	8.17	2.97	0.81	8.23	4.31	1.51
8.83	2.24	0.06	8.85	2.98	0.78	8.92	4.34	1.49
9.51	2.24	0.04	9.53	2.99	0.76	9.60	4.37	1.47
10.19	2.22	0.03	10.21	3.00	0.74	10.29	4.39	1.46
10.87	2.19	0.02	10.89	3.00	0.72	10.98	4.41	1.44
11.55	2.16	0.00	11.57	3.01	0.69	11.66	4.43	1.41
12.23	2.13	0.00	12.25	3.01	0.67	12.35	4.45	1.39
12.91	2.11	-0.01	12.93	3.02	0.65	13.03	4.47	1.37
13.59	2.09	-0.02	13.61	3.03	0.63	13.72	4.49	1.35
15.29	2.05	-0.03	15.31	3.08	0.57	15.43	4.51	1.29
16.98	2.01	-0.06	17.01	3.10	0.52	17.15	4.52	1.24
18.68	1.95	-0.09	18.72	3.11	0.48	18.86	4.52	1.18
20.38	1.90	-0.10	20.42	3.10	0.43	20.58	4.50	1.12

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



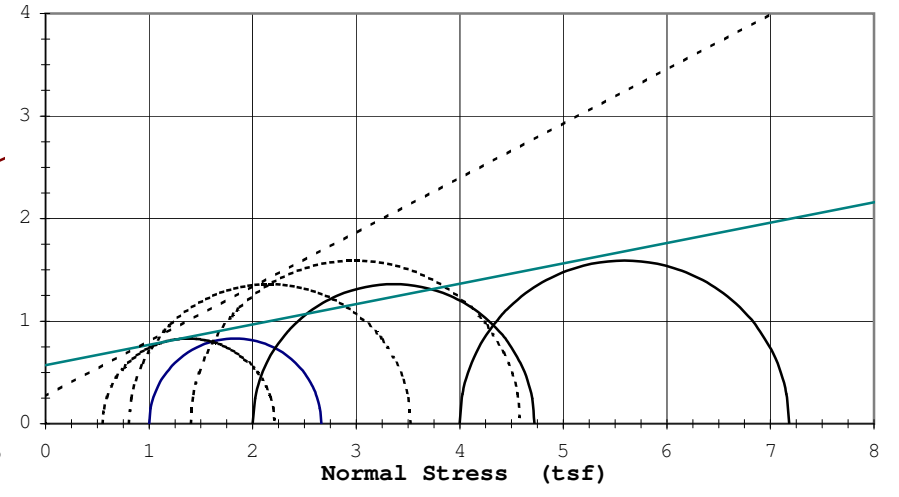
Rupture Envelope at Failure
 $\alpha = 25.2^\circ$ $a = 0.2$ (tsf)



Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 28.0^\circ$	
Apparent Cohesion, $c' = 0.27$ (tsf)	
Test Date: 8/26/10	Liquid Limit: 28.2
Test Type: CU w/pp	Plastic Limit: 17.1
Strain Rate (in/min): 0.00236	Plasticity Index: 11.1
Strain Rate (%/min): 0.059	Spec. Gravity (Assumed): 2.67
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10
Dry Density (pcf)	27.6 28.6 34.1
Void Ratio	95.8 94.2 87.2
After Consolidation	
Diameter (in)	0.74 0.77 0.91
Height (in)	1.94 1.93 1.90
Water Content (%)	4.01 3.99 3.94
Dry Density (pcf)	26.3 26.1 28.4
Void Ratio	97.9 98.3 94.8
Back Pressure (tsf)	0.70 0.70 0.76
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	2.56 2.80 3.23
Deviator Stress at Failure (tsf)	2.48 2.66 3.08
Max. Pore Pressure Buildup (tsf)	1.66 2.72 3.18
Pore Pressure Parameter "B"	0.62 1.21 2.64
Pct. Axial Strain at Failure	1.0 1.0 1.0
	5.5 4.0 10.2

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

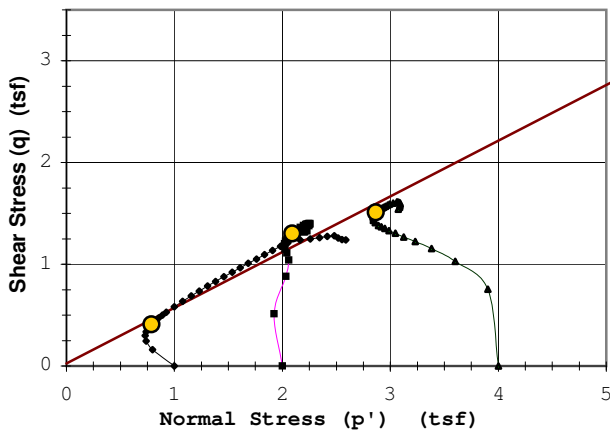
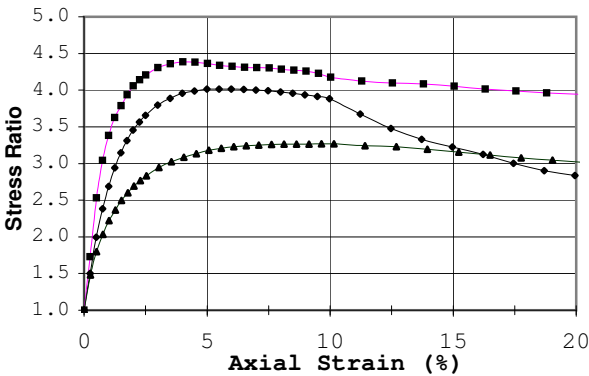
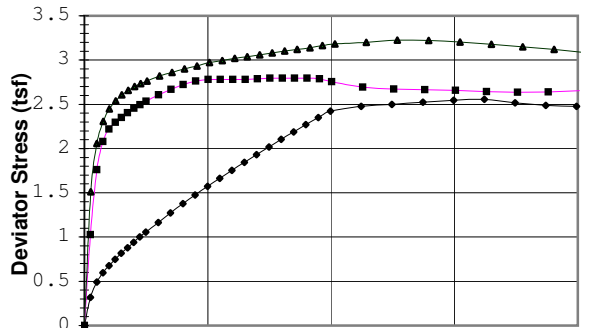
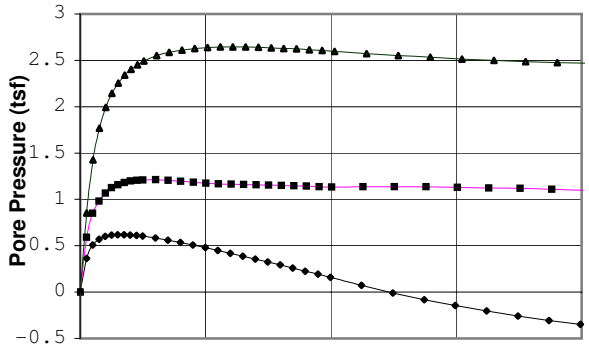


----- Effective ϕ' : 28.0° $c' = 0.27$ (tsf)
 _____ Total ϕ' : 11.2° $c = 0.57$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577
Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



Rupture Envelope at Failure
 $\alpha = 28.7^\circ$ $a = 0.0$ (tsf)



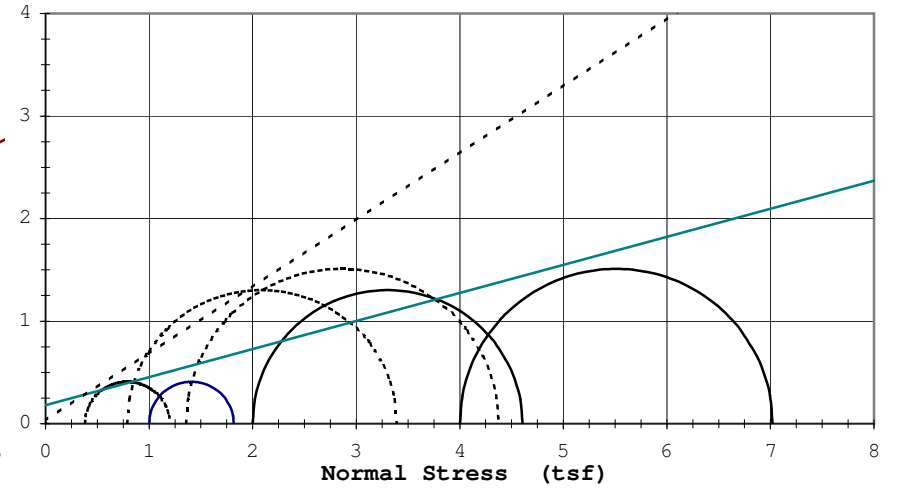
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X

Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 33.1^\circ$	
Apparent Cohesion, $c' = 0.03$ (tsf)	
Test Date: 8/26/10	Liquid Limit: 28.2
Test Type: CU w/pp	Plastic Limit: 17.1
Strain Rate (in/min): 0.00236	Plasticity Index: 11.1
Strain Rate (%/min): 0.059	Spec. Gravity (Assumed): 2.67
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10
Dry Density (pcf)	27.6 28.6 34.1
Void Ratio	95.8 94.2 87.2
After Consolidation	
Diameter (in)	0.74 0.77 0.91
Height (in)	1.94 1.93 1.90
Water Content (%)	4.01 3.99 3.94
Dry Density (pcf)	26.3 26.1 28.4
Void Ratio	97.9 98.3 94.8
Back Pressure (tsf)	0.70 0.70 0.76
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	2.56 2.80 3.23
Deviator Stress at Failure (tsf)	2.48 2.66 3.08
Max. Pore Pressure Buildup (tsf)	0.82 2.61 3.02
Pore Pressure Parameter "B"	0.62 1.21 2.64
Pct. Axial Strain at Failure	1.0 1.0 1.0
	1.5 3.0 6.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

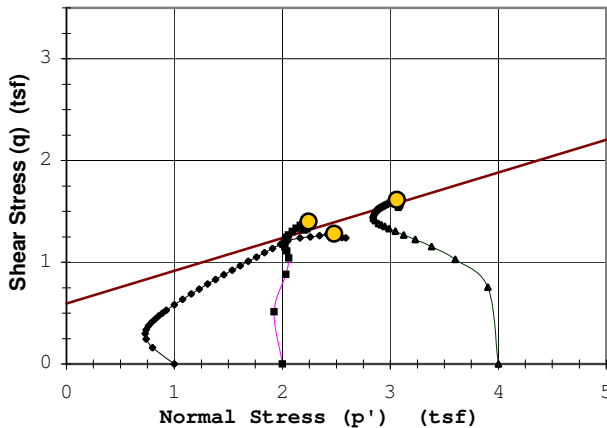
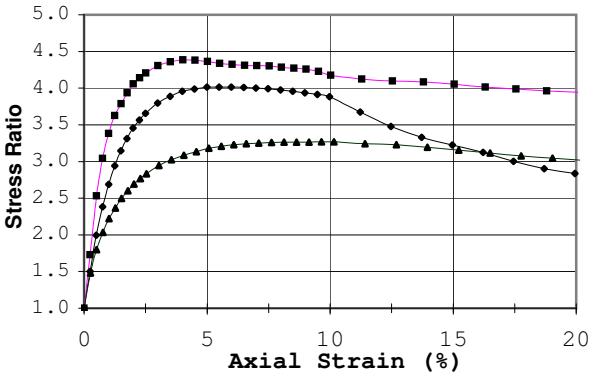
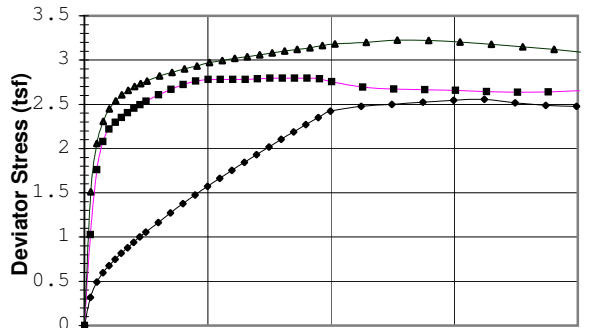
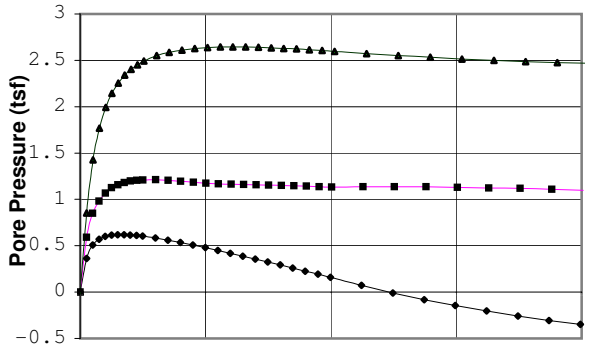


-----	Effective ϕ' : 33.1°	$c' = 0.03$ (tsf)
_____	Total ϕ : 15.3°	$c = 0.18$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577
Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



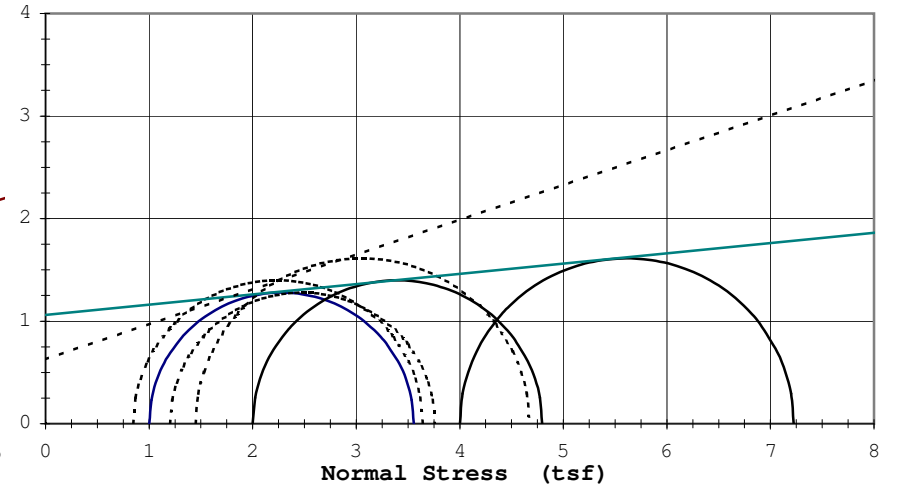
Rupture Envelope at Failure
 $\alpha = 17.9^\circ$ $a = 0.6$ (tsf)



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 18.8^\circ$	
Apparent Cohesion, $c' = 0.63$ (tsf)	
Test Date: 8/26/10	Liquid Limit: 28.2
Test Type: CU w/pp	Plastic Limit: 17.1
Strain Rate (in/min): 0.00236	Plasticity Index: 11.1
Strain Rate (%/min): 0.059	Spec. Gravity (Assumed): 2.67
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10 4.10 4.10
Dry Density (pcf)	27.6 28.6 34.1 34.1 34.1
Void Ratio	95.8 94.2 87.2 87.2 87.2
After Consolidation	
Diameter (in)	1.94 1.93 1.90
Height (in)	4.01 3.99 3.94
Water Content (%)	26.3 26.1 28.4
Dry Density (pcf)	97.9 98.3 94.8
Void Ratio	0.74 0.77 0.91
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	2.56 2.80 3.23
Ultimate Deviator Stress (tsf)	2.48 2.66 3.08
Deviator Stress at Failure (tsf)	2.56 2.80 3.23
Max. Pore Pressure Buildup (tsf)	0.62 1.21 2.64
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	16.2 7.5 12.7

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



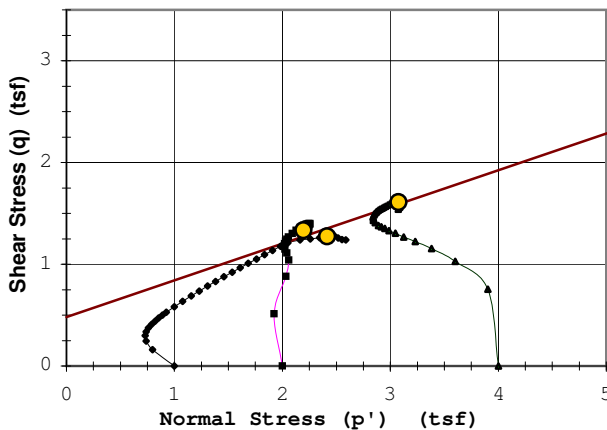
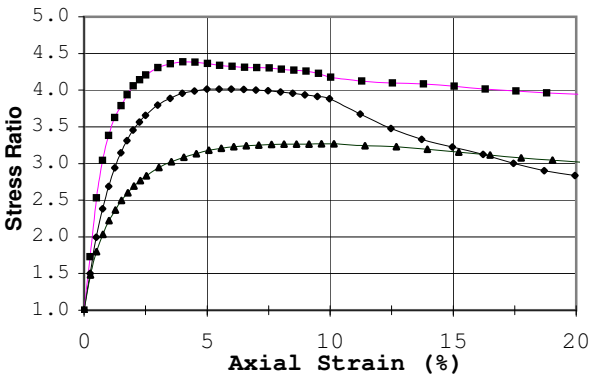
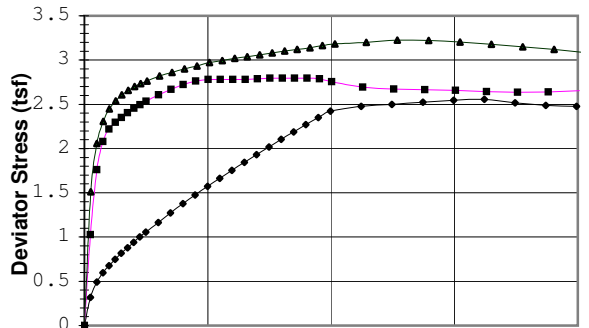
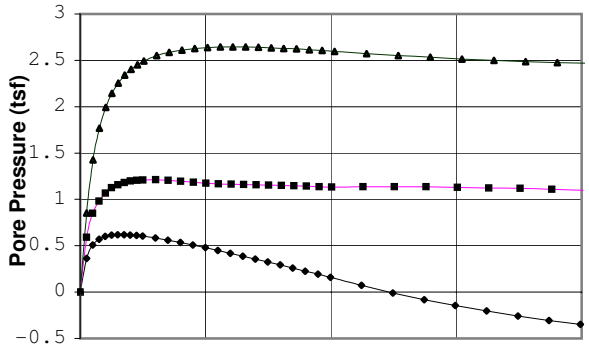
----- Effective ϕ' : 18.8° $c' = 0.63$ (tsf)
 _____ Total ϕ' : 5.7° $c = 1.06$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



Rupture Envelope at Failure
 $\alpha = 19.8^\circ$ $a = 0.5$ (tsf)



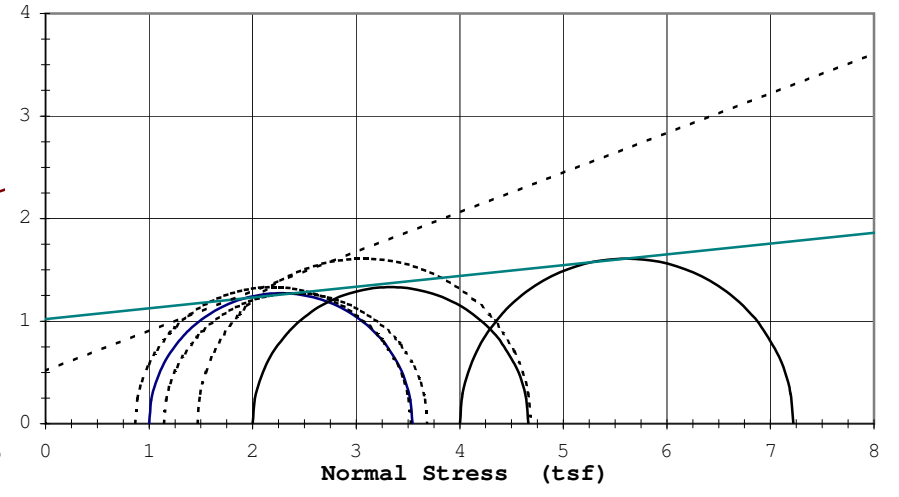
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Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 21.2^\circ$	
Apparent Cohesion, $c' = 0.51$ (tsf)	
Test Date: 8/26/10	Liquid Limit: 28.2
Test Type: CU w/pp	Plastic Limit: 17.1
Strain Rate (in/min): 0.00236	Plasticity Index: 11.1
Strain Rate (%/min): 0.059	Spec. Gravity (Assumed): 2.67
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10
Dry Density (pcf)	27.6 28.6 34.1
Void Ratio	95.8 94.2 87.2
After Consolidation	
Diameter (in)	0.74 0.77 0.91
Height (in)	1.94 1.93 1.90
Water Content (%)	4.01 3.99 3.94
Dry Density (pcf)	26.3 26.1 28.4
Void Ratio	97.9 98.3 94.8
Back Pressure (tsf)	0.70 0.70 0.76
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	2.56 2.80 3.23
Deviator Stress at Failure (tsf)	2.48 2.66 3.08
Max. Pore Pressure Buildup (tsf)	2.54 2.66 3.22
Pore Pressure Parameter "B"	0.62 1.21 2.64
Pct. Axial Strain at Failure	1.0 1.0 1.0
	15.0 15.0 15.0

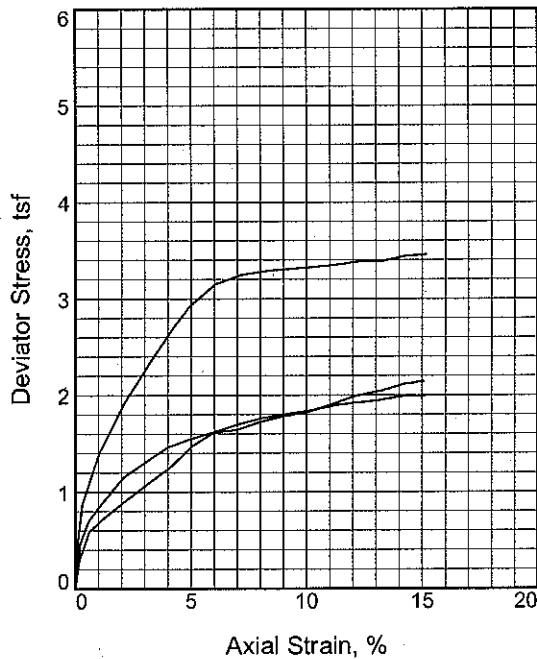
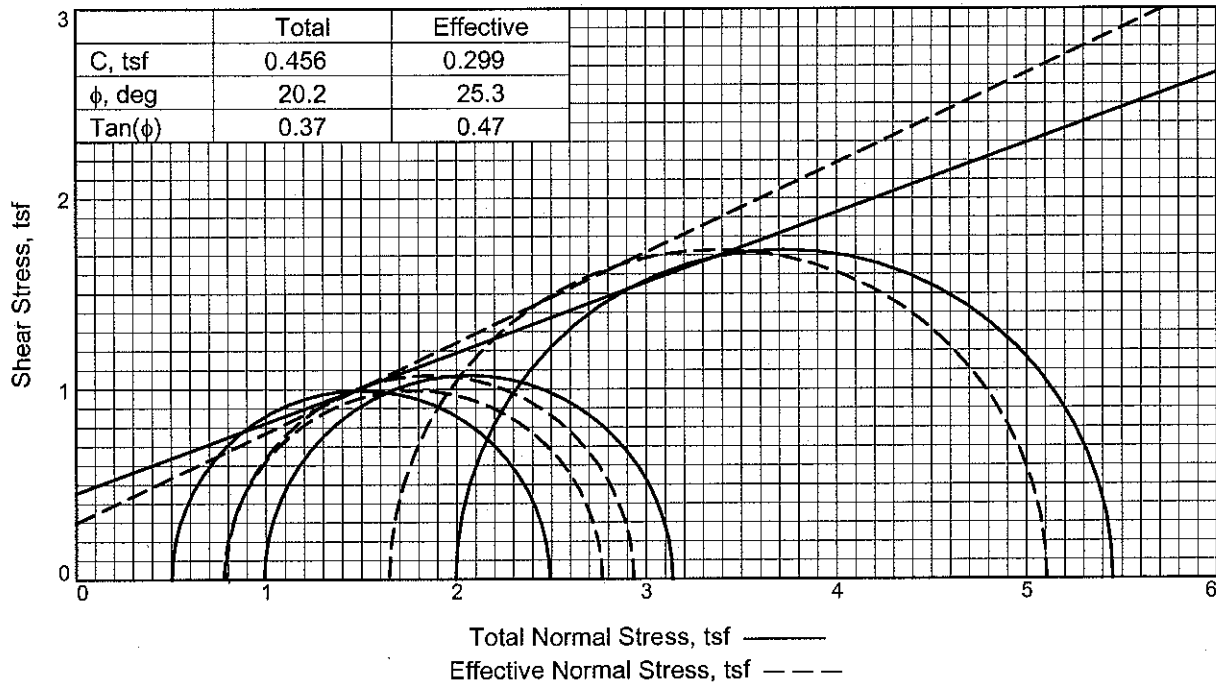
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



-----	Effective ϕ' : 21.2°	$c' =$ 0.51 (tsf)
_____	Total ϕ : 6.0°	$c =$ 1.02 (tsf)

Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.32	0.36	0.25	1.03	0.59	0.25	1.51	0.85
0.50	0.49	0.51	0.50	1.76	0.85	0.51	2.06	1.43
0.75	0.60	0.57	0.75	2.08	0.98	0.76	2.31	1.77
1.00	0.68	0.60	1.00	2.22	1.07	1.02	2.45	1.99
1.25	0.75	0.61	1.25	2.30	1.13	1.27	2.54	2.14
1.50	0.82	0.62	1.51	2.35	1.16	1.52	2.61	2.26
1.75	0.88	0.62	1.76	2.41	1.18	1.78	2.66	2.34
2.00	0.94	0.62	2.01	2.45	1.20	2.03	2.70	2.40
2.24	1.00	0.61	2.26	2.49	1.21	2.28	2.73	2.45
2.49	1.05	0.60	2.51	2.54	1.21	2.54	2.76	2.49
2.99	1.16	0.58	3.01	2.61	1.21	3.05	2.82	2.55
3.49	1.27	0.56	3.51	2.67	1.21	3.55	2.86	2.59
3.99	1.38	0.53	4.01	2.72	1.20	4.06	2.90	2.61
4.49	1.47	0.51	4.51	2.76	1.18	4.57	2.93	2.63
4.99	1.57	0.48	5.02	2.78	1.17	5.08	2.97	2.64
5.49	1.66	0.45	5.52	2.78	1.17	5.58	2.99	2.64
5.99	1.75	0.42	6.02	2.78	1.16	6.09	3.02	2.64
6.48	1.84	0.39	6.52	2.78	1.16	6.60	3.04	2.64
6.98	1.93	0.36	7.02	2.79	1.16	7.11	3.06	2.64
7.48	2.02	0.33	7.52	2.80	1.15	7.61	3.08	2.64
7.98	2.10	0.29	8.03	2.79	1.15	8.12	3.10	2.63
8.48	2.19	0.26	8.53	2.79	1.15	8.63	3.12	2.62
8.98	2.27	0.23	9.03	2.80	1.14	9.14	3.14	2.61
9.48	2.35	0.19	9.53	2.79	1.14	9.65	3.16	2.61
9.98	2.42	0.16	10.03	2.76	1.13	10.15	3.18	2.60
11.22	2.48	0.07	11.29	2.69	1.14	11.42	3.20	2.57
12.47	2.50	-0.01	12.54	2.67	1.14	12.69	3.23	2.55
13.72	2.52	-0.08	13.79	2.66	1.14	13.96	3.22	2.53
14.96	2.54	-0.14	15.05	2.66	1.13	15.23	3.20	2.51
16.21	2.56	-0.20	16.30	2.64	1.12	16.50	3.18	2.50
17.46	2.52	-0.26	17.56	2.63	1.12	17.77	3.15	2.48
18.70	2.49	-0.31	18.81	2.64	1.11	19.03	3.12	2.48
19.95	2.48	-0.35	20.06	2.66	1.10	20.30	3.08	2.47



Sample No.	1	2	3	
Initial	Water Content, %	30.4	30.2	30.3
	Dry Density, pcf	91.3	92.4	92.4
	Saturation, %	95.1	96.8	97.1
	Void Ratio	0.8797	0.8583	0.8584
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.81	2.81	2.82
At Test	Water Content, %	31.3	30.9	29.4
	Dry Density, pcf	92.3	92.9	94.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8597	0.8484	0.8092
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.80	2.80	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.51	0.99	2.00	
Back Pressure, tsf	6.63	6.15	5.15	
Cell Pressure, tsf	7.14	7.14	7.15	
Peak Deviator Stress, tsf	1.99	2.15	3.46	
Total Pore Pr., tsf	6.40	6.35	5.50	
Ultimate Deviator Stress, tsf	1.99	2.15	3.46	
Total Pore Pr., tsf	6.36	6.35	5.50	
Maj. Eff. Stress at Ultimate, tsf	2.77	2.93	5.11	
Min. Eff. Stress at Ultimate, tsf	0.78	0.79	1.65	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 70 PL= 21 PI= 49

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

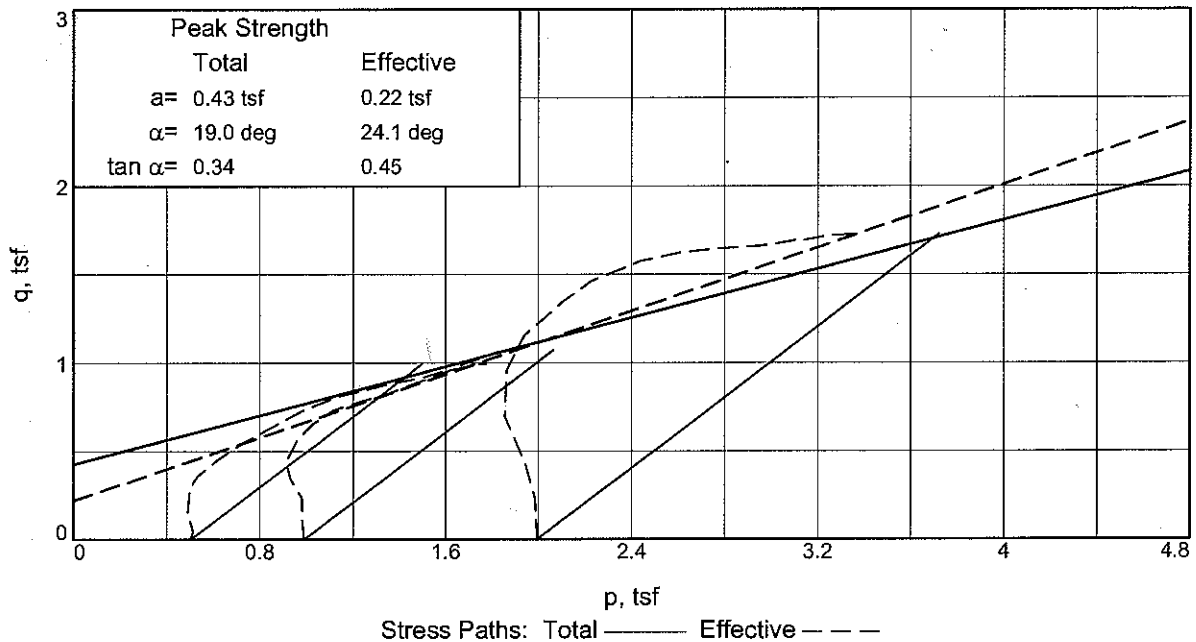
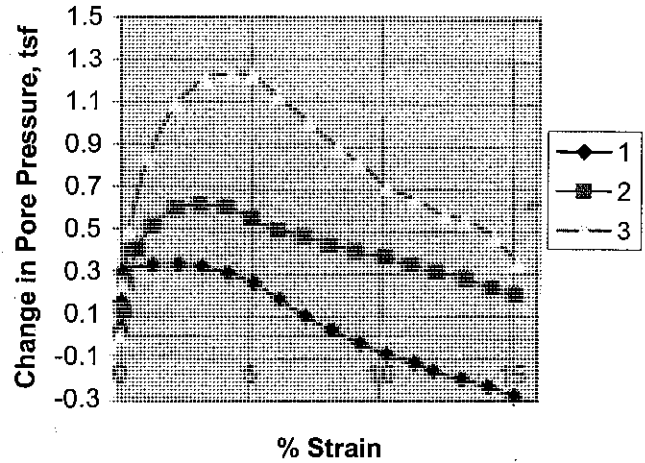
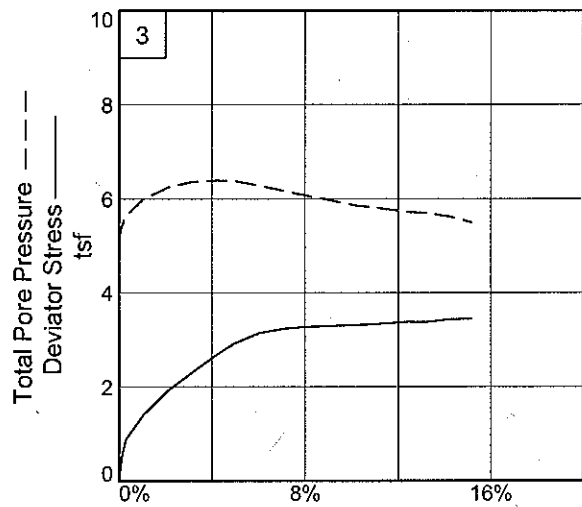
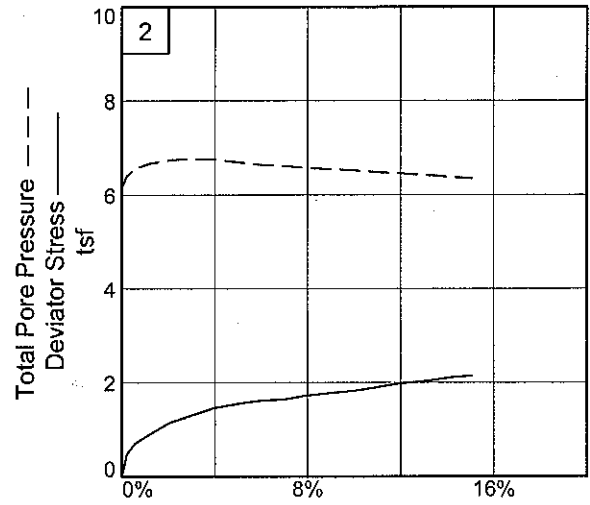
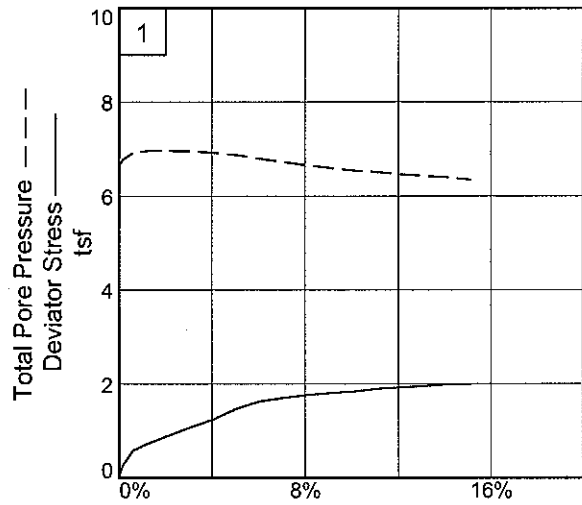
Location: SE-ED-01, East Diversion, Sherack Formation

Sample Number: Boring 09-11MU, #1 **Depth:** 10-12'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: SE-ED-01, East Diversion, Sherack Formation

Depth: 10-12'

Sample No.: Boring 09-11MU, #1

Project No.: DL-09-03127
 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

10/12/2009

3:02 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-01, East Diversion, Sherack Formation
Depth: 10-12' **Sample Number:** Boring 09-11MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**70 **PL=**21 **PI=**49
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	94.090			165.200
Moisture content: Dry soil+tare, gms.	79.430			133.140
Moisture content: Tare, gms.	31.260			30.350
Moisture, %	30.4	32.0	31.3	31.2
Moist specimen weight, gms.	133.9			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.51	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	119.1	120.5	121.2	
Dry density, pcf	91.3	91.3	92.3	
Void ratio	0.8797	0.8797	0.8597	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.136 tsf
Consolidation back pressure = 6.633 tsf
Consolidation effective confining stress = 0.503 tsf
Fail. Stress = 1.990 tsf at reading no. 17
Ult. Stress = 1.988 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0167	18.850	0.0	0.0	0.000	0.503	0.503	1.00	6.633	0.503	0.000
1	0.0173	20.750	1.9	0.0	0.091	0.469	0.560	1.19	6.667	0.514	0.045
2	0.0214	24.960	6.1	0.2	0.291	0.345	0.636	1.84	6.791	0.490	0.145
3	0.0335	31.240	12.4	0.6	0.587	0.206	0.793	3.85	6.930	0.499	0.293
4	0.0506	34.200	15.4	1.2	0.723	0.171	0.894	5.23	6.965	0.532	0.361
5	0.0773	38.360	19.5	2.2	0.910	0.167	1.077	6.45	6.969	0.622	0.455
6	0.1043	42.290	23.4	3.1	1.082	0.177	1.259	7.11	6.959	0.718	0.541
7	0.1310	46.230	27.4	4.1	1.251	0.209	1.460	6.99	6.927	0.835	0.626
8	0.1588	51.540	32.7	5.1	1.479	0.255	1.734	6.80	6.881	0.994	0.739
9	0.1866	55.230	36.4	6.1	1.628	0.329	1.957	5.95	6.807	1.143	0.814
10	0.2157	57.340	38.5	7.1	1.704	0.410	2.114	5.16	6.726	1.262	0.852
11	0.2446	59.230	40.4	8.1	1.768	0.473	2.241	4.74	6.663	1.357	0.884
12	0.2736	60.550	41.7	9.2	1.805	0.536	2.341	4.37	6.600	1.438	0.902
13	0.3024	61.930	43.1	10.2	1.844	0.588	2.432	4.14	6.548	1.510	0.922
14	0.3325	63.800	44.9	11.3	1.901	0.626	2.527	4.04	6.510	1.576	0.950
15	0.3535	64.660	45.8	12.0	1.921	0.665	2.586	3.89	6.471	1.625	0.960
16	0.3834	65.860	47.0	13.1	1.947	0.700	2.647	3.78	6.436	1.673	0.973
17	0.4123	67.470	48.6	14.1	1.990	0.734	2.724	3.71	6.402	1.729	0.995
18	0.4400	68.000	49.2	15.1	1.988	0.779	2.767	3.55	6.357	1.773	0.994

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	121.370			165.960
Moisture content: Dry soil+tare, gms.	100.210			134.150
Moisture content: Tare, gms.	30.180			30.780
Moisture, %	30.2	31.2	30.9	30.8
Moist specimen weight, gms.	134.9			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	120.3	121.2	121.5	
Dry density, pcf	92.4	92.4	92.9	
Void ratio	0.8583	0.8583	0.8484	
Saturation, %	96.8	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.139 tsf
 Consolidation back pressure = 6.148 tsf
 Consolidation effective confining stress = 0.991 tsf
 Fail. Stress = 2.147 tsf at reading no. 18
 Ult. Stress = 2.147 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0099	19.490	0.0	0.0	0.000	0.991	0.991	1.00	6.148	0.991	0.000
1	0.0128	23.920	4.4	0.1	0.210	0.878	1.088	1.24	6.261	0.983	0.105
2	0.0158	29.440	10.0	0.2	0.471	0.745	1.216	1.63	6.394	0.981	0.236
3	0.0256	34.270	14.8	0.6	0.698	0.583	1.281	2.20	6.556	0.932	0.349
4	0.0426	38.360	18.9	1.2	0.885	0.471	1.356	2.88	6.668	0.914	0.443
5	0.0684	44.310	24.8	2.1	1.154	0.389	1.543	3.97	6.750	0.966	0.577
6	0.0953	48.000	28.5	3.0	1.312	0.372	1.684	4.53	6.767	1.028	0.656
7	0.1223	51.630	32.1	4.0	1.465	0.381	1.846	4.84	6.758	1.113	0.732
8	0.1492	53.800	34.3	5.0	1.548	0.435	1.983	4.56	6.704	1.209	0.774
9	0.1770	55.690	36.2	6.0	1.616	0.492	2.108	4.29	6.647	1.300	0.808
10	0.2058	56.730	37.2	7.0	1.645	0.518	2.163	4.17	6.621	1.340	0.822
11	0.2345	59.050	39.6	8.0	1.728	0.559	2.287	4.09	6.580	1.423	0.864
12	0.2627	60.760	41.3	9.0	1.783	0.590	2.373	4.02	6.549	1.481	0.891
13	0.2917	62.220	42.7	10.1	1.825	0.615	2.440	3.97	6.524	1.527	0.912
14	0.3206	64.660	45.2	11.1	1.907	0.655	2.562	3.91	6.484	1.608	0.953
15	0.3495	67.230	47.7	12.1	1.992	0.683	2.675	3.92	6.456	1.679	0.996
16	0.3792	69.000	49.5	13.2	2.041	0.715	2.756	3.85	6.424	1.735	1.020
17	0.4084	71.440	52.0	14.2	2.116	0.760	2.876	3.78	6.379	1.818	1.058
18	0.4320	72.720	53.2	15.1	2.147	0.787	2.934	3.73	6.352	1.860	1.073

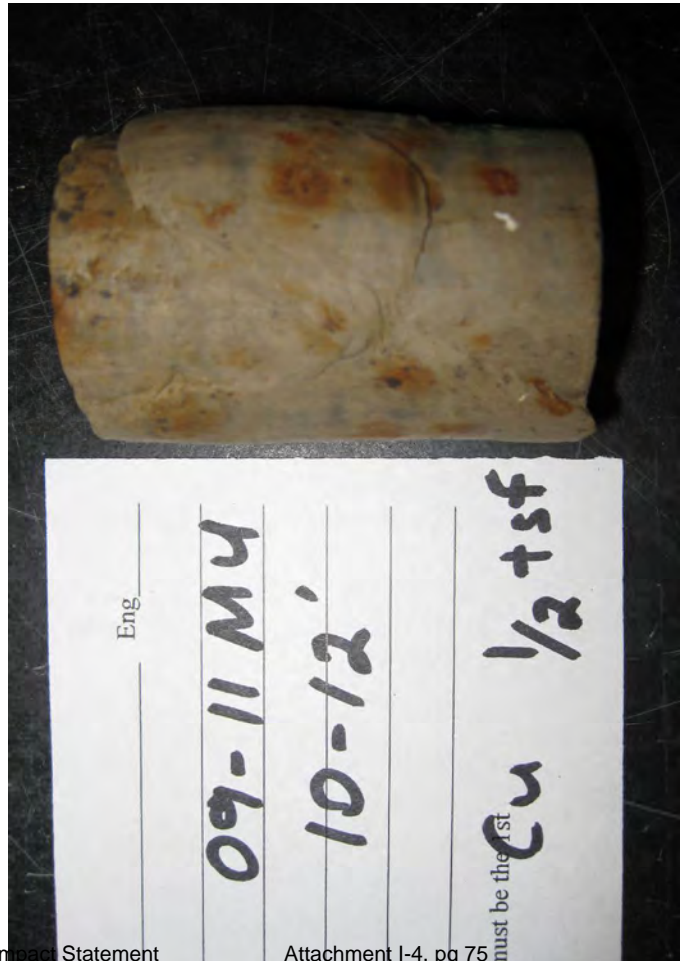
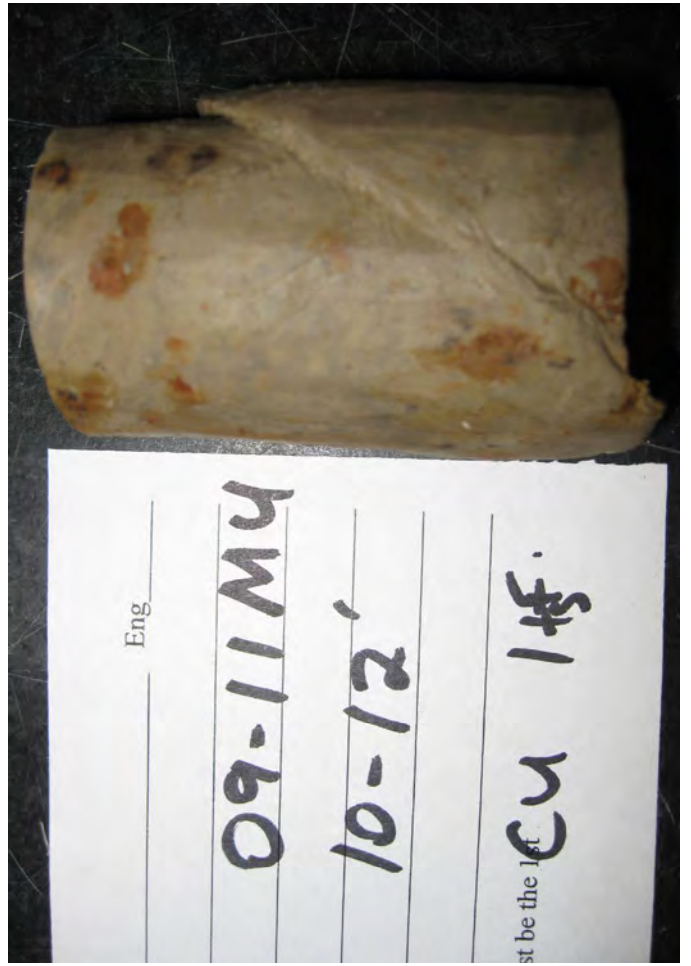
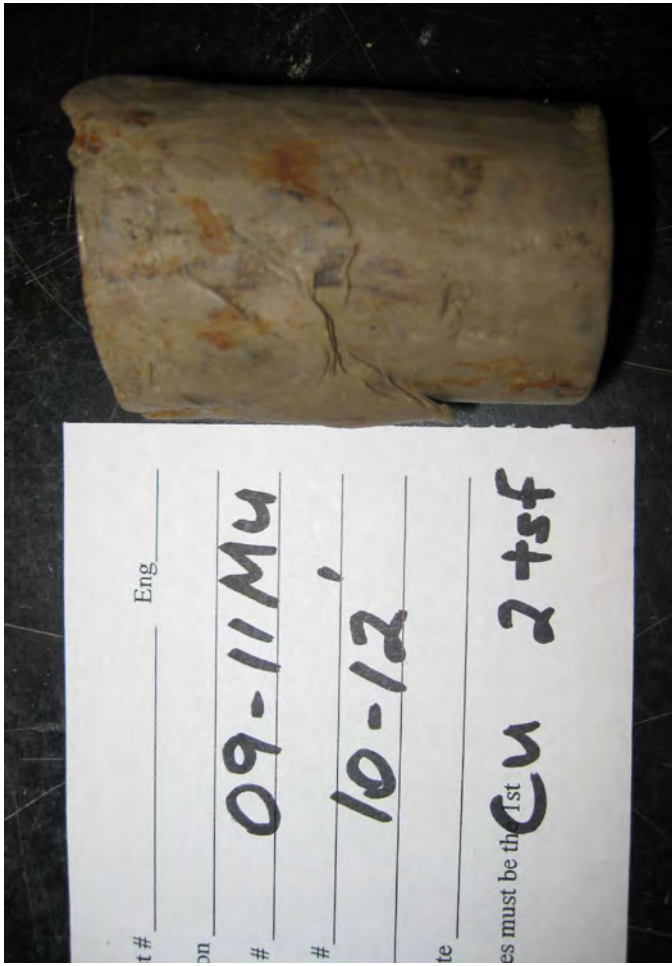
Parameters for Specimen No. 3

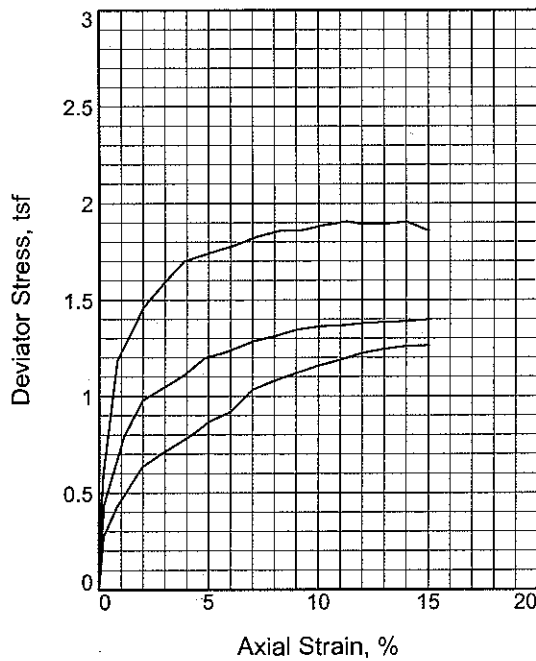
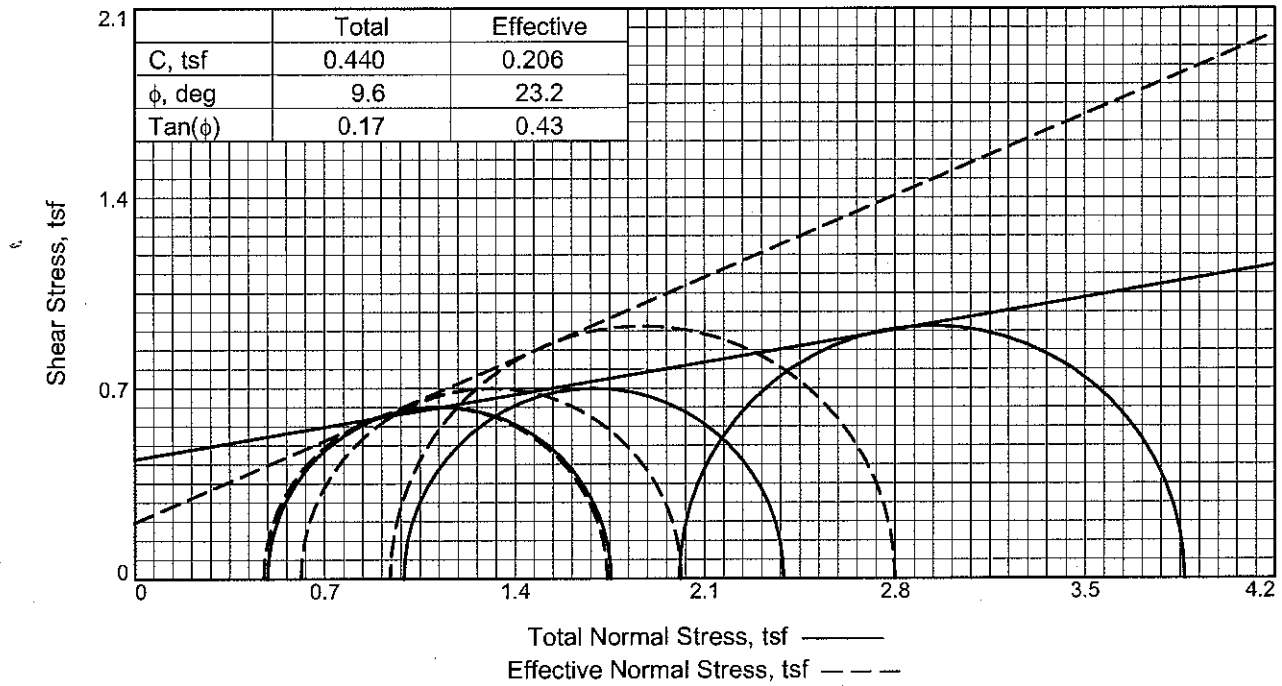
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	120.470			166.510
Moisture content: Dry soil+tare, gms.	99.790			135.780
Moisture content: Tare, gms.	31.550			30.900
Moisture, %	30.3	31.2	29.4	29.3
Moist specimen weight, gms.	136.2			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.53	1.53	1.50	
Height, in.	2.82	2.82	2.79	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	120.4	121.2	122.8	
Dry density, pcf	92.4	92.4	94.9	
Void ratio	0.8584	0.8584	0.8092	
Saturation, %	97.1	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.147 tsf
 Consolidation back pressure = 5.153 tsf
 Consolidation effective confining stress = 1.994 tsf
 Fail. Stress = 3.458 tsf at reading no. 17
 Ult. Stress = 3.458 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0230	18.670	0.0	0.0	0.000	1.994	1.994	1.00	5.153	1.994	0.000
1	0.0258	28.280	9.6	0.1	0.460	1.756	2.216	1.26	5.391	1.986	0.230
2	0.0309	36.920	18.3	0.3	0.872	1.508	2.380	1.58	5.639	1.944	0.436
3	0.0517	48.150	29.5	1.0	1.397	1.156	2.553	2.21	5.991	1.855	0.699
4	0.0817	59.630	41.0	2.1	1.920	0.903	2.823	3.13	6.244	1.863	0.960
5	0.1114	68.570	49.9	3.2	2.314	0.784	3.098	3.95	6.363	1.941	1.157
6	0.1412	77.510	58.8	4.2	2.699	0.758	3.457	4.56	6.389	2.107	1.349
7	0.1613	82.950	64.3	5.0	2.926	0.765	3.691	4.82	6.382	2.228	1.463
8	0.1917	88.720	70.1	6.0	3.152	0.865	4.017	4.64	6.282	2.441	1.576
9	0.2232	91.710	73.0	7.2	3.247	0.986	4.233	4.29	6.161	2.610	1.624
10	0.2549	93.510	74.8	8.3	3.286	1.104	4.390	3.98	6.043	2.747	1.643
11	0.2759	94.510	75.8	9.1	3.303	1.172	4.475	3.82	5.975	2.823	1.651
12	0.3070	95.930	77.3	10.2	3.324	1.286	4.610	3.58	5.861	2.948	1.662
13	0.3377	97.500	78.8	11.3	3.350	1.349	4.699	3.48	5.798	3.024	1.675
14	0.3697	99.550	80.9	12.4	3.392	1.419	4.811	3.39	5.728	3.115	1.696
15	0.3907	100.070	81.4	13.2	3.385	1.442	4.827	3.35	5.705	3.134	1.692
16	0.4216	102.510	83.8	14.3	3.442	1.525	4.967	3.26	5.622	3.246	1.721
17	0.4463	103.790	85.1	15.2	3.458	1.647	5.105	3.10	5.500	3.376	1.729





Sample No.		1	2	3
Initial	Water Content, %	38.1	38.8	41.4
	Dry Density, pcf	83.5	83.0	79.8
	Saturation, %	99.3	99.8	98.9
	Void Ratio	1.0551	1.0693	1.1516
	Diameter, in.	1.41	1.39	1.40
	Height, in.	2.80	2.83	2.81
At Test	Water Content, %	36.8	36.1	36.9
	Dry Density, pcf	85.4	86.1	85.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0113	0.9931	1.0156
	Diameter, in.	1.40	1.37	1.37
	Height, in.	2.78	2.79	2.75
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.49	0.99	2.01
Back Pressure, tsf		6.65	6.15	5.14
Cell Pressure, tsf		7.14	7.14	7.15
Peak Deviator Stress, tsf		1.26	1.40	1.91
Total Pore Pr., tsf		6.66	6.53	6.28
Ultimate Deviator Stress, tsf		1.26	1.40	1.86
Total Pore Pr., tsf		6.66	6.53	6.21
Maj. Eff. Stress at Ultimate, tsf		1.74	2.01	2.80
Min. Eff. Stress at Ultimate, tsf		0.48	0.61	0.94

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of SILT, brown (CH)

LL= 54 PL= 19 PI= 35

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

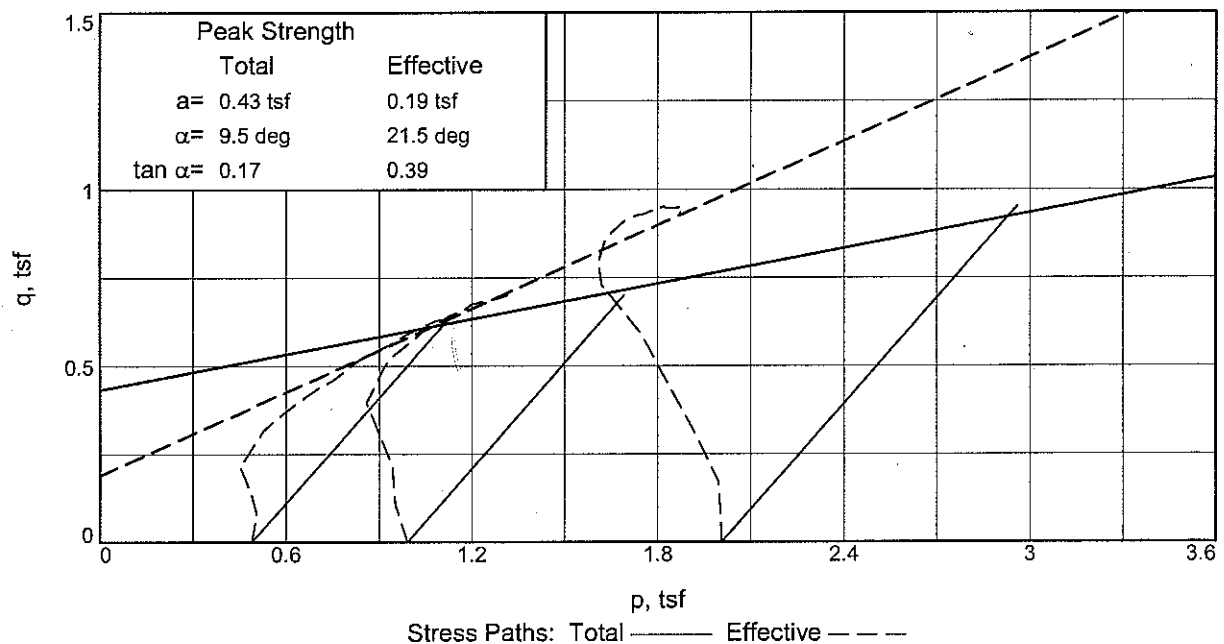
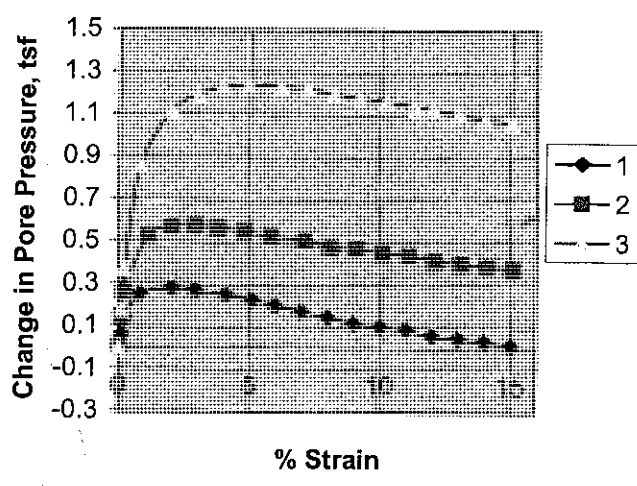
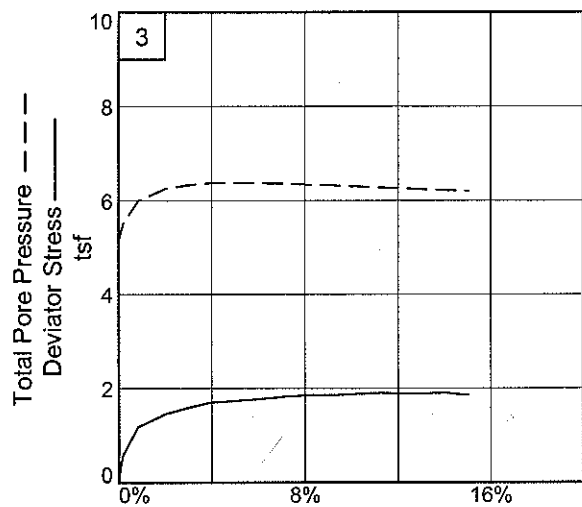
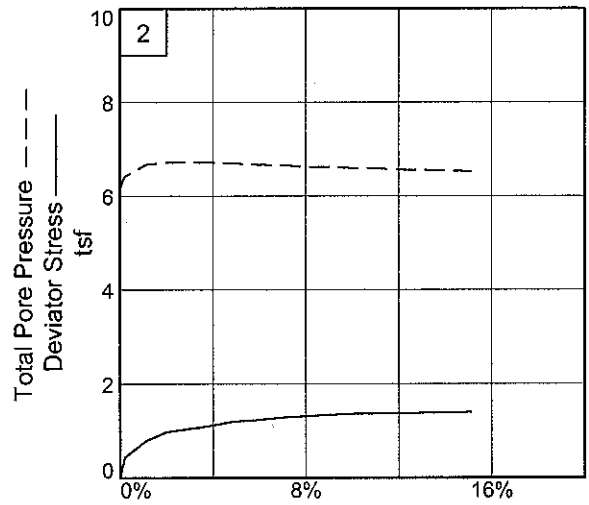
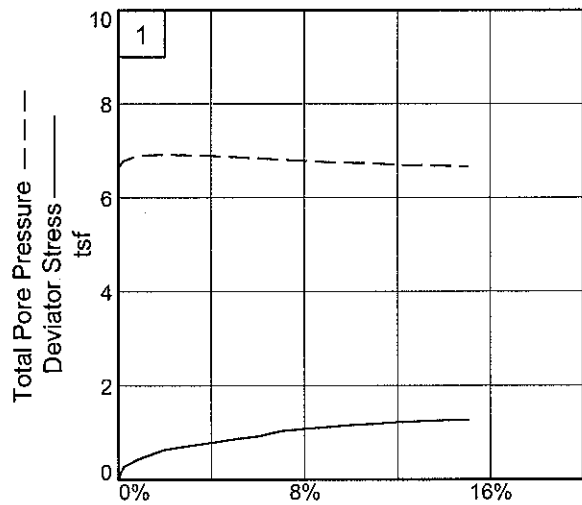
Location: SE-ED-15, East Diversion, Sherack Formation

Sample Number: Boring 09-14MU, #1 **Depth:** 8-10'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

10/12/2009

3:49 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-15, East Diversion, Sherack Formation
Depth: 8-10' **Sample Number:** Boring 09-14MU, #1
Description: FAT CLAY with layers of SILT, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**54 **PL=**19 **PI=**35
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	96.200			160.570
Moisture content: Dry soil+tare, gms.	77.950			126.200
Moisture content: Tare, gms.	30.060			29.890
Moisture, %	38.1	38.4	36.8	35.7
Moist specimen weight, gms.	132.6			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.56	1.56	1.54	
Height, in.	2.80	2.80	2.78	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	115.4	115.6	116.7	
Dry density, pcf	83.5	83.5	85.4	
Void ratio	1.0551	1.0551	1.0113	
Saturation, %	99.3	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.136 tsf
Consolidation back pressure = 6.646 tsf
Consolidation effective confining stress = 0.490 tsf
Fail. Stress = 1.264 tsf at reading no. 17
Ult. Stress = 1.264 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0139	18.940	0.0	0.0	0.000	0.490	0.490	1.00	6.646	0.490	0.000
1	0.0169	22.300	3.4	0.1	0.157	0.428	0.585	1.37	6.708	0.507	0.079
2	0.0197	24.770	5.8	0.2	0.272	0.353	0.625	1.77	6.783	0.489	0.136
3	0.0366	28.190	9.3	0.8	0.429	0.238	0.667	2.80	6.898	0.453	0.215
4	0.0686	32.770	13.8	2.0	0.634	0.211	0.845	4.01	6.925	0.528	0.317
5	0.0936	34.420	15.5	2.9	0.703	0.220	0.923	4.20	6.916	0.572	0.352
6	0.1283	36.550	17.6	4.1	0.790	0.241	1.031	4.28	6.895	0.636	0.395
7	0.1545	38.530	19.6	5.1	0.870	0.265	1.135	4.28	6.871	0.700	0.435
8	0.1812	39.870	20.9	6.0	0.920	0.291	1.211	4.16	6.845	0.751	0.460
9	0.2091	42.720	23.8	7.0	1.034	0.319	1.353	4.24	6.817	0.836	0.517
10	0.2359	44.020	25.1	8.0	1.080	0.345	1.425	4.13	6.791	0.885	0.540
11	0.2639	45.220	26.3	9.0	1.119	0.372	1.491	4.01	6.764	0.931	0.559
12	0.2918	46.440	27.5	10.0	1.158	0.389	1.547	3.98	6.747	0.968	0.579
13	0.3198	47.510	28.6	11.0	1.190	0.403	1.593	3.95	6.733	0.998	0.595
14	0.3473	48.640	29.7	12.0	1.223	0.431	1.654	3.84	6.705	1.042	0.611
15	0.3756	49.530	30.6	13.0	1.245	0.444	1.689	3.80	6.692	1.066	0.622
16	0.4045	50.260	31.3	14.0	1.259	0.457	1.716	3.76	6.679	1.087	0.630
17	0.4324	50.750	31.8	15.0	1.264	0.476	1.740	3.66	6.660	1.108	0.632

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	91.830			156.070
Moisture content: Dry soil+tare, gms.	74.510			123.400
Moisture content: Tare, gms.	29.880			30.150
Moisture, %	38.8	38.9	36.1	35.0
Moist specimen weight, gms.	129.3			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.51	1.51	1.48	
Height, in.	2.83	2.83	2.79	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	115.2	115.2	117.2	
Dry density, pcf	83.0	83.0	86.1	
Void ratio	1.0693	1.0693	0.9931	
Saturation, %	99.8	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.145 tsf
 Consolidation back pressure = 6.154 tsf
 Consolidation effective confining stress = 0.991 tsf
 Fail. Stress = 1.401 tsf at reading no. 17
 Ult. Stress = 1.401 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0108	19.620	0.0	0.0	0.000	0.991	0.991	1.00	6.154	0.991	0.000
1	0.0137	23.980	4.4	0.1	0.213	0.846	1.059	1.25	6.299	0.952	0.106
2	0.0168	28.590	9.0	0.2	0.437	0.723	1.160	1.60	6.422	0.941	0.218
3	0.0424	36.040	16.4	1.1	0.792	0.463	1.255	2.71	6.682	0.859	0.396
4	0.0663	40.060	20.4	2.0	0.977	0.422	1.399	3.32	6.723	0.911	0.489
5	0.0924	41.650	22.0	2.9	1.043	0.413	1.456	3.53	6.732	0.935	0.522
6	0.1181	43.190	23.6	3.8	1.106	0.426	1.532	3.60	6.719	0.979	0.553
7	0.1451	45.380	25.8	4.8	1.196	0.443	1.639	3.70	6.702	1.041	0.598
8	0.1720	46.360	26.7	5.8	1.229	0.464	1.693	3.65	6.681	1.079	0.615
9	0.2087	48.000	28.4	7.1	1.287	0.485	1.772	3.65	6.660	1.128	0.643
10	0.2368	48.940	29.3	8.1	1.315	0.515	1.830	3.55	6.630	1.172	0.657
11	0.2636	49.980	30.4	9.1	1.347	0.521	1.868	3.59	6.624	1.195	0.674
12	0.2917	50.690	31.1	10.1	1.363	0.543	1.906	3.51	6.602	1.225	0.682
13	0.3204	51.150	31.5	11.1	1.368	0.550	1.918	3.49	6.595	1.234	0.684
14	0.3484	51.780	32.2	12.1	1.379	0.578	1.957	3.39	6.567	1.268	0.690
15	0.3763	52.280	32.7	13.1	1.385	0.588	1.973	3.36	6.557	1.280	0.692
16	0.4045	52.800	33.2	14.1	1.391	0.598	1.989	3.33	6.547	1.293	0.695
17	0.4323	53.430	33.8	15.1	1.401	0.613	2.014	3.28	6.532	1.313	0.700

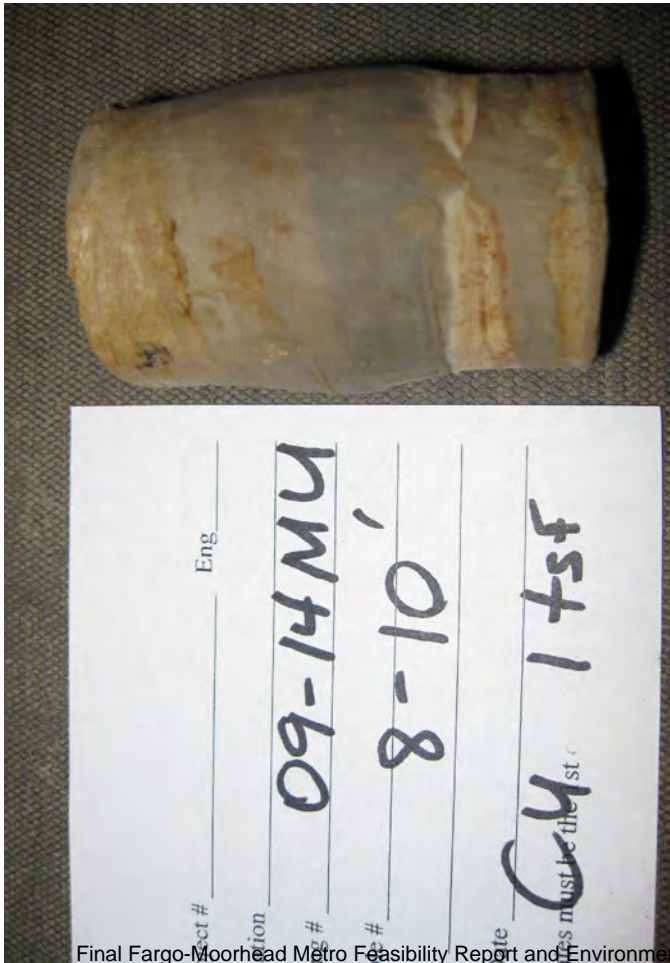
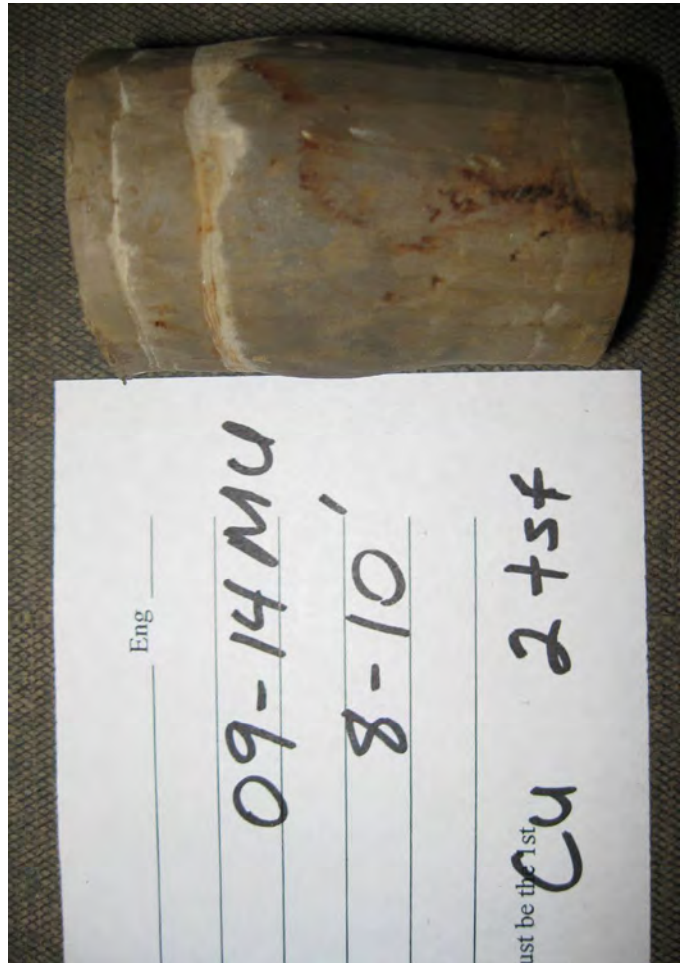
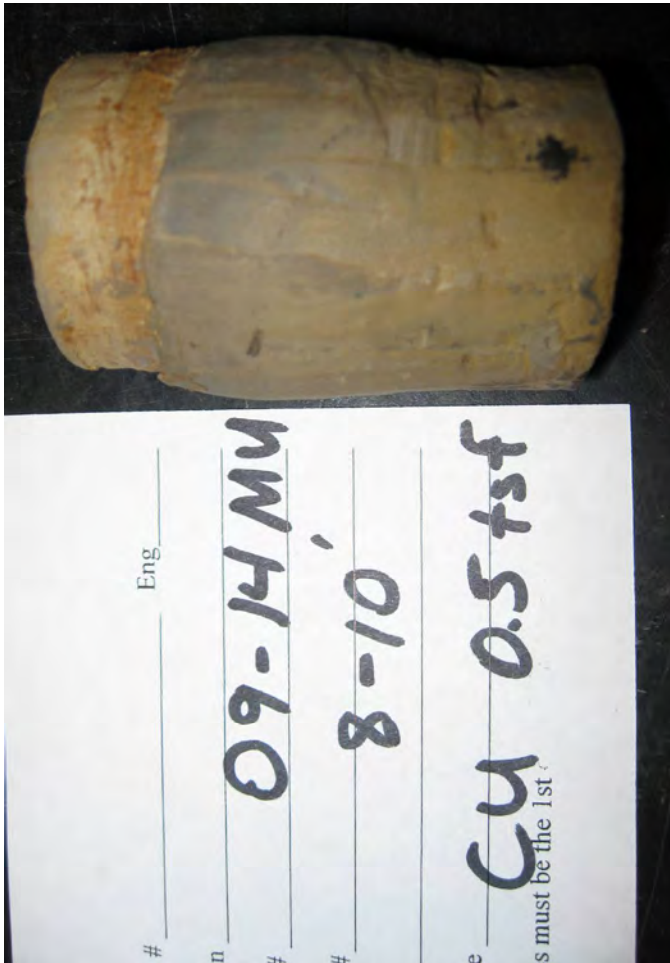
Parameters for Specimen No. 3

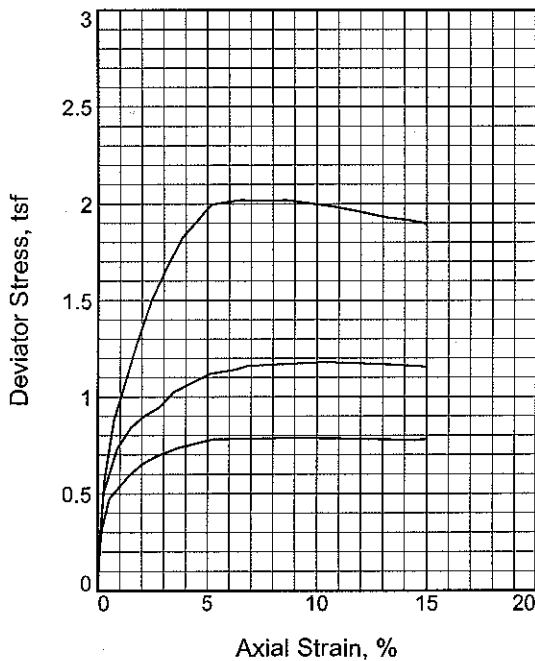
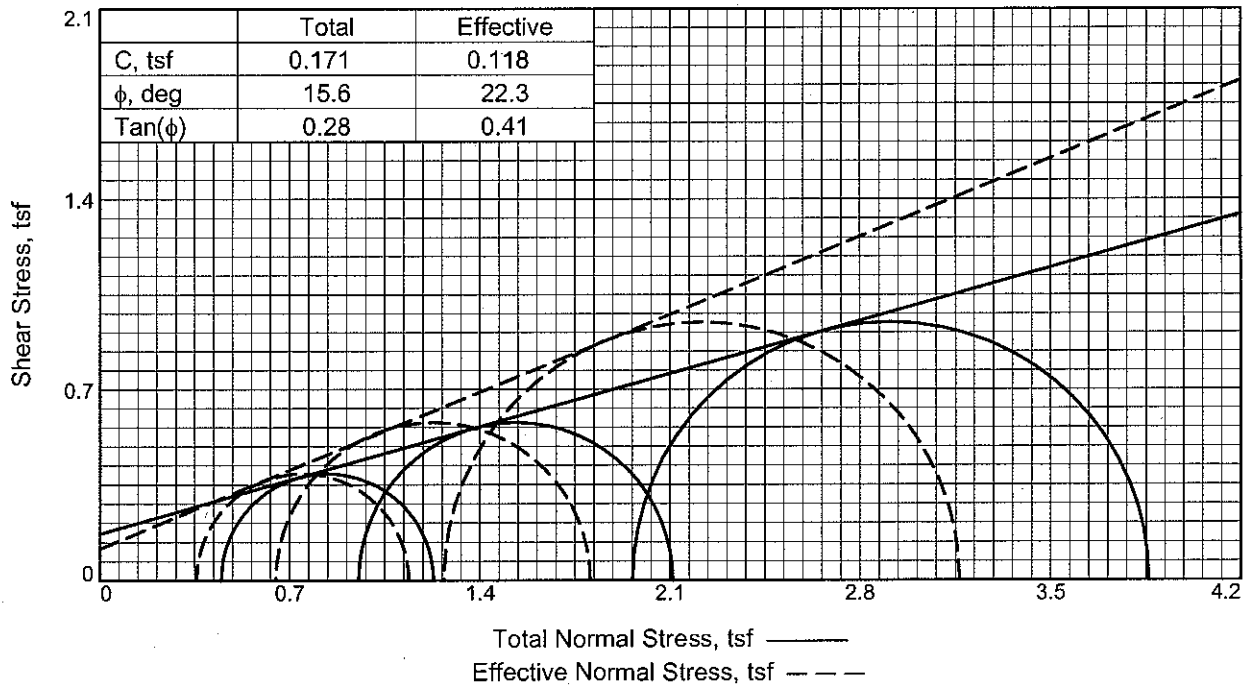
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.490			152.510
Moisture content: Dry soil+tare, gms.	74.960			120.390
Moisture content: Tare, gms.	30.240			29.810
Moisture, %	41.4	41.9	36.9	35.5
Moist specimen weight, gms.	128.2			
Diameter, in.	1.40	1.40	1.37	
Area, in. ²	1.54	1.54	1.48	
Height, in.	2.81	2.81	2.75	
Net decrease in height, in.		0.00	0.06	
Wet Density, pcf	112.9	113.2	116.6	
Dry density, pcf	79.8	79.8	85.2	
Void ratio	1.1516	1.1516	1.0156	
Saturation, %	98.9	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.146 tsf
 Consolidation back pressure = 5.139 tsf
 Consolidation effective confining stress = 2.007 tsf
 Fail. Stress = 1.906 tsf at reading no. 13
 Ult. Stress = 1.859 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0108	20.130	0.0	0.0	0.000	2.007	2.007	1.00	5.139	2.007	0.000
1	0.0128	27.120	7.0	0.1	0.341	1.826	2.167	1.19	5.320	1.996	0.170
2	0.0159	32.190	12.1	0.2	0.587	1.635	2.222	1.36	5.511	1.929	0.294
3	0.0336	44.670	24.5	0.8	1.187	1.151	2.338	2.03	5.995	1.745	0.594
4	0.0664	50.690	30.6	2.0	1.461	0.888	2.349	2.65	6.258	1.618	0.730
5	0.0924	53.710	33.6	3.0	1.590	0.814	2.404	2.95	6.332	1.609	0.795
6	0.1182	56.420	36.3	3.9	1.701	0.777	2.478	3.19	6.369	1.628	0.851
7	0.1451	57.550	37.4	4.9	1.737	0.769	2.506	3.26	6.377	1.637	0.868
8	0.1810	59.110	39.0	6.2	1.784	0.776	2.560	3.30	6.370	1.668	0.892
9	0.2091	60.510	40.4	7.2	1.828	0.783	2.611	3.33	6.363	1.697	0.914
10	0.2369	61.640	41.5	8.2	1.859	0.808	2.667	3.30	6.338	1.737	0.929
11	0.2647	62.160	42.0	9.2	1.861	0.825	2.686	3.26	6.321	1.756	0.931
12	0.2917	63.200	43.1	10.2	1.887	0.845	2.732	3.23	6.301	1.788	0.943
13	0.3207	64.150	44.0	11.3	1.906	0.869	2.775	3.19	6.277	1.822	0.953
14	0.3395	64.240	44.1	12.0	1.895	0.878	2.773	3.16	6.268	1.825	0.947
15	0.3674	64.760	44.6	13.0	1.895	0.904	2.799	3.10	6.242	1.851	0.947
16	0.3963	65.550	45.4	14.0	1.905	0.926	2.831	3.06	6.220	1.879	0.953
17	0.4240	64.970	44.8	15.0	1.859	0.941	2.800	2.98	6.205	1.870	0.929





Sample No.	1	2	3	
Initial	Water Content, %	41.9	35.8	36.9
	Dry Density, pcf	79.8	83.3	82.3
	Saturation, %	100.0	92.7	93.4
	Void Ratio	1.1514	1.0611	1.0864
	Diameter, in.	1.34	1.41	1.34
	Height, in.	2.81	2.72	2.81
At Test	Water Content, %	41.9	38.6	39.5
	Dry Density, pcf	79.8	83.3	82.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1514	1.0611	1.0864
	Diameter, in.	1.34	1.41	1.34
	Height, in.	2.81	2.72	2.81
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.45	0.96	1.97	
Back Pressure, tsf	5.39	5.37	4.82	
Cell Pressure, tsf	5.84	6.33	6.79	
Peak Deviator Stress, tsf	0.79	1.18	2.02	
Total Pore Pr., tsf	5.55	5.82	5.64	
Ultimate Deviator Stress, tsf	0.78	1.16	1.90	
Total Pore Pr., tsf	5.48	5.68	5.52	
Maj. Eff. Stress at Ultimate, tsf	1.14	1.81	3.16	
Min. Eff. Stress at Ultimate, tsf	0.36	0.65	1.27	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of Silt, brown (CH)

LL= 84 PL= 20 PI= 64

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #2

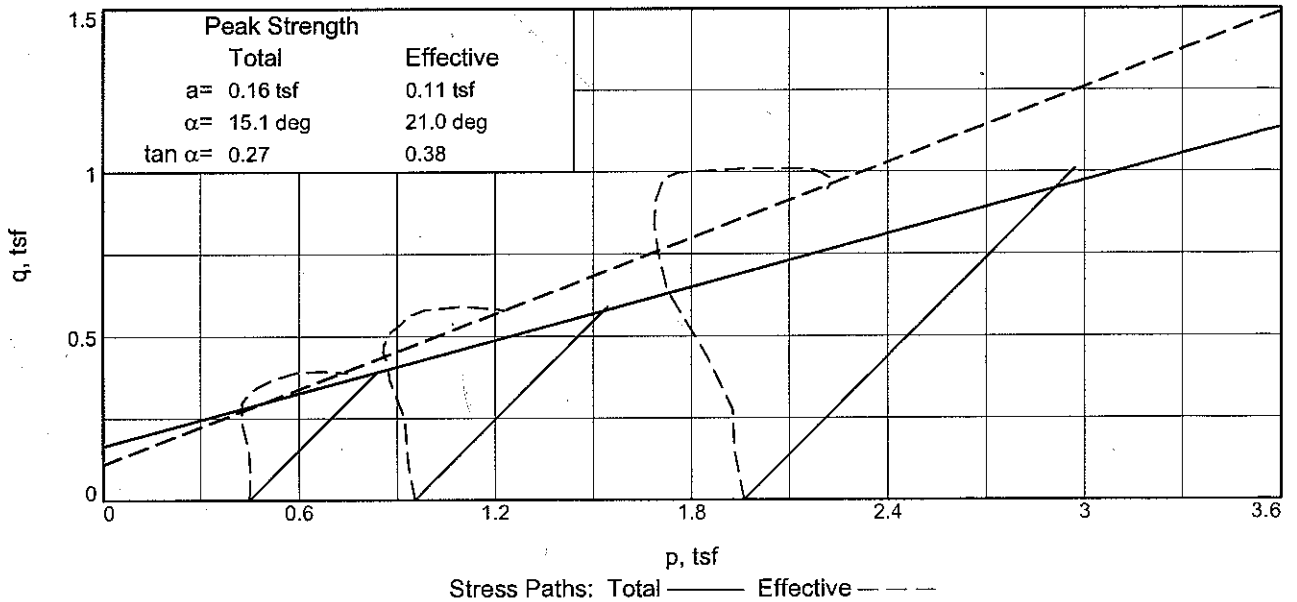
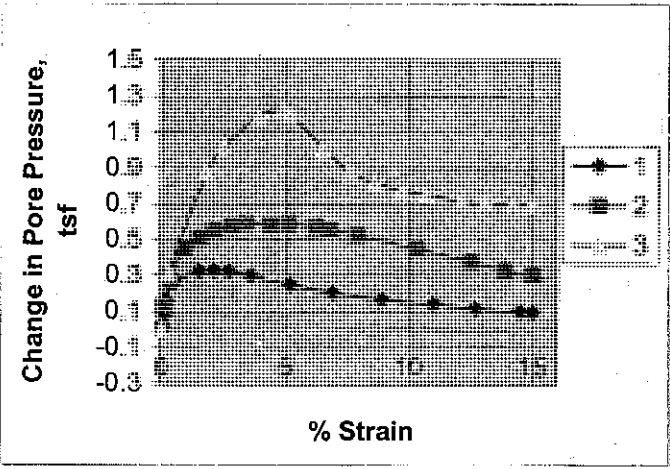
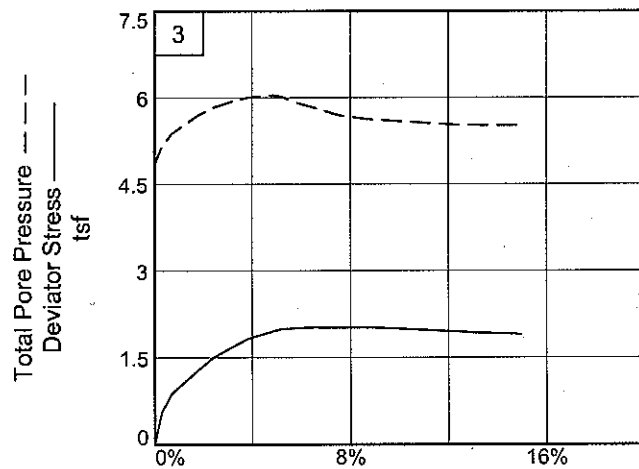
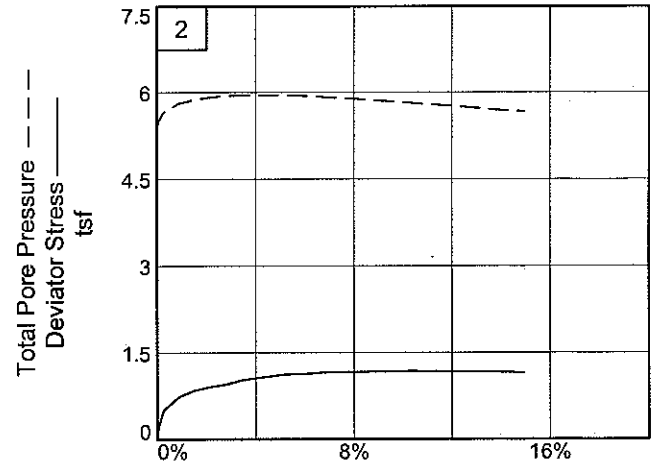
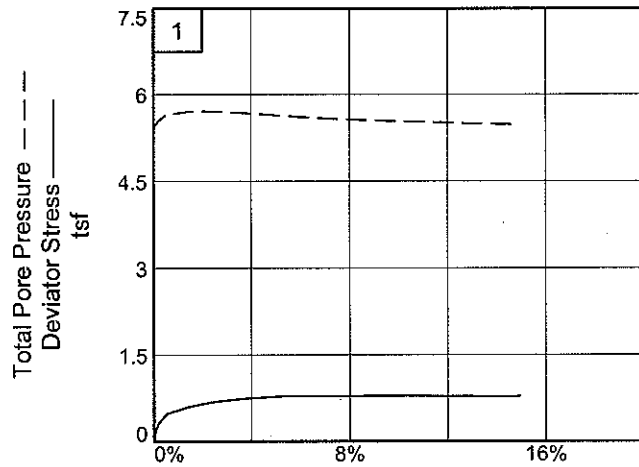
Depth: 10-12'

Sherack

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 10-12' **Sample Number:** Boring 09-23MU, #2 **Sherack**

Project No.: BL-09-03127

Figure _____

Braun Intertec

Tested By: jrs

Checked By: rs

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

8/31/2009
3:34 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 Fargo
Depth: 10-12' **Sample Number:** Boring 09-23MU, #2
Description: FAT CLAY with layers of Silt, brown (CH) Sherack
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**84 **PL=**20 **PI=**64
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	83.560			370.600
Moisture content: Dry soil+tare, gms.	67.710			336.590
Moisture content: Tare, gms.	29.860			251.660
Moisture, %	41.9	41.9	41.9	40.0
Moist specimen weight, gms.	117.9			
Diameter, in.	1.34	1.34	1.34	
Area, in. ²	1.41	1.41	1.41	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.2	113.2	113.2	
Dry density, pcf	79.8	79.8	79.8	
Void ratio	1.1514	1.1514	1.1514	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 5.836 tsf
Consolidation back pressure = 5.388 tsf
Consolidation effective confining stress = 0.448 tsf
Fail. Stress = 0.781 tsf at reading no. 14
Ult. Stress = 0.781 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0152	15.130	0.0	0.0	0.000	0.448	0.448	1.00	5.388	0.448	0.000
1	0.0172	18.490	3.4	0.1	0.171	0.365	0.536	1.47	5.471	0.451	0.086
2	0.0203	21.200	6.1	0.2	0.309	0.292	0.601	2.06	5.544	0.446	0.154
3	0.0303	24.560	9.4	0.5	0.478	0.186	0.664	3.57	5.650	0.425	0.239
4	0.0560	27.000	11.9	1.5	0.596	0.128	0.724	5.66	5.708	0.426	0.298
5	0.0731	28.250	13.1	2.1	0.655	0.122	0.777	6.37	5.714	0.450	0.328
6	0.0900	29.080	13.9	2.7	0.692	0.128	0.820	6.41	5.708	0.474	0.346
7	0.1169	30.110	15.0	3.6	0.736	0.151	0.887	5.87	5.685	0.519	0.368
8	0.1626	31.270	16.1	5.2	0.780	0.203	0.983	4.84	5.633	0.593	0.390
9	0.2086	31.640	16.5	6.9	0.784	0.245	1.029	4.20	5.591	0.637	0.392
10	0.2655	32.100	17.0	8.9	0.788	0.283	1.071	3.78	5.553	0.677	0.394
11	0.3241	32.430	17.3	11.0	0.785	0.308	1.093	3.55	5.528	0.700	0.392
12	0.3720	32.680	17.5	12.7	0.781	0.333	1.114	3.35	5.503	0.723	0.390
13	0.4210	32.920	17.8	14.5	0.776	0.353	1.129	3.20	5.483	0.741	0.388
14	0.4350	33.140	18.0	15.0	0.781	0.357	1.138	3.19	5.479	0.747	0.390

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	68.600			397.180
Moisture content: Dry soil+tare, gms.	58.660			362.440
Moisture content: Tare, gms.	30.880			271.860
Moisture, %	35.8	38.6	38.6	38.4
Moist specimen weight, gms.	125.9			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.72	2.72	2.72	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.1	115.4	115.4	
Dry density, pcf	83.3	83.3	83.3	
Void ratio	1.0611	1.0611	1.0611	
Saturation, %	92.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 6.326 tsf

Consolidation back pressure = 5.372 tsf

Consolidation effective confining stress = 0.954 tsf

Fail. Stress = 1.156 tsf at reading no. 16

Ult. Stress = 1.156 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0154	15.950	0.0	0.0	0.000	0.954	0.954	1.00	5.372	0.954	0.000
1	0.0173	20.620	4.7	0.1	0.215	0.825	1.040	1.26	5.501	0.933	0.108
2	0.0225	26.820	10.9	0.3	0.500	0.672	1.172	1.74	5.654	0.922	0.250
3	0.0392	31.980	16.0	0.9	0.733	0.511	1.244	2.43	5.815	0.877	0.366
4	0.0561	34.500	18.6	1.5	0.843	0.449	1.292	2.88	5.877	0.870	0.421
5	0.0731	35.940	20.0	2.1	0.902	0.407	1.309	3.22	5.919	0.858	0.451
6	0.0912	37.070	21.1	2.8	0.947	0.386	1.333	3.45	5.940	0.859	0.473
7	0.1090	38.970	23.0	3.4	1.025	0.368	1.393	3.79	5.958	0.880	0.512
8	0.1358	40.520	24.6	4.4	1.083	0.374	1.457	3.89	5.952	0.915	0.541
9	0.1549	41.590	25.6	5.1	1.122	0.369	1.491	4.04	5.957	0.930	0.561
10	0.1826	42.290	26.3	6.2	1.140	0.385	1.525	3.96	5.941	0.955	0.570
11	0.2014	42.960	27.0	6.8	1.160	0.404	1.564	3.87	5.922	0.984	0.580
12	0.2300	43.420	27.5	7.9	1.167	0.430	1.597	3.71	5.896	1.013	0.583
13	0.2964	44.520	28.6	10.3	1.181	0.506	1.687	3.33	5.820	1.097	0.591
14	0.3551	45.010	29.1	12.5	1.172	0.576	1.748	3.04	5.750	1.162	0.586
15	0.3931	45.280	29.3	13.9	1.164	0.627	1.791	2.86	5.699	1.209	0.582
16	0.4220	45.440	29.5	15.0	1.156	0.650	1.806	2.78	5.676	1.228	0.578

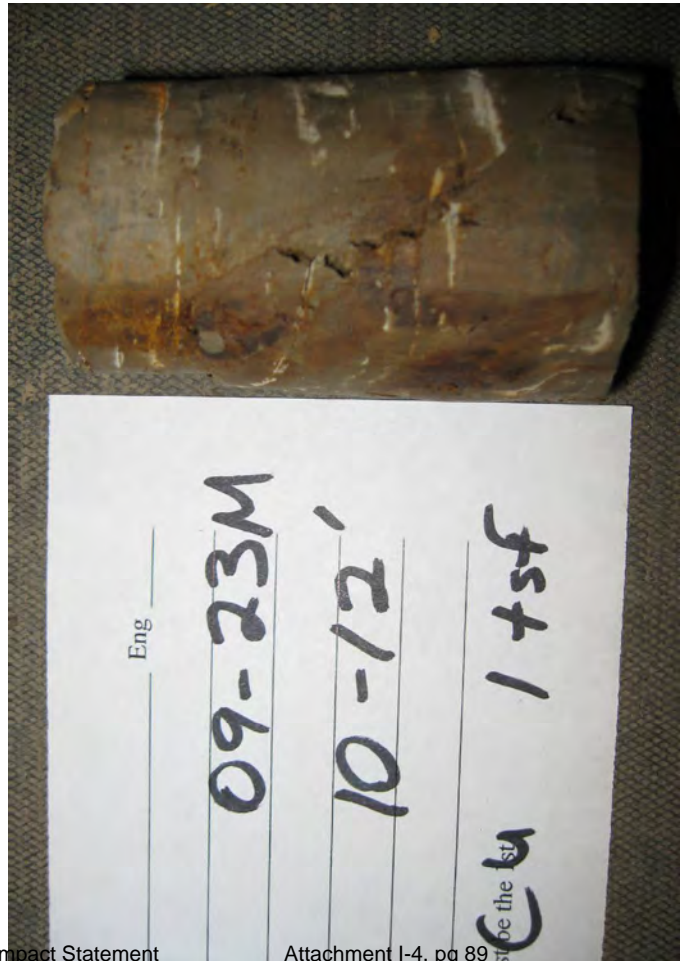
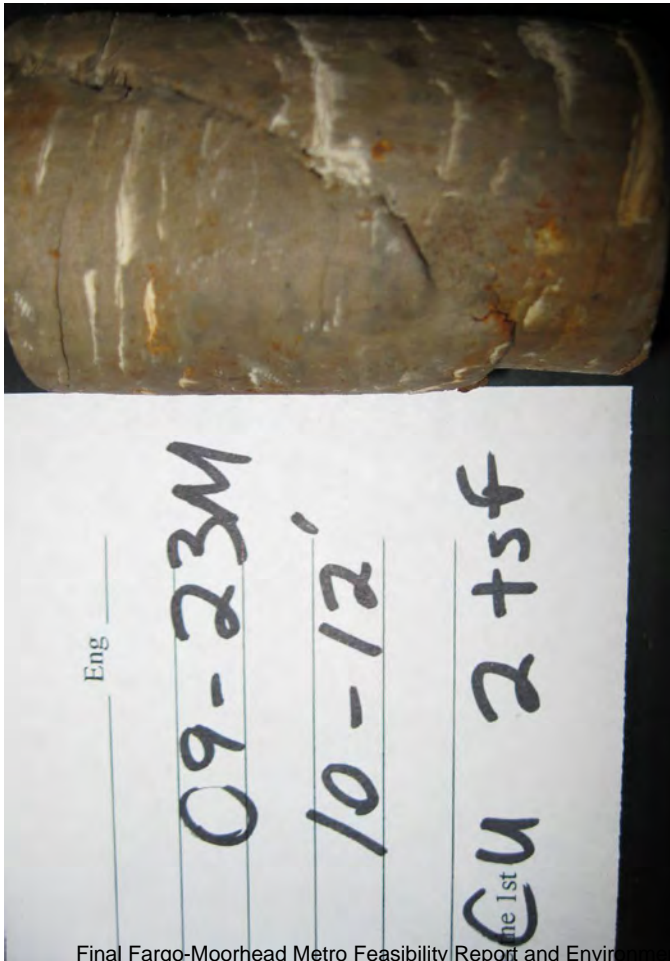
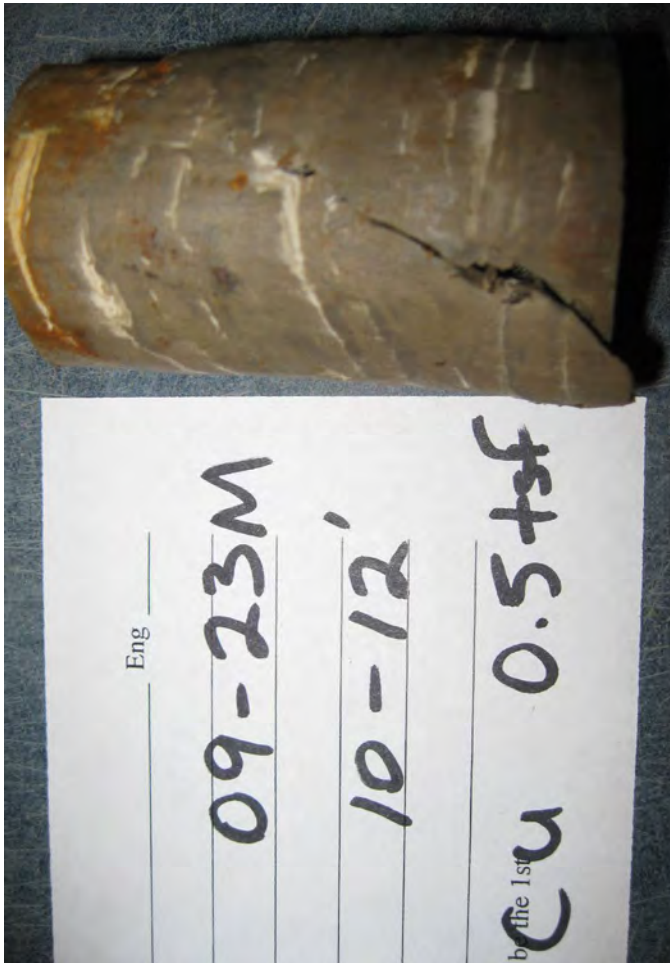
Parameters for Specimen No. 3

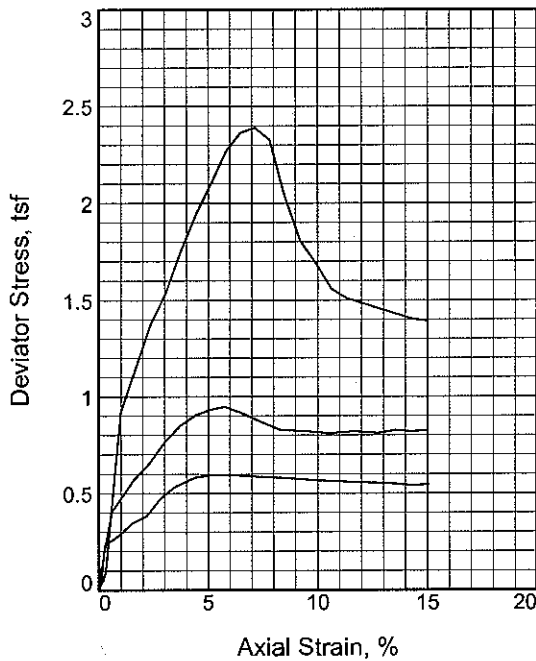
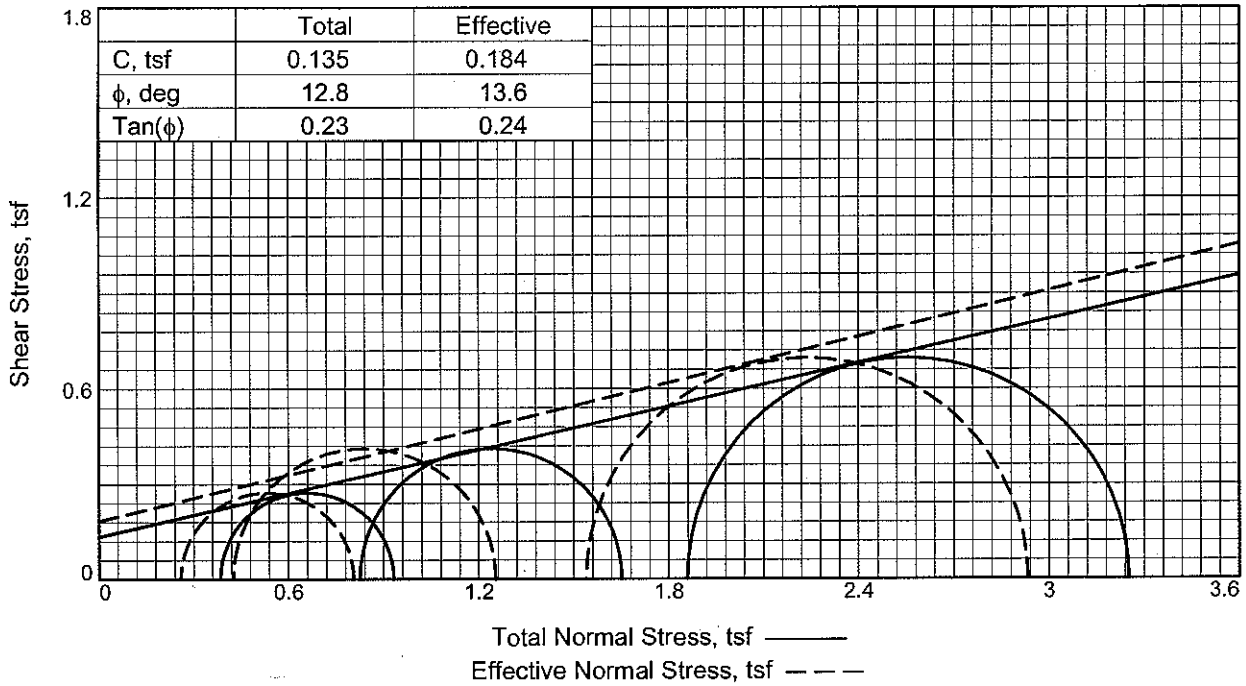
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	78.650			369.820
Moisture content: Dry soil+tare, gms.	65.780			337.920
Moisture content: Tare, gms.	30.890			253.800
Moisture, %	36.9	39.5	39.5	37.9
Moist specimen weight, gms.	116.8			
Diameter, in.	1.34	1.34	1.34	
Area, in. ²	1.40	1.40	1.40	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	112.6	114.8	114.8	
Dry density, pcf	82.3	82.3	82.3	
Void ratio	1.0864	1.0864	1.0864	
Saturation, %	93.4	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 6.786 tsf
 Consolidation back pressure = 4.824 tsf
 Consolidation effective confining stress = 1.962 tsf
 Fail. Stress = 1.898 tsf at reading no. 19
 Ult. Stress = 1.898 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0192	17.390	0.0	0.0	0.000	1.962	1.962	1.00	4.824	1.962	0.000
1	0.0236	23.400	6.0	0.2	0.308	1.778	2.086	1.17	5.008	1.932	0.154
2	0.0275	28.190	10.8	0.3	0.552	1.651	2.203	1.33	5.135	1.927	0.276
3	0.0392	34.540	17.1	0.7	0.873	1.413	2.286	1.62	5.373	1.850	0.437
4	0.0692	42.810	25.4	1.8	1.280	1.087	2.367	2.18	5.699	1.727	0.640
5	0.0883	47.540	30.1	2.5	1.508	0.945	2.453	2.60	5.841	1.699	0.754
6	0.1082	51.140	33.8	3.2	1.676	0.849	2.525	2.97	5.937	1.687	0.838
7	0.1278	54.440	37.0	3.9	1.827	0.778	2.605	3.35	6.008	1.691	0.913
8	0.1559	57.480	40.1	4.9	1.956	0.737	2.693	3.65	6.049	1.715	0.978
9	0.1648	58.420	41.0	5.2	1.995	0.762	2.757	3.62	6.024	1.760	0.998
10	0.1837	59.000	41.6	5.8	2.009	0.873	2.882	3.30	5.913	1.878	1.005
11	0.2028	59.500	42.1	6.5	2.019	0.957	2.976	3.11	5.829	1.966	1.009
12	0.2323	59.970	42.6	7.6	2.018	1.087	3.105	2.86	5.699	2.096	1.009
13	0.2616	60.490	43.1	8.6	2.020	1.149	3.169	2.76	5.637	2.159	1.010
14	0.2925	60.630	43.2	9.7	2.002	1.186	3.188	2.69	5.600	2.187	1.001
15	0.3214	60.760	43.4	10.7	1.985	1.211	3.196	2.64	5.575	2.204	0.993
16	0.3593	60.790	43.4	12.1	1.957	1.249	3.206	2.57	5.537	2.227	0.978
17	0.3891	60.700	43.3	13.1	1.929	1.261	3.190	2.53	5.525	2.226	0.965
18	0.4191	60.900	43.5	14.2	1.914	1.266	3.180	2.51	5.520	2.223	0.957
19	0.4400	60.900	43.5	15.0	1.898	1.267	3.165	2.50	5.519	2.216	0.949





Sample No.	1	2	3	
Initial	Water Content, %	37.5	37.5	38.9
	Dry Density, pcf	83.3	82.2	81.9
	Saturation, %	97.2	94.8	97.5
	Void Ratio	1.0618	1.0878	1.0966
	Diameter, in.	1.40	1.36	1.40
	Height, in.	2.80	2.67	2.80
At Test	Water Content, %	38.6	39.6	39.9
	Dry Density, pcf	83.3	82.2	81.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0618	1.0878	1.0966
	Diameter, in.	1.40	1.36	1.40
	Height, in.	2.80	2.67	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.39	0.83	1.86	
Back Pressure, tsf	5.59	5.64	5.03	
Cell Pressure, tsf	5.98	6.47	6.89	
Peak Deviator Stress, tsf	0.60	0.95	2.39	
Total Pore Pr., tsf	5.84	6.20	6.12	
Ultimate Deviator Stress, tsf	0.55	0.83	1.39	
Total Pore Pr., tsf	5.72	6.04	5.35	
Maj. Eff. Stress at Ultimate, tsf	0.81	1.25	2.93	
Min. Eff. Stress at Ultimate, tsf	0.26	0.43	1.54	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of Silt, brown (CH)

LL= 82 PL= 20 PI= 62

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #1

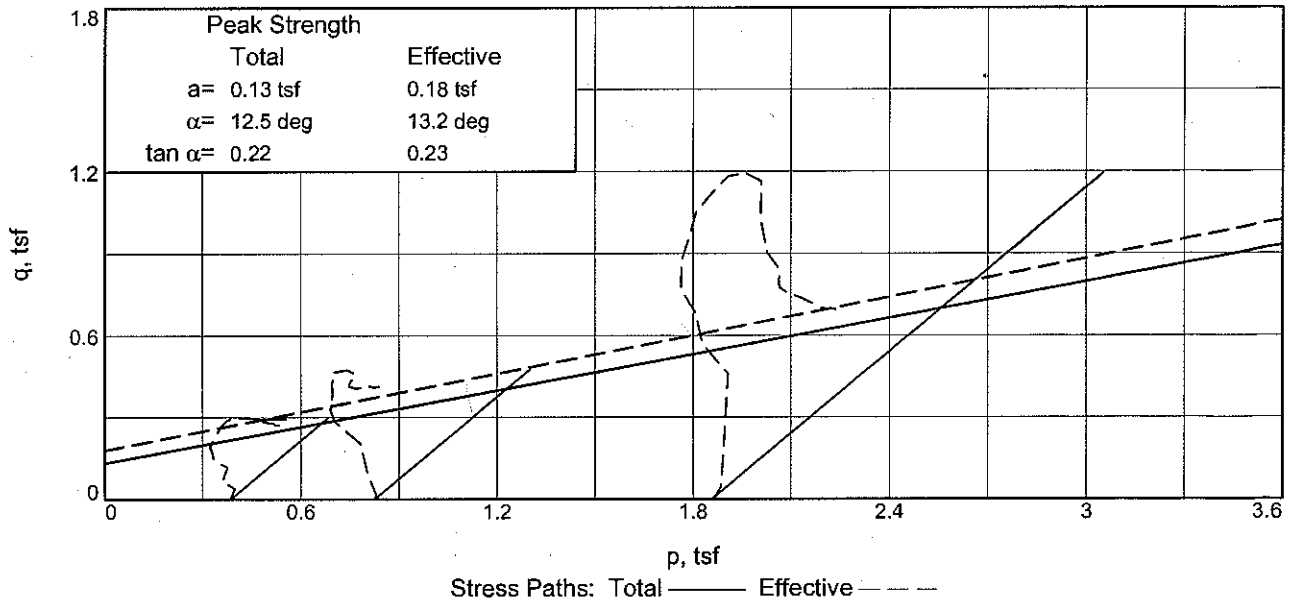
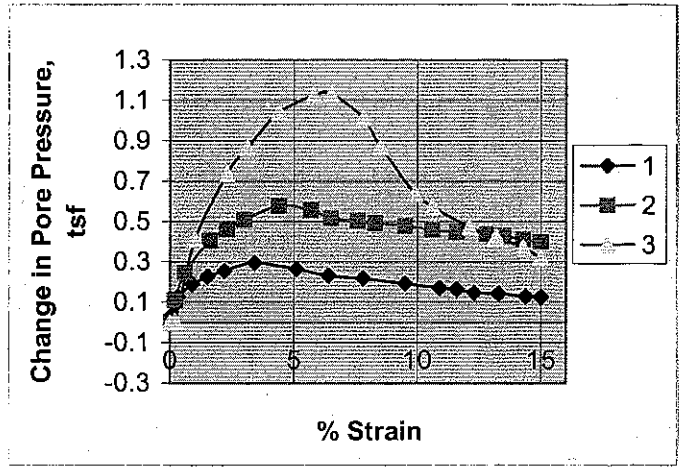
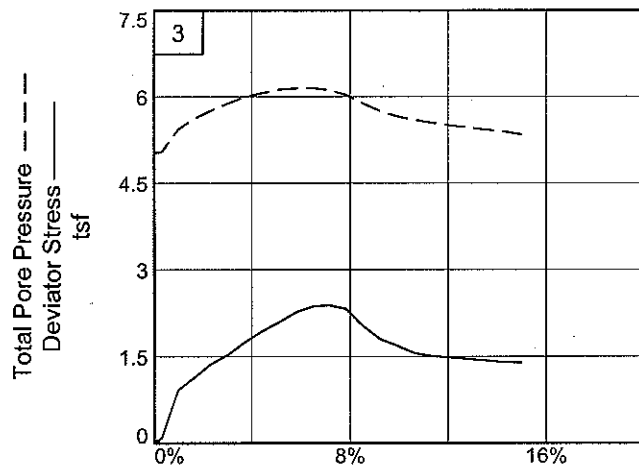
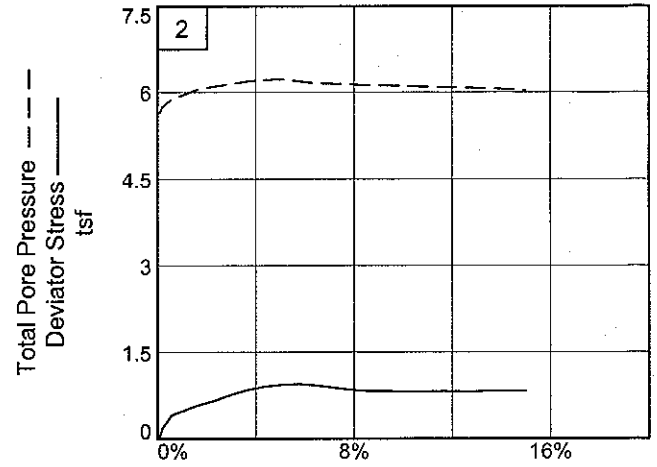
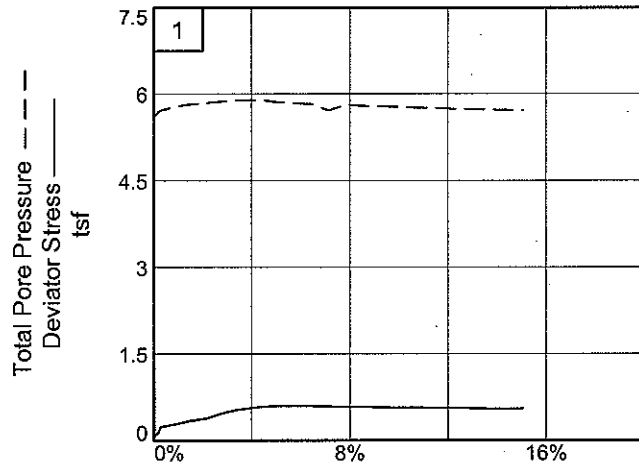
Depth: 8-10'

Sherack

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Depth: 8-10' **Sample Number:** Boring 09-25MU **Moorhead**

Sherack

Project No.: BL-09-03127

Figure _____

Braun Intertec

Tested By: jrs

Checked By: rs

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

8/31/2009

2:13 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 8-10' **Sample Number:** Boring 09-25MU
Description: FAT CLAY with layers of Silt, brown (CH) **Sherack**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were satuated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=82** **PL=20** **PI=62**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.100			161.930
Moisture content: Dry soil+tare, gms.	90.560			124.690
Moisture content: Tare, gms.	30.510			31.250
Moisture, %	37.5	38.6	38.6	39.9
Moist specimen weight, gms.	128.9			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.5	115.4	115.4	
Dry density, pcf	83.3	83.3	83.3	
Void ratio	1.0618	1.0618	1.0618	
Saturation, %	97.2	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 5.980 tsf
Consolidation back pressure = 5.595 tsf
Consolidation effective confining stress = 0.385 tsf
Fail. Stress = 0.546 tsf at reading no. 24
Ult. Stress = 0.546 tsf at reading no. 24

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0224	16.690	0.0	0.0	0.000	0.385	0.385	1.00	5.595	0.385	0.000
1	0.0232	18.360	1.7	0.0	0.079	0.360	0.439	1.22	5.620	0.399	0.039
2	0.0272	19.490	2.8	0.2	0.131	0.295	0.426	1.45	5.685	0.361	0.066
3	0.0303	21.690	5.0	0.3	0.235	0.259	0.494	1.91	5.721	0.376	0.117
4	0.0473	22.700	6.0	0.9	0.280	0.195	0.475	2.44	5.785	0.335	0.140
5	0.0651	24.130	7.4	1.5	0.345	0.157	0.502	3.20	5.823	0.329	0.172
6	0.0833	25.020	8.3	2.2	0.383	0.131	0.514	3.93	5.849	0.323	0.192
7	0.1011	27.030	10.3	2.8	0.473	0.105	0.578	5.50	5.875	0.341	0.236
8	0.1190	28.440	11.8	3.4	0.534	0.090	0.624	6.93	5.890	0.357	0.267
9	0.1458	29.630	12.9	4.4	0.582	0.085	0.667	7.85	5.895	0.376	0.291
10	0.1647	30.000	13.3	5.1	0.594	0.121	0.715	5.91	5.859	0.418	0.297
11	0.1838	30.150	13.5	5.8	0.597	0.141	0.738	5.23	5.839	0.439	0.298
12	0.2024	30.170	13.5	6.4	0.593	0.152	0.745	4.90	5.828	0.449	0.297
13	0.2224	30.160	13.5	7.1	0.588	0.261	0.849	3.25	5.719	0.555	0.294
14	0.2413	30.150	13.5	7.8	0.584	0.167	0.751	4.50	5.813	0.459	0.292
15	0.2694	30.170	13.5	8.8	0.578	0.187	0.765	4.09	5.793	0.476	0.289
16	0.2885	30.120	13.4	9.5	0.572	0.192	0.764	3.98	5.788	0.478	0.286
17	0.3083	30.090	13.4	10.2	0.566	0.204	0.770	3.77	5.776	0.487	0.283
18	0.3271	30.160	13.5	10.9	0.565	0.215	0.780	3.63	5.765	0.497	0.282
19	0.3472	30.070	13.4	11.6	0.556	0.221	0.777	3.52	5.759	0.499	0.278
20	0.3670	30.180	13.5	12.3	0.557	0.239	0.796	3.33	5.741	0.517	0.278
21	0.3961	30.190	13.5	13.3	0.550	0.243	0.793	3.26	5.737	0.518	0.275
22	0.4250	30.120	13.4	14.4	0.541	0.256	0.797	3.11	5.724	0.526	0.270
23	0.4352	30.250	13.6	14.7	0.544	0.262	0.806	3.08	5.718	0.534	0.272
24	0.4441	30.360	13.7	15.0	0.546	0.259	0.805	3.11	5.721	0.532	0.273

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	103.210			147.560
Moisture content: Dry soil+tare, gms.	83.420			113.540
Moisture content: Tare, gms.	30.670			29.980
Moisture, %	37.5	39.6	39.6	40.7
Moist specimen weight, gms.	115.9			
Diameter, in.	1.36	1.36	1.36	
Area, in. ²	1.46	1.46	1.46	
Height, in.	2.67	2.67	2.67	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.1	114.8	114.8	
Dry density, pcf	82.2	82.2	82.2	
Void ratio	1.0878	1.0878	1.0878	
Saturation, %	94.8	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 6.466 tsf
 Consolidation back pressure = 5.641 tsf
 Consolidation effective confining stress = 0.825 tsf
 Fail. Stress = 0.827 tsf at reading no. 20
 Ult. Stress = 0.827 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0512	17.050	0.0	0.0	0.000	0.825	0.825	1.00	5.641	0.825	0.000
1	0.0541	17.780	0.7	0.1	0.036	0.812	0.848	1.04	5.654	0.830	0.018
2	0.0570	20.710	3.7	0.2	0.180	0.715	0.895	1.25	5.751	0.805	0.090
3	0.0671	25.380	8.3	0.6	0.407	0.578	0.985	1.70	5.888	0.782	0.204
4	0.0941	28.830	11.8	1.6	0.570	0.419	0.989	2.36	6.047	0.704	0.285
5	0.1120	30.630	13.6	2.3	0.653	0.364	1.017	2.79	6.102	0.690	0.326
6	0.1309	33.000	15.9	3.0	0.761	0.316	1.077	3.41	6.150	0.697	0.381
7	0.1500	34.940	17.9	3.7	0.848	0.271	1.119	4.13	6.195	0.695	0.424
8	0.1689	36.300	19.2	4.4	0.905	0.248	1.153	4.65	6.218	0.701	0.453
9	0.1866	37.000	19.9	5.1	0.932	0.233	1.165	5.00	6.233	0.699	0.466
10	0.2046	37.500	20.4	5.7	0.948	0.268	1.216	4.54	6.198	0.742	0.474
11	0.2236	37.000	19.9	6.5	0.918	0.308	1.226	3.98	6.158	0.767	0.459
12	0.2536	36.000	18.9	7.6	0.862	0.321	1.183	3.68	6.145	0.752	0.431
13	0.2734	35.400	18.3	8.3	0.828	0.333	1.161	3.49	6.133	0.747	0.414
14	0.3034	35.490	18.4	9.5	0.822	0.346	1.168	3.37	6.120	0.757	0.411
15	0.3331	35.470	18.4	10.6	0.811	0.365	1.176	3.22	6.101	0.770	0.405
16	0.3620	35.900	18.8	11.6	0.819	0.377	1.196	3.17	6.089	0.787	0.410
17	0.3921	35.950	18.9	12.8	0.811	0.387	1.198	3.10	6.079	0.793	0.406
18	0.4120	36.500	19.4	13.5	0.828	0.397	1.225	3.08	6.069	0.811	0.414
19	0.4328	36.520	19.5	14.3	0.821	0.413	1.234	2.99	6.053	0.823	0.410
20	0.4520	36.820	19.8	15.0	0.827	0.426	1.253	2.94	6.040	0.839	0.413

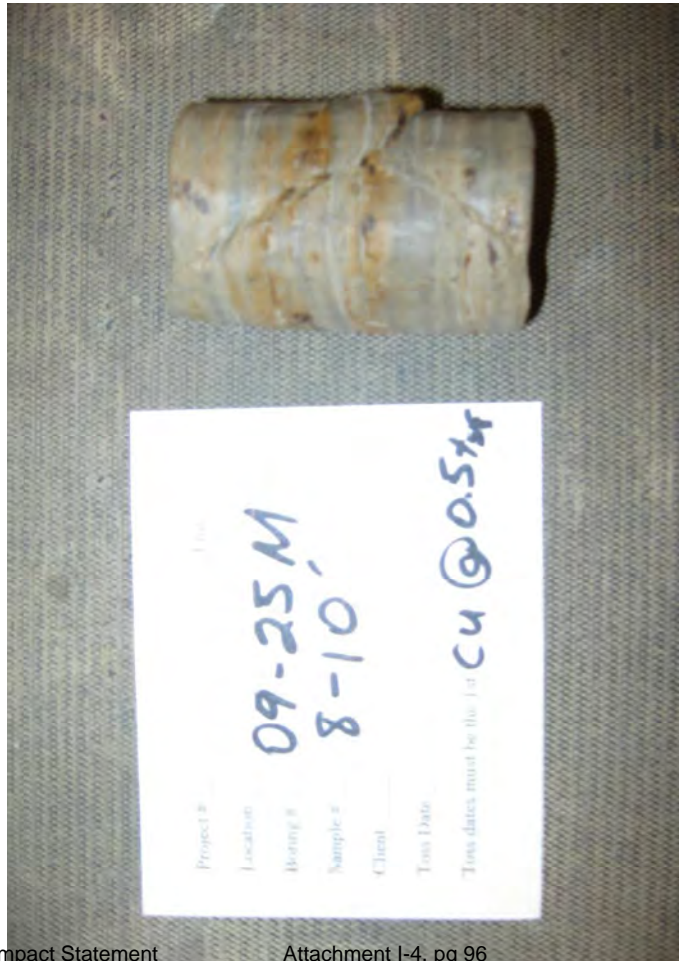
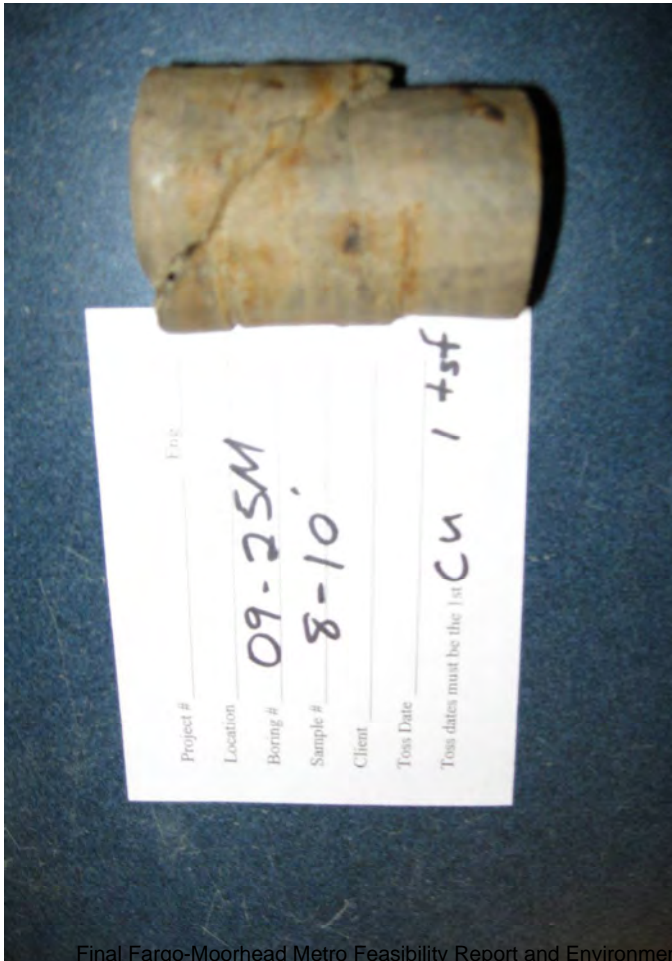
Parameters for Specimen No. 3

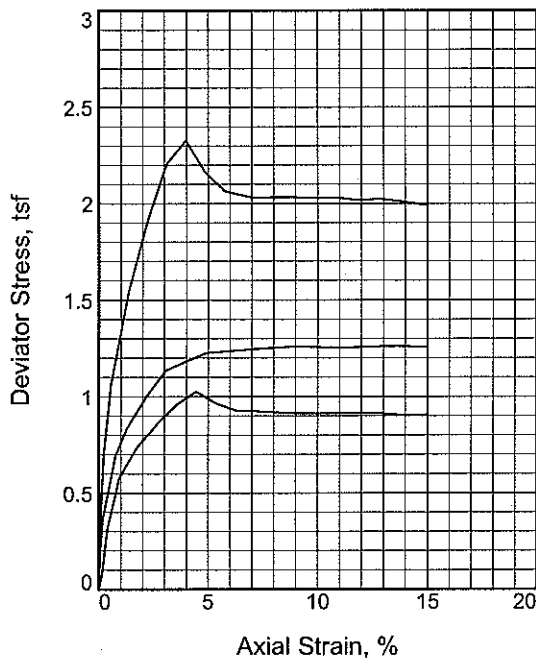
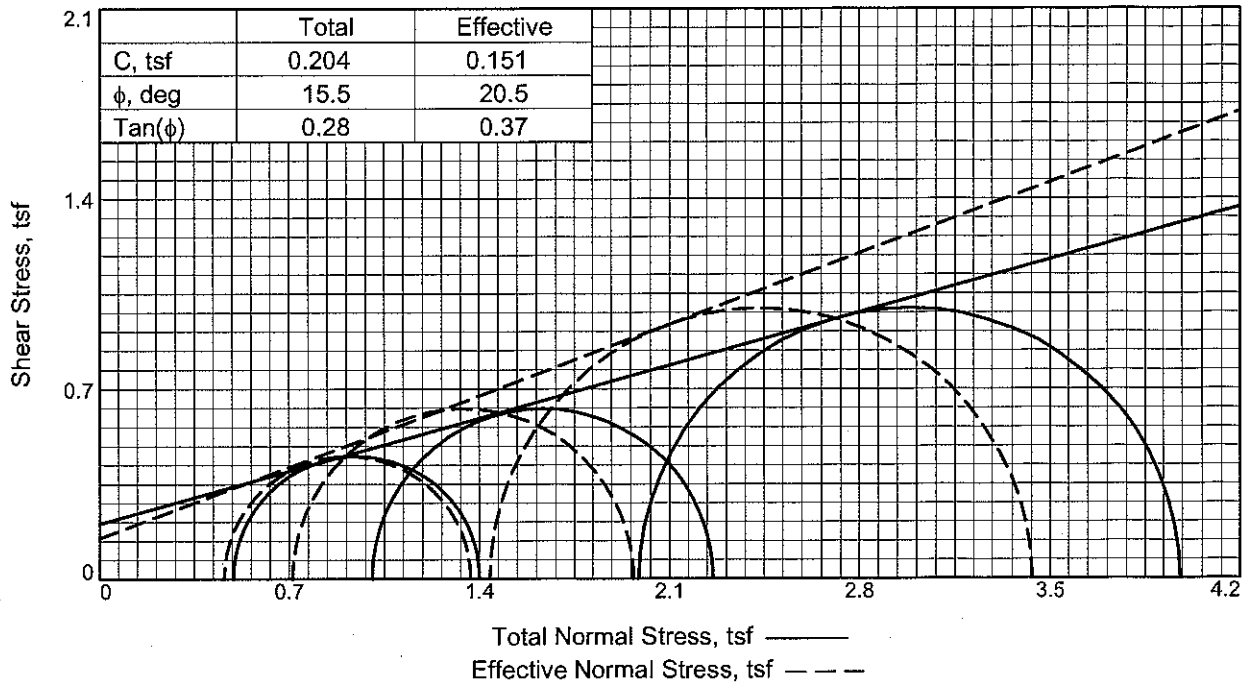
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	121.550			158.250
Moisture content: Dry soil+tare, gms.	96.280			124.380
Moisture content: Tare, gms.	31.260			30.290
Moisture, %	38.9	39.9	39.9	36.0
Moist specimen weight, gms.	129.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.7	114.5	114.5	
Dry density, pcf	81.9	81.9	81.9	
Void ratio	1.0966	1.0966	1.0966	
Saturation, %	97.5	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 6.886 tsf
 Consolidation back pressure = 5.028 tsf
 Consolidation effective confining stress = 1.858 tsf
 Fail. Stress = 1.394 tsf at reading no. 23
 Ult. Stress = 1.394 tsf at reading no. 23

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.1100	18.850	0.0	0.0	0.000	1.858	1.858	1.00	5.028	1.858	0.000
1	0.1108	19.770	0.9	0.0	0.043	1.856	1.899	1.02	5.030	1.877	0.021
2	0.1151	19.890	1.0	0.2	0.048	1.851	1.899	1.03	5.035	1.875	0.024
3	0.1187	20.780	1.9	0.3	0.090	1.842	1.932	1.05	5.044	1.887	0.045
4	0.1379	38.750	19.9	1.0	0.919	1.448	2.367	1.63	5.438	1.907	0.459
5	0.1566	43.730	24.9	1.7	1.141	1.258	2.399	1.91	5.628	1.829	0.571
6	0.1757	48.920	30.1	2.3	1.370	1.122	2.492	2.22	5.764	1.807	0.685
7	0.1956	52.880	34.0	3.1	1.539	0.995	2.534	2.55	5.891	1.764	0.769
8	0.2146	57.800	38.9	3.7	1.749	0.891	2.640	2.96	5.995	1.765	0.874
9	0.2344	62.470	43.6	4.4	1.944	0.819	2.763	3.37	6.067	1.791	0.972
10	0.2545	66.470	47.6	5.2	2.106	0.757	2.863	3.78	6.129	1.810	1.053
11	0.2733	70.520	51.7	5.8	2.269	0.734	3.003	4.09	6.152	1.869	1.135
12	0.2915	73.070	54.2	6.5	2.365	0.726	3.091	4.26	6.160	1.908	1.182
13	0.3102	74.040	55.2	7.1	2.390	0.765	3.155	4.12	6.121	1.960	1.195
14	0.3293	73.000	54.1	7.8	2.328	0.845	3.173	3.75	6.041	2.009	1.164
15	0.3482	66.680	47.8	8.5	2.041	0.988	3.029	3.07	5.898	2.009	1.021
16	0.3682	61.460	42.6	9.2	1.804	1.126	2.930	2.60	5.760	2.028	0.902
17	0.3881	59.050	40.2	9.9	1.689	1.221	2.910	2.38	5.665	2.065	0.844
18	0.4079	56.270	37.4	10.6	1.560	1.284	2.844	2.21	5.602	2.064	0.780
19	0.4272	55.390	36.5	11.3	1.511	1.335	2.846	2.13	5.551	2.091	0.756
20	0.4500	55.000	36.1	12.1	1.481	1.386	2.867	2.07	5.500	2.127	0.741
21	0.4800	54.500	35.6	13.2	1.443	1.437	2.880	2.00	5.449	2.159	0.722
22	0.5100	54.000	35.1	14.3	1.405	1.488	2.893	1.94	5.398	2.191	0.703
23	0.5300	54.000	35.1	15.0	1.394	1.539	2.933	1.91	5.347	2.236	0.697





Sample No.		1	2	3
Initial	Water Content, %	35.1	33.8	32.5
	Dry Density, pcf	85.1	88.0	89.6
	Saturation, %	95.2	98.1	97.9
	Void Ratio	1.0090	0.9433	0.9079
	Diameter, in.	1.42	1.40	1.40
	Height, in.	2.81	2.81	2.80
At Test	Water Content, %	36.9	33.3	31.3
	Dry Density, pcf	85.1	89.4	92.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0090	0.9122	0.8571
	Diameter, in.	1.42	1.39	1.39
	Height, in.	2.81	2.79	2.78
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.50	1.01	1.99
Back Pressure, tsf		6.64	6.13	5.14
Cell Pressure, tsf		7.14	7.14	7.13
Peak Deviator Stress, tsf		1.03	1.26	2.33
Total Pore Pr., tsf		6.89	6.44	6.06
Ultimate Deviator Stress, tsf		0.91	1.26	1.99
Total Pore Pr., tsf		6.68	6.43	5.69
Maj. Eff. Stress at Ultimate, tsf		1.27	1.96	3.40
Min. Eff. Stress at Ultimate, tsf		0.25	0.70	1.08

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of silt, brown (CH)

LL= 67 PL= 17 PI= 50

Assumed Specific Gravity= 2.738

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

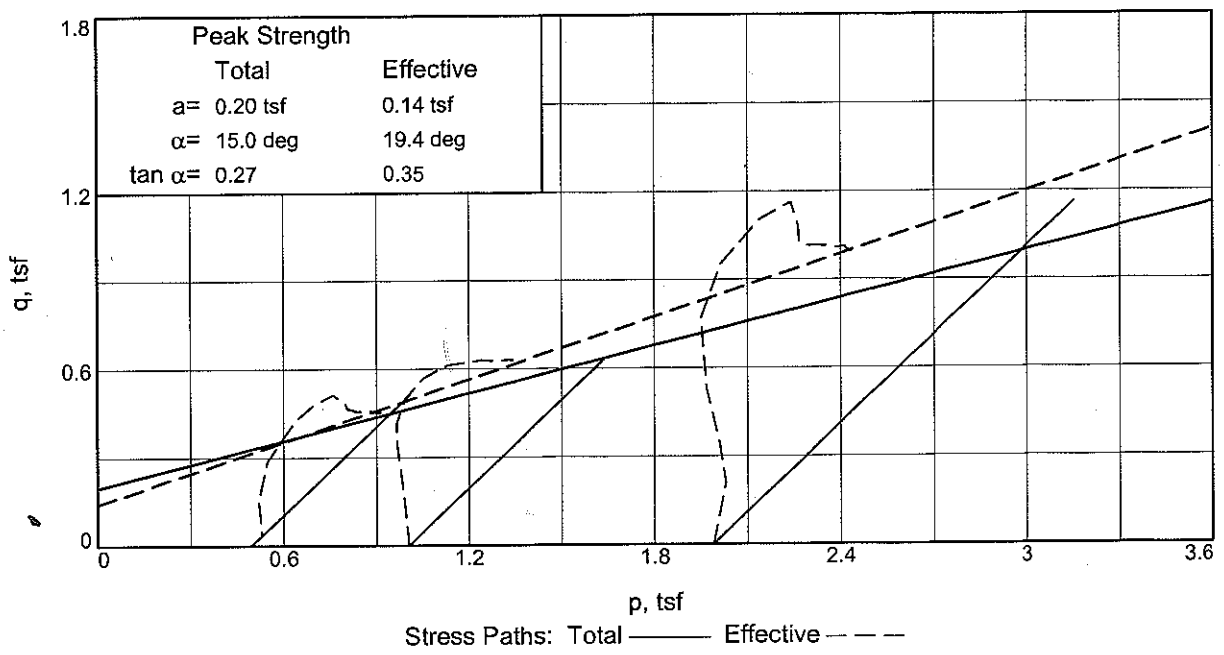
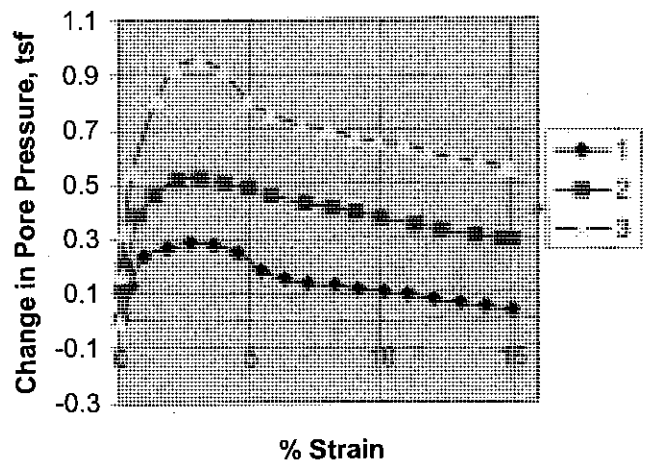
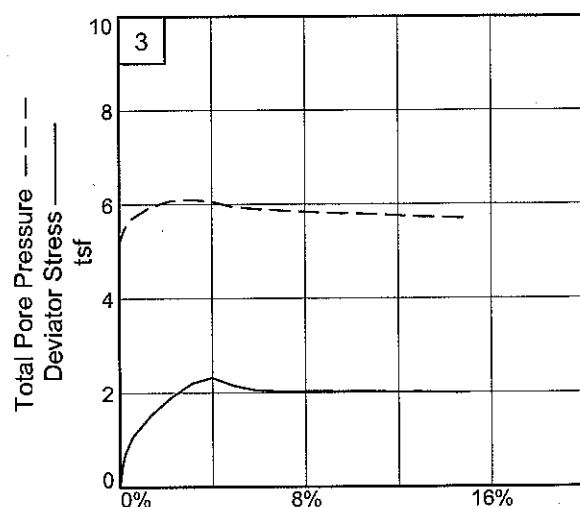
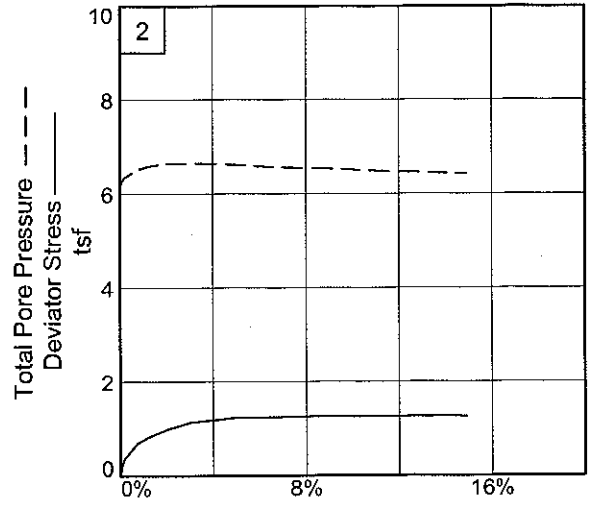
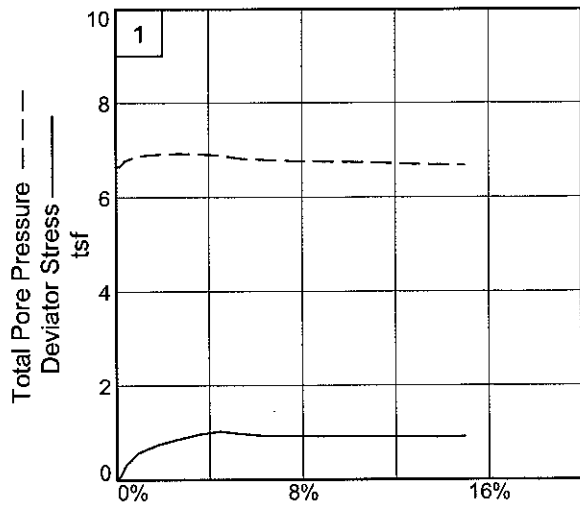
Location: SE-F-15, Fargo, Sherack Formation

Sample Number: Boring 09-26MU, #1 **Depth:** 8-10'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Location: SE-F-15, Fargo, Sherack Formation

Depth: 8-10'

Sample Number: Boring 09-26MU, #1

Project No.: D-09-0127 Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/9/2009
12:55 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Sherack Formation
Depth: 8-10' **Sample Number:** Boring 09-26MU, #1
Description: FAT CLAY with layers of silt, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.738 **LL**=67 **PL**=17 **PI**=50
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.140			164.220
Moisture content: Dry soil+tare, gms.	98.330			128.010
Moisture content: Tare, gms.	30.480			30.410
Moisture, %	35.1	36.9	36.9	37.1
Moist specimen weight, gms.	133.5			
Diameter, in.	1.42	1.42	1.42	
Area, in. ²	1.58	1.58	1.58	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.9	116.4	116.4	
Dry density, pcf	85.1	85.1	85.1	
Void ratio	1.0090	1.0090	1.0090	
Saturation, %	95.2	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.645 tsf
Consolidation effective confining stress = 0.495 tsf
Peak Stress = 1.026 tsf at reading no. 7
Ult. Stress = 0.906 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	-0.0009	17.330	0.0	0.0	0.000	0.495	0.495	1.00	6.645	0.495	0.000
1	0.0030	18.910	1.6	0.1	0.072	0.495	0.567	1.15	6.645	0.531	0.036
2	0.0098	24.100	6.8	0.4	0.308	0.366	0.674	1.84	6.774	0.520	0.154
3	0.0248	30.050	12.7	0.9	0.575	0.260	0.835	3.21	6.880	0.548	0.288
4	0.0492	33.930	16.6	1.8	0.744	0.230	0.974	4.24	6.910	0.602	0.372
5	0.0746	36.740	19.4	2.7	0.862	0.211	1.073	5.09	6.929	0.642	0.431
6	0.0994	39.150	21.8	3.6	0.961	0.218	1.179	5.41	6.922	0.698	0.480
7	0.1243	40.860	23.5	4.5	1.026	0.247	1.273	5.16	6.893	0.760	0.513
8	0.1494	39.700	22.4	5.4	0.967	0.316	1.283	4.06	6.824	0.799	0.483
9	0.1752	39.030	21.7	6.3	0.929	0.343	1.272	3.71	6.797	0.807	0.464
10	0.2019	39.170	21.8	7.2	0.925	0.361	1.286	3.56	6.779	0.824	0.463
11	0.2289	39.250	21.9	8.2	0.919	0.367	1.286	3.50	6.773	0.826	0.459
12	0.2558	39.330	22.0	9.1	0.913	0.384	1.297	3.38	6.756	0.840	0.456
13	0.2817	39.560	22.2	10.1	0.913	0.390	1.303	3.34	6.750	0.846	0.456
14	0.3086	39.850	22.5	11.0	0.915	0.401	1.316	3.28	6.739	0.858	0.457
15	0.3368	40.150	22.8	12.0	0.916	0.421	1.337	3.18	6.719	0.879	0.458
16	0.3635	40.310	23.0	13.0	0.913	0.435	1.348	3.10	6.705	0.891	0.456
17	0.3905	40.340	23.0	14.0	0.904	0.447	1.351	3.02	6.693	0.899	0.452
18	0.4190	40.670	23.3	15.0	0.906	0.461	1.367	2.97	6.679	0.914	0.453

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	102.110			163.700
Moisture content: Dry soil+tare, gms.	83.910			131.170
Moisture content: Tare, gms.	30.040			30.420
Moisture, %	33.8	34.5	33.3	32.3
Moist specimen weight, gms.	133.9			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.53	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	117.7	118.3	119.2	
Dry density, pcf	88.0	88.0	89.4	
Void ratio	0.9433	0.9433	0.9122	
Saturation, %	98.1	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.135 tsf
 Consolidation effective confining stress = 1.005 tsf
 Peak Stress = 1.263 tsf at reading no. 16
 Ult. Stress = 1.257 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0070	18.730	0.0	0.0	0.000	1.005	1.005	1.00	6.135	1.005	0.000
1	0.0091	23.250	4.5	0.1	0.213	0.888	1.101	1.24	6.252	0.994	0.106
2	0.0118	26.420	7.7	0.2	0.362	0.806	1.168	1.45	6.334	0.987	0.181
3	0.0279	33.530	14.8	0.7	0.692	0.620	1.312	2.12	6.520	0.966	0.346
4	0.0428	36.680	17.9	1.3	0.835	0.548	1.383	2.52	6.592	0.966	0.418
5	0.0677	40.490	21.8	2.2	1.004	0.491	1.495	3.04	6.649	0.993	0.502
6	0.0927	43.570	24.8	3.1	1.135	0.483	1.618	3.35	6.657	1.051	0.568
7	0.1188	44.890	26.2	4.0	1.184	0.499	1.683	3.37	6.641	1.091	0.592
8	0.1446	46.110	27.4	4.9	1.227	0.519	1.746	3.36	6.621	1.133	0.614
9	0.1695	46.560	27.8	5.8	1.236	0.549	1.785	3.25	6.591	1.167	0.618
10	0.2053	47.210	28.5	7.1	1.247	0.575	1.822	3.17	6.565	1.199	0.624
11	0.2322	47.650	28.9	8.1	1.253	0.595	1.848	3.11	6.545	1.222	0.627
12	0.2591	48.120	29.4	9.0	1.260	0.610	1.870	3.07	6.530	1.240	0.630
13	0.2861	48.350	29.6	10.0	1.257	0.630	1.887	2.99	6.510	1.258	0.628
14	0.3228	48.730	30.0	11.3	1.254	0.656	1.910	2.91	6.484	1.283	0.627
15	0.3498	49.150	30.4	12.3	1.258	0.676	1.934	2.86	6.464	1.305	0.629
16	0.3878	49.740	31.0	13.6	1.263	0.698	1.961	2.81	6.442	1.329	0.631
17	0.4152	50.010	31.3	14.6	1.259	0.712	1.971	2.77	6.428	1.342	0.630
18	0.4246	50.080	31.3	15.0	1.257	0.713	1.970	2.76	6.427	1.341	0.628

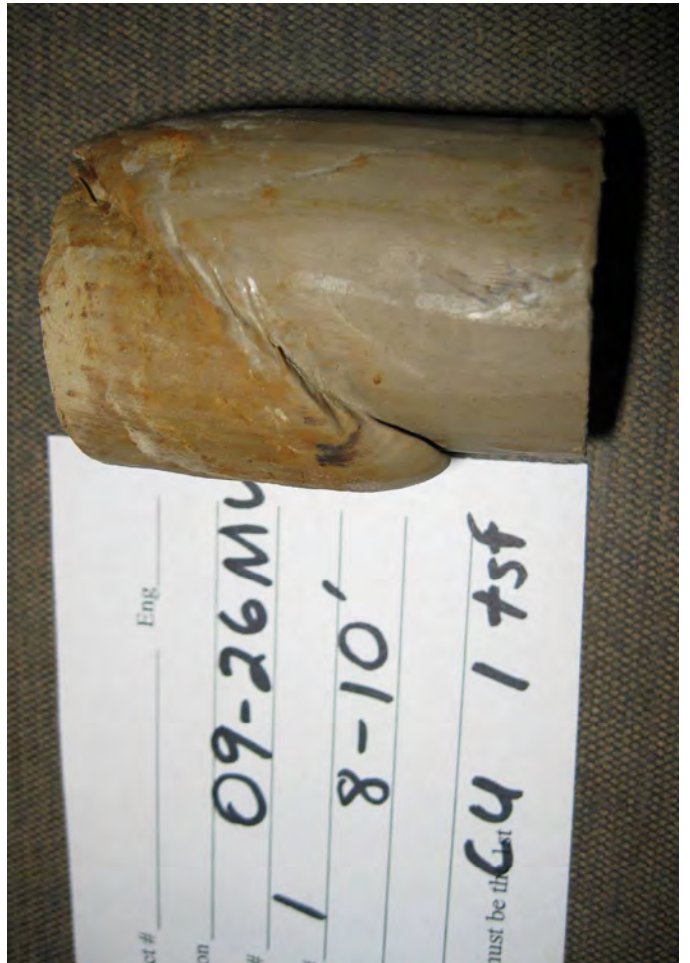
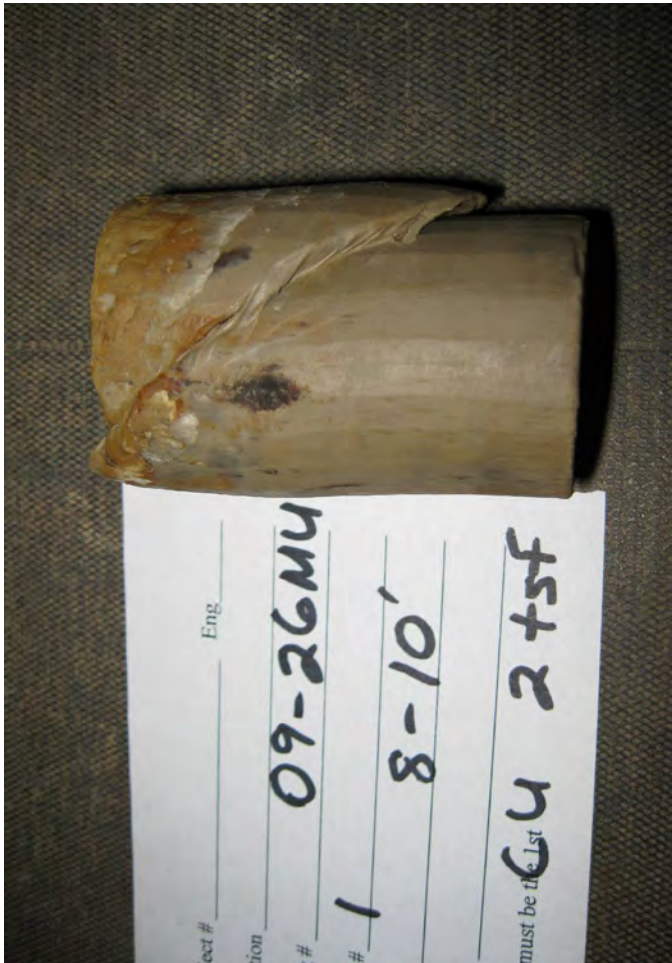
Parameters for Specimen No. 3

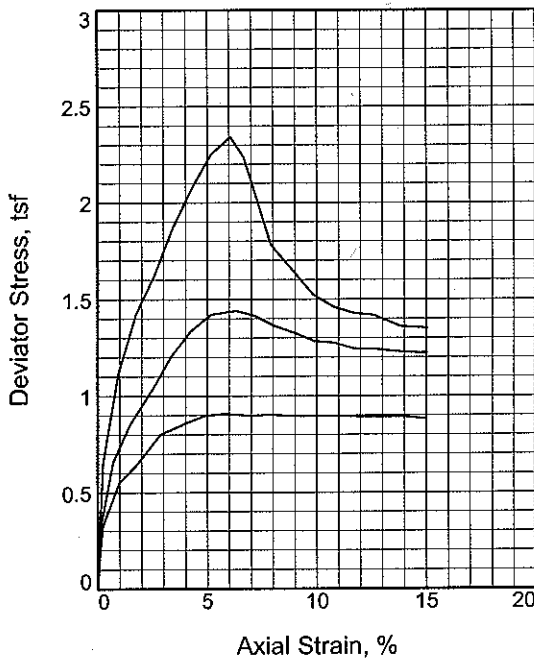
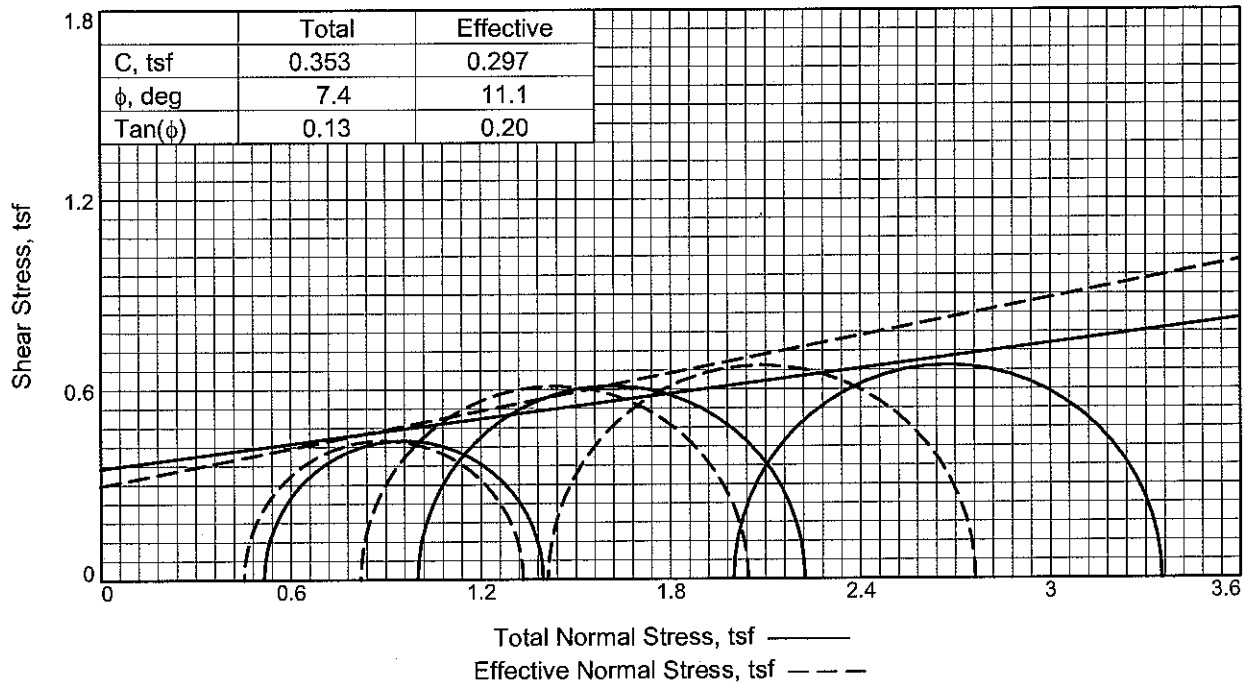
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	95.780			163.110
Moisture content: Dry soil+tare, gms.	79.790			132.190
Moisture content: Tare, gms.	30.520			30.370
Moisture, %	32.5	33.2	31.3	30.4
Moist specimen weight, gms.	134.5			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.51	
Height, in.	2.80	2.80	2.78	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	118.7	119.3	120.9	
Dry density, pcf	89.6	89.6	92.0	
Void ratio	0.9079	0.9079	0.8571	
Saturation, %	97.9	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.133 tsf
 Consolidation back pressure = 5.144 tsf
 Consolidation effective confining stress = 1.989 tsf
 Peak Stress = 2.327 tsf at reading no. 7
 Ult. Stress = 1.992 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0112	18.880	0.0	0.0	0.000	1.989	1.989	1.00	5.144	1.989	0.000
1	0.0139	27.670	8.8	0.1	0.418	1.820	2.238	1.23	5.313	2.029	0.209
2	0.0172	33.530	14.7	0.2	0.695	1.661	2.356	1.42	5.472	2.009	0.348
3	0.0261	41.260	22.4	0.5	1.059	1.438	2.497	1.74	5.695	1.967	0.529
4	0.0488	51.690	32.8	1.4	1.539	1.180	2.719	2.30	5.953	1.950	0.770
5	0.0728	59.900	41.0	2.2	1.907	1.060	2.967	2.80	6.073	2.014	0.954
6	0.0975	66.800	47.9	3.1	2.208	1.035	3.243	3.13	6.098	2.139	1.104
7	0.1216	69.850	51.0	4.0	2.327	1.076	3.403	3.16	6.057	2.240	1.164
8	0.1465	66.680	47.8	4.9	2.162	1.183	3.345	2.83	5.950	2.264	1.081
9	0.1714	64.940	46.1	5.8	2.064	1.234	3.298	2.67	5.899	2.266	1.032
10	0.2061	64.820	45.9	7.0	2.031	1.272	3.303	2.60	5.861	2.288	1.016
11	0.2331	65.350	46.5	8.0	2.033	1.289	3.322	2.58	5.844	2.306	1.017
12	0.2601	65.830	47.0	9.0	2.032	1.320	3.352	2.54	5.813	2.336	1.016
13	0.2857	66.230	47.4	9.9	2.029	1.332	3.361	2.52	5.801	2.347	1.015
14	0.3130	66.810	47.9	10.9	2.031	1.344	3.375	2.51	5.789	2.360	1.016
15	0.3399	67.000	48.1	11.8	2.017	1.374	3.391	2.47	5.759	2.383	1.009
16	0.3676	67.730	48.9	12.8	2.025	1.403	3.428	2.44	5.730	2.415	1.012
17	0.3947	67.950	49.1	13.8	2.011	1.413	3.424	2.42	5.720	2.419	1.006
18	0.4225	68.130	49.3	14.8	1.995	1.432	3.427	2.39	5.701	2.430	0.998
19	0.4280	68.170	49.3	15.0	1.992	1.440	3.432	2.38	5.693	2.436	0.996





Sample No.	1	2	3	
Initial	Water Content, %	43.0	42.6	42.9
	Dry Density, pcf	77.7	78.2	78.3
	Saturation, %	97.7	98.0	98.8
	Void Ratio	1.2094	1.1958	1.1928
	Diameter, in.	1.43	1.38	1.40
At Test	Height, in.	2.81	2.79	2.82
	Water Content, %	44.0	42.8	41.5
	Dry Density, pcf	77.7	78.9	80.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2094	1.1769	1.1418
Pore Pressure Parameter B	Diameter, in.	1.43	1.38	1.39
	Height, in.	2.81	2.78	2.80
	Pore Pressure Parameter B	1.0	1.0	1.0
	Consolidation Pressure, tsf	0.51	1.00	2.00
	Back Pressure, tsf	6.63	6.14	5.14
	Cell Pressure, tsf	7.14	7.14	7.14
	Peak Deviator Stress, tsf	0.91	1.44	2.34
	Total Pore Pr., tsf	6.93	6.70	6.33
	Ultimate Deviator Stress, tsf	0.88	1.22	1.35
	Total Pore Pr., tsf	6.69	6.32	5.73
Maj. Eff. Stress at Ultimate, tsf	1.12	1.88	3.16	
Min. Eff. Stress at Ultimate, tsf	0.21	0.44	0.81	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of silt, brown (CH)

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

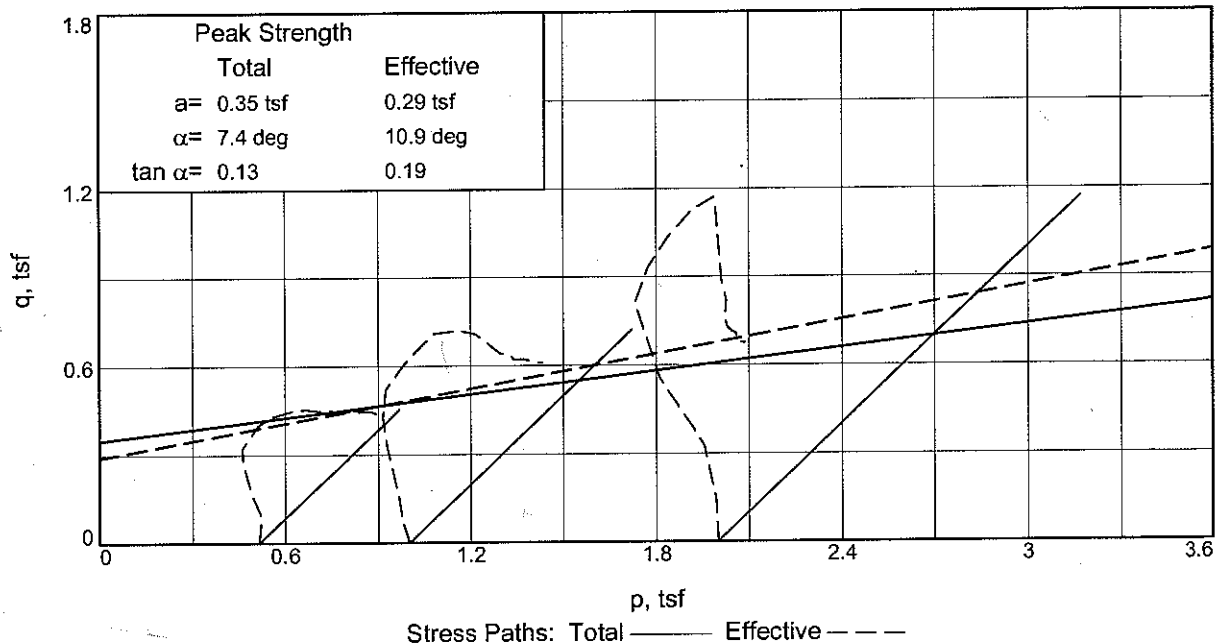
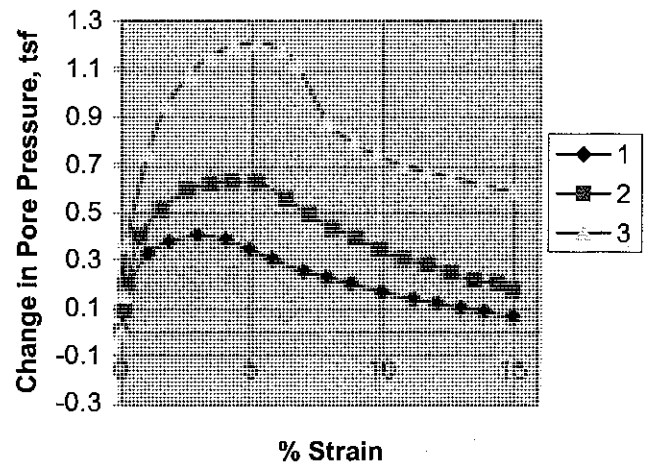
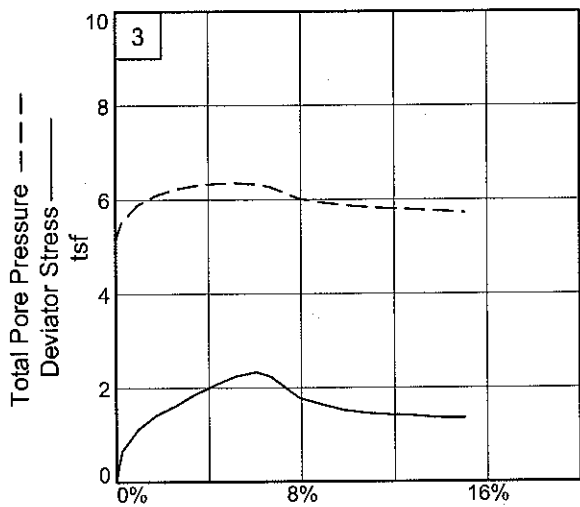
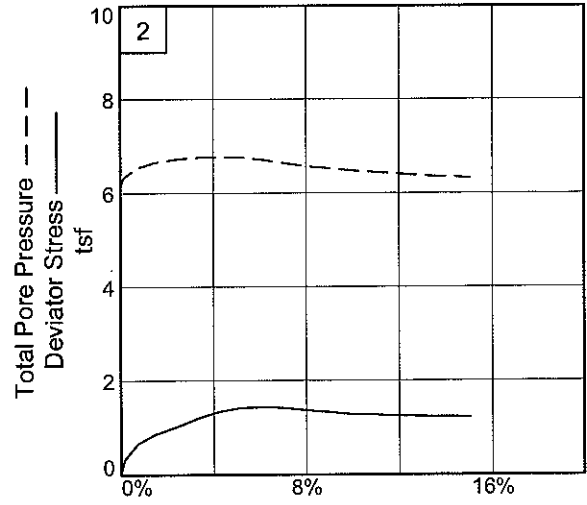
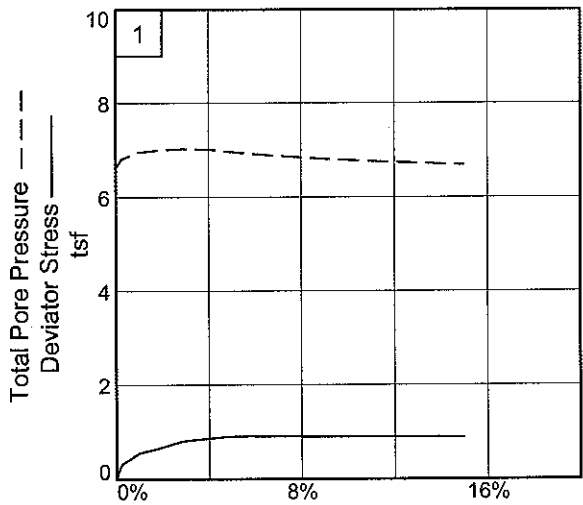
Location: SE-M-18, Moorhead, Sherack Formation

Sample Number: Boring 09-34MU, #1 **Depth:** 8-10'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-M-18, Moorhead, Sherack Formation

Depth: 8-10'

Sample No.: Boring 09-34MU, #1

Project No.: BR-09-00127 Feasibility Report and Environmental Impact Statement
July 2014

Braun-Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

11/17/2009

9:24 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, Sherack Formation
Depth: 8-10' **Sample Number:** Boring 09-34MU, #1
Description: FAT CLAY with layers of silt, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	92.060			161.080
Moisture content: Dry soil+tare, gms.	73.840			120.640
Moisture content: Tare, gms.	31.450			30.600
Moisture, %	43.0	44.0	44.0	44.9
Moist specimen weight, gms.	130.5			
Diameter, in.	1.43	1.43	1.43	
Area, in. ²	1.59	1.59	1.59	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	111.1	111.9	111.9	
Dry density, pcf	77.7	77.7	77.7	
Void ratio	1.2094	1.2094	1.2094	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.625 tsf
Consolidation effective confining stress = 0.515 tsf
Peak Stress = 0.909 tsf at reading no. 8
Ult. Stress = 0.881 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0130	19.310	0.0	0.0	0.000	0.515	0.515	1.00	6.625	0.515	0.000
1	0.0159	23.310	4.0	0.1	0.180	0.434	0.614	1.42	6.706	0.524	0.090
2	0.0195	26.540	7.2	0.2	0.326	0.330	0.656	1.99	6.810	0.493	0.163
3	0.0407	31.640	12.3	1.0	0.551	0.188	0.739	3.93	6.952	0.464	0.276
4	0.0635	33.900	14.6	1.8	0.647	0.138	0.785	5.69	7.002	0.461	0.323
5	0.0936	37.620	18.3	2.9	0.803	0.112	0.915	8.17	7.028	0.513	0.401
6	0.1255	39.150	19.8	4.0	0.860	0.127	0.987	7.77	7.013	0.557	0.430
7	0.1505	40.250	20.9	4.9	0.899	0.172	1.071	6.23	6.968	0.622	0.450
8	0.1753	40.680	21.4	5.8	0.909	0.211	1.120	5.31	6.929	0.665	0.454
9	0.2082	40.690	21.4	7.0	0.898	0.261	1.159	4.44	6.879	0.710	0.449
10	0.2338	41.040	21.7	7.9	0.904	0.289	1.193	4.13	6.851	0.741	0.452
11	0.2590	41.070	21.8	8.8	0.896	0.313	1.209	3.86	6.827	0.761	0.448
12	0.2938	41.320	22.0	10.0	0.894	0.349	1.243	3.56	6.791	0.796	0.447
13	0.3268	41.680	22.4	11.2	0.897	0.377	1.274	3.38	6.763	0.825	0.448
14	0.3529	41.790	22.5	12.1	0.892	0.395	1.287	3.26	6.745	0.841	0.446
15	0.3778	42.010	22.7	13.0	0.892	0.414	1.306	3.15	6.726	0.860	0.446
16	0.4043	42.310	23.0	13.9	0.894	0.431	1.325	3.07	6.709	0.878	0.447
17	0.4334	42.260	22.9	15.0	0.881	0.452	1.333	2.95	6.688	0.892	0.440

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	78.490			151.860
Moisture content: Dry soil+tare, gms.	64.300			115.540
Moisture content: Tare, gms.	30.990			30.210
Moisture, %	42.6	43.5	42.8	42.6
Moist specimen weight, gms.	122.6			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.49	
Height, in.	2.79	2.79	2.78	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.5	112.2	112.6	
Dry density, pcf	78.2	78.2	78.9	
Void ratio	1.1958	1.1958	1.1769	
Saturation, %	98.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.139 tsf
 Consolidation effective confining stress = 1.001 tsf
 Peak Stress = 1.442 tsf at reading no. 9
 Ult. Stress = 1.223 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0088	19.620	0.0	0.0	0.000	1.001	1.001	1.00	6.139	1.001	0.000
1	0.0108	22.640	3.0	0.1	0.145	0.907	1.052	1.16	6.233	0.980	0.073
2	0.0130	26.330	6.7	0.2	0.323	0.805	1.128	1.40	6.335	0.966	0.161
3	0.0287	33.380	13.8	0.7	0.659	0.599	1.258	2.10	6.541	0.928	0.329
4	0.0497	37.620	18.0	1.5	0.855	0.487	1.342	2.76	6.653	0.914	0.427
5	0.0796	41.800	22.2	2.5	1.042	0.403	1.445	3.59	6.737	0.924	0.521
6	0.1024	45.560	25.9	3.4	1.208	0.379	1.587	4.19	6.761	0.983	0.604
7	0.1263	48.550	28.9	4.2	1.336	0.371	1.707	4.60	6.769	1.039	0.668
8	0.1521	50.690	31.1	5.2	1.421	0.372	1.793	4.82	6.768	1.082	0.710
9	0.1841	51.540	31.9	6.3	1.442	0.441	1.883	4.27	6.699	1.162	0.721
10	0.2079	51.240	31.6	7.2	1.415	0.508	1.923	3.79	6.632	1.216	0.708
11	0.2329	50.380	30.8	8.1	1.363	0.567	1.930	3.40	6.573	1.249	0.682
12	0.2579	49.860	30.2	9.0	1.327	0.606	1.933	3.19	6.534	1.270	0.664
13	0.2839	49.160	29.5	9.9	1.283	0.655	1.938	2.96	6.485	1.297	0.642
14	0.3088	49.260	29.6	10.8	1.275	0.693	1.968	2.84	6.447	1.330	0.637
15	0.3336	48.870	29.2	11.7	1.245	0.716	1.961	2.74	6.424	1.339	0.623
16	0.3587	49.130	29.5	12.6	1.244	0.751	1.995	2.66	6.389	1.373	0.622
17	0.3847	49.160	29.5	13.5	1.231	0.783	2.014	2.57	6.357	1.399	0.616
18	0.4095	49.320	29.7	14.4	1.225	0.794	2.019	2.54	6.346	1.407	0.613
19	0.4266	49.480	29.9	15.0	1.223	0.821	2.044	2.49	6.319	1.433	0.612

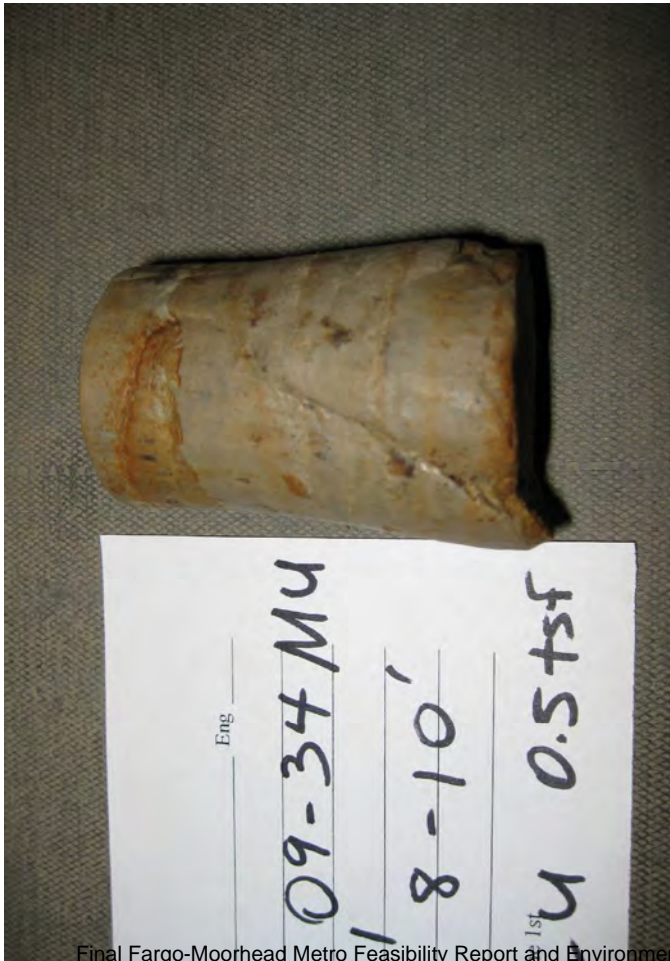
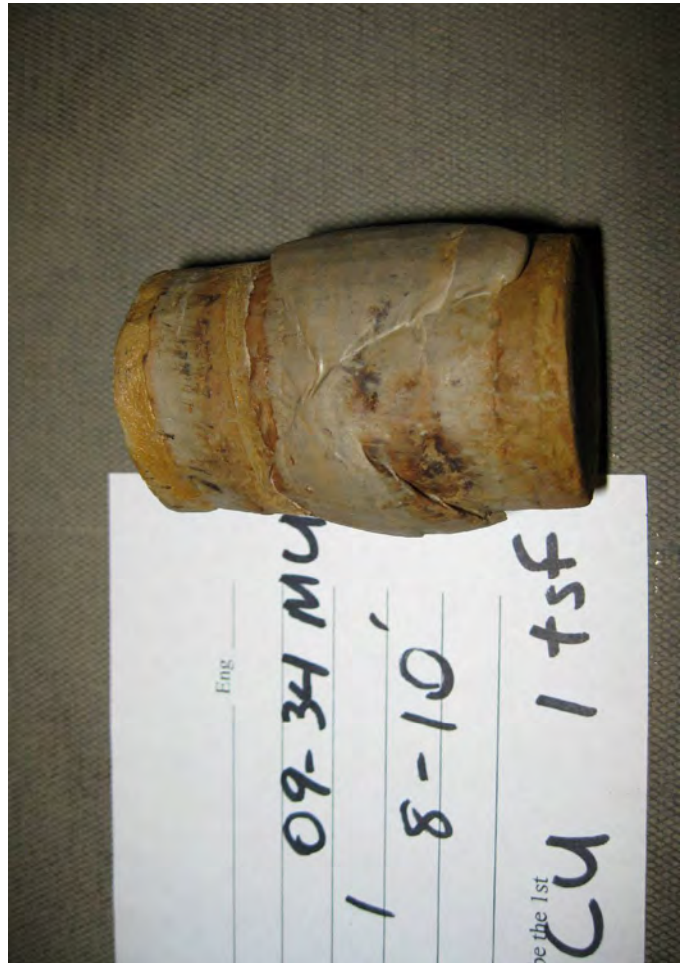
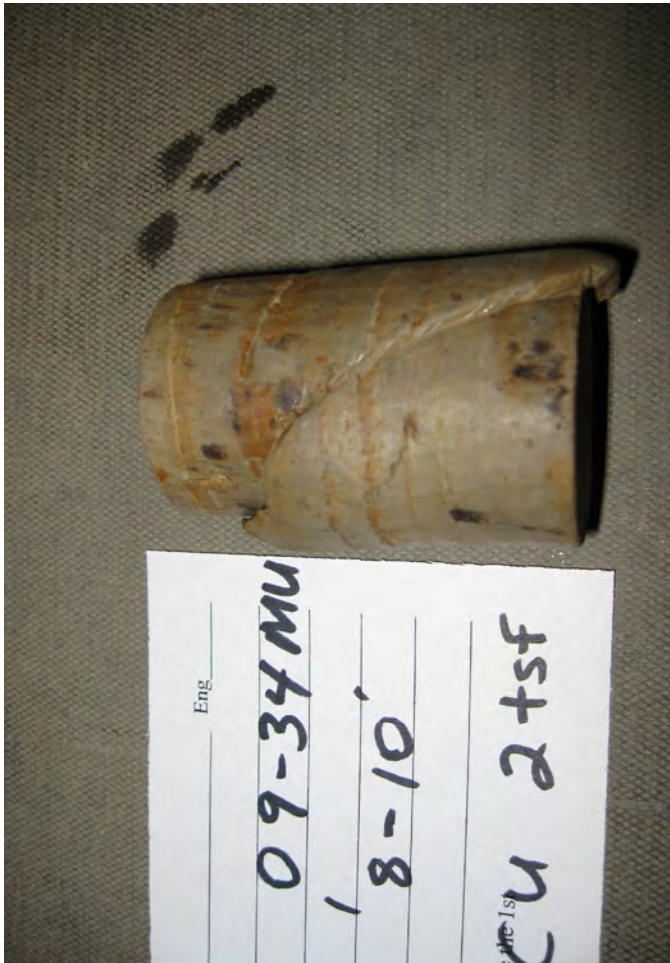
Parameters for Specimen No. 3

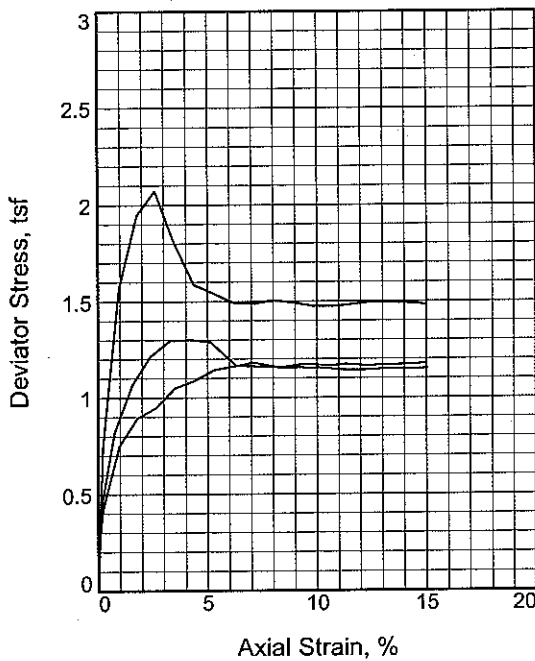
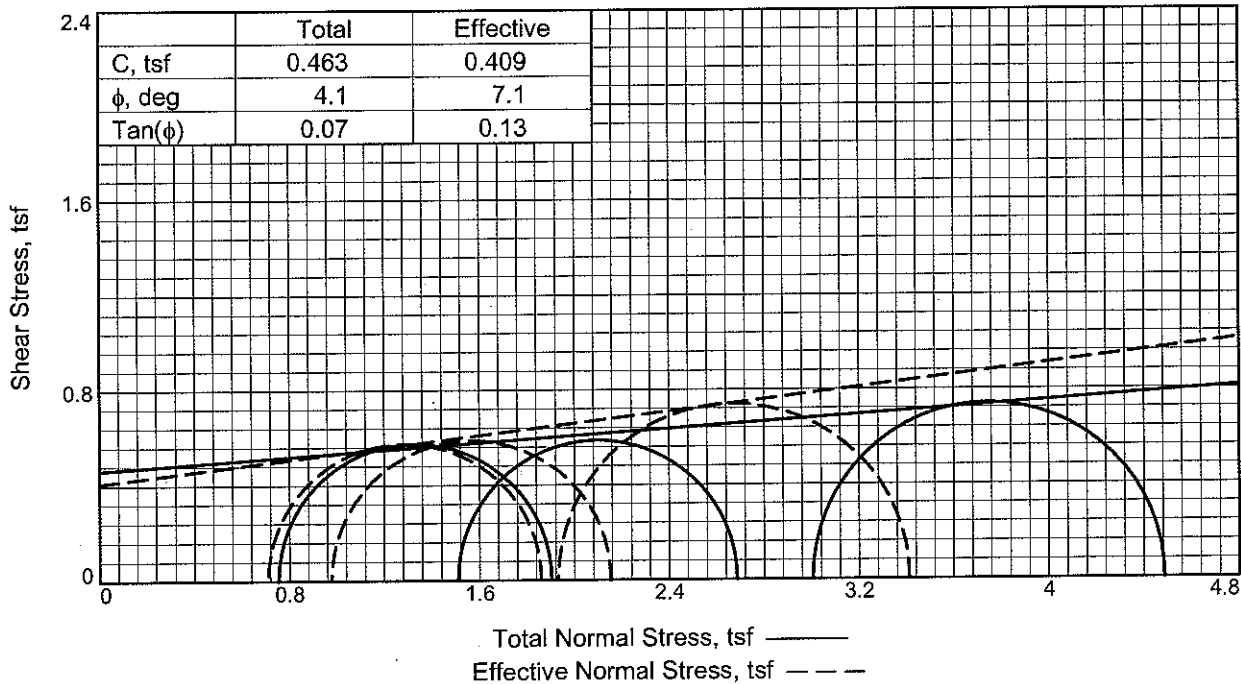
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	104.870			155.880
Moisture content: Dry soil+tare, gms.	82.730			119.670
Moisture content: Tare, gms.	31.080			30.140
Moisture, %	42.9	43.4	41.5	40.4
Moist specimen weight, gms.	128.1			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.55	1.55	1.52	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	111.9	112.2	113.4	
Dry density, pcf	78.3	78.3	80.2	
Void ratio	1.1928	1.1928	1.1418	
Saturation, %	98.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.141 tsf
 Consolidation effective confining stress = 1.999 tsf
 Peak Stress = 2.342 tsf at reading no. 9
 Ult. Stress = 1.351 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0103	18.940	0.0	0.0	0.000	1.999	1.999	1.00	5.141	1.999	0.000
1	0.0130	25.110	6.2	0.1	0.292	1.846	2.138	1.16	5.294	1.992	0.146
2	0.0170	32.800	13.9	0.2	0.654	1.628	2.282	1.40	5.512	1.955	0.327
3	0.0369	42.780	23.8	1.0	1.117	1.251	2.368	1.89	5.889	1.810	0.559
4	0.0588	49.590	30.7	1.7	1.425	1.050	2.475	2.36	6.090	1.762	0.712
5	0.0826	54.170	35.2	2.6	1.624	0.920	2.544	2.76	6.220	1.732	0.812
6	0.1056	59.750	40.8	3.4	1.865	0.840	2.705	3.22	6.300	1.772	0.932
7	0.1304	64.700	45.8	4.3	2.072	0.803	2.875	3.58	6.337	1.839	1.036
8	0.1554	69.120	50.2	5.2	2.251	0.788	3.039	3.86	6.352	1.913	1.125
9	0.1802	71.650	52.7	6.1	2.342	0.815	3.157	3.87	6.325	1.986	1.171
10	0.1971	69.610	50.7	6.7	2.237	0.875	3.112	3.56	6.265	1.994	1.119
11	0.2319	59.810	40.9	7.9	1.781	1.120	2.901	2.59	6.020	2.010	0.890
12	0.2600	57.070	38.1	8.9	1.643	1.205	2.848	2.36	5.935	2.027	0.822
13	0.2857	54.650	35.7	9.8	1.523	1.260	2.783	2.21	5.880	2.022	0.762
14	0.3117	53.560	34.6	10.8	1.462	1.299	2.761	2.13	5.841	2.030	0.731
15	0.3365	53.160	34.2	11.7	1.430	1.328	2.758	2.08	5.812	2.043	0.715
16	0.3634	53.250	34.3	12.6	1.418	1.348	2.766	2.05	5.792	2.057	0.709
17	0.3976	52.300	33.4	13.8	1.360	1.382	2.742	1.98	5.758	2.062	0.680
18	0.4313	52.550	33.6	15.0	1.351	1.412	2.763	1.96	5.728	2.087	0.675





Sample No.	1	2	3	
Initial	Water Content, %	40.9	42.6	43.8
	Dry Density, pcf	80.2	78.2	75.8
	Saturation, %	98.5	98.2	95.3
	Void Ratio	1.1410	1.1940	1.2647
	Diameter, in.	1.42	1.42	1.42
	Height, in.	2.80	2.80	2.82
At Test	Water Content, %	40.5	42.3	43.0
	Dry Density, pcf	81.2	79.4	78.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1136	1.1635	1.1812
	Diameter, in.	1.41	1.41	1.41
	Height, in.	2.79	2.79	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.75	1.51	3.01	
Back Pressure, tsf	6.39	5.63	4.13	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	1.18	1.30	2.07	
Total Pore Pr., tsf	6.60	6.36	5.37	
Ultimate Deviator Stress, tsf	1.15	1.18	1.48	
Total Pore Pr., tsf	6.43	6.16	5.21	
Maj. Eff. Stress at Ultimate, tsf	1.72	2.08	3.85	
Min. Eff. Stress at Ultimate, tsf	0.54	0.78	1.77	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of silt, brown (CH)

LL= 55 PL= 21 PI= 34

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115 **Sherack**

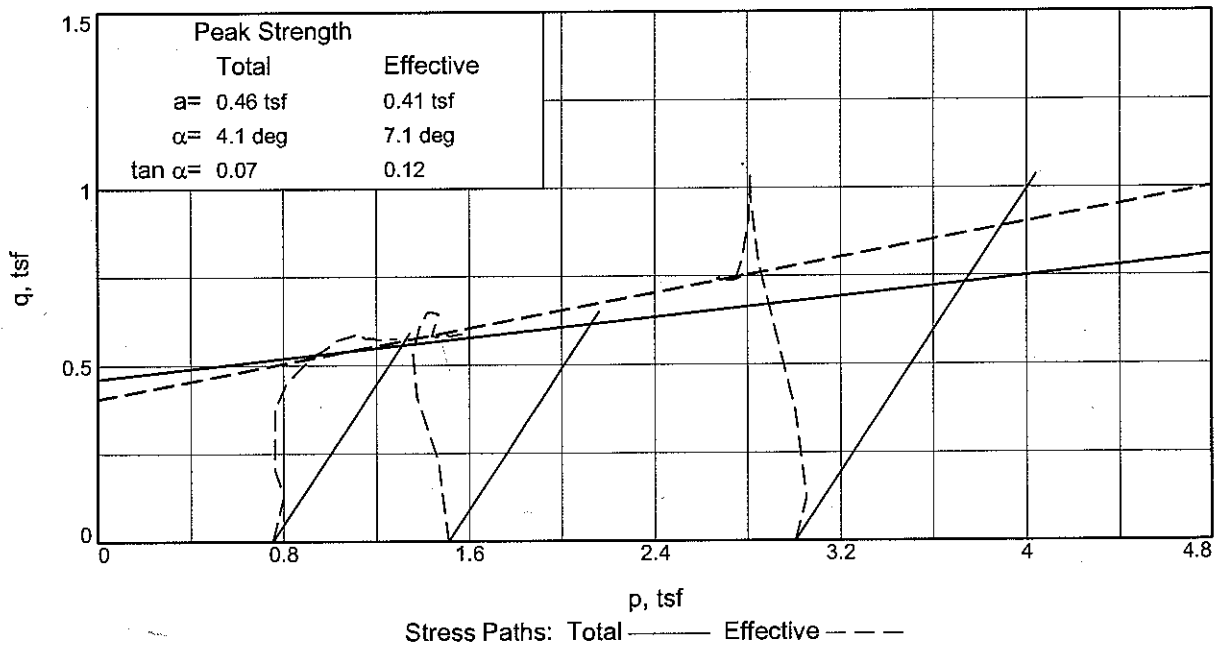
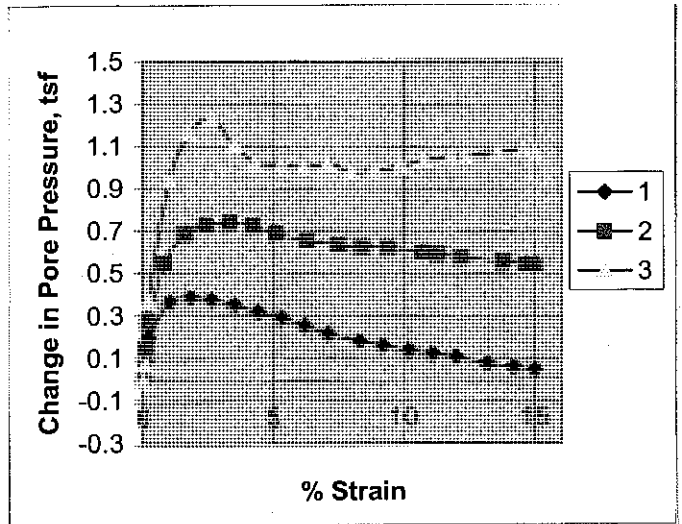
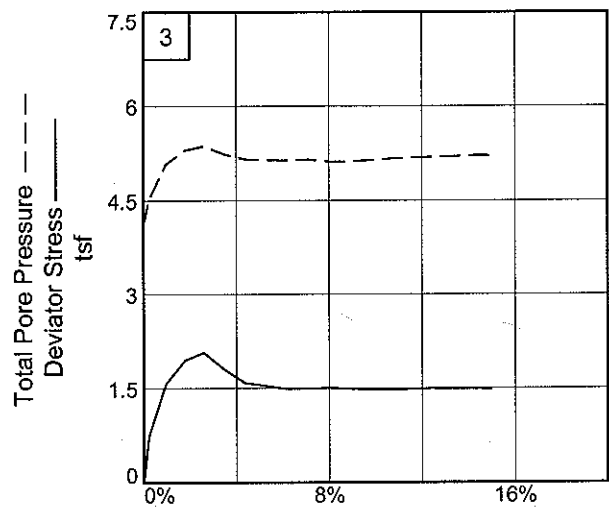
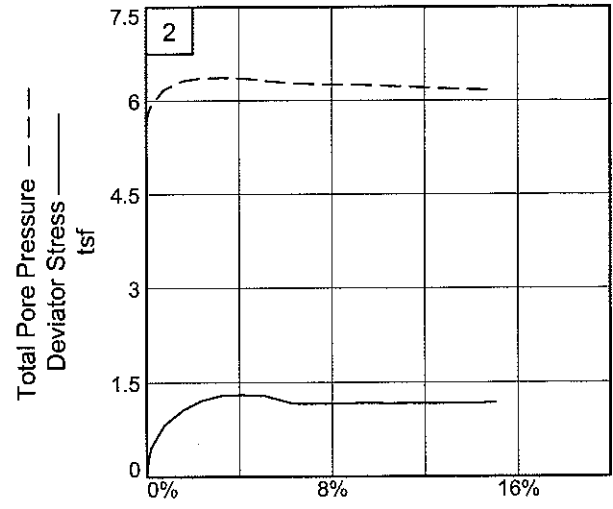
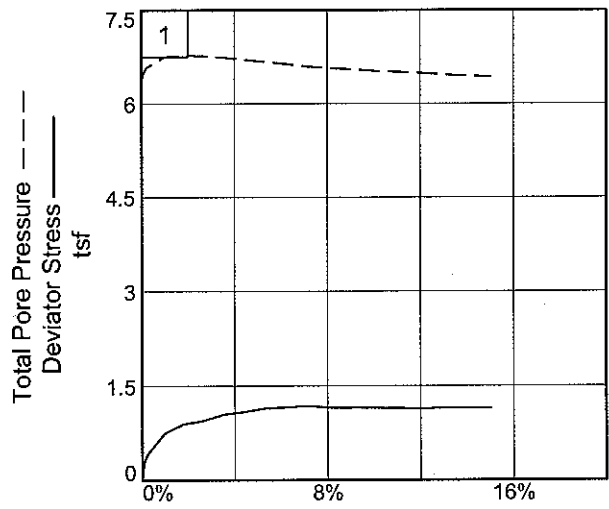
Location: SE-M-11, Moorhead, PL ~~Sherack Formation~~

Sample Number: Boring 09-53MU, #1 **Depth:** 18-20'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
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Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-M-11, Moorhead, PL ~~Sherack Formation~~

Depth: 18-20'

Sherack

Sample No.: Boring 09-53MU, #1

Project No. BL 09-0127 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/17/2009

9:17 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-11, Moorhead, ~~PL Sherack Formation~~
Depth: 18-20' **Sample Number:** Boring 09-53MU, #1
Description: FAT CLAY with layers of silt, brown (CH) **Sherack**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**55 **PL=**21 **PI=**34
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	104.970			160.870
Moisture content: Dry soil+tare, gms.	83.520			123.650
Moisture content: Tare, gms.	31.040			30.190
Moisture, %	40.9	41.5	40.5	39.8
Moist specimen weight, gms.	131.5			
Diameter, in.	1.42	1.42	1.41	
Area, in. ²	1.58	1.58	1.57	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	113.0	113.5	114.1	
Dry density, pcf	80.2	80.2	81.2	
Void ratio	1.1410	1.1410	1.1136	
Saturation, %	98.5	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.387 tsf
 Consolidation effective confining stress = 0.753 tsf
 Peak Stress = 1.182 tsf at reading no. 10
 Ult. Stress = 1.150 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0069	17.660	0.0	0.0	0.000	0.753	0.753	1.00	6.387	0.753	0.000
1	0.0088	23.340	5.7	0.1	0.260	0.671	0.931	1.39	6.469	0.801	0.130
2	0.0127	26.640	9.0	0.2	0.411	0.556	0.967	1.74	6.584	0.761	0.205
3	0.0343	34.200	16.5	1.0	0.751	0.387	1.138	2.94	6.753	0.763	0.376
4	0.0565	37.500	19.8	1.8	0.894	0.364	1.258	3.45	6.776	0.811	0.447
5	0.0802	38.910	21.2	2.6	0.949	0.374	1.323	3.54	6.766	0.848	0.474
6	0.1053	41.410	23.7	3.5	1.051	0.400	1.451	3.63	6.740	0.925	0.525
7	0.1301	42.520	24.9	4.4	1.090	0.434	1.524	3.51	6.706	0.979	0.545
8	0.1550	44.020	26.4	5.3	1.145	0.463	1.608	3.47	6.677	1.035	0.572
9	0.1801	44.680	27.0	6.2	1.162	0.500	1.662	3.32	6.640	1.081	0.581
10	0.2050	45.410	27.7	7.1	1.182	0.539	1.721	3.19	6.601	1.130	0.591
11	0.2396	45.100	27.4	8.3	1.153	0.573	1.726	3.01	6.567	1.150	0.577
12	0.2646	45.410	27.7	9.2	1.155	0.593	1.748	2.95	6.547	1.170	0.577
13	0.2907	45.660	28.0	10.2	1.153	0.616	1.769	2.87	6.524	1.193	0.577
14	0.3168	45.710	28.1	11.1	1.143	0.633	1.776	2.81	6.507	1.205	0.572
15	0.3426	46.000	28.3	12.0	1.143	0.647	1.790	2.77	6.493	1.219	0.572
16	0.3755	46.520	28.9	13.2	1.148	0.678	1.826	2.69	6.462	1.252	0.574
17	0.4024	46.860	29.2	14.2	1.149	0.694	1.843	2.66	6.446	1.269	0.575
18	0.4263	47.190	29.5	15.0	1.150	0.710	1.860	2.62	6.430	1.285	0.575

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	132.340			158.950
Moisture content: Dry soil+tare, gms.	101.710			121.110
Moisture content: Tare, gms.	29.880			31.300
Moisture, %	42.6	43.4	42.3	42.1
Moist specimen weight, gms.	129.5			
Diameter, in.	1.42	1.42	1.41	
Area, in. ²	1.58	1.58	1.56	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.6	112.2	112.9	
Dry density, pcf	78.2	78.2	79.4	
Void ratio	1.1940	1.1940	1.1635	
Saturation, %	98.2	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.630 tsf
 Consolidation effective confining stress = 1.510 tsf
 Peak Stress = 1.302 tsf at reading no. 7
 Ult. Stress = 1.176 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0099	19.490	0.0	0.0	0.000	1.510	1.510	1.00	5.630	1.510	0.000
1	0.0120	24.830	5.3	0.1	0.246	1.363	1.609	1.18	5.777	1.486	0.123
2	0.0150	29.410	9.9	0.2	0.456	1.239	1.695	1.37	5.901	1.467	0.228
3	0.0310	37.500	18.0	0.8	0.823	0.962	1.785	1.86	6.178	1.373	0.411
4	0.0539	43.090	23.6	1.6	1.069	0.823	1.892	2.30	6.317	1.357	0.534
5	0.0766	46.600	27.1	2.4	1.218	0.778	1.996	2.57	6.362	1.387	0.609
6	0.1015	48.640	29.2	3.3	1.297	0.769	2.066	2.69	6.371	1.418	0.649
7	0.1264	49.010	29.5	4.2	1.302	0.783	2.085	2.66	6.357	1.434	0.651
8	0.1524	49.040	29.6	5.1	1.290	0.823	2.113	2.57	6.317	1.468	0.645
9	0.1861	46.520	27.0	6.3	1.165	0.856	2.021	2.36	6.284	1.439	0.583
10	0.2198	46.780	27.3	7.5	1.161	0.876	2.037	2.33	6.264	1.457	0.581
11	0.2451	47.000	27.5	8.4	1.159	0.884	2.043	2.31	6.256	1.464	0.580
12	0.2720	47.650	28.2	9.4	1.174	0.887	2.061	2.32	6.253	1.474	0.587
13	0.3069	47.850	28.4	10.7	1.166	0.911	2.077	2.28	6.229	1.494	0.583
14	0.3248	48.230	28.7	11.3	1.173	0.920	2.093	2.28	6.220	1.507	0.587
15	0.3506	48.350	28.9	12.2	1.166	0.935	2.101	2.25	6.205	1.518	0.583
16	0.3945	49.000	29.5	13.8	1.171	0.958	2.129	2.22	6.182	1.543	0.585
17	0.4205	49.470	30.0	14.7	1.176	0.972	2.148	2.21	6.168	1.560	0.588
18	0.4284	49.570	30.1	15.0	1.176	0.977	2.153	2.20	6.163	1.565	0.588

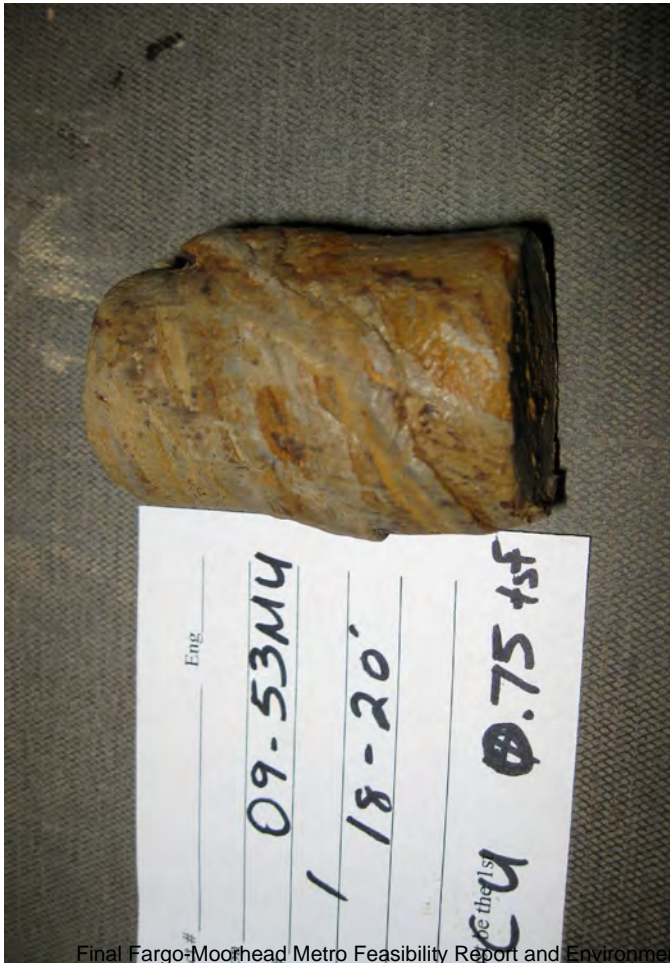
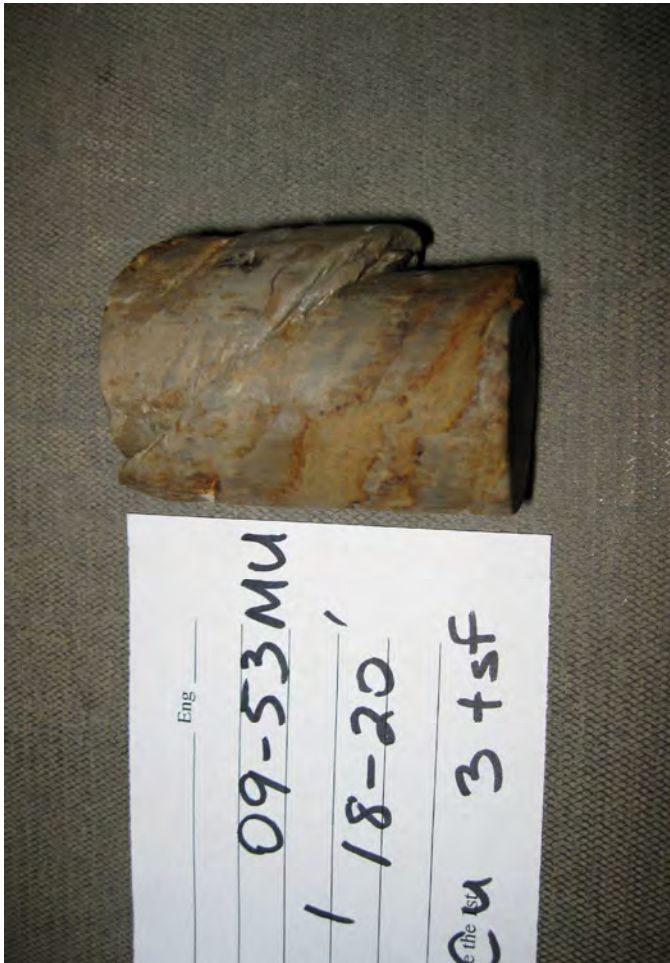
Parameters for Specimen No. 3

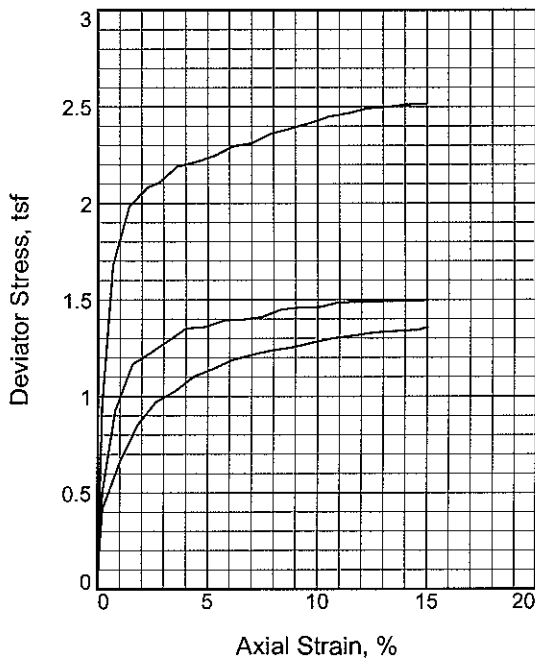
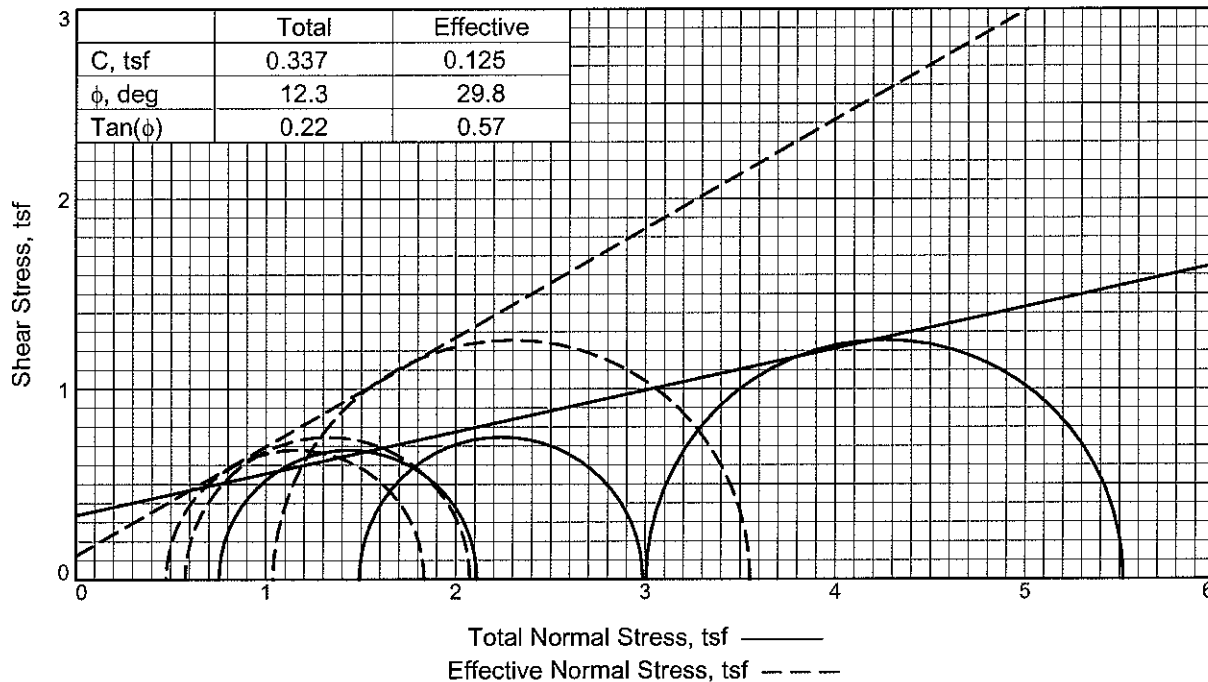
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	114.420			155.030
Moisture content: Dry soil+tare, gms.	88.830			119.200
Moisture content: Tare, gms.	30.470			30.510
Moisture, %	43.8	46.0	43.0	40.4
Moist specimen weight, gms.	128.4			
Diameter, in.	1.42	1.42	1.41	
Area, in. ²	1.59	1.59	1.55	
Height, in.	2.82	2.82	2.79	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	109.0	110.7	112.5	
Dry density, pcf	75.8	75.8	78.7	
Void ratio	1.2647	1.2647	1.1812	
Saturation, %	95.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 4.135 tsf
 Consolidation effective confining stress = 3.005 tsf
 Peak Stress = 2.073 tsf at reading no. 5
 Ult. Stress = 1.481 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0078	18.490	0.0	0.0	0.000	3.005	3.005	1.00	4.135	3.005	0.000
1	0.0097	23.740	5.3	0.1	0.244	2.930	3.174	1.08	4.210	3.052	0.122
2	0.0137	34.390	15.9	0.2	0.737	2.636	3.373	1.28	4.504	3.004	0.368
3	0.0347	52.640	34.2	1.0	1.570	2.063	3.633	1.76	5.077	2.848	0.785
4	0.0575	61.220	42.7	1.8	1.948	1.838	3.786	2.06	5.302	2.812	0.974
5	0.0804	64.330	45.8	2.6	2.073	1.775	3.848	2.17	5.365	2.811	1.036
6	0.1044	58.840	40.4	3.5	1.808	1.899	3.707	1.95	5.241	2.803	0.904
7	0.1290	54.230	35.7	4.3	1.587	1.981	3.568	1.80	5.159	2.775	0.794
8	0.1543	53.560	35.1	5.3	1.542	1.993	3.535	1.77	5.147	2.764	0.771
9	0.1800	52.760	34.3	6.2	1.493	2.004	3.497	1.74	5.136	2.750	0.746
10	0.2060	53.010	34.5	7.1	1.489	1.989	3.478	1.75	5.151	2.733	0.744
11	0.2309	53.760	35.3	8.0	1.506	2.024	3.530	1.74	5.116	2.777	0.753
12	0.2567	53.780	35.3	8.9	1.492	2.020	3.512	1.74	5.120	2.766	0.746
13	0.2825	53.730	35.2	9.9	1.475	1.999	3.474	1.74	5.141	2.736	0.737
14	0.3086	54.100	35.6	10.8	1.475	1.973	3.448	1.75	5.167	2.710	0.737
15	0.3356	54.780	36.3	11.8	1.487	1.959	3.446	1.76	5.181	2.702	0.743
16	0.3524	55.230	36.7	12.4	1.495	1.951	3.446	1.77	5.189	2.698	0.747
17	0.3875	55.710	37.2	13.6	1.492	1.938	3.430	1.77	5.202	2.684	0.746
18	0.4136	56.030	37.5	14.6	1.489	1.923	3.412	1.77	5.217	2.667	0.744
19	0.4250	56.000	37.5	15.0	1.481	1.931	3.412	1.77	5.209	2.671	0.740





Sample No.	1	2	3	
Initial	Water Content, %	39.1	41.9	40.7
	Dry Density, pcf	82.7	79.2	81.0
	Saturation, %	99.9	98.7	100.0
	Void Ratio	1.0765	1.1677	1.1200
	Diameter, in.	1.41	1.41	1.42
	Height, in.	2.80	2.79	2.81
At Test	Water Content, %	38.3	40.4	37.9
	Dry Density, pcf	83.6	81.4	84.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0543	1.1099	1.0414
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.79	2.77	2.77
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.75	1.49	3.01	
Back Pressure, tsf	6.40	5.64	4.14	
Cell Pressure, tsf	7.15	7.13	7.15	
Peak Deviator Stress, tsf	1.36	1.50	2.52	
Total Pore Pr., tsf	6.67	6.56	6.11	
Ultimate Deviator Stress, tsf	1.36	1.50	2.52	
Total Pore Pr., tsf	6.67	6.56	6.11	
Maj. Eff. Stress at Ultimate, tsf	1.83	2.07	3.55	
Min. Eff. Stress at Ultimate, tsf	0.48	0.58	1.03	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of silt, gray (CH)

LL= 50 PL= 22 PI= 28

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

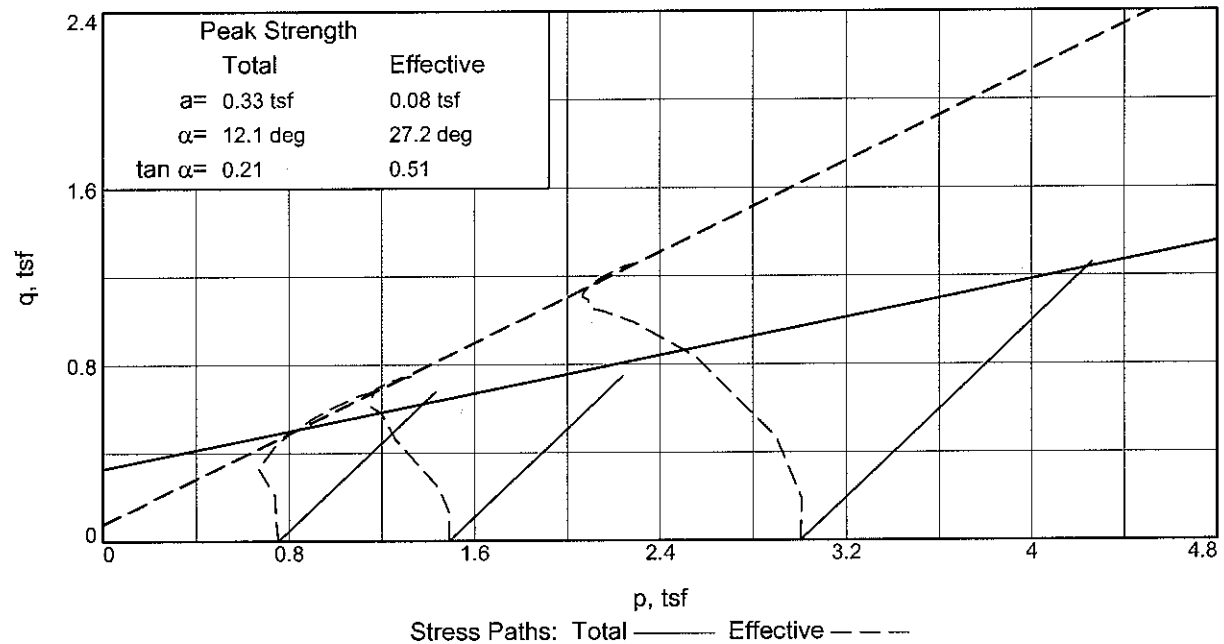
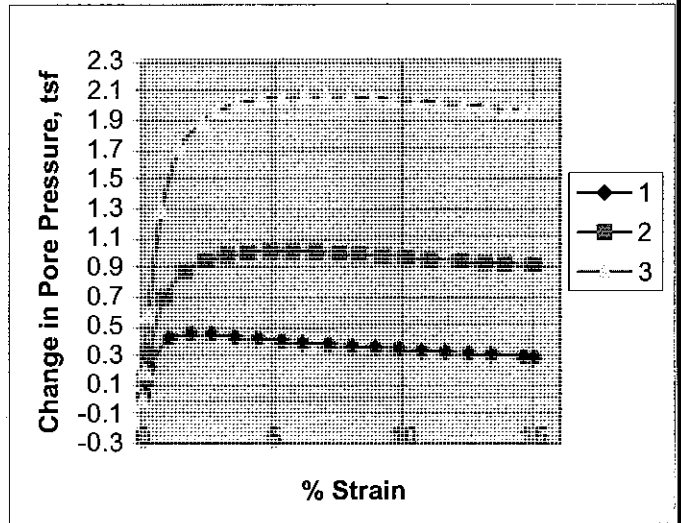
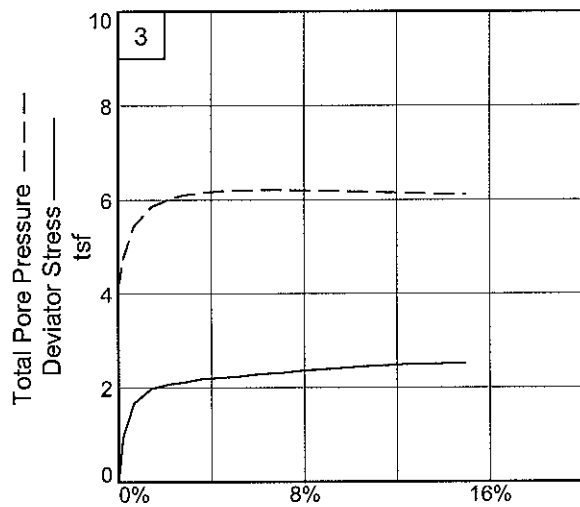
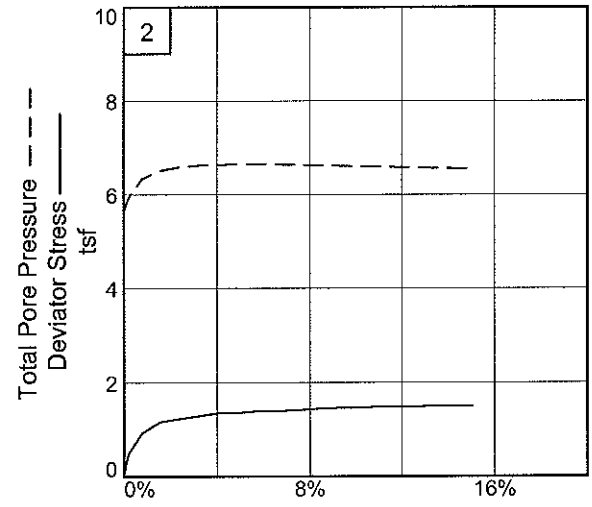
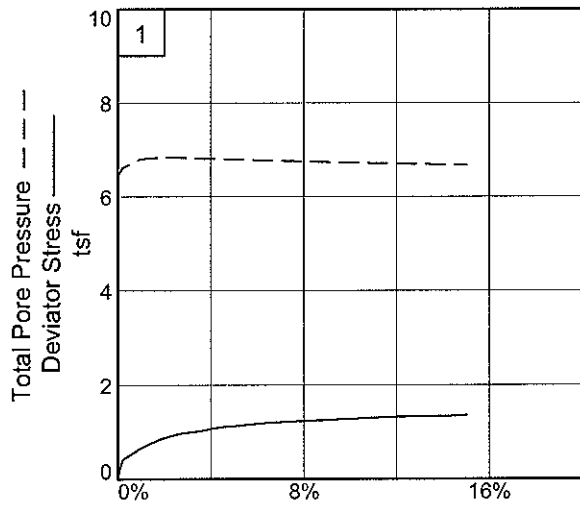
Location: SE-F-15, Fargo **Poplar River**

Sample Number: Boring 09-26MU, #2 **Depth:** 16-18'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Location: SE-F-15, Fargo

Depth: 16-18'

Sample Number: Boring 09-26MU, #2

Poplar River

Project No.: BL-09-09127 Fargo-Moorhead Feasibility Report and Environmental Impact Statement

Figure

Braun-Intertec

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/17/2009

9:26 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo
Depth: 16-18' **Sample Number:** Boring 09-26MU, #2
Description: FAT CLAY with layers of silt, gray (CH) **Poplar River**
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL**=50 **PL**=22 **PI**=28
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	87.720			161.300
Moisture content: Dry soil+tare, gms.	71.500			125.590
Moisture content: Tare, gms.	30.030			31.360
Moisture, %	39.1	39.1	38.3	37.9
Moist specimen weight, gms.	131.4			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	115.0	115.0	115.6	
Dry density, pcf	82.7	82.7	83.6	
Void ratio	1.0765	1.0765	1.0543	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.150 tsf
Consolidation back pressure = 6.396 tsf
Consolidation effective confining stress = 0.754 tsf
Peak Stress = 1.358 tsf at reading no. 19
Ult. Stress = 1.358 tsf at reading no. 19

Braun Intertec

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0109	19.520	0.0	0.0	0.000	0.754	0.754	1.00	6.396	0.754	0.000
1	0.0128	23.520	4.0	0.1	0.186	0.651	0.837	1.29	6.499	0.744	0.093
2	0.0168	28.440	8.9	0.2	0.415	0.532	0.947	1.78	6.618	0.740	0.208
3	0.0389	33.870	14.3	1.0	0.663	0.338	1.001	2.96	6.812	0.669	0.331
4	0.0616	38.110	18.6	1.8	0.851	0.309	1.160	3.75	6.841	0.735	0.426
5	0.0847	40.920	21.4	2.6	0.972	0.312	1.284	4.11	6.838	0.798	0.486
6	0.1093	42.350	22.8	3.5	1.027	0.331	1.358	4.10	6.819	0.845	0.514
7	0.1332	44.280	24.8	4.4	1.104	0.340	1.444	4.25	6.810	0.892	0.552
8	0.1573	45.380	25.9	5.3	1.143	0.354	1.497	4.23	6.796	0.925	0.571
9	0.1822	46.660	27.1	6.1	1.188	0.370	1.558	4.21	6.780	0.964	0.594
10	0.2079	47.580	28.1	7.1	1.216	0.381	1.597	4.19	6.769	0.989	0.608
11	0.2331	48.360	28.8	8.0	1.238	0.395	1.633	4.13	6.755	1.014	0.619
12	0.2589	49.010	29.5	8.9	1.253	0.405	1.658	4.09	6.745	1.032	0.627
13	0.2838	49.920	30.4	9.8	1.279	0.416	1.695	4.07	6.734	1.056	0.640
14	0.3088	50.710	31.2	10.7	1.299	0.426	1.725	4.05	6.724	1.076	0.650
15	0.3335	51.380	31.9	11.6	1.314	0.435	1.749	4.02	6.715	1.092	0.657
16	0.3585	52.070	32.5	12.5	1.329	0.446	1.775	3.98	6.704	1.110	0.664
17	0.3834	52.580	33.1	13.4	1.336	0.453	1.789	3.95	6.697	1.121	0.668
18	0.4174	53.220	33.7	14.6	1.343	0.469	1.812	3.86	6.681	1.140	0.671
19	0.4302	53.800	34.3	15.0	1.358	0.476	1.834	3.85	6.674	1.155	0.679

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	106.050			155.790
Moisture content: Dry soil+tare, gms.	83.620			120.880
Moisture content: Tare, gms.	30.110			31.350
Moisture, %	41.9	42.5	40.4	39.0
Moist specimen weight, gms.	127.8			
Diameter, in.	1.41	1.41	1.39	
Area, in. ²	1.55	1.55	1.52	
Height, in.	2.79	2.79	2.77	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	112.4	112.8	114.2	
Dry density, pcf	79.2	79.2	81.4	
Void ratio	1.1677	1.1677	1.1099	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.135 tsf
 Consolidation back pressure = 5.644 tsf
 Consolidation effective confining stress = 1.491 tsf
 Peak Stress = 1.496 tsf at reading no. 19
 Ult. Stress = 1.496 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0130	19.590	0.0	0.0	0.000	1.491	1.491	1.00	5.644	1.491	0.000
1	0.0159	25.540	5.9	0.1	0.281	1.345	1.626	1.21	5.790	1.486	0.141
2	0.0190	30.360	10.8	0.2	0.508	1.182	1.690	1.43	5.953	1.436	0.254
3	0.0347	39.330	19.7	0.8	0.926	0.796	1.722	2.16	6.339	1.259	0.463
4	0.0566	44.670	25.1	1.6	1.167	0.615	1.782	2.90	6.520	1.199	0.584
5	0.0793	46.140	26.6	2.4	1.225	0.540	1.765	3.27	6.595	1.153	0.613
6	0.1024	47.800	28.2	3.2	1.291	0.507	1.798	3.55	6.628	1.152	0.645
7	0.1243	49.370	29.8	4.0	1.352	0.492	1.844	3.75	6.643	1.168	0.676
8	0.1483	49.830	30.2	4.9	1.360	0.483	1.843	3.82	6.652	1.163	0.680
9	0.1721	50.840	31.3	5.7	1.393	0.484	1.877	3.88	6.651	1.180	0.696
10	0.1960	51.230	31.6	6.6	1.397	0.487	1.884	3.87	6.648	1.186	0.699
11	0.2200	51.850	32.3	7.5	1.411	0.496	1.907	3.85	6.639	1.202	0.706
12	0.2440	53.020	33.4	8.3	1.449	0.504	1.953	3.87	6.631	1.228	0.724
13	0.2680	53.590	34.0	9.2	1.460	0.515	1.975	3.83	6.620	1.245	0.730
14	0.2918	53.950	34.4	10.1	1.461	0.527	1.988	3.77	6.608	1.258	0.731
15	0.3167	54.870	35.3	11.0	1.485	0.537	2.022	3.77	6.598	1.280	0.743
16	0.3497	55.450	35.9	12.2	1.489	0.552	2.041	3.70	6.583	1.297	0.745
17	0.3745	55.870	36.3	13.1	1.492	0.562	2.054	3.65	6.573	1.308	0.746
18	0.3987	56.320	36.7	13.9	1.495	0.569	2.064	3.63	6.566	1.316	0.747
19	0.4295	56.820	37.2	15.0	1.496	0.578	2.074	3.59	6.557	1.326	0.748

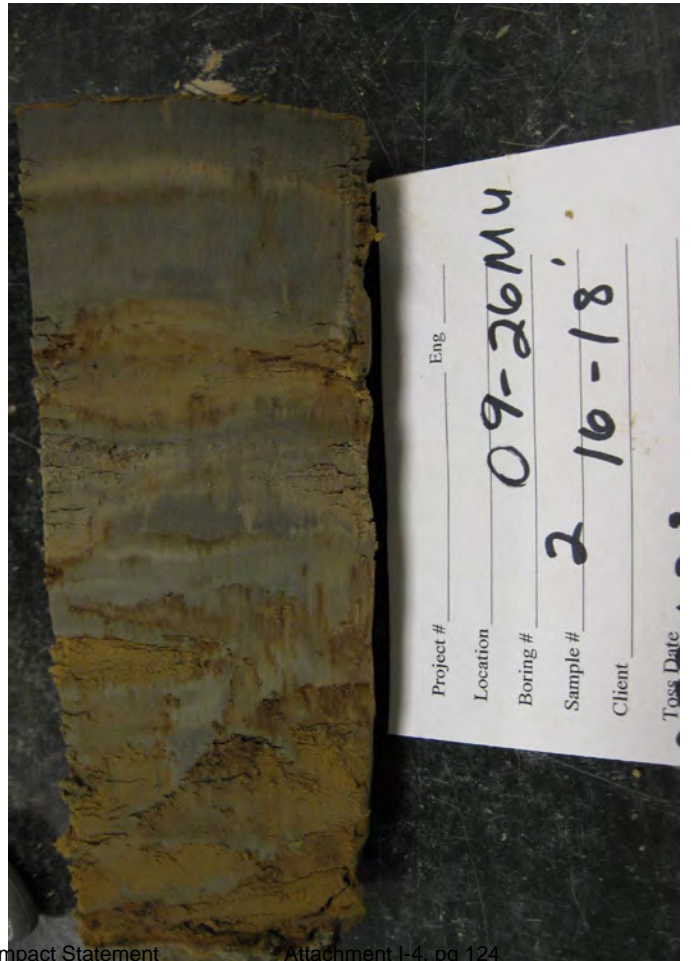
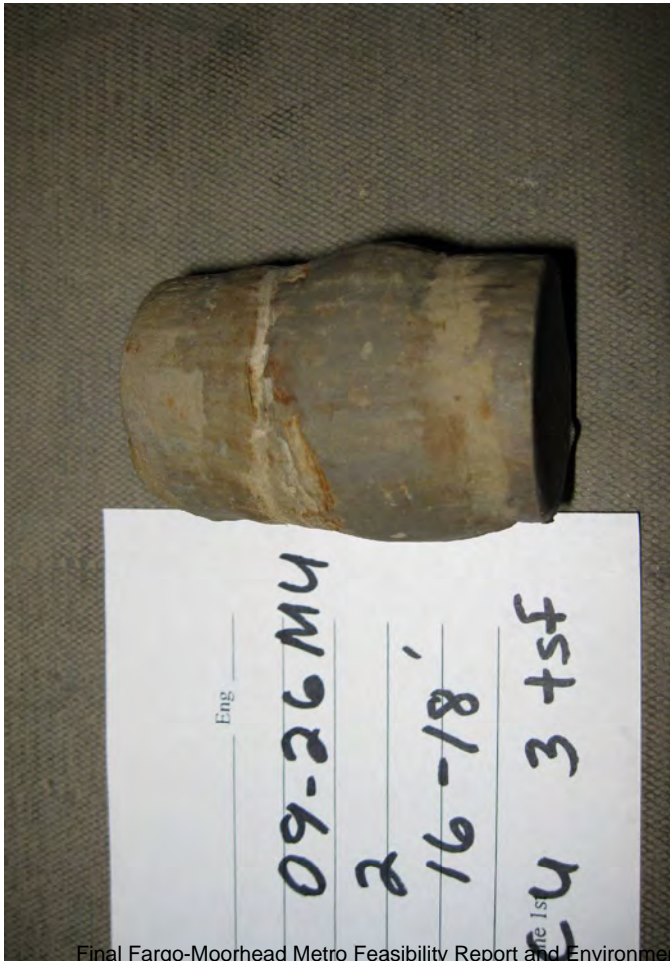
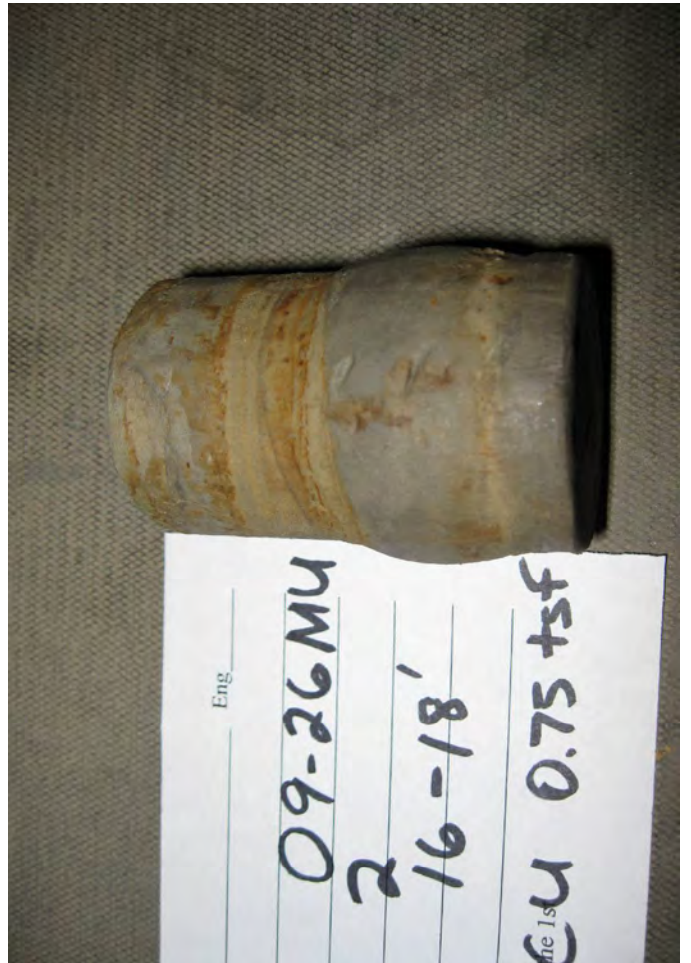
Parameters for Specimen No. 3

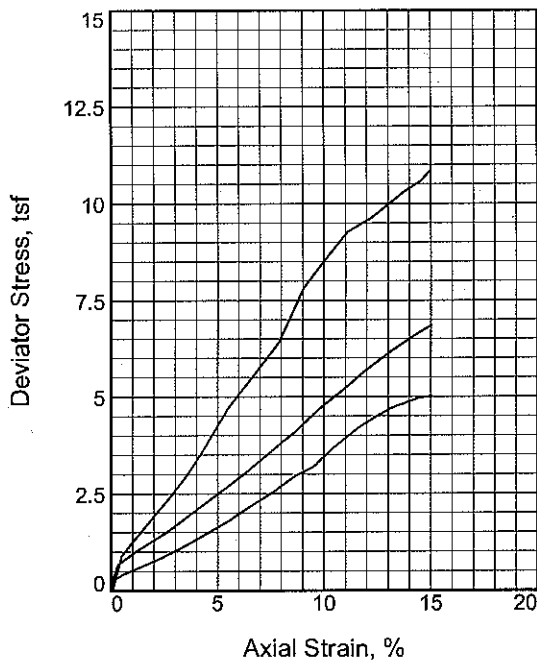
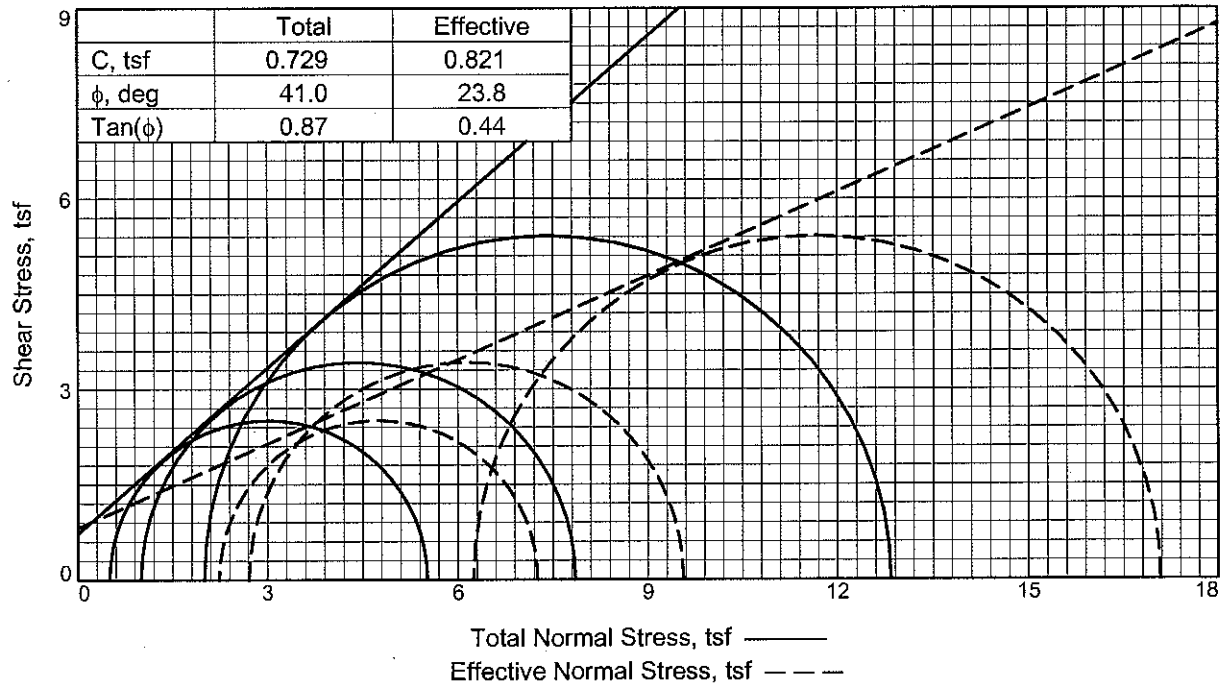
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	111.980			157.950
Moisture content: Dry soil+tare, gms.	88.360			125.380
Moisture content: Tare, gms.	30.340			30.360
Moisture, %	40.7	40.7	37.9	34.3
Moist specimen weight, gms.	132.4			
Diameter, in.	1.42	1.42	1.40	
Area, in. ²	1.58	1.58	1.54	
Height, in.	2.81	2.81	2.77	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	113.9	114.0	115.9	
Dry density, pcf	81.0	81.0	84.1	
Void ratio	1.1200	1.1200	1.0414	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.148 tsf
 Consolidation back pressure = 4.144 tsf
 Consolidation effective confining stress = 3.004 tsf
 Peak Stress = 2.516 tsf at reading no. 20
 Ult. Stress = 2.516 tsf at reading no. 21

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0101	19.310	0.0	0.0	0.000	3.004	3.004	1.00	4.144	3.004	0.000
1	0.0121	27.400	8.1	0.1	0.379	2.819	3.198	1.13	4.329	3.008	0.189
2	0.0152	39.450	20.1	0.2	0.942	2.428	3.370	1.39	4.720	2.899	0.471
3	0.0285	55.290	36.0	0.7	1.675	1.714	3.389	1.98	5.434	2.551	0.837
4	0.0497	62.280	43.0	1.4	1.985	1.295	3.280	2.53	5.853	2.287	0.992
5	0.0728	64.760	45.5	2.3	2.081	1.117	3.198	2.86	6.031	2.158	1.041
6	0.0876	65.580	46.3	2.8	2.107	1.049	3.156	3.01	6.099	2.103	1.054
7	0.1107	67.850	48.5	3.6	2.192	0.992	3.184	3.21	6.156	2.088	1.096
8	0.1343	68.790	49.5	4.5	2.215	0.959	3.174	3.31	6.189	2.066	1.107
9	0.1577	69.950	50.6	5.3	2.247	0.946	3.193	3.37	6.202	2.069	1.123
10	0.1813	71.550	52.2	6.2	2.297	0.940	3.237	3.44	6.208	2.088	1.148
11	0.2053	72.420	53.1	7.0	2.313	0.941	3.254	3.46	6.207	2.098	1.157
12	0.2293	74.070	54.8	7.9	2.363	0.946	3.309	3.50	6.202	2.128	1.182
13	0.2534	75.180	55.9	8.8	2.388	0.952	3.340	3.51	6.196	2.146	1.194
14	0.2772	76.380	57.1	9.6	2.417	0.964	3.381	3.51	6.184	2.172	1.208
15	0.3019	77.720	58.4	10.5	2.449	0.976	3.425	3.51	6.172	2.200	1.224
16	0.3268	78.760	59.5	11.4	2.468	0.986	3.454	3.50	6.162	2.220	1.234
17	0.3506	79.950	60.6	12.3	2.493	1.001	3.494	3.49	6.147	2.247	1.246
18	0.3755	80.740	61.4	13.2	2.499	1.012	3.511	3.47	6.136	2.262	1.250
19	0.3994	81.700	62.4	14.0	2.513	1.032	3.545	3.44	6.116	2.289	1.257
20	0.4154	82.200	62.9	14.6	2.516	1.034	3.550	3.43	6.114	2.292	1.258
21	0.4250	82.450	63.1	15.0	2.516	1.037	3.553	3.43	6.111	2.295	1.258





Sample No.	1	2	3	
Initial	Water Content, %	28.2	28.1	27.4
	Dry Density, pcf	94.6	96.7	96.2
	Saturation, %	95.1	99.7	96.1
	Void Ratio	0.8147	0.7749	0.7852
	Diameter, in.	1.48	1.46	1.48
Height, in.	3.01	3.06	3.04	
At Test	Water Content, %	29.6	28.2	28.6
	Dry Density, pcf	94.6	96.7	96.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8147	0.7749	0.7852
	Diameter, in.	1.48	1.46	1.48
Height, in.	3.01	3.06	3.04	
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.5	1.0	2.0	
Back Pressure, tsf	6.7	6.2	5.3	
Cell Pressure, tsf	7.2	7.2	7.3	
Peak Deviator Stress, tsf	5.0	6.8	10.8	
Total Pore Pr., tsf	4.9	4.5	1.1	
Ultimate Deviator Stress, tsf	5.0	6.8	10.8	
Total Pore Pr., tsf	4.9	4.5	1.1	
Maj. Eff. Stress at Ultimate, tsf	7.3	9.6	17.1	
Min. Eff. Stress at Ultimate, tsf	2.2	2.7	6.2	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: SILT, brown (ML)

LL= 31

PL= 23

PI= 8

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #3

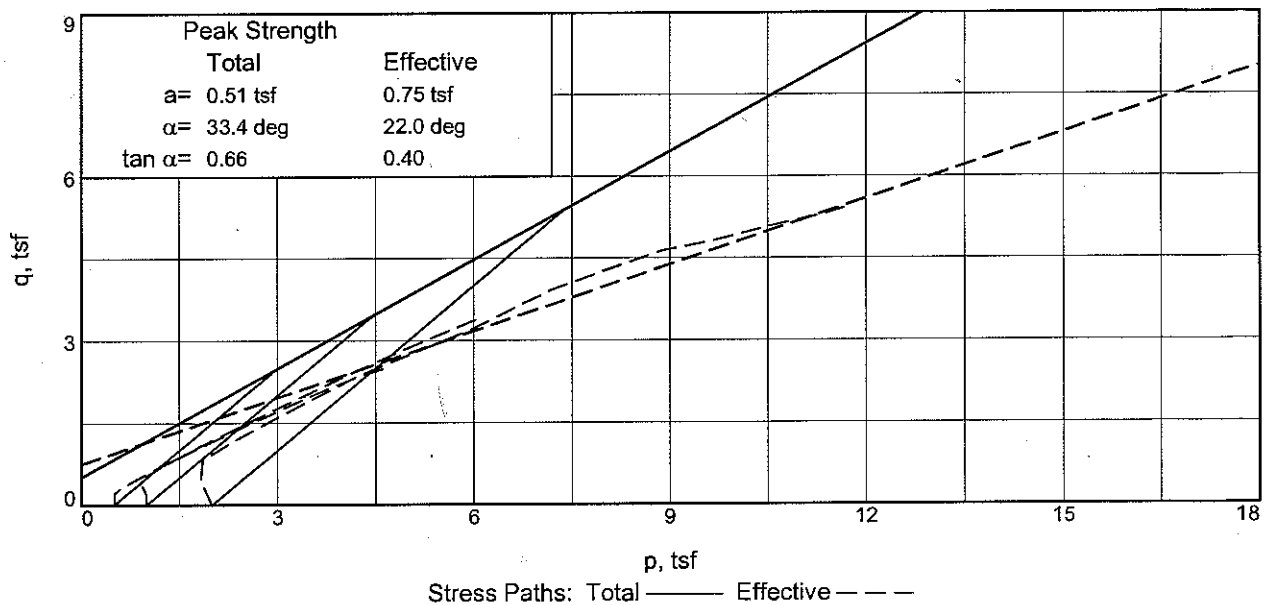
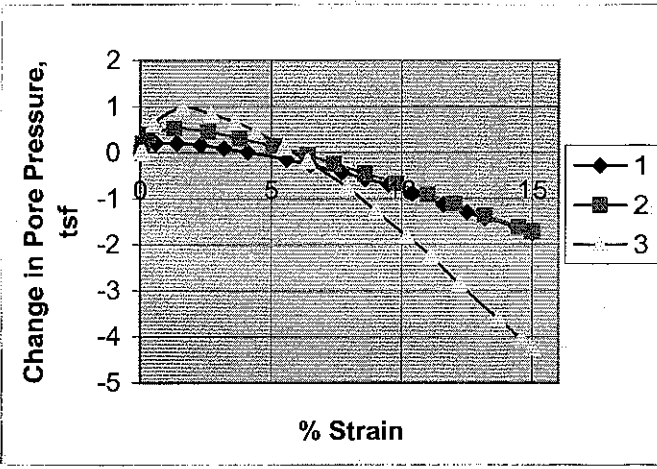
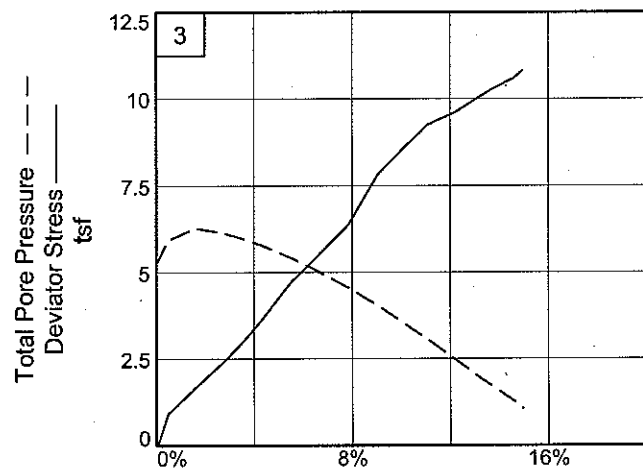
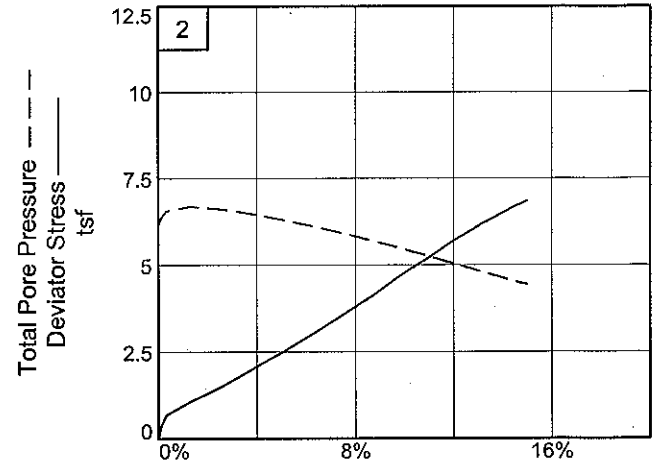
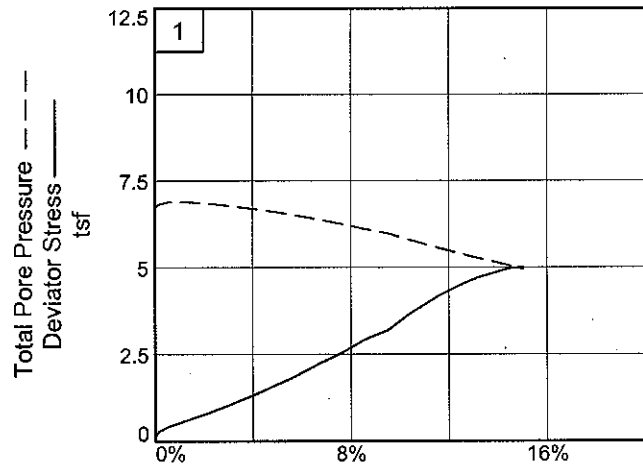
Depth: 20-22'

Poplar River - West Fargo

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 20-22' **Sample Number:** Boring 09-23MU, #3 **Poplar River - West Fargo**

Project No.: BL-09-03127

Figure _____

Braun Intertec

Tested By: jrs

Checked By: rs

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

9/1/2009
4:37 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Depth: 20-22' **Sample Number:** Fargo Boring 09-23MU, #3
Description: SILT, brown (ML) **Poplar River - West Fargo**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	145.890			193.570
Moisture content: Dry soil+tare, gms.	120.540			156.720
Moisture content: Tare, gms.	30.550			30.480
Moisture, %	28.2	29.6	29.6	29.2
Moist specimen weight, gms.	164.5			
Diameter, in.	1.48	1.48	1.48	
Area, in. ²	1.72	1.72	1.72	
Height, in.	3.01	3.01	3.01	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	121.3	122.6	122.6	
Dry density, pcf	94.6	94.6	94.6	
Void ratio	0.8147	0.8147	0.8147	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.186 tsf
Consolidation back pressure = 6.686 tsf
Consolidation effective confining stress = 0.500 tsf
Fail. Stress = 5.017 tsf at reading no. 19
Ult. Stress = 5.017 tsf at reading no. 19

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0176	19.100	0.0	0.0	0.000	0.500	0.500	1.00	6.686	0.500	0.000
1	0.0185	22.210	3.1	0.0	0.130	0.450	0.580	1.29	6.736	0.515	0.065
2	0.0218	25.750	6.6	0.1	0.278	0.366	0.644	1.76	6.820	0.505	0.139
3	0.0343	29.140	10.0	0.6	0.418	0.296	0.714	2.41	6.890	0.505	0.209
4	0.0593	34.020	14.9	1.4	0.617	0.296	0.913	3.08	6.890	0.604	0.308
5	0.0863	39.270	20.2	2.3	0.826	0.340	1.166	3.43	6.846	0.753	0.413
6	0.1129	45.530	26.4	3.2	1.073	0.408	1.481	3.63	6.778	0.944	0.536
7	0.1398	52.300	33.2	4.1	1.335	0.493	1.828	3.71	6.693	1.160	0.667
8	0.1676	59.930	40.8	5.0	1.626	0.580	2.206	3.80	6.606	1.393	0.813
9	0.1846	64.730	45.6	5.6	1.806	0.652	2.458	3.77	6.534	1.555	0.903
10	0.2126	73.880	54.8	6.5	2.147	0.768	2.915	3.80	6.418	1.841	1.073
11	0.2486	85.390	66.3	7.7	2.565	0.931	3.496	3.75	6.255	2.213	1.282
12	0.2763	95.740	76.6	8.6	2.936	1.073	4.009	3.74	6.113	2.541	1.468
13	0.3044	103.670	84.6	9.5	3.206	1.199	4.405	3.67	5.987	2.802	1.603
14	0.3306	116.730	97.6	10.4	3.666	1.389	5.055	3.64	5.797	3.222	1.833
15	0.3673	132.640	113.5	11.6	4.205	1.628	5.833	3.58	5.558	3.731	2.103
16	0.3943	142.220	123.1	12.5	4.514	1.797	6.311	3.51	5.389	4.054	2.257
17	0.4143	148.630	129.5	13.2	4.713	1.919	6.632	3.46	5.267	4.275	2.356
18	0.4511	157.480	138.4	14.4	4.964	2.117	7.081	3.34	5.069	4.599	2.482
19	0.4700	160.000	140.9	15.0	5.017	2.239	7.256	3.24	4.947	4.748	2.509

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.450			194.480
Moisture content: Dry soil+tare, gms.	102.480			158.190
Moisture content: Tare, gms.	31.370			30.280
Moisture, %	28.1	28.2	28.2	28.4
Moist specimen weight, gms.	165.8			
Diameter, in.	1.46	1.46	1.46	
Area, in. ²	1.67	1.67	1.67	
Height, in.	3.06	3.06	3.06	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	123.9	124.0	124.0	
Dry density, pcf	96.7	96.7	96.7	
Void ratio	0.7749	0.7749	0.7749	
Saturation, %	99.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.163 tsf
 Consolidation back pressure = 6.163 tsf
 Consolidation effective confining stress = 1.000 tsf
 Fail. Stress = 6.850 tsf at reading no. 15
 Ult. Stress = 6.850 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0155	18.330	0.0	0.0	0.000	1.000	1.000	1.00	6.163	1.000	0.000
1	0.0194	27.280	9.0	0.1	0.386	0.800	1.186	1.48	6.363	0.993	0.193
2	0.0252	33.900	15.6	0.3	0.670	0.607	1.277	2.10	6.556	0.942	0.335
3	0.0550	43.180	24.9	1.3	1.059	0.468	1.527	3.26	6.695	0.998	0.530
4	0.0941	53.830	35.5	2.6	1.494	0.549	2.043	3.72	6.614	1.296	0.747
5	0.1330	66.890	48.6	3.8	2.016	0.692	2.708	3.91	6.471	1.700	1.008
6	0.1719	80.050	61.7	5.1	2.529	0.862	3.391	3.93	6.301	2.126	1.264
7	0.2098	93.780	75.5	6.4	3.051	1.054	4.105	3.89	6.109	2.580	1.526
8	0.2426	107.030	88.7	7.4	3.546	1.240	4.786	3.86	5.923	3.013	1.773
9	0.2794	121.980	103.7	8.6	4.090	1.451	5.541	3.82	5.712	3.496	2.045
10	0.3144	138.430	120.1	9.8	4.679	1.665	6.344	3.81	5.498	4.005	2.340
11	0.3522	154.550	136.2	11.0	5.235	1.908	7.143	3.74	5.255	4.525	2.617
12	0.3813	167.830	149.5	12.0	5.684	2.103	7.787	3.70	5.060	4.945	2.842
13	0.4191	183.790	165.5	13.2	6.202	2.363	8.565	3.62	4.800	5.464	3.101
14	0.4580	199.080	180.8	14.5	6.676	2.613	9.289	3.55	4.550	5.951	3.338
15	0.4750	205.000	186.7	15.0	6.850	2.711	9.560	3.53	4.452	6.135	3.425

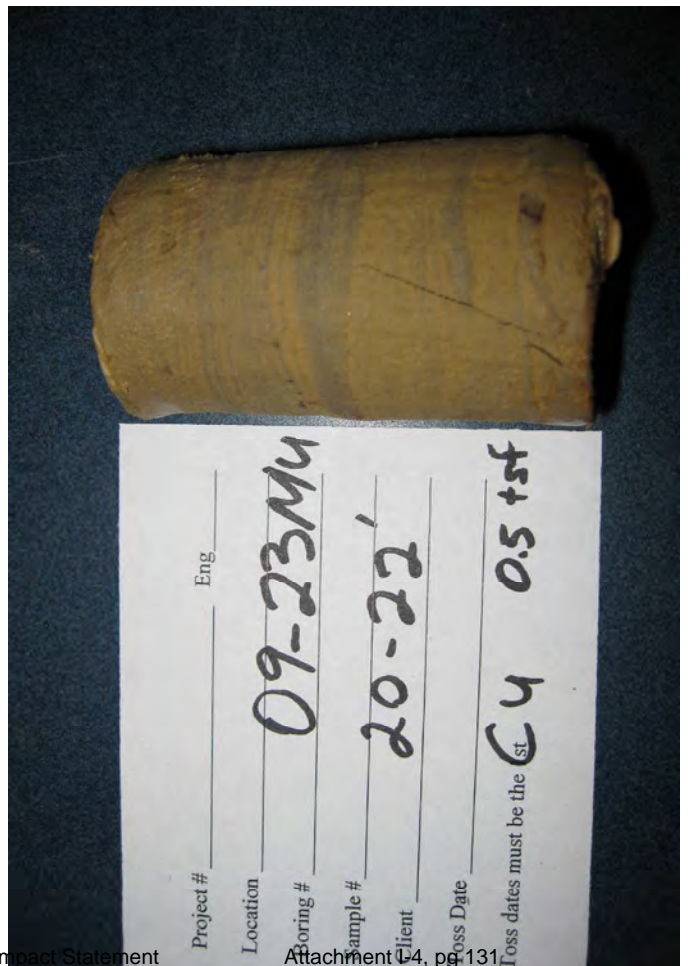
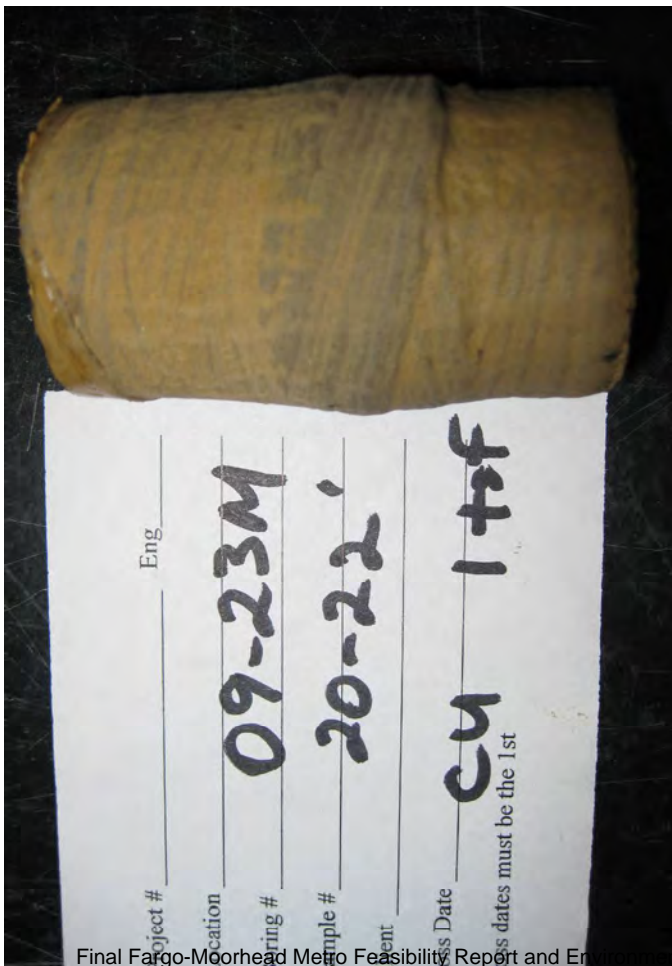
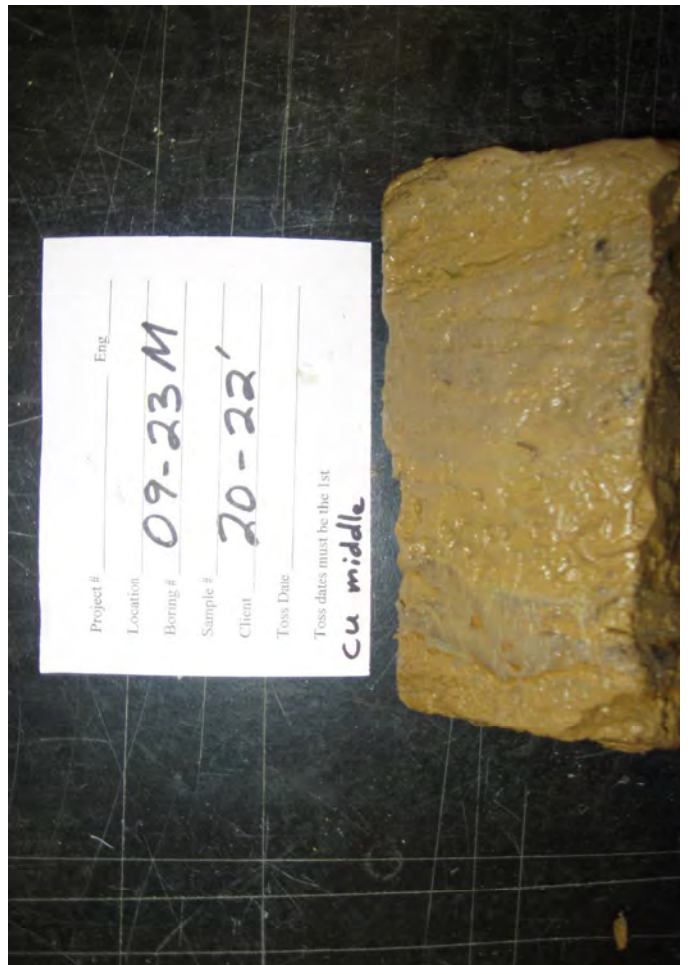
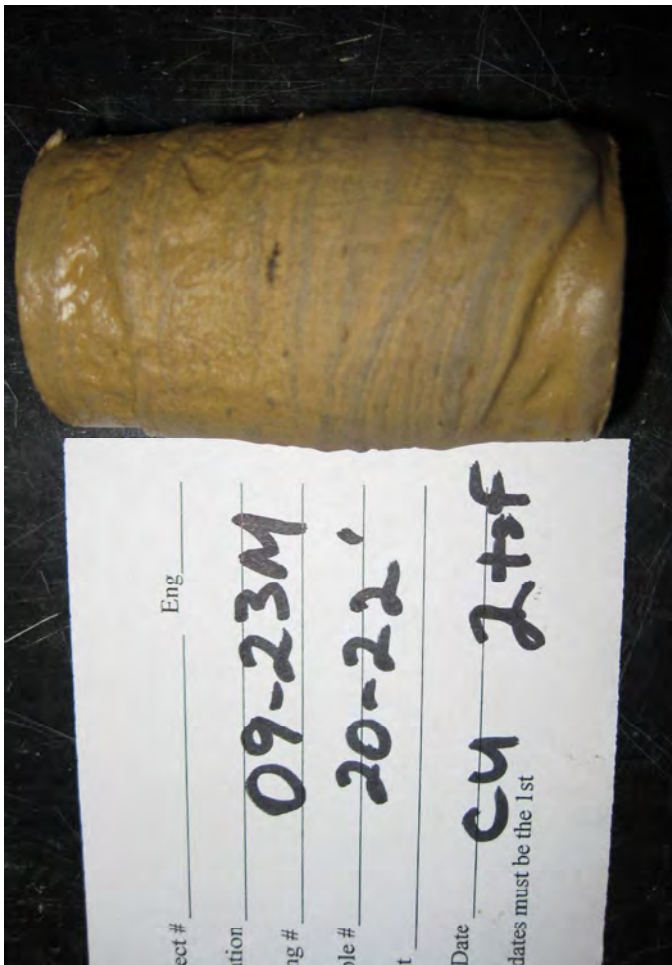
Parameters for Specimen No. 3

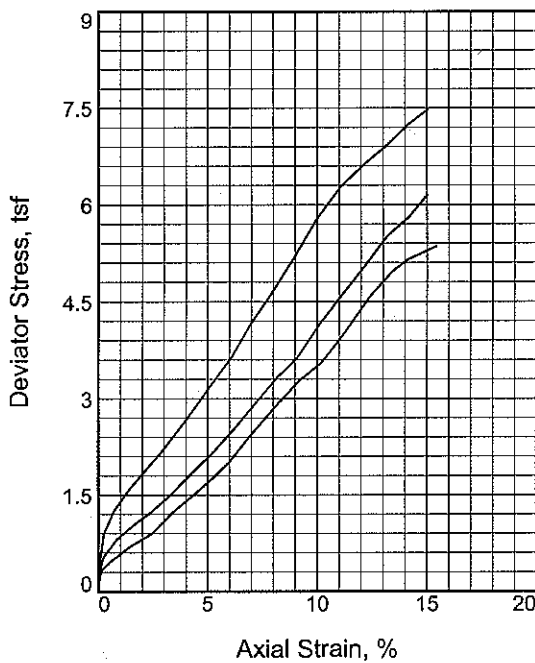
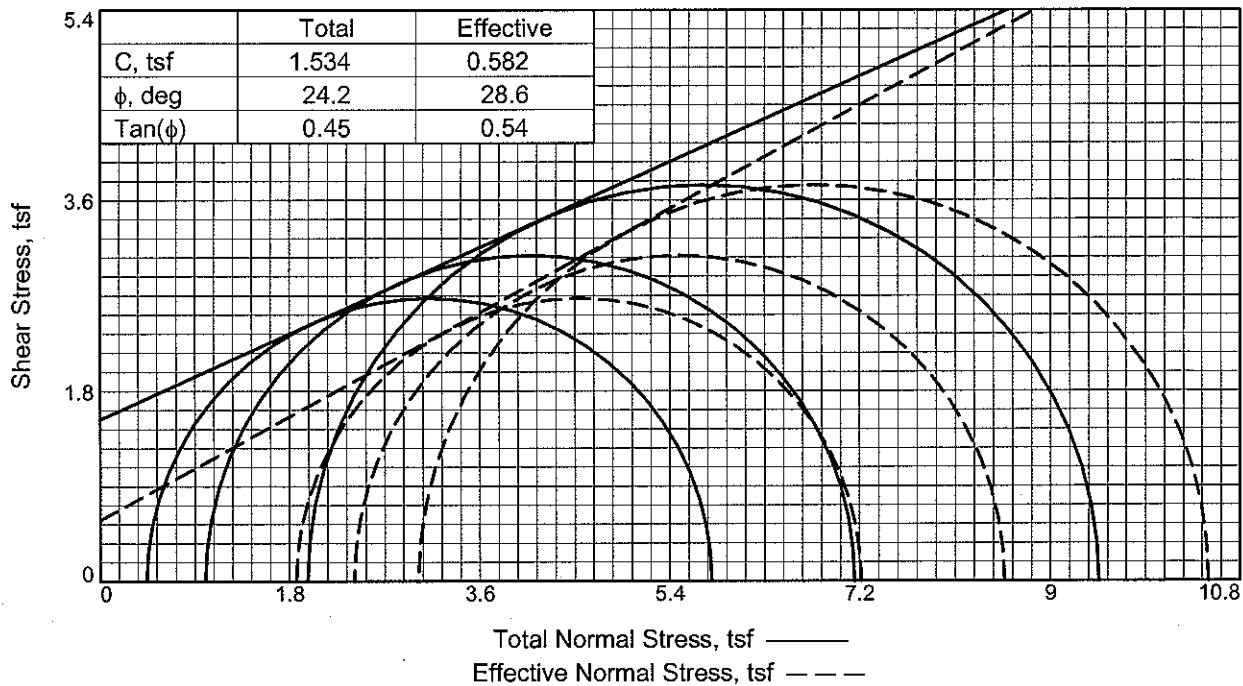
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	103.050			197.050
Moisture content: Dry soil+tare, gms.	87.410			161.910
Moisture content: Tare, gms.	30.410			31.040
Moisture, %	27.4	28.6	28.6	26.9
Moist specimen weight, gms.	168.2			
Diameter, in.	1.48	1.48	1.48	
Area, in. ²	1.72	1.72	1.72	
Height, in.	3.04	3.04	3.04	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	122.6	123.6	123.6	
Dry density, pcf	96.2	96.2	96.2	
Void ratio	0.7852	0.7852	0.7852	
Saturation, %	96.1	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.309 tsf
 Consolidation back pressure = 5.309 tsf
 Consolidation effective confining stress = 2.000 tsf
 Fail. Stress = 10.831 tsf at reading no. 16
 Ult. Stress = 10.831 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0252	23.860	0.0	0.0	0.000	2.000	2.000	1.00	5.309	2.000	0.000
1	0.0274	24.190	0.3	0.1	0.014	1.990	2.004	1.01	5.319	1.997	0.007
2	0.0401	45.560	21.7	0.5	0.904	1.378	2.282	1.66	5.931	1.830	0.452
3	0.0740	64.210	40.3	1.6	1.662	1.025	2.687	2.62	6.284	1.856	0.831
4	0.1080	82.280	58.4	2.7	2.378	1.161	3.539	3.05	6.148	2.350	1.189
5	0.1338	98.180	74.3	3.6	2.999	1.340	4.339	3.24	5.969	2.840	1.500
6	0.1578	115.180	91.3	4.4	3.655	1.533	5.188	3.38	5.776	3.361	1.828
7	0.1926	143.070	119.2	5.5	4.714	1.879	6.593	3.51	5.430	4.236	2.357
8	0.2195	159.914	136.1	6.4	5.330	2.186	7.516	3.44	5.123	4.851	2.665
9	0.2644	189.610	165.8	7.9	6.391	2.752	9.143	3.32	4.557	5.948	3.196
10	0.3003	229.620	205.8	9.0	7.832	3.264	11.096	3.40	4.045	7.180	3.916
11	0.3353	254.270	230.4	10.2	8.660	3.817	12.477	3.27	3.492	8.147	4.330
12	0.3622	272.810	248.9	11.1	9.264	4.245	13.509	3.18	3.064	8.877	4.632
13	0.3971	286.190	262.3	12.2	9.636	4.850	14.486	2.99	2.459	9.668	4.818
14	0.4422	308.910	285.1	13.7	10.294	5.610	15.904	2.83	1.699	10.757	5.147
15	0.4680	320.048	296.2	14.6	10.591	6.033	16.624	2.76	1.276	11.328	5.295
16	0.4800	328.190	304.3	15.0	10.831	6.245	17.076	2.73	1.065	11.660	5.416





Sample No.	1	2	3	
Initial	Water Content, %	28.5	27.7	29.1
	Dry Density, pcf	96.2	97.4	95.3
	Saturation, %	99.9	99.8	100.0
	Void Ratio	0.7841	0.7629	0.8006
	Diameter, in.	1.39	1.41	1.39
At Test	Height, in.	2.81	2.81	2.80
	Water Content, %	28.5	27.7	29.1
	Dry Density, pcf	96.2	97.4	95.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7841	0.7629	0.8006
Pore Pressure Parameter B	Diameter, in.	1.39	1.41	1.39
	Height, in.	2.81	2.81	2.80
	Consolidation Pressure, tsf	1.0	1.0	1.0
	Back Pressure, tsf	0.4	1.0	2.0
	Cell Pressure, tsf	6.7	6.1	5.2
	Peak Deviator Stress, tsf	7.1	7.1	7.1
	Total Pore Pr., tsf	5.4	6.2	7.5
	Ultimate Deviator Stress, tsf	5.3	4.7	4.1
	Total Pore Pr., tsf	5.4	6.2	7.5
	Maj. Eff. Stress at Ultimate, tsf	5.3	4.7	4.1
Min. Eff. Stress at Ultimate, tsf	7.2	8.6	10.5	
	1.9	2.4	3.0	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: SILT, layers of clay, gray-brown (ML)

LL= 30 PL= 24 PI= 6

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

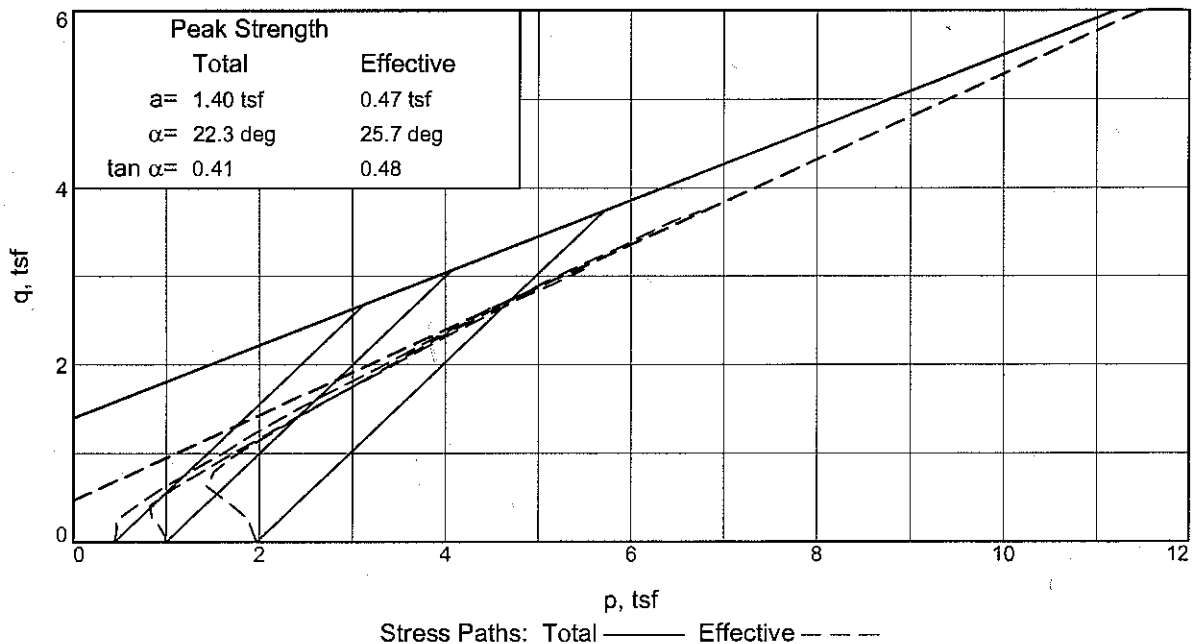
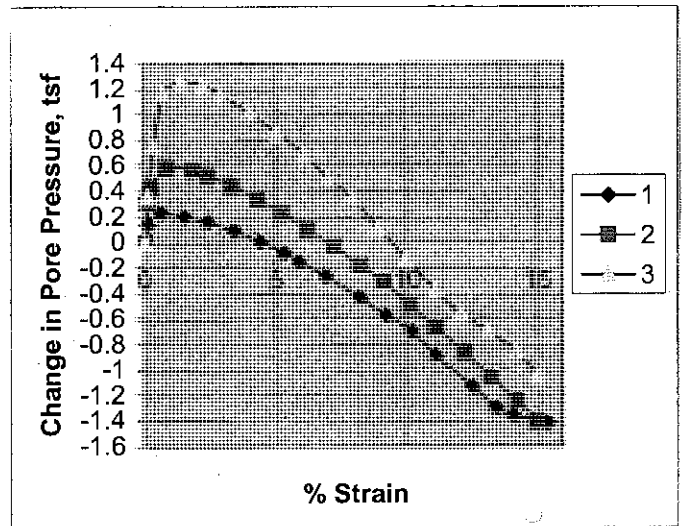
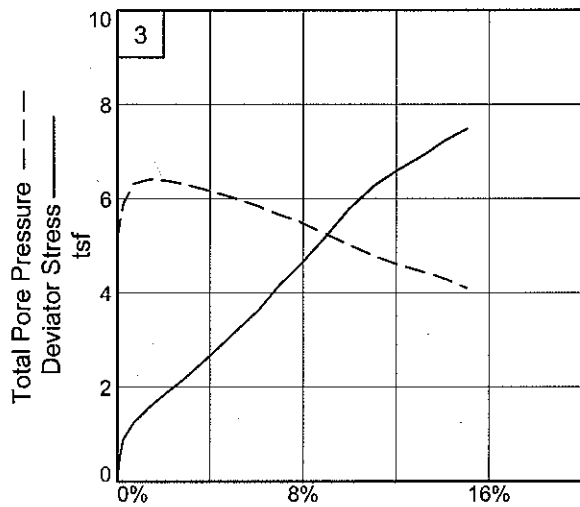
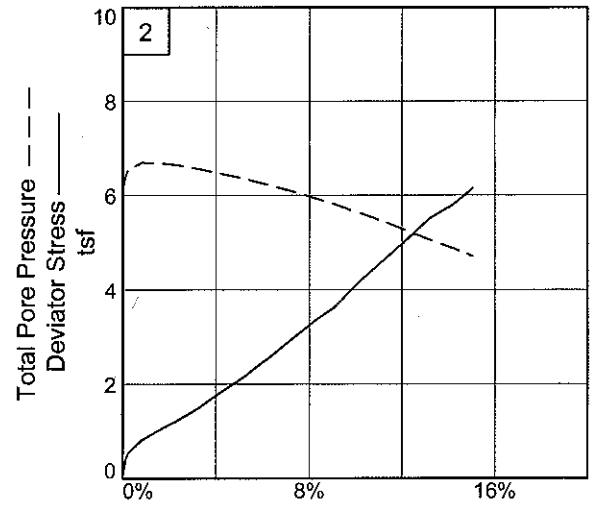
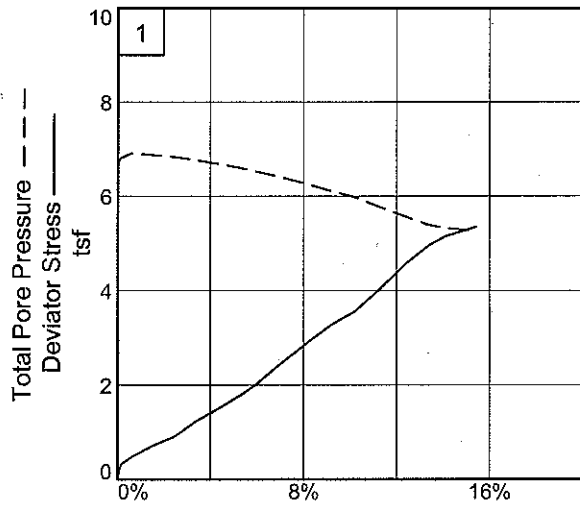
Sample Number: Boring 09-25MU, #2 **Depth:** 21-23'

Poplar River - West Fargo

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 21-23' **Sample Number:** Boring 09-25MU, #2

Poplar River - West Fargo

Project No. B109-03-M27
 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement
 July 2011

Braun Intertec
 Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

9/14/2009

4:26 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 Moorhead
Depth: 21-23' **Sample Number:** Boring 09-25MU, #2
Description: SILT, layers of clay, gray-brown (ML) Poplar River - West Fargo
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**30 **PL=**24 **PI=**6
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.480			166.550
Moisture content: Dry soil+tare, gms.	90.410			137.250
Moisture content: Tare, gms.	30.470			29.940
Moisture, %	28.5	28.5	28.5	27.3
Moist specimen weight, gms.	138.1			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	123.6	123.7	123.7	
Dry density, pcf	96.2	96.2	96.2	
Void ratio	0.7841	0.7841	0.7841	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.130 tsf
Consolidation back pressure = 6.686 tsf
Consolidation effective confining stress = 0.444 tsf
Fail. Stress = 5.353 tsf at reading no. 18
Ult. Stress = 5.353 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0176	19.100	0.0	0.0	0.000	0.444	0.444	1.00	6.686	0.444	0.000
1	0.0185	22.180	3.1	0.0	0.146	0.388	0.534	1.38	6.742	0.461	0.073
2	0.0218	25.950	6.8	0.1	0.325	0.309	0.634	2.05	6.821	0.471	0.162
3	0.0343	29.240	10.1	0.6	0.479	0.220	0.699	3.18	6.910	0.459	0.239
4	0.0593	34.210	15.1	1.5	0.707	0.250	0.957	3.83	6.880	0.604	0.354
5	0.0863	38.520	19.4	2.4	0.900	0.291	1.191	4.09	6.839	0.741	0.450
6	0.1129	45.910	26.8	3.4	1.231	0.361	1.592	4.41	6.769	0.976	0.615
7	0.1398	52.150	33.0	4.4	1.502	0.443	1.945	4.39	6.687	1.194	0.751
8	0.1676	58.930	39.8	5.3	1.791	0.531	2.322	4.37	6.599	1.427	0.896
9	0.1846	63.950	44.9	5.9	2.004	0.601	2.605	4.34	6.529	1.603	1.002
10	0.2126	74.010	54.9	6.9	2.428	0.713	3.141	4.41	6.417	1.927	1.214
11	0.2486	86.120	67.0	8.2	2.923	0.880	3.803	4.32	6.250	2.341	1.461
12	0.2763	95.280	76.2	9.2	3.286	1.019	4.305	4.23	6.111	2.662	1.643
13	0.3044	102.570	83.5	10.2	3.561	1.144	4.705	4.11	5.986	2.925	1.781
14	0.3306	113.240	94.1	11.1	3.975	1.334	5.309	3.98	5.796	3.321	1.987
15	0.3673	129.640	110.5	12.5	4.598	1.573	6.171	3.92	5.557	3.872	2.299
16	0.3943	139.720	120.6	13.4	4.963	1.742	6.705	3.85	5.388	4.223	2.481
17	0.4143	145.390	126.3	14.1	5.153	1.802	6.955	3.86	5.328	4.379	2.577
18	0.4511	152.310	133.2	15.4	5.353	1.864	7.217	3.87	5.266	4.540	2.676

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.300			172.910
Moisture content: Dry soil+tare, gms.	90.650			141.820
Moisture content: Tare, gms.	30.500			30.510
Moisture, %	27.7	27.7	27.7	27.9
Moist specimen weight, gms.	142.6			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	124.3	124.4	124.4	
Dry density, pcf	97.4	97.4	97.4	
Void ratio	0.7629	0.7629	0.7629	
Saturation, %	99.8	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.125 tsf
 Consolidation back pressure = 6.124 tsf
 Consolidation effective confining stress = 1.001 tsf
 Fail. Stress = 6.154 tsf at reading no. 19
 Ult. Stress = 6.154 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0117	19.950	0.0	0.0	0.000	1.001	1.001	1.00	6.124	1.001	0.000
1	0.0128	22.850	2.9	0.0	0.134	0.924	1.058	1.15	6.201	0.991	0.067
2	0.0156	29.080	9.1	0.1	0.422	0.696	1.118	1.61	6.429	0.907	0.211
3	0.0187	31.700	11.8	0.2	0.542	0.580	1.122	1.93	6.545	0.851	0.271
4	0.0355	37.620	17.7	0.8	0.810	0.421	1.231	2.92	6.704	0.826	0.405
5	0.0614	43.670	23.7	1.8	1.077	0.443	1.520	3.43	6.682	0.982	0.539
6	0.0783	47.120	27.2	2.4	1.227	0.480	1.707	3.56	6.645	1.093	0.613
7	0.1044	53.590	33.6	3.3	1.504	0.567	2.071	3.65	6.558	1.319	0.752
8	0.1312	61.490	41.5	4.3	1.839	0.666	2.505	3.76	6.459	1.586	0.920
9	0.1588	69.400	49.5	5.2	2.167	0.772	2.939	3.81	6.353	1.855	1.083
10	0.1868	78.700	58.8	6.2	2.547	0.899	3.446	3.83	6.226	2.173	1.274
11	0.2138	88.380	68.4	7.2	2.936	1.029	3.965	3.85	6.096	2.497	1.468
12	0.2416	98.480	78.5	8.2	3.334	1.178	4.512	3.83	5.947	2.845	1.667
13	0.2666	106.300	86.3	9.1	3.630	1.307	4.937	3.78	5.818	3.122	1.815
14	0.2954	119.790	99.8	10.1	4.150	1.497	5.647	3.77	5.628	3.572	2.075
15	0.3245	132.270	112.3	11.1	4.615	1.672	6.287	3.76	5.453	3.979	2.307
16	0.3532	144.260	124.3	12.2	5.049	1.866	6.915	3.71	5.259	4.390	2.524
17	0.3813	157.140	137.2	13.2	5.508	2.061	7.569	3.67	5.064	4.815	2.754
18	0.4094	166.240	146.3	14.2	5.806	2.242	8.048	3.59	4.883	5.145	2.903
19	0.4333	176.560	156.6	15.0	6.154	2.411	8.565	3.55	4.714	5.488	3.077

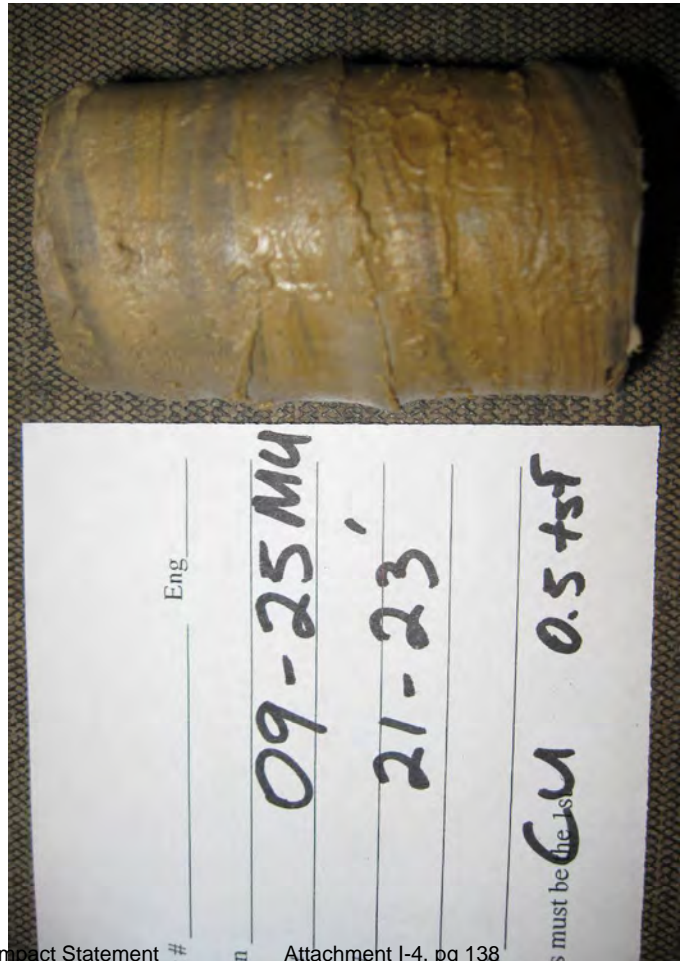
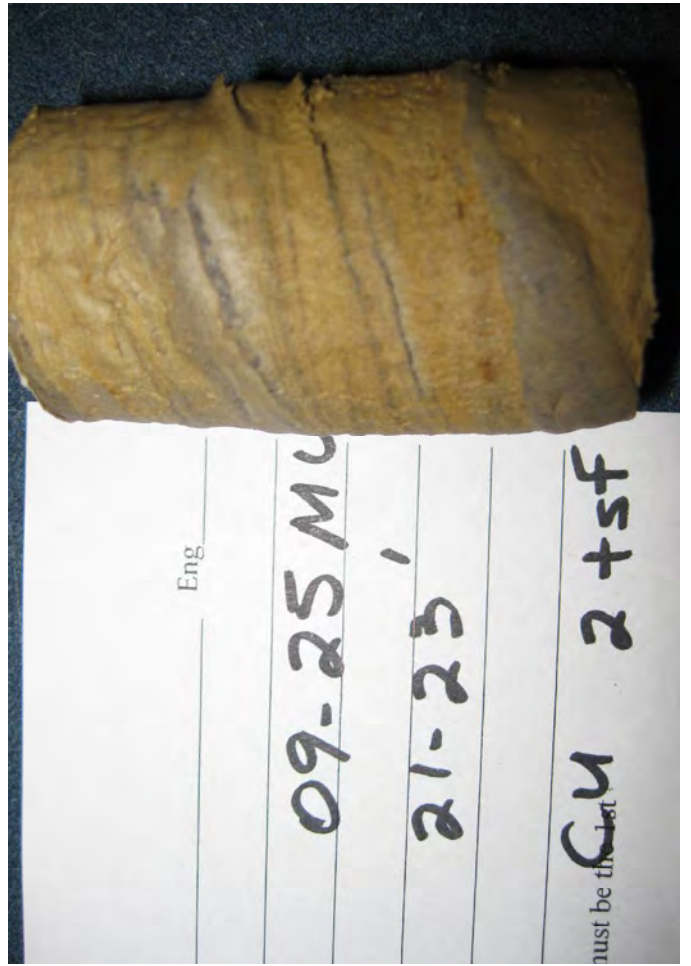
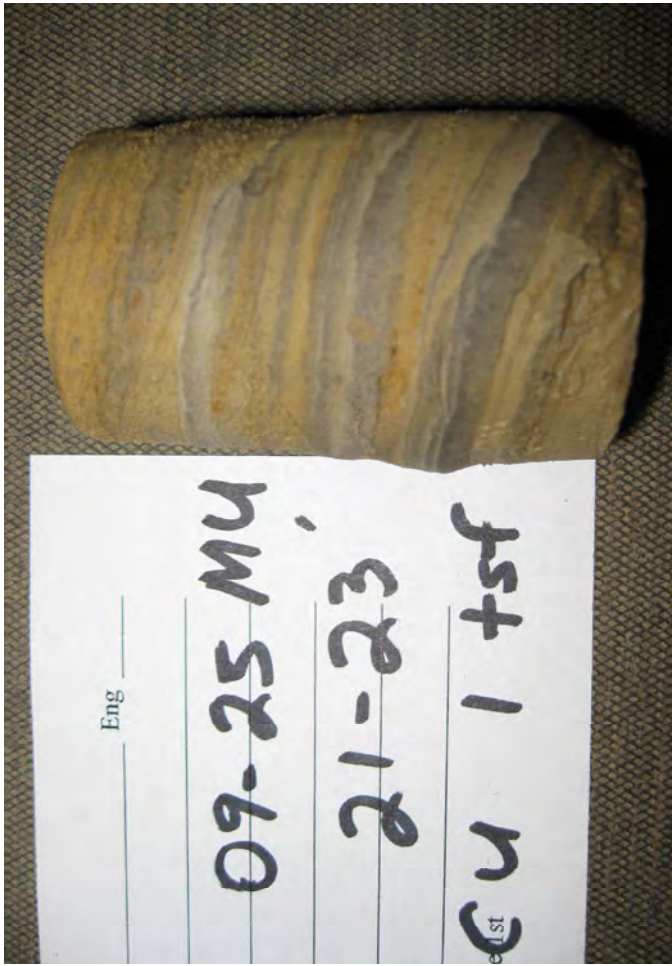
Parameters for Specimen No. 3

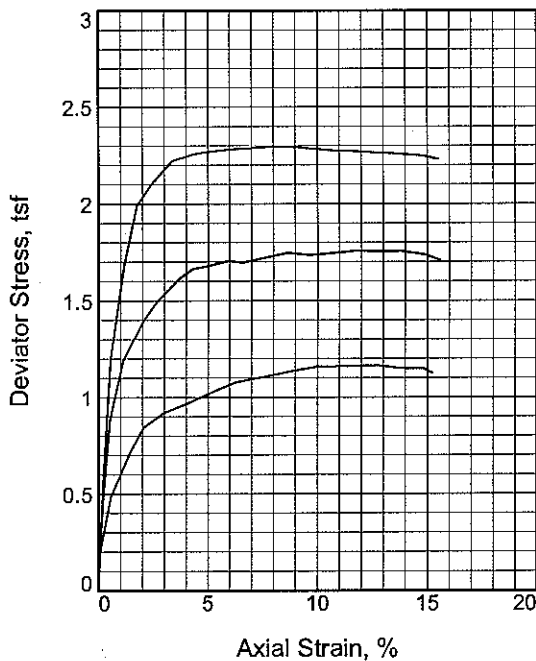
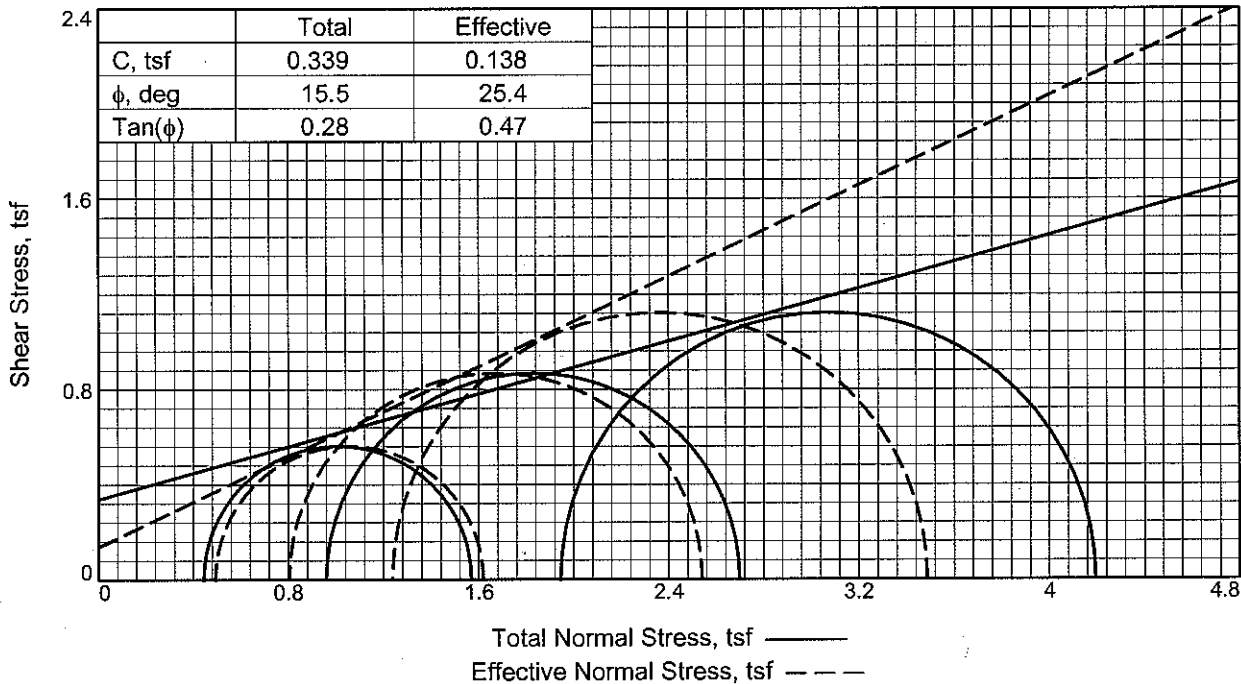
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	139.650			165.260
Moisture content: Dry soil+tare, gms.	115.250			136.420
Moisture content: Tare, gms.	31.470			30.630
Moisture, %	29.1	29.1	29.1	27.3
Moist specimen weight, gms.	136.7			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.51	1.51	1.51	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	123.1	123.1	123.1	
Dry density, pcf	95.3	95.3	95.3	
Void ratio	0.8006	0.8006	0.8006	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.127 tsf
 Consolidation back pressure = 5.156 tsf
 Consolidation effective confining stress = 1.971 tsf
 Fail. Stress = 7.483 tsf at reading no. 18
 Ult. Stress = 7.483 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0067	17.780	0.0	0.0	0.000	1.971	1.971	1.00	5.156	1.971	0.000
1	0.0097	28.830	11.0	0.1	0.526	1.615	2.141	1.33	5.512	1.878	0.263
2	0.0137	36.490	18.7	0.3	0.889	1.225	2.114	1.73	5.902	1.670	0.445
3	0.0265	44.310	26.5	0.7	1.255	0.807	2.062	2.56	6.320	1.435	0.628
4	0.0463	51.630	33.9	1.4	1.590	0.715	2.305	3.22	6.412	1.510	0.795
5	0.0672	58.410	40.6	2.2	1.894	0.745	2.639	3.54	6.382	1.692	0.947
6	0.0872	64.730	47.0	2.9	2.173	0.819	2.992	3.65	6.308	1.905	1.086
7	0.1181	75.870	58.1	4.0	2.658	0.962	3.620	3.76	6.165	2.291	1.329
8	0.1477	87.400	69.6	5.0	3.151	1.112	4.263	3.83	6.015	2.687	1.575
9	0.1778	99.490	81.7	6.1	3.656	1.293	4.949	3.83	5.834	3.121	1.828
10	0.2026	111.880	94.1	7.0	4.170	1.473	5.643	3.83	5.654	3.558	2.085
11	0.2275	122.780	105.0	7.9	4.609	1.626	6.235	3.83	5.501	3.930	2.304
12	0.2565	136.820	119.0	8.9	5.167	1.864	7.031	3.77	5.263	4.447	2.583
13	0.2863	152.630	134.8	10.0	5.784	2.104	7.888	3.75	5.023	4.996	2.892
14	0.3164	165.840	148.1	11.1	6.275	2.344	8.619	3.68	4.783	5.482	3.138
15	0.3454	175.700	157.9	12.1	6.615	2.528	9.143	3.62	4.599	5.836	3.308
16	0.3742	184.700	166.9	13.1	6.910	2.666	9.576	3.59	4.461	6.121	3.455
17	0.4030	194.990	177.2	14.2	7.249	2.829	10.078	3.56	4.298	6.454	3.625
18	0.4280	202.620	184.8	15.0	7.483	3.020	10.503	3.48	4.107	6.761	3.741





Sample No.	1	2	3	
Initial	Water Content, %	36.0	37.0	36.7
	Dry Density, pcf	83.1	83.2	82.0
	Saturation, %	92.9	95.7	92.3
	Void Ratio	1.0666	1.0631	1.0939
	Diameter, in.	1.37	1.39	1.40
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	38.8	38.7	39.8
	Dry Density, pcf	83.1	83.2	82.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0666	1.0631	1.0939
	Diameter, in.	1.37	1.39	1.40
	Height, in.	2.81	2.81	2.81
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.44	0.96	1.95	
Back Pressure, tsf	5.39	5.38	4.82	
Cell Pressure, tsf	5.83	6.34	6.77	
Peak Deviator Stress, tsf	1.17	1.76	2.30	
Total Pore Pr., tsf	5.37	5.59	5.74	
Ultimate Deviator Stress, tsf	1.13	1.74	2.25	
Total Pore Pr., tsf	5.34	5.54	5.53	
Maj. Eff. Stress at Ultimate, tsf	1.62	2.54	3.49	
Min. Eff. Stress at Ultimate, tsf	0.49	0.80	1.24	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY with layers of Silt, gray (CH)

LL= 83 PL= 20 PI= 63

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

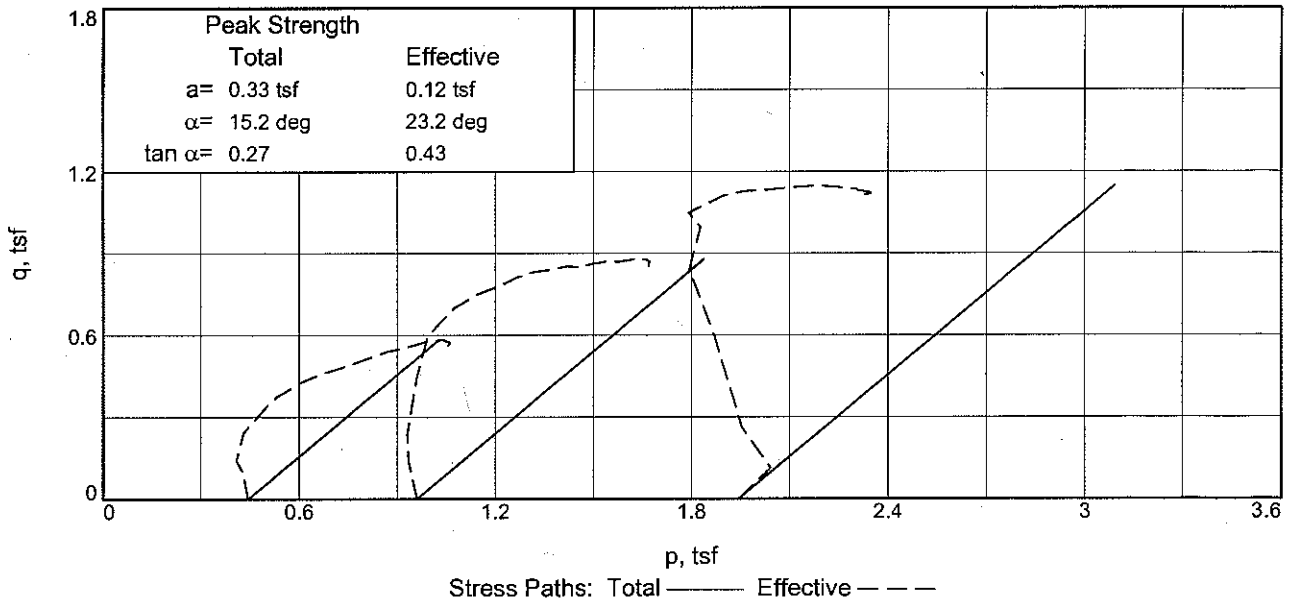
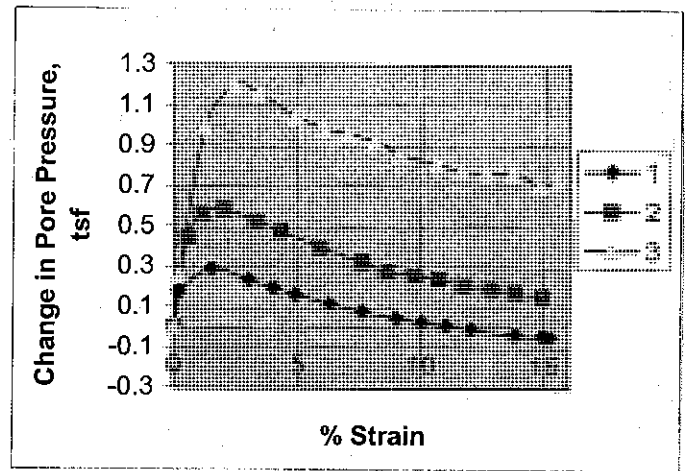
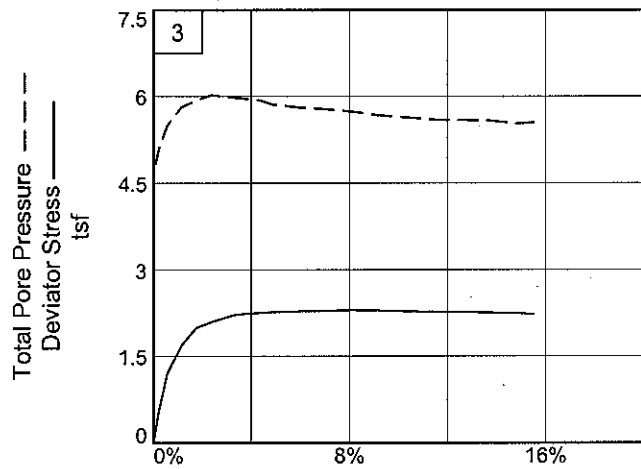
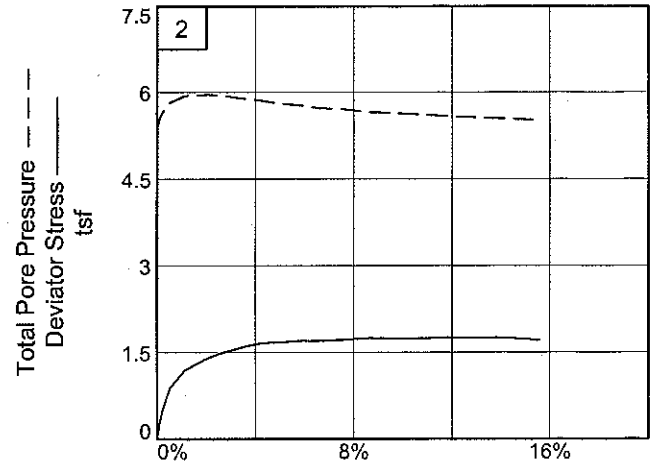
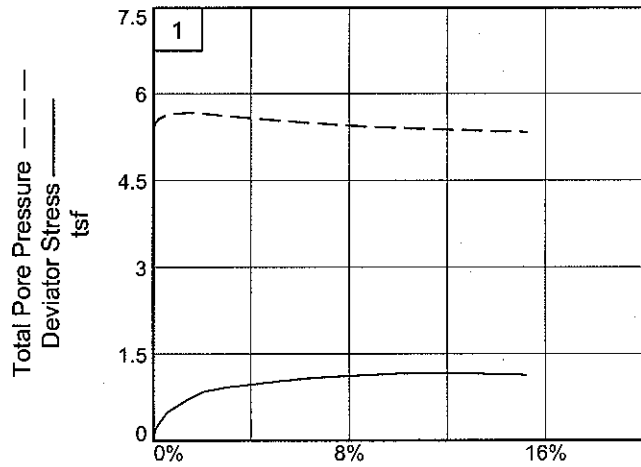
Sample Number: Boring 09-23MU, #4 **Depth:** 28-30'

Poplar River - Harwood

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 28-30' **Sample Number:** Boring 09-23MU, #4 **Poplar River - Harwood**

Project No.: BL-09-03127

Figure _____

Braun Intertec

Tested By: jrs

Checked By: rs

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

8/31/2009

3:51 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 Fargo
Depth: 28-30' **Sample Number:** Boring 09-23MU, #4
Description: FAT CLAY with layers of Silt, gray (CH) Poplar River - Harwood
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Type of Sample: Thinwall, 5", Middle of sample

Assumed Specific Gravity=2.75 **LL**=83 **PL**=20 **PI**=63

Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	85.750			382.010
Moisture content: Dry soil+tare, gms.	71.140			348.720
Moisture content: Tare, gms.	30.570			262.280
Moisture, %	36.0	38.8	38.8	38.5
Moist specimen weight, gms.	122.5			
Diameter, in.	1.37	1.37	1.37	
Area, in. ²	1.47	1.47	1.47	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.0	115.3	115.3	
Dry density, pcf	83.1	83.1	83.1	
Void ratio	1.0666	1.0666	1.0666	
Saturation, %	92.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 5.831 tsf
Consolidation back pressure = 5.387 tsf
Consolidation effective confining stress = 0.444 tsf
Fail. Stress = 1.125 tsf at reading no. 18
Ult. Stress = 1.125 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0771	16.230	0.0	0.0	0.000	0.444	0.444	1.00	5.387	0.444	0.000
1	0.0792	20.170	3.9	0.1	0.193	0.333	0.526	1.58	5.498	0.429	0.096
2	0.0831	21.970	5.7	0.2	0.280	0.269	0.549	2.04	5.562	0.409	0.140
3	0.0931	26.180	9.9	0.6	0.484	0.188	0.672	3.57	5.643	0.430	0.242
4	0.1178	31.090	14.9	1.5	0.716	0.156	0.872	5.59	5.675	0.514	0.358
5	0.1349	33.870	17.6	2.1	0.845	0.172	1.017	5.91	5.659	0.595	0.423
6	0.1617	35.670	19.4	3.0	0.922	0.212	1.134	5.35	5.619	0.673	0.461
7	0.1886	36.770	20.5	4.0	0.965	0.251	1.216	4.84	5.580	0.733	0.482
8	0.2156	38.050	21.8	4.9	1.015	0.284	1.299	4.57	5.547	0.791	0.507
9	0.2535	39.760	23.5	6.3	1.079	0.329	1.408	4.28	5.502	0.868	0.539
10	0.2904	40.740	24.5	7.6	1.108	0.366	1.474	4.03	5.465	0.920	0.554
11	0.3284	41.800	25.6	9.0	1.139	0.399	1.538	3.85	5.432	0.968	0.569
12	0.3572	42.570	26.3	10.0	1.160	0.418	1.578	3.77	5.413	0.998	0.580
13	0.3861	42.900	26.7	11.0	1.161	0.435	1.596	3.67	5.396	1.015	0.580
14	0.4150	43.270	27.0	12.0	1.163	0.452	1.615	3.57	5.379	1.034	0.582
15	0.4346	43.540	27.3	12.7	1.166	0.458	1.624	3.54	5.373	1.041	0.583
16	0.4640	43.500	27.3	13.8	1.150	0.480	1.630	3.40	5.351	1.055	0.575
17	0.4939	43.800	27.6	14.9	1.148	0.487	1.635	3.36	5.344	1.061	0.574
18	0.5040	43.360	27.1	15.2	1.125	0.493	1.618	3.28	5.338	1.056	0.563

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	121.670			388.410
Moisture content: Dry soil+tare, gms.	97.090			354.910
Moisture content: Tare, gms.	30.650			262.280
Moisture, %	37.0	38.7	38.7	36.2
Moist specimen weight, gms.	126.7			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.51	1.51	1.51	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.0	115.4	115.4	
Dry density, pcf	83.2	83.2	83.2	
Void ratio	1.0631	1.0631	1.0631	
Saturation, %	95.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 6.340 tsf
 Consolidation back pressure = 5.380 tsf
 Consolidation effective confining stress = 0.960 tsf
 Fail. Stress = 1.738 tsf at reading no. 20
 Ult. Stress = 1.738 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0056	16.530	0.0	0.0	0.000	0.960	0.960	1.00	5.380	0.960	0.000
1	0.0087	22.360	5.8	0.1	0.278	0.795	1.073	1.35	5.545	0.934	0.139
2	0.0115	26.570	10.0	0.2	0.478	0.691	1.169	1.69	5.649	0.930	0.239
3	0.0204	35.150	18.6	0.5	0.884	0.517	1.401	2.71	5.823	0.959	0.442
4	0.0372	41.770	25.2	1.1	1.191	0.396	1.587	4.01	5.944	0.991	0.595
5	0.0631	46.410	29.9	2.0	1.397	0.374	1.771	4.73	5.966	1.072	0.698
6	0.0811	48.820	32.3	2.7	1.499	0.394	1.893	4.81	5.946	1.144	0.750
7	0.0989	50.560	34.0	3.3	1.570	0.435	2.005	4.61	5.905	1.220	0.785
8	0.1079	51.570	35.0	3.6	1.611	0.450	2.061	4.58	5.890	1.256	0.806
9	0.1259	52.940	36.4	4.3	1.663	0.484	2.147	4.44	5.856	1.316	0.832
10	0.1437	53.500	37.0	4.9	1.677	0.526	2.203	4.19	5.814	1.365	0.839
11	0.1719	54.500	38.0	5.9	1.705	0.567	2.272	4.01	5.773	1.419	0.852
12	0.1905	54.600	38.1	6.6	1.697	0.608	2.305	3.79	5.732	1.457	0.849
13	0.2195	55.570	39.0	7.6	1.721	0.634	2.355	3.71	5.706	1.495	0.861
14	0.2484	56.610	40.1	8.6	1.747	0.684	2.431	3.55	5.656	1.558	0.874
15	0.2774	56.800	40.3	9.7	1.736	0.701	2.437	3.48	5.639	1.569	0.868
16	0.3053	57.460	40.9	10.7	1.745	0.722	2.467	3.42	5.618	1.594	0.872
17	0.3351	58.220	41.7	11.7	1.756	0.750	2.506	3.34	5.590	1.628	0.878
18	0.3642	58.650	42.1	12.8	1.753	0.766	2.519	3.29	5.574	1.643	0.877
19	0.3939	59.200	42.7	13.8	1.755	0.785	2.540	3.24	5.555	1.662	0.877
20	0.4240	59.320	42.8	14.9	1.738	0.803	2.541	3.16	5.537	1.672	0.869
21	0.4429	58.960	42.4	15.6	1.709	0.814	2.523	3.10	5.526	1.669	0.855

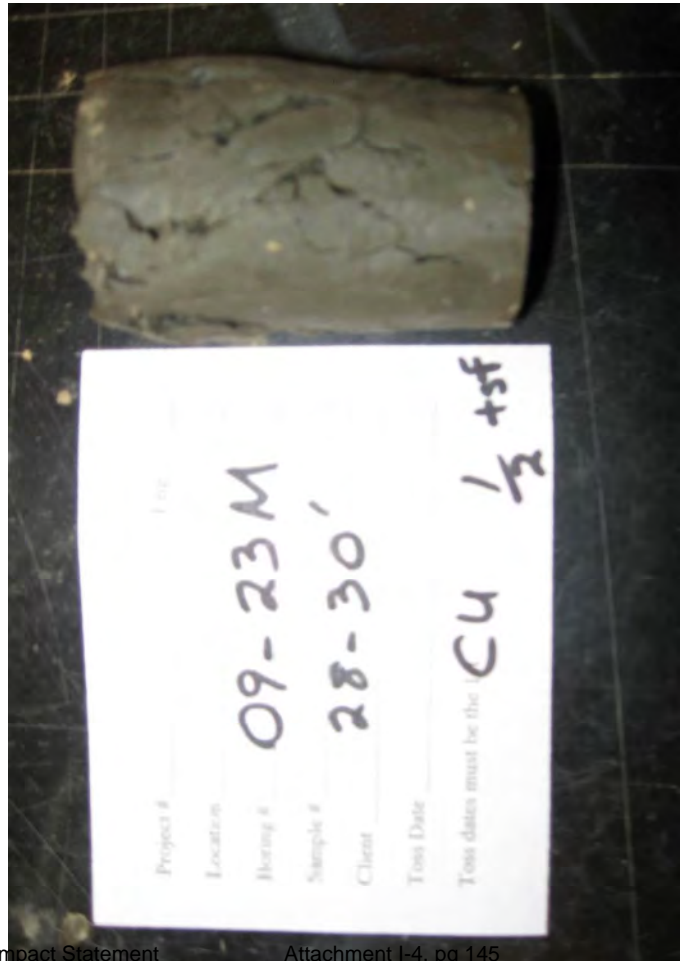
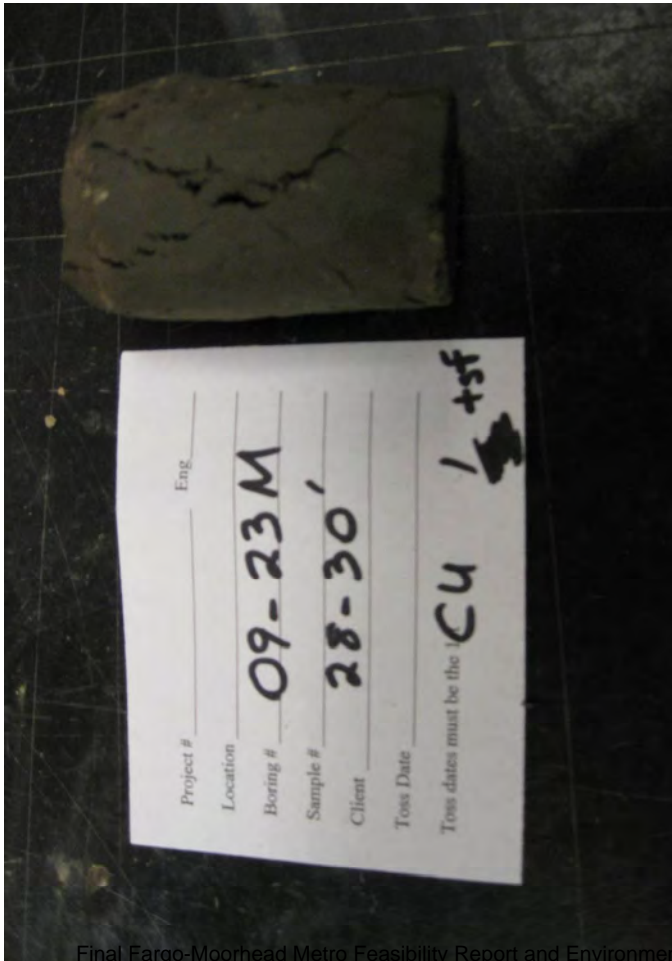
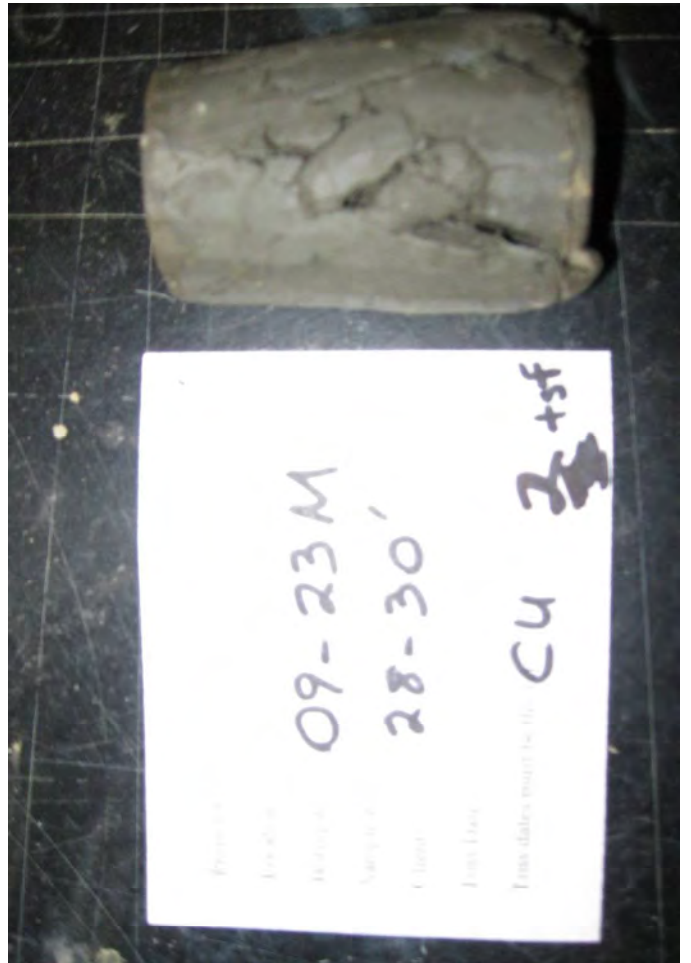
Parameters for Specimen No. 3

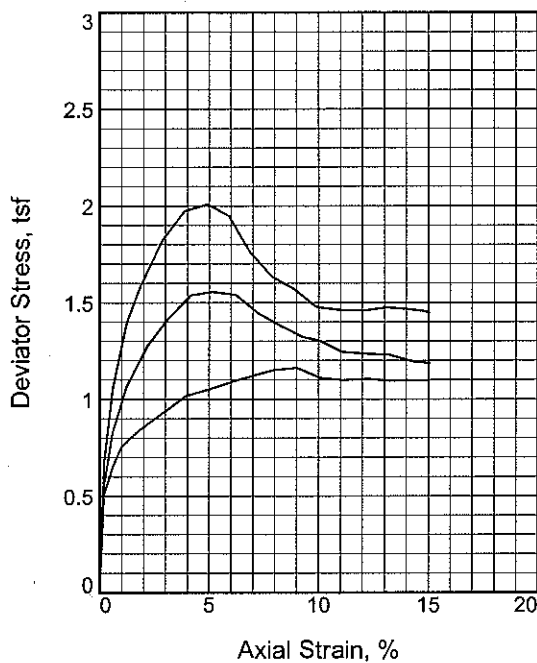
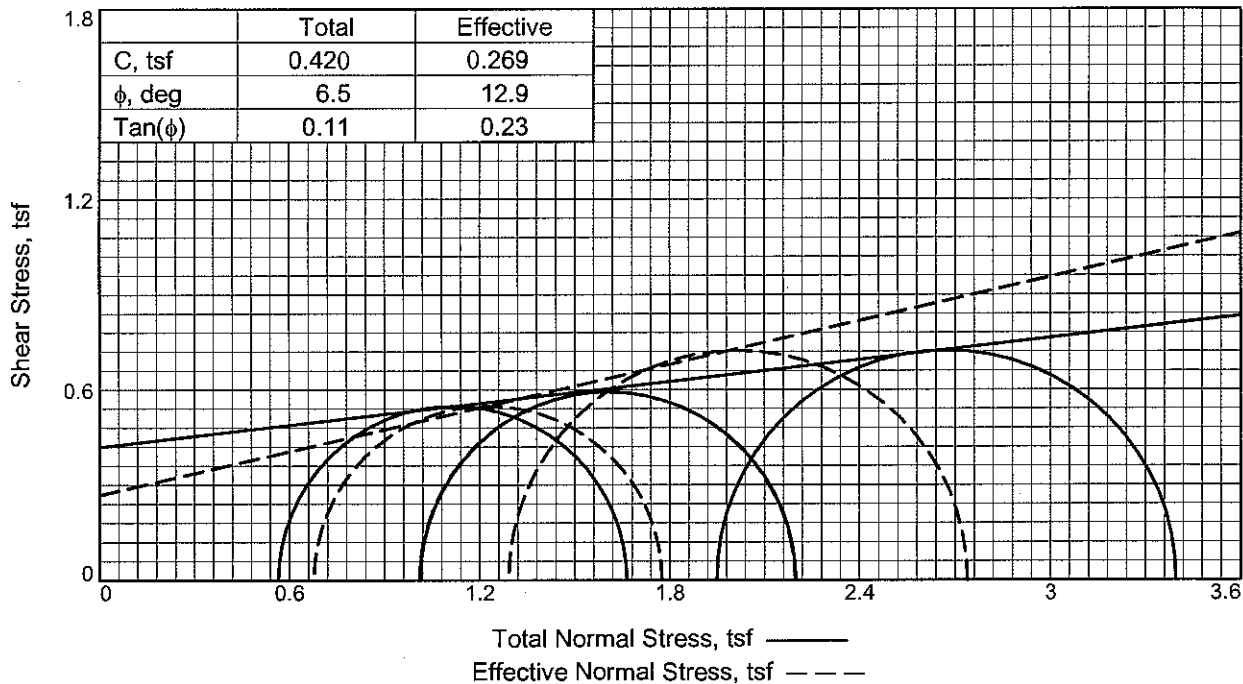
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.400			378.770
Moisture content: Dry soil+tare, gms.	87.000			344.000
Moisture content: Tare, gms.	31.410			252.750
Moisture, %	36.7	39.8	39.8	38.1
Moist specimen weight, gms.	127.5			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	112.1	114.6	114.6	
Dry density, pcf	82.0	82.0	82.0	
Void ratio	1.0939	1.0939	1.0939	
Saturation, %	92.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 6.767 tsf
 Consolidation back pressure = 4.822 tsf
 Consolidation effective confining stress = 1.945 tsf
 Fail. Stress = 2.249 tsf at reading no. 18
 Ult. Stress = 2.249 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0058	18.490	0.0	0.0	0.000	1.945	1.945	1.00	4.822	1.945	0.000
1	0.0084	23.340	4.9	0.1	0.226	1.929	2.155	1.12	4.838	2.042	0.113
2	0.0116	29.840	11.4	0.2	0.529	1.690	2.219	1.31	5.077	1.955	0.265
3	0.0215	44.340	25.9	0.6	1.201	1.270	2.471	1.95	5.497	1.870	0.600
4	0.0383	54.900	36.4	1.2	1.681	0.953	2.634	2.76	5.814	1.793	0.840
5	0.0552	61.890	43.4	1.8	1.991	0.832	2.823	3.39	5.935	1.828	0.996
6	0.0732	64.540	46.1	2.4	2.099	0.742	2.841	3.83	6.025	1.792	1.050
7	0.1002	67.720	49.2	3.4	2.222	0.786	3.008	3.83	5.981	1.897	1.111
8	0.1279	69.000	50.5	4.3	2.257	0.832	3.089	3.71	5.935	1.960	1.128
9	0.1427	69.500	51.0	4.9	2.266	0.902	3.168	3.51	5.865	2.035	1.133
10	0.1757	70.500	52.0	6.0	2.282	0.960	3.242	3.38	5.807	2.101	1.141
11	0.2040	71.200	52.7	7.0	2.288	0.987	3.275	3.32	5.780	2.131	1.144
12	0.2336	72.000	53.5	8.1	2.297	1.026	3.323	3.24	5.741	2.174	1.148
13	0.2627	72.500	54.0	9.1	2.292	1.089	3.381	3.10	5.678	2.235	1.146
14	0.3035	73.000	54.5	10.6	2.276	1.135	3.411	3.01	5.632	2.273	1.138
15	0.3322	73.500	55.0	11.6	2.271	1.170	3.441	2.94	5.597	2.306	1.136
16	0.3613	74.000	55.5	12.6	2.265	1.175	3.440	2.93	5.592	2.307	1.132
17	0.3910	74.500	56.0	13.7	2.258	1.181	3.439	2.91	5.586	2.310	1.129
18	0.4221	75.000	56.5	14.8	2.249	1.238	3.487	2.82	5.529	2.362	1.124
19	0.4421	75.000	56.5	15.5	2.230	1.216	3.446	2.83	5.551	2.331	1.115





Sample No.	1	2	3	
Initial	Water Content, %	37.0	37.0	37.0
	Dry Density, pcf	84.1	84.3	83.5
	Saturation, %	97.7	98.2	96.4
	Void Ratio	1.0417	1.0367	1.0565
	Diameter, in.	1.41	1.41	1.41
	Height, in.	2.82	2.81	2.82
At Test	Water Content, %	37.9	37.7	38.4
	Dry Density, pcf	84.1	84.3	83.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0417	1.0367	1.0565
	Diameter, in.	1.41	1.41	1.41
	Height, in.	2.82	2.81	2.82
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.57	1.01	1.95	
Back Pressure, tsf	6.64	6.13	5.18	
Cell Pressure, tsf	7.21	7.14	7.13	
Peak Deviator Stress, tsf	1.16	1.56	2.01	
Total Pore Pr., tsf	6.72	6.53	6.30	
Ultimate Deviator Stress, tsf	1.10	1.19	1.45	
Total Pore Pr., tsf	6.53	6.13	5.84	
Maj. Eff. Stress at Ultimate, tsf	1.77	2.20	2.74	
Min. Eff. Stress at Ultimate, tsf	0.68	1.01	1.29	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 80

PL= 21

PI= 59

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #3

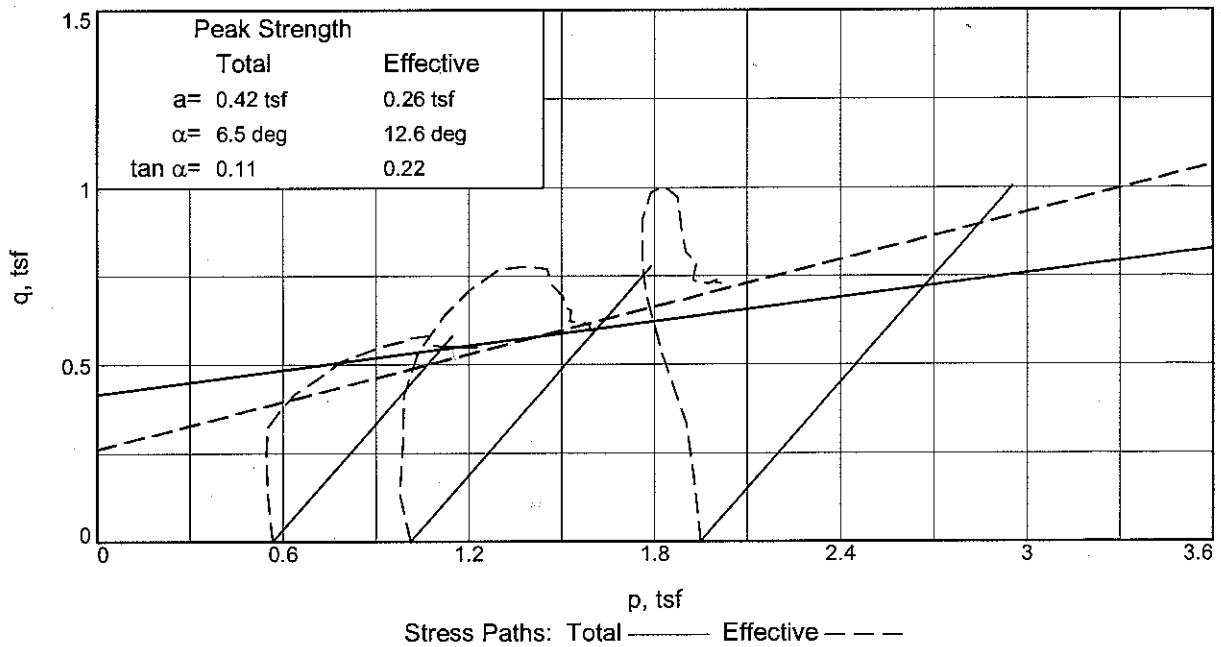
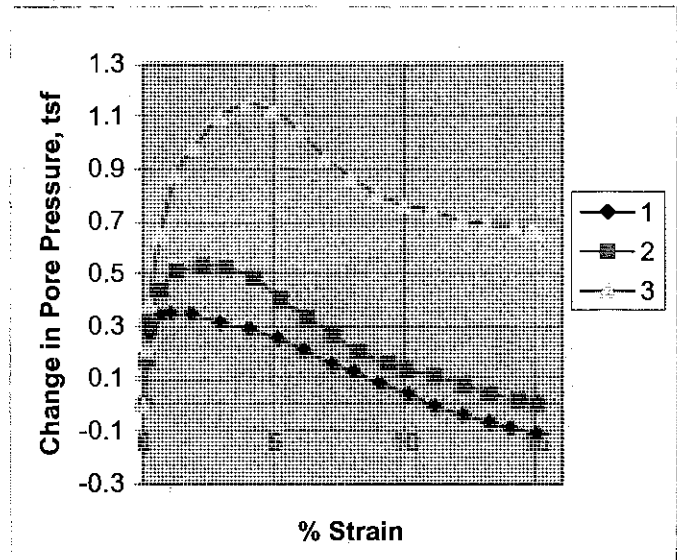
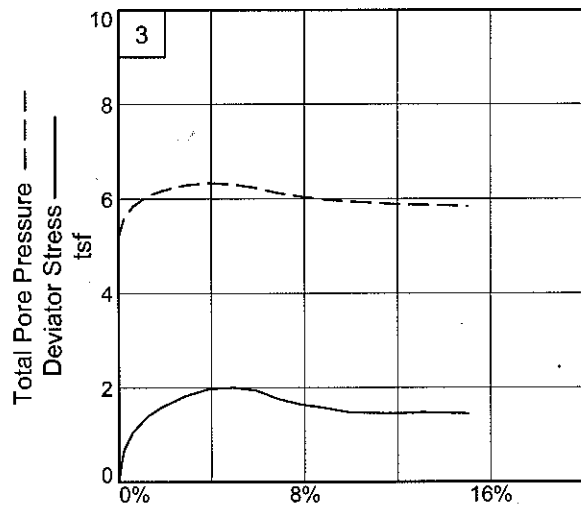
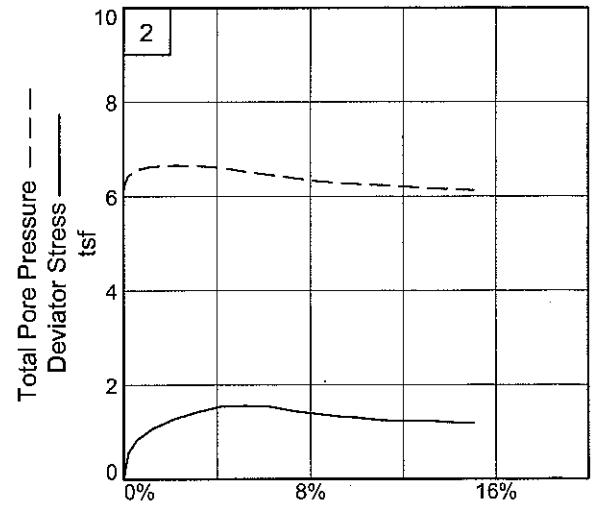
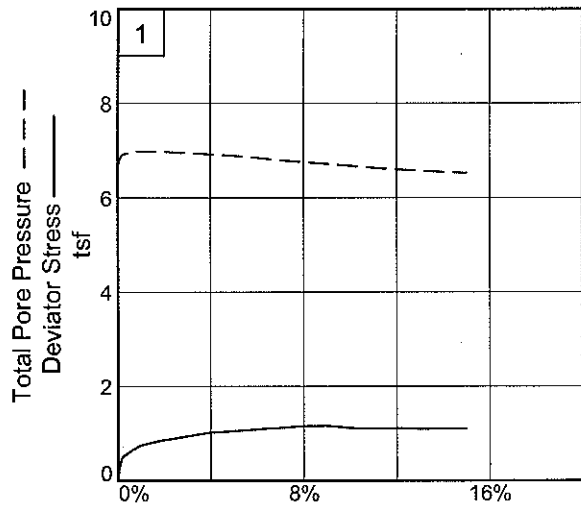
Depth: 25-27'

Poplar River - Harwood

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 25-27' **Sample Number:** Boring 09-25MU, #3

Poplar River - Harwood

Project No. B-09-0312 Final Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement July 2011

Braun Intertec
Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

9/14/2009

10:42 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 25-27' **Sample Number:** Boring 09-25MU, #3
Description: FAT CLAY, brown (CH) **Poplar River - Harwood**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Type of Sample: Thinwall, 5", Middle of sample**Assumed Specific Gravity=**2.75 **LL=** **PL=** **PI=****Test Method:** COE uniform strain**Parameters for Specimen No. 1**

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	111.090			164.110
Moisture content: Dry soil+tare, gms.	89.260			127.890
Moisture content: Tare, gms.	30.250			31.070
Moisture, %	37.0	37.9	37.9	37.4
Moist specimen weight, gms.	132.3			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	115.2	115.9	115.9	
Dry density, pcf	84.1	84.1	84.1	
Void ratio	1.0417	1.0417	1.0417	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.206 tsf
Consolidation back pressure = 6.640 tsf
Consolidation effective confining stress = 0.566 tsf
Fail. Stress = 1.098 tsf at reading no. 18
Ult. Stress = 1.098 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0075	18.090	0.0	0.0	0.000	0.566	0.566	1.00	6.640	0.566	0.000
1	0.0084	23.710	5.6	0.0	0.261	0.420	0.681	1.62	6.786	0.550	0.130
2	0.0125	28.800	10.7	0.2	0.496	0.297	0.793	2.67	6.909	0.545	0.248
3	0.0245	32.190	14.1	0.6	0.651	0.226	0.877	3.88	6.980	0.551	0.325
4	0.0353	34.480	16.4	1.0	0.754	0.219	0.973	4.44	6.987	0.596	0.377
5	0.0573	36.460	18.4	1.8	0.838	0.221	1.059	4.79	6.985	0.640	0.419
6	0.0882	38.650	20.6	2.9	0.927	0.254	1.181	4.65	6.952	0.718	0.464
7	0.1190	40.910	22.8	4.0	1.018	0.279	1.297	4.65	6.927	0.788	0.509
8	0.1500	41.970	23.9	5.1	1.053	0.316	1.369	4.33	6.890	0.842	0.526
9	0.1808	43.210	25.1	6.1	1.095	0.359	1.454	4.05	6.847	0.906	0.547
10	0.2117	44.280	26.2	7.2	1.128	0.413	1.541	3.73	6.793	0.977	0.564
11	0.2325	45.010	26.9	8.0	1.150	0.441	1.591	3.61	6.765	1.016	0.575
12	0.2616	45.590	27.5	9.0	1.162	0.487	1.649	3.39	6.719	1.068	0.581
13	0.2916	44.670	26.6	10.1	1.110	0.527	1.637	3.11	6.679	1.082	0.555
14	0.3213	44.730	26.6	11.1	1.100	0.573	1.673	2.92	6.633	1.123	0.550
15	0.3523	45.210	27.1	12.2	1.106	0.606	1.712	2.82	6.600	1.159	0.553
16	0.3813	45.270	27.2	13.2	1.095	0.635	1.730	2.72	6.571	1.183	0.548
17	0.4011	45.560	27.5	14.0	1.098	0.657	1.755	2.67	6.549	1.206	0.549
18	0.4311	45.910	27.8	15.0	1.098	0.677	1.775	2.62	6.529	1.226	0.549

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	131.410			164.140
Moisture content: Dry soil+tare, gms.	104.060			128.290
Moisture content: Tare, gms.	30.160			31.050
Moisture, %	37.0	37.7	37.7	36.9
Moist specimen weight, gms.	133.0			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	115.5	116.1	116.1	
Dry density, pcf	84.3	84.3	84.3	
Void ratio	1.0367	1.0367	1.0367	
Saturation, %	98.2	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.143 tsf
 Consolidation back pressure = 6.131 tsf
 Consolidation effective confining stress = 1.012 tsf
 Fail. Stress = 1.187 tsf at reading no. 18
 Ult. Stress = 1.187 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0098	18.850	0.0	0.0	0.000	1.012	1.012	1.00	6.131	1.012	0.000
1	0.0127	24.710	5.9	0.1	0.270	0.842	1.112	1.32	6.301	0.977	0.135
2	0.0156	30.880	12.0	0.2	0.554	0.710	1.264	1.78	6.433	0.987	0.277
3	0.0263	36.830	18.0	0.6	0.825	0.577	1.402	2.43	6.566	0.990	0.413
4	0.0443	42.200	23.4	1.2	1.065	0.503	1.568	3.12	6.640	1.035	0.532
5	0.0712	47.120	28.3	2.2	1.277	0.482	1.759	3.65	6.661	1.120	0.638
6	0.0981	50.590	31.7	3.1	1.420	0.491	1.911	3.89	6.652	1.201	0.710
7	0.1270	53.620	34.8	4.2	1.539	0.529	2.068	3.91	6.614	1.298	0.769
8	0.1560	54.380	35.5	5.2	1.555	0.611	2.166	3.55	6.532	1.389	0.778
9	0.1849	54.440	35.6	6.2	1.541	0.682	2.223	3.26	6.461	1.453	0.771
10	0.2136	52.610	33.8	7.2	1.446	0.747	2.193	2.94	6.396	1.470	0.723
11	0.2416	51.480	32.6	8.2	1.383	0.814	2.197	2.70	6.329	1.505	0.691
12	0.2716	50.410	31.6	9.3	1.322	0.855	2.177	2.55	6.288	1.516	0.661
13	0.2914	50.260	31.4	10.0	1.305	0.877	2.182	2.49	6.266	1.530	0.653
14	0.3213	49.160	30.3	11.1	1.245	0.904	2.149	2.38	6.239	1.526	0.622
15	0.3522	49.310	30.5	12.2	1.235	0.937	2.172	2.32	6.206	1.555	0.618
16	0.3818	49.570	30.7	13.2	1.231	0.970	2.201	2.27	6.173	1.585	0.615
17	0.4122	49.050	30.2	14.3	1.195	0.995	2.190	2.20	6.148	1.593	0.598
18	0.4332	49.110	30.3	15.0	1.187	1.010	2.197	2.18	6.133	1.604	0.594

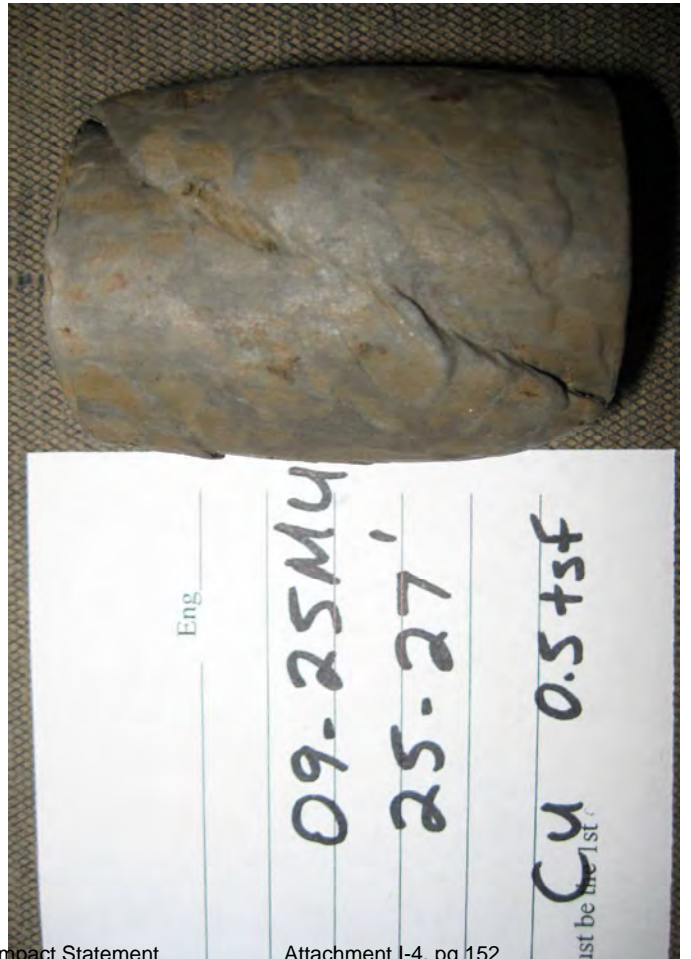
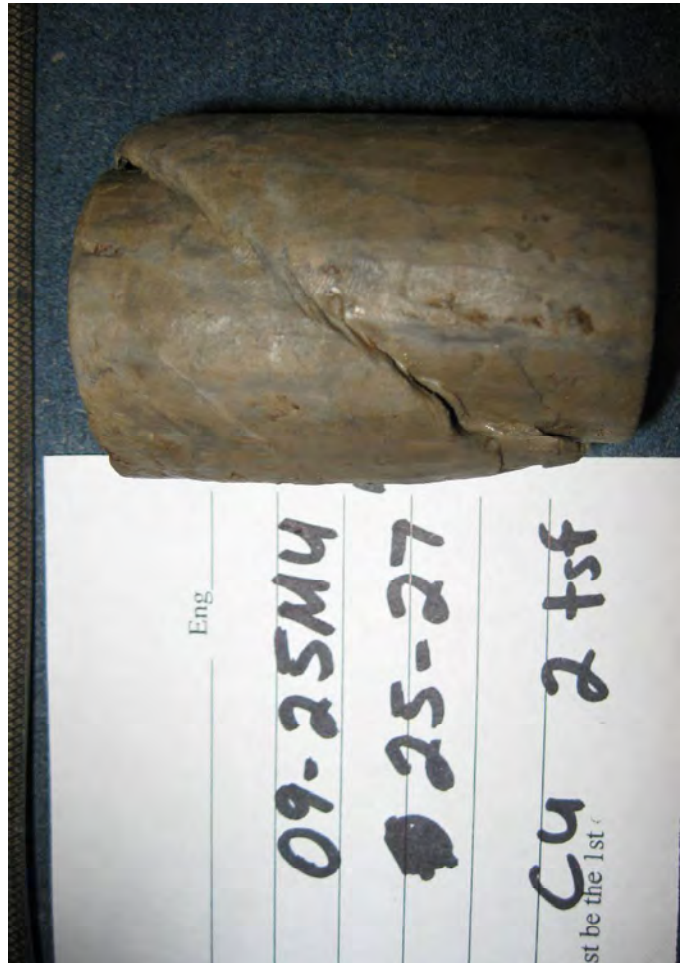
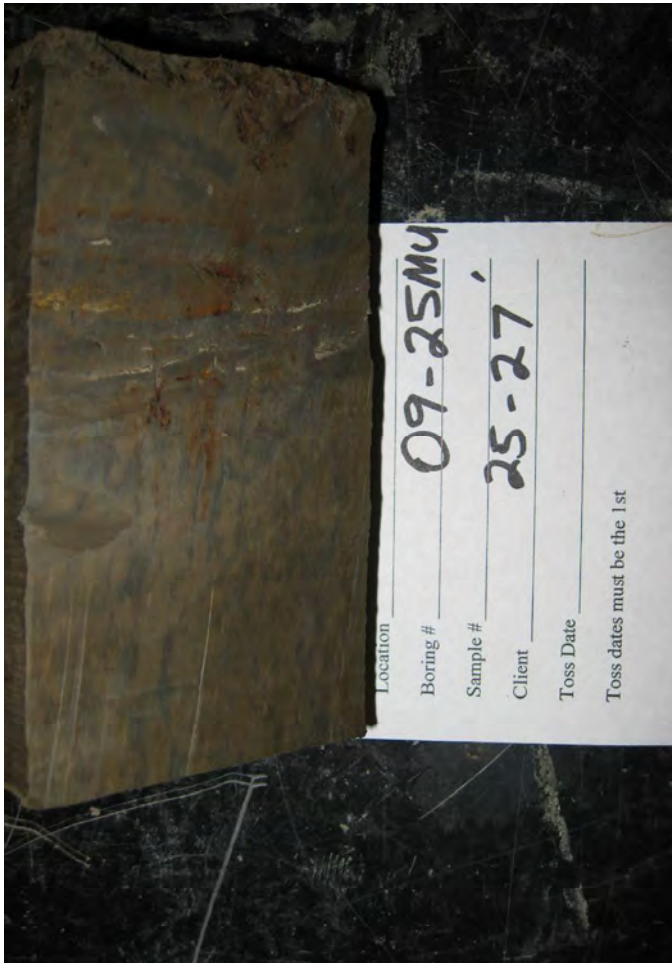
Parameters for Specimen No. 3

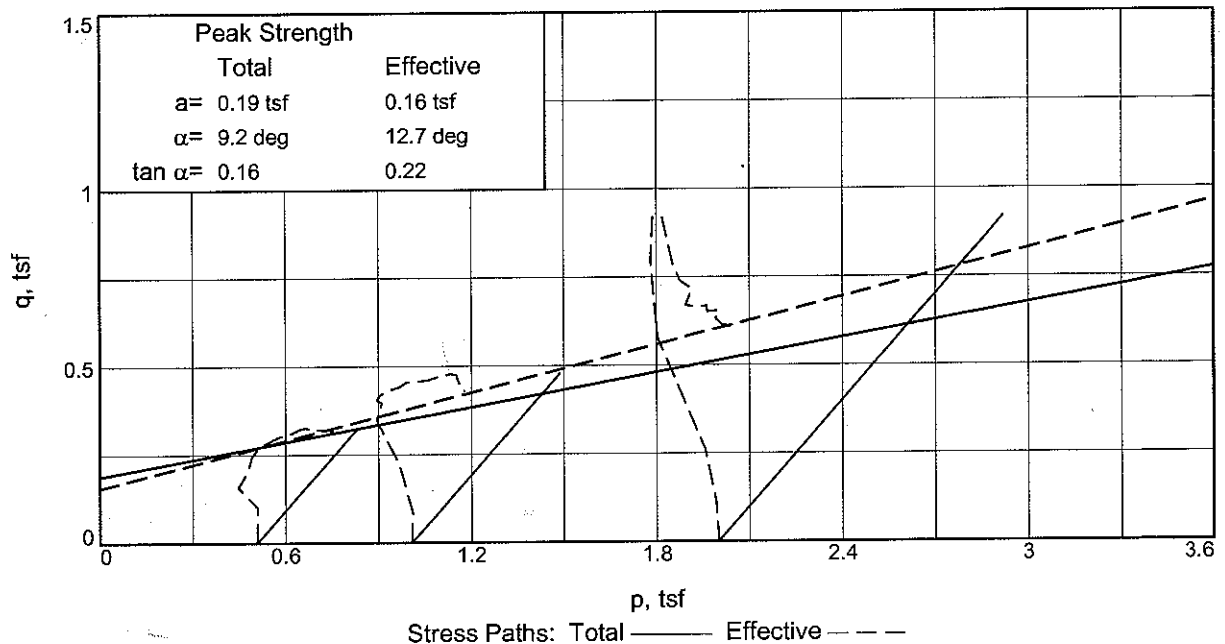
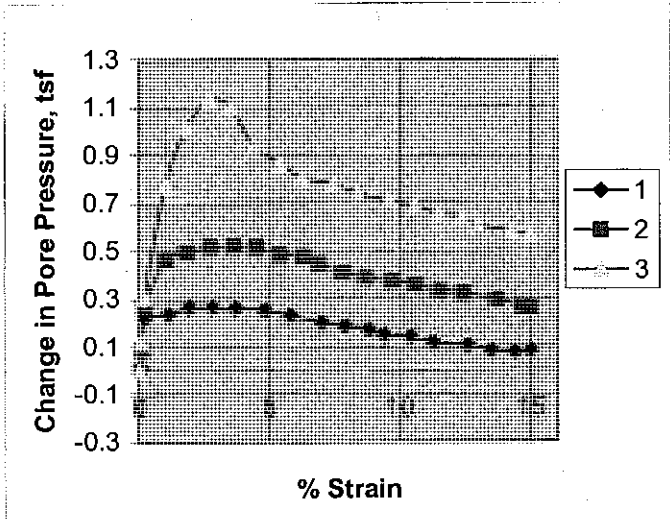
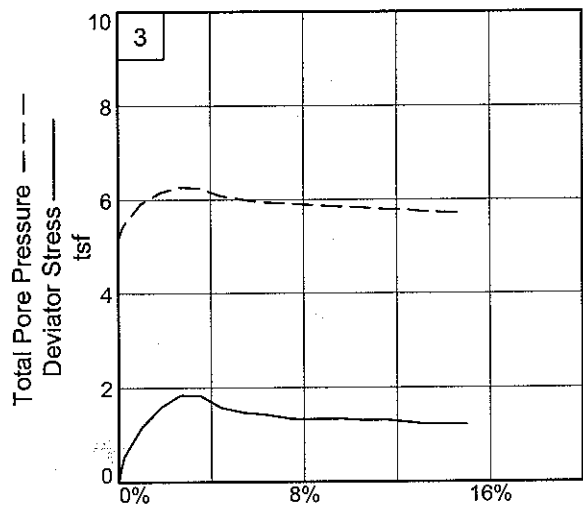
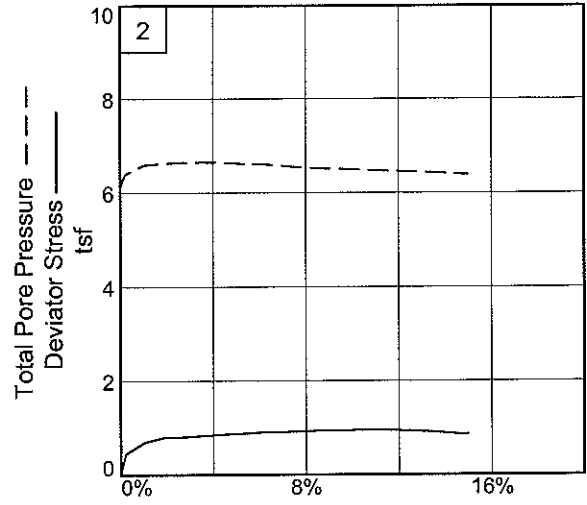
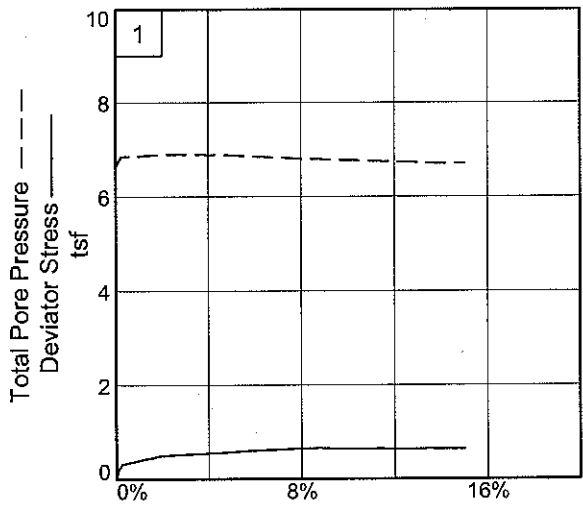
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.460			161.080
Moisture content: Dry soil+tare, gms.	112.200			125.150
Moisture content: Tare, gms.	30.490			30.240
Moisture, %	37.0	38.4	38.4	37.9
Moist specimen weight, gms.	131.4			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.4	115.6	115.6	
Dry density, pcf	83.5	83.5	83.5	
Void ratio	1.0565	1.0565	1.0565	
Saturation, %	96.4	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.130 tsf
 Consolidation back pressure = 5.181 tsf
 Consolidation effective confining stress = 1.949 tsf
 Fail. Stress = 1.448 tsf at reading no. 19
 Ult. Stress = 1.448 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0063	18.360	0.0	0.0	0.000	1.949	1.949	1.00	5.181	1.949	0.000
1	0.0094	26.390	8.0	0.1	0.371	1.740	2.111	1.21	5.390	1.926	0.186
2	0.0122	32.920	14.6	0.2	0.673	1.566	2.239	1.43	5.564	1.902	0.336
3	0.0232	41.260	22.9	0.6	1.054	1.299	2.353	1.81	5.831	1.826	0.527
4	0.0413	48.920	30.6	1.2	1.398	1.074	2.472	2.30	6.056	1.773	0.699
5	0.0591	53.370	35.0	1.9	1.591	0.965	2.556	2.65	6.165	1.760	0.795
6	0.0871	58.900	40.5	2.9	1.823	0.850	2.673	3.15	6.280	1.762	0.912
7	0.1152	62.710	44.4	3.9	1.974	0.802	2.776	3.46	6.328	1.789	0.987
8	0.1449	63.990	45.6	4.9	2.009	0.827	2.836	3.43	6.303	1.832	1.005
9	0.1726	63.050	44.7	5.9	1.947	0.902	2.849	3.16	6.228	1.876	0.974
10	0.1996	59.200	40.8	6.9	1.761	1.007	2.768	2.75	6.123	1.888	0.881
11	0.2276	56.730	38.4	7.9	1.637	1.082	2.719	2.51	6.048	1.901	0.819
12	0.2557	55.630	37.3	8.9	1.573	1.149	2.722	2.37	5.981	1.936	0.787
13	0.2853	53.800	35.4	9.9	1.479	1.185	2.664	2.25	5.945	1.924	0.739
14	0.3153	53.830	35.5	11.0	1.462	1.212	2.674	2.21	5.918	1.943	0.731
15	0.3462	54.200	35.8	12.1	1.459	1.245	2.704	2.17	5.885	1.975	0.730
16	0.3751	55.050	36.7	13.1	1.476	1.263	2.739	2.17	5.867	2.001	0.738
17	0.4052	55.230	36.9	14.2	1.465	1.267	2.732	2.16	5.863	2.000	0.733
18	0.4241	55.290	36.9	14.8	1.456	1.292	2.748	2.13	5.838	2.020	0.728
19	0.4296	55.160	36.8	15.0	1.448	1.291	2.739	2.12	5.839	2.015	0.724





Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study **Moorhead**

Oxidized Brenna

Loc.: SE-ED-29, East Diversion, ~~PL Shrock Formation~~

Depth: 20-22'

Sample No.: Boring 09-26MU, #2

Project No.: BB-09-0927 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2014

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

11/17/2009
9:18 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-29, East Diversion, ~~PL Sherack Formation~~ **Moorhead**
Depth: 20-22' **Sample Number:** Boring 09-26MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	138.130			152.360
Moisture content: Dry soil+tare, gms.	101.740			110.510
Moisture content: Tare, gms.	31.160			31.100
Moisture, %	51.6	51.7	51.7	52.7
Moist specimen weight, gms.	120.8			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	107.4	107.5	107.5	
Dry density, pcf	70.9	70.9	70.9	
Void ratio	1.4221	1.4221	1.4221	
Saturation, %	99.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.632 tsf
Consolidation effective confining stress = 0.508 tsf
Peak Stress = 0.654 tsf at reading no. 11
Ult. Stress = 0.635 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0150	19.190	0.0	0.0	0.000	0.508	0.508	1.00	6.632	0.508	0.000
1	0.0176	23.490	4.3	0.1	0.202	0.408	0.610	1.49	6.732	0.509	0.101
2	0.0219	25.970	6.8	0.2	0.318	0.288	0.606	2.10	6.852	0.447	0.159
3	0.0447	27.930	8.7	1.1	0.406	0.274	0.680	2.48	6.866	0.477	0.203
4	0.0686	29.840	10.6	1.9	0.491	0.245	0.736	3.00	6.895	0.490	0.245
5	0.0925	30.600	11.4	2.8	0.521	0.244	0.765	3.14	6.896	0.505	0.261
6	0.1176	31.170	12.0	3.7	0.542	0.247	0.789	3.19	6.893	0.518	0.271
7	0.1503	31.920	12.7	4.8	0.569	0.256	0.825	3.22	6.884	0.541	0.285
8	0.1761	32.820	13.6	5.8	0.603	0.279	0.882	3.16	6.861	0.581	0.302
9	0.2101	33.470	14.3	7.0	0.624	0.309	0.933	3.02	6.831	0.621	0.312
10	0.2353	34.140	14.9	7.9	0.647	0.326	0.973	2.98	6.814	0.649	0.323
11	0.2619	34.450	15.3	8.8	0.654	0.340	0.994	2.92	6.800	0.667	0.327
12	0.2788	34.300	15.1	9.4	0.643	0.361	1.004	2.78	6.779	0.682	0.321
13	0.3046	34.320	15.1	10.4	0.637	0.368	1.005	2.73	6.772	0.687	0.319
14	0.3317	34.600	15.4	11.3	0.642	0.393	1.035	2.63	6.747	0.714	0.321
15	0.3665	34.680	15.5	12.6	0.636	0.405	1.041	2.57	6.735	0.723	0.318
16	0.3925	34.970	15.8	13.5	0.641	0.428	1.069	2.50	6.712	0.749	0.321
17	0.4183	35.000	15.8	14.4	0.636	0.435	1.071	2.46	6.705	0.753	0.318
18	0.4355	35.100	15.9	15.0	0.635	0.429	1.064	2.48	6.711	0.746	0.317

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.630			151.880
Moisture content: Dry soil+tare, gms.	88.550			110.780
Moisture content: Tare, gms.	30.320			31.090
Moisture, %	51.7	51.9	51.7	51.6
Moist specimen weight, gms.	121.2			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	107.3	107.4	107.5	
Dry density, pcf	70.7	70.7	70.9	
Void ratio	1.4268	1.4268	1.4216	
Saturation, %	99.6	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 6.130 tsf
 Consolidation effective confining stress = 1.008 tsf
 Peak Stress = 0.958 tsf at reading no. 14
 Ult. Stress = 0.862 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0170	19.070	0.0	0.0	0.000	1.008	1.008	1.00	6.130	1.008	0.000
1	0.0190	22.790	3.7	0.1	0.175	0.922	1.097	1.19	6.216	1.009	0.087
2	0.0232	28.560	9.5	0.2	0.445	0.744	1.189	1.60	6.394	0.966	0.222
3	0.0459	34.080	15.0	1.0	0.698	0.545	1.243	2.28	6.593	0.894	0.349
4	0.0687	36.310	17.2	1.8	0.795	0.514	1.309	2.55	6.624	0.911	0.397
5	0.0925	36.740	17.7	2.7	0.808	0.491	1.299	2.64	6.647	0.895	0.404
6	0.1168	37.410	18.3	3.6	0.831	0.487	1.318	2.71	6.651	0.902	0.415
7	0.1421	38.260	19.2	4.5	0.861	0.492	1.353	2.75	6.646	0.923	0.431
8	0.1672	38.940	19.9	5.4	0.883	0.524	1.407	2.69	6.614	0.966	0.442
9	0.1929	39.730	20.7	6.3	0.910	0.534	1.444	2.70	6.604	0.989	0.455
10	0.2099	39.910	20.8	6.9	0.912	0.561	1.473	2.62	6.577	1.017	0.456
11	0.2358	40.410	21.3	7.8	0.924	0.600	1.524	2.54	6.538	1.062	0.462
12	0.2617	41.020	22.0	8.7	0.941	0.620	1.561	2.52	6.518	1.090	0.470
13	0.2877	41.290	22.2	9.7	0.943	0.635	1.578	2.48	6.503	1.106	0.471
14	0.3137	41.870	22.8	10.6	0.958	0.652	1.610	2.47	6.486	1.131	0.479
15	0.3404	41.960	22.9	11.5	0.951	0.676	1.627	2.41	6.462	1.152	0.476
16	0.3653	41.870	22.8	12.4	0.938	0.685	1.623	2.37	6.453	1.154	0.469
17	0.4014	41.260	22.2	13.7	0.899	0.713	1.612	2.26	6.425	1.163	0.450
18	0.4275	40.550	21.5	14.7	0.861	0.744	1.605	2.16	6.394	1.175	0.431
19	0.4364	40.640	21.6	15.0	0.862	0.748	1.610	2.15	6.390	1.179	0.431

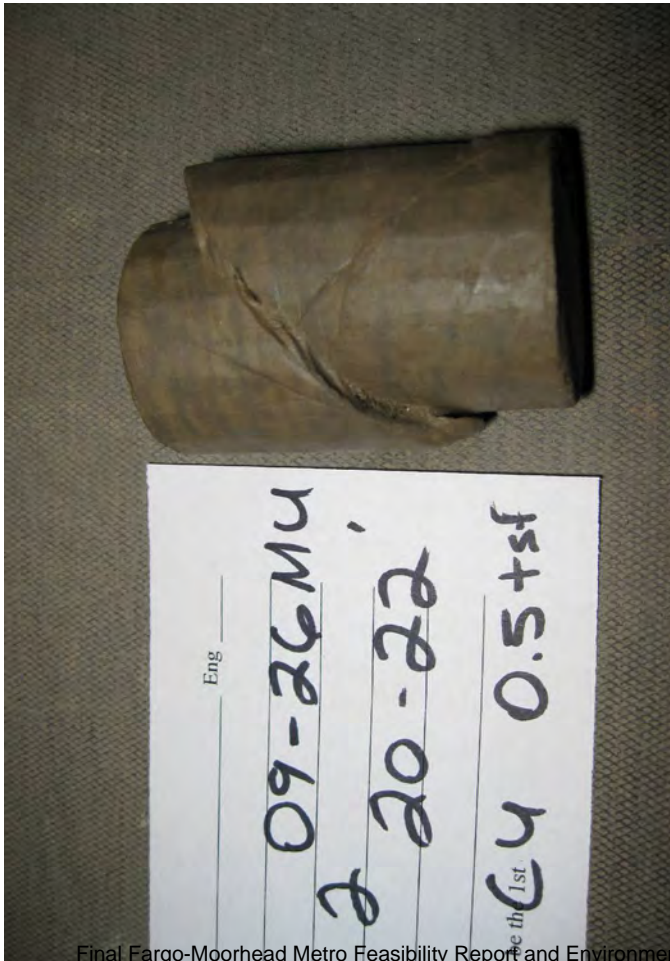
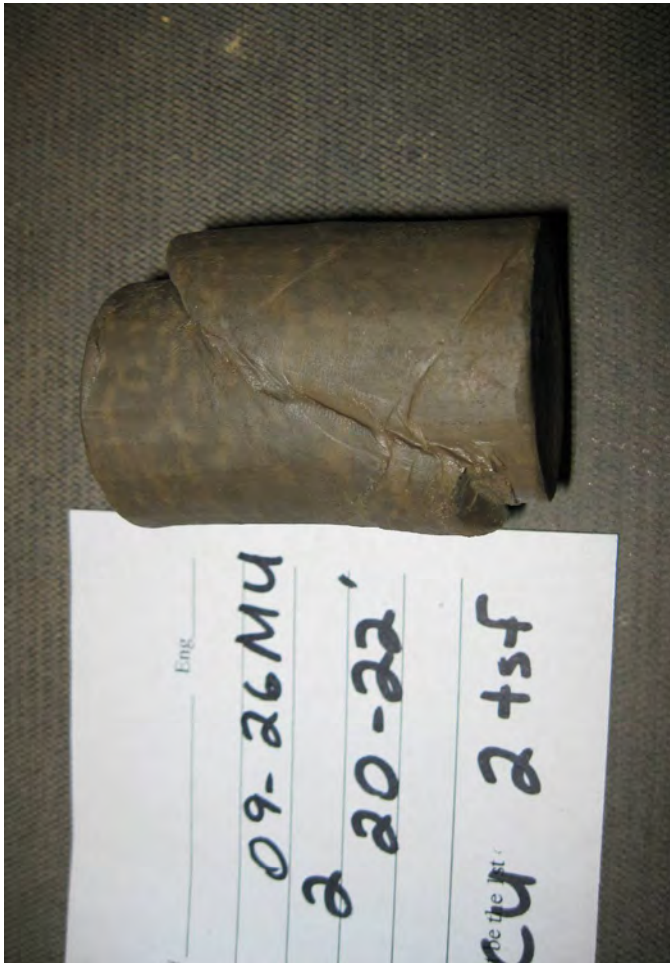
Parameters for Specimen No. 3

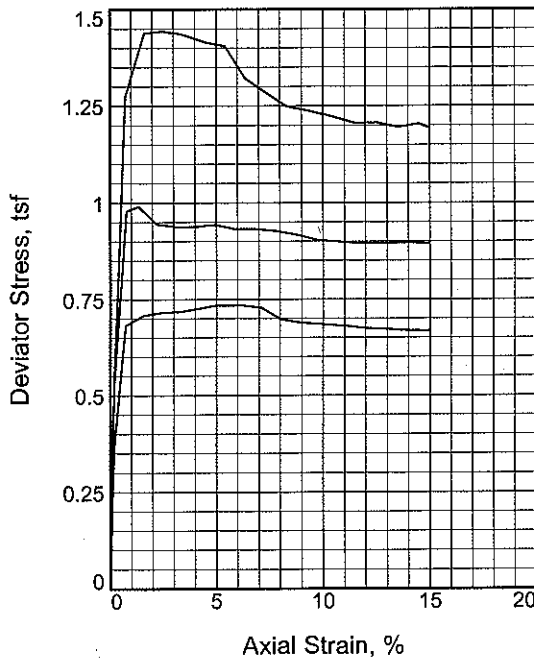
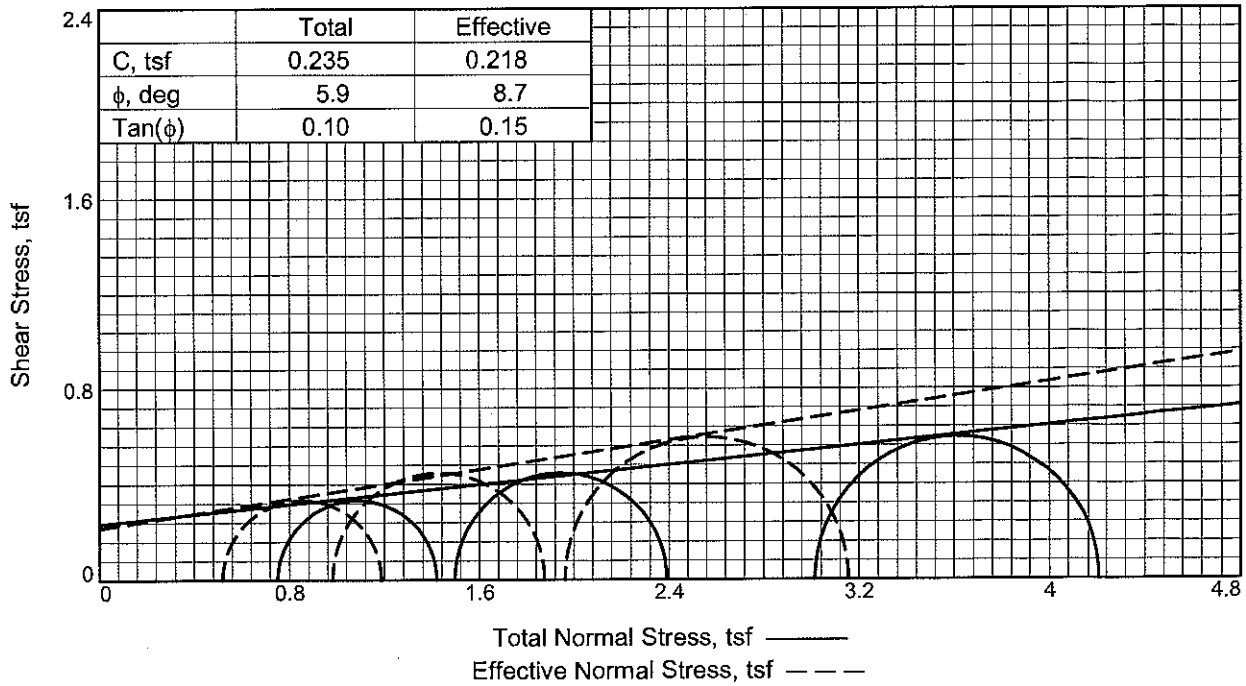
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.850			148.500
Moisture content: Dry soil+tare, gms.	92.010			109.240
Moisture content: Tare, gms.	31.100			30.430
Moisture, %	50.6	51.8	50.9	49.8
Moist specimen weight, gms.	120.3			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.53	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.6	107.5	108.0	
Dry density, pcf	70.8	70.8	71.5	
Void ratio	1.4255	1.4255	1.3995	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.140 tsf
 Consolidation effective confining stress = 2.000 tsf
 Peak Stress = 1.842 tsf at reading no. 5
 Ult. Stress = 1.221 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0139	19.550	0.0	0.0	0.000	2.000	2.000	1.00	5.140	2.000	0.000
1	0.0159	24.250	4.7	0.1	0.222	1.880	2.102	1.12	5.260	1.991	0.111
2	0.0198	30.690	11.1	0.2	0.524	1.694	2.218	1.31	5.446	1.956	0.262
3	0.0415	44.310	24.8	1.0	1.157	1.225	2.382	1.94	5.915	1.803	0.578
4	0.0647	53.950	34.4	1.8	1.593	0.984	2.577	2.62	6.156	1.781	0.797
5	0.0883	59.660	40.1	2.7	1.842	0.868	2.710	3.12	6.272	1.789	0.921
6	0.1121	59.930	40.4	3.5	1.838	0.899	2.737	3.04	6.241	1.818	0.919
7	0.1376	54.500	35.0	4.4	1.576	1.064	2.640	2.48	6.076	1.852	0.788
8	0.1632	52.700	33.2	5.4	1.480	1.135	2.615	2.30	6.005	1.875	0.740
9	0.1888	51.970	32.4	6.3	1.433	1.199	2.632	2.20	5.941	1.916	0.717
10	0.2217	50.260	30.7	7.5	1.341	1.223	2.564	2.10	5.917	1.893	0.670
11	0.2476	50.350	30.8	8.4	1.331	1.261	2.592	2.06	5.879	1.927	0.666
12	0.2826	50.950	31.4	9.6	1.339	1.292	2.631	2.04	5.848	1.961	0.669
13	0.3086	50.480	30.9	10.6	1.305	1.312	2.617	1.99	5.828	1.964	0.652
14	0.3344	50.930	31.4	11.5	1.310	1.346	2.656	1.97	5.794	2.001	0.655
15	0.3605	50.170	30.6	12.4	1.265	1.358	2.623	1.93	5.782	1.990	0.632
16	0.3772	49.530	30.0	13.0	1.230	1.395	2.625	1.88	5.745	2.010	0.615
17	0.4132	49.860	30.3	14.3	1.225	1.421	2.646	1.86	5.719	2.034	0.613
18	0.4313	49.980	30.4	15.0	1.221	1.426	2.647	1.86	5.714	2.036	0.610





Sample No.	1	2	3	
Initial	Water Content, %	61.0	60.5	62.1
	Dry Density, pcf	63.7	64.0	63.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6488	1.6370	1.6777
	Diameter, in.	1.40	1.41	1.39
	Height, in.	2.80	2.79	2.82
At Test	Water Content, %	61.0	59.5	57.9
	Dry Density, pcf	63.7	64.7	65.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6488	1.6088	1.5649
	Diameter, in.	1.40	1.40	1.37
	Height, in.	2.80	2.79	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.75	1.50	3.01	
Back Pressure, tsf	6.39	5.64	4.13	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	0.73	0.99	1.44	
Total Pore Pr., tsf	6.74	6.26	5.12	
Ultimate Deviator Stress, tsf	0.67	0.89	1.19	
Total Pore Pr., tsf	6.62	6.16	5.18	
Maj. Eff. Stress at Ultimate, tsf	1.14	1.87	3.46	
Min. Eff. Stress at Ultimate, tsf	0.40	0.88	2.02	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 114 **PL=** 24 **PI=** 90

Assumed Specific Gravity= 2.704

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115 **Oxidized Brenna**

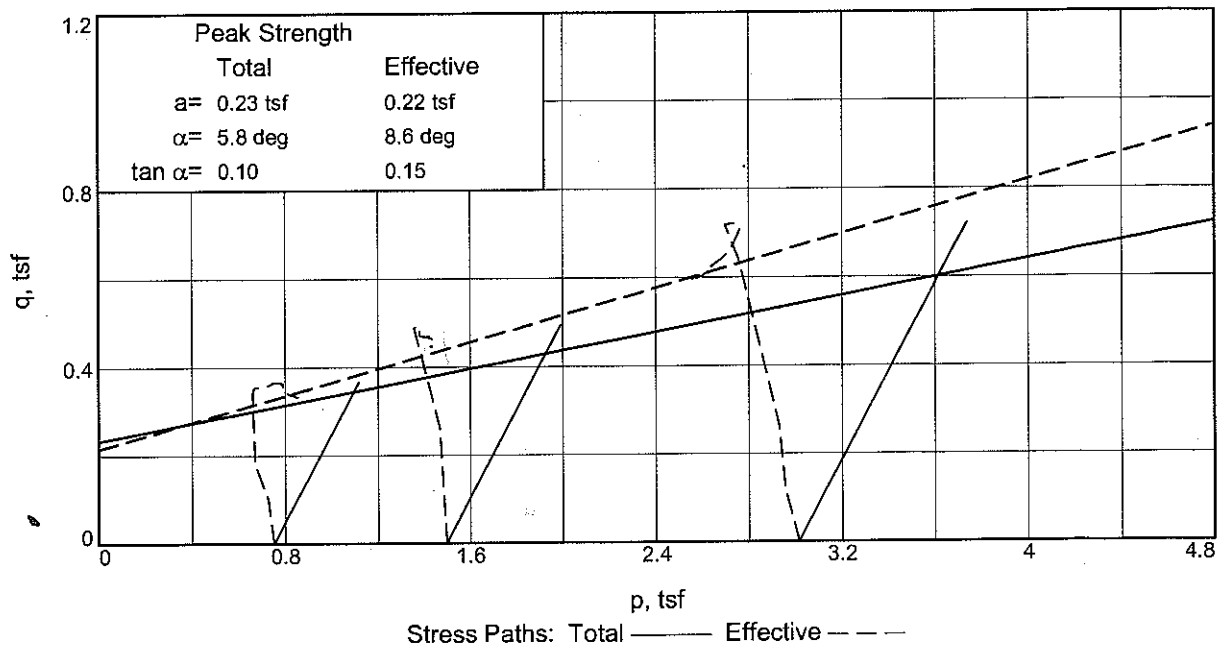
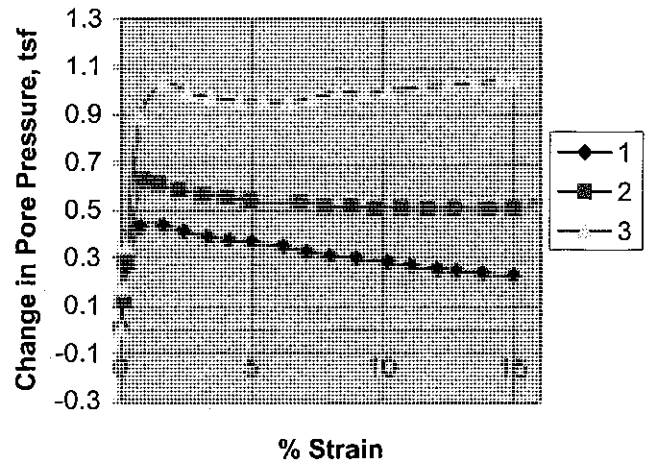
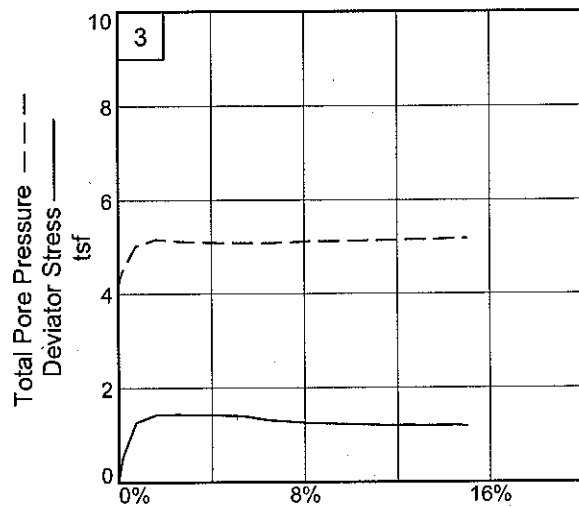
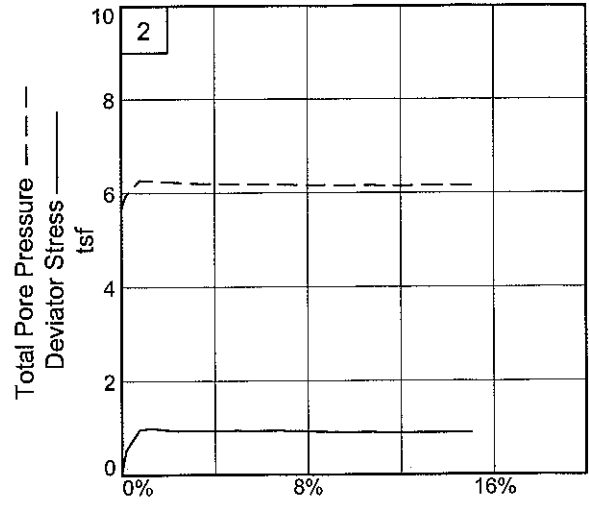
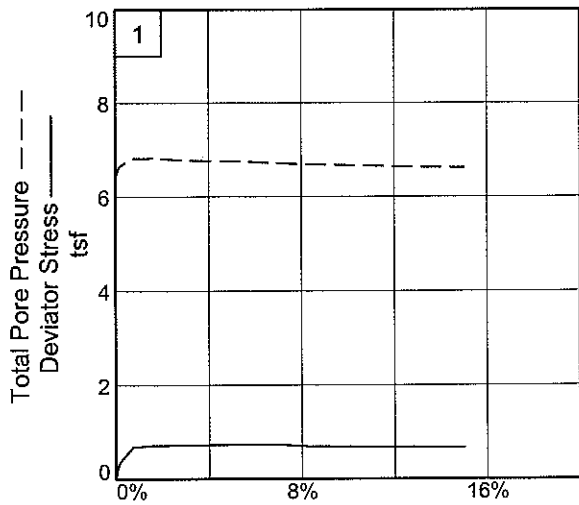
Location: SE-M-18, Moorhead, ~~PL Sherrick Formation~~

Sample Number: Boring 09-34MU, #2 **Depth:** 16-18'

Proj. No.: BL-09-03127

Date Sampled:





Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-M-18, Moorhead, PL Shrink Formation

Depth: 16-18'

Oxidized Brenna

Sample No.: Boring 09-34MU, #2

Project No.: BL-09-01-27 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

Geotechnical Design and Geology

July 2014

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/9/2009
1:00 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, ~~PL Sherack Formation~~
Depth: 16-18' **Sample Number:** Boring 09-34MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.704 **LL**=114 **PL**=24 **PI**=90
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.660			147.010
Moisture content: Dry soil+tare, gms.	85.600			102.640
Moisture content: Tare, gms.	31.370			30.600
Moisture, %	61.0	61.0	61.0	61.6
Moist specimen weight, gms.	116.3			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	102.6	102.6	102.6	
Dry density, pcf	63.7	63.7	63.7	
Void ratio	1.6488	1.6488	1.6488	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.138 tsf
Consolidation back pressure = 6.387 tsf
Consolidation effective confining stress = 0.751 tsf
Peak Stress = 0.734 tsf at reading no. 9
Ult. Stress = 0.668 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0167	19.190	0.0	0.0	0.000	0.751	0.751	1.00	6.387	0.751	0.000
1	0.0186	23.520	4.3	0.1	0.202	0.625	0.827	1.32	6.513	0.726	0.101
2	0.0216	27.030	7.8	0.2	0.366	0.488	0.854	1.75	6.650	0.671	0.183
3	0.0374	33.900	14.7	0.7	0.682	0.320	1.002	3.13	6.818	0.661	0.341
4	0.0604	34.600	15.4	1.6	0.709	0.314	1.023	3.26	6.824	0.668	0.354
5	0.0845	34.900	15.7	2.4	0.716	0.339	1.055	3.11	6.799	0.697	0.358
6	0.1083	35.090	15.9	3.3	0.718	0.364	1.082	2.97	6.774	0.723	0.359
7	0.1321	35.400	16.2	4.1	0.726	0.376	1.102	2.93	6.762	0.739	0.363
8	0.1561	35.730	16.5	5.0	0.734	0.382	1.116	2.92	6.756	0.749	0.367
9	0.1899	35.950	16.8	6.2	0.734	0.403	1.137	2.82	6.735	0.770	0.367
10	0.2159	36.000	16.8	7.1	0.729	0.425	1.154	2.72	6.713	0.790	0.365
11	0.2418	35.450	16.3	8.0	0.698	0.441	1.139	2.58	6.697	0.790	0.349
12	0.2678	35.390	16.2	9.0	0.689	0.451	1.140	2.53	6.687	0.795	0.344
13	0.3027	35.510	16.3	10.2	0.684	0.468	1.152	2.46	6.670	0.810	0.342
14	0.3286	35.570	16.4	11.1	0.680	0.480	1.160	2.42	6.658	0.820	0.340
15	0.3566	35.610	16.4	12.1	0.674	0.495	1.169	2.36	6.643	0.832	0.337
16	0.3754	35.730	16.5	12.8	0.674	0.503	1.177	2.34	6.635	0.840	0.337
17	0.4023	35.800	16.6	13.8	0.669	0.514	1.183	2.30	6.624	0.848	0.334
18	0.4374	36.010	16.8	15.0	0.668	0.520	1.188	2.28	6.618	0.854	0.334

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.430			146.380
Moisture content: Dry soil+tare, gms.	82.280			103.090
Moisture content: Tare, gms.	30.830			30.420
Moisture, %	60.5	60.5	59.5	59.6
Moist specimen weight, gms.	116.9			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.79	2.79	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	102.8	102.8	103.2	
Dry density, pcf	64.0	64.0	64.7	
Void ratio	1.6370	1.6370	1.6088	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.644 tsf
 Consolidation effective confining stress = 1.496 tsf
 Peak Stress = 0.990 tsf at reading no. 4
 Ult. Stress = 0.894 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0090	18.060	0.0	0.0	0.000	1.496	1.496	1.00	5.644	1.496	0.000
1	0.0109	22.820	4.8	0.1	0.222	1.373	1.595	1.16	5.767	1.484	0.111
2	0.0139	29.260	11.2	0.2	0.523	1.206	1.729	1.43	5.934	1.467	0.261
3	0.0309	39.150	21.1	0.8	0.979	0.868	1.847	2.13	6.272	1.357	0.489
4	0.0468	39.520	21.5	1.4	0.990	0.882	1.872	2.12	6.258	1.377	0.495
5	0.0707	38.710	20.7	2.2	0.944	0.909	1.853	2.04	6.231	1.381	0.472
6	0.0956	38.760	20.7	3.1	0.938	0.932	1.870	2.01	6.208	1.401	0.469
7	0.1203	38.960	20.9	4.0	0.939	0.941	1.880	2.00	6.199	1.410	0.469
8	0.1465	39.270	21.2	4.9	0.943	0.951	1.894	1.99	6.189	1.423	0.472
9	0.1721	39.230	21.2	5.9	0.932	0.956	1.888	1.98	6.184	1.422	0.466
10	0.1980	39.450	21.4	6.8	0.933	0.962	1.895	1.97	6.178	1.428	0.466
11	0.2260	39.560	21.5	7.8	0.927	0.977	1.904	1.95	6.163	1.441	0.464
12	0.2531	39.550	21.5	8.8	0.917	0.976	1.893	1.94	6.164	1.435	0.459
13	0.2797	39.450	21.4	9.7	0.903	0.985	1.888	1.92	6.155	1.437	0.452
14	0.3070	39.590	21.5	10.7	0.899	0.982	1.881	1.92	6.158	1.432	0.450
15	0.3347	39.730	21.7	11.7	0.895	0.987	1.882	1.91	6.153	1.435	0.448
16	0.3616	39.970	21.9	12.7	0.895	0.982	1.877	1.91	6.158	1.430	0.448
17	0.3994	40.350	22.3	14.0	0.896	0.986	1.882	1.91	6.154	1.434	0.448
18	0.4265	40.550	22.5	15.0	0.894	0.981	1.875	1.91	6.159	1.428	0.447

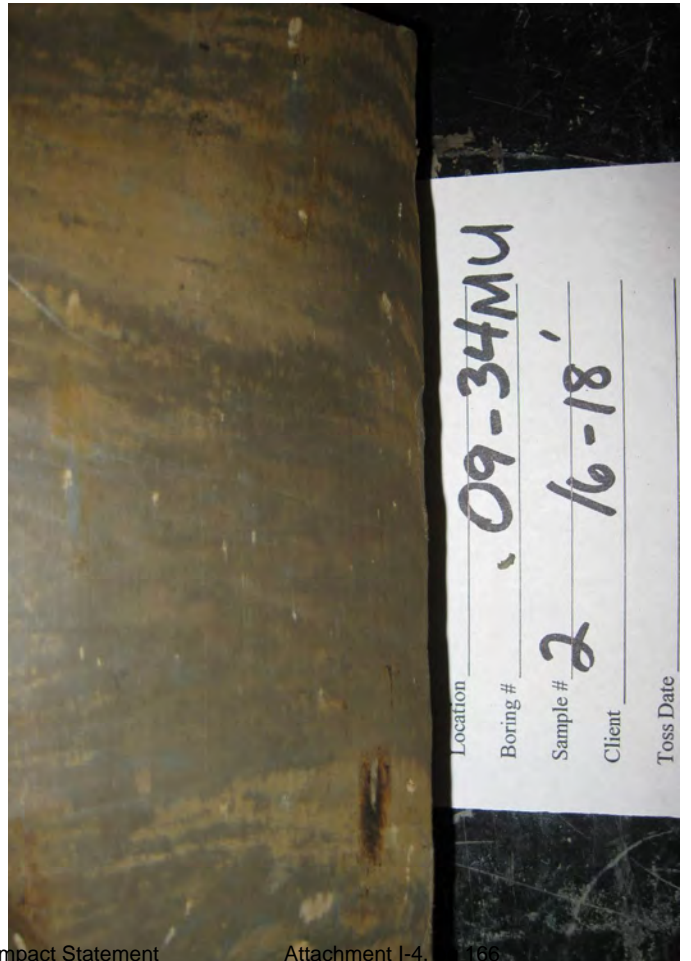
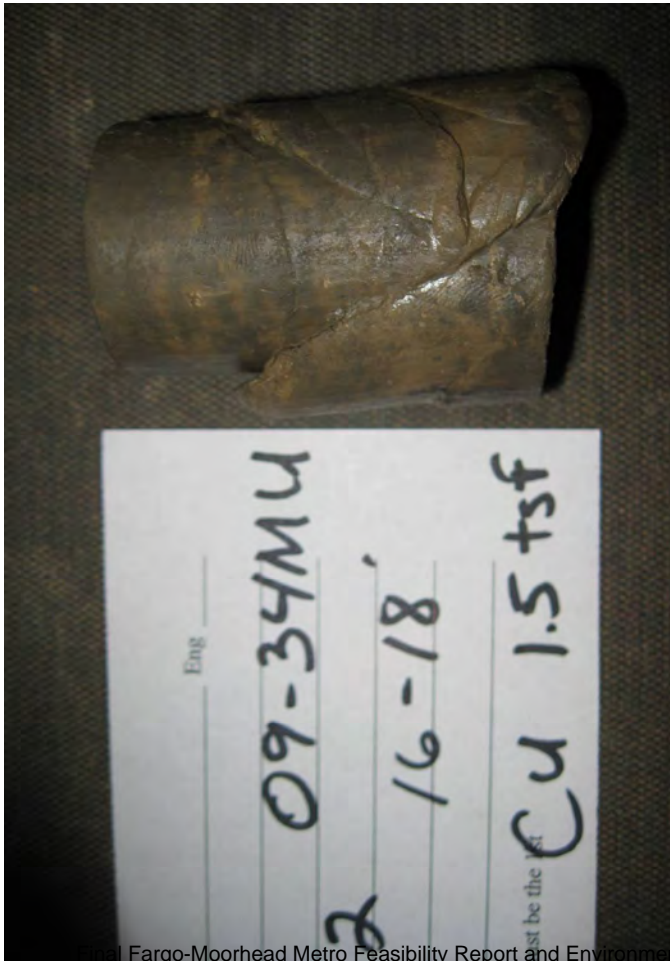
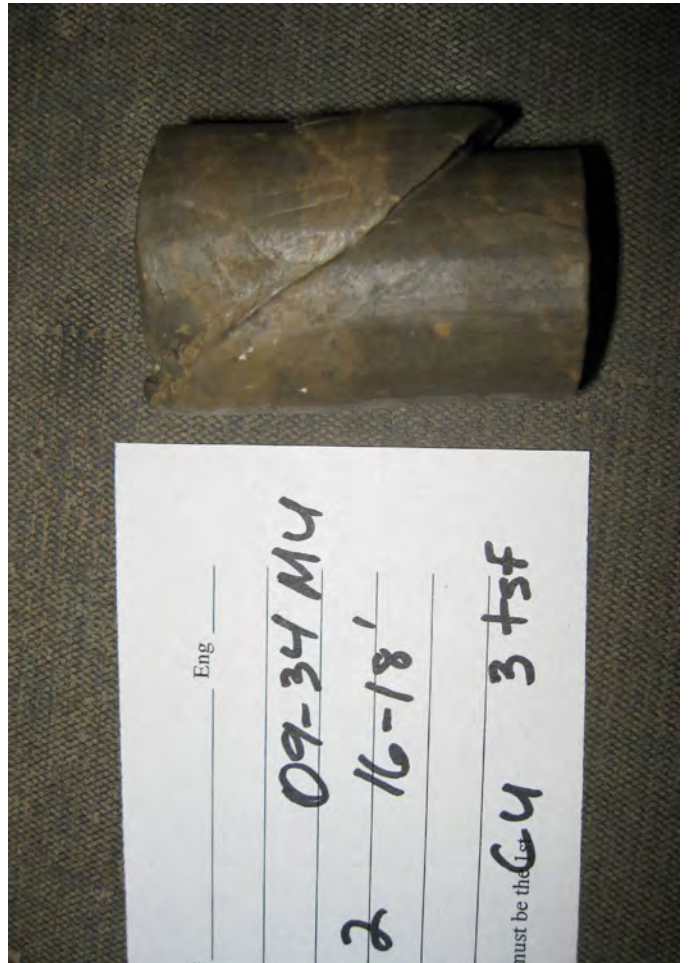
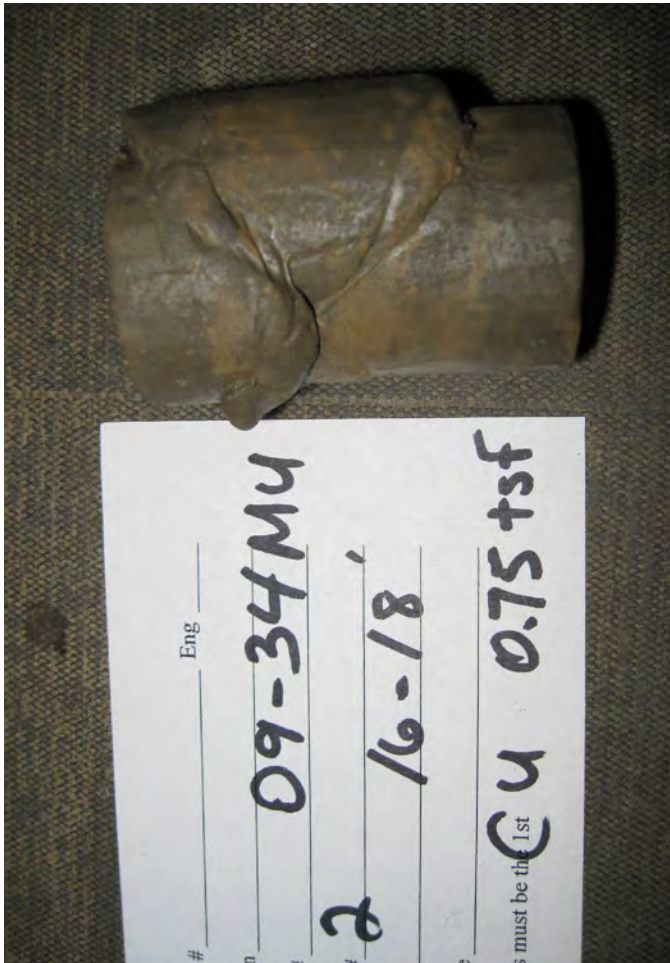
Parameters for Specimen No. 3

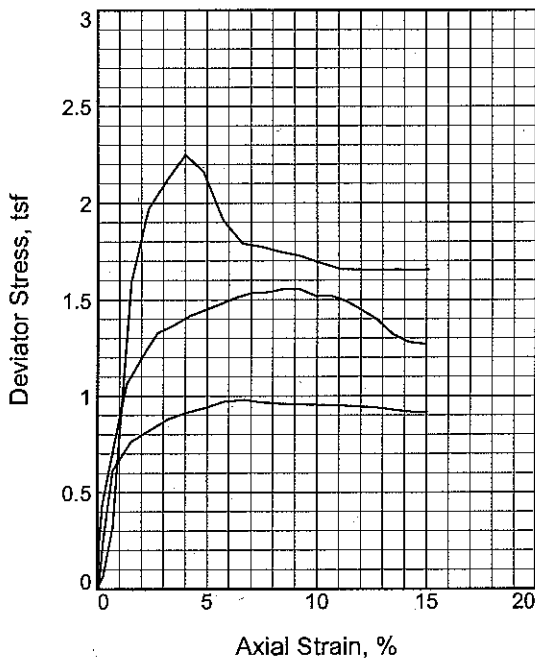
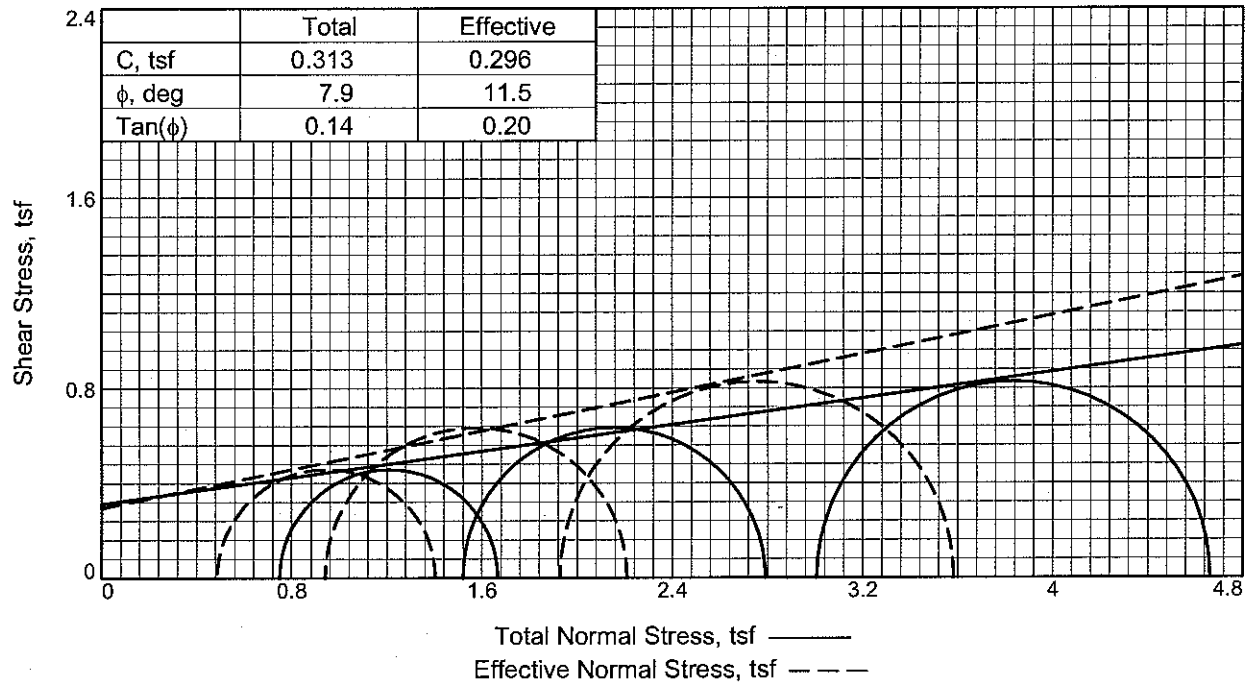
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	116.730			142.610
Moisture content: Dry soil+tare, gms.	83.650			101.810
Moisture content: Tare, gms.	30.360			30.000
Moisture, %	62.1	62.0	57.9	56.8
Moist specimen weight, gms.	115.4			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.53	1.53	1.48	
Height, in.	2.82	2.82	2.78	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	102.2	102.2	103.9	
Dry density, pcf	63.0	63.0	65.8	
Void ratio	1.6777	1.6777	1.5649	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.142 tsf
 Consolidation back pressure = 4.128 tsf
 Consolidation effective confining stress = 3.014 tsf
 Peak Stress = 1.444 tsf at reading no. 5
 Ult. Stress = 1.193 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0051	19.920	0.0	0.0	0.000	3.014	3.014	1.00	4.128	3.014	0.000
1	0.0069	24.740	4.8	0.1	0.234	2.840	3.074	1.08	4.302	2.957	0.117
2	0.0099	30.880	11.0	0.2	0.531	2.663	3.194	1.20	4.479	2.929	0.266
3	0.0257	46.350	26.4	0.7	1.274	2.123	3.397	1.60	5.019	2.760	0.637
4	0.0507	50.050	30.1	1.6	1.439	1.978	3.417	1.73	5.164	2.697	0.719
5	0.0748	50.430	30.5	2.5	1.444	2.019	3.463	1.72	5.123	2.741	0.722
6	0.0987	50.540	30.6	3.4	1.437	2.039	3.476	1.70	5.103	2.757	0.718
7	0.1305	50.430	30.5	4.5	1.415	2.054	3.469	1.69	5.088	2.761	0.707
8	0.1553	50.510	30.6	5.4	1.405	2.054	3.459	1.68	5.088	2.756	0.702
9	0.1822	49.020	29.1	6.4	1.323	2.060	3.383	1.64	5.082	2.721	0.661
10	0.2091	48.490	28.6	7.3	1.285	2.041	3.326	1.63	5.101	2.684	0.643
11	0.2362	47.990	28.1	8.3	1.250	2.013	3.263	1.62	5.129	2.638	0.625
12	0.2629	48.030	28.1	9.3	1.238	2.023	3.261	1.61	5.119	2.642	0.619
13	0.2899	48.040	28.1	10.2	1.225	2.010	3.235	1.61	5.132	2.623	0.613
14	0.3257	47.990	28.1	11.5	1.206	1.995	3.201	1.60	5.147	2.598	0.603
15	0.3537	48.350	28.4	12.5	1.207	1.986	3.193	1.61	5.156	2.590	0.604
16	0.3815	48.410	28.5	13.5	1.196	1.981	3.177	1.60	5.161	2.579	0.598
17	0.4085	48.920	29.0	14.5	1.204	1.964	3.168	1.61	5.178	2.566	0.602
18	0.4220	48.820	28.9	15.0	1.193	1.962	3.155	1.61	5.180	2.558	0.596





Sample No.	1	2	3	
Initial	Water Content, %	39.5	38.1	39.1
	Dry Density, pcf	82.2	83.8	82.3
	Saturation, %	99.9	99.9	99.0
	Void Ratio	1.0875	1.0479	1.0849
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.82	2.82	2.80
At Test	Water Content, %	39.4	38.1	38.6
	Dry Density, pcf	82.4	83.8	83.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0831	1.0479	1.0627
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.81	2.82	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.75	1.51	3.01	
Back Pressure, tsf	6.39	5.62	4.13	
Cell Pressure, tsf	7.14	7.13	7.14	
Peak Deviator Stress, tsf	0.98	1.56	2.25	
Total Pore Pr., tsf	6.88	6.43	5.55	
Ultimate Deviator Stress, tsf	0.92	1.27	1.66	
Total Pore Pr., tsf	6.65	6.20	5.21	
Maj. Eff. Stress at Ultimate, tsf	1.40	2.21	3.58	
Min. Eff. Stress at Ultimate, tsf	0.49	0.94	1.93	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Top of sample

Description: FAT CLAY, brown (CH)

LL= 89 PL= 21 PI= 68

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

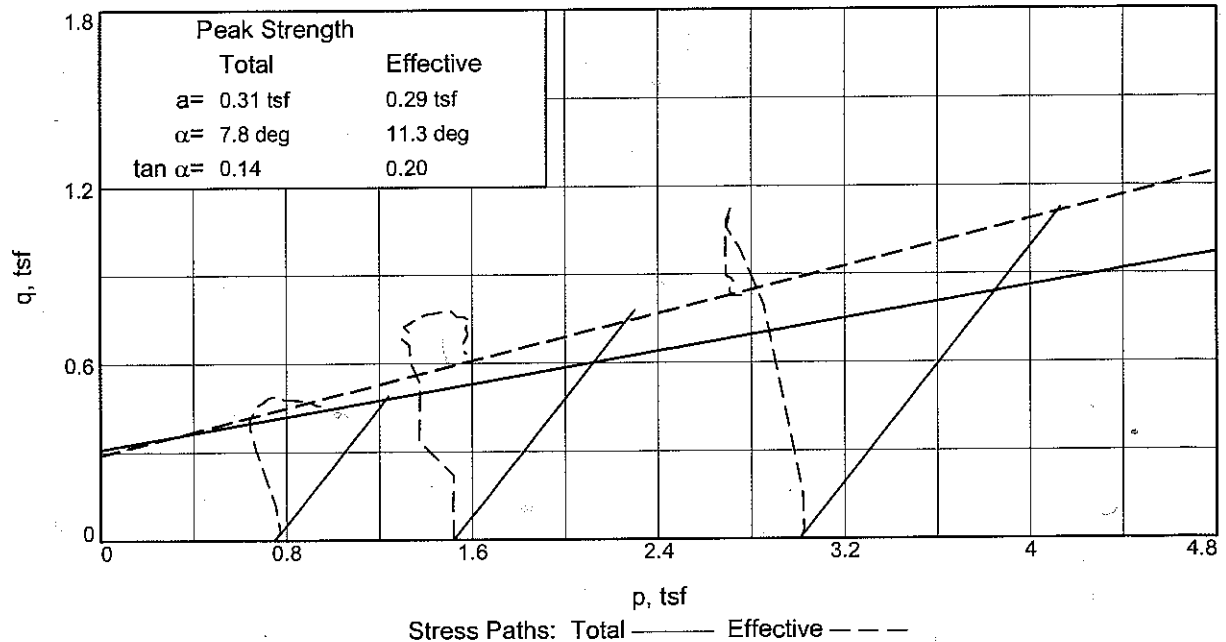
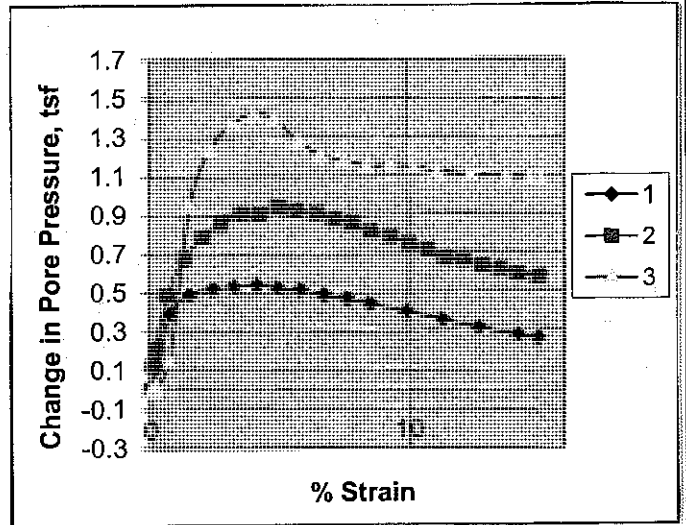
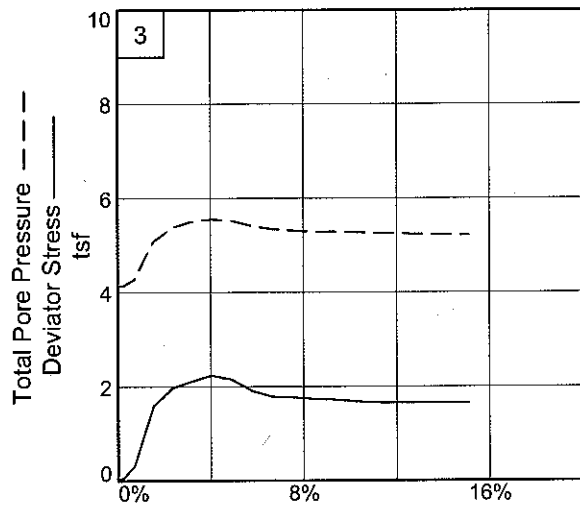
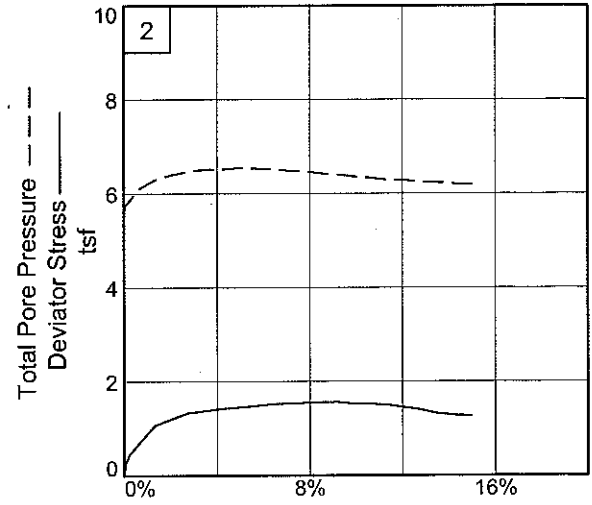
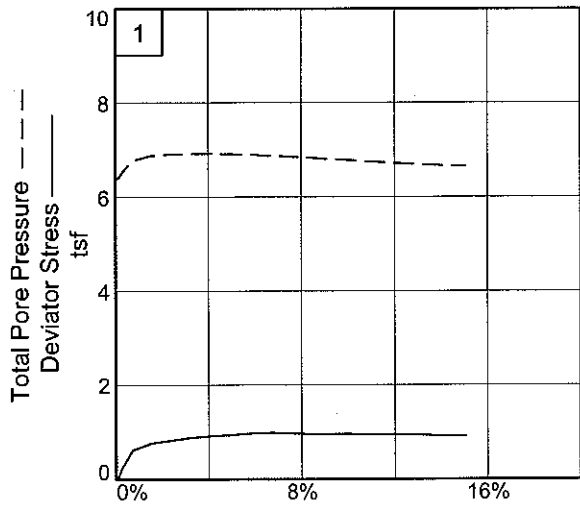
Project: Fargo-Moorhead Metro Feasibility Study
Fargo

Location: WD-28, ND Div **Oxidized Brenna**

Sample Number: Boring 09-59MU, #1 **Depth:** 10-12'

Proj. No.: BL0903127A **Date Sampled:**

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Location: WD-28, ND Div

Depth: 10-12'

Sample Number: Boring 09-59MU, #1

Project No.: BD0903127A Feasibility Report and Environmental Impact Statement

Figure

Braun-Intertec

Geotechnical Design and Geology

July 2011

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

2/23/2010

11:03 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-28, ND Div **Fargo**
Depth: 10-12' **Sample Number:** Boring 09-59MU, #1
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.75 **LL=**89 **PL=**21 **PI=**68
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	144.800			162.820
Moisture content: Dry soil+tare, gms.	112.610			125.690
Moisture content: Tare, gms.	31.100			30.690
Moisture, %	39.5	39.5	39.4	39.1
Moist specimen weight, gms.	132.0			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.55	
Height, in.	2.82	2.82	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.7	114.8	114.9	
Dry density, pcf	82.2	82.2	82.4	
Void ratio	1.0875	1.0875	1.0831	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.390 tsf
Consolidation effective confining stress = 0.750 tsf
Fail. Stress = 0.980 tsf at reading no. 10
Ult. Stress = 0.916 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0082	18.670	0.0	0.0	0.000	0.750	0.750	1.00	6.390	0.750	0.000
1	0.0110	19.950	1.3	0.1	0.059	0.745	0.804	1.08	6.395	0.775	0.030
2	0.0151	23.830	5.2	0.2	0.238	0.635	0.873	1.38	6.505	0.754	0.119
3	0.0278	31.980	13.3	0.7	0.612	0.362	0.974	2.69	6.778	0.668	0.306
4	0.0508	35.430	16.8	1.5	0.764	0.260	1.024	3.94	6.880	0.642	0.382
5	0.0746	36.820	18.1	2.4	0.821	0.230	1.051	4.57	6.910	0.640	0.410
6	0.0985	38.290	19.6	3.2	0.879	0.221	1.100	4.98	6.919	0.661	0.440
7	0.1225	39.240	20.6	4.1	0.914	0.214	1.128	5.27	6.926	0.671	0.457
8	0.1462	39.960	21.3	4.9	0.938	0.228	1.166	5.11	6.912	0.697	0.469
9	0.1712	40.920	22.3	5.8	0.971	0.238	1.209	5.08	6.902	0.723	0.485
10	0.1962	41.350	22.7	6.7	0.980	0.265	1.245	4.70	6.875	0.755	0.490
11	0.2211	41.260	22.6	7.6	0.967	0.284	1.251	4.40	6.856	0.767	0.483
12	0.2469	41.300	22.6	8.5	0.959	0.310	1.269	4.09	6.830	0.790	0.480
13	0.2868	41.570	22.9	9.9	0.955	0.352	1.307	3.71	6.788	0.830	0.478
14	0.3258	41.800	23.1	11.3	0.950	0.395	1.345	3.41	6.745	0.870	0.475
15	0.3665	41.930	23.3	12.7	0.940	0.435	1.375	3.16	6.705	0.905	0.470
16	0.4065	41.750	23.1	14.2	0.917	0.473	1.390	2.94	6.667	0.932	0.459
17	0.4314	41.960	23.3	15.0	0.916	0.487	1.403	2.88	6.653	0.945	0.458

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	153.500			161.920
Moisture content: Dry soil+tare, gms.	119.480			125.650
Moisture content: Tare, gms.	30.100			30.310
Moisture, %	38.1	38.1	38.1	38.0
Moist specimen weight, gms.	132.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	115.7	115.8	115.8	
Dry density, pcf	83.8	83.8	83.8	
Void ratio	1.0479	1.0479	1.0479	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.135 tsf
 Consolidation back pressure = 5.615 tsf
 Consolidation effective confining stress = 1.520 tsf
 Fail. Stress = 1.557 tsf at reading no. 14
 Ult. Stress = 1.269 tsf at reading no. 23

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0215	19.580	0.0	0.0	0.000	1.520	1.520	1.00	5.615	1.520	0.000
1	0.0233	24.830	5.3	0.1	0.245	1.393	1.638	1.18	5.742	1.515	0.122
2	0.0276	28.980	9.4	0.2	0.437	1.301	1.738	1.34	5.834	1.520	0.219
3	0.0395	34.160	14.6	0.6	0.676	1.034	1.710	1.65	6.101	1.372	0.338
4	0.0588	42.750	23.2	1.3	1.066	0.842	1.908	2.27	6.293	1.375	0.533
5	0.0792	45.920	26.3	2.0	1.203	0.733	1.936	2.64	6.402	1.335	0.602
6	0.0988	48.850	29.3	2.7	1.328	0.664	1.992	3.00	6.471	1.328	0.664
7	0.1193	49.970	30.4	3.5	1.368	0.614	1.982	3.23	6.521	1.298	0.684
8	0.1399	51.290	31.7	4.2	1.417	0.617	2.034	3.30	6.518	1.325	0.708
9	0.1604	52.240	32.7	4.9	1.448	0.581	2.029	3.49	6.554	1.305	0.724
10	0.1804	53.200	33.6	5.6	1.480	0.597	2.077	3.48	6.538	1.337	0.740
11	0.2008	54.220	34.6	6.4	1.513	0.609	2.122	3.48	6.526	1.365	0.756
12	0.2214	55.060	35.5	7.1	1.537	0.642	2.179	3.39	6.493	1.411	0.769
13	0.2419	55.390	35.8	7.8	1.539	0.665	2.204	3.31	6.470	1.435	0.770
14	0.2614	56.080	36.5	8.5	1.557	0.707	2.264	3.20	6.428	1.486	0.779
15	0.2822	56.300	36.7	9.3	1.554	0.734	2.288	3.12	6.401	1.511	0.777
16	0.3019	55.750	36.2	10.0	1.519	0.773	2.292	2.97	6.362	1.532	0.759
17	0.3221	56.030	36.5	10.7	1.519	0.804	2.323	2.89	6.331	1.563	0.759
18	0.3420	55.640	36.1	11.4	1.490	0.847	2.337	2.76	6.288	1.592	0.745
19	0.3615	54.820	35.2	12.1	1.445	0.850	2.295	2.70	6.285	1.573	0.723
20	0.3810	53.920	34.3	12.8	1.397	0.883	2.280	2.58	6.252	1.582	0.699
21	0.4015	52.280	32.7	13.5	1.319	0.898	2.217	2.47	6.237	1.558	0.660
22	0.4214	51.590	32.0	14.2	1.281	0.927	2.208	2.38	6.208	1.567	0.640
23	0.4431	51.590	32.0	15.0	1.269	0.940	2.209	2.35	6.195	1.575	0.635

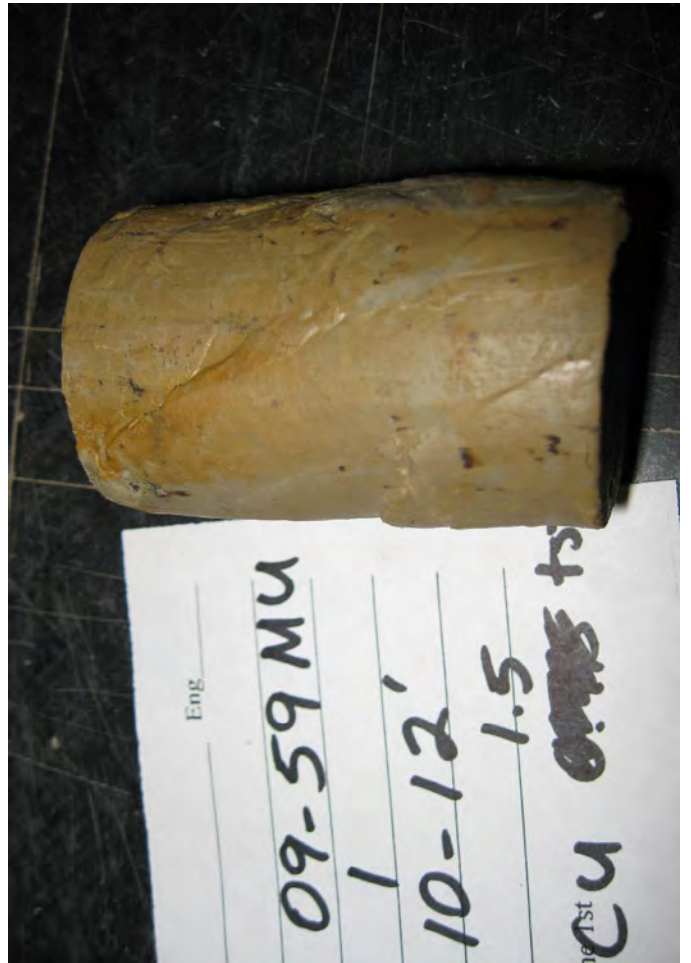
Parameters for Specimen No. 3

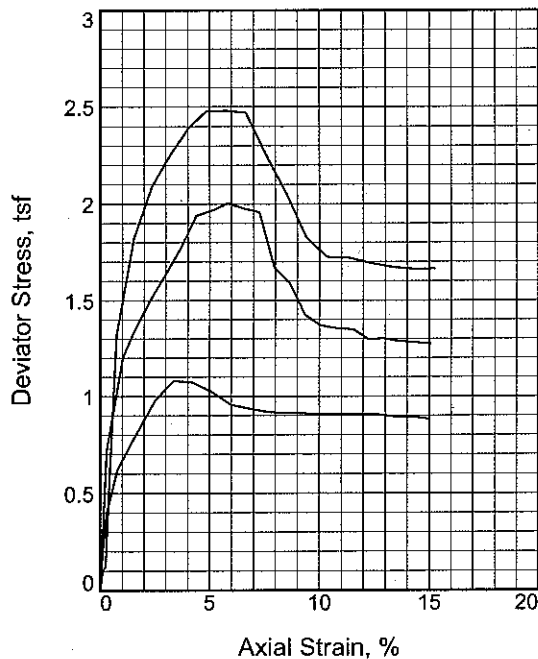
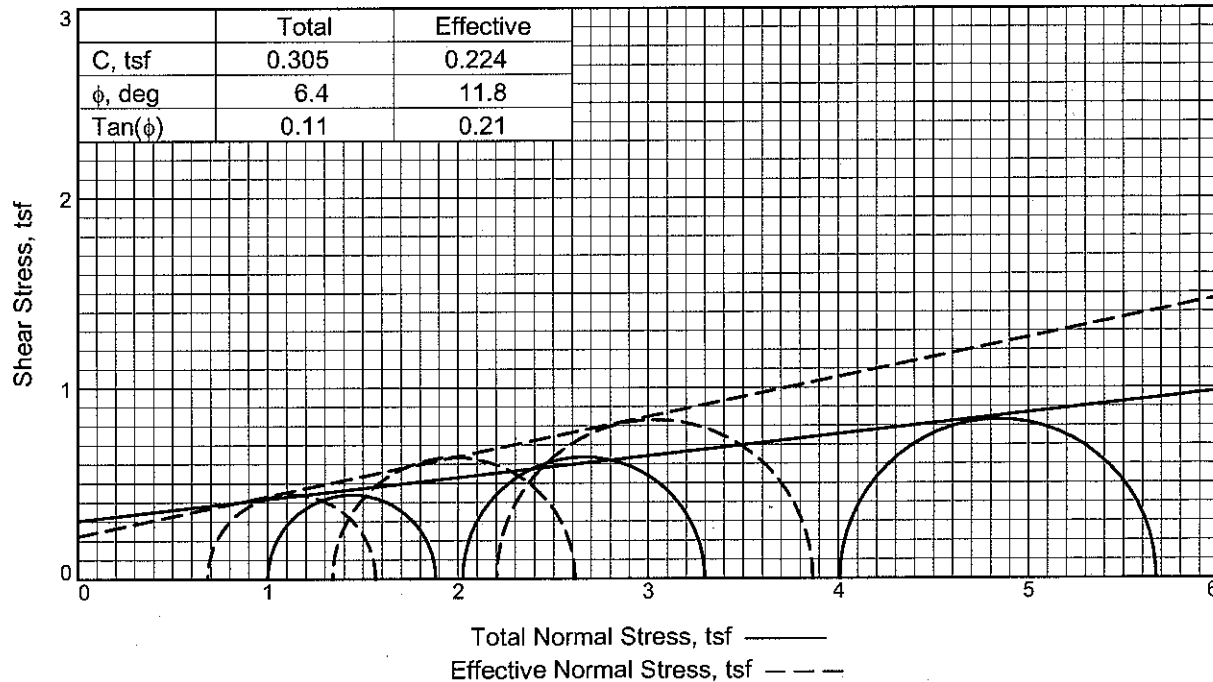
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	177.500			158.580
Moisture content: Dry soil+tare, gms.	136.410			123.950
Moisture content: Tare, gms.	31.200			30.800
Moisture, %	39.1	39.5	38.6	37.2
Moist specimen weight, gms.	130.5			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	114.5	114.8	115.4	
Dry density, pcf	82.3	82.3	83.2	
Void ratio	1.0849	1.0849	1.0627	
Saturation, %	99.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 4.133 tsf
 Consolidation effective confining stress = 3.007 tsf
 Fail. Stress = 2.249 tsf at reading no. 7
 Ult. Stress = 1.656 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0070	17.780	0.0	0.0	0.000	3.007	3.007	1.00	4.133	3.007	0.000
1	0.0099	18.520	0.7	0.1	0.035	3.001	3.036	1.01	4.139	3.018	0.017
2	0.0138	19.100	1.3	0.2	0.062	2.993	3.055	1.02	4.147	3.024	0.031
3	0.0267	24.590	6.8	0.7	0.317	2.860	3.177	1.11	4.280	3.018	0.158
4	0.0495	52.270	34.5	1.5	1.591	2.058	3.649	1.77	5.082	2.853	0.795
5	0.0725	60.880	43.1	2.3	1.971	1.765	3.736	2.12	5.375	2.751	0.986
6	0.0955	64.510	46.7	3.2	2.120	1.633	3.753	2.30	5.507	2.693	1.060
7	0.1193	67.810	50.0	4.0	2.249	1.586	3.835	2.42	5.554	2.711	1.125
8	0.1423	66.280	48.5	4.8	2.162	1.610	3.772	2.34	5.530	2.691	1.081
9	0.1671	61.090	43.3	5.7	1.912	1.731	3.643	2.10	5.409	2.687	0.956
10	0.1920	58.710	40.9	6.6	1.790	1.797	3.587	2.00	5.343	2.692	0.895
11	0.2168	58.710	40.9	7.5	1.773	1.826	3.599	1.97	5.314	2.713	0.887
12	0.2418	58.440	40.7	8.4	1.744	1.855	3.599	1.94	5.285	2.727	0.872
13	0.2656	58.410	40.6	9.3	1.727	1.848	3.575	1.93	5.292	2.711	0.863
14	0.2917	57.920	40.1	10.2	1.689	1.861	3.550	1.91	5.279	2.705	0.844
15	0.3164	57.590	39.8	11.1	1.658	1.885	3.543	1.88	5.255	2.714	0.829
16	0.3544	58.120	40.3	12.4	1.655	1.899	3.554	1.87	5.241	2.726	0.827
17	0.3914	58.760	41.0	13.8	1.655	1.914	3.569	1.86	5.226	2.742	0.828
18	0.4164	59.120	41.3	14.7	1.653	1.918	3.571	1.86	5.222	2.744	0.826
19	0.4292	59.420	41.6	15.1	1.656	1.927	3.583	1.86	5.213	2.755	0.828





Sample No.	1	2	3	
Initial	Water Content, %	47.5	48.0	50.4
	Dry Density, pcf	74.2	74.0	71.8
	Saturation, %	99.4	100.0	99.8
	Void Ratio	1.3147	1.3201	1.3906
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.81	2.82	2.81
At Test	Water Content, %	47.8	46.7	47.8
	Dry Density, pcf	74.2	75.2	74.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3147	1.2831	1.3147
	Diameter, in.	1.40	1.39	1.38
	Height, in.	2.81	2.80	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.00	2.03	4.01	
Back Pressure, tsf	6.14	5.11	3.13	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	1.08	2.00	2.48	
Total Pore Pr., tsf	6.68	6.13	5.03	
Ultimate Deviator Stress, tsf	0.88	1.27	1.66	
Total Pore Pr., tsf	6.46	5.80	4.94	
Maj. Eff. Stress at Ultimate, tsf	1.57	2.61	3.87	
Min. Eff. Stress at Ultimate, tsf	0.68	1.34	2.20	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Top of sample

Description: FAT CLAY, brown (CH)

LL= 92 PL= 19 PI= 73

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in./min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

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Project: Fargo-Moorhead Metro Feasibility Study
Fargo

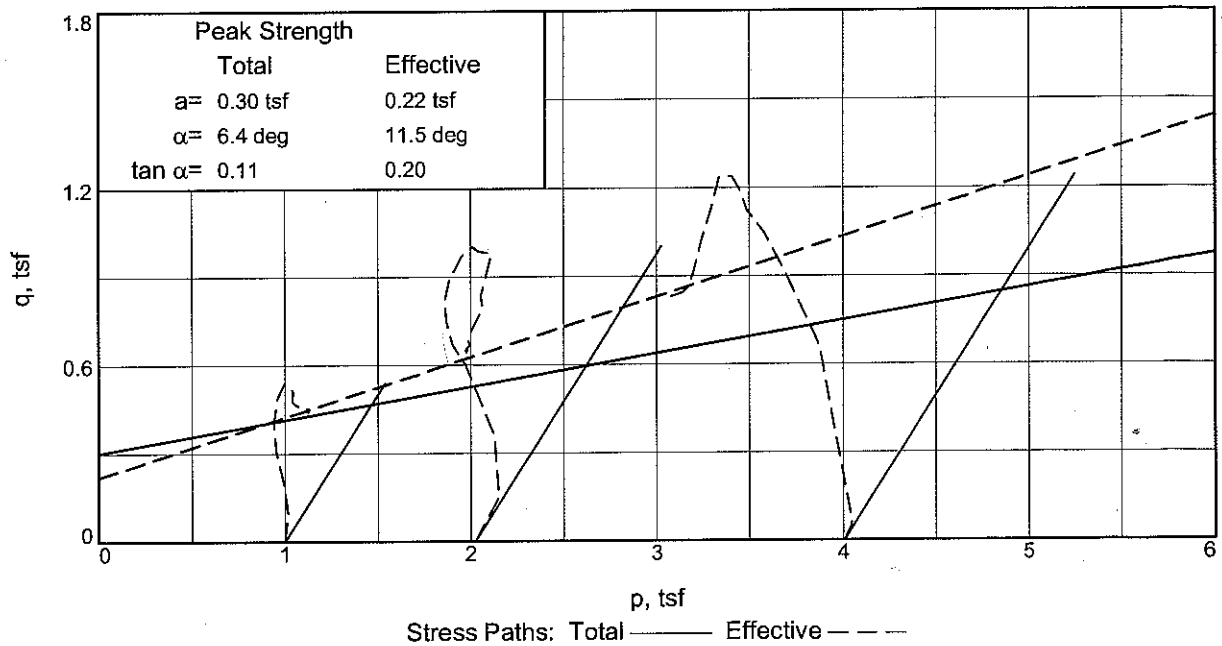
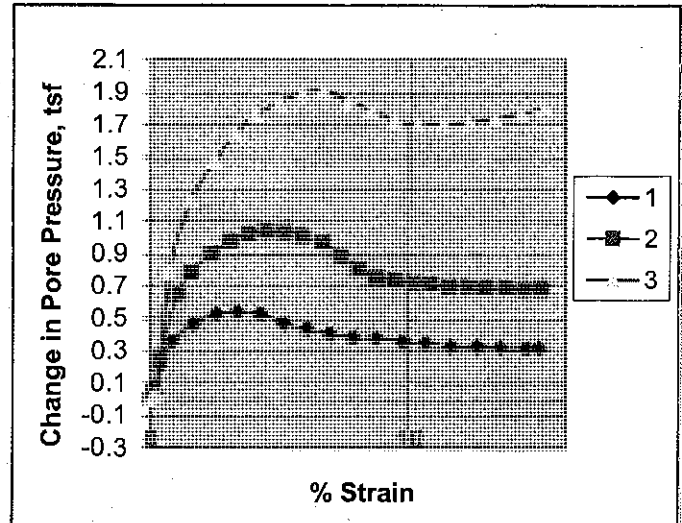
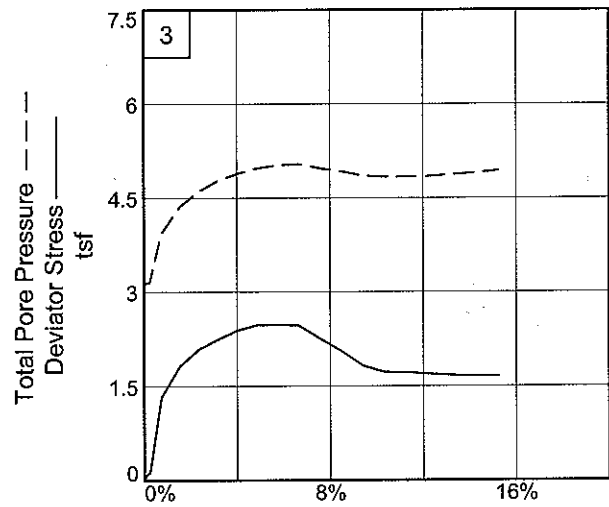
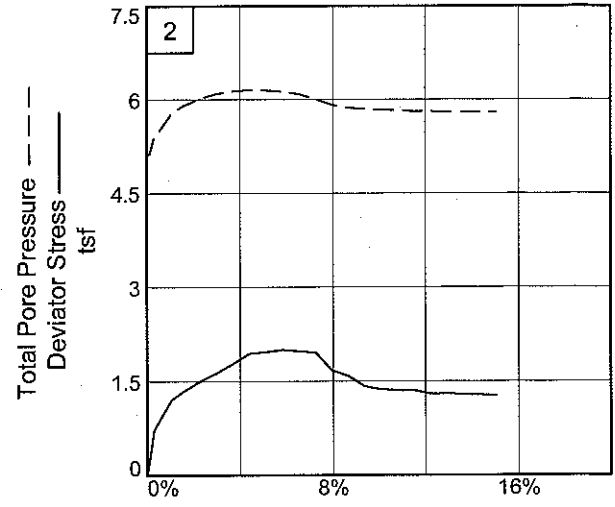
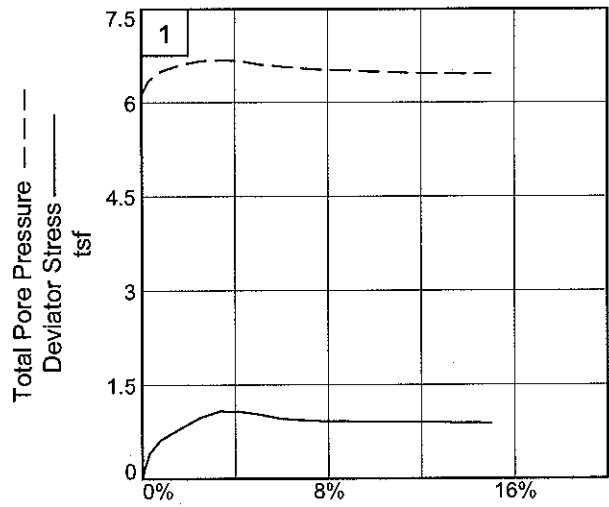
Location: WD-28, ND Div Oxidized Brenna

Sample Number: Boring 09-59MU, #2 **Depth:** 20-22'

Proj. No.: BL0903127A

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Location: WD-28, ND Div

Depth: 20-22'

Sample Number: Boring 09-59MU, #2

Project No.: B00903 M27A Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

2/23/2010
11:04 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-28, ND Div Fargo
Depth: 20-22' **Sample Number:** Boring 09-59MU, #2
Description: FAT CLAY, brown (CH) Oxidized Brenna
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.75 **LL**=92 **PL**=19 **PI**=73
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.800			154.010
Moisture content: Dry soil+tare, gms.	114.700			114.370
Moisture content: Tare, gms.	30.290			30.710
Moisture, %	47.5	47.8	47.8	47.4
Moist specimen weight, gms.	124.4			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	109.4	109.6	109.6	
Dry density, pcf	74.2	74.2	74.2	
Void ratio	1.3147	1.3147	1.3147	
Saturation, %	99.4	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.141 tsf
 Consolidation effective confining stress = 0.999 tsf
 Fail. Stress = 1.080 tsf at reading no. 6
 Ult. Stress = 0.882 tsf at reading no. 19

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0066	17.970	0.0	0.0	0.000	0.999	0.999	1.00	6.141	0.999	0.000
1	0.0100	22.030	4.1	0.1	0.189	0.922	1.111	1.21	6.218	1.017	0.095
2	0.0150	26.570	8.6	0.3	0.400	0.793	1.193	1.51	6.347	0.993	0.200
3	0.0288	31.370	13.4	0.8	0.621	0.641	1.262	1.97	6.499	0.951	0.310
4	0.0528	35.490	17.5	1.6	0.805	0.537	1.342	2.50	6.603	0.939	0.402
5	0.0768	39.390	21.4	2.5	0.975	0.472	1.447	3.07	6.668	0.960	0.488
6	0.1006	41.900	23.9	3.3	1.080	0.457	1.537	3.36	6.683	0.997	0.540
7	0.1245	41.980	24.0	4.2	1.074	0.470	1.544	3.29	6.670	1.007	0.537
8	0.1501	41.070	23.1	5.1	1.024	0.531	1.555	2.93	6.609	1.043	0.512
9	0.1746	39.730	21.8	6.0	0.956	0.563	1.519	2.70	6.577	1.041	0.478
10	0.2002	39.480	21.5	6.9	0.935	0.590	1.525	2.59	6.550	1.058	0.468
11	0.2261	39.270	21.3	7.8	0.917	0.617	1.534	2.49	6.523	1.076	0.459
12	0.2510	39.430	21.5	8.7	0.915	0.619	1.534	2.48	6.521	1.077	0.458
13	0.2779	39.540	21.6	9.7	0.910	0.642	1.552	2.42	6.498	1.097	0.455
14	0.3058	39.700	21.7	10.6	0.907	0.652	1.559	2.39	6.488	1.105	0.453
15	0.3328	39.970	22.0	11.6	0.908	0.671	1.579	2.35	6.469	1.125	0.454
16	0.3597	40.180	22.2	12.6	0.907	0.673	1.580	2.35	6.467	1.126	0.453
17	0.3867	40.080	22.1	13.5	0.893	0.681	1.574	2.31	6.459	1.127	0.446
18	0.4137	40.240	22.3	14.5	0.889	0.685	1.574	2.30	6.455	1.130	0.445
19	0.4277	40.190	22.2	15.0	0.882	0.683	1.565	2.29	6.457	1.124	0.441

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	155.950			152.610
Moisture content: Dry soil+tare, gms.	115.190			115.080
Moisture content: Tare, gms.	30.300			30.410
Moisture, %	48.0	48.0	46.7	44.3
Moist specimen weight, gms.	124.5			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.5	109.5	110.3	
Dry density, pcf	74.0	74.0	75.2	
Void ratio	1.3201	1.3201	1.2831	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 5.114 tsf
 Consolidation effective confining stress = 2.024 tsf
 Fail. Stress = 2.004 tsf at reading no. 10
 Ult. Stress = 1.274 tsf at reading no. 23

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0221	15.630	0.0	0.0	0.000	2.024	2.024	1.00	5.114	2.024	0.000
1	0.0259	21.970	6.3	0.1	0.300	2.000	2.300	1.15	5.138	2.150	0.150
2	0.0306	30.890	15.3	0.3	0.720	1.766	2.486	1.41	5.372	2.126	0.360
3	0.0511	41.290	25.7	1.0	1.202	1.372	2.574	1.88	5.766	1.973	0.601
4	0.0650	44.260	28.6	1.5	1.335	1.237	2.572	2.08	5.901	1.904	0.667
5	0.0855	47.980	32.3	2.3	1.497	1.120	2.617	2.34	6.018	1.868	0.748
6	0.1061	51.290	35.7	3.0	1.638	1.041	2.679	2.57	6.097	1.860	0.819
7	0.1259	54.600	39.0	3.7	1.777	0.997	2.774	2.78	6.141	1.885	0.888
8	0.1451	58.490	42.9	4.4	1.940	0.981	2.921	2.98	6.157	1.951	0.970
9	0.1661	59.450	43.8	5.1	1.968	0.987	2.955	2.99	6.151	1.971	0.984
10	0.1855	60.590	45.0	5.8	2.004	1.009	3.013	2.99	6.129	2.011	1.002
11	0.2060	60.310	44.7	6.6	1.976	1.050	3.026	2.88	6.088	2.038	0.988
12	0.2256	60.240	44.6	7.3	1.959	1.132	3.091	2.73	6.006	2.111	0.979
13	0.2448	53.970	38.3	8.0	1.671	1.218	2.889	2.37	5.920	2.053	0.835
14	0.2648	52.340	36.7	8.7	1.587	1.270	2.857	2.25	5.868	2.064	0.794
15	0.2843	48.790	33.2	9.4	1.423	1.286	2.709	2.11	5.852	1.997	0.711
16	0.3040	47.820	32.2	10.1	1.371	1.301	2.672	2.05	5.837	1.986	0.685
17	0.3246	47.720	32.1	10.8	1.355	1.309	2.664	2.04	5.829	1.987	0.678
18	0.3452	47.870	32.2	11.5	1.350	1.325	2.675	2.02	5.813	2.000	0.675
19	0.3647	46.840	31.2	12.2	1.297	1.323	2.620	1.98	5.815	1.971	0.648
20	0.3843	47.220	31.6	12.9	1.302	1.333	2.635	1.98	5.805	1.984	0.651
21	0.4050	47.130	31.5	13.7	1.287	1.333	2.620	1.97	5.805	1.977	0.644
22	0.4248	47.260	31.6	14.4	1.282	1.340	2.622	1.96	5.798	1.981	0.641
23	0.4440	47.310	31.7	15.1	1.274	1.340	2.614	1.95	5.798	1.977	0.637

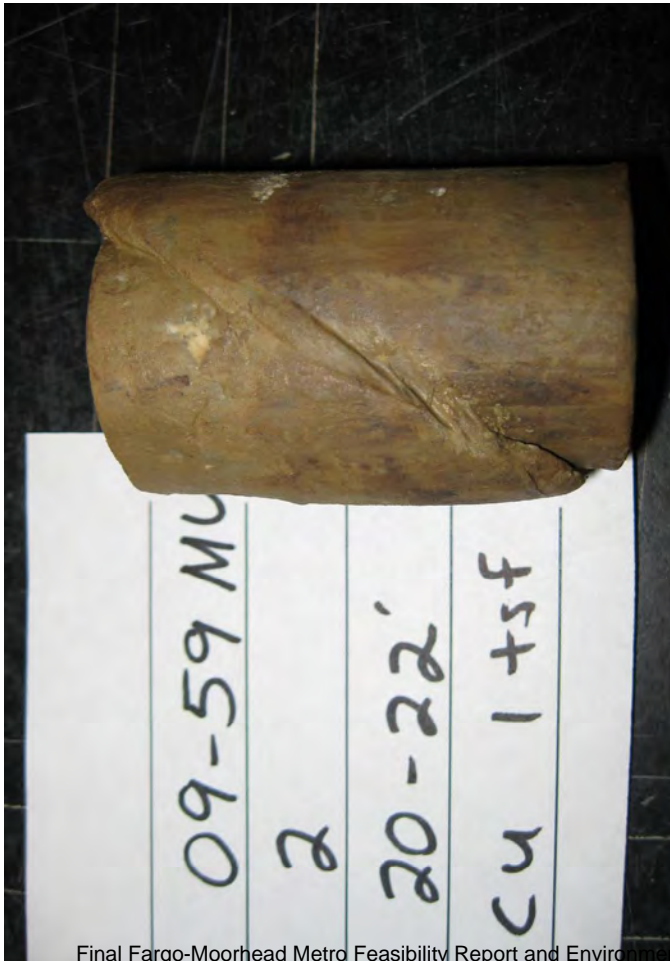
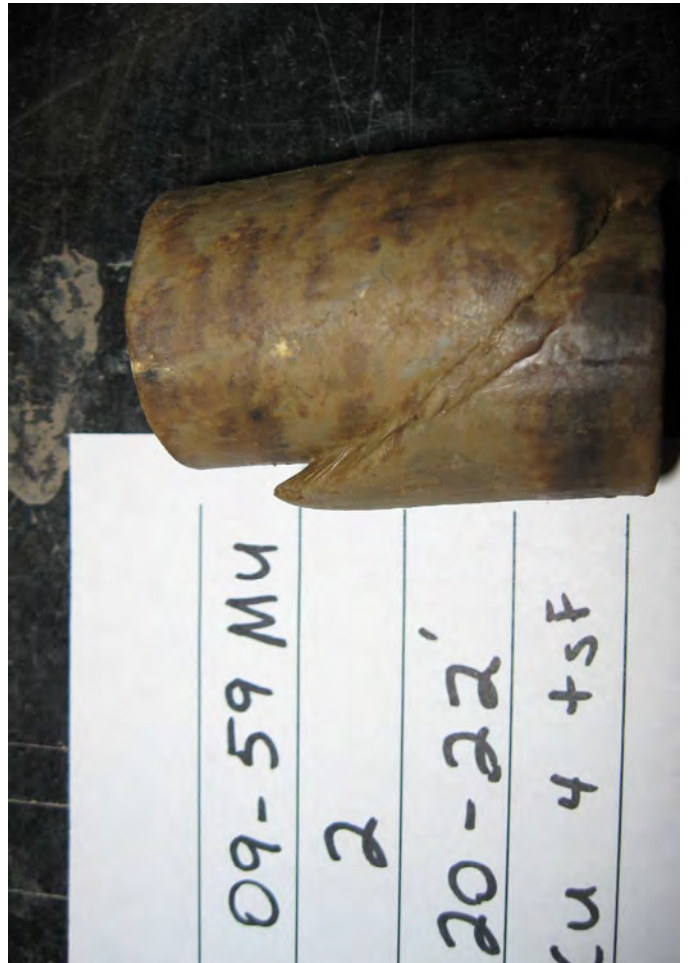
Parameters for Specimen No. 3

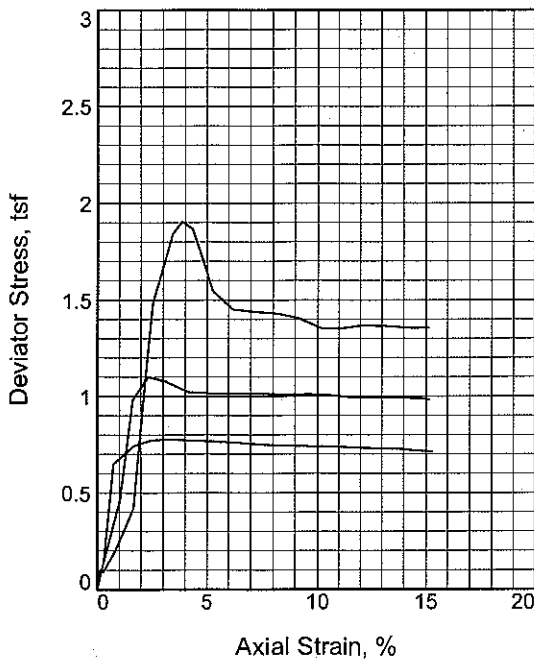
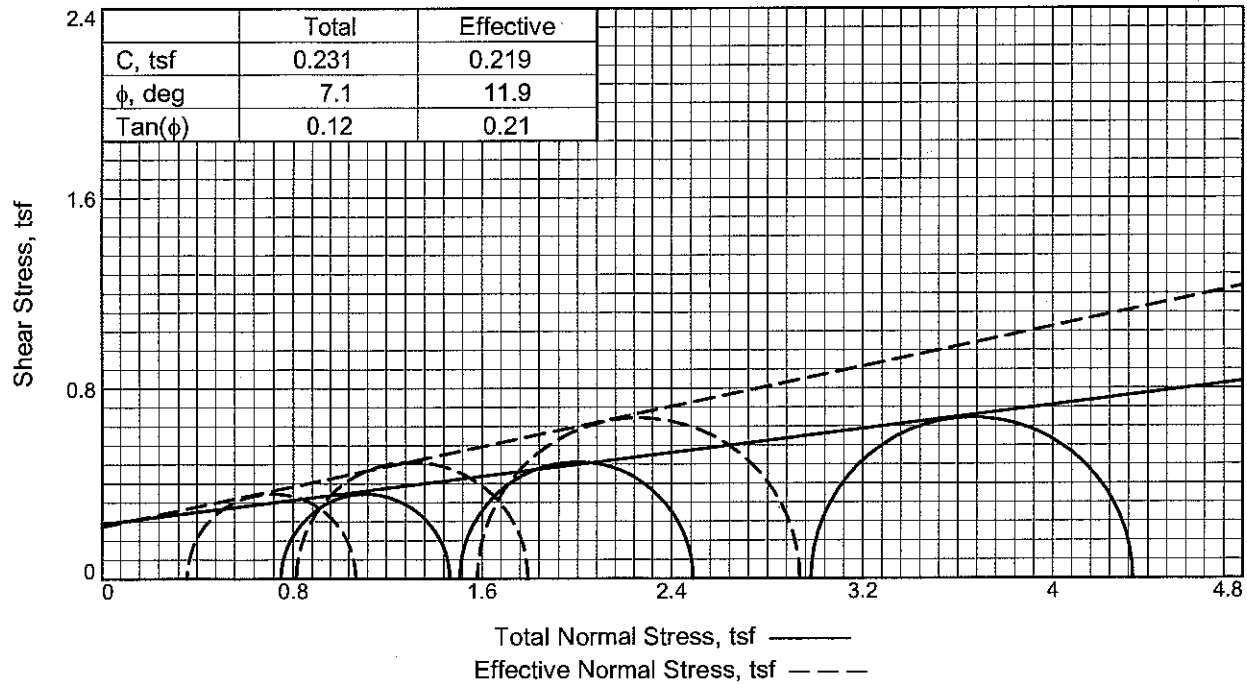
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.890			147.120
Moisture content: Dry soil+tare, gms.	123.250			111.530
Moisture content: Tare, gms.	30.800			30.340
Moisture, %	50.4	50.6	47.8	43.8
Moist specimen weight, gms.	122.0			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.53	1.53	1.50	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	108.0	108.1	109.6	
Dry density, pcf	71.8	71.8	74.2	
Void ratio	1.3906	1.3906	1.3147	
Saturation, %	99.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 3.132 tsf
 Consolidation effective confining stress = 4.008 tsf
 Fail. Stress = 2.481 tsf at reading no. 9
 Ult. Stress = 1.664 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0061	17.330	0.0	0.0	0.000	4.008	4.008	1.00	3.132	4.008	0.000
1	0.0092	19.280	2.0	0.1	0.094	3.995	4.089	1.02	3.145	4.042	0.047
2	0.0130	19.920	2.6	0.2	0.124	3.985	4.109	1.03	3.155	4.047	0.062
3	0.0268	44.980	27.6	0.7	1.321	3.215	4.536	1.41	3.925	3.876	0.661
4	0.0488	55.810	38.5	1.5	1.824	2.779	4.603	1.66	4.361	3.691	0.912
5	0.0719	61.860	44.5	2.4	2.093	2.534	4.627	1.83	4.606	3.580	1.046
6	0.0949	65.610	48.3	3.2	2.250	2.363	4.613	1.95	4.777	3.488	1.125
7	0.1184	69.120	51.8	4.0	2.392	2.249	4.641	2.06	4.891	3.445	1.196
8	0.1413	71.410	54.1	4.9	2.477	2.168	4.645	2.14	4.972	3.406	1.238
9	0.1663	72.030	54.7	5.8	2.481	2.114	4.595	2.17	5.026	3.355	1.241
10	0.1913	72.330	55.0	6.6	2.471	2.102	4.573	2.18	5.038	3.338	1.236
11	0.2172	68.020	50.7	7.6	2.255	2.166	4.421	2.04	4.974	3.293	1.127
12	0.2433	63.900	46.6	8.5	2.051	2.219	4.270	1.92	4.921	3.244	1.025
13	0.2681	59.230	41.9	9.4	1.827	2.284	4.111	1.80	4.856	3.198	0.914
14	0.2939	57.310	40.0	10.3	1.726	2.306	4.032	1.75	4.834	3.169	0.863
15	0.3211	57.680	40.4	11.3	1.723	2.305	4.028	1.75	4.835	3.166	0.861
16	0.3489	57.440	40.1	12.3	1.693	2.296	3.989	1.74	4.844	3.143	0.847
17	0.3771	57.420	40.1	13.3	1.673	2.264	3.937	1.74	4.876	3.100	0.836
18	0.4038	57.600	40.3	14.3	1.662	2.239	3.901	1.74	4.901	3.070	0.831
19	0.4307	58.130	40.8	15.2	1.664	2.202	3.866	1.76	4.938	3.034	0.832





Sample No.	1	2	3	
Initial	Water Content, %	59.1	59.5	58.7
	Dry Density, pcf	65.1	64.9	65.7
	Saturation, %	99.1	99.4	100.0
	Void Ratio	1.6381	1.6451	1.6144
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.79	2.80	2.80
At Test	Water Content, %	59.3	59.5	56.7
	Dry Density, pcf	65.3	65.1	67.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6296	1.6366	1.5586
	Diameter, in.	1.41	1.40	1.39
	Height, in.	2.79	2.79	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.75	1.51	2.98	
Back Pressure, tsf	6.39	5.63	4.16	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	0.78	1.10	1.90	
Total Pore Pr., tsf	6.89	6.44	5.69	
Ultimate Deviator Stress, tsf	0.71	0.98	1.35	
Total Pore Pr., tsf	6.78	6.33	5.56	
Maj. Eff. Stress at Ultimate, tsf	1.07	1.79	2.94	
Min. Eff. Stress at Ultimate, tsf	0.36	0.81	1.58	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Top of sample

Description: FAT CLAY, brown (CH)

LL= 113 PL= 26 PI= 87

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.001 in/min.

Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

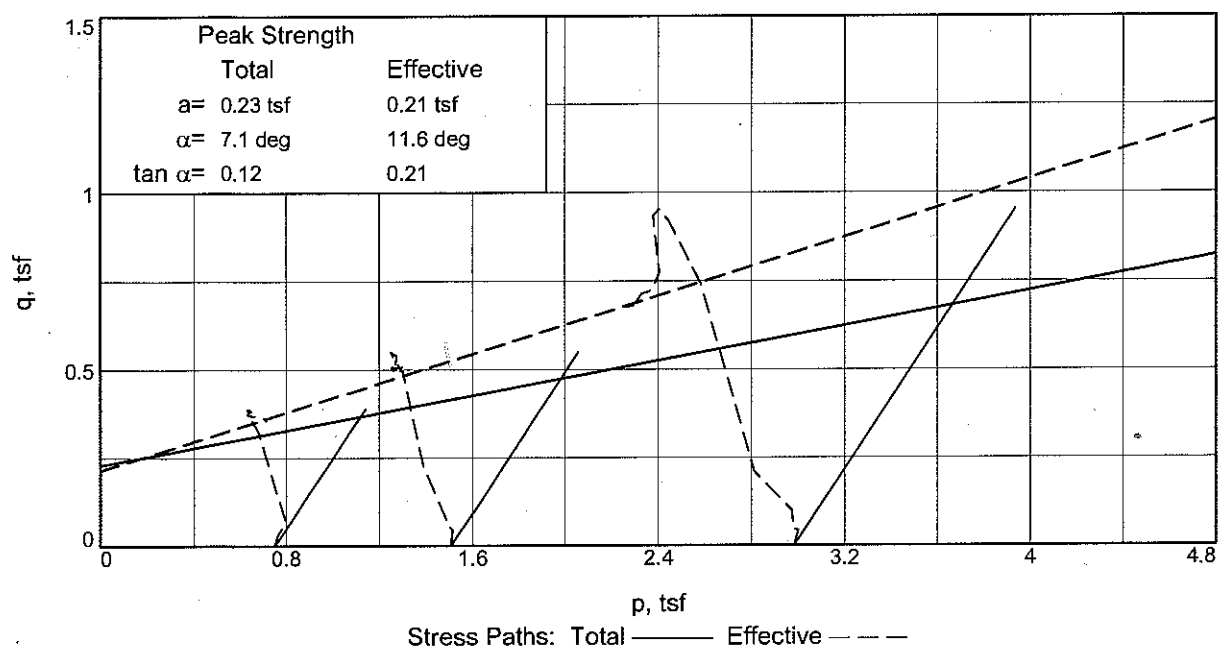
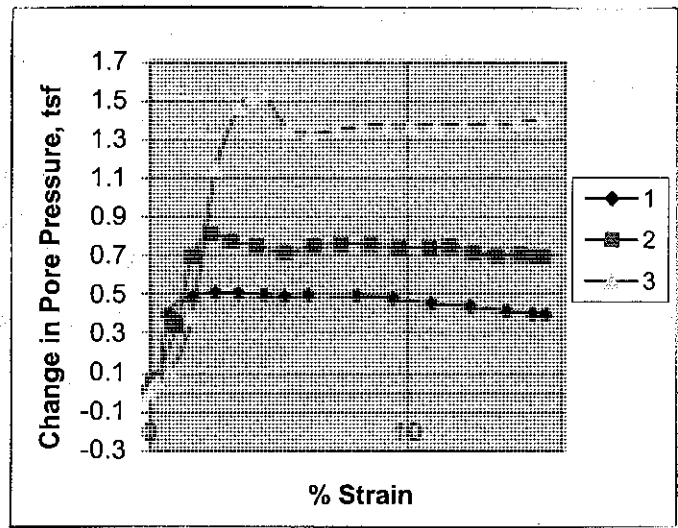
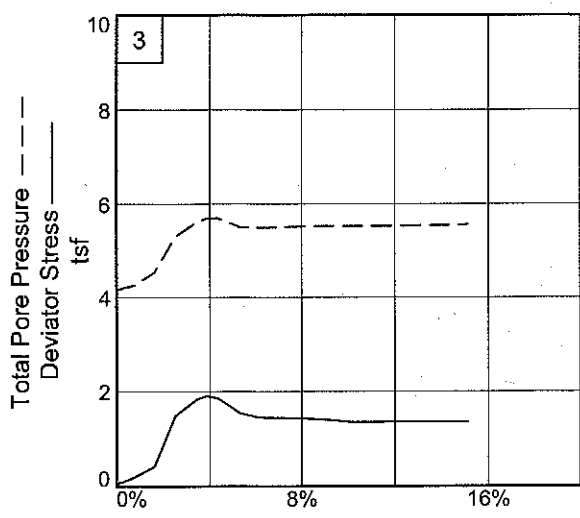
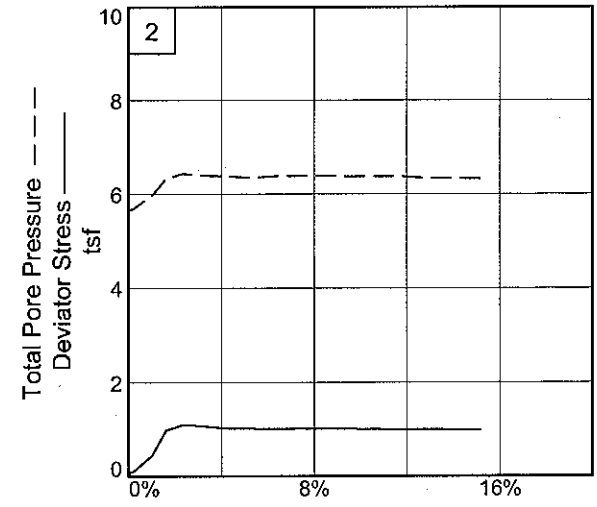
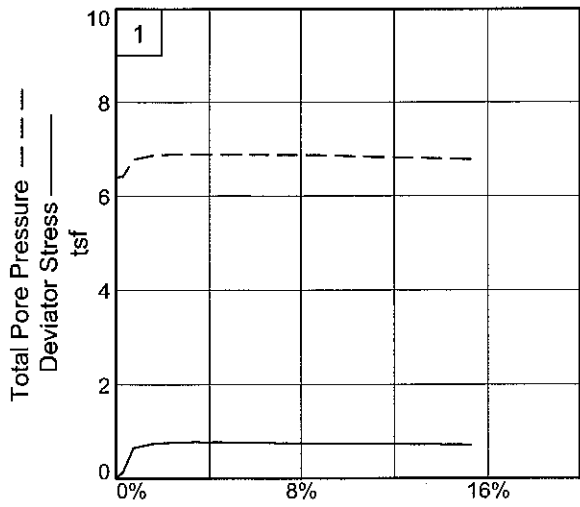
Fargo **Oxidized Brenna**

Location: WD-05, ND Div, ~~Sherlock Formation~~

Sample Number: Boring 09-60MU, #1 **Depth:** 15-17'

Proj. No.: BL0903127A **Date Sampled:**

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Loc.: WD-05, ND Div, Sherack Formation **Depth:** 15-17'

Sample No.: Boring 09-60MU, #1

Project No.: B-00903 M-7A Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

2/23/2010
11:02 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-05, ND Div, ~~Sherack Formation~~ **Fargo**
Depth: 15-17' **Sample Number:** Boring 09-60MU, #1
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: The rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.75 **LL**=113 **PL**=26 **PI**=87
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.000			149.400
Moisture content: Dry soil+tare, gms.	92.130			105.870
Moisture content: Tare, gms.	29.700			31.210
Moisture, %	59.1	59.6	59.3	58.3
Moist specimen weight, gms.	118.0			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.79	2.79	2.79	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.5	103.8	104.0	
Dry density, pcf	65.1	65.1	65.3	
Void ratio	1.6381	1.6381	1.6296	
Saturation, %	99.1	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.389 tsf
 Consolidation effective confining stress = 0.751 tsf
 Fail. Stress = 0.777 tsf at reading no. 6
 Ult. Stress = 0.714 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0062	17.750	0.0	0.0	0.000	0.751	0.751	1.00	6.389	0.751	0.000
1	0.0092	18.940	1.2	0.1	0.055	0.734	0.789	1.08	6.406	0.762	0.028
2	0.0141	20.750	3.0	0.3	0.139	0.729	0.868	1.19	6.411	0.798	0.069
3	0.0271	31.850	14.1	0.7	0.649	0.354	1.003	2.83	6.786	0.679	0.325
4	0.0519	34.020	16.3	1.6	0.743	0.266	1.009	3.79	6.874	0.637	0.371
5	0.0769	34.850	17.1	2.5	0.773	0.245	1.018	4.16	6.895	0.632	0.387
6	0.1017	35.090	17.3	3.4	0.777	0.248	1.025	4.13	6.892	0.637	0.389
7	0.1276	35.090	17.3	4.4	0.770	0.255	1.025	4.02	6.885	0.640	0.385
8	0.1525	35.200	17.5	5.2	0.767	0.264	1.031	3.91	6.876	0.648	0.384
9	0.1773	35.240	17.5	6.1	0.762	0.256	1.018	3.98	6.884	0.637	0.381
10	0.2291	35.240	17.5	8.0	0.747	0.259	1.006	3.88	6.881	0.632	0.373
11	0.2691	35.400	17.6	9.4	0.742	0.274	1.016	3.71	6.866	0.645	0.371
12	0.3099	35.610	17.9	10.9	0.739	0.300	1.039	3.46	6.840	0.669	0.369
13	0.3516	35.770	18.0	12.4	0.733	0.315	1.048	3.33	6.825	0.681	0.366
14	0.3924	35.950	18.2	13.8	0.728	0.337	1.065	3.16	6.803	0.701	0.364
15	0.4196	35.890	18.1	14.8	0.717	0.352	1.069	3.04	6.788	0.711	0.359
16	0.4328	35.910	18.2	15.3	0.714	0.357	1.071	3.00	6.783	0.714	0.357

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	120.200			146.160
Moisture content: Dry soil+tare, gms.	86.640			103.280
Moisture content: Tare, gms.	30.200			29.810
Moisture, %	59.5	59.8	59.5	58.4
Moist specimen weight, gms.	117.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.5	103.7	103.9	
Dry density, pcf	64.9	64.9	65.1	
Void ratio	1.6451	1.6451	1.6366	
Saturation, %	99.4	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 5.630 tsf
 Consolidation effective confining stress = 1.508 tsf
 Fail. Stress = 1.101 tsf at reading no. 5
 Ult. Stress = 0.982 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0208	18.000	0.0	0.0	0.000	1.508	1.508	1.00	5.630	1.508	0.000
1	0.0229	19.960	2.0	0.1	0.092	1.469	1.561	1.06	5.669	1.515	0.046
2	0.0267	20.260	2.3	0.2	0.106	1.451	1.557	1.07	5.687	1.504	0.053
3	0.0493	27.820	9.8	1.0	0.455	1.163	1.618	1.39	5.975	1.390	0.227
4	0.0658	39.280	21.3	1.6	0.980	0.812	1.792	2.21	6.326	1.302	0.490
5	0.0863	42.080	24.1	2.3	1.101	0.699	1.800	2.57	6.439	1.249	0.550
6	0.1069	41.780	23.8	3.1	1.079	0.735	1.814	2.47	6.403	1.274	0.539
7	0.1364	40.790	22.8	4.1	1.023	0.758	1.781	2.35	6.380	1.269	0.511
8	0.1672	40.880	22.9	5.2	1.015	0.792	1.807	2.28	6.346	1.299	0.507
9	0.1972	41.110	23.1	6.3	1.013	0.758	1.771	2.34	6.380	1.265	0.507
10	0.2274	41.410	23.4	7.4	1.015	0.749	1.764	2.35	6.389	1.256	0.507
11	0.2579	41.570	23.6	8.5	1.010	0.748	1.758	2.35	6.390	1.253	0.505
12	0.2901	41.900	23.9	9.6	1.011	0.766	1.777	2.32	6.372	1.271	0.505
13	0.3216	42.040	24.0	10.8	1.004	0.766	1.770	2.31	6.372	1.268	0.502
14	0.3459	42.010	24.0	11.6	0.993	0.759	1.752	2.31	6.379	1.255	0.496
15	0.3706	42.270	24.3	12.5	0.994	0.789	1.783	2.26	6.349	1.286	0.497
16	0.3950	42.510	24.5	13.4	0.994	0.804	1.798	2.24	6.334	1.301	0.497
17	0.4196	42.710	24.7	14.3	0.991	0.802	1.793	2.24	6.336	1.298	0.496
18	0.4364	42.790	24.8	14.9	0.988	0.811	1.799	2.22	6.327	1.305	0.494
19	0.4441	42.730	24.7	15.2	0.982	0.812	1.794	2.21	6.326	1.303	0.491

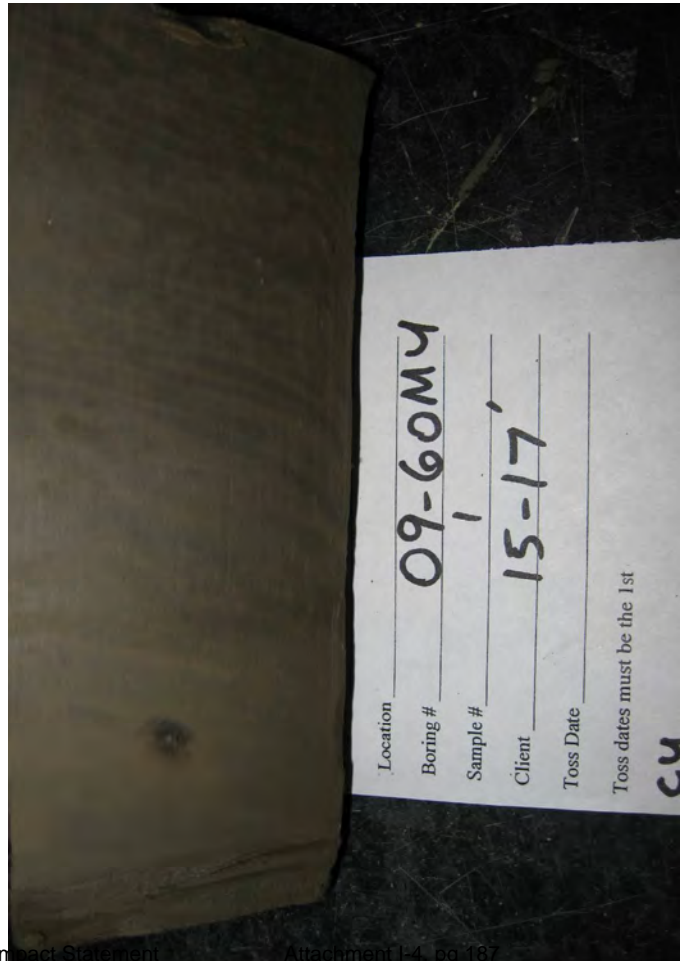
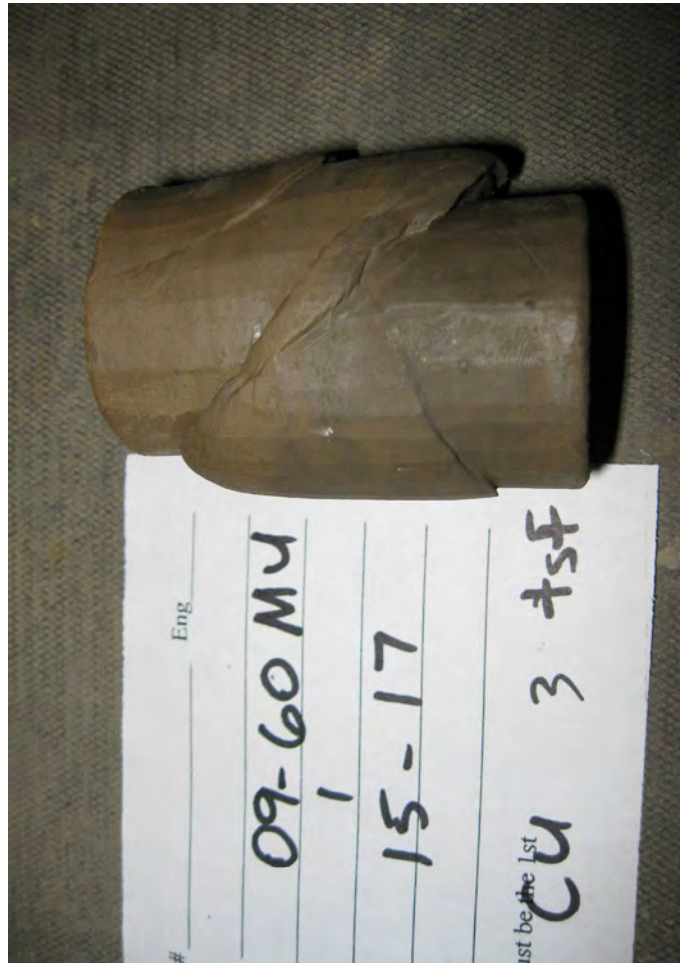
Parameters for Specimen No. 3

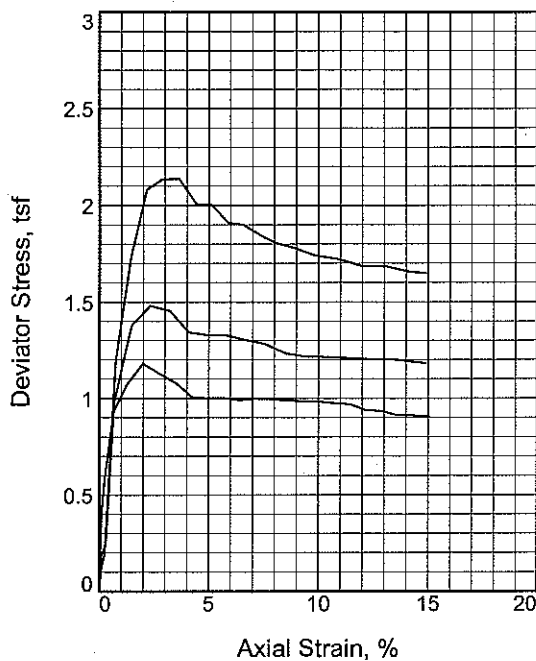
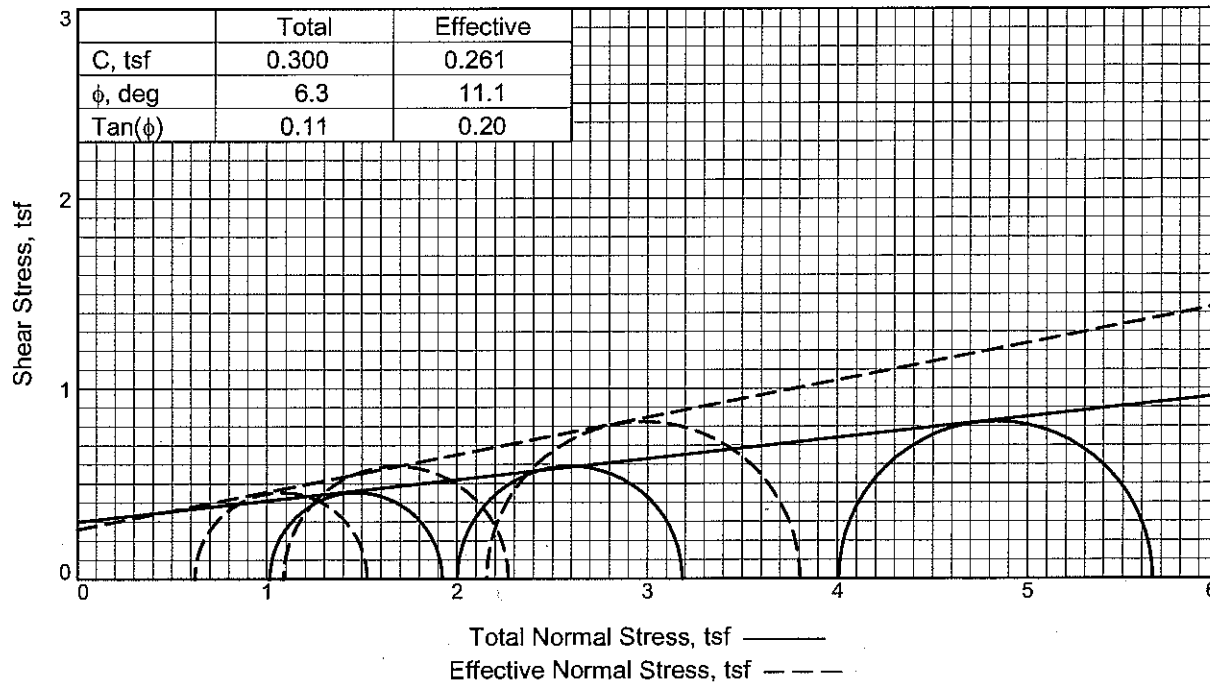
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.200			145.310
Moisture content: Dry soil+tare, gms.	100.210			104.610
Moisture content: Tare, gms.	30.400			30.680
Moisture, %	58.7	58.7	56.7	55.1
Moist specimen weight, gms.	117.7			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.80	2.80	2.78	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	104.2	104.2	105.1	
Dry density, pcf	65.7	65.7	67.1	
Void ratio	1.6144	1.6144	1.5586	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 4.157 tsf
 Consolidation effective confining stress = 2.983 tsf
 Fail. Stress = 1.905 tsf at reading no. 7
 Ult. Stress = 1.354 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0062	17.780	0.0	0.0	0.000	2.983	2.983	1.00	4.157	2.983	0.000
1	0.0103	19.620	1.8	0.1	0.087	2.957	3.044	1.03	4.183	3.001	0.044
2	0.0143	19.710	1.9	0.3	0.091	2.934	3.025	1.03	4.206	2.980	0.046
3	0.0288	21.970	4.2	0.8	0.197	2.875	3.072	1.07	4.265	2.974	0.099
4	0.0519	26.790	9.0	1.6	0.421	2.601	3.022	1.16	4.539	2.812	0.211
5	0.0768	49.920	32.1	2.5	1.488	1.837	3.325	1.81	5.303	2.581	0.744
6	0.1017	57.920	40.1	3.4	1.842	1.522	3.364	2.21	5.618	2.443	0.921
7	0.1136	59.480	41.7	3.9	1.905	1.451	3.356	2.31	5.689	2.403	0.952
8	0.1266	58.870	41.1	4.3	1.868	1.443	3.311	2.29	5.697	2.377	0.934
9	0.1525	52.150	34.4	5.3	1.547	1.631	3.178	1.95	5.509	2.405	0.774
10	0.1783	50.350	32.6	6.2	1.452	1.648	3.100	1.88	5.492	2.374	0.726
11	0.2062	50.440	32.7	7.2	1.440	1.636	3.076	1.88	5.504	2.356	0.720
12	0.2339	50.560	32.8	8.2	1.430	1.612	3.042	1.89	5.528	2.327	0.715
13	0.2612	50.320	32.5	9.2	1.404	1.612	3.016	1.87	5.528	2.314	0.702
14	0.2881	49.470	31.7	10.1	1.353	1.613	2.966	1.84	5.527	2.290	0.677
15	0.3157	49.830	32.0	11.1	1.353	1.609	2.962	1.84	5.531	2.286	0.677
16	0.3427	50.560	32.8	12.1	1.369	1.609	2.978	1.85	5.531	2.294	0.685
17	0.3716	50.840	33.1	13.2	1.364	1.599	2.963	1.85	5.541	2.281	0.682
18	0.3998	51.050	33.3	14.2	1.357	1.597	2.954	1.85	5.543	2.275	0.678
19	0.4265	51.360	33.6	15.1	1.354	1.581	2.935	1.86	5.559	2.258	0.677





Sample No.	1	2	3	
Initial	Water Content, %	57.9	64.9	60.3
	Dry Density, pcf	65.6	61.3	63.5
	Saturation, %	99.7	100.0	98.3
	Void Ratio	1.5679	1.7516	1.6563
	Diameter, in.	1.40	1.40	1.39
	Height, in.	2.81	2.81	2.79
At Test	Water Content, %	57.6	62.7	58.2
	Dry Density, pcf	66.0	62.6	65.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5542	1.6931	1.5713
	Diameter, in.	1.39	1.39	1.37
	Height, in.	2.81	2.79	2.76
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.01	2.00	4.01	
Back Pressure, tsf	6.13	5.14	3.13	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	1.18	1.48	2.14	
Total Pore Pr., tsf	6.76	6.08	4.71	
Ultimate Deviator Stress, tsf	0.91	1.18	1.65	
Total Pore Pr., tsf	6.52	6.05	4.98	
Maj. Eff. Stress at Ultimate, tsf	1.53	2.27	3.81	
Min. Eff. Stress at Ultimate, tsf	0.62	1.09	2.16	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Top of sample

Description: FAT CLAY, brown (CH)

LL= 106 PL= 24 PI= 82

Assumed Specific Gravity= 2.70

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo **Oxidized Brenna**

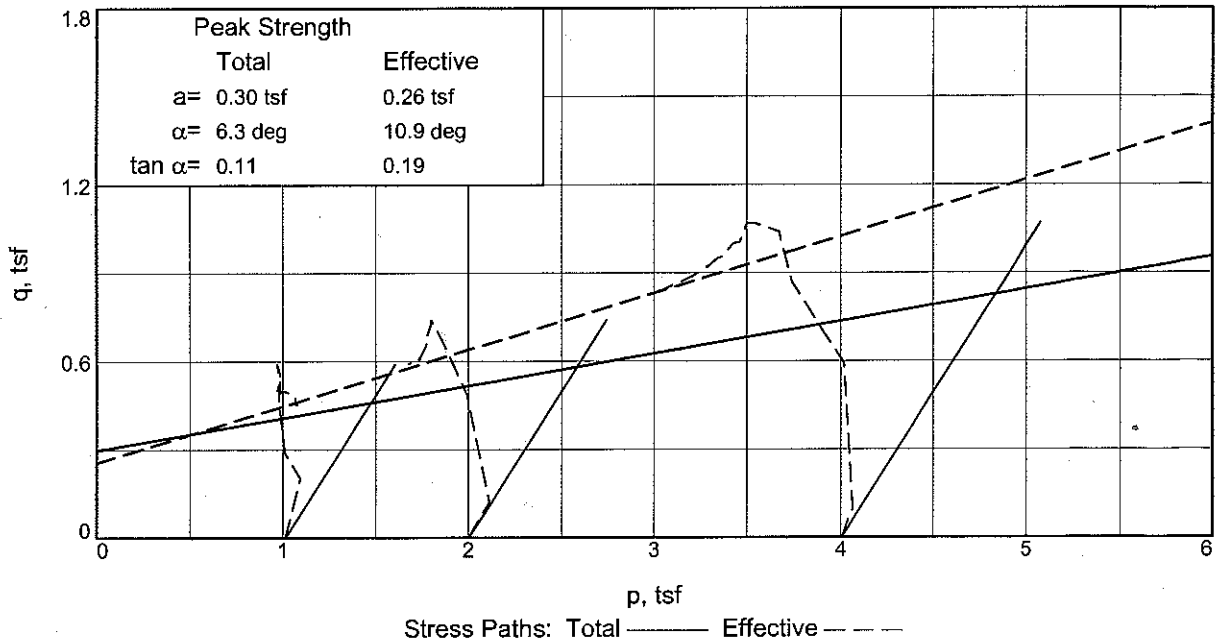
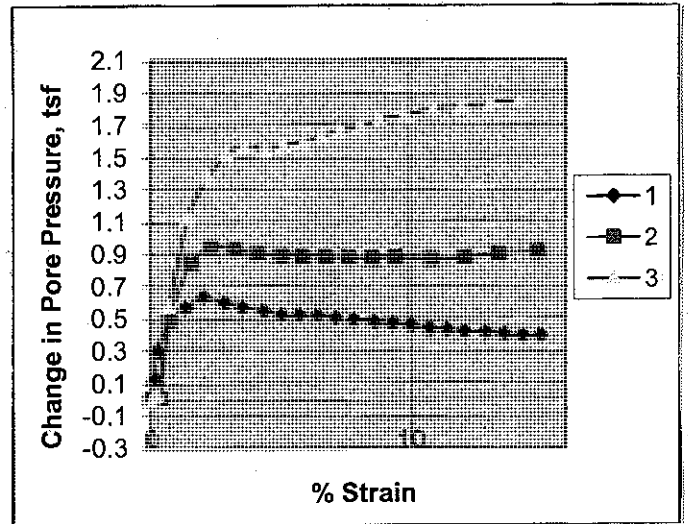
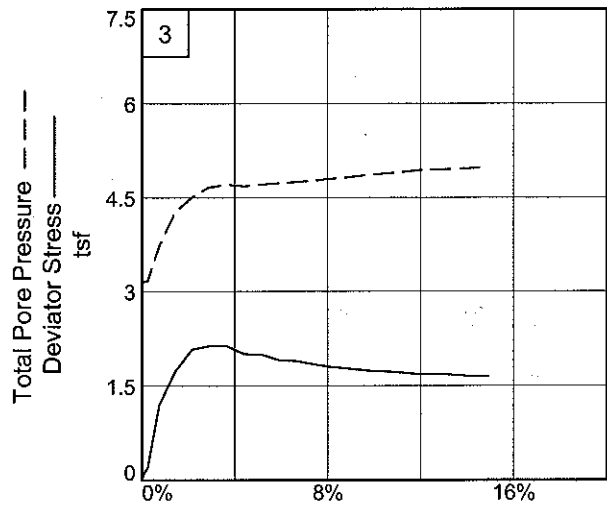
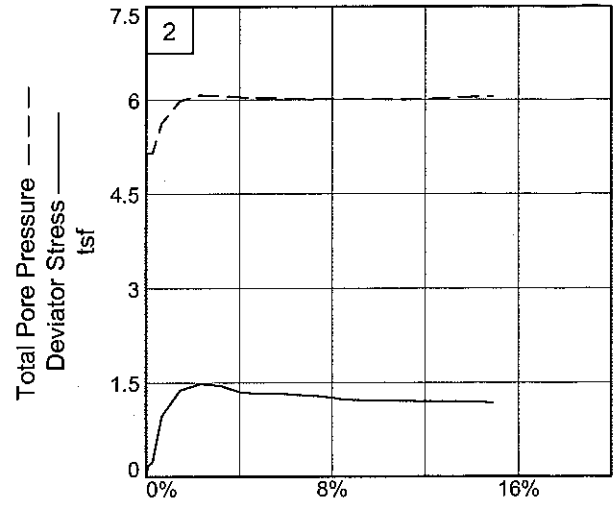
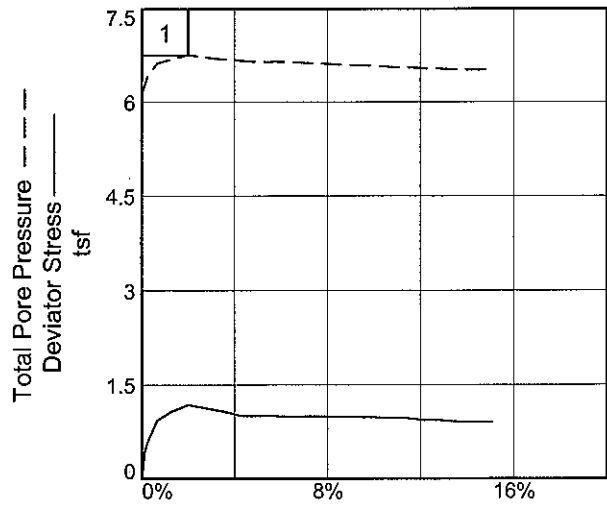
Location: WD-05, ND Div, ~~Shoreak Formation~~

Sample Number: Boring 09-60MU, #2 **Depth:** 25-27'

Proj. No.: BL0903127A

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Loc.: WD-05, ND Div, **Sherlock Formation**

Depth: 25-27'

Sample No.: Boring 09-60MU, #2

Project No.: W-09-03125-A Feasibility Report and Environmental Impact Statement

Braun Intertec

July 2014

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

2/23/2010

3:59 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-05, ND Div, ~~Shorack Formation~~ **Fargo**
Depth: 25-27' **Sample Number:** Boring 09-60MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.70 **LL**=106 **PL**=24 **PI**=82
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.200			145.890
Moisture content: Dry soil+tare, gms.	93.980			103.680
Moisture content: Tare, gms.	31.400			29.590
Moisture, %	57.9	58.1	57.6	57.0
Moist specimen weight, gms.	117.1			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	103.6	103.8	104.0	
Dry density, pcf	65.6	65.6	66.0	
Void ratio	1.5679	1.5679	1.5542	
Saturation, %	99.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.125 tsf
Consolidation effective confining stress = 1.015 tsf
Fail. Stress = 1.180 tsf at reading no. 5
Ult. Stress = 0.907 tsf at reading no. 23

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0490	16.600	0.0	0.0	0.000	1.015	1.015	1.00	6.125	1.015	0.000
1	0.0518	25.200	8.6	0.1	0.406	0.891	1.297	1.46	6.249	1.094	0.203
2	0.0559	28.980	12.4	0.2	0.583	0.719	1.302	1.81	6.421	1.011	0.292
3	0.0673	36.410	19.8	0.7	0.929	0.515	1.444	2.80	6.625	0.980	0.465
4	0.0850	39.700	23.1	1.3	1.077	0.447	1.524	3.41	6.693	0.985	0.538
5	0.1049	42.110	25.5	2.0	1.180	0.380	1.560	4.11	6.760	0.970	0.590
6	0.1262	41.210	24.6	2.8	1.130	0.419	1.549	3.70	6.721	0.984	0.565
7	0.1477	40.270	23.7	3.5	1.078	0.447	1.525	3.41	6.693	0.986	0.539
8	0.1683	38.850	22.3	4.3	1.006	0.469	1.475	3.14	6.671	0.972	0.503
9	0.1889	38.910	22.3	5.0	1.001	0.494	1.495	3.03	6.646	0.994	0.500
10	0.2094	39.090	22.5	5.7	1.001	0.492	1.493	3.03	6.648	0.993	0.501
11	0.2291	39.040	22.4	6.4	0.991	0.495	1.486	3.00	6.645	0.991	0.496
12	0.2496	39.380	22.8	7.1	0.999	0.510	1.509	2.96	6.630	1.009	0.499
13	0.2693	39.480	22.9	7.8	0.995	0.522	1.517	2.91	6.618	1.020	0.498
14	0.2898	39.530	22.9	8.6	0.990	0.534	1.524	2.85	6.606	1.029	0.495
15	0.3095	39.600	23.0	9.3	0.985	0.544	1.529	2.81	6.596	1.037	0.493
16	0.3302	39.750	23.1	10.0	0.983	0.558	1.541	2.76	6.582	1.050	0.492
17	0.3506	39.730	23.1	10.7	0.975	0.575	1.550	2.69	6.565	1.062	0.487
18	0.3703	39.780	23.2	11.4	0.969	0.582	1.551	2.67	6.558	1.067	0.485
19	0.3900	39.230	22.6	12.1	0.939	0.599	1.538	2.57	6.541	1.068	0.469
20	0.4103	39.340	22.7	12.9	0.935	0.601	1.536	2.56	6.539	1.069	0.468
21	0.4312	38.970	22.4	13.6	0.912	0.615	1.527	2.48	6.525	1.071	0.456
22	0.4508	39.150	22.5	14.3	0.912	0.622	1.534	2.47	6.518	1.078	0.456
23	0.4714	39.210	22.6	15.0	0.907	0.621	1.528	2.46	6.519	1.074	0.453

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	156.180			142.600
Moisture content: Dry soil+tare, gms.	106.760			100.290
Moisture content: Tare, gms.	30.600			30.300
Moisture, %	64.9	64.9	62.7	60.5
Moist specimen weight, gms.	114.1			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.51	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	101.0	101.0	101.8	
Dry density, pcf	61.3	61.3	62.6	
Void ratio	1.7516	1.7516	1.6931	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.138 tsf
 Consolidation effective confining stress = 2.002 tsf
 Fail. Stress = 1.481 tsf at reading no. 5
 Ult. Stress = 1.182 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0058	15.830	0.0	0.0	0.000	2.002	2.002	1.00	5.138	2.002	0.000
1	0.0087	19.770	3.9	0.1	0.187	1.991	2.178	1.09	5.149	2.085	0.094
2	0.0137	20.870	5.0	0.3	0.239	1.991	2.230	1.12	5.149	2.111	0.120
3	0.0246	36.400	20.6	0.7	0.973	1.506	2.479	1.65	5.634	1.993	0.487
4	0.0467	45.220	29.4	1.5	1.379	1.155	2.534	2.19	5.985	1.845	0.690
5	0.0706	47.660	31.8	2.3	1.481	1.060	2.541	2.40	6.080	1.800	0.740
6	0.0955	47.390	31.6	3.2	1.455	1.073	2.528	2.36	6.067	1.800	0.727
7	0.1193	45.220	29.4	4.1	1.343	1.099	2.442	2.22	6.041	1.770	0.671
8	0.1441	45.190	29.4	5.0	1.329	1.108	2.437	2.20	6.032	1.772	0.664
9	0.1683	45.410	29.6	5.8	1.327	1.114	2.441	2.19	6.026	1.777	0.663
10	0.1920	45.160	29.3	6.7	1.303	1.119	2.422	2.16	6.021	1.771	0.652
11	0.2169	44.950	29.1	7.6	1.282	1.121	2.403	2.14	6.019	1.762	0.641
12	0.2428	44.150	28.3	8.5	1.234	1.125	2.359	2.10	6.015	1.742	0.617
13	0.2677	44.030	28.2	9.4	1.217	1.122	2.339	2.08	6.018	1.730	0.608
14	0.3053	44.370	28.5	10.8	1.213	1.132	2.345	2.07	6.008	1.739	0.607
15	0.3427	44.580	28.8	12.1	1.204	1.127	2.331	2.07	6.013	1.729	0.602
16	0.3805	45.010	29.2	13.4	1.203	1.105	2.308	2.09	6.035	1.706	0.601
17	0.4224	45.010	29.2	15.0	1.182	1.087	2.269	2.09	6.053	1.678	0.591

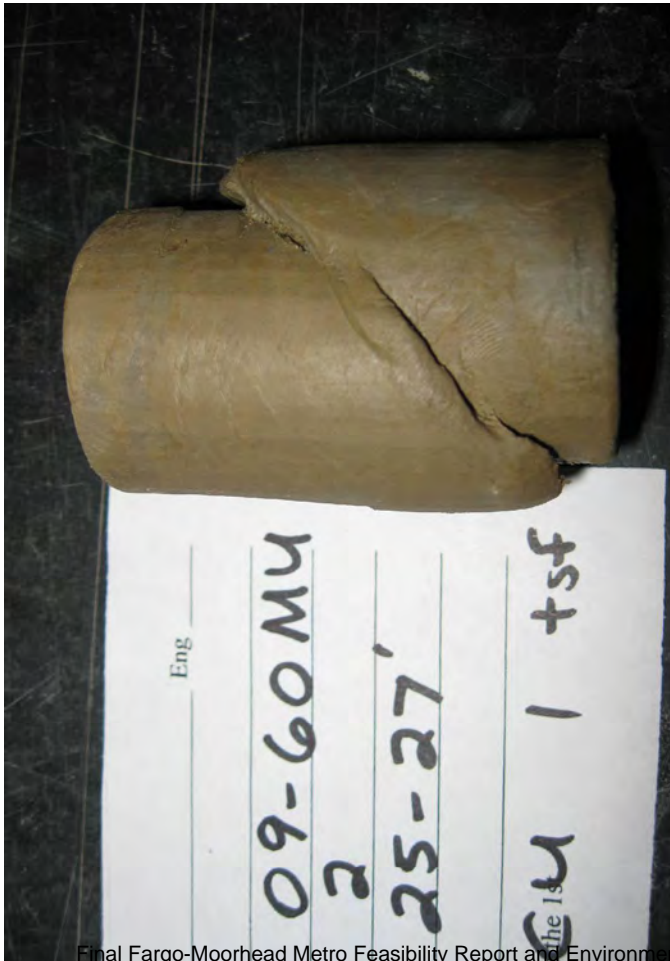
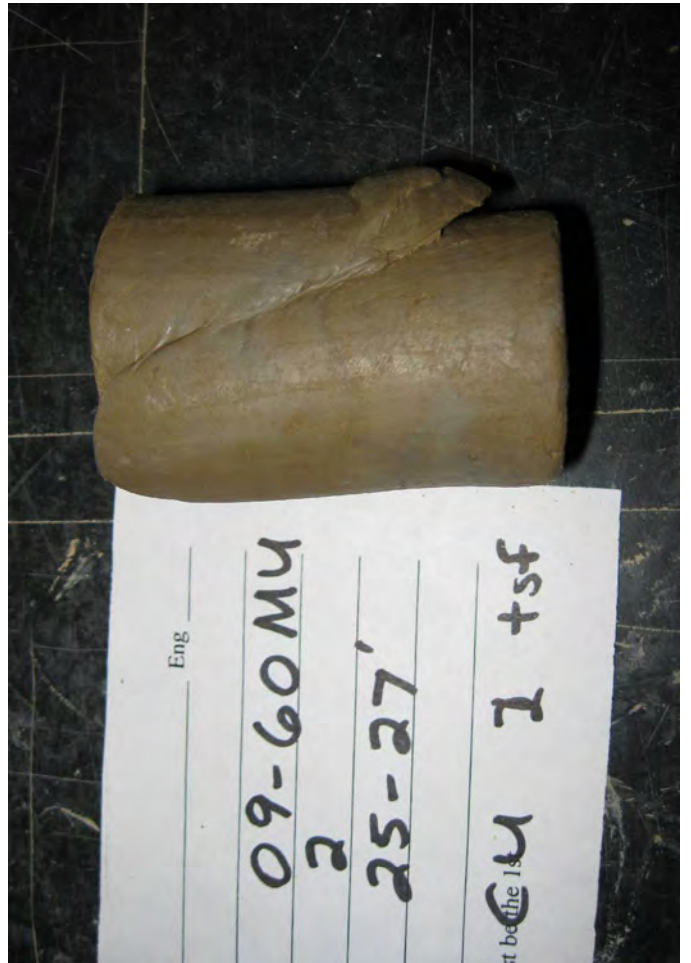
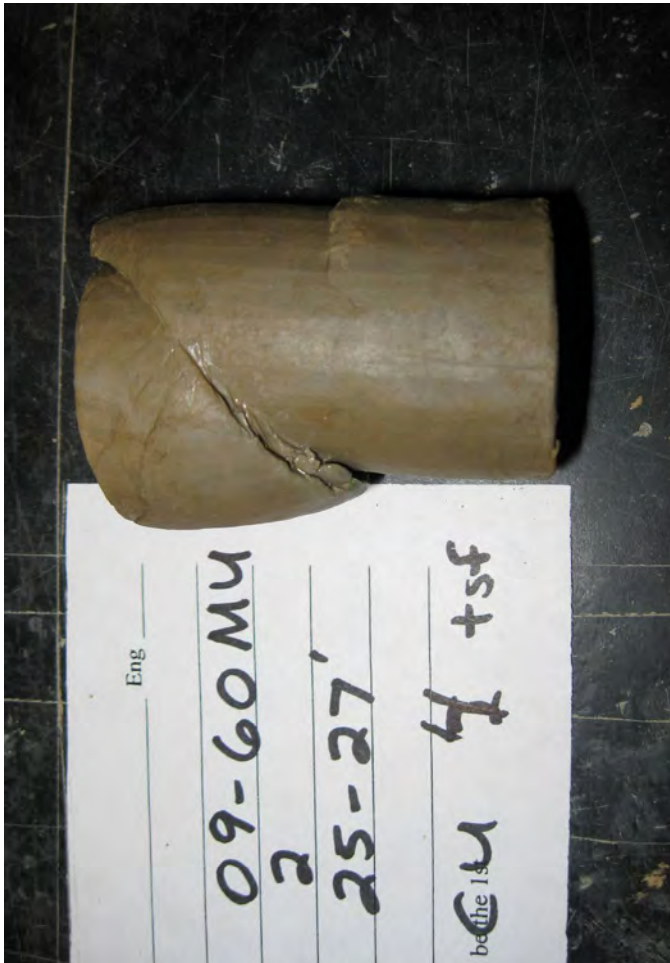
Parameters for Specimen No. 3

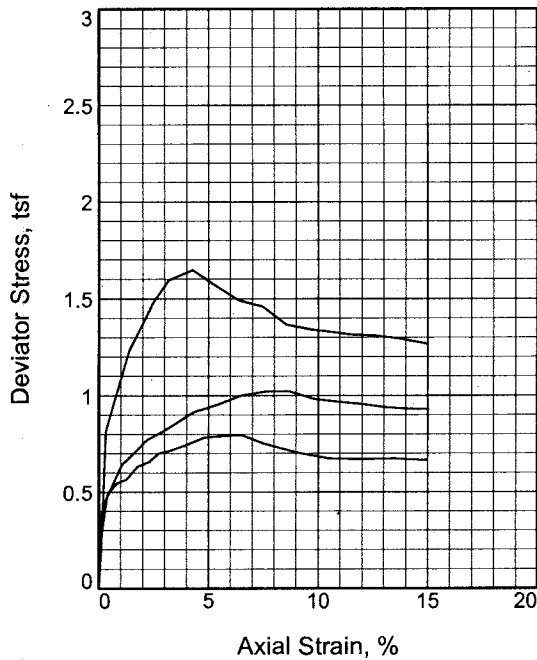
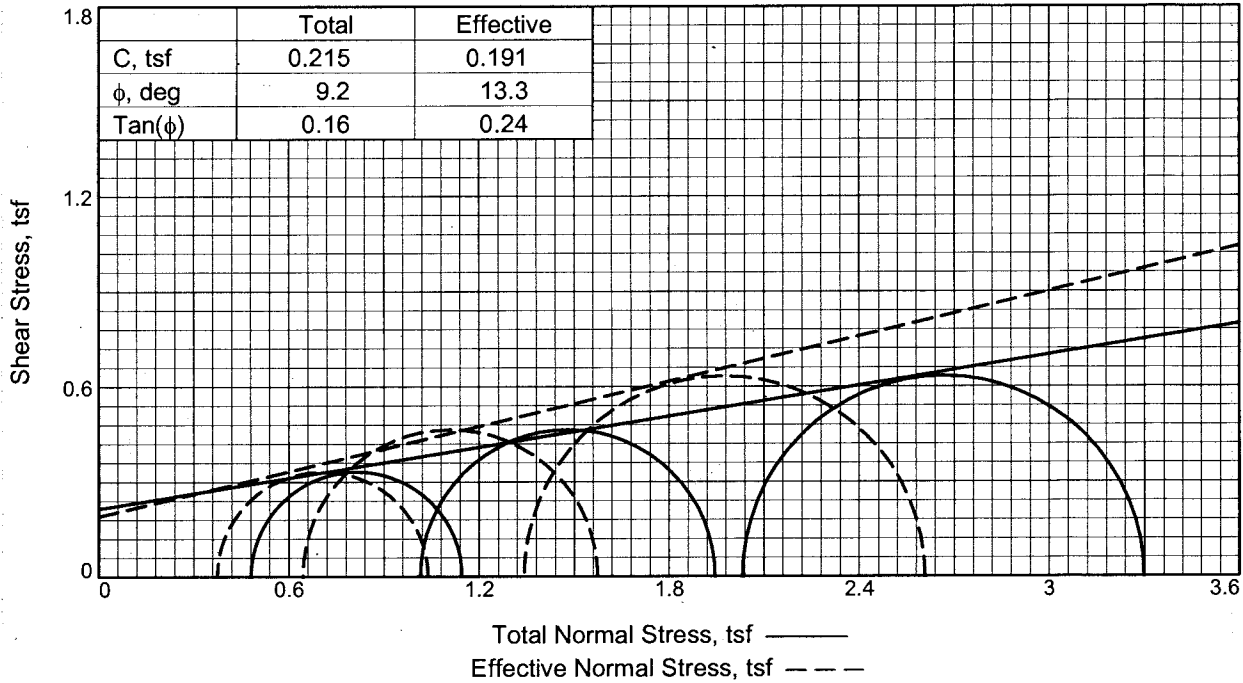
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	156.290			138.740
Moisture content: Dry soil+tare, gms.	108.990			99.790
Moisture content: Tare, gms.	30.510			30.280
Moisture, %	60.3	61.3	58.2	56.0
Moist specimen weight, gms.	112.8			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.51	1.51	1.48	
Height, in.	2.79	2.79	2.76	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	101.7	102.4	103.7	
Dry density, pcf	63.5	63.5	65.6	
Void ratio	1.6563	1.6563	1.5713	
Saturation, %	98.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 3.133 tsf
 Consolidation effective confining stress = 4.007 tsf
 Fail. Stress = 2.139 tsf at reading no. 7
 Ult. Stress = 1.648 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0218	14.290	0.0	0.0	0.000	4.007	4.007	1.00	3.133	4.007	0.000
1	0.0246	16.810	2.5	0.1	0.122	3.979	4.101	1.03	3.161	4.040	0.061
2	0.0285	18.250	4.0	0.2	0.192	3.971	4.163	1.05	3.169	4.067	0.096
3	0.0422	38.910	24.6	0.7	1.188	3.424	4.612	1.35	3.716	4.018	0.594
4	0.0616	50.550	36.3	1.4	1.738	2.871	4.609	1.61	4.269	3.740	0.869
5	0.0814	58.050	43.8	2.2	2.082	2.631	4.713	1.79	4.509	3.672	1.041
6	0.1012	59.510	45.2	2.9	2.136	2.480	4.616	1.86	4.660	3.548	1.068
7	0.1224	59.940	45.6	3.6	2.139	2.431	4.570	1.88	4.709	3.501	1.070
8	0.1440	57.500	43.2	4.4	2.008	2.458	4.466	1.82	4.682	3.462	1.004
9	0.1635	57.690	43.4	5.1	2.002	2.428	4.430	1.82	4.712	3.429	1.001
10	0.1843	56.040	41.8	5.9	1.911	2.413	4.324	1.79	4.727	3.368	0.955
11	0.2037	56.120	41.8	6.6	1.900	2.393	4.293	1.79	4.747	3.343	0.950
12	0.2243	55.300	41.0	7.3	1.848	2.371	4.219	1.78	4.769	3.295	0.924
13	0.2449	54.680	40.4	8.1	1.806	2.339	4.145	1.77	4.801	3.242	0.903
14	0.2646	54.490	40.2	8.8	1.783	2.322	4.105	1.77	4.818	3.214	0.892
15	0.2931	54.020	39.7	9.8	1.742	2.273	4.015	1.77	4.867	3.144	0.871
16	0.3233	54.030	39.7	10.9	1.722	2.244	3.966	1.77	4.896	3.105	0.861
17	0.3530	53.660	39.4	12.0	1.685	2.204	3.889	1.76	4.936	3.046	0.842
18	0.3843	54.140	39.9	13.1	1.684	2.189	3.873	1.77	4.951	3.031	0.842
19	0.4138	53.960	39.7	14.2	1.655	2.171	3.826	1.76	4.969	2.999	0.828
20	0.4356	54.150	39.9	15.0	1.648	2.156	3.804	1.76	4.984	2.980	0.824





Sample No.	1	2	3	
Initial	Water Content, %	48.6	48.9	48.3
	Dry Density, pcf	73.8	73.2	74.0
	Saturation, %	100.0	99.4	100.0
	Void Ratio	1.3499	1.3681	1.3413
	Diameter, in.	1.40	1.42	1.40
	Height, in.	2.81	2.79	2.82
At Test	Water Content, %	48.2	48.4	47.0
	Dry Density, pcf	74.2	74.0	75.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3374	1.3428	1.3041
	Diameter, in.	1.39	1.41	1.39
	Height, in.	2.81	2.78	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.48	1.01	2.03	
Back Pressure, tsf	6.63	6.12	5.10	
Cell Pressure, tsf	7.11	7.13	7.13	
Peak Deviator Stress, tsf	0.80	1.02	1.65	
Total Pore Pr., tsf	6.90	6.66	6.16	
Ultimate Deviator Stress, tsf	0.67	0.93	1.27	
Total Pore Pr., tsf	6.73	6.49	5.79	
Maj. Eff. Stress at Ultimate, tsf	1.04	1.57	2.61	
Min. Eff. Stress at Ultimate, tsf,	0.37	0.64	1.34	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 113 PL= 32 PI= 81

Specific Gravity= 2.777

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

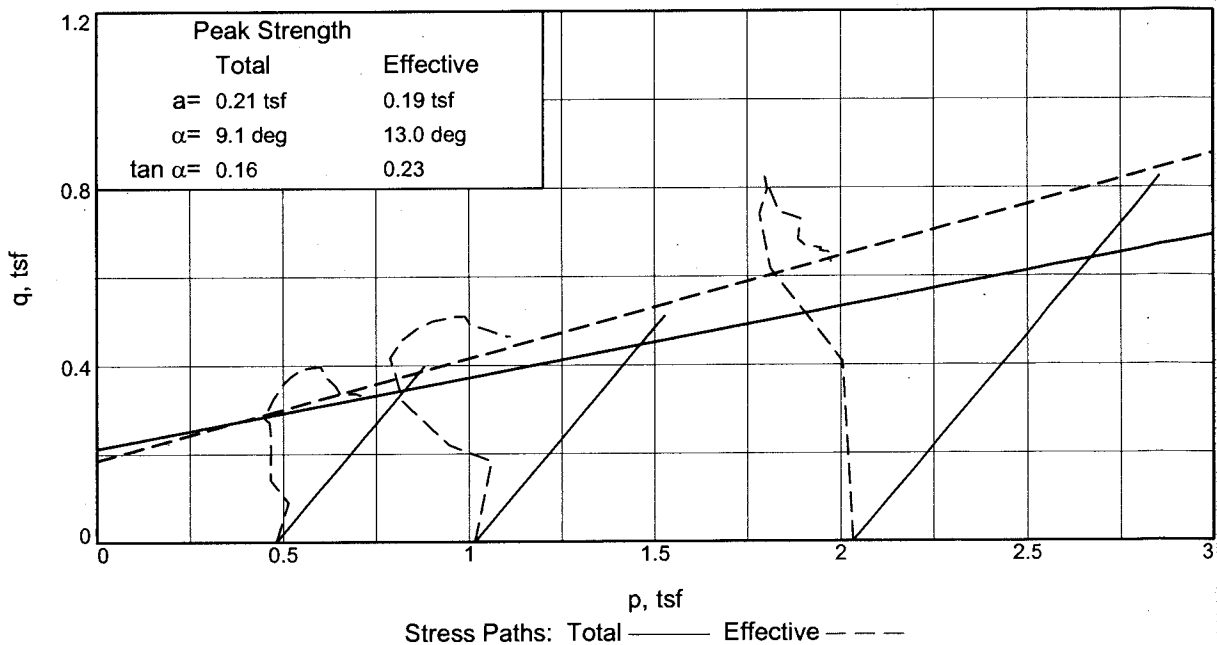
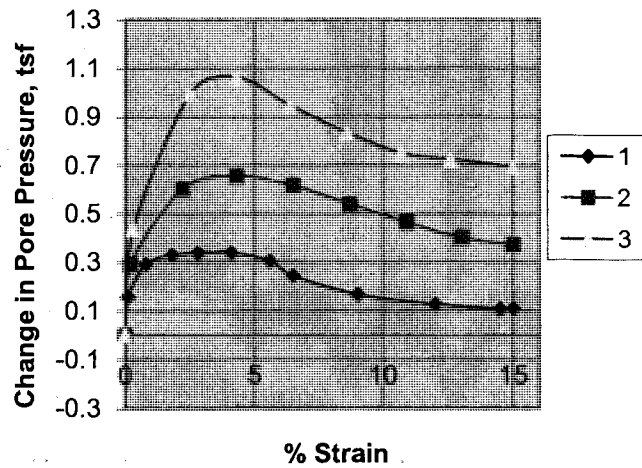
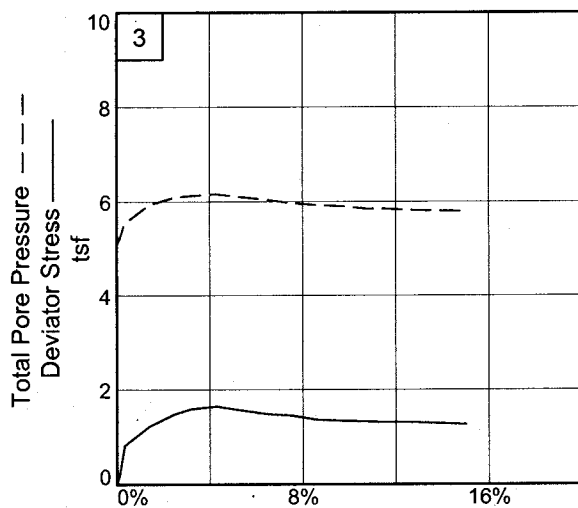
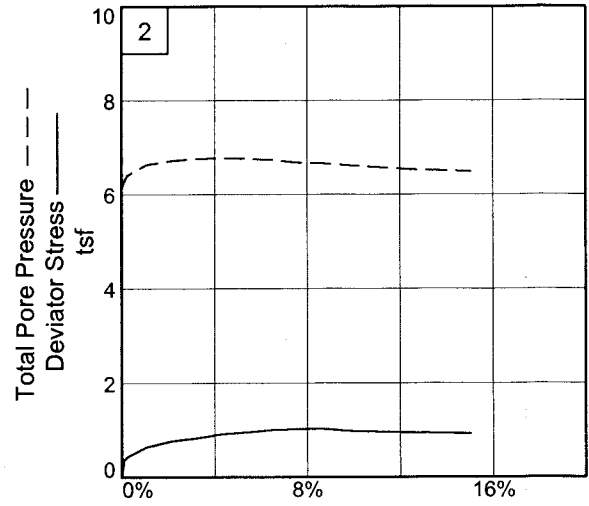
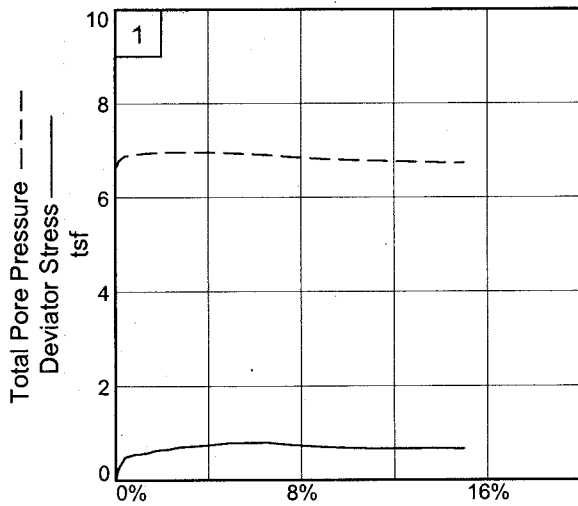
Location: Maple River, Dessicated Brenna Formation

Sample Number: Boring10-105MU, #1 **Depth:** 15-17'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Dessicated Brenna Formation

Depth: 15-17'

Sample No.: Boring10-105MU, #1

Project No.: B-10-10065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	111.460			154.080
Moisture content: Dry soil+tare, gms.	85.170			114.730
Moisture content: Tare, gms.	30.750			30.510
Moisture, %	48.3	48.3	47.0	46.7
Moist specimen weight, gms.	125.2			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.53	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.8	109.8	110.6	
Dry density, pcf	74.0	74.0	75.2	
Void ratio	1.3413	1.3413	1.3041	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.132 tsf
 Consolidation back pressure = 5.100 tsf
 Consolidation effective confining stress = 2.032 tsf
 Peak Stress = 1.648 tsf at reading no. 6
 Ult. Stress = 1.266 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0244	17.440	0.0	0.0	0.000	2.032	2.032	1.00	5.100	2.032	0.000
1	0.0276	21.790	4.3	0.1	0.205	1.924	2.129	1.11	5.208	2.027	0.103
2	0.0335	34.770	17.3	0.3	0.815	1.598	2.413	1.51	5.534	2.006	0.408
3	0.0635	43.970	26.5	1.4	1.235	1.193	2.428	2.04	5.939	1.810	0.617
4	0.0940	49.640	32.2	2.5	1.482	1.040	2.522	2.43	6.092	1.781	0.741
5	0.1134	52.330	34.9	3.2	1.595	1.005	2.600	2.59	6.127	1.802	0.797
6	0.1441	53.900	36.5	4.3	1.648	0.972	2.620	2.70	6.160	1.796	0.824
7	0.1742	52.500	35.1	5.3	1.567	1.033	2.600	2.52	6.099	1.816	0.783
8	0.2037	51.200	33.8	6.4	1.492	1.088	2.580	2.37	6.044	1.834	0.746
9	0.2340	50.860	33.4	7.5	1.460	1.162	2.622	2.26	5.970	1.892	0.730
10	0.2641	49.110	31.7	8.6	1.367	1.201	2.568	2.14	5.931	1.885	0.684
11	0.2949	48.900	31.5	9.7	1.342	1.231	2.573	2.09	5.901	1.902	0.671
12	0.3256	48.920	31.5	10.7	1.326	1.284	2.610	2.03	5.848	1.947	0.663
13	0.3465	48.900	31.5	11.5	1.314	1.286	2.600	2.02	5.846	1.943	0.657
14	0.3772	49.200	31.8	12.6	1.311	1.310	2.621	2.00	5.822	1.965	0.655
15	0.4074	49.200	31.8	13.7	1.294	1.328	2.622	1.97	5.804	1.975	0.647
16	0.4450	49.000	31.6	15.0	1.266	1.341	2.607	1.94	5.791	1.974	0.633

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:07 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Dessicated Brenna Formation
Depth: 15-17' **Sample Number:** Boring10-105MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.777 **LL**=113 **PL**=32 **PI**=81
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	120.890			154.680
Moisture content: Dry soil+tare, gms.	91.240			113.130
Moisture content: Tare, gms.	30.250			29.720
Moisture, %	48.6	48.6	48.2	49.8
Moist specimen weight, gms.	123.9			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.6	109.6	109.9	
Dry density, pcf	73.8	73.8	74.2	
Void ratio	1.3499	1.3499	1.3374	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.107 tsf
 Consolidation back pressure = 6.626 tsf
 Consolidation effective confining stress = 0.481 tsf
 Peak Stress = 0.796 tsf at reading no. 13
 Ult. Stress = 0.665 tsf at reading no. 20

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0095	18.730	0.0	0.0	0.000	0.481	0.481	1.00	6.626	0.481	0.000
1	0.0116	22.550	3.8	0.1	0.180	0.424	0.604	1.43	6.683	0.514	0.090
2	0.0136	24.740	6.0	0.1	0.283	0.325	0.608	1.87	6.782	0.467	0.142
3	0.0206	29.050	10.3	0.4	0.485	0.225	0.710	3.16	6.882	0.468	0.243
4	0.0325	30.360	11.6	0.8	0.545	0.192	0.737	3.84	6.915	0.464	0.272
5	0.0455	30.860	12.1	1.3	0.565	0.168	0.733	4.36	6.939	0.451	0.283
6	0.0593	32.370	13.6	1.8	0.632	0.153	0.785	5.13	6.954	0.469	0.316
7	0.0731	32.950	14.2	2.3	0.656	0.148	0.804	5.43	6.959	0.476	0.328
8	0.0871	34.020	15.3	2.8	0.702	0.145	0.847	5.84	6.962	0.496	0.351
9	0.1010	34.390	15.7	3.3	0.715	0.141	0.856	6.07	6.966	0.499	0.358
10	0.1232	35.240	16.5	4.1	0.748	0.144	0.892	6.19	6.963	0.518	0.374
11	0.1447	36.160	17.4	4.8	0.783	0.158	0.941	5.96	6.949	0.550	0.392
12	0.1677	36.460	17.7	5.6	0.790	0.178	0.968	5.44	6.929	0.573	0.395
13	0.1916	36.770	18.0	6.5	0.796	0.204	1.000	4.90	6.903	0.602	0.398
14	0.2204	35.940	17.2	7.5	0.751	0.239	0.990	4.14	6.868	0.615	0.376
15	0.2625	35.150	16.4	9.0	0.705	0.290	0.995	3.43	6.817	0.643	0.353
16	0.3043	34.690	16.0	10.5	0.674	0.316	0.990	3.13	6.791	0.653	0.337
17	0.3459	34.860	16.1	12.0	0.670	0.336	1.006	2.99	6.771	0.671	0.335
18	0.3878	35.240	16.5	13.5	0.674	0.356	1.030	2.89	6.751	0.693	0.337
19	0.4159	35.240	16.5	14.5	0.667	0.375	1.042	2.78	6.732	0.708	0.333
20	0.4300	35.300	16.6	15.0	0.665	0.374	1.039	2.78	6.733	0.707	0.333

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.880			156.970
Moisture content: Dry soil+tare, gms.	97.340			115.210
Moisture content: Tare, gms.	30.860			31.280
Moisture, %	48.9	49.3	48.4	49.8
Moist specimen weight, gms.	125.8			
Diameter, in.	1.42	1.42	1.41	
Area, in. ²	1.57	1.57	1.56	
Height, in.	2.79	2.79	2.78	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.0	109.3	109.8	
Dry density, pcf	73.2	73.2	74.0	
Void ratio	1.3681	1.3681	1.3428	
Saturation, %	99.4	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.135 tsf

Consolidation back pressure = 6.120 tsf

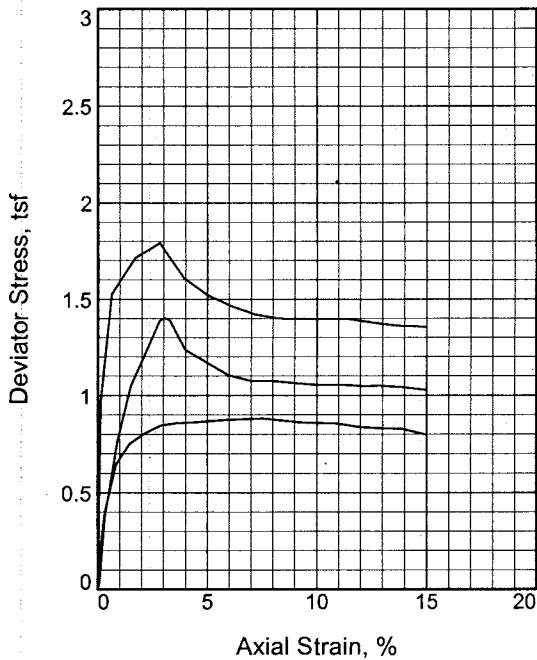
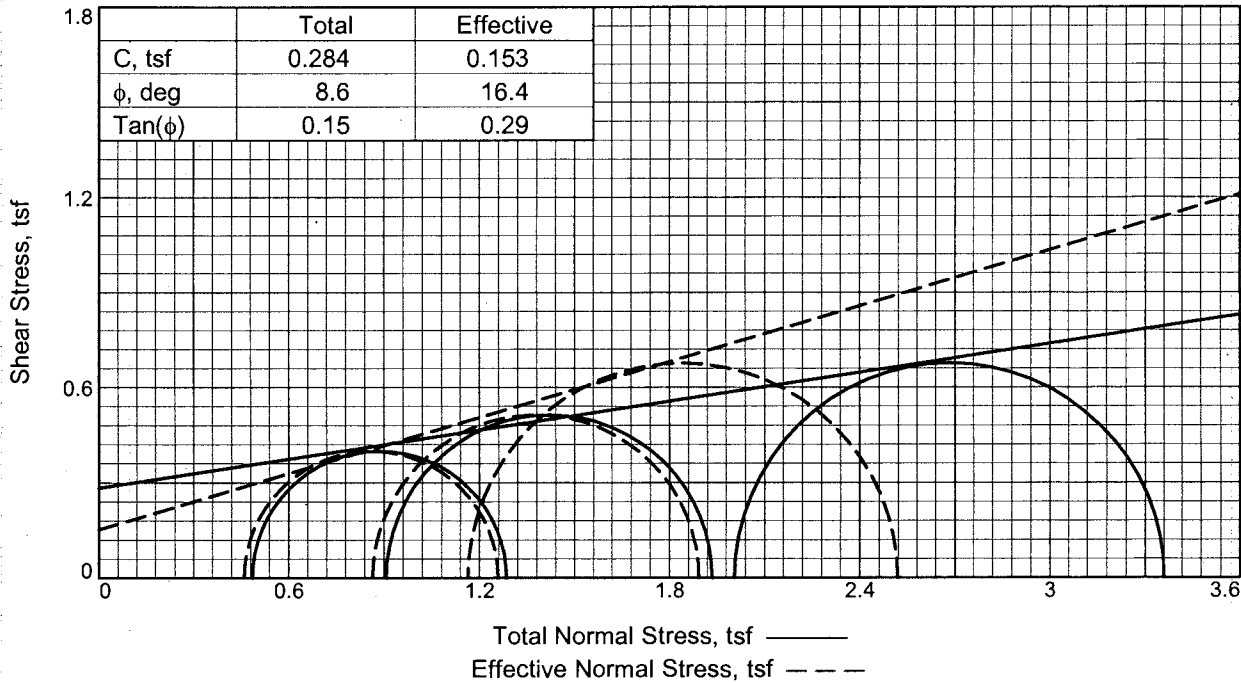
Consolidation effective confining stress = 1.015 tsf

Peak Stress = 1.023 tsf at reading no. 10

Ult. Stress = 0.930 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0305	18.860	0.0	0.0	0.000	1.015	1.015	1.00	6.120	1.015	0.000
1	0.0334	26.840	8.0	0.1	0.368	0.876	1.244	1.42	6.259	1.060	0.184
2	0.0374	28.420	9.6	0.2	0.440	0.727	1.167	1.60	6.408	0.947	0.220
3	0.0599	32.880	14.0	1.1	0.640	0.501	1.141	2.28	6.634	0.821	0.320
4	0.0914	35.930	17.1	2.2	0.770	0.415	1.185	2.86	6.720	0.800	0.385
5	0.1206	37.570	18.7	3.2	0.835	0.370	1.205	3.26	6.765	0.787	0.417
6	0.1509	39.610	20.8	4.3	0.916	0.361	1.277	3.54	6.774	0.819	0.458
7	0.1813	40.720	21.9	5.4	0.953	0.372	1.325	3.56	6.763	0.849	0.477
8	0.2117	42.080	23.2	6.5	1.001	0.400	1.401	3.50	6.735	0.901	0.501
9	0.2419	42.810	24.0	7.6	1.021	0.451	1.472	3.26	6.684	0.961	0.510
10	0.2723	43.150	24.3	8.7	1.023	0.477	1.500	3.14	6.658	0.988	0.511
11	0.3028	42.500	23.6	9.8	0.984	0.512	1.496	2.92	6.623	1.004	0.492
12	0.3333	42.400	23.5	10.9	0.968	0.552	1.520	2.75	6.583	1.036	0.484
13	0.3634	42.400	23.5	12.0	0.956	0.583	1.539	2.64	6.552	1.061	0.478
14	0.3937	42.300	23.4	13.0	0.940	0.616	1.556	2.53	6.519	1.086	0.470
15	0.4243	42.400	23.5	14.1	0.932	0.631	1.563	2.48	6.504	1.097	0.466
16	0.4490	42.600	23.7	15.0	0.930	0.644	1.574	2.44	6.491	1.109	0.465





Sample No.		1	2	3
Initial	Water Content, %	43.7	43.8	43.4
	Dry Density, pcf	77.9	77.8	78.2
	Saturation, %	99.9	100.0	100.0
	Void Ratio	1.1995	1.2029	1.1901
	Diameter, in.	1.42	1.40	1.39
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	43.7	43.7	43.3
	Dry Density, pcf	77.9	77.9	78.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1995	1.1982	1.1878
	Diameter, in.	1.42	1.40	1.39
	Height, in.	2.80	2.81	2.81
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.48	0.91	2.01
Back Pressure, tsf		6.64	6.13	5.12
Cell Pressure, tsf		7.12	7.04	7.13
Peak Deviator Stress, tsf		0.88	1.40	1.79
Total Pore Pr., tsf		6.80	6.70	6.17
Ultimate Deviator Stress, tsf		0.80	1.03	1.35
Total Pore Pr., tsf		6.66	6.17	5.96
Maj. Eff. Stress at Ultimate, tsf		1.26	1.89	2.52
Min. Eff. Stress at Ultimate, tsf		0.46	0.86	1.16

Type of Test:

CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 82

PL= 23

PI= 59

Specific Gravity= 2.744

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Sheyenne River, OX Brenna Formation

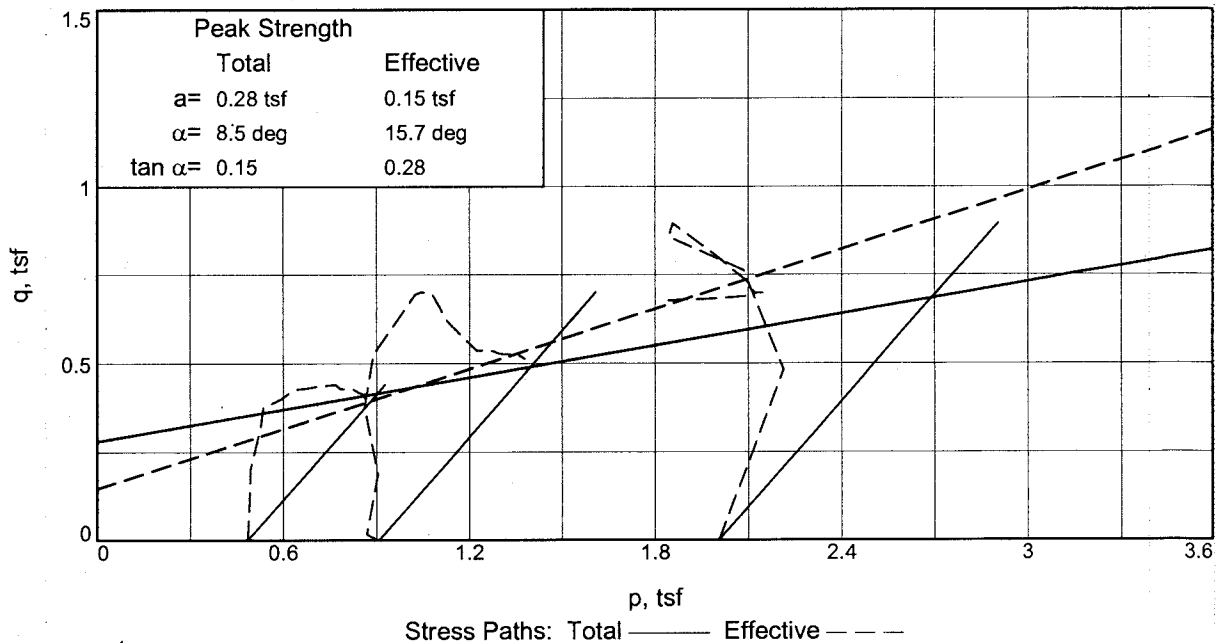
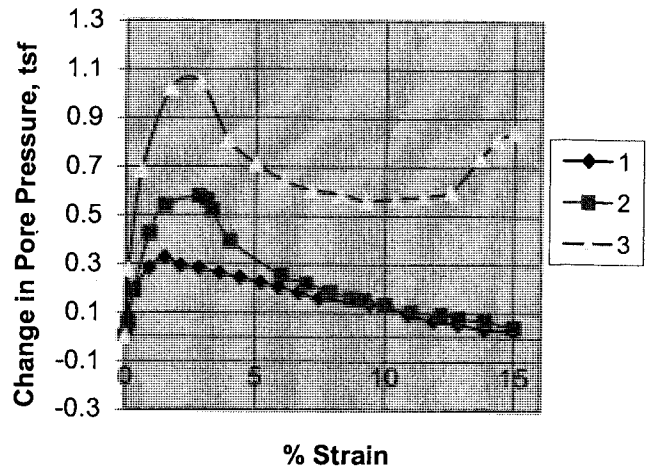
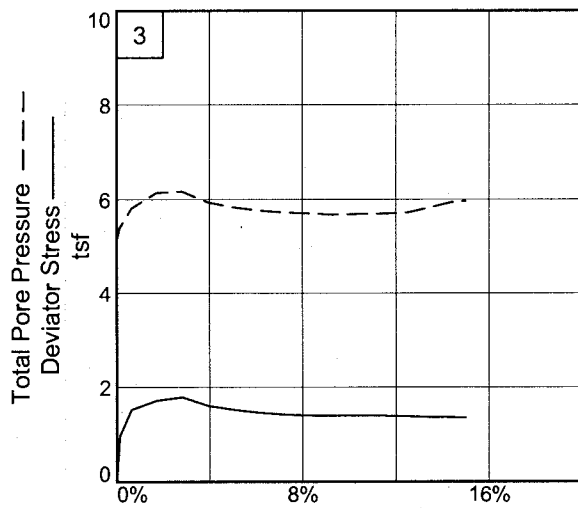
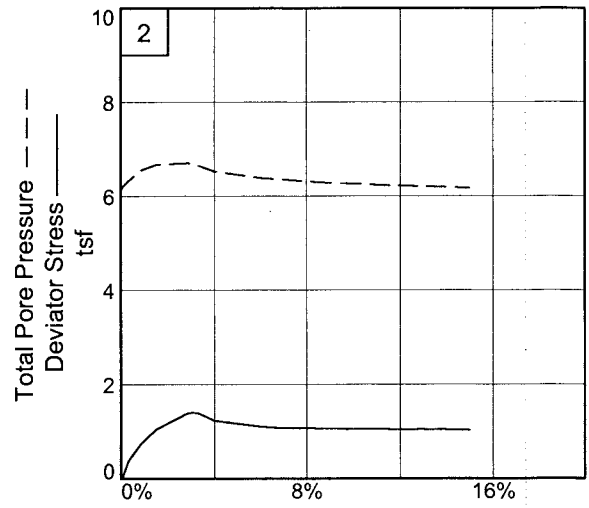
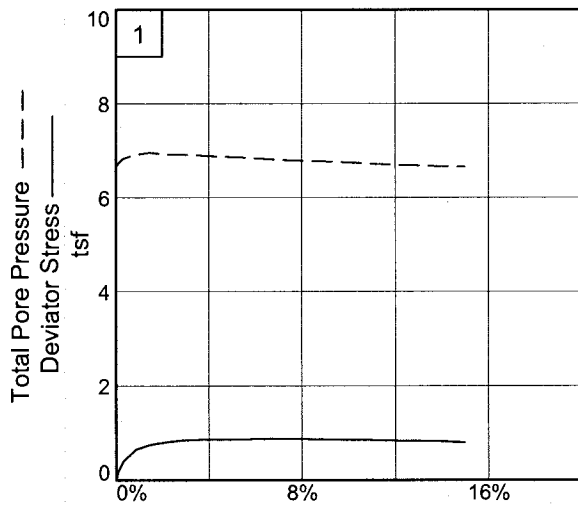
Sample Number: Boring11-110MU, #1

Depth: 25-27'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, OX Brenna Formation

Depth: 25-27'

Sample No.: Boring11-110MU_#1

Project No.: DL-10-0065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

4/26/2011

8:18 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, OX Brenna Formation
Depth: 25-27' **Sample Number:** Boring11-110MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity: 2.744 **LL:** 82 **PL:** 23 **PI:** 59
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	109.010			161.700
Moisture content: Dry soil+tare, gms.	85.070			121.120
Moisture content: Tare, gms.	30.270			30.330
Moisture, %	43.7	43.7	43.7	44.7
Moist specimen weight, gms.	130.5			
Diameter, in.	1.42	1.42	1.42	
Area, in. ²	1.59	1.59	1.59	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	111.9	111.9	111.9	
Dry density, pcf	77.9	77.9	77.9	
Void ratio	1.1995	1.1995	1.1995	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.124 tsf
 Consolidation back pressure = 6.638 tsf
 Consolidation effective confining stress = 0.486 tsf
 Peak Stress = 0.882 tsf at reading no. 12
 Ult. Stress = 0.799 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0116	19.500	0.0	0.0	0.000	0.486	0.486	1.00	6.638	0.486	0.000
1	0.0137	23.250	3.8	0.1	0.170	0.406	0.576	1.42	6.718	0.491	0.085
2	0.0204	28.380	8.9	0.3	0.402	0.294	0.696	2.37	6.830	0.495	0.201
3	0.0355	33.870	14.4	0.9	0.647	0.205	0.852	4.16	6.919	0.528	0.323
4	0.0524	36.310	16.8	1.5	0.752	0.160	0.913	5.69	6.963	0.537	0.376
5	0.0714	37.620	18.1	2.1	0.805	0.194	0.999	5.15	6.930	0.597	0.403
6	0.0913	38.660	19.2	2.8	0.845	0.204	1.049	5.14	6.920	0.627	0.423
7	0.1131	39.120	19.6	3.6	0.858	0.223	1.081	4.85	6.901	0.652	0.429
8	0.1339	39.340	19.8	4.4	0.861	0.242	1.103	4.56	6.882	0.673	0.431
9	0.1559	39.650	20.1	5.2	0.868	0.261	1.129	4.32	6.863	0.695	0.434
10	0.1779	39.970	20.5	5.9	0.874	0.281	1.155	4.11	6.843	0.718	0.437
11	0.1998	40.250	20.8	6.7	0.879	0.304	1.183	3.89	6.820	0.743	0.439
12	0.2227	40.520	21.0	7.5	0.882	0.328	1.210	3.69	6.796	0.769	0.441
13	0.2747	40.400	20.9	9.4	0.860	0.352	1.212	3.44	6.772	0.782	0.430
14	0.3161	40.680	21.2	10.9	0.857	0.395	1.252	3.17	6.729	0.824	0.429
15	0.3445	40.460	21.0	11.9	0.839	0.421	1.260	2.99	6.703	0.840	0.419
16	0.3720	40.540	21.0	12.9	0.832	0.434	1.266	2.92	6.690	0.850	0.416
17	0.4003	40.670	21.2	13.9	0.828	0.454	1.282	2.82	6.670	0.868	0.414
18	0.4310	40.190	20.7	15.0	0.799	0.460	1.259	2.74	6.664	0.859	0.399

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	138.070			157.720
Moisture content: Dry soil+tare, gms.	105.170			118.880
Moisture content: Tare, gms.	30.100			30.520
Moisture, %	43.8	43.8	43.7	44.0
Moist specimen weight, gms.	127.2			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	111.8	111.9	112.0	
Dry density, pcf	77.8	77.8	77.9	
Void ratio	1.2029	1.2029	1.1982	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.039 tsf
 Consolidation back pressure = 6.132 tsf
 Consolidation effective confining stress = 0.907 tsf
 Peak Stress = 1.403 tsf at reading no. 6
 Ult. Stress = 1.028 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0076	21.130	0.0	0.0	0.000	0.907	0.907	1.00	6.132	0.907	0.000
1	0.0096	21.840	0.7	0.1	0.033	0.851	0.884	1.04	6.188	0.868	0.017
2	0.0167	29.200	8.1	0.3	0.376	0.716	1.092	1.53	6.323	0.904	0.188
3	0.0325	37.500	16.4	0.9	0.759	0.481	1.240	2.58	6.558	0.860	0.379
4	0.0503	43.940	22.8	1.5	1.051	0.365	1.416	3.88	6.674	0.890	0.525
5	0.0870	51.690	30.6	2.8	1.389	0.329	1.718	5.22	6.710	1.023	0.694
6	0.0933	52.060	30.9	3.1	1.403	0.342	1.745	5.10	6.697	1.043	0.701
7	0.1002	51.850	30.7	3.3	1.389	0.385	1.774	4.61	6.654	1.080	0.695
8	0.1197	48.670	27.5	4.0	1.237	0.510	1.747	3.42	6.529	1.128	0.618
9	0.1758	46.230	25.1	6.0	1.104	0.653	1.757	2.69	6.386	1.205	0.552
10	0.2056	45.830	24.7	7.0	1.074	0.687	1.761	2.56	6.352	1.224	0.537
11	0.2287	46.110	25.0	7.9	1.076	0.721	1.797	2.49	6.318	1.259	0.538
12	0.2515	46.110	25.0	8.7	1.067	0.748	1.815	2.43	6.291	1.281	0.533
13	0.2666	46.140	25.0	9.2	1.062	0.756	1.818	2.40	6.283	1.287	0.531
14	0.2885	46.170	25.0	10.0	1.054	0.772	1.826	2.37	6.267	1.299	0.527
15	0.3263	46.540	25.4	11.3	1.054	0.805	1.859	2.31	6.234	1.332	0.527
16	0.3502	46.640	25.5	12.2	1.048	0.814	1.862	2.29	6.225	1.338	0.524
17	0.3693	46.910	25.8	12.9	1.051	0.828	1.879	2.27	6.211	1.353	0.525
18	0.3981	47.030	25.9	13.9	1.043	0.844	1.887	2.24	6.195	1.366	0.522
19	0.4291	46.990	25.9	15.0	1.028	0.865	1.893	2.19	6.174	1.379	0.514

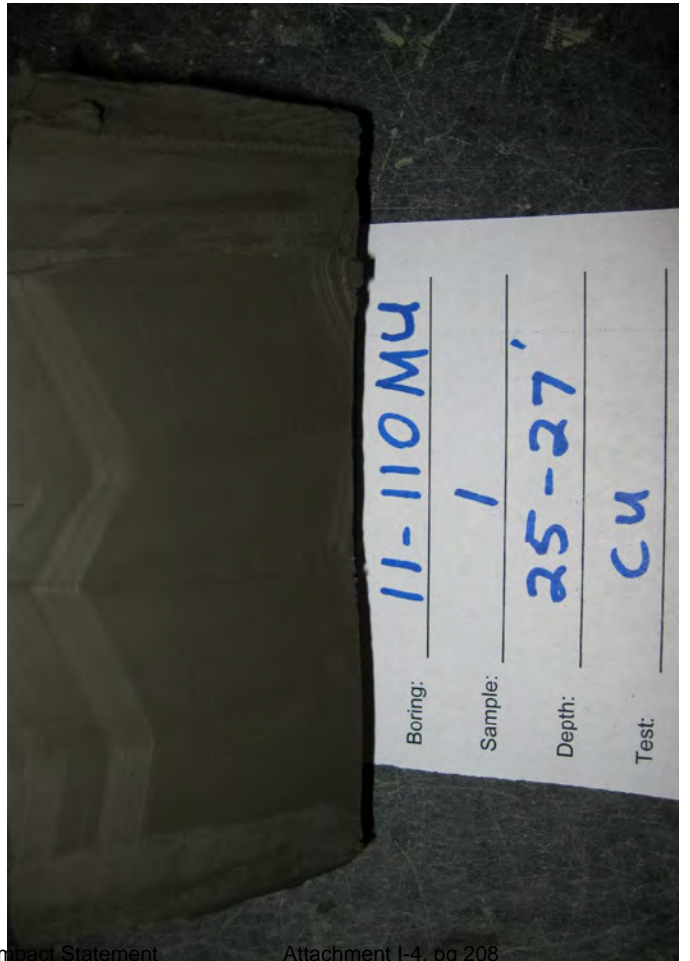
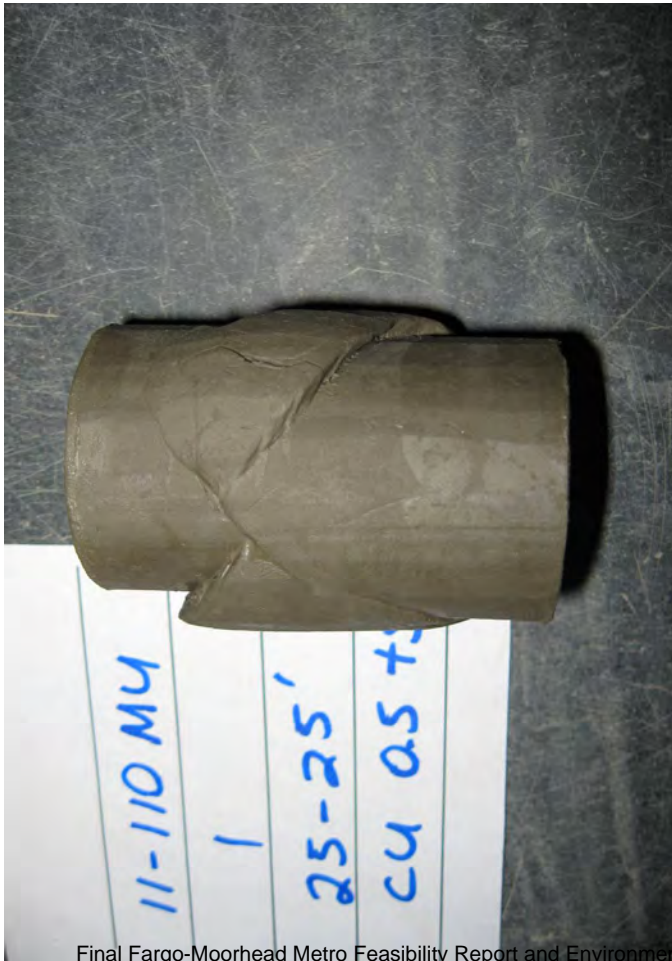
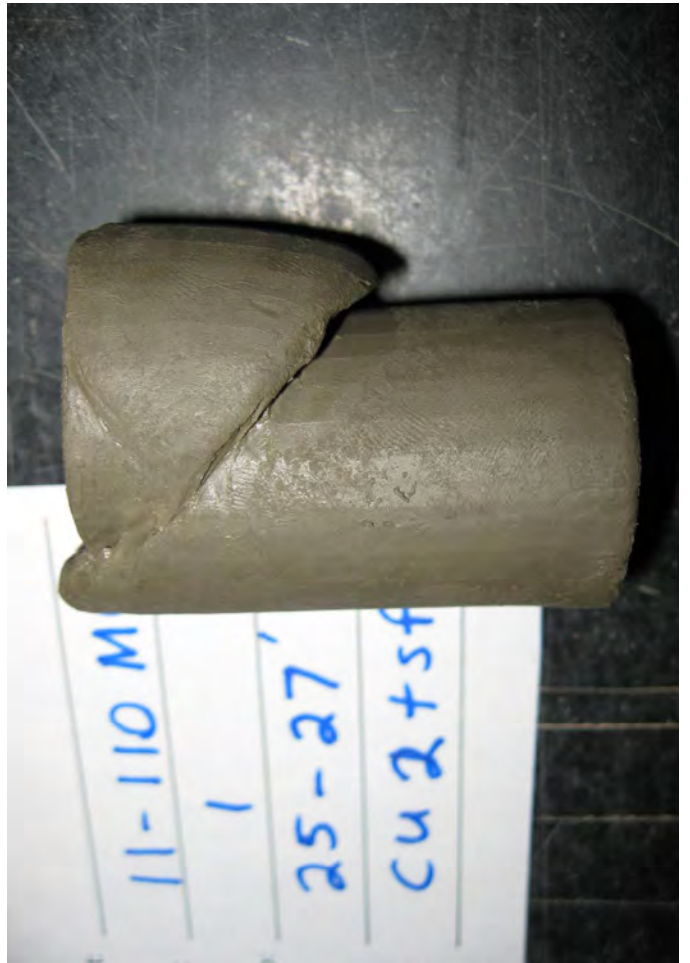
Parameters for Specimen No. 3

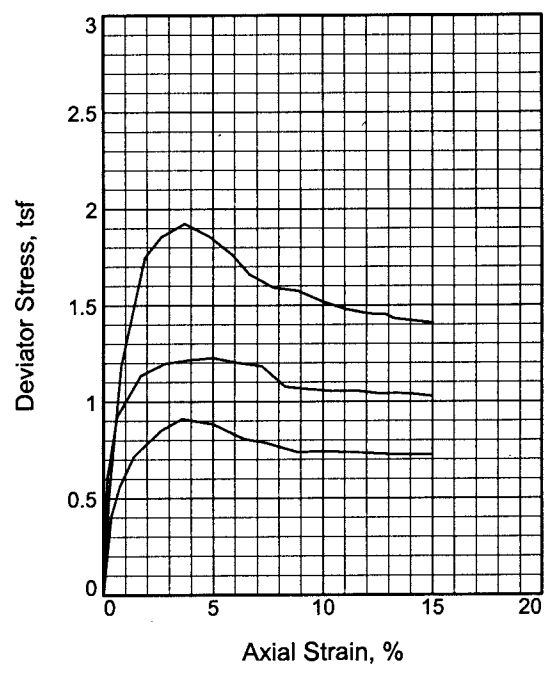
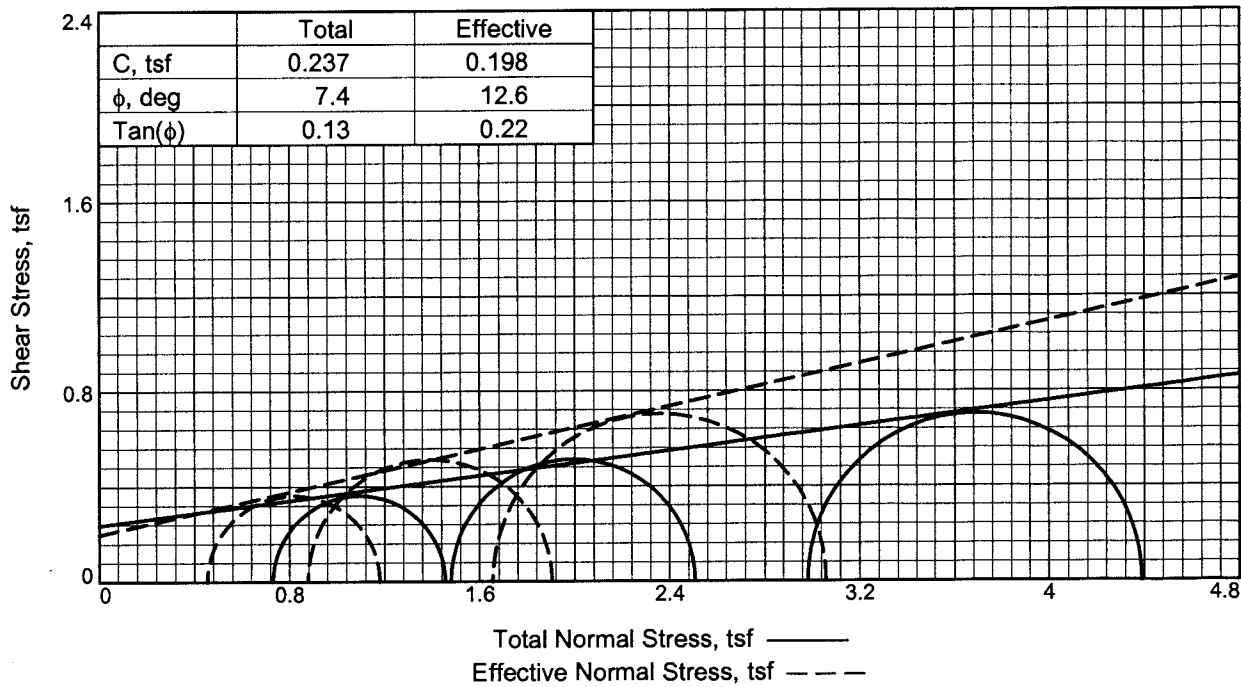
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	143.720			157.340
Moisture content: Dry soil+tare, gms.	109.390			118.280
Moisture content: Tare, gms.	30.250			30.700
Moisture, %	43.4	43.4	43.3	44.6
Moist specimen weight, gms.	125.9			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	112.1	112.1	112.2	
Dry density, pcf	78.2	78.2	78.3	
Void ratio	1.1901	1.1901	1.1878	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.127 tsf
 Consolidation back pressure = 5.121 tsf
 Consolidation effective confining stress = 2.006 tsf
 Peak Stress = 1.791 tsf at reading no. 4
 Ult. Stress = 1.354 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0403	19.950	0.0	0.0	0.000	2.006	2.006	1.00	5.121	2.006	0.000
1	0.0439	40.400	20.4	0.1	0.967	1.730	2.697	1.56	5.397	2.213	0.483
2	0.0579	52.400	32.5	0.6	1.526	1.321	2.847	2.16	5.806	2.084	0.763
3	0.0883	56.830	36.9	1.7	1.716	0.985	2.701	2.74	6.142	1.843	0.858
4	0.1194	58.900	39.0	2.8	1.791	0.961	2.752	2.86	6.166	1.857	0.896
5	0.1511	55.300	35.3	3.9	1.607	1.194	2.801	2.35	5.933	1.997	0.803
6	0.1812	53.800	33.8	5.0	1.522	1.294	2.816	2.18	5.833	2.055	0.761
7	0.2117	52.900	33.0	6.1	1.464	1.363	2.827	2.07	5.764	2.095	0.732
8	0.2420	52.300	32.3	7.2	1.421	1.401	2.822	2.01	5.726	2.112	0.711
9	0.2723	52.200	32.3	8.3	1.400	1.419	2.819	1.99	5.708	2.119	0.700
10	0.3028	52.530	32.6	9.3	1.398	1.447	2.845	1.97	5.680	2.146	0.699
11	0.3324	52.900	33.0	10.4	1.397	1.438	2.835	1.97	5.689	2.137	0.699
12	0.3628	53.300	33.3	11.5	1.397	1.426	2.823	1.98	5.701	2.125	0.699
13	0.3930	53.270	33.3	12.6	1.379	1.405	2.784	1.98	5.722	2.094	0.689
14	0.4244	53.260	33.3	13.7	1.361	1.270	2.631	2.07	5.857	1.950	0.680
15	0.4439	53.500	33.5	14.4	1.360	1.192	2.552	2.14	5.935	1.872	0.680
16	0.4610	53.610	33.7	15.0	1.354	1.164	2.518	2.16	5.963	1.841	0.677





Sample No.	1	2	3	
Initial	Water Content, %	55.7	54.0	49.7
	Dry Density, pcf	67.8	69.2	70.8
	Saturation, %	99.6	100.0	95.5
	Void Ratio	1.5462	1.4953	1.4399
	Diameter, in.	1.40	1.40	1.39
	Height, in.	2.81	2.81	2.82
At Test	Water Content, %	55.4	52.6	50.2
	Dry Density, pcf	68.2	70.3	72.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5327	1.4555	1.3882
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.81	2.80	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.73	1.48	2.98	
Back Pressure, tsf	6.37	5.65	4.14	
Cell Pressure, tsf	7.10	7.13	7.12	
Peak Deviator Stress, tsf	0.91	1.23	1.92	
Total Pore Pr., tsf	6.83	6.35	5.49	
Ultimate Deviator Stress, tsf	0.72	1.03	1.41	
Total Pore Pr., tsf	6.64	6.25	5.47	
Maj. Eff. Stress at Ultimate, tsf	1.18	1.90	3.06	
Min. Eff. Stress at Ultimate, tsf	0.46	0.88	1.65	

Type of Test:
CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 91 PL= 24 PI= 67

Specific Gravity= 2.767

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

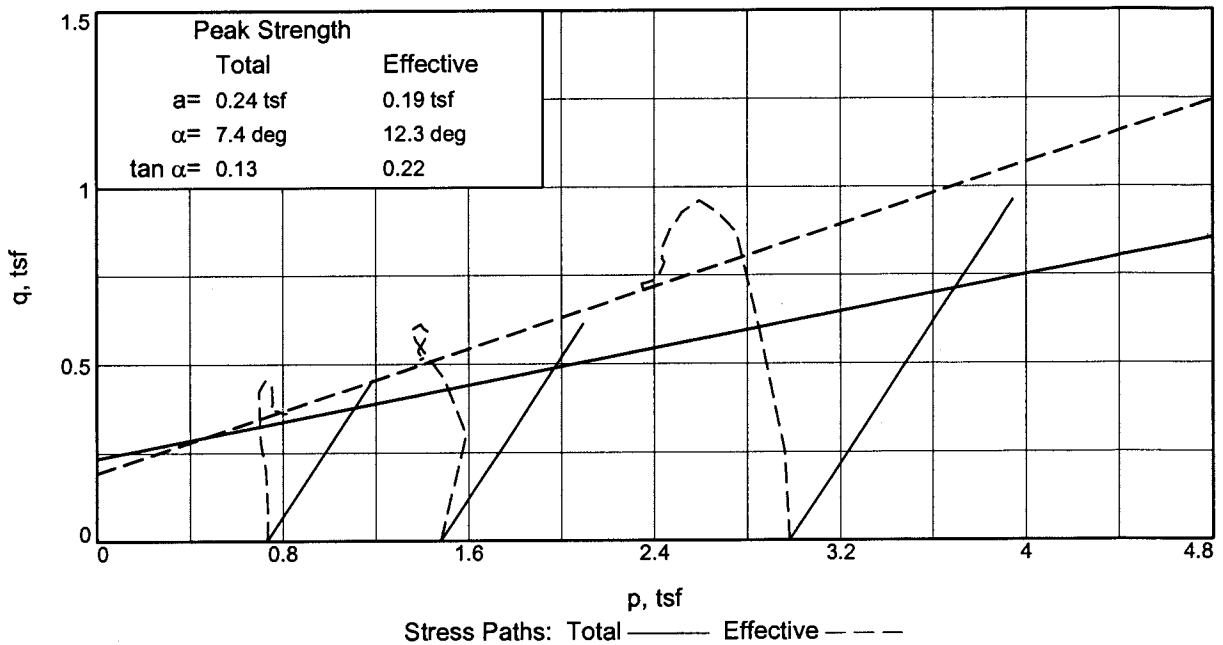
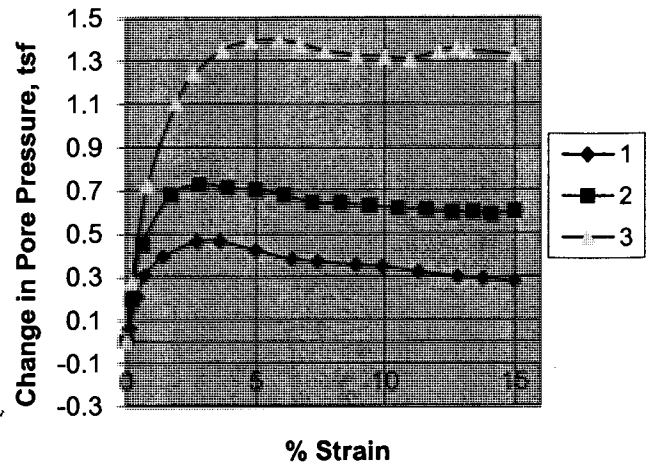
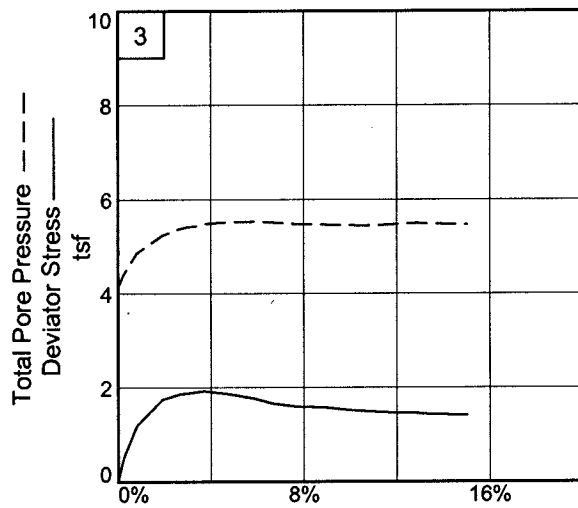
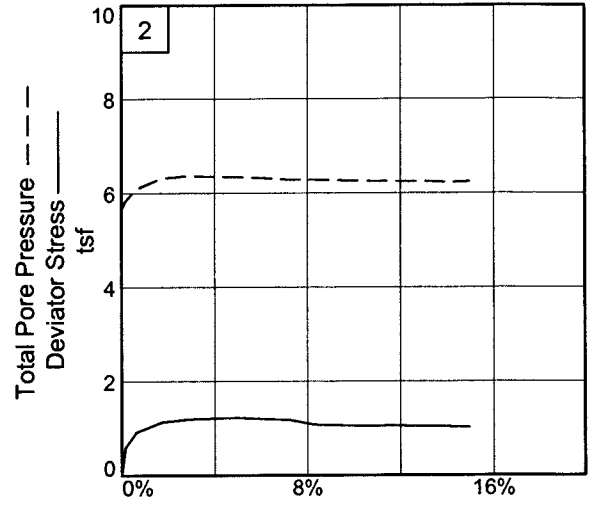
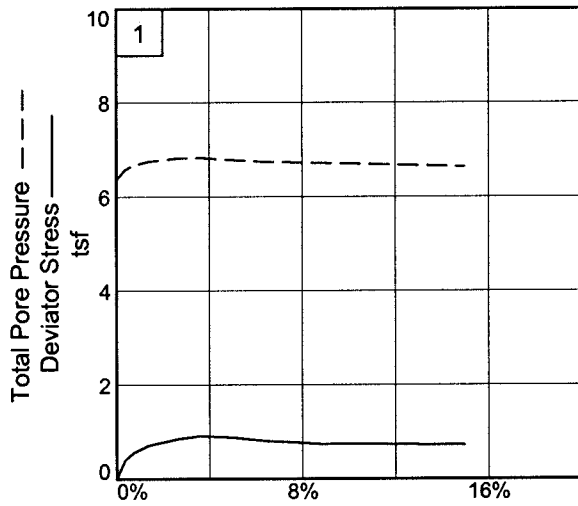
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

Location: Wild Rice, OX Brenna Formation

Sample Number: Boring11-118MU, #1 **Depth:** 20-21'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, OX Brenna Formation

Depth: 20-21'

Sample Number: Boring11-118MU, #1

Project No. BI-10-10065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

5/15/2011
11:42 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, OX Brenna Formation
Depth: 20-21' **Sample Number:** Boring11-118MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.767 **LL**=91 **PL**=24 **PI**=67
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.690			147.510
Moisture content: Dry soil+tare, gms.	87.230			106.500
Moisture content: Tare, gms.	30.730			30.100
Moisture, %	55.7	55.9	55.4	53.7
Moist specimen weight, gms.	119.3			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	105.6	105.8	106.0	
Dry density, pcf	67.8	67.8	68.2	
Void ratio	1.5462	1.5462	1.5327	
Saturation, %	99.6	100.0	100.0	

Consolidation cell pressure = 7.097 tsf
Consolidation back pressure = 6.366 tsf
Consolidation effective confining stress = 0.731 tsf
Peak Stress = 0.912 tsf at reading no. 6
Ult. Stress = 0.725 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0098	18.250	0.0	0.0	0.000	0.731	0.731	1.00	6.366	0.731	0.000
1	0.0127	20.960	2.7	0.1	0.128	0.672	0.800	1.19	6.425	0.736	0.064
2	0.0197	26.880	8.6	0.4	0.406	0.523	0.929	1.78	6.574	0.726	0.203
3	0.0305	30.210	12.0	0.7	0.560	0.424	0.984	2.32	6.673	0.704	0.280
4	0.0490	33.660	15.4	1.4	0.717	0.340	1.057	3.11	6.757	0.699	0.359
5	0.0842	36.770	18.5	2.7	0.851	0.271	1.122	4.14	6.826	0.697	0.426
6	0.1109	38.290	20.0	3.6	0.912	0.269	1.181	4.39	6.828	0.725	0.456
7	0.1500	37.930	19.7	5.0	0.883	0.311	1.194	3.84	6.786	0.752	0.441
8	0.1903	36.520	18.3	6.4	0.807	0.352	1.159	3.29	6.745	0.756	0.404
9	0.2174	36.250	18.0	7.4	0.787	0.363	1.150	3.17	6.734	0.756	0.393
10	0.2585	35.430	17.2	8.9	0.739	0.379	1.118	2.95	6.718	0.749	0.370
11	0.2862	35.670	17.4	9.9	0.741	0.387	1.128	2.92	6.710	0.758	0.371
12	0.3281	35.910	17.7	11.3	0.739	0.409	1.148	2.81	6.688	0.779	0.370
13	0.3691	35.970	17.7	12.8	0.729	0.431	1.160	2.69	6.666	0.796	0.365
14	0.3969	36.090	17.8	13.8	0.726	0.441	1.167	2.65	6.656	0.804	0.363
15	0.4299	36.310	18.1	15.0	0.725	0.455	1.180	2.59	6.642	0.817	0.362

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	125.900			149.220
Moisture content: Dry soil+tare, gms.	92.280			109.810
Moisture content: Tare, gms.	30.070			30.420
Moisture, %	54.0	54.0	52.6	49.6
Moist specimen weight, gms.	121.3			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.53	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.6	106.6	107.4	
Dry density, pcf	69.2	69.2	70.3	
Void ratio	1.4953	1.4953	1.4555	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.126 tsf

Consolidation back pressure = 5.646 tsf

Consolidation effective confining stress = 1.480 tsf

Peak Stress = 1.228 tsf at reading no. 6

Ult. Stress = 1.027 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0981	20.500	0.0	0.0	0.000	1.480	1.480	1.00	5.646	1.480	0.000
1	0.1029	33.310	12.8	0.2	0.604	1.287	1.891	1.47	5.839	1.589	0.302
2	0.1155	40.190	19.7	0.6	0.924	1.031	1.955	1.90	6.095	1.493	0.462
3	0.1461	44.970	24.5	1.7	1.135	0.803	1.938	2.41	6.323	1.371	0.568
4	0.1763	46.580	26.1	2.8	1.197	0.755	1.952	2.59	6.371	1.353	0.598
5	0.2068	47.270	26.8	3.9	1.215	0.769	1.984	2.58	6.357	1.376	0.607
6	0.2373	47.870	27.4	5.0	1.228	0.780	2.008	2.57	6.346	1.394	0.614
7	0.2693	47.630	27.1	6.1	1.202	0.805	2.007	2.49	6.321	1.406	0.601
8	0.2999	47.510	27.0	7.2	1.183	0.839	2.022	2.41	6.287	1.431	0.592
9	0.3301	45.390	24.9	8.3	1.078	0.842	1.920	2.28	6.284	1.381	0.539
10	0.3606	45.370	24.9	9.4	1.064	0.853	1.917	2.25	6.273	1.385	0.532
11	0.3909	45.430	24.9	10.5	1.054	0.864	1.918	2.22	6.262	1.391	0.527
12	0.4213	45.810	25.3	11.6	1.057	0.871	1.928	2.21	6.255	1.399	0.528
13	0.4516	45.750	25.3	12.6	1.041	0.882	1.923	2.18	6.244	1.403	0.521
14	0.4714	46.020	25.5	13.4	1.044	0.880	1.924	2.19	6.246	1.402	0.522
15	0.4919	46.110	25.6	14.1	1.039	0.892	1.931	2.16	6.234	1.411	0.519
16	0.5167	46.090	25.6	15.0	1.027	0.877	1.904	2.17	6.249	1.391	0.514

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	88.990			144.050
Moisture content: Dry soil+tare, gms.	69.390			108.130
Moisture content: Tare, gms.	29.970			31.060
Moisture, %	49.7	52.0	50.2	46.6
Moist specimen weight, gms.	118.7			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.49	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	106.0	107.6	108.6	
Dry density, pcf	70.8	70.8	72.3	
Void ratio	1.4399	1.4399	1.3882	
Saturation, %	95.5	100.0	100.0	

Consolidation cell pressure = 7.120 tsf

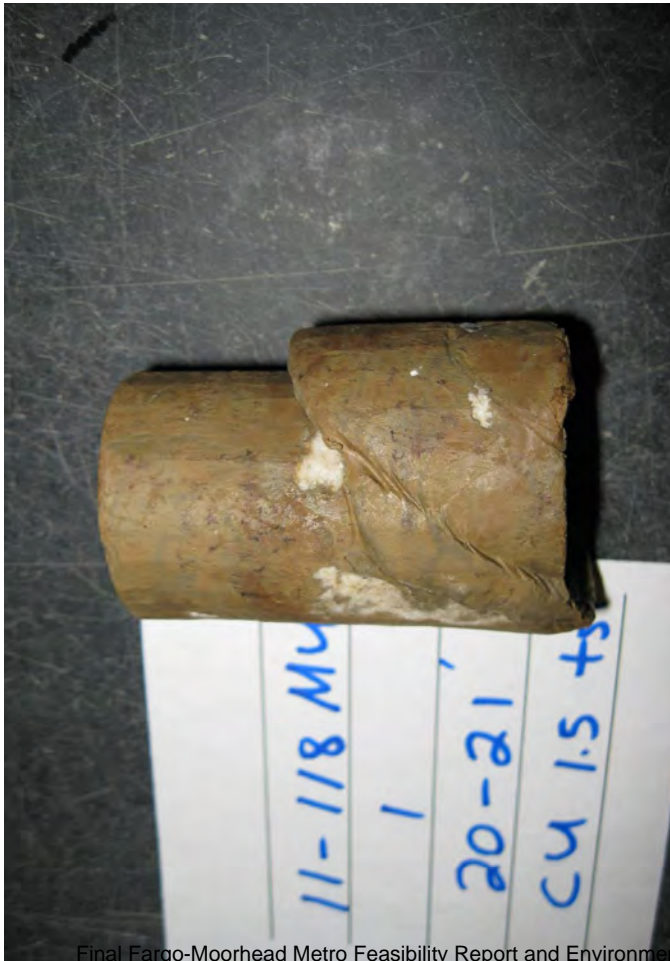
Consolidation back pressure = 4.138 tsf

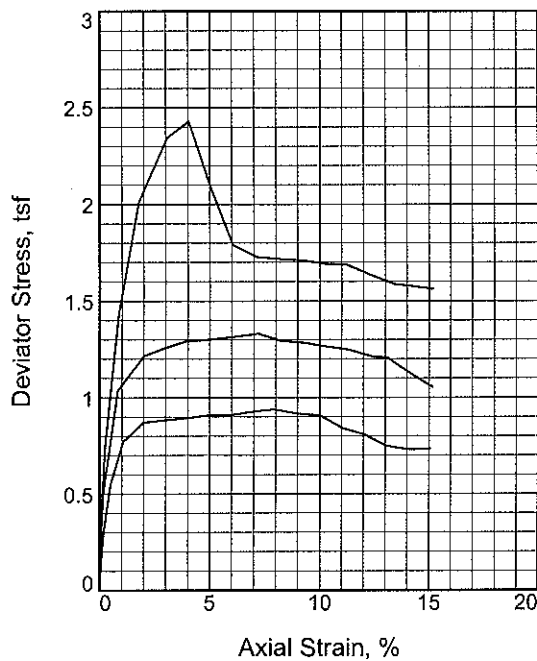
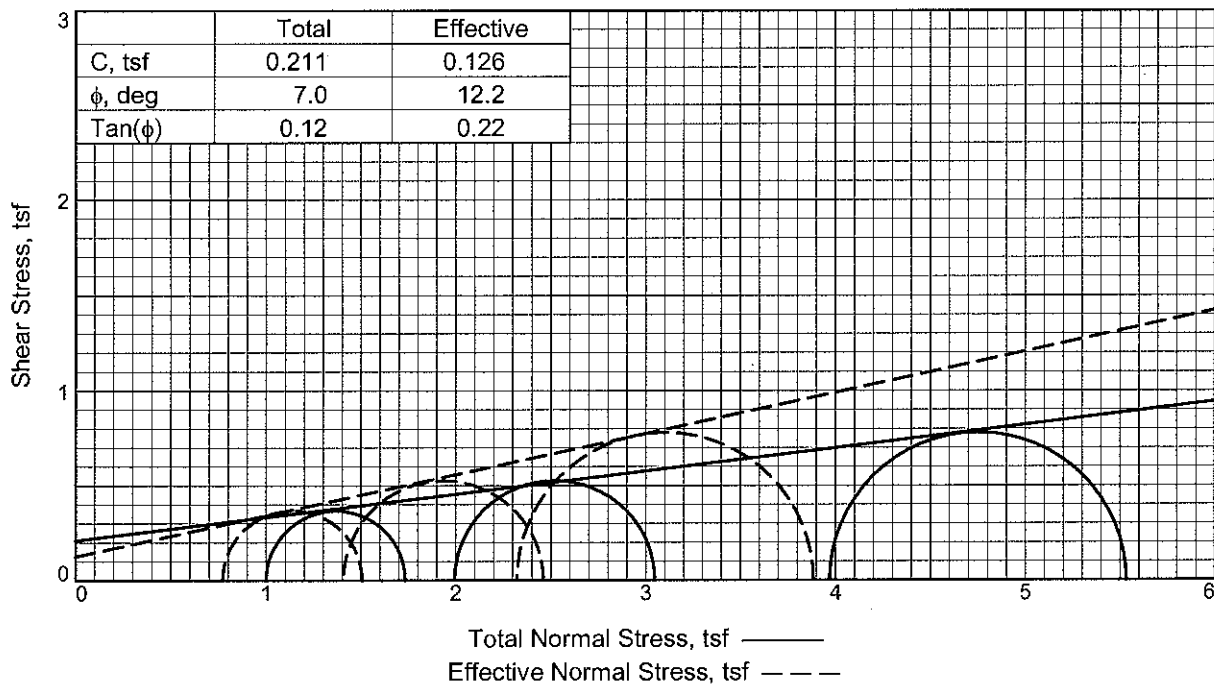
Consolidation effective confining stress = 2.982 tsf

Peak Stress = 1.924 tsf at reading no. 5

Ult. Stress = 1.407 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0646	17.640	0.0	0.0	0.000	2.982	2.982	1.00	4.138	2.982	0.000
1	0.0714	28.190	10.6	0.2	0.508	2.707	3.215	1.19	4.413	2.961	0.254
2	0.0873	42.390	24.8	0.8	1.185	2.259	3.444	1.52	4.861	2.851	0.592
3	0.1179	54.520	36.9	1.9	1.746	1.880	3.626	1.93	5.240	2.753	0.873
4	0.1382	57.110	39.5	2.6	1.855	1.744	3.599	2.06	5.376	2.672	0.928
5	0.1685	59.030	41.4	3.7	1.924	1.632	3.556	2.18	5.488	2.594	0.962
6	0.1999	58.040	40.4	4.8	1.856	1.594	3.450	2.16	5.526	2.522	0.928
7	0.2300	56.410	38.8	5.9	1.761	1.587	3.348	2.11	5.533	2.467	0.880
8	0.2508	54.510	36.9	6.7	1.661	1.605	3.266	2.04	5.515	2.436	0.831
9	0.2810	53.400	35.8	7.7	1.593	1.637	3.230	1.97	5.483	2.433	0.796
10	0.3125	53.460	35.8	8.9	1.576	1.656	3.232	1.95	5.464	2.444	0.788
11	0.3431	52.630	35.0	10.0	1.521	1.665	3.186	1.91	5.455	2.425	0.760
12	0.3733	52.110	34.5	11.0	1.480	1.674	3.154	1.88	5.446	2.414	0.740
13	0.4037	51.980	34.3	12.1	1.457	1.638	3.095	1.89	5.482	2.366	0.728
14	0.4242	52.210	34.6	12.8	1.454	1.620	3.074	1.90	5.500	2.347	0.727
15	0.4345	51.850	34.2	13.2	1.433	1.634	3.067	1.88	5.486	2.351	0.717
16	0.4851	51.950	34.3	15.0	1.407	1.654	3.061	1.85	5.466	2.358	0.704





Sample No.	1	2	3	
Initial	Water Content, %	56.4	55.8	58.5
	Dry Density, pcf	66.7	67.1	65.3
	Saturation, %	98.7	98.4	98.7
	Void Ratio	1.5728	1.5581	1.6308
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	56.2	54.2	55.3
	Dry Density, pcf	67.4	68.9	68.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5453	1.4899	1.5197
	Diameter, in.	1.39	1.38	1.38
	Height, in.	2.79	2.77	2.77
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.00	2.00	3.97	
Back Pressure, tsf	6.14	5.14	3.17	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	0.94	1.33	2.43	
Total Pore Pr., tsf	6.57	5.78	4.85	
Ultimate Deviator Stress, tsf	0.73	1.05	1.56	
Total Pore Pr., tsf	6.37	5.73	4.82	
Maj. Eff. Stress at Ultimate, tsf	1.51	2.46	3.89	
Min. Eff. Stress at Ultimate, tsf	0.77	1.41	2.32	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 102 PL= 24 PI= 78

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

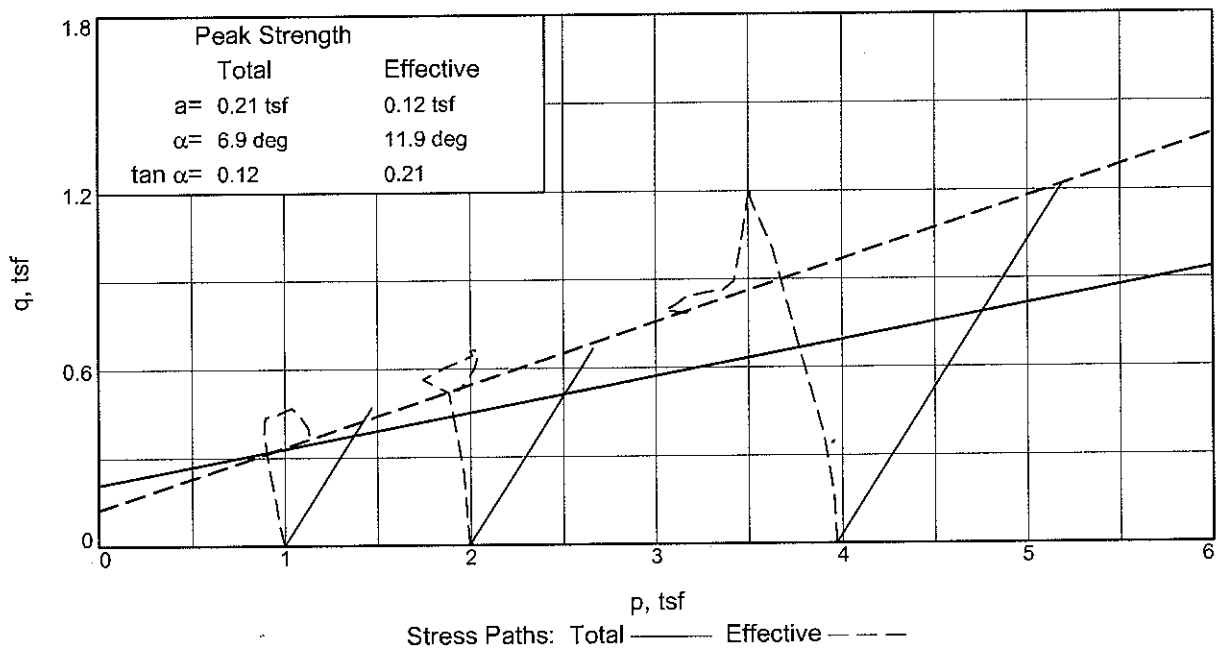
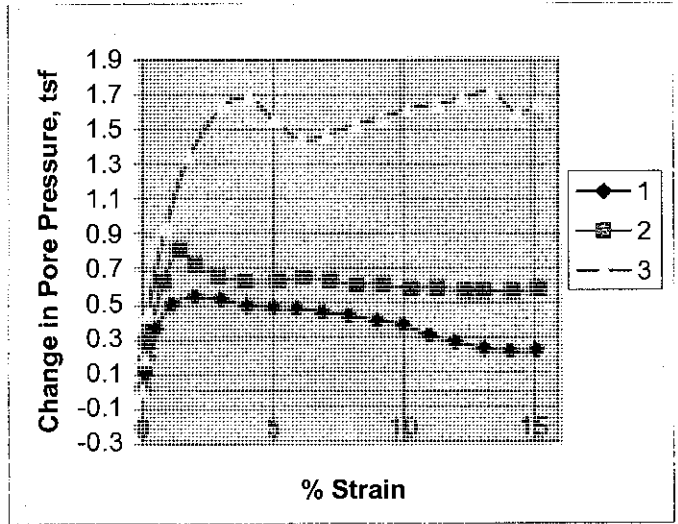
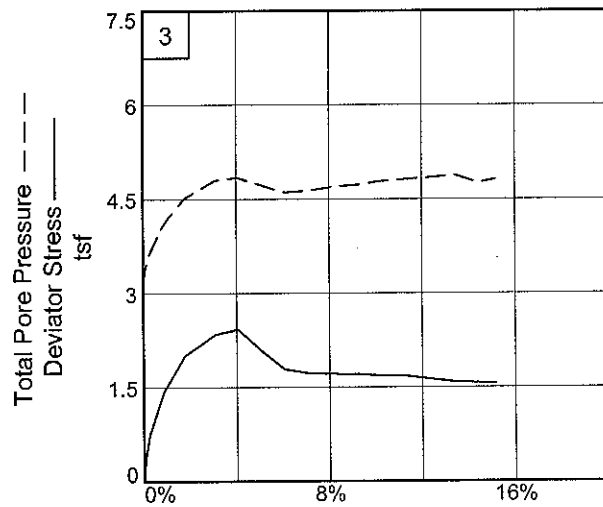
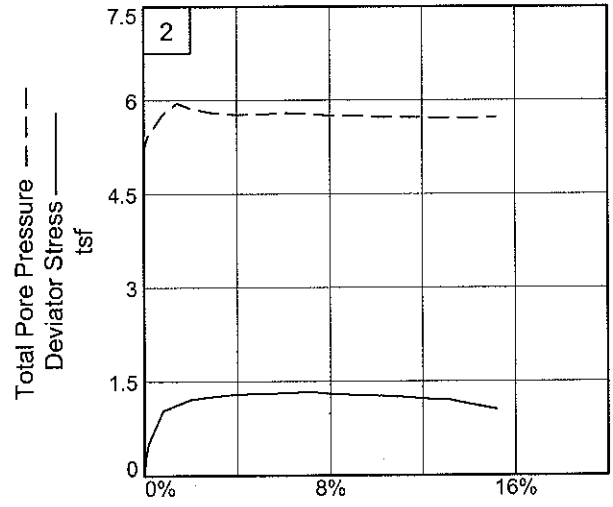
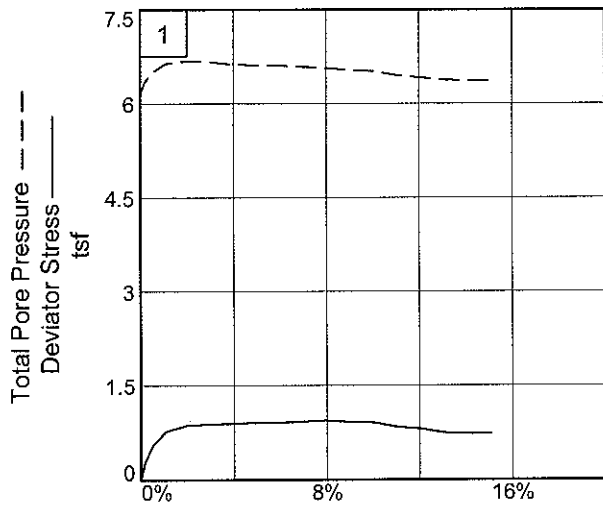
Location: SE-ED-01, East Diversion, Brenna Formation

Sample Number: Boring 09-11MU, #2 **Depth:** 30-32'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: SE-ED-01, East Diversion, Brenna Formation

Depth: 30-32'

Sample No.: Boring 09-11MU, #2

Project No.: BL-09-03127

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

10/12/2009

3:20 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-01, East Diversion, Brenna Formation
Depth: 30-32' **Sample Number:** Boring 09-11MU, #2
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**102 **PL=**24 **PI=**78
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	109.110			146.840
Moisture content: Dry soil+tare, gms.	80.640			105.100
Moisture content: Tare, gms.	30.200			30.510
Moisture, %	56.4	57.2	56.2	56.0
Moist specimen weight, gms.	116.5			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.51	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	104.4	104.9	105.3	
Dry density, pcf	66.7	66.7	67.4	
Void ratio	1.5728	1.5728	1.5453	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.137 tsf
Consolidation back pressure = 6.138 tsf
Consolidation effective confining stress = 0.999 tsf
Fail. Stress = 0.940 tsf **at reading no. 11**
Ult. Stress = 0.735 tsf **at reading no. 18**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0088	19.100	0.0	0.0	0.000	0.999	0.999	1.00	6.138	0.999	0.000
1	0.0108	21.970	2.9	0.1	0.137	0.903	1.040	1.15	6.234	0.971	0.068
2	0.0139	25.320	6.2	0.2	0.296	0.804	1.100	1.37	6.333	0.952	0.148
3	0.0227	30.630	11.5	0.5	0.547	0.639	1.186	1.86	6.498	0.913	0.274
4	0.0386	35.460	16.4	1.1	0.772	0.503	1.275	2.54	6.634	0.889	0.386
5	0.0644	37.750	18.6	2.0	0.872	0.457	1.329	2.91	6.680	0.893	0.436
6	0.0912	38.170	19.1	3.0	0.883	0.473	1.356	2.87	6.664	0.915	0.442
7	0.1191	38.610	19.5	4.0	0.894	0.513	1.407	2.74	6.624	0.960	0.447
8	0.1469	39.150	20.1	5.0	0.909	0.523	1.432	2.74	6.614	0.978	0.455
9	0.1740	39.380	20.3	5.9	0.910	0.528	1.438	2.72	6.609	0.983	0.455
10	0.2019	39.990	20.9	6.9	0.928	0.549	1.477	2.69	6.588	1.013	0.464
11	0.2298	40.490	21.4	7.9	0.940	0.567	1.507	2.66	6.570	1.037	0.470
12	0.2583	40.250	21.1	9.0	0.919	0.600	1.519	2.53	6.537	1.059	0.459
13	0.2875	40.260	21.2	10.0	0.909	0.622	1.531	2.46	6.515	1.076	0.454
14	0.3165	38.910	19.8	11.0	0.841	0.684	1.525	2.23	6.453	1.104	0.420
15	0.3444	38.360	19.3	12.0	0.808	0.721	1.529	2.12	6.416	1.125	0.404
16	0.3733	37.170	18.1	13.1	0.750	0.759	1.509	1.99	6.378	1.134	0.375
17	0.4022	36.930	17.8	14.1	0.731	0.773	1.504	1.95	6.364	1.138	0.365
18	0.4290	37.230	18.1	15.1	0.735	0.771	1.506	1.95	6.366	1.138	0.367

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	147.290			145.340
Moisture content: Dry soil+tare, gms.	105.370			105.040
Moisture content: Tare, gms.	30.180			29.960
Moisture, %	55.8	56.7	54.2	53.7
Moist specimen weight, gms.	117.0			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.50	
Height, in.	2.80	2.80	2.77	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	104.5	105.1	106.3	
Dry density, pcf	67.1	67.1	68.9	
Void ratio	1.5581	1.5581	1.4899	
Saturation, %	98.4	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.137 tsf
 Consolidation back pressure = 5.143 tsf
 Consolidation effective confining stress = 1.994 tsf
 Fail. Stress = 1.331 tsf at reading no. 10
 Ult. Stress = 1.054 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0078	18.790	0.0	0.0	0.000	1.994	1.994	1.00	5.143	1.994	0.000
1	0.0096	24.560	5.8	0.1	0.277	1.837	2.114	1.15	5.300	1.976	0.139
2	0.0127	29.350	10.6	0.2	0.507	1.709	2.216	1.30	5.428	1.963	0.254
3	0.0306	40.520	21.7	0.8	1.037	1.366	2.403	1.76	5.771	1.884	0.518
4	0.0476	42.610	23.8	1.4	1.129	1.181	2.310	1.96	5.956	1.746	0.565
5	0.0642	44.610	25.8	2.0	1.217	1.266	2.483	1.96	5.871	1.874	0.608
6	0.0895	45.730	26.9	2.9	1.258	1.332	2.590	1.94	5.805	1.961	0.629
7	0.1160	46.730	27.9	3.9	1.292	1.364	2.656	1.95	5.773	2.010	0.646
8	0.1509	47.350	28.6	5.2	1.303	1.356	2.659	1.96	5.781	2.007	0.651
9	0.1789	47.980	29.2	6.2	1.317	1.338	2.655	1.98	5.799	1.997	0.659
10	0.2078	48.610	29.8	7.2	1.331	1.357	2.688	1.98	5.780	2.022	0.665
11	0.2357	48.120	29.3	8.2	1.295	1.384	2.679	1.94	5.753	2.031	0.647
12	0.2638	48.240	29.5	9.2	1.286	1.382	2.668	1.93	5.755	2.025	0.643
13	0.2928	48.120	29.3	10.3	1.266	1.405	2.671	1.90	5.732	2.038	0.633
14	0.3217	48.060	29.3	11.3	1.249	1.406	2.655	1.89	5.731	2.030	0.624
15	0.3513	47.600	28.8	12.4	1.214	1.418	2.632	1.86	5.719	2.025	0.607
16	0.3713	47.690	28.9	13.1	1.208	1.419	2.627	1.85	5.718	2.023	0.604
17	0.4005	46.020	27.2	14.2	1.124	1.422	2.546	1.79	5.715	1.984	0.562
18	0.4285	44.610	25.8	15.2	1.054	1.407	2.461	1.75	5.730	1.934	0.527

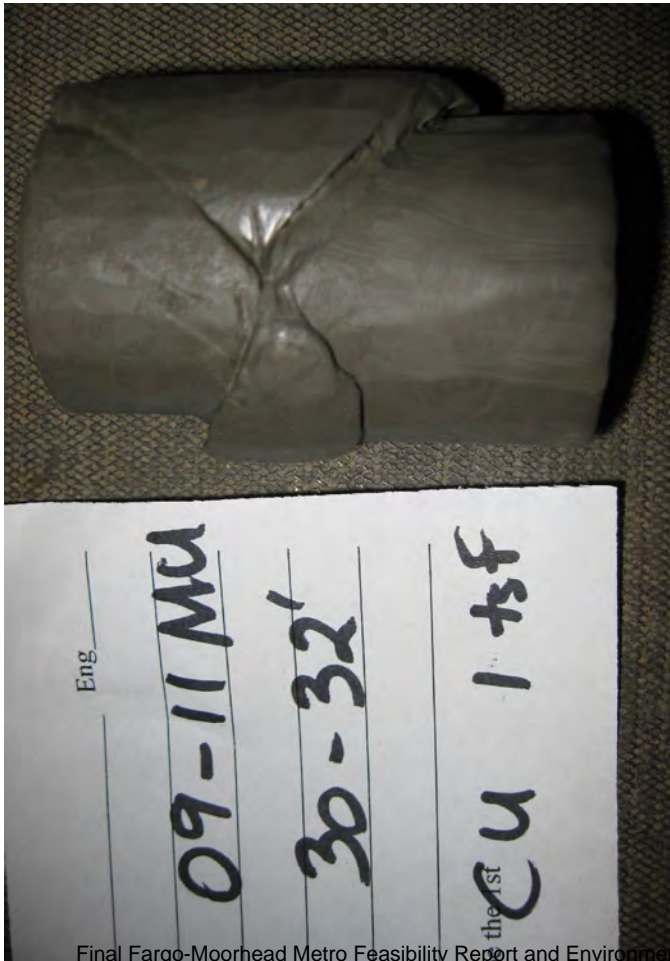
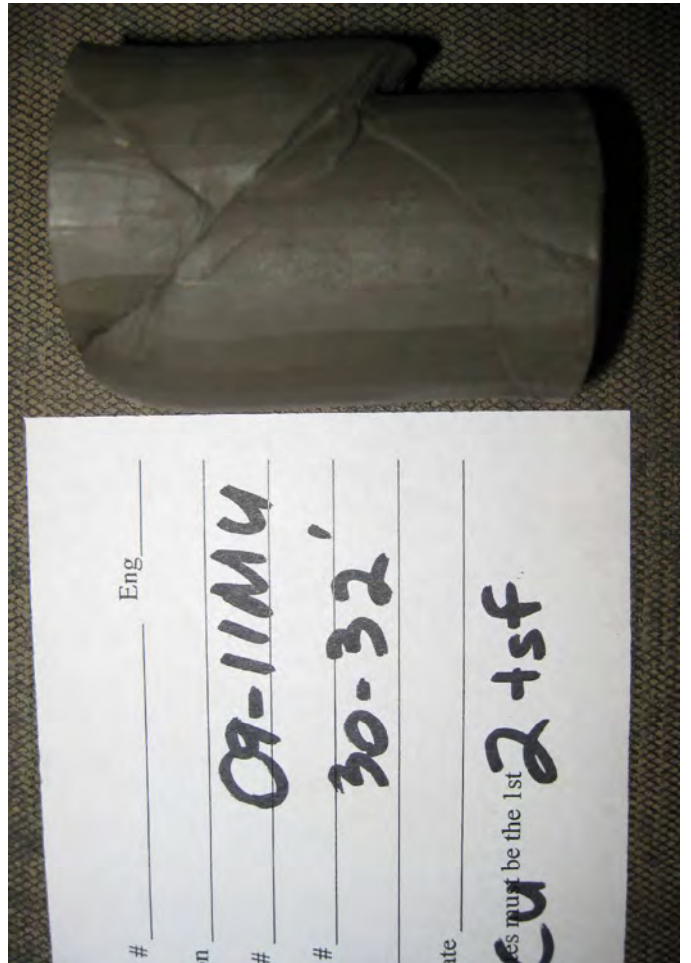
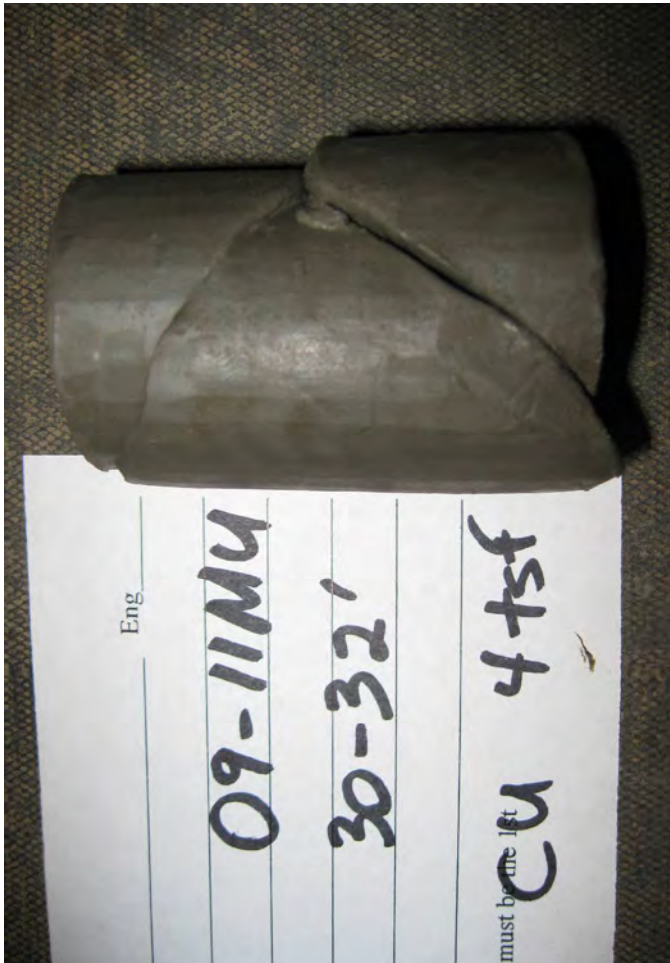
Parameters for Specimen No. 3

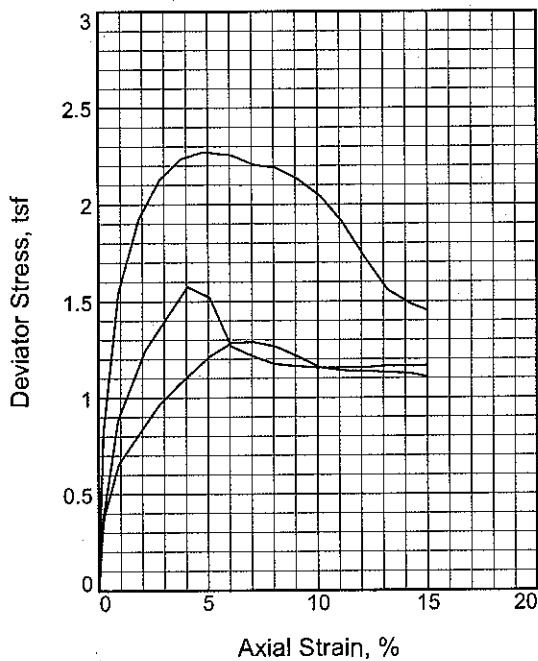
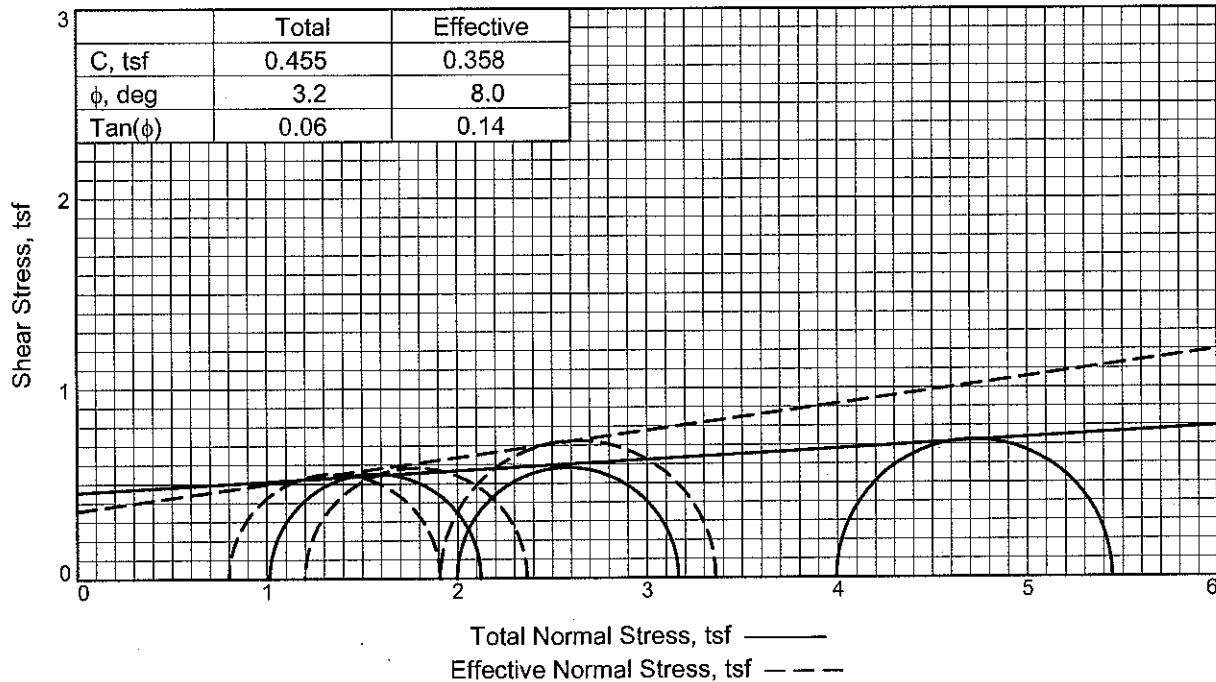
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	117.940			144.100
Moisture content: Dry soil+tare, gms.	85.580			104.940
Moisture content: Tare, gms.	30.290			30.740
Moisture, %	58.5	59.3	55.3	52.8
Moist specimen weight, gms.	117.0			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.53	1.53	1.49	
Height, in.	2.82	2.82	2.78	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	103.4	104.0	105.8	
Dry density, pcf	65.3	65.3	68.1	
Void ratio	1.6308	1.6308	1.5197	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 3.168 tsf
 Consolidation effective confining stress = 3.970 tsf
 Fail. Stress = 2.430 tsf at reading no. 6
 Ult. Stress = 1.563 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0188	19.280	0.0	0.0	0.000	3.970	3.970	1.00	3.168	3.970	0.000
1	0.0206	26.420	7.1	0.1	0.345	3.782	4.127	1.09	3.356	3.955	0.173
2	0.0255	34.720	15.4	0.2	0.746	3.528	4.274	1.21	3.610	3.901	0.373
3	0.0426	49.160	29.9	0.9	1.434	3.032	4.466	1.47	4.106	3.749	0.717
4	0.0682	61.550	42.3	1.8	2.010	2.623	4.633	1.77	4.515	3.628	1.005
5	0.1044	69.300	50.0	3.1	2.347	2.338	4.685	2.00	4.800	3.512	1.174
6	0.1312	71.590	52.3	4.1	2.430	2.292	4.722	2.06	4.846	3.507	1.215
7	0.1591	64.660	45.4	5.1	2.086	2.421	4.507	1.86	4.717	3.464	1.043
8	0.1869	58.620	39.3	6.1	1.789	2.528	4.317	1.71	4.610	3.423	0.895
9	0.2168	57.710	38.4	7.1	1.728	2.500	4.228	1.69	4.638	3.364	0.864
10	0.2459	57.920	38.6	8.2	1.718	2.442	4.160	1.70	4.696	3.301	0.859
11	0.2747	58.190	38.9	9.2	1.710	2.408	4.118	1.71	4.730	3.263	0.855
12	0.3024	58.190	38.9	10.2	1.691	2.356	4.047	1.72	4.782	3.202	0.846
13	0.3315	58.532	39.3	11.3	1.686	2.324	4.010	1.73	4.814	3.167	0.843
14	0.3605	57.800	38.5	12.3	1.635	2.297	3.932	1.71	4.841	3.115	0.818
15	0.3915	57.170	37.9	13.4	1.588	2.258	3.846	1.70	4.880	3.052	0.794
16	0.4193	57.270	38.0	14.4	1.574	2.382	3.956	1.66	4.756	3.169	0.787
17	0.4400	57.340	38.1	15.2	1.563	2.322	3.885	1.67	4.816	3.104	0.782





Sample No.	1	2	3	
Initial	Water Content, %	52.1	54.8	54.8
	Dry Density, pcf	70.1	67.3	67.2
	Saturation, %	98.8	97.3	96.8
	Void Ratio	1.4505	1.5508	1.5562
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.82	2.82	2.81
At Test	Water Content, %	51.3	53.4	52.7
	Dry Density, pcf	71.2	69.5	70.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.4115	1.4699	1.4482
	Diameter, in.	1.38	1.38	1.37
	Height, in.	2.80	2.79	2.77
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.01	2.00	4.00	
Back Pressure, tsf	6.13	5.14	3.15	
Cell Pressure, tsf	7.14	7.14	7.15	
Peak Deviator Stress, tsf	1.29	1.58	2.27	
Total Pore Pr., tsf	6.53	6.07	4.90	
Ultimate Deviator Stress, tsf	1.11	1.17	1.45	
Total Pore Pr., tsf	6.34	5.94	5.24	
Maj. Eff. Stress at Ultimate, tsf	1.91	2.37	3.36	
Min. Eff. Stress at Ultimate, tsf	0.80	1.20	1.91	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 90 PL= 24 PI= 66

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

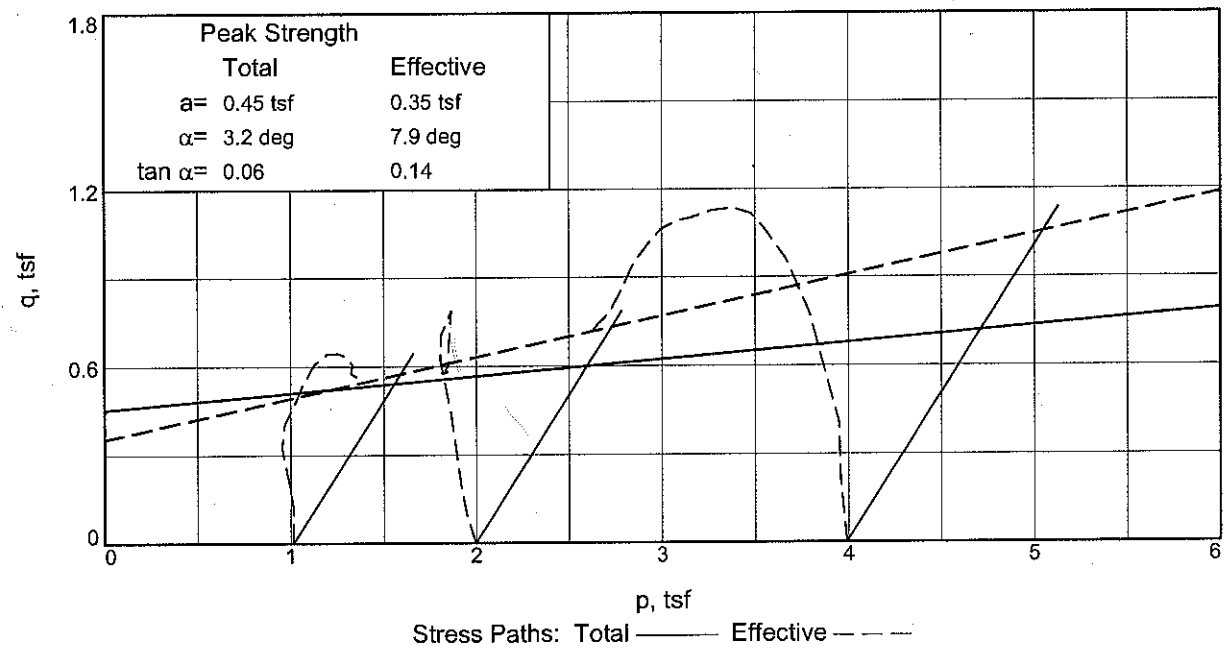
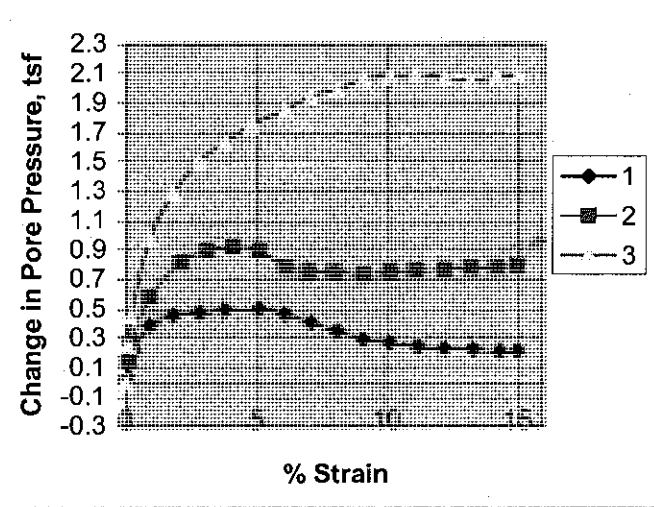
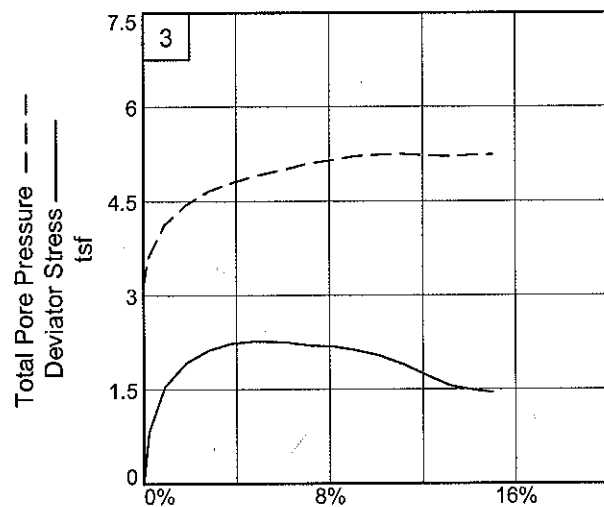
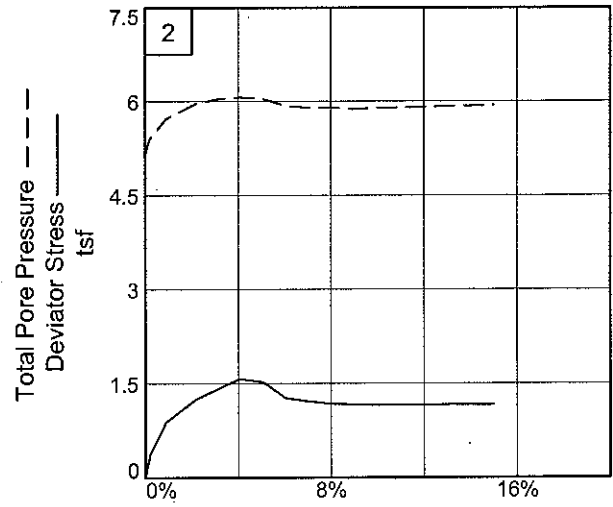
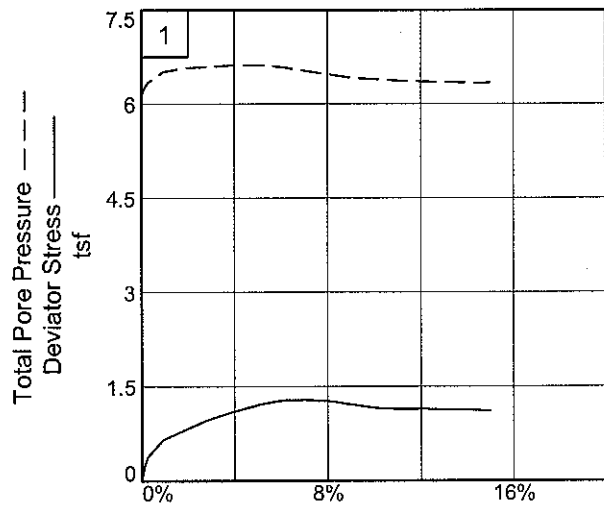
Location: SE-ED-01, East Diversion, Brenna Formation

Sample Number: Boring 09-11MU, #3 **Depth:** 40-42'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: SE-ED-01, East Diversion, Brenna Formation

Depth: 40-42'

Sample No.: Boring 09-11MU, #3

Project No.: W-09-0127 Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

10/12/2009

3:32 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-01, East Diversion, Brenna Formation
Depth: 40-42' **Sample Number:** Boring 09-11MU, #3
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**90 **PL=**24 **PI=**66
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	136.180			149.200
Moisture content: Dry soil+tare, gms.	100.340			109.230
Moisture content: Tare, gms.	31.590			30.630
Moisture, %	52.1	52.7	51.3	50.9
Moist specimen weight, gms.	119.1			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.49	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	106.6	107.0	107.7	
Dry density, pcf	70.1	70.1	71.2	
Void ratio	1.4505	1.4505	1.4115	
Saturation, %	98.8	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.139 tsf
Consolidation back pressure = 6.125 tsf
Consolidation effective confining stress = 1.014 tsf
Fail. Stress = 1.290 tsf **at reading no. 9**
Ult. Stress = 1.108 tsf **at reading no. 17**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0107	18.490	0.0	0.0	0.000	1.014	1.014	1.00	6.125	1.014	0.000
1	0.0137	23.340	4.9	0.1	0.233	0.899	1.132	1.26	6.240	1.016	0.117
2	0.0178	26.450	8.0	0.3	0.382	0.805	1.187	1.48	6.334	0.996	0.191
3	0.0364	32.220	13.7	0.9	0.655	0.627	1.282	2.05	6.512	0.955	0.328
4	0.0625	35.610	17.1	1.8	0.809	0.563	1.372	2.44	6.576	0.968	0.405
5	0.0893	39.180	20.7	2.8	0.969	0.545	1.514	2.78	6.594	1.029	0.484
6	0.1162	41.740	23.3	3.8	1.078	0.525	1.603	3.05	6.614	1.064	0.539
7	0.1532	45.090	26.6	5.1	1.216	0.520	1.736	3.34	6.619	1.128	0.608
8	0.1812	46.900	28.4	6.1	1.285	0.552	1.837	3.33	6.587	1.195	0.643
9	0.2088	47.300	28.8	7.1	1.290	0.610	1.900	3.11	6.529	1.255	0.645
10	0.2369	47.120	28.6	8.1	1.268	0.669	1.937	2.89	6.470	1.303	0.634
11	0.2655	46.230	27.7	9.1	1.215	0.725	1.940	2.68	6.414	1.332	0.607
12	0.2939	45.220	26.7	10.1	1.157	0.745	1.902	2.55	6.394	1.324	0.579
13	0.3235	45.130	26.6	11.2	1.140	0.771	1.911	2.48	6.368	1.341	0.570
14	0.3533	45.410	26.9	12.2	1.138	0.785	1.923	2.45	6.354	1.354	0.569
15	0.3824	45.560	27.1	13.3	1.131	0.789	1.920	2.43	6.350	1.354	0.565
16	0.4102	45.750	27.3	14.3	1.126	0.804	1.930	2.40	6.335	1.367	0.563
17	0.4304	45.550	27.1	15.0	1.108	0.800	1.908	2.39	6.339	1.354	0.554

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	109.990			147.470
Moisture content: Dry soil+tare, gms.	81.790			107.120
Moisture content: Tare, gms.	30.370			30.950
Moisture, %	54.8	56.4	53.4	53.0
Moist specimen weight, gms.	118.5			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.54	1.54	1.50	
Height, in.	2.82	2.82	2.79	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	104.2	105.3	106.7	
Dry density, pcf	67.3	67.3	69.5	
Void ratio	1.5508	1.5508	1.4699	
Saturation, %	97.3	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.142 tsf
 Consolidation back pressure = 5.145 tsf
 Consolidation effective confining stress = 1.997 tsf
 Fail. Stress = 1.575 tsf at reading no. 6
 Ult. Stress = 1.167 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0208	18.970	0.0	0.0	0.000	1.997	1.997	1.00	5.145	1.997	0.000
1	0.0237	22.940	4.0	0.1	0.190	1.853	2.043	1.10	5.289	1.948	0.095
2	0.0266	26.790	7.8	0.2	0.373	1.733	2.106	1.22	5.409	1.920	0.187
3	0.0455	37.620	18.6	0.9	0.885	1.420	2.305	1.62	5.722	1.862	0.442
4	0.0804	45.560	26.6	2.1	1.245	1.182	2.427	2.05	5.960	1.805	0.623
5	0.1073	49.430	30.5	3.1	1.413	1.103	2.516	2.28	6.039	1.809	0.706
6	0.1342	53.280	34.3	4.1	1.575	1.076	2.651	2.46	6.066	1.864	0.788
7	0.1621	52.460	33.5	5.1	1.522	1.100	2.622	2.38	6.042	1.861	0.761
8	0.1897	47.180	28.2	6.1	1.268	1.213	2.481	2.05	5.929	1.847	0.634
9	0.2168	46.320	27.4	7.0	1.217	1.243	2.460	1.98	5.899	1.851	0.608
10	0.2450	45.680	26.7	8.0	1.175	1.243	2.418	1.95	5.899	1.831	0.588
11	0.2738	45.730	26.8	9.1	1.164	1.265	2.429	1.92	5.877	1.847	0.582
12	0.3015	45.830	26.9	10.1	1.156	1.243	2.399	1.93	5.899	1.821	0.578
13	0.3306	46.140	27.2	11.1	1.156	1.235	2.391	1.94	5.907	1.813	0.578
14	0.3597	46.440	27.5	12.2	1.155	1.228	2.383	1.94	5.914	1.805	0.577
15	0.3874	47.020	28.1	13.2	1.166	1.218	2.384	1.96	5.924	1.801	0.583
16	0.4174	47.310	28.3	14.2	1.163	1.214	2.377	1.96	5.928	1.796	0.582
17	0.4385	47.650	28.7	15.0	1.167	1.199	2.366	1.97	5.943	1.782	0.583

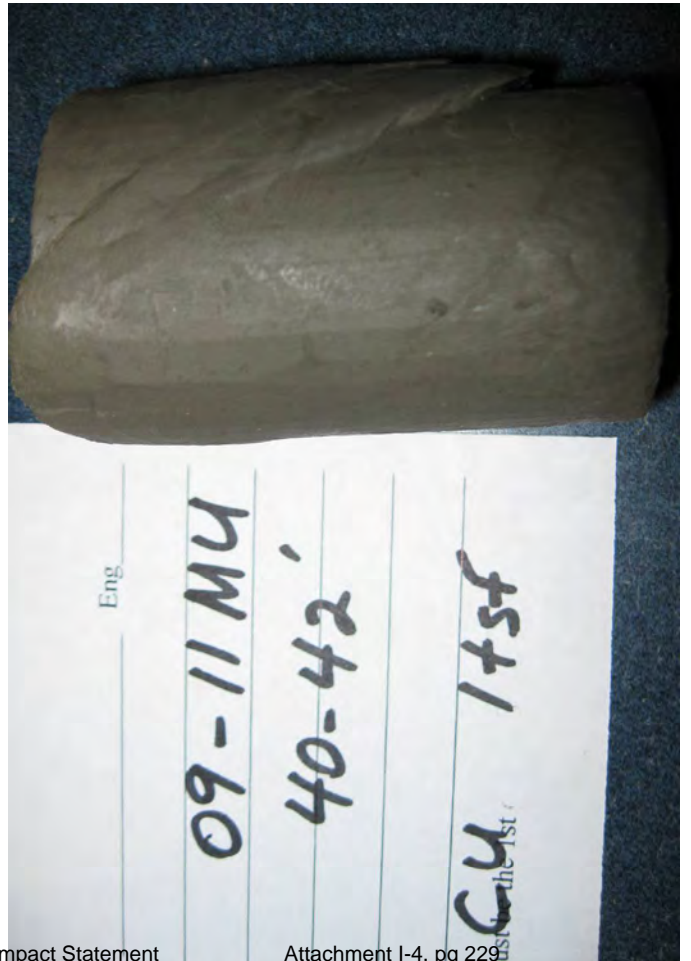
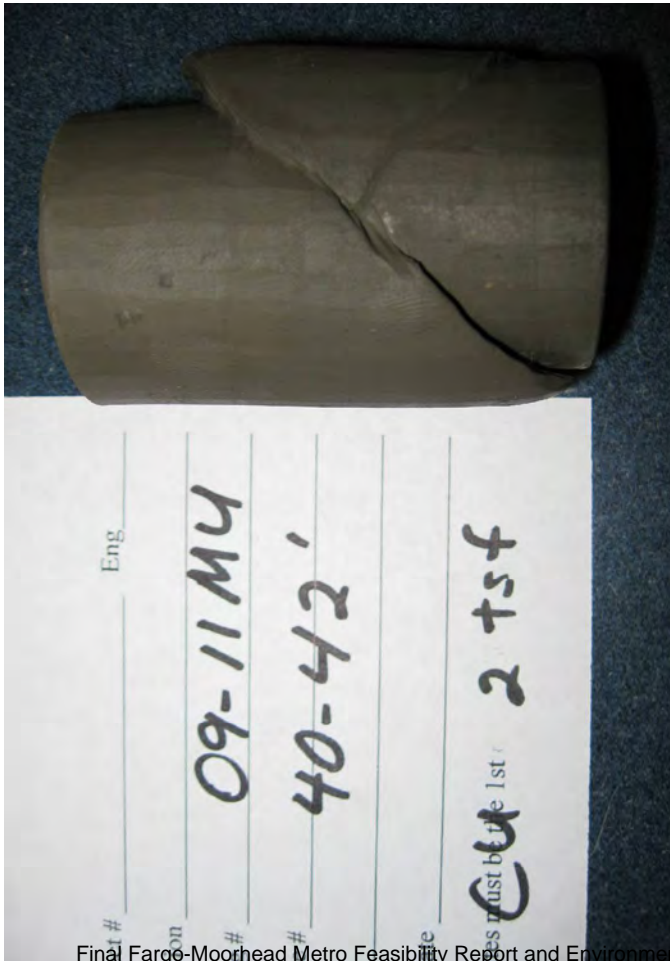
Parameters for Specimen No. 3

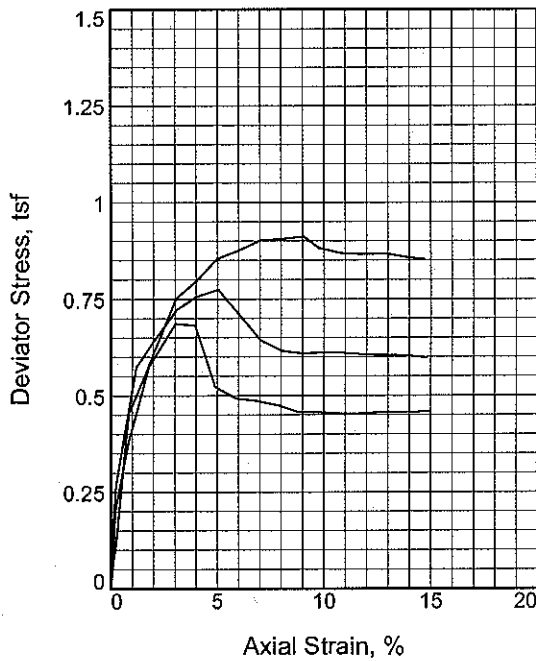
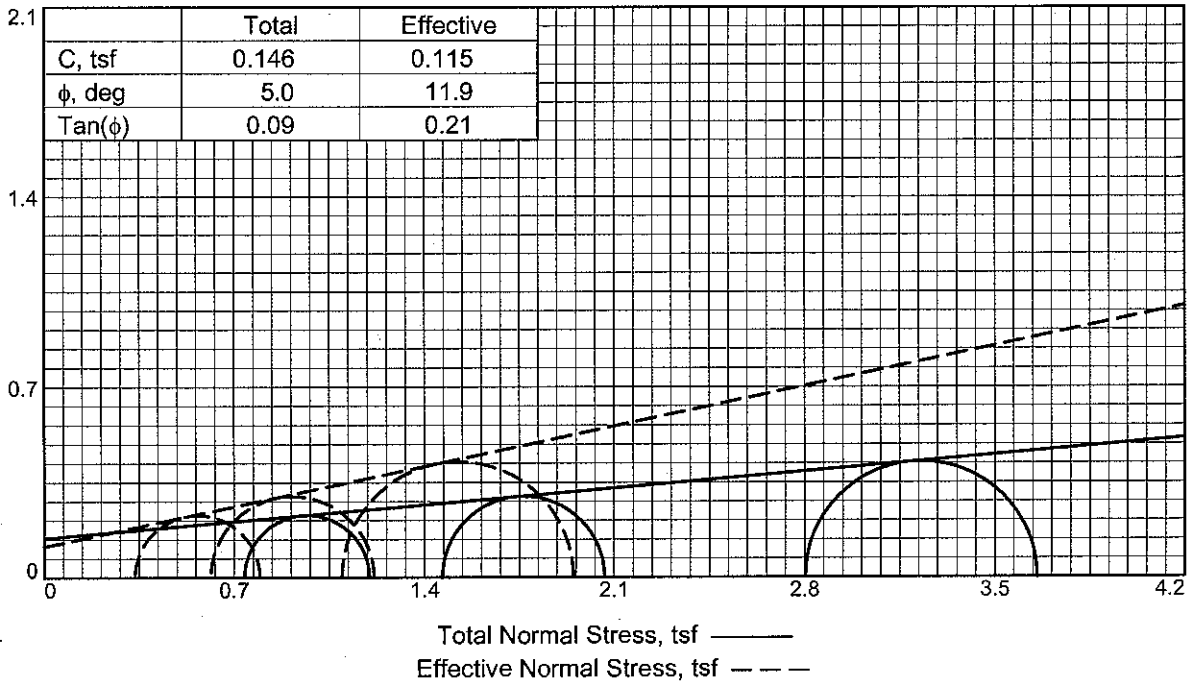
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.960			141.820
Moisture content: Dry soil+tare, gms.	103.140			104.670
Moisture content: Tare, gms.	30.420			30.260
Moisture, %	54.8	56.6	52.7	49.9
Moist specimen weight, gms.	116.0			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.51	1.51	1.47	
Height, in.	2.81	2.81	2.77	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	103.9	105.2	107.1	
Dry density, pcf	67.2	67.2	70.1	
Void ratio	1.5562	1.5562	1.4482	
Saturation, %	96.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.148 tsf
 Consolidation back pressure = 3.155 tsf
 Consolidation effective confining stress = 3.993 tsf
 Fail. Stress = 2.272 tsf at reading no. 7
 Ult. Stress = 1.451 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0506	19.770	0.0	0.0	0.000	3.993	3.993	1.00	3.155	3.993	0.000
1	0.0535	28.440	8.7	0.1	0.425	3.745	4.170	1.11	3.403	3.957	0.212
2	0.0566	36.490	16.7	0.2	0.818	3.540	4.358	1.23	3.608	3.949	0.409
3	0.0757	51.600	31.8	0.9	1.547	3.020	4.567	1.51	4.128	3.794	0.774
4	0.1015	59.720	40.0	1.8	1.923	2.704	4.627	1.71	4.444	3.666	0.962
5	0.1285	64.390	44.6	2.8	2.127	2.488	4.615	1.85	4.660	3.552	1.064
6	0.1552	67.110	47.3	3.8	2.234	2.361	4.595	1.95	4.787	3.478	1.117
7	0.1832	68.420	48.7	4.8	2.272	2.245	4.517	2.01	4.903	3.381	1.136
8	0.2198	68.750	49.0	6.1	2.256	2.138	4.394	2.06	5.010	3.266	1.128
9	0.2480	68.160	48.4	7.1	2.205	2.049	4.254	2.08	5.099	3.151	1.102
10	0.2759	68.380	48.6	8.1	2.191	1.997	4.188	2.10	5.151	3.092	1.095
11	0.3037	67.560	47.8	9.1	2.130	1.930	4.060	2.10	5.218	2.995	1.065
12	0.3318	66.100	46.3	10.1	2.042	1.911	3.953	2.07	5.237	2.932	1.021
13	0.3596	63.510	43.7	11.1	1.906	1.898	3.804	2.00	5.250	2.851	0.953
14	0.3877	59.810	40.0	12.2	1.725	1.924	3.649	1.90	5.224	2.787	0.863
15	0.4165	56.390	36.6	13.2	1.559	1.936	3.495	1.81	5.212	2.716	0.780
16	0.4445	55.170	35.4	14.2	1.490	1.913	3.403	1.78	5.235	2.658	0.745
17	0.4670	54.590	34.8	15.0	1.451	1.908	3.359	1.76	5.240	2.634	0.726





Sample No.	1	2	3	
Initial	Water Content, %	88.2	89.4	88.1
	Dry Density, pcf	49.9	49.3	49.9
	Saturation, %	99.5	99.1	99.3
	Void Ratio	2.4385	2.4789	2.4393
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.81	2.81	2.79
At Test	Water Content, %	86.7	83.5	75.6
	Dry Density, pcf	50.7	52.1	55.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	2.3836	2.2954	2.0787
	Diameter, in.	1.38	1.37	1.35
	Height, in.	2.79	2.76	2.69
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.74	1.47	2.80	
Back Pressure, tsf	6.40	5.67	4.34	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	0.69	0.77	0.91	
Total Pore Pr., tsf	6.86	6.37	5.84	
Ultimate Deviator Stress, tsf	0.46	0.60	0.85	
Total Pore Pr., tsf	6.80	6.53	6.05	
Maj. Eff. Stress at Ultimate, tsf	0.79	1.21	1.95	
Min. Eff. Stress at Ultimate, tsf	0.33	0.61	1.10	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 124 PL= 25 PI= 99

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead **Brenna**

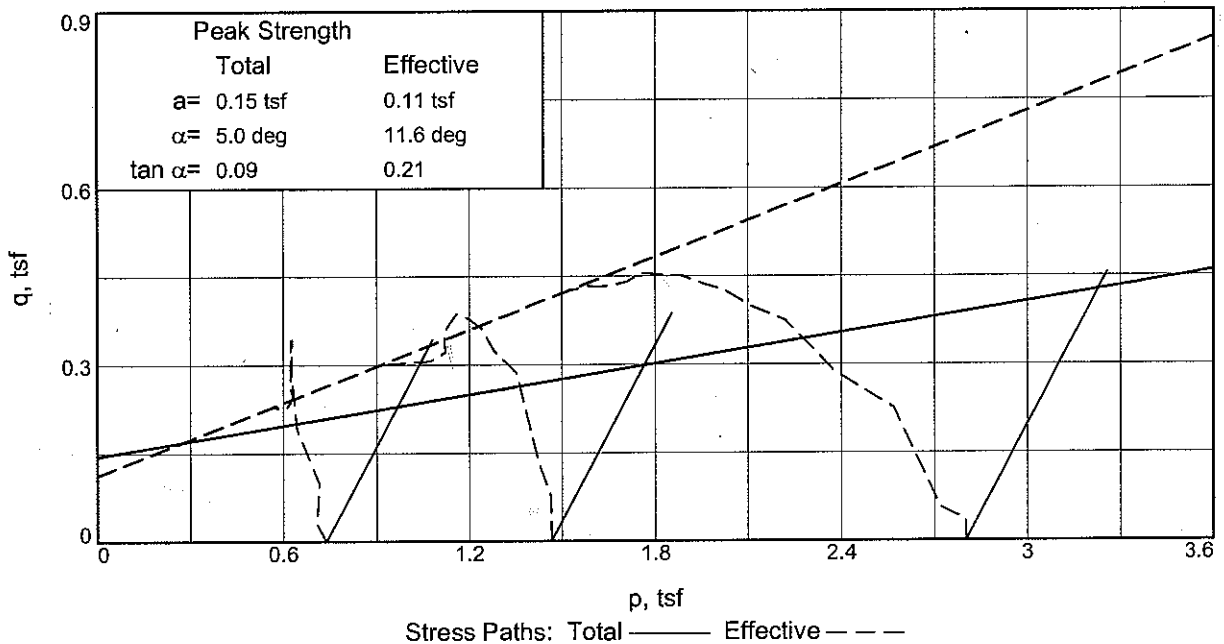
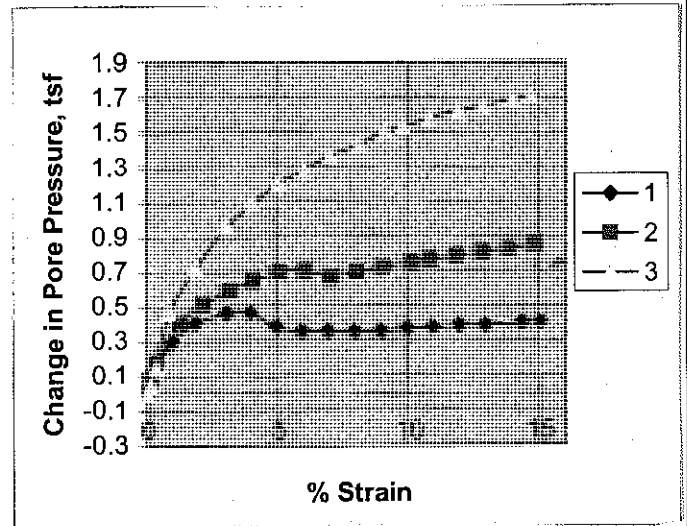
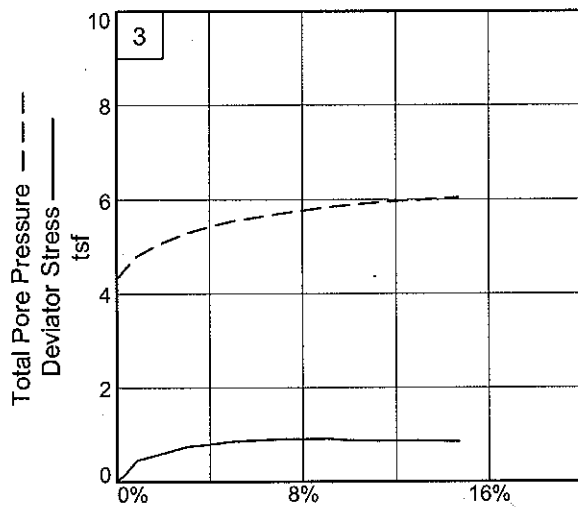
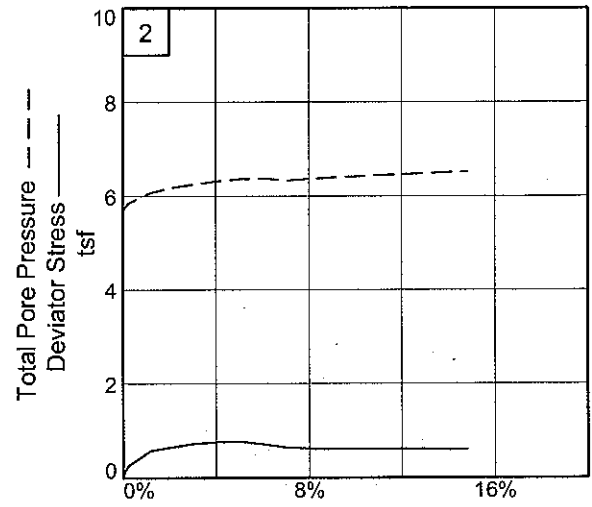
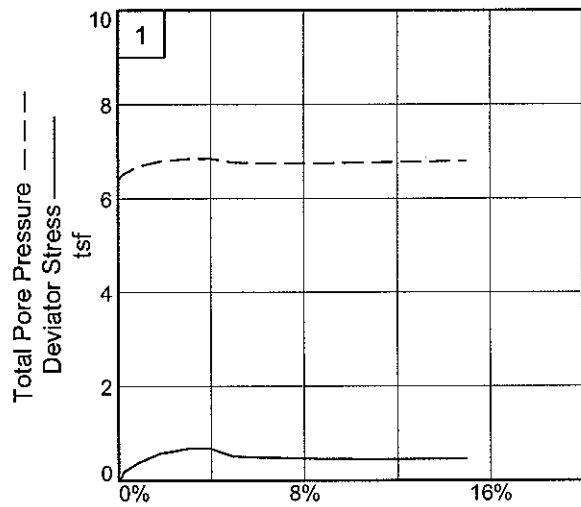
Location: SE-ED-15, East Diversion, ~~PL Sherack Formation~~

Sample Number: Boring 09-14MU, #2 **Depth:** 15-17'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: SE-ED-15, East Diversion, ~~PL Sherack Formation~~

Depth: 15-17'

Brenna

Sample No.: Boring 09-14MU, #2

Project No.: 09-03027 Feasibility Report and Environmental Impact Statement

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

10/13/2009

1:19 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-15, East Diversion, ~~PL Sherack Formation~~
Depth: 15-17' **Sample Number:** Boring 09-14MU, #2
Description: FAT CLAY, brown (CH) **Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**124 **PL=**25 **PI=**99
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	100.230			133.350
Moisture content: Dry soil+tare, gms.	67.530			85.610
Moisture content: Tare, gms.	30.450			30.220
Moisture, %	88.2	88.7	86.7	86.2
Moist specimen weight, gms.	105.5			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.51	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	94.0	94.2	94.7	
Dry density, pcf	49.9	49.9	50.7	
Void ratio	2.4385	2.4385	2.3836	
Saturation, %	99.5	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.402 tsf
Consolidation effective confining stress = 0.738 tsf
Fail. Stress = 0.686 tsf at reading no. 5
Ult. Stress = 0.460 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0209	19.070	0.0	0.0	0.000	0.738	0.738	1.00	6.402	0.738	0.000
1	0.0237	20.350	1.3	0.1	0.061	0.677	0.738	1.09	6.463	0.708	0.031
2	0.0268	23.190	4.1	0.2	0.197	0.618	0.815	1.32	6.522	0.716	0.098
3	0.0447	27.180	8.1	0.9	0.385	0.451	0.836	1.85	6.689	0.643	0.192
4	0.0705	31.270	12.2	1.8	0.573	0.340	0.913	2.69	6.800	0.627	0.287
5	0.1054	33.870	14.8	3.0	0.686	0.285	0.971	3.41	6.855	0.628	0.343
6	0.1312	33.930	14.9	3.9	0.683	0.283	0.966	3.41	6.857	0.624	0.341
7	0.1577	30.570	11.5	4.9	0.523	0.362	0.885	2.44	6.778	0.624	0.262
8	0.1850	30.020	10.9	5.9	0.493	0.385	0.878	2.28	6.755	0.631	0.246
9	0.2129	29.990	10.9	6.9	0.486	0.384	0.870	2.27	6.756	0.627	0.243
10	0.2409	29.840	10.8	7.9	0.475	0.386	0.861	2.23	6.754	0.623	0.237
11	0.2686	29.550	10.5	8.9	0.457	0.383	0.840	2.19	6.757	0.611	0.228
12	0.2966	29.670	10.6	9.9	0.457	0.373	0.830	2.22	6.767	0.601	0.228
13	0.3255	29.700	10.6	10.9	0.453	0.368	0.821	2.23	6.772	0.594	0.226
14	0.3533	29.850	10.8	11.9	0.454	0.355	0.809	2.28	6.785	0.582	0.227
15	0.3814	30.060	11.0	12.9	0.458	0.354	0.812	2.29	6.786	0.583	0.229
16	0.4194	30.220	11.1	14.3	0.457	0.336	0.793	2.36	6.804	0.565	0.229
17	0.4391	30.370	11.3	15.0	0.460	0.335	0.795	2.37	6.805	0.565	0.230

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	121.760			128.000
Moisture content: Dry soil+tare, gms.	78.950			86.000
Moisture content: Tare, gms.	31.040			31.480
Moisture, %	89.4	90.1	83.5	77.0
Moist specimen weight, gms.	104.8			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.52	1.52	1.47	
Height, in.	2.81	2.81	2.76	
Net decrease in height, in.		0.00	0.05	
Wet Density, pcf	93.4	93.8	95.6	
Dry density, pcf	49.3	49.3	52.1	
Void ratio	2.4789	2.4789	2.2954	
Saturation, %	99.1	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf

Consolidation back pressure = 5.674 tsf

Consolidation effective confining stress = 1.466 tsf

Fail. Stress = 0.774 tsf at reading no. 7

Ult. Stress = 0.599 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0546	18.490	0.0	0.0	0.000	1.466	1.466	1.00	5.674	1.466	0.000
1	0.0575	21.600	3.1	0.1	0.153	1.387	1.540	1.11	5.753	1.463	0.076
2	0.0616	23.920	5.4	0.3	0.266	1.292	1.558	1.21	5.848	1.425	0.133
3	0.0874	30.300	11.8	1.2	0.573	1.066	1.639	1.54	6.074	1.353	0.287
4	0.1124	31.940	13.5	2.1	0.647	0.957	1.604	1.68	6.183	1.280	0.323
5	0.1392	33.660	15.2	3.1	0.722	0.880	1.602	1.82	6.260	1.241	0.361
6	0.1661	34.550	16.1	4.0	0.757	0.820	1.577	1.92	6.320	1.199	0.379
7	0.1938	35.090	16.6	5.0	0.774	0.771	1.545	2.00	6.369	1.158	0.387
8	0.2207	33.900	15.4	6.0	0.711	0.760	1.471	1.94	6.380	1.116	0.356
9	0.2487	32.580	14.1	7.0	0.644	0.801	1.445	1.80	6.339	1.123	0.322
10	0.2767	32.120	13.6	8.0	0.616	0.769	1.385	1.80	6.371	1.077	0.308
11	0.3035	32.120	13.6	9.0	0.609	0.739	1.348	1.82	6.401	1.044	0.305
12	0.3324	32.330	13.8	10.1	0.611	0.716	1.327	1.85	6.424	1.022	0.306
13	0.3516	32.430	13.9	10.8	0.611	0.699	1.310	1.87	6.441	1.005	0.306
14	0.3805	32.500	14.0	11.8	0.607	0.678	1.285	1.90	6.462	0.982	0.304
15	0.4083	32.620	14.1	12.8	0.605	0.657	1.262	1.92	6.483	0.960	0.303
16	0.4353	32.750	14.3	13.8	0.604	0.636	1.240	1.95	6.504	0.938	0.302
17	0.4634	32.800	14.3	14.8	0.599	0.615	1.214	1.97	6.525	0.914	0.299

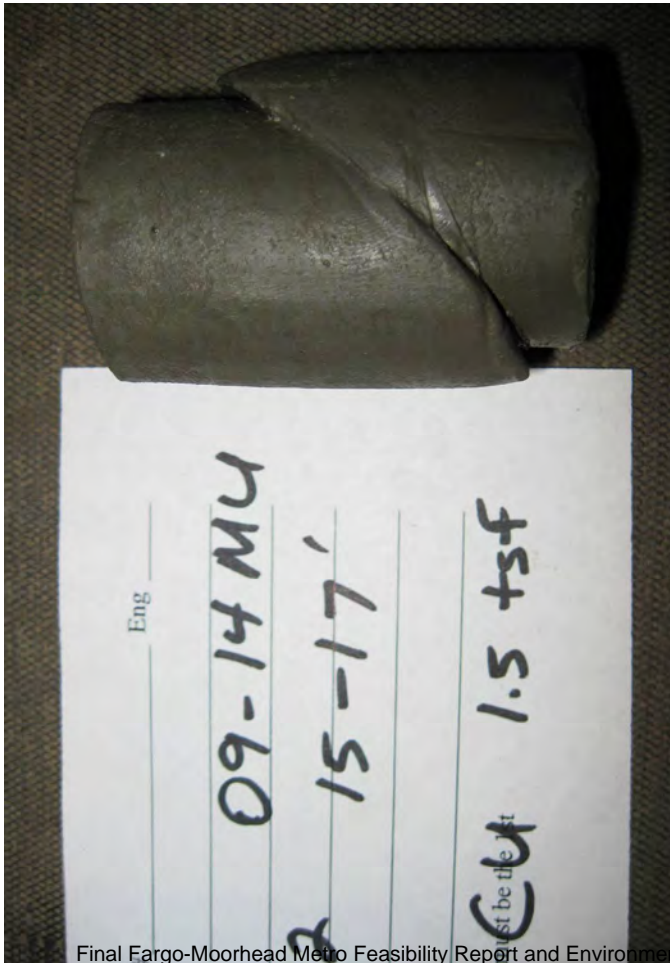
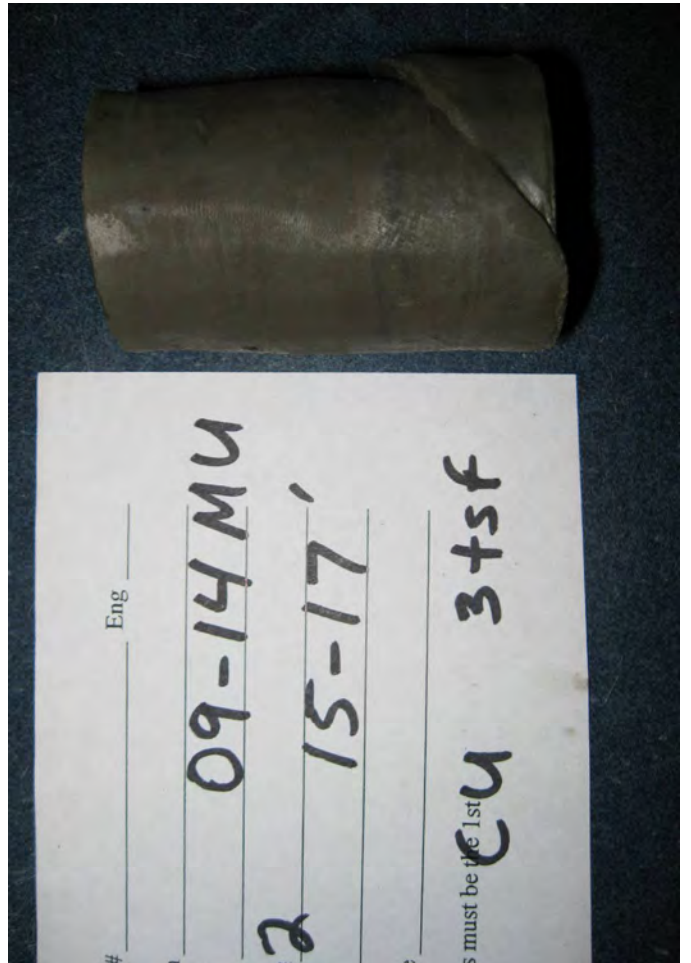
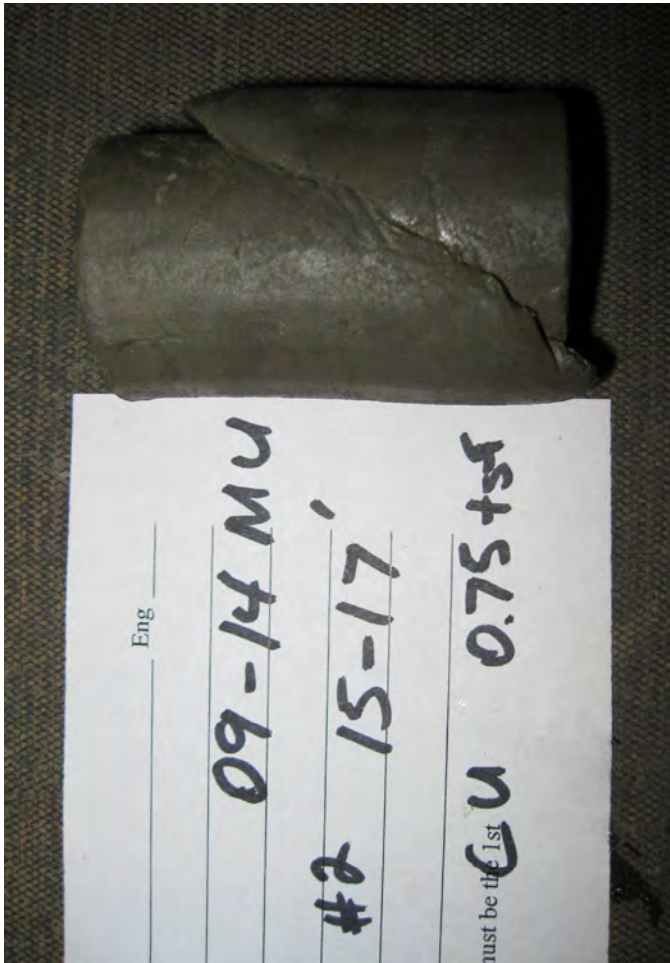
Parameters for Specimen No. 3

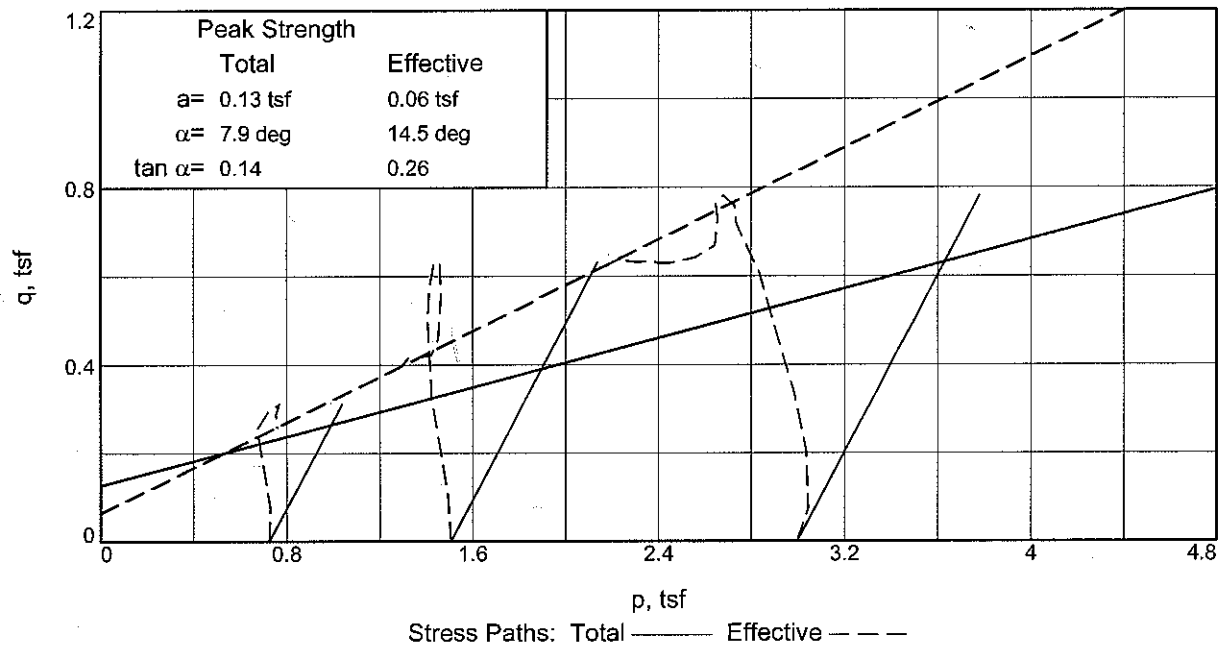
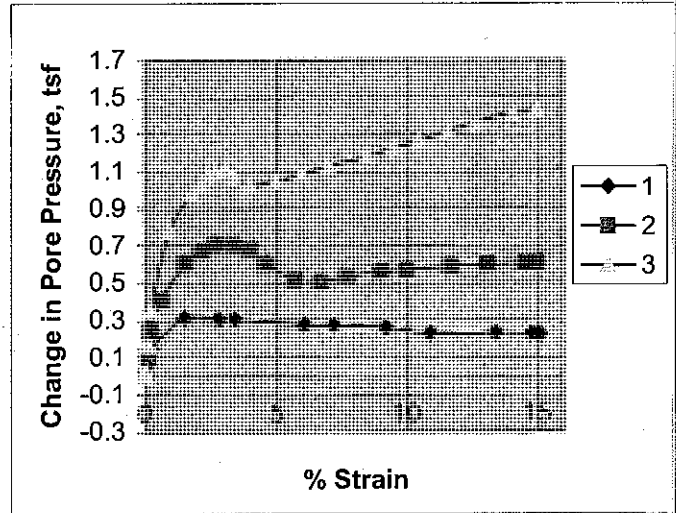
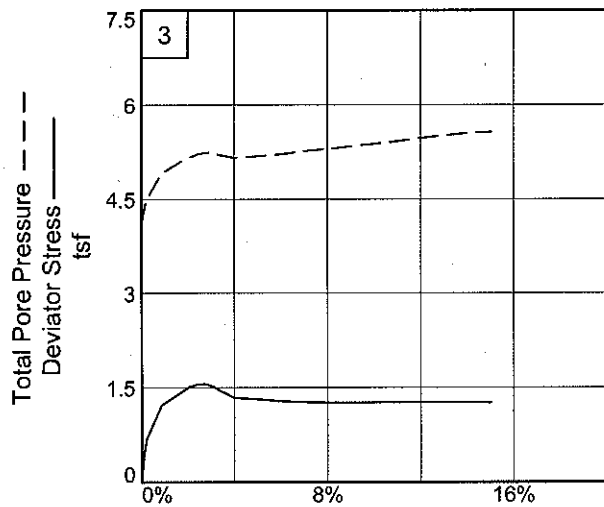
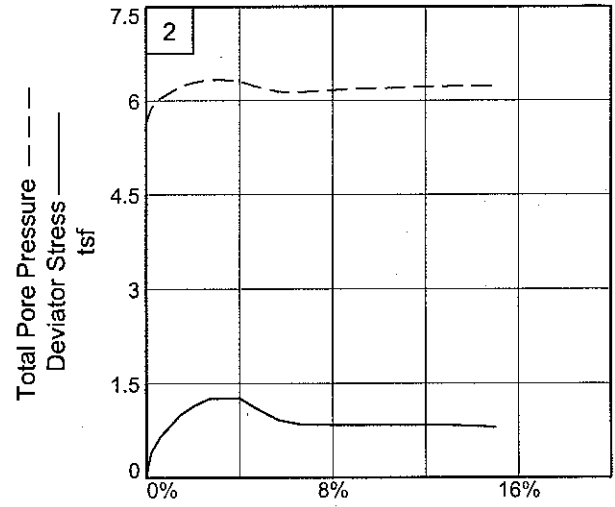
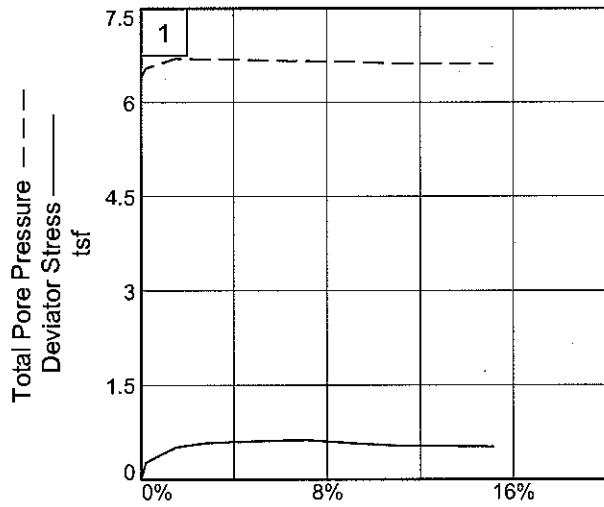
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	124.690			124.480
Moisture content: Dry soil+tare, gms.	80.510			86.640
Moisture content: Tare, gms.	30.370			31.070
Moisture, %	88.1	88.7	75.6	68.1
Moist specimen weight, gms.	105.5			
Diameter, in.	1.40	1.40	1.35	
Area, in. ²	1.53	1.53	1.42	
Height, in.	2.79	2.79	2.69	
Net decrease in height, in.		0.00	0.10	
Wet Density, pcf	93.9	94.2	97.9	
Dry density, pcf	49.9	49.9	55.8	
Void ratio	2.4393	2.4393	2.0787	
Saturation, %	99.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.144 tsf
 Consolidation back pressure = 4.342 tsf
 Consolidation effective confining stress = 2.802 tsf
 Fail. Stress = 0.911 tsf at reading no. 11
 Ult. Stress = 0.854 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0159	19.860	0.0	0.0	0.000	2.802	2.802	1.00	4.342	2.802	0.000
1	0.0189	21.290	1.4	0.1	0.072	2.763	2.835	1.03	4.381	2.799	0.036
2	0.0228	22.120	2.3	0.3	0.114	2.662	2.776	1.04	4.482	2.719	0.057
3	0.0386	28.890	9.0	0.8	0.453	2.343	2.796	1.19	4.801	2.570	0.227
4	0.0635	31.460	11.6	1.8	0.577	2.091	2.668	1.28	5.053	2.379	0.288
5	0.0975	35.150	15.3	3.0	0.750	1.846	2.596	1.41	5.298	2.221	0.375
6	0.1241	36.280	16.4	4.0	0.797	1.713	2.510	1.47	5.431	2.112	0.399
7	0.1503	37.640	17.8	5.0	0.855	1.594	2.449	1.54	5.550	2.021	0.427
8	0.1771	38.250	18.4	6.0	0.875	1.518	2.393	1.58	5.626	1.955	0.437
9	0.2050	39.030	19.2	7.0	0.902	1.438	2.340	1.63	5.706	1.889	0.451
10	0.2331	39.330	19.5	8.1	0.906	1.373	2.279	1.66	5.771	1.826	0.453
11	0.2599	39.670	19.8	9.1	0.911	1.300	2.211	1.70	5.844	1.756	0.456
12	0.2788	39.180	19.3	9.8	0.882	1.270	2.152	1.69	5.874	1.711	0.441
13	0.3068	39.110	19.3	10.8	0.869	1.222	2.091	1.71	5.922	1.656	0.434
14	0.3357	39.280	19.4	11.9	0.866	1.182	2.048	1.73	5.962	1.615	0.433
15	0.3634	39.550	19.7	12.9	0.868	1.152	2.020	1.75	5.992	1.586	0.434
16	0.3924	39.550	19.7	14.0	0.857	1.117	1.974	1.77	6.027	1.545	0.428
17	0.4114	39.640	19.8	14.7	0.854	1.097	1.951	1.78	6.047	1.524	0.427





Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 38-40' **Sample Number:** Boring 09-25MU, #4 **Brenna**

Project No. B-19-0312 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Braun Intertec
Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

9/10/2009
2:24 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 38-40' **Sample Number:** Boring 09-25MU, #4
Description: FAT CLAY, gray (CH) **Brenna**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**116 **PL=**25 **PI=**91
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	102.860			144.790
Moisture content: Dry soil+tare, gms.	74.100			99.450
Moisture content: Tare, gms.	30.260			29.960
Moisture, %	65.6	67.1	67.1	65.2
Moist specimen weight, gms.	114.4			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	99.9	100.8	100.8	
Dry density, pcf	60.3	60.3	60.3	
Void ratio	1.8466	1.8466	1.8466	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.117 tsf
 Consolidation back pressure = 6.391 tsf
 Consolidation effective confining stress = 0.726 tsf
 Fail. Stress = 0.519 tsf at reading no. 12
 Ult. Stress = 0.519 tsf at reading no. 12

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0290	18.730	0.0	0.0	0.000	0.726	0.726	1.00	6.391	0.726	0.000
1	0.0314	21.940	3.2	0.1	0.149	0.655	0.804	1.23	6.462	0.729	0.074
2	0.0343	24.650	5.9	0.2	0.274	0.574	0.848	1.48	6.543	0.711	0.137
3	0.0710	29.900	11.2	1.5	0.511	0.416	0.927	2.23	6.701	0.671	0.255
4	0.1082	31.610	12.9	2.8	0.581	0.425	1.006	2.37	6.692	0.716	0.291
5	0.1258	31.890	13.2	3.4	0.590	0.424	1.014	2.39	6.693	0.719	0.295
6	0.2015	32.920	14.2	6.1	0.619	0.453	1.072	2.37	6.664	0.762	0.309
7	0.2305	33.230	14.5	7.2	0.625	0.456	1.081	2.37	6.661	0.769	0.313
8	0.2883	32.310	13.6	9.2	0.573	0.467	1.040	2.23	6.650	0.753	0.286
9	0.3362	31.700	13.0	10.9	0.537	0.498	1.035	2.08	6.619	0.766	0.268
10	0.4061	31.850	13.1	13.4	0.528	0.496	1.024	2.06	6.621	0.760	0.264
11	0.4450	31.890	13.2	14.8	0.521	0.499	1.020	2.04	6.618	0.759	0.260
12	0.4551	31.900	13.2	15.1	0.519	0.503	1.022	2.03	6.614	0.763	0.260

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	105.480			144.430
Moisture content: Dry soil+tare, gms.	75.690			100.490
Moisture content: Tare, gms.	30.400			30.480
Moisture, %	65.8	66.4	66.4	62.8
Moist specimen weight, gms.	115.3			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	100.7	101.1	101.1	
Dry density, pcf	60.7	60.7	60.7	
Void ratio	1.8271	1.8271	1.8271	
Saturation, %	99.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 5.632 tsf
 Consolidation effective confining stress = 1.506 tsf
 Fail. Stress = 0.800 tsf at reading no. 18
 Ult. Stress = 0.800 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0165	19.340	0.0	0.0	0.000	1.506	1.506	1.00	5.632	1.506	0.000
1	0.0193	23.920	4.6	0.1	0.212	1.387	1.599	1.15	5.751	1.493	0.106
2	0.0225	27.980	8.6	0.2	0.399	1.264	1.663	1.32	5.874	1.464	0.200
3	0.0331	33.440	14.1	0.6	0.649	1.099	1.748	1.59	6.039	1.424	0.325
4	0.0582	41.350	22.0	1.5	1.004	0.904	1.908	2.11	6.234	1.406	0.502
5	0.0752	44.730	25.4	2.1	1.151	0.838	1.989	2.37	6.300	1.414	0.576
6	0.0930	47.300	28.0	2.7	1.259	0.804	2.063	2.57	6.334	1.434	0.630
7	0.1107	47.600	28.3	3.4	1.265	0.805	2.070	2.57	6.333	1.437	0.632
8	0.1288	47.760	28.4	4.0	1.263	0.827	2.090	2.53	6.311	1.459	0.632
9	0.1468	44.700	25.4	4.6	1.120	0.903	2.023	2.24	6.235	1.463	0.560

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Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
10	0.1753	40.350	21.0	5.7	0.918	0.992	1.910	1.93	6.146	1.451	0.459
11	0.2036	38.900	19.6	6.7	0.845	1.000	1.845	1.85	6.138	1.423	0.423
12	0.2314	39.010	19.7	7.7	0.841	0.973	1.814	1.86	6.165	1.394	0.421
13	0.2694	39.120	19.8	9.0	0.833	0.946	1.779	1.88	6.192	1.363	0.417
14	0.2973	39.330	20.0	10.0	0.833	0.940	1.773	1.89	6.198	1.357	0.417
15	0.3462	39.780	20.4	11.7	0.835	0.916	1.751	1.91	6.222	1.334	0.418
16	0.3842	40.040	20.7	13.1	0.833	0.907	1.740	1.92	6.231	1.324	0.417
17	0.4232	39.910	20.6	14.5	0.815	0.900	1.715	1.91	6.238	1.307	0.407
18	0.4370	39.670	20.3	15.0	0.800	0.897	1.697	1.89	6.241	1.297	0.400

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	86.100			138.850
Moisture content: Dry soil+tare, gms.	63.780			98.430
Moisture content: Tare, gms.	30.470			30.300
Moisture, %	67.0	68.3	68.3	59.3
Moist specimen weight, gms.	114.2			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	99.6	100.4	100.4	
Dry density, pcf	59.6	59.6	59.6	
Void ratio	1.8783	1.8783	1.8783	
Saturation, %	98.1	100.0	100.0	

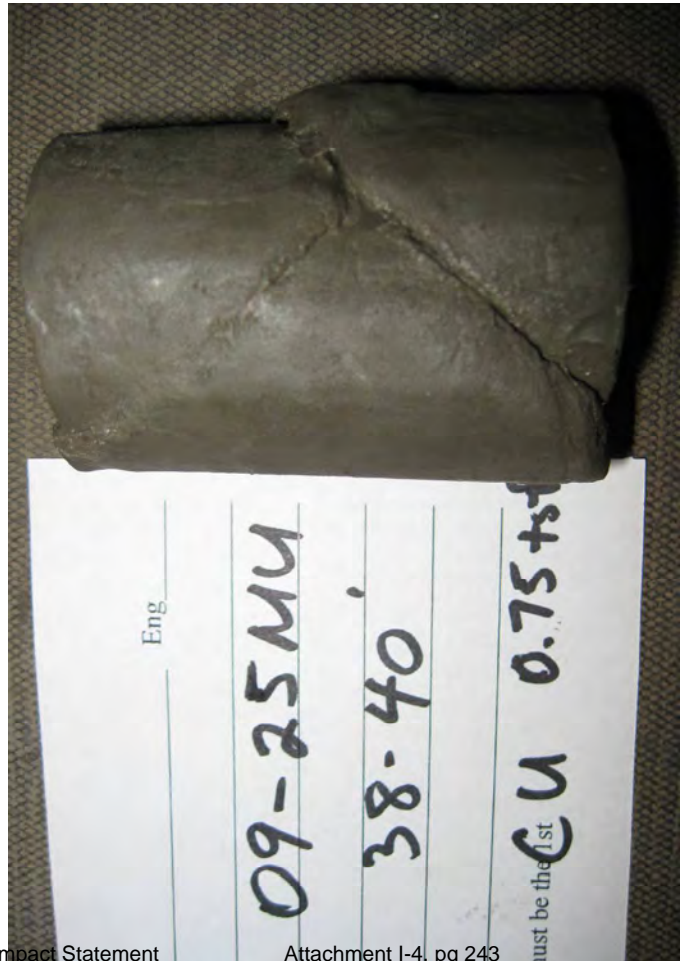
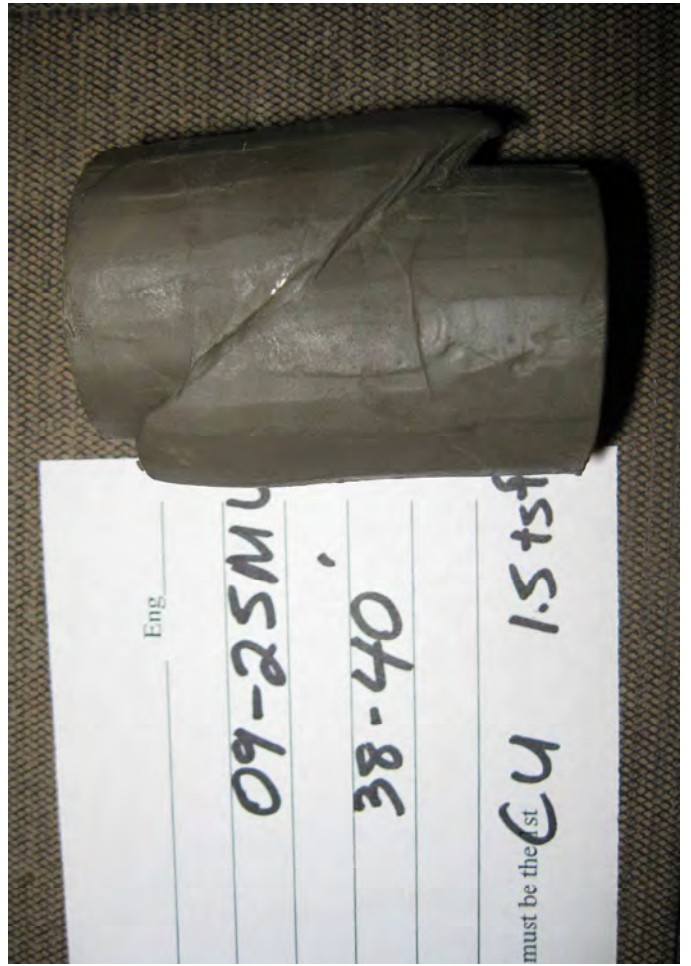
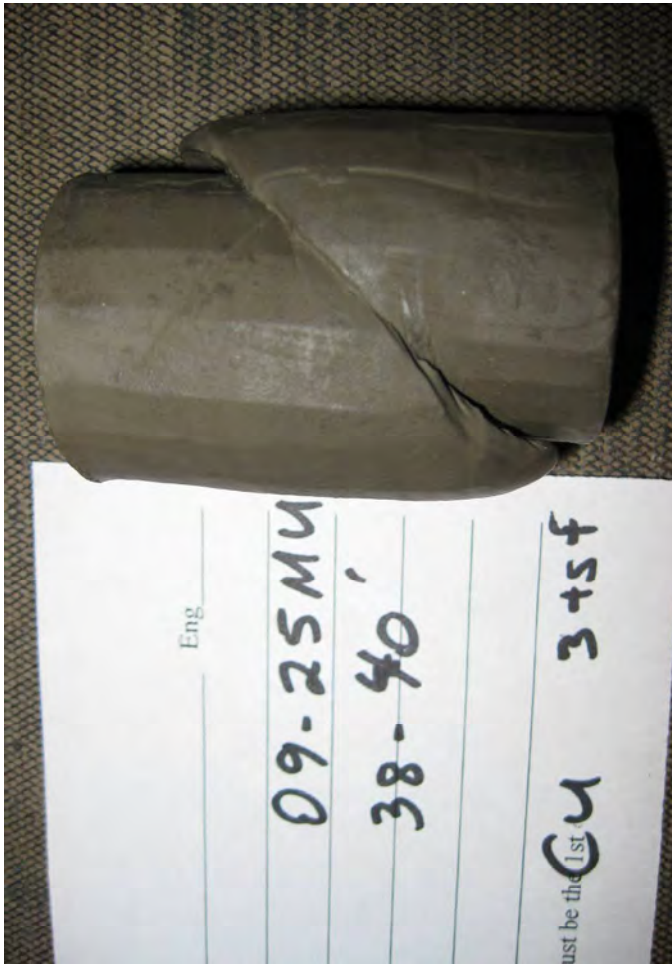
Test Readings for Specimen No. 3

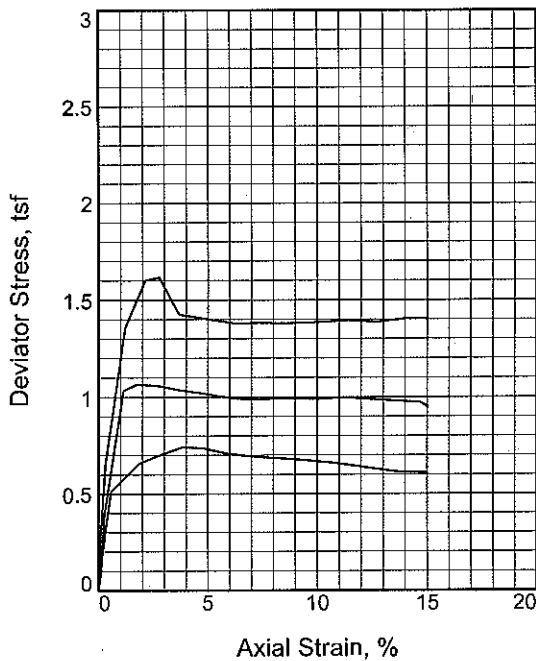
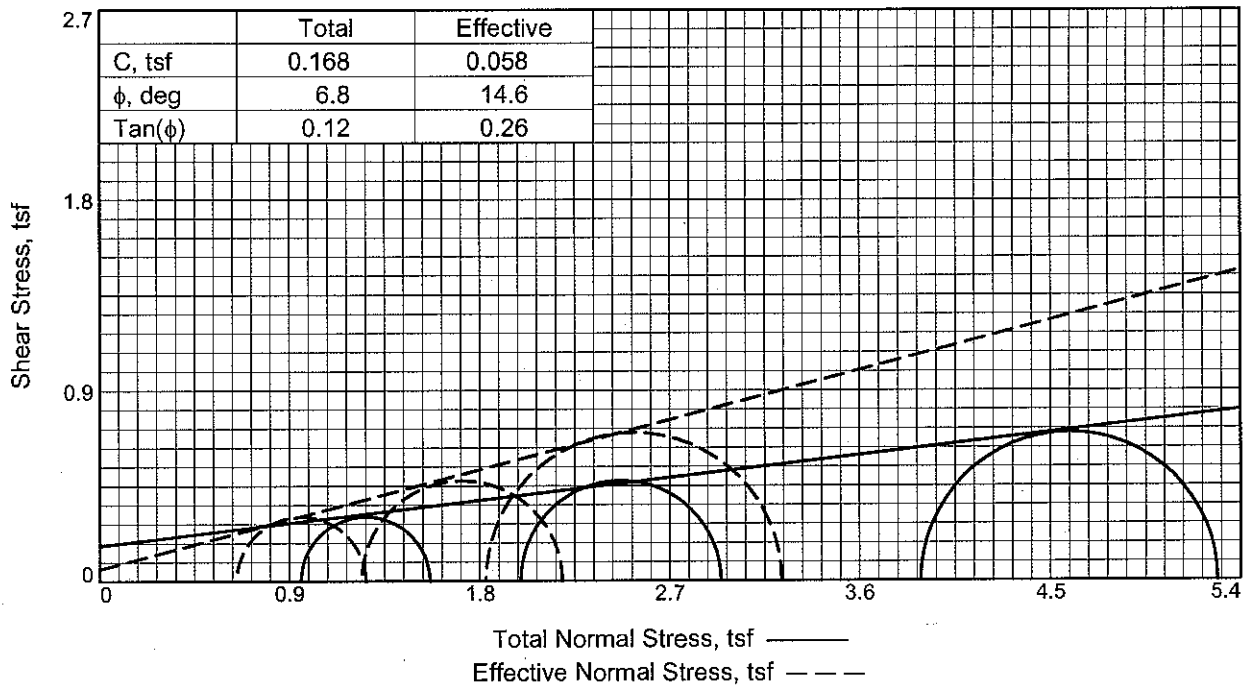
Consolidation cell pressure = 7.135 tsf
 Consolidation back pressure = 4.138 tsf
 Consolidation effective confining stress = 2.997 tsf
 Fail. Stress = 1.259 tsf at reading no. 21
 Ult. Stress = 1.259 tsf at reading no. 21

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0058	16.990	0.0	0.0	0.000	2.997	2.997	1.00	4.138	2.997	0.000
1	0.0065	20.170	3.2	0.0	0.147	2.970	3.117	1.05	4.165	3.044	0.074
2	0.0084	25.870	8.9	0.1	0.411	2.830	3.241	1.15	4.305	3.035	0.205
3	0.0115	31.640	14.7	0.2	0.677	2.645	3.322	1.26	4.490	2.984	0.339
4	0.0302	43.570	26.6	0.9	1.220	2.222	3.442	1.55	4.913	2.832	0.610
5	0.0553	48.580	31.6	1.8	1.437	2.017	3.454	1.71	5.118	2.736	0.719
6	0.0642	50.470	33.5	2.1	1.518	1.969	3.487	1.77	5.166	2.728	0.759
7	0.0733	51.300	34.3	2.4	1.551	1.916	3.467	1.81	5.219	2.691	0.775
8	0.0821	51.690	34.7	2.7	1.563	1.898	3.461	1.82	5.237	2.680	0.782
9	0.0918	50.990	34.0	3.1	1.526	1.883	3.409	1.81	5.252	2.646	0.763
10	0.1002	49.620	32.6	3.4	1.460	1.925	3.385	1.76	5.210	2.655	0.730
11	0.1190	47.100	30.1	4.0	1.338	1.975	3.313	1.68	5.160	2.644	0.669
12	0.1461	46.950	30.0	5.0	1.318	1.949	3.267	1.68	5.186	2.608	0.659
13	0.1739	46.520	29.5	6.0	1.286	1.918	3.204	1.67	5.217	2.561	0.643

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
14	0.2031	46.540	29.6	7.0	1.272	1.867	3.139	1.68	5.268	2.503	0.636
15	0.2437	46.710	29.7	8.5	1.260	1.817	3.077	1.69	5.318	2.447	0.630
16	0.2727	47.050	30.1	9.5	1.260	1.771	3.031	1.71	5.364	2.401	0.630
17	0.3015	47.650	30.7	10.5	1.270	1.732	3.002	1.73	5.403	2.367	0.635
18	0.3315	47.880	30.9	11.6	1.265	1.681	2.946	1.75	5.454	2.313	0.632
19	0.3614	48.380	31.4	12.7	1.270	1.630	2.900	1.78	5.505	2.265	0.635
20	0.4014	48.920	31.9	14.1	1.270	1.578	2.848	1.81	5.557	2.213	0.635
21	0.4280	48.980	32.0	15.0	1.259	1.564	2.823	1.80	5.571	2.193	0.629





Sample No.		1	2	3
Initial	Water Content, %	54.5	58.1	52.5
	Dry Density, pcf	66.7	65.1	69.4
	Saturation, %	95.1	97.7	97.9
	Void Ratio	1.5754	1.6360	1.4744
	Diameter, in.	1.40	1.42	1.41
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	57.3	59.5	53.6
	Dry Density, pcf	66.7	65.1	69.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5754	1.6360	1.4744
	Diameter, in.	1.40	1.42	1.41
	Height, in.	2.81	2.81	2.81
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.95	2.00	3.89
Back Pressure, tsf		5.88	6.50	3.32
Cell Pressure, tsf		6.83	8.50	7.21
Peak Deviator Stress, tsf		0.74	1.07	1.62
Total Pore Pr., tsf		6.29	7.16	4.69
Ultimate Deviator Stress, tsf		0.61	0.95	1.40
Total Pore Pr., tsf		6.18	7.25	5.38
Maj. Eff. Stress at Ultimate, tsf		1.26	2.19	3.23
Min. Eff. Stress at Ultimate, tsf		0.65	1.24	1.83

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 87 PL= 22 PI= 65

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.001 in/min.

Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #5

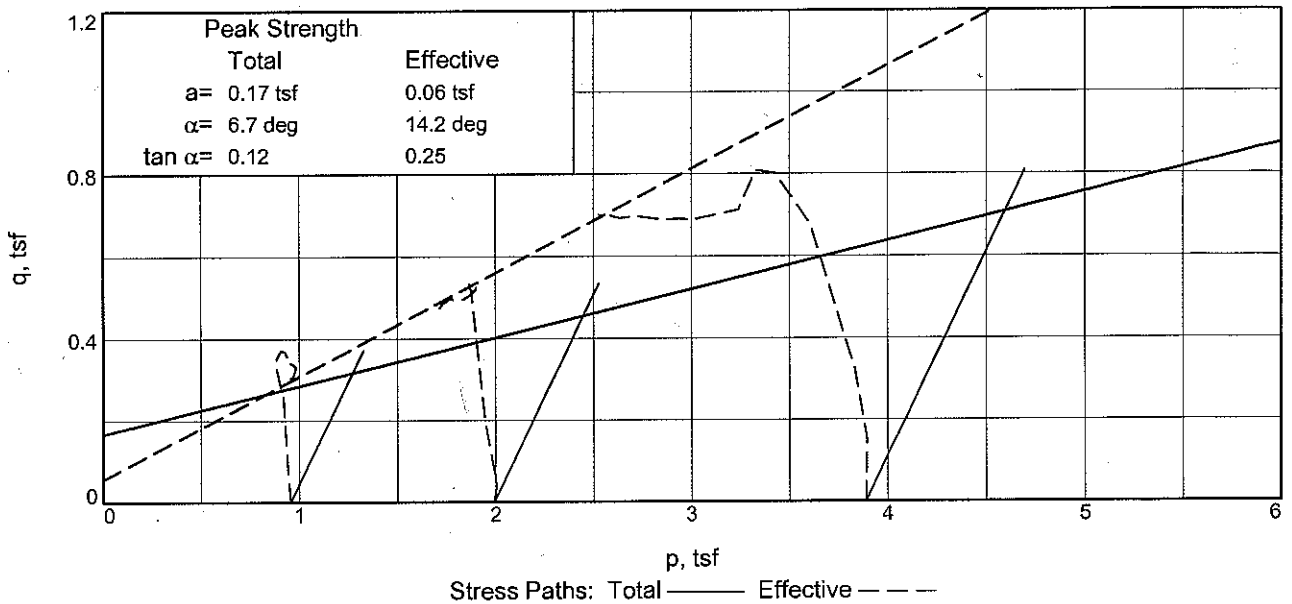
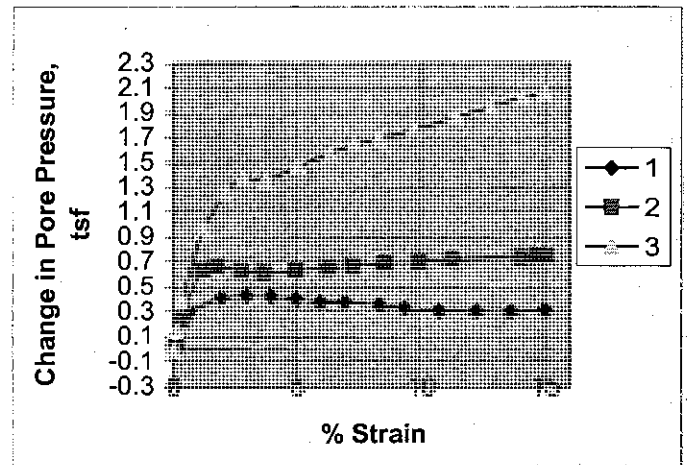
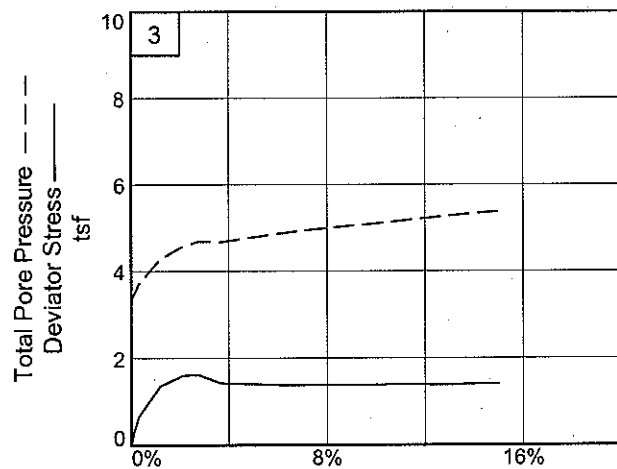
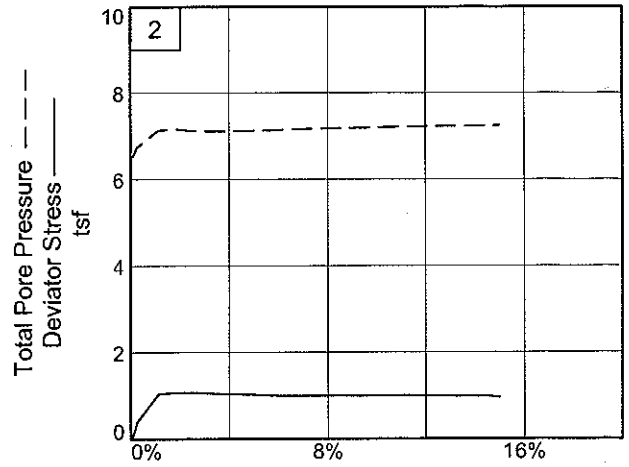
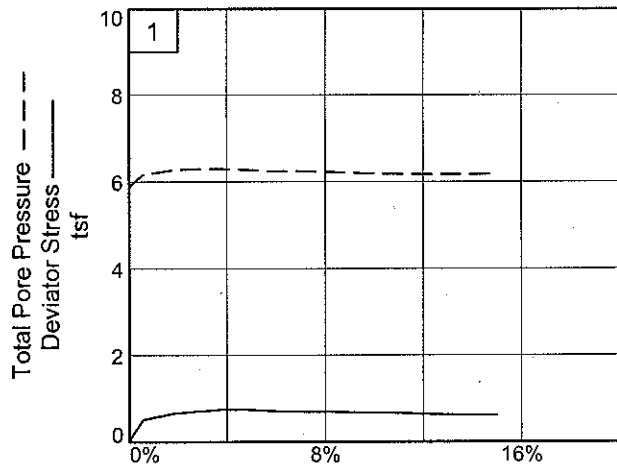
Depth: 68-70'

Brenna / Argusville Transition

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 68-70' Sample Number: Boring 09-25MU, #5

Project No.: BL-09-03127

Figure _____

Brenna / Argusville Transition

Braun Intertec

Tested By: irs

Checked By: rs

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

9/1/2009

5:35 PM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 68-70' **Sample Number:** Boring 09-25MU, #5
Description: FAT CLAY, gray (CH) **Brenna / Argusville Transition**
Remarks: The rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	125.950			148.740
Moisture content: Dry soil+tare, gms.	92.250			105.700
Moisture content: Tare, gms.	30.400			30.970
Moisture, %	54.5	57.3	57.3	57.6
Moist specimen weight, gms.	117.6			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.0	104.8	104.8	
Dry density, pcf	66.7	66.7	66.7	
Void ratio	1.5754	1.5754	1.5754	
Saturation, %	95.1	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 6.832 tsf
Consolidation back pressure = 5.877 tsf
Consolidation effective confining stress = 0.955 tsf
Fail. Stress = 0.609 tsf at reading no. 14.
Ult. Stress = 0.609 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0225	17.690	0.0	0.0	0.000	0.955	0.955	1.00	5.877	0.955	0.000
1	0.0263	20.750	3.1	0.1	0.142	0.872	1.014	1.16	5.960	0.943	0.071
2	0.0384	28.740	11.0	0.6	0.511	0.665	1.176	1.77	6.167	0.920	0.255
3	0.0751	32.130	14.4	1.9	0.659	0.554	1.213	2.19	6.278	0.883	0.329
4	0.1030	33.260	15.6	2.9	0.703	0.534	1.237	2.32	6.298	0.886	0.352
5	0.1309	34.330	16.6	3.9	0.744	0.537	1.281	2.39	6.295	0.909	0.372
6	0.1590	34.330	16.6	4.9	0.736	0.559	1.295	2.32	6.273	0.927	0.368
7	0.1877	33.900	16.2	5.9	0.710	0.584	1.294	2.21	6.248	0.939	0.355
8	0.2164	33.750	16.1	6.9	0.695	0.585	1.280	2.19	6.247	0.933	0.348
9	0.2565	33.750	16.1	8.3	0.685	0.605	1.290	2.13	6.227	0.947	0.342
10	0.2852	33.700	16.0	9.3	0.675	0.632	1.307	2.07	6.200	0.969	0.337
11	0.3242	33.600	15.9	10.7	0.660	0.654	1.314	2.01	6.178	0.984	0.330
12	0.3642	33.300	15.6	12.2	0.638	0.658	1.296	1.97	6.174	0.977	0.319
13	0.4050	32.980	15.3	13.6	0.614	0.661	1.275	1.93	6.171	0.968	0.307
14	0.4441	33.100	15.4	15.0	0.609	0.651	1.260	1.94	6.181	0.956	0.305

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	144.940			147.570
Moisture content: Dry soil+tare, gms.	102.840			104.100
Moisture content: Tare, gms.	30.430			30.180
Moisture, %	58.1	59.5	59.5	58.8
Moist specimen weight, gms.	119.4			
Diameter, in.	1.42	1.42	1.42	
Area, in. ²	1.57	1.57	1.57	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.0	103.9	103.9	
Dry density, pcf	65.1	65.1	65.1	
Void ratio	1.6360	1.6360	1.6360	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 8.496 tsf
 Consolidation back pressure = 6.503 tsf
 Consolidation effective confining stress = 1.993 tsf
 Fail. Stress = 0.949 tsf at reading no. 15
 Ult. Stress = 0.949 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0123	22.120	0.0	0.0	0.000	1.993	1.993	1.00	6.503	1.993	0.000
1	0.0154	24.010	1.9	0.1	0.086	1.963	2.049	1.04	6.533	2.006	0.043
2	0.0199	30.690	8.6	0.3	0.391	1.751	2.142	1.22	6.745	1.947	0.196
3	0.0441	44.980	22.9	1.1	1.035	1.359	2.394	1.76	7.137	1.876	0.517
4	0.0611	45.830	23.7	1.7	1.067	1.332	2.399	1.80	7.164	1.865	0.533
5	0.0870	45.930	23.8	2.7	1.061	1.375	2.436	1.77	7.121	1.906	0.531
6	0.1138	45.690	23.6	3.6	1.040	1.379	2.419	1.75	7.117	1.899	0.520
7	0.1507	45.470	23.3	4.9	1.016	1.367	2.383	1.74	7.129	1.875	0.508
8	0.1865	45.250	23.1	6.2	0.993	1.342	2.335	1.74	7.154	1.839	0.497
9	0.2144	45.370	23.2	7.2	0.988	1.324	2.312	1.75	7.172	1.818	0.494
10	0.2513	45.850	23.7	8.5	0.994	1.307	2.301	1.76	7.189	1.804	0.497
11	0.2903	46.110	24.0	9.9	0.990	1.290	2.280	1.77	7.206	1.785	0.495
12	0.3281	46.660	24.5	11.2	0.997	1.273	2.270	1.78	7.223	1.772	0.499
13	0.4049	46.950	24.8	14.0	0.978	1.256	2.234	1.78	7.240	1.745	0.489
14	0.4249	47.010	24.9	14.7	0.972	1.246	2.218	1.78	7.250	1.732	0.486
15	0.4347	46.530	24.4	15.0	0.949	1.241	2.190	1.77	7.255	1.716	0.475

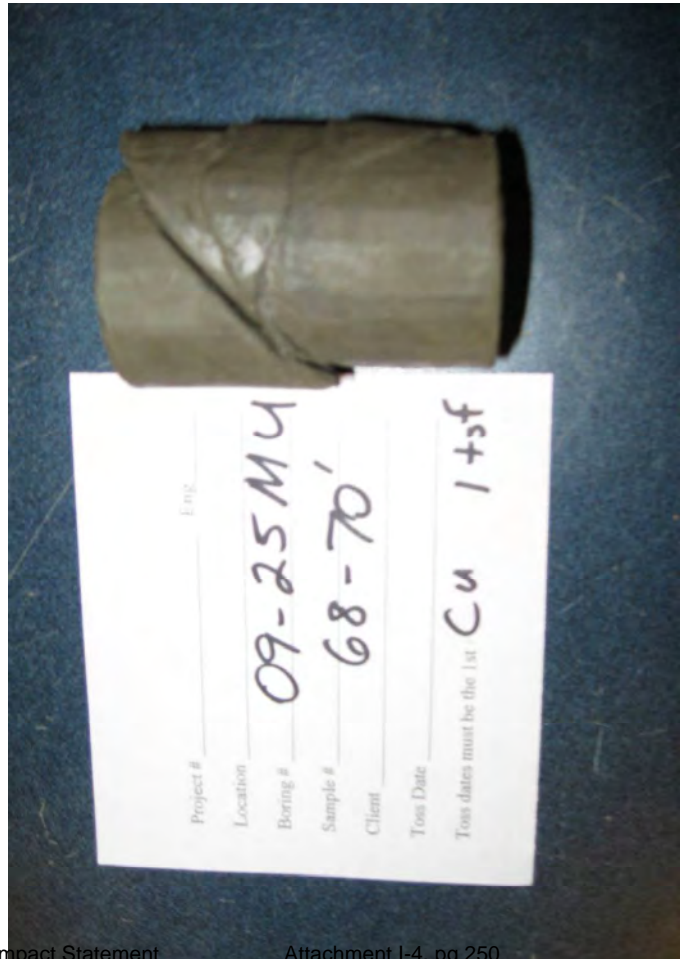
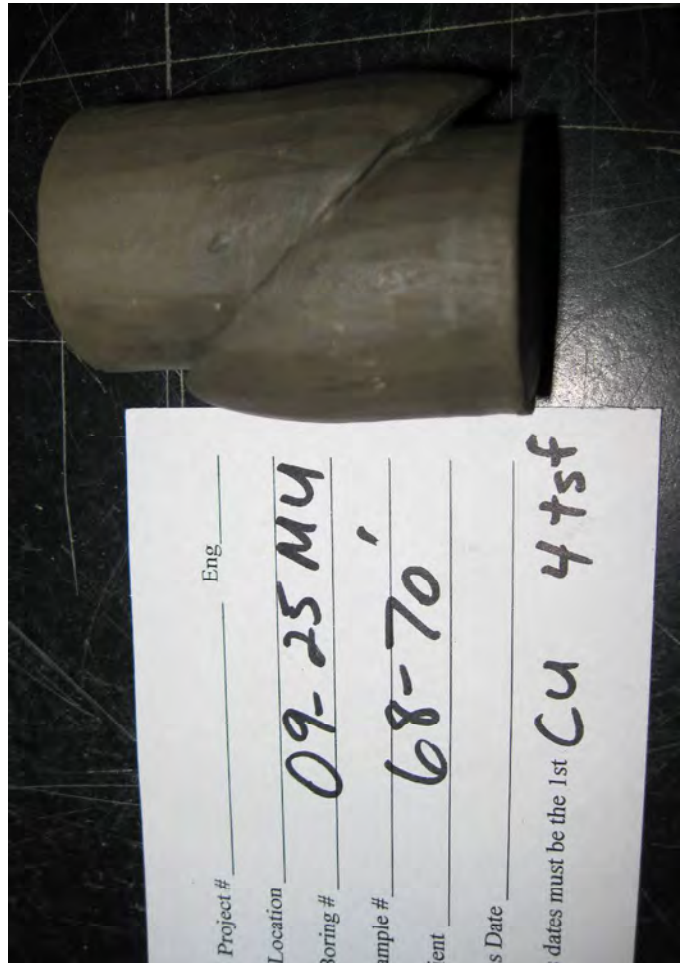
Parameters for Specimen No. 3

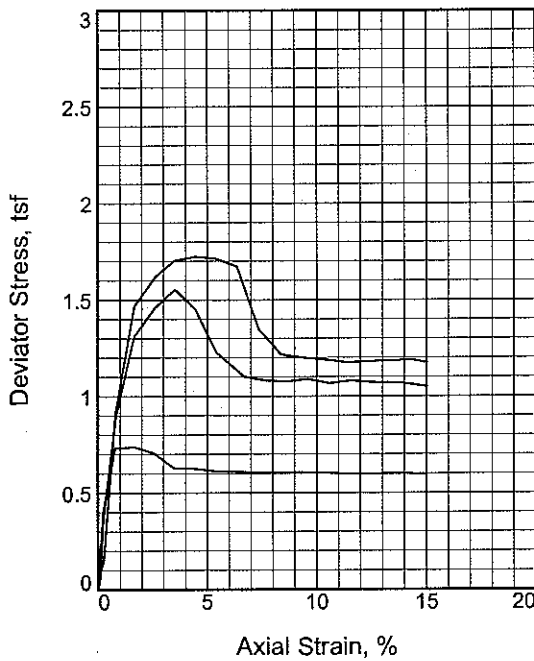
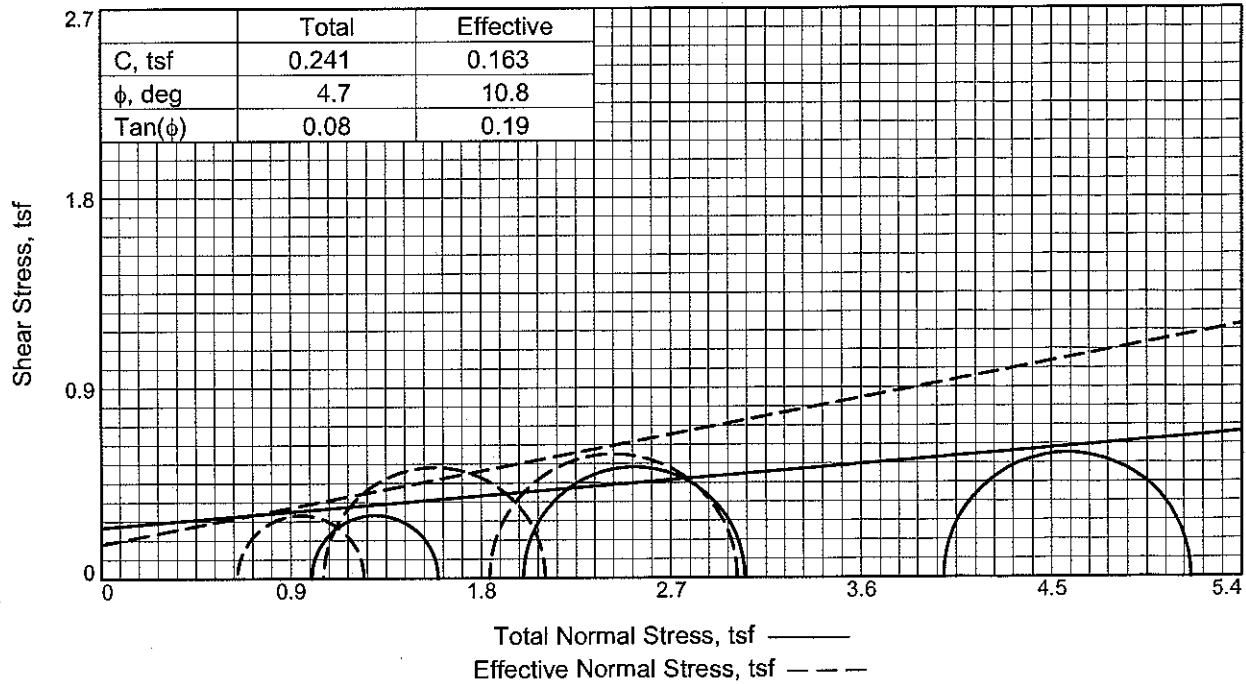
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.550			145.300
Moisture content: Dry soil+tare, gms.	95.800			105.000
Moisture content: Tare, gms.	31.470			29.950
Moisture, %	52.5	53.6	53.6	53.7
Moist specimen weight, gms.	120.8			
Diameter, in.	1.41	1.40	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	105.8	106.6	106.6	
Dry density, pcf	69.4	69.4	69.4	
Void ratio	1.4744	1.4744	1.4744	
Saturation, %	97.9	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.207 tsf
 Consolidation back pressure = 3.319 tsf
 Consolidation effective confining stress = 3.888 tsf
 Fail. Stress = 1.403 tsf at reading no. 15
 Ult. Stress = 1.403 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0212	18.790	0.0	0.0	0.000	3.888	3.888	1.00	3.319	3.888	0.000
1	0.0244	25.320	6.5	0.1	0.303	3.741	4.044	1.08	3.466	3.892	0.151
2	0.0300	32.890	14.1	0.3	0.653	3.506	4.159	1.19	3.701	3.832	0.326
3	0.0552	48.400	29.6	1.2	1.358	2.925	4.283	1.46	4.282	3.604	0.679
4	0.0809	54.040	35.3	2.1	1.602	2.626	4.228	1.61	4.581	3.427	0.801
5	0.0989	54.590	35.8	2.8	1.617	2.519	4.136	1.64	4.688	3.327	0.808
6	0.1245	50.670	31.9	3.7	1.426	2.530	3.956	1.56	4.677	3.243	0.713
7	0.1616	50.570	31.8	5.0	1.402	2.423	3.825	1.58	4.784	3.124	0.701
8	0.1986	50.480	31.7	6.3	1.379	2.315	3.694	1.60	4.892	3.004	0.689
9	0.2264	50.920	32.1	7.3	1.383	2.250	3.633	1.61	4.957	2.941	0.691
10	0.2541	51.190	32.4	8.3	1.380	2.191	3.571	1.63	5.016	2.881	0.690
11	0.2929	51.750	33.0	9.7	1.382	2.122	3.504	1.65	5.085	2.813	0.691
12	0.3409	52.700	33.9	11.4	1.395	2.022	3.417	1.69	5.185	2.720	0.698
13	0.3790	53.010	34.2	12.8	1.387	1.939	3.326	1.72	5.268	2.632	0.693
14	0.4169	54.010	35.2	14.1	1.405	1.862	3.267	1.75	5.345	2.564	0.702
15	0.4420	54.320	35.5	15.0	1.403	1.828	3.231	1.77	5.379	2.529	0.701





Sample No.		1	2	3
Initial	Water Content, %	63.1	63.1	62.9
	Dry Density, pcf	62.4	62.3	62.8
	Saturation, %	99.1	99.0	99.7
	Void Ratio	1.7508	1.7537	1.7353
	Diameter, in.	1.40	1.39	1.39
	Height, in.	2.81	2.81	2.80
At Test	Water Content, %	63.6	62.2	58.9
	Dry Density, pcf	62.5	63.4	65.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.7479	1.7097	1.6191
	Diameter, in.	1.40	1.38	1.37
	Height, in.	2.81	2.79	2.76
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		1.00	2.00	3.99
Back Pressure, tsf		6.14	5.14	3.15
Cell Pressure, tsf		7.14	7.14	7.14
Peak Deviator Stress, tsf		0.74	1.55	1.72
Total Pore Pr., tsf		6.68	6.20	4.93
Ultimate Deviator Stress, tsf		0.60	1.05	1.17
Total Pore Pr., tsf		6.49	6.09	5.30
Maj. Eff. Stress at Ultimate, tsf		1.20	2.49	3.93
Min. Eff. Stress at Ultimate, tsf		0.46	0.94	2.21

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 108 PL= 22 PI= 86

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Specimens were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

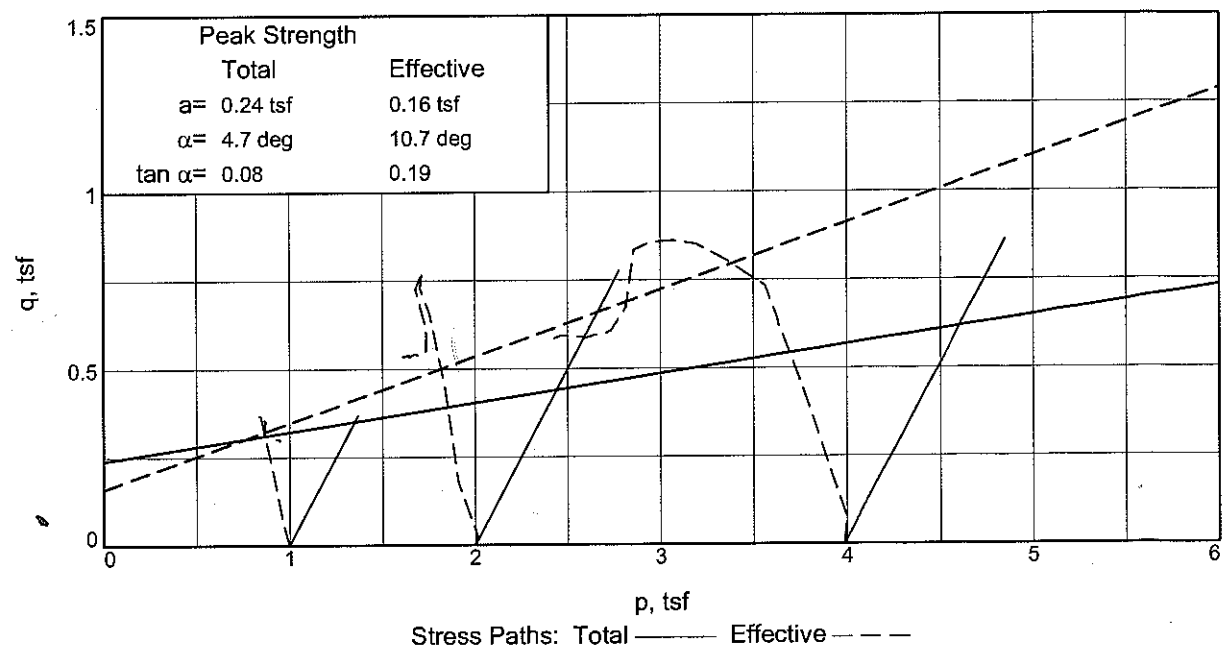
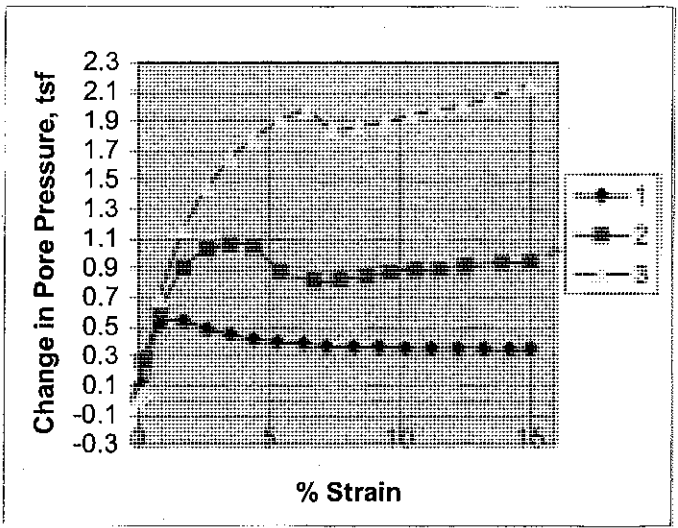
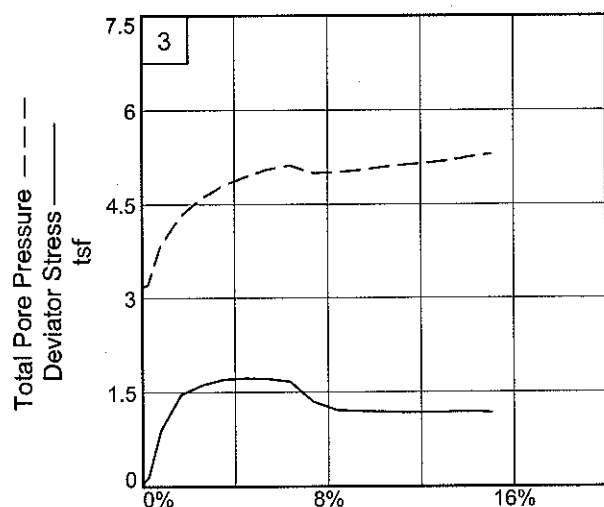
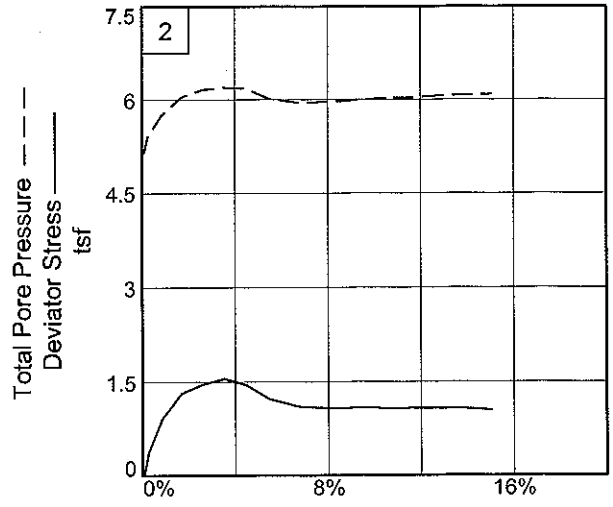
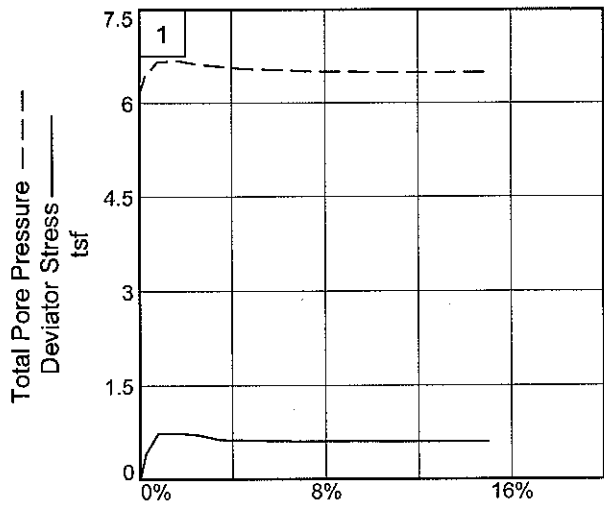
Location: SE-F-13, Fargo, Brenna Formation

Sample Number: Boring 09-25MU, #4 **Depth:** 50-52'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-13, Fargo, Brenna Formation

Depth: 50-52'

Sample No.: Boring 09-25MU, #4

Project No.: W-09-0127 Feasibility Report and Environmental Impact Statement

Braun Intertec
Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

11/9/2009
12:55 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Brenna Formation
Depth: 50-52' **Sample Number:** Boring 09-25MU, #4
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Specimens were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**108 **PL=**22 **PI=**86
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	115.080			144.800
Moisture content: Dry soil+tare, gms.	82.550			100.190
Moisture content: Tare, gms.	30.970			29.910
Moisture, %	63.1	63.7	63.6	63.5
Moist specimen weight, gms.	115.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	101.8	102.1	102.2	
Dry density, pcf	62.4	62.4	62.5	
Void ratio	1.7508	1.7508	1.7479	
Saturation, %	99.1	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.141 tsf
Consolidation effective confining stress = 0.999 tsf
Peak Stress = 0.739 tsf at reading no. 4
Ult. Stress = 0.597 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0128	18.970	0.0	0.0	0.000	0.999	0.999	1.00	6.141	0.999	0.000
1	0.0148	21.780	2.8	0.1	0.132	0.898	1.030	1.15	6.242	0.964	0.066
2	0.0197	27.580	8.6	0.2	0.404	0.712	1.116	1.57	6.428	0.914	0.202
3	0.0346	34.660	15.7	0.8	0.733	0.481	1.214	2.52	6.659	0.847	0.366
4	0.0595	34.940	16.0	1.7	0.739	0.461	1.200	2.60	6.679	0.831	0.370
5	0.0847	34.390	15.4	2.6	0.707	0.518	1.225	2.37	6.622	0.872	0.354
6	0.1103	32.800	13.8	3.5	0.628	0.550	1.178	2.14	6.590	0.864	0.314
7	0.1363	32.870	13.9	4.4	0.626	0.585	1.211	2.07	6.555	0.898	0.313
8	0.1632	32.730	13.8	5.3	0.613	0.604	1.217	2.02	6.536	0.911	0.307
9	0.1901	32.830	13.9	6.3	0.611	0.613	1.224	2.00	6.527	0.919	0.306
10	0.2168	32.800	13.8	7.2	0.604	0.631	1.235	1.96	6.509	0.933	0.302
11	0.2448	32.980	14.0	8.2	0.605	0.636	1.241	1.95	6.504	0.939	0.303
12	0.2718	33.150	14.2	9.2	0.606	0.639	1.245	1.95	6.501	0.942	0.303
13	0.2998	33.250	14.3	10.2	0.604	0.643	1.247	1.94	6.497	0.945	0.302
14	0.3276	33.290	14.3	11.2	0.599	0.646	1.245	1.93	6.494	0.945	0.299
15	0.3564	33.450	14.5	12.2	0.598	0.647	1.245	1.92	6.493	0.946	0.299
16	0.3845	33.620	14.6	13.2	0.599	0.649	1.248	1.92	6.491	0.948	0.299
17	0.4123	33.820	14.9	14.2	0.600	0.649	1.249	1.92	6.491	0.949	0.300
18	0.4350	33.900	14.9	15.0	0.597	0.648	1.245	1.92	6.492	0.947	0.299

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	104.250			142.560
Moisture content: Dry soil+tare, gms.	75.430			100.000
Moisture content: Tare, gms.	29.780			30.650
Moisture, %	63.1	63.8	62.2	61.4
Moist specimen weight, gms.	113.5			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.50	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	101.7	102.1	102.7	
Dry density, pcf	62.3	62.3	63.4	
Void ratio	1.7537	1.7537	1.7097	
Saturation, %	99.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 5.140 tsf
 Consolidation effective confining stress = 2.000 tsf
 Peak Stress = 1.554 tsf at reading no. 6
 Ult. Stress = 1.050 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0079	18.390	0.0	0.0	0.000	2.000	2.000	1.00	5.140	2.000	0.000
1	0.0108	19.520	1.1	0.1	0.054	1.985	2.039	1.03	5.155	2.012	0.027
2	0.0148	25.870	7.5	0.2	0.359	1.729	2.088	1.21	5.411	1.908	0.179
3	0.0306	37.260	18.9	0.8	0.900	1.386	2.286	1.65	5.754	1.836	0.450
4	0.0546	46.140	27.8	1.7	1.312	1.099	2.411	2.19	6.041	1.755	0.656
5	0.0805	49.560	31.2	2.6	1.460	0.973	2.433	2.50	6.167	1.703	0.730
6	0.1065	51.880	33.5	3.5	1.554	0.938	2.492	2.66	6.202	1.715	0.777
7	0.1322	50.010	31.6	4.4	1.453	0.953	2.406	2.52	6.187	1.680	0.727
8	0.1591	45.380	27.0	5.4	1.228	1.122	2.350	2.09	6.018	1.736	0.614
9	0.1950	42.960	24.6	6.7	1.103	1.184	2.287	1.93	5.956	1.735	0.551
10	0.2229	42.780	24.4	7.7	1.083	1.175	2.258	1.92	5.965	1.716	0.541
11	0.2498	42.900	24.5	8.7	1.077	1.160	2.237	1.93	5.980	1.698	0.538
12	0.2758	43.420	25.0	9.6	1.088	1.131	2.219	1.96	6.009	1.675	0.544
13	0.3037	43.230	24.8	10.6	1.068	1.109	2.177	1.96	6.031	1.643	0.534
14	0.3306	43.790	25.4	11.5	1.081	1.106	2.187	1.98	6.034	1.646	0.540
15	0.3584	43.890	25.5	12.5	1.073	1.084	2.157	1.99	6.056	1.620	0.536
16	0.3954	44.210	25.8	13.9	1.070	1.062	2.132	2.01	6.078	1.597	0.535
17	0.4280	44.090	25.7	15.0	1.050	1.054	2.104	2.00	6.086	1.579	0.525

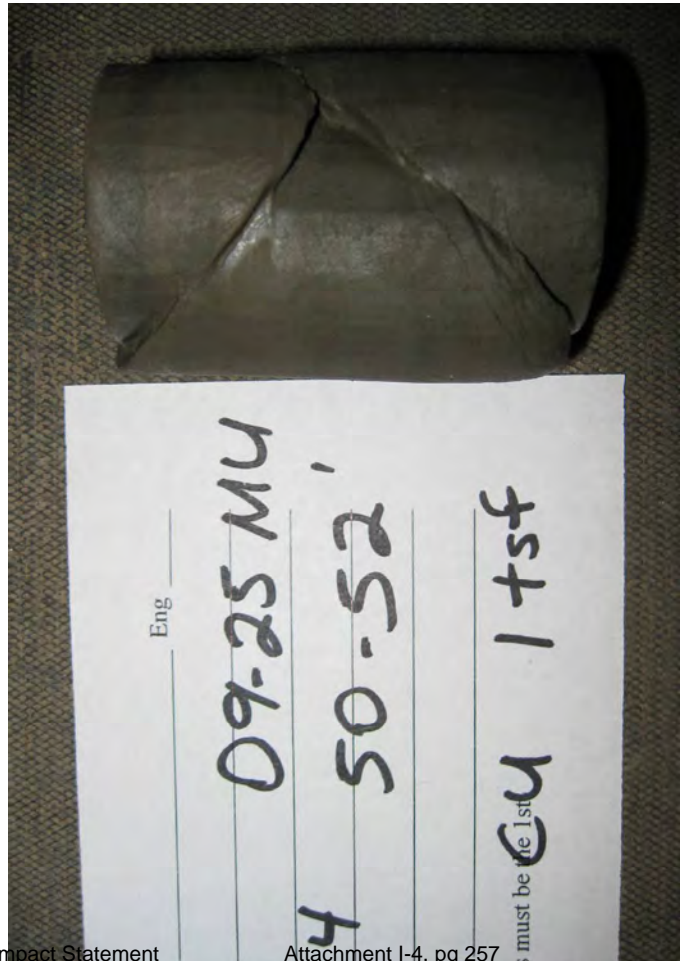
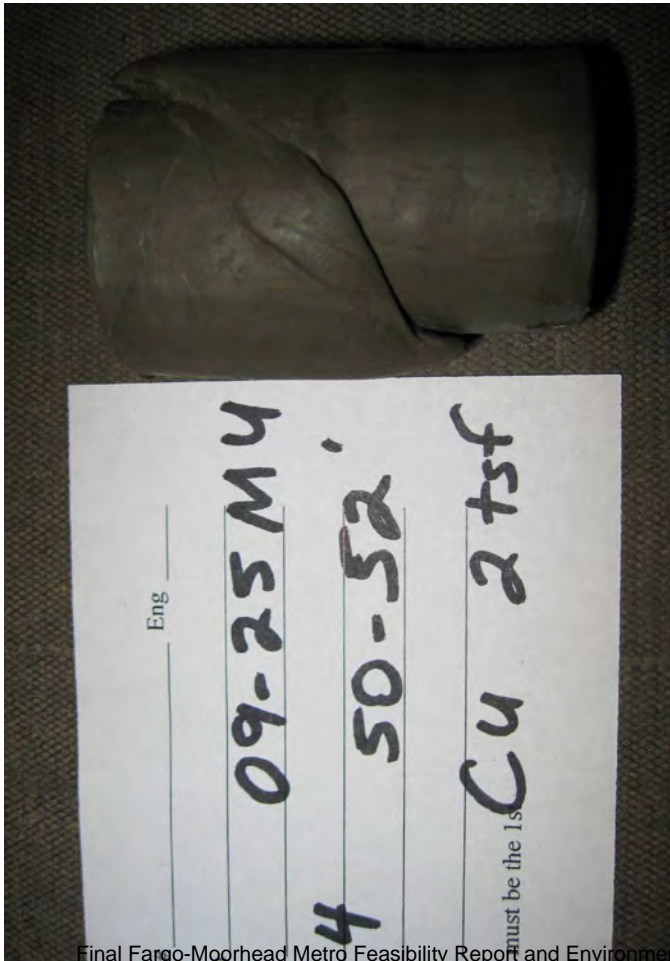
Parameters for Specimen No. 3

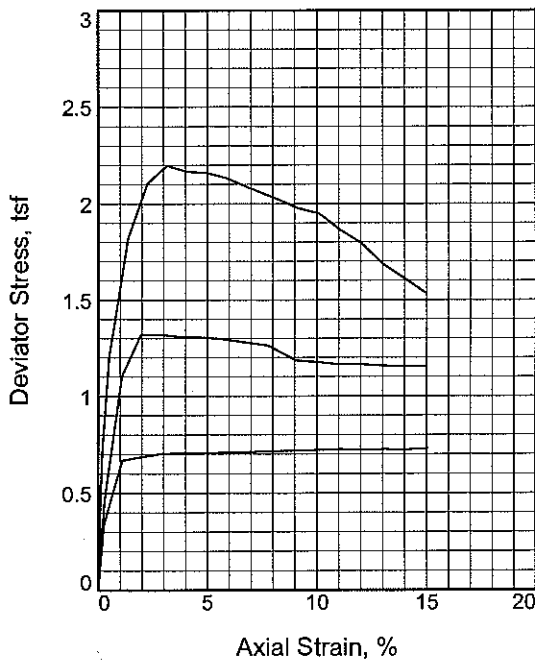
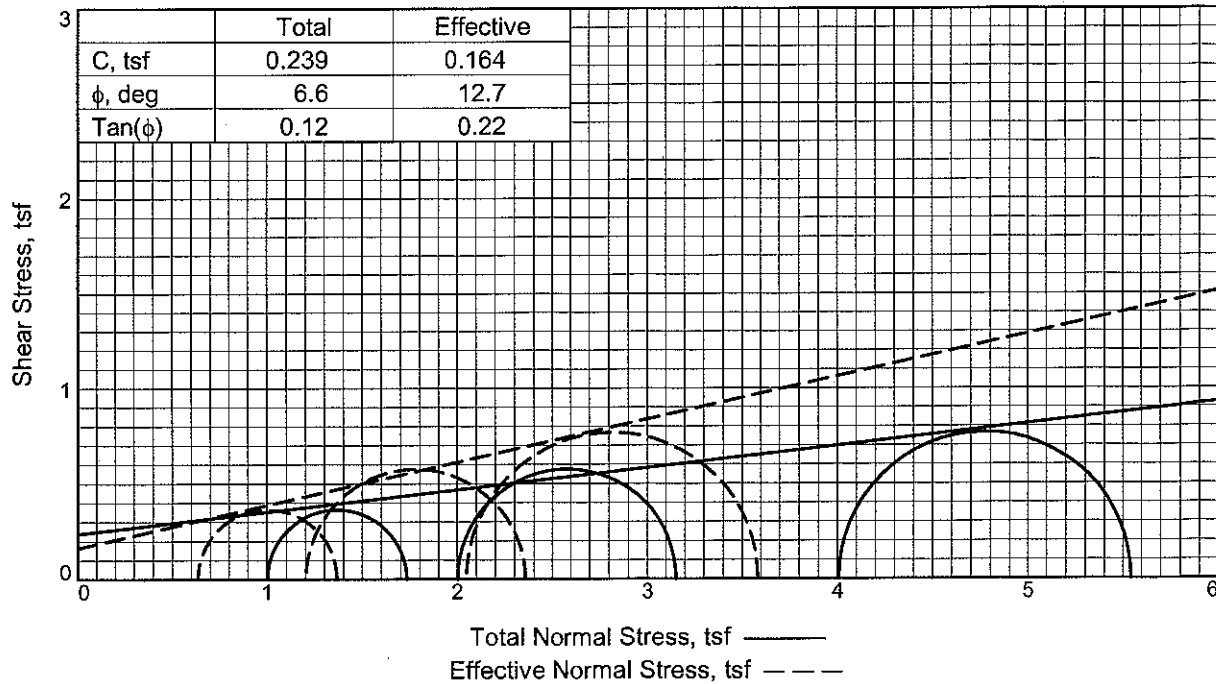
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.380			138.970
Moisture content: Dry soil+tare, gms.	87.320			100.390
Moisture content: Tare, gms.	29.990			30.860
Moisture, %	62.9	63.1	58.9	55.5
Moist specimen weight, gms.	113.5			
Diameter, in.	1.39	1.39	1.37	
Area, in. ²	1.51	1.51	1.47	
Height, in.	2.80	2.80	2.76	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	102.2	102.4	104.1	
Dry density, pcf	62.8	62.8	65.5	
Void ratio	1.7353	1.7353	1.6191	
Saturation, %	99.7	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 3.151 tsf
 Consolidation effective confining stress = 3.989 tsf
 Peak Stress = 1.723 tsf at reading no. 7
 Ult. Stress = 1.174 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0058	17.050	0.0	0.0	0.000	3.989	3.989	1.00	3.151	3.989	0.000
1	0.0081	18.730	1.7	0.1	0.082	3.953	4.035	1.02	3.187	3.994	0.041
2	0.0129	20.100	3.1	0.3	0.149	3.926	4.075	1.04	3.214	4.001	0.075
3	0.0277	35.760	18.7	0.8	0.909	3.301	4.210	1.28	3.839	3.756	0.455
4	0.0515	47.510	30.5	1.7	1.467	2.827	4.294	1.52	4.313	3.561	0.734
5	0.0773	50.930	33.9	2.6	1.617	2.538	4.155	1.64	4.602	3.346	0.808
6	0.1023	53.100	36.0	3.5	1.704	2.343	4.047	1.73	4.797	3.195	0.852
7	0.1283	53.860	36.8	4.4	1.723	2.205	3.928	1.78	4.935	3.067	0.862
8	0.1544	54.040	37.0	5.4	1.714	2.087	3.801	1.82	5.053	2.944	0.857
9	0.1810	53.490	36.4	6.4	1.672	2.020	3.692	1.83	5.120	2.856	0.836
10	0.2088	46.720	29.7	7.4	1.346	2.141	3.487	1.63	4.999	2.814	0.673
11	0.2368	44.150	27.1	8.4	1.216	2.125	3.341	1.57	5.015	2.733	0.608
12	0.2647	44.090	27.0	9.4	1.200	2.098	3.298	1.57	5.042	2.698	0.600
13	0.2917	44.180	27.1	10.4	1.191	2.045	3.236	1.58	5.095	2.641	0.596
14	0.3198	44.120	27.1	11.4	1.175	2.007	3.182	1.59	5.133	2.594	0.587
15	0.3469	44.570	27.5	12.4	1.181	1.980	3.161	1.60	5.160	2.571	0.591
16	0.3755	45.010	28.0	13.4	1.186	1.932	3.118	1.61	5.208	2.525	0.593
17	0.4023	45.410	28.4	14.4	1.189	1.867	3.056	1.64	5.273	2.462	0.595
18	0.4203	45.260	28.2	15.0	1.174	1.840	3.014	1.64	5.300	2.427	0.587





Sample No.		1	2	3
Initial	Water Content, %	55.5	55.7	55.6
	Dry Density, pcf	67.9	66.7	67.5
	Saturation, %	99.7	97.4	99.1
	Void Ratio	1.5301	1.5734	1.5425
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.80	2.82	2.81
At Test	Water Content, %	54.7	55.2	52.2
	Dry Density, pcf	68.6	68.2	70.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5030	1.5190	1.4349
	Diameter, in.	1.40	1.39	1.38
	Height, in.	2.79	2.80	2.77
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		1.00	2.00	4.01
Back Pressure, tsf		6.14	5.14	3.13
Cell Pressure, tsf		7.14	7.14	7.14
Peak Deviator Stress, tsf		0.73	1.32	2.20
Total Pore Pr., tsf		6.50	6.05	4.78
Ultimate Deviator Stress, tsf		0.73	1.15	1.54
Total Pore Pr., tsf		6.50	5.94	5.09
Maj. Eff. Stress at Ultimate, tsf		1.37	2.41	4.56
Min. Eff. Stress at Ultimate, tsf		0.63	1.09	2.37

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 110 PL= 24 PI= 86

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

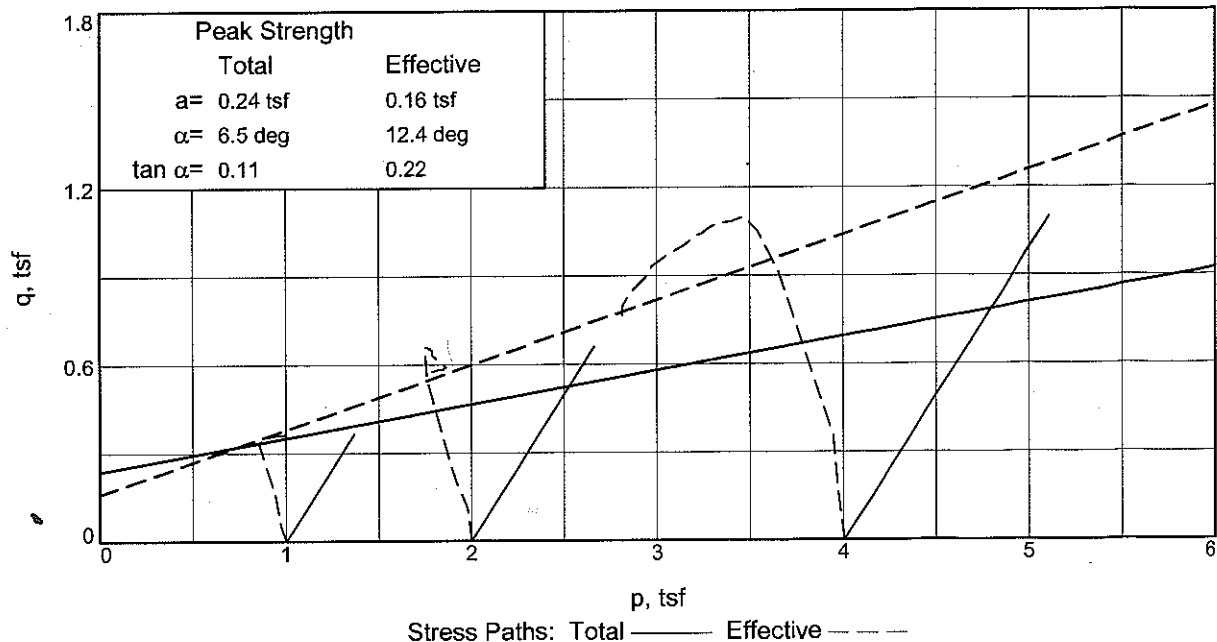
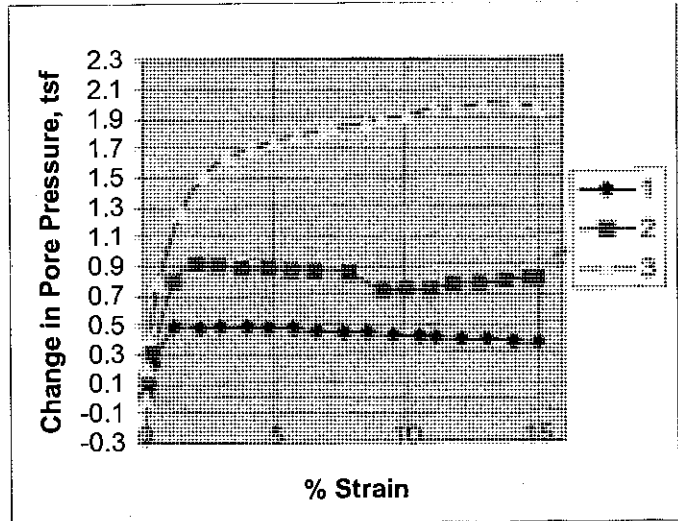
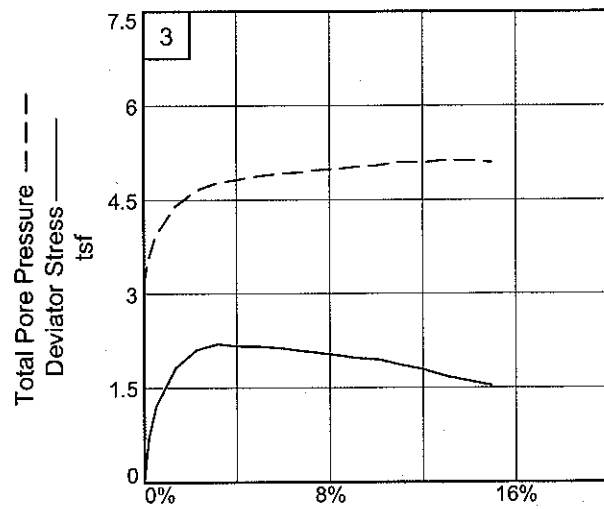
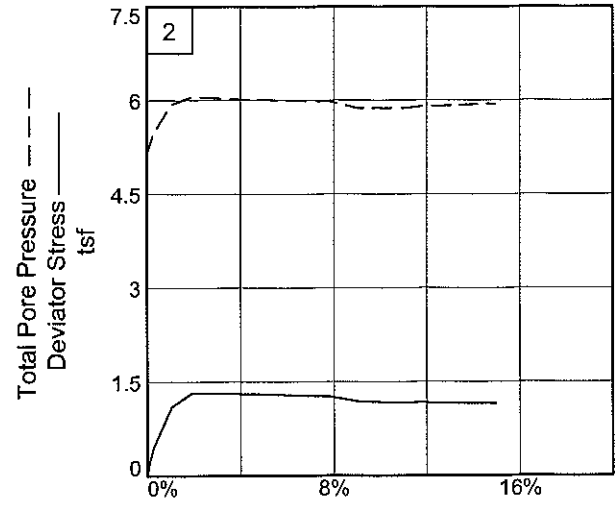
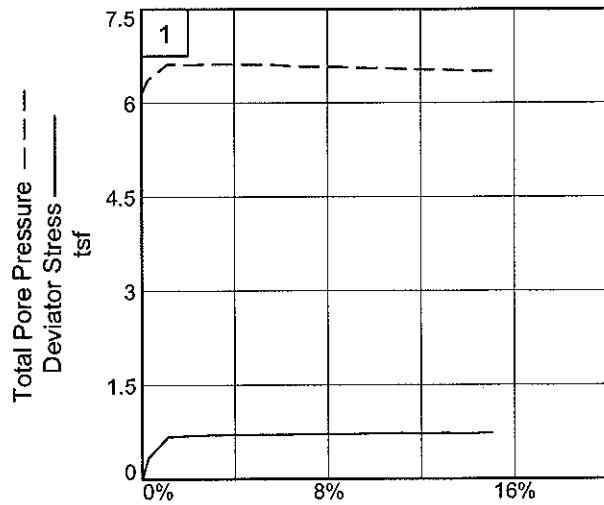
Location: SE-F-15, Fargo, Brenna Formation

Sample Number: Boring 09-26MU, #3 **Depth:** 28-30'

Proj. No.: BL-09-03127

Date Sampled:





Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-15, Fargo, Brenna Formation

Depth: 28-30'

Sample No.: Boring 09-26MU, #3

Project No.: W-09-0127 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

11/9/2009
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Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-26MU, #3
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL**=110 **PL**=24 **PI**=86
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	119.540			151.350
Moisture content: Dry soil+tare, gms.	87.720			109.440
Moisture content: Tare, gms.	30.360			31.090
Moisture, %	55.5	55.6	54.7	53.5
Moist specimen weight, gms.	120.7			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.56	1.56	1.55	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	105.5	105.6	106.1	
Dry density, pcf	67.9	67.9	68.6	
Void ratio	1.5301	1.5301	1.5030	
Saturation, %	99.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
Consolidation back pressure = 6.138 tsf
Consolidation effective confining stress = 1.002 tsf
Peak Stress = 0.730 tsf at reading no. 18
Ult. Stress = 0.730 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0237	19.800	0.0	0.0	0.000	1.002	1.002	1.00	6.138	1.002	0.000
1	0.0258	22.150	2.3	0.1	0.109	0.918	1.027	1.12	6.222	0.973	0.055
2	0.0308	27.060	7.3	0.3	0.337	0.771	1.108	1.44	6.369	0.940	0.169
3	0.0547	34.330	14.5	1.1	0.669	0.520	1.189	2.29	6.620	0.855	0.335
4	0.0815	34.910	15.1	2.1	0.689	0.530	1.219	2.30	6.610	0.875	0.345
5	0.1053	35.360	15.6	2.9	0.704	0.521	1.225	2.35	6.619	0.873	0.352
6	0.1313	35.590	15.8	3.9	0.707	0.522	1.229	2.35	6.618	0.876	0.354
7	0.1562	35.730	15.9	4.7	0.707	0.528	1.235	2.34	6.612	0.881	0.353
8	0.1823	35.930	16.1	5.7	0.709	0.529	1.238	2.34	6.611	0.883	0.354
9	0.2091	36.150	16.3	6.6	0.711	0.554	1.265	2.28	6.586	0.909	0.355
10	0.2359	36.440	16.6	7.6	0.716	0.563	1.279	2.27	6.577	0.921	0.358
11	0.2621	36.650	16.8	8.5	0.718	0.561	1.279	2.28	6.579	0.920	0.359
12	0.2897	36.890	17.1	9.5	0.720	0.582	1.302	2.24	6.558	0.942	0.360
13	0.3157	37.150	17.3	10.5	0.723	0.587	1.310	2.23	6.553	0.949	0.362
14	0.3336	37.320	17.5	11.1	0.725	0.598	1.323	2.21	6.542	0.961	0.363
15	0.3615	37.450	17.7	12.1	0.723	0.611	1.334	2.18	6.529	0.972	0.361
16	0.3885	37.720	17.9	13.1	0.725	0.611	1.336	2.19	6.529	0.974	0.363
17	0.4163	37.900	18.1	14.1	0.724	0.626	1.350	2.16	6.514	0.988	0.362
18	0.4433	38.260	18.5	15.0	0.730	0.635	1.365	2.15	6.505	1.000	0.365

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	160.290			147.800
Moisture content: Dry soil+tare, gms.	113.600			107.000
Moisture content: Tare, gms.	29.800			30.690
Moisture, %	55.7	57.2	55.2	53.5
Moist specimen weight, gms.	118.7			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	103.9	104.9	105.8	
Dry density, pcf	66.7	66.7	68.2	
Void ratio	1.5734	1.5734	1.5190	
Saturation, %	97.4	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.143 tsf
 Consolidation back pressure = 5.141 tsf
 Consolidation effective confining stress = 2.002 tsf
 Peak Stress = 1.320 tsf at reading no. 4
 Ult. Stress = 1.153 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0139	20.710	0.0	0.0	0.000	2.002	2.002	1.00	5.141	2.002	0.000
1	0.0170	25.380	4.7	0.1	0.221	1.869	2.090	1.12	5.274	1.980	0.111
2	0.0219	30.390	9.7	0.3	0.457	1.673	2.130	1.27	5.470	1.902	0.229
3	0.0446	44.280	23.6	1.1	1.104	1.209	2.313	1.91	5.934	1.761	0.552
4	0.0686	49.130	28.4	2.0	1.320	1.089	2.409	2.21	6.054	1.749	0.660
5	0.0936	49.370	28.7	2.8	1.319	1.100	2.419	2.20	6.043	1.760	0.660
6	0.1183	49.440	28.7	3.7	1.310	1.125	2.435	2.16	6.018	1.780	0.655
7	0.1443	49.620	28.9	4.7	1.306	1.122	2.428	2.16	6.021	1.775	0.653
8	0.1703	49.720	29.0	5.6	1.298	1.139	2.437	2.14	6.004	1.788	0.649
9	0.1960	49.680	29.0	6.5	1.283	1.146	2.429	2.12	5.997	1.788	0.642
10	0.2322	49.620	28.9	7.8	1.263	1.158	2.421	2.09	5.985	1.790	0.632
11	0.2679	48.210	27.5	9.1	1.185	1.271	2.456	1.93	5.872	1.863	0.592
12	0.2938	48.330	27.6	10.0	1.178	1.263	2.441	1.93	5.880	1.852	0.589
13	0.3199	48.330	27.6	10.9	1.166	1.267	2.433	1.92	5.876	1.850	0.583
14	0.3458	48.610	27.9	11.8	1.165	1.238	2.403	1.94	5.905	1.821	0.583
15	0.3736	48.790	28.1	12.8	1.160	1.228	2.388	1.94	5.915	1.808	0.580
16	0.4005	48.970	28.3	13.8	1.154	1.212	2.366	1.95	5.931	1.789	0.577
17	0.4274	49.310	28.6	14.7	1.155	1.198	2.353	1.96	5.945	1.776	0.578
18	0.4350	49.340	28.6	15.0	1.153	1.203	2.356	1.96	5.940	1.779	0.576

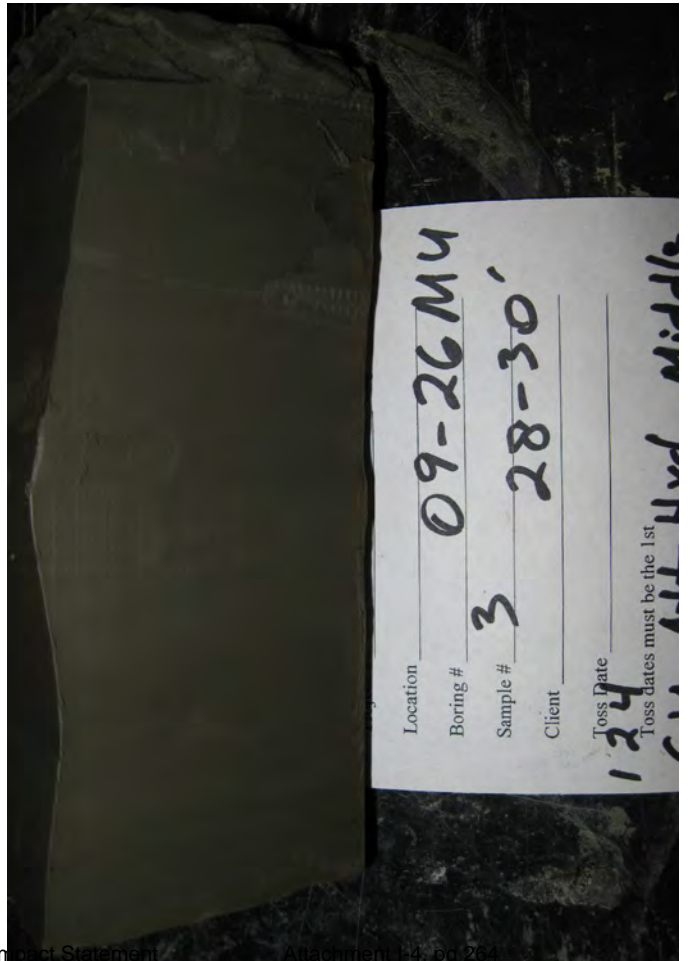
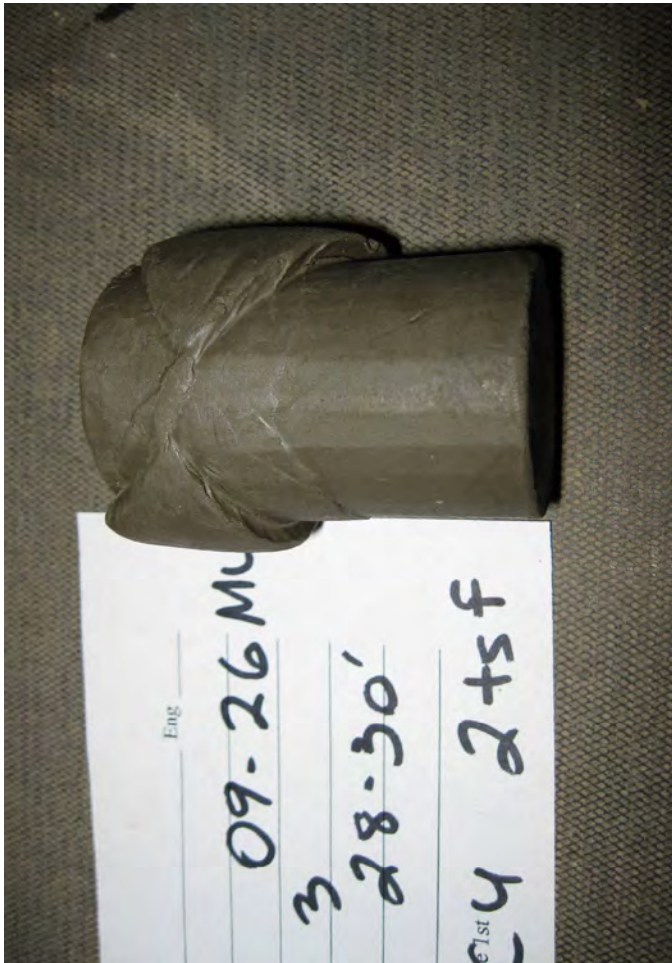
Parameters for Specimen No. 3

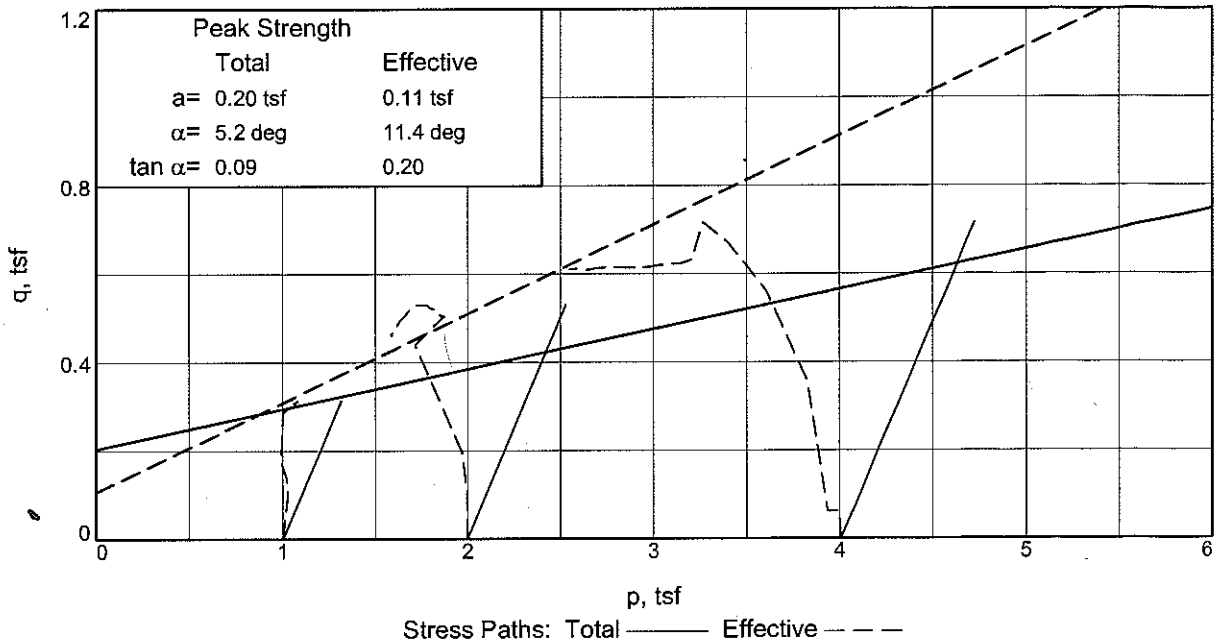
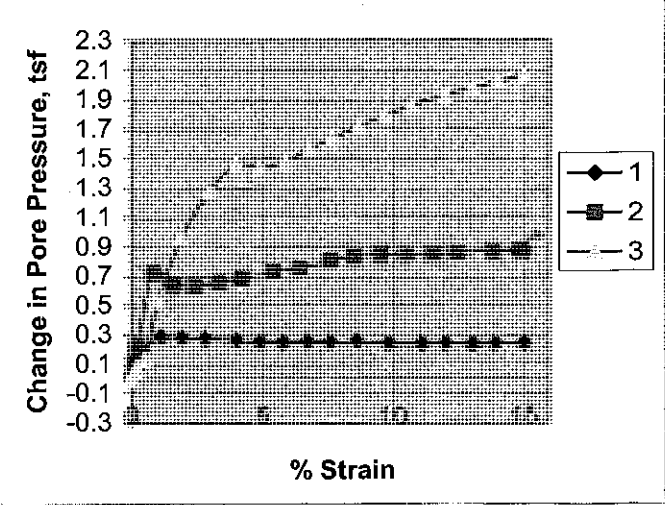
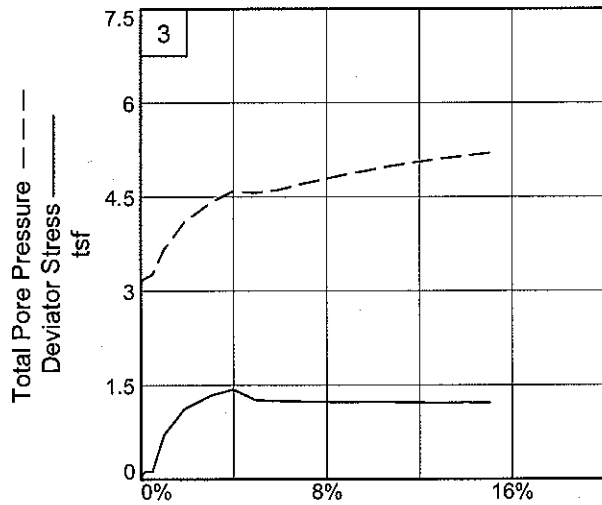
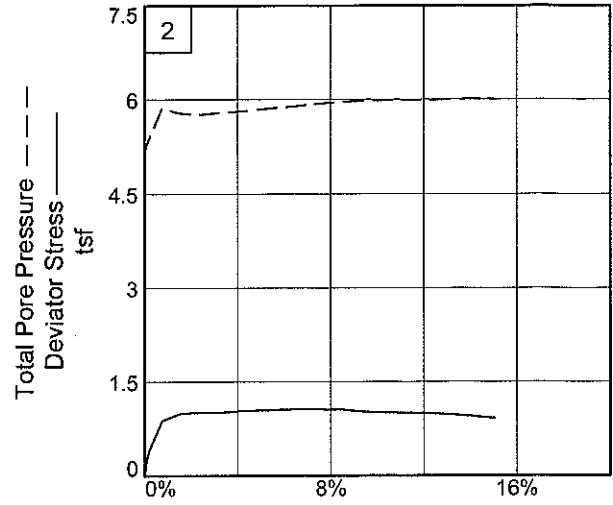
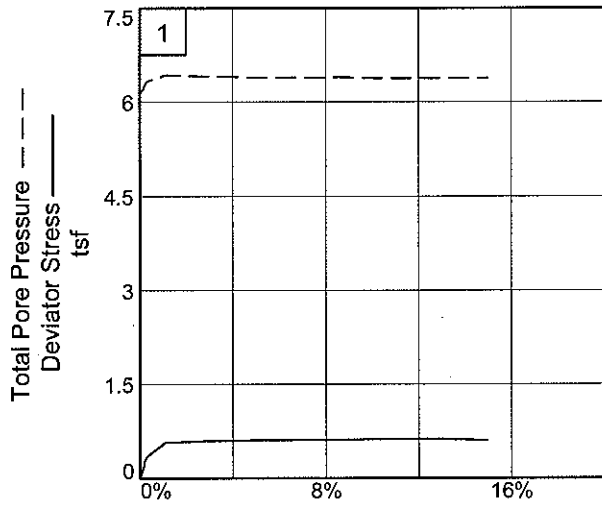
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	124.750			145.450
Moisture content: Dry soil+tare, gms.	91.260			106.970
Moisture content: Tare, gms.	31.010			30.300
Moisture, %	55.6	56.1	52.2	50.2
Moist specimen weight, gms.	119.3			
Diameter, in.	1.40	1.40	1.38	
Area, in. ²	1.54	1.54	1.50	
Height, in.	2.81	2.81	2.77	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	105.1	105.4	107.3	
Dry density, pcf	67.5	67.5	70.5	
Void ratio	1.5425	1.5425	1.4349	
Saturation, %	99.1	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.142 tsf
 Consolidation back pressure = 3.135 tsf
 Consolidation effective confining stress = 4.007 tsf
 Peak Stress = 2.198 tsf at reading no. 6
 Ult. Stress = 1.536 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0485	19.740	0.0	0.0	0.000	4.007	4.007	1.00	3.135	4.007	0.000
1	0.0506	26.790	7.1	0.1	0.339	3.803	4.142	1.09	3.339	3.972	0.169
2	0.0536	34.510	14.8	0.2	0.709	3.592	4.301	1.20	3.550	3.946	0.354
3	0.0626	44.980	25.2	0.5	1.207	3.213	4.420	1.38	3.929	3.817	0.604
4	0.0863	58.190	38.5	1.4	1.823	2.743	4.566	1.66	4.399	3.655	0.912
5	0.1113	64.570	44.8	2.3	2.106	2.488	4.594	1.85	4.654	3.541	1.053
6	0.1361	66.950	47.2	3.2	2.198	2.366	4.564	1.93	4.776	3.465	1.099
7	0.1611	66.710	47.0	4.1	2.166	2.315	4.481	1.94	4.827	3.398	1.083
8	0.1860	67.020	47.3	5.0	2.160	2.261	4.421	1.96	4.881	3.341	1.080
9	0.2118	66.860	47.1	5.9	2.132	2.221	4.353	1.96	4.921	3.287	1.066
10	0.2390	66.310	46.6	6.9	2.085	2.198	4.283	1.95	4.944	3.240	1.042
11	0.2469	66.160	46.4	7.2	2.072	2.172	4.244	1.95	4.970	3.208	1.036
12	0.2837	65.460	45.7	8.5	2.011	2.146	4.157	1.94	4.996	3.152	1.006
13	0.3015	65.000	45.3	9.1	1.977	2.114	4.091	1.94	5.028	3.102	0.988
14	0.3276	64.850	45.1	10.1	1.950	2.091	4.041	1.93	5.051	3.066	0.975
15	0.3544	63.350	43.6	11.1	1.865	2.039	3.904	1.91	5.103	2.971	0.932
16	0.3812	62.160	42.4	12.0	1.794	2.046	3.840	1.88	5.096	2.943	0.897
17	0.4083	60.060	40.3	13.0	1.686	2.011	3.697	1.84	5.131	2.854	0.843
18	0.4420	58.410	38.7	14.2	1.595	2.018	3.613	1.79	5.124	2.815	0.797
19	0.4624	57.310	37.6	15.0	1.536	2.048	3.584	1.75	5.094	2.816	0.768





Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-19, Fargo, Brenna Formation

Depth: 32-34'

Sample No.: Boring 09-27MU, #3

Project No.: D-09-03127 Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

11/9/2009
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Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, Brenna Formation
Depth: 32-34' **Sample Number:** Boring 09-27MU, #3
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL**=117 **PL**=25 **PI**=92
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	101.750			142.150
Moisture content: Dry soil+tare, gms.	72.560			96.480
Moisture content: Tare, gms.	30.370			30.280
Moisture, %	69.2	69.2	69.2	69.0
Moist specimen weight, gms.	112.7			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	100.0	100.1	100.1	
Dry density, pcf	59.1	59.1	59.1	
Void ratio	1.9031	1.9031	1.9031	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.142 tsf
Consolidation back pressure = 6.139 tsf
Consolidation effective confining stress = 1.003 tsf
Peak Stress = 0.627 tsf at reading no. 16
Ult. Stress = 0.600 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0036	18.360	0.0	0.0	0.000	1.003	1.003	1.00	6.139	1.003	0.000
1	0.0079	22.550	4.2	0.2	0.198	0.929	1.127	1.21	6.213	1.028	0.099
2	0.0090	24.130	5.8	0.2	0.272	0.887	1.159	1.31	6.255	1.023	0.136
3	0.0122	25.840	7.5	0.3	0.352	0.816	1.168	1.43	6.326	0.992	0.176
4	0.0344	30.600	12.2	1.1	0.572	0.717	1.289	1.80	6.425	1.003	0.286
5	0.0574	30.900	12.5	1.9	0.581	0.724	1.305	1.80	6.418	1.015	0.291
6	0.0824	31.280	12.9	2.8	0.593	0.730	1.323	1.81	6.412	1.027	0.297
7	0.1163	31.560	13.2	4.0	0.599	0.744	1.343	1.80	6.398	1.043	0.299
8	0.1412	31.760	13.4	4.9	0.602	0.754	1.356	1.80	6.388	1.055	0.301
9	0.1660	31.900	13.5	5.8	0.603	0.758	1.361	1.80	6.384	1.059	0.301
10	0.1919	32.190	13.8	6.7	0.610	0.754	1.364	1.81	6.388	1.059	0.305
11	0.2178	32.350	14.0	7.6	0.611	0.756	1.367	1.81	6.386	1.061	0.305
12	0.2447	32.600	14.2	8.6	0.615	0.749	1.364	1.82	6.393	1.057	0.308
13	0.2807	32.940	14.6	9.8	0.621	0.763	1.384	1.81	6.379	1.074	0.311
14	0.3155	33.180	14.8	11.1	0.623	0.766	1.389	1.81	6.376	1.077	0.311
15	0.3417	33.390	15.0	12.0	0.625	0.763	1.388	1.82	6.379	1.075	0.312
16	0.3694	33.620	15.3	13.0	0.627	0.767	1.394	1.82	6.375	1.081	0.314
17	0.3963	33.500	15.1	13.9	0.616	0.762	1.378	1.81	6.380	1.070	0.308
18	0.4250	33.290	14.9	15.0	0.600	0.763	1.363	1.79	6.379	1.063	0.300

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	125.260			140.970
Moisture content: Dry soil+tare, gms.	86.610			97.950
Moisture content: Tare, gms.	30.000			31.210
Moisture, %	68.3	68.2	66.0	64.5
Moist specimen weight, gms.	112.5			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.53	1.53	1.50	
Height, in.	2.79	2.79	2.77	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	100.4	100.4	101.2	
Dry density, pcf	59.7	59.7	61.0	
Void ratio	1.8767	1.8767	1.8152	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.135 tsf
 Consolidation back pressure = 5.137 tsf
 Consolidation effective confining stress = 1.998 tsf
 Peak Stress = 1.061 tsf at reading no. 9
 Ult. Stress = 0.922 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0058	18.300	0.0	0.0	0.000	1.998	1.998	1.00	5.137	1.998	0.000
1	0.0079	22.850	4.6	0.1	0.218	1.886	2.104	1.12	5.249	1.995	0.109
2	0.0107	26.540	8.2	0.2	0.394	1.773	2.167	1.22	5.362	1.970	0.197
3	0.0267	36.830	18.5	0.8	0.880	1.275	2.155	1.69	5.860	1.715	0.440
4	0.0495	39.450	21.2	1.6	0.996	1.355	2.351	1.74	5.780	1.853	0.498
5	0.0726	39.910	21.6	2.4	1.009	1.368	2.377	1.74	5.767	1.873	0.505
6	0.0975	40.240	21.9	3.3	1.015	1.339	2.354	1.76	5.796	1.847	0.508
7	0.1232	40.990	22.7	4.2	1.040	1.315	2.355	1.79	5.820	1.835	0.520
8	0.1561	41.450	23.2	5.4	1.048	1.270	2.318	1.83	5.865	1.794	0.524
9	0.1822	41.980	23.7	6.4	1.061	1.248	2.309	1.85	5.887	1.779	0.531
10	0.2169	42.290	24.0	7.6	1.061	1.194	2.255	1.89	5.941	1.724	0.530
11	0.2429	42.380	24.1	8.5	1.054	1.171	2.225	1.90	5.964	1.698	0.527
12	0.2698	41.780	23.5	9.5	1.017	1.155	2.172	1.88	5.980	1.663	0.508
13	0.2966	41.760	23.5	10.5	1.005	1.147	2.152	1.88	5.988	1.650	0.503
14	0.3236	41.920	23.6	11.5	1.001	1.147	2.148	1.87	5.988	1.648	0.501
15	0.3506	41.930	23.6	12.4	0.990	1.138	2.128	1.87	5.997	1.633	0.495
16	0.3875	41.510	23.2	13.8	0.958	1.129	2.087	1.85	6.006	1.608	0.479
17	0.4155	41.010	22.7	14.8	0.926	1.121	2.047	1.83	6.014	1.584	0.463
18	0.4231	40.980	22.7	15.0	0.922	1.129	2.051	1.82	6.006	1.590	0.461

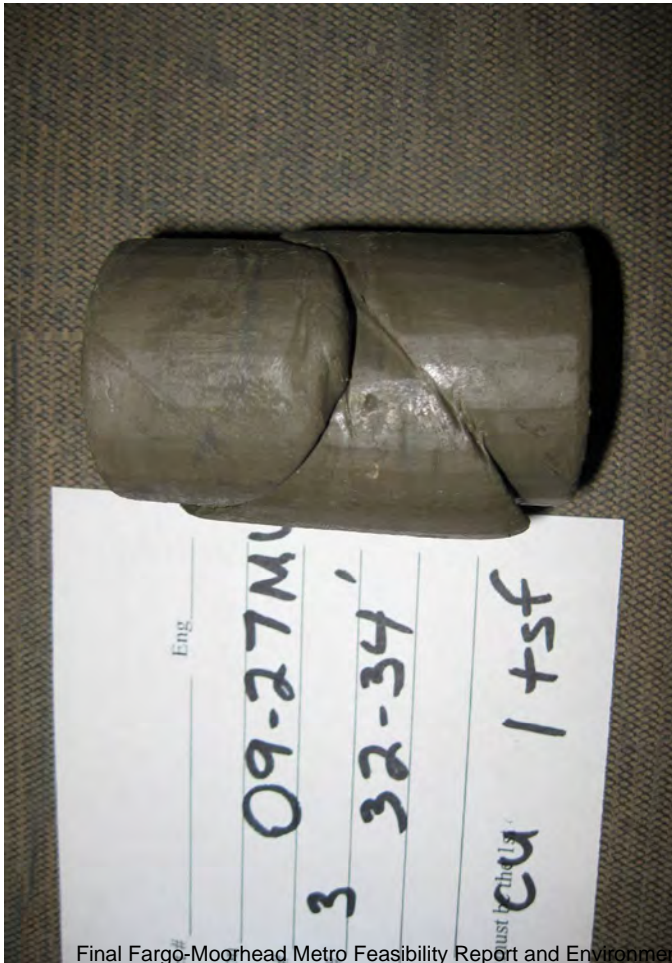
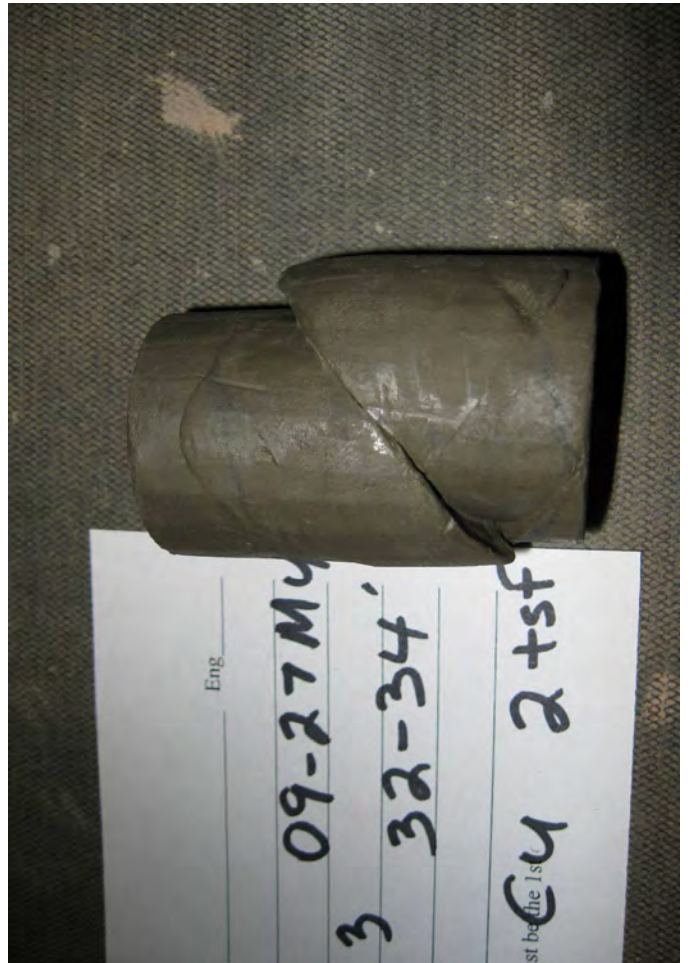
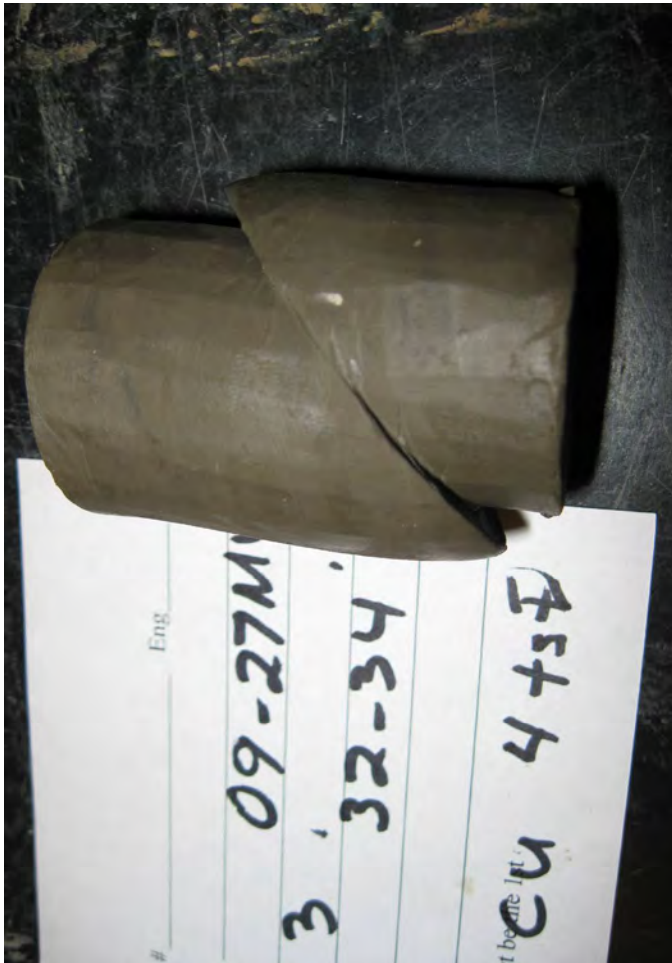
Parameters for Specimen No. 3

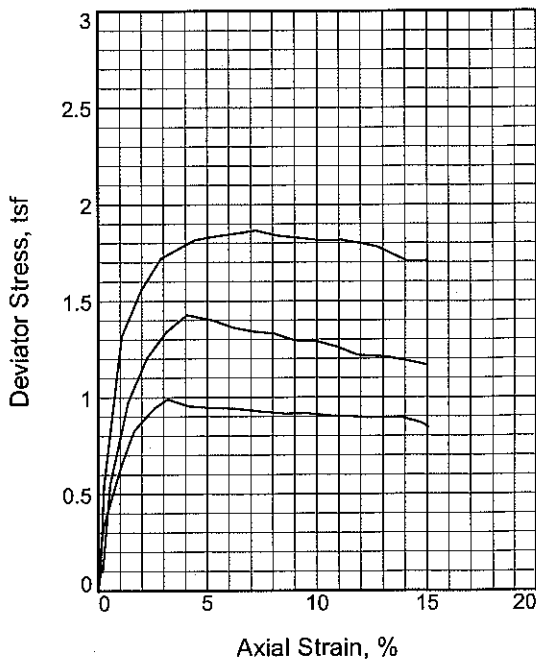
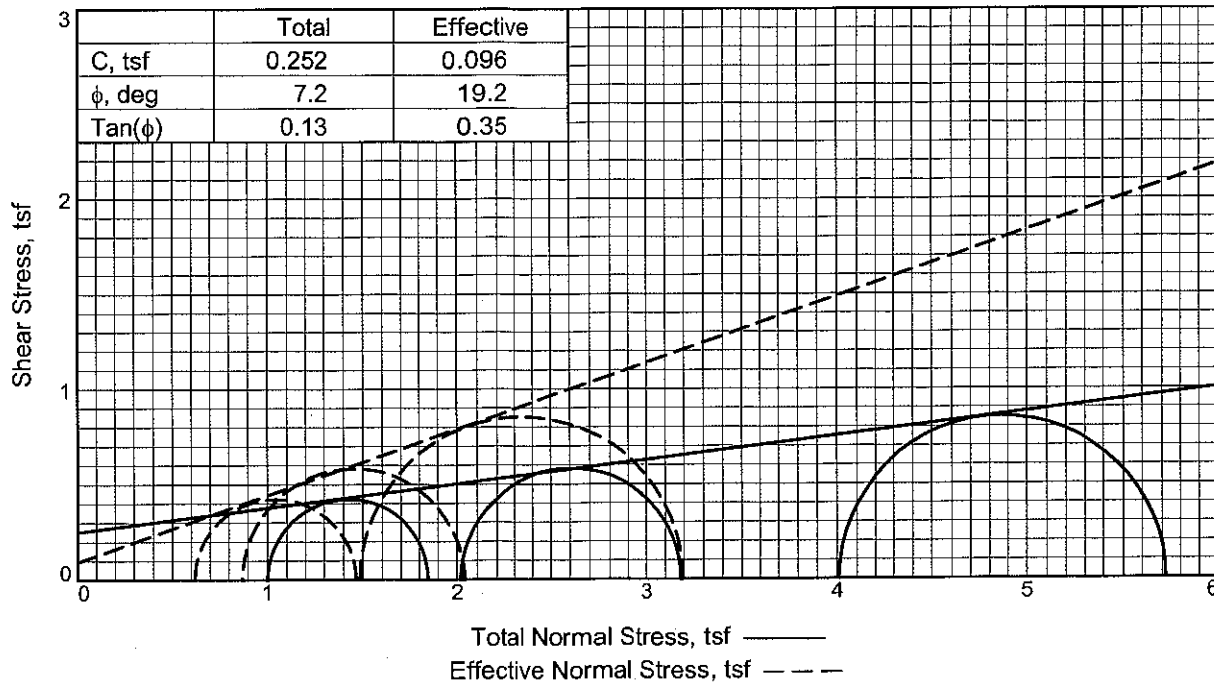
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.180			133.220
Moisture content: Dry soil+tare, gms.	88.460			95.800
Moisture content: Tare, gms.	29.780			30.960
Moisture, %	71.1	72.3	65.5	57.7
Moist specimen weight, gms.	111.9			
Diameter, in.	1.40	1.40	1.37	
Area, in. ²	1.54	1.54	1.48	
Height, in.	2.81	2.81	2.75	
Net decrease in height, in.		0.00	0.06	
Wet Density, pcf	98.3	99.0	101.4	
Dry density, pcf	57.4	57.4	61.3	
Void ratio	1.9886	1.9886	1.7999	
Saturation, %	98.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 3.129 tsf
 Consolidation effective confining stress = 4.009 tsf
 Peak Stress = 1.433 tsf at reading no. 7
 Ult. Stress = 1.220 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0061	16.750	0.0	0.0	0.000	4.009	4.009	1.00	3.129	4.009	0.000
1	0.0082	18.490	1.7	0.1	0.085	3.960	4.045	1.02	3.178	4.002	0.042
2	0.0112	19.310	2.6	0.2	0.124	3.933	4.057	1.03	3.205	3.995	0.062
3	0.0201	19.310	2.6	0.5	0.124	3.874	3.998	1.03	3.264	3.936	0.062
4	0.0338	31.580	14.8	1.0	0.715	3.470	4.185	1.21	3.668	3.828	0.358
5	0.0577	40.250	23.5	1.9	1.123	3.045	4.168	1.37	4.093	3.607	0.562
6	0.0895	45.220	28.5	3.0	1.345	2.726	4.071	1.49	4.412	3.398	0.672
7	0.1156	47.390	30.6	4.0	1.433	2.550	3.983	1.56	4.588	3.267	0.717
8	0.1416	44.090	27.3	4.9	1.266	2.573	3.839	1.49	4.565	3.206	0.633
9	0.1672	44.000	27.3	5.9	1.250	2.532	3.782	1.49	4.606	3.157	0.625
10	0.1933	44.180	27.4	6.8	1.245	2.443	3.688	1.51	4.695	3.066	0.623
11	0.2189	44.190	27.4	7.7	1.233	2.370	3.603	1.52	4.768	2.987	0.617
12	0.2462	44.390	27.6	8.7	1.229	2.288	3.517	1.54	4.850	2.903	0.615
13	0.2737	44.730	28.0	9.7	1.231	2.219	3.450	1.55	4.919	2.834	0.615
14	0.3008	45.080	28.3	10.7	1.232	2.152	3.384	1.57	4.986	2.768	0.616
15	0.3367	45.380	28.6	12.0	1.227	2.079	3.306	1.59	5.059	2.693	0.614
16	0.3635	45.510	28.8	13.0	1.219	2.029	3.248	1.60	5.109	2.639	0.610
17	0.3916	46.020	29.3	14.0	1.226	1.986	3.212	1.62	5.152	2.599	0.613
18	0.4195	46.230	29.5	15.0	1.220	1.942	3.162	1.63	5.196	2.552	0.610





Sample No.	1	2	3	
Initial	Water Content, %	52.3	49.7	50.2
	Dry Density, pcf	69.9	72.1	70.8
	Saturation, %	100.0	100.0	98.3
	Void Ratio	1.4140	1.3423	1.3827
	Diameter, in.	1.42	1.42	1.41
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	51.7	47.1	46.5
	Dry Density, pcf	70.4	74.3	74.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3986	1.2727	1.2568
	Diameter, in.	1.42	1.40	1.39
	Height, in.	2.80	2.78	2.76
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.00	2.02	4.01	
Back Pressure, tsf	6.14	5.12	3.13	
Cell Pressure, tsf	7.14	7.14	7.14	
Peak Deviator Stress, tsf	0.99	1.43	1.87	
Total Pore Pr., tsf	6.66	6.09	5.30	
Ultimate Deviator Stress, tsf	0.85	1.17	1.71	
Total Pore Pr., tsf	6.52	6.27	5.66	
Maj. Eff. Stress at Ultimate, tsf	1.47	2.48	3.71	
Min. Eff. Stress at Ultimate, tsf	0.48	1.05	1.84	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 89 PL= 20 PI= 69

Assumed Specific Gravity= 2.704

Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Brenna / Argusville Transition

Location: SE-F-19, Fargo, ~~Argusville Formation~~

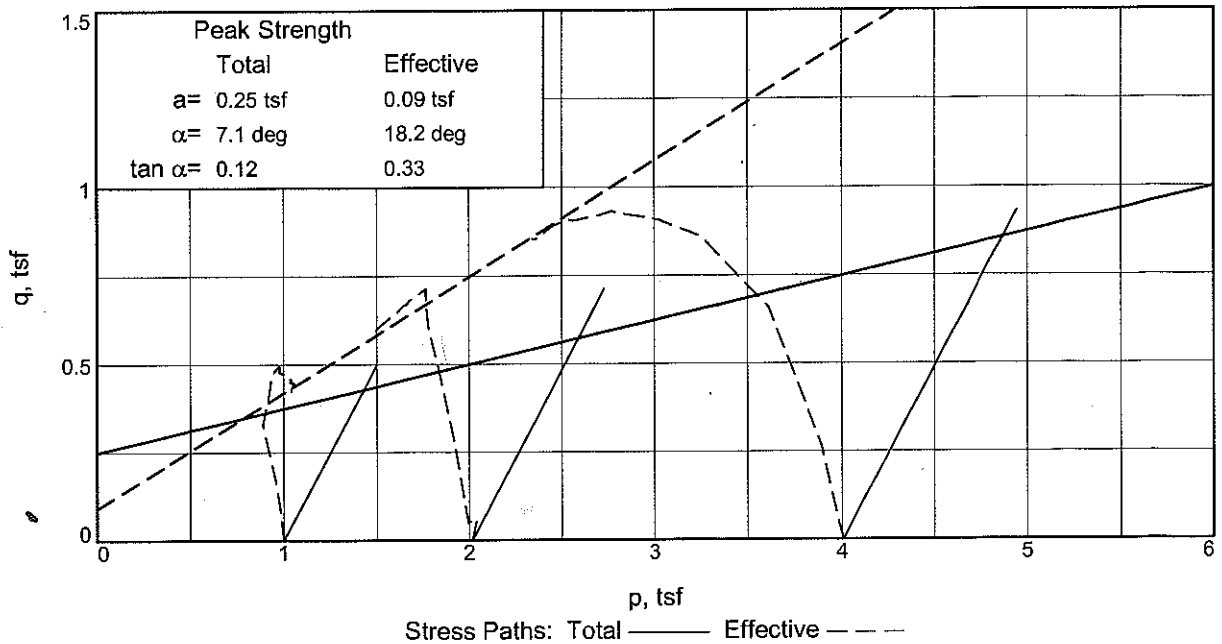
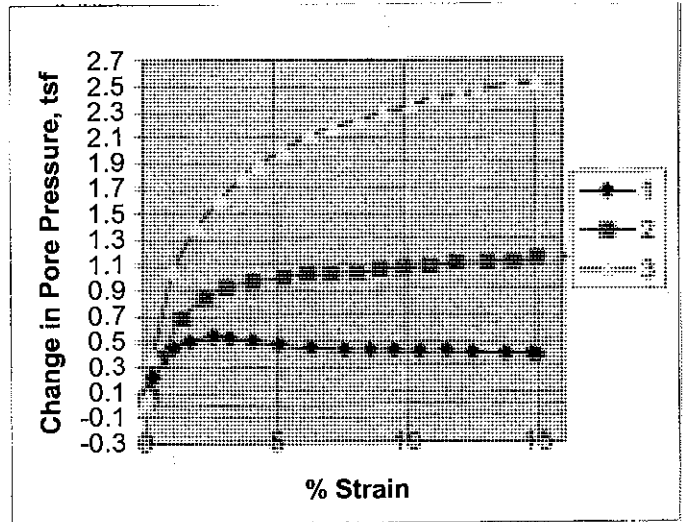
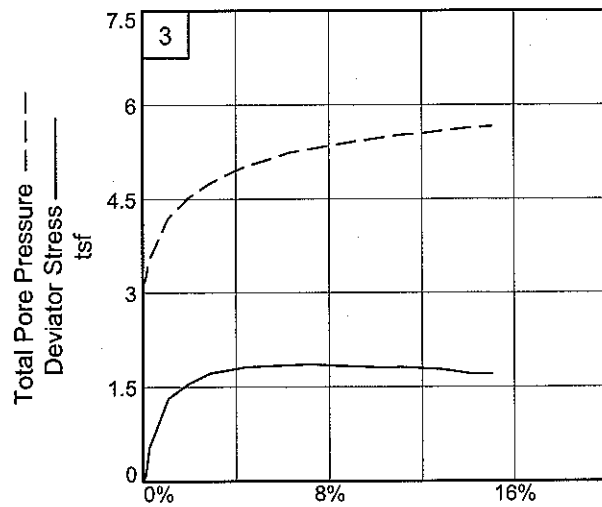
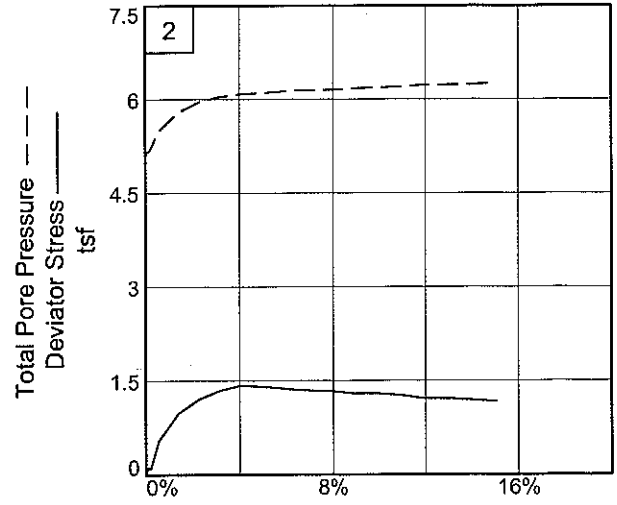
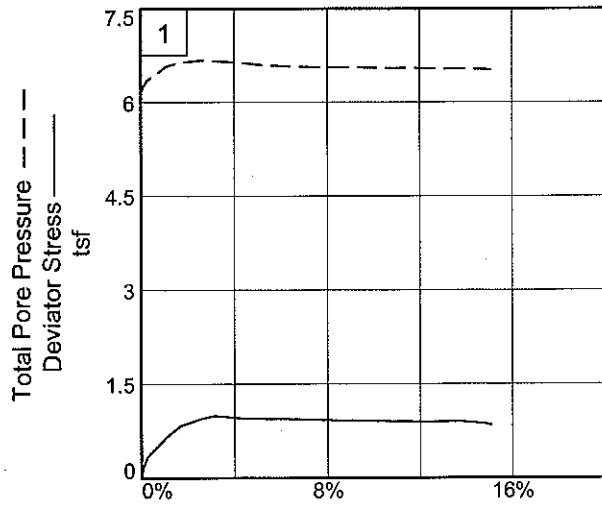
Sample Number: Boring 09-27MU, #4

Depth: 64-66'

Proj. No.: BL-09-03127

Date Sampled:

BRAUN™
INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-19, Fargo, ~~Argusville Formation~~

Depth: 64-66'

Brenna / Argusville Transition

Sample No.: Boring 09-27MU, #4

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

11/9/2009

1:47 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, ~~Argusville Formation~~
Depth: 64-66' **Sample Number:** Boring 09-27MU, #4
Description: FAT CLAY, gray (CH) **Brenna / Argusville Transition**
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.704 **LL**=89 **PL**=20 **PI**=69
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.490			154.160
Moisture content: Dry soil+tare, gms.	91.590			112.320
Moisture content: Tare, gms.	30.590			30.470
Moisture, %	52.3	52.3	51.7	51.1
Moist specimen weight, gms.	124.2			
Diameter, in.	1.42	1.42	1.42	
Area, in. ²	1.58	1.58	1.58	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.5	106.5	106.8	
Dry density, pcf	69.9	69.9	70.4	
Void ratio	1.4140	1.4140	1.3986	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 6.139 tsf
 Consolidation effective confining stress = 1.001 tsf
 Peak Stress = 0.991 tsf at reading no. 6
 Ult. Stress = 0.845 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0199	19.340	0.0	0.0	0.000	1.001	1.001	1.00	6.139	1.001	0.000
1	0.0220	23.000	3.7	0.1	0.167	0.900	1.067	1.19	6.240	0.983	0.083
2	0.0270	26.730	7.4	0.3	0.337	0.789	1.126	1.43	6.351	0.957	0.168
3	0.0506	33.900	14.6	1.1	0.658	0.560	1.218	2.17	6.580	0.889	0.329
4	0.0667	37.840	18.5	1.7	0.831	0.507	1.338	2.64	6.633	0.922	0.415
5	0.0925	40.580	21.2	2.6	0.945	0.464	1.409	3.04	6.676	0.936	0.472
6	0.1094	41.770	22.4	3.2	0.991	0.482	1.473	3.06	6.658	0.978	0.496
7	0.1352	41.160	21.8	4.1	0.955	0.501	1.456	2.91	6.639	0.979	0.478
8	0.1613	41.160	21.8	5.1	0.946	0.535	1.481	2.77	6.605	1.008	0.473
9	0.1962	41.340	22.0	6.3	0.941	0.562	1.503	2.67	6.578	1.033	0.471
10	0.2329	41.280	21.9	7.6	0.926	0.575	1.501	2.61	6.565	1.038	0.463
11	0.2601	41.260	21.9	8.6	0.915	0.577	1.492	2.59	6.563	1.034	0.457
12	0.2870	41.510	22.2	9.5	0.916	0.583	1.499	2.57	6.557	1.041	0.458
13	0.3140	41.500	22.2	10.5	0.905	0.593	1.498	2.53	6.547	1.046	0.453
14	0.3416	41.650	22.3	11.5	0.902	0.585	1.487	2.54	6.555	1.036	0.451
15	0.3696	41.730	22.4	12.5	0.895	0.600	1.495	2.49	6.540	1.047	0.447
16	0.4067	42.110	22.8	13.8	0.896	0.609	1.505	2.47	6.531	1.057	0.448
17	0.4343	41.530	22.2	14.8	0.863	0.612	1.475	2.41	6.528	1.044	0.432
18	0.4410	41.130	21.8	15.0	0.845	0.619	1.464	2.37	6.521	1.042	0.423

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	106.290			153.410
Moisture content: Dry soil+tare, gms.	80.980			115.020
Moisture content: Tare, gms.	30.010			30.920
Moisture, %	49.7	49.6	47.1	45.6
Moist specimen weight, gms.	125.1			
Diameter, in.	1.42	1.42	1.40	
Area, in. ²	1.57	1.57	1.54	
Height, in.	2.81	2.81	2.78	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	107.9	107.8	109.2	
Dry density, pcf	72.1	72.1	74.3	
Void ratio	1.3423	1.3423	1.2727	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.139 tsf
 Consolidation back pressure = 5.122 tsf
 Consolidation effective confining stress = 2.017 tsf
 Peak Stress = 1.428 tsf at reading no. 7
 Ult. Stress = 1.165 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0070	19.370	0.0	0.0	0.000	2.017	2.017	1.00	5.122	2.017	0.000
1	0.0099	21.970	2.6	0.1	0.121	1.981	2.102	1.06	5.158	2.042	0.061
2	0.0128	21.510	2.1	0.2	0.100	1.945	2.045	1.05	5.194	1.995	0.050
3	0.0223	31.240	11.9	0.6	0.551	1.647	2.198	1.33	5.492	1.923	0.276
4	0.0456	40.680	21.3	1.4	0.982	1.342	2.324	1.73	5.797	1.833	0.491
5	0.0698	45.830	26.5	2.3	1.208	1.176	2.384	2.03	5.963	1.780	0.604
6	0.0944	49.010	29.6	3.1	1.341	1.095	2.436	2.22	6.044	1.766	0.671
7	0.1201	51.240	31.9	4.1	1.428	1.050	2.478	2.36	6.089	1.764	0.714
8	0.1543	50.960	31.6	5.3	1.398	1.025	2.423	2.36	6.114	1.724	0.699
9	0.1800	50.450	31.1	6.2	1.362	0.996	2.358	2.37	6.143	1.677	0.681
10	0.2057	50.300	30.9	7.1	1.342	0.992	2.334	2.35	6.147	1.663	0.671
11	0.2309	50.370	31.0	8.1	1.332	0.980	2.312	2.36	6.159	1.646	0.666
12	0.2566	49.810	30.4	9.0	1.294	0.961	2.255	2.35	6.178	1.608	0.647
13	0.2837	50.080	30.7	9.9	1.292	0.949	2.241	2.36	6.190	1.595	0.646
14	0.3105	49.680	30.3	10.9	1.261	0.936	2.197	2.35	6.203	1.567	0.631
15	0.3375	48.960	29.6	11.9	1.218	0.909	2.127	2.34	6.230	1.518	0.609
16	0.3723	49.190	29.8	13.1	1.210	0.904	2.114	2.34	6.235	1.509	0.605
17	0.3992	48.980	29.6	14.1	1.188	0.899	2.087	2.32	6.240	1.493	0.594
18	0.4250	48.730	29.4	15.0	1.165	0.871	2.036	2.34	6.268	1.454	0.583

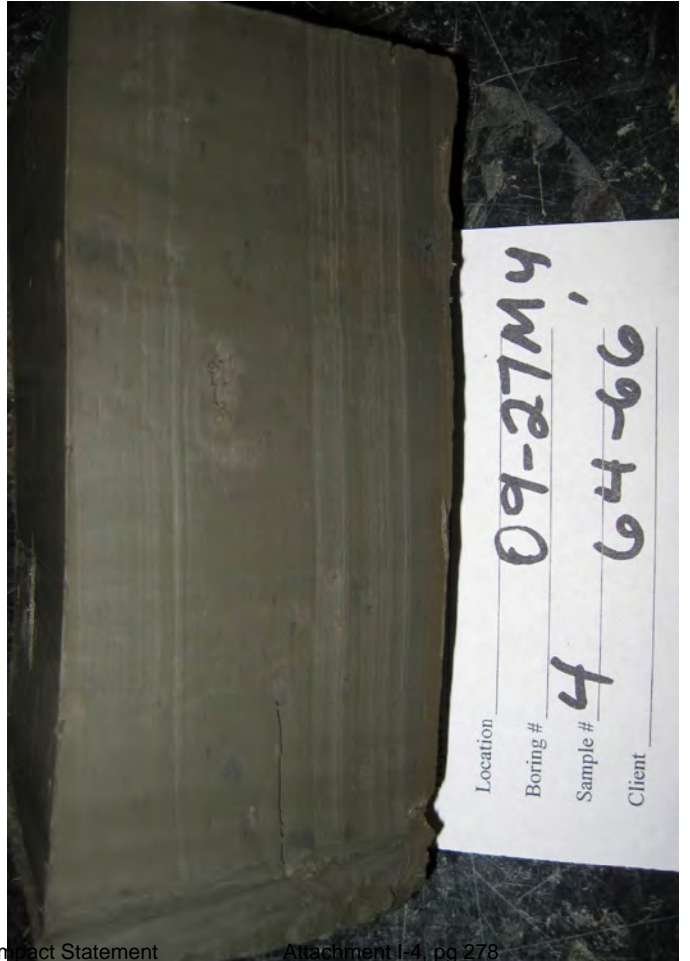
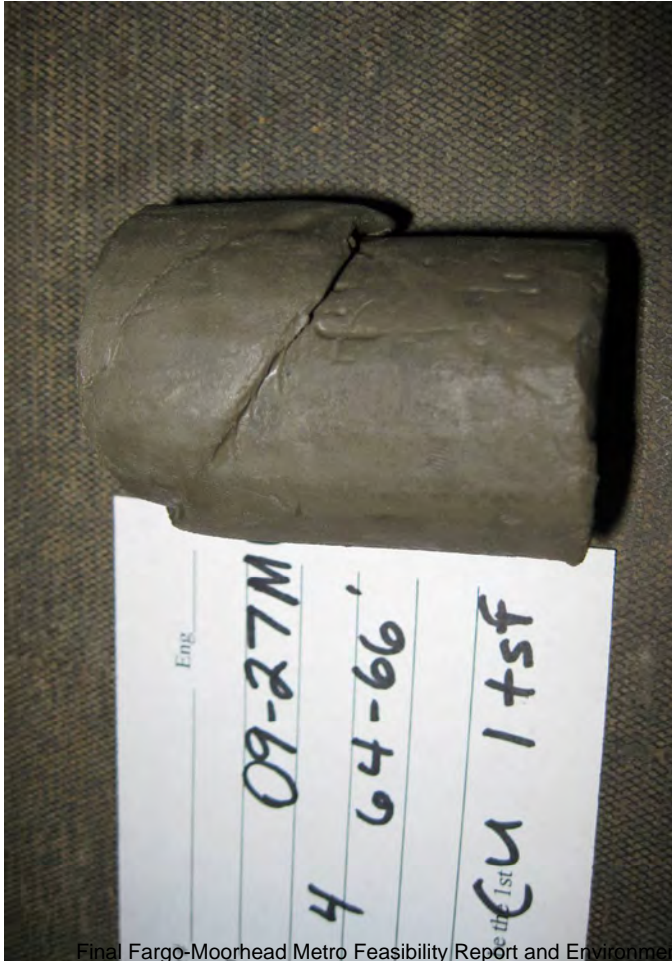
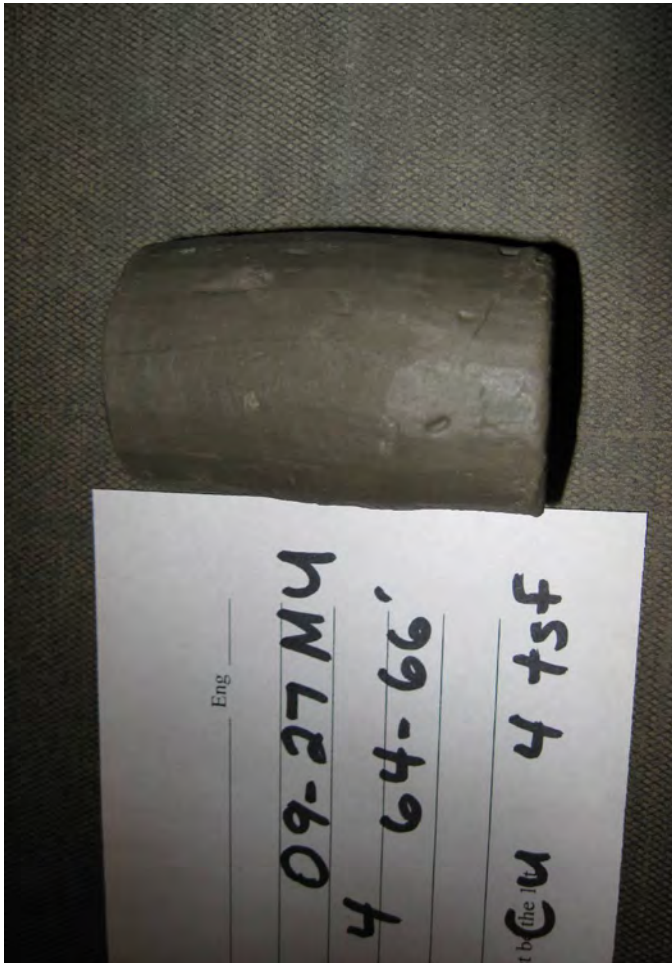
Parameters for Specimen No. 3

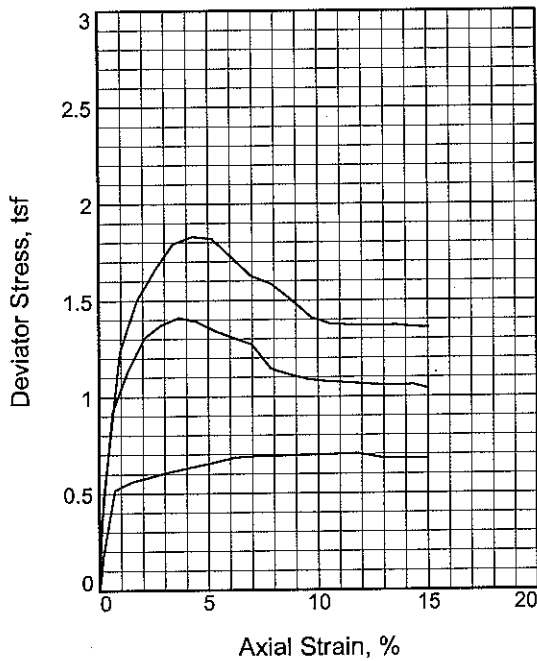
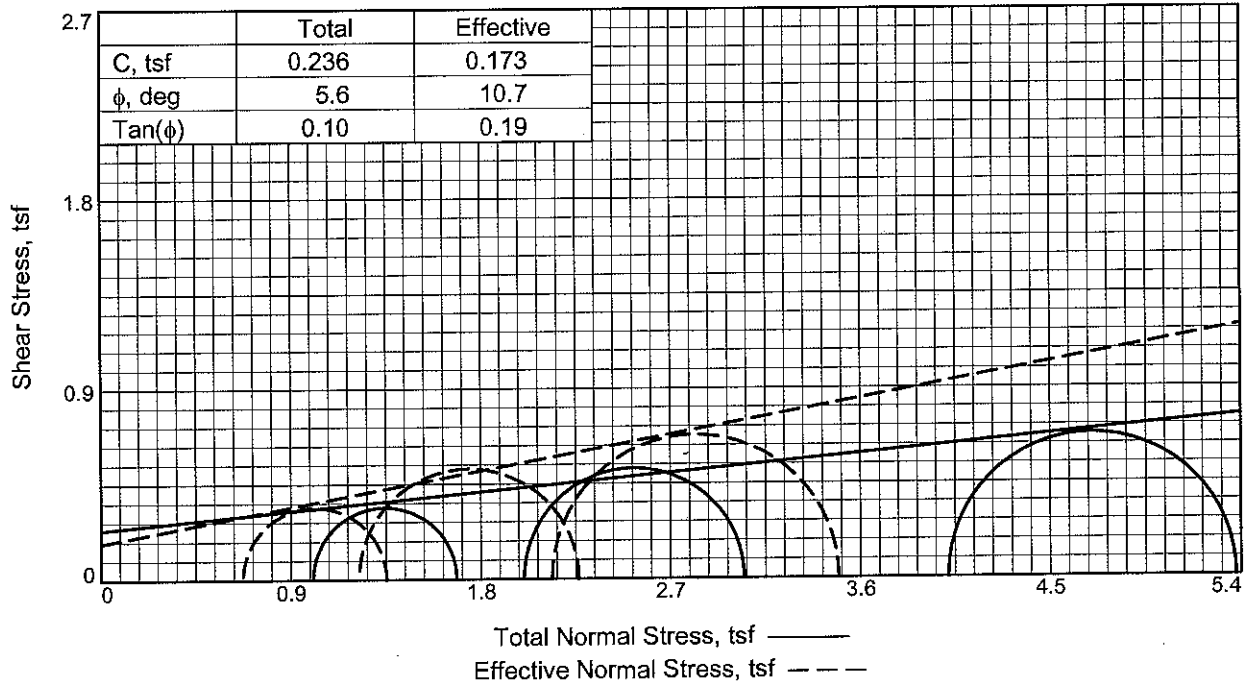
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.690			145.990
Moisture content: Dry soil+tare, gms.	96.600			110.880
Moisture content: Tare, gms.	30.740			30.240
Moisture, %	50.2	51.1	46.5	43.5
Moist specimen weight, gms.	122.6			
Diameter, in.	1.41	1.41	1.39	
Area, in. ²	1.56	1.56	1.51	
Height, in.	2.81	2.81	2.76	
Net decrease in height, in.		0.00	0.05	
Wet Density, pcf	106.4	107.1	109.6	
Dry density, pcf	70.8	70.8	74.8	
Void ratio	1.3827	1.3827	1.2568	
Saturation, %	98.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.140 tsf
 Consolidation back pressure = 3.130 tsf
 Consolidation effective confining stress = 4.010 tsf
 Peak Stress = 1.866 tsf at reading no. 10
 Ult. Stress = 1.709 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0069	20.930	0.0	0.0	0.000	4.010	4.010	1.00	3.130	4.010	0.000
1	0.0098	22.820	1.9	0.1	0.090	3.941	4.031	1.02	3.199	3.986	0.045
2	0.0139	32.190	11.3	0.3	0.536	3.626	4.162	1.15	3.514	3.894	0.268
3	0.0366	48.820	27.9	1.1	1.317	2.955	4.272	1.45	4.185	3.614	0.659
4	0.0615	54.230	33.3	2.0	1.558	2.615	4.173	1.60	4.525	3.394	0.779
5	0.0864	58.040	37.1	2.9	1.721	2.394	4.115	1.72	4.746	3.254	0.860
6	0.1117	59.660	38.7	3.8	1.779	2.218	3.997	1.80	4.922	3.107	0.889
7	0.1292	60.730	39.8	4.4	1.816	2.118	3.934	1.86	5.022	3.026	0.908
8	0.1543	61.520	40.6	5.3	1.834	2.014	3.848	1.91	5.126	2.931	0.917
9	0.1801	62.270	41.3	6.3	1.850	1.899	3.749	1.97	5.241	2.824	0.925
10	0.2060	63.050	42.1	7.2	1.866	1.840	3.706	2.01	5.300	2.773	0.933
11	0.2331	62.890	42.0	8.2	1.839	1.777	3.616	2.03	5.363	2.697	0.920
12	0.2599	63.050	42.1	9.2	1.826	1.716	3.542	2.06	5.424	2.629	0.913
13	0.2868	63.190	42.3	10.2	1.813	1.668	3.481	2.09	5.472	2.574	0.906
14	0.3129	63.720	42.8	11.1	1.816	1.615	3.431	2.12	5.525	2.523	0.908
15	0.3396	63.780	42.9	12.1	1.799	1.591	3.390	2.13	5.549	2.490	0.899
16	0.3585	63.660	42.7	12.8	1.780	1.557	3.337	2.14	5.583	2.447	0.890
17	0.3956	62.530	41.6	14.1	1.706	1.502	3.208	2.14	5.638	2.355	0.853
18	0.4210	63.050	42.1	15.0	1.709	1.485	3.194	2.15	5.655	2.339	0.854





Sample No.	1	2	3	
Initial	Water Content, %	65.1	65.0	65.2
	Dry Density, pcf	61.0	61.1	60.7
	Saturation, %	98.7	98.7	98.1
	Void Ratio	1.8130	1.8107	1.8265
	Diameter, in.	1.42	1.40	1.41
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	65.4	63.7	63.1
	Dry Density, pcf	61.4	62.4	62.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.7980	1.7510	1.7365
	Diameter, in.	1.41	1.39	1.39
	Height, in.	2.80	2.79	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.01	2.01	4.02	
Back Pressure, tsf	6.13	5.13	3.14	
Cell Pressure, tsf	7.14	7.14	7.16	
Peak Deviator Stress, tsf	0.70	1.41	1.83	
Total Pore Pr., tsf	6.51	5.89	4.77	
Ultimate Deviator Stress, tsf	0.68	1.04	1.36	
Total Pore Pr., tsf	6.47	5.92	5.02	
Maj. Eff. Stress at Ultimate, tsf	1.34	2.66	4.21	
Min. Eff. Stress at Ultimate, tsf	0.63	1.25	2.38	

Type of Test:

CU with Pore Pressures

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

Assumed Specific Gravity= 2.75

Remarks: Rate of strain is 0.001 in./min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

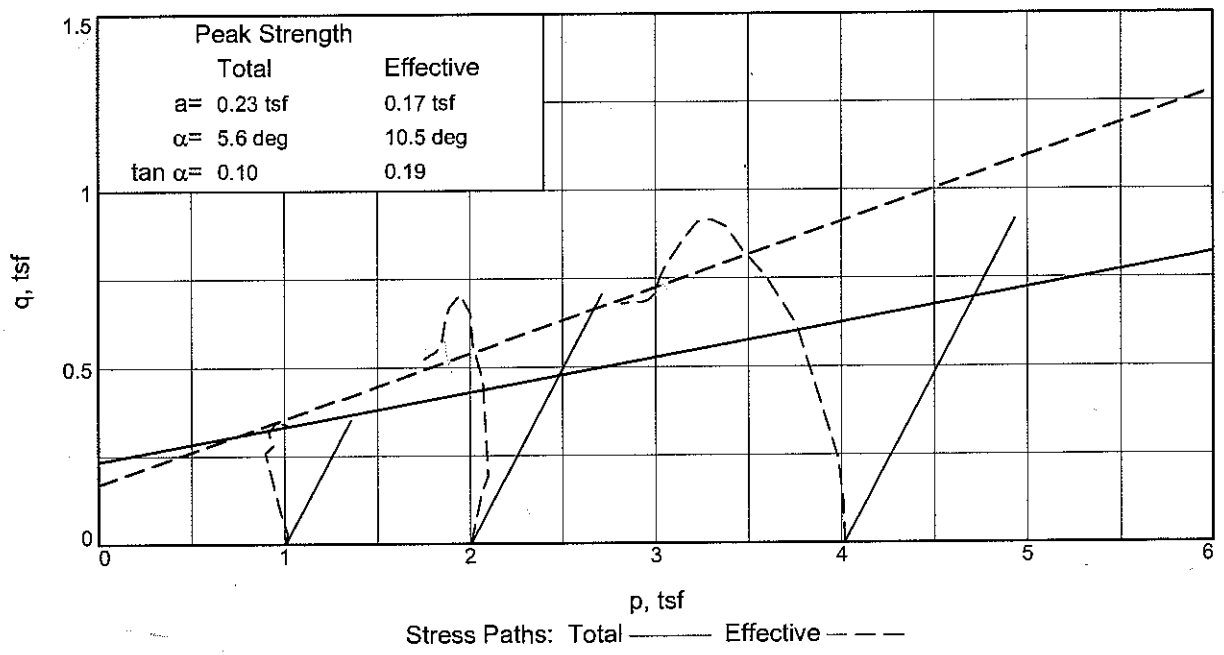
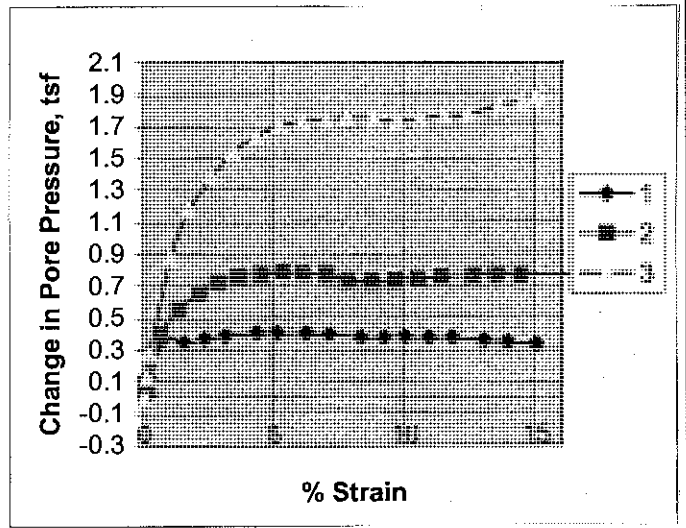
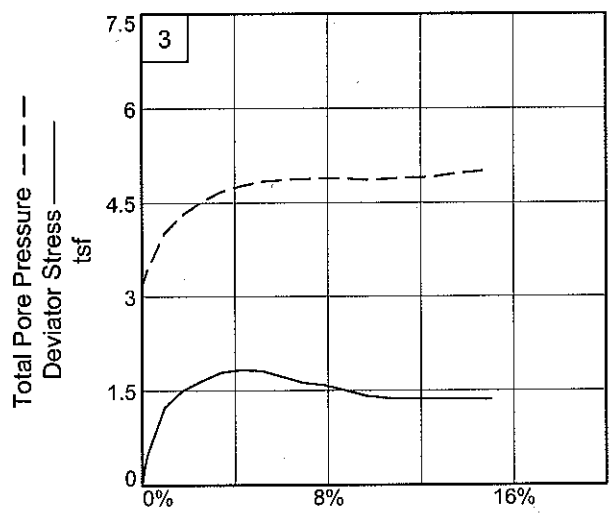
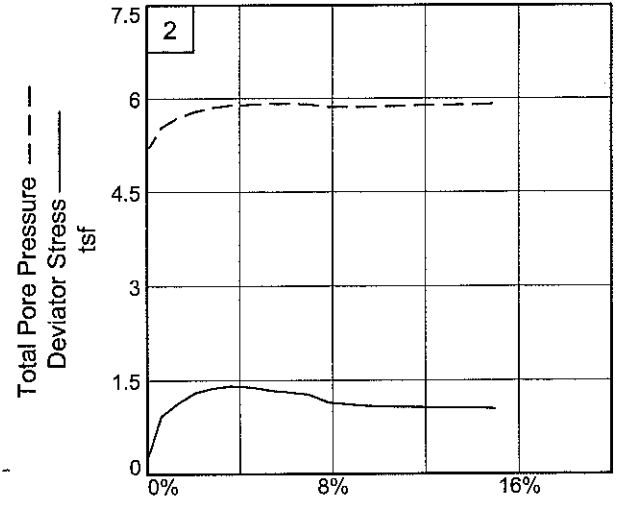
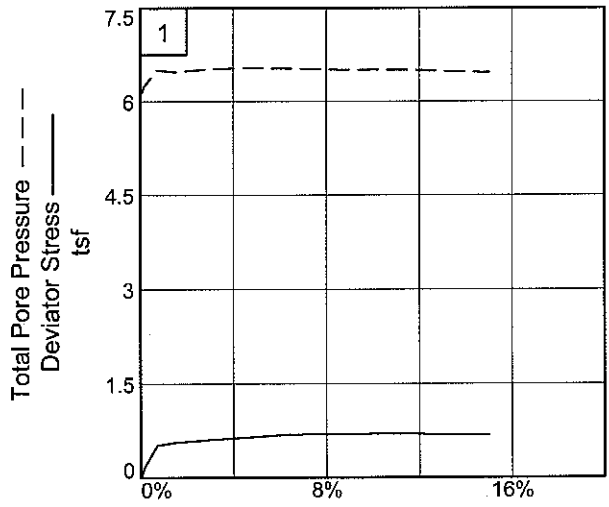
Location: SE-M-11, Moorhead, Brenna Formation

Sample Number: Boring 09-53MU, #2 **Depth:** 28-30'

Proj. No.: BL-09-03127

Date Sampled:

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INTERTEC



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-M-11, Moorhead, Brenna Formation

Depth: 28-30'

Sample No.: Boring 09-53MU, #2

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

11/18/2009
10:50 AM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-11, Moorhead, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-53MU, #2
Description: FAT CLAY, gray (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	109.180			147.290
Moisture content: Dry soil+tare, gms.	78.530			101.360
Moisture content: Tare, gms.	31.430			30.600
Moisture, %	65.1	65.9	65.4	64.9
Moist specimen weight, gms.	116.8			
Diameter, in.	1.42	1.42	1.41	
Area, in. ²	1.57	1.57	1.57	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	100.7	101.3	101.5	
Dry density, pcf	61.0	61.0	61.4	
Void ratio	1.8130	1.8130	1.7980	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.139 tsf
Consolidation back pressure = 6.134 tsf
Consolidation effective confining stress = 1.005 tsf
Peak Stress = 0.704 tsf at reading no. 15
Ult. Stress = 0.680 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0071	18.910	0.0	0.0	0.000	1.005	1.005	1.00	6.134	1.005	0.000
1	0.0092	20.230	1.3	0.1	0.061	0.985	1.046	1.06	6.154	1.015	0.030
2	0.0121	22.760	3.9	0.2	0.176	0.891	1.067	1.20	6.248	0.979	0.088
3	0.0270	30.290	11.4	0.7	0.518	0.637	1.155	1.81	6.502	0.896	0.259
4	0.0489	31.340	12.4	1.5	0.562	0.660	1.222	1.85	6.479	0.941	0.281
5	0.0718	31.960	13.1	2.3	0.585	0.636	1.221	1.92	6.503	0.928	0.292
6	0.0947	32.610	13.7	3.1	0.609	0.617	1.226	1.99	6.522	0.921	0.304
7	0.1263	33.380	14.5	4.3	0.636	0.599	1.235	2.06	6.540	0.917	0.318
8	0.1503	33.990	15.1	5.1	0.657	0.603	1.260	2.09	6.536	0.931	0.328
9	0.1813	34.850	15.9	6.2	0.686	0.605	1.291	2.13	6.534	0.948	0.343
10	0.2062	35.130	16.2	7.1	0.691	0.614	1.305	2.13	6.525	0.960	0.346
11	0.2393	35.420	16.5	8.3	0.695	0.629	1.324	2.10	6.510	0.976	0.347
12	0.2639	35.650	16.7	9.2	0.698	0.632	1.330	2.10	6.507	0.981	0.349
13	0.2876	35.850	16.9	10.0	0.699	0.625	1.324	2.12	6.514	0.975	0.350
14	0.3129	36.100	17.2	10.9	0.703	0.634	1.337	2.11	6.505	0.985	0.351
15	0.3378	36.310	17.4	11.8	0.704	0.631	1.335	2.12	6.508	0.983	0.352
16	0.3705	35.970	17.1	13.0	0.681	0.650	1.331	2.05	6.489	0.991	0.341
17	0.3958	36.150	17.2	13.9	0.681	0.660	1.341	2.03	6.479	1.001	0.341
18	0.4275	36.340	17.4	15.0	0.680	0.673	1.353	2.01	6.466	1.013	0.340

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.430			142.540
Moisture content: Dry soil+tare, gms.	89.230			99.980
Moisture content: Tare, gms.	30.420			30.690
Moisture, %	65.0	65.8	63.7	61.4
Moist specimen weight, gms.	114.3			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	100.8	101.3	102.1	
Dry density, pcf	61.1	61.1	62.4	
Void ratio	1.8107	1.8107	1.7510	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.139 tsf
 Consolidation back pressure = 5.134 tsf
 Consolidation effective confining stress = 2.005 tsf
 Peak Stress = 1.411 tsf at reading no. 7
 Ult. Stress = 1.043 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0060	15.590	0.0	0.0	0.000	2.005	2.005	1.00	5.134	2.005	0.000
1	0.0070	21.690	6.1	0.0	0.290	1.918	2.208	1.15	5.221	2.063	0.145
2	0.0099	23.640	8.1	0.1	0.382	1.906	2.288	1.20	5.233	2.097	0.191
3	0.0231	35.150	19.6	0.6	0.924	1.607	2.531	1.57	5.532	2.069	0.462
4	0.0428	39.700	24.1	1.3	1.130	1.448	2.578	1.78	5.691	2.013	0.565
5	0.0639	43.670	28.1	2.1	1.307	1.349	2.656	1.97	5.790	2.002	0.653
6	0.0847	45.280	29.7	2.8	1.371	1.283	2.654	2.07	5.856	1.968	0.685
7	0.1074	46.410	30.8	3.6	1.411	1.247	2.658	2.13	5.892	1.953	0.706
8	0.1305	46.230	30.6	4.5	1.391	1.232	2.623	2.13	5.907	1.927	0.695
9	0.1545	45.410	29.8	5.3	1.342	1.219	2.561	2.10	5.920	1.890	0.671
10	0.1772	44.890	29.3	6.1	1.307	1.225	2.532	2.07	5.914	1.878	0.653
11	0.2010	44.370	28.8	7.0	1.272	1.231	2.503	2.03	5.908	1.867	0.636
12	0.2250	41.740	26.2	7.8	1.145	1.276	2.421	1.90	5.863	1.849	0.573
13	0.2491	41.280	25.7	8.7	1.114	1.276	2.390	1.87	5.863	1.833	0.557
14	0.2739	40.950	25.4	9.6	1.089	1.272	2.361	1.86	5.867	1.817	0.545
15	0.2977	40.920	25.3	10.5	1.078	1.263	2.341	1.85	5.876	1.802	0.539
16	0.3228	41.070	25.5	11.4	1.073	1.250	2.323	1.86	5.889	1.787	0.537
17	0.3566	41.130	25.5	12.6	1.061	1.244	2.305	1.85	5.895	1.775	0.531
18	0.3819	41.340	25.8	13.5	1.059	1.237	2.296	1.86	5.902	1.766	0.529
19	0.4067	41.650	26.1	14.4	1.060	1.240	2.300	1.86	5.899	1.770	0.530
20	0.4235	41.410	25.8	15.0	1.043	1.221	2.264	1.85	5.918	1.743	0.522

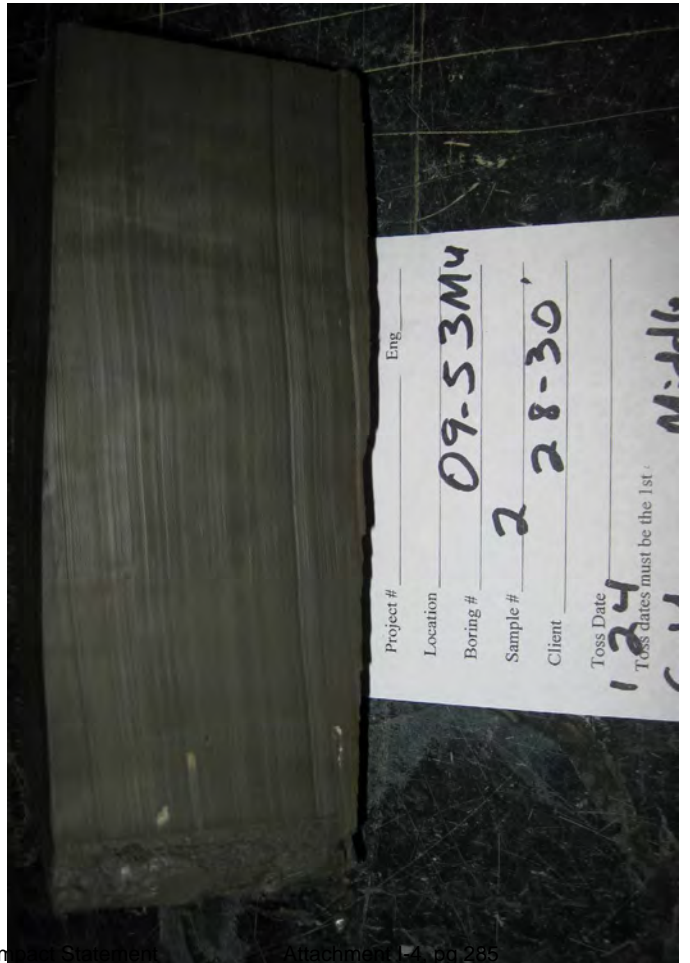
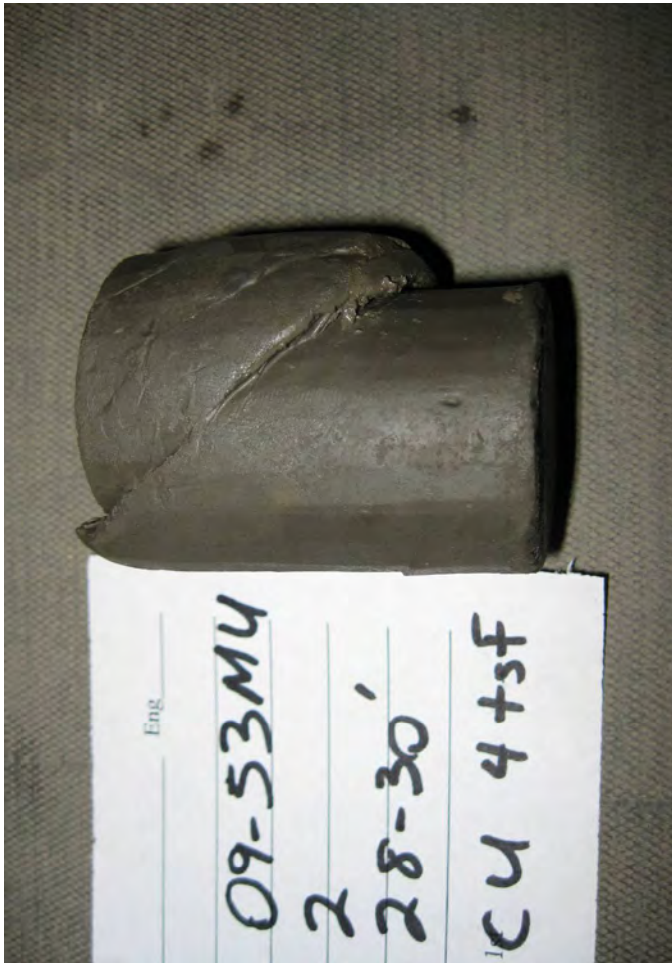
Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.880			140.080
Moisture content: Dry soil+tare, gms.	89.200			98.000
Moisture content: Tare, gms.	29.850			30.470
Moisture, %	65.2	66.4	63.1	62.3
Moist specimen weight, gms.	115.4			
Diameter, in.	1.41	1.41	1.39	
Area, in. ²	1.56	1.56	1.53	
Height, in.	2.81	2.81	2.78	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	100.3	101.1	102.4	
Dry density, pcf	60.7	60.7	62.7	
Void ratio	1.8265	1.8265	1.7365	
Saturation, %	98.1	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.155 tsf
 Consolidation back pressure = 3.137 tsf
 Consolidation effective confining stress = 4.018 tsf
 Peak Stress = 1.830 tsf at reading no. 7
 Ult. Stress = 1.359 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0072	16.500	0.0	0.0	0.000	4.018	4.018	1.00	3.137	4.018	0.000
1	0.0092	21.540	5.0	0.1	0.237	3.890	4.127	1.06	3.265	4.009	0.119
2	0.0130	26.730	10.2	0.2	0.481	3.741	4.222	1.13	3.414	3.982	0.241
3	0.0339	42.930	26.4	1.0	1.233	3.143	4.376	1.39	4.012	3.760	0.617
4	0.0557	49.010	32.5	1.7	1.505	2.844	4.349	1.53	4.311	3.597	0.753
5	0.0787	52.670	36.2	2.6	1.660	2.636	4.296	1.63	4.519	3.466	0.830
6	0.1015	55.910	39.4	3.4	1.794	2.479	4.273	1.72	4.676	3.376	0.897
7	0.1255	57.070	40.6	4.3	1.830	2.384	4.214	1.77	4.771	3.299	0.915
8	0.1503	57.220	40.7	5.2	1.820	2.315	4.135	1.79	4.840	3.225	0.910
9	0.1753	55.420	38.9	6.1	1.723	2.288	4.011	1.75	4.867	3.149	0.861
10	0.2002	53.560	37.1	7.0	1.625	2.274	3.899	1.71	4.881	3.086	0.812
11	0.2250	53.010	36.5	7.8	1.585	2.265	3.850	1.70	4.890	3.058	0.793
12	0.2511	51.450	35.0	8.8	1.502	2.270	3.772	1.66	4.885	3.021	0.751
13	0.2761	49.680	33.2	9.7	1.412	2.288	3.700	1.62	4.867	2.994	0.706
14	0.3012	49.190	32.7	10.6	1.377	2.272	3.649	1.61	4.883	2.961	0.689
15	0.3259	49.380	32.9	11.5	1.371	2.253	3.624	1.61	4.902	2.939	0.686
16	0.3516	49.670	33.2	12.4	1.369	2.248	3.617	1.61	4.907	2.932	0.684
17	0.3848	50.130	33.6	13.6	1.369	2.188	3.557	1.63	4.967	2.873	0.685
18	0.4103	50.280	33.8	14.5	1.361	2.159	3.520	1.63	4.996	2.839	0.680
19	0.4244	50.440	33.9	15.0	1.359	2.138	3.497	1.64	5.017	2.817	0.679

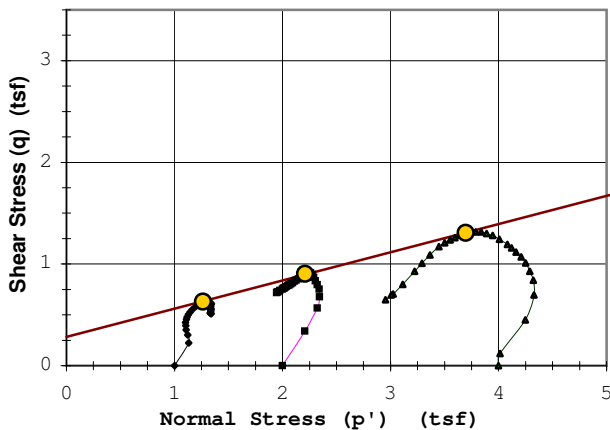
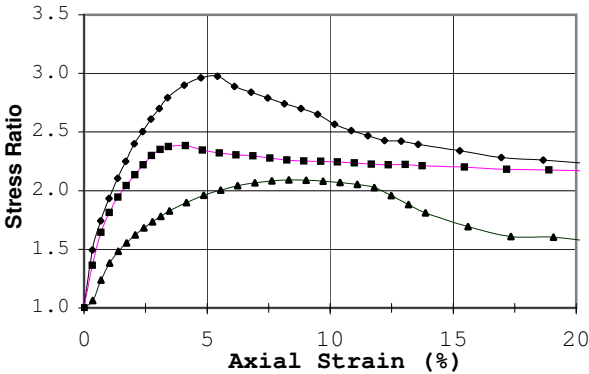
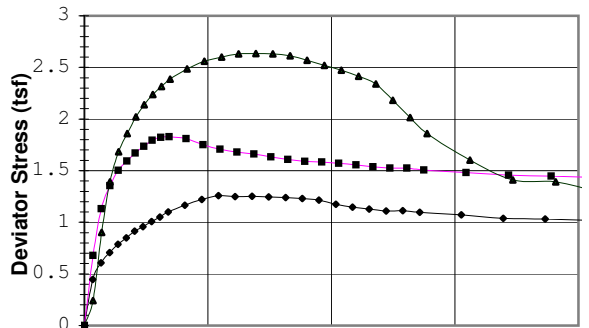
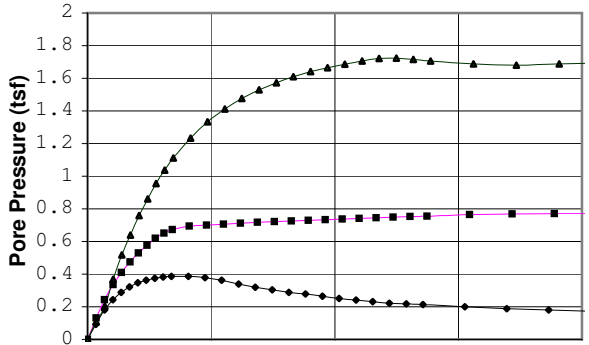


TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Top)**
 Soil Type: **Fat Clay (CH) Brenna**



Rupture Envelope at Failure
 $\alpha = 15.5^\circ$ $a = 0.3$ (tsf)



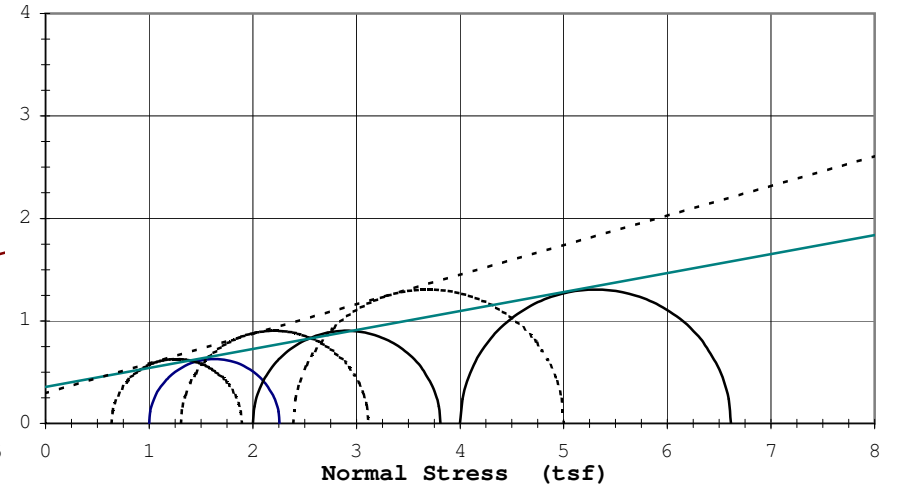
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Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 16.1^\circ$	
Apparent Cohesion, $c' = 0.29$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 63.8
Test Type: CU w/pp	Plastic Limit: 23.1
Strain Rate (in/min): 0.0039	Plasticity Index: 40.7
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.76
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	41.2 42.8 44.4
Void Ratio	78.9 77.4 76.0
After Consolidation	
Diameter (in)	1.43 1.43 1.39
Height (in)	2.95 2.91 2.88
Water Content (%)	40.3 39.9 36.6
Dry Density (pcf)	81.5 82.0 85.7
Void Ratio	1.11 1.10 1.01
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	1.26 1.83 2.63
Ultimate Deviator Stress (tsf)	1.02 1.44 1.30
Deviator Stress at Failure (tsf)	1.26 1.81 2.61
Max. Pore Pressure Buildup (tsf)	0.39 0.77 1.72
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	5.4 4.1 8.3

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

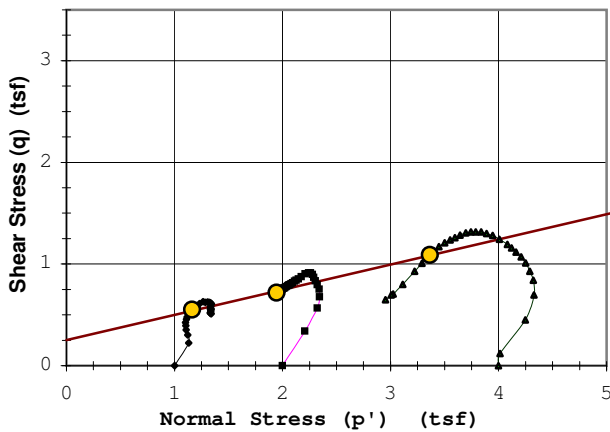
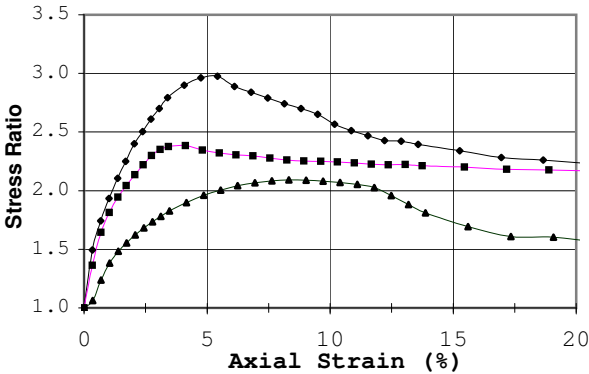
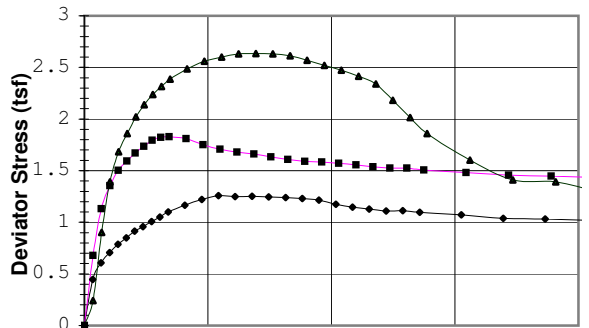
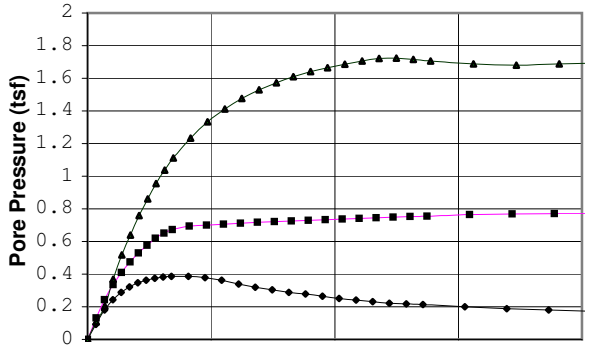


----- Effective ϕ' : 16.1° $c' = 0.29$ (tsf)
 _____ Total ϕ' : 10.5° $c = 0.36$ (tsf)

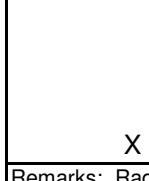
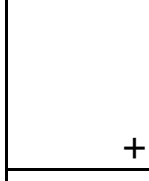
TRIAxIAL TEST ASTM: D 4767

Job No. 7577
Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Top)**
 Soil Type: **Fat Clay (CH) Brenna**



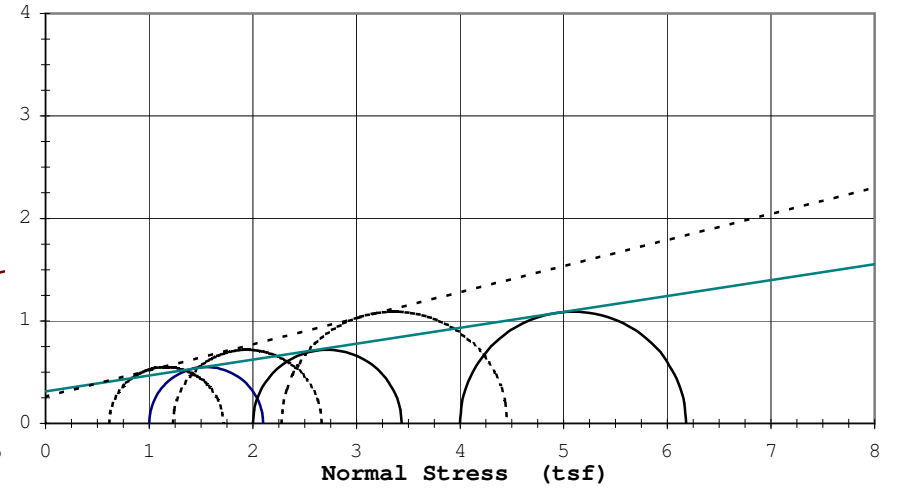
Rupture Envelope at Failure
 $\alpha = 13.9^\circ$ $a = 0.3$ (tsf)



Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 14.3^\circ$	
Apparent Cohesion, $c' = 0.26$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 63.8
Test Type: CU w/pp	Plastic Limit: 23.1
Strain Rate (in/min): 0.0039	Plasticity Index: 40.7
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.76
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	41.2 42.8 44.4
Void Ratio	78.9 77.4 76.0
After Consolidation	
Diameter (in)	1.43 1.43 1.39
Height (in)	2.95 2.91 2.88
Water Content (%)	40.3 39.9 36.6
Dry Density (pcf)	81.5 82.0 85.7
Void Ratio	1.11 1.10 1.01
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	1.26 1.83 2.63
Ultimate Deviator Stress (tsf)	1.02 1.44 1.30
Deviator Stress at Failure (tsf)	1.10 1.44 2.18
Max. Pore Pressure Buildup (tsf)	0.39 0.77 1.72
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	3.4 20.6 12.5

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



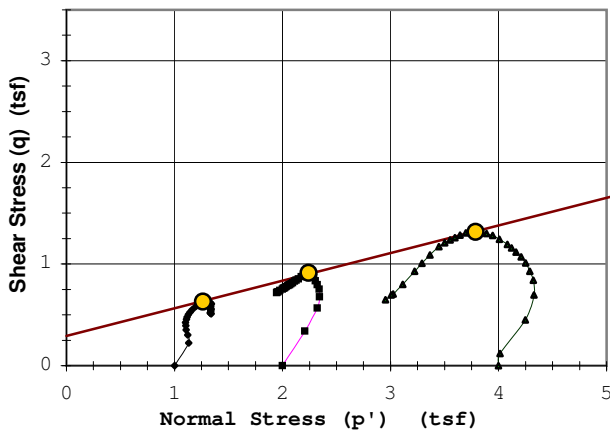
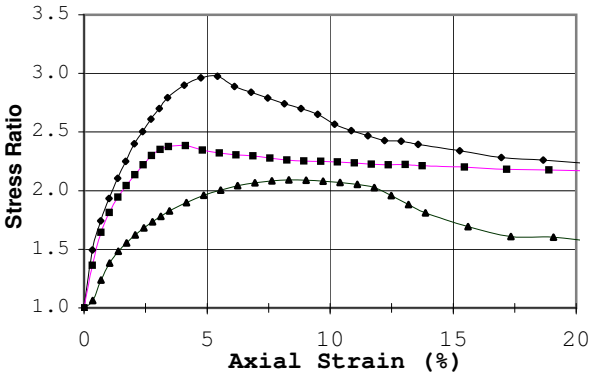
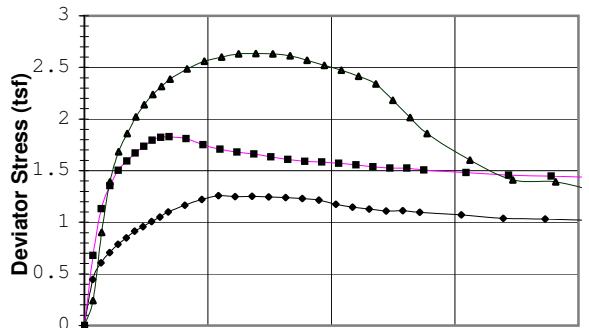
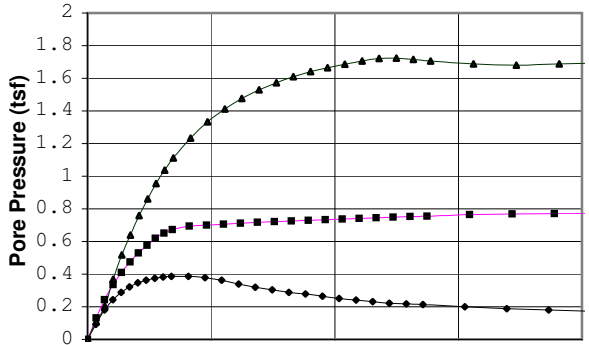
-----	Effective ϕ' : 14.3°	$c' = 0.26$ (tsf)
_____	Total ϕ' : 8.8°	$c = 0.31$ (tsf)

TRIAXIAL TEST ASTM: D 4767

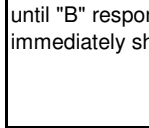
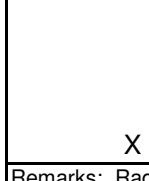
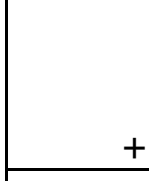
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Top)**
 Soil Type: **Fat Clay (CH) Brenna**



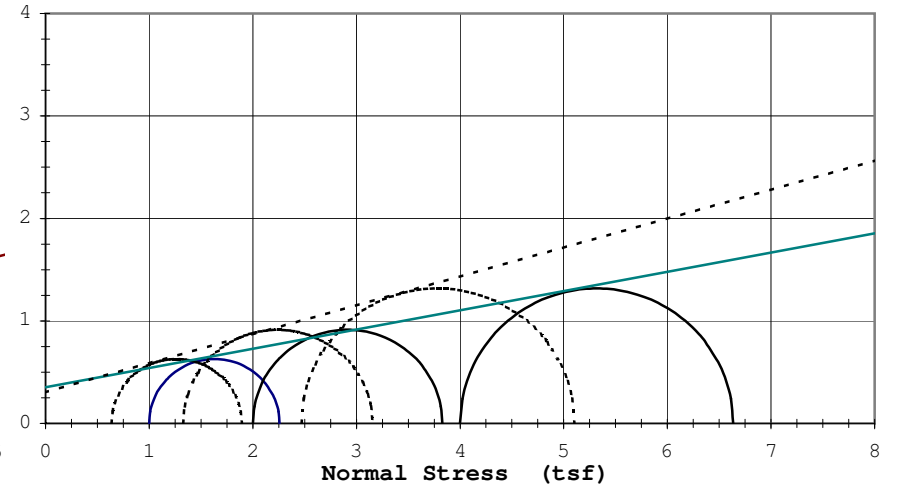
Rupture Envelope at Failure
 $\alpha = 15.2^\circ$ $a = 0.3$ (tsf)



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 15.8^\circ$	
Apparent Cohesion, $c' = 0.30$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 63.8
Test Type: CU w/pp	Plastic Limit: 23.1
Strain Rate (in/min): 0.0039	Plasticity Index: 40.7
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.76
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	41.2 42.8 44.4
Void Ratio	78.9 77.4 76.0
After Consolidation	
Diameter (in)	1.43 1.43 1.39
Height (in)	2.95 2.91 2.88
Water Content (%)	40.3 39.9 36.6
Dry Density (pcf)	81.5 82.0 85.7
Void Ratio	1.11 1.10 1.01
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	1.26 1.83 2.63
Ultimate Deviator Stress (tsf)	1.02 1.44 1.30
Deviator Stress at Failure (tsf)	1.26 1.83 2.63
Max. Pore Pressure Buildup (tsf)	0.39 0.77 1.72
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	5.4 3.4 6.9

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



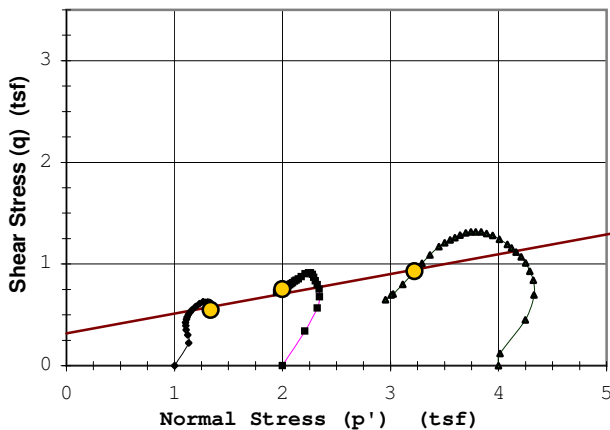
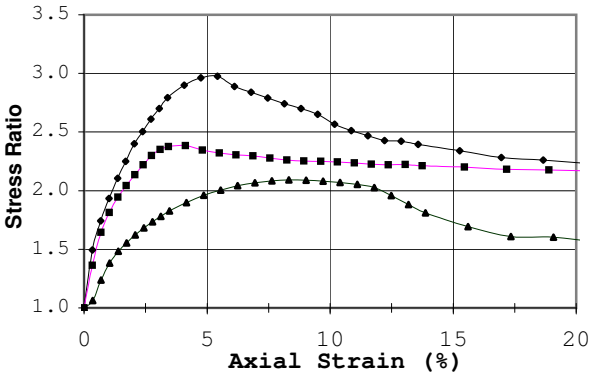
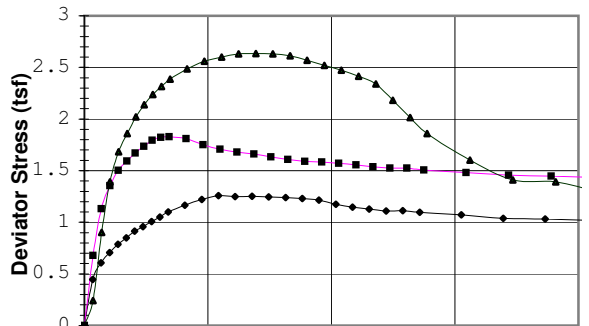
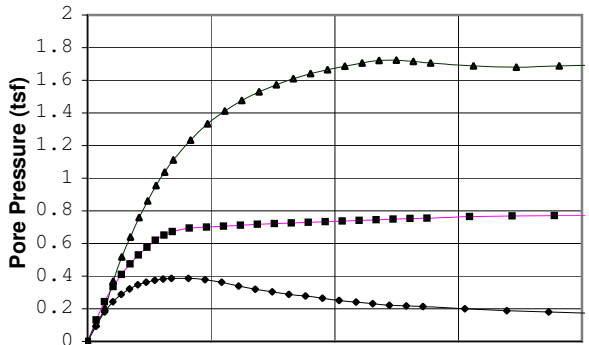
----- Effective ϕ' : 15.8° $c' = 0.30$ (tsf)
 _____ Total ϕ' : 10.6° $c = 0.35$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Top)**
 Soil Type: **Fat Clay (CH) Brenna**



Rupture Envelope at Failure
 $\alpha = 11.0^\circ$ $a = 0.3$ (tsf)



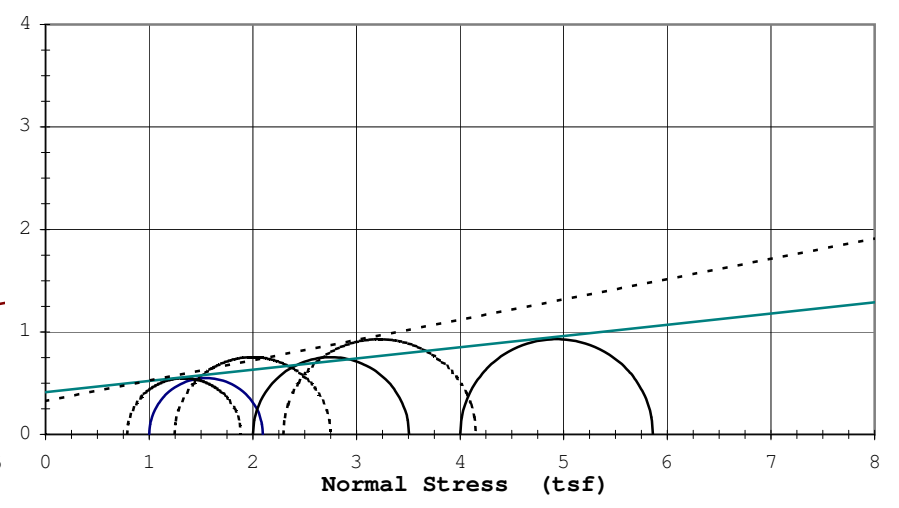
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Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 11.2^\circ$	
Apparent Cohesion, $c' = 0.32$ (tsf)	
Test Date: 8/12/10	Liquid Limit: 63.8
Test Type: CU w/pp	Plastic Limit: 23.1
Strain Rate (in/min): 0.0039	Plasticity Index: 40.7
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.76
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	41.2 42.8 44.4
Void Ratio	78.9 77.4 76.0
After Consolidation	
Diameter (in)	1.43 1.43 1.39
Height (in)	2.95 2.91 2.88
Water Content (%)	40.3 39.9 36.6
Dry Density (pcf)	81.5 82.0 85.7
Void Ratio	1.11 1.10 1.01
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	1.26 1.83 2.63
Ultimate Deviator Stress (tsf)	1.02 1.44 1.30
Deviator Stress at Failure (tsf)	1.10 1.51 1.86
Max. Pore Pressure Buildup (tsf)	0.39 0.77 1.72
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	15.0 15.0 15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 11.2° $c' = 0.32$ (tsf)
 _____ Total ϕ' : 6.3° $c = 0.41$ (tsf)

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095
 Boring No.: 10-78MU, Sample No.: 2, Depth (ft.): 25 - 27 (Top)

Job No.: 7577
 Test Type: CU w/pp

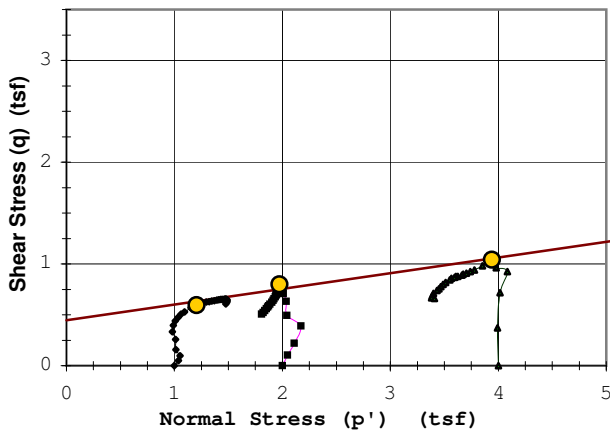
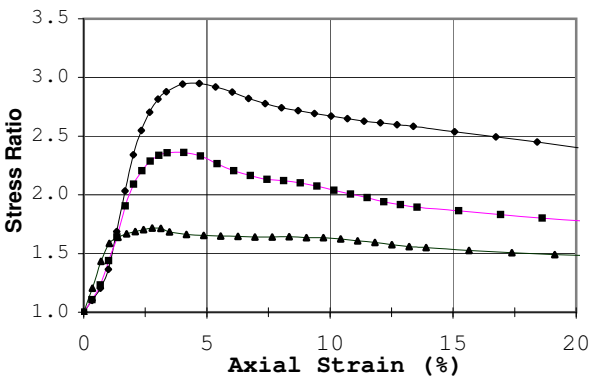
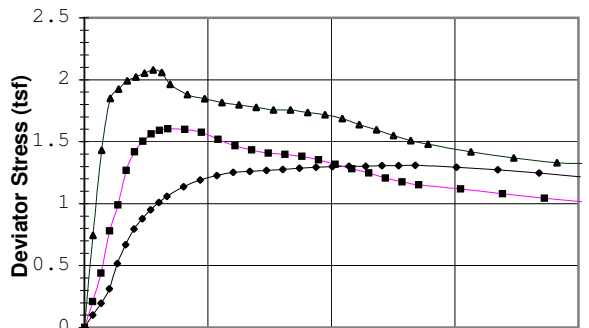
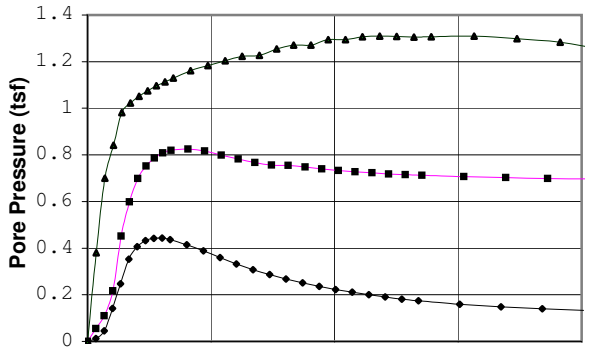
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.34	0.45	0.09	0.34	0.68	0.13	0.35	0.24	0.11
0.68	0.61	0.18	0.69	1.13	0.24	0.70	0.90	0.20
1.02	0.71	0.24	1.03	1.35	0.33	1.04	1.39	0.37
1.36	0.79	0.29	1.38	1.50	0.41	1.39	1.68	0.52
1.70	0.85	0.32	1.72	1.59	0.47	1.74	1.86	0.64
2.04	0.92	0.35	2.06	1.67	0.53	2.08	2.02	0.76
2.37	0.96	0.36	2.40	1.73	0.58	2.43	2.14	0.86
2.71	1.01	0.37	2.75	1.79	0.62	2.78	2.24	0.96
3.05	1.05	0.38	3.09	1.82	0.65	3.12	2.32	1.04
3.39	1.10	0.39	3.44	1.83	0.67	3.47	2.39	1.11
4.07	1.17	0.39	4.12	1.81	0.69	4.16	2.49	1.23
4.75	1.22	0.38	4.81	1.75	0.70	4.86	2.56	1.33
5.43	1.26	0.36	5.50	1.71	0.71	5.55	2.60	1.41
6.11	1.25	0.34	6.18	1.68	0.71	6.24	2.63	1.48
6.79	1.25	0.32	6.87	1.66	0.72	6.94	2.63	1.53
7.46	1.25	0.30	7.56	1.63	0.72	7.63	2.63	1.57
8.14	1.24	0.29	8.24	1.61	0.73	8.33	2.61	1.61
8.82	1.23	0.28	8.93	1.59	0.73	9.02	2.57	1.64
9.50	1.21	0.27	9.62	1.58	0.73	9.71	2.52	1.67
10.18	1.17	0.25	10.30	1.57	0.74	10.41	2.47	1.69
10.86	1.15	0.24	10.99	1.55	0.74	11.10	2.41	1.71
11.53	1.13	0.23	11.68	1.54	0.75	11.80	2.34	1.72
12.21	1.11	0.22	12.37	1.53	0.75	12.49	2.18	1.72
12.89	1.11	0.22	13.05	1.52	0.75	13.18	2.01	1.72
13.57	1.10	0.21	13.74	1.51	0.76	13.88	1.86	1.71
15.26	1.07	0.20	15.46	1.48	0.76	15.61	1.60	1.69
16.96	1.04	0.19	17.17	1.46	0.77	17.35	1.41	1.68
18.66	1.03	0.18	18.89	1.45	0.77	19.08	1.39	1.69
20.35	1.02	0.17	20.61	1.44	0.77	20.81	1.30	1.69

TRIAXIAL TEST ASTM: D 4767

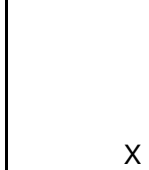
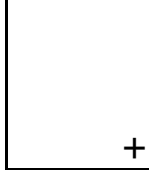
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid-Top)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



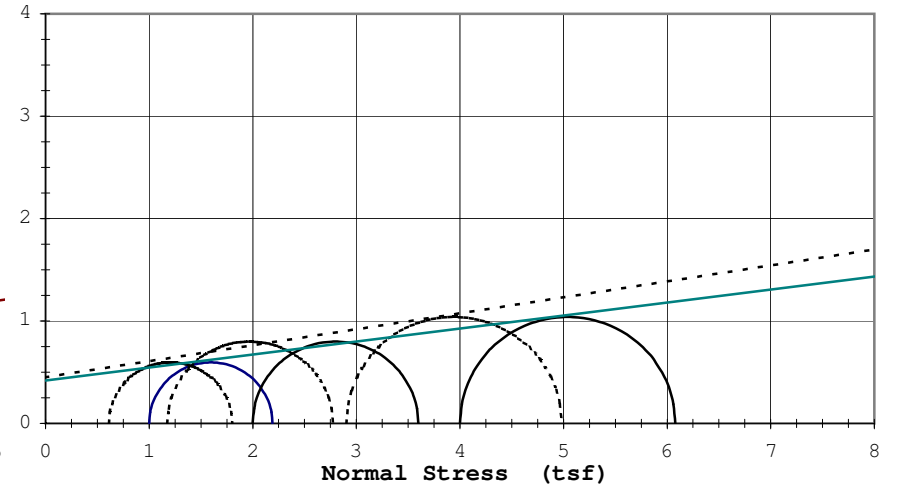
Rupture Envelope at Failure
 $\alpha = 8.8^\circ$ $a = 0.4$ (tsf)



Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 8.9^\circ$	
Apparent Cohesion, $c' = 0.45$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 90.7
Test Type: CU w/pp	Plastic Limit: 29.1
Strain Rate (in/min): 0.0039	Plasticity Index: 61.6
Strain Rate (%/min): 0.131	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	39.3 43.1 47.2
Void Ratio	80.7 76.9 73.5
After Consolidation	
Diameter (in)	1.15 1.26 1.36
Height (in)	1.44 1.42 1.41
Water Content (%)	2.99 2.95 2.88
Dry Density (pcf)	40.4 41.2 42.0
Void Ratio	81.8 80.9 80.0
Back Pressure (tsf)	1.12 1.15 1.17
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	1.31 1.60 2.08
Deviator Stress at Failure (tsf)	1.19 1.60 2.08
Max. Pore Pressure Buildup (tsf)	0.44 0.83 1.31
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	4.7 4.1 2.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



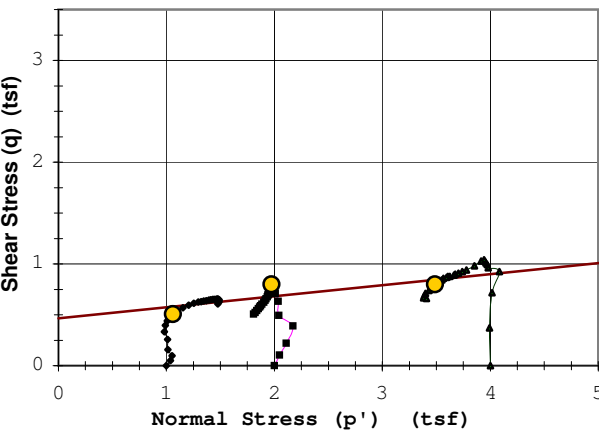
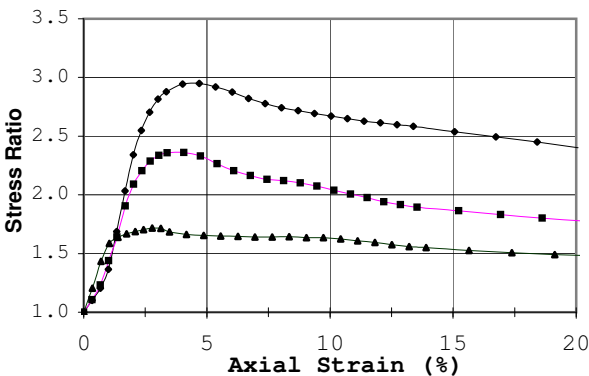
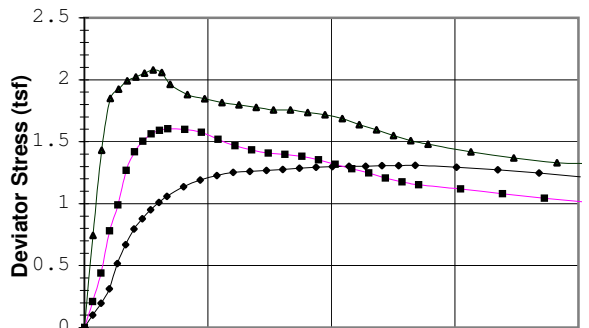
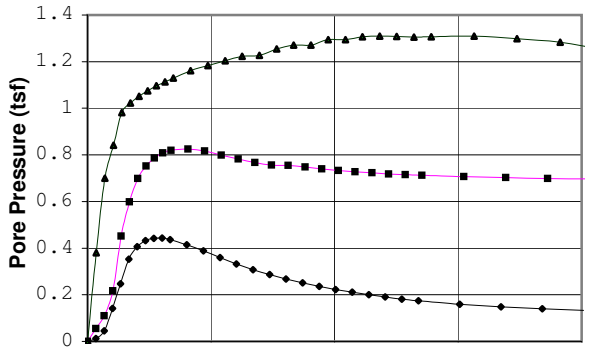
----- Effective ϕ' : 8.9° $c' = 0.45$ (tsf)
 _____ Total ϕ' : 7.2° $c = 0.42$ (tsf)

TRIAXIAL TEST ASTM: D 4767

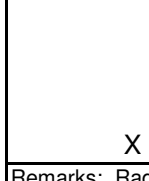
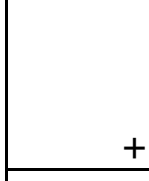
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid-Top)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



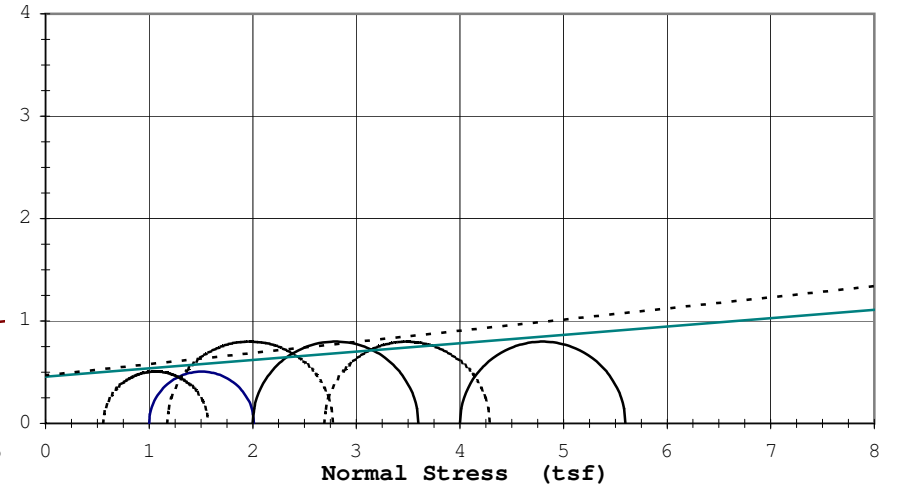
Rupture Envelope at Failure
 $\alpha = 6.2^\circ$ $a = 0.5$ (tsf)



Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 6.2^\circ$	
Apparent Cohesion, $c' = 0.47$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 90.7
Test Type: CU w/pp	Plastic Limit: 29.1
Strain Rate (in/min): 0.0039	Plasticity Index: 61.6
Strain Rate (%/min): 0.131	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	39.3 43.1 47.2
Void Ratio	80.7 76.9 73.5
After Consolidation	
Diameter (in)	1.15 1.26 1.36
Height (in)	1.44 1.42 1.41
Water Content (%)	2.99 2.95 2.88
Dry Density (pcf)	40.4 41.2 42.0
Void Ratio	81.8 80.9 80.0
Back Pressure (tsf)	1.12 1.15 1.17
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	1.31 1.60 2.08
Deviator Stress at Failure (tsf)	1.22 1.01 1.32
Max. Pore Pressure Buildup (tsf)	1.01 1.60 1.60
Pore Pressure Parameter "B"	0.44 0.83 1.31
Pct. Axial Strain at Failure	1.0 1.0 1.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



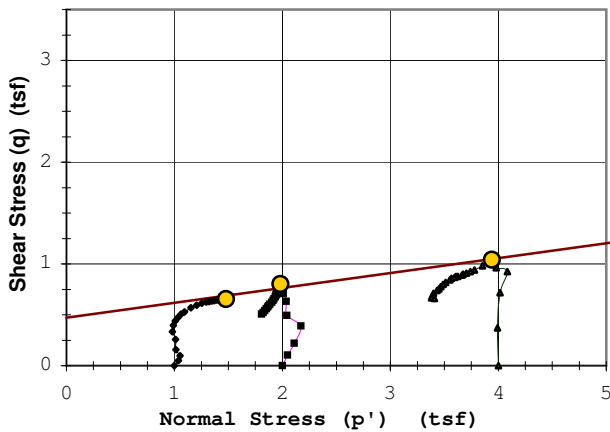
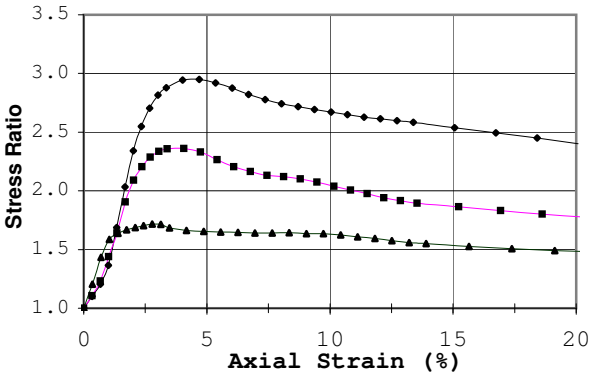
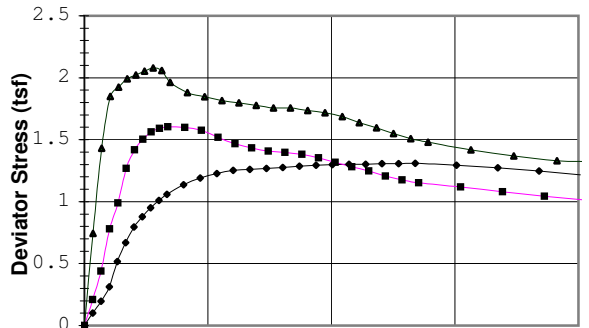
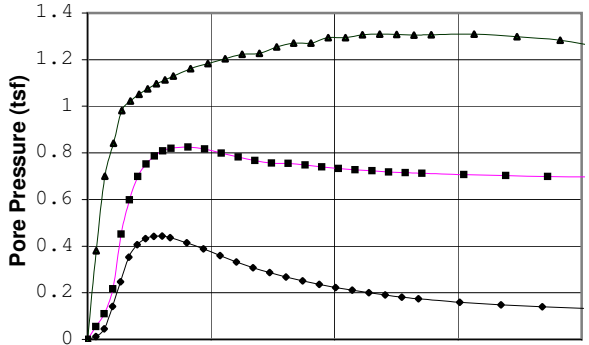
----- Effective ϕ' : 6.2° $c' = 0.47$ (tsf)
 _____ Total ϕ' : 4.7° $c = 0.46$ (tsf)

TRIAXIAL TEST ASTM: D 4767

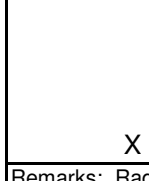
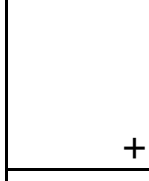
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid-Top)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



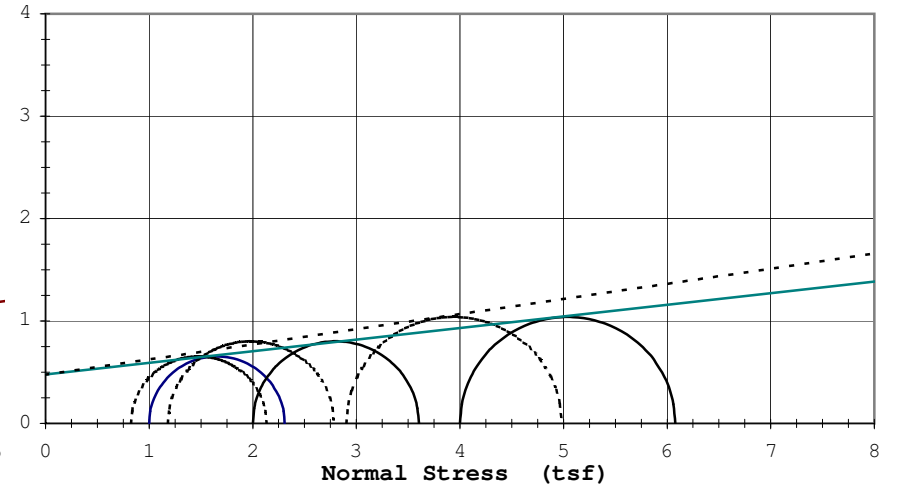
Rupture Envelope at Failure
 $\alpha = 8.3^\circ$ $a = 0.5$ (tsf)



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 8.4^\circ$	
Apparent Cohesion, $c' = 0.48$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 90.7
Test Type: CU w/pp	Plastic Limit: 29.1
Strain Rate (in/min): 0.0039	Plasticity Index: 61.6
Strain Rate (%/min): 0.131	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	39.3 43.1 47.2
Void Ratio	80.7 76.9 73.5
After Consolidation	
Diameter (in)	1.15 1.26 1.36
Height (in)	1.44 1.42 1.41
Water Content (%)	2.99 2.95 2.88
Dry Density (pcf)	40.4 41.2 42.0
Void Ratio	81.8 80.9 80.0
Back Pressure (tsf)	1.12 1.15 1.17
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	1.31 1.60 2.08
Deviator Stress at Failure (tsf)	1.22 1.01 1.32
Max. Pore Pressure Buildup (tsf)	1.31 1.60 2.08
Pore Pressure Parameter "B"	0.44 0.83 1.31
Pct. Axial Strain at Failure	1.0 1.0 1.0
	13.4 3.4 2.8

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



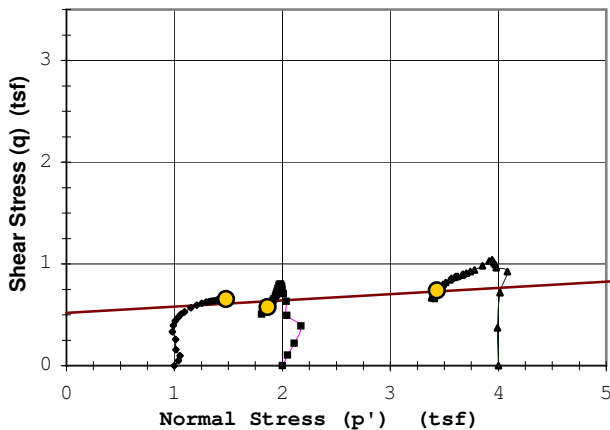
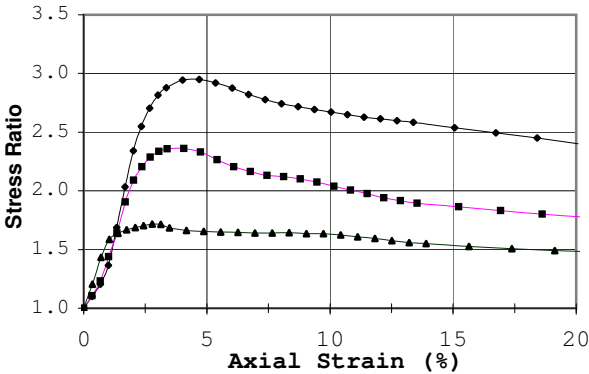
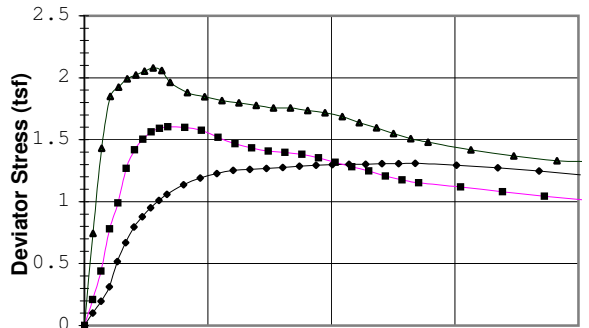
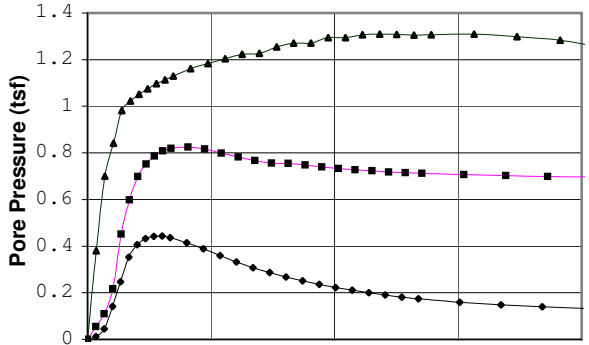
----- Effective ϕ' : 8.4° $c' = 0.48$ (tsf)
 _____ Total ϕ' : 6.5° $c = 0.48$ (tsf)

TRIAXIAL TEST ASTM: D 4767

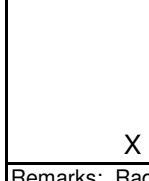
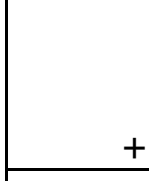
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid-Top)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



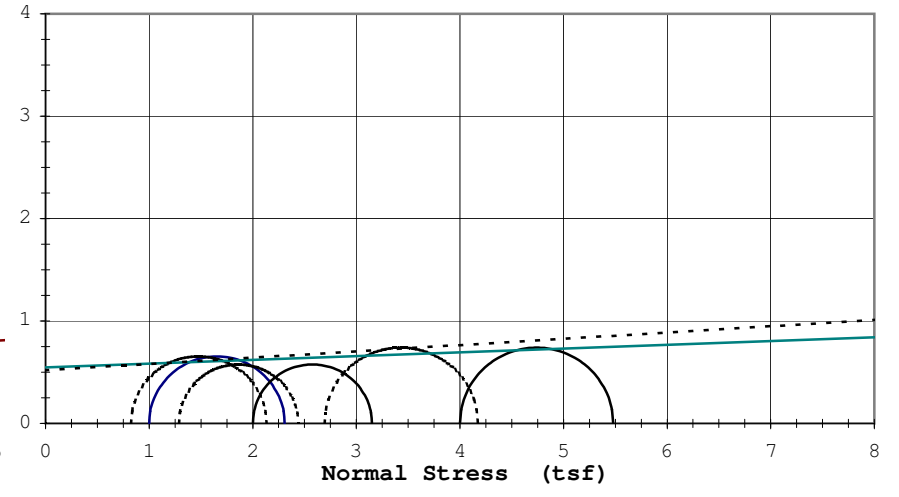
Rupture Envelope at Failure
 $\alpha = 3.5^\circ$ $a = 0.5$ (tsf)



Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 3.5^\circ$	
Apparent Cohesion, $c' = 0.52$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 90.7
Test Type: CU w/pp	Plastic Limit: 29.1
Strain Rate (in/min): 0.0039	Plasticity Index: 61.6
Strain Rate (%/min): 0.131	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	2.99 2.99 2.99
Dry Density (pcf)	39.3 43.1 47.2
Void Ratio	80.7 76.9 73.5
After Consolidation	
Diameter (in)	1.15 1.26 1.36
Height (in)	1.44 1.42 1.41
Water Content (%)	2.99 2.95 2.88
Dry Density (pcf)	40.4 41.2 42.0
Void Ratio	81.8 80.9 80.0
Back Pressure (tsf)	1.12 1.15 1.17
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	1.00 2.00 4.00
Ultimate Deviator Stress (tsf)	1.31 1.60 2.08
Deviator Stress at Failure (tsf)	1.22 1.01 1.32
Max. Pore Pressure Buildup (tsf)	1.31 1.15 1.48
Pore Pressure Parameter "B"	0.44 0.83 1.31
Pct. Axial Strain at Failure	1.0 1.0 1.0
	15.0 15.0 15.0

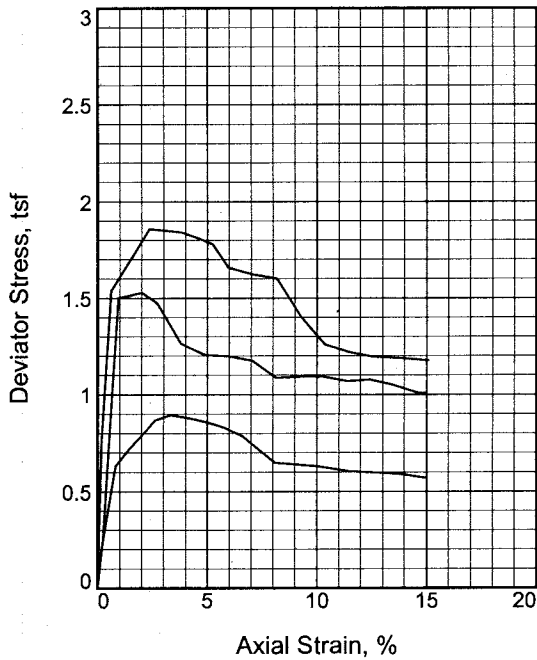
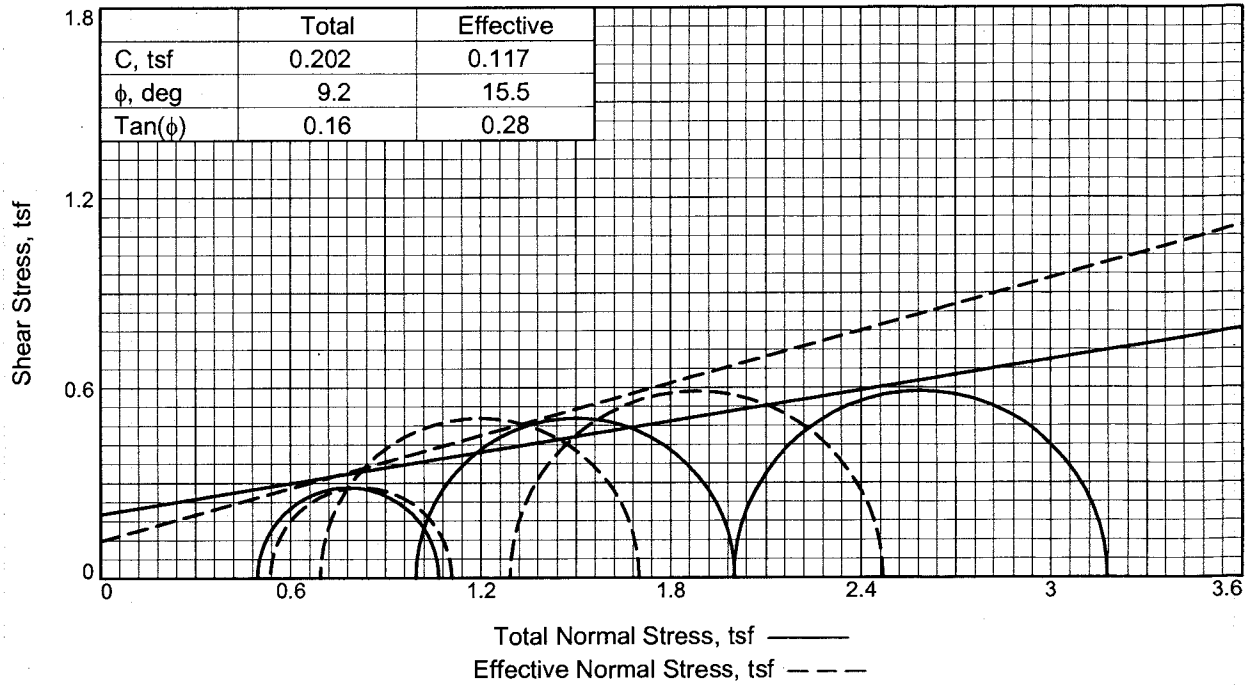
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 3.5° $c' = 0.52$ (tsf)
 _____ Total ϕ' : 2.1° $c = 0.55$ (tsf)

Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.34	0.10	0.01	0.34	0.21	0.06	0.35	0.74	0.38
0.67	0.20	0.05	0.68	0.44	0.11	0.70	1.43	0.70
1.01	0.31	0.14	1.02	0.78	0.22	1.04	1.85	0.84
1.34	0.52	0.25	1.35	0.99	0.45	1.39	1.92	0.98
1.67	0.67	0.35	1.69	1.27	0.60	1.74	1.99	1.02
2.01	0.80	0.41	2.03	1.42	0.70	2.09	2.02	1.05
2.34	0.88	0.43	2.37	1.50	0.75	2.43	2.05	1.08
2.68	0.95	0.44	2.71	1.56	0.79	2.78	2.08	1.10
3.01	1.01	0.44	3.05	1.59	0.81	3.13	2.06	1.11
3.35	1.06	0.44	3.39	1.60	0.82	3.48	1.96	1.13
4.02	1.14	0.41	4.06	1.60	0.83	4.17	1.88	1.16
4.69	1.19	0.39	4.74	1.58	0.82	4.87	1.85	1.18
5.36	1.23	0.36	5.42	1.52	0.80	5.56	1.82	1.20
6.03	1.25	0.33	6.09	1.47	0.78	6.26	1.80	1.22
6.69	1.26	0.31	6.77	1.43	0.77	6.96	1.78	1.23
7.36	1.27	0.29	7.45	1.41	0.76	7.65	1.76	1.25
8.03	1.27	0.27	8.13	1.40	0.75	8.35	1.76	1.27
8.70	1.29	0.25	8.80	1.38	0.75	9.04	1.74	1.27
9.37	1.29	0.24	9.48	1.35	0.74	9.74	1.72	1.29
10.04	1.30	0.22	10.16	1.32	0.73	10.43	1.69	1.29
10.71	1.30	0.21	10.83	1.28	0.73	11.13	1.64	1.31
11.38	1.30	0.20	11.51	1.25	0.72	11.82	1.60	1.31
12.05	1.31	0.19	12.19	1.21	0.72	12.52	1.55	1.31
12.72	1.31	0.18	12.87	1.18	0.71	13.21	1.51	1.30
13.39	1.31	0.17	13.54	1.15	0.71	13.91	1.48	1.31
15.06	1.29	0.16	15.24	1.12	0.71	15.65	1.42	1.31
16.74	1.27	0.15	16.93	1.08	0.70	17.39	1.37	1.30
18.41	1.25	0.14	18.62	1.04	0.70	19.13	1.33	1.28
20.08	1.22	0.13	20.31	1.01	0.70	20.86	1.32	1.25



Sample No.	1	2	3	
Initial	Water Content, %	57.5	57.3	58.4
	Dry Density, pcf	66.2	66.4	65.5
	Saturation, %	100.0	100.0	99.8
	Void Ratio	1.5632	1.5578	1.5926
	Diameter, in.	1.40	1.41	1.41
	Height, in.	2.82	2.82	2.80
At Test	Water Content, %	57.5	56.8	57.8
	Dry Density, pcf	66.2	66.7	66.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5632	1.5442	1.5732
	Diameter, in.	1.40	1.41	1.40
	Height, in.	2.82	2.81	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.49	1.00	2.00	
Back Pressure, tsf	6.65	6.13	5.13	
Cell Pressure, tsf	7.14	7.13	7.13	
Peak Deviator Stress, tsf	0.89	1.53	1.86	
Total Pore Pr., tsf	6.87	6.85	6.16	
Ultimate Deviator Stress, tsf	0.57	1.01	1.18	
Total Pore Pr., tsf	6.61	6.43	5.84	
Maj. Eff. Stress at Ultimate, tsf	1.11	1.70	2.47	
Min. Eff. Stress at Ultimate, tsf	0.54	0.69	1.29	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 119 **PL=** 32 **PI=** 87

Specific Gravity= 2.720

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

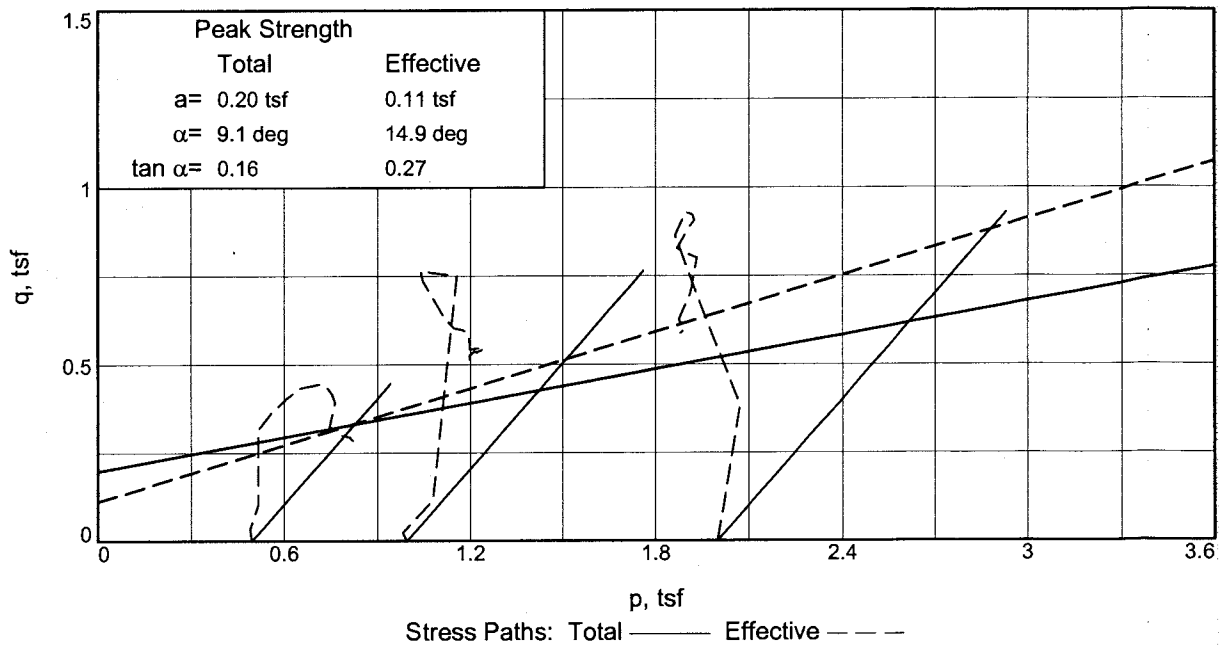
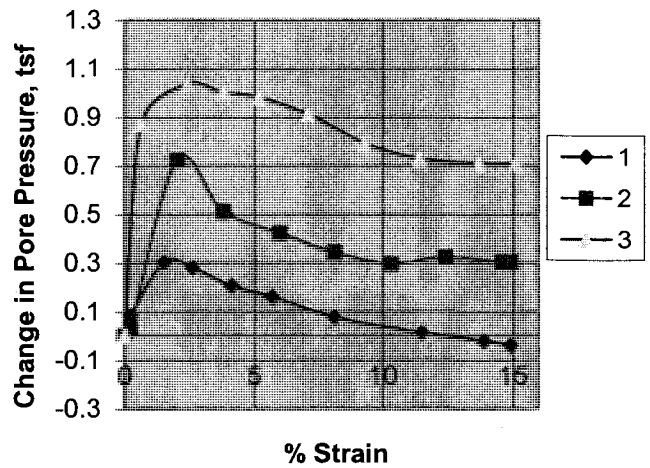
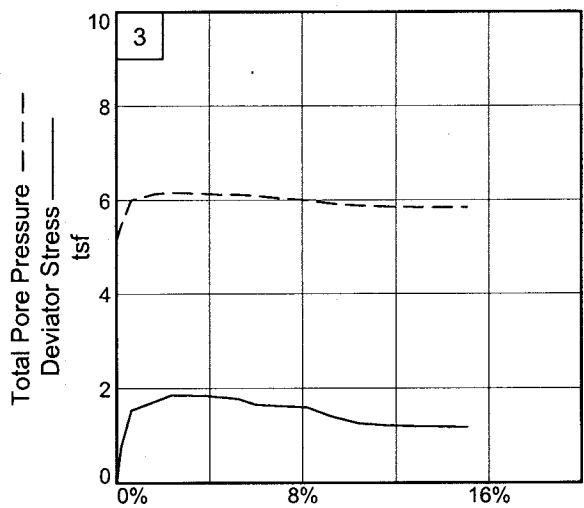
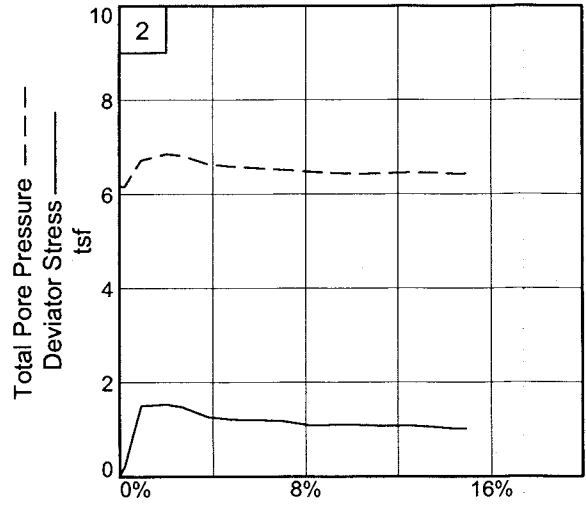
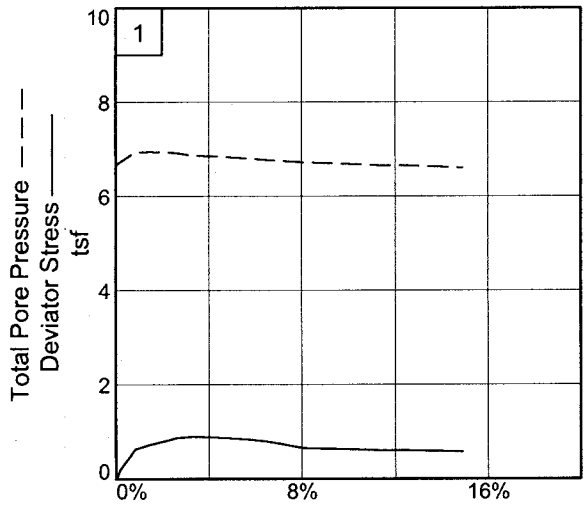
Location: Maple River, Brenna Formation

Sample Number: Boring10-105MU, #2 **Depth:** 25-27'

Proj. No.: BL-10-10065

Date Sampled:





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Brenna Formation

Depth: 25-27'

Sample Number: Boring10-105MU, #2

Project No.: W912ES-11-P-0024 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2014

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:16 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Brenna Formation
Depth: 25-27' **Sample Number:** Boring10-105MU, #2
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.720 **LL=**119 **PL=**32 **PI=**87
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.990			149.530
Moisture content: Dry soil+tare, gms.	83.510			105.390
Moisture content: Tare, gms.	30.500			30.270
Moisture, %	57.5	57.5	57.5	58.8
Moist specimen weight, gms.	118.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	104.3	104.3	104.3	
Dry density, pcf	66.2	66.2	66.2	
Void ratio	1.5632	1.5632	1.5632	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.142 tsf
Consolidation back pressure = 6.646 tsf
Consolidation effective confining stress = 0.496 tsf
Peak Stress = 0.894 tsf at reading no. 7
Ult. Stress = 0.572 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0085	18.730	0.0	0.0	0.000	0.496	0.496	1.00	6.646	0.496	0.000
1	0.0105	20.200	1.5	0.1	0.069	0.456	0.525	1.15	6.686	0.491	0.035
2	0.0137	23.100	4.4	0.2	0.205	0.414	0.619	1.50	6.728	0.517	0.103
3	0.0317	32.280	13.6	0.8	0.632	0.200	0.832	4.16	6.942	0.516	0.316
4	0.0495	34.330	15.6	1.5	0.723	0.195	0.918	4.71	6.947	0.557	0.362
5	0.0693	36.310	17.6	2.2	0.809	0.203	1.012	4.99	6.939	0.608	0.405
6	0.0823	37.680	18.9	2.6	0.868	0.219	1.087	4.96	6.923	0.653	0.434
7	0.1022	38.390	19.7	3.3	0.894	0.276	1.170	4.24	6.866	0.723	0.447
8	0.1241	38.250	19.5	4.1	0.881	0.293	1.174	4.01	6.849	0.733	0.440
9	0.1459	37.980	19.2	4.9	0.861	0.312	1.173	3.76	6.830	0.743	0.431
10	0.1690	37.530	18.8	5.7	0.834	0.337	1.171	3.47	6.805	0.754	0.417
11	0.1946	36.650	17.9	6.6	0.787	0.370	1.157	3.13	6.772	0.764	0.394
12	0.2365	33.760	15.0	8.1	0.650	0.421	1.071	2.54	6.721	0.746	0.325
13	0.2903	33.620	14.9	10.0	0.630	0.457	1.087	2.38	6.685	0.772	0.315
14	0.3324	33.230	14.5	11.5	0.604	0.485	1.089	2.24	6.657	0.787	0.302
15	0.3602	33.290	14.6	12.5	0.599	0.487	1.086	2.23	6.655	0.787	0.300
16	0.4010	33.290	14.6	13.9	0.590	0.518	1.108	2.14	6.624	0.813	0.295
17	0.4288	33.010	14.3	14.9	0.572	0.536	1.108	2.07	6.606	0.822	0.286

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.010			153.000
Moisture content: Dry soil+tare, gms.	79.280			108.090
Moisture content: Tare, gms.	30.860			30.590
Moisture, %	57.3	57.3	56.8	57.9
Moist specimen weight, gms.	121.3			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.57	1.57	1.56	
Height, in.	2.82	2.82	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	104.4	104.4	104.6	
Dry density, pcf	66.4	66.4	66.7	
Void ratio	1.5578	1.5578	1.5442	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.128 tsf
 Consolidation back pressure = 6.133 tsf
 Consolidation effective confining stress = 0.995 tsf
 Peak Stress = 1.530 tsf at reading no. 4
 Ult. Stress = 1.007 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0238	20.370	0.0	0.0	0.000	0.995	0.995	1.00	6.133	0.995	0.000
1	0.0246	21.420	1.1	0.0	0.048	0.959	1.007	1.05	6.169	0.983	0.024
2	0.0305	25.440	5.1	0.2	0.233	0.962	1.195	1.24	6.166	1.078	0.116
3	0.0502	53.300	32.9	0.9	1.501	0.406	1.907	4.70	6.722	1.157	0.751
4	0.0806	54.300	33.9	2.0	1.530	0.274	1.804	6.58	6.854	1.039	0.765
5	0.1000	53.300	32.9	2.7	1.474	0.309	1.783	5.77	6.819	1.046	0.737
6	0.1304	48.910	28.5	3.8	1.263	0.486	1.749	3.60	6.642	1.118	0.632
7	0.1619	47.930	27.6	4.9	1.206	0.545	1.751	3.21	6.583	1.148	0.603
8	0.1920	48.070	27.7	6.0	1.198	0.575	1.773	3.08	6.553	1.174	0.599
9	0.2225	47.850	27.5	7.1	1.175	0.607	1.782	2.94	6.521	1.195	0.588
10	0.2526	46.100	25.7	8.1	1.088	0.654	1.742	2.66	6.474	1.198	0.544
11	0.2832	46.540	26.2	9.2	1.093	0.676	1.769	2.62	6.452	1.223	0.547
12	0.3137	46.820	26.4	10.3	1.092	0.701	1.793	2.56	6.427	1.247	0.546
13	0.3440	46.600	26.2	11.4	1.070	0.685	1.755	2.56	6.443	1.220	0.535
14	0.3732	47.100	26.7	12.4	1.077	0.674	1.751	2.60	6.454	1.213	0.539
15	0.4037	46.750	26.4	13.5	1.050	0.672	1.722	2.56	6.456	1.197	0.525
16	0.4339	46.110	25.7	14.6	1.012	0.695	1.707	2.46	6.433	1.201	0.506
17	0.4441	46.100	25.7	14.9	1.007	0.693	1.700	2.45	6.435	1.197	0.504

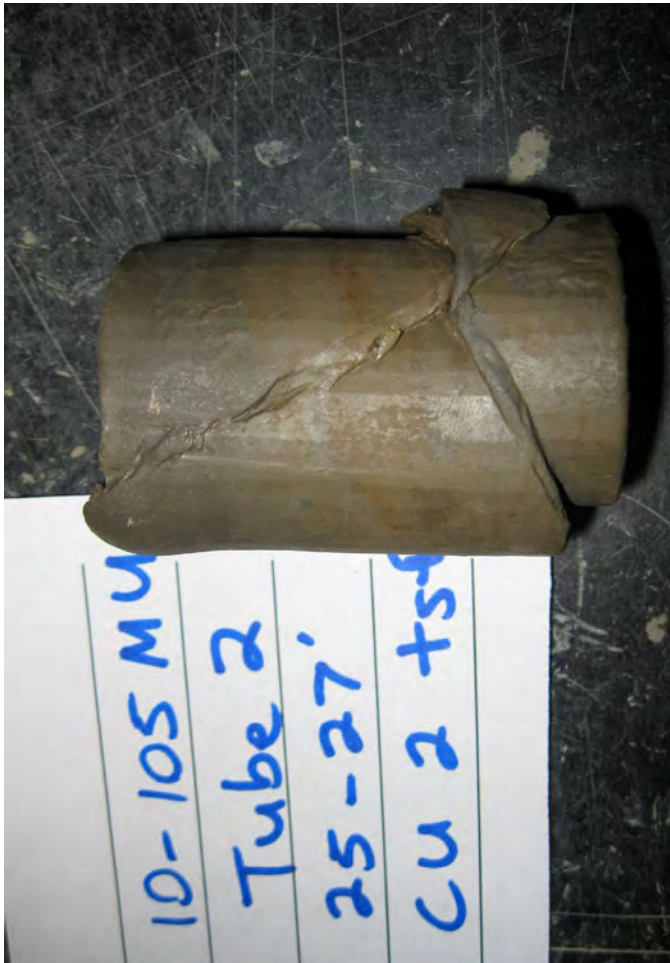
Parameters for Specimen No. 3

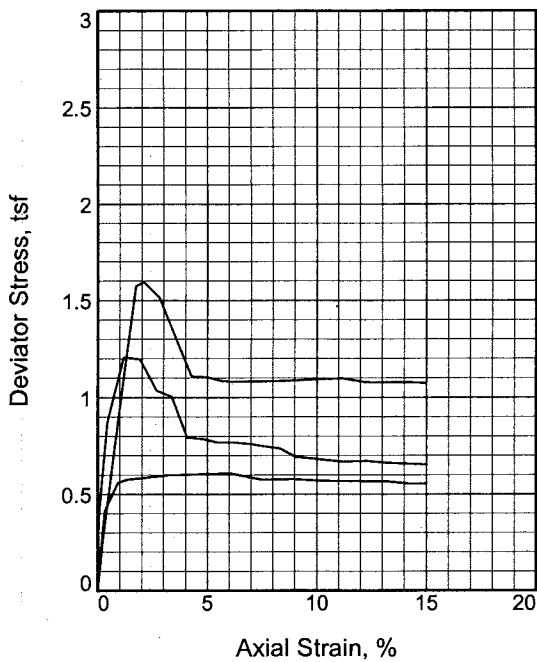
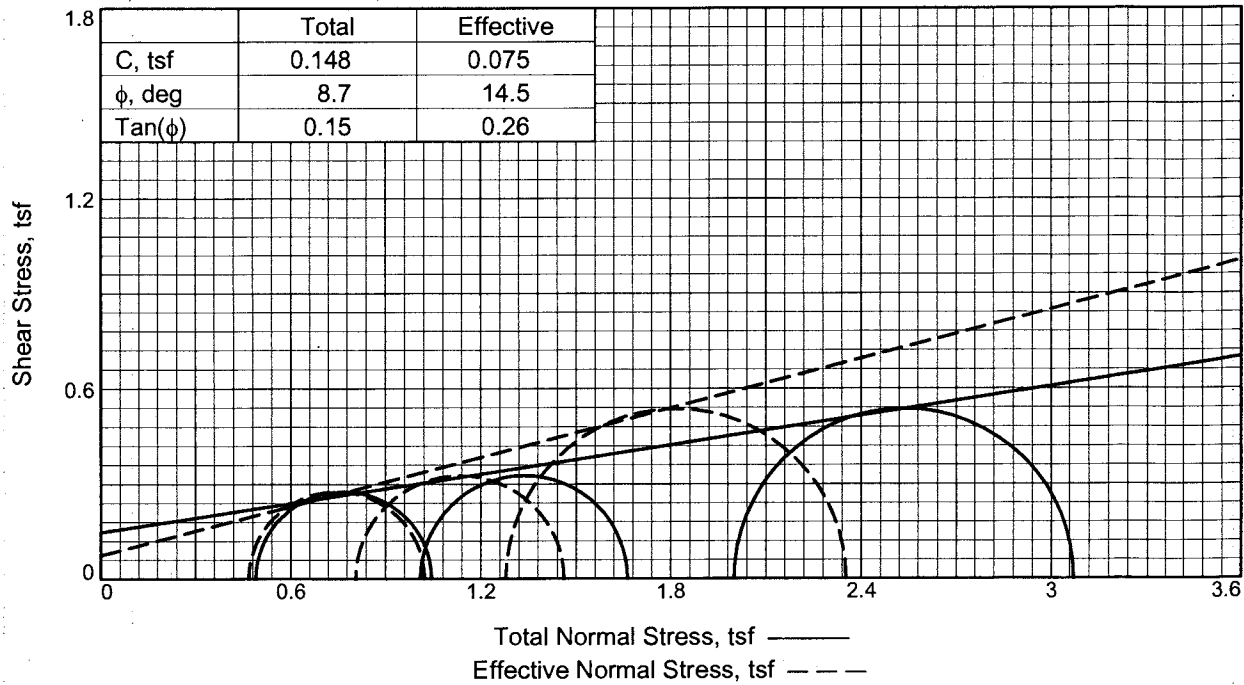
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.250			149.350
Moisture content: Dry soil+tare, gms.	78.840			106.400
Moisture content: Tare, gms.	30.210			31.580
Moisture, %	58.4	58.6	57.8	57.4
Moist specimen weight, gms.	118.2			
Diameter, in.	1.41	1.40	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	103.8	103.8	104.2	
Dry density, pcf	65.5	65.5	66.0	
Void ratio	1.5926	1.5926	1.5732	
Saturation, %	99.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.130 tsf
 Consolidation back pressure = 5.131 tsf
 Consolidation effective confining stress = 1.999 tsf
 Peak Stress = 1.858 tsf at reading no. 4
 Ult. Stress = 1.178 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0274	17.190	0.0	0.0	0.000	1.999	1.999	1.00	5.131	1.999	0.000
1	0.0325	33.790	16.6	0.2	0.773	1.684	2.457	1.46	5.446	2.071	0.387
2	0.0444	50.370	33.2	0.6	1.539	1.132	2.671	2.36	5.998	1.902	0.770
3	0.0737	54.880	37.7	1.7	1.730	0.997	2.727	2.74	6.133	1.862	0.865
4	0.0932	57.970	40.8	2.4	1.858	0.966	2.824	2.92	6.164	1.895	0.929
5	0.1137	58.090	40.9	3.1	1.850	0.986	2.836	2.88	6.144	1.911	0.925
6	0.1332	58.210	41.0	3.8	1.842	0.999	2.841	2.84	6.131	1.920	0.921
7	0.1538	57.880	40.7	4.5	1.813	1.017	2.830	2.78	6.113	1.924	0.907
8	0.1736	57.420	40.2	5.2	1.779	1.019	2.798	2.75	6.111	1.909	0.890
9	0.1940	54.940	37.8	6.0	1.657	1.040	2.697	2.59	6.090	1.868	0.828
10	0.2242	54.640	37.5	7.1	1.625	1.091	2.716	2.49	6.039	1.903	0.812
11	0.2556	54.560	37.4	8.2	1.602	1.132	2.734	2.41	5.998	1.933	0.801
12	0.2862	50.360	33.2	9.3	1.405	1.209	2.614	2.16	5.921	1.911	0.702
13	0.3168	47.260	30.1	10.4	1.258	1.245	2.503	2.01	5.885	1.874	0.629
14	0.3469	46.710	29.5	11.4	1.220	1.272	2.492	1.96	5.858	1.882	0.610
15	0.3783	46.490	29.3	12.6	1.196	1.284	2.480	1.93	5.846	1.882	0.598
16	0.4106	46.710	29.5	13.7	1.189	1.291	2.480	1.92	5.839	1.885	0.594
17	0.4481	46.900	29.7	15.1	1.178	1.291	2.469	1.91	5.839	1.880	0.589





Sample No.	1	2	3	
Initial	Water Content, %	61.5	61.1	61.2
	Dry Density, pcf	63.9	64.2	63.9
	Saturation, %	100.0	100.0	99.4
	Void Ratio	1.6987	1.6893	1.7000
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	61.5	61.1	61.5
	Dry Density, pcf	63.9	64.2	63.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6987	1.6893	1.7000
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.49	1.01	2.00	
Back Pressure, tsf	6.64	6.12	5.13	
Cell Pressure, tsf	7.13	7.13	7.13	
Peak Deviator Stress, tsf	0.61	1.21	1.60	
Total Pore Pr., tsf	6.76	6.67	6.01	
Ultimate Deviator Stress, tsf	0.55	0.65	1.07	
Total Pore Pr., tsf	6.66	6.33	5.85	
Maj. Eff. Stress at Ultimate, tsf	1.02	1.46	2.35	
Min. Eff. Stress at Ultimate, tsf	0.47	0.81	1.28	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 106 **PL=** 29 **PI=** 77

Specific Gravity= 2.764

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

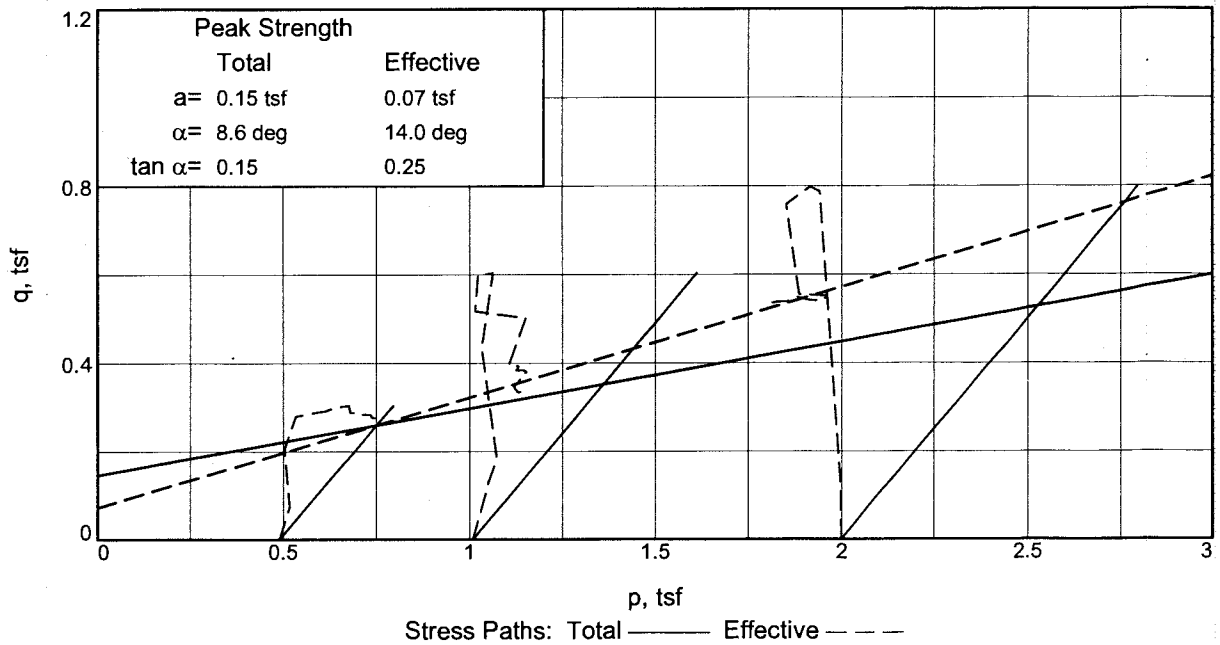
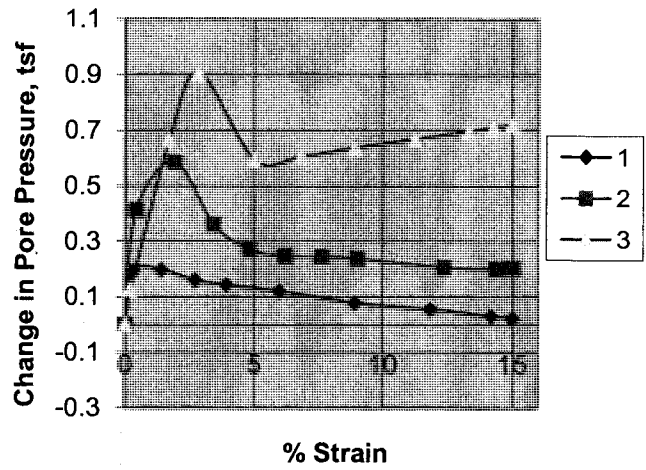
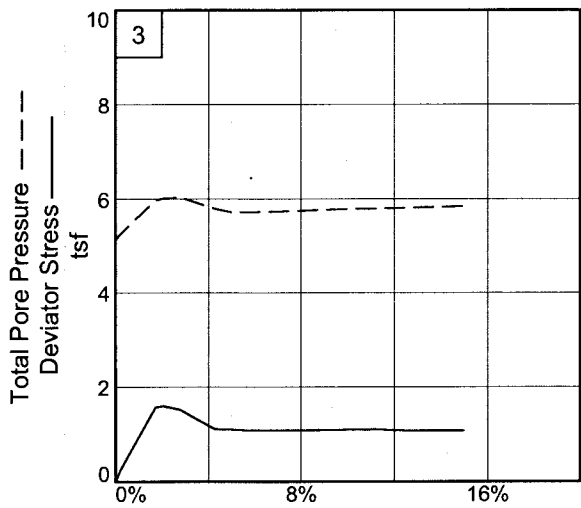
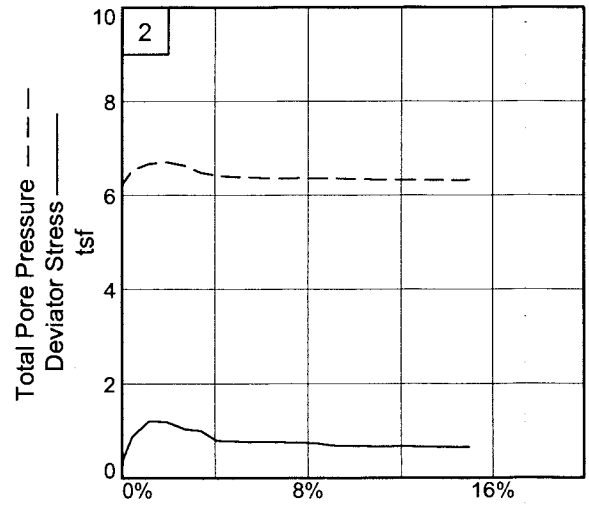
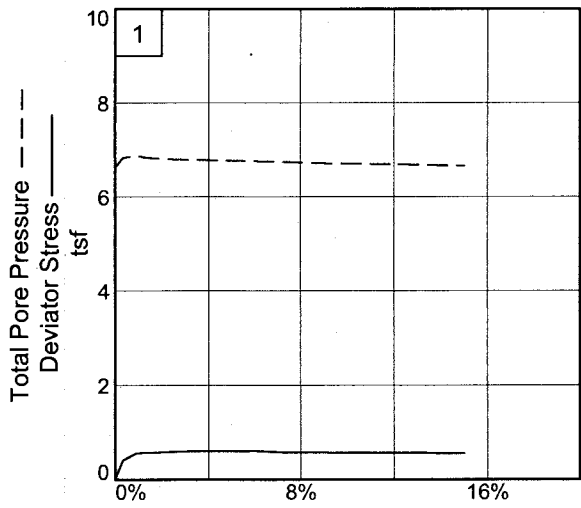
Location: Maple River, Brenna Formation

Sample Number: Boring10-105MU, #3 **Depth:** 35-37'

Proj. No.: BL-10-10065

Date Sampled:





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Brenna Formation

Depth: 35-37'

Sample Number: Boring10-105MU, #3

Project No. BI-10-10065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:22 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Brenna Formation
Depth: 35-37' **Sample Number:** Boring10-105MU, #3
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.764 **LL**=106 **PL**=29 **PI**=77
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	105.580			147.960
Moisture content: Dry soil+tare, gms.	76.750			102.970
Moisture content: Tare, gms.	29.840			31.280
Moisture, %	61.5	61.5	61.5	62.8
Moist specimen weight, gms.	115.5			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.2	103.2	103.2	
Dry density, pcf	63.9	63.9	63.9	
Void ratio	1.6987	1.6987	1.6987	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.131 tsf
 Consolidation back pressure = 6.641 tsf
 Consolidation effective confining stress = 0.490 tsf
 Peak Stress = 0.609 tsf at reading no. 10
 Ult. Stress = 0.554 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0067	18.690	0.0	0.0	0.000	0.490	0.490	1.00	6.641	0.490	0.000
1	0.0096	21.840	3.1	0.1	0.149	0.443	0.592	1.34	6.688	0.517	0.074
2	0.0158	27.430	8.7	0.3	0.412	0.298	0.710	2.38	6.833	0.504	0.206
3	0.0325	30.630	11.9	0.9	0.560	0.254	0.814	3.20	6.877	0.534	0.280
4	0.0445	31.020	12.3	1.4	0.575	0.293	0.868	2.96	6.838	0.581	0.288
5	0.0634	31.290	12.6	2.0	0.584	0.322	0.906	2.81	6.809	0.614	0.292
6	0.0833	31.580	12.9	2.7	0.593	0.331	0.924	2.79	6.800	0.628	0.297
7	0.0963	31.760	13.1	3.2	0.599	0.342	0.941	2.75	6.789	0.641	0.299
8	0.1162	31.910	13.2	3.9	0.601	0.348	0.949	2.73	6.783	0.648	0.300
9	0.1380	32.090	13.4	4.7	0.604	0.355	0.959	2.70	6.776	0.657	0.302
10	0.1758	32.400	13.7	6.0	0.609	0.371	0.980	2.64	6.760	0.676	0.305
11	0.2157	31.850	13.2	7.5	0.576	0.391	0.967	2.47	6.740	0.679	0.288
12	0.2563	32.090	13.4	8.9	0.577	0.413	0.990	2.40	6.718	0.702	0.289
13	0.2963	32.100	13.4	10.3	0.569	0.426	0.995	2.34	6.705	0.710	0.284
14	0.3373	32.300	13.6	11.8	0.568	0.436	1.004	2.30	6.695	0.720	0.284
15	0.3780	32.500	13.8	13.3	0.567	0.451	1.018	2.26	6.680	0.734	0.283
16	0.4052	32.370	13.7	14.2	0.555	0.460	1.015	2.21	6.671	0.738	0.278
17	0.4269	32.470	13.8	15.0	0.554	0.468	1.022	2.18	6.663	0.745	0.277

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.390			146.280
Moisture content: Dry soil+tare, gms.	87.730			102.020
Moisture content: Tare, gms.	31.040			30.210
Moisture, %	61.1	61.1	61.1	61.6
Moist specimen weight, gms.	115.3			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.4	103.4	103.4	
Dry density, pcf	64.2	64.2	64.2	
Void ratio	1.6893	1.6893	1.6893	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.132 tsf
 Consolidation back pressure = 6.123 tsf
 Consolidation effective confining stress = 1.009 tsf
 Peak Stress = 1.208 tsf at reading no. 3
 Ult. Stress = 0.654 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0238	18.000	0.0	0.0	0.000	1.009	1.009	1.00	6.123	1.009	0.000
1	0.0248	25.990	8.0	0.0	0.380	0.883	1.263	1.43	6.249	1.073	0.190
2	0.0361	36.410	18.4	0.4	0.871	0.597	1.468	2.46	6.535	1.032	0.435
3	0.0571	43.720	25.7	1.2	1.208	0.459	1.667	3.63	6.673	1.063	0.604
4	0.0775	43.690	25.7	1.9	1.197	0.424	1.621	3.82	6.708	1.023	0.599
5	0.0989	40.400	22.4	2.7	1.036	0.497	1.533	3.08	6.635	1.015	0.518
6	0.1186	39.890	21.9	3.4	1.005	0.649	1.654	2.55	6.483	1.151	0.502
7	0.1382	35.400	17.4	4.1	0.793	0.709	1.502	2.12	6.423	1.106	0.397
8	0.1579	35.400	17.4	4.8	0.787	0.738	1.525	2.07	6.394	1.132	0.394
9	0.1773	35.110	17.1	5.5	0.768	0.742	1.510	2.04	6.390	1.126	0.384
10	0.1980	35.250	17.3	6.2	0.769	0.763	1.532	2.01	6.369	1.147	0.384
11	0.2174	35.210	17.2	6.9	0.761	0.774	1.535	1.98	6.358	1.155	0.381
12	0.2371	35.060	17.1	7.6	0.749	0.766	1.515	1.98	6.366	1.140	0.374
13	0.2576	34.910	16.9	8.3	0.736	0.772	1.508	1.95	6.360	1.140	0.368
14	0.2773	34.050	16.0	9.0	0.694	0.772	1.466	1.90	6.360	1.119	0.347
15	0.3372	33.850	15.9	11.2	0.669	0.796	1.465	1.84	6.336	1.130	0.334
16	0.3677	34.110	16.1	12.3	0.672	0.805	1.477	1.83	6.327	1.141	0.336
17	0.3968	34.080	16.1	13.3	0.662	0.810	1.472	1.82	6.322	1.141	0.331
18	0.4272	34.150	16.1	14.4	0.657	0.809	1.466	1.81	6.323	1.137	0.328
19	0.4449	34.200	16.2	15.0	0.654	0.807	1.461	1.81	6.325	1.134	0.327

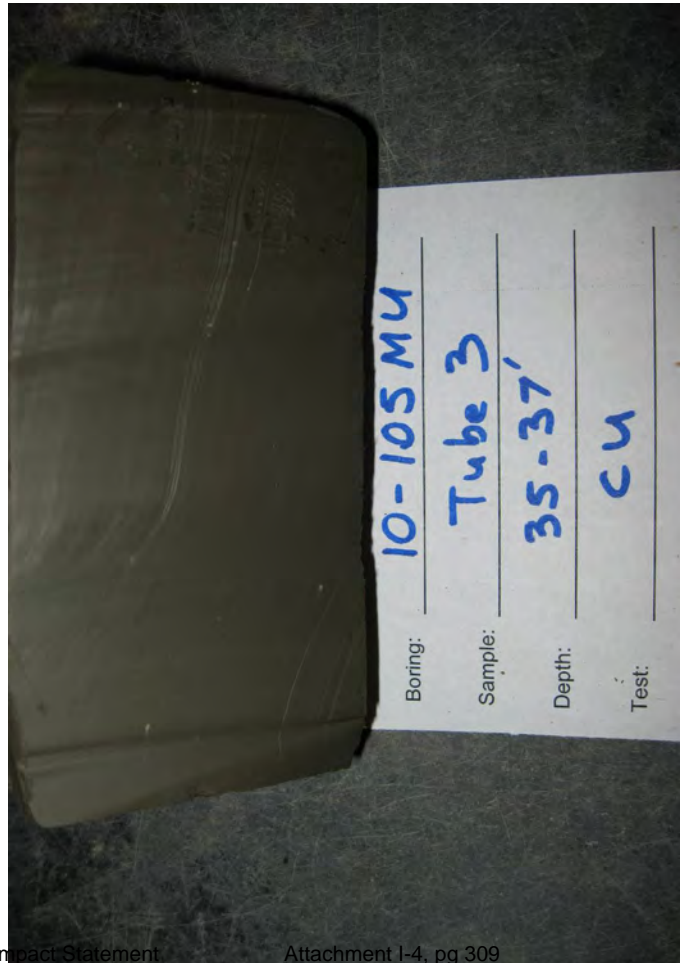
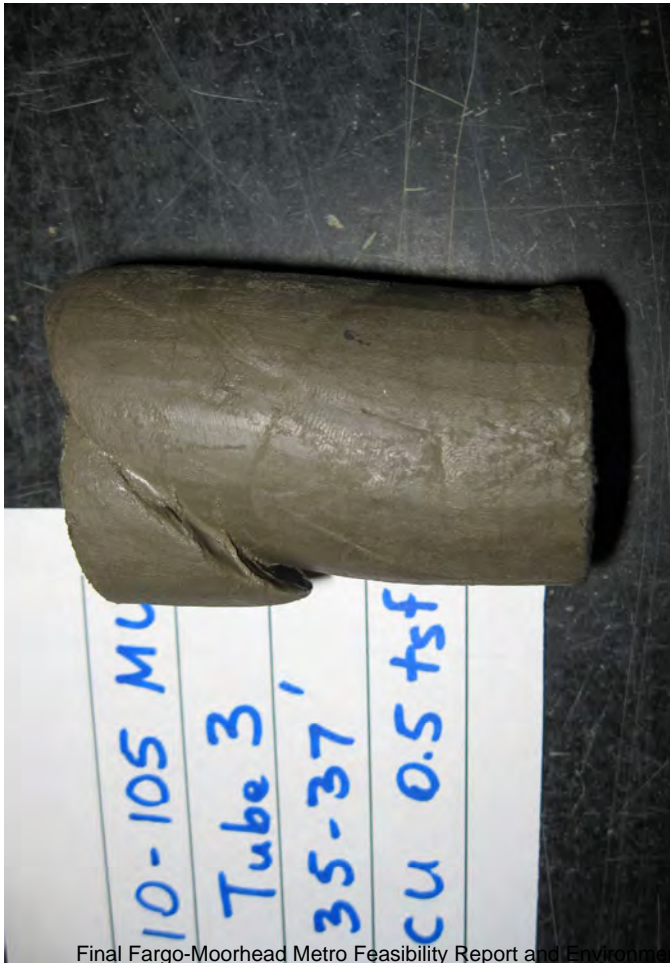
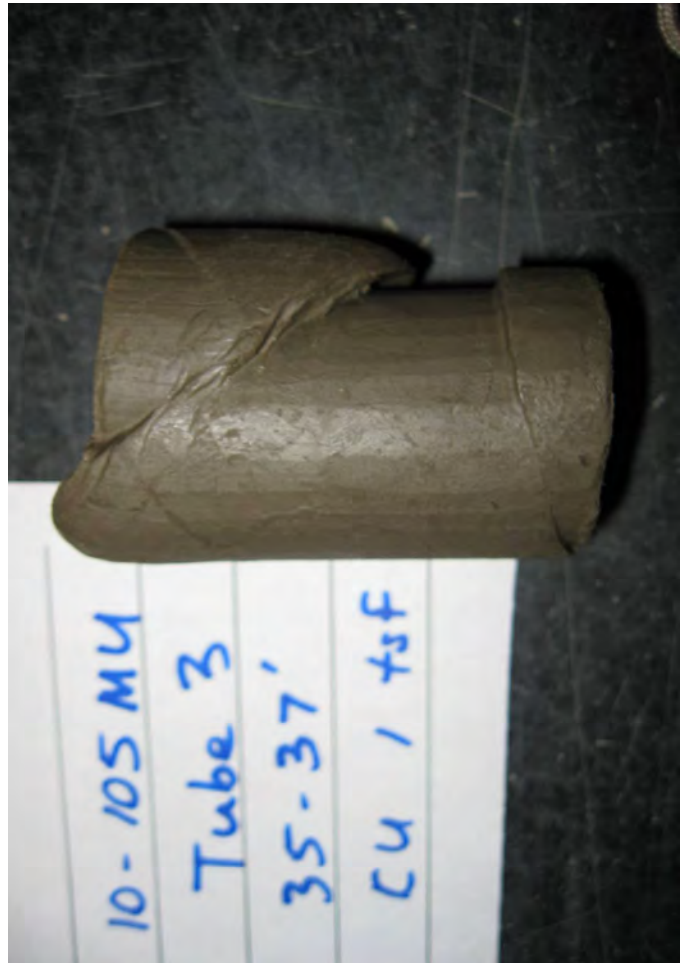
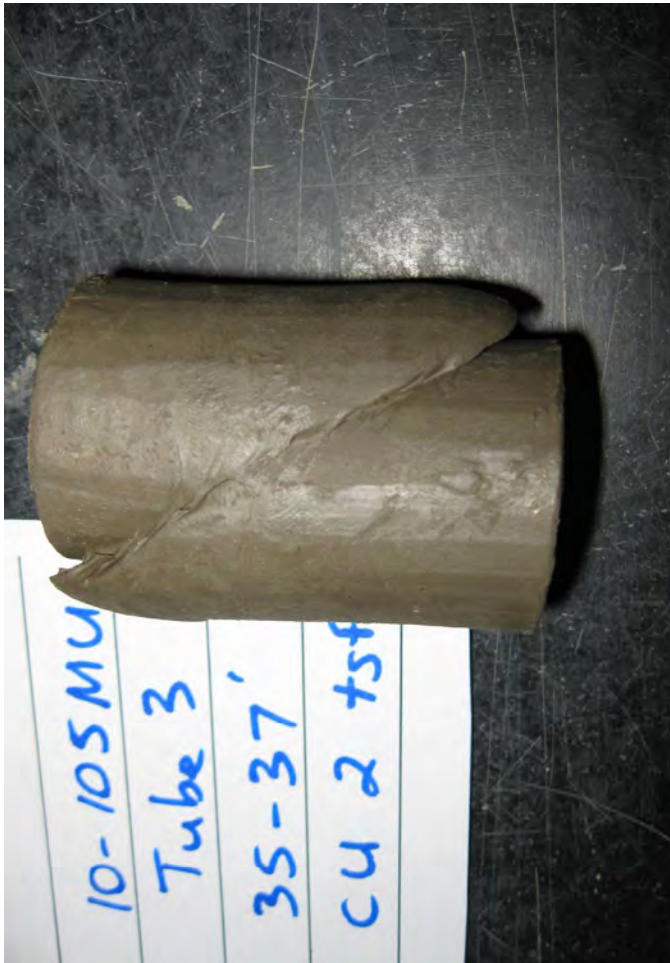
Parameters for Specimen No. 3

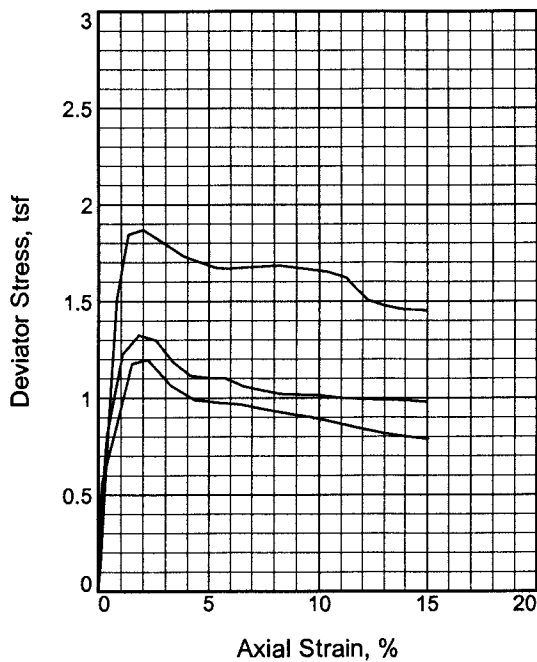
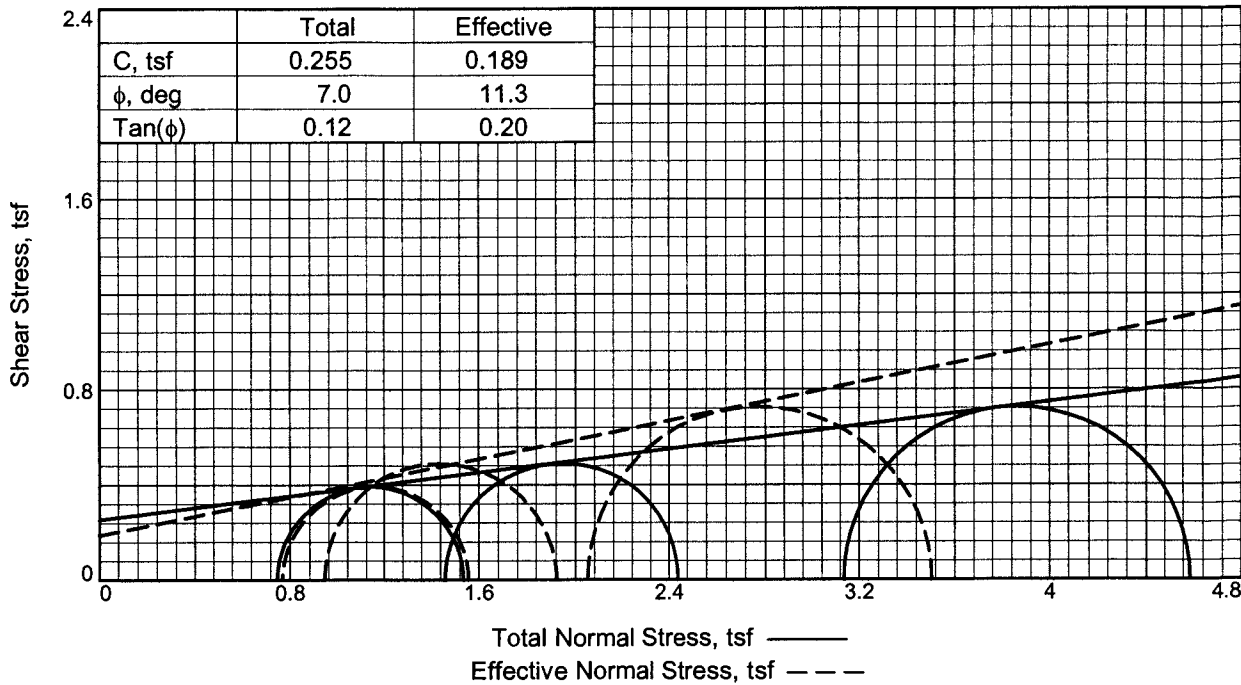
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	111.410			145.980
Moisture content: Dry soil+tare, gms.	80.520			103.150
Moisture content: Tare, gms.	30.010			30.440
Moisture, %	61.2	61.5	61.5	58.9
Moist specimen weight, gms.	117.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	103.0	103.2	103.2	
Dry density, pcf	63.9	63.9	63.9	
Void ratio	1.7000	1.7000	1.7000	
Saturation, %	99.4	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.127 tsf
 Consolidation back pressure = 5.128 tsf
 Consolidation effective confining stress = 1.999 tsf
 Peak Stress = 1.596 tsf at reading no. 3
 Ult. Stress = 1.074 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0274	18.500	0.0	0.0	0.000	1.999	1.999	1.00	5.128	1.999	0.000
1	0.0334	23.860	5.4	0.2	0.249	1.872	2.121	1.13	5.255	1.997	0.125
2	0.0757	52.900	34.4	1.7	1.574	1.155	2.729	2.36	5.972	1.942	0.787
3	0.0854	53.500	35.0	2.1	1.596	1.118	2.714	2.43	6.009	1.916	0.798
4	0.1059	52.000	33.5	2.8	1.516	1.095	2.611	2.38	6.032	1.853	0.758
5	0.1469	43.400	24.9	4.3	1.110	1.332	2.442	1.83	5.795	1.887	0.555
6	0.1667	43.480	25.0	5.0	1.106	1.407	2.513	1.79	5.720	1.960	0.553
7	0.1877	43.210	24.7	5.7	1.085	1.410	2.495	1.77	5.717	1.952	0.542
8	0.2183	43.460	25.0	6.8	1.083	1.395	2.478	1.78	5.732	1.937	0.542
9	0.2478	43.750	25.3	7.9	1.083	1.381	2.464	1.78	5.746	1.923	0.542
10	0.2781	44.150	25.6	8.9	1.088	1.363	2.451	1.80	5.764	1.907	0.544
11	0.3085	44.630	26.1	10.0	1.095	1.341	2.436	1.82	5.786	1.888	0.547
12	0.3400	45.060	26.6	11.2	1.099	1.332	2.431	1.83	5.795	1.881	0.549
13	0.3694	44.890	26.4	12.2	1.079	1.317	2.396	1.82	5.810	1.857	0.540
14	0.3990	45.190	26.7	13.3	1.078	1.304	2.382	1.83	5.823	1.843	0.539
15	0.4292	45.510	27.0	14.3	1.078	1.290	2.368	1.84	5.837	1.829	0.539
16	0.4468	45.610	27.1	15.0	1.074	1.279	2.353	1.84	5.848	1.816	0.537





Sample No.		1	2	3
Initial	Water Content, %	40.5	43.0	46.1
	Dry Density, pcf	81.1	77.3	74.9
	Saturation, %	100.0	97.3	98.2
	Void Ratio	1.1095	1.2125	1.2860
	Diameter, in.	1.39	1.40	1.38
	Height, in.	2.81	2.80	2.80
At Test	Water Content, %	40.5	44.2	46.0
	Dry Density, pcf	81.1	77.3	75.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1095	1.2125	1.2616
	Diameter, in.	1.39	1.40	1.38
	Height, in.	2.81	2.80	2.79
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.75	1.46	3.14
Back Pressure, tsf		6.38	5.63	3.99
Cell Pressure, tsf		7.13	7.09	7.13
Peak Deviator Stress, tsf		1.20	1.33	1.87
Total Pore Pr., tsf		6.92	6.49	5.31
Ultimate Deviator Stress, tsf		0.79	0.98	1.45
Total Pore Pr., tsf		6.36	6.15	5.08
Maj. Eff. Stress at Ultimate, tsf		1.56	1.92	3.50
Min. Eff. Stress at Ultimate, tsf		0.77	0.94	2.05

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 71

PL= 19

PI= 52

Specific Gravity= 2.741

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Brenna Formation

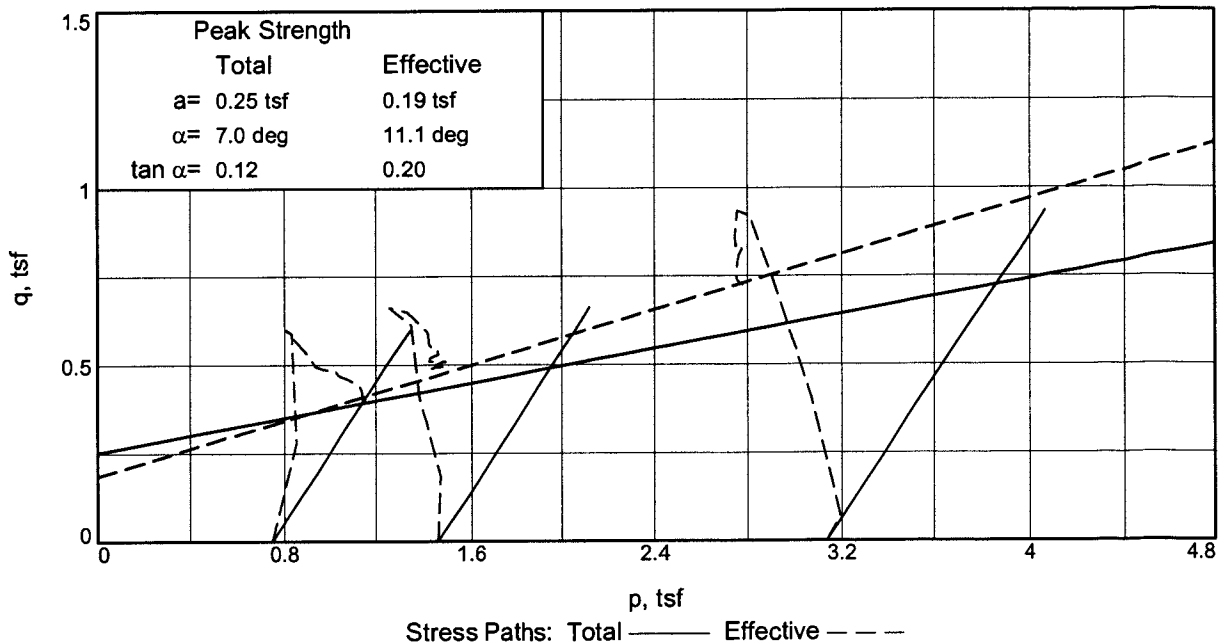
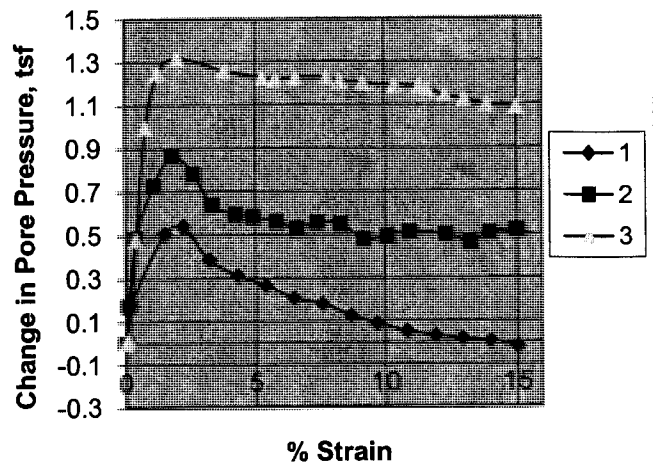
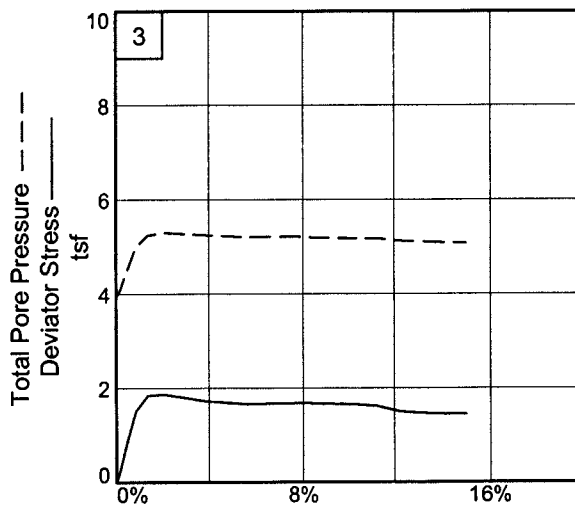
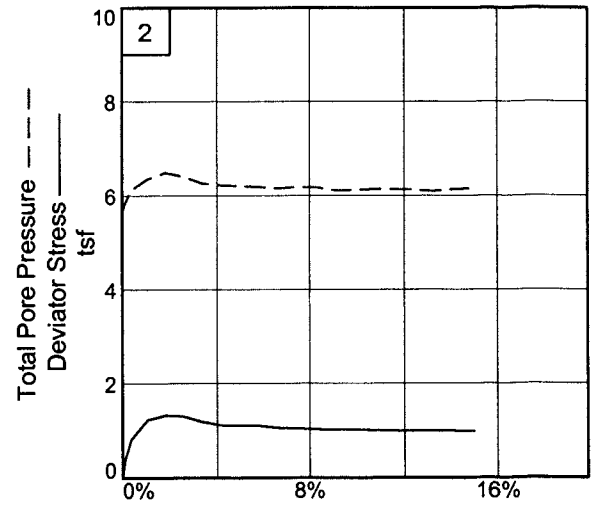
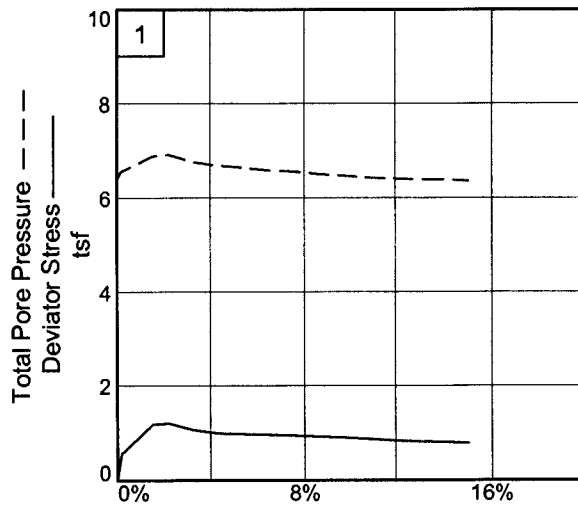
Sample Number: Boring11-107MU, #1

Depth: 20-22'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN
INTERTEC



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Brenna Formation

Depth: 20-22'

Sample No.: Boring11-107MU, #1

Project No.: B-10-10066 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/30/2011

12:19 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Brenna Formation
Depth: 20-22' **Sample Number:** Boring11-107MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.741 **LL**=71 **PL**=19 **PI**=52
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	161.620			158.820
Moisture content: Dry soil+tare, gms.	123.870			121.320
Moisture content: Tare, gms.	30.570			30.570
Moisture, %	40.5	40.5	40.5	41.3
Moist specimen weight, gms.	127.3			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.9	113.9	113.9	
Dry density, pcf	81.1	81.1	81.1	
Void ratio	1.1095	1.1095	1.1095	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.129 tsf
Consolidation back pressure = 6.382 tsf
Consolidation effective confining stress = 0.747 tsf
Peak Stress = 1.200 tsf at reading no. 3
Ult. Stress = 0.788 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0327	19.870	0.0	0.0	0.000	0.747	0.747	1.00	6.382	0.747	0.000
1	0.0375	31.710	11.8	0.2	0.561	0.573	1.134	1.98	6.556	0.853	0.280
2	0.0748	45.070	25.2	1.5	1.178	0.243	1.421	5.85	6.886	0.832	0.589
3	0.0944	45.720	25.8	2.2	1.200	0.207	1.407	6.79	6.922	0.807	0.600
4	0.1235	43.070	23.2	3.2	1.065	0.364	1.429	3.93	6.765	0.897	0.533
5	0.1539	41.700	21.8	4.3	0.991	0.438	1.429	3.26	6.691	0.934	0.496
6	0.1843	41.610	21.7	5.4	0.976	0.483	1.459	3.02	6.646	0.971	0.488
7	0.2156	41.640	21.8	6.5	0.966	0.543	1.509	2.78	6.586	1.026	0.483
8	0.2461	41.360	21.5	7.6	0.942	0.568	1.510	2.66	6.561	1.039	0.471
9	0.2755	41.080	21.2	8.7	0.919	0.623	1.542	2.48	6.506	1.083	0.460
10	0.3060	40.890	21.0	9.7	0.900	0.660	1.560	2.36	6.469	1.110	0.450
11	0.3360	40.480	20.6	10.8	0.872	0.698	1.570	2.25	6.431	1.134	0.436
12	0.3667	40.030	20.2	11.9	0.843	0.719	1.562	2.17	6.410	1.140	0.421
13	0.3959	39.670	19.8	12.9	0.818	0.731	1.549	2.12	6.398	1.140	0.409
14	0.4264	39.550	19.7	14.0	0.803	0.743	1.546	2.08	6.386	1.144	0.401
15	0.4548	39.420	19.6	15.0	0.788	0.769	1.557	2.02	6.360	1.163	0.394

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	132.150			155.490
Moisture content: Dry soil+tare, gms.	101.480			116.780
Moisture content: Tare, gms.	30.210			30.550
Moisture, %	43.0	44.2	44.2	44.9
Moist specimen weight, gms.	124.8			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	110.6	111.6	111.6	
Dry density, pcf	77.3	77.3	77.3	
Void ratio	1.2125	1.2125	1.2125	
Saturation, %	97.3	100.0	100.0	

Consolidation cell pressure = 7.091 tsf

Consolidation back pressure = 5.632 tsf

Consolidation effective confining stress = 1.459 tsf

Peak Stress = 1.325 tsf at reading no. 4

Ult. Stress = 0.980 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0101	18.490	0.0	0.0	0.000	1.459	1.459	1.00	5.632	1.459	0.000
1	0.0131	26.450	8.0	0.1	0.374	1.284	1.658	1.29	5.807	1.471	0.187
2	0.0210	35.880	17.4	0.4	0.814	0.974	1.788	1.84	6.117	1.381	0.407
3	0.0404	44.890	26.4	1.1	1.227	0.734	1.961	2.67	6.357	1.347	0.613
4	0.0609	47.220	28.7	1.8	1.325	0.597	1.922	3.22	6.494	1.260	0.663
5	0.0819	46.900	28.4	2.6	1.300	0.682	1.982	2.91	6.409	1.332	0.650
6	0.1040	44.610	26.1	3.3	1.186	0.823	2.009	2.44	6.268	1.416	0.593
7	0.1266	43.270	24.8	4.2	1.116	0.865	1.981	2.29	6.226	1.423	0.558
8	0.1485	43.210	24.7	4.9	1.104	0.877	1.981	2.26	6.214	1.429	0.552
9	0.1714	43.390	24.9	5.8	1.102	0.900	2.002	2.22	6.191	1.451	0.551
10	0.1954	42.660	24.2	6.6	1.060	0.932	1.992	2.14	6.159	1.462	0.530
11	0.2183	42.430	23.9	7.4	1.041	0.906	1.947	2.15	6.185	1.427	0.521
12	0.2432	42.200	23.7	8.3	1.021	0.912	1.933	2.12	6.179	1.423	0.511
13	0.2672	42.350	23.9	9.2	1.018	0.983	2.001	2.04	6.108	1.492	0.509
14	0.2921	42.500	24.0	10.1	1.014	0.969	1.983	2.05	6.122	1.476	0.507
15	0.3160	42.400	23.9	10.9	1.001	0.948	1.949	2.06	6.143	1.448	0.500
16	0.3553	42.580	24.1	12.3	0.992	0.962	1.954	2.03	6.129	1.458	0.496
17	0.3798	42.800	24.3	13.2	0.991	0.998	1.989	1.99	6.093	1.494	0.496
18	0.4037	42.950	24.5	14.0	0.988	0.953	1.941	2.04	6.138	1.447	0.494
19	0.4307	43.040	24.6	15.0	0.980	0.943	1.923	2.04	6.148	1.433	0.490

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	150.620			149.270
Moisture content: Dry soil+tare, gms.	112.810			112.160
Moisture content: Tare, gms.	30.750			30.270
Moisture, %	46.1	46.9	46.0	45.3
Moist specimen weight, gms.	120.4			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.49	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.3	110.0	110.5	
Dry density, pcf	74.9	74.9	75.7	
Void ratio	1.2860	1.2860	1.2616	
Saturation, %	98.2	100.0	100.0	

Consolidation cell pressure = 7.126 tsf

Consolidation back pressure = 3.990 tsf

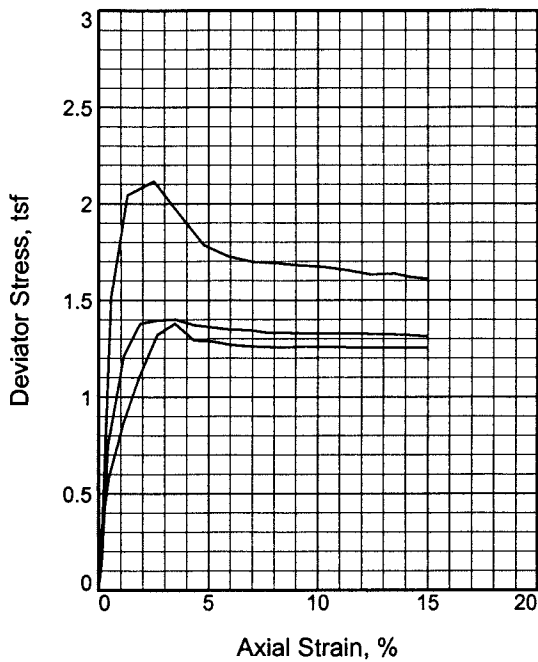
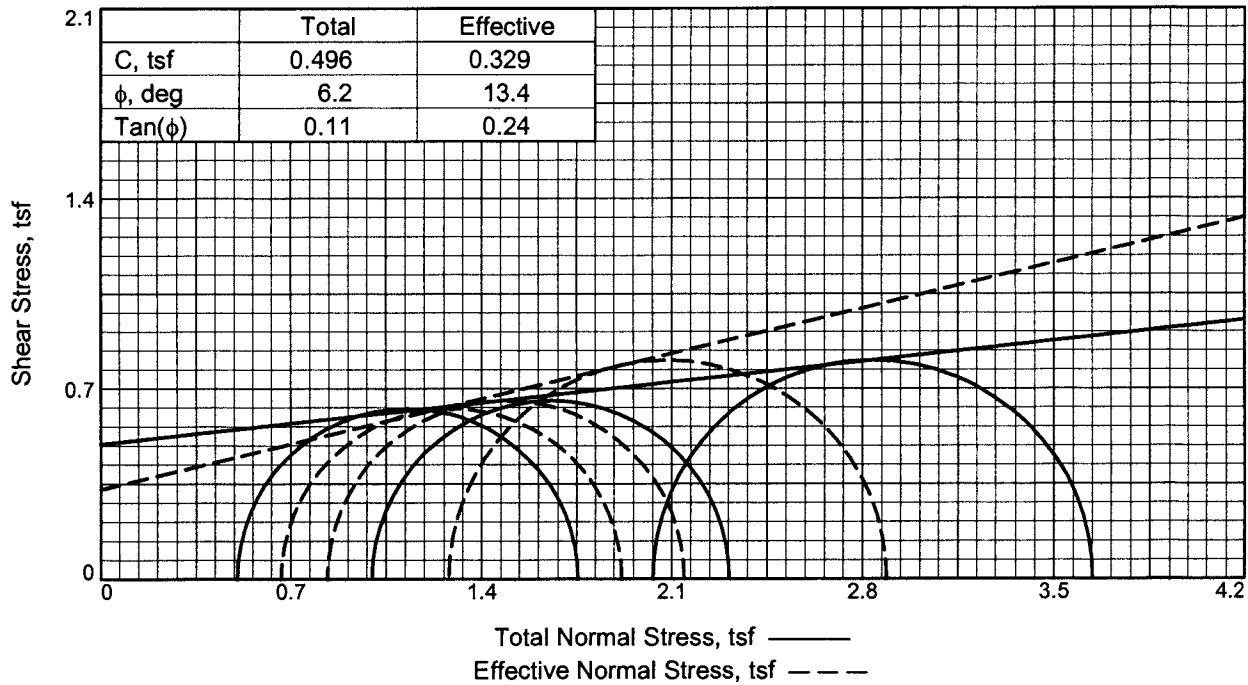
Consolidation effective confining stress = 3.136 tsf

Peak Stress = 1.869 tsf at reading no. 5

Ult. Stress = 1.452 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0370	17.500	0.0	0.0	0.000	3.136	3.136	1.00	3.990	3.136	0.000
1	0.0400	20.400	2.9	0.1	0.140	3.124	3.264	1.04	4.002	3.194	0.070
2	0.0490	34.600	17.1	0.4	0.824	2.658	3.482	1.31	4.468	3.070	0.412
3	0.0600	49.100	31.6	0.8	1.517	2.139	3.656	1.71	4.987	2.898	0.759
4	0.0740	56.100	38.6	1.3	1.844	1.887	3.731	1.98	5.239	2.809	0.922
5	0.0930	56.900	39.4	2.0	1.869	1.820	3.689	2.03	5.306	2.755	0.935
6	0.1440	54.700	37.2	3.8	1.732	1.878	3.610	1.92	5.248	2.744	0.866
7	0.1860	54.000	36.5	5.3	1.673	1.910	3.583	1.88	5.216	2.746	0.836
8	0.1990	54.100	36.6	5.8	1.669	1.915	3.584	1.87	5.211	2.750	0.835
9	0.2200	54.500	37.0	6.6	1.674	1.910	3.584	1.88	5.216	2.747	0.837
10	0.2550	55.200	37.7	7.8	1.683	1.910	3.593	1.88	5.216	2.751	0.841
11	0.2680	55.400	37.9	8.3	1.683	1.926	3.609	1.87	5.200	2.768	0.842
12	0.2940	55.500	38.0	9.2	1.670	1.936	3.606	1.86	5.190	2.771	0.835
13	0.3270	55.570	38.1	10.4	1.652	1.949	3.601	1.85	5.177	2.775	0.826
14	0.3510	55.200	37.7	11.3	1.620	1.951	3.571	1.83	5.175	2.761	0.810
15	0.3600	54.400	36.9	11.6	1.580	1.966	3.546	1.80	5.160	2.756	0.790
16	0.3790	52.900	35.4	12.3	1.504	1.997	3.501	1.75	5.129	2.749	0.752
17	0.4000	52.600	35.1	13.0	1.478	2.013	3.491	1.73	5.113	2.752	0.739
18	0.4240	52.500	35.0	13.9	1.460	2.036	3.496	1.72	5.090	2.766	0.730
19	0.4560	52.800	35.3	15.0	1.452	2.051	3.503	1.71	5.075	2.777	0.726





Sample No.	1	2	3	
Initial	Water Content, %	40.3	39.9	39.6
	Dry Density, pcf	80.9	80.5	80.0
	Saturation, %	98.4	96.8	94.8
	Void Ratio	1.1297	1.1392	1.1538
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	40.9	40.9	41.4
	Dry Density, pcf	80.9	81.0	80.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1297	1.1278	1.1423
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.50	1.00	2.03	
Back Pressure, tsf	6.63	6.13	5.11	
Cell Pressure, tsf	7.13	7.13	7.14	
Peak Deviator Stress, tsf	1.38	1.40	2.12	
Total Pore Pr., tsf	6.78	6.54	6.18	
Ultimate Deviator Stress, tsf	1.25	1.31	1.61	
Total Pore Pr., tsf	6.47	6.29	5.87	
Maj. Eff. Stress at Ultimate, tsf	1.92	2.15	2.89	
Min. Eff. Stress at Ultimate, tsf	0.67	0.83	1.28	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 52

PL= 21

PI= 31

Specific Gravity= 2.76

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Brenna Formation

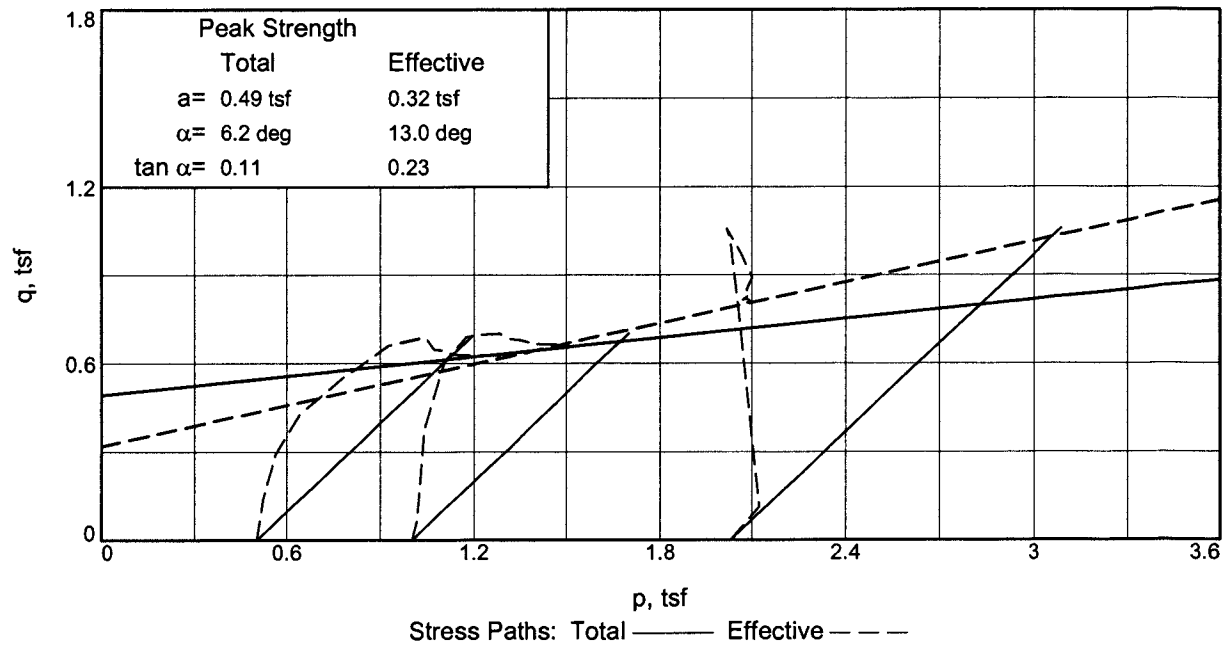
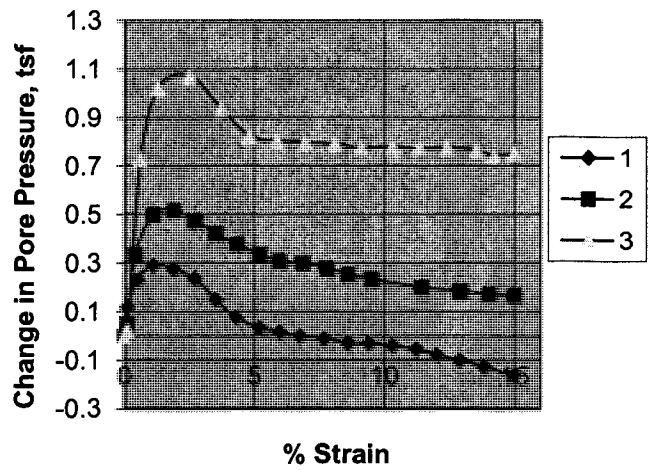
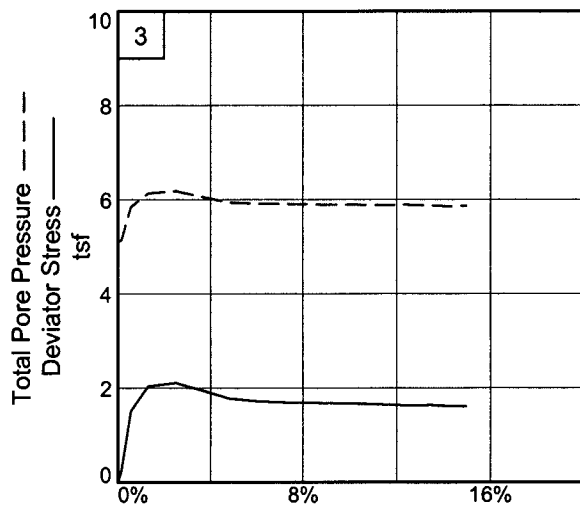
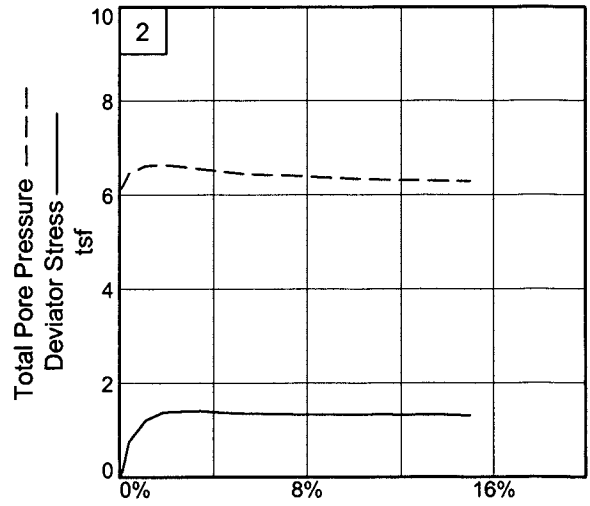
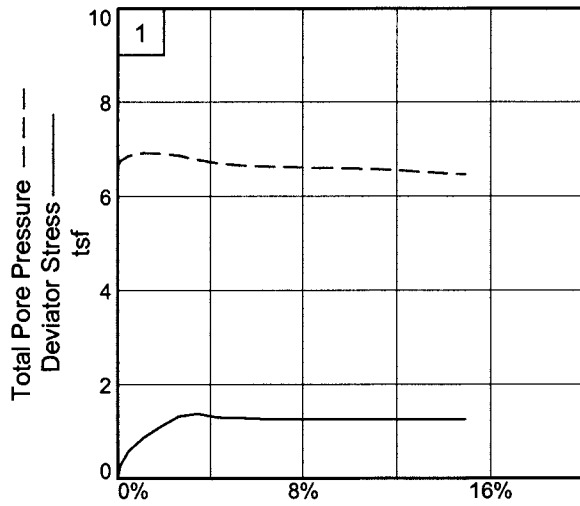
Sample Number: Boring11-107MU, #2

Depth: 30-32'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN
INTERTEC



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Brenna Formation

Depth: 30-32'

Sample No.: Boring11-107MU, #2

Project No.: DL 10-0065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/30/2011

12:19 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Brenna Formation
Depth: 30-32' **Sample Number:** Boring11-107MU, #2
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.76 **LL=**52 **PL=**21 **PI=**31
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.470			158.370
Moisture content: Dry soil+tare, gms.	109.540			121.530
Moisture content: Tare, gms.	30.290			31.220
Moisture, %	40.3	40.9	40.9	40.8
Moist specimen weight, gms.	126.9			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.5	114.0	114.0	
Dry density, pcf	80.9	80.9	80.9	
Void ratio	1.1297	1.1297	1.1297	
Saturation, %	98.4	100.0	100.0	

Consolidation cell pressure = 7.131 tsf
Consolidation back pressure = 6.629 tsf
Consolidation effective confining stress = 0.502 tsf
Peak Stress = 1.379 tsf at reading no. 6
Ult. Stress = 1.253 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0094	19.310	0.0	0.0	0.000	0.502	0.502	1.00	6.629	0.502	0.000
1	0.0125	25.260	6.0	0.1	0.282	0.382	0.664	1.74	6.749	0.523	0.141
2	0.0223	31.700	12.4	0.5	0.584	0.271	0.855	3.16	6.860	0.563	0.292
3	0.0410	37.780	18.5	1.1	0.865	0.212	1.077	5.08	6.919	0.645	0.433
4	0.0620	43.150	23.8	1.9	1.108	0.228	1.336	5.86	6.903	0.782	0.554
5	0.0840	47.970	28.7	2.7	1.322	0.267	1.589	5.95	6.864	0.928	0.661
6	0.1066	49.470	30.2	3.5	1.379	0.354	1.733	4.90	6.777	1.044	0.690
7	0.1305	47.840	28.5	4.3	1.293	0.427	1.720	4.03	6.704	1.074	0.647
8	0.1545	47.960	28.7	5.2	1.287	0.469	1.756	3.74	6.662	1.113	0.644
9	0.1773	47.810	28.5	6.0	1.269	0.487	1.756	3.61	6.644	1.122	0.635
10	0.2011	47.910	28.6	6.8	1.262	0.503	1.765	3.51	6.628	1.134	0.631
11	0.2242	48.080	28.8	7.7	1.259	0.514	1.773	3.45	6.617	1.143	0.629
12	0.2492	48.320	29.0	8.6	1.257	0.531	1.788	3.37	6.600	1.159	0.628
13	0.2732	48.670	29.4	9.4	1.260	0.534	1.794	3.36	6.597	1.164	0.630
14	0.2980	48.910	29.6	10.3	1.258	0.542	1.800	3.32	6.589	1.171	0.629
15	0.3219	49.150	29.8	11.2	1.256	0.558	1.814	3.25	6.573	1.186	0.628
16	0.3460	49.440	30.1	12.0	1.256	0.580	1.836	3.17	6.551	1.208	0.628
17	0.3697	49.720	30.4	12.9	1.256	0.604	1.860	3.08	6.527	1.232	0.628
18	0.3947	50.000	30.7	13.8	1.254	0.630	1.884	2.99	6.501	1.257	0.627
19	0.4287	50.410	31.1	15.0	1.253	0.665	1.918	2.88	6.466	1.291	0.626

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	139.780			155.490
Moisture content: Dry soil+tare, gms.	108.610			119.160
Moisture content: Tare, gms.	30.570			29.890
Moisture, %	39.9	41.3	40.9	40.7
Moist specimen weight, gms.	126.0			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.51	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	112.7	113.8	114.1	
Dry density, pcf	80.5	80.5	81.0	
Void ratio	1.1392	1.1392	1.1278	
Saturation, %	96.8	100.0	100.0	

Consolidation cell pressure = 7.125 tsf

Consolidation back pressure = 6.125 tsf

Consolidation effective confining stress = 1.000 tsf

Peak Stress = 1.402 tsf at reading no. 6

Ult. Stress = 1.313 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0065	17.660	0.0	0.0	0.000	1.000	1.000	1.00	6.125	1.000	0.000
1	0.0104	20.530	2.9	0.1	0.136	0.949	1.085	1.14	6.176	1.017	0.068
2	0.0182	33.500	15.8	0.4	0.750	0.666	1.416	2.13	6.459	1.041	0.375
3	0.0383	43.420	25.8	1.1	1.211	0.502	1.713	3.41	6.623	1.107	0.605
4	0.0591	47.240	29.6	1.9	1.380	0.484	1.864	3.85	6.641	1.174	0.690
5	0.0809	47.820	30.2	2.7	1.396	0.527	1.923	3.65	6.598	1.225	0.698
6	0.1039	48.210	30.6	3.5	1.402	0.580	1.982	3.42	6.545	1.281	0.701
7	0.1278	47.820	30.2	4.3	1.372	0.624	1.996	3.20	6.501	1.310	0.686
8	0.1507	47.820	30.2	5.2	1.360	0.666	2.026	3.04	6.459	1.346	0.680
9	0.1747	47.840	30.2	6.0	1.349	0.693	2.042	2.95	6.432	1.367	0.674
10	0.1997	48.040	30.4	6.9	1.345	0.701	2.046	2.92	6.424	1.373	0.672
11	0.2234	48.030	30.4	7.8	1.332	0.722	2.054	2.85	6.403	1.388	0.666
12	0.2483	48.310	30.7	8.6	1.331	0.747	2.078	2.78	6.378	1.413	0.666
13	0.2736	48.550	30.9	9.5	1.329	0.767	2.096	2.73	6.358	1.431	0.664
14	0.3250	49.190	31.5	11.4	1.329	0.801	2.130	2.66	6.324	1.465	0.664
15	0.3676	49.670	32.0	12.9	1.326	0.817	2.143	2.62	6.308	1.480	0.663
16	0.3969	49.980	32.3	14.0	1.322	0.829	2.151	2.60	6.296	1.490	0.661
17	0.4258	50.140	32.5	15.0	1.313	0.834	2.147	2.57	6.291	1.490	0.656

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.360			156.230
Moisture content: Dry soil+tare, gms.	97.000			119.560
Moisture content: Tare, gms.	30.500			30.280
Moisture, %	39.6	41.8	41.4	41.1
Moist specimen weight, gms.	127.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.7	113.4	113.7	
Dry density, pcf	80.0	80.0	80.4	
Void ratio	1.1538	1.1538	1.1423	
Saturation, %	94.8	100.0	100.0	

Consolidation cell pressure = 7.143 tsf

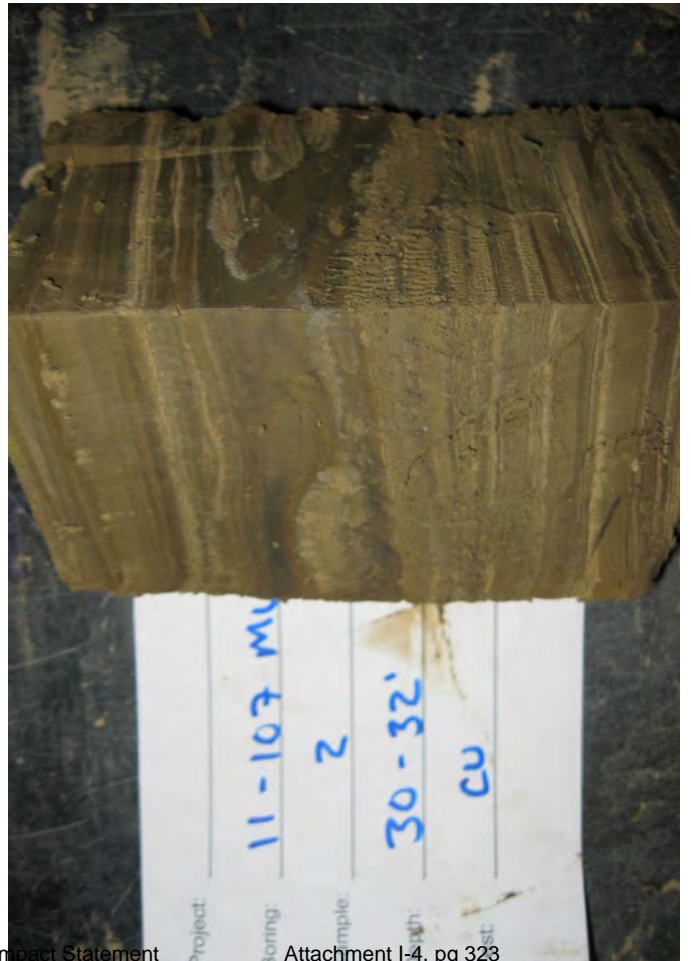
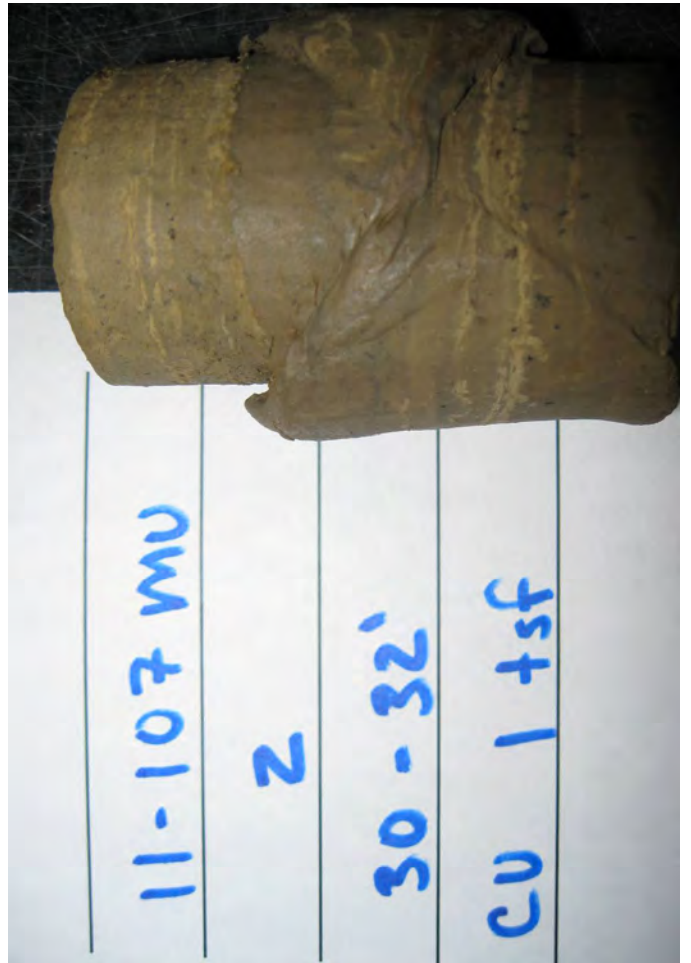
Consolidation back pressure = 5.112 tsf

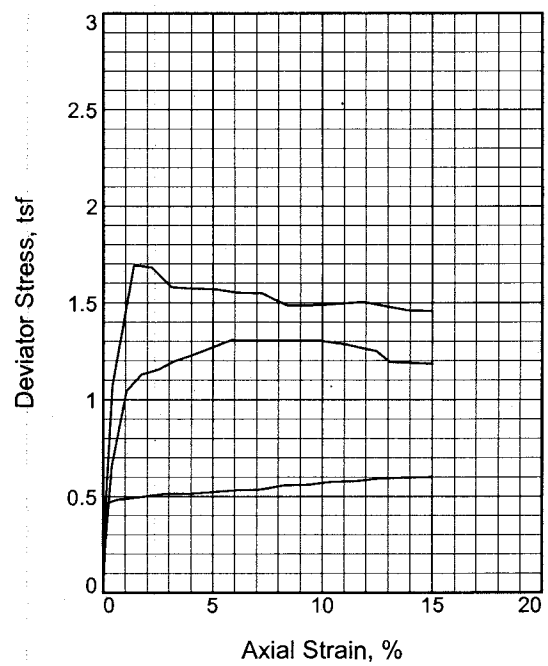
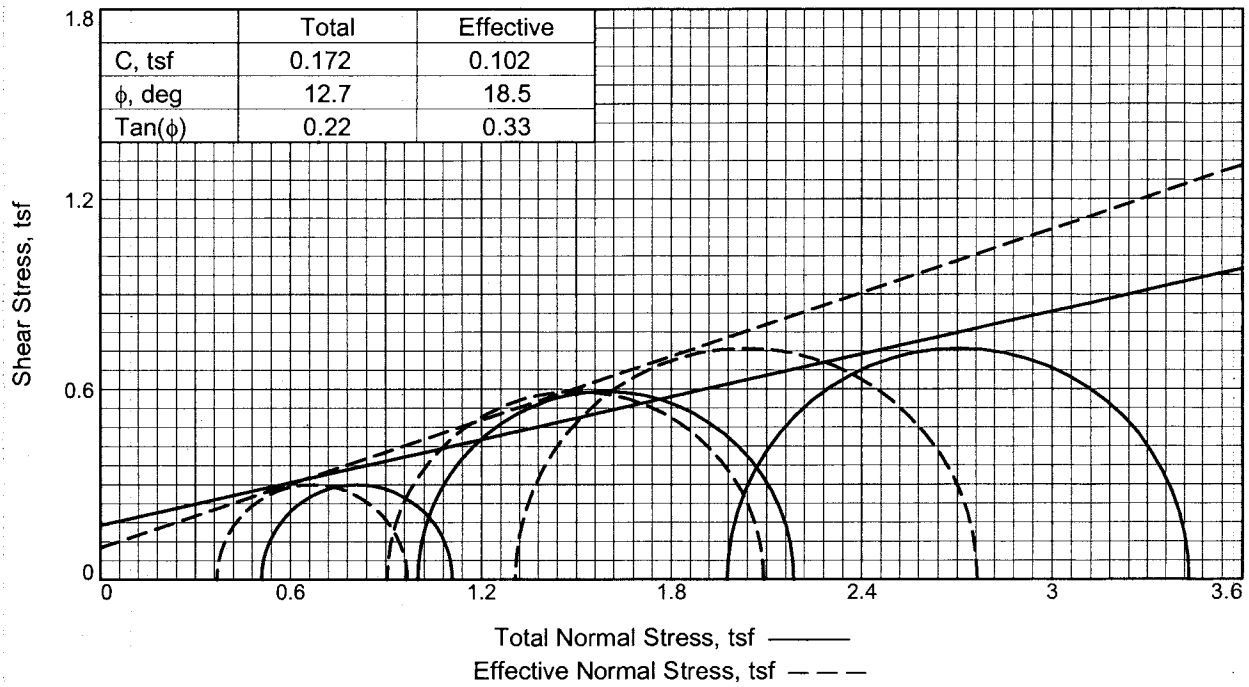
Consolidation effective confining stress = 2.031 tsf

Peak Stress = 2.117 tsf at reading no. 4

Ult. Stress = 1.611 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0476	17.410	0.0	0.0	0.000	2.031	2.031	1.00	5.112	2.031	0.000
1	0.0516	22.270	4.9	0.1	0.227	2.010	2.237	1.11	5.133	2.124	0.114
2	0.0632	49.940	32.5	0.6	1.514	1.302	2.816	2.16	5.841	2.059	0.757
3	0.0844	61.650	44.2	1.3	2.043	1.008	3.051	3.03	6.135	2.030	1.022
4	0.1179	63.800	46.4	2.5	2.117	0.959	3.076	3.21	6.184	2.017	1.058
5	0.1513	60.530	43.1	3.7	1.944	1.094	3.038	2.78	6.049	2.066	0.972
6	0.1815	57.450	40.0	4.8	1.785	1.208	2.993	2.48	5.935	2.100	0.892
7	0.2128	56.620	39.2	5.9	1.727	1.225	2.952	2.41	5.918	2.089	0.864
8	0.2433	56.420	39.0	7.0	1.698	1.234	2.932	2.38	5.909	2.083	0.849
9	0.2739	56.720	39.3	8.1	1.691	1.240	2.931	2.36	5.903	2.086	0.846
10	0.3039	56.920	39.5	9.1	1.680	1.255	2.935	2.34	5.888	2.095	0.840
11	0.3353	57.230	39.8	10.3	1.672	1.252	2.924	2.34	5.891	2.088	0.836
12	0.3646	57.300	39.9	11.3	1.656	1.258	2.914	2.32	5.885	2.086	0.828
13	0.3953	57.210	39.8	12.4	1.632	1.255	2.887	2.30	5.888	2.071	0.816
14	0.4254	57.840	40.4	13.5	1.637	1.267	2.904	2.29	5.876	2.086	0.819
15	0.4462	57.720	40.3	14.2	1.618	1.288	2.906	2.26	5.855	2.097	0.809
16	0.4679	57.900	40.5	15.0	1.611	1.278	2.889	2.26	5.865	2.083	0.805





Sample No.	1	2	3	
Initial	Water Content, %	47.7	39.5	38.0
	Dry Density, pcf	73.2	81.8	83.3
	Saturation, %	98.4	100.0	99.6
	Void Ratio	1.3167	1.0737	1.0380
	Diameter, in.	1.41	1.41	1.40
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	48.4	38.7	37.4
	Dry Density, pcf	73.2	82.7	84.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3167	1.0516	1.0163
	Diameter, in.	1.41	1.41	1.39
	Height, in.	2.81	2.80	2.80
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.51	1.00	1.98	
Back Pressure, tsf	6.60	6.13	5.15	
Cell Pressure, tsf	7.11	7.13	7.13	
Peak Deviator Stress, tsf	0.60	1.31	1.69	
Total Pore Pr., tsf	6.75	6.35	5.93	
Ultimate Deviator Stress, tsf	0.60	1.19	1.46	
Total Pore Pr., tsf	6.75	6.22	5.82	
Maj. Eff. Stress at Ultimate, tsf	0.97	2.09	2.76	
Min. Eff. Stress at Ultimate, tsf	0.37	0.91	1.31	

Type of Test:
CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 95 PL= 28 PI= 67

Specific Gravity= 2.718

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

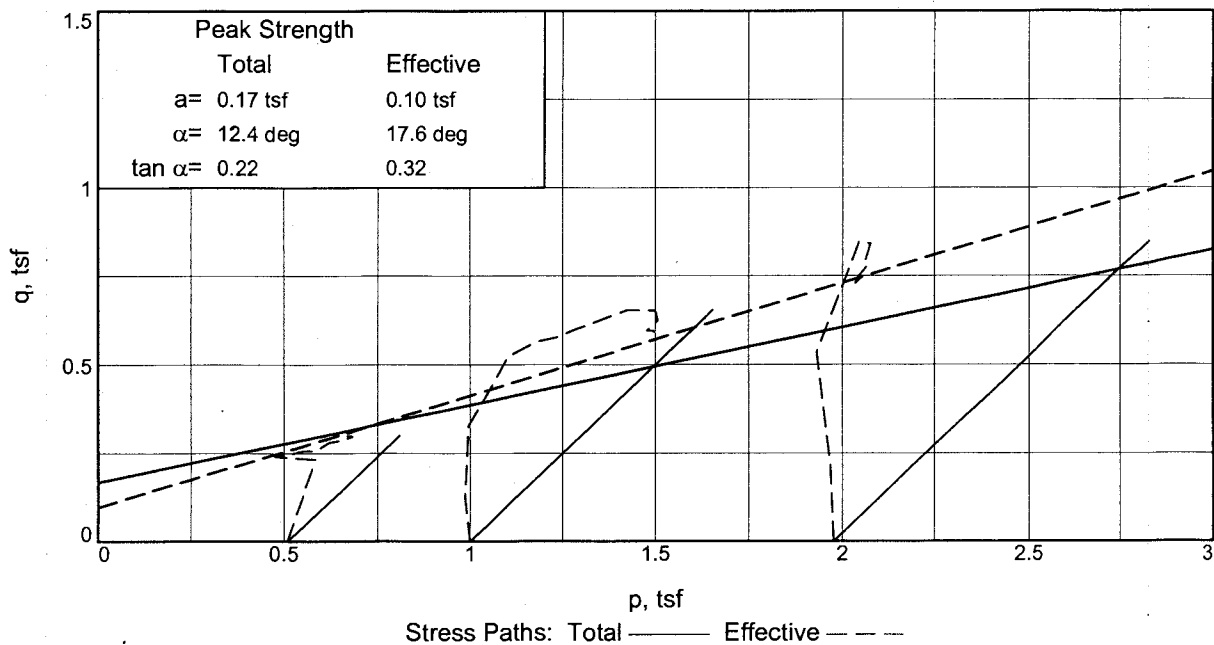
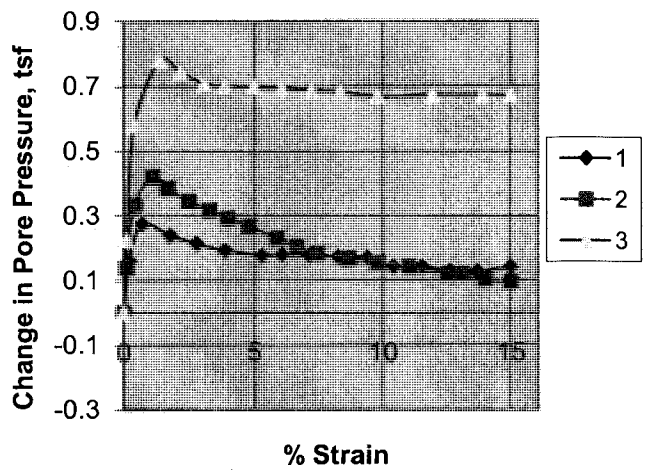
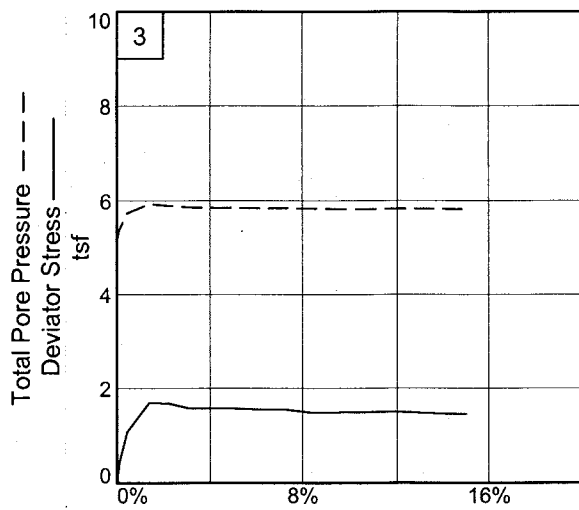
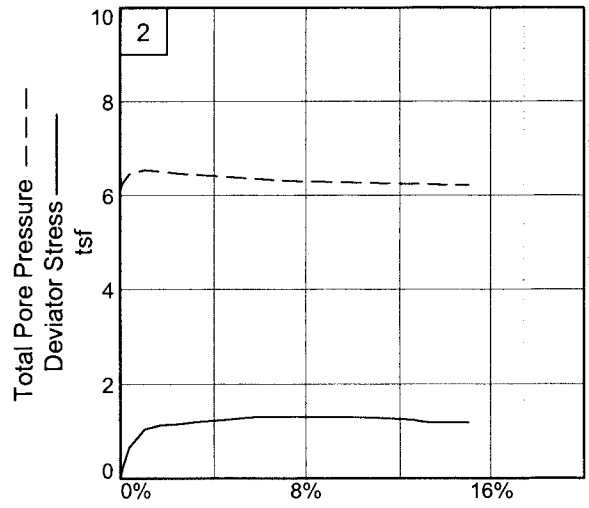
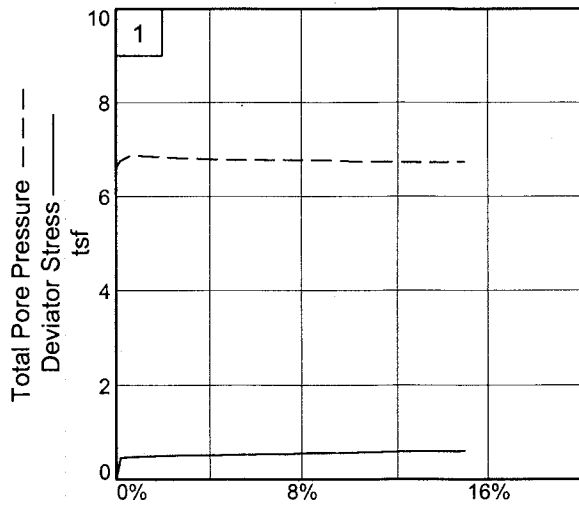
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Brenna Formation

Sample Number: Boring11-110MU, #2 **Depth:** 35-37'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Brenna Formation

Depth: 35-37'

Sample No.: Boring11-110MU, #2

Project No.: B110065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

4/26/2011

8:18 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Brenna Formation
Depth: 35-37' **Sample Number:** Boring11-110MU, #2
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity=2.718 **LL=**95 **PL=**28 **PI=**67
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	124.130			156.790
Moisture content: Dry soil+tare, gms.	93.730			114.520
Moisture content: Tare, gms.	29.970			30.290
Moisture, %	47.7	48.4	48.4	50.2
Moist specimen weight, gms.	124.5			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	108.2	108.7	108.7	
Dry density, pcf	73.2	73.2	73.2	
Void ratio	1.3167	1.3167	1.3167	
Saturation, %	98.4	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.113 tsf
Consolidation back pressure = 6.604 tsf
Consolidation effective confining stress = 0.509 tsf
Peak Stress = 0.600 tsf at reading no. 15
Ult. Stress = 0.600 tsf at reading no. 15

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0451	19.470	0.0	0.0	0.000	0.509	0.509	1.00	6.604	0.509	0.000
1	0.0502	29.610	10.1	0.2	0.466	0.350	0.816	2.33	6.763	0.583	0.233
2	0.0640	30.020	10.6	0.7	0.483	0.235	0.718	3.05	6.878	0.476	0.241
3	0.0942	30.490	11.0	1.8	0.499	0.271	0.770	2.84	6.842	0.520	0.249
4	0.1246	30.970	11.5	2.8	0.515	0.296	0.811	2.74	6.817	0.553	0.257
5	0.1558	31.120	11.7	3.9	0.515	0.318	0.833	2.62	6.795	0.576	0.258
6	0.1951	31.530	12.1	5.3	0.526	0.333	0.859	2.58	6.780	0.596	0.263
7	0.2160	31.790	12.3	6.1	0.533	0.331	0.864	2.61	6.782	0.597	0.266
8	0.2469	32.020	12.6	7.2	0.536	0.333	0.869	2.61	6.780	0.601	0.268
9	0.2772	32.690	13.2	8.3	0.558	0.337	0.895	2.66	6.776	0.616	0.279
10	0.3076	32.920	13.5	9.4	0.561	0.340	0.901	2.65	6.773	0.621	0.281
11	0.3382	33.430	14.0	10.4	0.576	0.368	0.944	2.56	6.745	0.656	0.288
12	0.3686	33.700	14.2	11.5	0.580	0.368	0.948	2.58	6.745	0.658	0.290
13	0.3989	34.200	14.7	12.6	0.593	0.382	0.975	2.55	6.731	0.678	0.296
14	0.4292	34.500	15.0	13.7	0.597	0.383	0.980	2.56	6.730	0.682	0.299
15	0.4650	34.800	15.3	15.0	0.600	0.368	0.968	2.63	6.745	0.668	0.300

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	140.600			163.130
Moisture content: Dry soil+tare, gms.	109.290			127.050
Moisture content: Tare, gms.	30.040			29.720
Moisture, %	39.5	39.5	38.7	37.1
Moist specimen weight, gms.	132.3			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.57	1.57	1.56	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	114.2	114.1	114.7	
Dry density, pcf	81.8	81.8	82.7	
Void ratio	1.0737	1.0737	1.0516	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.125 tsf
 Consolidation back pressure = 6.125 tsf
 Consolidation effective confining stress = 1.000 tsf
 Peak Stress = 1.308 tsf at reading no. 9
 Ult. Stress = 1.186 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0146	20.470	0.0	0.0	0.000	1.000	1.000	1.00	6.125	1.000	0.000
1	0.0176	25.840	5.4	0.1	0.248	0.862	1.110	1.29	6.263	0.986	0.124
2	0.0256	34.720	14.3	0.4	0.655	0.668	1.323	1.98	6.457	0.996	0.328
3	0.0444	43.380	22.9	1.1	1.047	0.579	1.626	2.81	6.546	1.102	0.523
4	0.0634	45.380	24.9	1.7	1.130	0.615	1.745	2.84	6.510	1.180	0.565
5	0.0843	46.110	25.6	2.5	1.155	0.656	1.811	2.76	6.469	1.233	0.577
6	0.1062	47.350	26.9	3.3	1.201	0.684	1.885	2.76	6.441	1.284	0.600
7	0.1271	48.180	27.7	4.0	1.228	0.708	1.936	2.73	6.417	1.322	0.614
8	0.1490	49.190	28.7	4.8	1.263	0.734	1.997	2.72	6.391	1.365	0.631
9	0.1789	50.560	30.1	5.9	1.308	0.771	2.079	2.70	6.354	1.425	0.654
10	0.2018	50.780	30.3	6.7	1.306	0.796	2.102	2.64	6.329	1.449	0.653
11	0.2257	51.080	30.6	7.5	1.307	0.818	2.125	2.60	6.307	1.472	0.654
12	0.2575	51.420	31.0	8.7	1.305	0.833	2.138	2.57	6.292	1.486	0.653
13	0.2904	51.820	31.4	9.8	1.305	0.846	2.151	2.54	6.279	1.499	0.653
14	0.3225	51.790	31.3	11.0	1.287	0.859	2.146	2.50	6.266	1.503	0.644
15	0.3643	51.420	31.0	12.5	1.251	0.881	2.132	2.42	6.244	1.506	0.625
16	0.3811	50.200	29.7	13.1	1.193	0.881	2.074	2.35	6.244	1.478	0.597
17	0.4062	50.430	30.0	14.0	1.190	0.899	2.089	2.32	6.226	1.494	0.595
18	0.4351	50.690	30.2	15.0	1.186	0.905	2.091	2.31	6.220	1.498	0.593

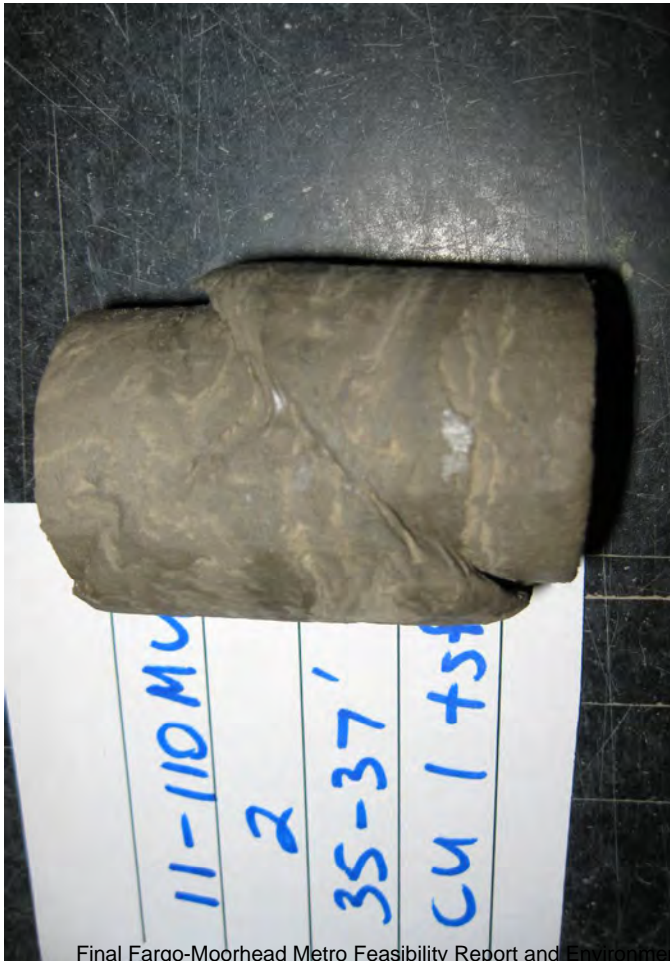
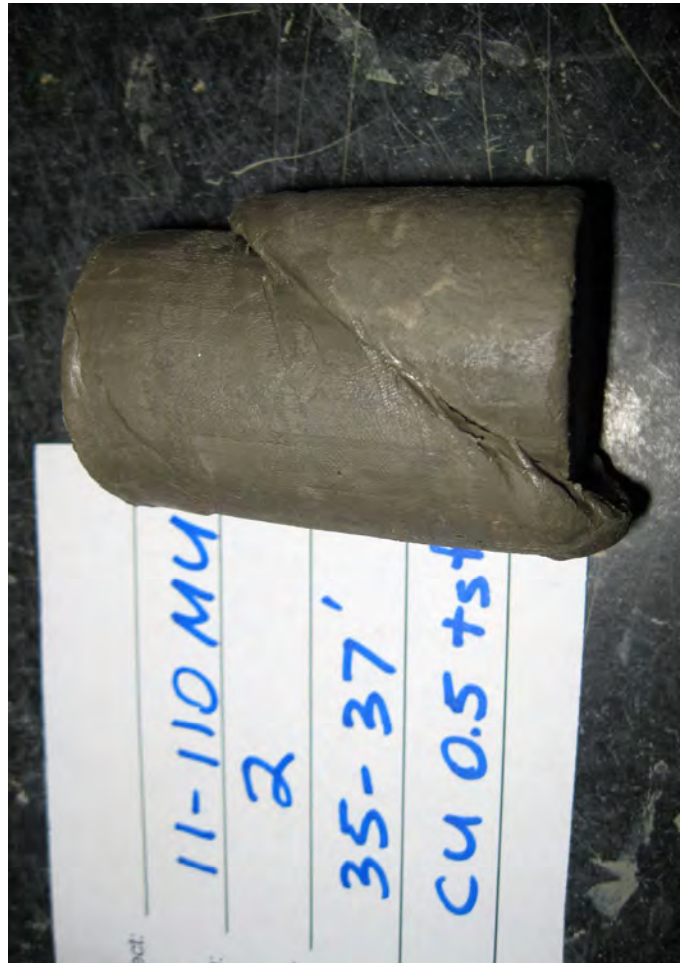
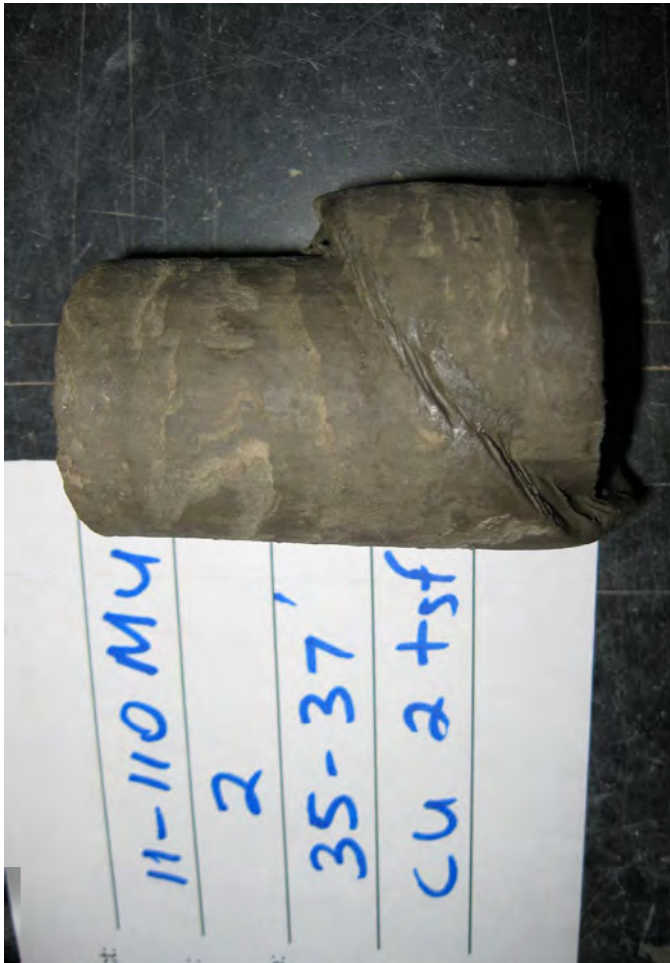
Parameters for Specimen No. 3

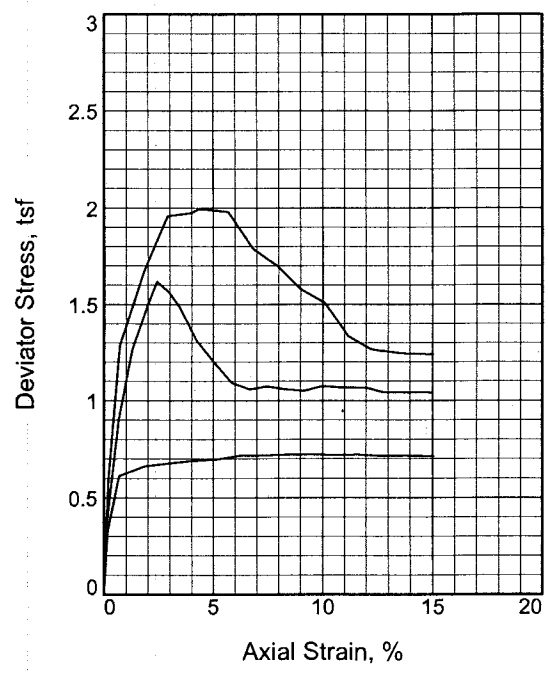
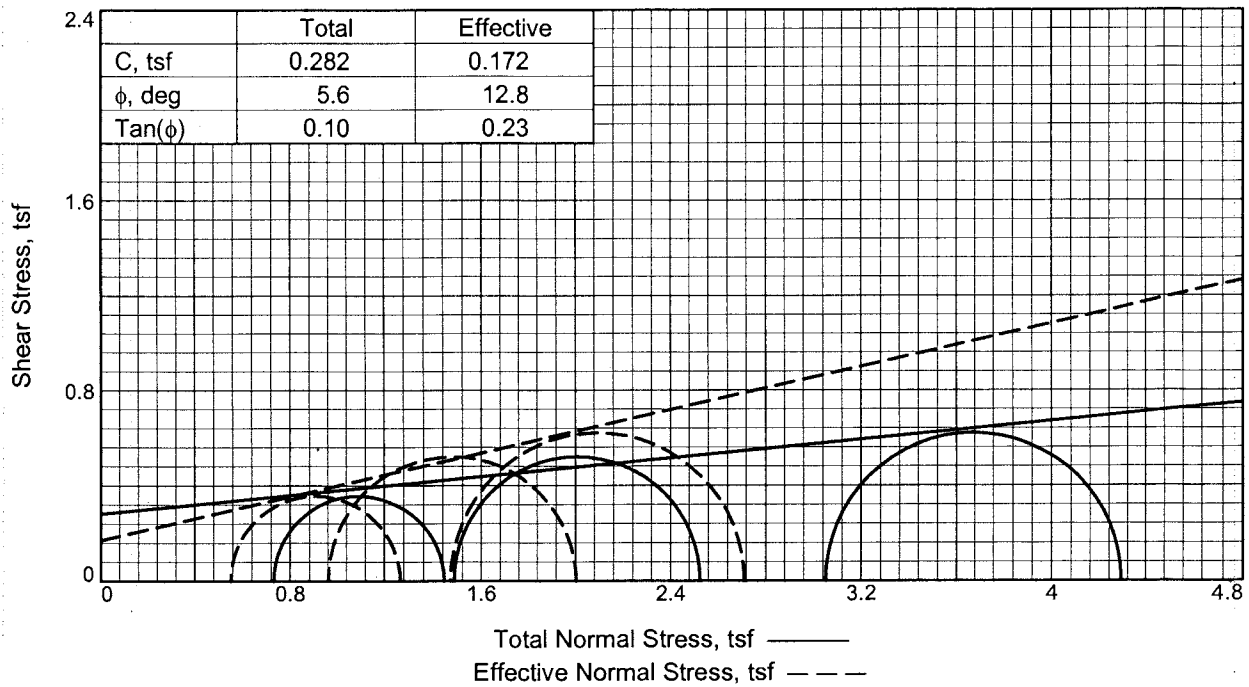
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	135.070			160.370
Moisture content: Dry soil+tare, gms.	106.200			125.630
Moisture content: Tare, gms.	30.290			30.580
Moisture, %	38.0	38.2	37.4	36.5
Moist specimen weight, gms.	130.0			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.52	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	114.9	115.1	115.6	
Dry density, pcf	83.3	83.3	84.2	
Void ratio	1.0380	1.0380	1.0163	
Saturation, %	99.6	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.129 tsf
 Consolidation back pressure = 5.152 tsf
 Consolidation effective confining stress = 1.977 tsf
 Peak Stress = 1.694 tsf at reading no. 3
 Ult. Stress = 1.458 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0096	19.500	0.0	0.0	0.000	1.977	1.977	1.00	5.152	1.977	0.000
1	0.0125	28.590	9.1	0.1	0.429	1.754	2.183	1.24	5.375	1.968	0.214
2	0.0216	42.260	22.8	0.4	1.071	1.397	2.468	1.77	5.732	1.932	0.535
3	0.0484	55.870	36.4	1.4	1.694	1.198	2.892	2.41	5.931	2.045	0.847
4	0.0715	55.910	36.4	2.2	1.682	1.235	2.917	2.36	5.894	2.076	0.841
5	0.0962	54.040	34.5	3.1	1.581	1.270	2.851	2.25	5.859	2.061	0.791
6	0.1189	54.170	34.7	3.9	1.574	1.277	2.851	2.23	5.852	2.064	0.787
7	0.1501	54.510	35.0	5.0	1.571	1.280	2.851	2.23	5.849	2.065	0.785
8	0.1808	54.490	35.0	6.1	1.552	1.285	2.837	2.21	5.844	2.061	0.776
9	0.2126	54.850	35.4	7.3	1.549	1.290	2.839	2.20	5.839	2.064	0.774
10	0.2445	53.850	34.4	8.4	1.486	1.295	2.781	2.15	5.834	2.038	0.743
11	0.2844	54.440	34.9	9.8	1.488	1.309	2.797	2.14	5.820	2.053	0.744
12	0.3411	55.620	36.1	11.9	1.504	1.304	2.808	2.15	5.825	2.056	0.752
13	0.3981	55.420	35.9	13.9	1.461	1.304	2.765	2.12	5.825	2.035	0.731
14	0.4299	55.820	36.3	15.0	1.458	1.306	2.764	2.12	5.823	2.035	0.729





Sample No.	1	2	3	
Initial	Water Content, %	54.8	55.7	55.9
	Dry Density, pcf	68.1	66.9	67.2
	Saturation, %	100.0	98.6	100.0
	Void Ratio	1.4861	1.5298	1.5165
	Diameter, in.	1.39	1.40	1.41
	Height, in.	2.81	2.81	2.80
At Test	Water Content, %	54.8	56.3	53.5
	Dry Density, pcf	68.1	66.9	69.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.4861	1.5271	1.4494
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.81	2.80	2.77
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.74	1.49	3.05	
Back Pressure, tsf	6.38	5.64	4.12	
Cell Pressure, tsf	7.12	7.13	7.17	
Peak Deviator Stress, tsf	0.72	1.62	1.99	
Total Pore Pr., tsf	6.61	6.33	5.50	
Ultimate Deviator Stress, tsf	0.71	1.04	1.24	
Total Pore Pr., tsf	6.56	6.17	5.70	
Maj. Eff. Stress at Ultimate, tsf	1.27	2.00	2.71	
Min. Eff. Stress at Ultimate, tsf	0.55	0.96	1.47	

Type of Test:
CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 86 PL= 22 PI= 64

Specific Gravity= 2.710

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

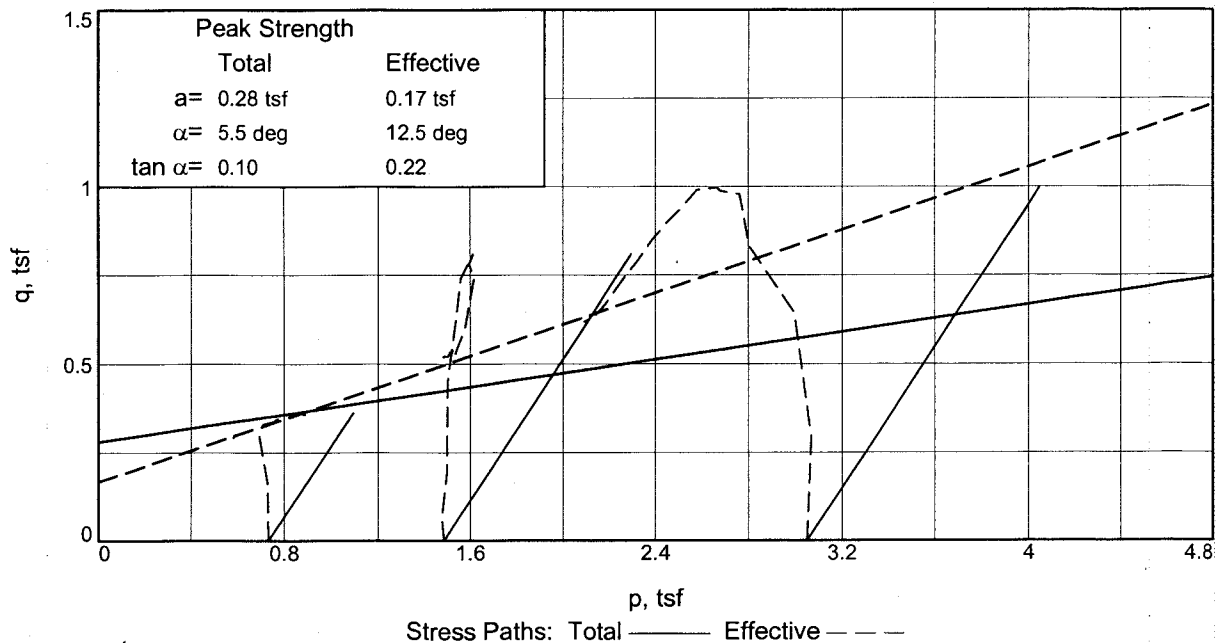
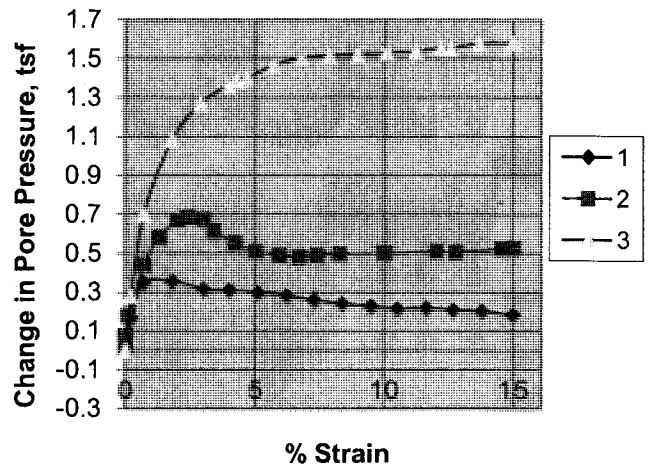
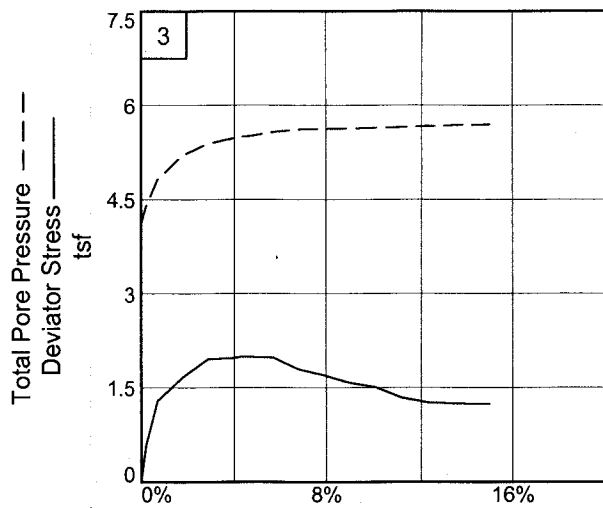
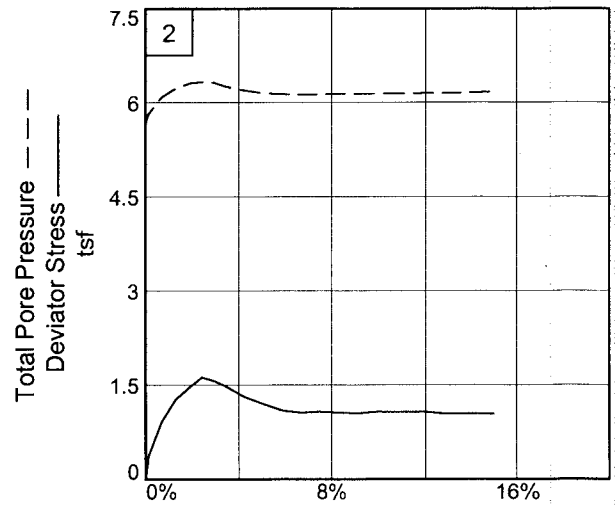
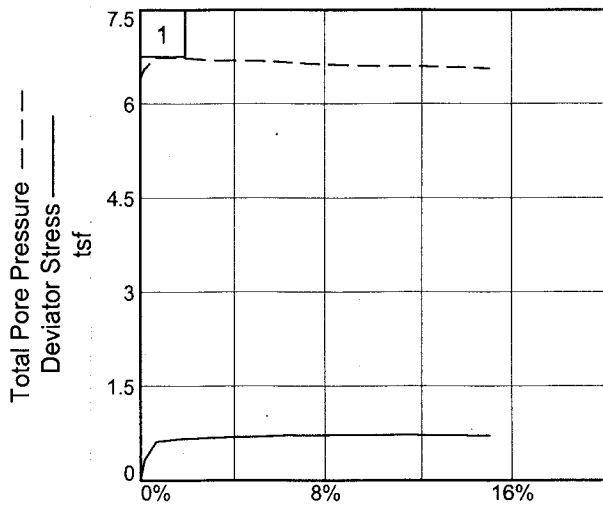
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Brenna Formation

Sample Number: Boring11-110MU, #3 **Depth:** 48-50'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Brenna Formation

Depth: 48-50'

Sample No.: Boring11-110MU, #3

Project No.: BL10-0065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

4/26/2011

8:18 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Brenna Formation
Depth: 48-50' **Sample Number:** Boring11-110MU, #3
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity=2.710 **LL=**86 **PL=**22 **PI=**64
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	145.160			149.460
Moisture content: Dry soil+tare, gms.	104.740			107.140
Moisture content: Tare, gms.	31.020			30.460
Moisture, %	54.8	54.8	54.8	55.2
Moist specimen weight, gms.	118.2			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	105.4	105.4	105.4	
Dry density, pcf	68.1	68.1	68.1	
Void ratio	1.4861	1.4861	1.4861	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.116 tsf
Consolidation back pressure = 6.384 tsf
Consolidation effective confining stress = 0.732 tsf
Peak Stress = 0.724 tsf at reading no. 10
Ult. Stress = 0.714 tsf at reading no. 15

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0579	20.500	0.0	0.0	0.000	0.732	0.732	1.00	6.384	0.732	0.000
1	0.0628	27.390	6.9	0.2	0.325	0.566	0.891	1.57	6.550	0.728	0.162
2	0.0773	33.550	13.0	0.7	0.612	0.386	0.998	2.59	6.730	0.692	0.306
3	0.1096	34.770	14.3	1.8	0.662	0.380	1.042	2.74	6.736	0.711	0.331
4	0.1412	35.290	14.8	3.0	0.678	0.418	1.096	2.62	6.698	0.757	0.339
5	0.1715	35.730	15.2	4.0	0.690	0.423	1.113	2.63	6.693	0.768	0.345
6	0.2020	36.070	15.6	5.1	0.698	0.437	1.135	2.60	6.679	0.786	0.349
7	0.2322	36.680	16.2	6.2	0.717	0.453	1.170	2.58	6.663	0.811	0.358
8	0.2627	36.920	16.4	7.3	0.719	0.475	1.194	2.51	6.641	0.835	0.360
9	0.2930	37.190	16.7	8.4	0.722	0.493	1.215	2.47	6.623	0.854	0.361
10	0.3233	37.430	16.9	9.5	0.724	0.506	1.230	2.43	6.610	0.868	0.362
11	0.3537	37.560	17.1	10.5	0.721	0.519	1.240	2.39	6.597	0.879	0.360
12	0.3840	37.790	17.3	11.6	0.722	0.516	1.238	2.40	6.600	0.877	0.361
13	0.4145	37.870	17.4	12.7	0.716	0.526	1.242	2.36	6.590	0.884	0.358
14	0.4460	38.110	17.6	13.8	0.717	0.533	1.250	2.34	6.583	0.891	0.358
15	0.4800	38.290	17.8	15.0	0.714	0.552	1.266	2.29	6.564	0.909	0.357

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	138.280			147.670
Moisture content: Dry soil+tare, gms.	99.670			105.340
Moisture content: Tare, gms.	30.290			29.710
Moisture, %	55.7	56.4	56.3	56.0
Moist specimen weight, gms.	118.5			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	104.1	104.6	104.7	
Dry density, pcf	66.9	66.9	66.9	
Void ratio	1.5298	1.5298	1.5271	
Saturation, %	98.6	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.131 tsf
 Consolidation back pressure = 5.645 tsf
 Consolidation effective confining stress = 1.486 tsf
 Peak Stress = 1.619 tsf at reading no. 6
 Ult. Stress = 1.041 tsf at reading no. 21

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0074	21.340	0.0	0.0	0.000	1.486	1.486	1.00	5.645	1.486	0.000
1	0.0085	24.130	2.8	0.0	0.130	1.411	1.541	1.09	5.720	1.476	0.065
2	0.0115	29.470	8.1	0.1	0.378	1.309	1.687	1.29	5.822	1.498	0.189
3	0.0263	40.890	19.6	0.7	0.905	1.049	1.954	1.86	6.082	1.501	0.452
4	0.0433	48.920	27.6	1.3	1.269	0.906	2.175	2.40	6.225	1.540	0.634
5	0.0621	53.800	32.5	2.0	1.483	0.819	2.302	2.81	6.312	1.561	0.742
6	0.0752	56.940	35.6	2.4	1.619	0.803	2.422	3.02	6.328	1.613	0.810
7	0.0902	55.940	34.6	3.0	1.565	0.813	2.378	2.92	6.318	1.595	0.782
8	0.1040	54.320	33.0	3.4	1.484	0.874	2.358	2.70	6.257	1.616	0.742
9	0.1258	50.780	29.4	4.2	1.314	0.936	2.250	2.40	6.195	1.593	0.657
10	0.1488	48.430	27.1	5.0	1.199	0.979	2.178	2.22	6.152	1.578	0.599
11	0.1716	46.230	24.9	5.9	1.092	0.999	2.091	2.09	6.132	1.545	0.546
12	0.1945	45.710	24.4	6.7	1.060	1.008	2.068	2.05	6.123	1.538	0.530
13	0.2163	46.230	24.9	7.4	1.074	1.000	2.074	2.07	6.131	1.537	0.537
14	0.2403	46.110	24.8	8.3	1.059	0.992	2.051	2.07	6.139	1.521	0.529
15	0.2643	46.170	24.8	9.2	1.051	0.990	2.041	2.06	6.141	1.516	0.526
16	0.2877	47.000	25.7	10.0	1.076	0.988	2.064	2.09	6.143	1.526	0.538
17	0.3122	47.050	25.7	10.9	1.068	0.984	2.052	2.09	6.147	1.518	0.534
18	0.3438	47.360	26.0	12.0	1.067	0.979	2.046	2.09	6.152	1.513	0.534
19	0.3669	47.010	25.7	12.8	1.043	0.981	2.024	2.06	6.150	1.503	0.522
20	0.4168	47.570	26.2	14.6	1.044	0.965	2.009	2.08	6.166	1.487	0.522
21	0.4280	47.610	26.3	15.0	1.041	0.962	2.003	2.08	6.169	1.482	0.520

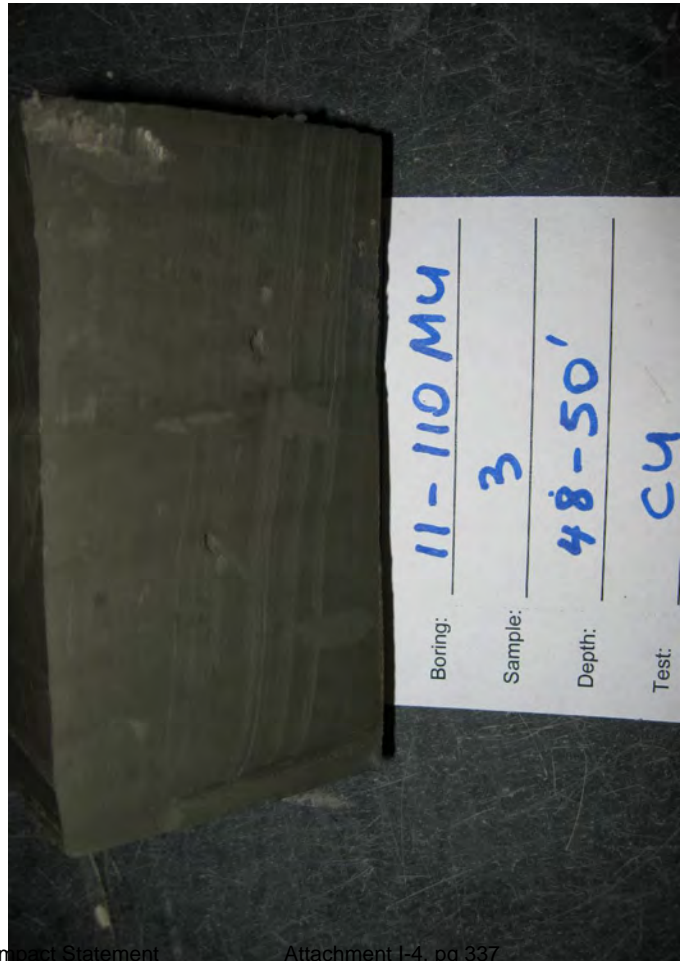
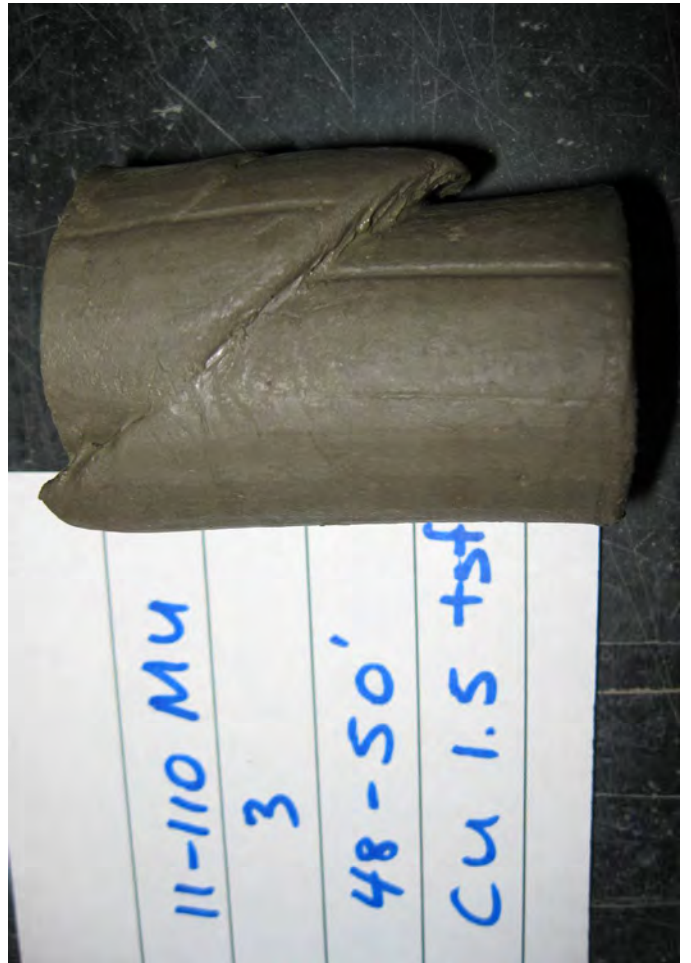
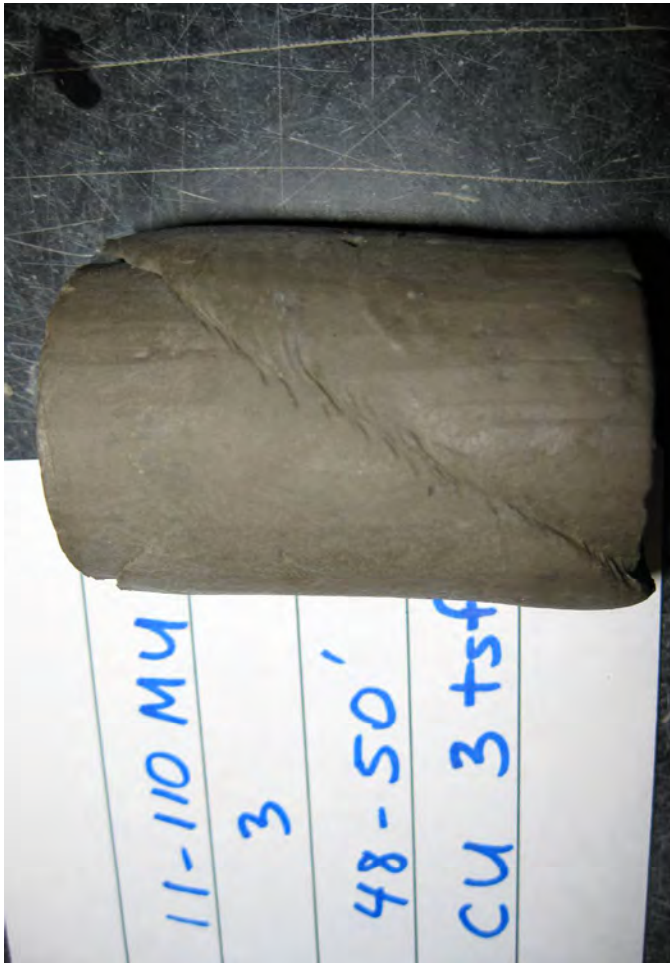
Parameters for Specimen No. 3

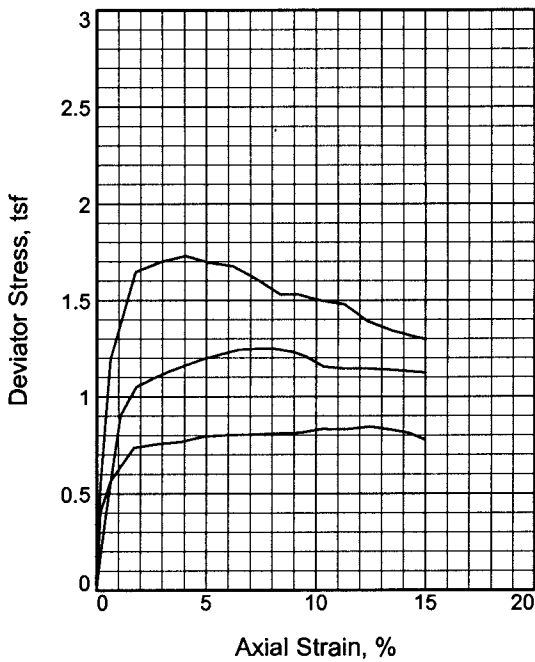
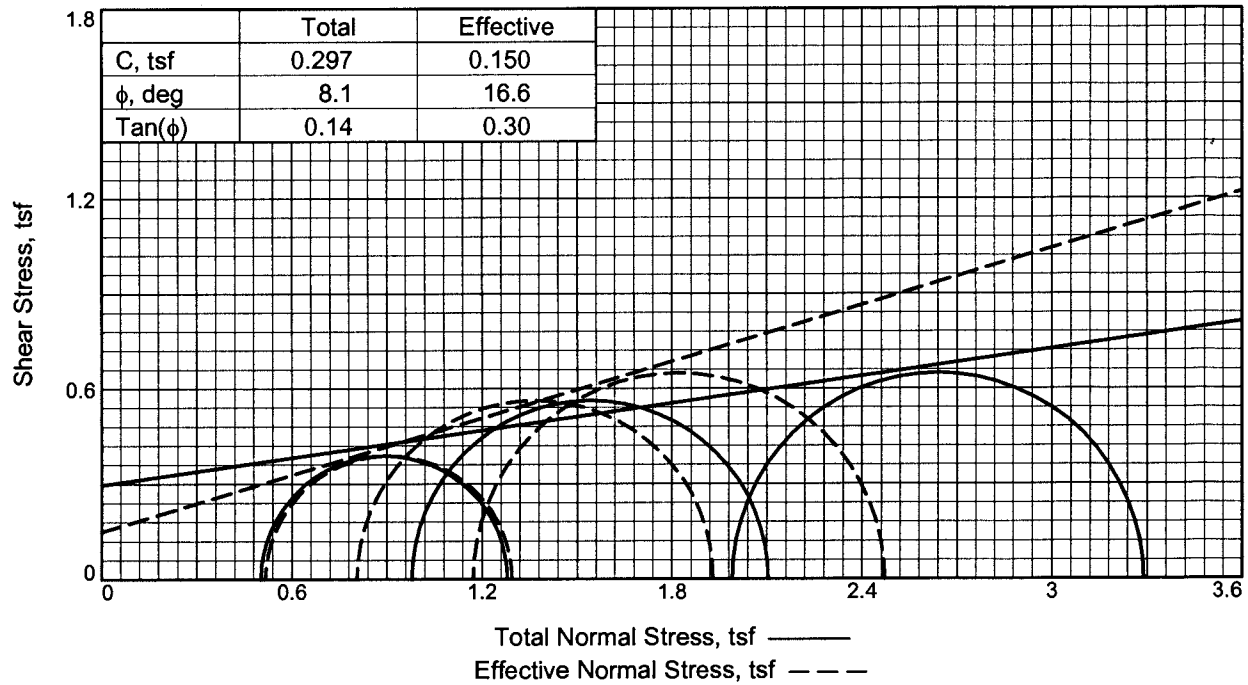
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.140			148.190
Moisture content: Dry soil+tare, gms.	94.360			108.690
Moisture content: Tare, gms.	30.400			31.190
Moisture, %	55.9	56.0	53.5	51.0
Moist specimen weight, gms.	119.4			
Diameter, in.	1.41	1.41	1.39	
Area, in. ²	1.55	1.55	1.52	
Height, in.	2.80	2.80	2.77	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	104.8	104.8	106.0	
Dry density, pcf	67.2	67.2	69.1	
Void ratio	1.5165	1.5165	1.4494	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.166 tsf
 Consolidation back pressure = 4.115 tsf
 Consolidation effective confining stress = 3.051 tsf
 Peak Stress = 1.995 tsf at reading no. 6
 Ult. Stress = 1.240 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0519	17.770	0.0	0.0	0.000	3.051	3.051	1.00	4.115	3.051	0.000
1	0.0577	30.320	12.6	0.2	0.592	2.772	3.364	1.21	4.394	3.068	0.296
2	0.0717	45.250	27.5	0.7	1.289	2.351	3.640	1.55	4.815	2.996	0.645
3	0.1018	53.660	35.9	1.8	1.665	1.970	3.635	1.85	5.196	2.803	0.833
4	0.1320	60.430	42.7	2.9	1.957	1.782	3.739	2.10	5.384	2.761	0.979
5	0.1627	61.310	43.5	4.0	1.975	1.690	3.665	2.17	5.476	2.678	0.988
6	0.1722	61.900	44.1	4.3	1.995	1.665	3.660	2.20	5.501	2.662	0.997
7	0.1830	62.010	44.2	4.7	1.992	1.651	3.643	2.21	5.515	2.647	0.996
8	0.2094	62.200	44.4	5.7	1.980	1.588	3.568	2.25	5.578	2.578	0.990
9	0.2409	58.420	40.7	6.8	1.790	1.551	3.341	2.15	5.615	2.446	0.895
10	0.2712	56.870	39.1	7.9	1.701	1.537	3.238	2.11	5.629	2.388	0.851
11	0.3006	54.520	36.8	9.0	1.581	1.532	3.113	2.03	5.634	2.322	0.790
12	0.3311	53.300	35.5	10.1	1.510	1.523	3.033	1.99	5.643	2.278	0.755
13	0.3615	49.580	31.8	11.2	1.335	1.516	2.851	1.88	5.650	2.184	0.668
14	0.3906	48.330	30.6	12.2	1.268	1.498	2.766	1.85	5.668	2.132	0.634
15	0.4006	48.270	30.5	12.6	1.260	1.500	2.760	1.84	5.666	2.130	0.630
16	0.4313	48.290	30.5	13.7	1.245	1.477	2.722	1.84	5.689	2.099	0.622
17	0.4680	48.660	30.9	15.0	1.240	1.471	2.711	1.84	5.695	2.091	0.620





Sample No.		1	2	3
Initial	Water Content, %	43.4	44.8	41.4
	Dry Density, pcf	77.6	76.3	79.1
	Saturation, %	100.0	100.0	98.7
	Void Ratio	1.1726	1.2102	1.1307
	Diameter, in.	1.39	1.41	1.40
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	43.4	44.4	41.5
	Dry Density, pcf	77.6	76.7	79.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1726	1.1984	1.1193
	Diameter, in.	1.39	1.41	1.39
	Height, in.	2.80	2.80	2.80
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.50	0.98	2.00
Back Pressure, tsf		6.63	6.13	5.13
Cell Pressure, tsf		7.13	7.11	7.13
Peak Deviator Stress, tsf		0.84	1.25	1.73
Total Pore Pr., tsf		6.64	6.37	5.92
Ultimate Deviator Stress, tsf		0.78	1.12	1.30
Total Pore Pr., tsf		6.62	6.30	5.95
Maj. Eff. Stress at Ultimate, tsf		1.30	1.93	2.47
Min. Eff. Stress at Ultimate, tsf		0.52	0.81	1.17

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 72 PL= 19 PI= 53

Specific Gravity= 2.70

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

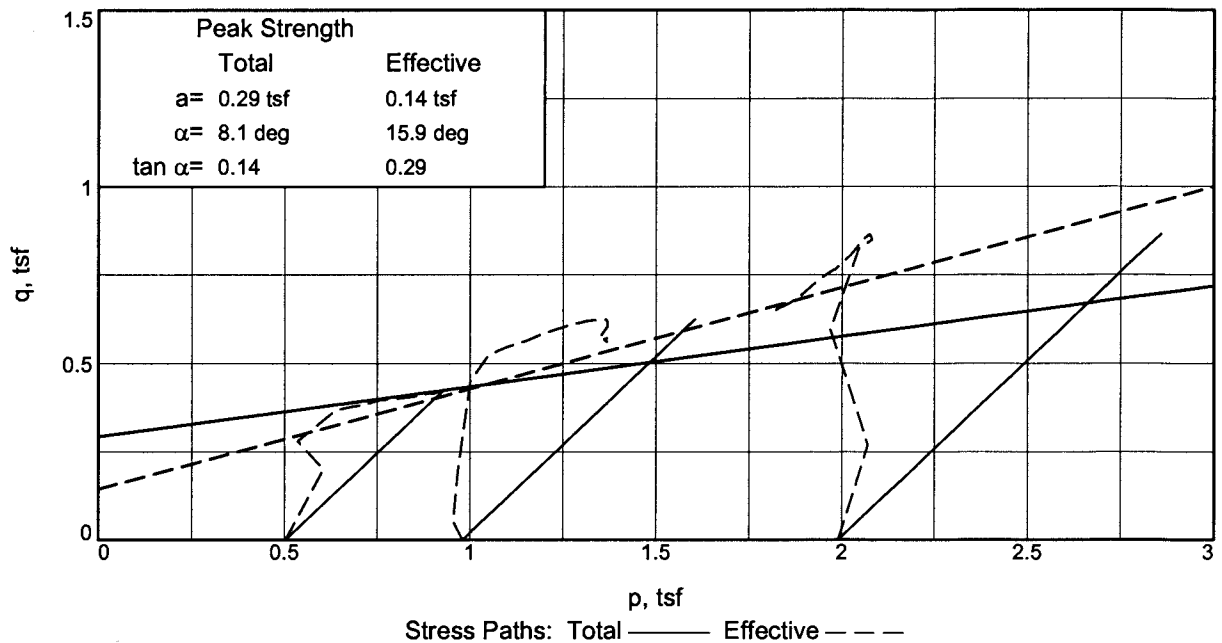
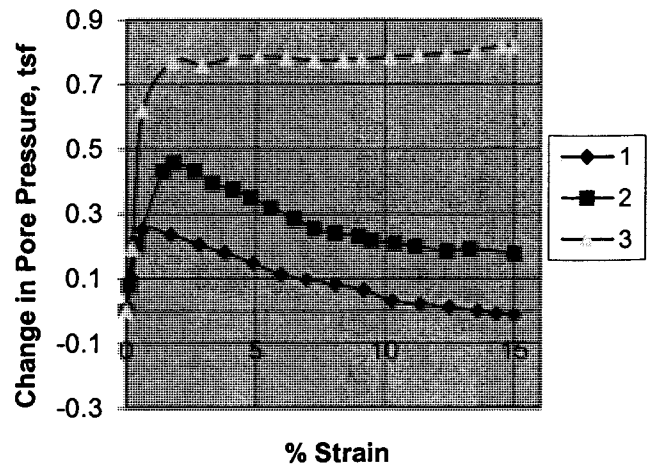
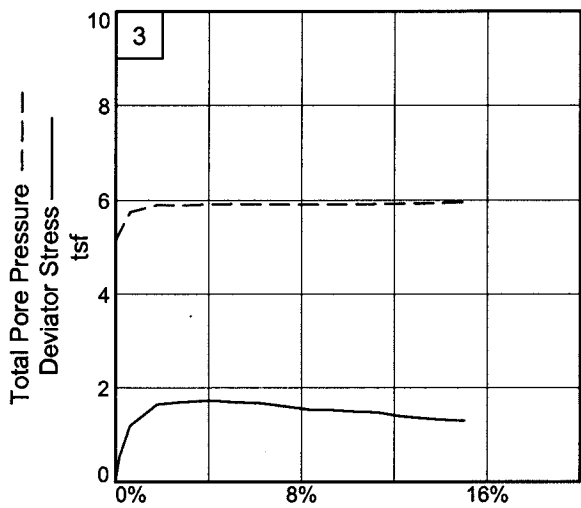
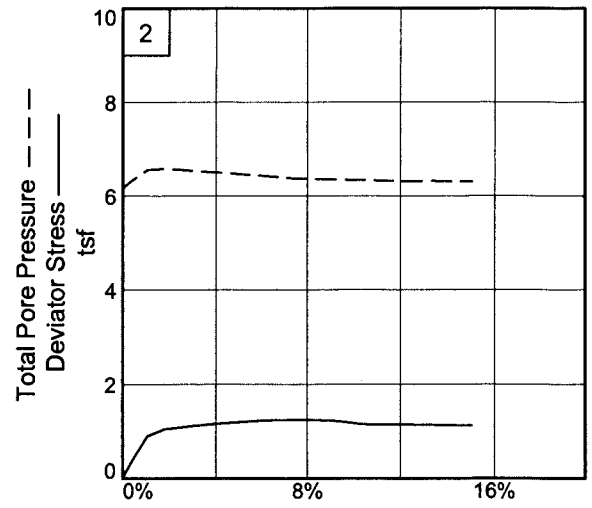
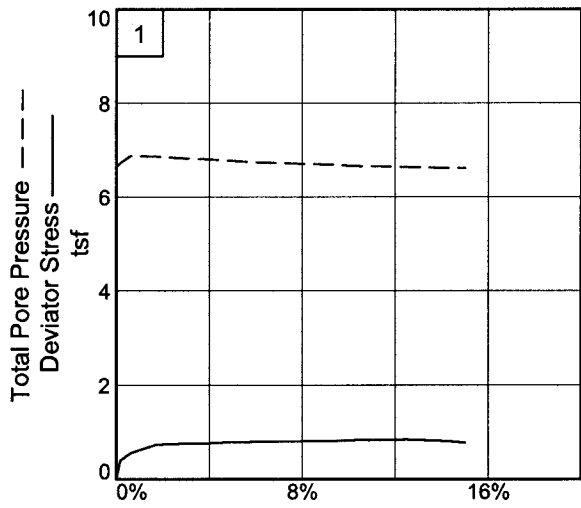
Location: Wild Rice, Brenna Formation

Sample Number: Boring11-118MU, #2 **Depth:** 33-35'

Proj. No.: BL-10-10065

Date Sampled:





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Brenna Formation

Depth: 33-35'

Sample Number: Boring11-118MU, #2

Project No.: DL-10-10065

Figure

Braun Intertec

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

5/15/2011
11:43 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Brenna Formation
Depth: 33-35' **Sample Number:** Boring11-118MU, #2
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.70 **LL**=72 **PL**=19 **PI**=53
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.240			155.300
Moisture content: Dry soil+tare, gms.	107.610			116.540
Moisture content: Tare, gms.	30.190			29.990
Moisture, %	43.4	43.4	43.4	44.8
Moist specimen weight, gms.	124.6			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	111.3	111.3	111.3	
Dry density, pcf	77.6	77.6	77.6	
Void ratio	1.1726	1.1726	1.1726	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.134 tsf
Consolidation back pressure = 6.631 tsf
Consolidation effective confining stress = 0.503 tsf
Peak Stress = 0.844 tsf at reading no. 13
Ult. Stress = 0.777 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0464	17.880	0.0	0.0	0.000	0.503	0.503	1.00	6.631	0.503	0.000
1	0.0511	26.420	8.5	0.2	0.403	0.404	0.807	2.00	6.730	0.606	0.202
2	0.0639	29.830	11.9	0.6	0.562	0.255	0.817	3.20	6.879	0.536	0.281
3	0.0941	33.730	15.8	1.7	0.737	0.270	1.007	3.73	6.864	0.639	0.369
4	0.1235	34.300	16.4	2.8	0.755	0.301	1.056	3.51	6.833	0.679	0.378
5	0.1538	34.740	16.9	3.8	0.767	0.326	1.093	3.35	6.808	0.710	0.384
6	0.1840	35.540	17.7	4.9	0.794	0.358	1.152	3.22	6.776	0.755	0.397
7	0.2137	35.900	18.0	6.0	0.802	0.393	1.195	3.04	6.741	0.794	0.401
8	0.2437	36.190	18.3	7.0	0.805	0.408	1.213	2.97	6.726	0.811	0.403
9	0.2743	36.520	18.6	8.1	0.810	0.423	1.233	2.92	6.711	0.828	0.405
10	0.3050	36.840	19.0	9.2	0.814	0.441	1.255	2.85	6.693	0.848	0.407
11	0.3352	37.520	19.6	10.3	0.833	0.474	1.307	2.76	6.660	0.891	0.417
12	0.3653	37.730	19.8	11.4	0.832	0.483	1.315	2.72	6.651	0.899	0.416
13	0.3959	38.270	20.4	12.5	0.844	0.493	1.337	2.71	6.641	0.915	0.422
14	0.4266	38.080	20.2	13.6	0.826	0.504	1.330	2.64	6.630	0.917	0.413
15	0.4462	37.900	20.0	14.3	0.812	0.514	1.326	2.58	6.620	0.920	0.406
16	0.4668	37.210	19.3	15.0	0.777	0.518	1.295	2.50	6.616	0.907	0.389

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	132.180			156.720
Moisture content: Dry soil+tare, gms.	100.700			119.370
Moisture content: Tare, gms.	30.480			30.160
Moisture, %	44.8	44.8	44.4	41.9
Moist specimen weight, gms.	126.7			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.55	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	110.4	110.4	110.7	
Dry density, pcf	76.3	76.3	76.7	
Void ratio	1.2102	1.2102	1.1984	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.111 tsf

Consolidation back pressure = 6.131 tsf

Consolidation effective confining stress = 0.980 tsf

Peak Stress = 1.249 tsf at reading no. 12

Ult. Stress = 1.125 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0097	20.710	0.0	0.0	0.000	0.980	0.980	1.00	6.131	0.980	0.000
1	0.0125	22.970	2.3	0.1	0.105	0.902	1.007	1.12	6.209	0.954	0.052
2	0.0215	29.050	8.3	0.4	0.385	0.774	1.159	1.50	6.337	0.966	0.192
3	0.0403	40.400	19.7	1.1	0.902	0.550	1.452	2.64	6.561	1.001	0.451
4	0.0602	43.820	23.1	1.8	1.052	0.524	1.576	3.01	6.587	1.050	0.526
5	0.0811	44.930	24.2	2.6	1.094	0.550	1.644	2.99	6.561	1.097	0.547
6	0.1020	45.960	25.3	3.3	1.132	0.588	1.720	2.92	6.523	1.154	0.566
7	0.1238	46.900	26.2	4.1	1.164	0.607	1.771	2.92	6.504	1.189	0.582
8	0.1447	47.760	27.0	4.8	1.193	0.633	1.826	2.88	6.478	1.230	0.597
9	0.1670	48.590	27.9	5.6	1.219	0.663	1.882	2.84	6.448	1.273	0.610
10	0.1905	49.390	28.7	6.5	1.243	0.697	1.940	2.78	6.414	1.319	0.622
11	0.2136	49.790	29.1	7.3	1.249	0.728	1.977	2.72	6.383	1.353	0.625
12	0.2365	50.050	29.3	8.1	1.249	0.742	1.991	2.68	6.369	1.367	0.625
13	0.2605	49.920	29.2	9.0	1.232	0.753	1.985	2.64	6.358	1.369	0.616
14	0.2754	49.560	28.9	9.5	1.210	0.765	1.975	2.58	6.346	1.370	0.605
15	0.2994	48.530	27.8	10.4	1.156	0.773	1.929	2.50	6.338	1.351	0.578
16	0.3244	48.580	27.9	11.2	1.146	0.782	1.928	2.47	6.329	1.355	0.573
17	0.3560	48.910	28.2	12.4	1.145	0.797	1.942	2.44	6.314	1.370	0.573
18	0.3831	49.060	28.4	13.3	1.138	0.790	1.928	2.44	6.321	1.359	0.569
19	0.4300	49.270	28.6	15.0	1.125	0.806	1.931	2.40	6.305	1.368	0.562

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.830			155.230
Moisture content: Dry soil+tare, gms.	101.690			118.650
Moisture content: Tare, gms.	31.220			30.610
Moisture, %	41.4	41.9	41.5	41.5
Moist specimen weight, gms.	125.7			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.8	112.2	112.5	
Dry density, pcf	79.1	79.1	79.5	
Void ratio	1.1307	1.1307	1.1193	
Saturation, %	98.7	100.0	100.0	

Consolidation cell pressure = 7.126 tsf

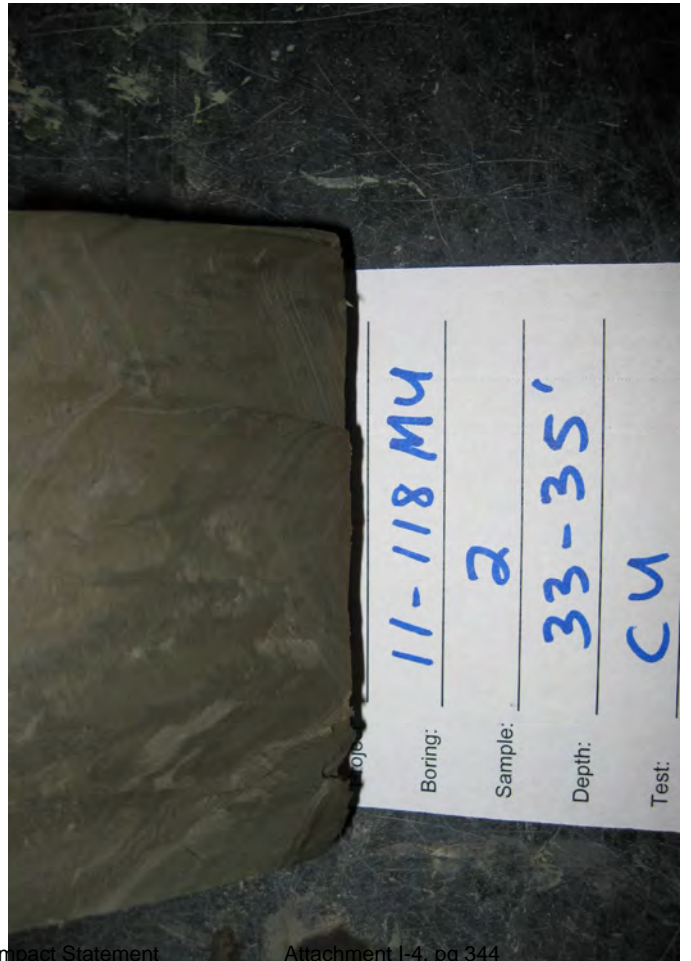
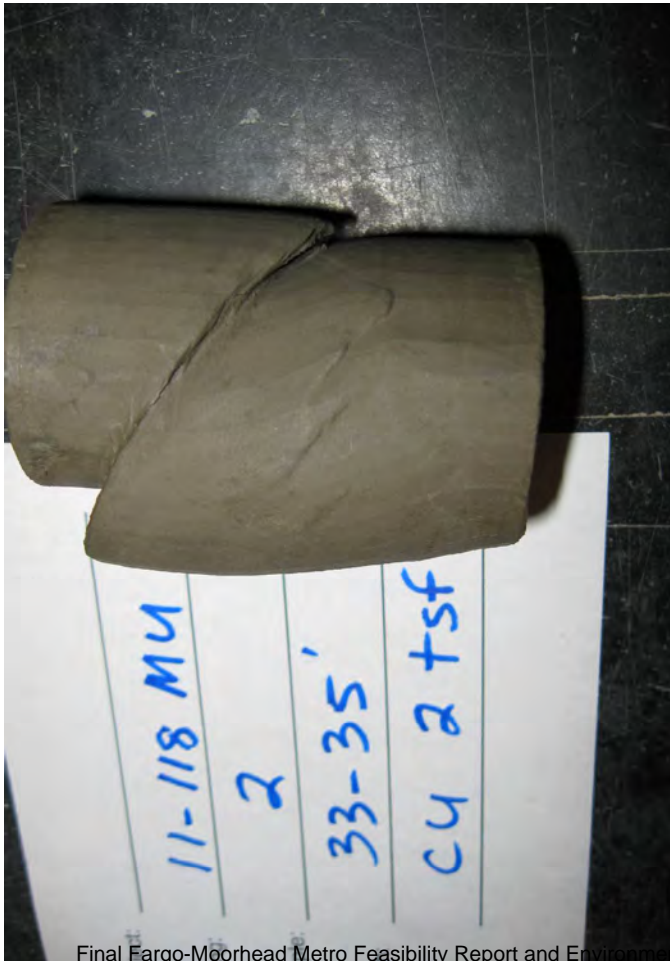
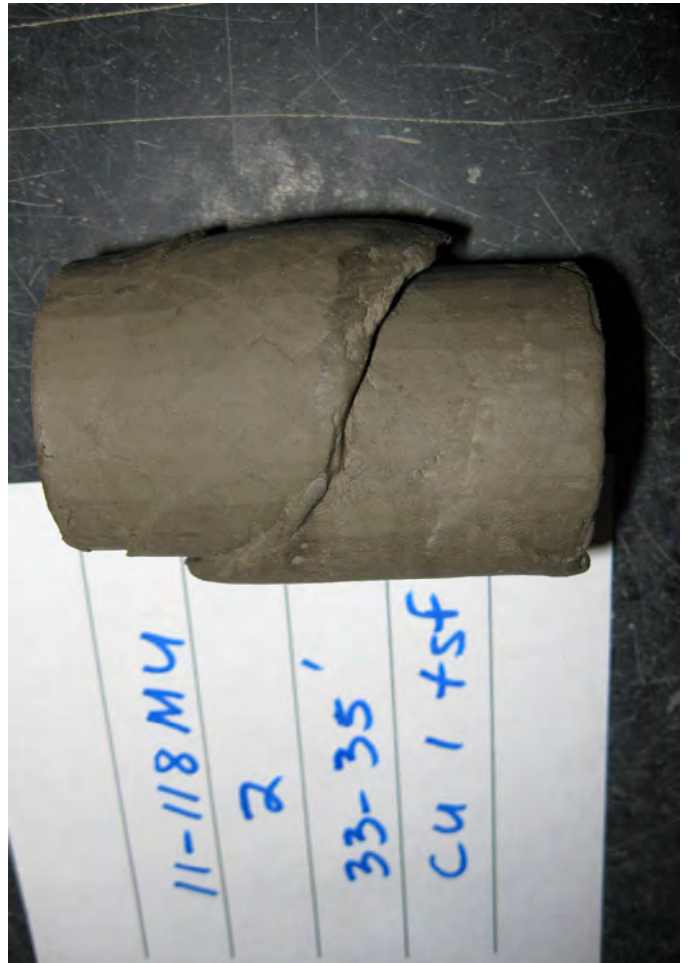
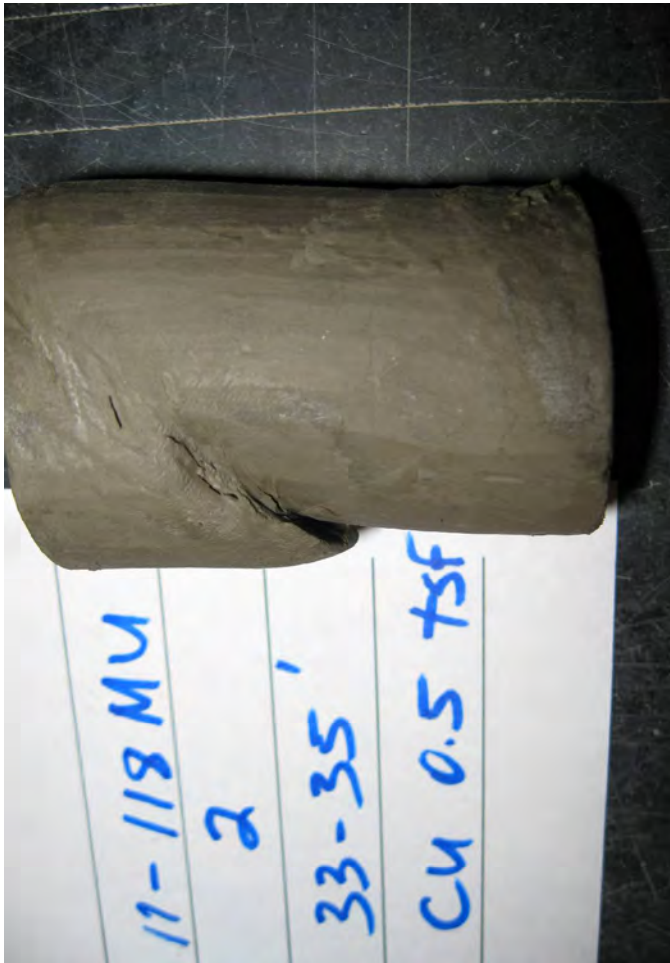
Consolidation back pressure = 5.135 tsf

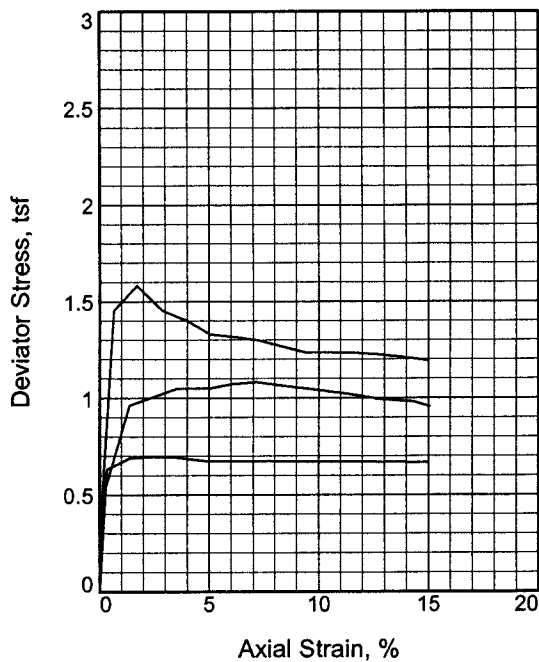
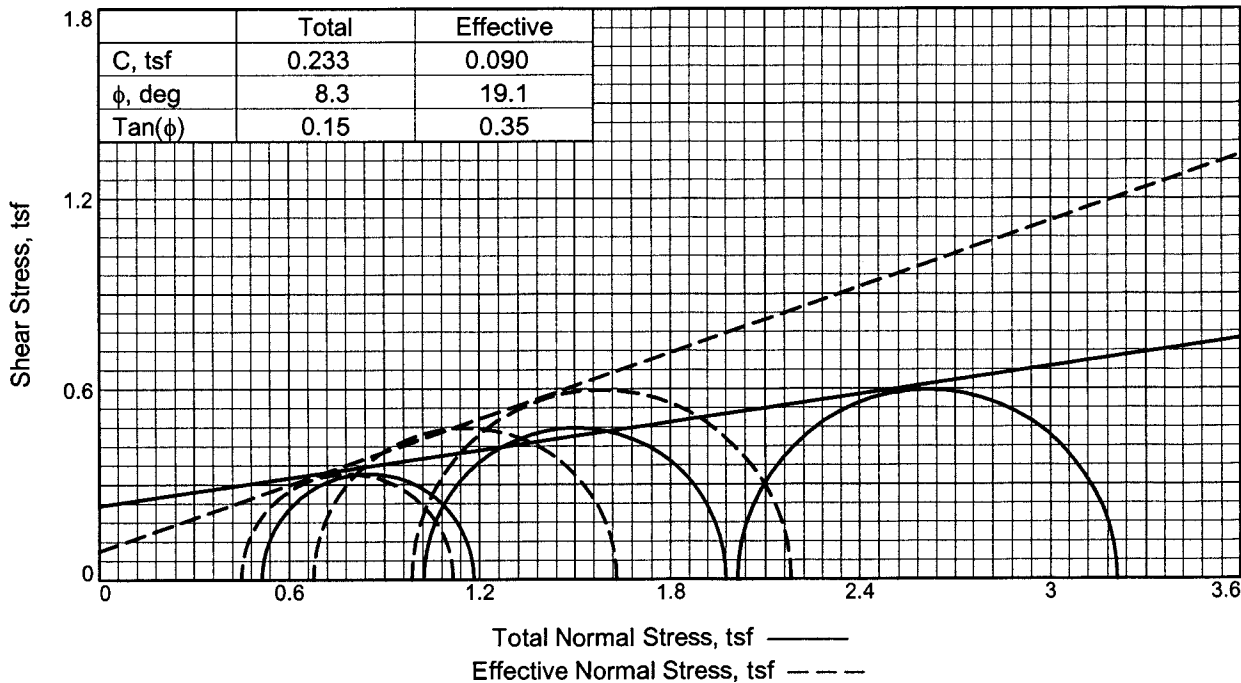
Consolidation effective confining stress = 1.991 tsf

Peak Stress = 1.730 tsf at reading no. 5

Ult. Stress = 1.298 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0464	17.970	0.0	0.0	0.000	1.991	1.991	1.00	5.135	1.991	0.000
1	0.0512	29.400	11.4	0.2	0.539	1.801	2.340	1.30	5.325	2.071	0.270
2	0.0638	43.360	25.4	0.6	1.193	1.373	2.566	1.87	5.753	1.969	0.596
3	0.0960	53.430	35.5	1.8	1.647	1.222	2.869	2.35	5.904	2.045	0.823
4	0.1284	55.010	37.0	2.9	1.700	1.233	2.933	2.38	5.893	2.083	0.850
5	0.1598	56.120	38.1	4.1	1.730	1.210	2.940	2.43	5.916	2.075	0.865
6	0.1890	55.760	37.8	5.1	1.695	1.206	2.901	2.41	5.920	2.054	0.848
7	0.2195	55.790	37.8	6.2	1.677	1.210	2.887	2.39	5.916	2.049	0.839
8	0.2506	54.690	36.7	7.3	1.609	1.217	2.826	2.32	5.909	2.022	0.805
9	0.2812	53.270	35.3	8.4	1.529	1.215	2.744	2.26	5.911	1.979	0.764
10	0.3019	53.590	35.6	9.1	1.530	1.213	2.743	2.26	5.913	1.978	0.765
11	0.3313	53.300	35.3	10.2	1.500	1.207	2.707	2.24	5.919	1.957	0.750
12	0.3616	53.240	35.3	11.3	1.479	1.202	2.681	2.23	5.924	1.942	0.740
13	0.3921	51.540	33.6	12.4	1.391	1.196	2.587	2.16	5.930	1.891	0.695
14	0.4235	50.780	32.8	13.5	1.342	1.187	2.529	2.13	5.939	1.858	0.671
15	0.4530	50.380	32.4	14.5	1.309	1.172	2.481	2.12	5.954	1.827	0.655
16	0.4659	50.280	32.3	15.0	1.298	1.172	2.470	2.11	5.954	1.821	0.649





Sample No.		1	2	3
Initial	Water Content, %	46.4	45.5	40.4
	Dry Density, pcf	73.0	75.7	80.4
	Saturation, %	95.4	100.0	99.4
	Void Ratio	1.3132	1.2298	1.0998
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	48.6	45.3	39.8
	Dry Density, pcf	73.0	75.9	81.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3132	1.2250	1.0773
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.80	2.81	2.79
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.52	1.02	2.02
Back Pressure, tsf		6.63	6.12	5.12
Cell Pressure, tsf		7.15	7.14	7.14
Peak Deviator Stress, tsf		0.70	1.08	1.58
Total Pore Pr., tsf		6.82	6.48	5.94
Ultimate Deviator Stress, tsf		0.67	0.96	1.19
Total Pore Pr., tsf		6.70	6.46	6.15
Maj. Eff. Stress at Ultimate, tsf		1.12	1.63	2.18
Min. Eff. Stress at Ultimate, tsf		0.45	0.68	0.99

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 56

PL= 19

PI= 37

Specific Gravity: 2.704

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

Location: Fargo Pile Load Test, Brenna Formation

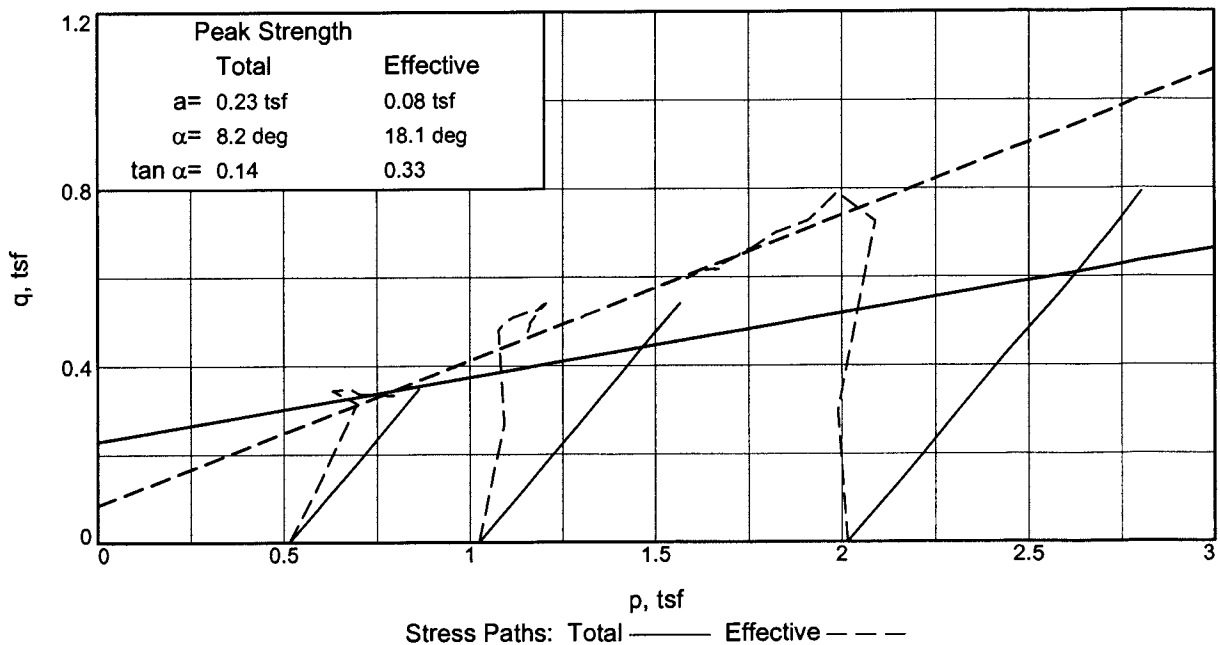
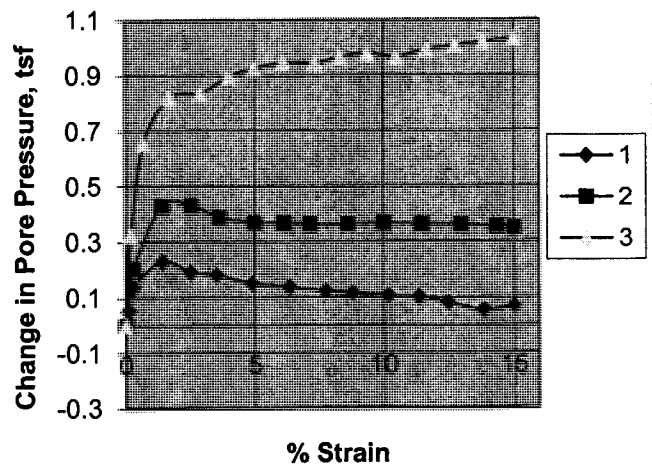
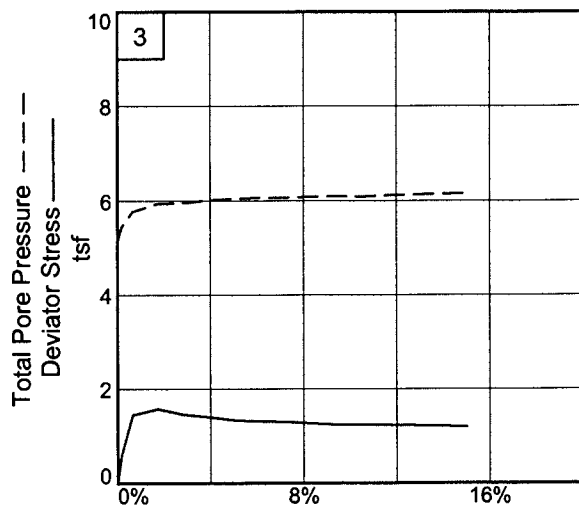
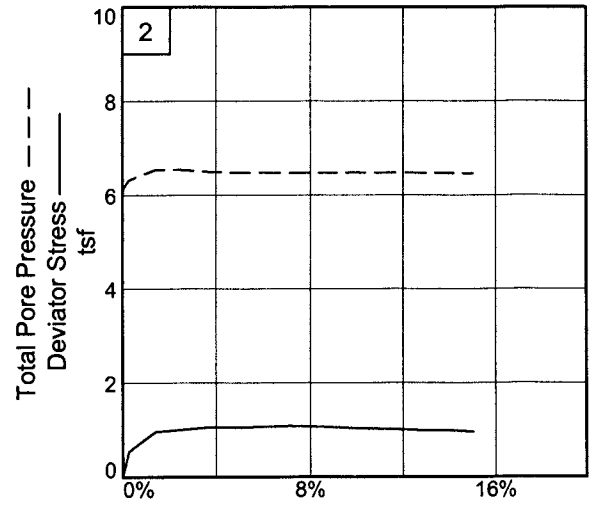
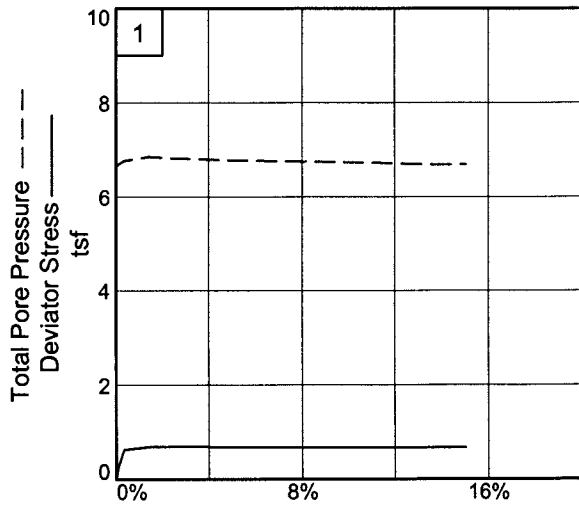
Sample Number: Boring11-119MU, #1

Depth: 30-32'

Proj. No.: BL-10-10065

Date Sampled:





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Brenna Formation

Depth: 30-32'

Sample No.: Boring11-119MU, #1

Project No.: B-10-10066 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/30/2011

12:17 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Brenna Formation
Depth: 30-32' **Sample Number:** Boring11-119MU, #1
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.704 **LL**=56 **PL**=19 **PI**=37
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	137.720			150.030
Moisture content: Dry soil+tare, gms.	103.720			109.010
Moisture content: Tare, gms.	30.369			30.350
Moisture, %	46.4	48.6	48.6	52.1
Moist specimen weight, gms.	119.6			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	106.8	108.4	108.4	
Dry density, pcf	73.0	73.0	73.0	
Void ratio	1.3132	1.3132	1.3132	
Saturation, %	95.4	100.0	100.0	

Consolidation cell pressure = 7.147 tsf
Consolidation back pressure = 6.632 tsf
Consolidation effective confining stress = 0.515 tsf
Peak Stress = 0.697 tsf at reading no. 4
Ult. Stress = 0.668 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0494	18.500	0.0	0.0	0.000	0.515	0.515	1.00	6.632	0.515	0.000
1	0.0519	24.100	5.6	0.1	0.265	0.462	0.727	1.57	6.685	0.594	0.132
2	0.0589	31.900	13.4	0.3	0.632	0.380	1.012	2.66	6.767	0.696	0.316
3	0.0891	33.300	14.8	1.4	0.690	0.286	0.976	3.41	6.861	0.631	0.345
4	0.1183	33.600	15.1	2.5	0.697	0.325	1.022	3.14	6.822	0.673	0.348
5	0.1470	33.700	15.2	3.5	0.694	0.335	1.029	3.07	6.812	0.682	0.347
6	0.1871	33.500	15.0	4.9	0.675	0.365	1.040	2.85	6.782	0.702	0.337
7	0.2262	33.700	15.2	6.3	0.674	0.379	1.053	2.78	6.768	0.716	0.337
8	0.2662	33.950	15.5	7.7	0.674	0.393	1.067	2.72	6.754	0.730	0.337
9	0.2970	34.100	15.6	8.8	0.673	0.400	1.073	2.68	6.747	0.736	0.336
10	0.3359	34.300	15.8	10.2	0.671	0.410	1.081	2.64	6.737	0.746	0.336
11	0.3665	34.500	16.0	11.3	0.671	0.415	1.086	2.62	6.732	0.751	0.336
12	0.3967	34.680	16.2	12.4	0.671	0.435	1.106	2.54	6.712	0.770	0.335
13	0.4369	34.910	16.4	13.8	0.669	0.461	1.130	2.45	6.686	0.796	0.335
14	0.4700	35.100	16.6	15.0	0.668	0.449	1.117	2.49	6.698	0.783	0.334

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	134.750			155.370
Moisture content: Dry soil+tare, gms.	101.990			116.570
Moisture content: Tare, gms.	29.960			30.510
Moisture, %	45.5	45.5	45.3	45.1
Moist specimen weight, gms.	125.6			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	110.1	110.1	110.2	
Dry density, pcf	75.7	75.7	75.9	
Void ratio	1.2298	1.2298	1.2250	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.142 tsf

Consolidation back pressure = 6.118 tsf

Consolidation effective confining stress = 1.024 tsf

Peak Stress = 1.082 tsf at reading no. 7

Ult. Stress = 0.956 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0511	21.870	0.0	0.0	0.000	1.024	1.024	1.00	6.118	1.024	0.000
1	0.0589	33.420	11.6	0.3	0.537	0.824	1.361	1.65	6.318	1.093	0.269
2	0.0901	42.800	20.9	1.4	0.963	0.596	1.559	2.62	6.546	1.077	0.481
3	0.1201	43.970	22.1	2.5	1.005	0.595	1.600	2.69	6.547	1.098	0.503
4	0.1508	45.180	23.3	3.6	1.049	0.638	1.687	2.64	6.504	1.162	0.524
5	0.1909	45.560	23.7	5.0	1.050	0.656	1.706	2.60	6.486	1.181	0.525
6	0.2211	46.350	24.5	6.1	1.073	0.658	1.731	2.63	6.484	1.194	0.536
7	0.2516	46.860	25.0	7.1	1.082	0.664	1.746	2.63	6.478	1.205	0.541
8	0.2919	46.770	24.9	8.6	1.062	0.663	1.725	2.60	6.479	1.194	0.531
9	0.3311	46.660	24.8	10.0	1.041	0.660	1.701	2.58	6.482	1.180	0.520
10	0.3721	46.570	24.7	11.4	1.020	0.664	1.684	2.54	6.478	1.174	0.510
11	0.4125	46.300	24.4	12.9	0.993	0.665	1.658	2.49	6.477	1.161	0.496
12	0.4527	46.410	24.5	14.3	0.981	0.671	1.652	2.46	6.471	1.161	0.490
13	0.4735	46.000	24.1	15.0	0.956	0.677	1.633	2.41	6.465	1.155	0.478

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	135.190			155.660
Moisture content: Dry soil+tare, gms.	105.020			120.450
Moisture content: Tare, gms.	30.410			31.330
Moisture, %	40.4	40.7	39.8	39.5
Moist specimen weight, gms.	125.9			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.51	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	112.9	113.1	113.6	
Dry density, pcf	80.4	80.4	81.3	
Void ratio	1.0998	1.0998	1.0773	
Saturation, %	99.4	100.0	100.0	

Consolidation cell pressure = 7.137 tsf

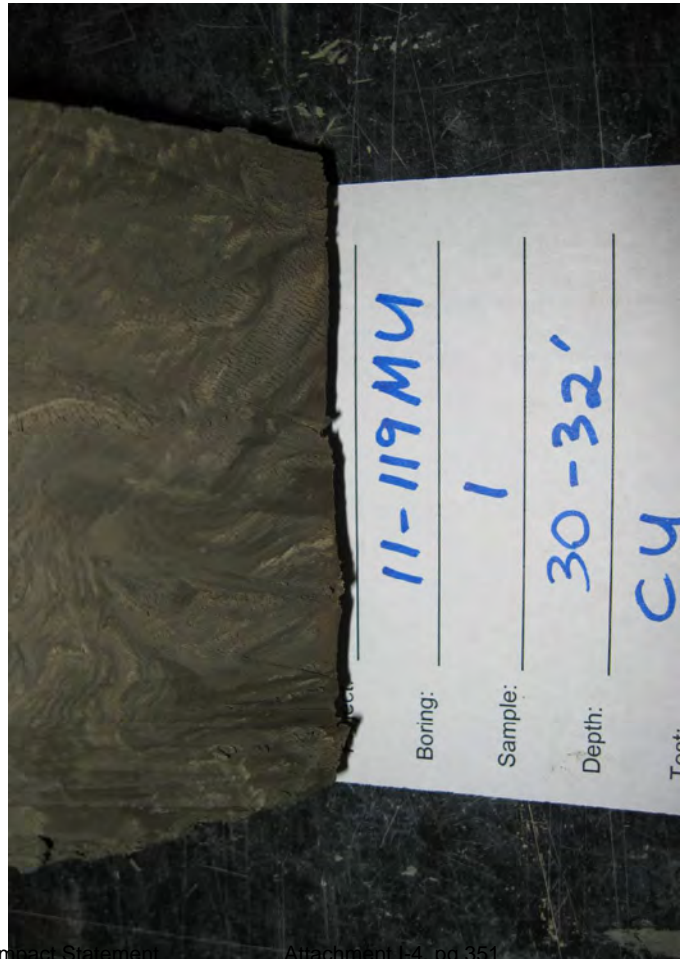
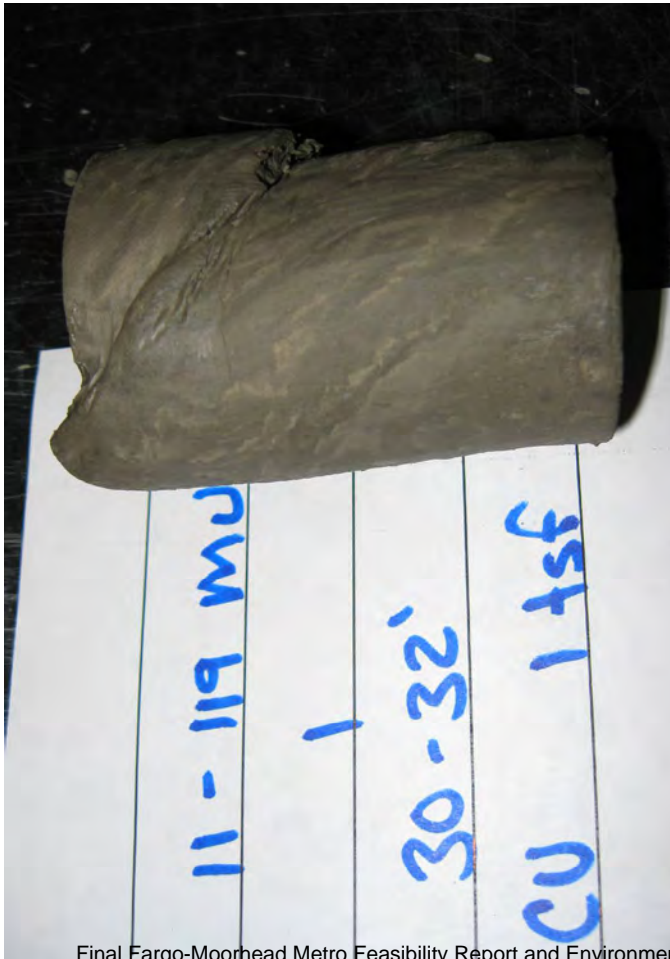
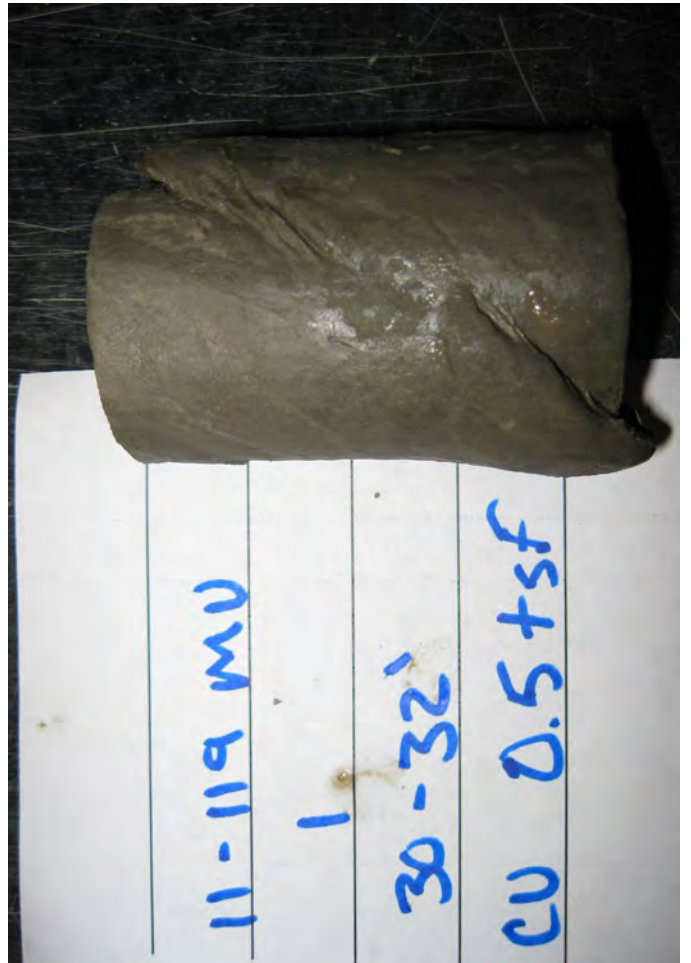
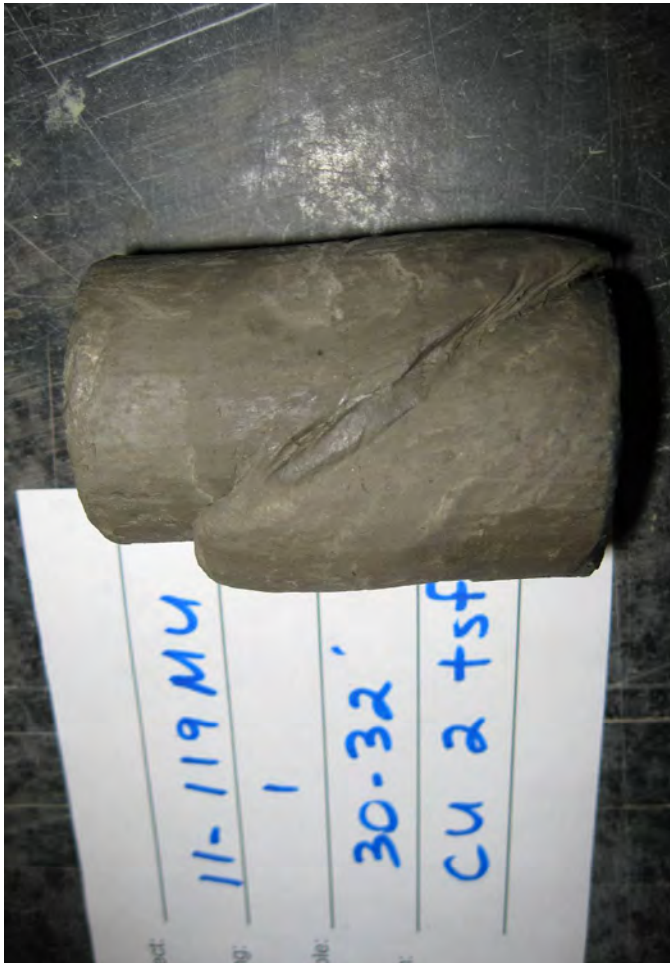
Consolidation back pressure = 5.121 tsf

Consolidation effective confining stress = 2.016 tsf

Peak Stress = 1.582 tsf at reading no. 3

Ult. Stress = 1.194 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0493	18.260	0.0	0.0	0.000	2.016	2.016	1.00	5.121	2.016	0.000
1	0.0541	30.750	12.5	0.2	0.596	1.692	2.288	1.35	5.445	1.990	0.298
2	0.0677	48.860	30.6	0.7	1.453	1.364	2.817	2.07	5.773	2.090	0.726
3	0.0972	51.940	33.7	1.7	1.582	1.197	2.779	2.32	5.940	1.988	0.791
4	0.1293	49.580	31.3	2.9	1.454	1.183	2.637	2.23	5.954	1.910	0.727
5	0.1597	48.820	30.6	4.0	1.403	1.121	2.524	2.25	6.016	1.822	0.701
6	0.1899	47.580	29.3	5.0	1.331	1.093	2.424	2.22	6.044	1.758	0.665
7	0.2203	47.600	29.3	6.1	1.316	1.072	2.388	2.23	6.065	1.730	0.658
8	0.2517	47.570	29.3	7.3	1.299	1.073	2.372	2.21	6.064	1.723	0.650
9	0.2821	47.170	28.9	8.3	1.266	1.052	2.318	2.20	6.085	1.685	0.633
10	0.3117	46.800	28.5	9.4	1.236	1.038	2.274	2.19	6.099	1.656	0.618
11	0.3412	47.140	28.9	10.5	1.236	1.052	2.288	2.17	6.085	1.670	0.618
12	0.3727	47.470	29.2	11.6	1.234	1.025	2.259	2.20	6.112	1.642	0.617
13	0.4030	47.630	29.4	12.7	1.226	1.010	2.236	2.21	6.127	1.623	0.613
14	0.4334	47.690	29.4	13.8	1.213	0.997	2.210	2.22	6.140	1.603	0.606
15	0.4680	47.660	29.4	15.0	1.194	0.986	2.180	2.21	6.151	1.583	0.597

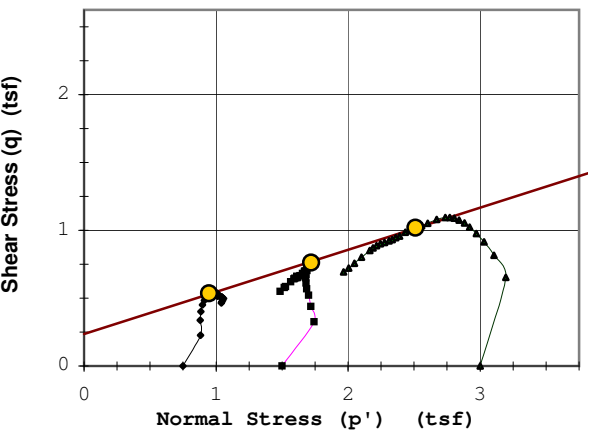
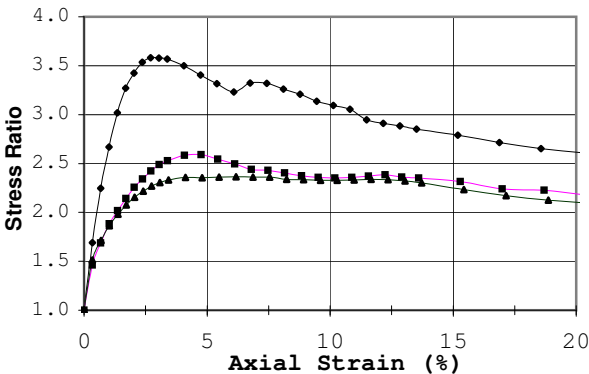
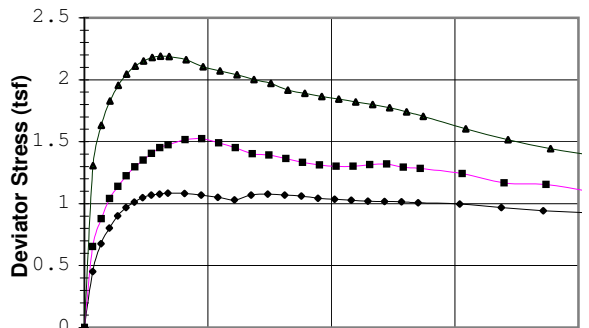
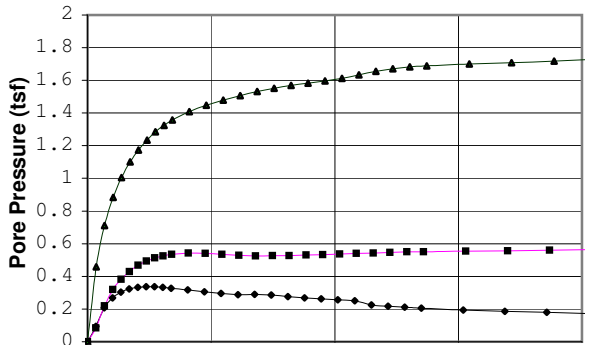


TRIAxIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid-Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 17.2^\circ$ $a = 0.2$ (tsf)

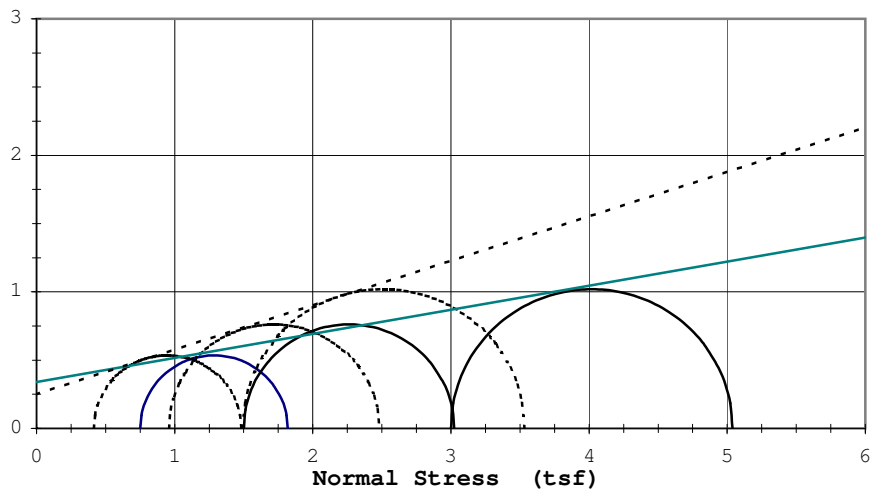


Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 18.1^\circ$	
Apparent Cohesion, $c' = 0.25$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 83.0
Test Type: CU w/pp	Plastic Limit: 25.2
Strain Rate (in/min): 0.0039	Plasticity Index: 57.8
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	3.00 3.00 3.00
Dry Density (pcf)	44.0 43.7 45.1
Void Ratio	76.1 76.0 75.2
After Consolidation	
Diameter (in)	1.28 1.28 1.31
Height (in)	1.44 1.43 1.42
Water Content (%)	2.96 2.94 2.91
Dry Density (pcf)	43.8 42.5 41.1
Void Ratio	78.2 79.6 81.0
Back Pressure (tsf)	1.22 1.18 1.14
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	0.75 1.50 3.00
Ultimate Deviator Stress (tsf)	1.08 1.52 2.19
Deviator Stress at Failure (tsf)	0.93 1.10 1.39
Max. Pore Pressure Buildup (tsf)	1.07 1.52 2.04
Pore Pressure Parameter "B"	0.34 0.56 1.73
Pct. Axial Strain at Failure	1.0 1.0 1.0
	2.7 4.8 6.2

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X

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 18.1° $c' = 0.25$ (tsf)
 _____ Total ϕ' : 10.0° $c = 0.34$ (tsf)

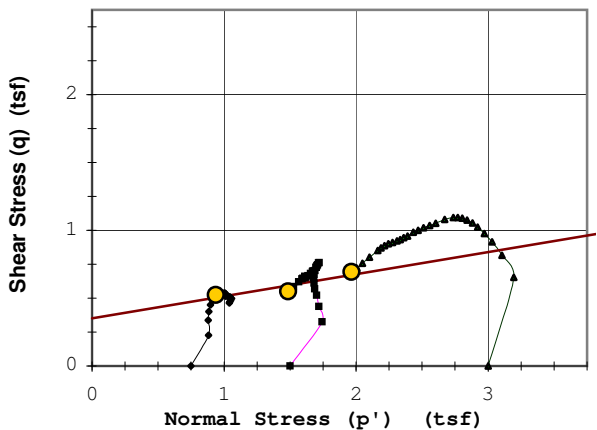
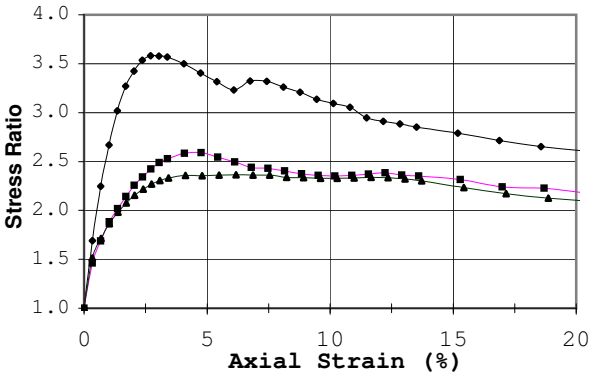
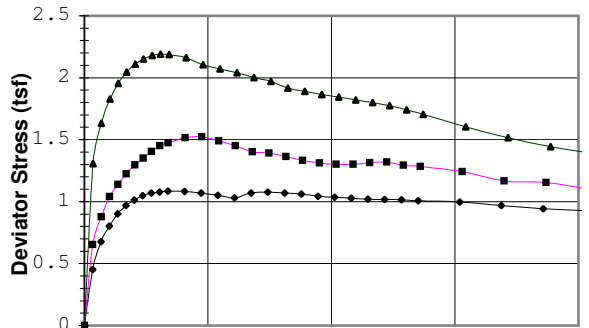
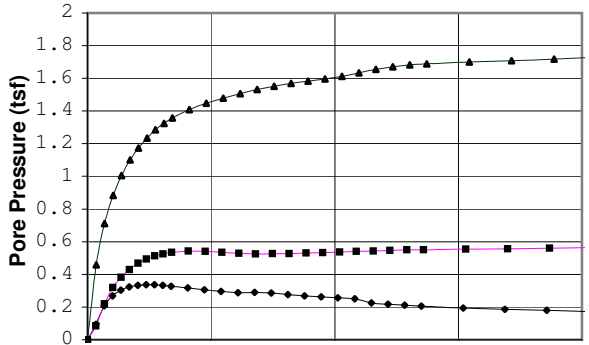


TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid-Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 9.2^\circ$ $a = 0.4$ (tsf)

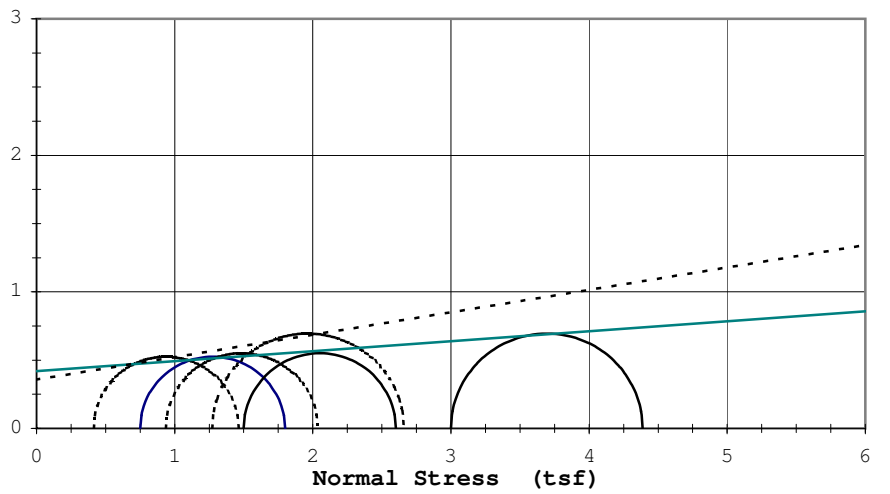


Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 9.3^\circ$	
Apparent Cohesion, $c' = 0.36$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 83.0
Test Type: CU w/pp	Plastic Limit: 25.2
Strain Rate (in/min): 0.0039	Plasticity Index: 57.8
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	3.00 3.00 3.00
Dry Density (pcf)	44.0 43.7 45.1
Void Ratio	76.1 76.0 75.2
After Consolidation	
Diameter (in)	1.28 1.28 1.31
Height (in)	1.44 1.43 1.42
Water Content (%)	2.96 2.94 2.91
Dry Density (pcf)	43.8 42.5 41.1
Void Ratio	78.2 79.6 81.0
Back Pressure (tsf)	1.22 1.18 1.14
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	0.75 1.50 3.00
Ultimate Deviator Stress (tsf)	1.08 1.52 2.19
Deviator Stress at Failure (tsf)	0.93 1.10 1.39
Max. Pore Pressure Buildup (tsf)	1.05 1.10 1.39
Pore Pressure Parameter "B"	0.34 0.56 1.73
Pct. Axial Strain at Failure	1.0 1.0 1.0
	2.4 20.4 20.6

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"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



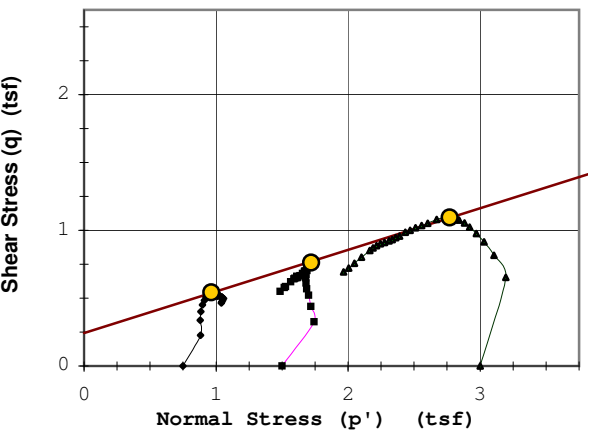
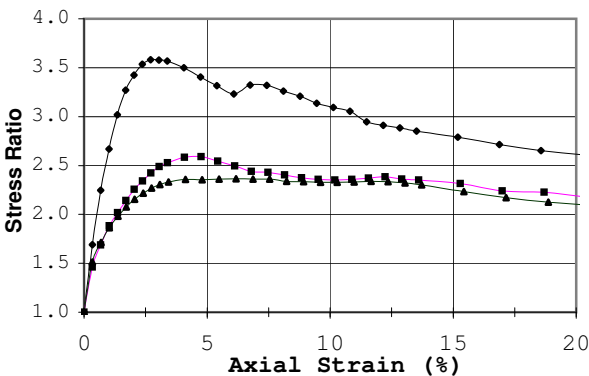
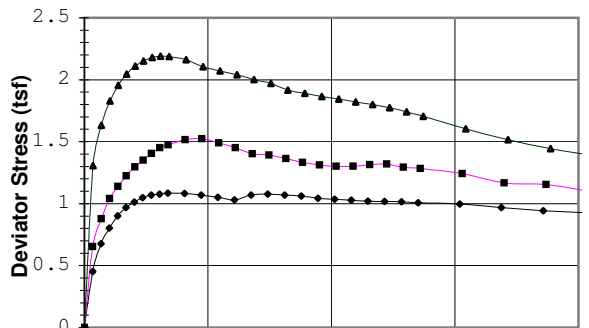
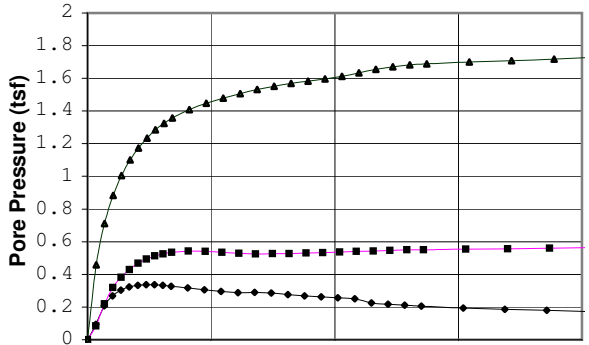
----- Effective ϕ' : 9.3° $c' = 0.36$ (tsf)
 _____ Total ϕ : 4.2° $c = 0.42$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid-Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 17.0^\circ$ $a = 0.2$ (tsf)

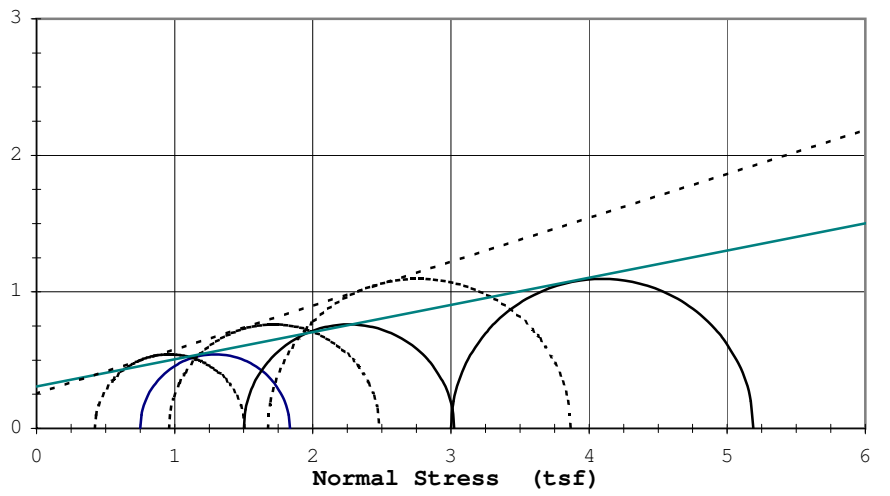


Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 17.9^\circ$	
Apparent Cohesion, $c' = 0.25$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 83.0
Test Type: CU w/pp	Plastic Limit: 25.2
Strain Rate (in/min): 0.0039	Plasticity Index: 57.8
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	3.00 3.00 3.00
Dry Density (pcf)	44.0 43.7 45.1
Void Ratio	76.1 76.0 75.2
After Consolidation	
Diameter (in)	1.28 1.28 1.31
Height (in)	1.44 1.43 1.42
Water Content (%)	2.96 2.94 2.91
Dry Density (pcf)	43.8 42.5 41.1
Void Ratio	78.2 79.6 81.0
Back Pressure (tsf)	1.22 1.18 1.14
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	0.75 1.50 3.00
Ultimate Deviator Stress (tsf)	1.08 1.52 2.19
Deviator Stress at Failure (tsf)	0.93 1.10 1.39
Max. Pore Pressure Buildup (tsf)	1.08 1.52 2.19
Pore Pressure Parameter "B"	0.34 0.56 1.73
Pct. Axial Strain at Failure	1.0 1.0 1.0
	3.4 4.8 3.1

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"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



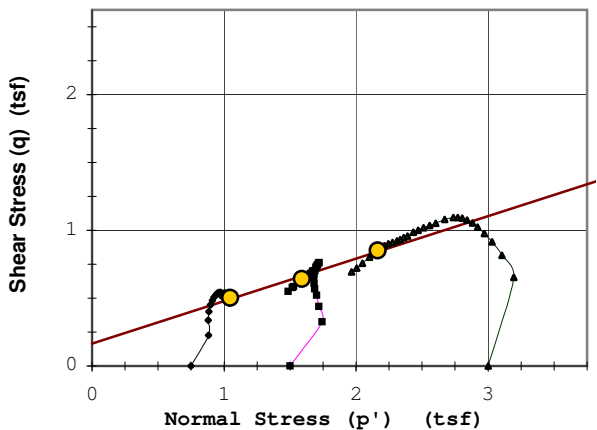
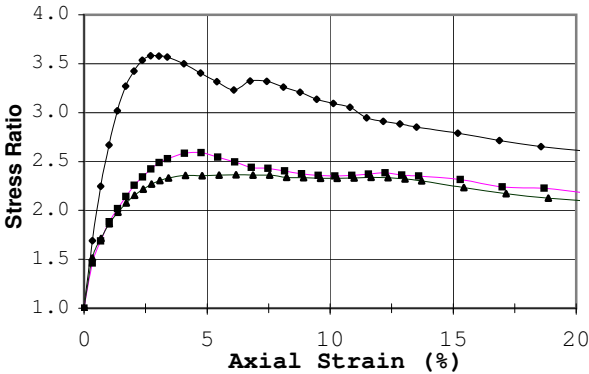
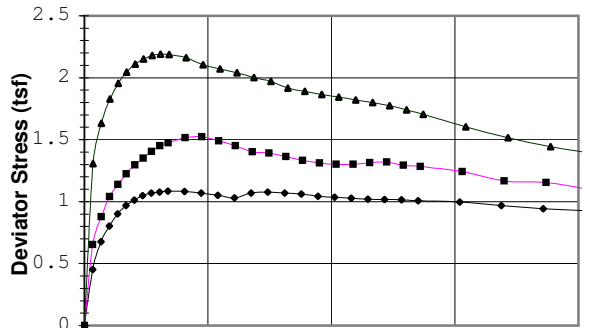
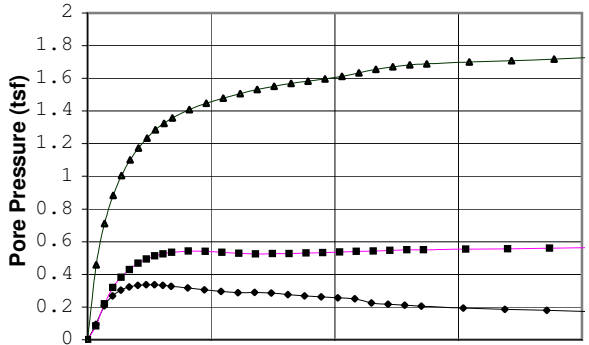
----- Effective ϕ' : 17.9° $c' = 0.25$ (tsf)
 _____ Total ϕ' : 11.3° $c = 0.31$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid-Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 17.4^\circ$ $a = 0.2$ (tsf)

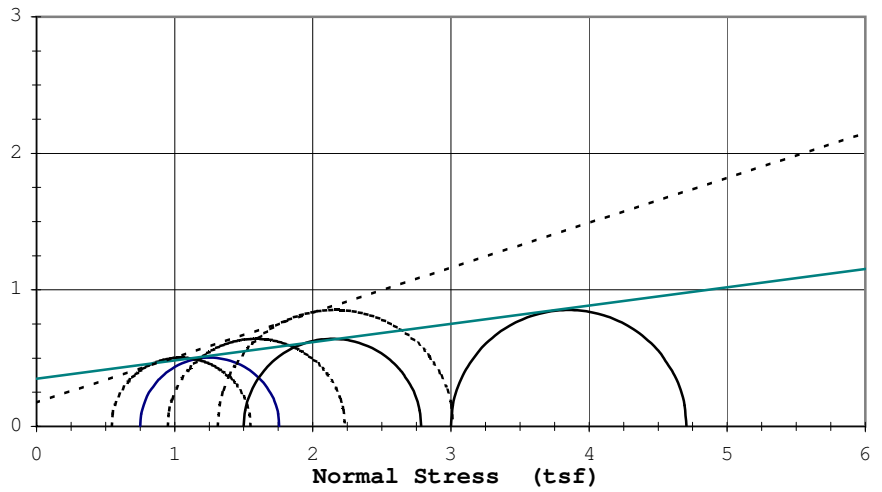


Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 18.2^\circ$	
Apparent Cohesion, $c' = 0.17$ (tsf)	
Test Date: 8/13/10	Liquid Limit: 83.0
Test Type: CU w/pp	Plastic Limit: 25.2
Strain Rate (in/min): 0.0039	Plasticity Index: 57.8
Strain Rate (%/min): 0.132	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.45 1.45 1.45
Water Content (%)	3.00 3.00 3.00
Dry Density (pcf)	44.0 43.7 45.1
Void Ratio	76.1 76.0 75.2
After Consolidation	
Diameter (in)	1.28 1.28 1.31
Height (in)	1.44 1.43 1.42
Water Content (%)	2.96 2.94 2.91
Dry Density (pcf)	43.8 42.5 41.1
Void Ratio	78.2 79.6 81.0
Back Pressure (tsf)	1.22 1.18 1.14
Minor Principal Stress (tsf)	5.76 5.76 5.76
Max. Deviator Stress (tsf)	0.75 1.50 3.00
Ultimate Deviator Stress (tsf)	1.08 1.52 2.19
Deviator Stress at Failure (tsf)	0.93 1.10 1.39
Max. Pore Pressure Buildup (tsf)	1.01 1.28 1.71
Pore Pressure Parameter "B"	0.34 0.56 1.73
Pct. Axial Strain at Failure	1.0 1.0 1.0
	15.0 15.0 15.0

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"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 18.2° $c' = 0.17$ (tsf)
 _____ Total ϕ : 7.6° $c = 0.35$ (tsf)



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095
 Boring No.: 10-79MU, Sample No.: 2, Depth (ft.): 40 - 42 (Mid-Top)

Job No.: 7577
 Test Type: CU w/pp

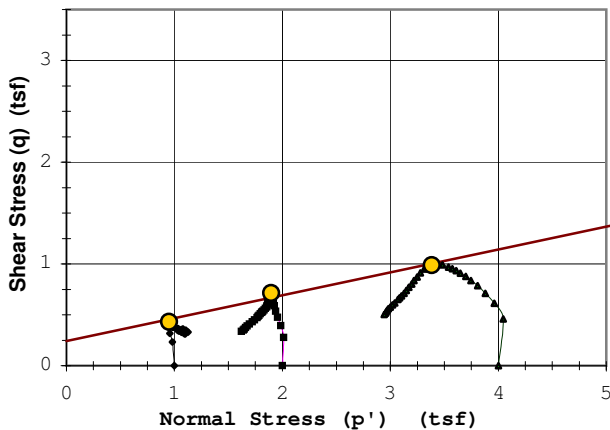
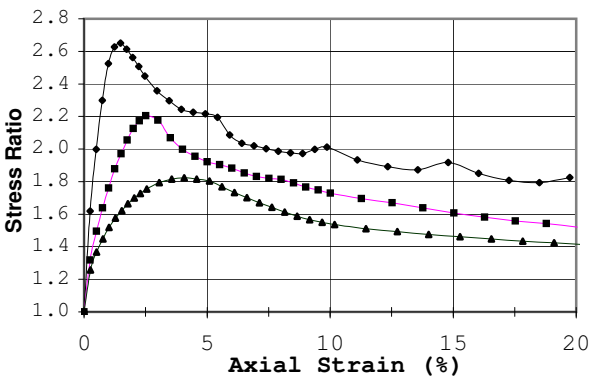
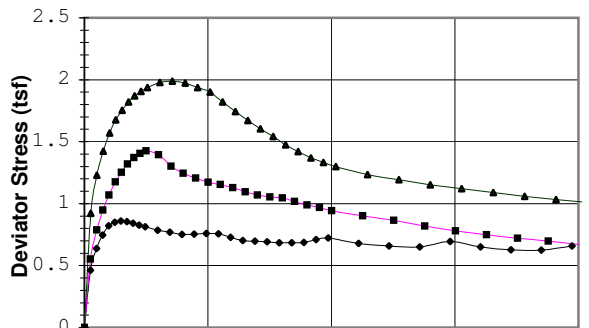
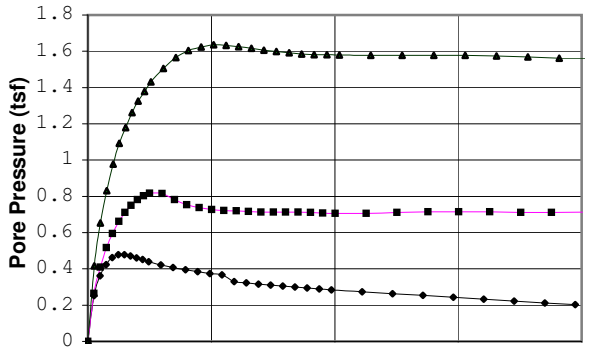
Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.34	0.45	0.09	0.34	0.65	0.08	0.34	1.31	0.46
0.68	0.68	0.21	0.68	0.88	0.22	0.69	1.63	0.71
1.01	0.80	0.27	1.02	1.04	0.32	1.03	1.83	0.88
1.35	0.90	0.30	1.36	1.14	0.38	1.37	1.96	1.01
1.69	0.97	0.32	1.70	1.22	0.43	1.72	2.05	1.10
2.03	1.01	0.33	2.04	1.30	0.47	2.06	2.11	1.17
2.36	1.05	0.34	2.38	1.35	0.49	2.40	2.15	1.23
2.70	1.07	0.34	2.72	1.40	0.51	2.75	2.18	1.28
3.04	1.08	0.33	3.06	1.45	0.53	3.09	2.19	1.32
3.38	1.08	0.33	3.40	1.48	0.53	3.43	2.19	1.36
4.05	1.08	0.32	4.08	1.52	0.54	4.12	2.16	1.41
4.73	1.07	0.31	4.76	1.52	0.54	4.80	2.10	1.45
5.40	1.05	0.30	5.44	1.49	0.54	5.49	2.07	1.48
6.08	1.03	0.29	6.12	1.45	0.53	6.18	2.04	1.51
6.75	1.07	0.29	6.80	1.40	0.53	6.86	2.00	1.53
7.43	1.08	0.29	7.48	1.39	0.53	7.55	1.97	1.55
8.10	1.07	0.28	8.16	1.36	0.53	8.23	1.92	1.57
8.78	1.06	0.27	8.84	1.33	0.53	8.92	1.89	1.58
9.45	1.04	0.26	9.52	1.31	0.53	9.61	1.86	1.60
10.13	1.04	0.26	10.20	1.30	0.54	10.29	1.84	1.61
10.81	1.03	0.25	10.88	1.30	0.54	10.98	1.82	1.63
11.48	1.02	0.23	11.56	1.31	0.54	11.67	1.80	1.66
12.16	1.02	0.22	12.24	1.32	0.55	12.35	1.78	1.67
12.83	1.01	0.21	12.92	1.29	0.55	13.04	1.74	1.68
13.51	1.01	0.21	13.60	1.28	0.55	13.72	1.71	1.69
15.19	1.00	0.19	15.30	1.24	0.55	15.44	1.60	1.70
16.88	0.97	0.19	16.99	1.17	0.56	17.15	1.51	1.71
18.57	0.94	0.18	18.70	1.15	0.56	18.87	1.44	1.72
20.26	0.93	0.17	20.39	1.10	0.56	20.58	1.39	1.73

TRIAXIAL TEST ASTM: D 4767

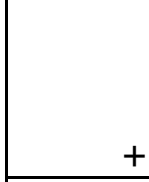
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel, a few pockets of Silt (CH) Argusville**



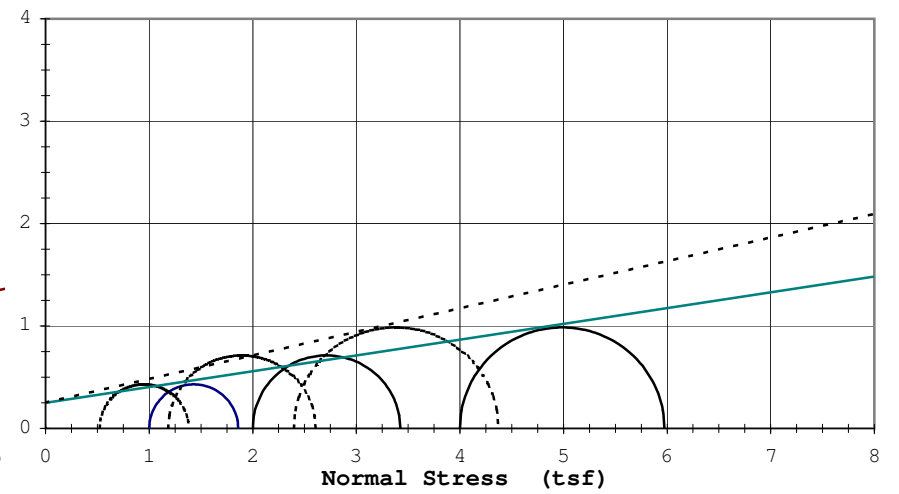
Rupture Envelope at Failure
 $\alpha = 12.7^\circ$ $a = 0.2$ (tsf)



Failure Criterion: Max. Stress Ratio	
Angle of internal friction, $\phi' = 13.0^\circ$	
Apparent Cohesion, $c' = 0.25$ (tsf)	
Test Date: 8/24/10	Liquid Limit: 78.1
Test Type: CU w/pp	Plastic Limit: 26.8
Strain Rate (in/min): 0.0039	Plasticity Index: 51.3
Strain Rate (%/min): 0.096	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	47.4 49.2 51.1
Dry Density (pcf)	73.7 72.2 70.8
Void Ratio	1.35 1.40 1.45
After Consolidation	
Diameter (in)	1.92 1.91 1.88
Height (in)	4.05 3.99 3.93
Water Content (%)	46.2 45.5 43.7
Dry Density (pcf)	75.9 76.6 78.4
Void Ratio	1.29 1.26 1.21
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.86 1.42 1.99
Ultimate Deviator Stress (tsf)	0.66 0.67 1.01
Deviator Stress at Failure (tsf)	0.86 1.42 1.97
Max. Pore Pressure Buildup (tsf)	0.48 0.82 1.64
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	1.5 2.5 4.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



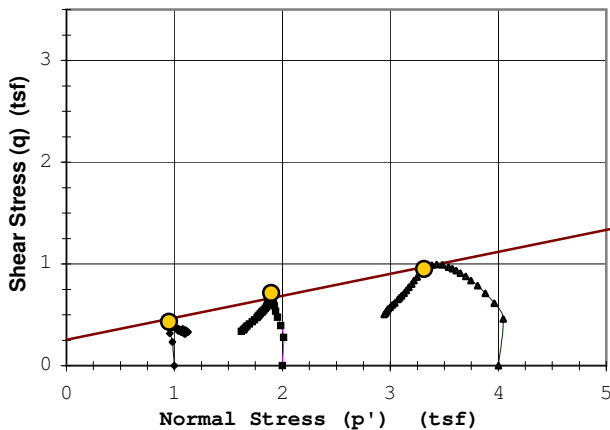
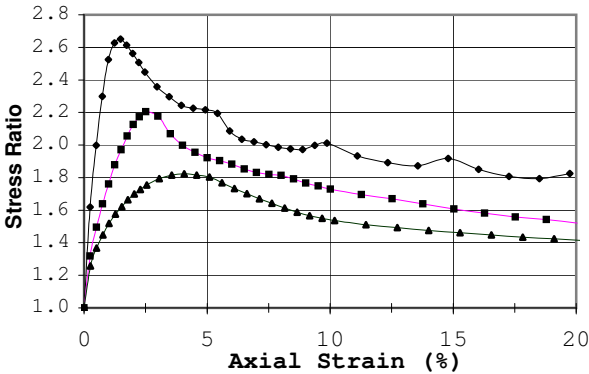
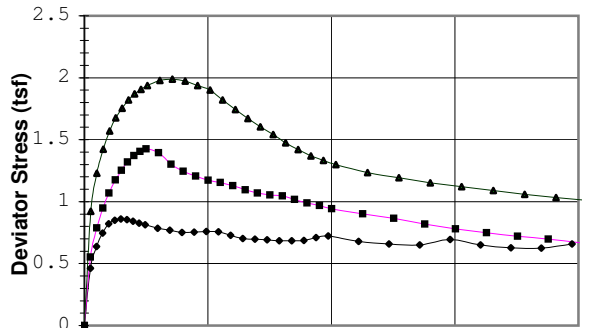
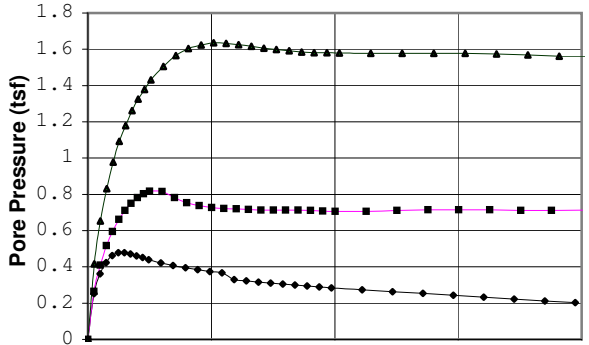
----- Effective ϕ' : 13.0° $c' = 0.25$ (tsf)
 _____ Total ϕ' : 8.8° $c = 0.25$ (tsf)

TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel, a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 12.2^\circ$ $a = 0.3$ (tsf)



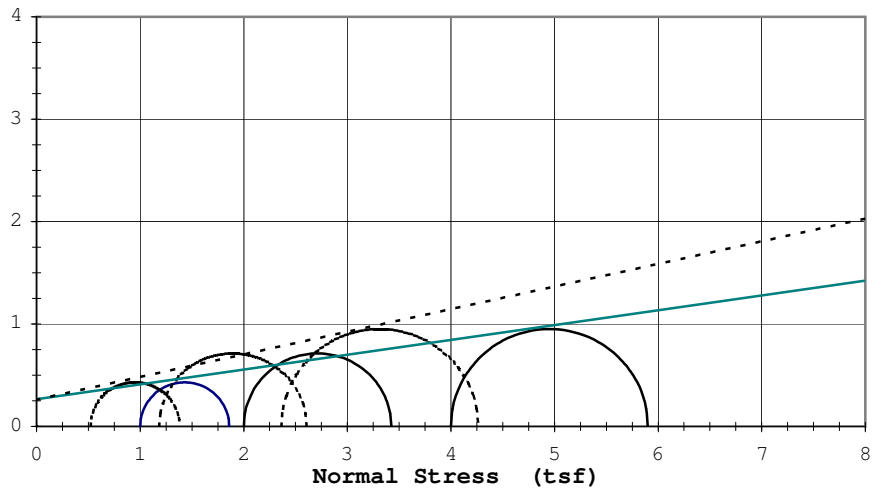
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Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 12.5^\circ$	
Apparent Cohesion, $c' = 0.26$ (tsf)	
Test Date: 8/24/10	Liquid Limit: 78.1
Test Type: CU w/pp	Plastic Limit: 26.8
Strain Rate (in/min): 0.0039	Plasticity Index: 51.3
Strain Rate (%/min): 0.096	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	47.4 49.2 51.1
Dry Density (pcf)	73.7 72.2 70.8
Void Ratio	1.35 1.40 1.45
After Consolidation	
Diameter (in)	1.92 1.91 1.88
Height (in)	4.05 3.99 3.93
Water Content (%)	46.2 45.5 43.7
Dry Density (pcf)	75.9 76.6 78.4
Void Ratio	1.29 1.26 1.21
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.86 1.42 1.99
Ultimate Deviator Stress (tsf)	0.66 0.67 1.01
Deviator Stress at Failure (tsf)	0.86 1.42 1.90
Max. Pore Pressure Buildup (tsf)	0.48 0.82 1.64
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	1.5 2.5 5.1

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



-----	Effective ϕ' : 12.5°	$c' = 0.26$ (tsf)
_____	Total ϕ' : 8.2°	$c = 0.27$ (tsf)

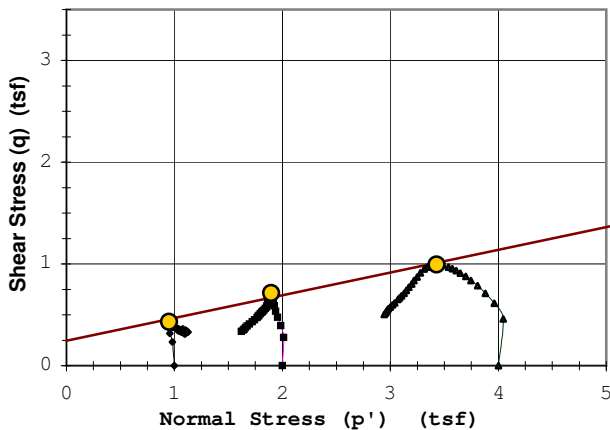
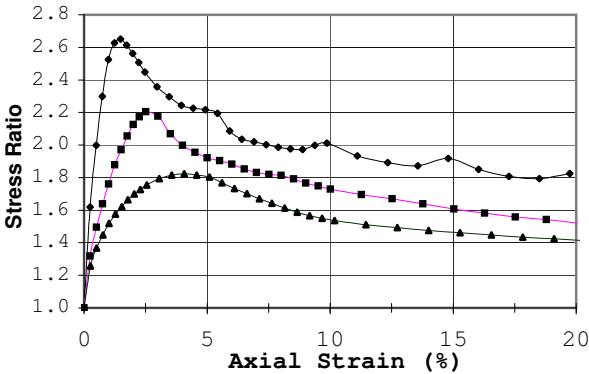
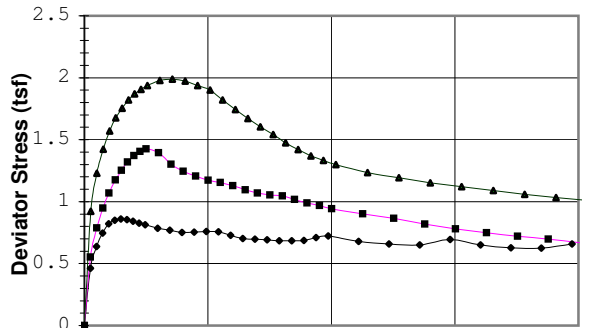
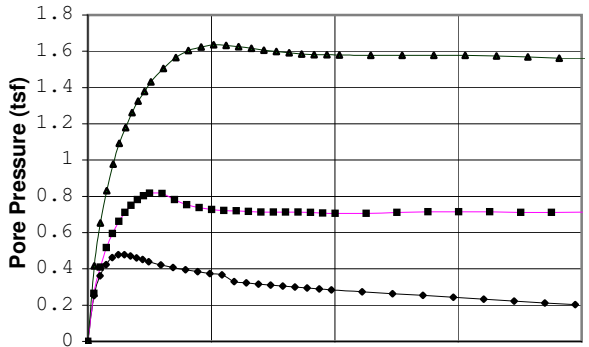


TRIAxIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel, a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 12.6^\circ$ $a = 0.2$ (tsf)



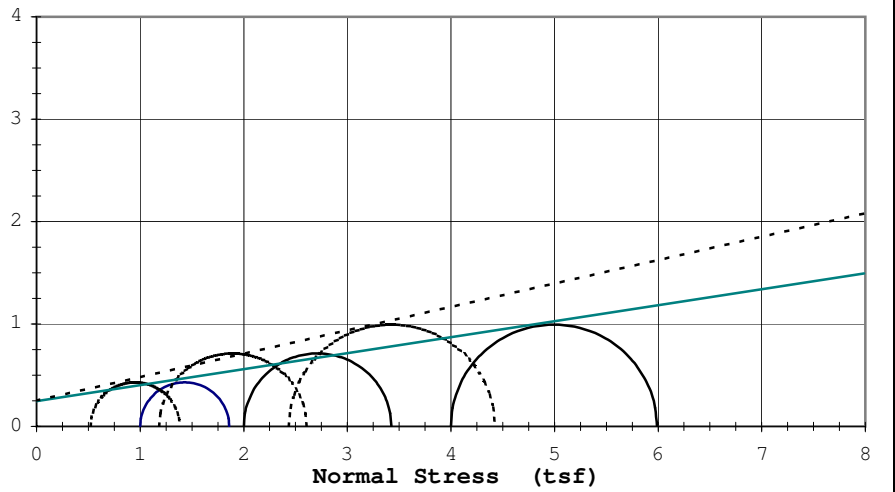
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Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 12.9^\circ$	
Apparent Cohesion, $c' = 0.25$ (tsf)	
Test Date: 8/24/10	Liquid Limit: 78.1
Test Type: CU w/pp	Plastic Limit: 26.8
Strain Rate (in/min): 0.0039	Plasticity Index: 51.3
Strain Rate (%/min): 0.096	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	47.4 49.2 51.1
Dry Density (pcf)	73.7 72.2 70.8
Void Ratio	1.35 1.40 1.45
After Consolidation	
Diameter (in)	1.92 1.91 1.88
Height (in)	4.05 3.99 3.93
Water Content (%)	46.2 45.5 43.7
Dry Density (pcf)	75.9 76.6 78.4
Void Ratio	1.29 1.26 1.21
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.86 1.42 1.99
Ultimate Deviator Stress (tsf)	0.66 0.67 1.01
Deviator Stress at Failure (tsf)	0.86 1.42 1.99
Max. Pore Pressure Buildup (tsf)	0.48 0.82 1.64
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	1.5 2.5 3.6

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 12.9° $c' = 0.25$ (tsf)
 _____ Total ϕ' : 8.9° $c = 0.25$ (tsf)

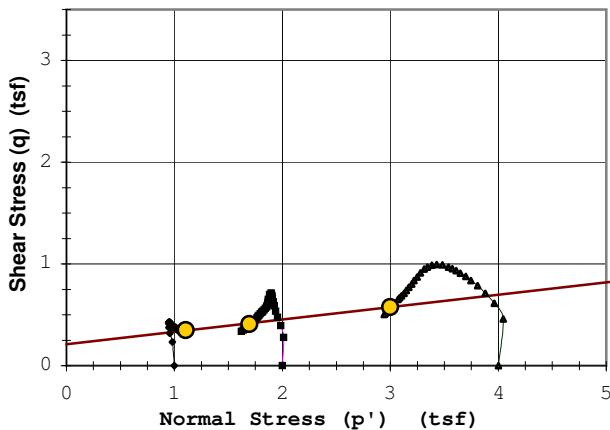
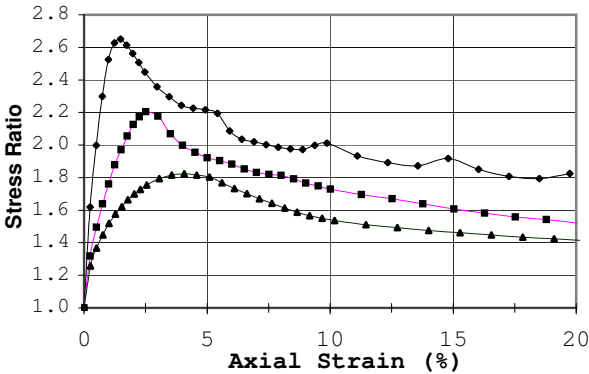
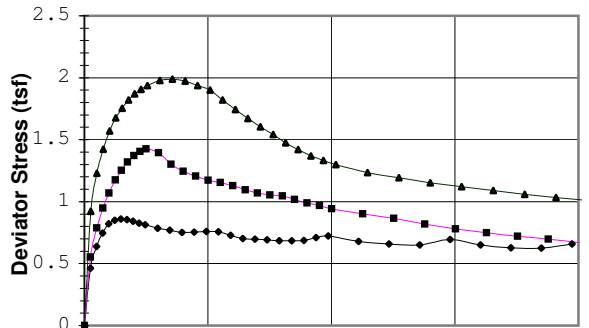
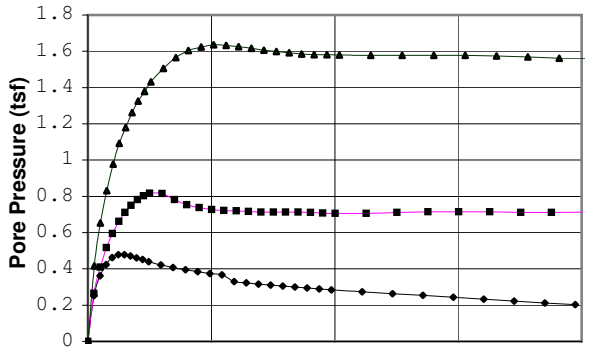


TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Top)**
 Soil Type: **Fat Clay w/a few pieces of Gravel, a few pockets of Silt (CH) Argusville**



Rupture Envelope at Failure
 $\alpha = 6.9^\circ$ $a = 0.2$ (tsf)



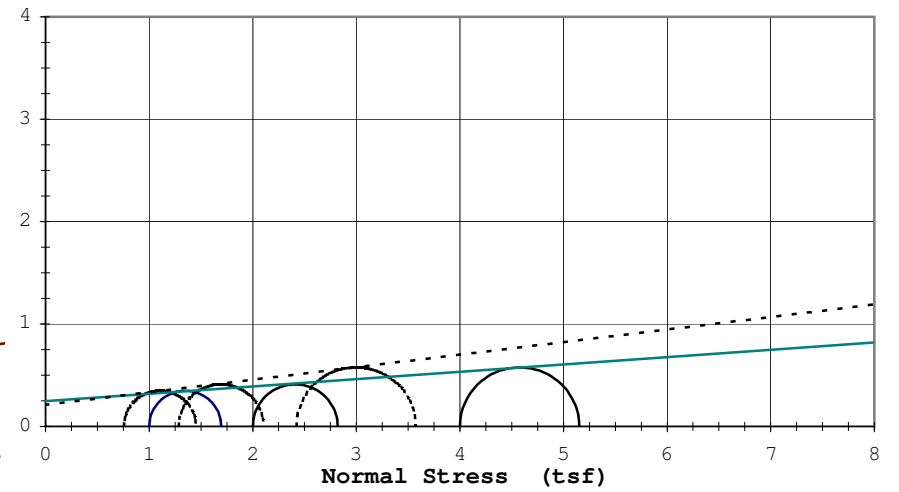
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Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 7.0^\circ$	
Apparent Cohesion, $c' = 0.21$ (tsf)	
Test Date: 8/24/10	Liquid Limit: 78.1
Test Type: CU w/pp	Plastic Limit: 26.8
Strain Rate (in/min): 0.0039	Plasticity Index: 51.3
Strain Rate (%/min): 0.096	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	47.4 49.2 51.1
Dry Density (pcf)	73.7 72.2 70.8
Void Ratio	1.35 1.40 1.45
After Consolidation	
Diameter (in)	1.92 1.91 1.88
Height (in)	4.05 3.99 3.93
Water Content (%)	46.2 45.5 43.7
Dry Density (pcf)	75.9 76.6 78.4
Void Ratio	1.29 1.26 1.21
Back Pressure (tsf)	5.76 5.76 5.76
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.86 1.42 1.99
Ultimate Deviator Stress (tsf)	0.66 0.67 1.01
Deviator Stress at Failure (tsf)	0.70 0.82 1.15
Max. Pore Pressure Buildup (tsf)	0.48 0.82 1.64
Pore Pressure Parameter "B"	1.0 1.0 1.0
Pct. Axial Strain at Failure	15.0 15.0 15.0

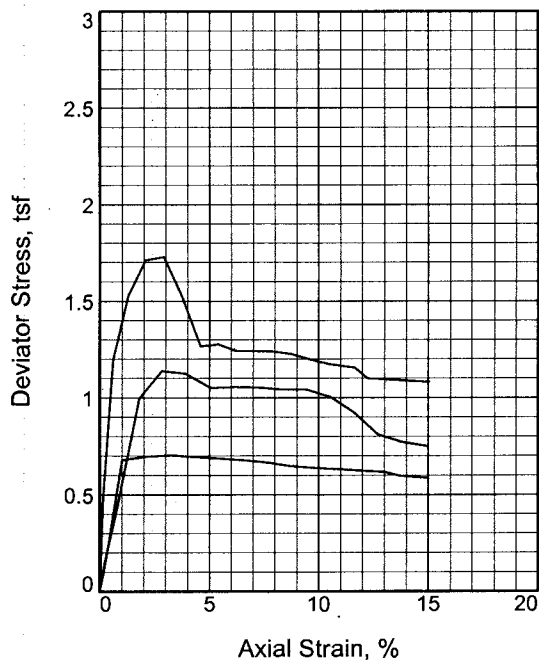
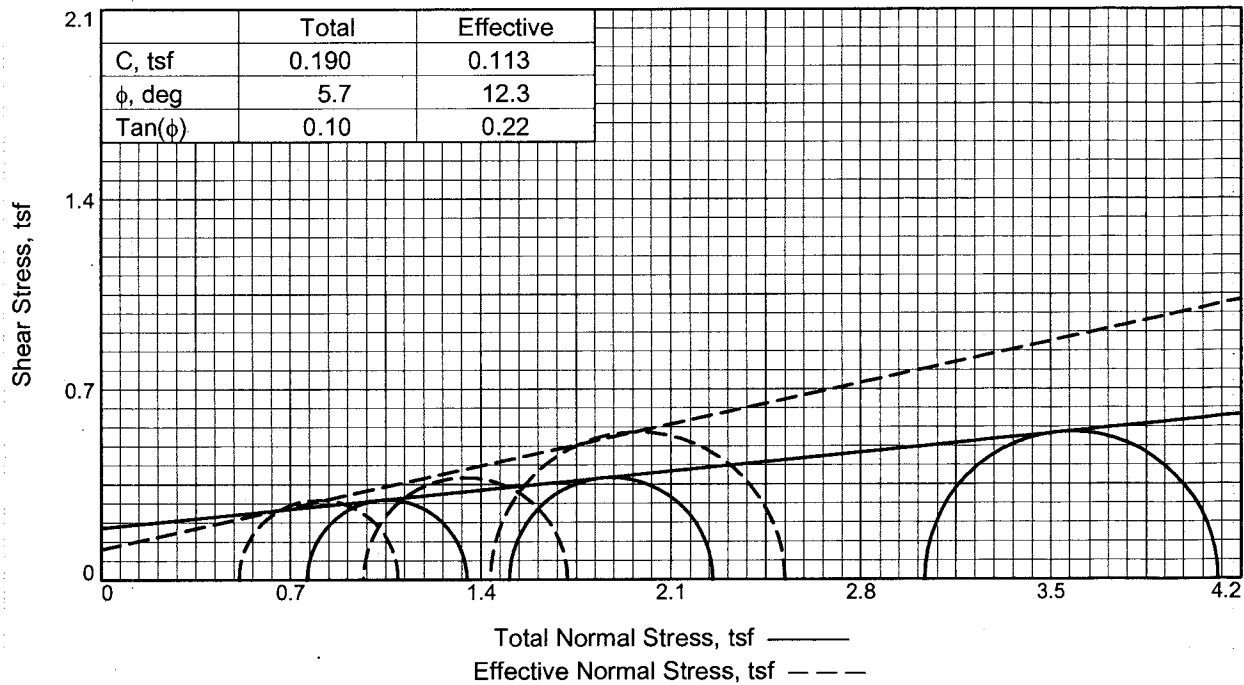
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.



----- Effective ϕ' : 7.0° $c' = 0.21$ (tsf)
 _____ Total ϕ' : 4.1° $c = 0.25$ (tsf)

Sample 1			Sample 2			Sample 3		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.46	0.25	0.25	0.55	0.26	0.26	0.92	0.42
0.49	0.64	0.36	0.50	0.79	0.41	0.51	1.23	0.65
0.74	0.75	0.42	0.75	0.95	0.52	0.76	1.42	0.83
0.99	0.82	0.46	1.00	1.07	0.60	1.02	1.57	0.98
1.23	0.85	0.48	1.25	1.18	0.66	1.27	1.68	1.09
1.48	0.86	0.48	1.50	1.25	0.71	1.53	1.75	1.18
1.73	0.85	0.47	1.75	1.32	0.75	1.78	1.82	1.26
1.97	0.84	0.46	2.00	1.37	0.78	2.04	1.87	1.33
2.22	0.83	0.45	2.25	1.41	0.80	2.29	1.91	1.38
2.47	0.81	0.44	2.51	1.42	0.82	2.55	1.94	1.43
2.96	0.79	0.42	3.01	1.39	0.82	3.06	1.98	1.51
3.45	0.77	0.41	3.51	1.30	0.78	3.57	1.99	1.56
3.95	0.75	0.39	4.01	1.24	0.75	4.07	1.97	1.60
4.44	0.76	0.38	4.51	1.21	0.74	4.58	1.94	1.62
4.93	0.76	0.38	5.01	1.17	0.73	5.09	1.90	1.64
5.43	0.76	0.37	5.51	1.15	0.72	5.60	1.82	1.63
5.92	0.73	0.33	6.01	1.13	0.72	6.11	1.74	1.62
6.42	0.70	0.32	6.51	1.09	0.72	6.62	1.67	1.62
6.91	0.70	0.32	7.01	1.07	0.71	7.13	1.60	1.61
7.40	0.69	0.31	7.51	1.05	0.71	7.64	1.54	1.60
7.90	0.68	0.31	8.02	1.05	0.71	8.15	1.48	1.59
8.39	0.68	0.30	8.52	1.02	0.71	8.66	1.42	1.58
8.88	0.69	0.29	9.02	0.99	0.71	9.17	1.37	1.58
9.38	0.71	0.29	9.52	0.97	0.71	9.68	1.33	1.58
9.87	0.72	0.28	10.02	0.94	0.71	10.19	1.30	1.58
11.10	0.68	0.27	11.27	0.90	0.71	11.46	1.24	1.58
12.34	0.66	0.26	12.52	0.86	0.71	12.73	1.19	1.58
13.57	0.65	0.25	13.78	0.82	0.72	14.01	1.15	1.58
14.80	0.70	0.24	15.03	0.78	0.72	15.28	1.12	1.58
16.04	0.65	0.23	16.28	0.75	0.71	16.55	1.09	1.57
17.27	0.63	0.22	17.53	0.72	0.71	17.83	1.06	1.57
18.50	0.62	0.21	18.78	0.70	0.71	19.10	1.03	1.56
19.74	0.66	0.20	20.04	0.67	0.71	20.37	1.01	1.56



Sample No.	1	2	3	
Initial	Water Content, %	61.2	61.9	61.6
	Dry Density, pcf	62.7	63.1	62.5
	Saturation, %	97.7	99.9	97.8
	Void Ratio	1.6959	1.6802	1.7065
	Diameter, in.	1.43	1.41	1.43
	Height, in.	2.80	2.79	2.79
At Test	Water Content, %	62.6	61.8	61.9
	Dry Density, pcf	62.7	63.2	63.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6959	1.6745	1.6774
	Diameter, in.	1.42	1.41	1.42
	Height, in.	2.80	2.79	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.76	1.50	3.04	
Back Pressure, tsf	6.38	5.63	4.12	
Cell Pressure, tsf	7.14	7.13	7.16	
Peak Deviator Stress, tsf	0.70	1.14	1.73	
Total Pore Pr., tsf	6.77	6.20	5.48	
Ultimate Deviator Stress, tsf	0.59	0.75	1.08	
Total Pore Pr., tsf	6.63	6.16	5.72	
Maj. Eff. Stress at Ultimate, tsf	1.10	1.72	2.52	
Min. Eff. Stress at Ultimate, tsf	0.51	0.97	1.44	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 90 PL= 27 PI= 63

Specific Gravity= 2.709

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

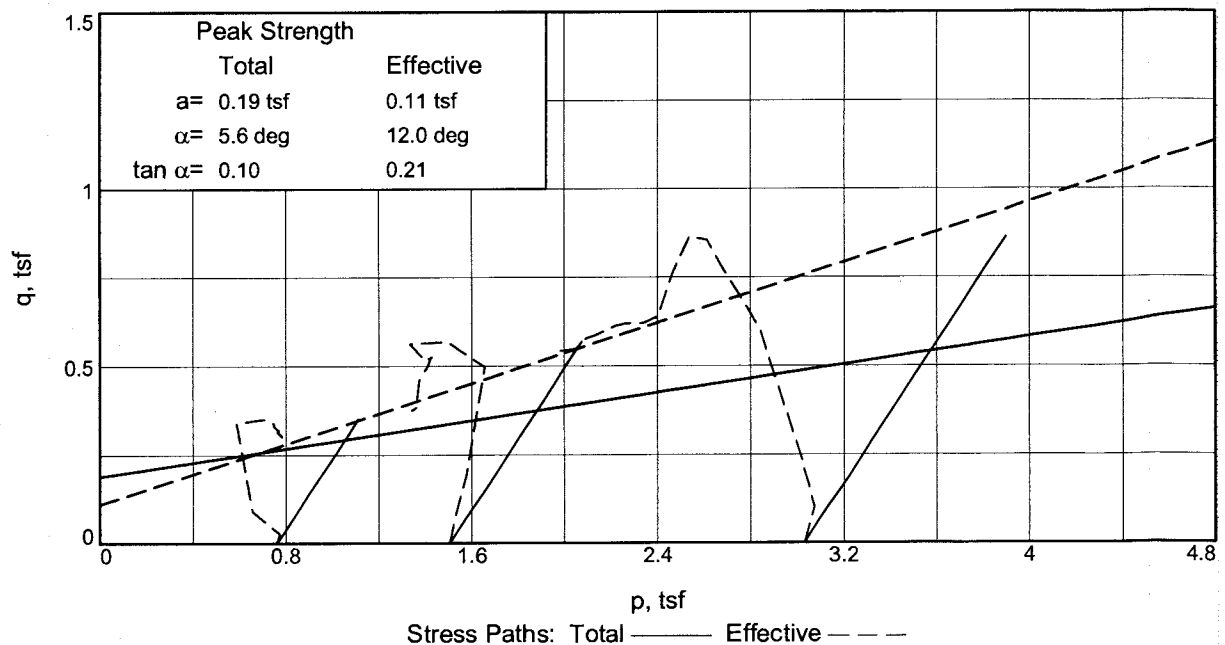
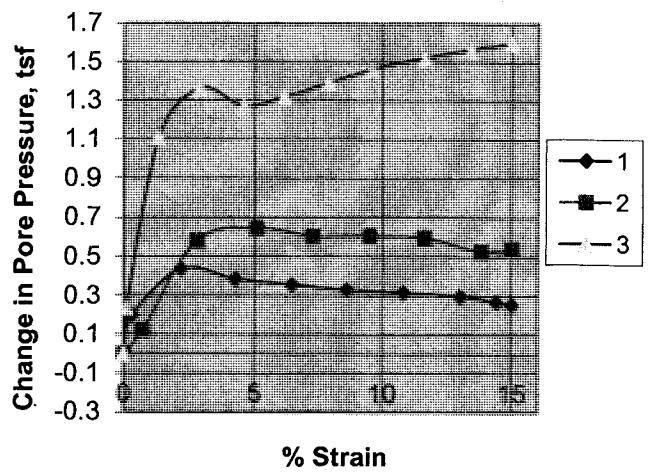
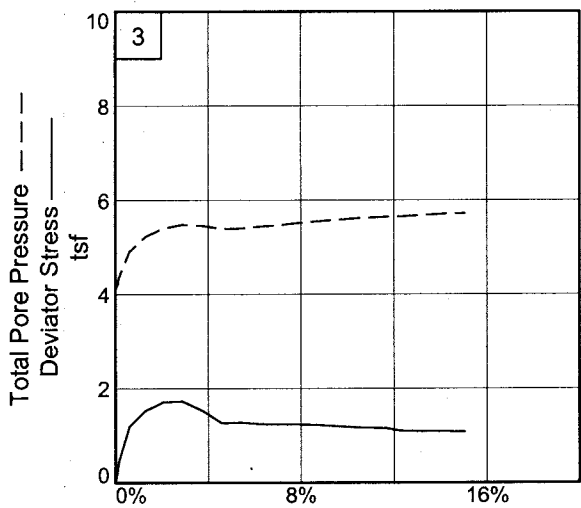
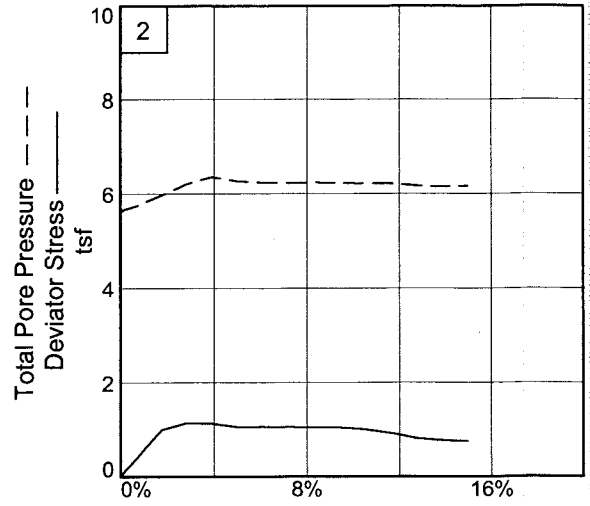
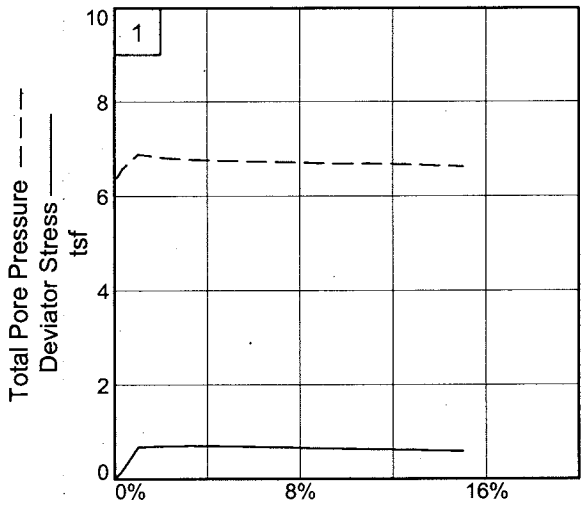
Location: Maple River, Argusville Formation

Sample Number: Boring10-105MU, #4 **Depth:** 45-47'

Proj. No.: BL-10-10065

Date Sampled:





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Argusville Formation

Depth: 45-47'

Sample No.: Boring10-105MU, #4

Project No.: BL10-0066 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:27 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Argusville Formation
Depth: 45-47' **Sample Number:** Boring10-105MU, #4
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.709 **LL**=90 **PL**=27 **PI**=63
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	124.540			150.290
Moisture content: Dry soil+tare, gms.	89.000			104.050
Moisture content: Tare, gms.	30.900			30.650
Moisture, %	61.2	62.6	62.6	63.0
Moist specimen weight, gms.	118.6			
Diameter, in.	1.43	1.43	1.42	
Area, in. ²	1.59	1.59	1.59	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	101.1	102.0	102.0	
Dry density, pcf	62.7	62.7	62.7	
Void ratio	1.6959	1.6959	1.6959	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.137 tsf
Consolidation back pressure = 6.375 tsf
Consolidation effective confining stress = 0.762 tsf
Peak Stress = 0.703 tsf at reading no. 5
Ult. Stress = 0.587 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0374	19.400	0.0	0.0	0.000	0.762	0.762	1.00	6.375	0.762	0.000
1	0.0405	20.630	1.2	0.1	0.055	0.747	0.802	1.07	6.390	0.775	0.028
2	0.0464	23.430	4.0	0.3	0.181	0.567	0.748	1.32	6.570	0.658	0.091
3	0.0658	34.600	15.2	1.0	0.679	0.249	0.928	3.73	6.888	0.589	0.340
4	0.0981	35.200	15.8	2.2	0.698	0.327	1.025	3.13	6.810	0.676	0.349
5	0.1284	35.500	16.1	3.2	0.703	0.363	1.066	2.94	6.774	0.715	0.352
6	0.1587	35.500	16.1	4.3	0.695	0.381	1.076	2.83	6.756	0.729	0.348
7	0.1892	35.500	16.1	5.4	0.687	0.392	1.079	2.75	6.745	0.736	0.344
8	0.2195	35.500	16.1	6.5	0.680	0.410	1.090	2.66	6.727	0.750	0.340
9	0.2500	35.400	16.0	7.6	0.668	0.415	1.083	2.61	6.722	0.749	0.334
10	0.2792	35.150	15.8	8.6	0.650	0.436	1.086	2.49	6.701	0.761	0.325
11	0.3105	35.100	15.7	9.7	0.640	0.451	1.091	2.42	6.686	0.771	0.320
12	0.3410	35.100	15.7	10.8	0.632	0.449	1.081	2.41	6.688	0.765	0.316
13	0.3703	35.100	15.7	11.9	0.625	0.457	1.082	2.37	6.680	0.769	0.312
14	0.4009	35.100	15.7	13.0	0.617	0.469	1.086	2.32	6.668	0.777	0.308
15	0.4204	34.730	15.3	13.7	0.597	0.489	1.086	2.22	6.648	0.788	0.299
16	0.4407	34.710	15.3	14.4	0.592	0.497	1.089	2.19	6.640	0.793	0.296
17	0.4580	34.690	15.3	15.0	0.587	0.510	1.097	2.15	6.627	0.803	0.293

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.430			147.490
Moisture content: Dry soil+tare, gms.	90.390			102.780
Moisture content: Tare, gms.	30.590			30.480
Moisture, %	61.9	62.0	61.8	61.8
Moist specimen weight, gms.	117.2			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.57	1.57	1.56	
Height, in.	2.79	2.79	2.79	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	102.2	102.2	102.3	
Dry density, pcf	63.1	63.1	63.2	
Void ratio	1.6802	1.6802	1.6745	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.130 tsf
 Consolidation back pressure = 5.625 tsf
 Consolidation effective confining stress = 1.505 tsf
 Peak Stress = 1.138 tsf at reading no. 4
 Ult. Stress = 0.750 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0354	19.860	0.0	0.0	0.000	1.505	1.505	1.00	5.625	1.505	0.000
1	0.0414	22.940	3.1	0.2	0.142	1.456	1.598	1.10	5.674	1.527	0.071
2	0.0551	28.220	8.4	0.7	0.382	1.385	1.767	1.28	5.745	1.576	0.191
3	0.0851	41.900	22.0	1.8	0.997	1.155	2.152	1.86	5.975	1.653	0.498
4	0.1145	45.300	25.4	2.8	1.138	0.926	2.064	2.23	6.204	1.495	0.569
5	0.1443	45.300	25.4	3.9	1.126	0.773	1.899	2.46	6.357	1.336	0.563
6	0.1764	43.900	24.0	5.1	1.051	0.861	1.912	2.22	6.269	1.386	0.525
7	0.2077	44.300	24.4	6.2	1.056	0.890	1.946	2.19	6.240	1.418	0.528
8	0.2380	44.500	24.6	7.3	1.052	0.902	1.954	2.17	6.228	1.428	0.526
9	0.2683	44.580	24.7	8.4	1.043	0.893	1.936	2.17	6.237	1.415	0.522
10	0.2989	44.870	25.0	9.5	1.043	0.900	1.943	2.16	6.230	1.421	0.521
11	0.3292	44.230	24.4	10.5	1.004	0.909	1.913	2.10	6.221	1.411	0.502
12	0.3597	42.500	22.6	11.6	0.921	0.913	1.834	2.01	6.217	1.374	0.461
13	0.3901	40.010	20.1	12.7	0.810	0.960	1.770	1.84	6.170	1.365	0.405
14	0.4195	39.290	19.4	13.8	0.771	0.980	1.751	1.79	6.150	1.366	0.386
15	0.4530	39.010	19.1	15.0	0.750	0.968	1.718	1.77	6.162	1.343	0.375

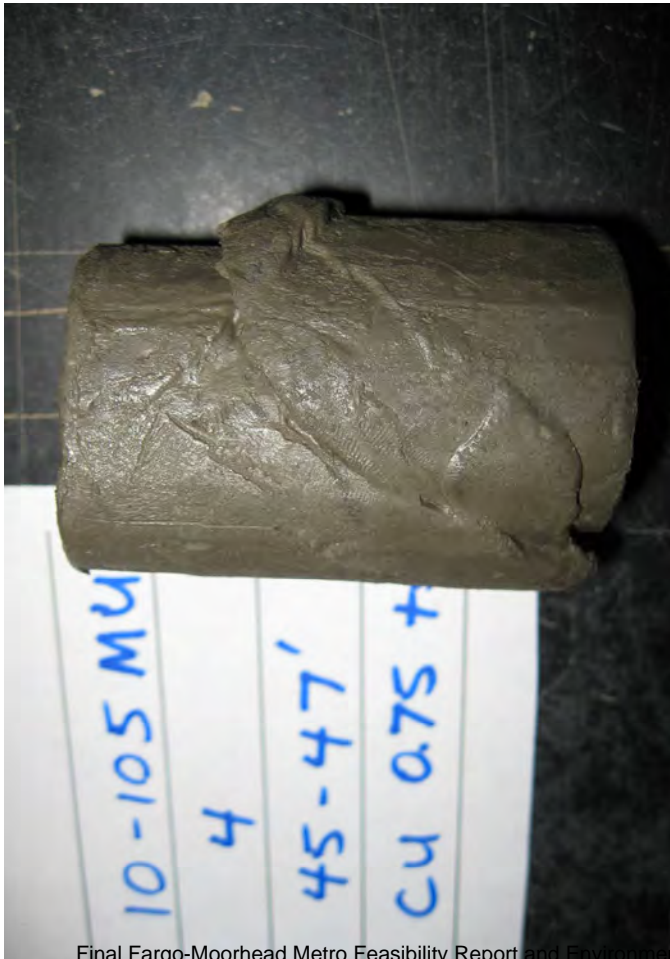
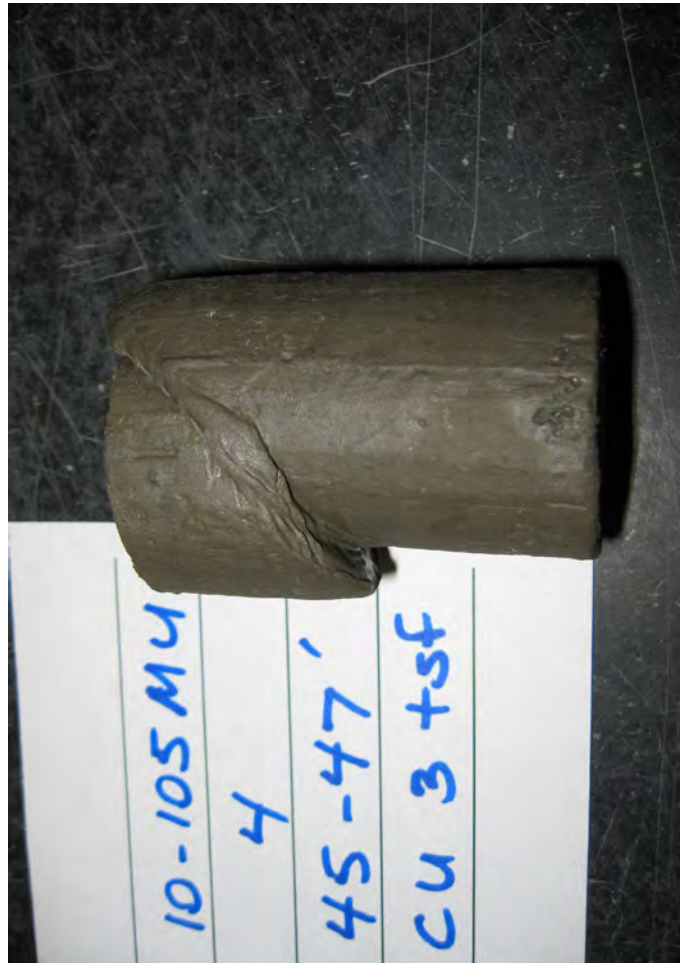
Parameters for Specimen No. 3

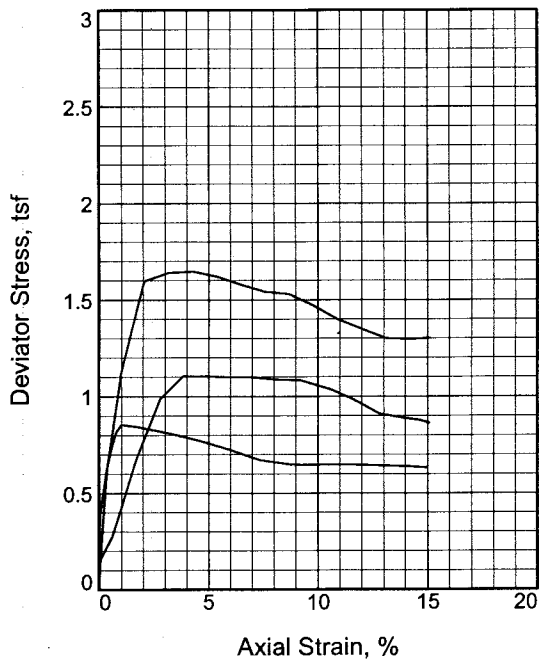
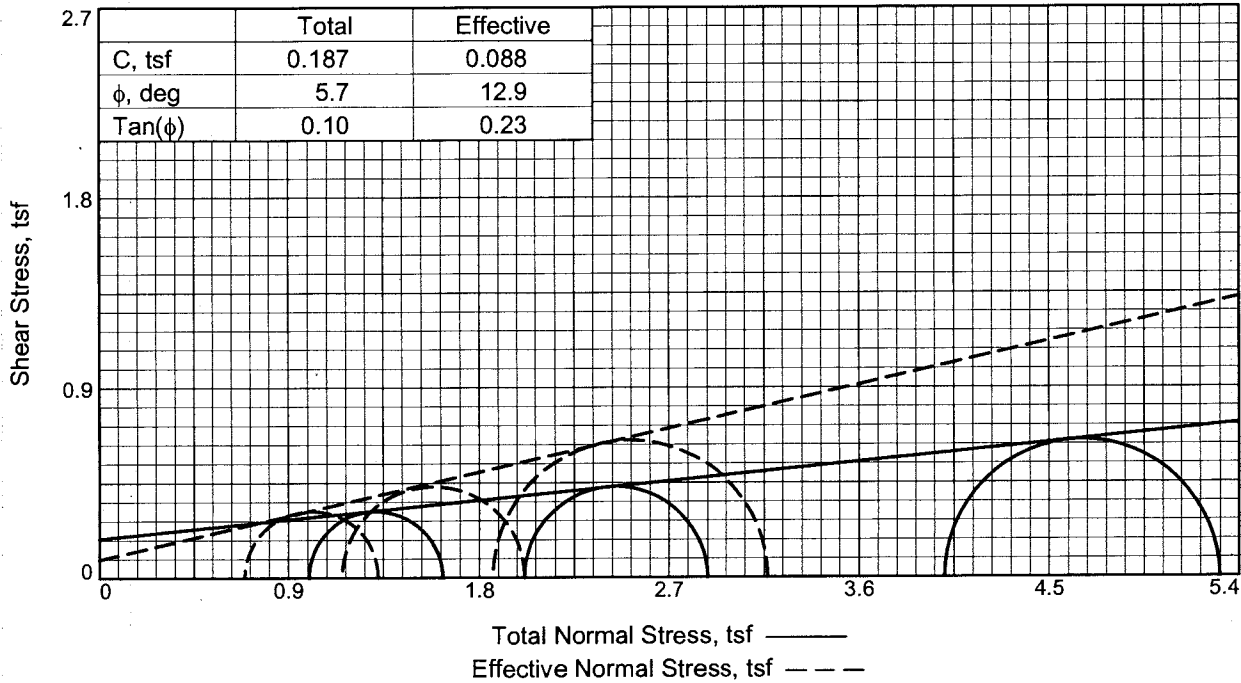
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	119.720			145.960
Moisture content: Dry soil+tare, gms.	85.630			102.860
Moisture content: Tare, gms.	30.280			30.250
Moisture, %	61.6	63.0	61.9	59.4
Moist specimen weight, gms.	118.6			
Diameter, in.	1.43	1.43	1.42	
Area, in. ²	1.60	1.60	1.59	
Height, in.	2.79	2.79	2.78	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	101.0	101.8	102.3	
Dry density, pcf	62.5	62.5	63.2	
Void ratio	1.7065	1.7065	1.6774	
Saturation, %	97.8	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.155 tsf
 Consolidation back pressure = 4.122 tsf
 Consolidation effective confining stress = 3.033 tsf
 Peak Stress = 1.728 tsf at reading no. 6
 Ult. Stress = 1.083 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0126	17.060	0.0	0.0	0.000	3.033	3.033	1.00	4.122	3.033	0.000
1	0.0147	21.510	4.5	0.1	0.201	2.976	3.177	1.07	4.179	3.077	0.101
2	0.0165	27.120	10.1	0.1	0.454	2.799	3.253	1.16	4.356	3.026	0.227
3	0.0295	43.700	26.6	0.6	1.197	2.246	3.443	1.53	4.909	2.845	0.599
4	0.0484	51.360	34.3	1.3	1.531	1.926	3.457	1.79	5.229	2.691	0.765
5	0.0703	55.720	38.7	2.1	1.712	1.759	3.471	1.97	5.396	2.615	0.856
6	0.0935	56.420	39.4	2.9	1.728	1.672	3.400	2.03	5.483	2.536	0.864
7	0.1172	52.030	35.0	3.8	1.522	1.705	3.227	1.89	5.450	2.466	0.761
8	0.1402	46.440	29.4	4.6	1.268	1.764	3.032	1.72	5.391	2.398	0.634
9	0.1629	46.900	29.8	5.4	1.276	1.754	3.030	1.73	5.401	2.392	0.638
10	0.1858	46.350	29.3	6.2	1.242	1.715	2.957	1.72	5.440	2.336	0.621
11	0.2086	46.600	29.5	7.0	1.242	1.688	2.930	1.74	5.467	2.309	0.621
12	0.2315	46.840	29.8	7.9	1.241	1.643	2.884	1.76	5.512	2.263	0.620
13	0.2554	46.810	29.8	8.7	1.228	1.606	2.834	1.76	5.549	2.220	0.614
14	0.2796	46.380	29.3	9.6	1.198	1.572	2.770	1.76	5.583	2.171	0.599
15	0.3044	46.050	29.0	10.5	1.173	1.542	2.715	1.76	5.613	2.129	0.587
16	0.3362	45.990	28.9	11.6	1.156	1.514	2.670	1.76	5.641	2.092	0.578
17	0.3531	44.800	27.7	12.2	1.101	1.502	2.603	1.73	5.653	2.052	0.550
18	0.3861	44.950	27.9	13.4	1.092	1.472	2.564	1.74	5.683	2.018	0.546
19	0.4110	45.100	28.0	14.3	1.086	1.441	2.527	1.75	5.714	1.984	0.543
20	0.4309	45.260	28.2	15.0	1.083	1.435	2.518	1.75	5.720	1.977	0.542





Sample No.	1	2	3	
Initial	Water Content, %	56.9	63.0	63.5
	Dry Density, pcf	66.4	61.9	61.5
	Saturation, %	99.9	98.8	98.7
	Void Ratio	1.5354	1.7193	1.7370
	Diameter, in.	1.41	1.41	1.39
	Height, in.	2.82	2.82	2.81
At Test	Water Content, %	55.9	61.6	61.1
	Dry Density, pcf	67.1	63.3	63.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.5085	1.6616	1.6498
	Diameter, in.	1.40	1.40	1.38
	Height, in.	2.81	2.80	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.00	2.01	4.00	
Back Pressure, tsf	6.13	5.12	3.13	
Cell Pressure, tsf	7.13	7.13	7.13	
Peak Deviator Stress, tsf	0.85	1.11	1.65	
Total Pore Pr., tsf	6.60	5.94	4.70	
Ultimate Deviator Stress, tsf	0.63	0.86	1.30	
Total Pore Pr., tsf	6.44	5.98	5.27	
Maj. Eff. Stress at Ultimate, tsf	1.33	2.02	3.17	
Min. Eff. Stress at Ultimate, tsf	0.69	1.15	1.86	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 91 PL= 25 PI= 66

Specific Gravity= 2.698

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

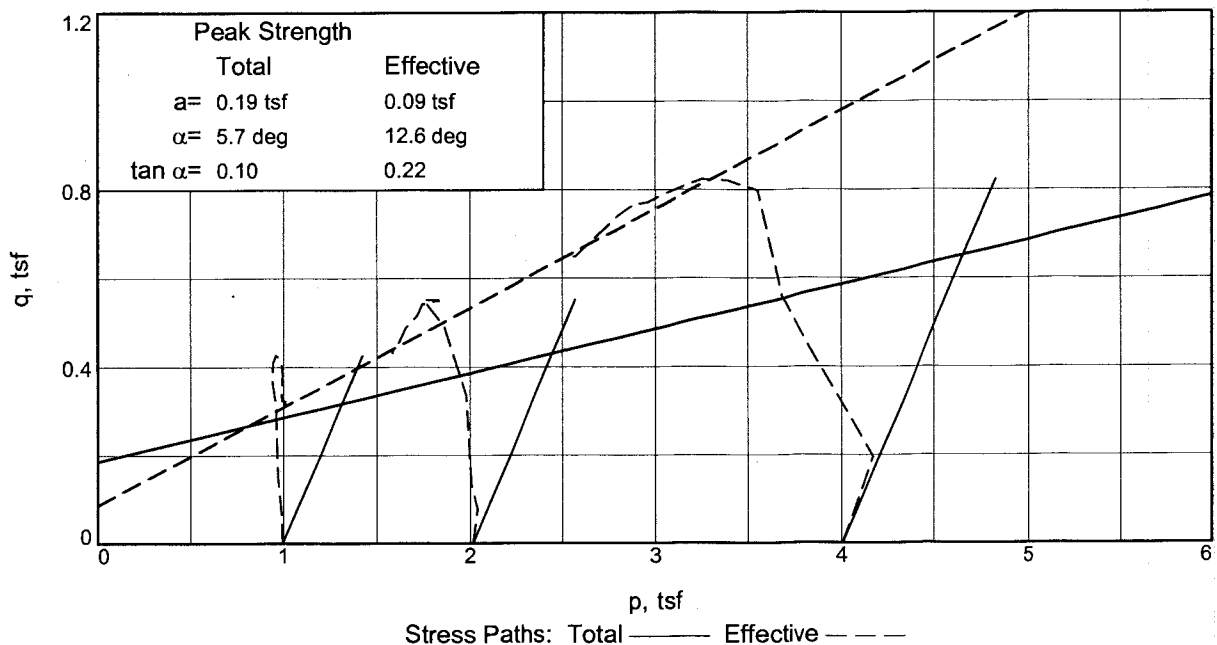
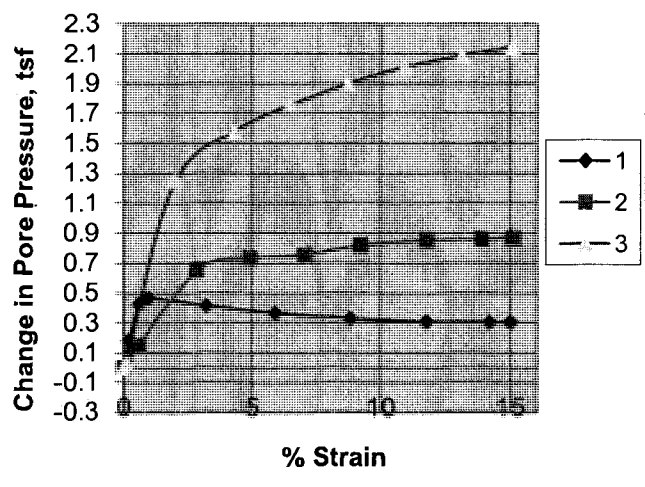
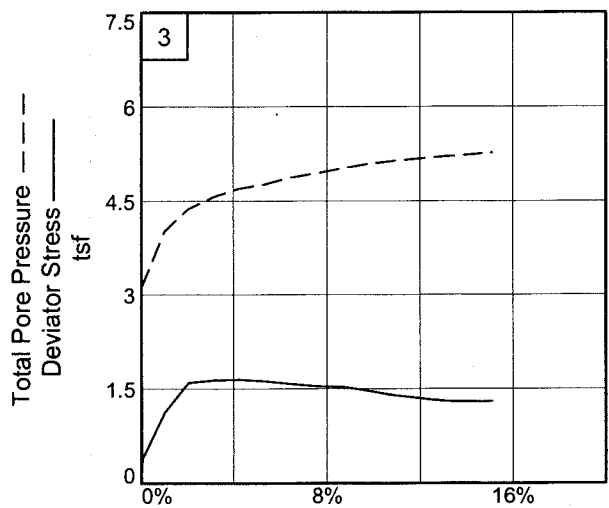
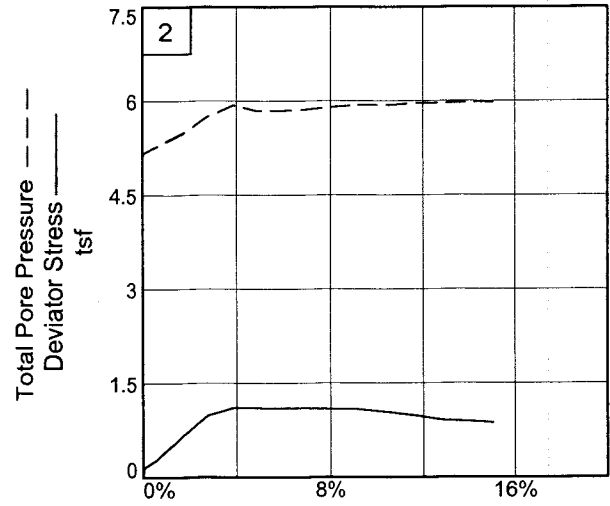
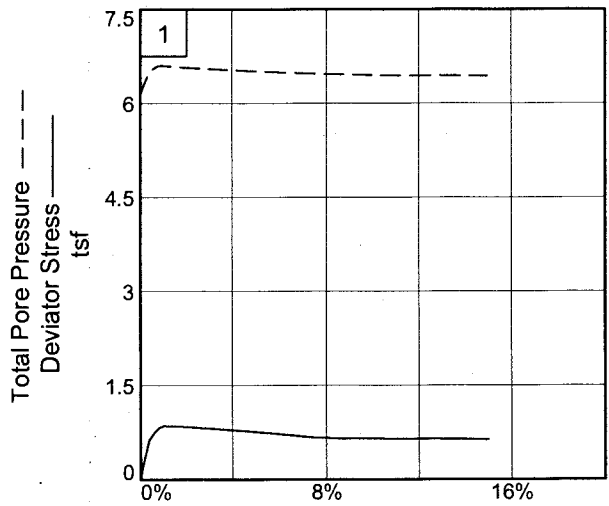
Location: Maple River, Argusville Formation

Sample Number: Boring10-105MU, #5 **Depth:** 55-57'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Argusville Formation

Depth: 55-57'

Sample No.: Boring10-105MU, #5

Project No.: B-10-0065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:46 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Argusville Formation
Depth: 55-57' **Sample Number:** Boring10-105MU, #5
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity: 2.698 **LL:** 91 **PL:** 25 **PI:** 66
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	108.780			149.920
Moisture content: Dry soil+tare, gms.	80.310			107.860
Moisture content: Tare, gms.	30.250			30.460
Moisture, %	56.9	56.9	55.9	54.3
Moist specimen weight, gms.	119.6			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.82	2.82	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	104.2	104.2	104.7	
Dry density, pcf	66.4	66.4	67.1	
Void ratio	1.5354	1.5354	1.5085	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.130 tsf
Consolidation back pressure = 6.134 tsf
Consolidation effective confining stress = 0.996 tsf
Peak Stress = 0.855 tsf at reading no. 6
Ult. Stress = 0.633 tsf at reading no. 17

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0110	19.770	0.0	0.0	0.000	0.996	0.996	1.00	6.134	0.996	0.000
1	0.0122	22.550	2.8	0.0	0.130	0.926	1.056	1.14	6.204	0.991	0.065
2	0.0154	26.390	6.6	0.2	0.309	0.815	1.124	1.38	6.315	0.970	0.155
3	0.0212	33.290	13.5	0.4	0.630	0.644	1.274	1.98	6.486	0.959	0.315
4	0.0271	35.640	15.9	0.6	0.738	0.571	1.309	2.29	6.559	0.940	0.369
5	0.0329	37.440	17.7	0.8	0.820	0.533	1.353	2.54	6.597	0.943	0.410
6	0.0390	38.230	18.5	1.0	0.855	0.531	1.386	2.61	6.599	0.958	0.427
7	0.0613	38.140	18.4	1.8	0.844	0.555	1.399	2.52	6.575	0.977	0.422
8	0.0997	37.680	17.9	3.2	0.811	0.584	1.395	2.39	6.546	0.990	0.406
9	0.1385	37.100	17.3	4.5	0.774	0.609	1.383	2.27	6.521	0.996	0.387
10	0.1774	36.280	16.5	5.9	0.726	0.631	1.357	2.15	6.499	0.994	0.363
11	0.2172	35.300	15.5	7.3	0.673	0.654	1.327	2.03	6.476	0.991	0.337
12	0.2582	35.000	15.2	8.8	0.650	0.668	1.318	1.97	6.462	0.993	0.325
13	0.2992	35.210	15.4	10.3	0.648	0.678	1.326	1.96	6.452	1.002	0.324
14	0.3399	35.430	15.7	11.7	0.647	0.689	1.336	1.94	6.441	1.012	0.323
15	0.3672	35.550	15.8	12.7	0.644	0.686	1.330	1.94	6.444	1.008	0.322
16	0.4087	35.670	15.9	14.2	0.638	0.693	1.331	1.92	6.437	1.012	0.319
17	0.4328	35.700	15.9	15.0	0.633	0.693	1.326	1.91	6.437	1.010	0.317

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.890			156.540
Moisture content: Dry soil+tare, gms.	89.720			110.000
Moisture content: Tare, gms.	30.680			30.290
Moisture, %	63.0	63.7	61.6	58.4
Moist specimen weight, gms.	115.9			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.53	
Height, in.	2.82	2.82	2.80	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	100.9	101.4	102.3	
Dry density, pcf	61.9	61.9	63.3	
Void ratio	1.7193	1.7193	1.6616	
Saturation, %	98.8	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.134 tsf
 Consolidation back pressure = 5.118 tsf
 Consolidation effective confining stress = 2.016 tsf
 Peak Stress = 1.106 tsf at reading no. 5
 Ult. Stress = 0.864 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0404	20.630	0.0	0.0	0.000	2.016	2.016	1.00	5.118	2.016	0.000
1	0.0423	23.980	3.4	0.1	0.157	1.961	2.118	1.08	5.173	2.040	0.079
2	0.0568	26.480	5.9	0.6	0.274	1.868	2.142	1.15	5.266	2.005	0.137
3	0.0874	35.170	14.5	1.7	0.672	1.643	2.315	1.41	5.491	1.979	0.336
4	0.1177	42.220	21.6	2.8	0.988	1.370	2.358	1.72	5.764	1.864	0.494
5	0.1479	45.070	24.4	3.8	1.106	1.198	2.304	1.92	5.936	1.751	0.553
6	0.1773	45.300	24.7	4.9	1.104	1.283	2.387	1.86	5.851	1.835	0.552
7	0.2076	45.480	24.8	6.0	1.099	1.286	2.385	1.85	5.848	1.836	0.550
8	0.2368	45.750	25.1	7.0	1.099	1.264	2.363	1.87	5.870	1.813	0.549
9	0.2671	45.770	25.1	8.1	1.087	1.231	2.318	1.88	5.903	1.774	0.543
10	0.2978	46.030	25.4	9.2	1.085	1.201	2.286	1.90	5.933	1.743	0.542
11	0.3379	45.220	24.6	10.6	1.034	1.199	2.233	1.86	5.935	1.716	0.517
12	0.3685	44.190	23.6	11.7	0.978	1.167	2.145	1.84	5.967	1.656	0.489
13	0.3985	42.810	22.2	12.8	0.910	1.162	2.072	1.78	5.972	1.617	0.455
14	0.4290	42.590	22.0	13.9	0.889	1.159	2.048	1.77	5.975	1.604	0.445
15	0.4494	42.500	21.9	14.6	0.878	1.150	2.028	1.76	5.984	1.589	0.439
16	0.4620	42.260	21.6	15.1	0.864	1.152	2.016	1.75	5.982	1.584	0.432

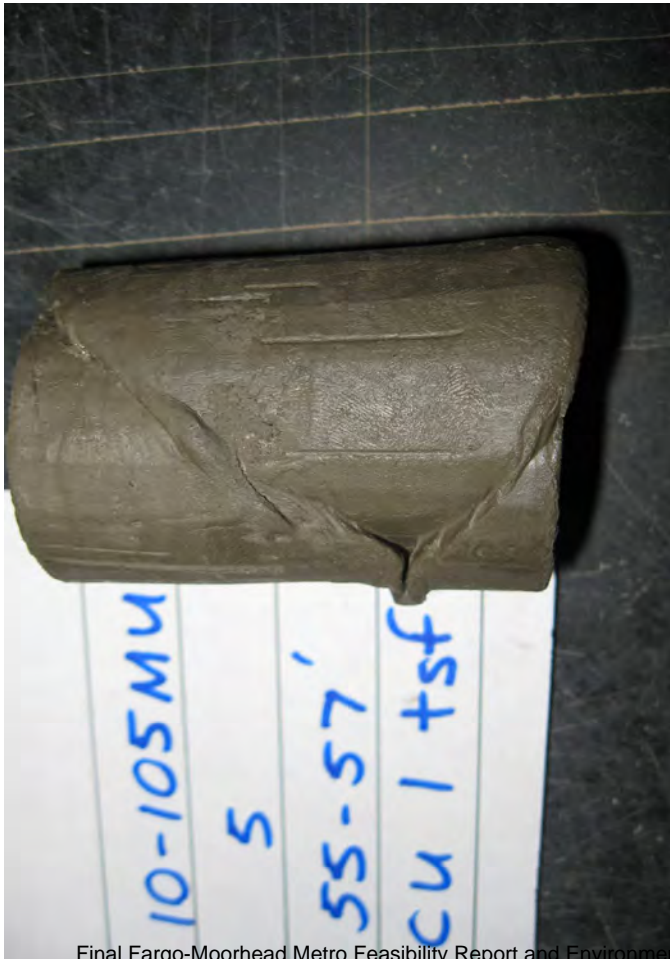
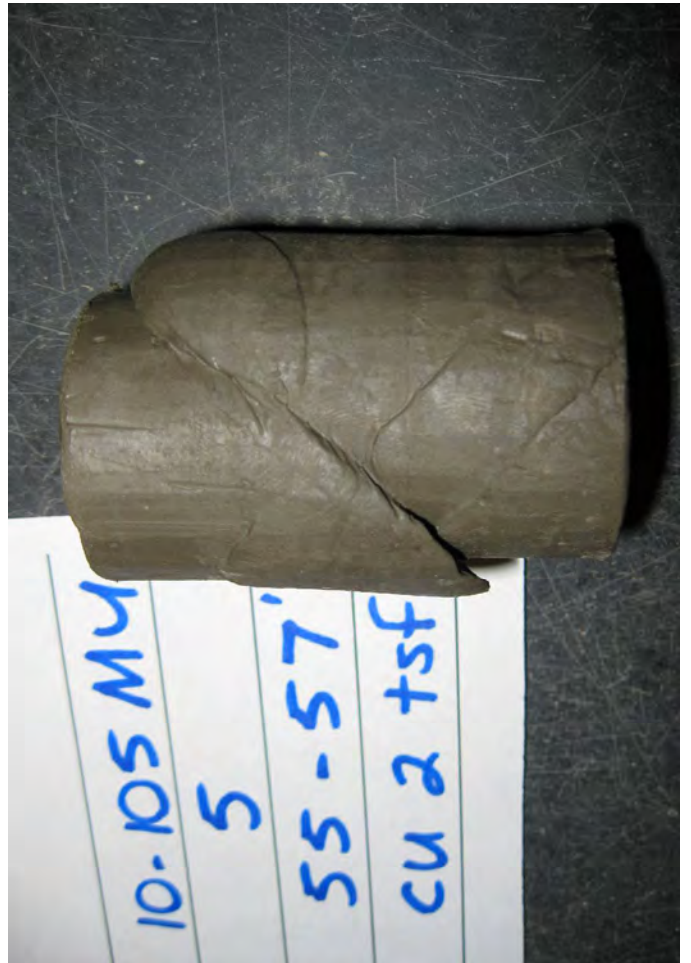
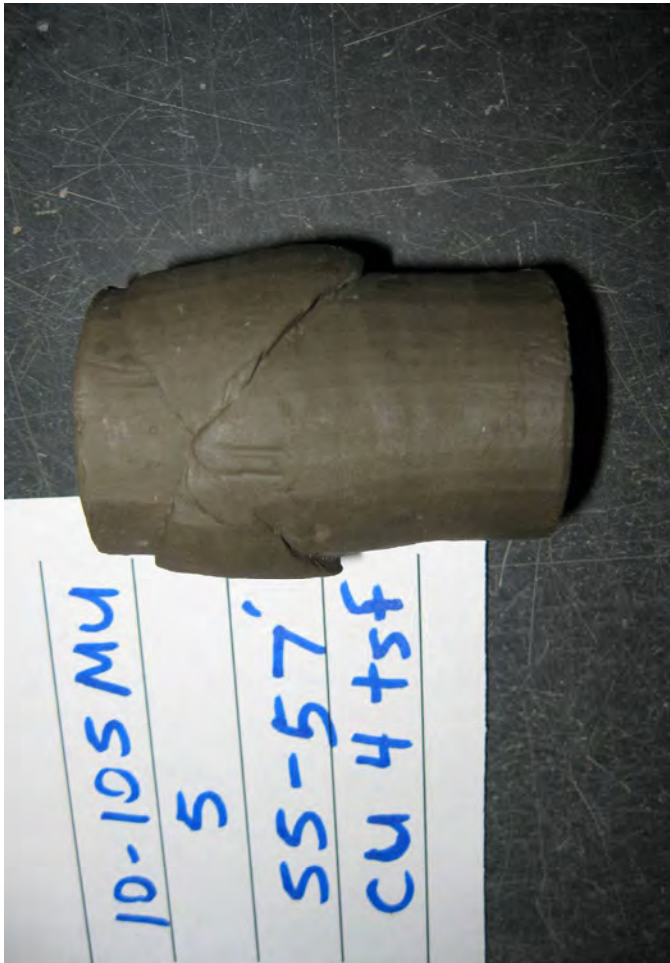
Parameters for Specimen No. 3

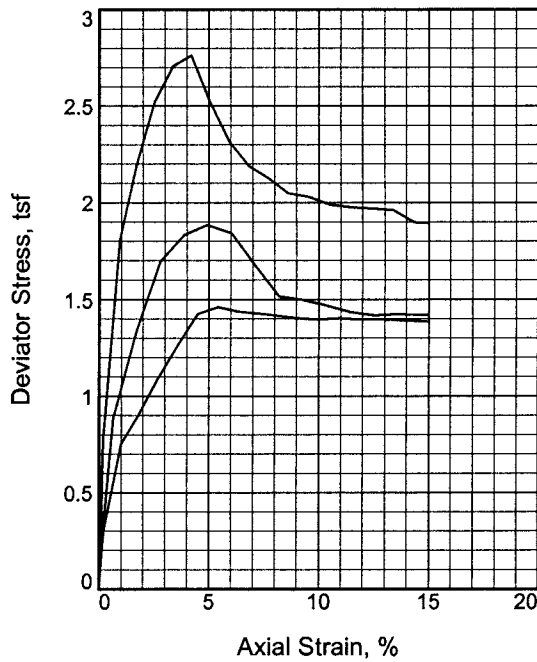
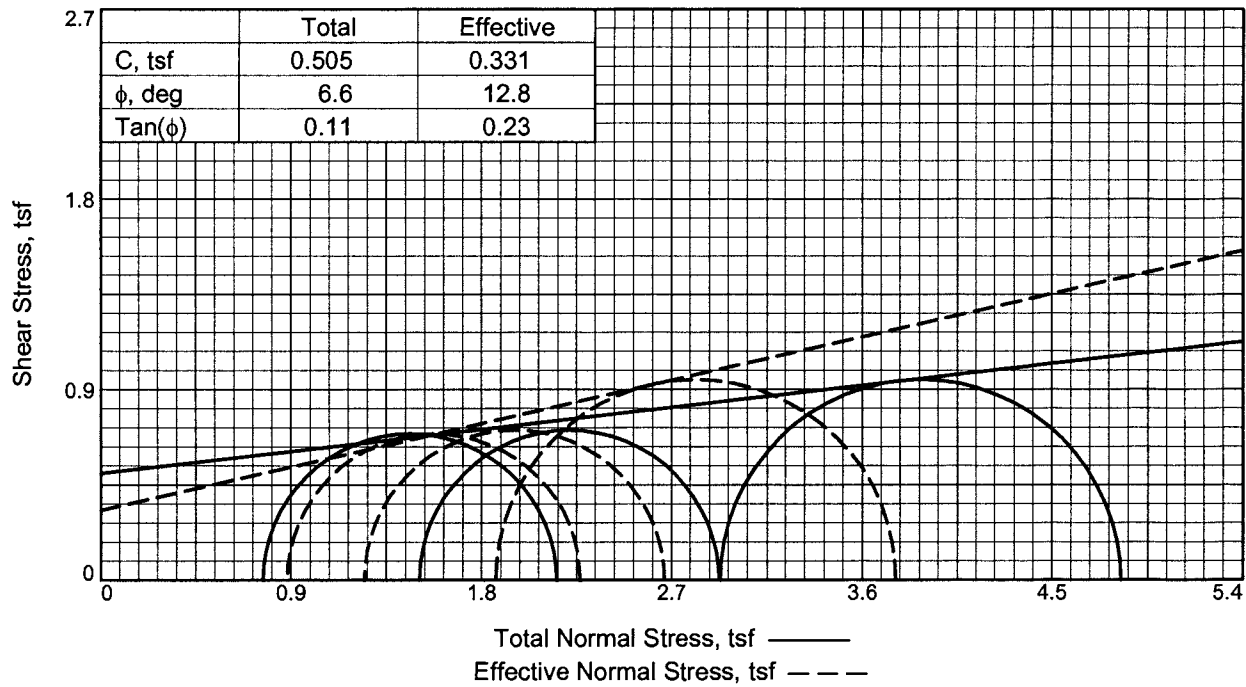
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	116.950			157.150
Moisture content: Dry soil+tare, gms.	83.290			110.510
Moisture content: Tare, gms.	30.310			30.270
Moisture, %	63.5	64.4	61.1	58.1
Moist specimen weight, gms.	113.1			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.53	1.53	1.49	
Height, in.	2.81	2.81	2.78	
Net decrease in height, in.		0.00	0.03	
Wet Density, pcf	100.6	101.2	102.4	
Dry density, pcf	61.5	61.5	63.6	
Void ratio	1.7370	1.7370	1.6498	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.132 tsf
 Consolidation back pressure = 3.126 tsf
 Consolidation effective confining stress = 4.006 tsf
 Peak Stress = 1.647 tsf at reading no. 6
 Ult. Stress = 1.302 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0304	17.650	0.0	0.0	0.000	4.006	4.006	1.00	3.126	4.006	0.000
1	0.0305	22.500	4.9	0.0	0.234	3.987	4.221	1.06	3.145	4.104	0.117
2	0.0318	25.810	8.2	0.1	0.393	3.973	4.366	1.10	3.159	4.170	0.197
3	0.0580	41.170	23.5	1.0	1.123	3.112	4.235	1.36	4.020	3.673	0.561
4	0.0870	51.470	33.8	2.0	1.597	2.755	4.352	1.58	4.377	3.554	0.799
5	0.1175	52.790	35.1	3.1	1.641	2.563	4.204	1.64	4.569	3.383	0.820
6	0.1490	53.350	35.7	4.3	1.647	2.431	4.078	1.68	4.701	3.255	0.824
7	0.1792	53.190	35.5	5.4	1.621	2.364	3.985	1.69	4.768	3.175	0.811
8	0.2106	52.690	35.0	6.5	1.579	2.250	3.829	1.70	4.882	3.040	0.790
9	0.2408	52.270	34.6	7.6	1.542	2.190	3.732	1.70	4.942	2.961	0.771
10	0.2714	52.440	34.8	8.7	1.531	2.111	3.642	1.73	5.021	2.877	0.766
11	0.3018	51.470	33.8	9.8	1.471	2.044	3.515	1.72	5.088	2.779	0.735
12	0.3323	50.220	32.6	10.9	1.399	1.997	3.396	1.70	5.135	2.697	0.700
13	0.3615	49.470	31.8	11.9	1.351	1.960	3.311	1.69	5.172	2.635	0.675
14	0.3938	48.670	31.0	13.1	1.300	1.922	3.222	1.68	5.210	2.572	0.650
15	0.4262	49.030	31.4	14.3	1.297	1.892	3.189	1.69	5.240	2.540	0.648
16	0.4500	49.480	31.8	15.1	1.302	1.864	3.166	1.70	5.268	2.515	0.651





Sample No.		1	2	3
Initial	Water Content, %	32.6	35.8	36.1
	Dry Density, pcf	88.5	84.5	85.0
	Saturation, %	97.9	98.0	99.8
	Void Ratio	0.8917	0.9797	0.9695
	Diameter, in.	1.40	1.38	1.40
	Height, in.	2.81	2.80	2.80
At Test	Water Content, %	33.3	36.5	35.5
	Dry Density, pcf	88.5	84.5	85.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8917	0.9797	0.9527
	Diameter, in.	1.40	1.38	1.39
	Height, in.	2.81	2.80	2.79
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.77	1.50	2.94
Back Pressure, tsf		6.37	5.66	4.15
Cell Pressure, tsf		7.14	7.16	7.09
Peak Deviator Stress, tsf		1.46	1.89	2.76
Total Pore Pr., tsf		6.51	6.38	5.32
Ultimate Deviator Stress, tsf		1.38	1.42	1.89
Total Pore Pr., tsf		6.26	5.92	5.22
Maj. Eff. Stress at Ultimate, tsf		2.27	2.66	3.76
Min. Eff. Stress at Ultimate, tsf		0.88	1.25	1.87

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 60

PL= 18

PI= 42

Specific Gravity= 2.681

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Argusville Formation

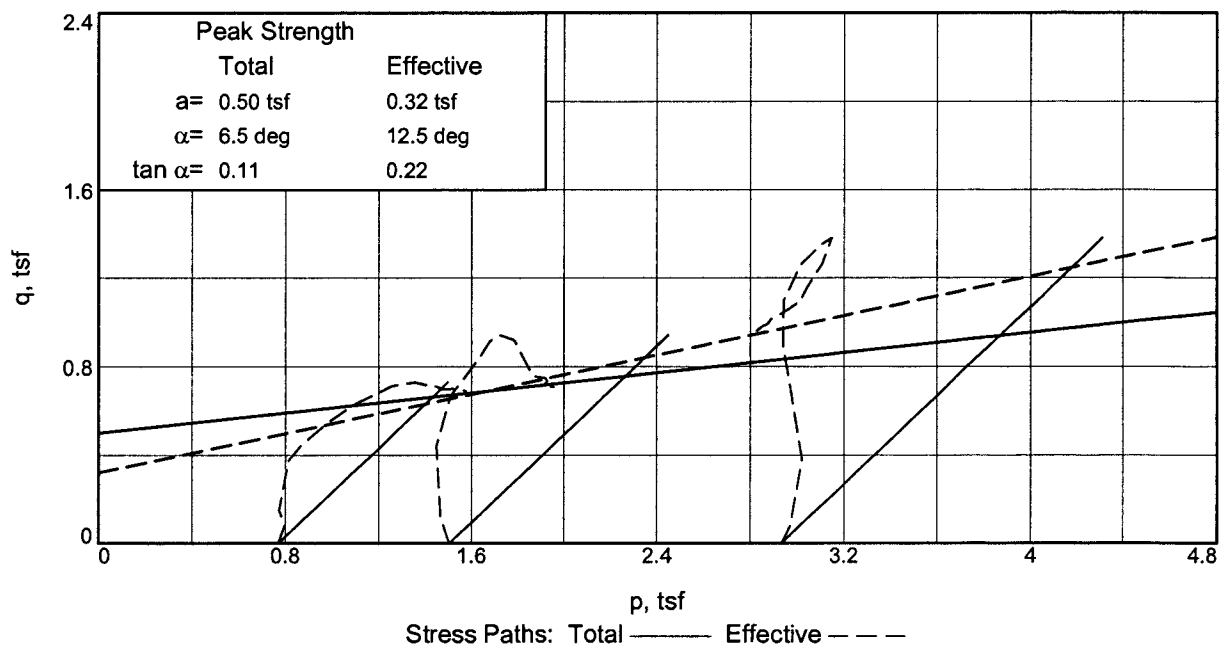
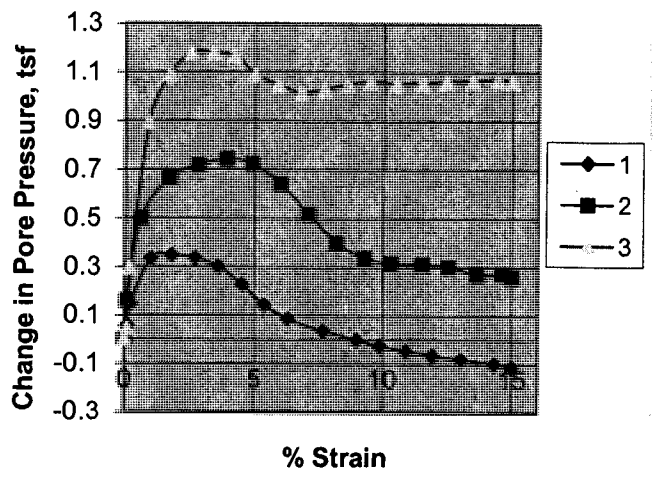
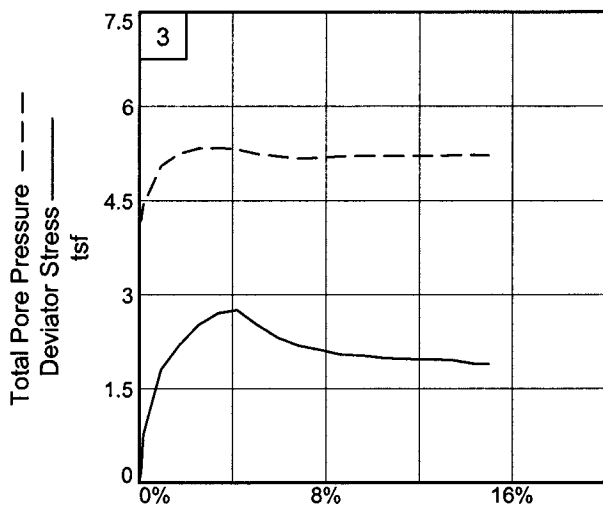
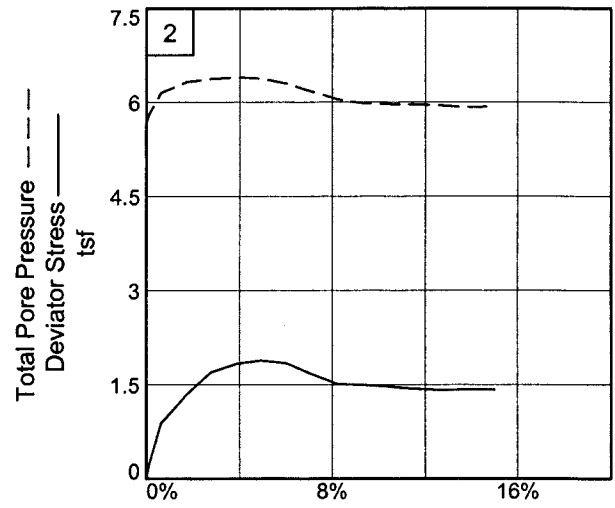
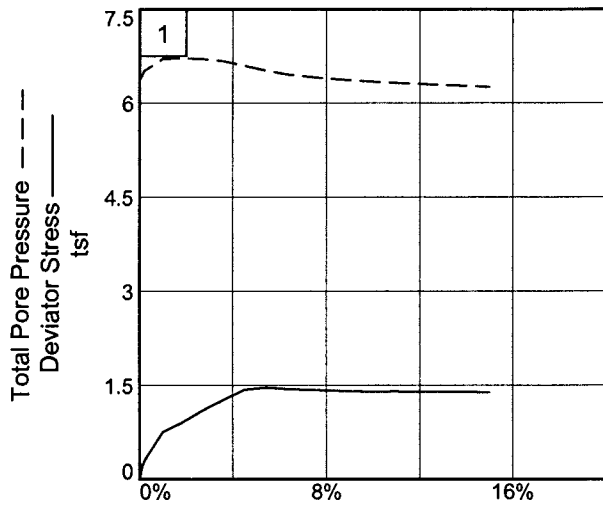
Sample Number: Boring11-107MU, #3

Depth: 40-42'

Proj. No.: BL-10-10065

Date Sampled:

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Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Argusville Formation

Depth: 40-42'

Sample No.: Boring11-107MU, #3

Project No.: BL-10-10065
Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

6/16/2011

10:48 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Argusville Formation
Depth: 40-42' **Sample Number:** Boring11-107MU, #3
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.681 **LL**=60 **PL**=18 **PI**=42
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.800			165.710
Moisture content: Dry soil+tare, gms.	103.710			131.290
Moisture content: Tare, gms.	29.750			31.160
Moisture, %	32.6	33.3	33.3	34.4
Moist specimen weight, gms.	133.2			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	117.3	117.9	117.9	
Dry density, pcf	88.5	88.5	88.5	
Void ratio	0.8917	0.8917	0.8917	
Saturation, %	97.9	100.0	100.0	

Test Results for Specimen No. 1

Consolidation cell pressure = 7.141 tsf
Consolidation back pressure = 6.372 tsf
Consolidation effective confining stress = 0.769 tsf
Peak Stress = 1.460 tsf at reading no. 8
Ult. Stress = 1.385 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0127	21.840	0.0	0.0	0.000	0.769	0.769	1.00	6.372	0.769	0.000
1	0.0154	25.480	3.6	0.1	0.170	0.713	0.883	1.24	6.428	0.798	0.085
2	0.0183	28.280	6.4	0.2	0.300	0.623	0.923	1.48	6.518	0.773	0.150
3	0.0404	38.110	16.3	1.0	0.752	0.436	1.188	2.73	6.705	0.812	0.376
4	0.0633	41.530	19.7	1.8	0.903	0.422	1.325	3.14	6.719	0.874	0.452
5	0.0880	45.890	24.1	2.7	1.093	0.433	1.526	3.52	6.708	0.980	0.547
6	0.1141	50.010	28.2	3.6	1.268	0.468	1.736	3.71	6.673	1.102	0.634
7	0.1389	53.830	32.0	4.5	1.427	0.543	1.970	3.63	6.598	1.256	0.713
8	0.1648	54.900	33.1	5.4	1.460	0.626	2.086	3.33	6.515	1.356	0.730
9	0.1908	54.710	32.9	6.3	1.438	0.684	2.122	3.10	6.457	1.403	0.719
10	0.2275	54.840	33.0	7.7	1.423	0.735	2.158	2.94	6.406	1.447	0.712
11	0.2644	54.870	33.0	9.0	1.404	0.771	2.175	2.82	6.370	1.473	0.702
12	0.2913	55.020	33.2	9.9	1.396	0.797	2.193	2.75	6.344	1.495	0.698
13	0.3195	55.580	33.7	10.9	1.404	0.817	2.221	2.72	6.324	1.519	0.702
14	0.3471	55.790	34.0	11.9	1.397	0.834	2.231	2.67	6.307	1.532	0.698
15	0.3762	56.200	34.4	13.0	1.397	0.850	2.247	2.64	6.291	1.548	0.698
16	0.4149	56.580	34.7	14.3	1.390	0.869	2.259	2.60	6.272	1.564	0.695
17	0.4339	56.730	34.9	15.0	1.385	0.883	2.268	2.57	6.258	1.575	0.692

Parameters of Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	144.510			157.640
Moisture content: Dry soil+tare, gms.	114.410			122.550
Moisture content: Tare, gms.	30.390			30.310
Moisture, %	35.8	36.5	36.5	38.0
Moist specimen weight, gms.	126.8			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.50	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.8	115.4	115.4	
Dry density, pcf	84.5	84.5	84.5	
Void ratio	0.9797	0.9797	0.9797	
Saturation, %	98.0	100.0	100.0	

Parameters of Specimen No. 2

Consolidation cell pressure = 7.163 tsf
 Consolidation back pressure = 5.657 tsf
 Consolidation effective confining stress = 1.506 tsf
 Peak Stress = 1.885 tsf at reading no. 6
 Ult. Stress = 1.419 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0439	18.360	0.0	0.0	0.000	1.506	1.506	1.00	5.657	1.506	0.000
1	0.0477	23.430	5.1	0.1	0.243	1.346	1.589	1.18	5.817	1.467	0.121
2	0.0616	36.900	18.5	0.6	0.883	1.008	1.891	1.88	6.155	1.449	0.441
3	0.0918	46.780	28.4	1.7	1.339	0.842	2.181	2.59	6.321	1.511	0.669
4	0.1220	54.790	36.4	2.8	1.697	0.790	2.487	3.15	6.373	1.639	0.849
5	0.1525	58.140	39.8	3.9	1.833	0.764	2.597	3.40	6.399	1.680	0.916
6	0.1818	59.730	41.4	4.9	1.885	0.784	2.669	3.40	6.379	1.727	0.943
7	0.2131	59.250	40.9	6.0	1.841	0.866	2.707	3.13	6.297	1.787	0.921
8	0.2433	55.940	37.6	7.1	1.673	0.989	2.662	2.69	6.174	1.825	0.836
9	0.2736	52.810	34.5	8.2	1.516	1.108	2.624	2.37	6.055	1.866	0.758
10	0.3031	52.820	34.5	9.3	1.499	1.170	2.669	2.28	5.993	1.919	0.749
11	0.3335	52.570	34.2	10.3	1.470	1.193	2.663	2.23	5.970	1.928	0.735
12	0.3649	52.180	33.8	11.5	1.435	1.195	2.630	2.20	5.968	1.913	0.718
13	0.3950	52.190	33.8	12.5	1.418	1.205	2.623	2.18	5.958	1.914	0.709
14	0.4236	52.730	34.4	13.6	1.424	1.237	2.661	2.15	5.926	1.949	0.712
15	0.4540	53.080	34.7	14.6	1.420	1.234	2.654	2.15	5.929	1.944	0.710
16	0.4640	53.190	34.8	15.0	1.419	1.246	2.665	2.14	5.917	1.955	0.709

Consolidation of Specimen No. 5

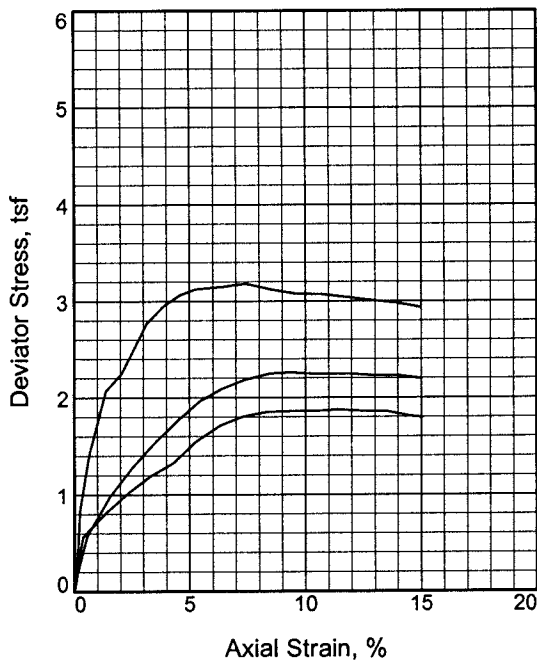
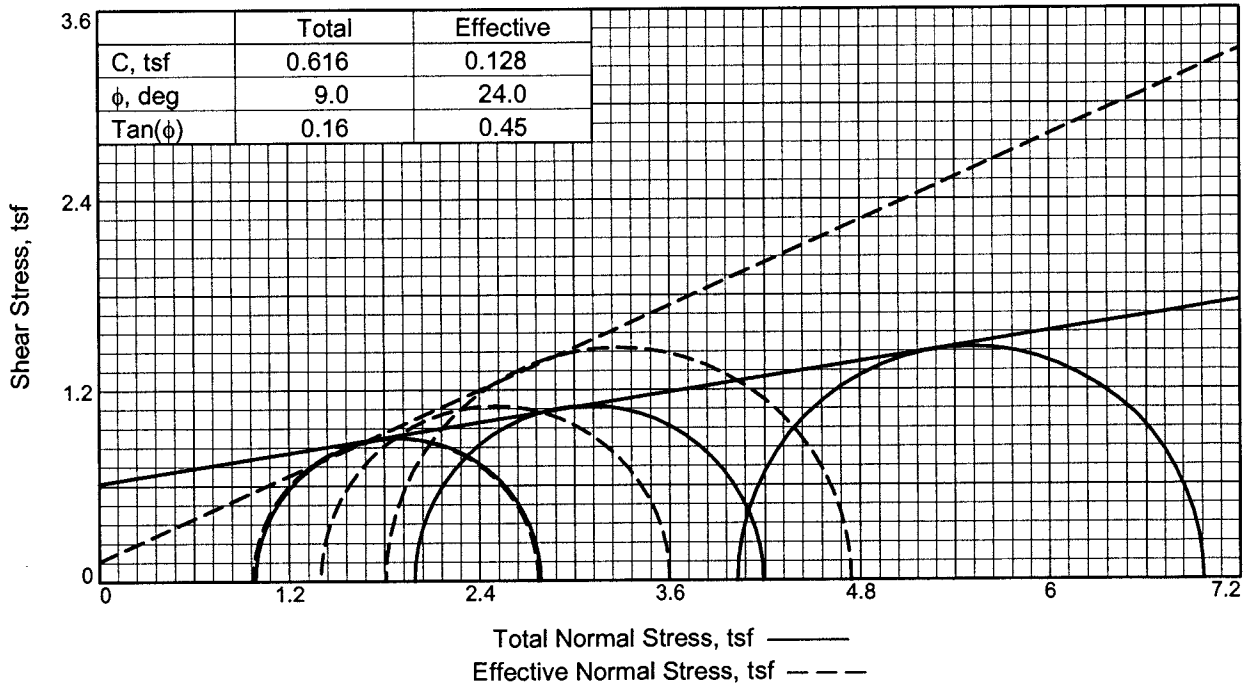
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	111.930			160.120
Moisture content: Dry soil+tare, gms.	90.320			126.830
Moisture content: Tare, gms.	30.460			30.420
Moisture, %	36.1	36.2	35.5	34.5
Moist specimen weight, gms.	130.6			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	115.7	115.7	116.2	
Dry density, pcf	85.0	85.0	85.7	
Void ratio	0.9695	0.9695	0.9527	
Saturation, %	99.8	100.0	100.0	

Consolidation of Specimen No. 6

Consolidation cell pressure = 7.086 tsf
 Consolidation back pressure = 4.154 tsf
 Consolidation effective confining stress = 2.932 tsf
 Peak Stress = 2.763 tsf at reading no. 7
 Ult. Stress = 1.894 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0074	18.550	0.0	0.0	0.000	2.932	2.932	1.00	4.154	2.932	0.000
1	0.0094	22.000	3.4	0.1	0.163	2.889	3.052	1.06	4.197	2.970	0.081
2	0.0123	34.880	16.3	0.2	0.769	2.637	3.406	1.29	4.449	3.022	0.385
3	0.0332	57.070	38.5	0.9	1.800	2.037	3.837	1.88	5.049	2.937	0.900
4	0.0552	65.890	47.3	1.7	2.195	1.843	4.038	2.19	5.243	2.941	1.098
5	0.0780	73.360	54.8	2.5	2.520	1.754	4.274	2.44	5.332	3.014	1.260
6	0.1018	77.970	59.4	3.4	2.708	1.752	4.460	2.55	5.334	3.106	1.354
7	0.1249	79.680	61.1	4.2	2.763	1.765	4.528	2.57	5.321	3.146	1.381
8	0.1483	74.950	56.4	5.0	2.527	1.842	4.369	2.37	5.244	3.105	1.263
9	0.1731	70.740	52.2	5.9	2.316	1.885	4.201	2.23	5.201	3.043	1.158
10	0.1984	68.390	49.8	6.8	2.190	1.917	4.107	2.14	5.169	3.012	1.095
11	0.2235	67.380	48.8	7.7	2.125	1.903	4.028	2.12	5.183	2.966	1.063
12	0.2482	66.100	47.5	8.6	2.050	1.883	3.933	2.09	5.203	2.908	1.025
13	0.2742	66.130	47.6	9.5	2.030	1.873	3.903	2.08	5.213	2.888	1.015
14	0.3012	65.670	47.1	10.5	1.989	1.879	3.868	2.06	5.207	2.874	0.995
15	0.3281	65.860	47.3	11.5	1.976	1.877	3.853	2.05	5.209	2.865	0.988
16	0.3550	66.220	47.7	12.4	1.969	1.871	3.840	2.05	5.215	2.856	0.985
17	0.3821	66.560	48.0	13.4	1.961	1.868	3.829	2.05	5.218	2.849	0.981
18	0.4088	65.520	47.0	14.4	1.897	1.861	3.758	2.02	5.225	2.810	0.949
19	0.4268	65.790	47.2	15.0	1.894	1.867	3.761	2.01	5.219	2.814	0.947





Sample No.	1	2	3	
Initial	Water Content, %	36.8	37.0	37.3
	Dry Density, pcf	84.0	84.1	84.0
	Saturation, %	98.5	99.3	99.9
	Void Ratio	1.0100	1.0076	1.0099
	Diameter, in.	1.38	1.38	1.39
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	37.3	36.9	36.1
	Dry Density, pcf	84.0	84.6	85.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0100	0.9968	0.9777
	Diameter, in.	1.38	1.38	1.38
	Height, in.	2.80	2.80	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.98	1.99	4.04	
Back Pressure, tsf	6.13	5.15	3.09	
Cell Pressure, tsf	7.11	7.14	7.13	
Peak Deviator Stress, tsf	1.88	2.26	3.18	
Total Pore Pr., tsf	6.25	5.80	5.14	
Ultimate Deviator Stress, tsf	1.80	2.20	2.93	
Total Pore Pr., tsf	6.14	5.74	5.32	
Maj. Eff. Stress at Ultimate, tsf	2.77	3.60	4.74	
Min. Eff. Stress at Ultimate, tsf	0.97	1.40	1.81	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 63

PL= 19

PI= 44

Specific Gravity= 2.705

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Argusville Formation

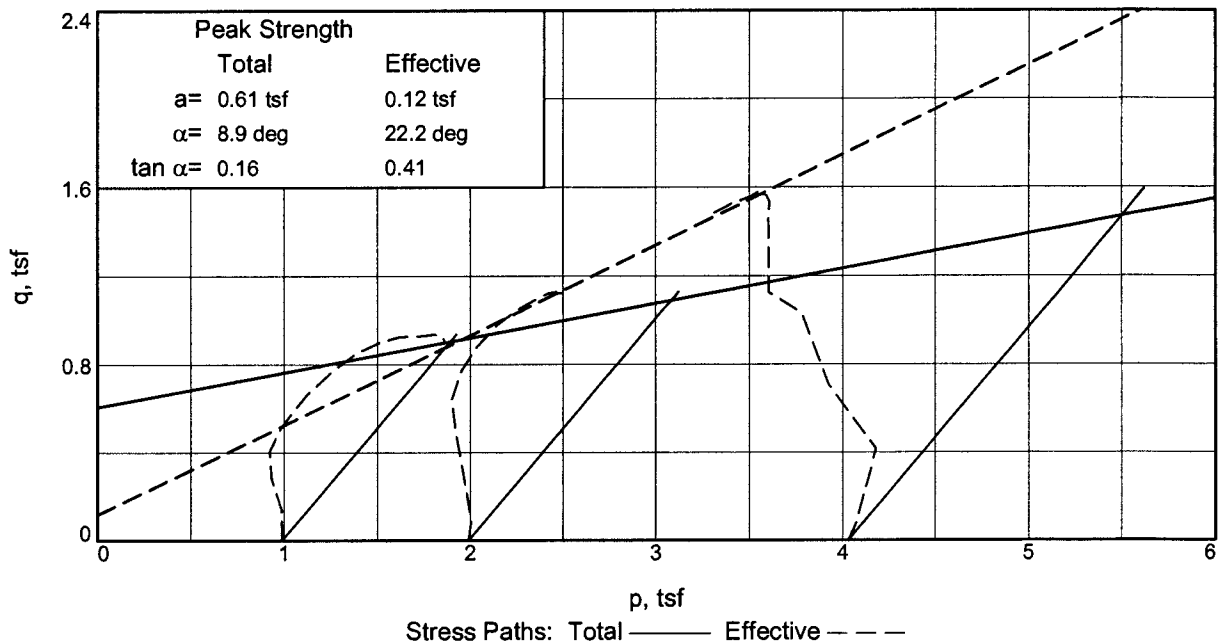
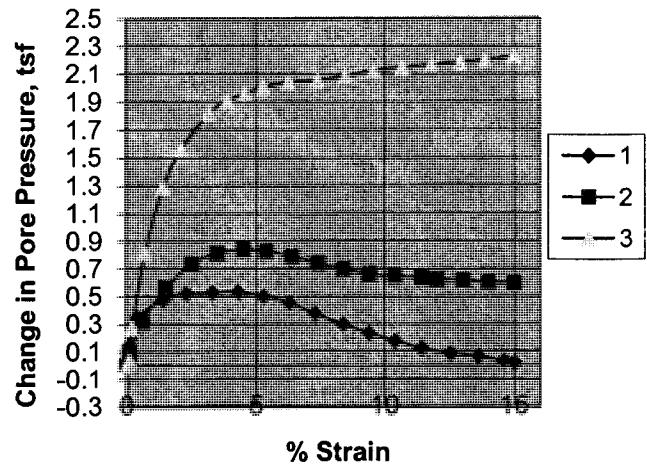
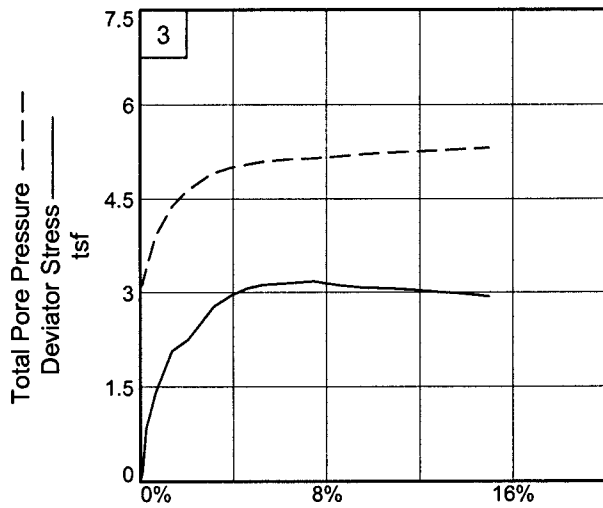
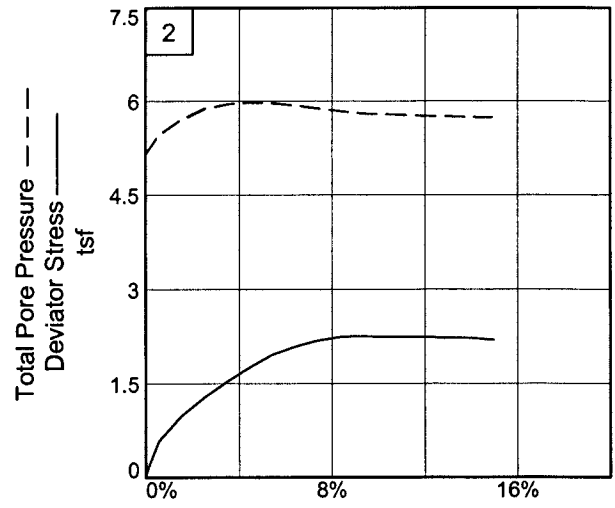
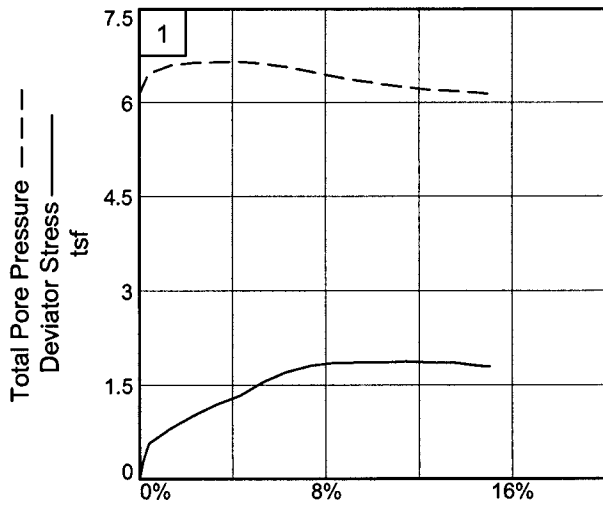
Sample Number: Boring11-107MU, #4

Depth: 50-52'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Argusville Formation

Depth: 50-52'

Sample No.: Boring11-107MU, #4

Project No.: BL10-0065

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

6/16/2011

10:49 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Argusville Formation
Depth: 50-52' **Sample Number:** Boring11-107MU, #4
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.705 **LL**=63 **PL**=19 **PI**=44
Test Method: COE uniform strain

Table of Soil Properties

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	125.620			155.650
Moisture content: Dry soil+tare, gms.	99.920			120.860
Moisture content: Tare, gms.	30.070			30.280
Moisture, %	36.8	37.3	37.3	38.4
Moist specimen weight, gms.	125.5			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.48	1.48	1.48	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.9	115.4	115.4	
Dry density, pcf	84.0	84.0	84.0	
Void ratio	1.0100	1.0100	1.0100	
Saturation, %	98.5	100.0	100.0	

Table of Test Results

Consolidation cell pressure = 7.113 tsf
Consolidation back pressure = 6.125 tsf
Consolidation effective confining stress = 0.988 tsf
Peak Stress = 1.877 tsf at reading no. 13
Ult. Stress = 1.798 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0062	17.850	0.0	0.0	0.000	0.988	0.988	1.00	6.125	0.988	0.000
1	0.0103	23.740	5.9	0.1	0.285	0.844	1.129	1.34	6.269	0.987	0.143
2	0.0172	29.630	11.8	0.4	0.569	0.647	1.216	1.88	6.466	0.931	0.284
3	0.0442	34.820	17.0	1.4	0.812	0.515	1.327	2.58	6.598	0.921	0.406
4	0.0719	39.390	21.5	2.3	1.020	0.471	1.491	3.17	6.642	0.981	0.510
5	0.0988	43.270	25.4	3.3	1.192	0.462	1.654	3.58	6.651	1.058	0.596
6	0.1267	46.500	28.6	4.3	1.329	0.457	1.786	3.91	6.656	1.122	0.665
7	0.1536	51.450	33.6	5.3	1.543	0.489	2.032	4.16	6.624	1.261	0.772
8	0.1824	55.450	37.6	6.3	1.708	0.538	2.246	4.18	6.575	1.392	0.854
9	0.2115	58.070	40.2	7.3	1.807	0.617	2.424	3.93	6.496	1.521	0.904
10	0.2403	59.570	41.7	8.4	1.854	0.694	2.548	3.67	6.419	1.621	0.927
11	0.2681	60.150	42.3	9.4	1.859	0.759	2.618	3.45	6.354	1.689	0.930
12	0.2970	60.670	42.8	10.4	1.861	0.815	2.676	3.28	6.298	1.745	0.930
13	0.3259	61.550	43.7	11.4	1.877	0.868	2.745	3.16	6.245	1.807	0.939
14	0.3560	61.690	43.8	12.5	1.860	0.906	2.766	3.05	6.207	1.836	0.930
15	0.3858	62.120	44.3	13.6	1.856	0.925	2.781	3.01	6.188	1.853	0.928
16	0.4155	61.490	43.6	14.6	1.807	0.959	2.766	2.88	6.154	1.862	0.903
17	0.4277	61.490	43.6	15.0	1.798	0.972	2.770	2.85	6.141	1.871	0.899

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	137.990			156.310
Moisture content: Dry soil+tare, gms.	109.100			122.750
Moisture content: Tare, gms.	30.990			30.840
Moisture, %	37.0	37.2	36.9	36.5
Moist specimen weight, gms.	126.6			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.49	1.49	1.49	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	115.2	115.4	115.7	
Dry density, pcf	84.1	84.1	84.6	
Void ratio	1.0076	1.0076	0.9968	
Saturation, %	99.3	100.0	100.0	

Parameters for Specimen No. 2

Consolidation cell pressure = 7.137 tsf
 Consolidation back pressure = 5.147 tsf
 Consolidation effective confining stress = 1.990 tsf
 Peak Stress = 2.260 tsf at reading no. 11
 Ult. Stress = 2.199 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0127	18.790	0.0	0.0	0.000	1.990	1.990	1.00	5.147	1.990	0.000
1	0.0167	22.480	3.7	0.1	0.178	1.916	2.094	1.09	5.221	2.005	0.089
2	0.0284	30.820	12.0	0.6	0.579	1.677	2.256	1.35	5.460	1.966	0.289
3	0.0553	39.360	20.6	1.5	0.980	1.432	2.412	1.68	5.705	1.922	0.490
4	0.0832	45.990	27.2	2.5	1.283	1.259	2.542	2.02	5.878	1.900	0.641
5	0.1111	51.880	33.1	3.5	1.545	1.179	2.724	2.31	5.958	1.951	0.772
6	0.1379	56.940	38.1	4.5	1.763	1.154	2.917	2.53	5.983	2.036	0.882
7	0.1648	61.700	42.9	5.4	1.963	1.166	3.129	2.68	5.971	2.148	0.982
8	0.1917	65.000	46.2	6.4	2.093	1.203	3.296	2.74	5.934	2.249	1.046
9	0.2195	67.560	48.8	7.4	2.185	1.254	3.439	2.74	5.883	2.347	1.093
10	0.2485	69.550	50.8	8.4	2.249	1.298	3.547	2.73	5.839	2.422	1.124
11	0.2753	70.340	51.6	9.4	2.260	1.335	3.595	2.69	5.802	2.465	1.130
12	0.3032	70.540	51.8	10.4	2.244	1.347	3.591	2.67	5.790	2.469	1.122
13	0.3314	71.140	52.4	11.4	2.244	1.361	3.605	2.65	5.776	2.483	1.122
14	0.3493	71.510	52.7	12.0	2.244	1.373	3.617	2.63	5.764	2.495	1.122
15	0.3771	71.770	53.0	13.0	2.229	1.381	3.610	2.61	5.756	2.496	1.115
16	0.4049	72.320	53.5	14.0	2.227	1.391	3.618	2.60	5.746	2.504	1.113
17	0.4318	72.260	53.5	15.0	2.199	1.398	3.597	2.57	5.739	2.498	1.100

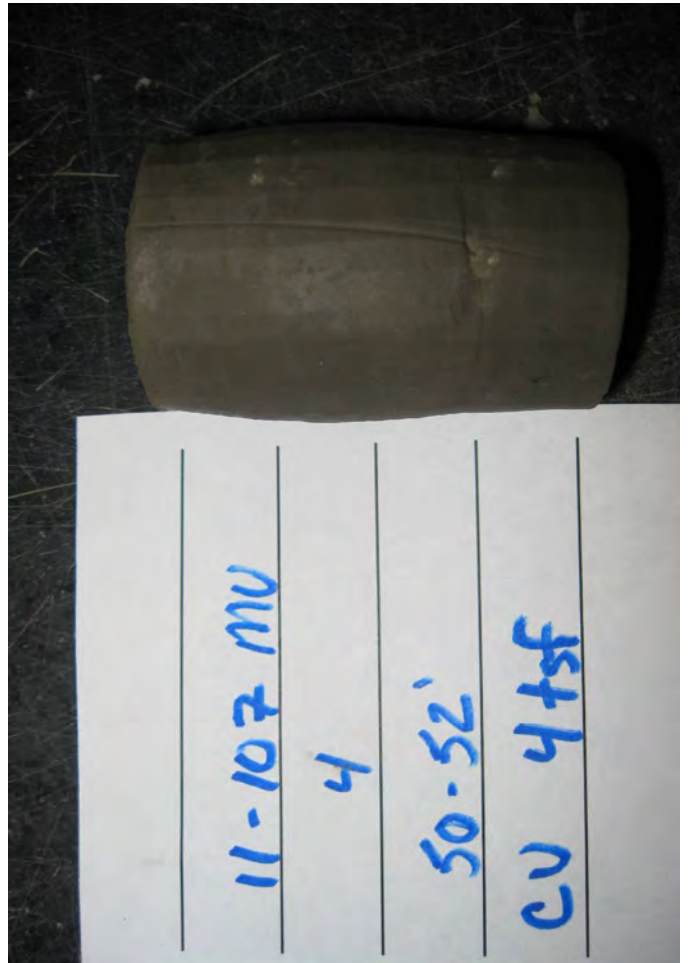
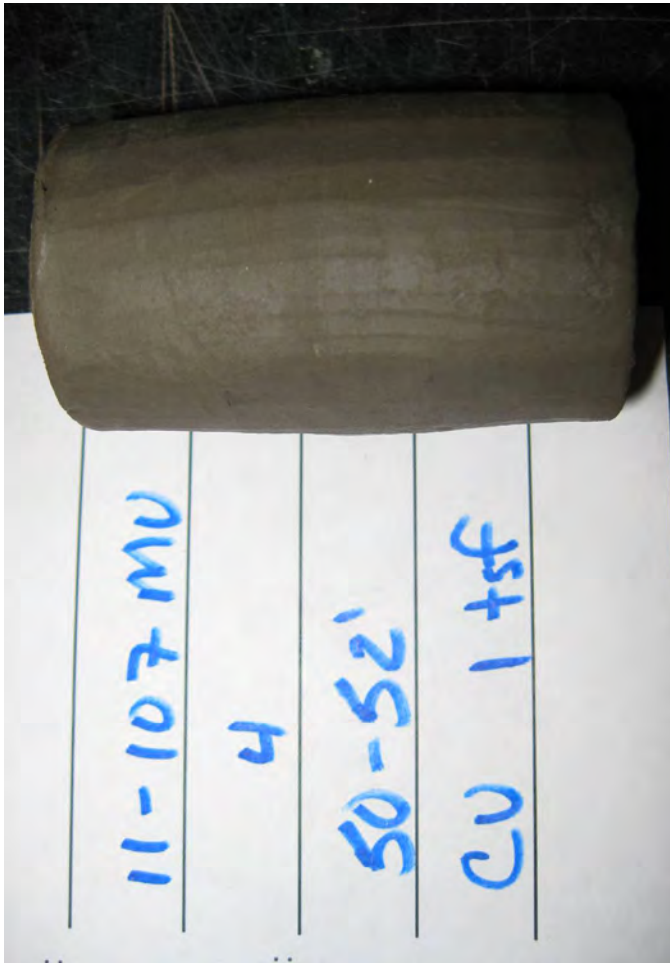
Readings for Specimen No. 3

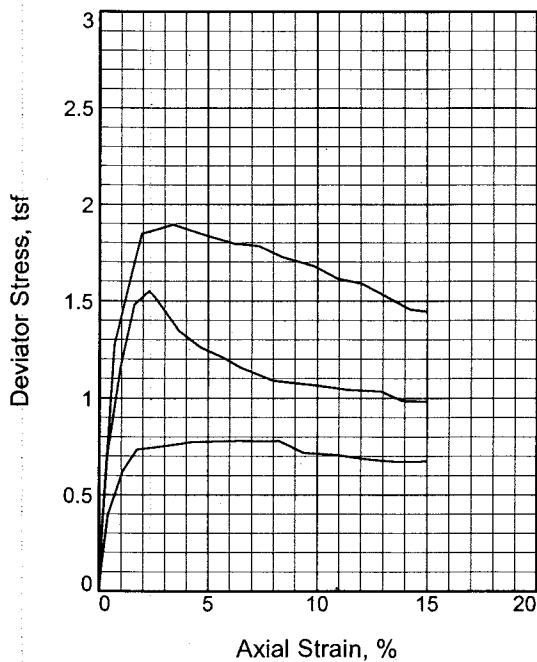
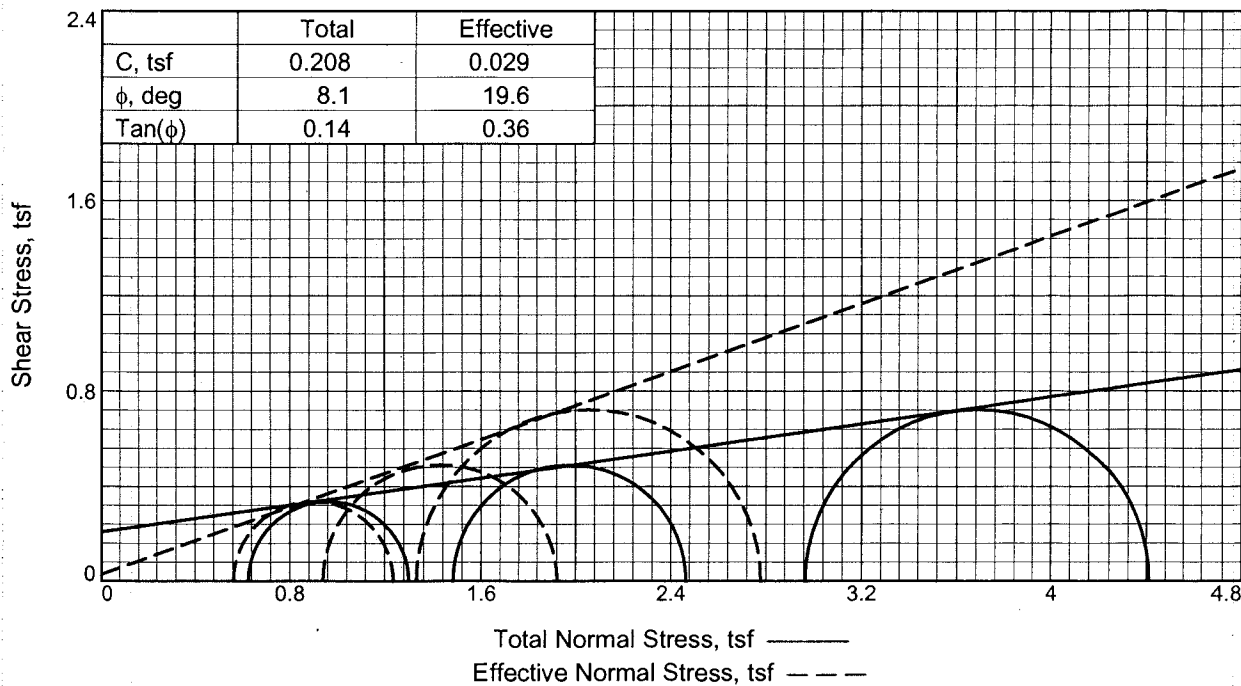
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	143.620			156.860
Moisture content: Dry soil+tare, gms.	112.930			123.940
Moisture content: Tare, gms.	30.660			30.620
Moisture, %	37.3	37.3	36.1	35.3
Moist specimen weight, gms.	128.7			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.50	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	115.4	115.4	116.2	
Dry density, pcf	84.0	84.0	85.4	
Void ratio	1.0099	1.0099	0.9777	
Saturation, %	99.9	100.0	100.0	

Readings for Specimen No. 3

Consolidation cell pressure = 7.125 tsf
 Consolidation back pressure = 3.093 tsf
 Consolidation effective confining stress = 4.032 tsf
 Peak Stress = 3.182 tsf at reading no. 11
 Ult. Stress = 2.935 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0407	20.630	0.0	0.0	0.000	4.032	4.032	1.00	3.093	4.032	0.000
1	0.0434	23.800	3.2	0.1	0.152	3.997	4.149	1.04	3.128	4.073	0.076
2	0.0475	38.120	17.5	0.2	0.837	3.761	4.598	1.22	3.364	4.179	0.418
3	0.0589	50.310	29.7	0.7	1.414	3.218	4.632	1.44	3.907	3.925	0.707
4	0.0787	64.330	43.7	1.4	2.067	2.747	4.814	1.75	4.378	3.781	1.034
5	0.0981	68.660	48.0	2.1	2.256	2.474	4.730	1.91	4.651	3.602	1.128
6	0.1286	80.420	59.8	3.2	2.777	2.215	4.992	2.25	4.910	3.604	1.389
7	0.1490	84.690	64.1	3.9	2.953	2.125	5.078	2.39	5.000	3.601	1.476
8	0.1686	87.650	67.0	4.6	3.067	2.075	5.142	2.48	5.050	3.608	1.533
9	0.1873	89.400	68.8	5.3	3.125	2.028	5.153	2.54	5.097	3.590	1.562
10	0.2176	90.720	70.1	6.3	3.148	1.993	5.141	2.58	5.132	3.567	1.574
11	0.2478	92.300	71.7	7.4	3.182	1.980	5.162	2.61	5.145	3.571	1.591
12	0.2784	91.770	71.1	8.5	3.121	1.950	5.071	2.60	5.175	3.510	1.560
13	0.3079	91.660	71.0	9.6	3.080	1.910	4.990	2.61	5.215	3.450	1.540
14	0.3382	92.310	71.7	10.7	3.071	1.887	4.958	2.63	5.238	3.422	1.535
15	0.3686	92.500	71.9	11.8	3.041	1.872	4.913	2.62	5.253	3.393	1.521
16	0.3989	92.600	72.0	12.9	3.008	1.851	4.859	2.63	5.274	3.355	1.504
17	0.4284	92.870	72.2	13.9	2.983	1.832	4.815	2.63	5.293	3.323	1.491
18	0.4579	92.600	72.0	15.0	2.935	1.808	4.743	2.62	5.317	3.275	1.467





Sample No.	1	2	3	
Initial	Water Content, %	52.4	52.5	50.5
	Dry Density, pcf	69.5	69.6	70.9
	Saturation, %	99.3	100.0	99.3
	Void Ratio	1.4194	1.4141	1.3705
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	52.7	52.0	49.5
	Dry Density, pcf	69.5	70.0	72.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.4194	1.4012	1.3326
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.80	2.80	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.63	1.49	2.96	
Back Pressure, tsf	6.50	5.64	4.17	
Cell Pressure, tsf	7.13	7.13	7.13	
Peak Deviator Stress, tsf	0.78	1.55	1.89	
Total Pore Pr., tsf	6.61	6.38	5.41	
Ultimate Deviator Stress, tsf	0.67	0.98	1.45	
Total Pore Pr., tsf	6.56	6.19	5.80	
Maj. Eff. Stress at Ultimate, tsf	1.24	1.92	2.78	
Min. Eff. Stress at Ultimate, tsf	0.56	0.94	1.33	

Type of Test:

CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 85

PL= 21

PI= 64

Specific Gravity= 2.693

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Argusville Formation

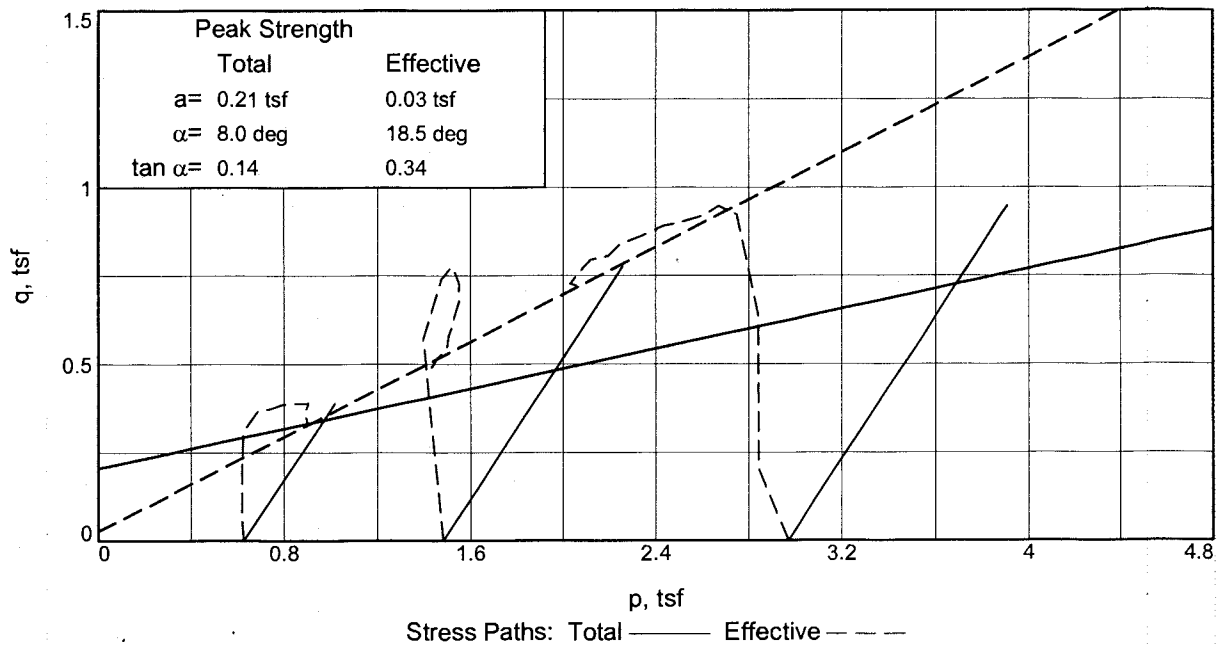
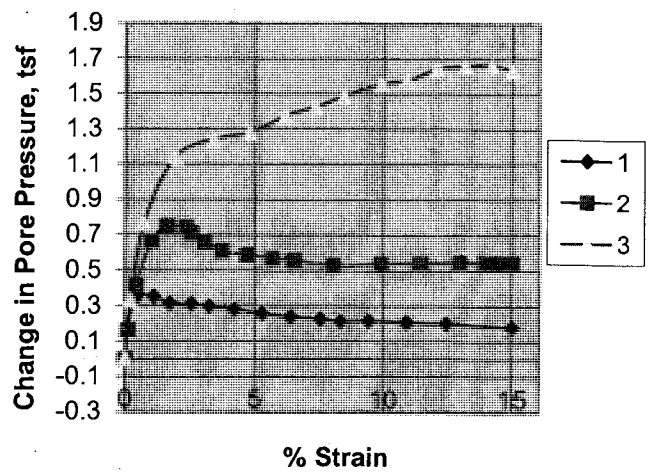
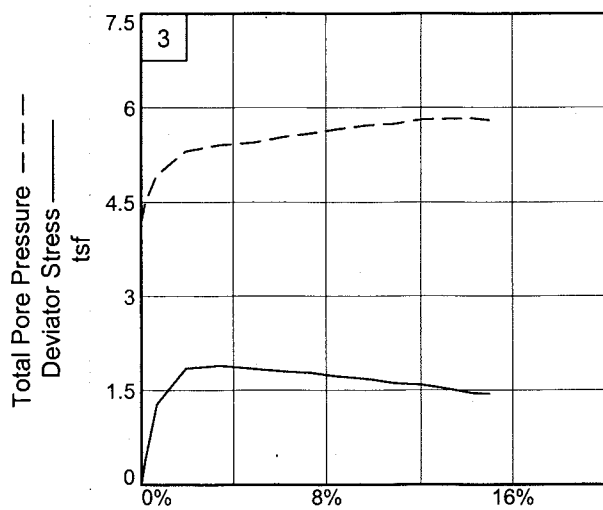
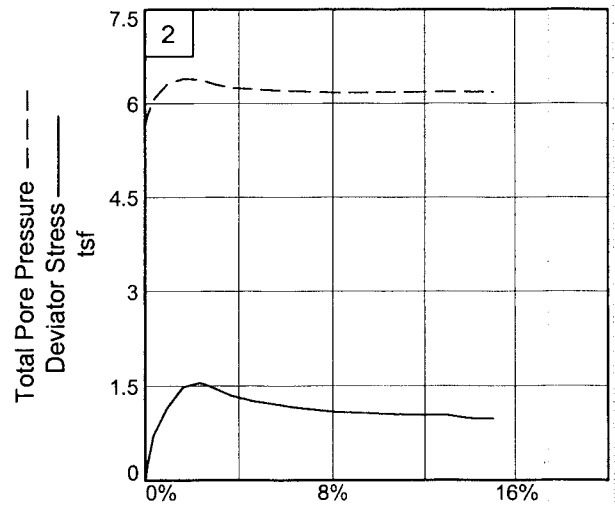
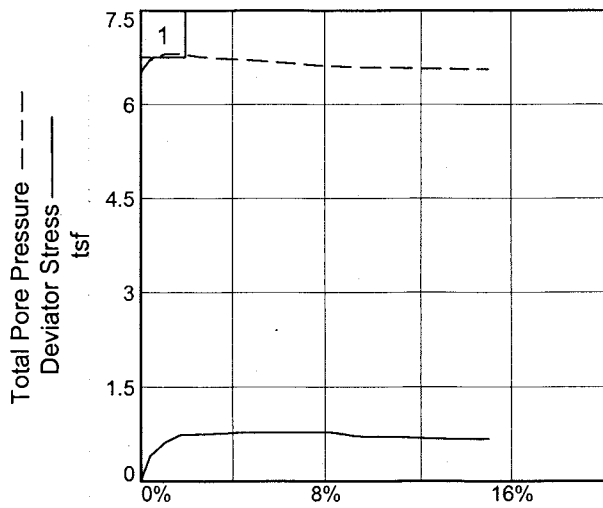
Sample Number: Boring11-110MU, #4

Depth: 55-57'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Argusville Formation

Depth: 55-57'

Sample No.: Boring11-110MU, #4

Project No.: B110-0065 to Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

4/26/2011
8:19 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Argusville Formation
Depth: 55-57' **Sample Number:** Boring11-110MU, #4
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity=2.693 **LL**=85 **PL**=21 **PI**=64
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	131.740			151.740
Moisture content: Dry soil+tare, gms.	96.940			109.960
Moisture content: Tare, gms.	30.480			31.110
Moisture, %	52.4	52.7	52.7	53.0
Moist specimen weight, gms.	120.1			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	105.9	106.1	106.1	
Dry density, pcf	69.5	69.5	69.5	
Void ratio	1.4194	1.4194	1.4194	
Saturation, %	99.3	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.126 tsf
Consolidation back pressure = 6.499 tsf
Consolidation effective confining stress = 0.627 tsf
Peak Stress = 0.781 tsf at reading no. 11
Ult. Stress = 0.674 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0142	21.690	0.0	0.0	0.000	0.627	0.627	1.00	6.499	0.627	0.000
1	0.0172	24.410	2.7	0.1	0.127	0.556	0.683	1.23	6.570	0.619	0.063
2	0.0252	30.240	8.5	0.4	0.398	0.421	0.819	1.94	6.705	0.620	0.199
3	0.0441	35.120	13.4	1.1	0.621	0.315	0.936	2.97	6.811	0.625	0.310
4	0.0630	37.710	16.0	1.7	0.735	0.320	1.055	3.30	6.806	0.688	0.368
5	0.0839	38.050	16.4	2.5	0.745	0.356	1.101	3.09	6.770	0.729	0.373
6	0.1047	38.450	16.8	3.2	0.758	0.382	1.140	2.98	6.744	0.761	0.379
7	0.1326	39.000	17.3	4.2	0.774	0.405	1.179	2.91	6.721	0.792	0.387
8	0.1625	39.240	17.6	5.3	0.776	0.437	1.213	2.78	6.689	0.825	0.388
9	0.1934	39.530	17.8	6.4	0.780	0.467	1.247	2.67	6.659	0.857	0.390
10	0.2242	39.700	18.0	7.5	0.778	0.498	1.276	2.56	6.628	0.887	0.389
11	0.2463	39.910	18.2	8.3	0.781	0.514	1.295	2.52	6.612	0.904	0.390
12	0.2771	38.660	17.0	9.4	0.718	0.527	1.245	2.36	6.599	0.886	0.359
13	0.3190	38.660	17.0	10.9	0.706	0.538	1.244	2.31	6.588	0.891	0.353
14	0.3608	38.390	16.7	12.4	0.684	0.555	1.239	2.23	6.571	0.897	0.342
15	0.3948	38.360	16.7	13.6	0.673	0.560	1.233	2.20	6.566	0.896	0.336
16	0.4350	38.660	17.0	15.0	0.674	0.563	1.237	2.20	6.563	0.900	0.337

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.870			150.480
Moisture content: Dry soil+tare, gms.	104.280			109.790
Moisture content: Tare, gms.	30.780			30.340
Moisture, %	52.5	52.5	52.0	51.2
Moist specimen weight, gms.	120.6			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.54	1.54	1.54	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.2	106.2	106.4	
Dry density, pcf	69.6	69.6	70.0	
Void ratio	1.4141	1.4141	1.4012	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.127 tsf
 Consolidation back pressure = 5.645 tsf
 Consolidation effective confining stress = 1.482 tsf
 Peak Stress = 1.551 tsf at reading no. 5
 Ult. Stress = 0.983 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0202	20.380	0.0	0.0	0.000	1.482	1.482	1.00	5.645	1.482	0.000
1	0.0232	26.330	5.9	0.1	0.278	1.321	1.599	1.21	5.806	1.460	0.139
2	0.0304	35.640	15.3	0.4	0.712	1.070	1.782	1.67	6.057	1.426	0.356
3	0.0469	45.220	24.8	1.0	1.152	0.820	1.972	2.40	6.307	1.396	0.576
4	0.0650	52.550	32.2	1.6	1.482	0.734	2.216	3.02	6.393	1.475	0.741
5	0.0840	54.290	33.9	2.3	1.551	0.743	2.294	3.09	6.384	1.518	0.775
6	0.0911	53.710	33.3	2.5	1.520	0.773	2.293	2.97	6.354	1.533	0.760
7	0.1028	52.430	32.0	3.0	1.456	0.824	2.280	2.77	6.303	1.552	0.728
8	0.1228	50.260	29.9	3.7	1.347	0.875	2.222	2.54	6.252	1.549	0.674
9	0.1507	48.610	28.2	4.7	1.260	0.897	2.157	2.40	6.230	1.527	0.630
10	0.1796	47.760	27.4	5.7	1.209	0.916	2.125	2.32	6.211	1.520	0.604
11	0.2024	46.810	26.4	6.5	1.156	0.926	2.082	2.25	6.201	1.504	0.578
12	0.2435	45.710	25.3	8.0	1.091	0.954	2.045	2.14	6.173	1.499	0.545
13	0.2982	45.680	25.3	9.9	1.066	0.946	2.012	2.13	6.181	1.479	0.533
14	0.3401	45.540	25.2	11.4	1.043	0.942	1.985	2.11	6.185	1.463	0.521
15	0.3809	45.800	25.4	12.9	1.036	0.938	1.974	2.10	6.189	1.456	0.518
16	0.4089	44.850	24.5	13.9	0.986	0.940	1.926	2.05	6.187	1.433	0.493
17	0.4229	44.950	24.6	14.4	0.984	0.938	1.922	2.05	6.189	1.430	0.492
18	0.4398	45.090	24.7	15.0	0.983	0.940	1.923	2.05	6.187	1.432	0.492

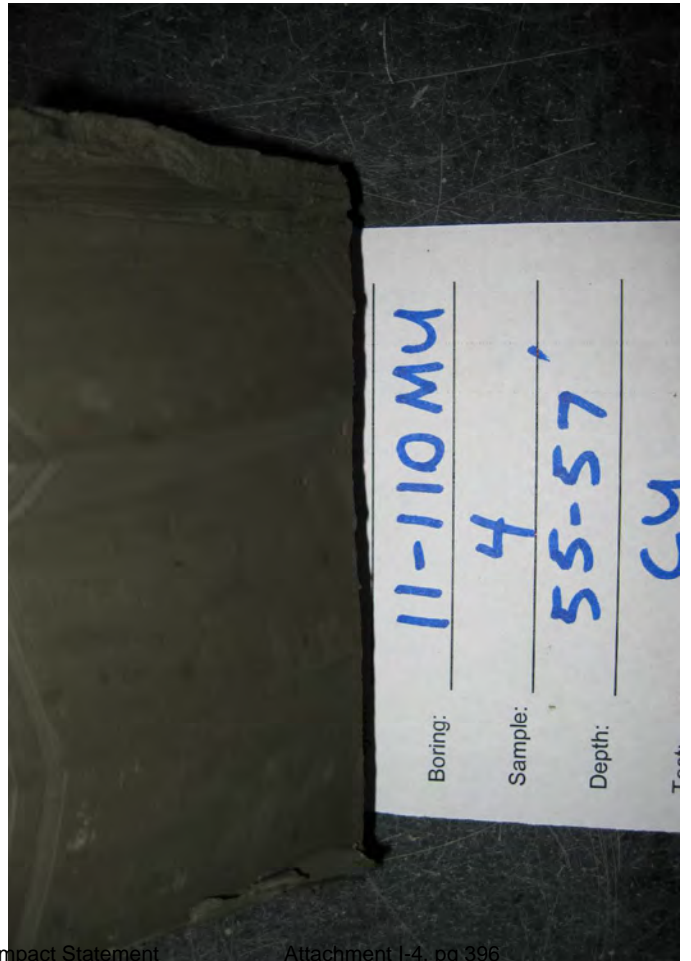
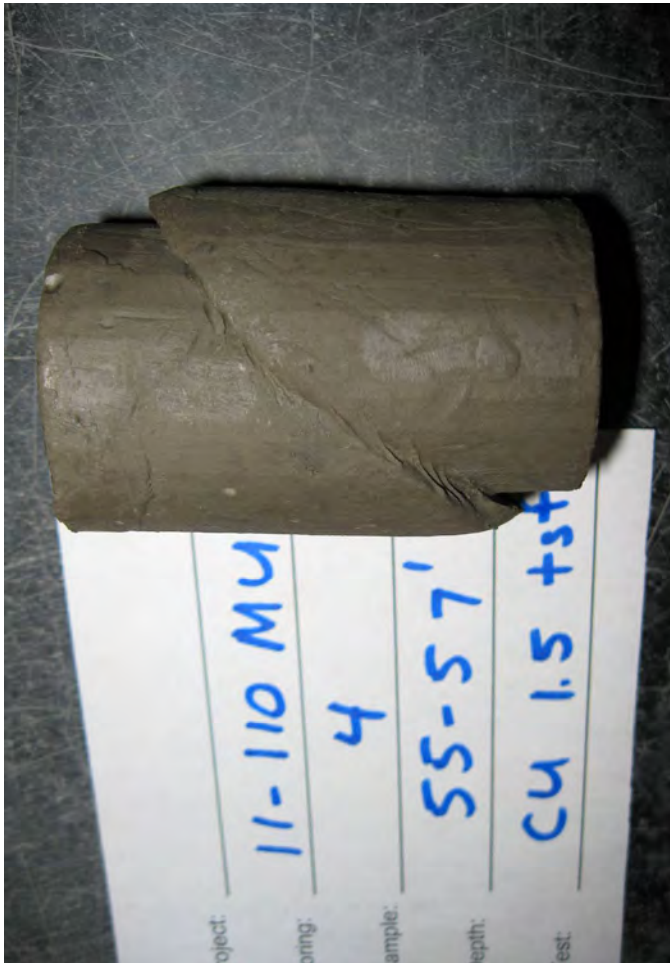
Parameters for Specimen No. 3

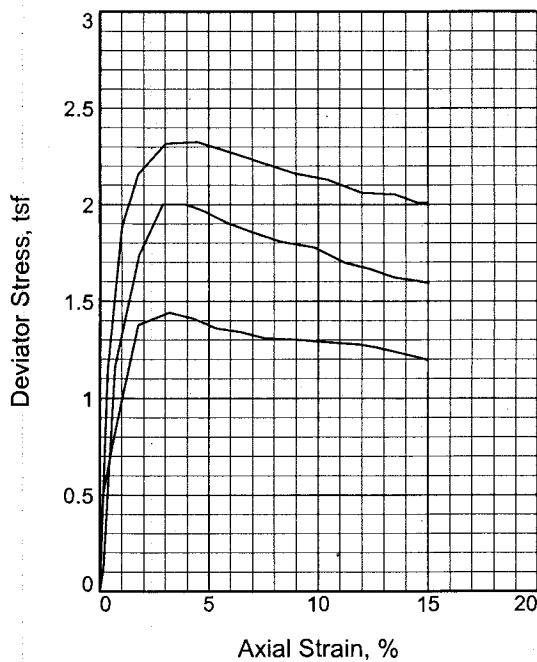
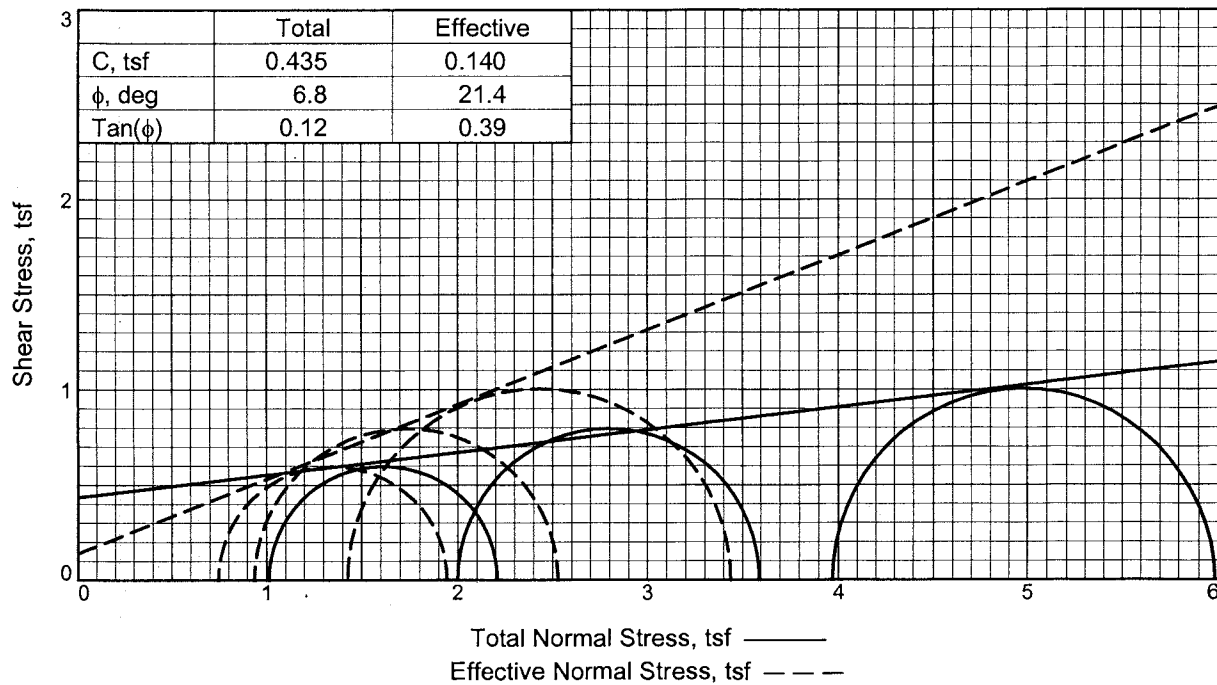
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	135.410			150.380
Moisture content: Dry soil+tare, gms.	100.160			111.420
Moisture content: Tare, gms.	30.400			30.500
Moisture, %	50.5	50.9	49.5	48.1
Moist specimen weight, gms.	122.0			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.8	107.0	107.7	
Dry density, pcf	70.9	70.9	72.1	
Void ratio	1.3705	1.3705	1.3326	
Saturation, %	99.3	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.132 tsf
 Consolidation back pressure = 4.166 tsf
 Consolidation effective confining stress = 2.966 tsf
 Peak Stress = 1.894 tsf at reading no. 4
 Ult. Stress = 1.446 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0624	21.660	0.0	0.0	0.000	2.966	2.966	1.00	4.166	2.966	0.000
1	0.0673	30.440	8.8	0.2	0.410	2.637	3.047	1.16	4.495	2.842	0.205
2	0.0812	49.090	27.4	0.7	1.275	2.203	3.478	1.58	4.929	2.841	0.638
3	0.1166	61.890	40.2	1.9	1.846	1.825	3.671	2.01	5.307	2.748	0.923
4	0.1568	63.540	41.9	3.4	1.894	1.724	3.618	2.10	5.408	2.671	0.947
5	0.1963	62.990	41.3	4.8	1.842	1.687	3.529	2.09	5.445	2.608	0.921
6	0.2358	62.560	40.9	6.2	1.795	1.591	3.386	2.13	5.541	2.489	0.898
7	0.2664	62.770	41.1	7.3	1.783	1.541	3.324	2.16	5.591	2.433	0.892
8	0.2967	61.950	40.3	8.4	1.727	1.480	3.207	2.17	5.652	2.344	0.864
9	0.3368	61.460	39.8	9.9	1.679	1.408	3.087	2.19	5.724	2.248	0.840
10	0.3672	60.360	38.7	10.9	1.613	1.390	3.003	2.16	5.742	2.197	0.807
11	0.3977	60.250	38.6	12.0	1.589	1.323	2.912	2.20	5.809	2.117	0.794
12	0.4282	59.150	37.5	13.1	1.524	1.309	2.833	2.16	5.823	2.071	0.762
13	0.4587	57.930	36.3	14.2	1.456	1.302	2.758	2.12	5.830	2.030	0.728
14	0.4800	57.990	36.3	15.0	1.446	1.332	2.778	2.09	5.800	2.055	0.723





Sample No.	1	2	3	
Initial	Water Content, %	46.4	44.9	45.9
	Dry Density, pcf	73.6	75.5	75.0
	Saturation, %	97.7	99.0	100.0
	Void Ratio	1.2725	1.2153	1.2297
	Diameter, in.	1.41	1.38	1.39
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	47.4	44.7	44.1
	Dry Density, pcf	73.7	76.1	76.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2701	1.1964	1.1821
	Diameter, in.	1.41	1.38	1.38
	Height, in.	2.80	2.80	2.78
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.02	2.00	3.97	
Back Pressure, tsf	6.10	5.15	3.16	
Cell Pressure, tsf	7.12	7.15	7.13	
Peak Deviator Stress, tsf	1.44	2.00	2.33	
Total Pore Pr., tsf	6.58	5.97	5.10	
Ultimate Deviator Stress, tsf	1.20	1.59	2.01	
Total Pore Pr., tsf	6.37	6.21	5.70	
Maj. Eff. Stress at Ultimate, tsf	1.94	2.53	3.44	
Min. Eff. Stress at Ultimate, tsf	0.75	0.94	1.43	

Type of Test:

CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 70

PL= 22

PI= 48

Specific Gravity= 2.679

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Argusville Formation

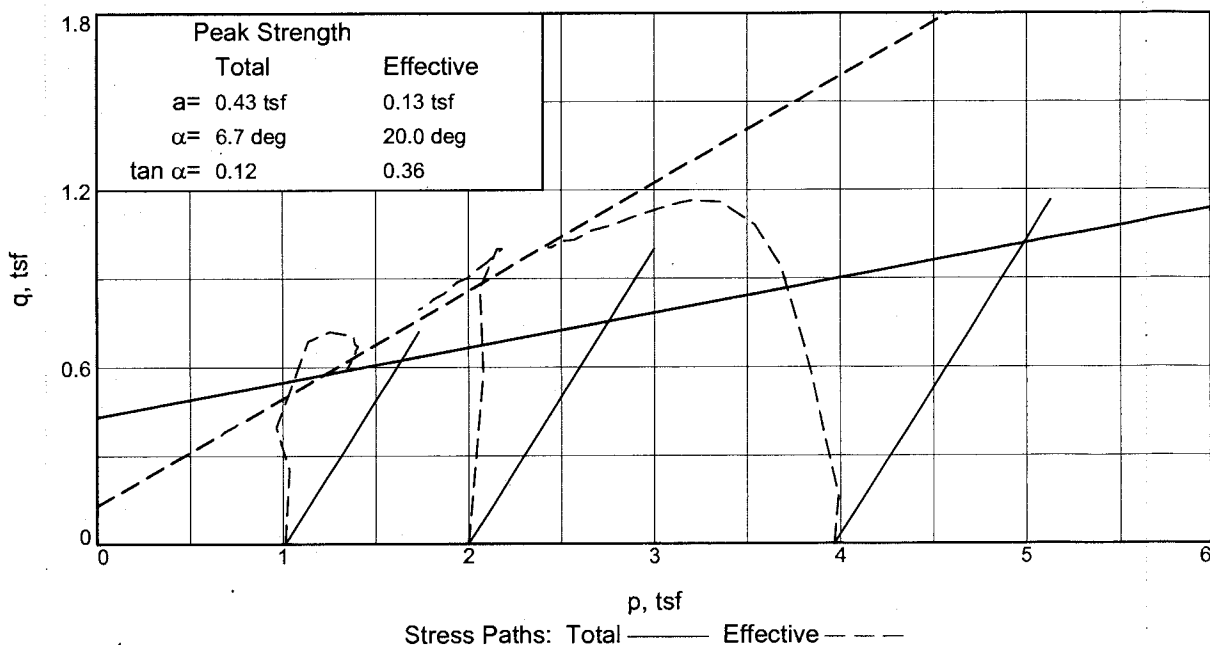
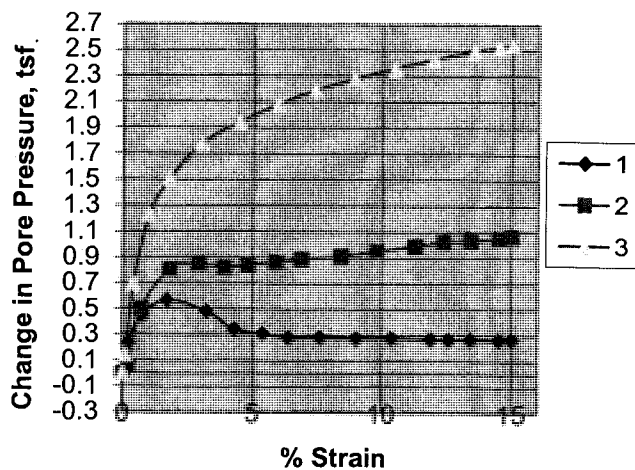
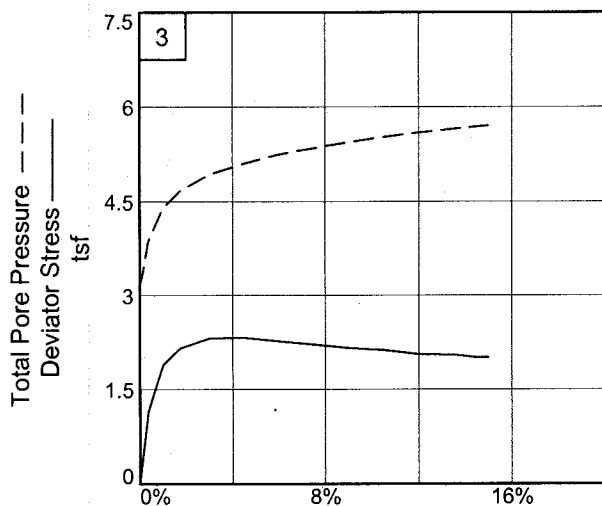
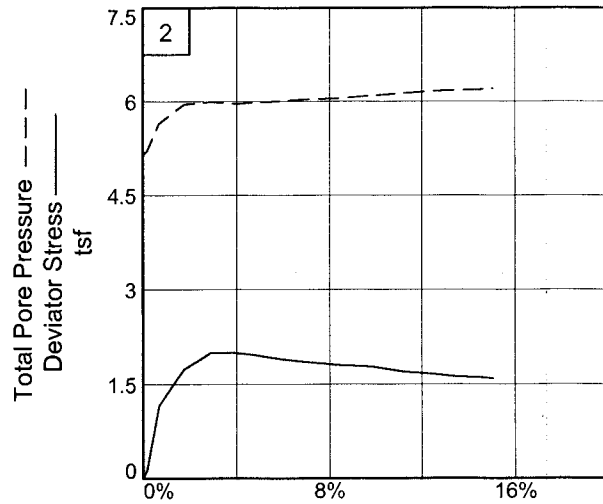
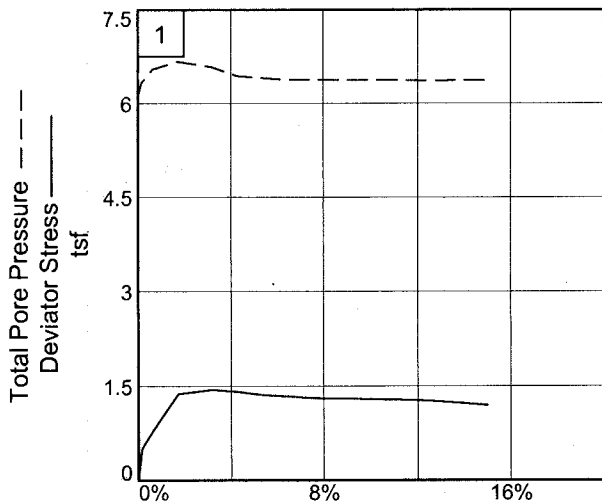
Sample Number: Boring11-110MU, #5

Depth: 60-62'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN[™]
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Argusville Formation

Depth: 60-62'

Sample No.: Boring11-110MU, #5

Project No. W912ES-11-P-0024 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July, 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

4/26/2011

8:19 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Argusville Formation
Depth: 60-62' **Sample Number:** Boring11-110MU, #5
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity=2.679 **LL**=70 **PL**=22 **PI**=48
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.110			153.830
Moisture content: Dry soil+tare, gms.	106.410			114.170
Moisture content: Tare, gms.	29.470			30.520
Moisture, %	46.4	47.5	47.4	47.4
Moist specimen weight, gms.	123.3			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.56	1.56	1.56	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	107.7	108.6	108.6	
Dry density, pcf	73.6	73.6	73.7	
Void ratio	1.2725	1.2725	1.2701	
Saturation, %	97.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.116 tsf
Consolidation back pressure = 6.104 tsf
Consolidation effective confining stress = 1.012 tsf
Strain rate, %/min. = 0.05
Peak Stress = 1.442 tsf at reading no. 4
Ult. Stress = 1.197 tsf at reading no. 15

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0511	19.810	0.0	0.0	0.000	1.012	1.012	1.00	6.104	1.012	0.000
1	0.0557	30.810	11.0	0.2	0.507	0.781	1.288	1.65	6.335	1.035	0.254
2	0.0696	37.150	17.3	0.7	0.796	0.568	1.364	2.40	6.548	0.966	0.398
3	0.0997	50.150	30.3	1.7	1.378	0.447	1.825	4.08	6.669	1.136	0.689
4	0.1401	52.040	32.2	3.2	1.442	0.533	1.975	3.71	6.583	1.254	0.721
5	0.1703	51.720	31.9	4.3	1.412	0.673	2.085	3.10	6.443	1.379	0.706
6	0.2007	50.900	31.1	5.4	1.360	0.706	2.066	2.93	6.410	1.386	0.680
7	0.2310	50.850	31.0	6.4	1.342	0.735	2.077	2.83	6.381	1.406	0.671
8	0.2626	50.480	30.7	7.6	1.310	0.733	2.043	2.79	6.383	1.388	0.655
9	0.3028	50.770	31.0	9.0	1.302	0.740	2.042	2.76	6.376	1.391	0.651
10	0.3430	50.950	31.1	10.4	1.289	0.736	2.025	2.75	6.380	1.380	0.644
11	0.3833	51.160	31.3	11.9	1.277	0.747	2.024	2.71	6.369	1.385	0.638
12	0.4037	51.110	31.3	12.6	1.264	0.750	2.014	2.69	6.366	1.382	0.632
13	0.4262	50.870	31.1	13.4	1.243	0.746	1.989	2.67	6.370	1.367	0.621
14	0.4567	50.510	30.7	14.5	1.213	0.749	1.962	2.62	6.367	1.355	0.606
15	0.4700	50.280	30.5	15.0	1.197	0.747	1.944	2.60	6.369	1.346	0.599

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	149.370			150.370
Moisture content: Dry soil+tare, gms.	112.440			114.150
Moisture content: Tare, gms.	30.200			30.470
Moisture, %	44.9	45.4	44.7	43.3
Moist specimen weight, gms.	120.9			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.49	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	109.4	109.7	110.2	
Dry density, pcf	75.5	75.5	76.1	
Void ratio	1.2153	1.2153	1.1964	
Saturation, %	99.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.147 tsf
 Consolidation back pressure = 5.148 tsf
 Consolidation effective confining stress = 1.999 tsf
 Peak Stress = 2.001 tsf at reading no. 5
 Ult. Stress = 1.592 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0442	19.500	0.0	0.0	0.000	1.999	1.999	1.00	5.148	1.999	0.000
1	0.0490	22.090	2.6	0.2	0.125	1.947	2.072	1.06	5.200	2.009	0.062
2	0.0637	43.670	24.2	0.7	1.160	1.498	2.658	1.77	5.649	2.078	0.580
3	0.0940	56.100	36.6	1.8	1.738	1.192	2.930	2.46	5.955	2.061	0.869
4	0.1251	62.110	42.6	2.9	2.000	1.151	3.151	2.74	5.996	2.151	1.000
5	0.1546	62.590	43.1	3.9	2.001	1.179	3.180	2.70	5.968	2.180	1.001
6	0.1790	62.180	42.7	4.8	1.964	1.162	3.126	2.69	5.985	2.144	0.982
7	0.2093	61.330	41.8	5.9	1.903	1.138	3.041	2.67	6.009	2.090	0.952
8	0.2388	60.800	41.3	6.9	1.858	1.112	2.970	2.67	6.035	2.041	0.929
9	0.2790	60.260	40.8	8.4	1.805	1.092	2.897	2.65	6.055	1.995	0.903
10	0.3198	60.270	40.8	9.8	1.777	1.049	2.826	2.69	6.098	1.938	0.889
11	0.3595	59.050	39.5	11.3	1.697	1.013	2.710	2.68	6.134	1.861	0.848
12	0.3908	58.800	39.3	12.4	1.665	0.979	2.644	2.70	6.168	1.811	0.832
13	0.4211	58.270	38.8	13.4	1.622	0.968	2.590	2.68	6.179	1.779	0.811
14	0.4517	58.340	38.8	14.5	1.605	0.950	2.555	2.69	6.197	1.752	0.802
15	0.4656	58.270	38.8	15.0	1.592	0.936	2.528	2.70	6.211	1.732	0.796

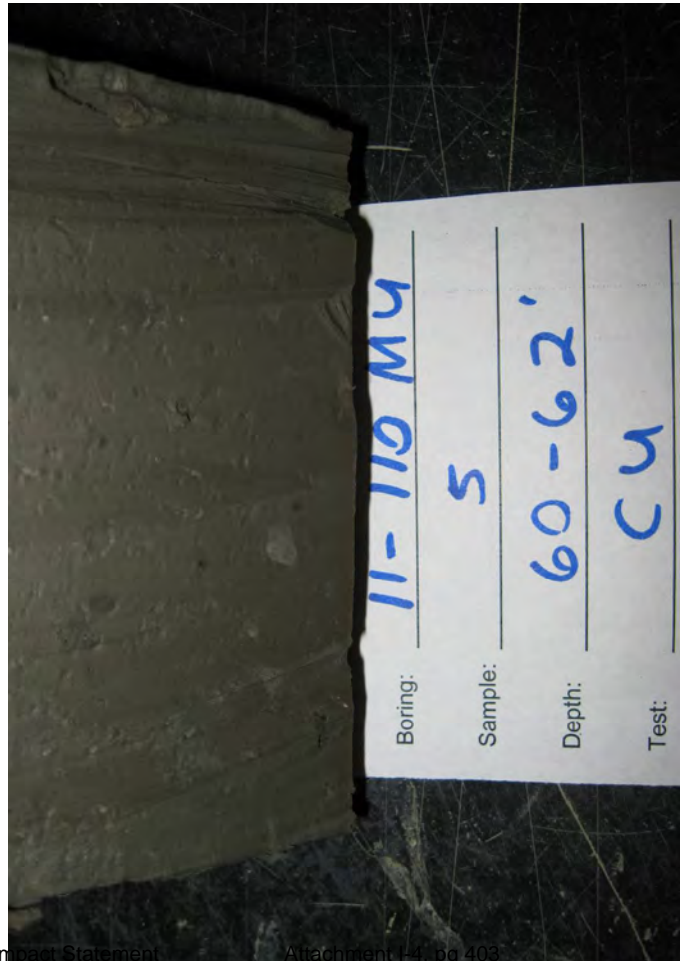
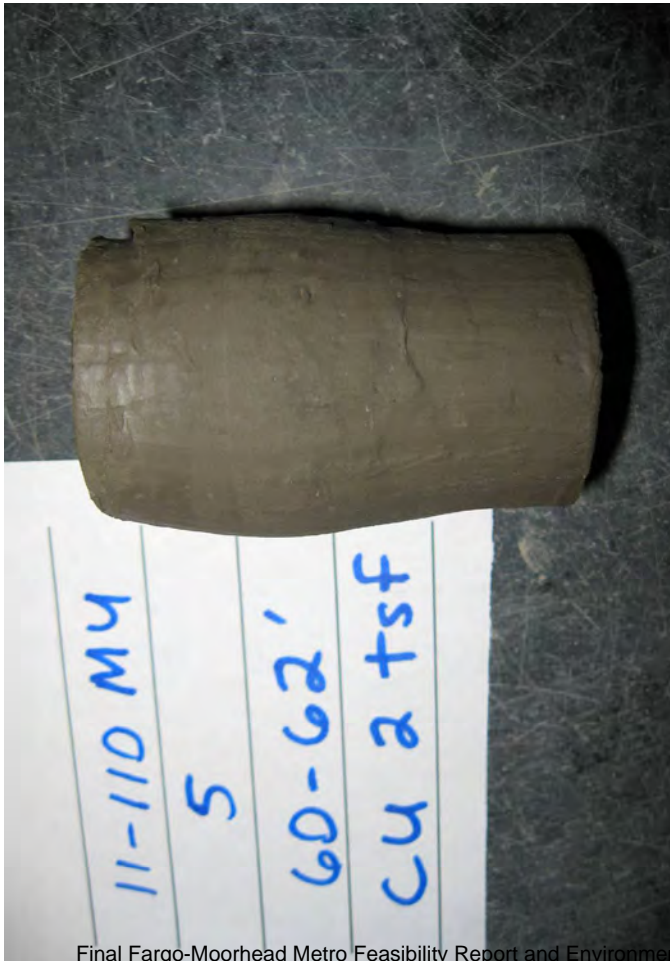
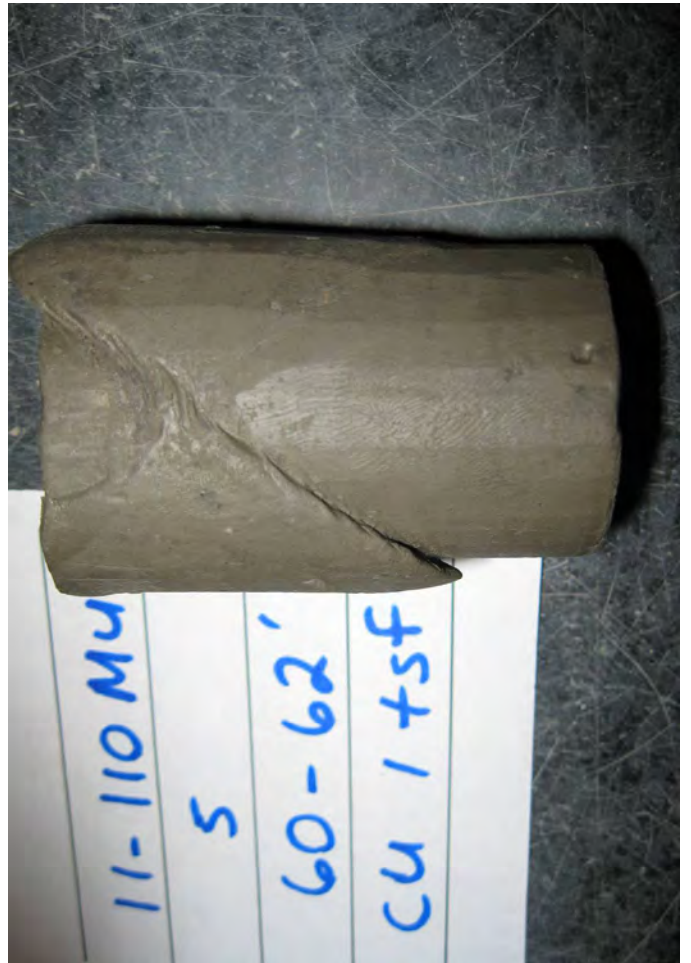
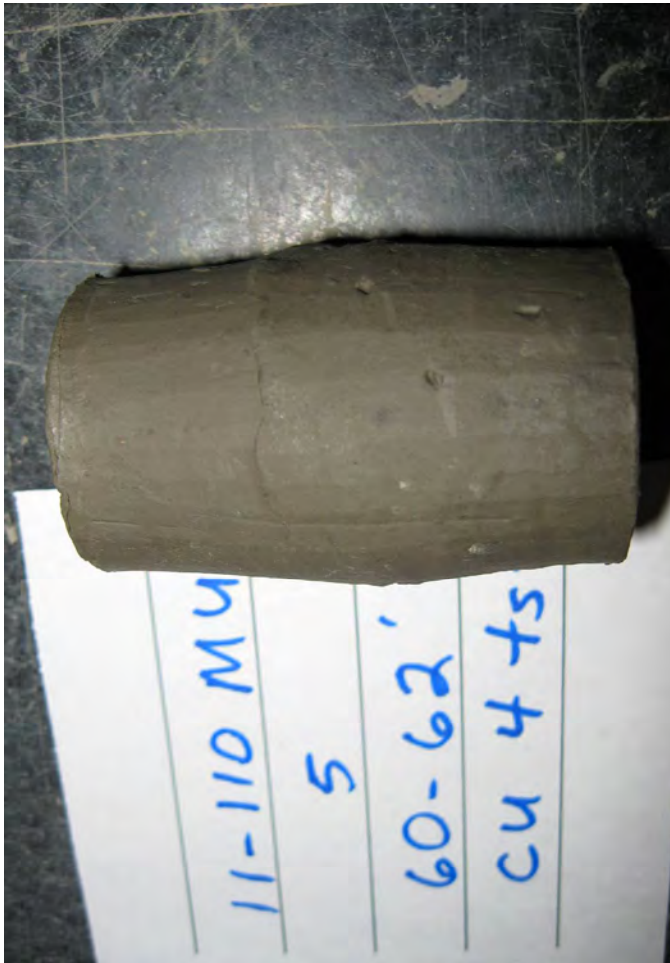
Parameters for Specimen No. 3

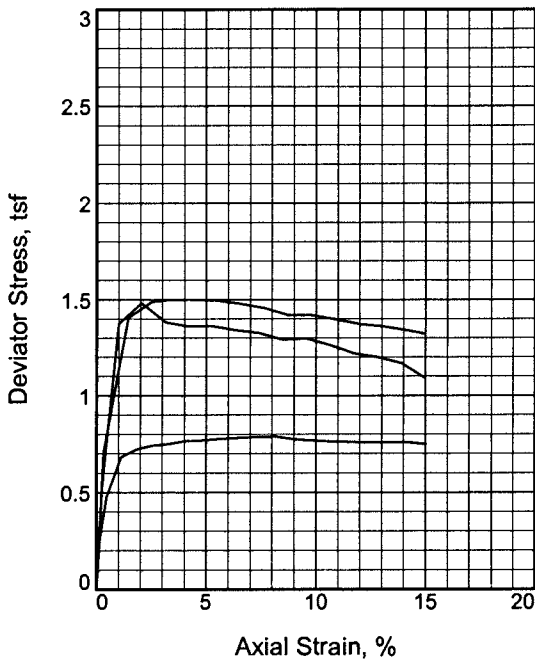
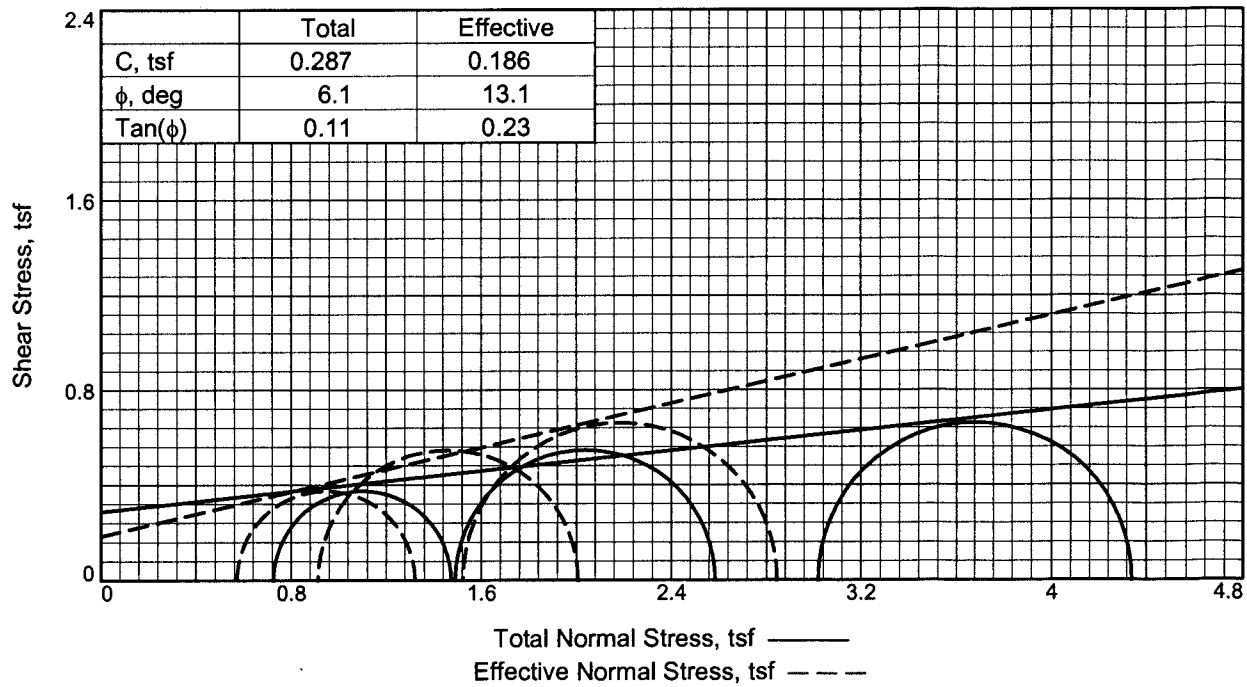
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	160.530			149.680
Moisture content: Dry soil+tare, gms.	119.590			114.990
Moisture content: Tare, gms.	30.380			31.100
Moisture, %	45.9	45.9	44.1	41.4
Moist specimen weight, gms.	122.3			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.50	
Height, in.	2.80	2.80	2.78	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	109.4	109.4	110.5	
Dry density, pcf	75.0	75.0	76.6	
Void ratio	1.2297	1.2297	1.1821	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.131 tsf
 Consolidation back pressure = 3.162 tsf
 Consolidation effective confining stress = 3.969 tsf
 Peak Stress = 2.327 tsf at reading no. 6
 Ult. Stress = 2.009 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0077	18.790	0.0	0.0	0.000	3.969	3.969	1.00	3.162	3.969	0.000
1	0.0105	25.720	6.9	0.1	0.332	3.825	4.157	1.09	3.306	3.991	0.166
2	0.0177	42.780	24.0	0.4	1.148	3.272	4.420	1.35	3.859	3.846	0.574
3	0.0359	58.500	39.7	1.0	1.887	2.737	4.624	1.69	4.394	3.681	0.944
4	0.0564	64.600	45.8	1.8	2.161	2.460	4.621	1.88	4.671	3.541	1.081
5	0.0920	68.570	49.8	3.0	2.318	2.199	4.517	2.05	4.932	3.358	1.159
6	0.1318	69.520	50.7	4.5	2.327	2.028	4.355	2.15	5.103	3.192	1.164
7	0.1735	69.150	50.4	6.0	2.274	1.888	4.162	2.20	5.243	3.025	1.137
8	0.2146	68.720	49.9	7.4	2.219	1.783	4.002	2.24	5.348	2.892	1.109
9	0.2563	68.240	49.4	8.9	2.162	1.694	3.856	2.28	5.437	2.775	1.081
10	0.2983	68.300	49.5	10.5	2.129	1.610	3.739	2.32	5.521	2.674	1.064
11	0.3401	67.560	48.8	12.0	2.062	1.539	3.601	2.34	5.592	2.570	1.031
12	0.3832	68.210	49.4	13.5	2.052	1.477	3.529	2.39	5.654	2.503	1.026
13	0.4110	67.750	49.0	14.5	2.010	1.442	3.452	2.39	5.689	2.447	1.005
14	0.4240	68.000	49.2	15.0	2.009	1.427	3.436	2.41	5.704	2.431	1.004





Sample No.		1	2	3
Initial	Water Content, %	45.0	44.7	49.1
	Dry Density, pcf	74.8	75.1	71.4
	Saturation, %	97.0	97.2	97.7
	Void Ratio	1.2484	1.2396	1.3543
	Diameter, in.	1.42	1.41	1.40
	Height, in.	2.79	2.81	2.80
At Test	Water Content, %	46.4	46.0	49.4
	Dry Density, pcf	74.8	75.1	72.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2484	1.2396	1.3292
	Diameter, in.	1.42	1.41	1.39
	Height, in.	2.79	2.81	2.79
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.73	1.49	3.02
Back Pressure, tsf		6.41	5.64	4.11
Cell Pressure, tsf		7.14	7.13	7.13
Peak Deviator Stress, tsf		0.79	1.48	1.50
Total Pore Pr., tsf		6.64	6.20	5.13
Ultimate Deviator Stress, tsf		0.75	1.09	1.32
Total Pore Pr., tsf		6.57	6.22	5.61
Maj. Eff. Stress at Ultimate, tsf		1.32	2.01	2.85
Min. Eff. Stress at Ultimate, tsf		0.57	0.91	1.52

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 60 PL= 17 PI= 43

Specific Gravity= 2.693

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

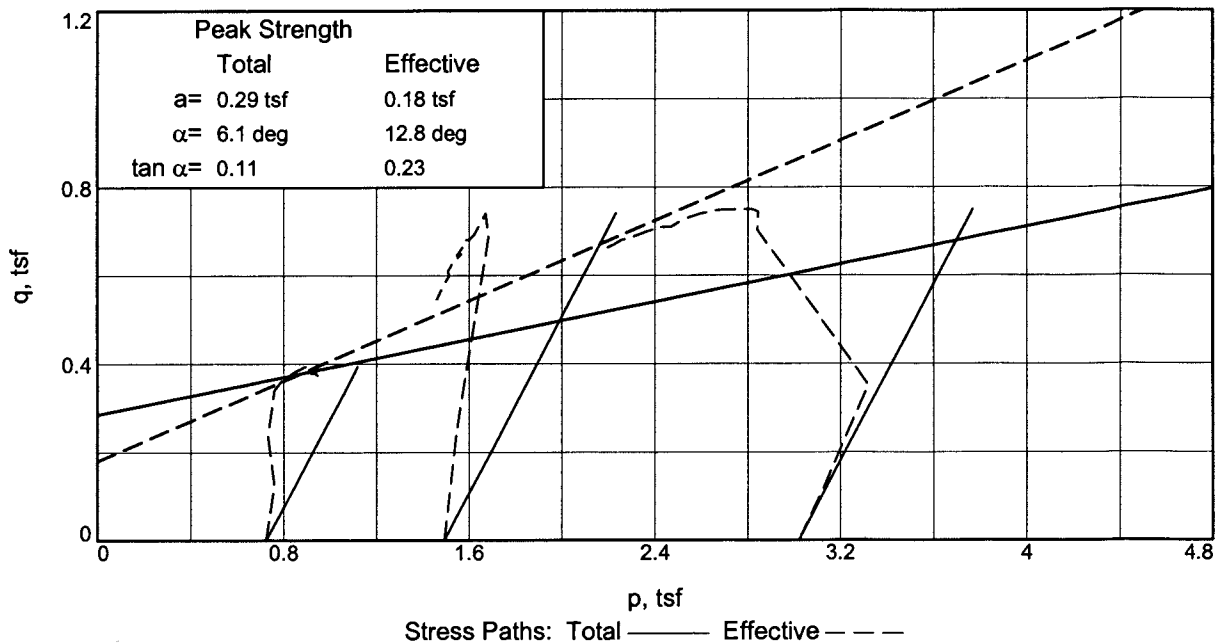
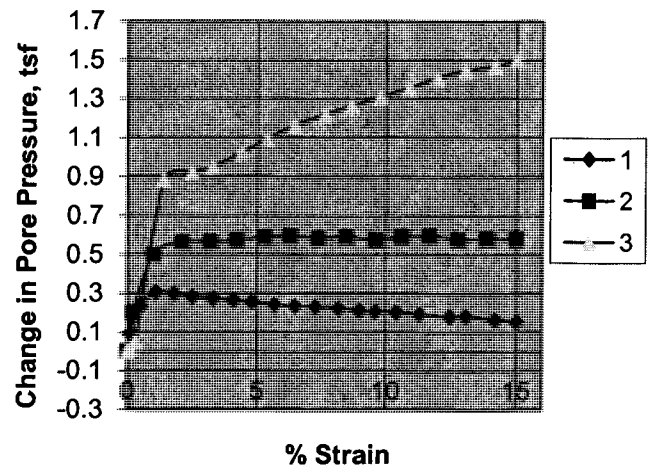
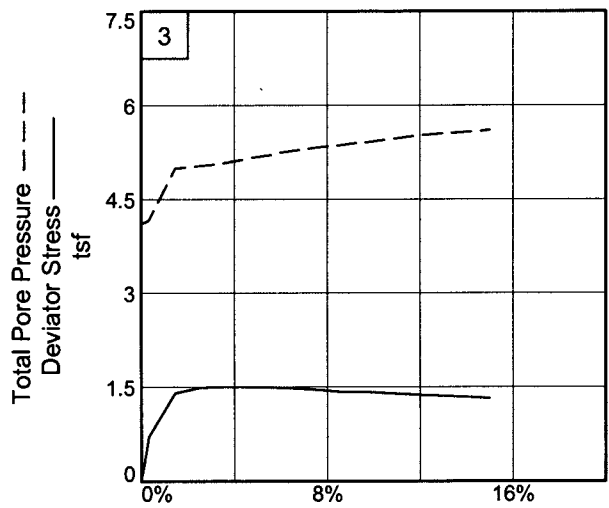
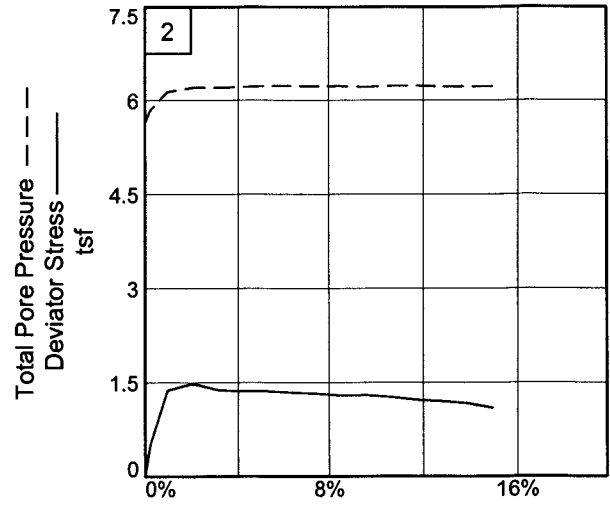
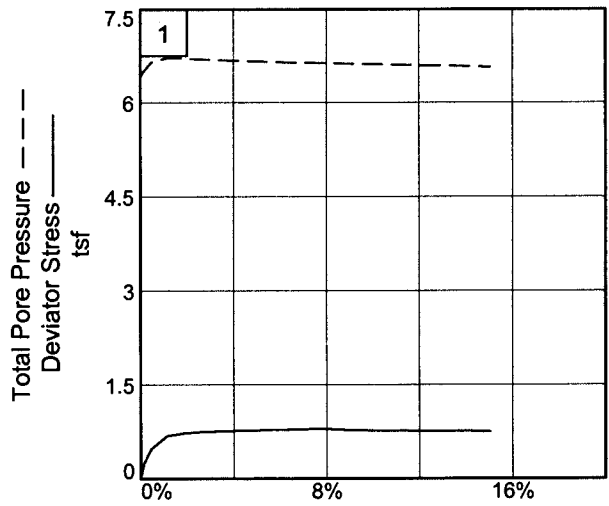
Location: Wild Rice, Argusville Formation

Sample Number: Boring11-118MU, #3 **Depth:** 45-47'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusville Formation

Depth: 45-47'

Sample Number: Boring11-118MU, #3

Project No. BL-10-10065

Figure

Braun Intertec

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

5/15/2011

11:45 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusville Formation
Depth: 45-47' **Sample Number:** Boring11-118MU, #3
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.693 **LL**=60 **PL**=17 **PI**=43
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.210			155.610
Moisture content: Dry soil+tare, gms.	94.210			113.610
Moisture content: Tare, gms.	29.720			29.460
Moisture, %	45.0	46.4	46.4	49.9
Moist specimen weight, gms.	126.1			
Diameter, in.	1.42	1.42	1.42	
Area, in. ²	1.59	1.59	1.59	
Height, in.	2.79	2.79	2.79	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	108.4	109.4	109.4	
Dry density, pcf	74.8	74.8	74.8	
Void ratio	1.2484	1.2484	1.2484	
Saturation, %	97.0	100.0	100.0	

Consolidation cell pressure = 7.138 tsf
Consolidation back pressure = 6.413 tsf
Consolidation effective confining stress = 0.725 tsf
Peak Stress = 0.789 tsf at reading no. 12
Ult. Stress = 0.750 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0096	17.280	0.0	0.0	0.000	0.725	0.725	1.00	6.413	0.725	0.000
1	0.0135	22.790	5.5	0.1	0.250	0.635	0.885	1.39	6.503	0.760	0.125
2	0.0225	27.860	10.6	0.5	0.478	0.494	0.972	1.97	6.644	0.733	0.239
3	0.0412	32.470	15.2	1.1	0.682	0.420	1.102	2.62	6.718	0.761	0.341
4	0.0602	33.470	16.2	1.8	0.722	0.429	1.151	2.68	6.709	0.790	0.361
5	0.0802	34.060	16.8	2.5	0.743	0.443	1.186	2.68	6.695	0.814	0.371
6	0.1010	34.370	17.1	3.3	0.751	0.453	1.204	2.66	6.685	0.828	0.375
7	0.1229	34.840	17.6	4.1	0.765	0.462	1.227	2.66	6.676	0.844	0.382
8	0.1448	35.090	17.8	4.8	0.769	0.472	1.241	2.63	6.666	0.857	0.385
9	0.1676	35.430	18.1	5.7	0.777	0.484	1.261	2.61	6.654	0.873	0.389
10	0.1906	35.710	18.4	6.5	0.783	0.491	1.274	2.59	6.647	0.882	0.391
11	0.2146	36.000	18.7	7.3	0.788	0.496	1.284	2.59	6.642	0.890	0.394
12	0.2374	36.200	18.9	8.2	0.789	0.502	1.291	2.57	6.636	0.896	0.394
13	0.2613	36.050	18.8	9.0	0.775	0.514	1.289	2.51	6.624	0.902	0.388
14	0.2776	36.040	18.8	9.6	0.770	0.519	1.289	2.48	6.619	0.904	0.385
15	0.3012	36.050	18.8	10.4	0.763	0.524	1.287	2.46	6.614	0.906	0.382
16	0.3262	36.200	18.9	11.3	0.762	0.532	1.294	2.43	6.606	0.913	0.381
17	0.3590	36.350	19.1	12.5	0.758	0.545	1.303	2.39	6.593	0.924	0.379
18	0.3760	36.530	19.3	13.1	0.759	0.544	1.303	2.40	6.594	0.924	0.380
19	0.4059	36.740	19.5	14.2	0.758	0.561	1.319	2.35	6.577	0.940	0.379
20	0.4297	36.710	19.4	15.0	0.750	0.572	1.322	2.31	6.566	0.947	0.375

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	137.960			154.680
Moisture content: Dry soil+tare, gms.	104.570			115.480
Moisture content: Tare, gms.	29.930			31.000
Moisture, %	44.7	46.0	46.0	46.4
Moist specimen weight, gms.	124.5			
Diameter, in.	1.41	1.41	1.41	
Area, in. ²	1.55	1.55	1.55	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	108.6	109.6	109.6	
Dry density, pcf	75.1	75.1	75.1	
Void ratio	1.2396	1.2396	1.2396	
Saturation, %	97.2	100.0	100.0	

Consolidation cell pressure = 7.133 tsf

Consolidation back pressure = 5.641 tsf

Consolidation effective confining stress = 1.492 tsf

Peak Stress = 1.482 tsf at reading no. 3

Ult. Stress = 1.093 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0483	20.810	0.0	0.0	0.000	1.492	1.492	1.00	5.641	1.492	0.000
1	0.0551	32.030	11.2	0.2	0.518	1.290	1.808	1.40	5.843	1.549	0.259
2	0.0764	50.790	30.0	1.0	1.374	0.995	2.369	2.38	6.138	1.682	0.687
3	0.1059	53.490	32.7	2.1	1.482	0.929	2.411	2.60	6.204	1.670	0.741
4	0.1372	51.630	30.8	3.2	1.382	0.928	2.310	2.49	6.205	1.619	0.691
5	0.1655	51.500	30.7	4.2	1.362	0.919	2.281	2.48	6.214	1.600	0.681
6	0.1957	51.870	31.1	5.3	1.363	0.903	2.266	2.51	6.230	1.584	0.681
7	0.2254	51.750	30.9	6.3	1.342	0.899	2.241	2.49	6.234	1.570	0.671
8	0.2558	51.750	30.9	7.4	1.327	0.908	2.235	2.46	6.225	1.571	0.663
9	0.2861	51.300	30.5	8.5	1.292	0.902	2.194	2.43	6.231	1.548	0.646
10	0.3165	51.800	31.0	9.6	1.298	0.918	2.216	2.41	6.215	1.567	0.649
11	0.3468	51.350	30.5	10.6	1.264	0.901	2.165	2.40	6.232	1.533	0.632
12	0.3775	50.660	29.8	11.7	1.220	0.897	2.117	2.36	6.236	1.507	0.610
13	0.4076	50.540	29.7	12.8	1.201	0.914	2.115	2.31	6.219	1.514	0.600
14	0.4386	50.140	29.3	13.9	1.169	0.909	2.078	2.29	6.224	1.494	0.585
15	0.4688	48.580	27.8	15.0	1.093	0.913	2.006	2.20	6.220	1.460	0.547

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	140.490			146.630
Moisture content: Dry soil+tare, gms.	104.220			108.420
Moisture content: Tare, gms.	30.400			30.200
Moisture, %	49.1	50.3	49.4	48.8
Moist specimen weight, gms.	119.8			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.53	1.53	1.52	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	106.5	107.3	107.8	
Dry density, pcf	71.4	71.4	72.2	
Void ratio	1.3543	1.3543	1.3292	
Saturation, %	97.7	100.0	100.0	

Consolidation cell pressure = 7.131 tsf

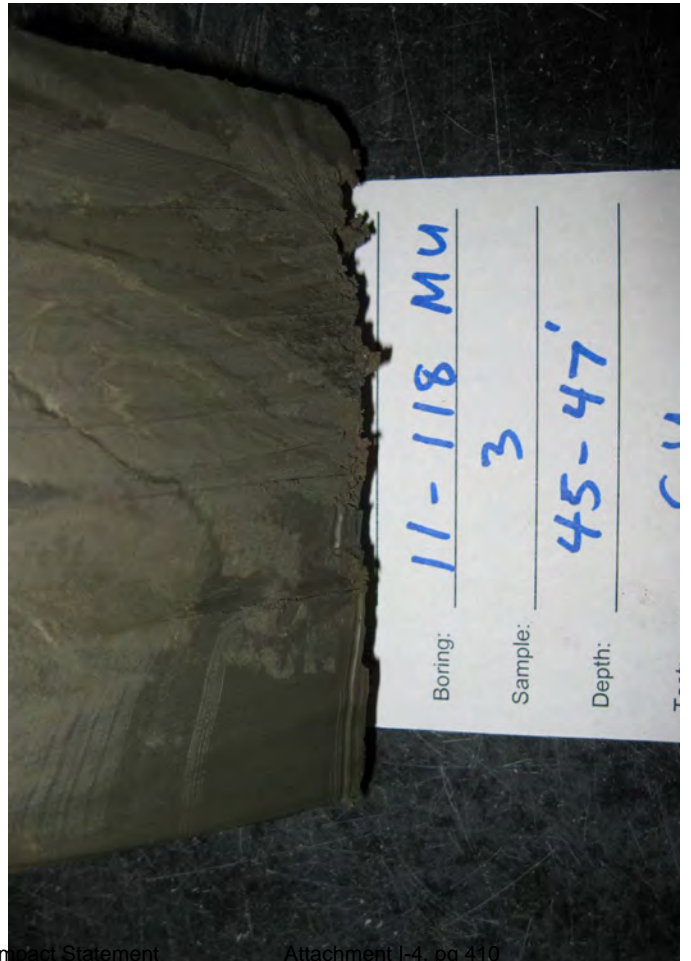
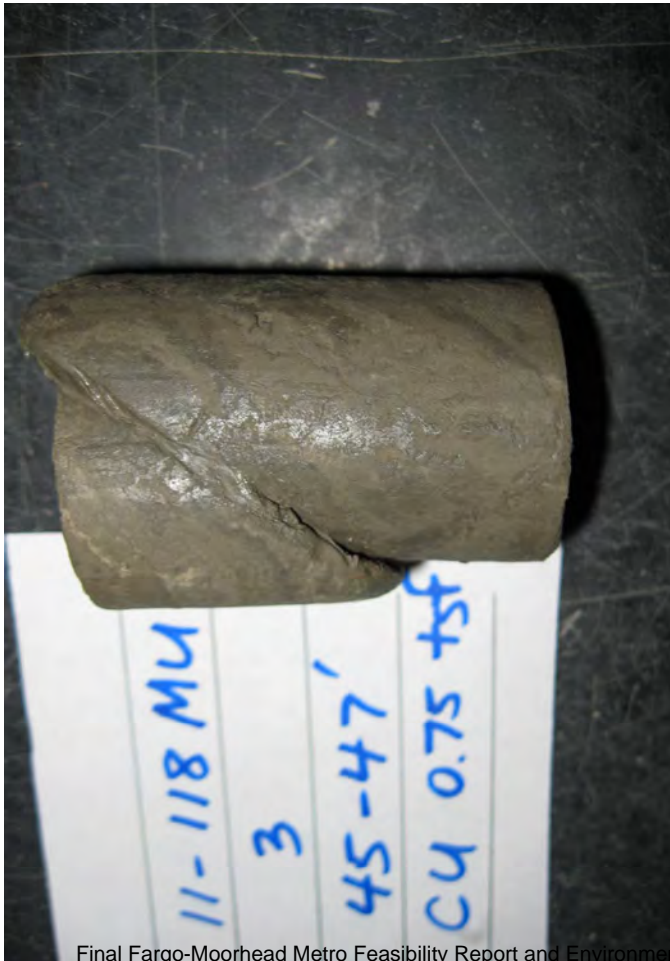
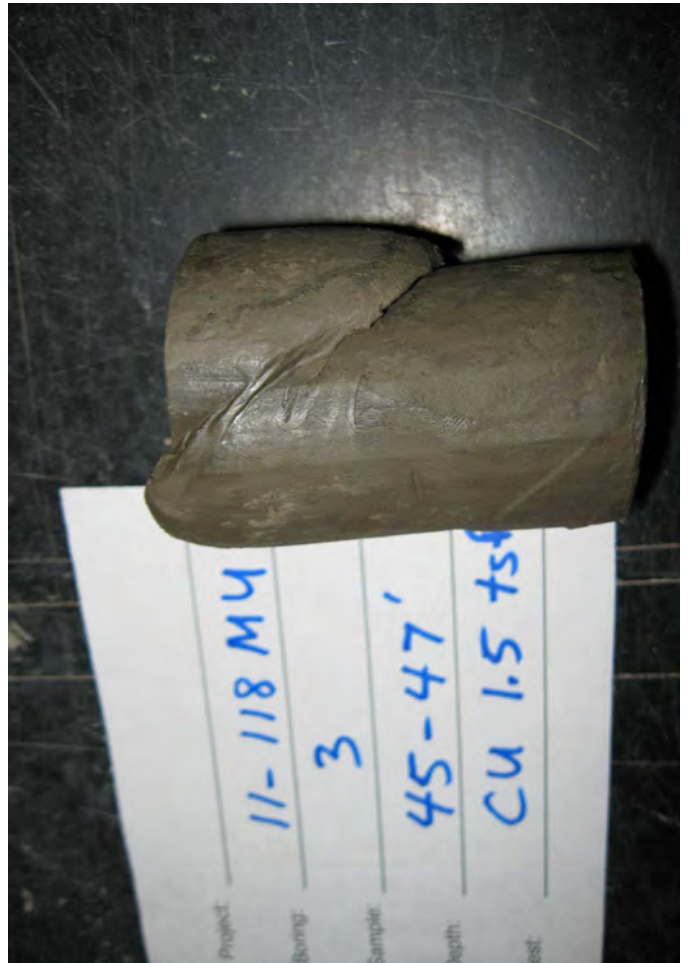
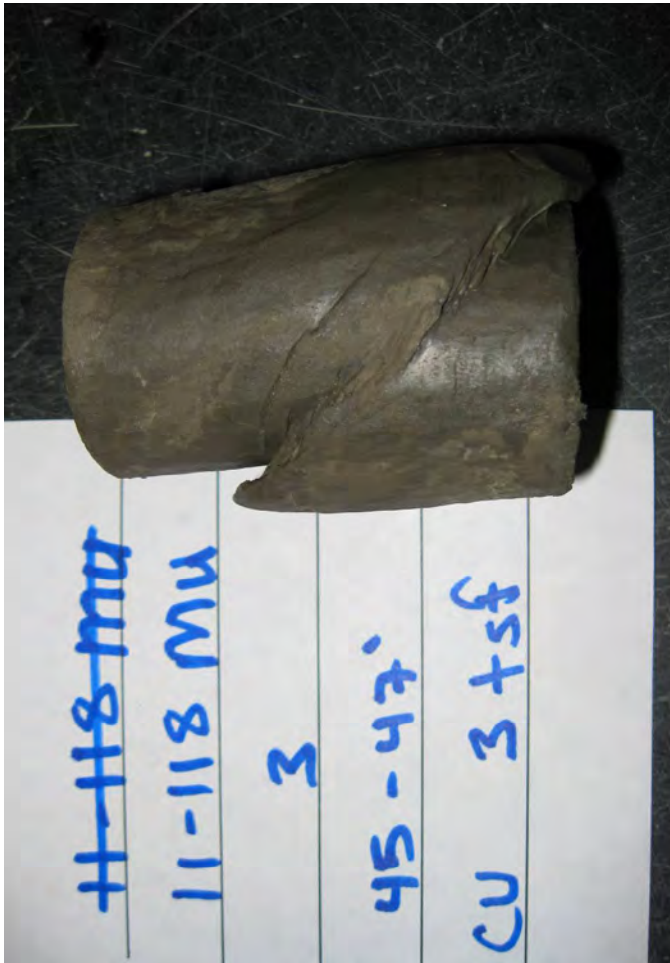
Consolidation back pressure = 4.112 tsf

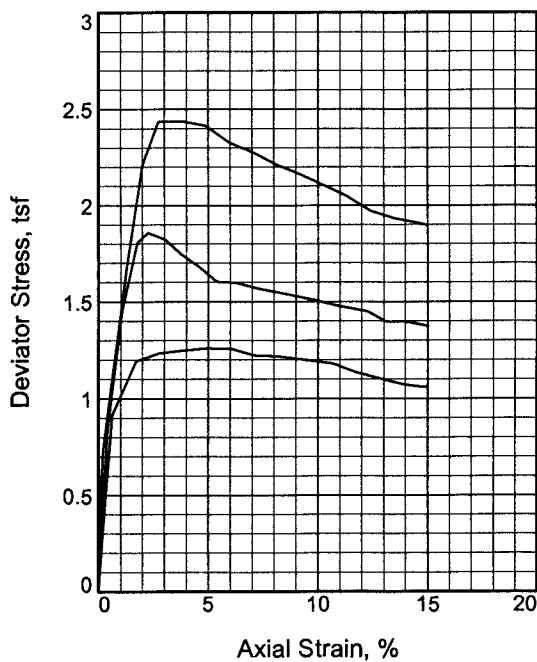
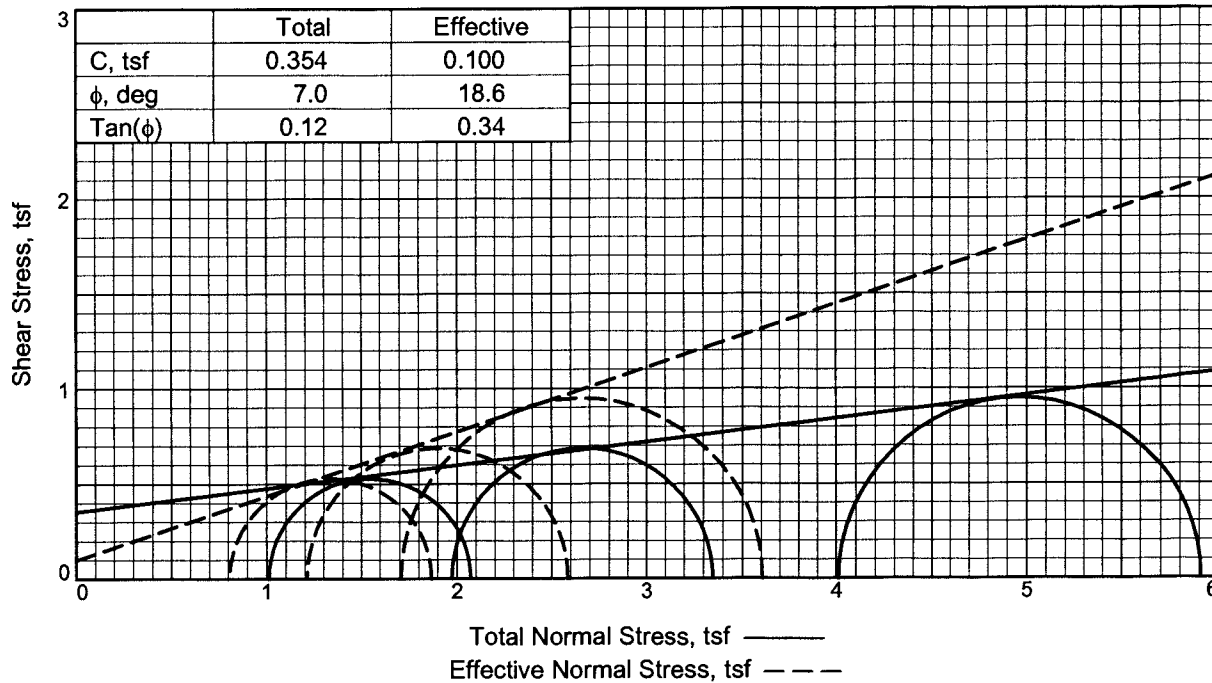
Consolidation effective confining stress = 3.019 tsf

Peak Stress = 1.499 tsf at reading no. 6

Ult. Stress = 1.322 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0294	17.600	0.0	0.0	0.000	3.019	3.019	1.00	4.112	3.019	0.000
1	0.0325	22.500	4.9	0.1	0.232	3.007	3.239	1.08	4.124	3.123	0.116
2	0.0385	32.520	14.9	0.3	0.705	2.969	3.674	1.24	4.162	3.321	0.352
3	0.0696	47.700	30.1	1.4	1.406	2.138	3.544	1.66	4.993	2.841	0.703
4	0.1000	49.860	32.3	2.5	1.490	2.099	3.589	1.71	5.032	2.844	0.745
5	0.1206	50.300	32.7	3.3	1.499	2.070	3.569	1.72	5.061	2.819	0.749
6	0.1509	50.680	33.1	4.4	1.499	1.999	3.498	1.75	5.132	2.749	0.750
7	0.1814	50.990	33.4	5.4	1.496	1.928	3.424	1.78	5.203	2.676	0.748
8	0.2114	51.020	33.4	6.5	1.480	1.857	3.337	1.80	5.274	2.597	0.740
9	0.2430	50.880	33.3	7.7	1.456	1.799	3.255	1.81	5.332	2.527	0.728
10	0.2734	50.440	32.8	8.7	1.420	1.757	3.177	1.81	5.374	2.467	0.710
11	0.3029	50.810	33.2	9.8	1.419	1.712	3.131	1.83	5.419	2.422	0.710
12	0.3334	50.730	33.1	10.9	1.399	1.664	3.063	1.84	5.467	2.363	0.699
13	0.3637	50.530	32.9	12.0	1.373	1.613	2.986	1.85	5.518	2.300	0.687
14	0.3942	50.630	33.0	13.1	1.360	1.575	2.935	1.86	5.556	2.255	0.680
15	0.4251	50.550	32.9	14.2	1.340	1.554	2.894	1.86	5.577	2.224	0.670
16	0.4472	50.430	32.8	15.0	1.322	1.523	2.845	1.87	5.608	2.184	0.661





Sample No.		1	2	3
Initial	Water Content, %	46.1	43.8	45.0
	Dry Density, pcf	74.4	76.9	74.9
	Saturation, %	98.9	99.7	97.5
	Void Ratio	1.2533	1.1803	1.2387
	Diameter, in.	1.39	1.39	1.41
At Test	Height, in.	2.81	2.81	2.80
	Water Content, %	46.6	43.1	44.8
	Dry Density, pcf	74.4	77.8	76.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2533	1.1571	1.2029
Diameter, in.	1.39	1.39	1.40	
Height, in.	2.81	2.80	2.79	
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		1.01	1.98	4.01
Back Pressure, tsf		6.12	5.15	3.12
Cell Pressure, tsf		7.13	7.13	7.13
Peak Deviator Stress, tsf		1.26	1.86	2.44
Total Pore Pr., tsf		6.52	6.06	4.87
Ultimate Deviator Stress, tsf		1.06	1.38	1.90
Total Pore Pr., tsf		6.33	5.92	5.42
Maj. Eff. Stress at Ultimate, tsf		1.87	2.59	3.61
Min. Eff. Stress at Ultimate, tsf		0.81	1.21	1.71

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 77 PL= 22 PI= 55

Specific Gravity= 2.687

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

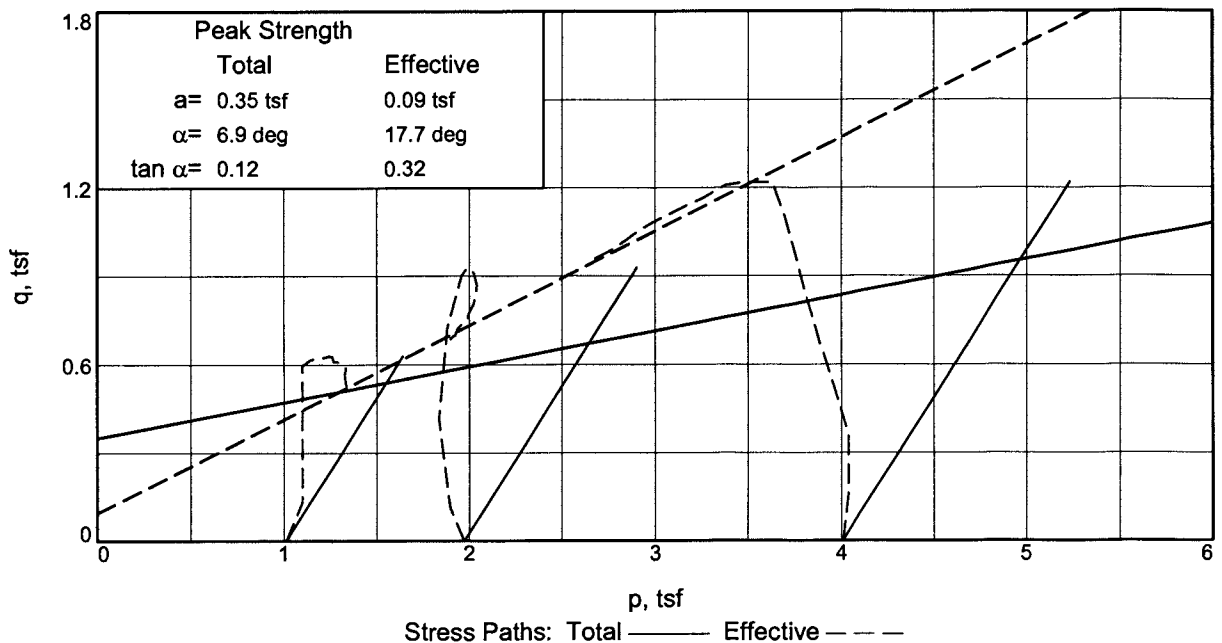
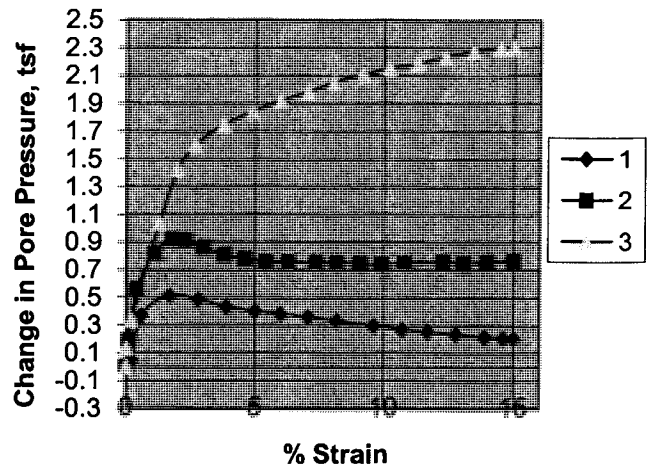
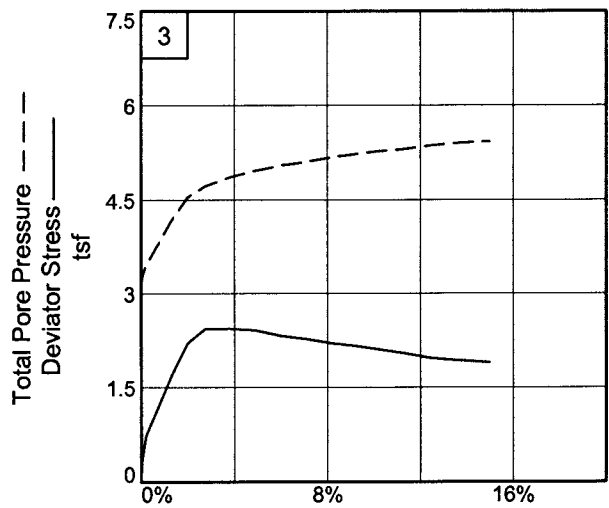
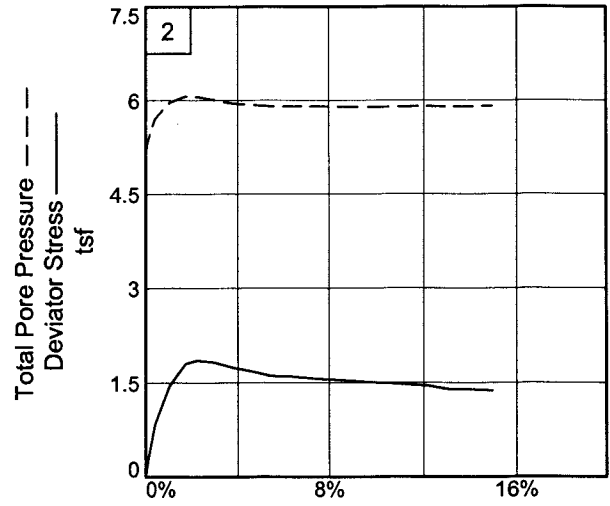
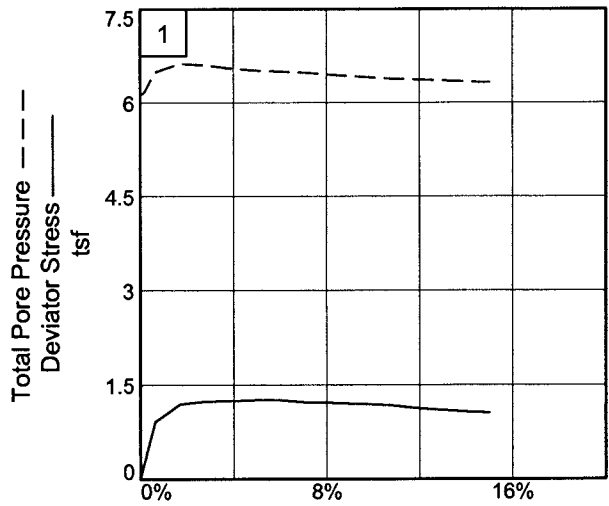
Location: Wild Rice, Argusvill Formation

Sample Number: Boring11-118MU, #4 **Depth:** 55-57'

Proj. No.: BL-10-10065

Date Sampled:





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusvill Formation

Depth: 55-57'

Sample Number: Boring11-118MU, #4

Project No. BI-10-10065 Fargo-Moorhead Metro Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/15/2011

11:46 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusvill Formation
Depth: 55-57' **Sample Number:** Boring11-118MU, #4
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.687 **LL**=77 **PL**=22 **PI**=55
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.590			152.920
Moisture content: Dry soil+tare, gms.	115.280			113.690
Moisture content: Tare, gms.	30.100			30.300
Moisture, %	46.1	46.6	46.6	47.0
Moist specimen weight, gms.	122.0			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.52	1.52	1.52	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	108.8	109.2	109.2	
Dry density, pcf	74.4	74.4	74.4	
Void ratio	1.2533	1.2533	1.2533	
Saturation, %	98.9	100.0	100.0	

Consolidation cell pressure = 7.134 tsf
Consolidation back pressure = 6.122 tsf
Consolidation effective confining stress = 1.012 tsf
Peak Stress = 1.260 tsf at reading no. 6
Ult. Stress = 1.059 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0441	18.090	0.0	0.0	0.000	1.012	1.012	1.00	6.122	1.012	0.000
1	0.0490	23.670	5.6	0.2	0.264	0.968	1.232	1.27	6.166	1.100	0.132
2	0.0618	37.540	19.4	0.6	0.916	0.642	1.558	2.43	6.492	1.100	0.458
3	0.0922	43.740	25.7	1.7	1.194	0.503	1.697	3.37	6.631	1.100	0.597
4	0.1225	44.920	26.8	2.8	1.236	0.528	1.764	3.34	6.606	1.146	0.618
5	0.1528	45.510	27.4	3.9	1.249	0.582	1.831	3.15	6.552	1.206	0.624
6	0.1833	46.070	28.0	5.0	1.260	0.614	1.874	3.05	6.520	1.244	0.630
7	0.2136	46.350	28.3	6.0	1.258	0.632	1.890	2.99	6.502	1.261	0.629
8	0.2441	45.910	27.8	7.1	1.224	0.654	1.878	2.87	6.480	1.266	0.612
9	0.2743	46.120	28.0	8.2	1.219	0.682	1.901	2.79	6.452	1.292	0.610
10	0.3144	46.040	27.9	9.6	1.197	0.717	1.914	2.67	6.417	1.315	0.598
11	0.3441	45.970	27.9	10.7	1.180	0.745	1.925	2.58	6.389	1.335	0.590
12	0.3744	45.240	27.2	11.7	1.135	0.759	1.894	2.50	6.375	1.327	0.568
13	0.4046	44.840	26.8	12.8	1.105	0.777	1.882	2.42	6.357	1.329	0.552
14	0.4363	44.400	26.3	13.9	1.073	0.796	1.869	2.35	6.338	1.332	0.536
15	0.4559	44.370	26.3	14.6	1.063	0.803	1.866	2.32	6.331	1.334	0.531
16	0.4658	44.390	26.3	15.0	1.059	0.808	1.867	2.31	6.326	1.338	0.530

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	135.290			153.920
Moisture content: Dry soil+tare, gms.	103.340			117.040
Moisture content: Tare, gms.	30.410			29.760
Moisture, %	43.8	43.9	43.1	42.3
Moist specimen weight, gms.	124.5			
Diameter, in.	1.39	1.39	1.39	
Area, in. ²	1.53	1.53	1.52	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	110.6	110.7	111.3	
Dry density, pcf	76.9	76.9	77.8	
Void ratio	1.1803	1.1803	1.1571	
Saturation, %	99.7	100.0	100.0	

Consolidation cell pressure = 7.125 tsf

Consolidation back pressure = 5.152 tsf

Consolidation effective confining stress = 1.973 tsf

Peak Stress = 1.858 tsf at reading no. 5

Ult. Stress = 1.375 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0075	20.500	0.0	0.0	0.000	1.973	1.973	1.00	5.152	1.973	0.000
1	0.0104	25.350	4.9	0.1	0.230	1.781	2.011	1.13	5.344	1.896	0.115
2	0.0191	38.140	17.6	0.4	0.835	1.419	2.254	1.59	5.706	1.836	0.417
3	0.0372	51.300	30.8	1.1	1.448	1.157	2.605	2.25	5.968	1.881	0.724
4	0.0571	59.200	38.7	1.8	1.806	1.056	2.862	2.71	6.069	1.959	0.903
5	0.0711	60.510	40.0	2.3	1.858	1.061	2.919	2.75	6.064	1.990	0.929
6	0.0920	60.060	39.6	3.0	1.823	1.113	2.936	2.64	6.012	2.024	0.911
7	0.1130	58.650	38.1	3.8	1.744	1.167	2.911	2.49	5.958	2.039	0.872
8	0.1358	57.610	37.1	4.6	1.682	1.195	2.877	2.41	5.930	2.036	0.841
9	0.1587	56.180	35.7	5.4	1.604	1.219	2.823	2.32	5.906	2.021	0.802
10	0.1828	56.390	35.9	6.3	1.598	1.218	2.816	2.31	5.907	2.017	0.799
11	0.2144	56.090	35.6	7.4	1.566	1.220	2.786	2.28	5.905	2.003	0.783
12	0.2375	56.000	35.5	8.2	1.548	1.222	2.770	2.27	5.903	1.996	0.774
13	0.2614	55.840	35.3	9.1	1.527	1.229	2.756	2.24	5.896	1.992	0.763
14	0.2852	55.680	35.2	9.9	1.506	1.233	2.739	2.22	5.892	1.986	0.753
15	0.3102	55.450	35.0	10.8	1.481	1.224	2.705	2.21	5.901	1.965	0.741
16	0.3511	55.260	34.8	12.3	1.449	1.213	2.662	2.19	5.912	1.937	0.724
17	0.3749	54.320	33.8	13.1	1.396	1.225	2.621	2.14	5.900	1.923	0.698
18	0.3990	54.710	34.2	14.0	1.398	1.218	2.616	2.15	5.907	1.917	0.699
19	0.4279	54.560	34.1	15.0	1.375	1.210	2.585	2.14	5.915	1.898	0.688

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	110.950			151.530
Moisture content: Dry soil+tare, gms.	85.870			114.750
Moisture content: Tare, gms.	30.080			29.910
Moisture, %	45.0	46.1	44.8	43.4
Moist specimen weight, gms.	124.3			
Diameter, in.	1.41	1.41	1.40	
Area, in. ²	1.55	1.55	1.54	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	108.6	109.5	110.2	
Dry density, pcf	74.9	74.9	76.1	
Void ratio	1.2387	1.2387	1.2029	
Saturation, %	97.5	100.0	100.0	

Consolidation cell pressure = 7.132 tsf

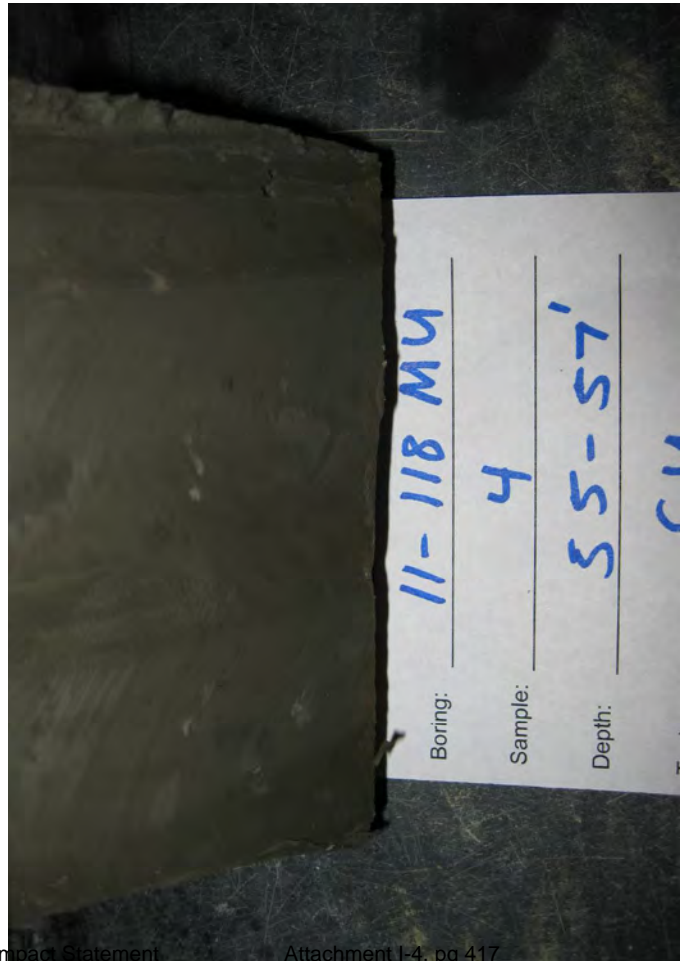
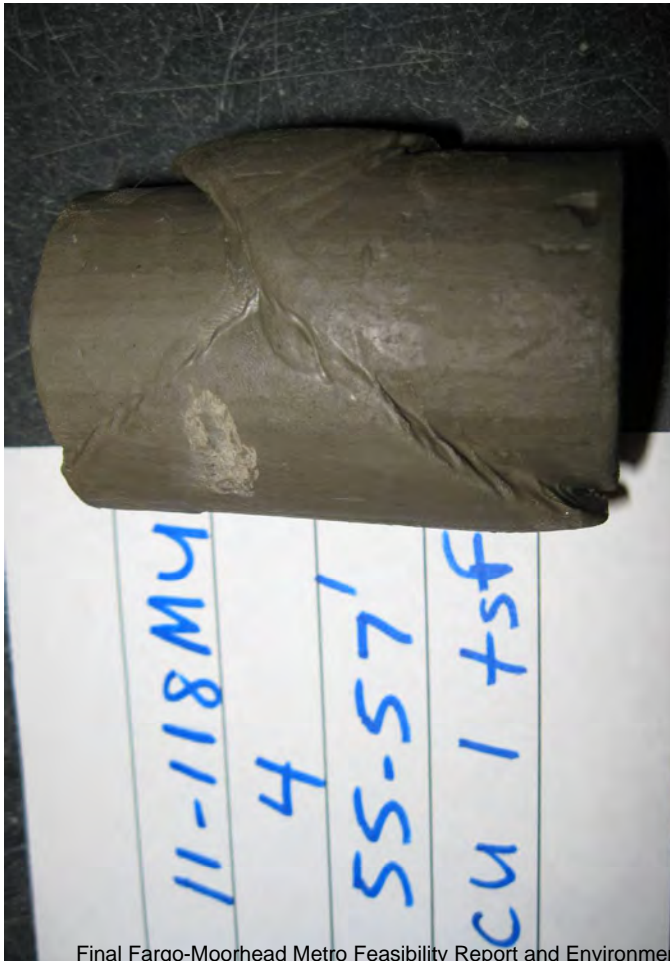
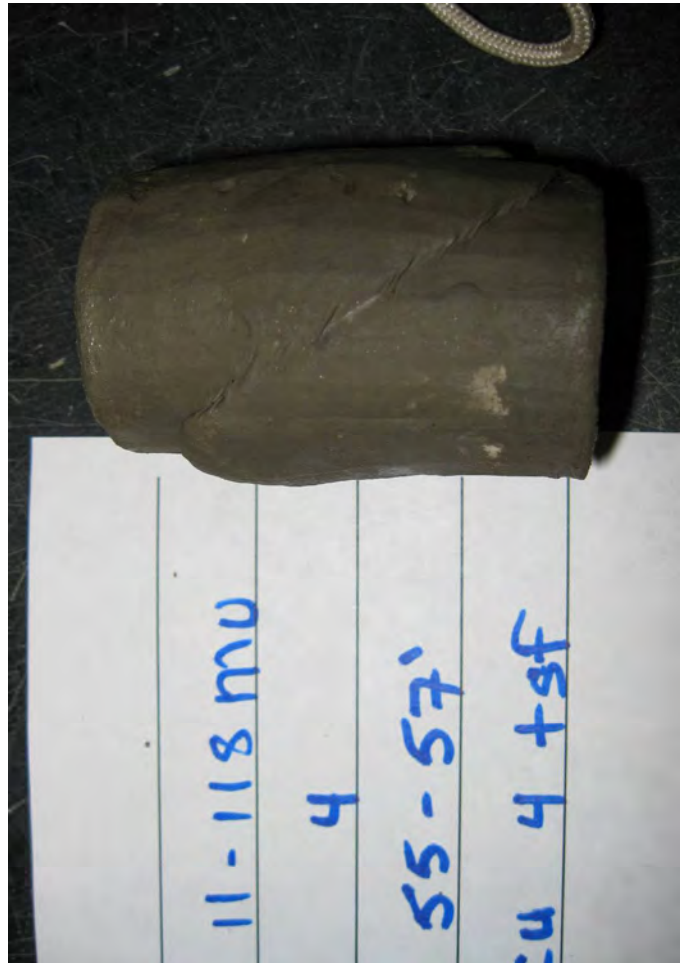
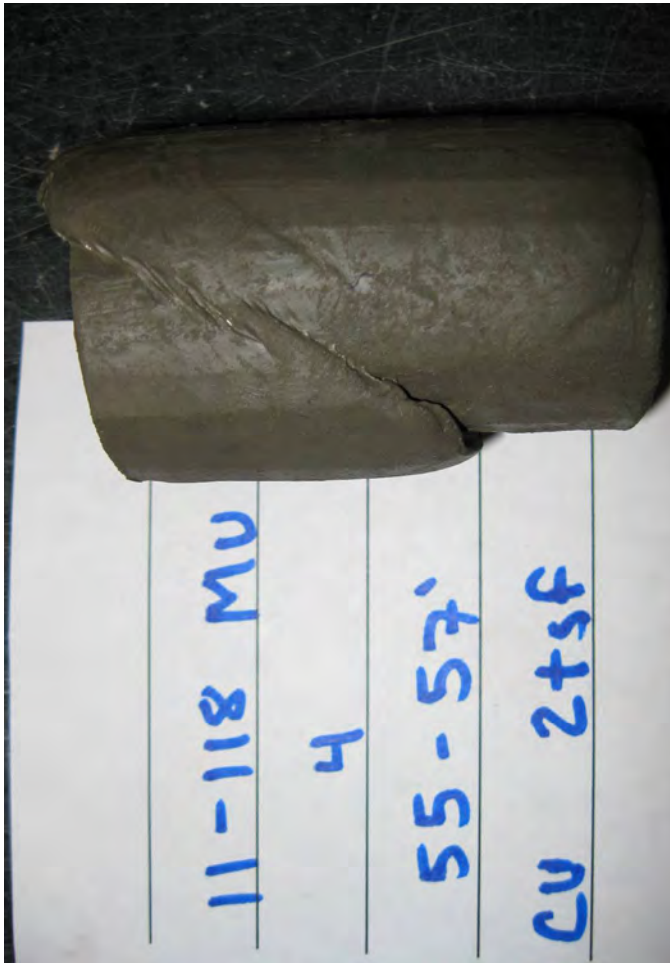
Consolidation back pressure = 3.120 tsf

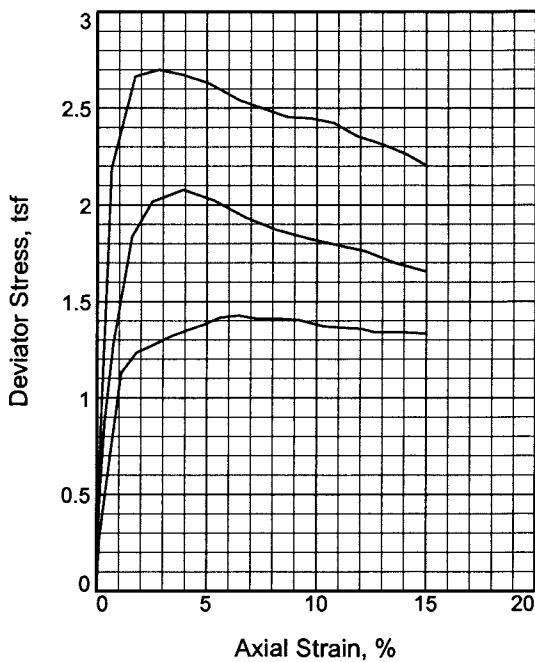
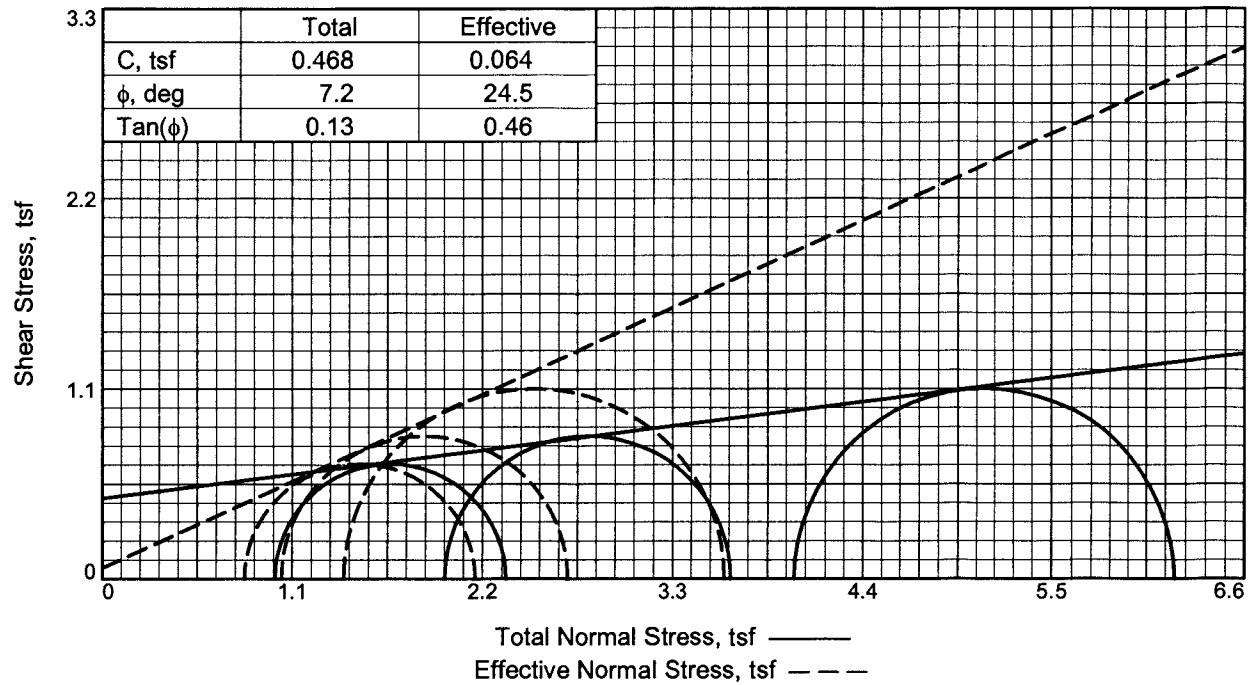
Consolidation effective confining stress = 4.012 tsf

Peak Stress = 2.438 tsf at reading no. 6

Ult. Stress = 1.898 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0530	17.350	0.0	0.0	0.000	4.012	4.012	1.00	3.120	4.012	0.000
1	0.0540	24.100	6.8	0.0	0.316	3.882	4.198	1.08	3.250	4.040	0.158
2	0.0587	32.920	15.6	0.2	0.727	3.677	4.404	1.20	3.455	4.041	0.364
3	0.0884	53.480	36.1	1.3	1.670	2.975	4.645	1.56	4.157	3.810	0.835
4	0.1088	65.490	48.1	2.0	2.208	2.590	4.798	1.85	4.542	3.694	1.104
5	0.1293	70.850	53.5	2.7	2.436	2.412	4.848	2.01	4.720	3.630	1.218
6	0.1598	71.510	54.2	3.8	2.438	2.264	4.702	2.08	4.868	3.483	1.219
7	0.1892	71.600	54.2	4.9	2.415	2.170	4.585	2.11	4.962	3.378	1.208
8	0.2194	70.230	52.9	6.0	2.328	2.090	4.418	2.11	5.042	3.254	1.164
9	0.2498	69.710	52.4	7.1	2.278	2.028	4.306	2.12	5.104	3.167	1.139
10	0.2802	68.800	51.4	8.1	2.212	1.958	4.170	2.13	5.174	3.064	1.106
11	0.3088	68.240	50.9	9.2	2.164	1.905	4.069	2.14	5.227	2.987	1.082
12	0.3382	67.510	50.2	10.2	2.108	1.858	3.966	2.13	5.274	2.912	1.054
13	0.3685	66.690	49.3	11.3	2.048	1.825	3.873	2.12	5.307	2.849	1.024
14	0.3989	65.400	48.1	12.4	1.970	1.773	3.743	2.11	5.359	2.758	0.985
15	0.4294	65.080	47.7	13.5	1.933	1.734	3.667	2.11	5.398	2.700	0.966
16	0.4588	65.090	47.7	14.5	1.910	1.710	3.620	2.12	5.422	2.665	0.955
17	0.4707	65.030	47.7	15.0	1.898	1.708	3.606	2.11	5.424	2.657	0.949





Sample No.	1	2	3	
Initial	Water Content, %	39.2	39.1	38.5
	Dry Density, pcf	81.5	81.6	82.1
	Saturation, %	99.2	99.3	98.9
	Void Ratio	1.0651	1.0611	1.0482
	Diameter, in.	1.38	1.38	1.39
	Height, in.	2.81	2.82	2.81
At Test	Water Content, %	38.7	38.7	37.3
	Dry Density, pcf	82.3	82.3	83.9
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0431	1.0436	1.0046
	Diameter, in.	1.38	1.37	1.38
	Height, in.	2.80	2.82	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	1.00	1.98	4.01	
Back Pressure, tsf	6.13	5.15	3.13	
Cell Pressure, tsf	7.13	7.13	7.14	
Peak Deviator Stress, tsf	1.43	2.08	2.70	
Total Pore Pr., tsf	6.41	6.01	5.00	
Ultimate Deviator Stress, tsf	1.33	1.66	2.21	
Total Pore Pr., tsf	6.30	6.10	5.74	
Maj. Eff. Stress at Ultimate, tsf	2.16	2.69	3.60	
Min. Eff. Stress at Ultimate, tsf	0.82	1.04	1.40	

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 61 PL= 20 PI= 41

Specific Gravity= 2.695

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

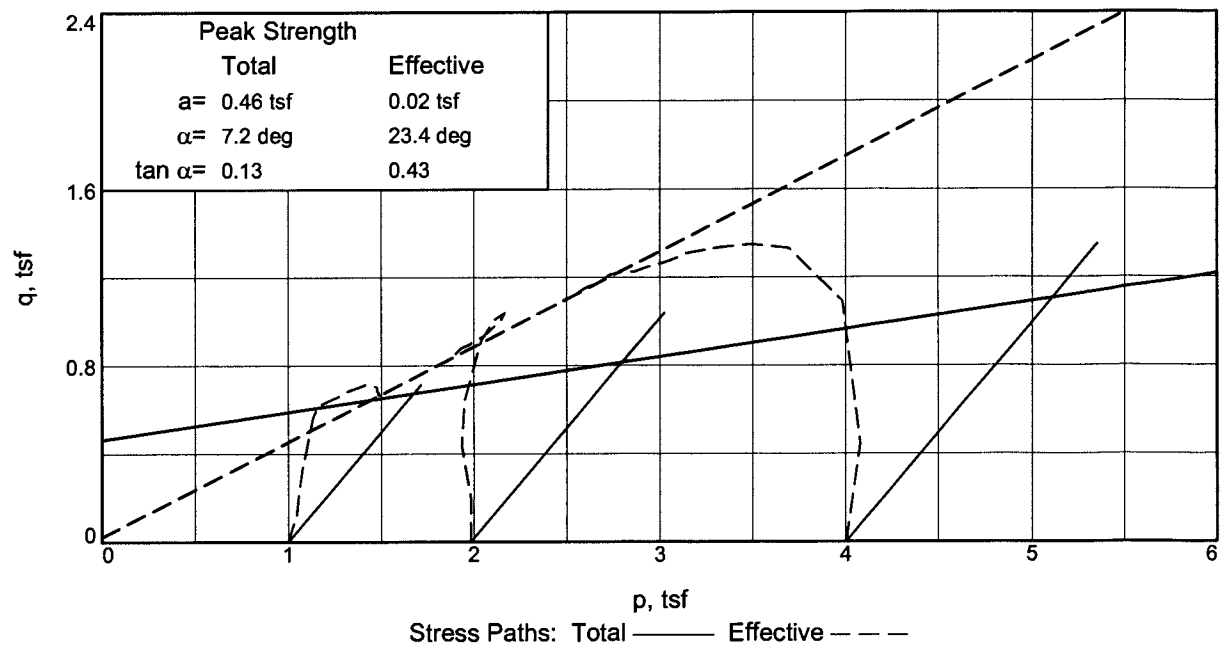
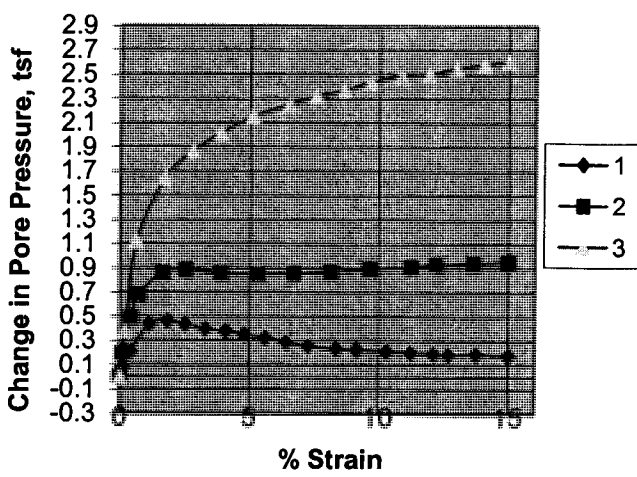
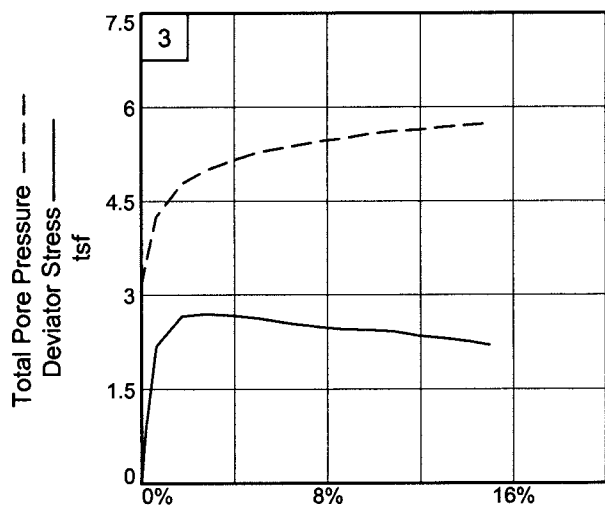
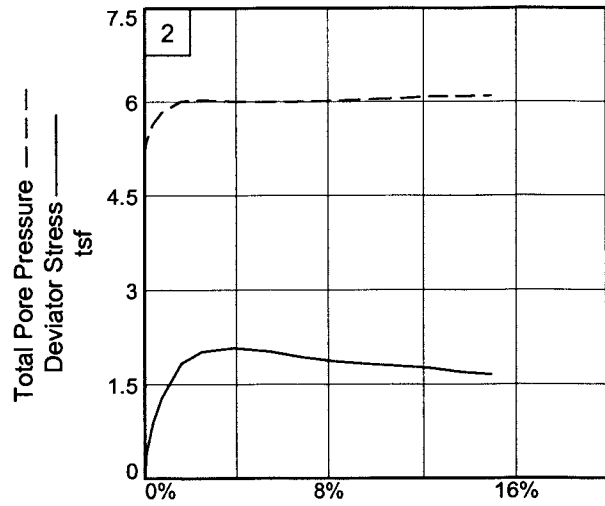
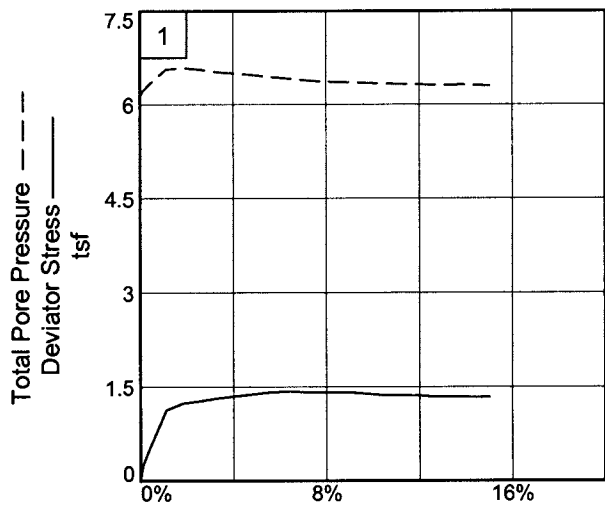
Location: Wild Rice, Argusville Formation

Sample Number: Boring11-118, #5 **Depth:** 65-67'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusville Formation

Depth: 65-67'

Sample Number: Boring11-118, #5

Project No.: BL 010065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

5/15/2011

11:47 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusville Formation
Depth: 65-67' **Sample Number:** Boring 11-118, #5
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.695 **LL**=61 **PL**=20 **PI**=41
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	134.810			153.820
Moisture content: Dry soil+tare, gms.	105.490			120.620
Moisture content: Tare, gms.	30.710			30.500
Moisture, %	39.2	39.5	38.7	36.8
Moist specimen weight, gms.	126.0			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.49	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	113.4	113.7	114.2	
Dry density, pcf	81.5	81.5	82.3	
Void ratio	1.0651	1.0651	1.0431	
Saturation, %	99.2	100.0	100.0	

Consolidation cell pressure = 7.129 tsf
Consolidation back pressure = 6.129 tsf
Consolidation effective confining stress = 1.000 tsf
Peak Stress = 1.429 tsf at reading no. 10
Ult. Stress = 1.334 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0097	17.710	0.0	0.0	0.000	0.998	0.998	1.00	6.131	0.998	0.000
1	0.0125	22.970	5.3	0.1	0.253	0.920	1.173	1.28	6.209	1.047	0.127
2	0.0215	29.050	11.3	0.4	0.544	0.792	1.336	1.69	6.337	1.064	0.272
3	0.0403	41.400	23.7	1.1	1.129	0.568	1.697	2.99	6.561	1.133	0.565
4	0.0602	43.820	26.1	1.8	1.236	0.542	1.778	3.28	6.587	1.160	0.618
5	0.0811	44.830	27.1	2.5	1.274	0.568	1.842	3.24	6.561	1.205	0.637
6	0.1020	45.960	28.3	3.3	1.317	0.606	1.923	3.17	6.523	1.264	0.658
7	0.1238	46.900	29.2	4.1	1.350	0.625	1.975	3.16	6.504	1.300	0.675
8	0.1447	47.760	30.0	4.8	1.379	0.651	2.030	3.12	6.478	1.340	0.689
9	0.1670	48.890	31.2	5.6	1.419	0.681	2.100	3.08	6.448	1.390	0.709
10	0.1905	49.390	31.7	6.4	1.429	0.715	2.144	3.00	6.414	1.429	0.714
11	0.2136	49.290	31.6	7.3	1.412	0.746	2.158	2.89	6.383	1.452	0.706
12	0.2443	49.680	32.0	8.4	1.412	0.766	2.178	2.84	6.363	1.472	0.706
13	0.2672	49.780	32.1	9.2	1.404	0.775	2.179	2.81	6.354	1.477	0.702
14	0.2994	49.430	31.7	10.3	1.371	0.791	2.162	2.73	6.338	1.477	0.686
15	0.3244	49.590	31.9	11.2	1.364	0.800	2.164	2.71	6.329	1.482	0.682
16	0.3482	49.760	32.0	12.1	1.358	0.808	2.166	2.68	6.321	1.487	0.679
17	0.3651	49.560	31.9	12.7	1.341	0.814	2.155	2.65	6.315	1.484	0.670
18	0.3980	50.010	32.3	13.8	1.341	0.812	2.153	2.65	6.317	1.483	0.671
19	0.4310	50.270	32.6	15.0	1.334	0.824	2.158	2.62	6.305	1.491	0.667

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	121.170			155.290
Moisture content: Dry soil+tare, gms.	95.620			120.760
Moisture content: Tare, gms.	30.300			30.540
Moisture, %	39.1	39.4	38.7	38.3
Moist specimen weight, gms.	125.5			
Diameter, in.	1.38	1.38	1.37	
Area, in. ²	1.49	1.49	1.48	
Height, in.	2.82	2.82	2.82	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	113.6	113.8	114.2	
Dry density, pcf	81.6	81.6	82.3	
Void ratio	1.0611	1.0611	1.0436	
Saturation, %	99.3	100.0	100.0	

Consolidation cell pressure = 7.135 tsf

Consolidation back pressure = 5.152 tsf

Consolidation effective confining stress = 1.983 tsf

Peak Stress = 2.080 tsf at reading no. 6

Ult. Stress = 1.656 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0086	20.510	0.0	0.0	0.000	1.983	1.983	1.00	5.152	1.983	0.000
1	0.0107	28.500	8.0	0.1	0.388	1.791	2.179	1.22	5.344	1.985	0.194
2	0.0185	38.660	18.1	0.4	0.878	1.496	2.374	1.59	5.639	1.935	0.439
3	0.0294	47.180	26.7	0.7	1.285	1.307	2.592	1.98	5.828	1.950	0.643
4	0.0532	58.930	38.4	1.6	1.836	1.124	2.960	2.63	6.011	2.042	0.918
5	0.0792	63.140	42.6	2.5	2.018	1.101	3.119	2.83	6.034	2.110	1.009
6	0.1189	65.090	44.6	3.9	2.080	1.128	3.208	2.84	6.007	2.168	1.040
7	0.1587	64.510	44.0	5.3	2.022	1.137	3.159	2.78	5.998	2.148	1.011
8	0.1986	63.290	42.8	6.7	1.937	1.129	3.066	2.72	6.006	2.097	0.968
9	0.2396	62.470	42.0	8.2	1.870	1.118	2.988	2.67	6.017	2.053	0.935
10	0.2813	62.130	41.6	9.7	1.825	1.094	2.919	2.67	6.041	2.007	0.913
11	0.3231	61.920	41.4	11.2	1.786	1.076	2.862	2.66	6.059	1.969	0.893
12	0.3511	61.830	41.3	12.2	1.762	1.054	2.816	2.67	6.081	1.935	0.881
13	0.3930	60.970	40.5	13.7	1.696	1.046	2.742	2.62	6.089	1.894	0.848
14	0.4309	60.640	40.1	15.0	1.656	1.037	2.693	2.60	6.098	1.865	0.828

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	143.560			154.540
Moisture content: Dry soil+tare, gms.	112.060			121.740
Moisture content: Tare, gms.	30.140			30.390
Moisture, %	38.5	38.9	37.3	35.9
Moist specimen weight, gms.	127.3			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.50	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	113.7	114.1	115.2	
Dry density, pcf	82.1	82.1	83.9	
Void ratio	1.0482	1.0482	1.0046	
Saturation, %	98.9	100.0	100.0	

Consolidation cell pressure = 7.138 tsf

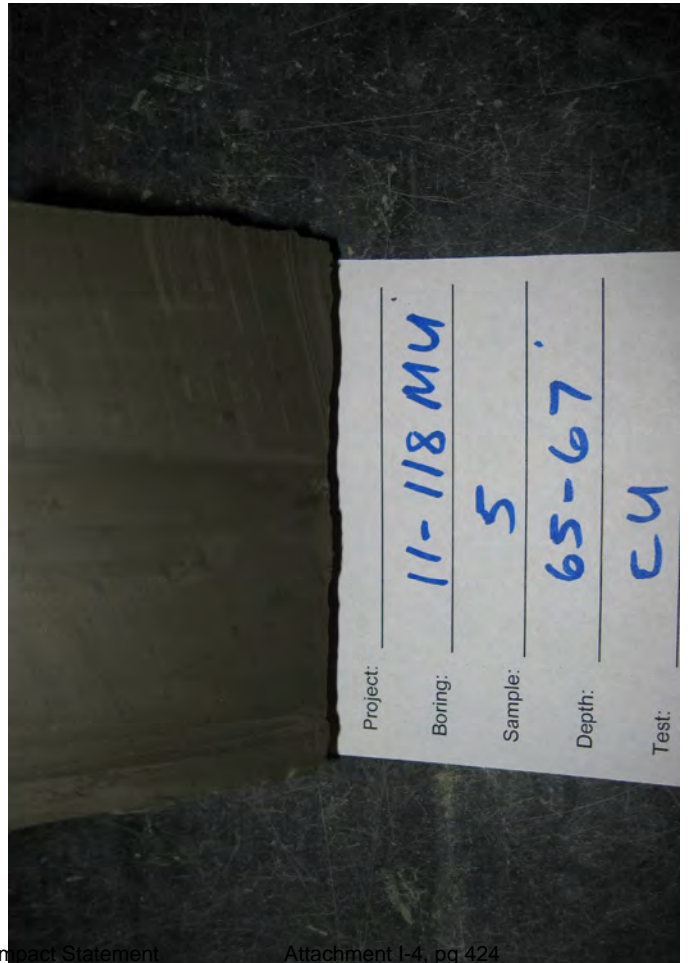
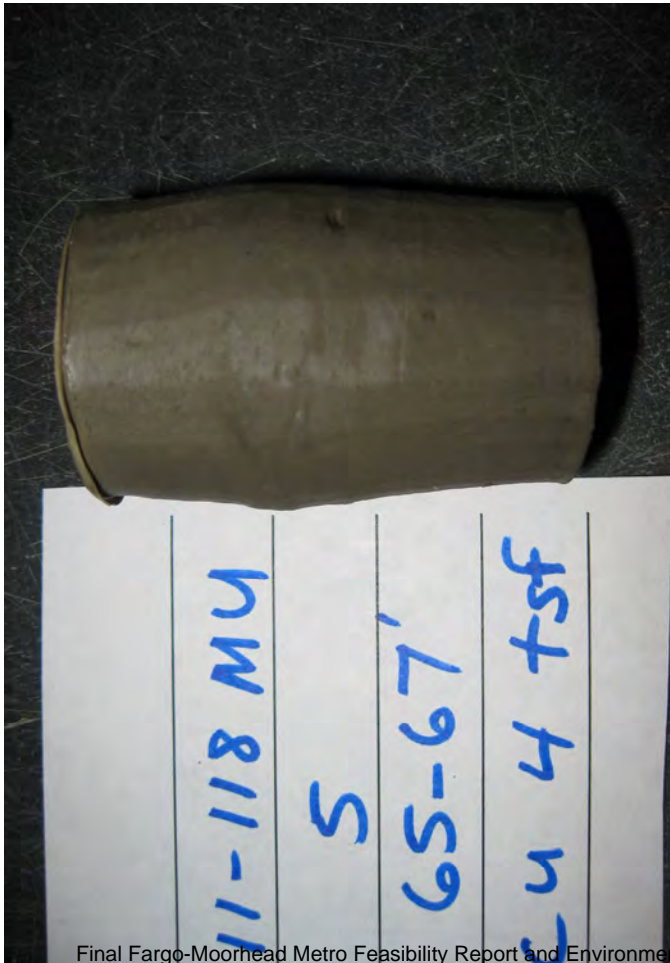
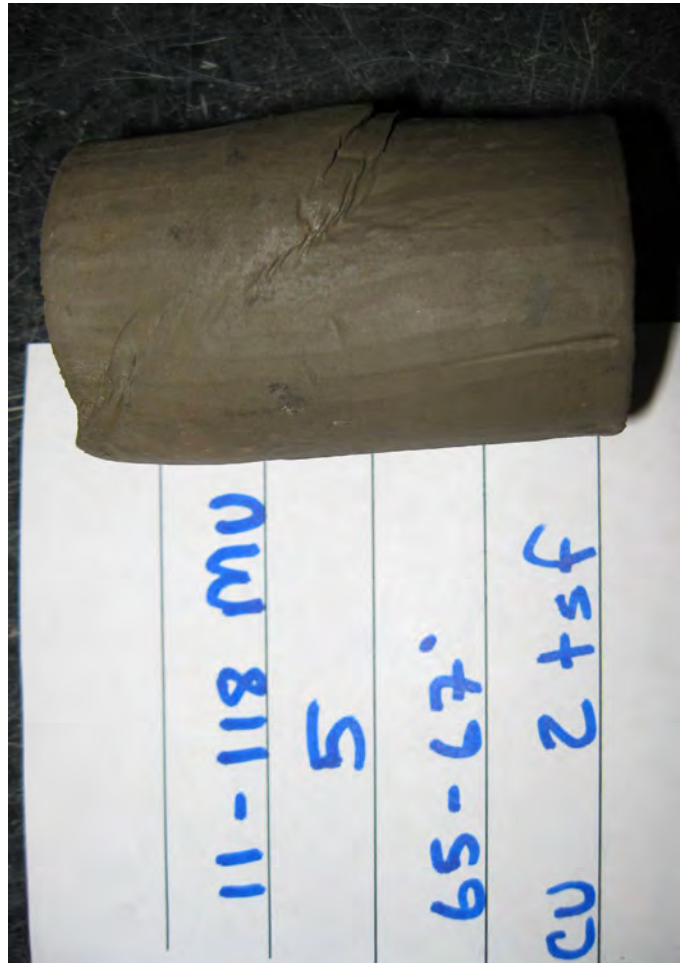
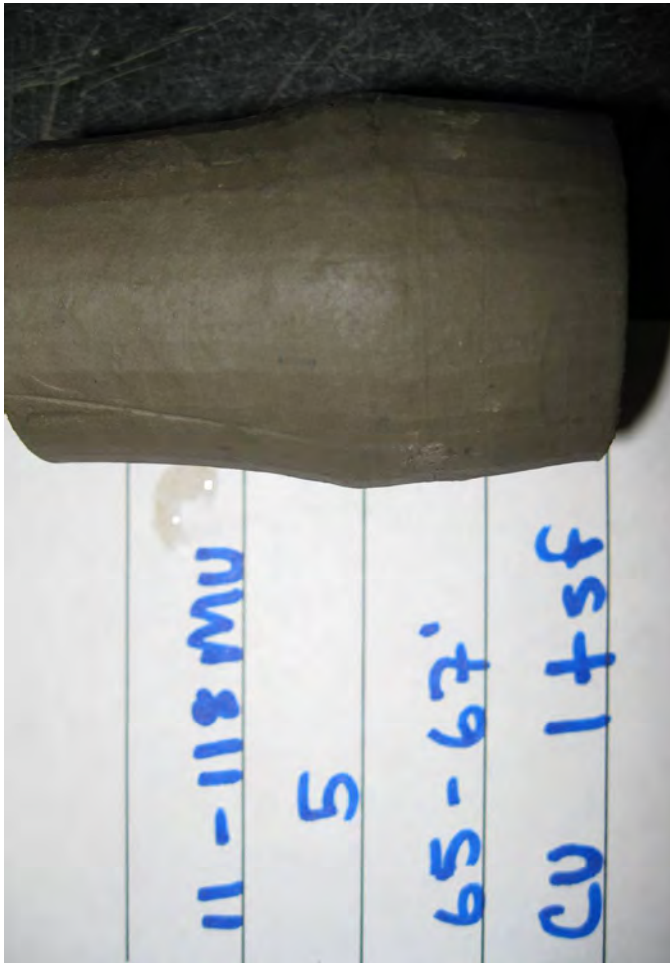
Consolidation back pressure = 3.133 tsf

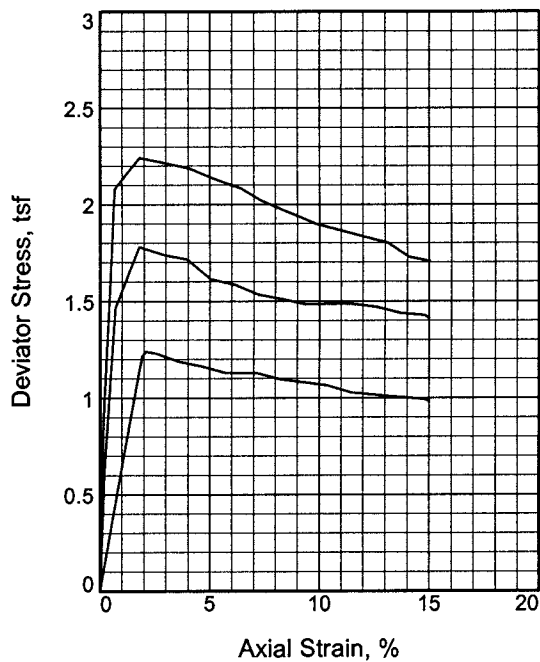
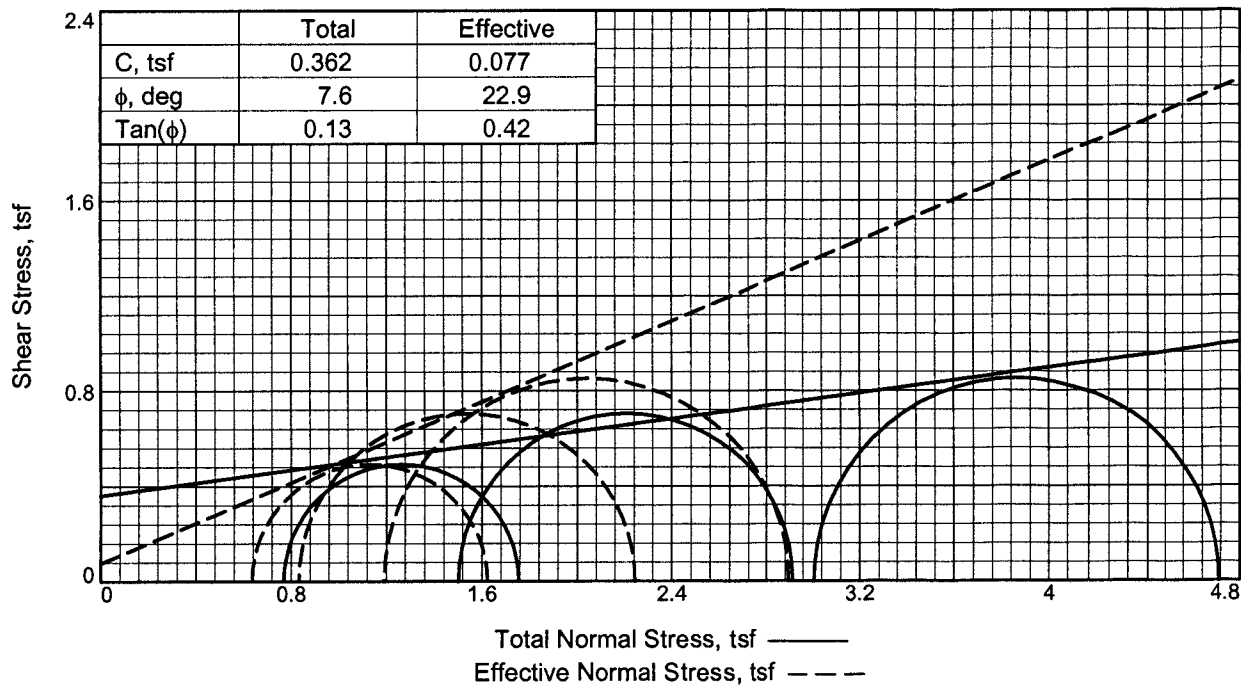
Consolidation effective confining stress = 4.005 tsf

Peak Stress = 2.699 tsf at reading no. 4

Ult. Stress = 2.205 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0219	18.260	0.0	0.0	0.000	4.005	4.005	1.00	3.133	4.005	0.000
1	0.0270	36.840	18.6	0.2	0.891	3.634	4.525	1.25	3.504	4.080	0.446
2	0.0396	64.060	45.8	0.6	2.187	2.890	5.077	1.76	4.248	3.984	1.094
3	0.0700	74.680	56.4	1.7	2.665	2.361	5.026	2.13	4.777	3.693	1.332
4	0.1000	76.040	57.8	2.8	2.699	2.140	4.839	2.26	4.998	3.490	1.350
5	0.1305	76.150	57.9	3.9	2.674	1.993	4.667	2.34	5.145	3.330	1.337
6	0.1630	75.930	57.7	5.1	2.632	1.854	4.486	2.42	5.284	3.170	1.316
7	0.2031	74.800	56.5	6.5	2.541	1.758	4.299	2.45	5.380	3.028	1.270
8	0.2332	74.470	56.2	7.6	2.497	1.686	4.183	2.48	5.452	2.934	1.248
9	0.2635	74.180	55.9	8.7	2.455	1.638	4.093	2.50	5.500	2.865	1.227
10	0.2933	74.680	56.4	9.7	2.448	1.570	4.018	2.56	5.568	2.794	1.224
11	0.3224	74.790	56.5	10.8	2.424	1.521	3.945	2.59	5.617	2.733	1.212
12	0.3528	73.850	55.6	11.9	2.355	1.501	3.856	2.57	5.637	2.678	1.177
13	0.3843	73.580	55.3	13.0	2.313	1.454	3.767	2.59	5.684	2.611	1.157
14	0.4147	73.030	54.8	14.1	2.261	1.426	3.687	2.59	5.712	2.557	1.131
15	0.4393	72.220	54.0	15.0	2.205	1.397	3.602	2.58	5.741	2.500	1.103





Sample No.		1	2	3
Initial	Water Content, %	43.6	43.0	40.0
	Dry Density, pcf	77.3	78.0	81.0
	Saturation, %	99.9	100.0	100.0
	Void Ratio	1.1775	1.1596	1.0800
	Diameter, in.	1.39	1.40	1.40
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	42.8	41.7	38.6
	Dry Density, pcf	78.2	79.3	82.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1543	1.1250	1.0402
	Diameter, in.	1.38	1.39	1.39
	Height, in.	2.79	2.79	2.79
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.77	1.50	3.00
Back Pressure, tsf		6.36	5.63	4.13
Cell Pressure, tsf		7.13	7.13	7.13
Peak Deviator Stress, tsf		1.24	1.78	2.24
Total Pore Pr., tsf		6.67	6.23	5.43
Ultimate Deviator Stress, tsf		0.99	1.41	1.70
Total Pore Pr., tsf		6.49	6.30	5.94
Maj. Eff. Stress at Ultimate, tsf		1.62	2.24	2.89
Min. Eff. Stress at Ultimate, tsf		0.64	0.83	1.19

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 56 PL= 22 PI= 34

Specific Gravity= 2.698

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

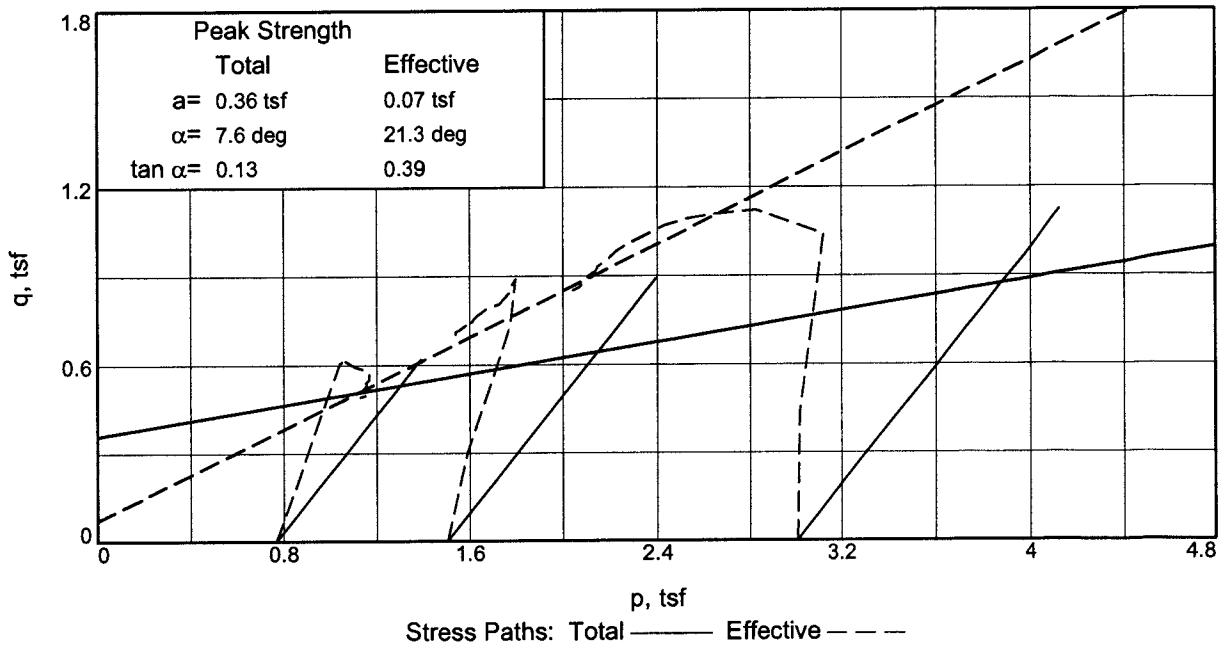
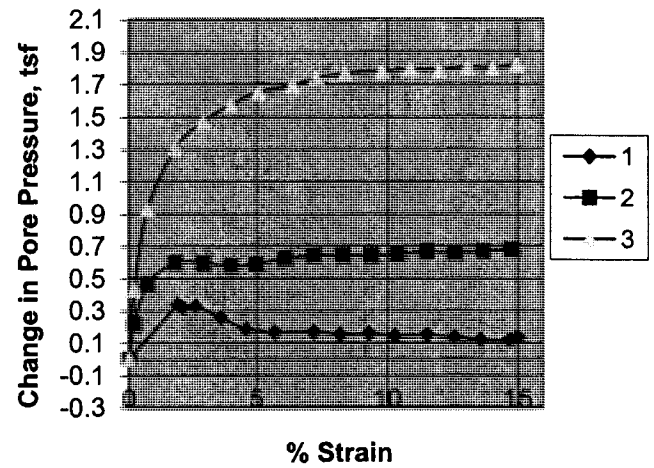
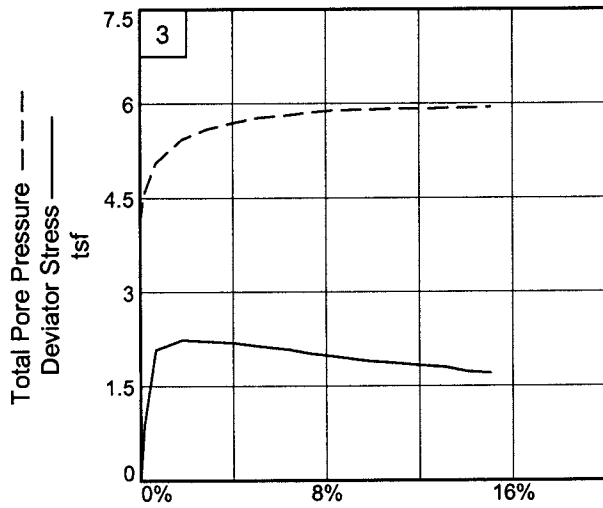
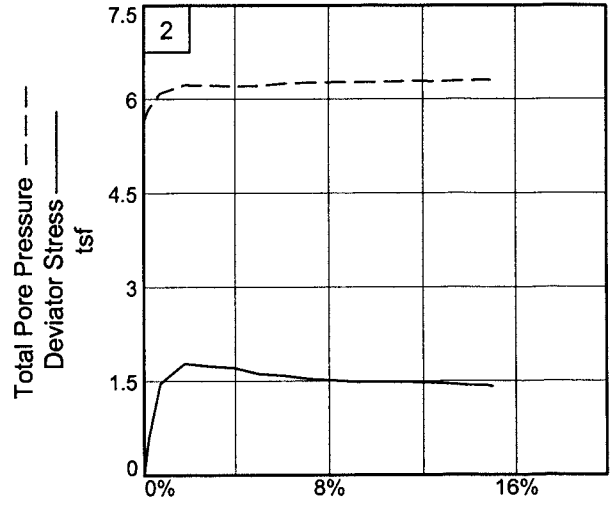
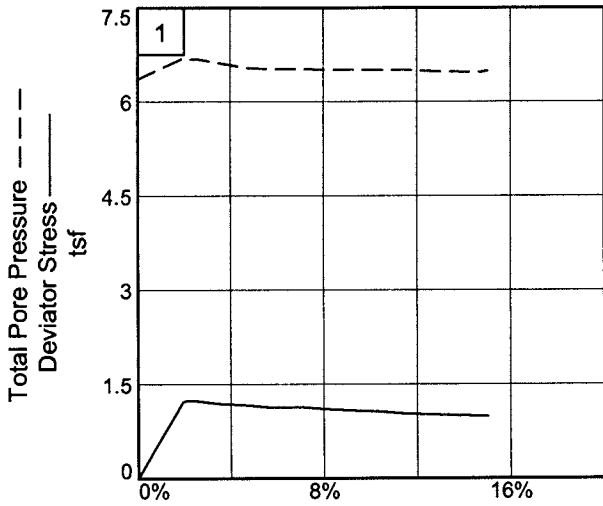
Location: Fargo Pile Load Test, Argusville Formation

Sample Number: Boring11-119MU, #2 **Depth:** 40-42'

Proj. No.: BL-10-10065

Date Sampled:





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Argusville Formation

Depth: 40-42'

Sample No.: Boring11-119MU, #2

Project No.: B11010065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

Geotechnical Design and Geology

July, 2011

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/30/2011

12:18 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Argusville Formation
Depth: 40-42' **Sample Number:** Boring11-119MU, #2
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.698 **LL**=56 **PL**=22 **PI**=34
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	151.840			153.850
Moisture content: Dry soil+tare, gms.	114.940			117.170
Moisture content: Tare, gms.	30.310			30.490
Moisture, %	43.6	43.6	42.8	42.3
Moist specimen weight, gms.	123.5			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.50	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.1	111.1	111.6	
Dry density, pcf	77.3	77.3	78.2	
Void ratio	1.1775	1.1775	1.1543	
Saturation, %	99.9	100.0	100.0	

Consolidation cell pressure = 7.127 tsf
Consolidation back pressure = 6.358 tsf
Consolidation effective confining stress = 0.769 tsf
Peak Stress = 1.240 tsf at reading no. 2
Ult. Stress = 0.986 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0544	18.490	0.0	0.0	0.000	0.769	0.769	1.00	6.358	0.769	0.000
1	0.1080	44.350	25.9	1.9	1.216	0.434	1.650	3.80	6.693	1.042	0.608
2	0.1127	44.910	26.4	2.1	1.240	0.452	1.692	3.74	6.675	1.072	0.620
3	0.1264	44.850	26.4	2.6	1.231	0.445	1.676	3.77	6.682	1.060	0.615
4	0.1548	44.210	25.7	3.6	1.188	0.515	1.703	3.31	6.612	1.109	0.594
5	0.1841	43.970	25.5	4.6	1.164	0.584	1.748	2.99	6.543	1.166	0.582
6	0.2138	43.530	25.0	5.7	1.132	0.604	1.736	2.87	6.523	1.170	0.566
7	0.2541	43.870	25.4	7.2	1.129	0.603	1.732	2.87	6.524	1.168	0.565
8	0.2839	43.460	25.0	8.2	1.098	0.618	1.716	2.78	6.509	1.167	0.549
9	0.3138	43.340	24.9	9.3	1.080	0.613	1.693	2.76	6.514	1.153	0.540
10	0.3432	43.280	24.8	10.3	1.065	0.626	1.691	2.70	6.501	1.159	0.533
11	0.3743	42.700	24.2	11.5	1.027	0.621	1.648	2.65	6.506	1.135	0.514
12	0.4047	42.730	24.2	12.6	1.016	0.639	1.655	2.59	6.488	1.147	0.508
13	0.4350	42.760	24.3	13.6	1.005	0.652	1.657	2.54	6.475	1.154	0.502
14	0.4648	42.810	24.3	14.7	0.994	0.655	1.649	2.52	6.472	1.152	0.497
15	0.4735	42.700	24.2	15.0	0.986	0.637	1.623	2.55	6.490	1.130	0.493

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	137.010			155.590
Moisture content: Dry soil+tare, gms.	105.180			119.490
Moisture content: Tare, gms.	31.150			30.230
Moisture, %	43.0	43.0	41.7	40.4
Moist specimen weight, gms.	126.1			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.80	2.80	2.79	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.5	111.5	112.3	
Dry density, pcf	78.0	78.0	79.3	
Void ratio	1.1596	1.1596	1.1250	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.133 tsf

Consolidation back pressure = 5.630 tsf

Consolidation effective confining stress = 1.503 tsf

Peak Stress = 1.781 tsf at reading no. 3

Ult. Stress = 1.410 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0482	20.470	0.0	0.0	0.000	1.503	1.503	1.00	5.630	1.503	0.000
1	0.0540	33.180	12.7	0.2	0.601	1.289	1.890	1.47	5.844	1.589	0.300
2	0.0678	51.590	31.1	0.7	1.464	1.040	2.504	2.41	6.093	1.772	0.732
3	0.0980	58.740	38.3	1.8	1.781	0.907	2.688	2.96	6.226	1.797	0.890
4	0.1283	58.290	37.8	2.9	1.740	0.910	2.650	2.91	6.223	1.780	0.870
5	0.1587	58.150	37.7	4.0	1.715	0.926	2.641	2.85	6.207	1.783	0.857
6	0.1890	56.330	35.9	5.0	1.613	0.919	2.532	2.76	6.214	1.726	0.807
7	0.2195	56.140	35.7	6.1	1.586	0.881	2.467	2.80	6.252	1.674	0.793
8	0.2498	55.390	34.9	7.2	1.535	0.864	2.399	2.78	6.269	1.631	0.767
9	0.2802	55.240	34.8	8.3	1.510	0.862	2.372	2.75	6.271	1.617	0.755
10	0.3097	55.030	34.6	9.4	1.484	0.863	2.347	2.72	6.270	1.605	0.742
11	0.3390	55.470	35.0	10.4	1.485	0.856	2.341	2.74	6.277	1.599	0.743
12	0.3694	55.900	35.4	11.5	1.485	0.838	2.323	2.77	6.295	1.581	0.743
13	0.4009	55.980	35.5	12.6	1.470	0.849	2.319	2.73	6.284	1.584	0.735
14	0.4312	55.650	35.2	13.7	1.438	0.837	2.275	2.72	6.296	1.556	0.719
15	0.4615	55.850	35.4	14.8	1.428	0.825	2.253	2.73	6.308	1.539	0.714
16	0.4670	55.500	35.0	15.0	1.410	0.833	2.243	2.69	6.300	1.538	0.705

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.970			156.410
Moisture content: Dry soil+tare, gms.	110.800			122.200
Moisture content: Tare, gms.	30.410			30.480
Moisture, %	40.0	40.0	38.6	37.3
Moist specimen weight, gms.	128.6			
Diameter, in.	1.40	1.40	1.39	
Area, in. ²	1.54	1.54	1.52	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	113.4	113.4	114.4	
Dry density, pcf	81.0	81.0	82.6	
Void ratio	1.0800	1.0800	1.0402	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.134 tsf

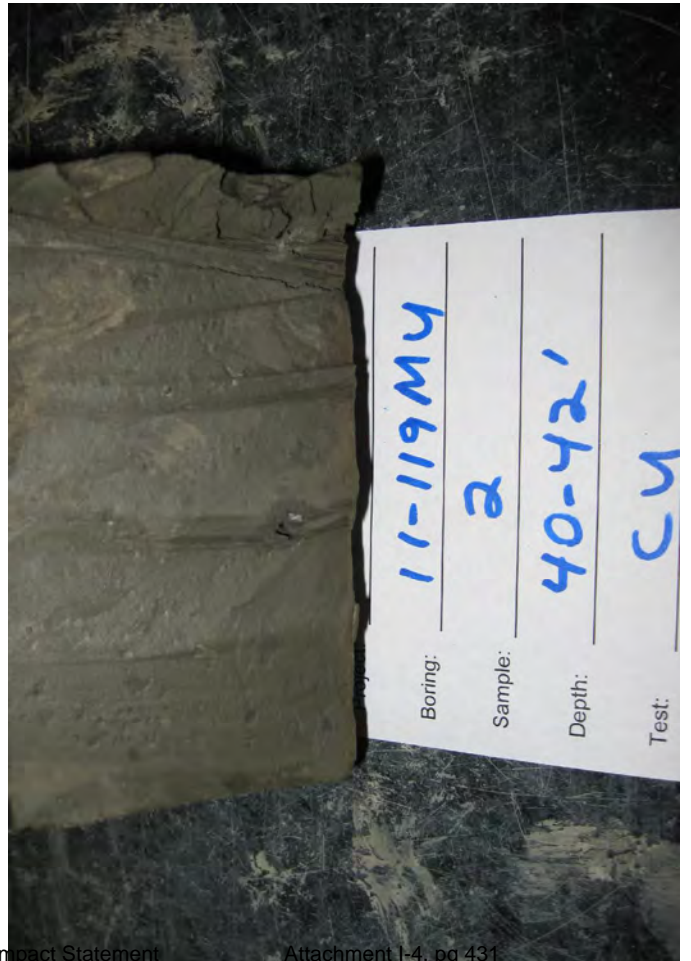
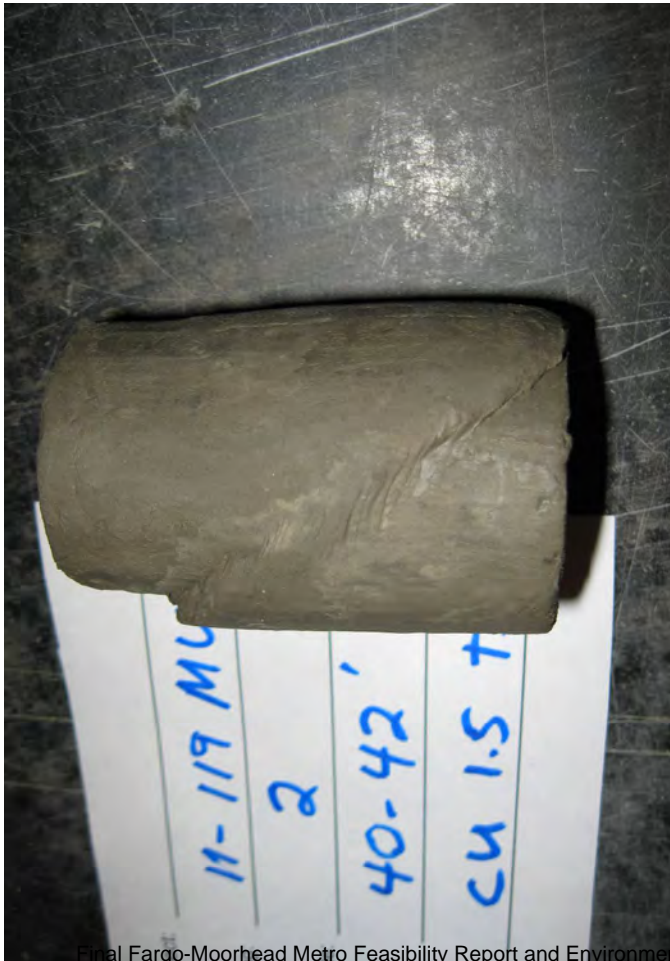
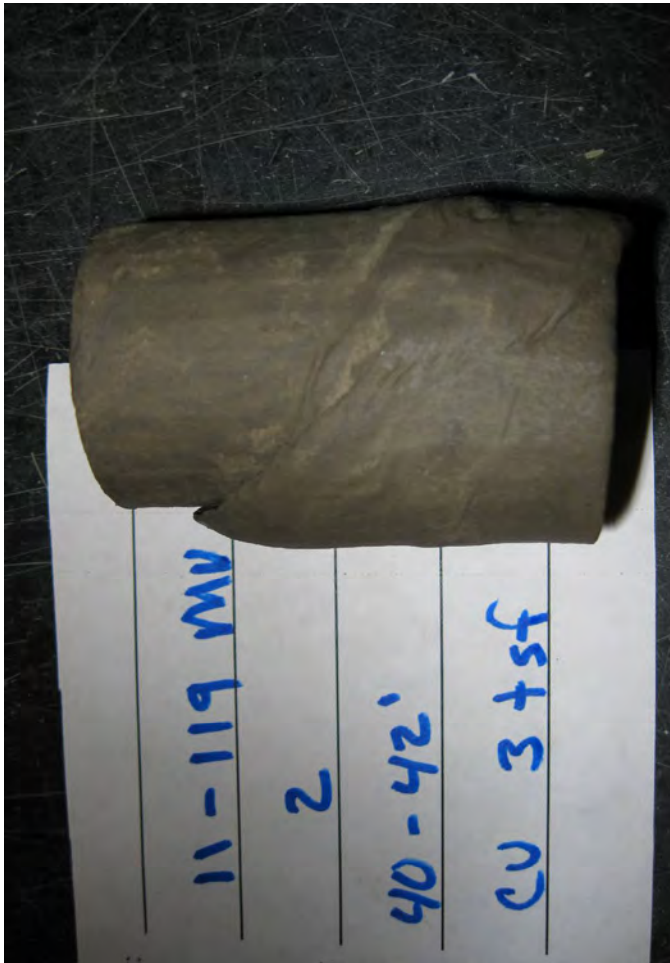
Consolidation back pressure = 4.126 tsf

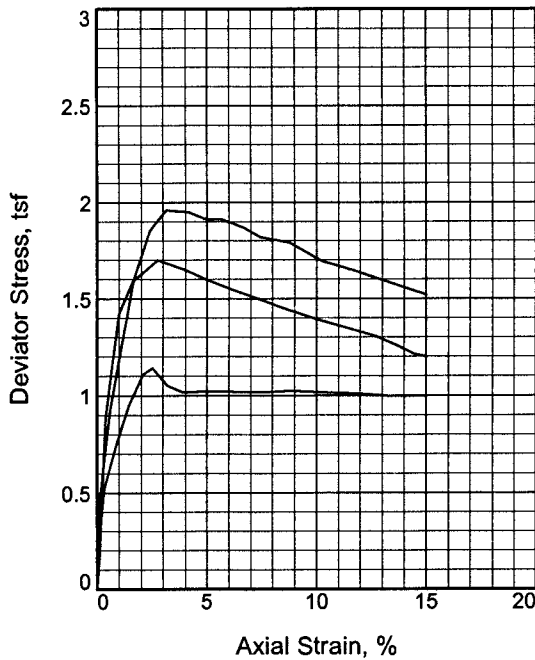
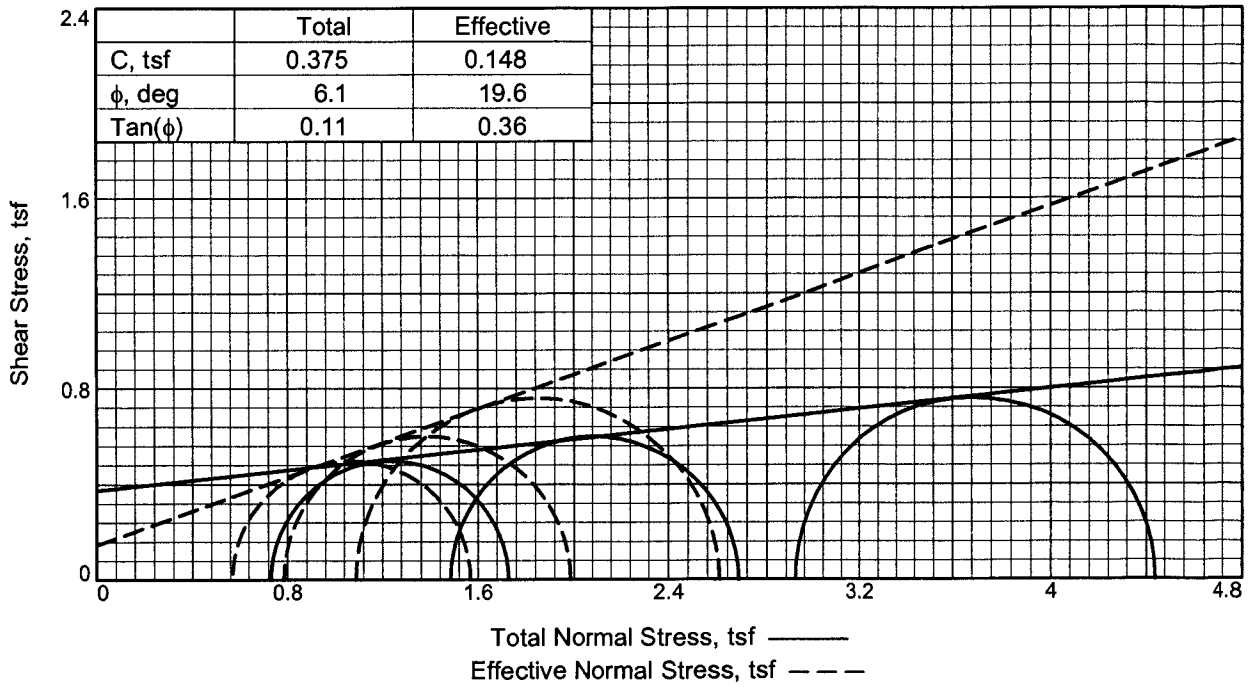
Consolidation effective confining stress = 3.008 tsf

Peak Stress = 2.244 tsf at reading no. 3

Ult. Stress = 1.705 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0489	17.090	0.0	0.0	0.000	3.008	3.008	1.00	4.126	3.008	0.000
1	0.0532	35.500	18.4	0.2	0.871	2.580	3.451	1.34	4.554	3.015	0.435
2	0.0676	61.300	44.2	0.7	2.081	2.080	4.161	2.00	5.054	3.120	1.040
3	0.0989	65.310	48.2	1.8	2.244	1.704	3.948	2.32	5.430	2.826	1.122
4	0.1304	65.270	48.2	2.9	2.216	1.539	3.755	2.44	5.595	2.647	1.108
5	0.1618	65.230	48.1	4.0	2.189	1.437	3.626	2.52	5.697	2.531	1.094
6	0.1910	64.670	47.6	5.1	2.139	1.358	3.497	2.58	5.776	2.428	1.070
7	0.2281	64.090	47.0	6.4	2.084	1.319	3.403	2.58	5.815	2.361	1.042
8	0.2530	63.160	46.1	7.3	2.023	1.271	3.294	2.59	5.863	2.283	1.012
9	0.2830	62.470	45.4	8.4	1.970	1.242	3.212	2.59	5.892	2.227	0.985
10	0.3235	61.550	44.5	9.8	1.899	1.230	3.129	2.54	5.904	2.180	0.950
11	0.3539	61.330	44.2	10.9	1.867	1.215	3.082	2.54	5.919	2.148	0.933
12	0.3840	61.060	44.0	12.0	1.833	1.221	3.054	2.50	5.913	2.137	0.916
13	0.4147	60.870	43.8	13.1	1.802	1.207	3.009	2.49	5.927	2.108	0.901
14	0.4411	59.550	42.5	14.1	1.729	1.208	2.937	2.43	5.926	2.072	0.864
15	0.4686	59.440	42.3	15.0	1.705	1.190	2.895	2.43	5.944	2.042	0.852





Sample No.		1	2	3
Initial	Water Content, %	41.0	43.5	38.9
	Dry Density, pcf	79.3	77.6	82.0
	Saturation, %	98.2	99.8	99.1
	Void Ratio	1.1340	1.1826	1.0645
	Diameter, in.	1.40	1.39	1.39
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	41.8	43.1	37.6
	Dry Density, pcf	79.3	78.1	83.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.1340	1.1686	1.0205
	Diameter, in.	1.40	1.38	1.38
	Height, in.	2.80	2.81	2.78
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		0.73	1.48	2.92
Back Pressure, tsf		6.40	5.66	4.22
Cell Pressure, tsf		7.13	7.14	7.14
Peak Deviator Stress, tsf		1.14	1.70	1.96
Total Pore Pr., tsf		6.75	6.38	5.49
Ultimate Deviator Stress, tsf		1.00	1.20	1.52
Total Pore Pr., tsf		6.56	6.36	6.05
Maj. Eff. Stress at Ultimate, tsf		1.57	1.99	2.61
Min. Eff. Stress at Ultimate, tsf		0.57	0.79	1.09

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 62 PL= 19 PI= 43

Specific Gravity= 2.712

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

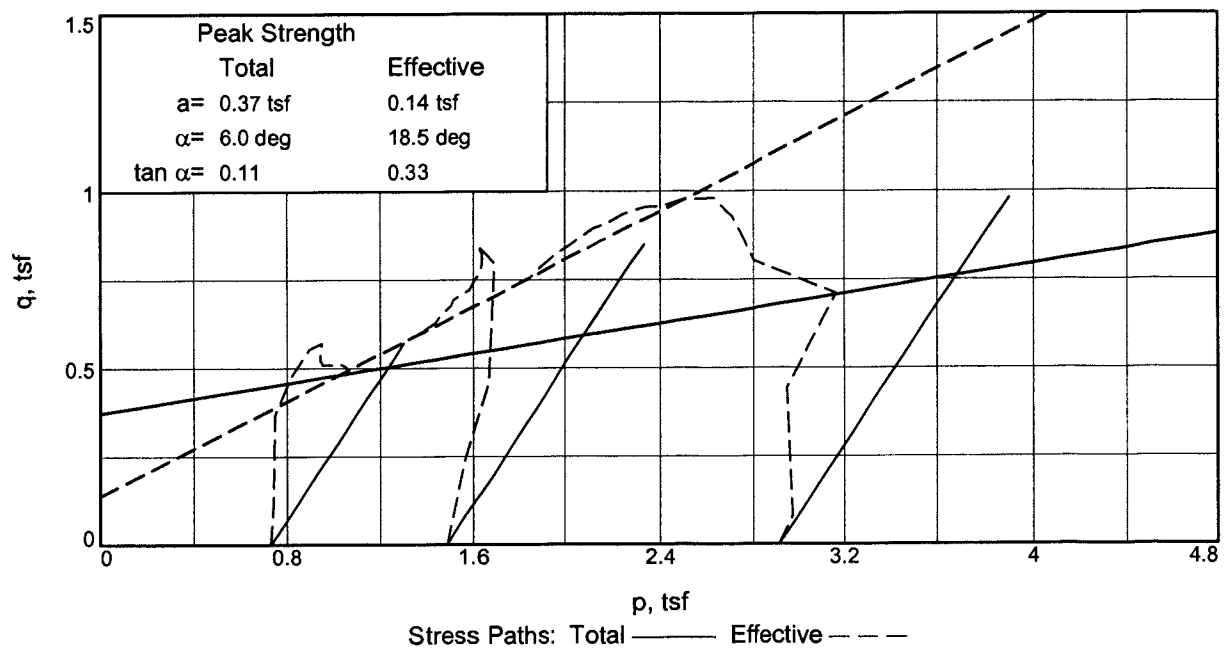
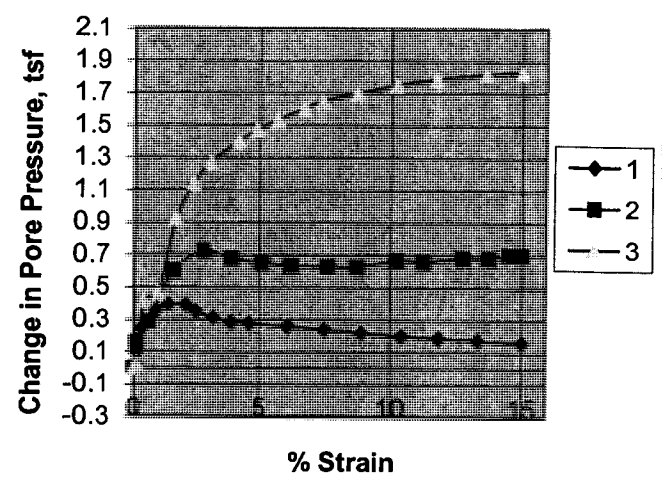
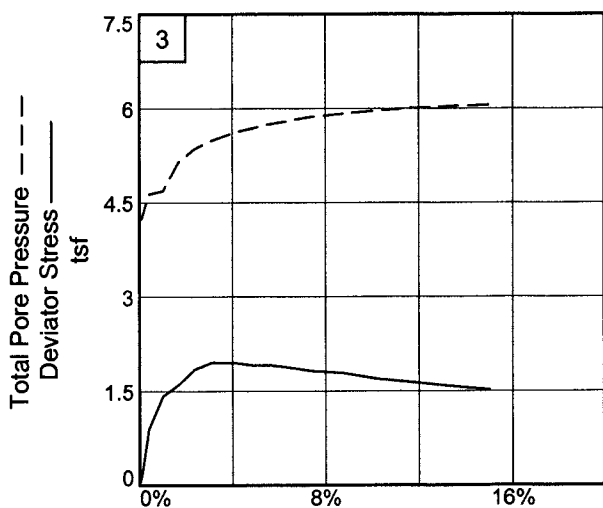
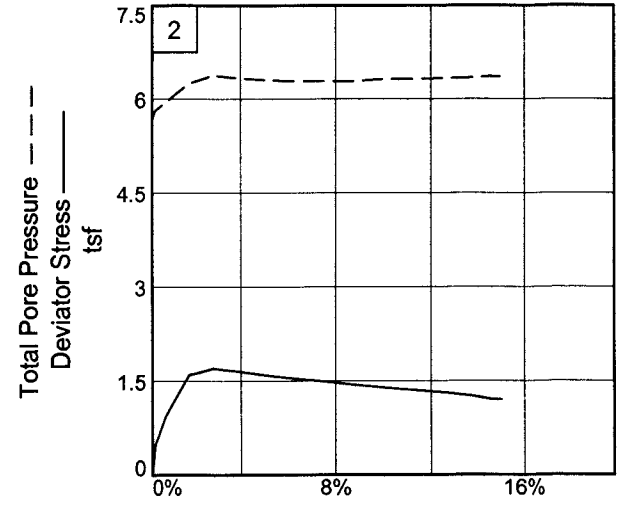
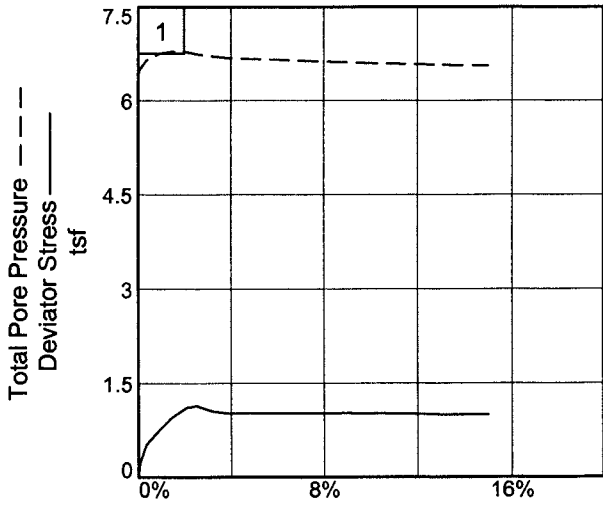
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

Location: Fargo Pile Load Test, Argusville Formation

Sample Number: Boring11-119MU, #3 **Depth:** 50-52'

Proj. No.: BL-10-10065 **Date Sampled:**





TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

5/30/2011

12:18 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Argusville Formation
Depth: 50-52' **Sample Number:** Boring 11-119MU, #3
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.712 **LL=**62 **PL=**19 **PI=**43
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	150.030			156.590
Moisture content: Dry soil+tare, gms.	115.290			119.610
Moisture content: Tare, gms.	30.650			30.510
Moisture, %	41.0	41.8	41.8	41.5
Moist specimen weight, gms.	126.3			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.80	2.80	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	111.9	112.5	112.5	
Dry density, pcf	79.3	79.3	79.3	
Void ratio	1.1340	1.1340	1.1340	
Saturation, %	98.2	100.0	100.0	

Consolidation cell pressure = 7.128 tsf
Consolidation back pressure = 6.397 tsf
Consolidation effective confining stress = 0.731 tsf
Peak Stress = 1.142 tsf at reading no. 6
Ult. Stress = 0.998 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0077	18.550	0.0	0.0	0.000	0.731	0.731	1.00	6.397	0.731	0.000
1	0.0096	23.250	4.7	0.1	0.220	0.633	0.853	1.35	6.495	0.743	0.110
2	0.0170	29.630	11.1	0.3	0.518	0.488	1.006	2.06	6.640	0.747	0.259
3	0.0319	34.420	15.9	0.9	0.738	0.380	1.118	2.94	6.748	0.749	0.369
4	0.0480	39.120	20.6	1.4	0.951	0.342	1.293	3.78	6.786	0.817	0.475
5	0.0657	42.690	24.1	2.1	1.109	0.345	1.454	4.21	6.783	0.899	0.554
6	0.0787	43.540	25.0	2.5	1.142	0.381	1.523	4.00	6.747	0.952	0.571
7	0.0977	41.710	23.2	3.2	1.051	0.419	1.470	3.51	6.709	0.945	0.526
8	0.1168	41.130	22.6	3.9	1.018	0.447	1.465	3.28	6.681	0.956	0.509
9	0.1377	41.370	22.8	4.6	1.021	0.455	1.476	3.24	6.673	0.965	0.510
10	0.1775	41.710	23.2	6.1	1.020	0.474	1.494	3.15	6.654	0.984	0.510
11	0.2174	42.020	23.5	7.5	1.018	0.494	1.512	3.06	6.634	1.003	0.509
12	0.2580	42.550	24.0	8.9	1.025	0.511	1.536	3.01	6.617	1.024	0.513
13	0.2980	42.720	24.2	10.4	1.016	0.533	1.549	2.91	6.595	1.041	0.508
14	0.3391	43.010	24.5	11.8	1.012	0.544	1.556	2.86	6.584	1.050	0.506
15	0.3807	43.100	24.6	13.3	0.998	0.559	1.557	2.79	6.569	1.058	0.499
16	0.4277	43.570	25.0	15.0	0.998	0.570	1.568	2.75	6.558	1.069	0.499

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.710			153.940
Moisture content: Dry soil+tare, gms.	108.510			117.410
Moisture content: Tare, gms.	29.910			30.660
Moisture, %	43.5	43.6	43.1	42.1
Moist specimen weight, gms.	124.2			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.51	1.51	1.50	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.01	
Wet Density, pcf	111.3	111.4	111.7	
Dry density, pcf	77.6	77.6	78.1	
Void ratio	1.1826	1.1826	1.1686	
Saturation, %	99.8	100.0	100.0	

Consolidation cell pressure = 7.143 tsf

Consolidation back pressure = 5.658 tsf

Consolidation effective confining stress = 1.485 tsf

Peak Stress = 1.701 tsf at reading no. 4

Ult. Stress = 1.200 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0390	17.210	0.0	0.0	0.000	1.485	1.485	1.00	5.658	1.485	0.000
1	0.0431	27.330	10.1	0.1	0.484	1.325	1.809	1.36	5.818	1.567	0.242
2	0.0559	36.510	19.3	0.6	0.918	1.201	2.119	1.76	5.942	1.660	0.459
3	0.0852	51.080	33.9	1.6	1.594	0.889	2.483	2.79	6.254	1.686	0.797
4	0.1165	53.760	36.5	2.8	1.701	0.763	2.464	3.23	6.380	1.613	0.850
5	0.1489	53.140	35.9	3.9	1.652	0.807	2.459	3.05	6.336	1.633	0.826
6	0.1809	52.340	35.1	5.1	1.596	0.837	2.433	2.91	6.306	1.635	0.798
7	0.2121	51.650	34.4	6.2	1.547	0.853	2.400	2.81	6.290	1.626	0.773
8	0.2524	50.900	33.7	7.6	1.490	0.857	2.347	2.74	6.286	1.602	0.745
9	0.2827	50.240	33.0	8.7	1.443	0.862	2.305	2.67	6.281	1.584	0.722
10	0.3241	49.510	32.3	10.2	1.389	0.820	2.209	2.69	6.323	1.514	0.694
11	0.3541	49.060	31.9	11.2	1.353	0.827	2.180	2.64	6.316	1.504	0.677
12	0.3949	48.480	31.3	12.7	1.307	0.807	2.114	2.62	6.336	1.460	0.653
13	0.4241	47.620	30.4	13.7	1.256	0.805	2.061	2.56	6.338	1.433	0.628
14	0.4449	46.870	29.7	14.5	1.214	0.781	1.995	2.55	6.362	1.388	0.607
15	0.4606	46.720	29.5	15.0	1.200	0.785	1.985	2.53	6.358	1.385	0.600

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	119.120			155.890
Moisture content: Dry soil+tare, gms.	94.020			123.300
Moisture content: Tare, gms.	29.520			31.170
Moisture, %	38.9	39.3	37.6	35.4
Moist specimen weight, gms.	127.7			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.50	
Height, in.	2.80	2.80	2.78	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	113.9	114.2	115.3	
Dry density, pcf	82.0	82.0	83.8	
Void ratio	1.0645	1.0645	1.0205	
Saturation, %	99.1	100.0	100.0	

Consolidation cell pressure = 7.142 tsf

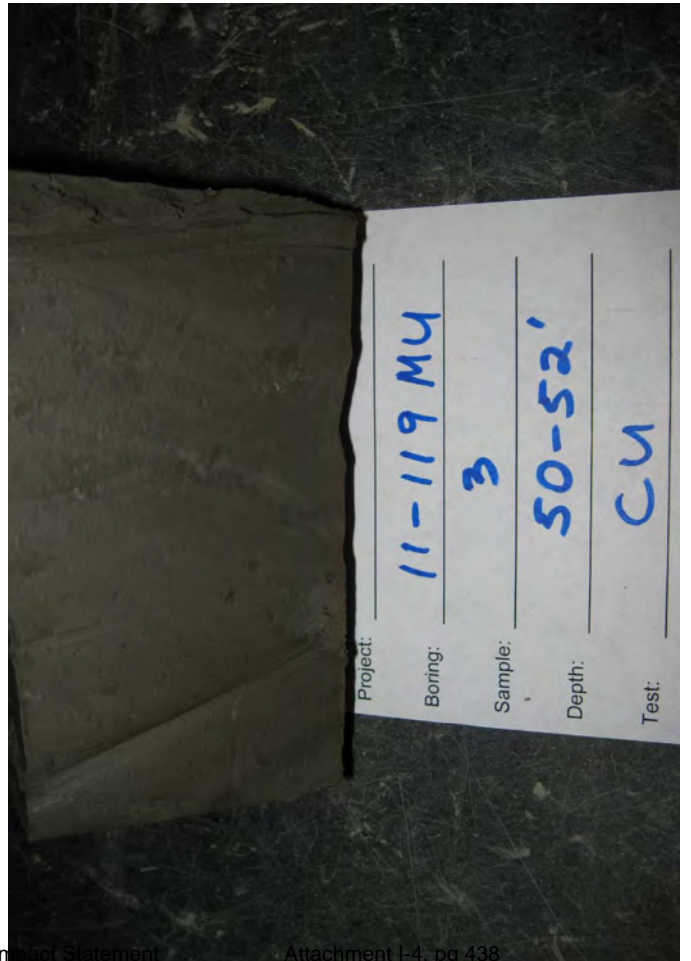
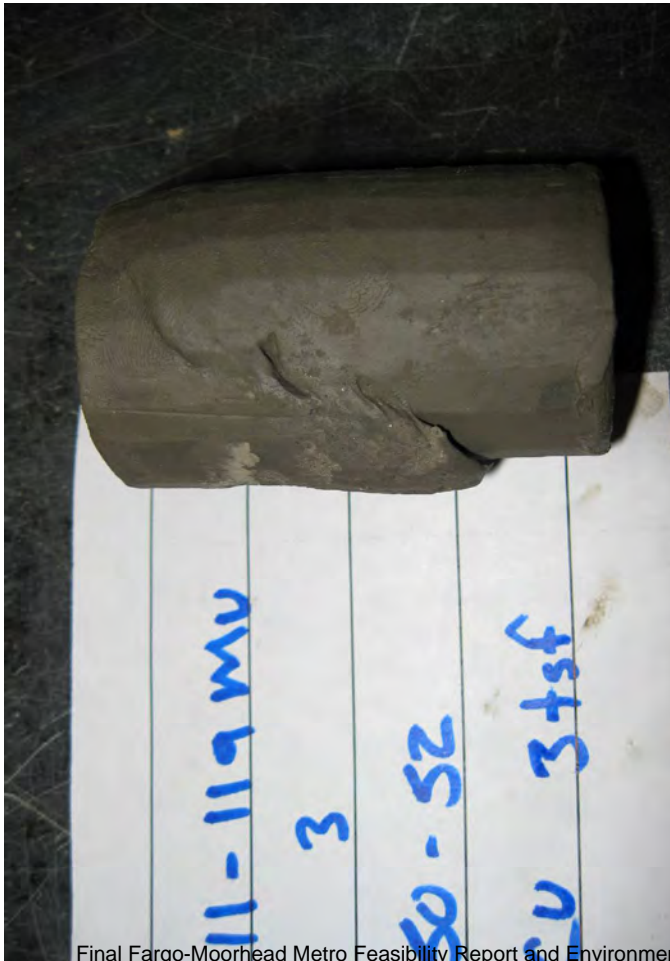
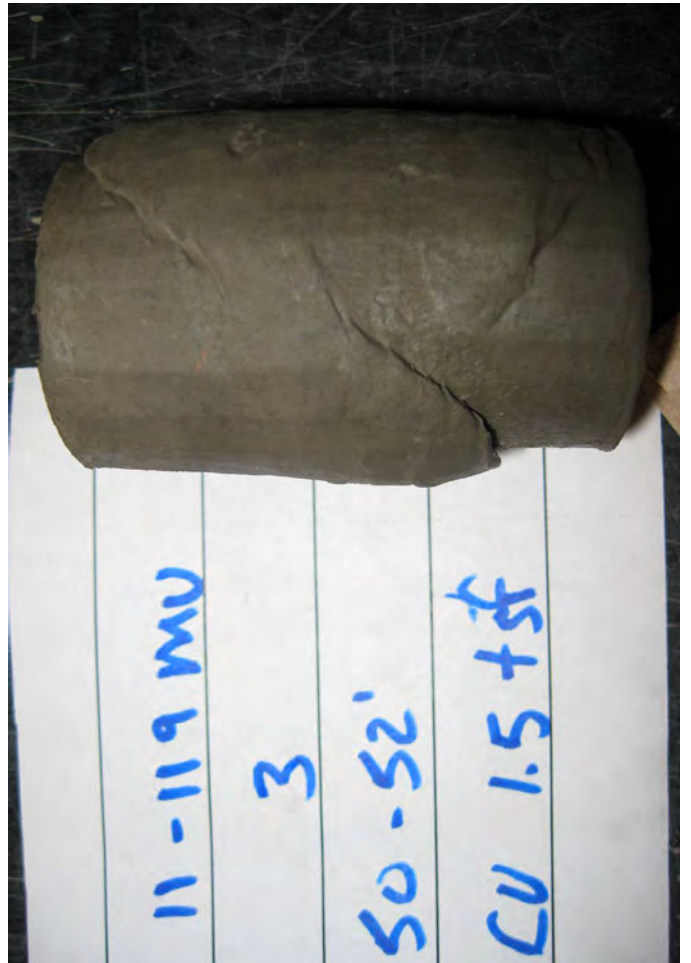
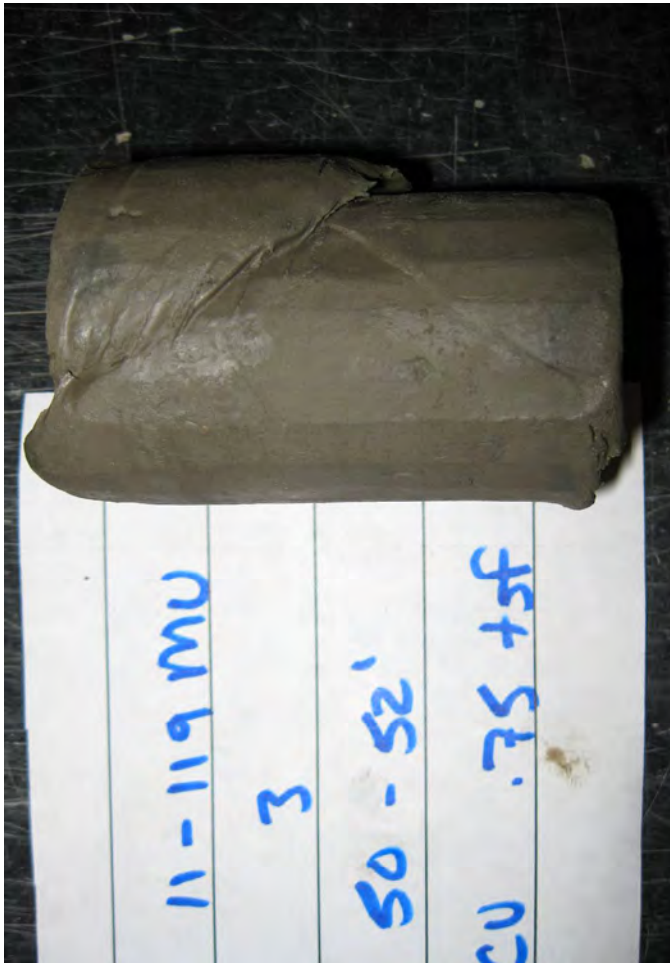
Consolidation back pressure = 4.222 tsf

Consolidation effective confining stress = 2.920 tsf

Peak Stress = 1.959 tsf at reading no. 6

Ult. Stress = 1.519 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0111	18.620	0.0	0.0	0.000	2.920	2.920	1.00	4.222	2.920	0.000
1	0.0141	21.970	3.3	0.1	0.160	2.896	3.056	1.06	4.246	2.976	0.080
2	0.0219	37.170	18.6	0.4	0.886	2.508	3.394	1.35	4.634	2.951	0.443
3	0.0390	48.620	30.0	1.0	1.423	2.456	3.879	1.58	4.686	3.168	0.712
4	0.0578	52.760	34.1	1.7	1.609	1.997	3.606	1.81	5.145	2.801	0.804
5	0.0778	58.220	39.6	2.4	1.852	1.779	3.631	2.04	5.363	2.705	0.926
6	0.0986	60.820	42.2	3.1	1.959	1.648	3.607	2.19	5.494	2.627	0.979
7	0.1266	61.060	42.4	4.2	1.950	1.516	3.466	2.29	5.626	2.491	0.975
8	0.1476	60.620	42.0	4.9	1.914	1.447	3.361	2.32	5.695	2.404	0.957
9	0.1686	60.910	42.3	5.7	1.912	1.385	3.297	2.38	5.757	2.341	0.956
10	0.1964	60.420	41.8	6.7	1.870	1.315	3.185	2.42	5.827	2.250	0.935
11	0.2182	59.660	41.0	7.4	1.820	1.271	3.091	2.43	5.871	2.181	0.910
12	0.2543	59.570	41.0	8.7	1.791	1.224	3.015	2.46	5.918	2.120	0.896
13	0.2961	58.010	39.4	10.2	1.694	1.172	2.866	2.45	5.970	2.019	0.847
14	0.3368	57.490	38.9	11.7	1.645	1.133	2.778	2.45	6.009	1.955	0.822
15	0.3900	56.610	38.0	13.6	1.573	1.102	2.675	2.43	6.040	1.888	0.786
16	0.4289	55.910	37.3	15.0	1.519	1.089	2.608	2.39	6.053	1.848	0.759

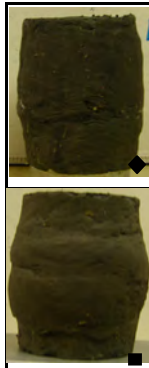
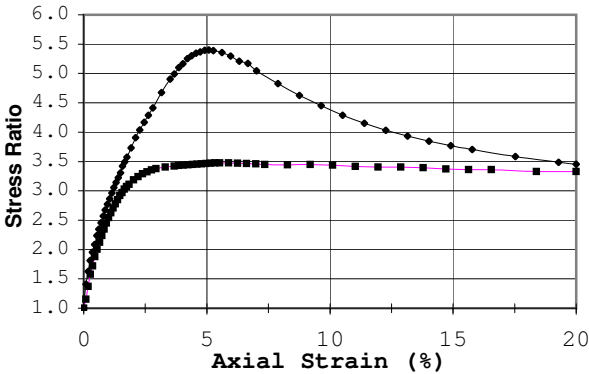
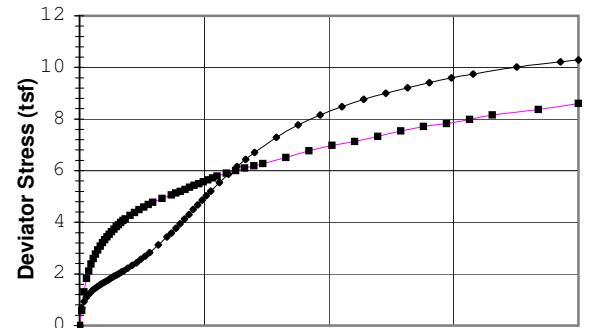
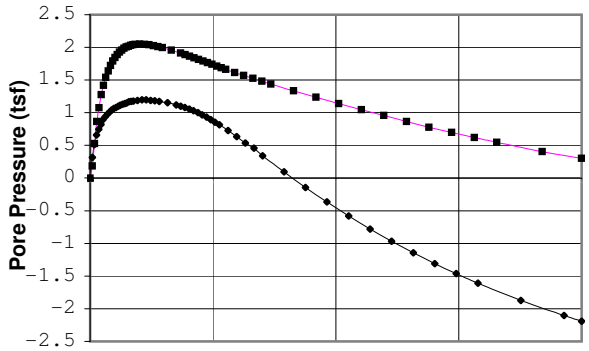


TRIAXIAL TEST ASTM: D 4767

Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **4** Type: **5T** Depth (ft): **70-71.2**
 Soil Type: **Clayey Sand w/gravel (SC) Unit "A" Till**



Failure Criterion: **Max. Stress Ratio**

Angle of internal friction, $\phi' = 15.0^\circ$

Apparent Cohesion, $c' = 1.63$ (tsf)

Test Date: 8/18/10

Liquid Limit: 29.5

Test Type: CU w/pp

Plastic Limit: 16.9

Strain Rate (in/min): 0.00285

Plasticity Index: 12.6

Strain Rate (%/min): 0.050

Spec. Gravity (Assumed): 2.69

Before Consolidation

	A	B	C	D	E
Diameter (in)	2.85	2.89			
Height (in)	5.78	5.49			
Water Content (%)	14.7	16.4			
Dry Density (pcf)	113.3	110.7			
Void Ratio	0.48	0.52			

After Consolidation

Diameter (in)	2.83	2.86			
Height (in)	5.70	5.44			
Water Content (%)	16.5	17.5			
Dry Density (pcf)	116.3	114.3			
Void Ratio	0.44	0.47			

Back Pressure (tsf) 5.8 5.8

Minor Principal Stress (tsf) 2.00 4.00

Max. Deviator Stress (tsf) 10.29 8.61

Ultimate Deviator Stress (tsf) 10.29 8.61

Deviator Stress at Failure (tsf) 5.04 5.90

Max. Pore Pressure Buildup (tsf) 1.20 2.05

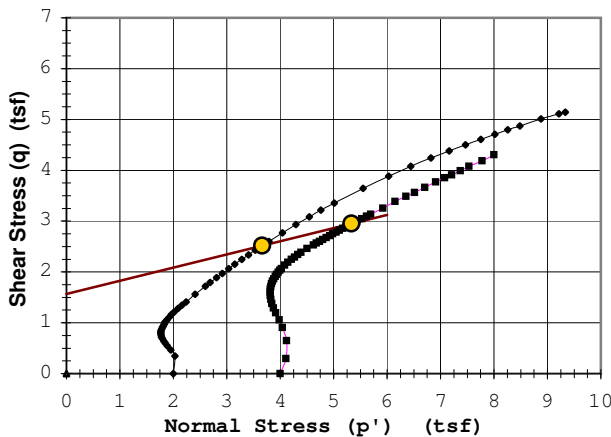
Pore Pressure Parameter "B" 1.0 1.0

Pct. Axial Strain at Failure 5.1 5.9

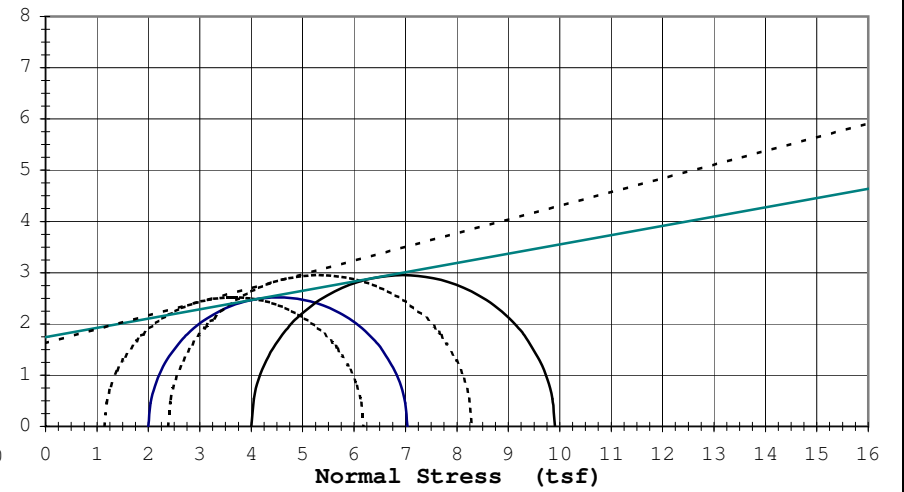
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

*Height to diameter ratio of 2:1 not achieved for specimen B.



Rupture Envelope at Failure
 $\alpha = 14.5^\circ$ $a = 1.6$ (tsf)



----- Effective ϕ' : 15.0° $c' = 1.63$ (tsf)
 _____ Total ϕ : 10.3° $c = 1.74$ (tsf)

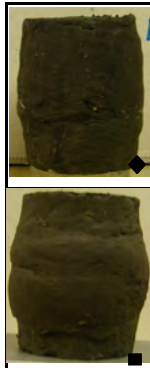
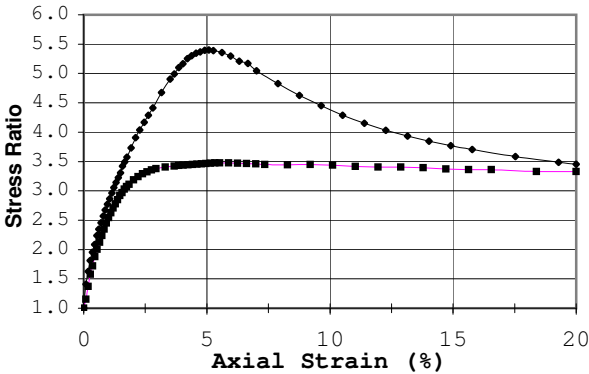
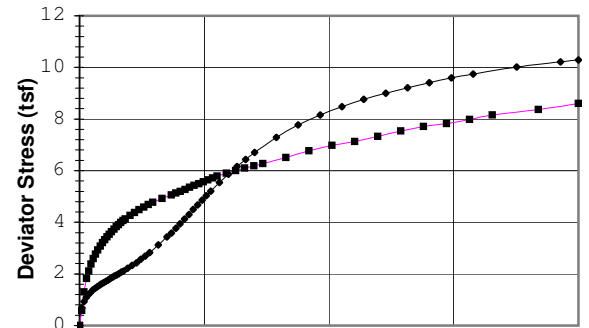
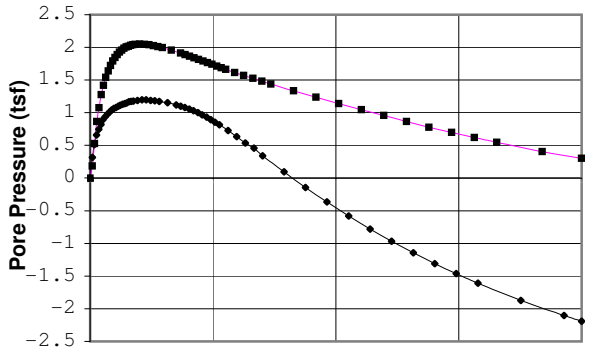


TRIAxIAL TEST ASTM: D 4767

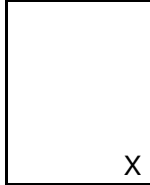
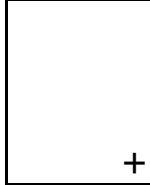
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **4** Type: **5T** Depth (ft): **70-71.2**
 Soil Type: **Clayey Sand w/gravel (SC) Unit "A" Till**



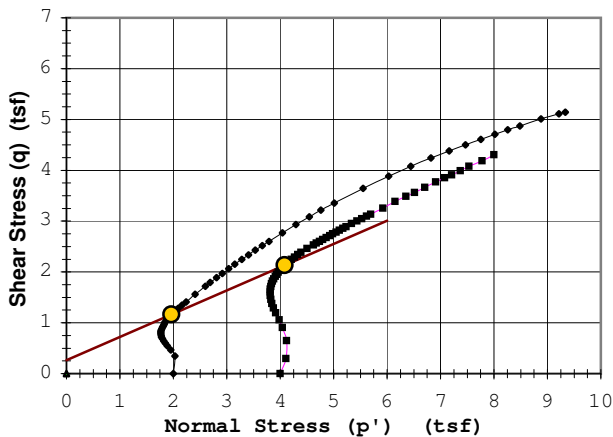
Failure Criterion: Max. Pore Pressure	
Angle of internal friction, $\phi' = 27.2^\circ$	
Apparent Cohesion, $c' = 0.30$ (tsf)	
Test Date: 8/18/10	Liquid Limit: 29.5
Test Type: CU w/pp	Plastic Limit: 16.9
Strain Rate (in/min): 0.00285	Plasticity Index: 12.6
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.69
Before Consolidation	
	A B C D E
Diameter (in)	2.85 2.89
Height (in)	5.78 5.49
Water Content (%)	14.7 16.4
Dry Density (pcf)	113.3 110.7
Void Ratio	0.48 0.52
After Consolidation	
Diameter (in)	2.83 2.86
Height (in)	5.70 5.44
Water Content (%)	16.5 17.5
Dry Density (pcf)	116.3 114.3
Void Ratio	0.44 0.47
Back Pressure (tsf)	5.8 5.8
Minor Principal Stress (tsf)	2.00 4.00
Max. Deviator Stress (tsf)	10.29 8.61
Ultimate Deviator Stress (tsf)	10.29 8.61
Deviator Stress at Failure (tsf)	2.33 4.26
Max. Pore Pressure Buildup (tsf)	1.20 2.05
Pore Pressure Parameter "B"	1.0 1.0
Pct. Axial Strain at Failure	2.1 2.0



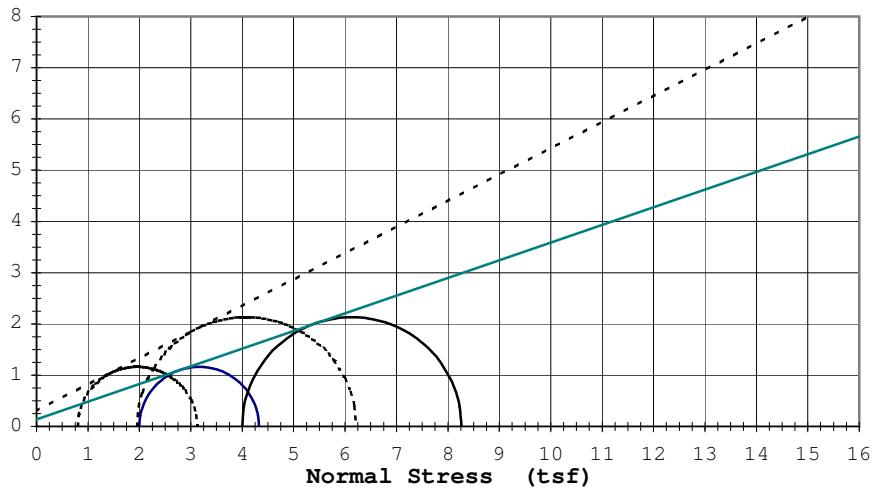
"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

*Height to diameter ratio of 2:1 not achieved for specimen B.



Rupture Envelope at Failure
 $\alpha = 24.6^\circ$ $a = 0.3$ (tsf)



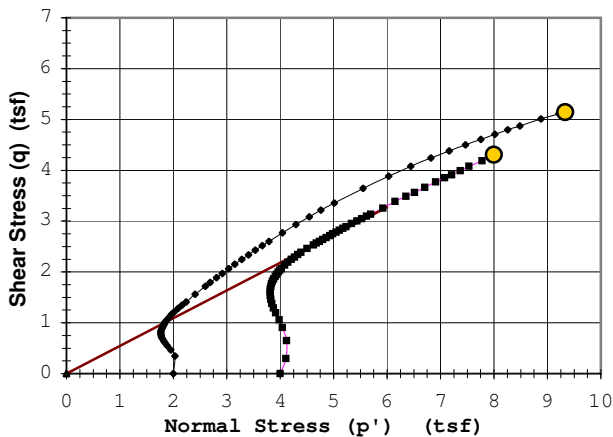
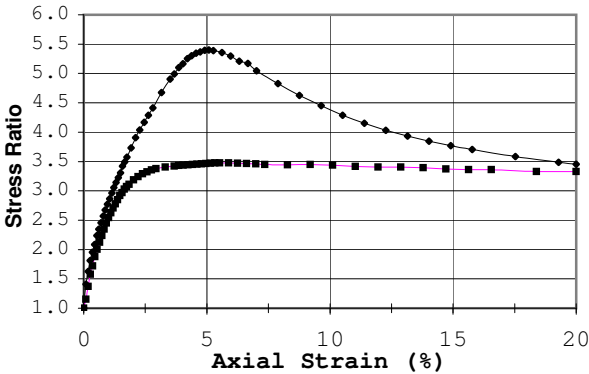
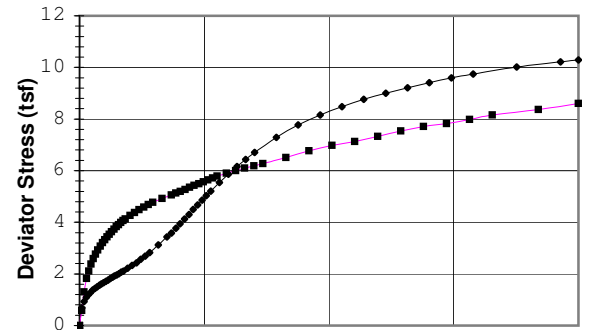
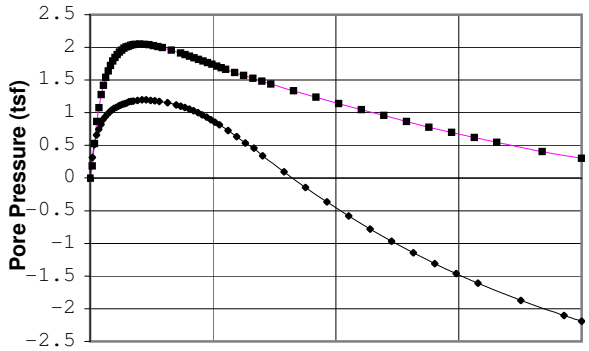
----- Effective $\phi' = 27.2^\circ$ $c' = 0.30$ (tsf)
 _____ Total $\phi = 19.0^\circ$ $c = 0.14$ (tsf)

TRIAXIAL TEST ASTM: D 4767

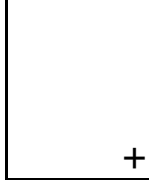
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **4** Type: **5T** Depth (ft): **70-71.2**
 Soil Type: **Clayey Sand w/gravel (SC) Unit "A" Till**



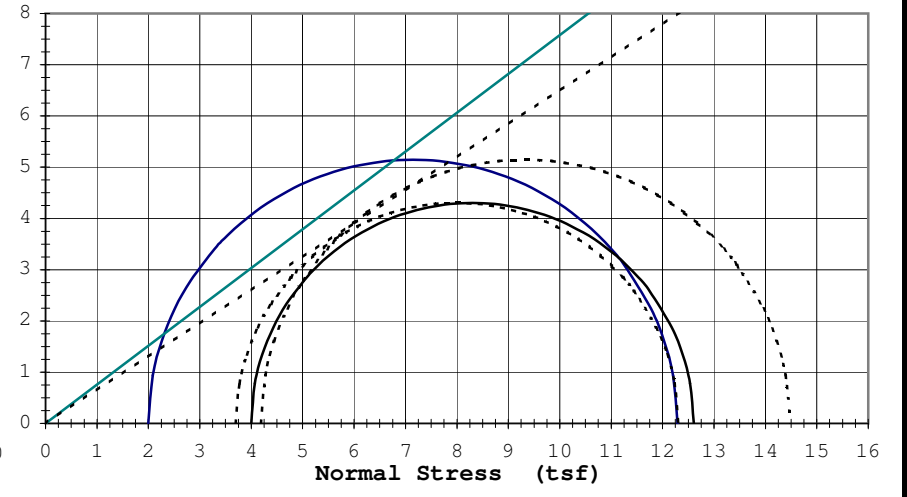
Rupture Envelope at Failure
 $\alpha = 28.6^\circ$ $a = 0.0$ (tsf)



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi' = 33.1^\circ$	
Apparent Cohesion, $c' = 0.00$ (tsf)	
Test Date: 8/18/10	Liquid Limit: 29.5
Test Type: CU w/pp	Plastic Limit: 16.9
Strain Rate (in/min): 0.00285	Plasticity Index: 12.6
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.69
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	2.85 2.89
Water Content (%)	5.78 5.49
Dry Density (pcf)	14.7 16.4
Void Ratio	113.3 110.7
After Consolidation	
Diameter (in)	0.48 0.52
Height (in)	2.83 2.86
Water Content (%)	5.70 5.44
Dry Density (pcf)	16.5 17.5
Void Ratio	116.3 114.3
Back Pressure (tsf)	0.44 0.47
Minor Principal Stress (tsf)	5.8 5.8
Max. Deviator Stress (tsf)	2.00 4.00
Ultimate Deviator Stress (tsf)	10.29 8.61
Deviator Stress at Failure (tsf)	10.29 8.61
Max. Pore Pressure Buildup (tsf)	1.20 2.05
Pore Pressure Parameter "B"	1.0 1.0
Pct. Axial Strain at Failure	20.0 20.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.
 *Height to diameter ratio of 2:1 no achieved for specimen B.



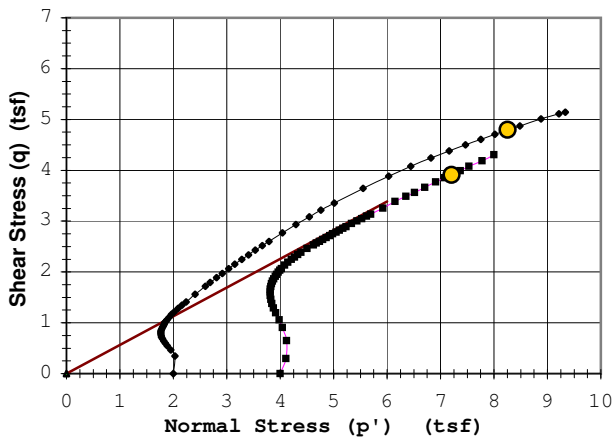
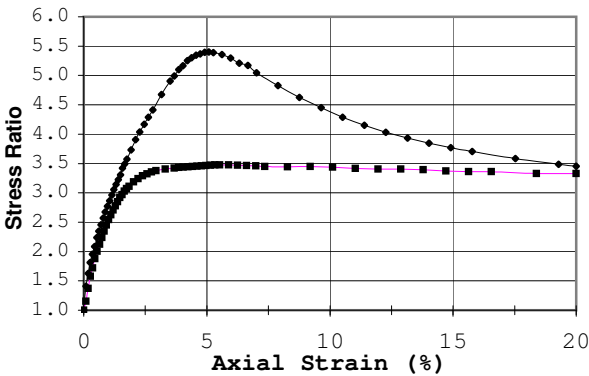
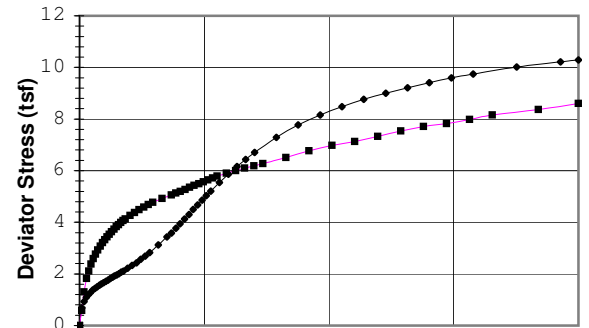
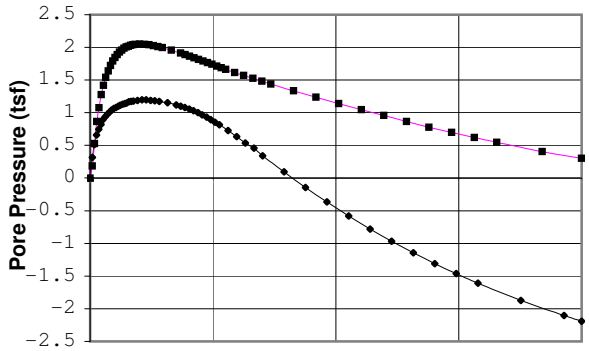
-----	Effective ϕ' : 33.1°	$c' = 0.00$ (tsf)
_____	Total ϕ' : 37.2°	$c = 0.00$ (tsf)

TRIAXIAL TEST ASTM: D 4767

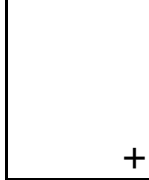
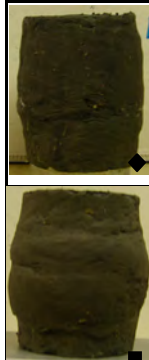
Job No. 7577

Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING**
 Boring #: **10-78MU Fargo** Sample #: **4** Type: **5T** Depth (ft): **70-71.2**
 Soil Type: **Clayey Sand w/gravel (SC) Unit "A" Till**



Rupture Envelope at Failure
 $\alpha = 29.4^\circ$ $a = 0.0$ (tsf)

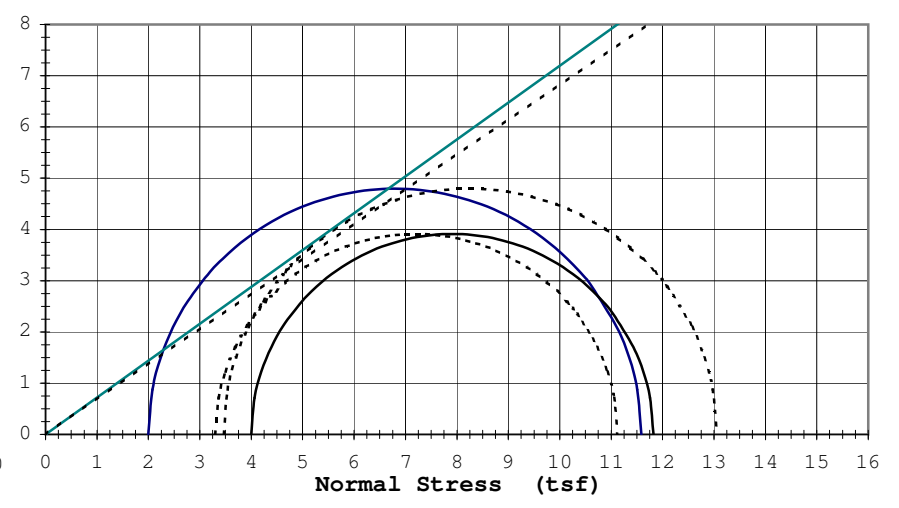


Failure Criterion: Given Strain of: 15%	
Angle of internal friction, $\phi' = 34.3^\circ$	
Apparent Cohesion, $c' = 0.00$ (tsf)	
Test Date: 8/18/10	Liquid Limit: 29.5
Test Type: CU w/pp	Plastic Limit: 16.9
Strain Rate (in/min): 0.00285	Plasticity Index: 12.6
Strain Rate (%/min): 0.050	Spec. Gravity (Assumed): 2.69
Before Consolidation	
	A B C D E
Diameter (in)	2.85 2.89
Height (in)	5.78 5.49
Water Content (%)	14.7 16.4
Dry Density (pcf)	113.3 110.7
Void Ratio	0.48 0.52
After Consolidation	
Diameter (in)	2.83 2.86
Height (in)	5.70 5.44
Water Content (%)	16.5 17.5
Dry Density (pcf)	116.3 114.3
Void Ratio	0.44 0.47
Back Pressure (tsf)	5.8 5.8
Minor Principal Stress (tsf)	2.00 4.00
Max. Deviator Stress (tsf)	10.29 8.61
Ultimate Deviator Stress (tsf)	10.29 8.61
Deviator Stress at Failure (tsf)	9.59 7.82
Max. Pore Pressure Buildup (tsf)	1.20 2.05
Pore Pressure Parameter "B"	1.0 1.0
Pct. Axial Strain at Failure	15.0 15.0

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

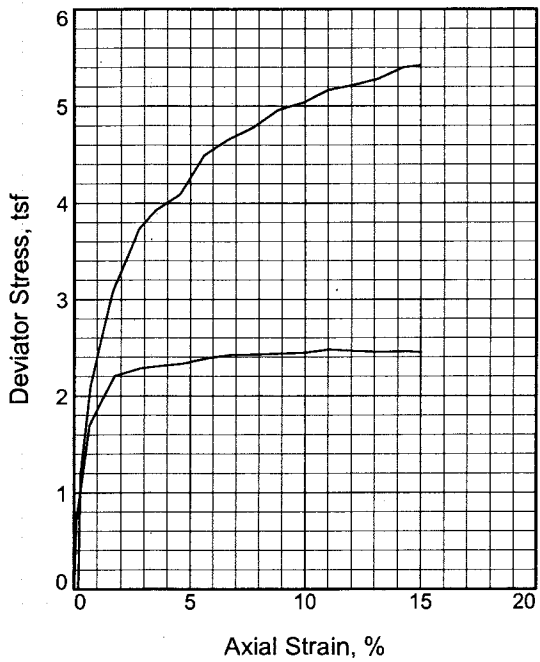
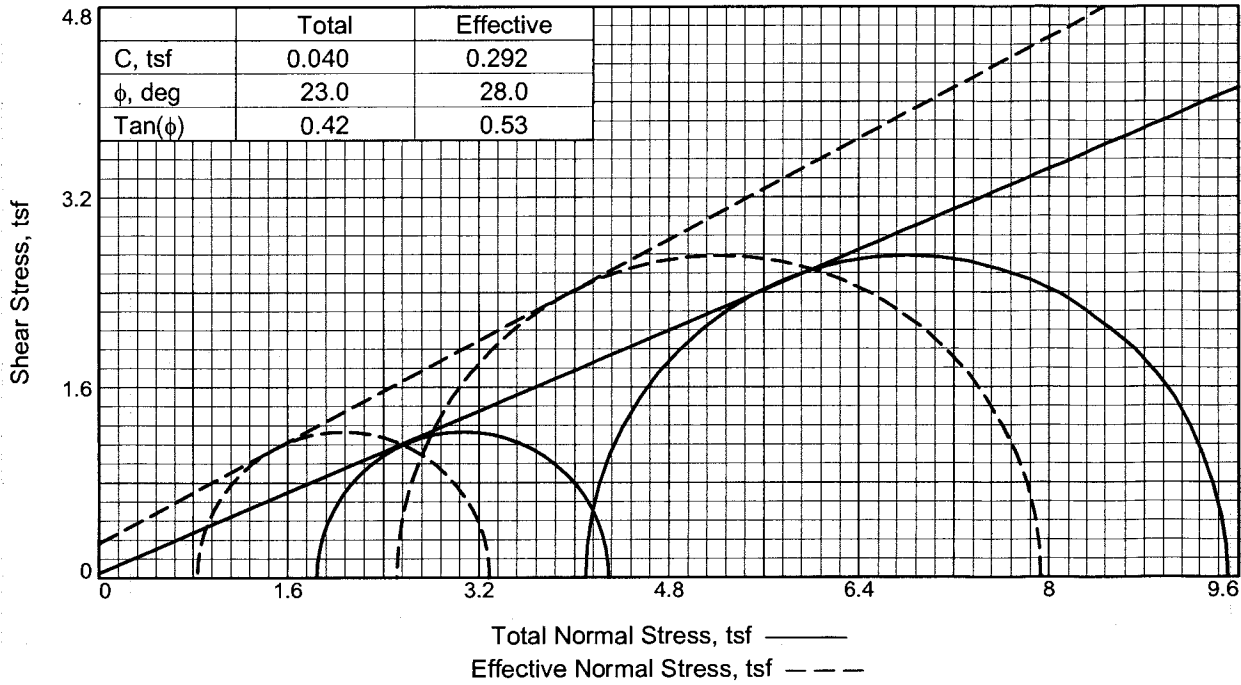
Remarks: Radial drainage strips applied to trimmed specimen; Saturated, backpressured until "B" response was 0.95 to 1.00; Consolidated; All Drainage valves closed and immediately sheared.

*Height to diameter ratio of 2:1 no achieved for specimen B.



-----	Effective ϕ' : 34.3°	$c' = 0.00$ (tsf)
_____	Total ϕ' : 35.7°	$c = 0.00$ (tsf)

Sample 1			Sample 2			Sample 3			Sample 4			Sample 5		
Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)	Strain (%)	Deviator Stress (tsf)	Pore Pressure (tsf)
0.00	0.00	0.00	0.00	0.00	0.00									
0.09	0.69	0.32	0.09	0.59	0.18									
0.18	0.93	0.51	0.18	1.30	0.53									
0.26	1.09	0.66	0.28	1.82	0.86									
0.35	1.19	0.75	0.37	2.11	1.08									
0.44	1.28	0.82	0.46	2.39	1.28									
0.53	1.37	0.89	0.55	2.59	1.42									
0.61	1.43	0.94	0.64	2.76	1.54									
0.70	1.49	0.98	0.74	2.93	1.64									
0.79	1.56	1.01	0.83	3.07	1.72									
0.88	1.61	1.04	0.92	3.21	1.79									
0.96	1.66	1.06	1.01	3.32	1.85									
1.05	1.71	1.08	1.11	3.43	1.89									
1.14	1.77	1.10	1.20	3.54	1.93									
1.23	1.82	1.12	1.29	3.63	1.96									
1.32	1.87	1.13	1.38	3.73	1.98									
1.40	1.92	1.14	1.47	3.83	2.00									
1.49	1.96	1.15	1.56	3.90	2.02									
1.58	2.01	1.17	1.66	4.00	2.03									
1.67	2.07	1.17	1.75	4.07	2.04									
1.75	2.11	1.18	1.84	4.13	2.04									
1.93	2.22	1.19	2.02	4.26	2.05									
2.10	2.33	1.20	2.21	4.38	2.05									
2.28	2.43	1.20	2.39	4.49	2.04									
2.46	2.56	1.19	2.57	4.59	2.03									
2.63	2.69	1.18	2.76	4.68	2.01									
2.81	2.82	1.17	2.94	4.77	1.99									
3.16	3.12	1.15	3.31	4.92	1.96									
3.51	3.43	1.12	3.68	5.06	1.91									
3.68	3.59	1.10	3.86	5.13	1.89									
3.86	3.77	1.08	4.05	5.20	1.86									
4.03	3.94	1.05	4.23	5.27	1.84									
4.21	4.13	1.03	4.41	5.35	1.81									
4.38	4.30	1.00	4.60	5.43	1.79									
4.56	4.49	0.97	4.78	5.50	1.76									
4.73	4.67	0.93	4.97	5.57	1.74									
4.91	4.86	0.89	5.15	5.65	1.71									
5.08	5.04	0.85	5.33	5.72	1.69									
5.26	5.21	0.81	5.52	5.78	1.66									
5.61	5.54	0.73	5.89	5.90	1.61									
5.96	5.86	0.64	6.26	6.01	1.57									
6.31	6.16	0.54	6.62	6.10	1.52									
6.66	6.43	0.46	6.99	6.19	1.48									
7.01	6.71	0.34	7.36	6.27	1.44									
7.89	7.29	0.10	8.28	6.51	1.33									
8.77	7.77	-0.14	9.20	6.77	1.24									
9.64	8.16	-0.36	10.12	6.98	1.14									
10.52	8.48	-0.58	11.04	7.13	1.05									
11.39	8.76	-0.78	11.96	7.33	0.96									
12.27	9.00	-0.97	12.87	7.54	0.86									
13.15	9.22	-1.14	13.79	7.71	0.78									
14.02	9.41	-1.31	14.71	7.82	0.70									
14.90	9.59	-1.46	15.63	7.98	0.62									
15.78	9.75	-1.61	16.55	8.16	0.55									
17.53	10.02	-1.87	18.39	8.37	0.41									
19.28	10.22	-2.11	20.00	8.61	0.30									
20.00	10.29	-2.19												



Sample No.	1	2	
Initial	Water Content, %	18.9	17.0
	Dry Density, pcf	110.4	114.1
	Saturation, %	98.5	97.9
	Void Ratio	0.5131	0.4640
	Diameter, in.	1.38	1.40
	Height, in.	2.81	2.81
At Test	Water Content, %	19.2	17.3
	Dry Density, pcf	110.4	114.1
	Saturation, %	100.0	100.0
	Void Ratio	0.5131	0.4640
	Diameter, in.	1.38	1.40
	Height, in.	2.81	2.81
Pore Pressure Parameter B	1.0	1.0	
Consolidation Pressure, tsf	1.85	4.09	
Back Pressure, tsf	5.22	3.14	
Cell Pressure, tsf	7.07	7.23	
Peak Deviator Stress, tsf	2.48	5.42	
Total Pore Pr., tsf	6.27	4.72	
Ultimate Deviator Stress, tsf	2.45	5.42	
Total Pore Pr., tsf	6.23	4.72	
Maj. Eff. Stress at Ultimate, tsf	3.29	7.93	
Min. Eff. Stress at Ultimate, tsf	0.84	2.51	

Type of Test:

CU with Pore Pressures

Sample Type: 3" Thinwall, Middle of sample

Description: SANDY LEAN CLAY, brown (CL)

LL= 31 PL= 15 PI= 16

Specific Gravity= 2.676

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

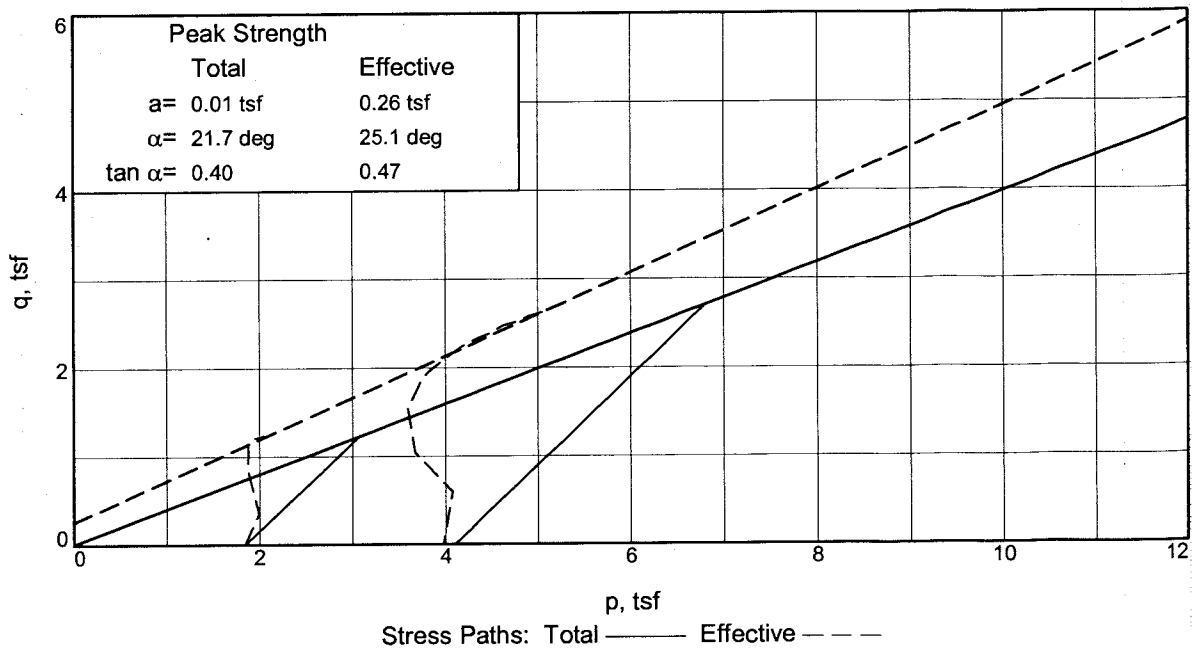
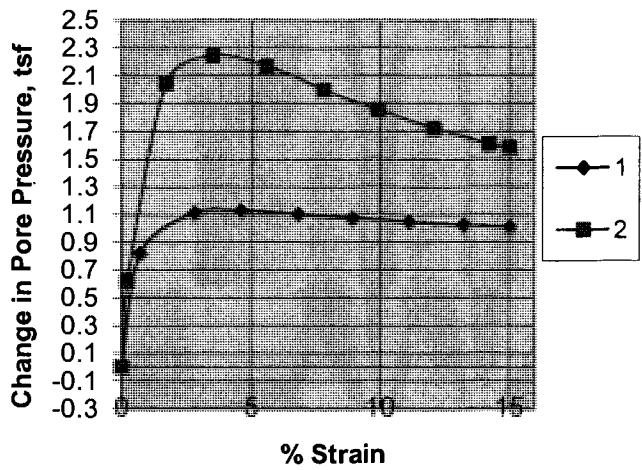
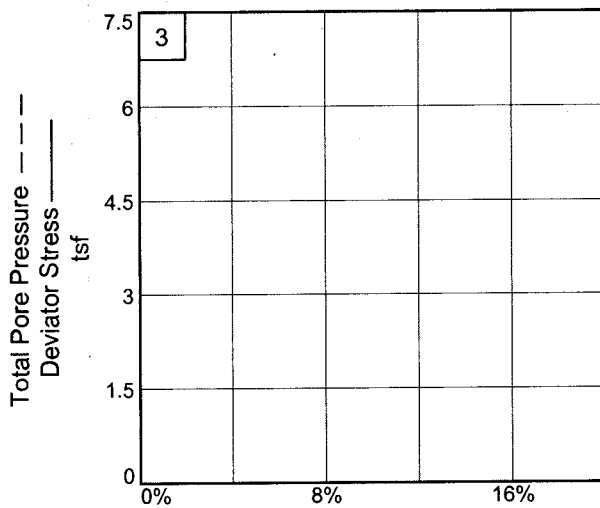
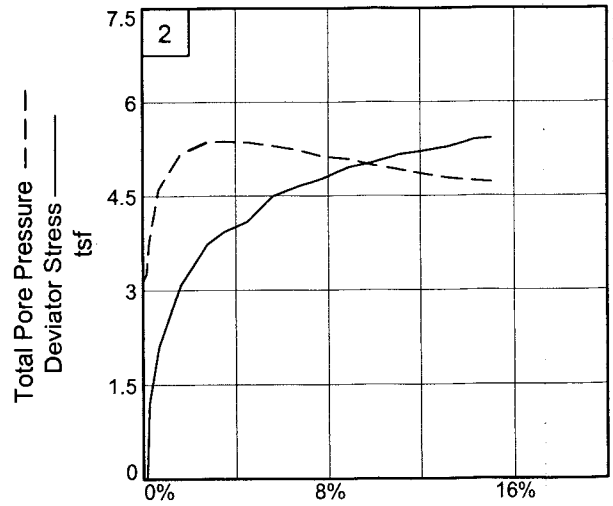
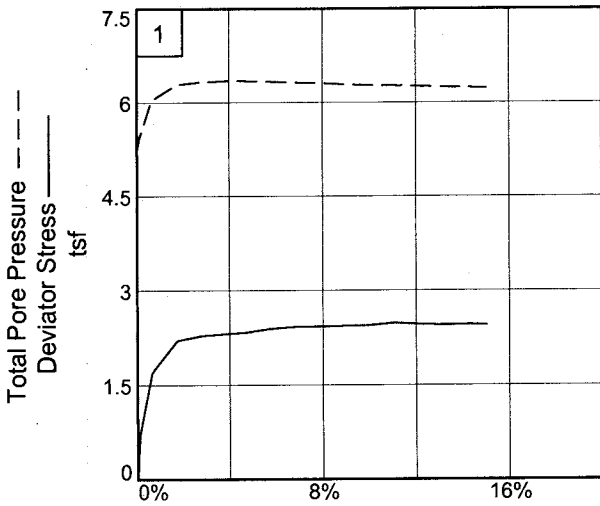
Location: Maple River, Till Formation

Sample Number: Boring10-105MU, #6 **Depth:** 67-69'

Proj. No.: BL-10-10065

Date Sampled:

BRAUN™
INTERTEC



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Till Formation

Depth: 67-69'

Sample Number: Boring10-105MU, #6

Project No.: B-10-10066 Feasibility Report and Environmental Impact Statement

Braun Intertec

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

3/4/2011

2:31 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Till Formation
Depth: 67-69' **Sample Number:** Boring10-105MU, #6
Description: SANDY LEAN CLAY, brown (CL)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 3" Thinwall, Middle of sample
Specific Gravity=2.676 **LL=**31 **PL=**15 **PI=**16
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	154.860			174.130
Moisture content: Dry soil+tare, gms.	135.090			152.050
Moisture content: Tare, gms.	30.430			30.440
Moisture, %	18.9	19.2	19.2	18.2
Moist specimen weight, gms.	145.2			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.50	1.50	1.50	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	131.3	131.6	131.6	
Dry density, pcf	110.4	110.4	110.4	
Void ratio	0.5131	0.5131	0.5131	
Saturation, %	98.5	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.068 tsf
Consolidation back pressure = 5.224 tsf
Consolidation effective confining stress = 1.844 tsf
Peak Stress = 2.481 tsf at reading no. 12
Ult. Stress = 2.452 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0443	12.840	0.0	0.0	0.000	1.844	1.844	1.00	5.224	1.844	0.000
1	0.0471	27.580	14.7	0.1	0.707	1.642	2.349	1.43	5.426	1.995	0.353
2	0.0628	48.420	35.6	0.7	1.697	1.029	2.726	2.65	6.039	1.877	0.848
3	0.0934	59.640	46.8	1.7	2.207	0.778	2.985	3.84	6.290	1.882	1.104
4	0.1235	61.830	49.0	2.8	2.285	0.736	3.021	4.10	6.332	1.879	1.143
5	0.1538	63.030	50.2	3.9	2.315	0.721	3.036	4.21	6.347	1.879	1.158
6	0.1740	63.730	50.9	4.6	2.330	0.718	3.048	4.24	6.350	1.883	1.165
7	0.2047	65.630	52.8	5.7	2.389	0.730	3.119	4.27	6.338	1.925	1.195
8	0.2351	66.990	54.1	6.8	2.423	0.743	3.166	4.26	6.325	1.954	1.211
9	0.2643	67.720	54.9	7.8	2.428	0.756	3.184	4.21	6.312	1.970	1.214
10	0.2951	68.600	55.8	8.9	2.437	0.773	3.210	4.15	6.295	1.992	1.219
11	0.3254	69.490	56.6	10.0	2.447	0.788	3.235	4.11	6.280	2.012	1.224
12	0.3556	70.980	58.1	11.1	2.481	0.798	3.279	4.11	6.270	2.039	1.241
13	0.3862	71.270	58.4	12.2	2.463	0.808	3.271	4.05	6.260	2.040	1.232
14	0.4157	71.760	58.9	13.2	2.454	0.822	3.276	3.99	6.246	2.049	1.227
15	0.4469	72.710	59.9	14.3	2.462	0.828	3.290	3.97	6.240	2.059	1.231
16	0.4665	72.960	60.1	15.0	2.452	0.837	3.289	3.93	6.231	2.063	1.226

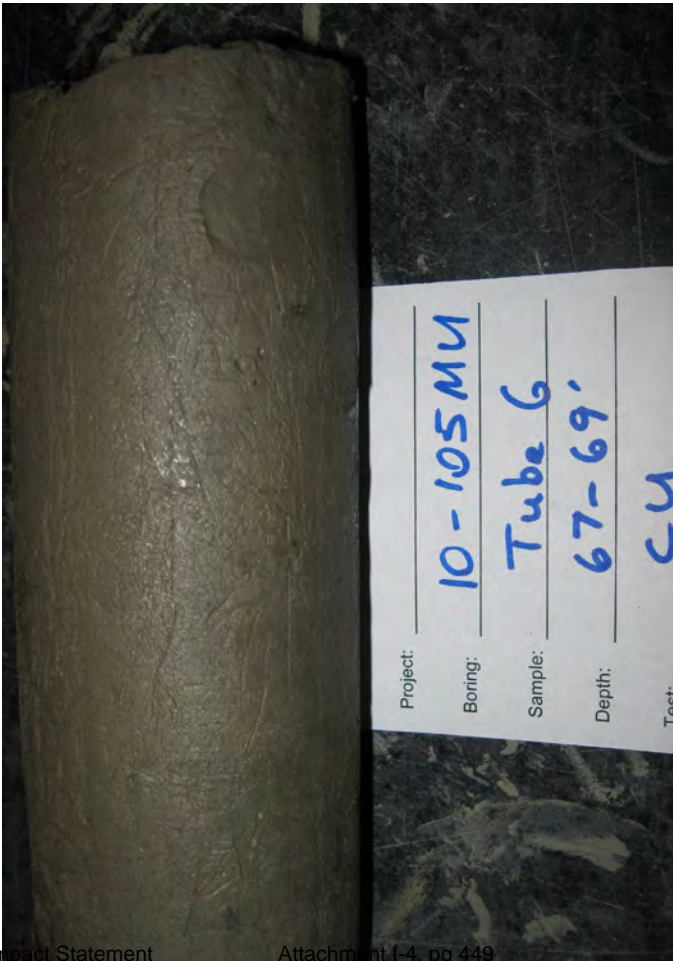
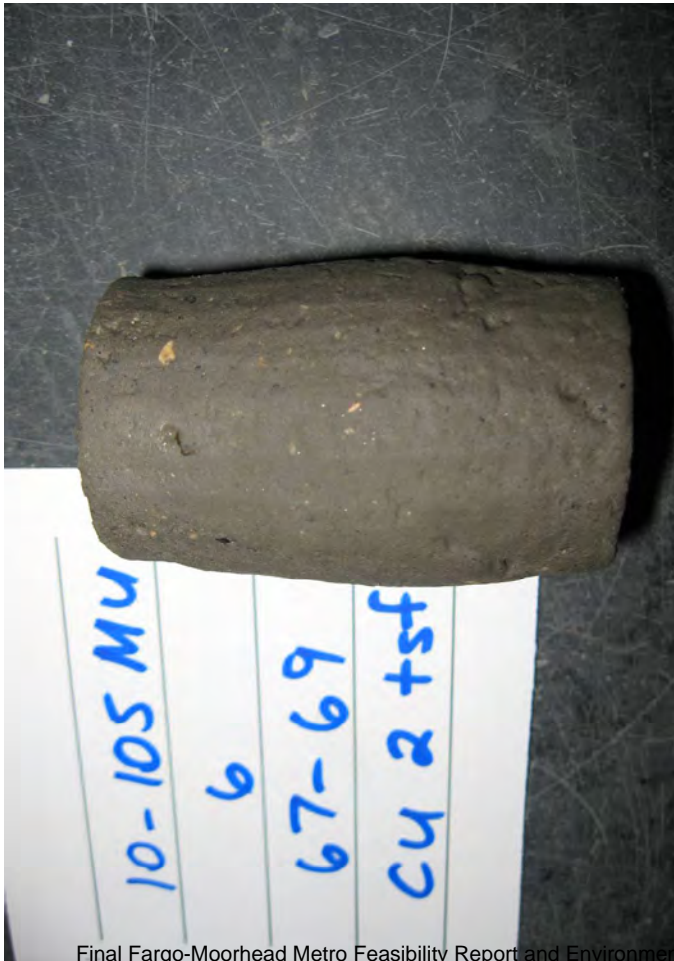
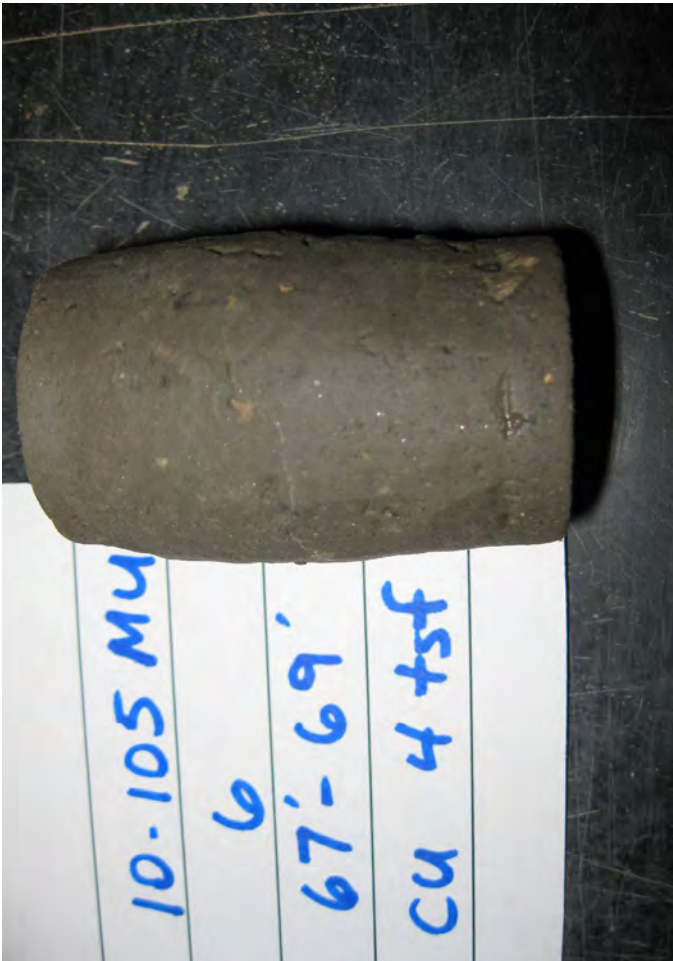
Parameters for Specimen No. 2

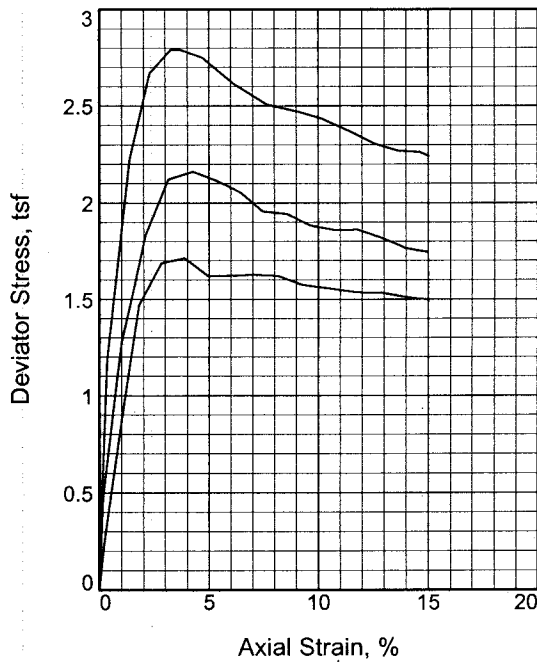
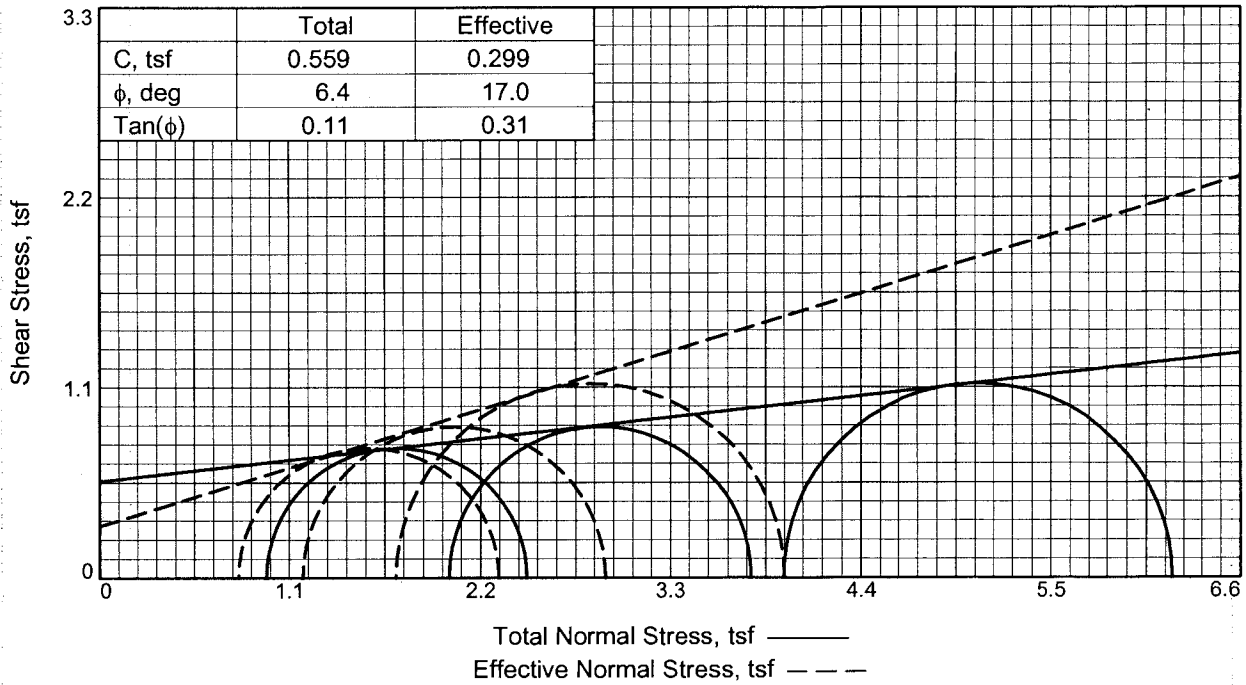
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	131.390			178.020
Moisture content: Dry soil+tare, gms.	116.630			158.450
Moisture content: Tare, gms.	29.720			30.270
Moisture, %	17.0	17.3	17.3	15.3
Moist specimen weight, gms.	150.5			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	133.5	133.9	133.9	
Dry density, pcf	114.1	114.1	114.1	
Void ratio	0.4640	0.4640	0.4640	
Saturation, %	97.9	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.232 tsf
 Consolidation back pressure = 3.136 tsf
 Consolidation effective confining stress = 4.096 tsf
 Peak Stress = 5.419 tsf at reading no. 17
 Ult. Stress = 5.419 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0385	28.610	0.0	0.0	0.000	4.096	4.096	1.00	3.136	4.096	0.000
1	0.0434	28.610	0.0	0.2	0.000	3.976	3.976	1.00	3.256	3.976	0.000
2	0.0463	54.150	25.5	0.3	1.198	3.475	4.673	1.34	3.757	4.074	0.599
3	0.0584	73.470	44.9	0.7	2.095	2.622	4.717	1.80	4.610	3.670	1.048
4	0.0850	95.410	66.8	1.7	3.090	2.052	5.142	2.51	5.180	3.597	1.545
5	0.1155	110.160	81.5	2.7	3.731	1.874	5.605	2.99	5.358	3.739	1.865
6	0.1361	115.040	86.4	3.5	3.924	1.856	5.780	3.11	5.376	3.818	1.962
7	0.1654	119.670	91.1	4.5	4.090	1.875	5.965	3.18	5.357	3.920	2.045
8	0.1957	129.790	101.2	5.6	4.493	1.930	6.423	3.33	5.302	4.176	2.246
9	0.2262	134.790	106.2	6.7	4.661	2.000	6.661	3.33	5.232	4.330	2.330
10	0.2565	138.870	110.3	7.8	4.784	2.099	6.883	3.28	5.133	4.491	2.392
11	0.2871	144.360	115.8	8.9	4.963	2.144	7.107	3.31	5.088	4.625	2.481
12	0.3173	147.530	118.9	9.9	5.038	2.246	7.284	3.24	4.986	4.765	2.519
13	0.3477	152.040	123.4	11.0	5.167	2.315	7.482	3.23	4.917	4.898	2.583
14	0.3771	154.720	126.1	12.1	5.217	2.375	7.592	3.20	4.857	4.983	2.608
15	0.4075	157.890	129.3	13.1	5.282	2.443	7.725	3.16	4.789	5.084	2.641
16	0.4379	162.470	133.9	14.2	5.401	2.493	7.894	3.17	4.739	5.193	2.700
17	0.4584	164.080	135.5	15.0	5.419	2.514	7.933	3.16	4.718	5.224	2.710





Sample No.	1	2	3	
Initial	Water Content, %	34.9	39.3	40.5
	Dry Density, pcf	85.1	81.6	80.3
	Saturation, %	96.7	100.0	100.0
	Void Ratio	0.9720	1.0579	1.0902
	Diameter, in.	1.40	1.38	1.39
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	36.1	39.0	38.9
	Dry Density, pcf	85.1	81.9	82.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.9720	1.0491	1.0458
	Diameter, in.	1.40	1.38	1.38
	Height, in.	2.81	2.80	2.79
Pore Pressure Parameter B	1.0	1.0	1.0	
Consolidation Pressure, tsf	0.97	2.02	3.96	
Back Pressure, tsf	6.13	5.13	3.18	
Cell Pressure, tsf	7.10	7.15	7.14	
Peak Deviator Stress, tsf	1.71	2.16	2.79	
Total Pore Pr., tsf	6.64	6.02	4.91	
Ultimate Deviator Stress, tsf	1.50	1.74	2.24	
Total Pore Pr., tsf	6.29	5.97	5.42	
Maj. Eff. Stress at Ultimate, tsf	2.31	2.92	3.96	
Min. Eff. Stress at Ultimate, tsf	0.81	1.18	1.72	

Type of Test:

CU with Pore Pressures

Sample Type: Undisturbed, 5" Thinwall, Middle

Description: FAT CLAY, brown (CH)

LL= 66 PL= 20 PI= 46

Specific Gravity= 2.689

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: W912ES-11-P-0024

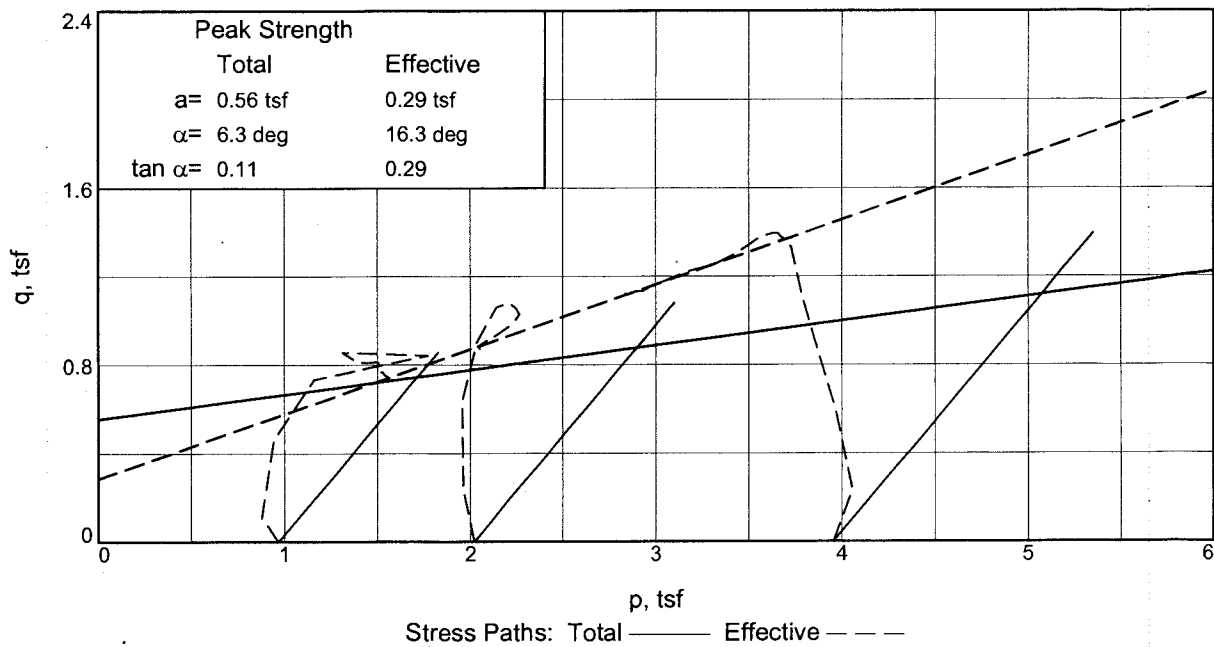
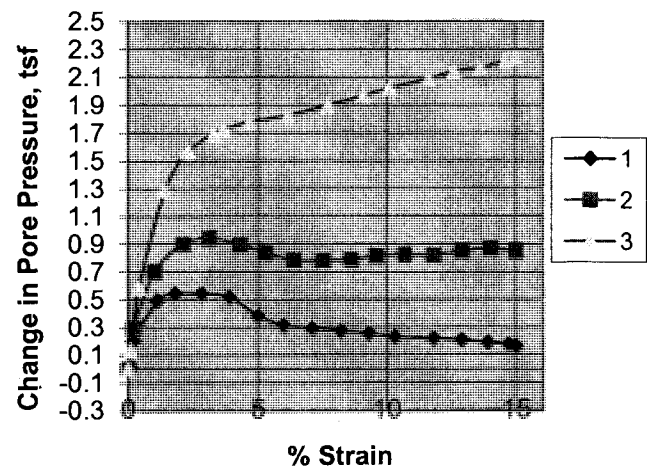
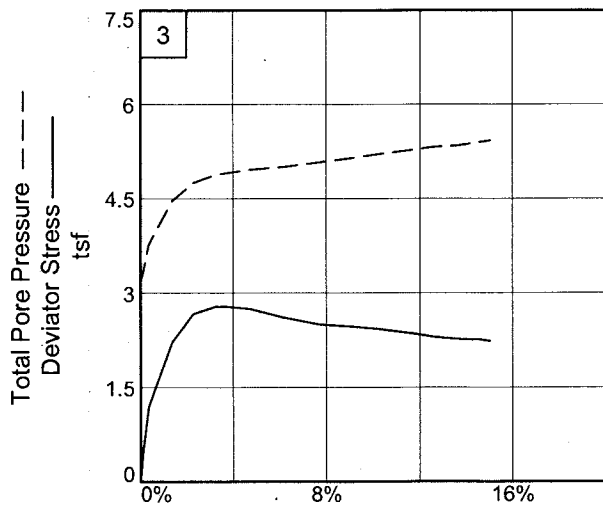
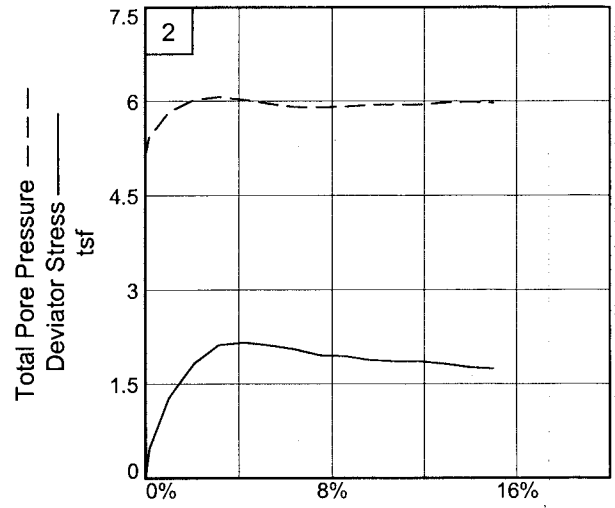
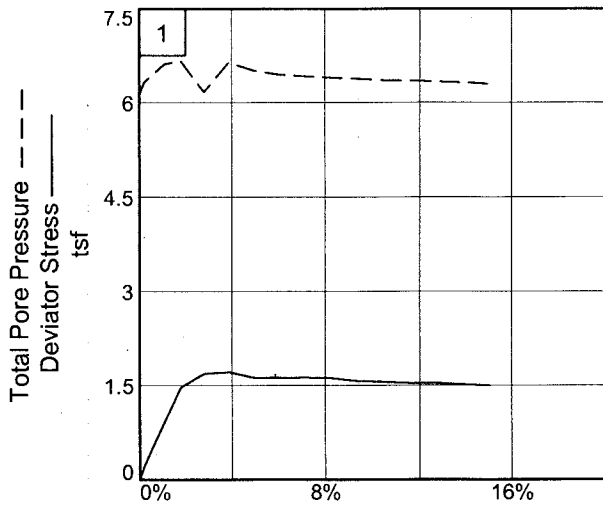
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Till Formation

Sample Number: Boring11-110, #6 **Depth:** 65-67'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Sheyenne River, Till Formation

Depth: 65-67'

Sample Number: Boring11-110, #6

Project No. B1110-0065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec

July 2011

Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

CU with Pore Pressures

4/26/2011

8:19 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Till Formation
Depth: 65-67' **Sample Number:** Boring11-110MU, #6
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: Undisturbed, 5" Thinwall, Middle
Specific Gravity=2.689 **LL**=66 **PL**=20 **PI**=46
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.640			161.240
Moisture content: Dry soil+tare, gms.	112.790			125.650
Moisture content: Tare, gms.	30.240			30.980
Moisture, %	34.9	36.1	36.1	37.6
Moist specimen weight, gms.	129.9			
Diameter, in.	1.40	1.40	1.40	
Area, in. ²	1.53	1.53	1.53	
Height, in.	2.81	2.81	2.81	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	114.9	115.9	115.9	
Dry density, pcf	85.1	85.1	85.1	
Void ratio	0.9720	0.9720	0.9720	
Saturation, %	96.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 7.098 tsf
 Consolidation back pressure = 6.130 tsf
 Consolidation effective confining stress = 0.968 tsf
 Peak Stress = 1.714 tsf at reading no. 5
 Ult. Stress = 1.499 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0560	20.000	0.0	0.0	0.000	0.968	0.968	1.00	6.130	0.968	0.000
1	0.0619	24.890	4.9	0.2	0.229	0.767	0.996	1.30	6.331	0.881	0.114
2	0.0863	39.950	20.0	1.1	0.926	0.481	1.407	2.92	6.617	0.944	0.463
3	0.1059	51.890	31.9	1.8	1.469	0.427	1.896	4.44	6.671	1.162	0.735
4	0.1353	57.000	37.0	2.8	1.686	0.926	2.613	2.82	6.171	1.770	0.843
5	0.1648	58.010	38.0	3.9	1.714	0.453	2.167	4.78	6.645	1.310	0.857
6	0.1950	56.360	36.4	5.0	1.621	0.589	2.210	3.75	6.509	1.400	0.811
7	0.2244	56.780	36.8	6.0	1.622	0.653	2.275	3.48	6.445	1.464	0.811
8	0.2547	57.320	37.3	7.1	1.627	0.676	2.303	3.41	6.422	1.489	0.813
9	0.2852	57.620	37.6	8.2	1.620	0.697	2.317	3.32	6.401	1.507	0.810
10	0.3164	56.990	37.0	9.3	1.574	0.715	2.289	3.20	6.383	1.502	0.787
11	0.3459	57.080	37.1	10.3	1.560	0.739	2.299	3.11	6.359	1.519	0.780
12	0.3859	57.110	37.1	11.8	1.536	0.750	2.286	3.05	6.348	1.518	0.768
13	0.4169	57.520	37.5	12.9	1.534	0.763	2.297	3.01	6.335	1.530	0.767
14	0.4471	57.490	37.5	13.9	1.513	0.780	2.293	2.94	6.318	1.537	0.757
15	0.4674	57.550	37.5	14.7	1.503	0.792	2.295	2.90	6.306	1.544	0.752
16	0.4773	57.610	37.6	15.0	1.499	0.806	2.305	2.86	6.292	1.556	0.750

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	136.490			155.500
Moisture content: Dry soil+tare, gms.	106.530			120.910
Moisture content: Tare, gms.	30.380			30.360
Moisture, %	39.3	39.3	39.0	38.2
Moist specimen weight, gms.	126.0			
Diameter, in.	1.38	1.38	1.38	
Area, in. ²	1.51	1.51	1.50	
Height, in.	2.81	2.81	2.80	
Net decrease in height, in.		0.00	0.00	
Wet Density, pcf	113.7	113.7	113.9	
Dry density, pcf	81.6	81.6	81.9	
Void ratio	1.0579	1.0579	1.0491	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 2

Consolidation cell pressure = 7.149 tsf
 Consolidation back pressure = 5.129 tsf
 Consolidation effective confining stress = 2.020 tsf
 Peak Stress = 2.162 tsf at reading no. 5
 Ult. Stress = 1.745 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0385	20.580	0.0	0.0	0.000	2.020	2.020	1.00	5.129	2.020	0.000
1	0.0433	30.440	9.9	0.2	0.472	1.726	2.198	1.27	5.423	1.962	0.236
2	0.0669	47.450	26.9	1.0	1.275	1.320	2.595	1.97	5.829	1.958	0.638
3	0.0969	59.640	39.1	2.1	1.834	1.123	2.957	2.63	6.026	2.040	0.917
4	0.1264	66.280	45.7	3.1	2.122	1.080	3.202	2.96	6.069	2.141	1.061
5	0.1578	67.680	47.1	4.3	2.162	1.129	3.291	2.91	6.020	2.210	1.081
6	0.1882	67.210	46.6	5.3	2.116	1.189	3.305	2.78	5.960	2.247	1.058
7	0.2184	66.400	45.8	6.4	2.056	1.239	3.295	2.66	5.910	2.267	1.028
8	0.2479	64.660	44.1	7.5	1.955	1.243	3.198	2.57	5.906	2.221	0.978
9	0.2784	64.900	44.3	8.6	1.943	1.236	3.179	2.57	5.913	2.207	0.971
10	0.3085	64.040	43.5	9.6	1.883	1.211	3.094	2.55	5.938	2.152	0.941
11	0.3392	64.040	43.5	10.7	1.860	1.200	3.060	2.55	5.949	2.130	0.930
12	0.3685	64.590	44.0	11.8	1.861	1.204	3.065	2.55	5.945	2.135	0.931
13	0.3997	64.110	43.5	12.9	1.818	1.175	2.993	2.55	5.974	2.084	0.909
14	0.4302	63.400	42.8	14.0	1.766	1.156	2.922	2.53	5.993	2.039	0.883
15	0.4580	63.390	42.8	15.0	1.745	1.179	2.924	2.48	5.970	2.051	0.872

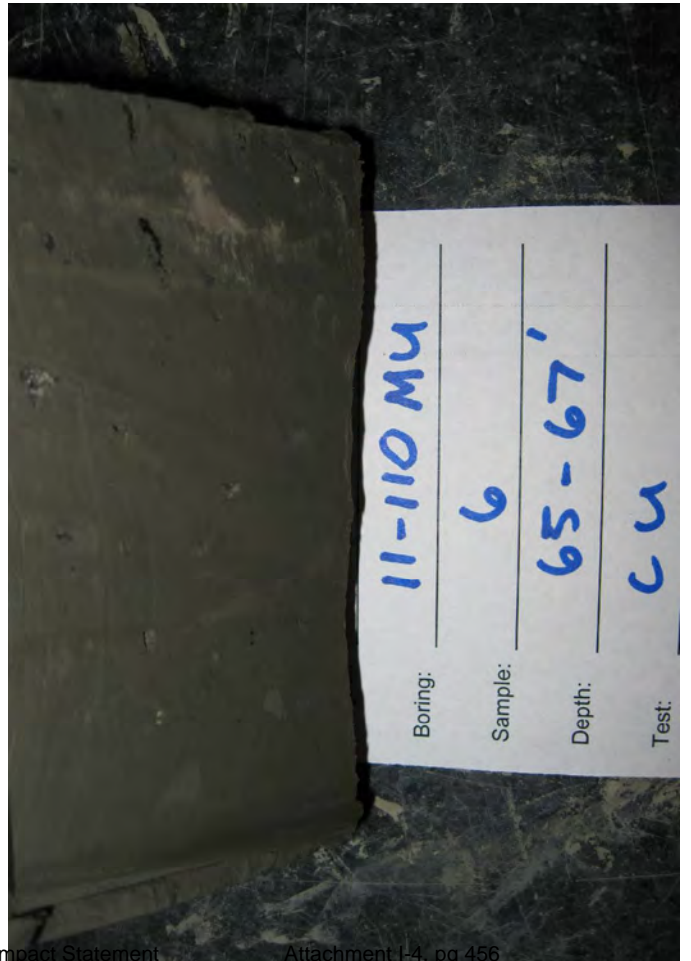
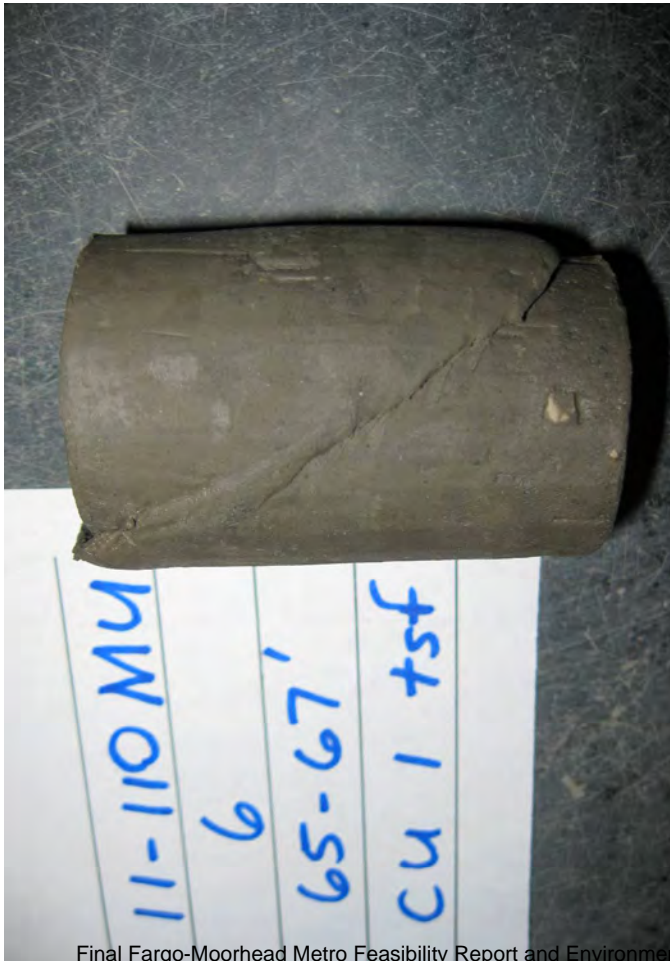
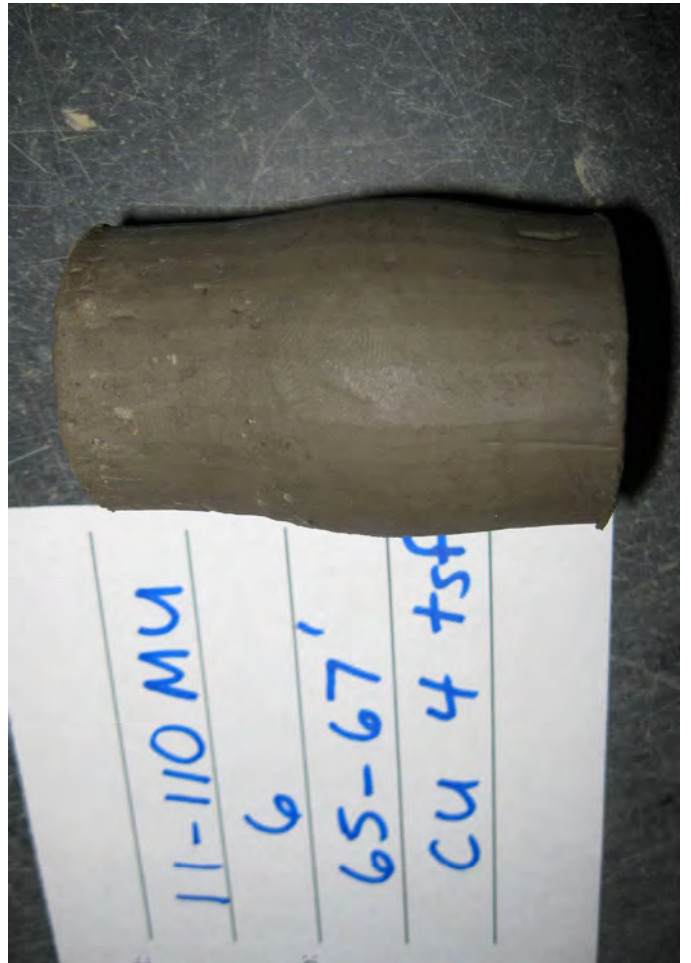
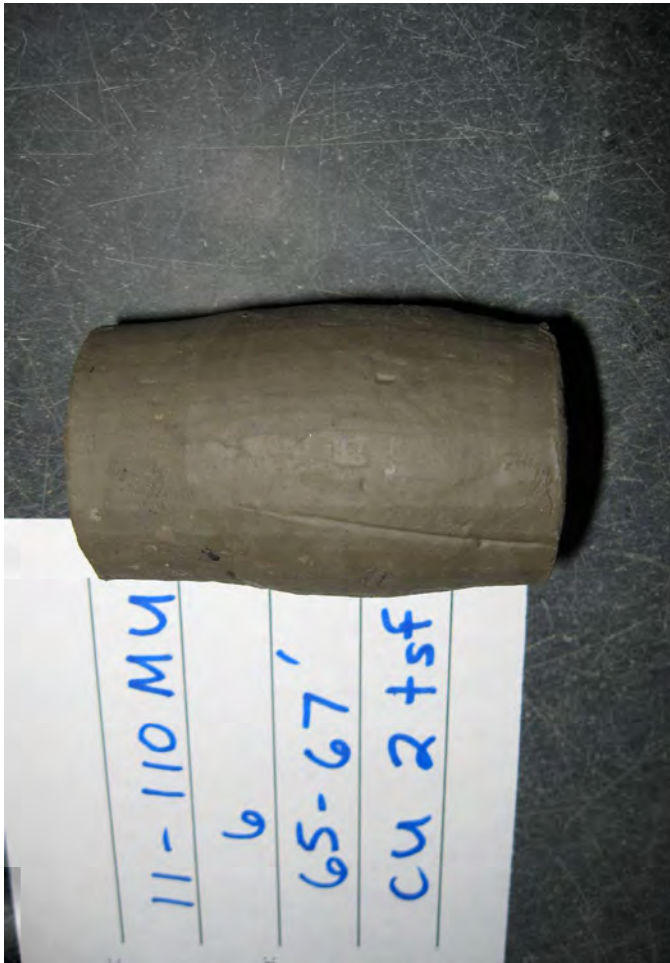
Parameters for Specimen No. 3

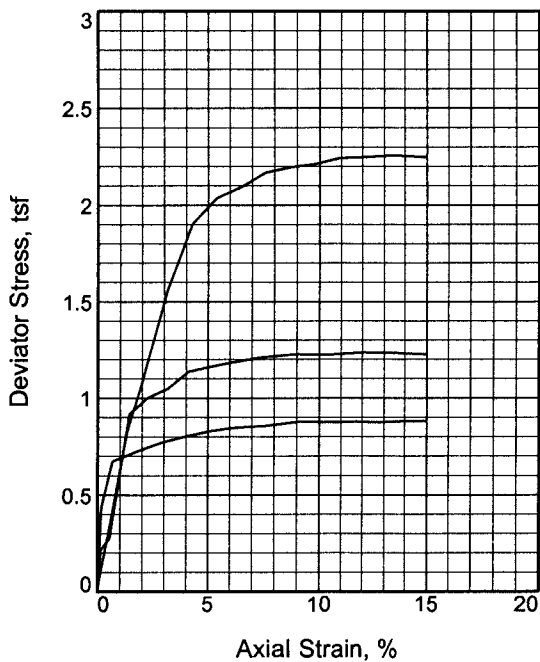
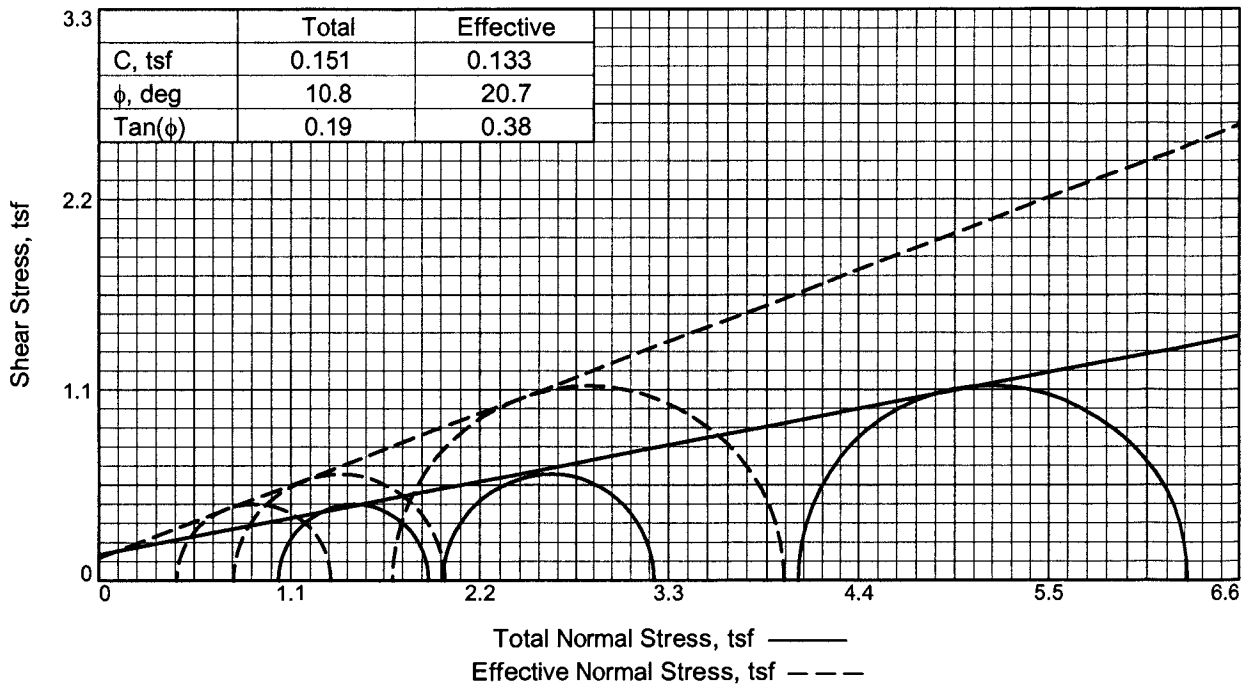
Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	128.450			153.900
Moisture content: Dry soil+tare, gms.	100.200			120.390
Moisture content: Tare, gms.	30.490			30.430
Moisture, %	40.5	40.5	38.9	37.2
Moist specimen weight, gms.	126.0			
Diameter, in.	1.39	1.39	1.38	
Area, in. ²	1.52	1.52	1.49	
Height, in.	2.81	2.81	2.79	
Net decrease in height, in.		0.00	0.02	
Wet Density, pcf	112.9	112.9	114.0	
Dry density, pcf	80.3	80.3	82.1	
Void ratio	1.0902	1.0902	1.0458	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 3

Consolidation cell pressure = 7.138 tsf
 Consolidation back pressure = 3.182 tsf
 Consolidation effective confining stress = 3.956 tsf
 Peak Stress = 2.790 tsf at reading no. 6
 Ult. Stress = 2.244 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0096	18.500	0.0	0.0	0.000	3.956	3.956	1.00	3.182	3.956	0.000
1	0.0126	28.190	9.7	0.1	0.467	3.824	4.291	1.12	3.314	4.057	0.233
2	0.0196	43.300	24.8	0.4	1.191	3.373	4.564	1.35	3.765	3.969	0.596
3	0.0473	65.280	46.8	1.4	2.224	2.671	4.895	1.83	4.467	3.783	1.112
4	0.0732	75.160	56.7	2.3	2.669	2.391	5.060	2.12	4.747	3.725	1.334
5	0.1002	78.310	59.8	3.3	2.789	2.264	5.053	2.23	4.874	3.659	1.395
6	0.1130	78.610	60.1	3.7	2.790	2.232	5.022	2.25	4.906	3.627	1.395
7	0.1408	78.370	59.9	4.7	2.750	2.179	4.929	2.26	4.959	3.554	1.375
8	0.1817	76.260	57.8	6.2	2.612	2.132	4.744	2.23	5.006	3.438	1.306
9	0.2236	74.860	56.4	7.7	2.508	2.062	4.570	2.22	5.076	3.316	1.254
10	0.2644	74.890	56.4	9.1	2.470	1.990	4.460	2.24	5.148	3.225	1.235
11	0.2923	74.740	56.2	10.1	2.436	1.937	4.373	2.26	5.201	3.155	1.218
12	0.3333	73.940	55.4	11.6	2.362	1.870	4.232	2.26	5.268	3.051	1.181
13	0.3610	73.210	54.7	12.6	2.305	1.816	4.121	2.27	5.322	2.968	1.152
14	0.3891	73.030	54.5	13.6	2.270	1.795	4.065	2.26	5.343	2.930	1.135
15	0.4169	73.490	55.0	14.6	2.263	1.737	4.000	2.30	5.401	2.869	1.132
16	0.4280	73.270	54.8	15.0	2.244	1.716	3.960	2.31	5.422	2.838	1.122





Sample No.		1	2	3
Initial	Water Content, %	50.9	51.3	47.5
	Dry Density, pcf	71.0	70.7	73.9
	Saturation, %	100.0	99.9	100.0
	Void Ratio	1.3761	1.3866	1.2828
	Diameter, in.	1.43	1.41	1.41
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	46.3	47.6	41.2
	Dry Density, pcf	75.0	73.8	79.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2503	1.2853	1.1144
	Diameter, in.	1.40	1.39	1.37
	Height, in.	2.75	2.76	2.73
Pore Pressure Parameter B		1.0	1.0	1.0
Consolidation Pressure, tsf		1.03	2.00	4.04
Back Pressure, tsf		6.12	5.13	3.08
Cell Pressure, tsf		7.15	7.13	7.12
Peak Deviator Stress, tsf		0.88	1.24	2.26
Total Pore Pr., tsf		6.70	6.34	5.42
Ultimate Deviator Stress, tsf		0.88	1.23	2.25
Total Pore Pr., tsf		6.70	6.35	5.42
Maj. Eff. Stress at Ultimate, tsf		1.33	2.00	3.95
Min. Eff. Stress at Ultimate, tsf		0.45	0.78	1.70

Type of Test:

CU with Pore Pressures

Sample Type: 5" Thinwall, Middle of sample

Description: FAT CLAY, brown (CH)

LL= 66

PL= 19

PI= 47

Specific Gravity= 2.702

Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

Location: Fargo Pile Load Test, Till Formation

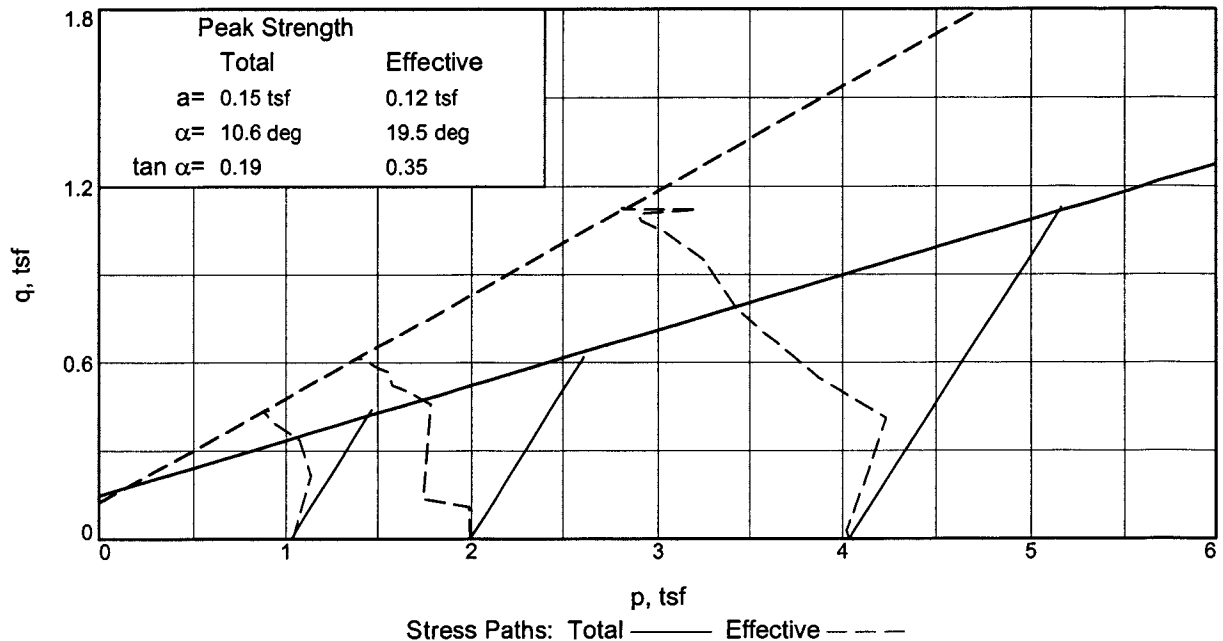
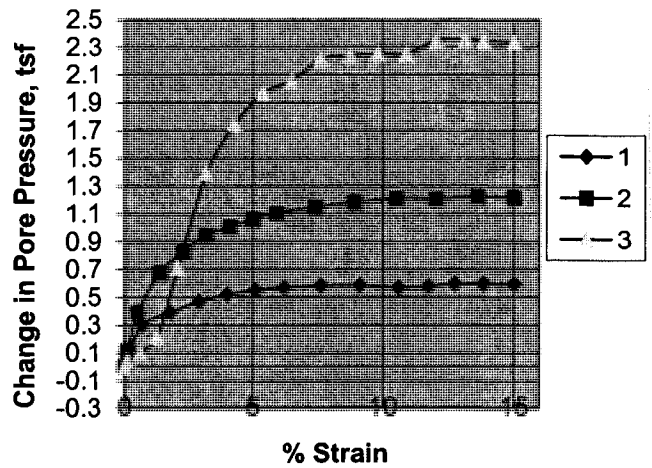
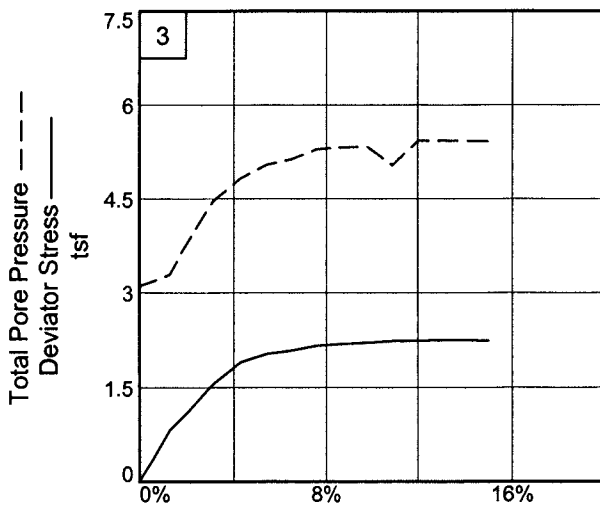
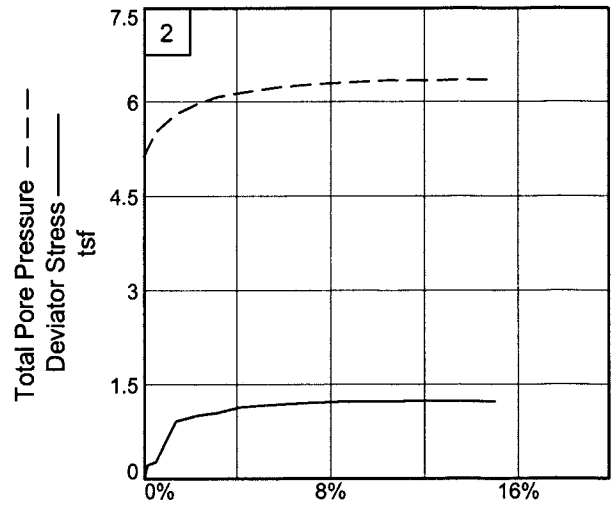
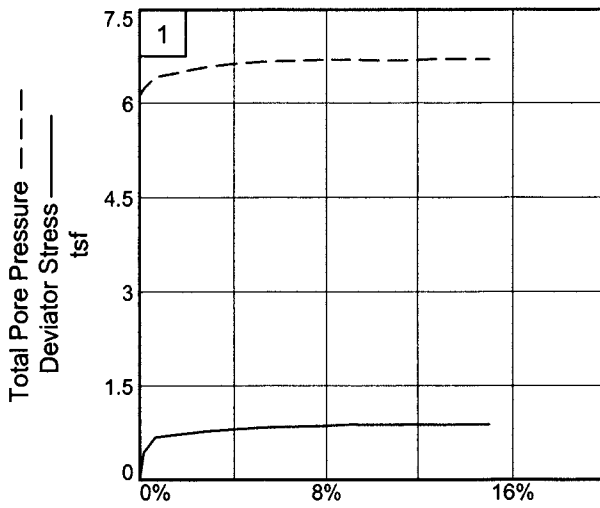
Sample Number: Boring11-119MU, #4

Depth: 61-64'

Proj. No.: BL-10-10065

Date Sampled:





Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Till Formation

Depth: 61-64'

Sample No.: Boring11-119MU, #4

Project No.: DL 10-0065

Figure

Braun Intertec

TRIAxIAL COMPRESSION TEST
CU with Pore Pressures

5/30/2011
12:18 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Till Formation
Depth: 61-64' **Sample Number:** Boring11-119MU, #4
Description: FAT CLAY, brown (CH)
Remarks: Rate of strain is 0.001 in/min. Failure criteria is based on the ultimate stress which occurs at 15% strain. Samples were saturated for 10 days and consolidated for 3 days.
Type of Sample: 5" Thinwall, Middle of sample
Specific Gravity=2.702 **LL=**66 **PL=**19 **PI=**47
Test Method: COE uniform strain

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.950			144.960
Moisture content: Dry soil+tare, gms.	92.350			113.460
Moisture content: Tare, gms.	30.280			30.790
Moisture, %	50.9	50.9	46.3	38.1
Moist specimen weight, gms.	125.7			
Diameter, in.	1.43	1.43	1.40	
Area, in. ²	1.60	1.60	1.54	
Height, in.	2.80	2.80	2.75	
Net decrease in height, in.		0.00	0.05	
Wet Density, pcf	107.1	107.1	109.6	
Dry density, pcf	71.0	71.0	75.0	
Void ratio	1.3761	1.3761	1.2503	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.151 tsf
Consolidation back pressure = 6.122 tsf
Consolidation effective confining stress = 1.029 tsf
Peak Stress = 0.882 tsf at reading no. 14
Ult. Stress = 0.882 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0554	18.090	0.0	0.0	0.000	1.039	1.039	1.00	6.112	1.039	0.000
1	0.0602	27.390	9.3	0.2	0.434	0.925	1.359	1.47	6.226	1.142	0.217
2	0.0740	32.590	14.5	0.7	0.674	0.741	1.415	1.91	6.410	1.078	0.337
3	0.1040	33.890	15.8	1.8	0.726	0.649	1.375	2.12	6.502	1.012	0.363
4	0.1346	35.060	17.0	2.9	0.771	0.574	1.345	2.34	6.577	0.959	0.385
5	0.1641	35.930	17.8	4.0	0.801	0.523	1.324	2.53	6.628	0.924	0.401
6	0.1952	36.790	18.7	5.1	0.830	0.490	1.320	2.69	6.661	0.905	0.415
7	0.2255	37.390	19.3	6.2	0.847	0.473	1.320	2.79	6.678	0.896	0.423
8	0.2656	37.920	19.8	7.6	0.856	0.459	1.315	2.87	6.692	0.887	0.428
9	0.3059	38.770	20.7	9.1	0.879	0.456	1.335	2.93	6.695	0.896	0.440
10	0.3469	39.000	20.9	10.6	0.874	0.471	1.345	2.86	6.680	0.908	0.437
11	0.3764	39.350	21.3	11.7	0.878	0.463	1.341	2.90	6.688	0.902	0.439
12	0.4058	39.530	21.4	12.7	0.875	0.444	1.319	2.97	6.707	0.881	0.437
13	0.4362	39.920	21.8	13.8	0.880	0.445	1.325	2.98	6.706	0.885	0.440
14	0.4676	40.270	22.2	15.0	0.882	0.449	1.331	2.96	6.702	0.890	0.441

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	134.200			138.260
Moisture content: Dry soil+tare, gms.	98.970			110.200
Moisture content: Tare, gms.	30.280			30.180
Moisture, %	51.3	51.3	47.6	35.1
Moist specimen weight, gms.	122.5			
Diameter, in.	1.41	1.41	1.39	
Area, in. ²	1.56	1.56	1.51	
Height, in.	2.80	2.80	2.76	
Net decrease in height, in.		0.00	0.04	
Wet Density, pcf	106.9	106.9	108.9	
Dry density, pcf	70.7	70.7	73.8	
Void ratio	1.3866	1.3866	1.2853	
Saturation, %	99.9	100.0	100.0	

Consolidation cell pressure = 7.127 tsf

Consolidation back pressure = 5.135 tsf

Consolidation effective confining stress = 1.992 tsf

Peak Stress = 1.237 tsf at reading no. 12

Ult. Stress = 1.227 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0066	17.600	0.0	0.0	0.000	1.992	1.992	1.00	5.135	1.992	0.000
1	0.0105	22.180	4.6	0.1	0.217	1.880	2.097	1.12	5.247	1.989	0.109
2	0.0215	23.400	5.8	0.5	0.274	1.603	1.877	1.17	5.524	1.740	0.137
3	0.0455	37.170	19.6	1.4	0.917	1.319	2.236	1.70	5.808	1.778	0.459
4	0.0694	39.180	21.6	2.3	1.002	1.167	2.169	1.86	5.960	1.668	0.501
5	0.0942	40.400	22.8	3.2	1.049	1.051	2.100	2.00	6.076	1.576	0.525
6	0.1200	42.540	24.9	4.1	1.137	0.987	2.124	2.15	6.140	1.555	0.568
7	0.1440	43.270	25.7	5.0	1.159	0.935	2.094	2.24	6.192	1.515	0.580
8	0.1688	44.000	26.4	5.9	1.181	0.889	2.070	2.33	6.238	1.480	0.591
9	0.2095	45.100	27.5	7.4	1.211	0.846	2.057	2.43	6.281	1.452	0.606
10	0.2523	45.920	28.3	8.9	1.226	0.815	2.041	2.50	6.312	1.428	0.613
11	0.2961	46.410	28.8	10.5	1.226	0.785	2.011	2.56	6.342	1.398	0.613
12	0.3391	47.180	29.6	12.0	1.237	0.788	2.025	2.57	6.339	1.406	0.618
13	0.3831	47.660	30.1	13.6	1.234	0.771	2.005	2.60	6.356	1.388	0.617
14	0.4200	47.950	30.4	15.0	1.227	0.777	2.004	2.58	6.350	1.390	0.613

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	144.410			139.130
Moisture content: Dry soil+tare, gms.	108.030			114.600
Moisture content: Tare, gms.	31.390			30.330
Moisture, %	47.5	47.5	41.2	29.1
Moist specimen weight, gms.	124.9			
Diameter, in.	1.41	1.41	1.37	
Area, in. ²	1.56	1.56	1.48	
Height, in.	2.80	2.80	2.73	
Net decrease in height, in.		0.00	0.07	
Wet Density, pcf	109.0	109.0	112.7	
Dry density, pcf	73.9	73.9	79.8	
Void ratio	1.2828	1.2828	1.1144	
Saturation, %	100.0	100.0	100.0	

Consolidation cell pressure = 7.119 tsf

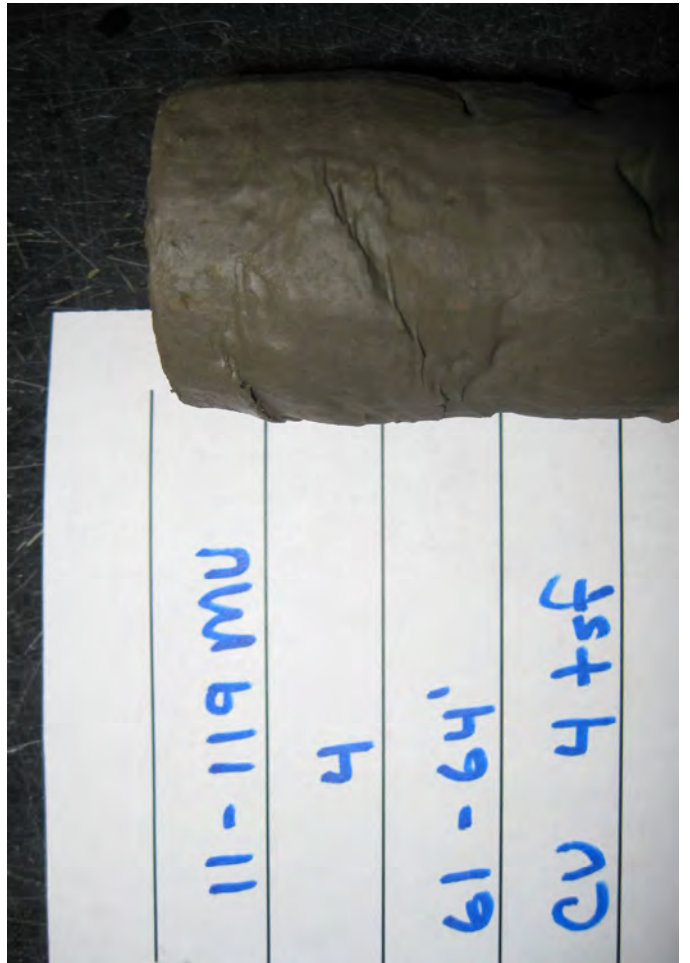
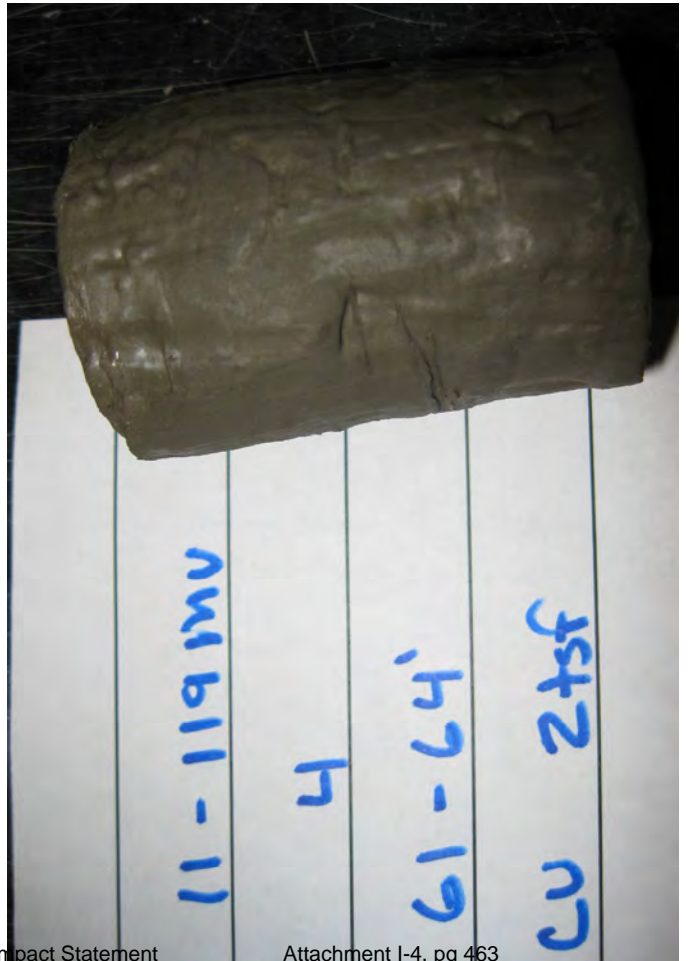
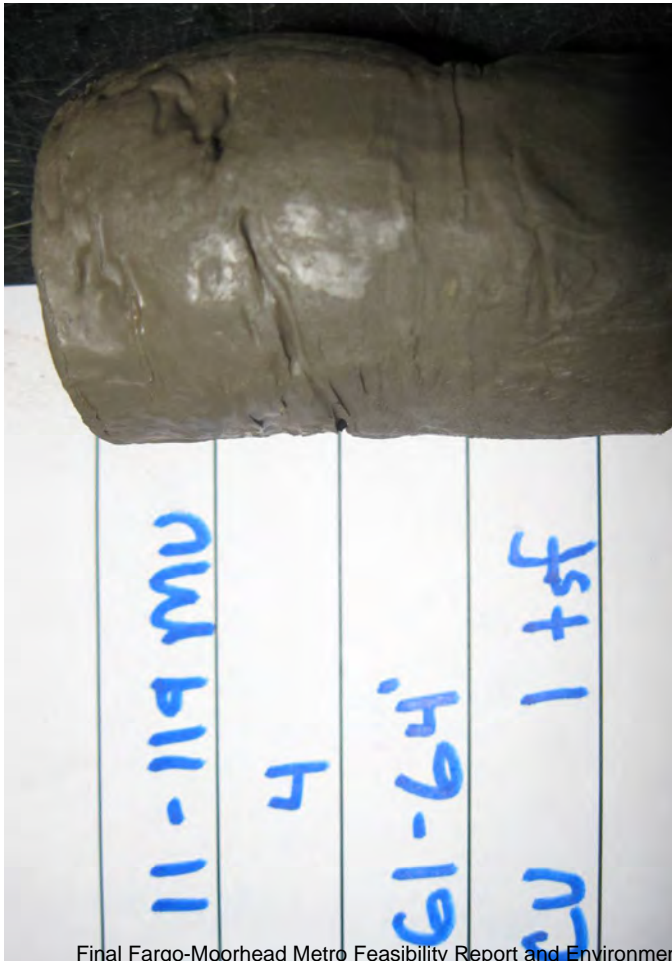
Consolidation back pressure = 3.082 tsf

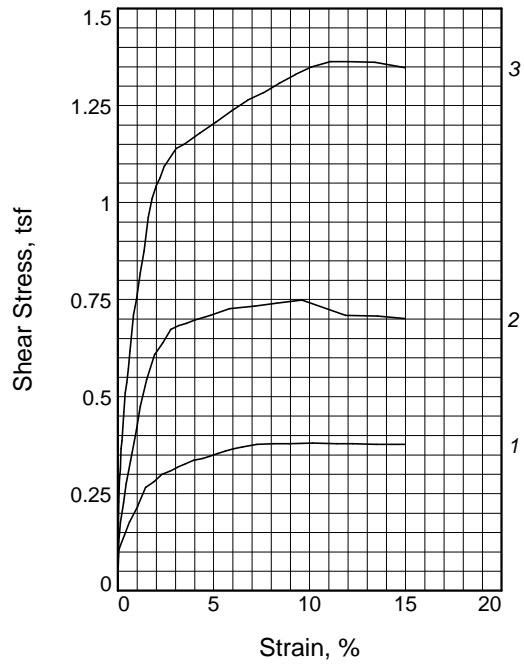
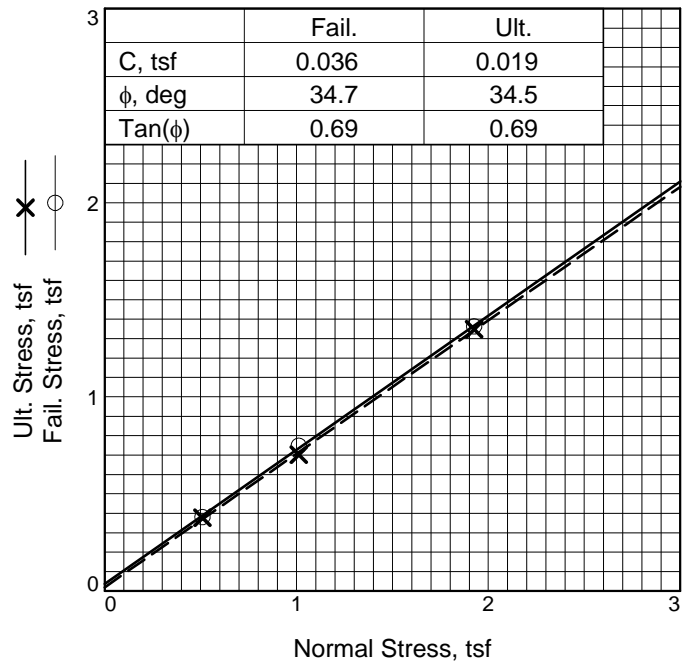
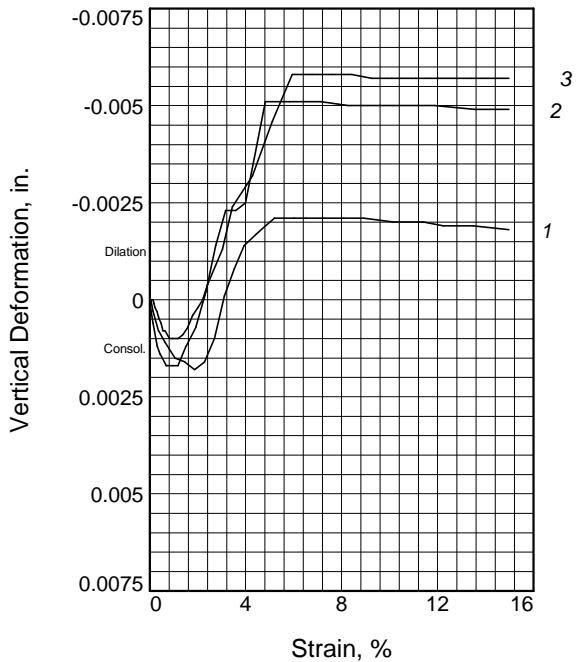
Consolidation effective confining stress = 4.037 tsf

Peak Stress = 2.256 tsf at reading no. 15

Ult. Stress = 2.249 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Eff. Stress tsf	Major Eff. Stress tsf	1:3 Ratio	Pore Press. tsf	P tsf	Q tsf
0	0.0403	21.470	0.0	0.0	0.000	4.037	4.037	1.00	3.082	4.037	0.000
1	0.0423	22.640	1.2	0.1	0.057	3.995	4.052	1.01	3.124	4.023	0.028
2	0.0563	28.890	7.4	0.6	0.359	3.933	4.292	1.09	3.186	4.112	0.179
3	0.0761	38.630	17.2	1.3	0.823	3.824	4.647	1.22	3.295	4.236	0.412
4	0.0963	44.520	23.1	2.1	1.097	3.328	4.425	1.33	3.791	3.877	0.549
5	0.1267	54.760	33.3	3.2	1.567	2.646	4.213	1.59	4.473	3.429	0.783
6	0.1571	62.380	40.9	4.3	1.903	2.295	4.198	1.83	4.824	3.247	0.952
7	0.1875	65.790	44.3	5.4	2.038	2.073	4.111	1.98	5.046	3.092	1.019
8	0.2178	67.540	46.1	6.5	2.094	1.981	4.075	2.06	5.138	3.028	1.047
9	0.2479	69.740	48.3	7.6	2.168	1.824	3.992	2.19	5.295	2.908	1.084
10	0.2784	71.000	49.5	8.7	2.198	1.801	3.999	2.22	5.318	2.900	1.099
11	0.3080	71.960	50.5	9.8	2.214	1.786	4.000	2.24	5.333	2.893	1.107
12	0.3380	73.260	51.8	10.9	2.243	2.087	4.330	2.07	5.032	3.208	1.121
13	0.3685	74.030	52.6	12.0	2.248	1.691	3.939	2.33	5.428	2.815	1.124
14	0.3979	74.860	53.4	13.1	2.255	1.684	3.939	2.34	5.435	2.812	1.128
15	0.4175	75.320	53.8	13.8	2.256	1.694	3.950	2.33	5.425	2.822	1.128
16	0.4490	75.880	54.4	15.0	2.249	1.702	3.951	2.32	5.417	2.826	1.124





Sample No.	1	2	3
Initial			
Water Content, %	27.6	27.1	24.7
Dry Density, pcf	95.7	98.4	100.0
Saturation, %	95.6	100.0	94.6
Void Ratio	0.7934	0.7454	0.7176
Diameter, in.	2.41	2.41	2.41
Height, in.	1.00	1.01	1.00
At Test			
Water Content, %	27.7	26.3	25.0
Dry Density, pcf	97.3	99.6	101.6
Saturation, %	99.5	100.0	99.6
Void Ratio	0.7652	0.7237	0.6893
Diameter, in.	2.41	2.41	2.41
Height, in.	0.98	1.00	0.98
Normal Stress, tsf	0.509	1.011	1.926
Fail. Stress, tsf	0.380	0.748	1.363
Strain, %	10.2	9.6	11.1
Ult. Stress, tsf	0.377	0.701	1.347
Strain, %	15.0	15.0	15.0
Strain rate, in./min.	0.00	0.00	0.00

Sample Type: Thinwall, 5", Bottom of sample
Description: SILT, brown (ML)
 LL= 31 PL= 23 PI= 8
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00064 in/min.

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Fargo
Location: SE-F-05, Poplar River/West Fargo Formation
Sample Number: Boring 09-23MU, #3 **Depth:** 20-22'
Proj. No.: BL-09-03127 **Date Sampled:**



Figure DirectShear ASTM D3080

DIRECT SHEAR TEST

10/12/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Location: SE-F-05, Poplar River/West Fargo Formation Fargo
Depth: 20-22' **Sample Number:** Boring 09-23MU, #3
Description: SILT, brown (ML)
Remarks: The rate of strain is 0.00064 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**31 **PL=**23 **PI=**8

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	114.650		142.070
Moisture content: Dry soil+tare, gms.	96.600		117.810
Moisture content: Tare, gms.	31.150		30.150
Moisture, %	27.6	27.7	27.7
Moist specimen weight, gms.	146.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	122.1	124.2	
Dry density, pcf	95.7	97.3	
Void ratio	0.7934	0.7652	
Saturation, %	95.6	99.5	

Test Readings for Specimen No. 1

Normal stress = .509 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.380 tsf at reading no. 23
Ult. Stress = 0.377 tsf at reading no. 27

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0248	0.000	0.0	0.0	0.000	0.1467
1	0.0252	3.400	3.4	0.0	0.054	0.1467
2	0.0260	6.600	6.6	0.0	0.104	0.1467
3	0.0280	7.400	7.4	0.1	0.117	0.1464
4	0.0335	9.100	9.1	0.4	0.143	0.1459
5	0.0400	11.300	11.3	0.6	0.178	0.1456
6	0.0500	13.800	13.8	1.0	0.217	0.1452
7	0.0600	16.900	16.9	1.5	0.266	0.1451
8	0.0700	17.800	17.8	1.9	0.280	0.1449
9	0.0800	19.000	19.0	2.3	0.299	0.1451
10	0.0900	19.500	19.5	2.7	0.307	0.1457
11	0.1000	20.200	20.2	3.1	0.318	0.1468
12	0.1100	20.700	20.7	3.5	0.326	0.1475
13	0.1200	21.300	21.3	3.9	0.336	0.1481

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1320	21.600	21.6	4.4	0.340	0.1484
15	0.1410	22.000	22.0	4.8	0.347	0.1486
16	0.1500	22.400	22.4	5.2	0.353	0.1488
17	0.1600	22.800	22.8	5.6	0.359	0.1488
18	0.1700	23.200	23.2	6.0	0.366	0.1488
19	0.1820	23.500	23.5	6.5	0.370	0.1488
20	0.2000	23.900	23.9	7.3	0.377	0.1488
21	0.2200	24.000	24.0	8.1	0.378	0.1488
22	0.2400	24.000	24.0	8.9	0.378	0.1488
23	0.2700	24.100	24.1	10.2	0.380	0.1487
24	0.3000	24.000	24.0	11.4	0.378	0.1487
25	0.3200	24.000	24.0	12.2	0.378	0.1486
26	0.3500	23.900	23.9	13.5	0.377	0.1486
27	0.3860	23.900	23.9	15.0	0.377	0.1485

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	142.370		108.720
Moisture content: Dry soil+tare, gms.	118.310		92.450
Moisture content: Tare, gms.	29.550		30.640
Moisture, %	27.1	26.3	26.3
Moist specimen weight, gms.	151.8		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.01	1.00	
Net decrease in height, in.		0.01	
Wet Density, pcf	125.0	125.8	
Dry density, pcf	98.4	99.6	
Void ratio	0.7454	0.7237	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 2

Normal stress = 1.011 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.748 tsf at reading no. 20

Ult. Stress = 0.701 tsf at reading no. 23

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0236	0.000	0.0	0.0	0.000	0.1528
1	0.0240	5.000	5.0	0.0	0.079	0.1527
2	0.0250	8.000	8.0	0.1	0.126	0.1525
3	0.0270	11.100	11.1	0.1	0.175	0.1522
4	0.0310	14.400	14.4	0.3	0.227	0.1516
5	0.0340	17.500	17.5	0.4	0.276	0.1514
6	0.0400	21.300	21.3	0.7	0.336	0.1511
7	0.0470	26.200	26.2	1.0	0.413	0.1511
8	0.0520	30.100	30.1	1.2	0.474	0.1511
9	0.0600	34.500	34.5	1.5	0.544	0.1516

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
10	0.0700	38.600	38.6	1.9	0.608	0.1521
11	0.0800	40.500	40.5	2.3	0.638	0.1530
12	0.0900	42.700	42.7	2.8	0.673	0.1542
13	0.1000	43.300	43.3	3.2	0.682	0.1551
14	0.1100	43.700	43.7	3.6	0.689	0.1551
15	0.1200	44.200	44.2	4.0	0.696	0.1553
16	0.1400	45.000	45.0	4.8	0.709	0.1579
17	0.1640	46.100	46.1	5.8	0.726	0.1579
18	0.1960	46.500	46.5	7.1	0.733	0.1579
19	0.2230	47.000	47.0	8.3	0.741	0.1578
20	0.2550	47.500	47.5	9.6	0.748	0.1578
21	0.3100	45.000	45.0	11.9	0.709	0.1578
22	0.3500	44.900	44.9	13.5	0.708	0.1577
23	0.3850	44.500	44.5	15.0	0.701	0.1577

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	136.690		95.910
Moisture content: Dry soil+tare, gms.	115.600		82.950
Moisture content: Tare, gms.	30.210		31.040
Moisture, %	24.7	25.0	25.0
Moist specimen weight, gms.	149.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	124.6	127.0	
Dry density, pcf	100.0	101.6	
Void ratio	0.7176	0.6893	
Saturation, %	94.6	99.6	

Test Readings for Specimen No. 3

Normal stress = 1.926 tsf

Strain rate, in./min. = 0.00

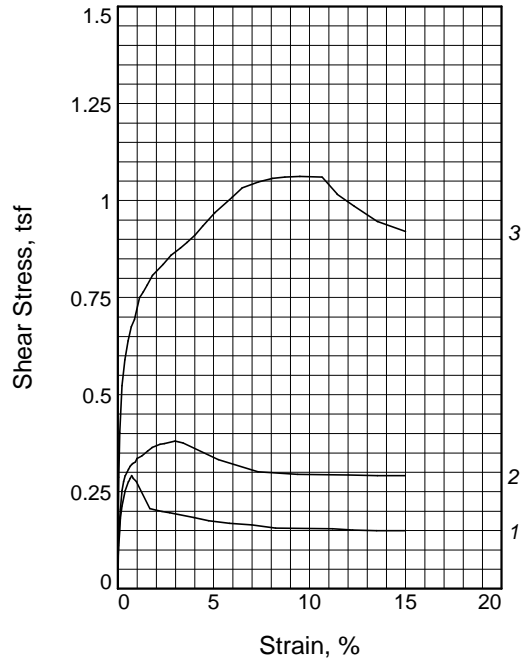
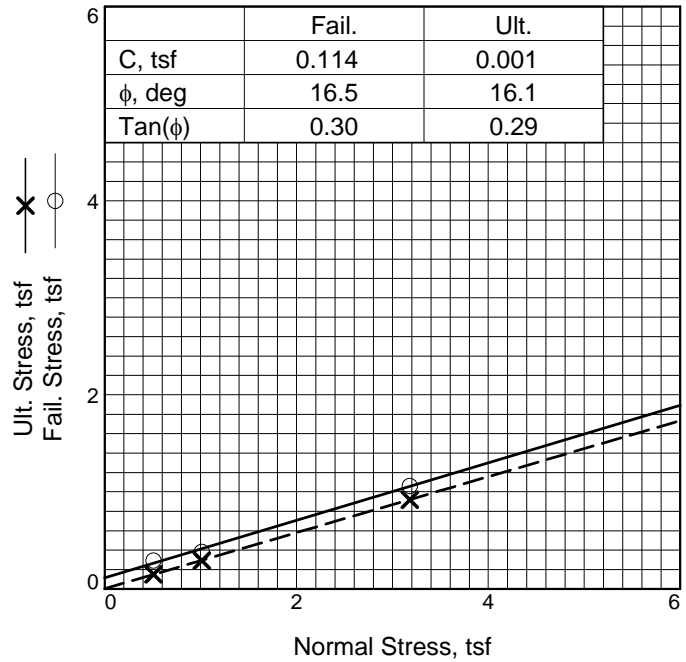
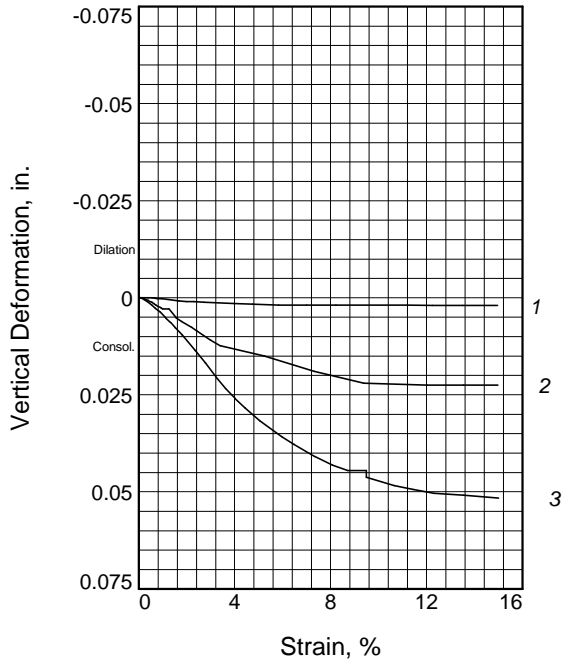
Fail. Stress = 1.363 tsf at reading no. 31

Ult. Stress = 1.347 tsf at reading no. 34

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0267	0.000	0.0	0.0	0.000	0.1294
1	0.0270	6.000	6.0	0.0	0.095	0.1294
2	0.0280	14.500	14.5	0.1	0.228	0.1294
3	0.0290	18.100	18.1	0.1	0.285	0.1294
4	0.0300	19.900	19.9	0.1	0.314	0.1294
5	0.0310	23.200	23.2	0.2	0.366	0.1293
6	0.0320	24.500	24.5	0.2	0.386	0.1292
7	0.0340	28.500	28.5	0.3	0.449	0.1291
8	0.0360	32.300	32.3	0.4	0.509	0.1289
9	0.0380	34.000	34.0	0.5	0.536	0.1288

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
10	0.0400	36.300	36.3	0.6	0.572	0.1286
11	0.0420	39.200	39.2	0.6	0.618	0.1286
12	0.0464	45.100	45.1	0.8	0.711	0.1284
13	0.0500	47.500	47.5	1.0	0.748	0.1284
14	0.0550	51.900	51.9	1.2	0.818	0.1284
15	0.0600	55.500	55.5	1.4	0.875	0.1285
16	0.0650	61.000	61.0	1.6	0.961	0.1287
17	0.0700	64.100	64.1	1.8	1.010	0.1290
18	0.0750	66.200	66.2	2.0	1.043	0.1292
19	0.0800	67.500	67.5	2.2	1.064	0.1294
20	0.0850	69.400	69.4	2.4	1.094	0.1298
21	0.1000	72.300	72.3	3.0	1.139	0.1307
22	0.1100	73.000	73.0	3.5	1.150	0.1318
23	0.1300	74.800	74.8	4.3	1.179	0.1326
24	0.1500	76.600	76.6	5.1	1.207	0.1340
25	0.1700	78.500	78.5	5.9	1.237	0.1352
26	0.1900	80.200	80.2	6.8	1.264	0.1352
27	0.2100	81.400	81.4	7.6	1.283	0.1352
28	0.2300	83.000	83.0	8.4	1.308	0.1352
29	0.2500	84.400	84.4	9.3	1.330	0.1351
30	0.2700	85.600	85.6	10.1	1.349	0.1351
31	0.2940	86.500	86.5	11.1	1.363	0.1351
32	0.3170	86.500	86.5	12.0	1.363	0.1351
33	0.3500	86.400	86.4	13.4	1.361	0.1351
34	0.3880	85.500	85.5	15.0	1.347	0.1351



Sample No.	1	2	3	
Initial	Water Content, %	64.3	59.5	66.4
	Dry Density, pcf	61.7	65.1	60.7
	Saturation, %	99.3	99.9	100.0
	Void Ratio	1.7814	1.6372	1.8260
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.99	1.00	1.00
At Test	Water Content, %	63.0	56.5	47.4
	Dry Density, pcf	62.8	67.2	74.5
	Saturation, %	99.9	99.9	100.0
	Void Ratio	1.7331	1.5538	1.3048
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.97	0.96	0.82
Normal Stress, tsf	0.509	1.011	3.181	
Fail. Stress, tsf	0.292	0.380	1.062	
Strain, %	0.7	3.0	9.5	
Ult. Stress, tsf	0.150	0.292	0.920	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	0.00	0.00	0.00	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 100 **PL=** 22 **PI=** 78

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

Location: East Diversion, SE-ED-15, Brenna Formation

Sample Number: Boring 09-14MU, #3 **Depth:** 38-40'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

10/12/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Location: East Diversion, SE-ED-15, Brenna Formation
Depth: 38-40' **Sample Number:** Boring 09-14MU, #3
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**100 **PL=**22 **PI=**78

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	100.270		149.540
Moisture content: Dry soil+tare, gms.	72.770		103.420
Moisture content: Tare, gms.	30.020		30.200
Moisture, %	64.3	63.0	63.0
Moist specimen weight, gms.	120.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	0.99	0.97	
Net decrease in height, in.		0.02	
Wet Density, pcf	101.4	102.4	
Dry density, pcf	61.7	62.8	
Void ratio	1.7814	1.7331	
Saturation, %	99.3	99.9	

Test Readings for Specimen No. 1

Normal stress = .509 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.292 tsf at reading no. 9
Ult. Stress = 0.150 tsf at reading no. 24

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0246	0.000	0.0	0.0	0.000	0.1359
1	0.0248	4.000	4.0	0.0	0.063	0.1359
2	0.0255	6.500	6.5	0.0	0.102	0.1359
3	0.0270	9.500	9.5	0.1	0.150	0.1359
4	0.0280	11.500	11.5	0.1	0.181	0.1359
5	0.0300	13.500	13.5	0.2	0.213	0.1359
6	0.0340	16.000	16.0	0.4	0.252	0.1359
7	0.0380	17.500	17.5	0.6	0.276	0.1359
8	0.0400	18.000	18.0	0.6	0.284	0.1358
9	0.0420	18.500	18.5	0.7	0.292	0.1357
10	0.0440	18.000	18.0	0.8	0.284	0.1356
11	0.0480	17.500	17.5	1.0	0.276	0.1356
12	0.0651	13.100	13.1	1.7	0.206	0.1351
13	0.0730	12.800	12.8	2.0	0.202	0.1349

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.0801	12.600	12.6	2.3	0.199	0.1349
15	0.0900	12.400	12.4	2.7	0.195	0.1347
16	0.1203	11.600	11.6	4.0	0.183	0.1344
17	0.1390	11.100	11.1	4.7	0.175	0.1342
18	0.1652	10.700	10.7	5.8	0.169	0.1340
19	0.1933	10.400	10.4	7.0	0.164	0.1340
20	0.2230	9.900	9.9	8.2	0.156	0.1340
21	0.2947	9.800	9.8	11.2	0.154	0.1340
22	0.3200	9.600	9.6	12.2	0.151	0.1339
23	0.3500	9.500	9.5	13.5	0.150	0.1339
24	0.3854	9.500	9.5	15.0	0.150	0.1339

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.920		149.600
Moisture content: Dry soil+tare, gms.	86.100		107.020
Moisture content: Tare, gms.	30.910		31.610
Moisture, %	59.5	56.5	56.5
Moist specimen weight, gms.	124.0		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.03	
Wet Density, pcf	103.8	105.2	
Dry density, pcf	65.1	67.2	
Void ratio	1.6372	1.5538	
Saturation, %	99.9	99.9	

Test Readings for Specimen No. 2

Normal stress = 1.011 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.380 tsf at reading no. 21

Ult. Stress = 0.292 tsf at reading no. 28

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0237	0.000	0.0	0.0	0.000	0.1350
1	0.0240	3.500	3.5	0.0	0.055	0.1350
2	0.0245	7.000	7.0	0.0	0.110	0.1350
3	0.0250	9.000	9.0	0.1	0.142	0.1350
4	0.0260	11.500	11.5	0.1	0.181	0.1350
5	0.0270	13.000	13.0	0.1	0.205	0.1350
6	0.0290	16.000	16.0	0.2	0.252	0.1348
7	0.0310	17.500	17.5	0.3	0.276	0.1345
8	0.0330	18.500	18.5	0.4	0.292	0.1343
9	0.0350	19.000	19.0	0.5	0.299	0.1340
10	0.0370	19.500	19.5	0.6	0.307	0.1338
11	0.0390	20.000	20.0	0.6	0.315	0.1335
12	0.0410	20.300	20.3	0.7	0.320	0.1331

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.0430	20.500	20.5	0.8	0.323	0.1328
14	0.0460	20.700	20.7	0.9	0.326	0.1324
15	0.0480	21.300	21.3	1.0	0.336	0.1321
16	0.0540	21.700	21.7	1.3	0.342	0.1321
17	0.0610	22.500	22.5	1.5	0.355	0.1299
18	0.0670	23.100	23.1	1.8	0.364	0.1289
19	0.0768	23.600	23.6	2.2	0.372	0.1274
20	0.0820	23.700	23.7	2.4	0.373	0.1265
21	0.0960	24.100	24.1	3.0	0.380	0.1241
22	0.1060	23.800	23.8	3.4	0.375	0.1226
23	0.1500	21.100	21.1	5.2	0.332	0.1200
24	0.2000	19.100	19.1	7.3	0.301	0.1160
25	0.2500	18.700	18.7	9.4	0.295	0.1130
26	0.3138	18.600	18.6	12.0	0.293	0.1125
27	0.3500	18.500	18.5	13.5	0.292	0.1125
28	0.3850	18.500	18.5	15.0	0.292	0.1125

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	104.860		133.600
Moisture content: Dry soil+tare, gms.	75.270		100.330
Moisture content: Tare, gms.	30.700		30.190
Moisture, %	66.4	47.4	47.4
Moist specimen weight, gms.	121.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.82	
Net decrease in height, in.		0.19	
Wet Density, pcf	101.1	109.8	
Dry density, pcf	60.7	74.5	
Void ratio	1.8260	1.3048	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 3

Normal stress = 3.181 tsf

Strain rate, in./min. = 0.00

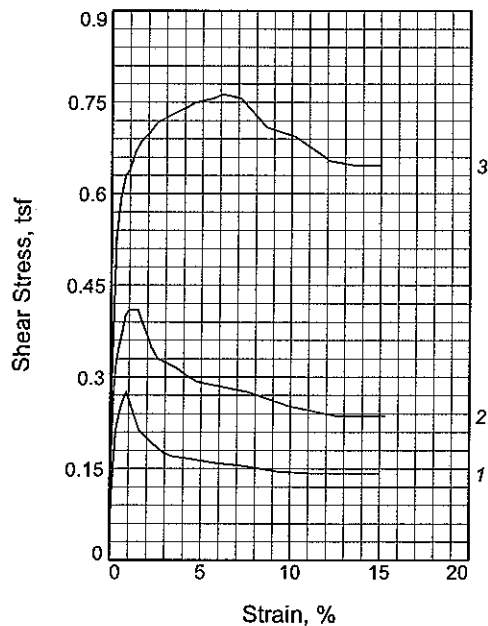
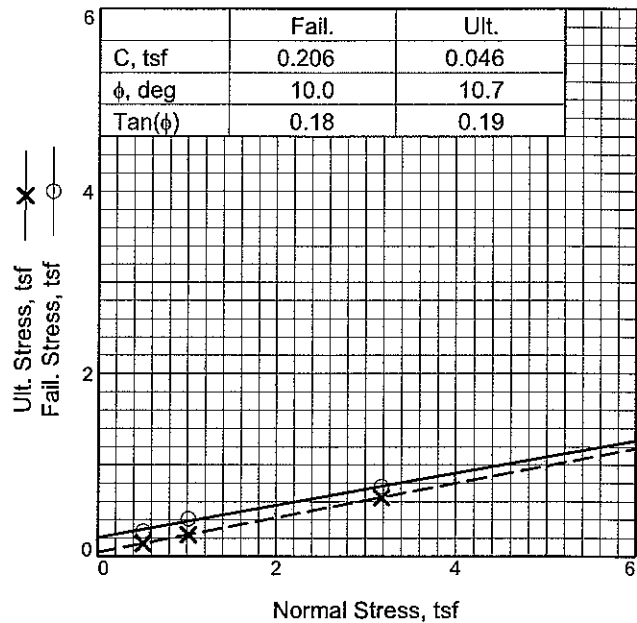
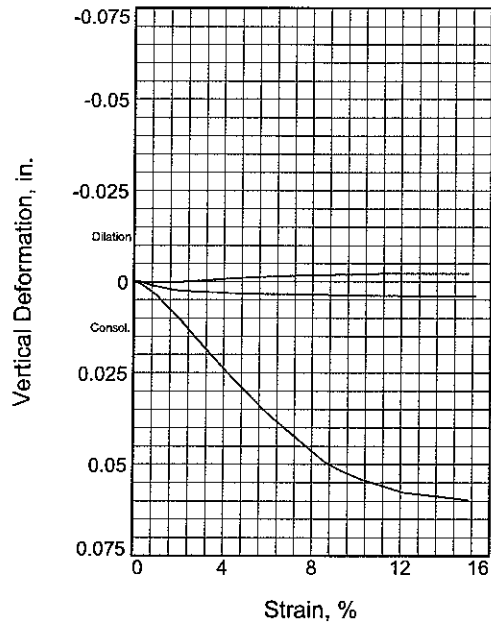
Fail. Stress = 1.062 tsf at reading no. 26

Ult. Stress = 0.920 tsf at reading no. 32

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0231	0.000	0.0	0.0	0.000	0.1696
1	0.0232	4.100	4.1	0.0	0.065	0.1696
2	0.0236	9.400	9.4	0.0	0.148	0.1696
3	0.0243	18.200	18.2	0.0	0.287	0.1696
4	0.0255	25.500	25.5	0.1	0.402	0.1695
5	0.0285	33.200	33.2	0.2	0.523	0.1692
6	0.0320	37.400	37.4	0.4	0.589	0.1686
7	0.0360	40.500	40.5	0.5	0.638	0.1678
8	0.0400	42.800	42.8	0.7	0.674	0.1669
9	0.0440	44.000	44.0	0.9	0.693	0.1660
10	0.0505	47.600	47.6	1.1	0.750	0.1643
11	0.0550	48.500	48.5	1.3	0.764	0.1632
12	0.0600	49.600	49.6	1.5	0.782	0.1618
13	0.0665	51.200	51.2	1.8	0.807	0.1600
14	0.0800	53.000	53.0	2.4	0.835	0.1560
15	0.0900	54.500	54.5	2.8	0.859	0.1528
16	0.1020	55.700	55.7	3.3	0.878	0.1487
17	0.1103	56.600	56.6	3.6	0.892	0.1462
18	0.1200	57.800	57.8	4.0	0.911	0.1436
19	0.1300	59.300	59.3	4.4	0.934	0.1412
20	0.1450	61.500	61.5	5.1	0.969	0.1379
21	0.1670	64.000	64.0	6.0	1.008	0.1338
22	0.1793	65.500	65.5	6.5	1.032	0.1318
23	0.2003	66.500	66.5	7.3	1.048	0.1287
24	0.2180	67.100	67.1	8.1	1.057	0.1265
25	0.2333	67.300	67.3	8.7	1.060	0.1251
26	0.2520	67.400	67.4	9.5	1.062	0.1251
27	0.2520	67.400	67.4	9.5	1.062	0.1233

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
28	0.2800	67.300	67.3	10.7	1.060	0.1212
29	0.2990	64.500	64.5	11.4	1.016	0.1202
30	0.3200	62.600	62.6	12.3	0.986	0.1192
31	0.3500	60.000	60.0	13.6	0.945	0.1187
32	0.3850	58.400	58.4	15.0	0.920	0.1180



Sample No.	1	2	3	
Initial	Water Content, %	69.3	72.5	72.2
	Dry Density, pcf	57.5	56.6	56.6
	Saturation, %	96.0	98.1	97.7
	Void Ratio	1.9852	2.0310	2.0335
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	70.2	71.7	62.6
	Dry Density, pcf	58.5	57.7	62.6
	Saturation, %	99.8	99.9	98.9
	Void Ratio	1.9347	1.9754	1.7413
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.99	0.91
Normal Stress, tsf	0.509	1.011	3.181	
Fail. Stress, tsf	0.276	0.410	0.763	
Strain, %	0.8	1.0	6.1	
Ult. Stress, tsf	0.142	0.236	0.646	
Strain, %	15.0	15.3	15.0	
Strain rate, in./min.	0.00	0.00	0.00	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, gray (CH)

LL= 111 PL= 25 PI= 86

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00064 in./min.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Sample Number: Boring 09-23MU, #5 **Depth:** 38-40'
Fargo
Brenna

Proj. No.: BL-09-03127

Date Sampled:

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INTERTEC

Figure DirectShear ASTM D3080

Tested By: jrs

Checked By: rs

DIRECT SHEAR TEST

9/22/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Depth: 38-40' **Sample Number:** Fargo
Description: FAT CLAY, gray (CH) **Brenna**
Remarks: The rate of strain is 0.00064 in/min.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**111 **PL=**25 **PI=**86

Parameters for Specimen No. 1			
Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	86.990		147.700
Moisture content: Dry soil+tare, gms.	64.170		99.600
Moisture content: Tare, gms.	31.240		31.060
Moisture, %	69.3	70.2	70.2
Moist specimen weight, gms.	116.7		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	97.4	99.6	
Dry density, pcf	57.5	58.5	
Void ratio	1.9852	1.9347	
Saturation, %	96.0	99.8	

Test Readings for Specimen No. 1

Normal stress = .509 tsf
 Strain rate, in./min. = 0.00
 Fail. Stress = 0.276 tsf at reading no. 5
 Ult. Stress = 0.142 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0255	0.000	0.0	0.0	0.000	0.0245
1	0.0260	4.000	4.0	0.0	0.063	0.0246
2	0.0270	6.500	6.5	0.1	0.102	0.0246
3	0.0323	13.500	13.5	0.3	0.213	0.0245
4	0.0393	16.000	16.0	0.6	0.252	0.0242
5	0.0459	17.500	17.5	0.8	0.276	0.0241
6	0.0632	13.500	13.5	1.6	0.213	0.0242
7	0.0761	12.500	12.5	2.1	0.197	0.0244
8	0.0956	11.200	11.2	2.9	0.176	0.0247
9	0.1069	10.800	10.8	3.4	0.170	0.0249
10	0.1252	10.600	10.6	4.1	0.167	0.0252
11	0.1640	10.100	10.1	5.7	0.159	0.0257
12	0.2042	9.800	9.8	7.4	0.154	0.0261
13	0.2503	9.200	9.2	9.3	0.145	0.0264
14	0.2768	9.100	9.1	10.4	0.143	0.0265

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Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.2934	9.000	9.0	11.1	0.142	0.0266
16	0.3024	9.000	9.0	11.5	0.142	0.0266
17	0.3870	9.000	9.0	15.0	0.142	0.0266

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	120.020		146.440
Moisture content: Dry soil+tare, gms.	82.400		97.970
Moisture content: Tare, gms.	30.480		30.410
Moisture, %	72.5	71.7	71.7
Moist specimen weight, gms.	117.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.99	
Net decrease in height, in.		0.02	
Wet Density, pcf	97.7	99.1	
Dry density, pcf	56.6	57.7	
Void ratio	2.0310	1.9754	
Saturation, %	98.1	99.9	

Test Readings for Specimen No. 2

Normal stress = 1.011 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.410 tsf at reading no. 10

Ult. Stress = 0.236 tsf at reading no. 25

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0212	0.000	0.0	0.0	0.000	0.1785
1	0.0214	4.000	4.0	0.0	0.063	0.1785
2	0.0218	7.000	7.0	0.0	0.110	0.1785
3	0.0225	10.500	10.5	0.1	0.165	0.1785
4	0.0235	13.500	13.5	0.1	0.213	0.1785
5	0.0248	17.000	17.0	0.2	0.268	0.1784
6	0.0281	20.500	20.5	0.3	0.323	0.1783
7	0.0330	22.500	22.5	0.5	0.355	0.1779
8	0.0370	24.000	24.0	0.7	0.378	0.1777
9	0.0407	25.500	25.5	0.8	0.402	0.1774
10	0.0456	26.000	26.0	1.0	0.410	0.1772
11	0.0507	26.000	26.0	1.2	0.410	0.1768
12	0.0565	26.000	26.0	1.5	0.410	0.1765
13	0.0637	24.500	24.5	1.8	0.386	0.1762
14	0.0689	23.500	23.5	2.0	0.370	0.1760
15	0.0755	22.000	22.0	2.3	0.347	0.1759
16	0.0830	21.000	21.0	2.6	0.331	0.1758
17	0.0954	20.500	20.5	3.1	0.323	0.1756
18	0.1083	20.000	20.0	3.6	0.315	0.1755
19	0.1256	19.000	19.0	4.3	0.299	0.1753
20	0.1381	18.500	18.5	4.8	0.292	0.1752

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Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
21	0.1450	18.400	18.4	5.1	0.290	0.1751
22	0.2033	17.500	17.5	7.6	0.276	0.1749
23	0.2600	16.000	16.0	9.9	0.252	0.1747
24	0.3230	15.000	15.0	12.5	0.236	0.1745
25	0.3900	15.000	15.0	15.3	0.236	0.1745

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	100.110		136.960
Moisture content: Dry soil+tare, gms.	70.830		95.900
Moisture content: Tare, gms.	30.300		30.360
Moisture, %	72.2	62.6	62.6
Moist specimen weight, gms.	117.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.91	
Net decrease in height, in.		0.10	
Wet Density, pcf	97.5	101.9	
Dry density, pcf	56.6	62.6	
Void ratio	2.0335	1.7413	
Saturation, %	97.7	98.9	

Test Readings for Specimen No. 3

Normal stress = 3.181 tsf
 Strain rate, in./min. = 0.00
 Fail. Stress = 0.763 tsf at reading no. 18
 Ult. Stress = 0.646 tsf at reading no. 26

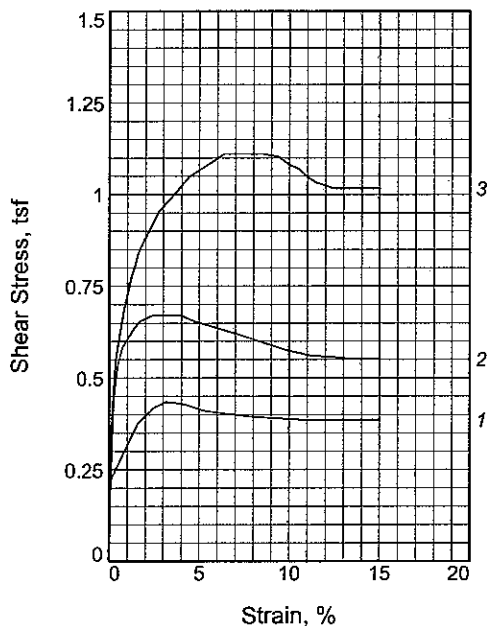
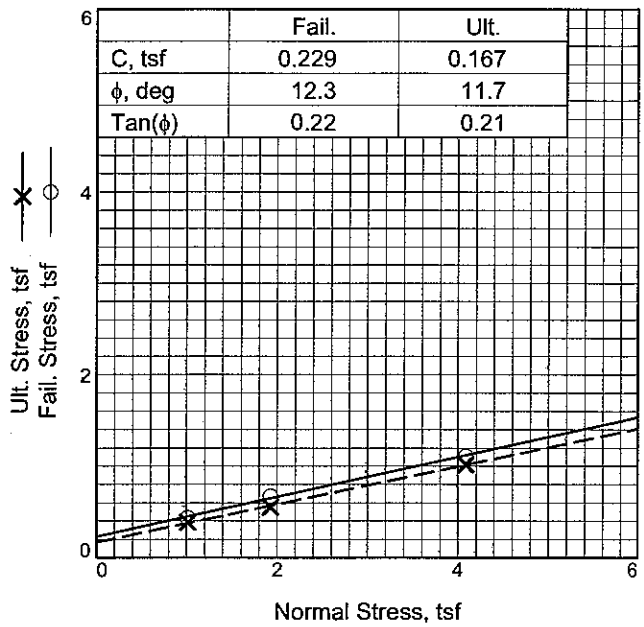
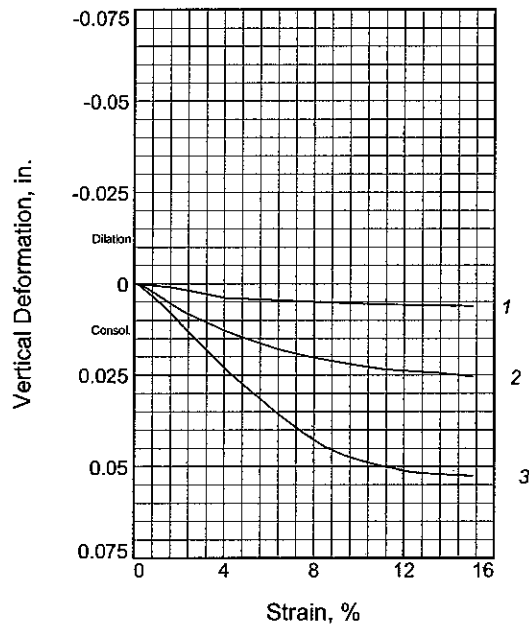
No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0209	0.000	0.0	0.0	0.000	0.0666
1	0.0210	6.000	6.0	0.0	0.095	0.0666
2	0.0220	16.000	16.0	0.0	0.252	0.0665
3	0.0276	33.500	33.5	0.3	0.528	0.0660
4	0.0329	37.500	37.5	0.5	0.591	0.0652
5	0.0396	40.000	40.0	0.8	0.630	0.0639
6	0.0440	40.500	40.5	1.0	0.638	0.0630
7	0.0483	41.500	41.5	1.1	0.654	0.0619
8	0.0525	42.500	42.5	1.3	0.670	0.0608
9	0.0597	43.500	43.5	1.6	0.685	0.0589
10	0.0649	44.000	44.0	1.8	0.693	0.0576
11	0.0714	44.500	44.5	2.1	0.701	0.0558
12	0.0810	45.500	45.5	2.5	0.717	0.0529
13	0.0925	46.000	46.0	3.0	0.725	0.0497
14	0.1047	46.500	46.5	3.5	0.733	0.0461
15	0.1182	47.000	47.0	4.0	0.741	0.0425
16	0.1294	47.500	47.5	4.5	0.748	0.0395
17	0.1562	48.000	48.0	5.6	0.756	0.0326
18	0.1691	48.400	48.4	6.1	0.763	0.0296

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Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
19	0.1924	48.000	48.0	7.1	0.756	0.0246
20	0.2275	45.000	45.0	8.6	0.709	0.0174
21	0.2462	44.500	44.5	9.3	0.701	0.0148
22	0.2673	44.000	44.0	10.2	0.693	0.0125
23	0.3053	42.000	42.0	11.8	0.662	0.0095
24	0.3126	41.500	41.5	12.1	0.654	0.0089
25	0.3500	41.000	41.0	13.6	0.646	0.0079
26	0.3830	41.000	41.0	15.0	0.646	0.0068

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Sample No.	1	2	3	
Initial	Water Content, %	52.2	54.2	57.2
	Dry Density, pcf	70.5	68.8	66.7
	Saturation, %	99.9	99.6	99.9
	Void Ratio	1.4358	1.4962	1.5753
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.01	1.00	1.01
At Test	Water Content, %	49.8	51.0	43.8
	Dry Density, pcf	72.3	71.4	77.9
	Saturation, %	99.7	99.9	100.0
	Void Ratio	1.3735	1.4030	1.2036
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.96	0.86
Normal Stress, tsf	1.011	1.926	4.084	
Fail. Stress, tsf	0.433	0.670	1.111	
Strain, %	3.2	2.4	6.4	
Ult. Stress, tsf	0.386	0.552	1.016	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 92 PL= 22 PI= 70

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00064 in/min.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Sample Number: Fargo Boring 09-23MU, #6 **Depth:** 80-82'
 Brenna

Proj. No.: BL-09-03127 **Date Sampled:**

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INTERTEC

Figure DirectShear ASTM D3080

Tested By: jrs

Checked By: rs

DIRECT SHEAR TEST

9/22/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Depth: 80-82' **Sample Number:** Fargo Boring 09-23MU, #6
Description: FAT CLAY, gray (CH) **Brenna**
Remarks: The rate of strain is 0.00064 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**92 **PL=**22 **PI=**70

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	76.970		157.930
Moisture content: Dry soil+tare, gms.	61.170		115.600
Moisture content: Tare, gms.	30.890		30.610
Moisture, %	52.2	49.8	49.8
Moist specimen weight, gms.	129.7		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.01	0.98	
Net decrease in height, in.		0.03	
Wet Density, pcf	107.3	108.4	
Dry density, pcf	70.5	72.3	
Void ratio	1.4358	1.3735	
Saturation, %	99.9	99.7	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.433 tsf at reading no. 5
Ult. Stress = 0.386 tsf at reading no. 11

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0208	0.000	0.0	0.0	0.000	0.0970
1	0.0213	6.000	6.0	0.0	0.095	0.0970
2	0.0230	14.000	14.0	0.1	0.221	0.0970
3	0.0600	24.000	24.0	1.6	0.378	0.0960
4	0.0800	26.500	26.5	2.5	0.418	0.0950
5	0.0970	27.500	27.5	3.2	0.433	0.0942
6	0.1200	27.200	27.2	4.1	0.429	0.0930
7	0.1480	26.000	26.0	5.3	0.410	0.0928
8	0.2100	25.000	25.0	7.8	0.394	0.0920
9	0.2780	24.500	24.5	10.7	0.386	0.0914
10	0.3190	24.500	24.5	12.4	0.386	0.0911
11	0.3830	24.500	24.5	15.0	0.386	0.0908

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Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	100.630		152.850
Moisture content: Dry soil+tare, gms.	76.310		111.520
Moisture content: Tare, gms.	31.440		30.420
Moisture, %	54.2	51.0	51.0
Moist specimen weight, gms.	126.8		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	106.1	107.9	
Dry density, pcf	68.8	71.4	
Void ratio	1.4962	1.4030	
Saturation, %	99.6	99.9	

Test Readings for Specimen No. 2

Normal stress = 1.926 tsf

Fail. Stress = 0.670 tsf at reading no. 7

Ult. Stress = 0.552 tsf at reading no. 15

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0209	0.000	0.0	0.0	0.000	0.1392
1	0.0213	6.500	6.5	0.0	0.102	0.1392
2	0.0270	28.000	28.0	0.3	0.441	0.1389
3	0.0327	34.000	34.0	0.5	0.536	0.1383
4	0.0387	37.000	37.0	0.7	0.583	0.1373
5	0.0554	40.500	40.5	1.4	0.638	0.1345
6	0.0616	41.500	41.5	1.7	0.654	0.1335
7	0.0778	42.500	42.5	2.4	0.670	0.1310
8	0.1174	42.500	42.5	4.0	0.670	0.1264
9	0.1353	41.500	41.5	4.7	0.654	0.1246
10	0.1744	40.000	40.0	6.4	0.630	0.1213
11	0.2110	38.500	38.5	7.9	0.607	0.1191
12	0.2581	36.500	36.5	9.8	0.575	0.1169
13	0.2900	35.600	35.6	11.2	0.561	0.1157
14	0.3500	35.000	35.0	13.6	0.552	0.1147
15	0.3830	35.000	35.0	15.0	0.552	0.1137

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	99.420		143.510
Moisture content: Dry soil+tare, gms.	74.370		109.400
Moisture content: Tare, gms.	30.600		31.440
Moisture, %	57.2	43.8	43.8
Moist specimen weight, gms.	126.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.01	0.86	
Net decrease in height, in.		0.15	
Wet Density, pcf	104.8	112.0	
Dry density, pcf	66.7	77.9	
Void ratio	1.5753	1.2036	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 3

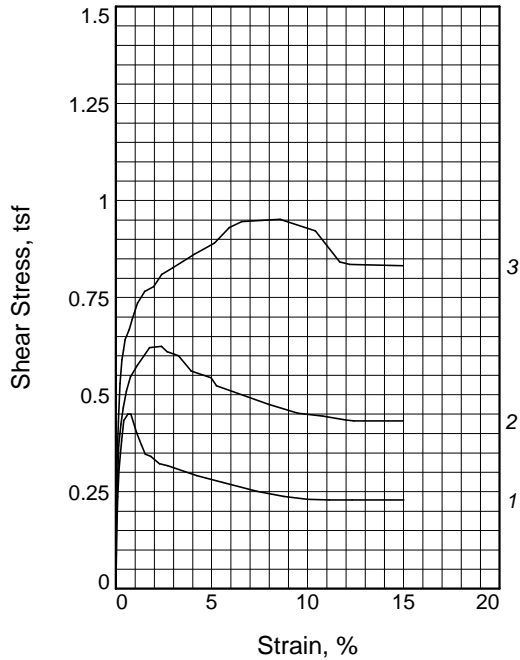
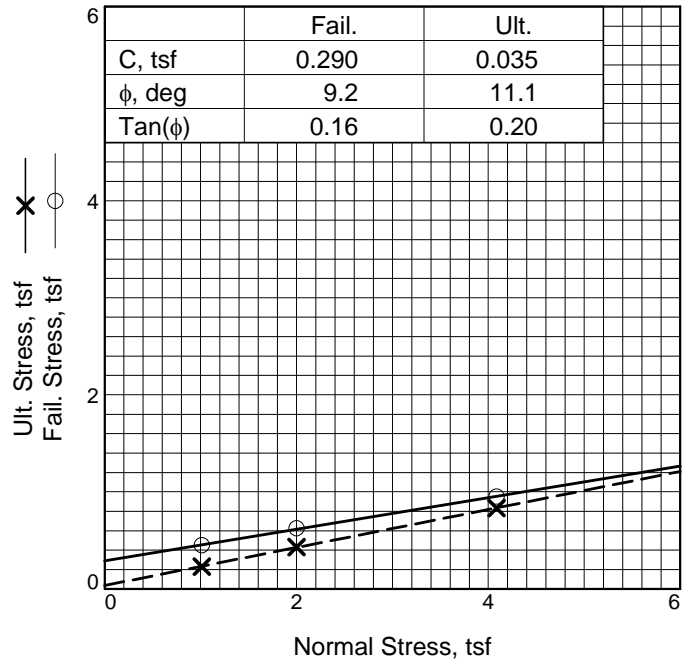
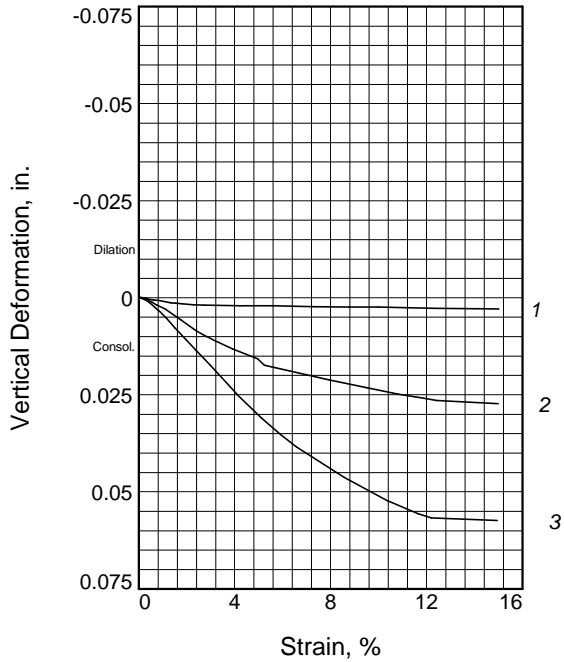
Normal stress = 4.084 tsf

Fail. Stress = 1.111 tsf at reading no. 11

Ult. Stress = 1.016 tsf at reading no. 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0187	0.000	0.0	0.0	0.000	0.1048
1	0.0223	25.000	25.0	0.2	0.394	0.1046
2	0.0276	35.000	35.0	0.4	0.552	0.1037
3	0.0389	43.500	43.5	0.8	0.685	0.1012
4	0.0483	49.000	49.0	1.2	0.772	0.0991
5	0.0528	51.000	51.0	1.4	0.804	0.0979
6	0.0579	53.500	53.5	1.6	0.843	0.0966
7	0.0670	56.000	56.0	2.0	0.882	0.0942
8	0.0850	60.500	60.5	2.8	0.953	0.0894
9	0.1089	64.000	64.0	3.7	1.008	0.0833
10	0.1250	66.500	66.5	4.4	1.048	0.0795
11	0.1720	70.500	70.5	6.4	1.111	0.0694
12	0.1988	70.500	70.5	7.5	1.111	0.0643
13	0.2240	70.500	70.5	8.5	1.111	0.0601
14	0.2450	70.000	70.0	9.4	1.103	0.0577
15	0.2608	68.500	68.5	10.0	1.079	0.0565
16	0.2708	68.000	68.0	10.5	1.072	0.0558
17	0.2844	66.500	66.5	11.0	1.048	0.0549
18	0.2955	65.500	65.5	11.5	1.032	0.0544
19	0.3080	65.000	65.0	12.0	1.024	0.0536
20	0.3183	64.500	64.5	12.4	1.016	0.0532
21	0.3400	64.500	64.5	13.3	1.016	0.0528
22	0.3810	64.500	64.5	15.0	1.016	0.0522

Braun Intertec



Sample No.	1	2	3	
Initial	Water Content, %	61.1	58.8	60.4
	Dry Density, pcf	63.2	64.2	63.9
	Saturation, %	98.0	96.5	98.5
	Void Ratio	1.7155	1.6759	1.6871
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	59.9	57.5	51.0
	Dry Density, pcf	64.7	66.5	71.4
	Saturation, %	99.7	99.9	99.8
	Void Ratio	1.6542	1.5820	1.4040
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.97	0.90
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.449	0.624	0.952	
Strain, %	0.6	2.4	8.6	
Ult. Stress, tsf	0.228	0.432	0.832	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 108 **PL=** 22 **PI=** 86

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-13, Fargo, Brenna Formation

Sample Number: Boring 09-25MU, #4 **Depth:** 50-52'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Brenna Formation
Depth: 50-52' **Sample Number:** Boring 09-25MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=108** **PL=22** **PI=86**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.660		151.740
Moisture content: Dry soil+tare, gms.	82.520		106.370
Moisture content: Tare, gms.	31.570		30.690
Moisture, %	61.1	59.9	59.9
Moist specimen weight, gms.	121.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	101.9	103.5	
Dry density, pcf	63.2	64.7	
Void ratio	1.7155	1.6542	
Saturation, %	98.0	99.7	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.449 tsf at reading no. 6
Ult. Stress = 0.228 tsf at reading no. 21

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0208	0.000	0.0	0.0	0.000	0.1505
1	0.0227	11.500	11.5	0.1	0.181	0.1505
2	0.0234	15.000	15.0	0.1	0.236	0.1505
3	0.0248	19.500	19.5	0.2	0.307	0.1505
4	0.0280	24.150	24.2	0.3	0.381	0.1504
5	0.0310	27.500	27.5	0.4	0.433	0.1501
6	0.0358	28.500	28.5	0.6	0.449	0.1499
7	0.0400	28.500	28.5	0.8	0.449	0.1498
8	0.0470	25.500	25.5	1.1	0.402	0.1495
9	0.0530	23.500	23.5	1.3	0.370	0.1492
10	0.0580	22.000	22.0	1.5	0.347	0.1491
11	0.0650	21.600	21.6	1.8	0.340	0.1489
12	0.0760	20.400	20.4	2.3	0.321	0.1487
13	0.0863	20.100	20.1	2.7	0.317	0.1486

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1228	18.500	18.5	4.2	0.292	0.1484
15	0.1550	17.400	17.4	5.6	0.274	0.1484
16	0.1984	15.900	15.9	7.4	0.251	0.1482
17	0.2320	15.100	15.1	8.8	0.238	0.1481
18	0.2620	14.600	14.6	10.0	0.230	0.1481
19	0.2893	14.500	14.5	11.1	0.228	0.1479
20	0.3180	14.500	14.5	12.3	0.228	0.1478
21	0.3830	14.500	14.5	15.0	0.228	0.1476

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	100.570		149.150
Moisture content: Dry soil+tare, gms.	74.700		105.650
Moisture content: Tare, gms.	30.720		29.960
Moisture, %	58.8	57.5	57.5
Moist specimen weight, gms.	122.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.04	
Wet Density, pcf	101.9	104.7	
Dry density, pcf	64.2	66.5	
Void ratio	1.6759	1.5820	
Saturation, %	96.5	99.9	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.624 tsf at reading no. 10

Ult. Stress = 0.432 tsf at reading no. 21

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0215	0.000	0.0	0.0	0.000	0.1520
1	0.0218	8.500	8.5	0.0	0.134	0.1521
2	0.0230	15.100	15.1	0.1	0.238	0.1521
3	0.0253	23.400	23.4	0.2	0.369	0.1520
4	0.0280	26.900	26.9	0.3	0.424	0.1517
5	0.0310	29.500	29.5	0.4	0.465	0.1514
6	0.0350	32.300	32.3	0.6	0.509	0.1508
7	0.0400	34.700	34.7	0.8	0.547	0.1501
8	0.0485	36.500	36.5	1.1	0.575	0.1490
9	0.0639	39.400	39.4	1.8	0.621	0.1463
10	0.0789	39.600	39.6	2.4	0.624	0.1436
11	0.0862	38.700	38.7	2.7	0.610	0.1425
12	0.1000	38.100	38.1	3.3	0.600	0.1407
13	0.1160	35.600	35.6	3.9	0.561	0.1388
14	0.1412	34.500	34.5	5.0	0.544	0.1362
15	0.1480	33.200	33.2	5.2	0.523	0.1346
16	0.2133	30.131	30.1	8.0	0.475	0.1308

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
17	0.2507	28.700	28.7	9.5	0.452	0.1288
18	0.2820	28.200	28.2	10.8	0.444	0.1272
19	0.3104	27.600	27.6	12.0	0.435	0.1260
20	0.3210	27.400	27.4	12.4	0.432	0.1255
21	0.3830	27.400	27.4	15.0	0.432	0.1247

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	124.600		142.500
Moisture content: Dry soil+tare, gms.	89.120		104.510
Moisture content: Tare, gms.	30.380		29.960
Moisture, %	60.4	51.0	51.0
Moist specimen weight, gms.	123.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.90	
Net decrease in height, in.		0.11	
Wet Density, pcf	102.5	107.8	
Dry density, pcf	63.9	71.4	
Void ratio	1.6871	1.4040	
Saturation, %	98.5	99.8	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

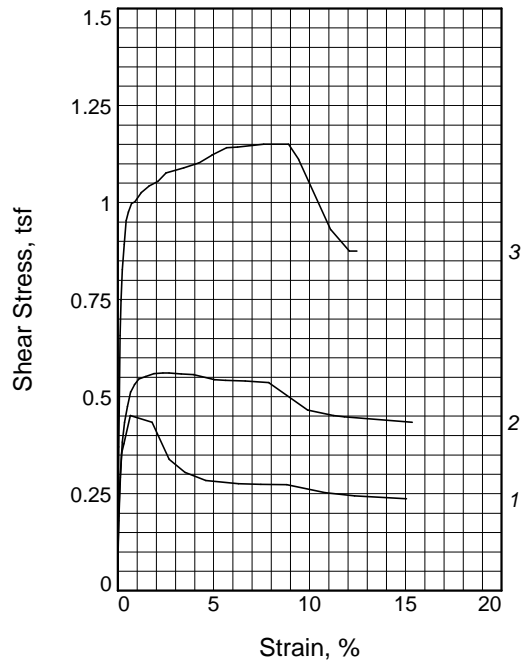
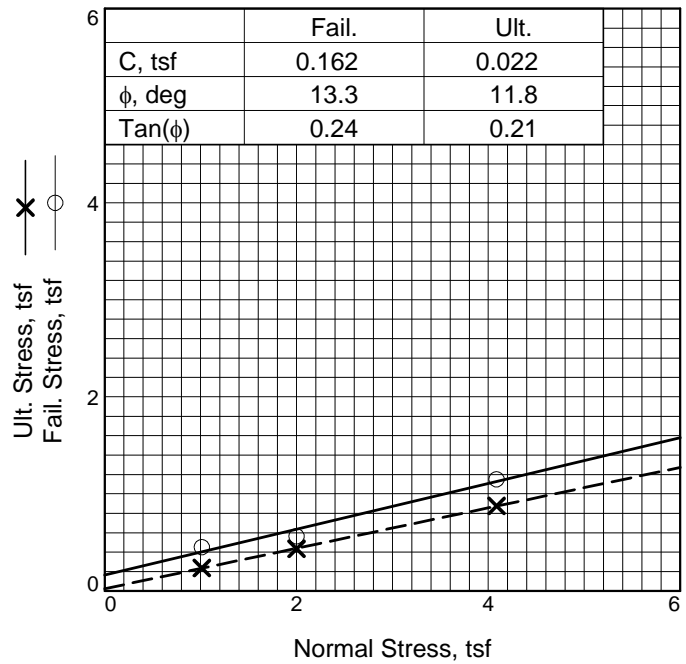
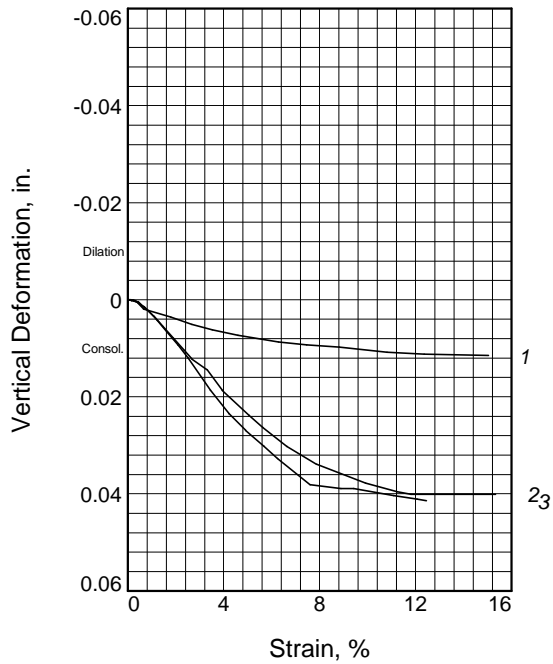
Fail. Stress = 0.952 tsf at reading no. 20

Ult. Stress = 0.832 tsf at reading no. 24

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0244	0.000	0.0	0.0	0.000	0.0766
1	0.0246	7.400	7.4	0.0	0.117	0.0765
2	0.0250	12.700	12.7	0.0	0.200	0.0765
3	0.0260	21.200	21.2	0.1	0.334	0.0765
4	0.0275	27.300	27.3	0.1	0.430	0.0764
5	0.0297	33.500	33.5	0.2	0.528	0.0762
6	0.0320	37.400	37.4	0.3	0.589	0.0759
7	0.0340	39.000	39.0	0.4	0.615	0.0756
8	0.0360	40.700	40.7	0.5	0.641	0.0752
9	0.0413	42.400	42.4	0.7	0.668	0.0740
10	0.0450	44.000	44.0	0.9	0.693	0.0731
11	0.0520	46.700	46.7	1.1	0.736	0.0713
12	0.0606	48.600	48.6	1.5	0.766	0.0688
13	0.0720	49.400	49.4	2.0	0.778	0.0657
14	0.0820	51.400	51.4	2.4	0.810	0.0630
15	0.0961	52.500	52.5	3.0	0.827	0.0592
16	0.1230	54.700	54.7	4.1	0.862	0.0518
17	0.1482	56.500	56.5	5.1	0.890	0.0456
18	0.1670	59.000	59.0	5.9	0.930	0.0414
19	0.1830	60.000	60.0	6.6	0.945	0.0382

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
20	0.2310	60.400	60.4	8.6	0.952	0.0303
21	0.2753	58.500	58.5	10.4	0.922	0.0242
22	0.3056	53.400	53.4	11.7	0.841	0.0209
23	0.3186	53.000	53.0	12.2	0.835	0.0199
24	0.3850	52.800	52.8	15.0	0.832	0.0192



Sample No.	1	2	3	
Initial	Water Content, %	72.3	73.6	73.5
	Dry Density, pcf	57.1	56.4	55.6
	Saturation, %	99.1	99.1	96.9
	Void Ratio	2.0064	2.0428	2.0850
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.03
At Test	Water Content, %	70.9	69.7	63.6
	Dry Density, pcf	58.2	58.8	62.3
	Saturation, %	100.0	100.0	99.7
	Void Ratio	1.9497	1.9178	1.7549
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.96	0.92
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.451	0.561	1.150	
Strain, %	0.7	2.4	7.6	
Ult. Stress, tsf	0.236	0.433	0.875	
Strain, %	15.0	15.3	12.5	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

Location: SE-ED-29, East Diversion, Brenna Formation

Sample Number: Boring 09-26MU, #3 **Depth:** 28-30'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-ED-29, East Diversion, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-26MU, #3
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	116.840		146.120
Moisture content: Dry soil+tare, gms.	80.550		98.510
Moisture content: Tare, gms.	30.360		31.380
Moisture, %	72.3	70.9	70.9
Moist specimen weight, gms.	117.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	98.4	99.5	
Dry density, pcf	57.1	58.2	
Void ratio	2.0064	1.9497	
Saturation, %	99.1	100.0	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf

Fail. Stress = 0.451 tsf at reading no. 6

Ult. Stress = 0.236 tsf at reading no. 16

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0220	0.000	0.0	0.0	0.000	0.1515
1	0.0226	6.600	6.6	0.0	0.104	0.1515
2	0.0235	11.400	11.4	0.1	0.180	0.1515
3	0.0253	18.500	18.5	0.1	0.292	0.1515
4	0.0270	22.500	22.5	0.2	0.355	0.1514
5	0.0297	24.000	24.0	0.3	0.378	0.1513
6	0.0377	28.600	28.6	0.7	0.451	0.1496
7	0.0652	27.500	27.5	1.8	0.433	0.1479
8	0.0863	21.500	21.5	2.7	0.339	0.1464
9	0.1069	19.300	19.3	3.5	0.304	0.1453
10	0.1327	18.000	18.0	4.6	0.284	0.1442
11	0.1737	17.500	17.5	6.3	0.276	0.1428
12	0.2020	17.400	17.4	7.5	0.274	0.1422
13	0.2347	17.300	17.3	8.8	0.273	0.1417

Braun Intertec

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.2827	16.000	16.0	10.8	0.252	0.1407
15	0.3200	15.500	15.5	12.4	0.244	0.1403
16	0.3850	15.000	15.0	15.0	0.236	0.1400

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	77.740		142.070
Moisture content: Dry soil+tare, gms.	57.810		96.330
Moisture content: Tare, gms.	30.730		30.730
Moisture, %	73.6	69.7	69.7
Moist specimen weight, gms.	117.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	97.9	99.9	
Dry density, pcf	56.4	58.8	
Void ratio	2.0428	1.9178	
Saturation, %	99.1	100.0	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.561 tsf at reading no. 12

Ult. Stress = 0.433 tsf at reading no. 23

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0149	0.000	0.0	0.0	0.000	0.1440
1	0.0152	5.500	5.5	0.0	0.087	0.1440
2	0.0163	12.200	12.2	0.1	0.192	0.1440
3	0.0175	17.400	17.4	0.1	0.274	0.1440
4	0.0207	24.300	24.3	0.2	0.383	0.1439
5	0.0236	27.500	27.5	0.4	0.433	0.1436
6	0.0270	30.100	30.1	0.5	0.474	0.1432
7	0.0310	32.500	32.5	0.7	0.512	0.1426
8	0.0360	33.700	33.7	0.9	0.531	0.1416
9	0.0410	34.600	34.6	1.1	0.545	0.1406
10	0.0502	35.000	35.0	1.5	0.552	0.1385
11	0.0606	35.500	35.5	1.9	0.559	0.1361
12	0.0718	35.600	35.6	2.4	0.561	0.1336
13	0.0795	35.600	35.6	2.7	0.561	0.1318
14	0.0945	35.400	35.4	3.3	0.558	0.1296
15	0.1099	35.300	35.3	3.9	0.556	0.1253
16	0.1369	34.500	34.5	5.1	0.544	0.1202
17	0.1508	34.400	34.4	5.6	0.542	0.1177
18	0.1750	34.300	34.3	6.6	0.540	0.1138
19	0.2050	34.000	34.0	7.9	0.536	0.1101
20	0.2540	29.500	29.5	9.9	0.465	0.1062
21	0.2861	28.600	28.6	11.2	0.451	0.1044

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
22	0.3000	28.400	28.4	11.8	0.448	0.1039
23	0.3850	27.500	27.5	15.3	0.433	0.1039

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	116.510		138.280
Moisture content: Dry soil+tare, gms.	80.070		96.460
Moisture content: Tare, gms.	30.470		30.750
Moisture, %	73.5	63.6	63.6
Moist specimen weight, gms.	119.1		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.03	0.92	
Net decrease in height, in.		0.11	
Wet Density, pcf	96.5	102.0	
Dry density, pcf	55.6	62.3	
Void ratio	2.0850	1.7549	
Saturation, %	96.9	99.7	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

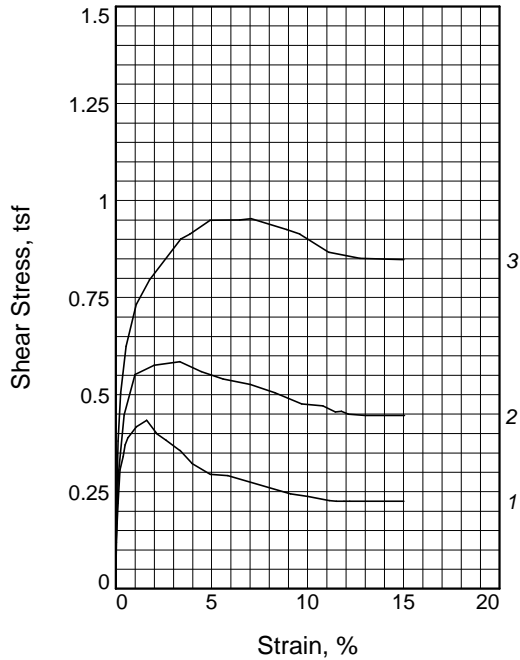
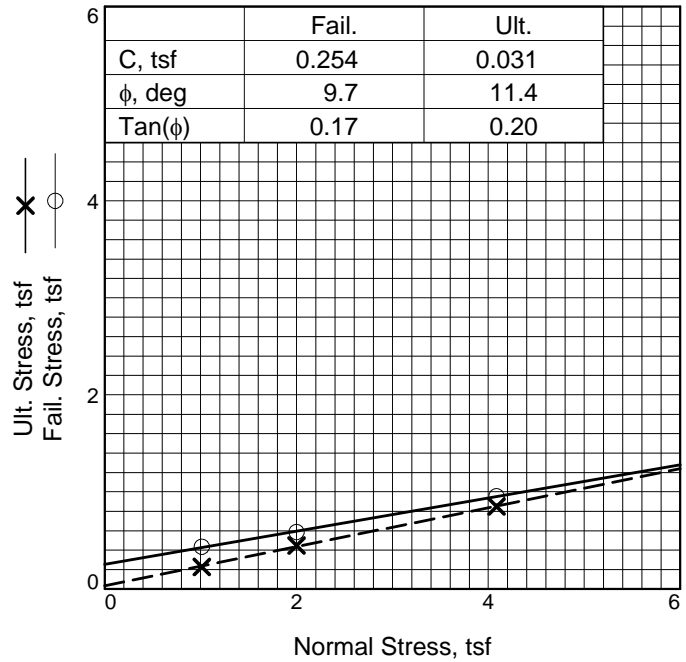
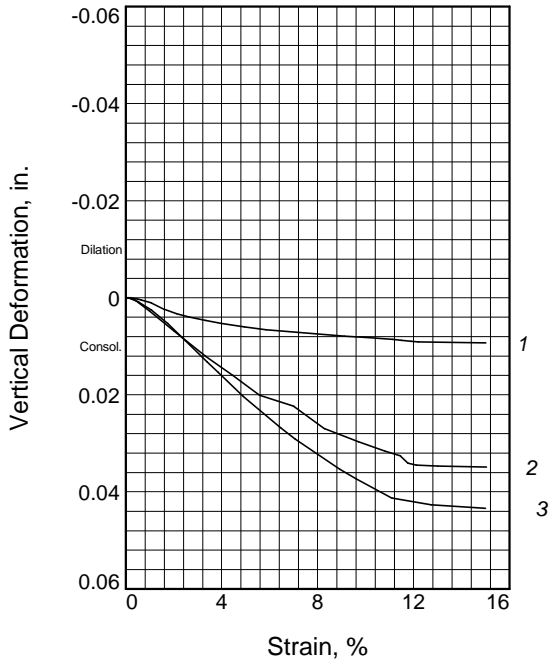
Fail. Stress = 1.150 tsf at reading no. 19

Ult. Stress = 0.875 tsf at reading no. 24

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0095	0.000	0.0	0.0	0.000	0.0389
1	0.0107	23.500	23.5	0.0	0.370	0.0389
2	0.0124	41.700	41.7	0.1	0.657	0.0388
3	0.0135	47.400	47.4	0.2	0.747	0.0387
4	0.0153	52.500	52.5	0.2	0.827	0.0386
5	0.0175	56.600	56.6	0.3	0.892	0.0385
6	0.0200	60.500	60.5	0.4	0.953	0.0385
7	0.0230	61.900	61.9	0.6	0.975	0.0378
8	0.0270	63.300	63.3	0.7	0.997	0.0372
9	0.0304	63.500	63.5	0.9	1.001	0.0366
10	0.0391	65.100	65.1	1.2	1.026	0.0346
11	0.0490	66.200	66.2	1.6	1.043	0.0322
12	0.0600	66.900	66.9	2.1	1.054	0.0295
13	0.0700	68.300	68.3	2.5	1.076	0.0269
14	0.0925	69.100	69.1	3.4	1.089	0.0202
15	0.1112	69.900	69.9	4.2	1.101	0.0154
16	0.1280	71.200	71.2	4.9	1.122	0.0120
17	0.1466	72.400	72.4	5.7	1.141	0.0087
18	0.1603	72.500	72.5	6.3	1.142	0.0062
19	0.1930	73.000	73.0	7.6	1.150	0.0008
20	0.2240	73.000	73.0	8.9	1.150	0.0000
21	0.2370	70.500	70.5	9.4	1.111	0.0000
22	0.2770	59.000	59.0	11.1	0.930	-0.0015

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
23	0.3005	55.500	55.5	12.1	0.875	-0.0022
24	0.3100	55.500	55.5	12.5	0.875	-0.0025



Sample No.	1	2	3	
Initial	Water Content, %	64.8	65.3	66.2
	Dry Density, pcf	61.3	60.8	60.2
	Saturation, %	99.0	98.4	98.4
	Void Ratio	1.8014	1.8233	1.8517
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	63.9	62.0	54.0
	Dry Density, pcf	62.3	63.2	69.1
	Saturation, %	100.0	99.4	100.0
	Void Ratio	1.7576	1.7156	1.4840
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.96	0.87
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.433	0.585	0.953	
Strain, %	1.6	3.3	7.1	
Ult. Stress, tsf	0.225	0.446	0.848	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)

LL= 117 **PL=** 25 **PI=** 92

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-19, Fargo, Brenna Formation

Sample Number: Boring 09-27MU, #3 **Depth:** 32-34'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, Brenna Formation
Depth: 32-34' **Sample Number:** Boring 09-27MU, #3
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=117** **PL=25** **PI=92**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.270		150.270
Moisture content: Dry soil+tare, gms.	89.220		103.920
Moisture content: Tare, gms.	30.540		31.390
Moisture, %	64.8	63.9	63.9
Moist specimen weight, gms.	120.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	101.0	102.0	
Dry density, pcf	61.3	62.3	
Void ratio	1.8014	1.7576	
Saturation, %	99.0	100.0	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.433 tsf at reading no. 10
Ult. Stress = 0.225 tsf at reading no. 23

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0177	0.000	0.0	0.0	0.000	0.1531
1	0.0180	5.100	5.1	0.0	0.080	0.1531
2	0.0186	7.600	7.6	0.0	0.120	0.1531
3	0.0193	10.700	10.7	0.1	0.169	0.1531
4	0.0207	14.000	14.0	0.1	0.221	0.1531
5	0.0229	19.400	19.4	0.2	0.306	0.1531
6	0.0270	21.600	21.6	0.4	0.340	0.1529
7	0.0296	23.500	23.5	0.5	0.370	0.1528
8	0.0331	24.700	24.7	0.6	0.389	0.1526
9	0.0434	26.500	26.5	1.1	0.418	0.1520
10	0.0565	27.500	27.5	1.6	0.433	0.1507
11	0.0690	25.400	25.4	2.1	0.400	0.1498
12	0.0811	24.300	24.3	2.6	0.383	0.1491
13	0.0982	22.600	22.6	3.3	0.356	0.1484

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1133	20.500	20.5	4.0	0.323	0.1478
15	0.1370	18.700	18.7	4.9	0.295	0.1471
16	0.1587	18.500	18.5	5.8	0.292	0.1465
17	0.2375	15.500	15.5	9.1	0.244	0.1452
18	0.2593	15.100	15.1	10.0	0.238	0.1449
19	0.2862	14.400	14.4	11.1	0.227	0.1445
20	0.2950	14.300	14.3	11.5	0.225	0.1443
21	0.3046	14.300	14.3	11.9	0.225	0.1441
22	0.3120	14.300	14.3	12.2	0.225	0.1440
23	0.3800	14.300	14.3	15.0	0.225	0.1438

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.680		146.600
Moisture content: Dry soil+tare, gms.	86.190		102.500
Moisture content: Tare, gms.	30.280		31.420
Moisture, %	65.3	62.0	62.0
Moist specimen weight, gms.	120.1		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	100.5	102.4	
Dry density, pcf	60.8	63.2	
Void ratio	1.8233	1.7156	
Saturation, %	98.4	99.4	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.585 tsf at reading no. 7

Ult. Stress = 0.446 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0160	0.000	0.0	0.0	0.000	0.1354
1	0.0162	5.300	5.3	0.0	0.084	0.1354
2	0.0168	9.700	9.7	0.0	0.153	0.1354
3	0.0191	18.700	18.7	0.1	0.295	0.1354
4	0.0267	28.400	28.4	0.4	0.448	0.1347
5	0.0400	35.000	35.0	1.0	0.552	0.1327
6	0.0643	36.500	36.5	2.0	0.575	0.1286
7	0.0966	37.100	37.1	3.3	0.585	0.1233
8	0.1235	35.500	35.5	4.5	0.559	0.1194
9	0.1510	34.300	34.3	5.6	0.540	0.1153
10	0.1850	33.400	33.4	7.0	0.526	0.1130
11	0.2160	32.000	32.0	8.3	0.504	0.1084
12	0.2500	30.200	30.2	9.7	0.476	0.1057
13	0.2765	29.900	29.9	10.8	0.471	0.1038
14	0.2922	28.900	28.9	11.5	0.455	0.1028

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.2999	29.000	29.0	11.8	0.457	0.1013
16	0.3084	28.500	28.5	12.1	0.449	0.1009
17	0.3300	28.300	28.3	13.0	0.446	0.1007
18	0.3789	28.300	28.3	15.0	0.446	0.1005

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.430		128.220
Moisture content: Dry soil+tare, gms.	88.690		93.940
Moisture content: Tare, gms.	30.200		30.420
Moisture, %	66.2	54.0	54.0
Moist specimen weight, gms.	119.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.87	
Net decrease in height, in.		0.13	
Wet Density, pcf	100.1	106.4	
Dry density, pcf	60.2	69.1	
Void ratio	1.8517	1.4840	
Saturation, %	98.4	100.0	

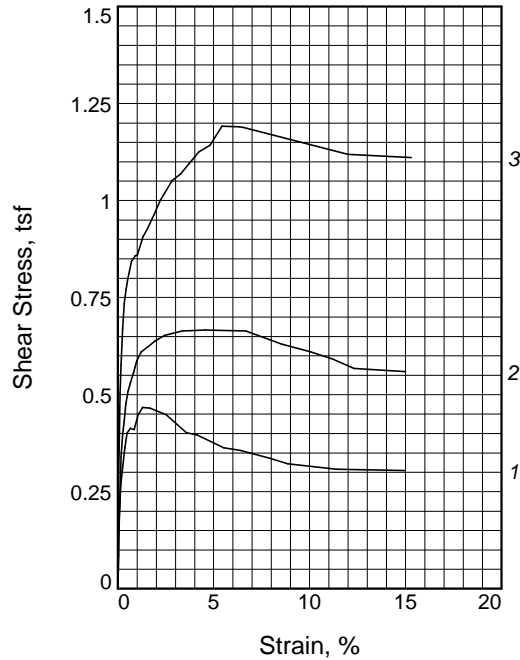
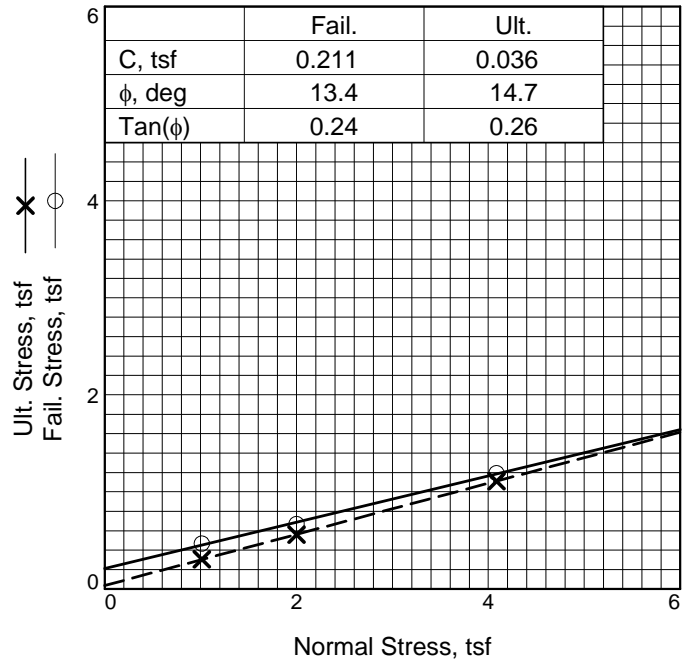
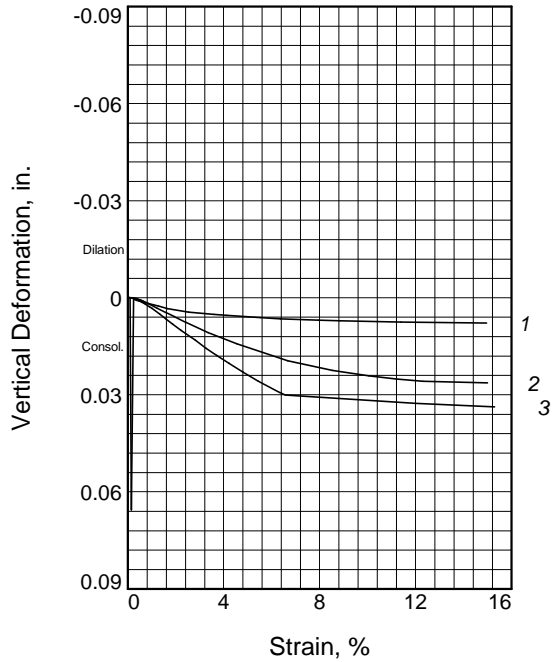
Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

Fail. Stress = 0.953 tsf at reading no. 12

Ult. Stress = 0.848 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0130	0.000	0.0	0.0	0.000	0.1159
1	0.0134	7.700	7.7	0.0	0.121	0.1159
2	0.0143	14.900	14.9	0.1	0.235	0.1158
3	0.0160	24.100	24.1	0.1	0.380	0.1158
4	0.0192	31.900	31.9	0.3	0.503	0.1156
5	0.0260	39.600	39.6	0.5	0.624	0.1150
6	0.0387	46.500	46.5	1.1	0.733	0.1134
7	0.0553	50.500	50.5	1.8	0.796	0.1106
8	0.0947	57.200	57.2	3.4	0.901	0.1027
9	0.1060	58.000	58.0	3.9	0.914	0.1005
10	0.1312	60.200	60.2	4.9	0.949	0.0956
11	0.1687	60.300	60.3	6.5	0.950	0.0891
12	0.1834	60.500	60.5	7.1	0.953	0.0868
13	0.2280	58.700	58.7	8.9	0.925	0.0806
14	0.2446	58.000	58.0	9.6	0.914	0.0786
15	0.2809	55.000	55.0	11.1	0.867	0.0746
16	0.3200	54.000	54.0	12.7	0.851	0.0732
17	0.3750	53.800	53.8	15.0	0.848	0.0725



Sample No.	1	2	3	
Initial	Water Content, %	51.0	52.4	51.4
	Dry Density, pcf	70.3	69.5	70.6
	Saturation, %	98.5	99.3	99.8
	Void Ratio	1.4001	1.4275	1.3924
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.01
At Test	Water Content, %	50.9	49.8	40.4
	Dry Density, pcf	71.0	72.0	80.6
	Saturation, %	99.9	100.0	100.0
	Void Ratio	1.3784	1.3452	1.0934
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.99	0.97	0.88
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.466	0.667	1.191	
Strain, %	1.3	4.6	5.4	
Ult. Stress, tsf	0.304	0.559	1.111	
Strain, %	15.0	15.0	15.3	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Top of sample
Description: FAT CLAY, gray (CH)

LL= 89 **PL=** 20 **PI=** 69

Assumed Specific Gravity= 2.704

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-19, Fargo, ~~Argusville Formation~~ Brenna

Sample Number: Boring 09-27MU, #4 **Depth:** 64-66'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, ~~Argusville Formation~~ **Brenna**
Depth: 64-66' **Sample Number:** Boring 09-27MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.704 **LL=**89 **PL=**20 **PI=**69

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	118.480		154.950
Moisture content: Dry soil+tare, gms.	88.550		112.760
Moisture content: Tare, gms.	29.860		29.920
Moisture, %	51.0	50.9	50.9
Moist specimen weight, gms.	126.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.99	
Net decrease in height, in.		0.01	
Wet Density, pcf	106.2	107.1	
Dry density, pcf	70.3	71.0	
Void ratio	1.4001	1.3784	
Saturation, %	98.5	99.9	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.466 tsf at reading no. 11
Ult. Stress = 0.304 tsf at reading no. 21

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0243	0.000	0.0	0.0	0.000	0.1706
1	0.0245	4.500	4.5	0.0	0.071	0.1706
2	0.0254	10.100	10.1	0.0	0.159	0.1706
3	0.0266	13.400	13.4	0.1	0.211	0.1706
4	0.0280	16.800	16.8	0.2	0.265	0.1050
5	0.0300	19.300	19.3	0.2	0.304	0.1702
6	0.0330	23.000	23.0	0.4	0.362	0.1698
7	0.0360	25.500	25.5	0.5	0.402	0.1696
8	0.0400	26.200	26.2	0.7	0.413	0.1693
9	0.0450	26.000	26.0	0.9	0.410	0.1688
10	0.0500	28.500	28.5	1.1	0.449	0.1684
11	0.0553	29.600	29.6	1.3	0.466	0.1680
12	0.0644	29.500	29.5	1.7	0.465	0.1672
13	0.0856	28.400	28.4	2.5	0.448	0.1661

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1110	25.500	25.5	3.6	0.402	0.1654
15	0.1240	25.100	25.1	4.1	0.396	0.1651
16	0.1575	23.000	23.0	5.5	0.362	0.1644
17	0.1780	22.600	22.6	6.4	0.356	0.1641
18	0.2160	21.300	21.3	7.9	0.336	0.1637
19	0.2380	20.400	20.4	8.9	0.321	0.1635
20	0.2990	19.500	19.5	11.4	0.307	0.1631
21	0.3850	19.300	19.3	15.0	0.304	0.1628

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	94.380		153.000
Moisture content: Dry soil+tare, gms.	72.420		112.250
Moisture content: Tare, gms.	30.550		30.360
Moisture, %	52.4	49.8	49.8
Moist specimen weight, gms.	127.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	106.0	107.8	
Dry density, pcf	69.5	72.0	
Void ratio	1.4275	1.3452	
Saturation, %	99.3	100.0	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.667 tsf at reading no. 17

Ult. Stress = 0.559 tsf at reading no. 23

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0231	0.000	0.0	0.0	0.000	0.1508
1	0.0242	5.500	5.5	0.0	0.087	0.1508
2	0.0247	10.200	10.2	0.1	0.161	0.1508
3	0.0262	17.400	17.4	0.1	0.274	0.1508
4	0.0274	21.500	21.5	0.2	0.339	0.1508
5	0.0294	25.200	25.2	0.3	0.397	0.1507
6	0.0311	27.400	27.4	0.3	0.432	0.1506
7	0.0332	30.200	30.2	0.4	0.476	0.1504
8	0.0360	32.300	32.3	0.5	0.509	0.1501
9	0.0390	33.600	33.6	0.7	0.529	0.1497
10	0.0432	35.500	35.5	0.8	0.559	0.1491
11	0.0470	37.200	37.2	1.0	0.586	0.1485
12	0.0525	38.700	38.7	1.2	0.610	0.1476
13	0.0615	39.600	39.6	1.6	0.624	0.1462
14	0.0700	40.500	40.5	1.9	0.638	0.1449
15	0.0816	41.400	41.4	2.4	0.652	0.1432
16	0.1041	42.100	42.1	3.4	0.663	0.1400

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
17	0.1330	42.300	42.3	4.6	0.667	0.1365
18	0.1840	42.100	42.1	6.7	0.663	0.1313
19	0.2290	40.000	40.0	8.5	0.630	0.1283
20	0.2654	38.700	38.7	10.0	0.610	0.1266
21	0.2934	37.500	37.5	11.2	0.591	0.1257
22	0.3200	36.000	36.0	12.3	0.567	0.1250
23	0.3850	35.500	35.5	15.0	0.559	0.1245

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	98.630		146.020
Moisture content: Dry soil+tare, gms.	75.300		112.930
Moisture content: Tare, gms.	29.920		31.090
Moisture, %	51.4	40.4	40.4
Moist specimen weight, gms.	129.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.01	0.88	
Net decrease in height, in.		0.13	
Wet Density, pcf	106.8	113.2	
Dry density, pcf	70.6	80.6	
Void ratio	1.3924	1.0934	
Saturation, %	99.8	100.0	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

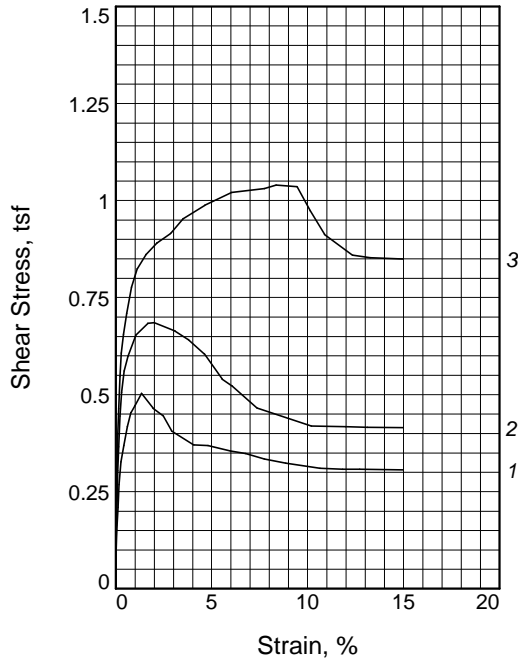
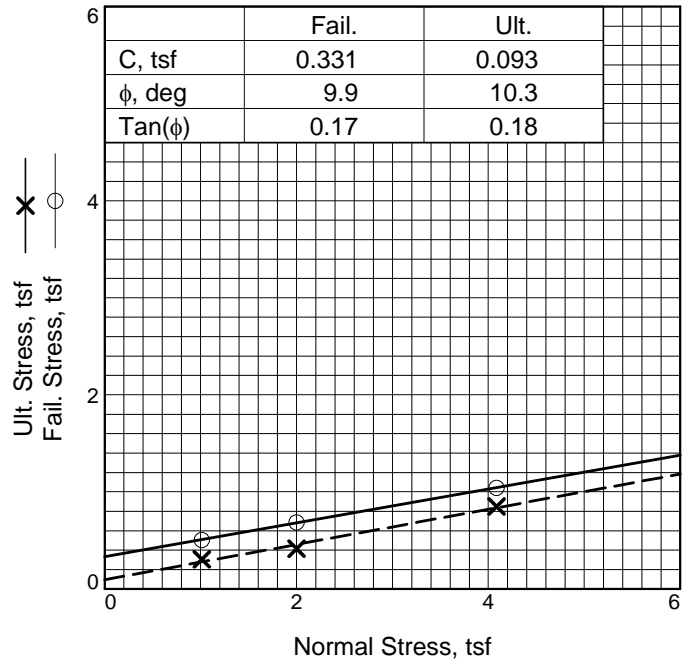
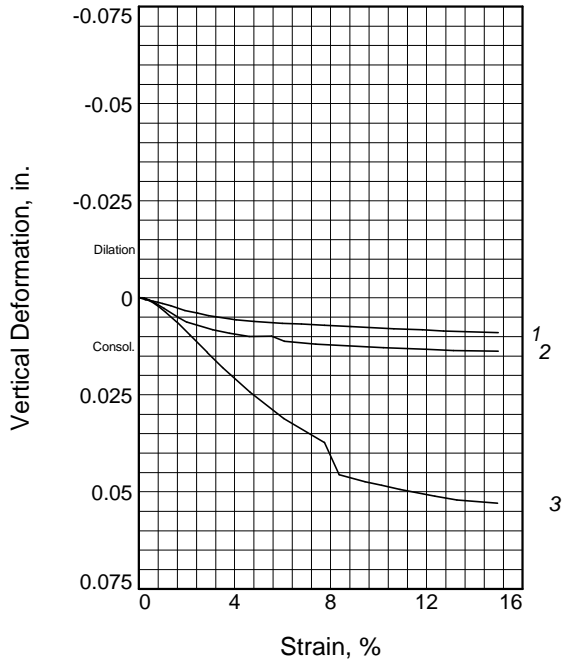
Fail. Stress = 1.191 tsf at reading no. 22

Ult. Stress = 1.111 tsf at reading no. 26

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0160	0.000	0.0	0.0	0.000	0.0392
1	0.0164	7.400	7.4	0.0	0.117	0.0393
2	0.0173	19.400	19.4	0.1	0.306	0.0393
3	0.0181	25.500	25.5	0.1	0.402	0.0392
4	0.0190	32.000	32.0	0.1	0.504	0.0392
5	0.0202	36.500	36.5	0.2	0.575	0.0391
6	0.0222	42.500	42.5	0.3	0.670	0.0390
7	0.0240	46.600	46.6	0.3	0.734	0.0388
8	0.0266	49.000	49.0	0.4	0.772	0.0384
9	0.0287	50.600	50.6	0.5	0.797	0.0381
10	0.0336	53.600	53.6	0.7	0.845	0.0373
11	0.0379	54.400	54.4	0.9	0.857	0.0364
12	0.0406	54.500	54.5	1.0	0.859	0.0359
13	0.0480	57.600	57.6	1.3	0.908	0.0342
14	0.0540	59.000	59.0	1.6	0.930	0.0328
15	0.0612	61.000	61.0	1.9	0.961	0.0311
16	0.0700	63.600	63.6	2.2	1.002	0.0291
17	0.0840	66.700	66.7	2.8	1.051	0.0261

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
18	0.0950	67.800	67.8	3.3	1.068	0.0236
19	0.1056	69.500	69.5	3.7	1.095	0.0214
20	0.1180	71.400	71.4	4.2	1.125	0.0189
21	0.1320	72.500	72.5	4.8	1.142	0.0162
22	0.1470	75.600	75.6	5.4	1.191	0.0135
23	0.1690	75.500	75.5	6.3	1.190	0.0099
24	0.1744	75.400	75.4	6.6	1.188	0.0091
25	0.3056	71.000	71.0	12.0	1.119	0.0065
26	0.3850	70.500	70.5	15.3	1.111	0.0054



Sample No.	1	2	3	
Initial	Water Content, %	60.3	59.3	59.4
	Dry Density, pcf	63.9	65.0	64.6
	Saturation, %	98.4	99.5	98.6
	Void Ratio	1.6851	1.6400	1.6580
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	59.3	56.6	50.0
	Dry Density, pcf	65.2	67.1	72.2
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.6317	1.5580	1.3762
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.97	0.90
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.503	0.685	1.040	
Strain, %	1.3	2.0	8.4	
Ult. Stress, tsf	0.306	0.414	0.849	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)

Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

Location: SE-M-18, Moorhead, Brenna Formation

Sample Number: Boring 09-34MU, #3 **Depth:** 28-30'

Proj. No.: BL-09-03127

Date Sampled:



DIRECT SHEAR TEST

11/16/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-34MU, #3
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	122.420		152.080
Moisture content: Dry soil+tare, gms.	88.000		106.750
Moisture content: Tare, gms.	30.920		30.330
Moisture, %	60.3	59.3	59.3
Moist specimen weight, gms.	123.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	102.5	103.9	
Dry density, pcf	63.9	65.2	
Void ratio	1.6851	1.6317	
Saturation, %	98.4	100.0	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.503 tsf at reading no. 10
Ult. Stress = 0.306 tsf at reading no. 23

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0134	0.000	0.0	0.0	0.000	0.1513
1	0.0137	4.500	4.5	0.0	0.071	0.1514
2	0.0147	9.600	9.6	0.1	0.151	0.1513
3	0.0163	13.300	13.3	0.1	0.210	0.1511
4	0.0176	17.000	17.0	0.2	0.268	0.1510
5	0.0199	20.700	20.7	0.3	0.326	0.1508
6	0.0237	23.400	23.4	0.4	0.369	0.1506
7	0.0279	26.500	26.5	0.6	0.418	0.1504
8	0.0325	28.800	28.8	0.8	0.454	0.1501
9	0.0373	29.900	29.9	1.0	0.471	0.1498
10	0.0458	31.900	31.9	1.3	0.503	0.1492
11	0.0600	29.500	29.5	1.9	0.465	0.1480
12	0.0728	28.300	28.3	2.5	0.446	0.1473
13	0.0837	25.800	25.8	2.9	0.407	0.1467

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1115	23.500	23.5	4.1	0.370	0.1456
15	0.1294	23.400	23.4	4.8	0.369	0.1452
16	0.1576	22.500	22.5	6.0	0.355	0.1447
17	0.1769	22.100	22.1	6.8	0.348	0.1445
18	0.2002	21.200	21.2	7.7	0.334	0.1442
19	0.2270	20.500	20.5	8.9	0.323	0.1439
20	0.2702	19.700	19.7	10.6	0.310	0.1433
21	0.2986	19.500	19.5	11.8	0.307	0.1430
22	0.3200	19.500	19.5	12.7	0.307	0.1427
23	0.3750	19.400	19.4	15.0	0.306	0.1423

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	123.430		151.150
Moisture content: Dry soil+tare, gms.	89.180		107.620
Moisture content: Tare, gms.	31.470		30.750
Moisture, %	59.3	56.6	56.6
Moist specimen weight, gms.	124.1		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	103.6	105.1	
Dry density, pcf	65.0	67.1	
Void ratio	1.6400	1.5580	
Saturation, %	99.5	100.0	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.685 tsf at reading no. 12

Ult. Stress = 0.414 tsf at reading no. 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0146	0.000	0.0	0.0	0.000	0.1253
1	0.0149	6.100	6.1	0.0	0.096	0.1253
2	0.0154	10.300	10.3	0.0	0.162	0.1253
3	0.0162	14.400	14.4	0.1	0.227	0.1253
4	0.0170	19.300	19.3	0.1	0.304	0.1253
5	0.0182	23.200	23.2	0.2	0.366	0.1253
6	0.0200	28.200	28.2	0.2	0.444	0.1252
7	0.0220	32.100	32.1	0.3	0.506	0.1250
8	0.0250	35.600	35.6	0.4	0.561	0.1247
9	0.0300	38.000	38.0	0.6	0.599	0.1241
10	0.0400	41.500	41.5	1.1	0.654	0.1226
11	0.0550	43.400	43.4	1.7	0.684	0.1202
12	0.0630	43.500	43.5	2.0	0.685	0.1190
13	0.0890	42.100	42.1	3.1	0.663	0.1170
14	0.1060	40.700	40.7	3.8	0.641	0.1161

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.1257	38.400	38.4	4.6	0.605	0.1153
16	0.1483	34.300	34.3	5.5	0.540	0.1154
17	0.1610	33.100	33.1	6.1	0.522	0.1141
18	0.1927	29.500	29.5	7.4	0.465	0.1133
19	0.2605	26.600	26.6	10.2	0.419	0.1124
20	0.3037	26.500	26.5	12.0	0.418	0.1120
21	0.3310	26.400	26.4	13.1	0.416	0.1117
22	0.3760	26.300	26.3	15.0	0.414	0.1115

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	134.850		138.490
Moisture content: Dry soil+tare, gms.	96.240		102.580
Moisture content: Tare, gms.	31.290		30.830
Moisture, %	59.4	50.0	50.0
Moist specimen weight, gms.	123.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.90	
Net decrease in height, in.		0.11	
Wet Density, pcf	103.0	108.4	
Dry density, pcf	64.6	72.2	
Void ratio	1.6580	1.3762	
Saturation, %	98.6	100.0	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

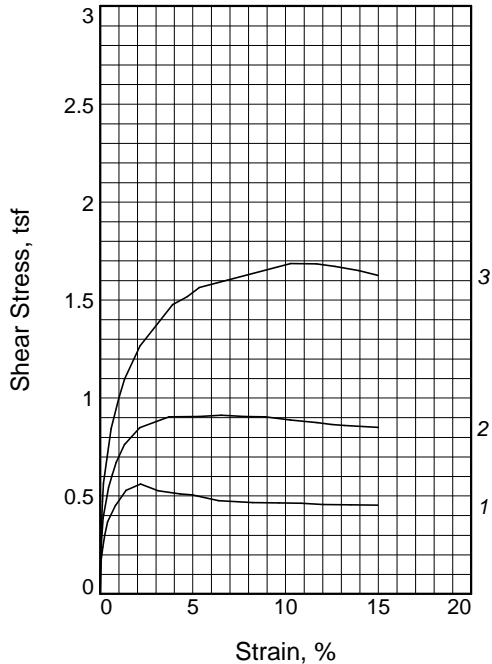
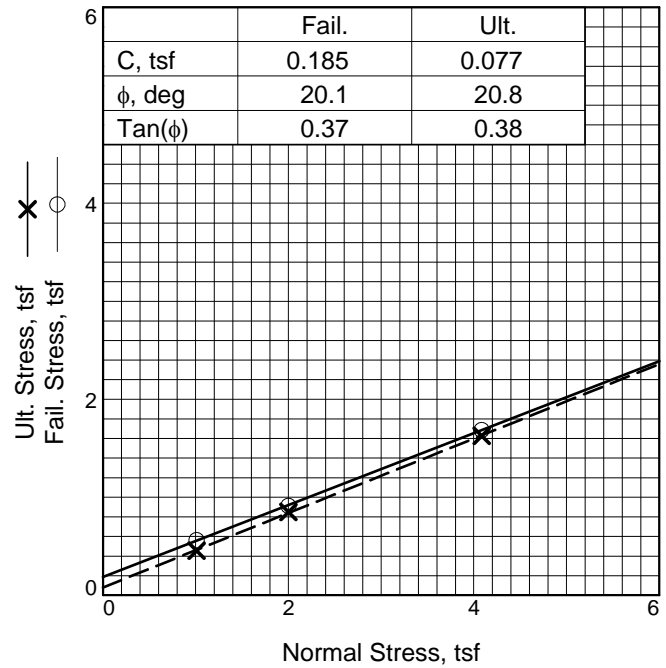
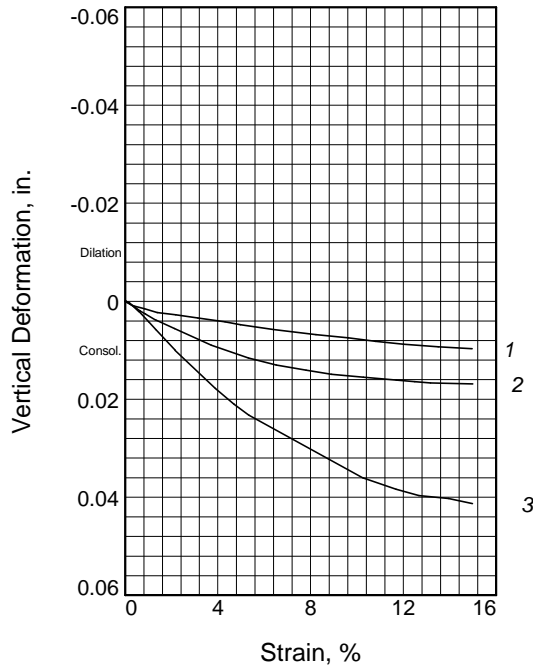
Fail. Stress = 1.040 tsf at reading no. 19

Ult. Stress = 0.849 tsf at reading no. 25

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0151	0.000	0.0	0.0	0.000	0.0616
1	0.0153	6.500	6.5	0.0	0.102	0.0616
2	0.0159	13.700	13.7	0.0	0.216	0.0616
3	0.0169	19.900	19.9	0.1	0.314	0.0615
4	0.0177	25.200	25.2	0.1	0.397	0.0615
5	0.0188	29.400	29.4	0.2	0.463	0.0615
6	0.0206	34.700	34.7	0.2	0.547	0.0614
7	0.0220	38.500	38.5	0.3	0.607	0.0612
8	0.0250	41.600	41.6	0.4	0.656	0.0609
9	0.0290	45.000	45.0	0.6	0.709	0.0604
10	0.0350	49.300	49.3	0.8	0.777	0.0594
11	0.0423	52.300	52.3	1.1	0.824	0.0579
12	0.0532	54.600	54.6	1.6	0.860	0.0554
13	0.0666	56.500	56.5	2.1	0.890	0.0519
14	0.0839	58.100	58.1	2.9	0.916	0.0475
15	0.0995	60.500	60.5	3.5	0.953	0.0436
16	0.1272	62.700	62.7	4.6	0.988	0.0373

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
17	0.1609	64.800	64.8	6.0	1.021	0.0305
18	0.2018	65.400	65.4	7.7	1.031	0.0243
19	0.2166	66.000	66.0	8.4	1.040	0.0160
20	0.2428	65.700	65.7	9.4	1.035	0.0142
21	0.2596	61.800	61.8	10.1	0.974	0.0133
22	0.2777	57.900	57.9	10.9	0.912	0.0122
23	0.3130	54.500	54.5	12.4	0.859	0.0105
24	0.3350	54.100	54.1	13.3	0.852	0.0095
25	0.3760	53.900	53.9	15.0	0.849	0.0087



Sample No.	1	2	3
Initial			
Water Content, %	39.6	39.4	39.0
Dry Density, pcf	81.5	82.1	81.6
Saturation, %	98.4	99.3	97.3
Void Ratio	1.1076	1.0905	1.1030
Diameter, in.	2.41	2.41	2.41
Height, in.	1.00	1.00	1.00
At Test			
Water Content, %	38.7	37.3	34.4
Dry Density, pcf	83.1	84.8	88.2
Saturation, %	99.9	99.9	99.9
Void Ratio	1.0656	1.0254	0.9460
Diameter, in.	2.41	2.41	2.41
Height, in.	0.98	0.96	0.93
Normal Stress, tsf	1.011	2.000	4.084
Fail. Stress, tsf	0.561	0.912	1.686
Strain, %	2.2	6.5	10.3
Ult. Stress, tsf	0.454	0.849	1.626
Strain, %	15.0	15.0	15.0
Strain rate, in./min.	N/A	N/A	N/A

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)

LL= 64 **PL=** 17 **PI=** 47

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in./min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo **Brenna / Argusville Transition**

Location: WD-28, ND Div, ~~Brenna Formation~~

Sample Number: Boring 09-59MU, #3 **Depth:** 35-37'

Proj. No.: BL09-03127A **Date Sampled:**

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

3/2/2010

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL09-03127A
Location: WD-28, ND Div, ~~Brenna Formation~~ **Brenna / Argusville Transition**
Depth: 35-37' **Sample Number:** Boring 09-59MU, #3
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**64 **PL=**17 **PI=**47

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	155.200		165.410
Moisture content: Dry soil+tare, gms.	119.590		127.650
Moisture content: Tare, gms.	29.700		30.130
Moisture, %	39.6	38.7	38.7
Moist specimen weight, gms.	136.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	113.7	115.3	
Dry density, pcf	81.5	83.1	
Void ratio	1.1076	1.0656	
Saturation, %	98.4	99.9	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.561 tsf at reading no. 7
Ult. Stress = 0.454 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0141	0.000	0.0	0.0	0.000	0.1361
1	0.0152	10.300	10.3	0.0	0.162	0.1361
2	0.0175	15.100	15.1	0.1	0.238	0.1358
3	0.0200	19.000	19.0	0.2	0.299	0.1355
4	0.0240	23.400	23.4	0.4	0.369	0.1351
5	0.0342	28.700	28.7	0.8	0.452	0.1346
6	0.0475	33.500	33.5	1.4	0.528	0.1338
7	0.0668	35.600	35.6	2.2	0.561	0.1333
8	0.0897	33.400	33.4	3.1	0.526	0.1327
9	0.1182	32.400	32.4	4.3	0.511	0.1319
10	0.1342	32.100	32.1	5.0	0.506	0.1313
11	0.1684	30.200	30.2	6.4	0.476	0.1303
12	0.2127	29.600	29.6	8.2	0.466	0.1293
13	0.2463	29.500	29.5	9.6	0.465	0.1286
14	0.2750	29.400	29.4	10.8	0.463	0.1279

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.3040	29.000	29.0	12.0	0.457	0.1273
16	0.3400	28.900	28.9	13.5	0.455	0.1268
17	0.3750	28.800	28.8	15.0	0.454	0.1264

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	169.900		163.570
Moisture content: Dry soil+tare, gms.	130.600		127.340
Moisture content: Tare, gms.	30.800		30.110
Moisture, %	39.4	37.3	37.3
Moist specimen weight, gms.	136.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.03	
Wet Density, pcf	114.5	116.3	
Dry density, pcf	82.1	84.8	
Void ratio	1.0905	1.0254	
Saturation, %	99.3	99.9	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.912 tsf at reading no. 11

Ult. Stress = 0.849 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0171	0.000	0.0	0.0	0.000	0.1272
1	0.0175	6.800	6.8	0.0	0.107	0.1272
2	0.0190	16.900	16.9	0.1	0.266	0.1270
3	0.0210	24.600	24.6	0.2	0.388	0.1268
4	0.0280	34.500	34.5	0.5	0.544	0.1259
5	0.0330	38.700	38.7	0.7	0.610	0.1252
6	0.0382	42.600	42.6	0.9	0.671	0.1246
7	0.0488	48.400	48.4	1.3	0.763	0.1234
8	0.0684	53.800	53.8	2.1	0.848	0.1216
9	0.1069	57.400	57.4	3.7	0.904	0.1182
10	0.1455	57.500	57.5	5.3	0.906	0.1156
11	0.1744	57.900	57.9	6.5	0.912	0.1142
12	0.2054	57.500	57.5	7.8	0.906	0.1131
13	0.2320	57.400	57.4	8.9	0.904	0.1123
14	0.2650	56.300	56.3	10.3	0.887	0.1117
15	0.2992	55.500	55.5	11.7	0.875	0.1111
16	0.3187	54.900	54.9	12.5	0.865	0.1108
17	0.3348	54.600	54.6	13.2	0.860	0.1105
18	0.3790	53.900	53.9	15.0	0.849	0.1103

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.900		158.590
Moisture content: Dry soil+tare, gms.	110.820		125.860
Moisture content: Tare, gms.	31.200		30.630
Moisture, %	39.0	34.4	34.4
Moist specimen weight, gms.	136.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.93	
Net decrease in height, in.		0.07	
Wet Density, pcf	113.5	118.5	
Dry density, pcf	81.6	88.2	
Void ratio	1.1030	0.9460	
Saturation, %	97.3	99.9	

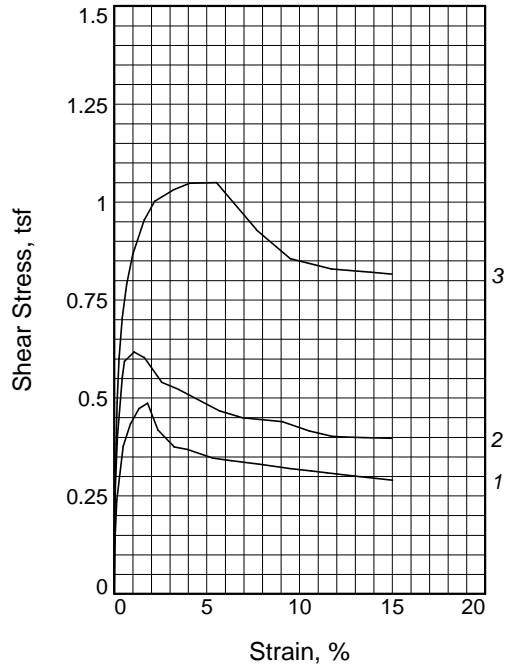
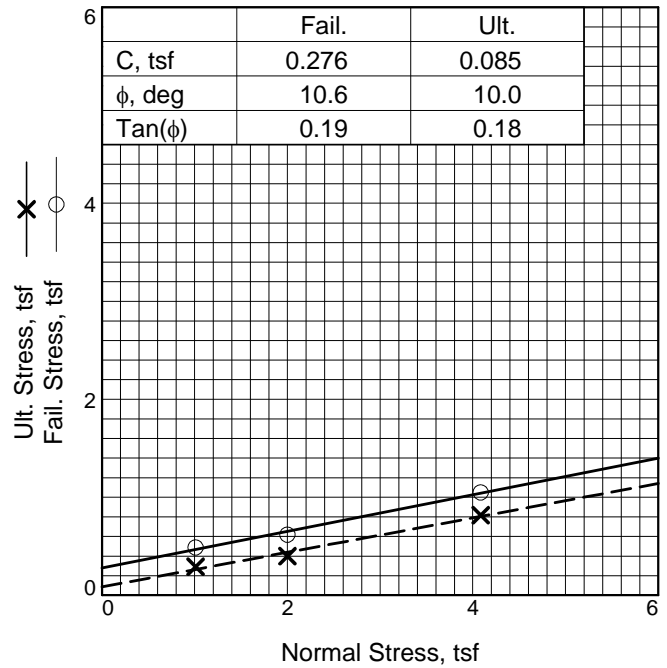
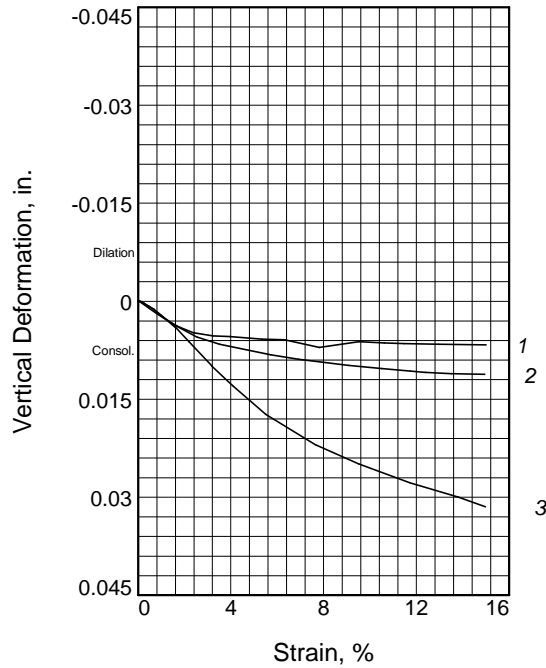
Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

Fail. Stress = 1.686 tsf at reading no. 13

Ult. Stress = 1.626 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0147	0.000	0.0	0.0	0.000	0.0783
1	0.0149	6.300	6.3	0.0	0.099	0.0783
2	0.0156	14.400	14.4	0.0	0.227	0.0783
3	0.0165	22.500	22.5	0.1	0.355	0.0782
4	0.0178	29.900	29.9	0.1	0.471	0.0781
5	0.0190	35.800	35.8	0.2	0.564	0.0780
6	0.0290	53.500	53.5	0.6	0.843	0.0762
7	0.0390	63.400	63.4	1.0	0.999	0.0741
8	0.0466	69.600	69.6	1.3	1.097	0.0725
9	0.0667	80.500	80.5	2.2	1.268	0.0683
10	0.1087	93.700	93.7	3.9	1.476	0.0605
11	0.1280	96.300	96.3	4.7	1.517	0.0573
12	0.1434	99.200	99.2	5.3	1.563	0.0551
13	0.2625	107.000	107.0	10.3	1.686	0.0422
14	0.2964	106.900	106.9	11.7	1.684	0.0399
15	0.3204	106.100	106.1	12.7	1.672	0.0386
16	0.3510	104.700	104.7	13.9	1.650	0.0380
17	0.3760	103.200	103.2	15.0	1.626	0.0370



Sample No.	1	2	3	
Initial	Water Content, %	64.5	67.9	41.3
	Dry Density, pcf	61.0	59.0	71.5
	Saturation, %	97.7	97.8	81.1
	Void Ratio	1.8152	1.9076	1.3999
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	64.4	65.6	47.4
	Dry Density, pcf	61.9	61.2	74.5
	Saturation, %	99.8	100.0	100.0
	Void Ratio	1.7745	1.8057	1.3039
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.99	0.97	0.96
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.487	0.618	1.049	
Strain, %	1.8	1.1	5.5	
Ult. Stress, tsf	0.290	0.397	0.816	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 111 PL= 26 PI= 85

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in./min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Fargo

Location: WD-05, ND Div, Brenna Formation

Sample Number: Boring 09-60MU, #3 **Depth:** 35-37'

Proj. No.: BL09-03127A **Date Sampled:**

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

3/2/2010

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL09-03127A
Location: WD-05, ND Div, Brenna Formation
Depth: 35-37' **Sample Number:** Boring 09-60MU, #3
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**111 **PL=**26 **PI=**85

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	139.390		149.510
Moisture content: Dry soil+tare, gms.	96.940		102.870
Moisture content: Tare, gms.	31.100		30.440
Moisture, %	64.5	64.4	64.4
Moist specimen weight, gms.	120.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.99	
Net decrease in height, in.		0.01	
Wet Density, pcf	100.3	101.7	
Dry density, pcf	61.0	61.9	
Void ratio	1.8152	1.7745	
Saturation, %	97.7	99.8	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.487 tsf at reading no. 7
Ult. Stress = 0.290 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0186	0.000	0.0	0.0	0.000	0.1059
1	0.0190	5.400	5.4	0.0	0.085	0.1059
2	0.0200	9.500	9.5	0.1	0.150	0.1059
3	0.0220	15.200	15.2	0.1	0.240	0.1057
4	0.0305	23.900	23.9	0.5	0.377	0.1048
5	0.0400	27.600	27.6	0.9	0.435	0.1038
6	0.0510	30.000	30.0	1.3	0.473	0.1028
7	0.0620	30.900	30.9	1.8	0.487	0.1019
8	0.0760	26.500	26.5	2.4	0.418	0.1011
9	0.0965	23.800	23.8	3.2	0.375	0.1006
10	0.1140	23.400	23.4	4.0	0.369	0.1005
11	0.1468	22.000	22.0	5.3	0.347	0.1001
12	0.1710	21.600	21.6	6.3	0.340	0.1000
13	0.2072	21.000	21.0	7.8	0.331	0.0988
14	0.2484	20.300	20.3	9.5	0.320	0.0997

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.2748	19.900	19.9	10.6	0.314	0.0995
16	0.2956	19.600	19.6	11.5	0.309	0.0994
17	0.3310	19.100	19.1	13.0	0.301	0.0993
18	0.3808	18.400	18.4	15.0	0.290	0.0992

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	148.290		146.790
Moisture content: Dry soil+tare, gms.	100.590		100.630
Moisture content: Tare, gms.	30.300		30.310
Moisture, %	67.9	65.6	65.6
Moist specimen weight, gms.	119.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.04	
Wet Density, pcf	99.1	101.4	
Dry density, pcf	59.0	61.2	
Void ratio	1.9076	1.8057	
Saturation, %	97.8	100.0	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.618 tsf at reading no. 6

Ult. Stress = 0.397 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0140	0.000	0.0	0.0	0.000	0.1106
1	0.0142	7.500	7.5	0.0	0.118	0.1106
2	0.0157	18.100	18.1	0.1	0.285	0.1106
3	0.0183	25.400	25.4	0.2	0.400	0.1104
4	0.0244	35.000	35.0	0.4	0.552	0.1099
5	0.0276	37.700	37.7	0.6	0.594	0.1096
6	0.0399	39.200	39.2	1.1	0.618	0.1082
7	0.0528	38.300	38.3	1.6	0.604	0.1069
8	0.0756	34.300	34.3	2.6	0.540	0.1051
9	0.0986	33.100	33.1	3.5	0.522	0.1040
10	0.1520	29.600	29.6	5.7	0.466	0.1024
11	0.1810	28.500	28.5	6.9	0.449	0.1017
12	0.2325	27.900	27.9	9.1	0.440	0.1008
13	0.2676	26.400	26.4	10.5	0.416	0.1003
14	0.2976	25.500	25.5	11.8	0.402	0.0999
15	0.3128	25.400	25.4	12.4	0.400	0.0997
16	0.3398	25.300	25.3	13.5	0.399	0.0995
17	0.3748	25.200	25.2	15.0	0.397	0.0994

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	164.910		141.160
Moisture content: Dry soil+tare, gms.	125.710		105.410
Moisture content: Tare, gms.	30.700		30.020
Moisture, %	41.3	47.4	47.4
Moist specimen weight, gms.	121.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	101.0	109.9	
Dry density, pcf	71.5	74.5	
Void ratio	1.3999	1.3039	
Saturation, %	81.1	100.0	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

Fail. Stress = 1.049 tsf at reading no. 13

Ult. Stress = 0.816 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0176	0.000	0.0	0.0	0.000	0.0535
1	0.0180	9.500	9.5	0.0	0.150	0.0535
2	0.0187	15.900	15.9	0.0	0.251	0.0535
3	0.0200	24.300	24.3	0.1	0.383	0.0535
4	0.0215	31.000	31.0	0.2	0.488	0.0534
5	0.0240	38.100	38.1	0.3	0.600	0.0532
6	0.0282	44.700	44.7	0.4	0.704	0.0528
7	0.0341	50.200	50.2	0.7	0.791	0.0523
8	0.0420	55.000	55.0	1.0	0.867	0.0513
9	0.0568	60.600	60.6	1.6	0.955	0.0494
10	0.0702	63.600	63.6	2.2	1.002	0.0473
11	0.0944	65.400	65.4	3.2	1.031	0.0436
12	0.1158	66.500	66.5	4.1	1.048	0.0406
13	0.1505	66.600	66.6	5.5	1.049	0.0362
14	0.2027	59.000	59.0	7.7	0.930	0.0315
15	0.2470	54.300	54.3	9.5	0.856	0.0286
16	0.3003	52.600	52.6	11.7	0.829	0.0257
17	0.3510	52.100	52.1	13.8	0.821	0.0235
18	0.3790	51.800	51.8	15.0	0.816	0.0220

Direct Shear Test

ASTM: D3080

Job No.: **7577**

Project: **Fargo-Moorhead Metro Feasibility Project - # W912ES-10-T-0095**

Boring No.: **10-80MU** Sample No. **2** Depth: **35 - 37 (Top)**

Location: **Fargo ND Sheyenne** Sample Type: **5T**

Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**

Test Date: **8/18/2010**

Date Reported: **8/23/2010**

Shear Rate

0.000378 (in/min)

Remarks: Specimens trimmed to given sizes; Inundated after applying normal load; Allowed to consolidate for about 3-6 Hrs.; Sheared to given displacements at constant rate of 0.000378"/min..

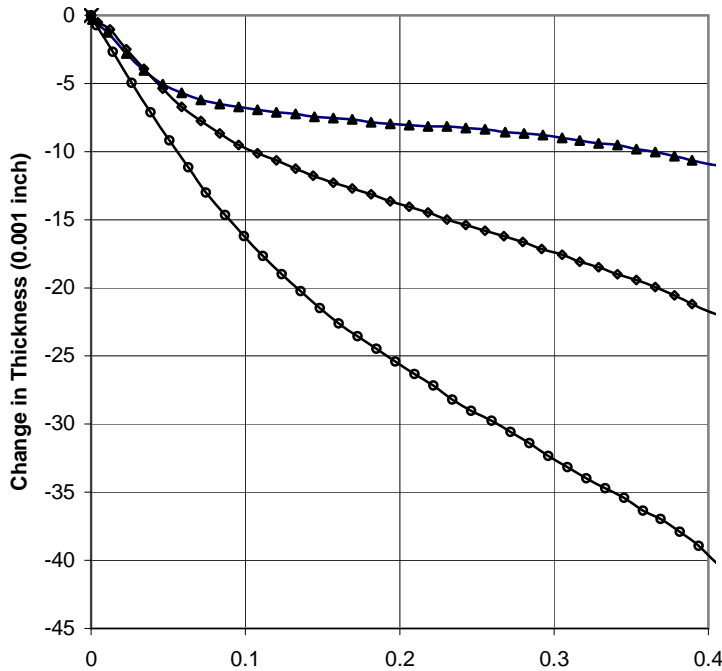
Liquid Limit: **90.7**

Plastic Limit: **29.1**

Plasticity Index: **61.6**

Specific Gravity (*): **2.78**

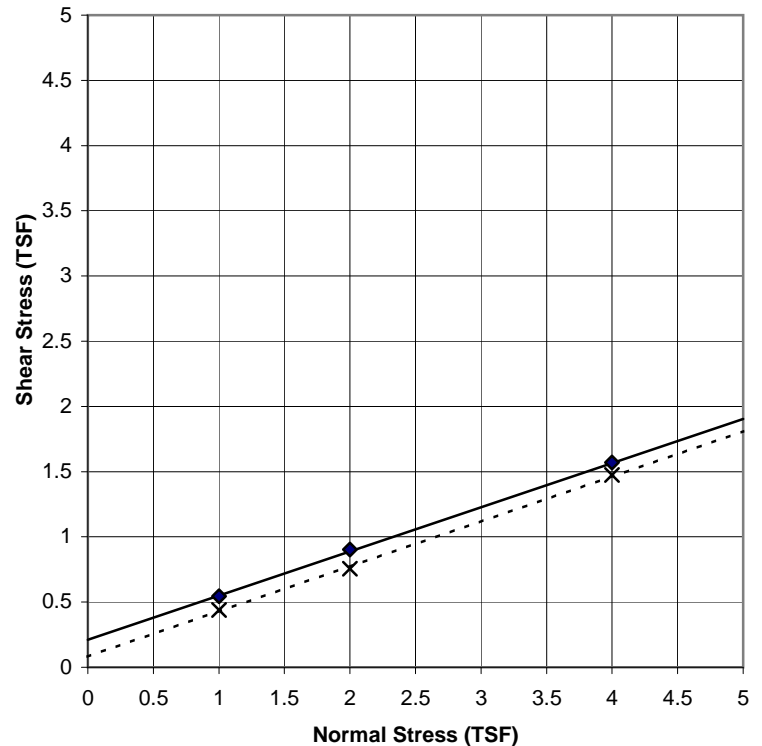
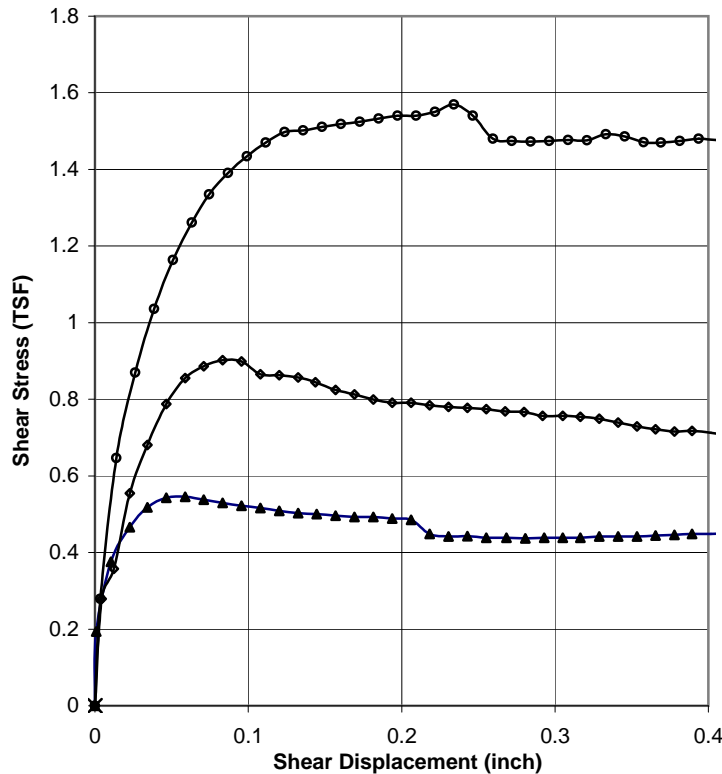
(*) = Assumed Specific Gravity

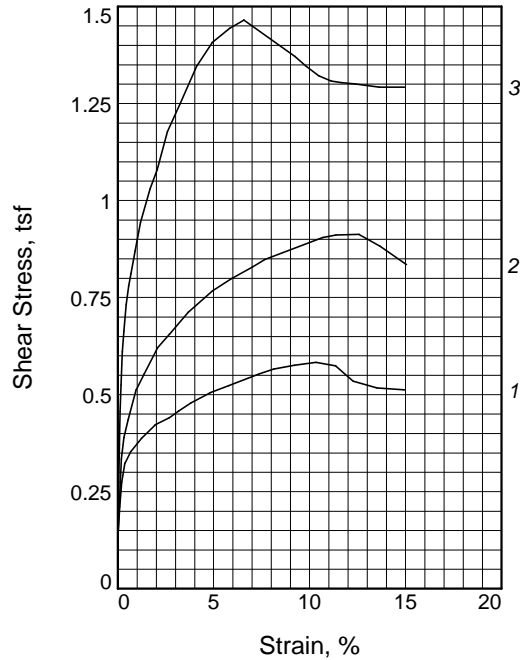
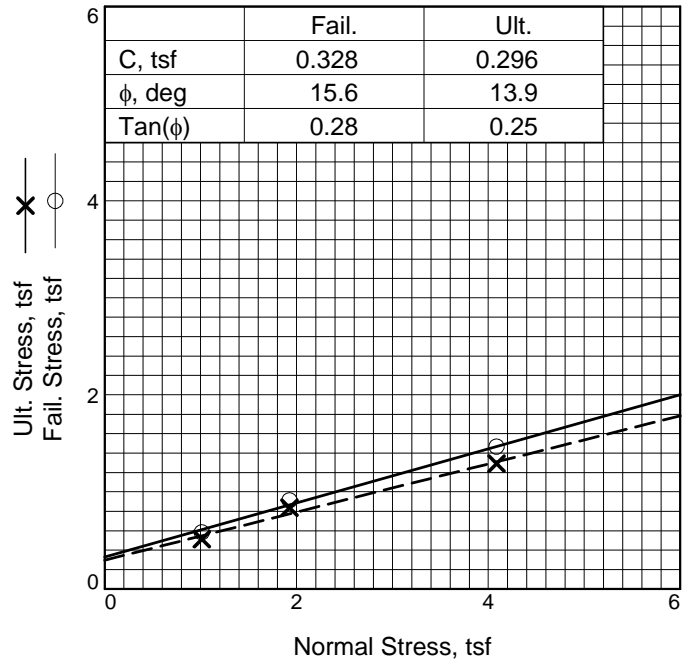
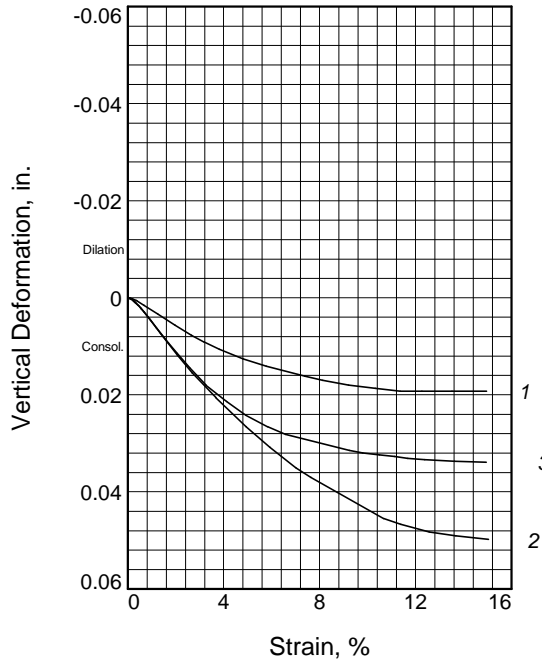


Failure Criterion:				
Max. Shear Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	0.72	0.72	0.72	
Water Content (%)	49.4	51.9	48.0	
Dry Density (pcf)	71.3	70.8	74.8	
Before Shear				
Thickness (In.)	0.68	0.67	0.65	
Water Content (%)	46.7	46.4	39.4	
Dry Density (pcf)	75.5	75.8	82.8	
Normal Stress				
	1.00	2.00	4.00	
Shear Stress				
	0.55	0.90	1.57	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of: 0.3	
Friction Angle: $\phi =$	18.7 deg.	Friction Angle: $\phi =$	19.1 deg.
Apparent Cohesion	0.212 TSF	Apparent Cohesion	0.080 TSF





Sample No.	1	2	3	
Initial	Water Content, %	38.0	41.5	43.2
	Dry Density, pcf	82.8	80.2	77.0
	Saturation, %	97.5	100.0	96.6
	Void Ratio	1.0725	1.1419	1.2299
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	36.0	37.1	33.6
	Dry Density, pcf	86.1	85.0	89.1
	Saturation, %	99.4	100.0	99.7
	Void Ratio	0.9950	1.0204	0.9274
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.96	0.94	0.86
Normal Stress, tsf	1.011	1.926	4.084	
Fail. Stress, tsf	0.583	0.912	1.465	
Strain, %	10.3	12.6	6.6	
Ult. Stress, tsf	0.512	0.835	1.292	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, gray (CH)

LL= 53 PL= 17 PI= 36

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
Moorhead

Location: East Diversion, SE-ED-15, Argusville Formation

Sample Number: Boring 09-14MU, #4 **Depth:** 58-60'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

10/12/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127
Location: East Diversion, SE-ED-15, Argusville Formation
Depth: 58-60' **Sample Number:** Boring 09-14MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**53 **PL=**17 **PI=**36

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	103.020		163.210
Moisture content: Dry soil+tare, gms.	82.980		127.940
Moisture content: Tare, gms.	30.250		29.890
Moisture, %	38.0	36.0	36.0
Moist specimen weight, gms.	137.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	114.3	117.0	
Dry density, pcf	82.8	86.1	
Void ratio	1.0725	0.9950	
Saturation, %	97.5	99.4	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.583 tsf at reading no. 17
Ult. Stress = 0.512 tsf at reading no. 21

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0240	0.000	0.0	0.0	0.000	0.1513
1	0.0241	5.000	5.0	0.0	0.079	0.1513
2	0.0246	9.200	9.2	0.0	0.145	0.1513
3	0.0263	13.400	13.4	0.1	0.211	0.1512
4	0.0290	17.300	17.3	0.2	0.273	0.1510
5	0.0330	20.500	20.5	0.4	0.323	0.1507
6	0.0400	22.400	22.4	0.7	0.353	0.1498
7	0.0540	24.600	24.6	1.2	0.388	0.1480
8	0.0713	26.800	26.8	2.0	0.422	0.1457
9	0.0882	27.900	27.9	2.7	0.440	0.1436
10	0.1008	29.100	29.1	3.2	0.459	0.1422
11	0.1160	30.400	30.4	3.8	0.479	0.1407
12	0.1400	32.000	32.0	4.8	0.504	0.1387
13	0.1633	33.200	33.2	5.8	0.523	0.1372
14	0.2020	35.100	35.1	7.4	0.553	0.1351

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
15	0.2200	35.900	35.9	8.1	0.566	0.1343
16	0.2460	36.500	36.5	9.2	0.575	0.1333
17	0.2730	37.000	37.0	10.3	0.583	0.1326
18	0.2980	36.400	36.4	11.4	0.574	0.1320
19	0.3200	33.900	33.9	12.3	0.534	0.1320
20	0.3500	32.800	32.8	13.5	0.517	0.1320
21	0.3850	32.500	32.5	15.0	0.512	0.1320

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	112.180		155.770
Moisture content: Dry soil+tare, gms.	88.100		121.700
Moisture content: Tare, gms.	30.100		29.890
Moisture, %	41.5	37.1	37.1
Moist specimen weight, gms.	135.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.94	
Net decrease in height, in.		0.06	
Wet Density, pcf	113.4	116.5	
Dry density, pcf	80.2	85.0	
Void ratio	1.1419	1.0204	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 2

Normal stress = 1.926 tsf

Fail. Stress = 0.912 tsf at reading no. 17

Ult. Stress = 0.835 tsf at reading no. 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0201	0.000	0.0	0.0	0.000	0.1293
1	0.0202	5.400	5.4	0.0	0.085	0.1293
2	0.0207	9.100	9.1	0.0	0.143	0.1293
3	0.0247	21.200	21.2	0.2	0.334	0.1290
4	0.0280	24.700	24.7	0.3	0.389	0.1283
5	0.0330	27.600	27.6	0.5	0.435	0.1272
6	0.0430	32.500	32.5	1.0	0.512	0.1246
7	0.0530	35.100	35.1	1.4	0.553	0.1219
8	0.0700	39.400	39.4	2.1	0.621	0.1174
9	0.0850	41.600	41.6	2.7	0.656	0.1138
10	0.1086	45.200	45.2	3.7	0.712	0.1087
11	0.1393	48.700	48.7	4.9	0.767	0.1027
12	0.1630	50.700	50.7	5.9	0.799	0.0985
13	0.1890	52.600	52.6	7.0	0.829	0.0943
14	0.2044	53.800	53.8	7.6	0.848	0.0923
15	0.2775	57.400	57.4	10.7	0.904	0.0838
16	0.2947	57.800	57.8	11.4	0.911	0.0826
17	0.3235	57.900	57.9	12.6	0.912	0.0810

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
18	0.3500	56.000	56.0	13.7	0.882	0.0802
19	0.3830	53.000	53.0	15.0	0.835	0.0795

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	96.360		145.630
Moisture content: Dry soil+tare, gms.	76.690		116.600
Moisture content: Tare, gms.	31.180		30.280
Moisture, %	43.2	33.6	33.6
Moist specimen weight, gms.	131.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.86	
Net decrease in height, in.		0.14	
Wet Density, pcf	110.3	119.0	
Dry density, pcf	77.0	89.1	
Void ratio	1.2299	0.9274	
Saturation, %	96.6	99.7	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

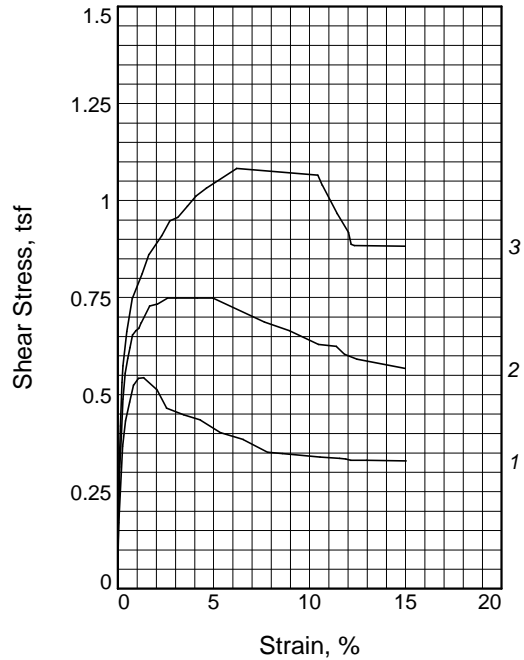
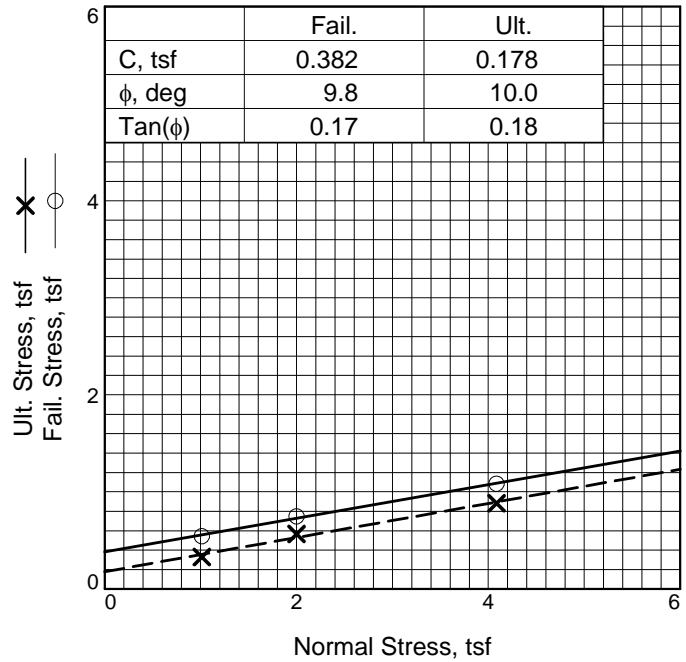
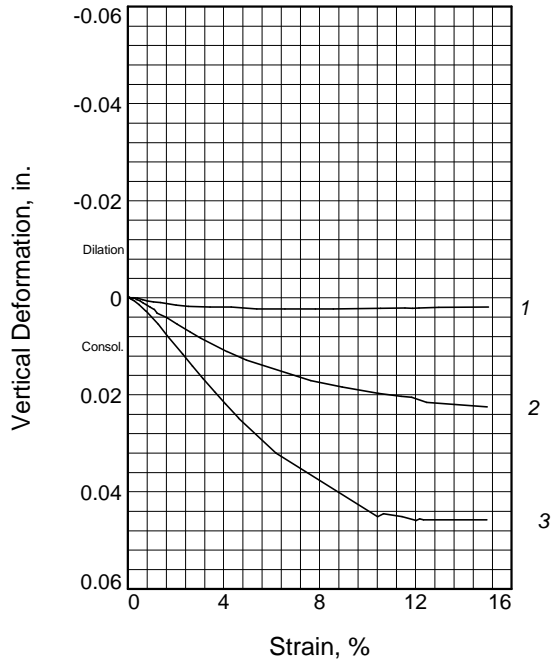
Fail. Stress = 1.465 tsf at reading no. 21

Ult. Stress = 1.292 tsf at reading no. 29

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0214	0.000	0.0	0.0	0.000	0.0356
1	0.0215	5.600	5.6	0.0	0.088	0.0356
2	0.0220	12.200	12.2	0.0	0.192	0.0356
3	0.0226	17.400	17.4	0.1	0.274	0.0355
4	0.0234	23.600	23.6	0.1	0.372	0.0354
5	0.0244	29.000	29.0	0.1	0.457	0.0353
6	0.0256	33.300	33.3	0.2	0.525	0.0352
7	0.0270	38.700	38.7	0.2	0.610	0.0349
8	0.0290	42.100	42.1	0.3	0.663	0.0346
9	0.0320	46.400	46.4	0.4	0.731	0.0340
10	0.0350	49.500	49.5	0.6	0.780	0.0333
11	0.0380	51.500	51.5	0.7	0.812	0.0326
12	0.0430	55.200	55.2	0.9	0.870	0.0313
13	0.0500	59.900	59.9	1.2	0.944	0.0294
14	0.0622	65.400	65.4	1.7	1.031	0.0262
15	0.0710	68.500	68.5	2.1	1.079	0.0241
16	0.0840	74.700	74.7	2.6	1.177	0.0211
17	0.1000	79.300	79.3	3.3	1.250	0.0176
18	0.1210	85.500	85.5	4.1	1.347	0.0142
19	0.1403	89.300	89.3	4.9	1.407	0.0114
20	0.1620	91.600	91.6	5.8	1.443	0.0090
21	0.1800	93.000	93.0	6.6	1.465	0.0074
22	0.2442	87.000	87.0	9.2	1.371	0.0041

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
23	0.2577	85.500	85.5	9.8	1.347	0.0036
24	0.2746	83.800	83.8	10.5	1.320	0.0032
25	0.2900	83.000	83.0	11.1	1.308	0.0029
26	0.3030	82.700	82.7	11.7	1.303	0.0025
27	0.3200	82.500	82.5	12.4	1.300	0.0022
28	0.3500	82.000	82.0	13.6	1.292	0.0019
29	0.3820	82.000	82.0	15.0	1.292	0.0017



Sample No.	1	2	3	
Initial	Water Content, %	47.5	47.3	54.4
	Dry Density, pcf	73.7	74.1	68.4
	Saturation, %	99.2	99.9	100.0
	Void Ratio	1.3003	1.2850	1.4760
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.99	1.00	1.00
At Test	Water Content, %	46.7	45.0	45.3
	Dry Density, pcf	74.7	76.3	76.0
	Saturation, %	99.9	99.9	100.0
	Void Ratio	1.2679	1.2213	1.2299
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.98	0.90
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.544	0.748	1.083	
Strain, %	1.4	2.6	6.2	
Ult. Stress, tsf	0.329	0.567	0.882	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 81 **PL=** 20 **PI=** 61

Assumed Specific Gravity= 2.714

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTM D3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-13, Fargo, Argusville Formation

Sample Number: Boring 09-25MU, #5 **Depth:** 66-68'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Argusville Formation
Depth: 66-68' **Sample Number:** Boring 09-25MU, #5
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.714 **LL=**81 **PL=**20 **PI=**61

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.330		158.430
Moisture content: Dry soil+tare, gms.	95.390		117.900
Moisture content: Tare, gms.	30.270		31.040
Moisture, %	47.5	46.7	46.7
Moist specimen weight, gms.	129.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	0.99	0.98	
Net decrease in height, in.		0.01	
Wet Density, pcf	108.6	109.6	
Dry density, pcf	73.7	74.7	
Void ratio	1.3003	1.2679	
Saturation, %	99.2	99.9	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.544 tsf at reading no. 8
Ult. Stress = 0.329 tsf at reading no. 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0172	0.000	0.0	0.0	0.000	0.1078
1	0.0179	6.400	6.4	0.0	0.101	0.1078
2	0.0187	10.800	10.8	0.1	0.170	0.1078
3	0.0235	23.300	23.3	0.3	0.367	0.1078
4	0.0270	27.400	27.4	0.4	0.432	0.1077
5	0.0320	30.500	30.5	0.6	0.481	0.1074
6	0.0370	33.300	33.3	0.8	0.525	0.1071
7	0.0430	34.400	34.4	1.1	0.542	0.1069
8	0.0500	34.500	34.5	1.4	0.544	0.1068
9	0.0660	32.600	32.6	2.0	0.514	0.1063
10	0.0783	29.500	29.5	2.5	0.465	0.1060
11	0.1000	28.400	28.4	3.4	0.448	0.1059
12	0.1213	27.600	27.6	4.3	0.435	0.1059
13	0.1470	25.500	25.5	5.4	0.402	0.1055

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1752	24.400	24.4	6.6	0.384	0.1055
15	0.2060	22.300	22.3	7.8	0.351	0.1055
16	0.2240	22.100	22.1	8.6	0.348	0.1055
17	0.2715	21.500	21.5	10.5	0.339	0.1056
18	0.2960	21.300	21.3	11.6	0.336	0.1057
19	0.3037	21.200	21.2	11.9	0.334	0.1056
20	0.3101	21.000	21.0	12.1	0.331	0.1057
21	0.3300	21.000	21.0	13.0	0.331	0.1058
22	0.3800	20.900	20.9	15.0	0.329	0.1059

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	108.830		159.380
Moisture content: Dry soil+tare, gms.	83.750		119.390
Moisture content: Tare, gms.	30.750		30.460
Moisture, %	47.3	45.0	45.0
Moist specimen weight, gms.	131.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.03	
Wet Density, pcf	109.2	110.6	
Dry density, pcf	74.1	76.3	
Void ratio	1.2850	1.2213	
Saturation, %	99.9	99.9	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.748 tsf at reading no. 16

Ult. Stress = 0.567 tsf at reading no. 26

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0145	0.000	0.0	0.0	0.000	0.1386
1	0.0147	4.500	4.5	0.0	0.071	0.1386
2	0.0155	10.600	10.6	0.0	0.167	0.1386
3	0.0163	15.200	15.2	0.1	0.240	0.1387
4	0.0171	19.900	19.9	0.1	0.314	0.1386
5	0.0190	24.900	24.9	0.2	0.392	0.1385
6	0.0212	31.000	31.0	0.3	0.488	0.1385
7	0.0240	35.200	35.2	0.4	0.555	0.1382
8	0.0270	37.600	37.6	0.5	0.592	0.1379
9	0.0300	39.400	39.4	0.6	0.621	0.1375
10	0.0330	41.500	41.5	0.8	0.654	0.1372
11	0.0370	42.200	42.2	0.9	0.665	0.1367
12	0.0410	42.600	42.6	1.1	0.671	0.1362
13	0.0440	43.500	43.5	1.2	0.685	0.1354
14	0.0544	46.200	46.2	1.7	0.728	0.1344
15	0.0640	46.500	46.5	2.1	0.733	0.1332

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
16	0.0770	47.500	47.5	2.6	0.748	0.1316
17	0.0880	47.500	47.5	3.0	0.748	0.1303
18	0.1145	47.500	47.5	4.1	0.748	0.1275
19	0.1340	47.500	47.5	5.0	0.748	0.1257
20	0.1987	43.600	43.6	7.6	0.687	0.1215
21	0.2303	42.200	42.2	8.9	0.665	0.1202
22	0.2670	39.900	39.9	10.5	0.629	0.1189
23	0.2893	39.600	39.6	11.4	0.624	0.1183
24	0.3000	38.300	38.3	11.8	0.604	0.1181
25	0.3153	37.500	37.5	12.5	0.591	0.1170
26	0.3760	36.000	36.0	15.0	0.567	0.1161

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	104.540		145.840
Moisture content: Dry soil+tare, gms.	78.550		109.590
Moisture content: Tare, gms.	30.770		29.570
Moisture, %	54.4	45.3	45.3
Moist specimen weight, gms.	126.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.90	
Net decrease in height, in.		0.10	
Wet Density, pcf	105.6	110.4	
Dry density, pcf	68.4	76.0	
Void ratio	1.4760	1.2299	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

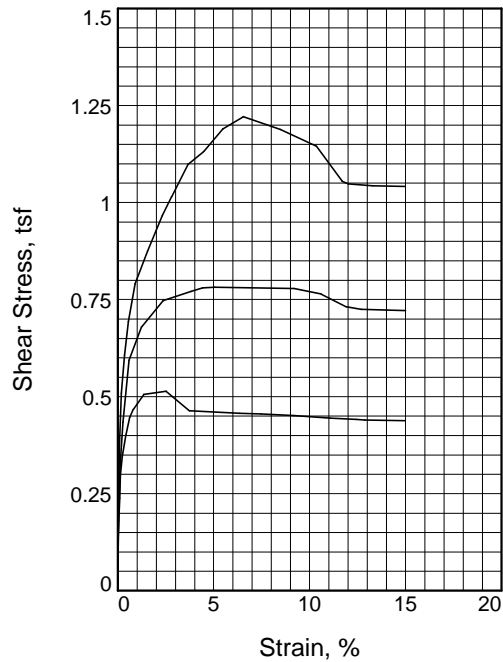
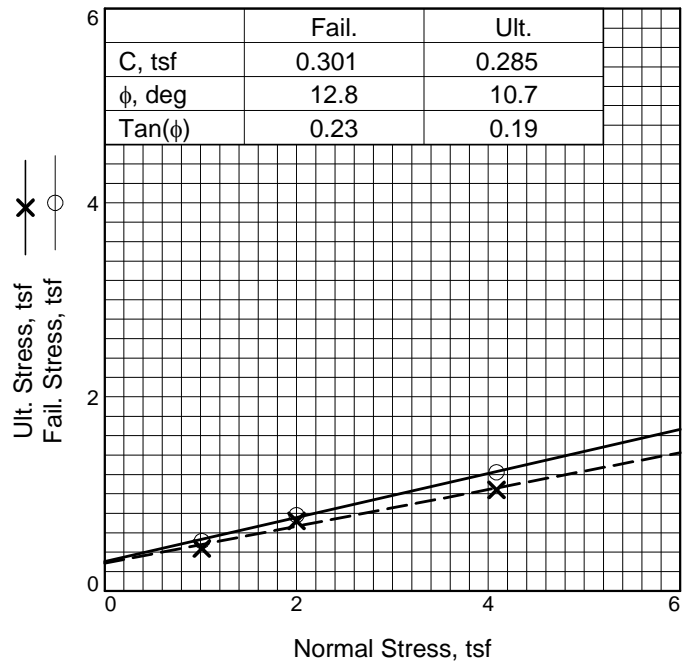
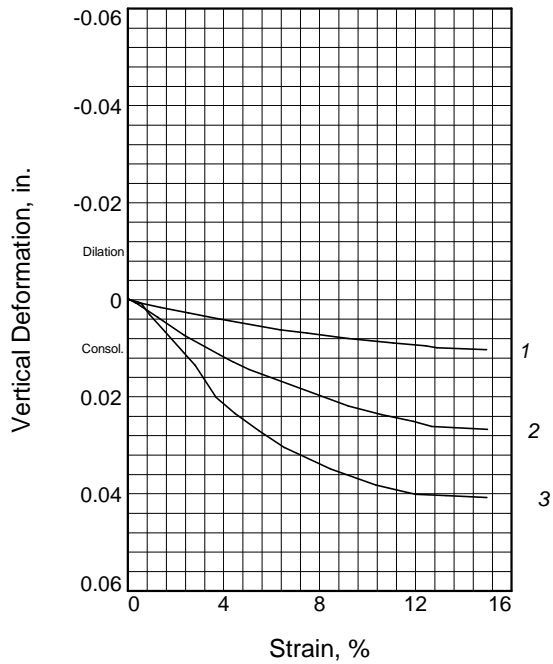
Fail. Stress = 1.083 tsf at reading no. 17

Ult. Stress = 0.882 tsf at reading no. 24

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0148	0.000	0.0	0.0	0.000	0.1229
1	0.0150	6.500	6.5	0.0	0.102	0.1229
2	0.0157	12.400	12.4	0.0	0.195	0.1228
3	0.0164	18.900	18.9	0.1	0.298	0.1229
4	0.0181	26.600	26.6	0.1	0.419	0.1226
5	0.0200	33.700	33.7	0.2	0.531	0.1224
6	0.0215	36.400	36.4	0.3	0.574	0.1222
7	0.0260	42.000	42.0	0.5	0.662	0.1215
8	0.0330	47.400	47.4	0.8	0.747	0.1202
9	0.0453	51.500	51.5	1.3	0.812	0.1174
10	0.0540	54.600	54.6	1.6	0.860	0.1151
11	0.0700	57.700	57.7	2.3	0.909	0.1113
12	0.0800	60.100	60.1	2.7	0.947	0.1088
13	0.0903	60.700	60.7	3.1	0.956	0.1063

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1020	62.500	62.5	3.6	0.985	0.1035
15	0.1130	64.200	64.2	4.1	1.012	0.1010
16	0.1263	65.500	65.5	4.6	1.032	0.0981
17	0.1640	68.700	68.7	6.2	1.083	0.0909
18	0.2662	67.600	67.6	10.4	1.065	0.0778
19	0.2720	65.900	65.9	10.7	1.038	0.0784
20	0.2907	61.300	61.3	11.4	0.966	0.0778
21	0.3050	58.200	58.2	12.0	0.917	0.0770
22	0.3084	56.300	56.3	12.2	0.887	0.0773
23	0.3122	56.100	56.1	12.3	0.884	0.0771
24	0.3760	56.000	56.0	15.0	0.882	0.0771



Sample No.	1	2	3	
Initial	Water Content, %	44.8	46.3	49.7
	Dry Density, pcf	76.9	75.0	71.2
	Saturation, %	100.0	98.7	96.8
	Void Ratio	1.2314	1.2886	1.4113
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	0.99
At Test	Water Content, %	43.0	42.8	41.1
	Dry Density, pcf	78.5	78.5	80.5
	Saturation, %	99.6	99.3	99.8
	Void Ratio	1.1859	1.1863	1.1321
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.96	0.88
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.514	0.782	1.221	
Strain, %	2.5	5.1	6.5	
Ult. Stress, tsf	0.438	0.722	1.042	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 79 **PL=** 21 **PI=** 58

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

Figure DirectShear ASTMD3080

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-M-18, Moorhead, Argusville Formation

Sample Number: Boring 09-34MU, #4 **Depth:** 56-58'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, Argusville Formation
Depth: 56-58' **Sample Number:** Boring 09-34MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=79** **PL=21** **PI=58**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	136.510		161.690
Moisture content: Dry soil+tare, gms.	103.810		122.200
Moisture content: Tare, gms.	30.800		30.260
Moisture, %	44.8	43.0	43.0
Moist specimen weight, gms.	133.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	111.4	112.3	
Dry density, pcf	76.9	78.5	
Void ratio	1.2314	1.1859	
Saturation, %	100.0	99.6	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.514 tsf at reading no. 11
Ult. Stress = 0.438 tsf at reading no. 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0091	0.000	0.0	0.0	0.000	0.1569
1	0.0092	3.400	3.4	0.0	0.054	0.1570
2	0.0098	8.600	8.6	0.0	0.136	0.1570
3	0.0104	11.500	11.5	0.1	0.181	0.1570
4	0.0115	15.100	15.1	0.1	0.238	0.1569
5	0.0125	18.900	18.9	0.1	0.298	0.1568
6	0.0147	22.000	22.0	0.2	0.347	0.1567
7	0.0194	25.400	25.4	0.4	0.400	0.1564
8	0.0240	28.300	28.3	0.6	0.446	0.1561
9	0.0287	29.600	29.6	0.8	0.466	0.1559
10	0.0420	32.100	32.1	1.4	0.506	0.1553
11	0.0701	32.600	32.6	2.5	0.514	0.1542
12	0.0993	29.400	29.4	3.7	0.463	0.1530
13	0.1624	29.000	29.0	6.4	0.457	0.1507

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1893	28.900	28.9	7.5	0.455	0.1500
15	0.2305	28.600	28.6	9.2	0.451	0.1489
16	0.2760	28.200	28.2	11.1	0.444	0.1480
17	0.3090	28.000	28.0	12.4	0.441	0.1474
18	0.3200	27.900	27.9	12.9	0.440	0.1470
19	0.3700	27.800	27.8	15.0	0.438	0.1466

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	126.490		156.510
Moisture content: Dry soil+tare, gms.	96.170		118.820
Moisture content: Tare, gms.	30.620		30.830
Moisture, %	46.3	42.8	42.8
Moist specimen weight, gms.	131.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	109.7	112.2	
Dry density, pcf	75.0	78.5	
Void ratio	1.2886	1.1863	
Saturation, %	98.7	99.3	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.782 tsf at reading no. 10

Ult. Stress = 0.722 tsf at reading no. 15

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0140	0.000	0.0	0.0	0.000	0.1482
1	0.0142	3.400	3.4	0.0	0.054	0.1481
2	0.0152	12.700	12.7	0.0	0.200	0.1481
3	0.0170	20.300	20.3	0.1	0.320	0.1481
4	0.0204	27.500	27.5	0.3	0.433	0.1478
5	0.0280	37.700	37.7	0.6	0.594	0.1468
6	0.0440	43.100	43.1	1.2	0.679	0.1446
7	0.0709	47.400	47.4	2.4	0.747	0.1409
8	0.1061	48.900	48.9	3.8	0.771	0.1369
9	0.1207	49.500	49.5	4.4	0.780	0.1353
10	0.1360	49.600	49.6	5.1	0.782	0.1338
11	0.2358	49.400	49.4	9.2	0.778	0.1263
12	0.2694	48.500	48.5	10.6	0.764	0.1245
13	0.3012	46.400	46.4	11.9	0.731	0.1231
14	0.3200	46.000	46.0	12.7	0.725	0.1221
15	0.3760	45.800	45.8	15.0	0.722	0.1215

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	113.770		147.150
Moisture content: Dry soil+tare, gms.	86.010		113.350
Moisture content: Tare, gms.	30.120		31.120
Moisture, %	49.7	41.1	41.1
Moist specimen weight, gms.	127.0		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	0.99	0.88	
Net decrease in height, in.		0.12	
Wet Density, pcf	106.6	113.6	
Dry density, pcf	71.2	80.5	
Void ratio	1.4113	1.1321	
Saturation, %	96.8	99.8	

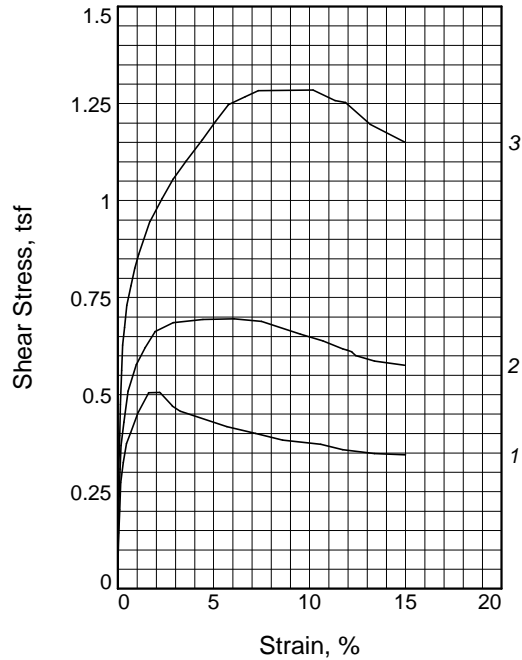
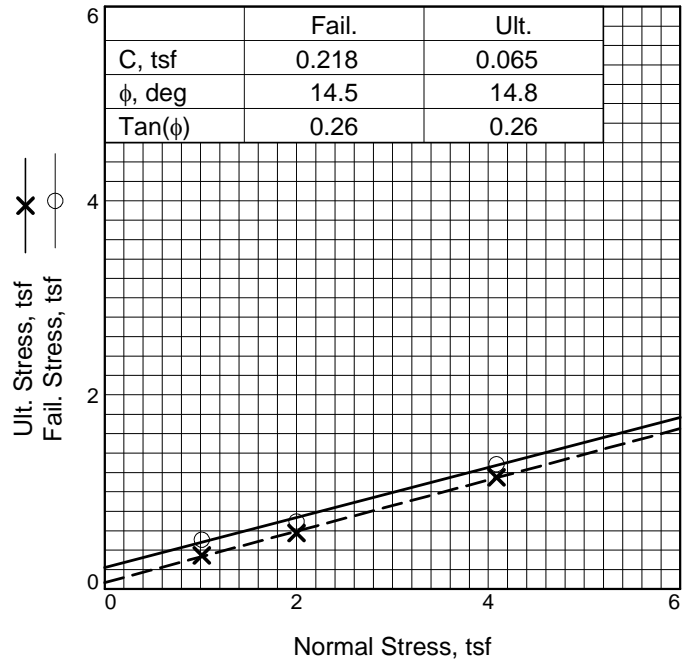
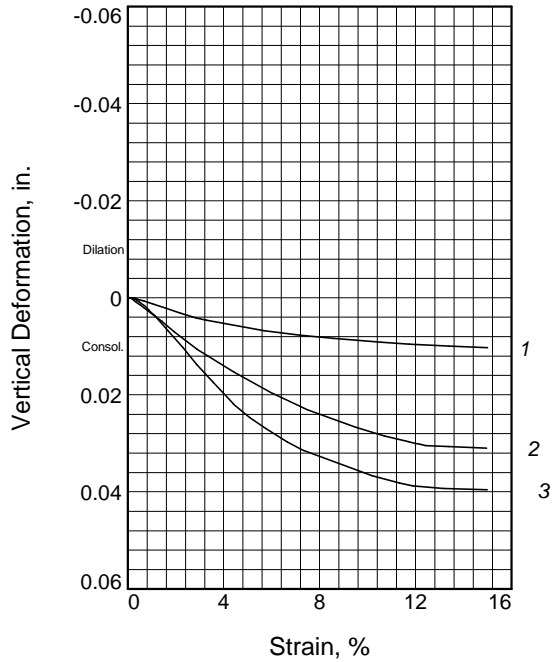
Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

Fail. Stress = 1.221 tsf at reading no. 13

Ult. Stress = 1.042 tsf at reading no. 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0207	0.000	0.0	0.0	0.000	0.0423
1	0.0217	13.900	13.9	0.0	0.219	0.0423
2	0.0230	23.700	23.7	0.1	0.373	0.0422
3	0.0252	32.300	32.3	0.2	0.509	0.0420
4	0.0293	38.500	38.5	0.4	0.607	0.0416
5	0.0342	44.000	44.0	0.6	0.693	0.0415
6	0.0427	50.200	50.2	0.9	0.791	0.0392
7	0.0581	55.500	55.5	1.6	0.875	0.0357
8	0.0769	61.300	61.3	2.3	0.966	0.0314
9	0.0883	64.400	64.4	2.8	1.015	0.0288
10	0.1089	69.700	69.7	3.7	1.098	0.0223
11	0.1287	71.800	71.8	4.5	1.131	0.0189
12	0.1526	75.500	75.5	5.5	1.190	0.0153
13	0.1784	77.500	77.5	6.5	1.221	0.0118
14	0.2250	75.400	75.4	8.5	1.188	0.0074
15	0.2703	72.700	72.7	10.3	1.146	0.0041
16	0.3030	66.900	66.9	11.7	1.054	0.0025
17	0.3105	66.500	66.5	12.0	1.048	0.0022
18	0.3410	66.200	66.2	13.3	1.043	0.0019
19	0.3820	66.100	66.1	15.0	1.042	0.0015



Sample No.	1	2	3	
Initial	Water Content, %	47.9	47.3	48.9
	Dry Density, pcf	74.0	73.3	72.4
	Saturation, %	99.8	96.9	98.0
	Void Ratio	1.3194	1.3435	1.3725
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	46.2	44.8	40.6
	Dry Density, pcf	75.5	76.5	80.9
	Saturation, %	99.7	98.9	99.7
	Void Ratio	1.2734	1.2454	1.1213
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.96	0.89
Normal Stress, tsf	1.011	2.000	4.084	
Fail. Stress, tsf	0.506	0.695	1.284	
Strain, %	2.2	6.1	10.2	
Ult. Stress, tsf	0.345	0.575	1.150	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	N/A	N/A	N/A	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY with a trace of gravel, brown (CH)
LL= 76 **PL=** 20 **PI=** 56
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min.

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-M-11, Moorhead, Argusville Formation
Sample Number: Boring 09-53MU, #3 **Depth:** 68-70'
Proj. No.: BL-09-03127 **Date Sampled:**

Figure DirectShear ASTM D3080



DIRECT SHEAR TEST

11/16/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-11, Moorhead, Argusville Formation
Depth: 68-70' **Sample Number:** Boring 09-53MU, #3
Description: FAT CLAY with a trace of gravel, brown (CH)
Remarks: The rate of strain is 0.00096 in/min.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=76** **PL=20** **PI=56**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	139.810		160.240
Moisture content: Dry soil+tare, gms.	104.500		119.550
Moisture content: Tare, gms.	30.740		31.430
Moisture, %	47.9	46.2	46.2
Moist specimen weight, gms.	130.9		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	109.4	110.4	
Dry density, pcf	74.0	75.5	
Void ratio	1.3194	1.2734	
Saturation, %	99.8	99.7	

Test Readings for Specimen No. 1

Normal stress = 1.011 tsf
Fail. Stress = 0.506 tsf at reading no. 10
Ult. Stress = 0.345 tsf at reading no. 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0112	0.000	0.0	0.0	0.000	0.1033
1	0.0119	5.500	5.5	0.0	0.087	0.1033
2	0.0126	9.100	9.1	0.1	0.143	0.1033
3	0.0138	12.900	12.9	0.1	0.203	0.1033
4	0.0149	17.300	17.3	0.2	0.273	0.1033
5	0.0182	20.600	20.6	0.3	0.325	0.1032
6	0.0222	23.700	23.7	0.5	0.373	0.1029
7	0.0275	25.500	25.5	0.7	0.402	0.1026
8	0.0369	28.900	28.9	1.1	0.455	0.1020
9	0.0500	32.000	32.0	1.6	0.504	0.1011
10	0.0640	32.100	32.1	2.2	0.506	0.1001
11	0.0798	29.900	29.9	2.8	0.471	0.0991
12	0.0900	29.000	29.0	3.3	0.457	0.0987
13	0.1485	26.500	26.5	5.7	0.418	0.0965

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
14	0.1844	25.400	25.4	7.2	0.400	0.0956
15	0.2185	24.300	24.3	8.6	0.383	0.0949
16	0.2663	23.600	23.6	10.6	0.372	0.0941
17	0.2943	22.700	22.7	11.7	0.358	0.0937
18	0.3340	22.100	22.1	13.4	0.348	0.0933
19	0.3730	21.900	21.9	15.0	0.345	0.0930

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	101.110		155.910
Moisture content: Dry soil+tare, gms.	78.670		116.990
Moisture content: Tare, gms.	31.270		30.130
Moisture, %	47.3	44.8	44.8
Moist specimen weight, gms.	129.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	107.9	110.7	
Dry density, pcf	73.3	76.5	
Void ratio	1.3435	1.2454	
Saturation, %	96.9	98.9	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Fail. Stress = 0.695 tsf at reading no. 13

Ult. Stress = 0.575 tsf at reading no. 22

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0122	0.000	0.0	0.0	0.000	0.1240
1	0.0124	4.400	4.4	0.0	0.069	0.1240
2	0.0130	9.900	9.9	0.0	0.156	0.1240
3	0.0140	15.100	15.1	0.1	0.238	0.1240
4	0.0150	19.500	19.5	0.1	0.307	0.1239
5	0.0165	23.400	23.4	0.2	0.369	0.1238
6	0.0200	27.200	27.2	0.3	0.429	0.1232
7	0.0250	32.300	32.3	0.5	0.509	0.1225
8	0.0357	36.700	36.7	1.0	0.578	0.1208
9	0.0463	39.400	39.4	1.4	0.621	0.1192
10	0.0589	42.000	42.0	1.9	0.662	0.1170
11	0.0820	43.500	43.5	2.9	0.685	0.1134
12	0.1193	44.000	44.0	4.4	0.693	0.1087
13	0.1582	44.100	44.1	6.1	0.695	0.1043
14	0.1930	43.700	43.7	7.5	0.689	0.1009
15	0.2419	41.600	41.6	9.5	0.656	0.0973
16	0.2703	40.500	40.5	10.7	0.638	0.0955
17	0.2950	39.200	39.2	11.7	0.618	0.0943
18	0.3009	39.000	39.0	12.0	0.615	0.0940

Test Readings for Specimen No. 2

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
19	0.3065	38.700	38.7	12.2	0.610	0.0938
20	0.3117	38.100	38.1	12.4	0.600	0.0935
21	0.3350	37.200	37.2	13.4	0.586	0.0933
22	0.3730	36.500	36.5	15.0	0.575	0.0930

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	120.060		149.050
Moisture content: Dry soil+tare, gms.	90.520		114.750
Moisture content: Tare, gms.	30.140		30.350
Moisture, %	48.9	40.6	40.6
Moist specimen weight, gms.	129.3		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.89	
Net decrease in height, in.		0.11	
Wet Density, pcf	107.8	113.8	
Dry density, pcf	72.4	80.9	
Void ratio	1.3725	1.1213	
Saturation, %	98.0	99.7	

Test Readings for Specimen No. 3

Normal stress = 4.084 tsf

Fail. Stress = 1.284 tsf at reading no. 23

Ult. Stress = 1.150 tsf at reading no. 27

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0136	0.000	0.0	0.0	0.000	0.1330
1	0.0137	4.900	4.9	0.0	0.077	0.1330
2	0.0140	10.400	10.4	0.0	0.164	0.1330
3	0.0145	14.400	14.4	0.0	0.227	0.1330
4	0.0150	19.600	19.6	0.1	0.309	0.1330
5	0.0159	25.000	25.0	0.1	0.394	0.1330
6	0.0169	30.100	30.1	0.1	0.474	0.1329
7	0.0185	35.700	35.7	0.2	0.563	0.1329
8	0.0197	39.800	39.8	0.3	0.627	0.1327
9	0.0222	42.700	42.7	0.4	0.673	0.1325
10	0.0250	46.300	46.3	0.5	0.730	0.1322
11	0.0300	49.500	49.5	0.7	0.780	0.1314
12	0.0350	52.400	52.4	0.9	0.826	0.1304
13	0.0400	54.600	54.6	1.1	0.860	0.1294
14	0.0540	60.000	60.0	1.7	0.945	0.1262
15	0.0690	63.800	63.8	2.3	1.005	0.1227
16	0.0829	66.900	66.9	2.9	1.054	0.1192
17	0.0995	69.900	69.9	3.6	1.101	0.1155
18	0.1200	73.400	73.4	4.4	1.157	0.1111
19	0.1362	76.400	76.4	5.1	1.204	0.1083
20	0.1524	79.100	79.1	5.8	1.246	0.1061

Test Readings for Specimen No. 3

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
21	0.1740	80.400	80.4	6.7	1.267	0.1033
22	0.1905	81.400	81.4	7.3	1.283	0.1015
23	0.2592	81.500	81.5	10.2	1.284	0.0963
24	0.2870	79.800	79.8	11.3	1.257	0.0948
25	0.3003	79.500	79.5	11.9	1.253	0.0942
26	0.3310	75.900	75.9	13.2	1.196	0.0937
27	0.3750	73.000	73.0	15.0	1.150	0.0934

Direct Shear Test

ASTM: D3080

Job No.: 7577

Project: Fargo-Moorhead Metro Feasibility Project - # W912ES-10-T-0095

Boring No.: 10-78MU Sample No. 3 Depth: 55 - 57 (Bot)

Location: Fargo ND Wild Rice Sample Type: 5T

Soil Type: Fat Clay w/a few pockets of Silt (CH) Argusville

Test Date: 8/13/2010

Date Reported: 8/19/2010

Shear Rate

0.000378 (in/min)

Remarks: Specimens trimmed to given sizes; Inundated after applying normal load; Allowed to consolidate for about 3-16 Hrs.; Sheared to given displacements at constant rate of 0.000378"/min..

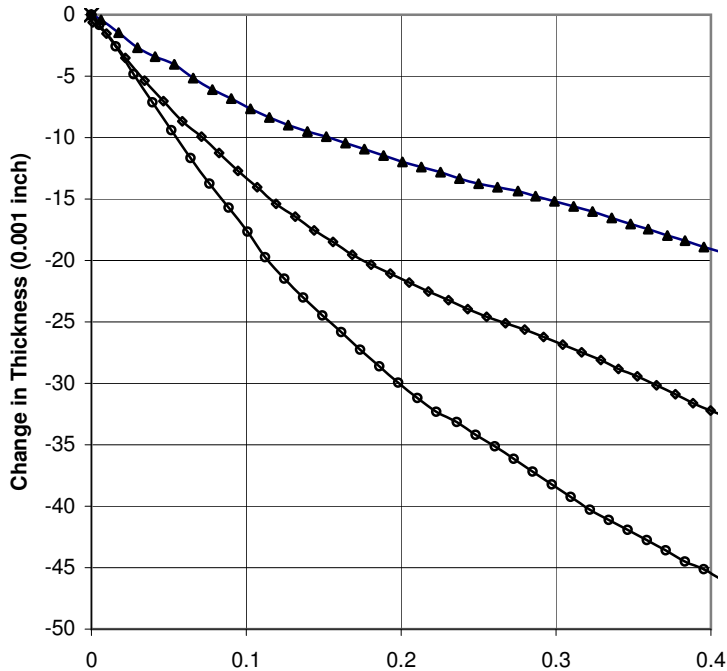
Liquid Limit: **63.8**

Plastic Limit: **23.1**

Plasticity Index: **40.7**

Specific Gravity (*): **2.78**

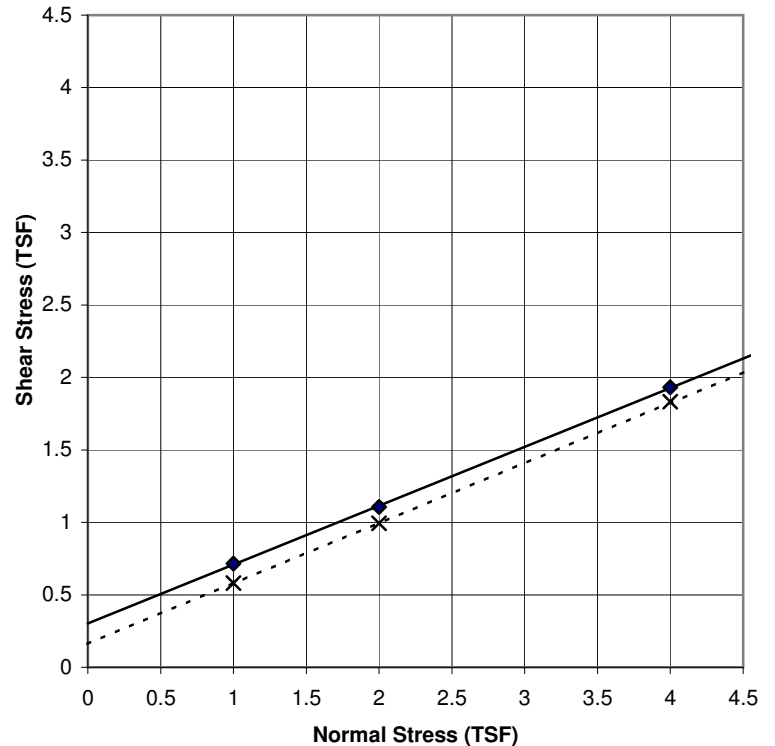
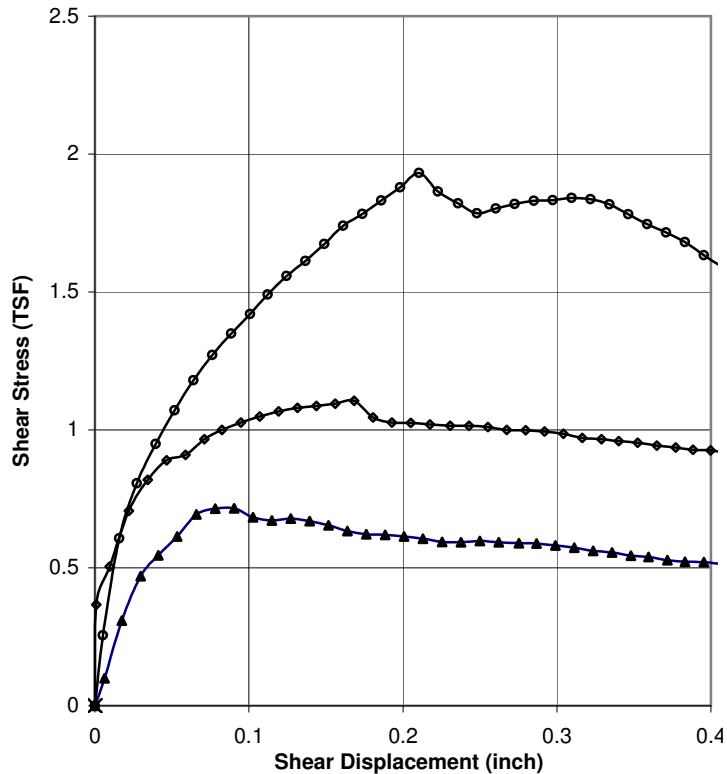
(*) = Assumed Specific Gravity



Failure Criterion:				
Max. Shear Stress	A	B	C	D
Initial	▲	◇	○	X
Diameter (In.)	2.50	2.50	2.50	
Thickness (In.)	0.72	0.72	0.72	
Water Content (%)	43.3	42.3	46.6	
Dry Density (pcf)	76.2	77.9	75.4	
<i>Before Shear</i>				
Thickness (In.)	0.69	0.68	0.65	
Water Content (%)	42.9	39.8	38.4	
Dry Density (pcf)	79.1	82.4	83.9	
<i>After Shear</i>				
Normal Stress	1.00	2.00	4.00	
Shear Stress	0.72	1.11	1.93	

"These tests are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design."

Peak Conditions		At Given Shear Disp. Of: 0.3	
Friction Angle: $\phi =$	22.1 deg.	Friction Angle: $\phi =$	22.6 deg.
Apparent Cohesion	0.303 TSF	Apparent Cohesion	0.161 TSF

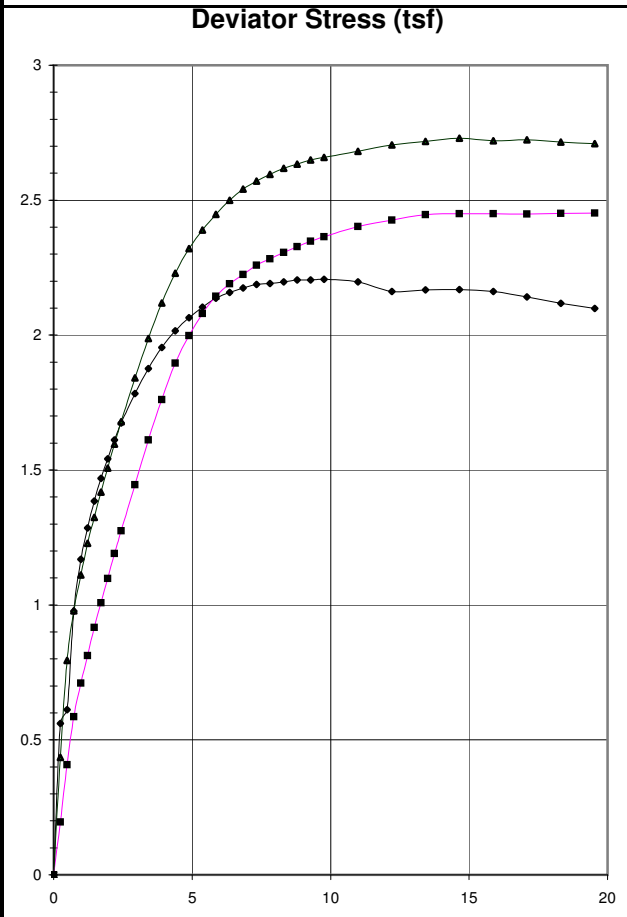


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

Date: 8/24/10

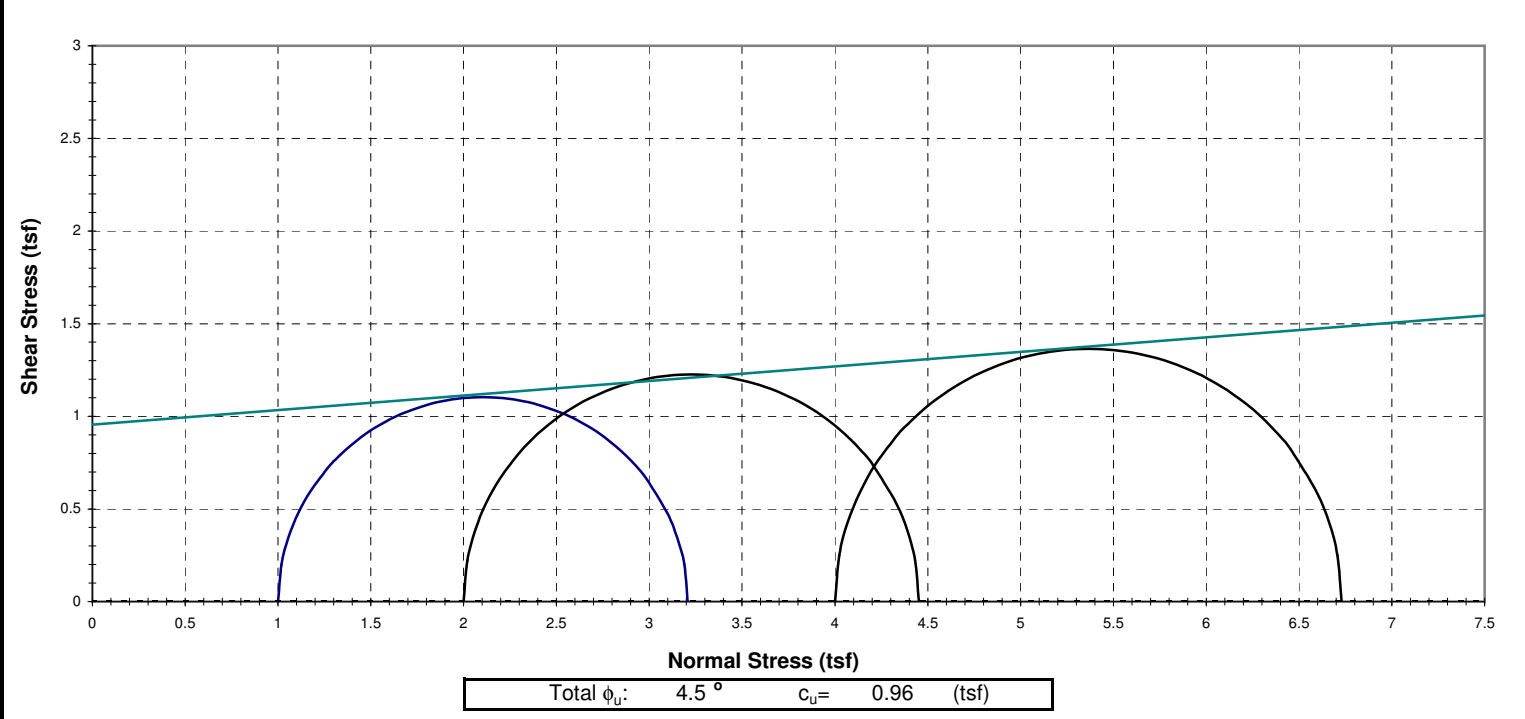
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid.)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few Laminations of Silt, Slightly Blocky (CH) Alluvium**



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi_u = 4.5^\circ$	
Apparent Cohesion, $c_u = 0.96$ (tsf)	
Test Date: 8/19/10	Liquid Limit: 51.8
Test Type: U-U	Plastic Limit: 20.5
Strain Rate (in/min): 0.05	Plasticity Index: 31.3
Strain Rate (%/min): 1.221	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10
Dry Density (pcf)	27.5 28.2 29.1
Void Ratio	96.1 95.0 93.8
	0.81 0.83 0.85
After Consolidation	
Diameter (in)	
Height (in)	
Water Content (%)	
Dry Density (pcf)	
Void Ratio	
Back Pressure (tsf)	
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	2.21 2.45 2.73
Ultimate Deviator Stress (tsf)	2.10 2.45 2.71
Deviator Stress at Failure (tsf)	2.21 2.45 2.73
Max. Pore Pressure Buildup (tsf)	-----
Pore Pressure Parameter "B"	-----
Pct. Axial Strain at Failure	9.8 19.5 14.7

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

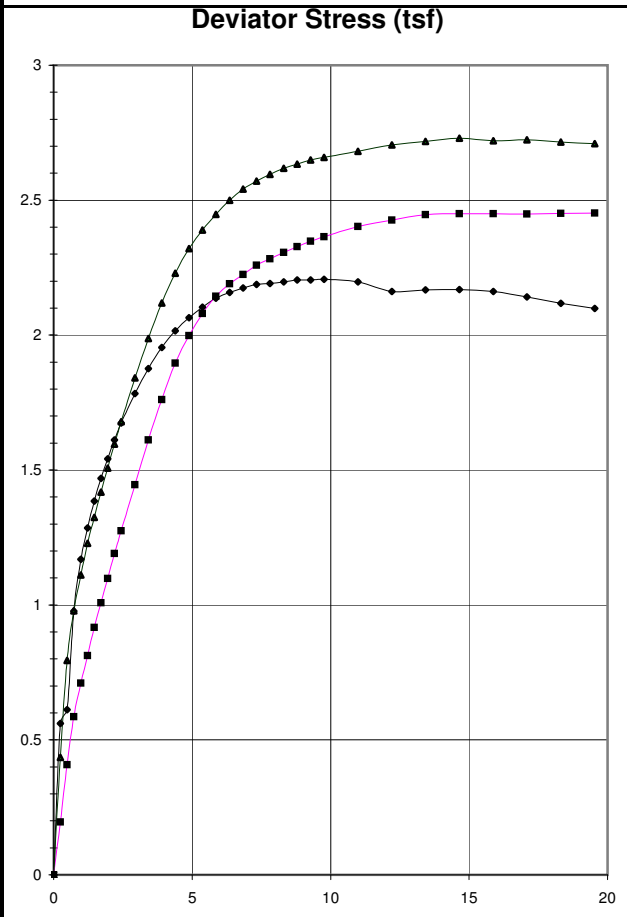


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

Date: 8/24/10

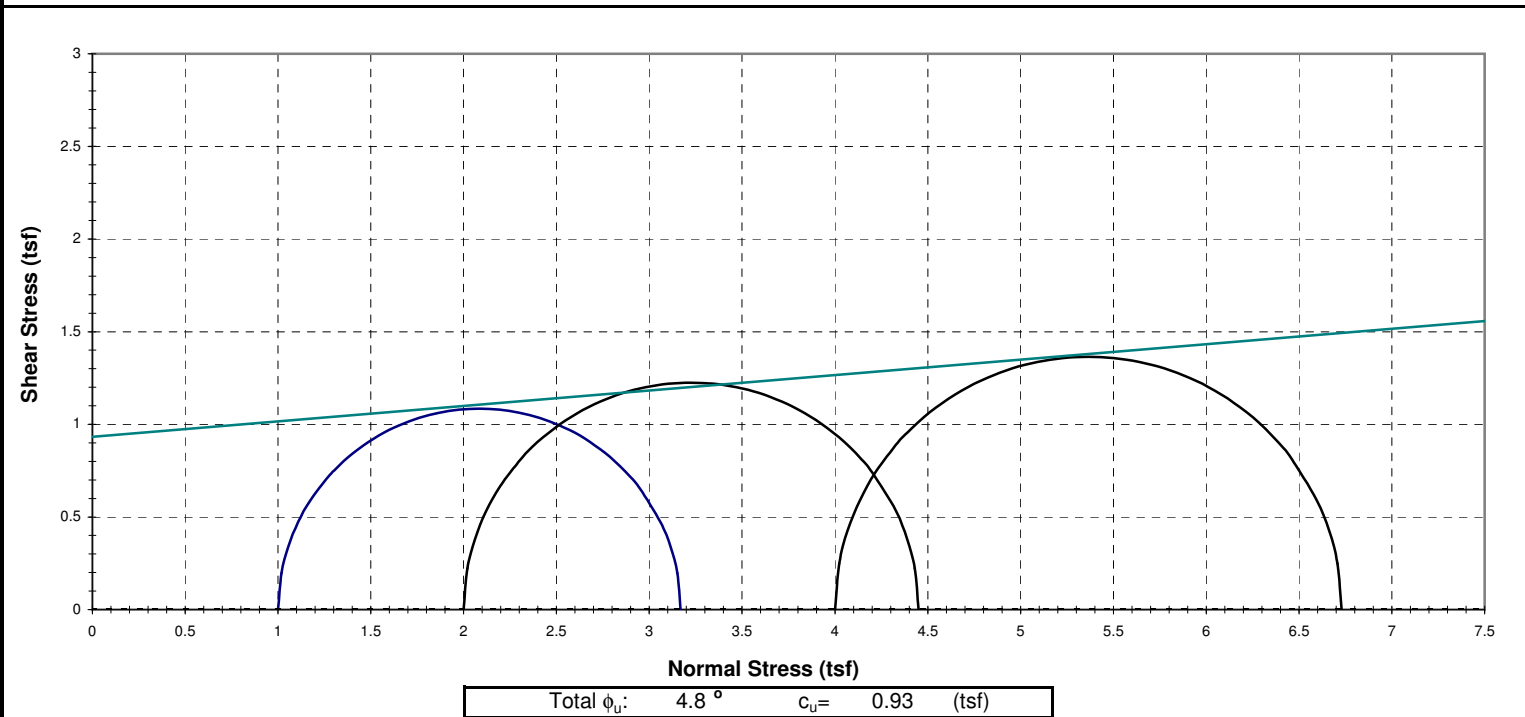
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **20 - 22 (Mid.)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few Laminations of Silt, Slightly Blocky (CH) Alluvium**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 4.8^\circ$				
		Apparent Cohesion, $c_u = 0.93$ (tsf)				
Test Date:	8/19/10	Liquid Limit:	51.8			
Test Type:	U-U	Plastic Limit:	20.5			
Strain Rate (in/min):	0.05	Plasticity Index:	31.3			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.78			
Before Consolidation		A	B	C	D	E
Diameter (in)	1.94	1.94	1.94			
Height (in)	4.10	4.10	4.10			
Water Content (%)	27.5	28.2	29.1			
Dry Density (pcf)	96.1	95.0	93.8			
Void Ratio	0.81	0.83	0.85			
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)	1.00	2.00	4.00			
Max. Deviator Stress (tsf)	2.21	2.45	2.73			
Ultimate Deviator Stress (tsf)	2.10	2.45	2.71			
Deviator Stress at Failure (tsf)	2.17	2.45	2.73			
Max. Pore Pressure Buildup (tsf)	-----	-----	-----			
Pore Pressure Parameter "B"	-----	-----	-----			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Total ϕ_u : 4.8° $c_u = 0.93$ (tsf)



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-79MU, Sample No.: 1, Depth (ft.): 20 - 22 (Mid.)

Sample 1	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.56
0.49	0.61
0.73	0.98
0.98	1.17
1.22	1.29
1.47	1.39
1.71	1.47
1.95	1.54
2.20	1.61
2.44	1.67
2.93	1.78
3.42	1.88
3.91	1.95
4.40	2.02
4.88	2.06
5.37	2.10
5.86	2.14
6.35	2.16
6.84	2.17
7.33	2.19
7.81	2.19
8.30	2.20
8.79	2.20
9.28	2.20
9.77	2.21
10.99	2.20
12.21	2.16
13.43	2.17
14.65	2.17
15.87	2.16
17.09	2.14
18.32	2.12
19.54	2.10

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.20
0.49	0.41
0.73	0.59
0.98	0.71
1.22	0.81
1.47	0.92
1.71	1.01
1.95	1.10
2.20	1.19
2.44	1.27
2.93	1.45
3.42	1.61
3.91	1.76
4.40	1.90
4.88	2.00
5.37	2.08
5.86	2.14
6.35	2.19
6.84	2.22
7.33	2.26
7.81	2.28
8.30	2.31
8.79	2.33
9.28	2.35
9.77	2.36
10.99	2.40
12.21	2.43
13.43	2.45
14.65	2.45
15.87	2.45
17.09	2.45
18.32	2.45
19.54	2.45

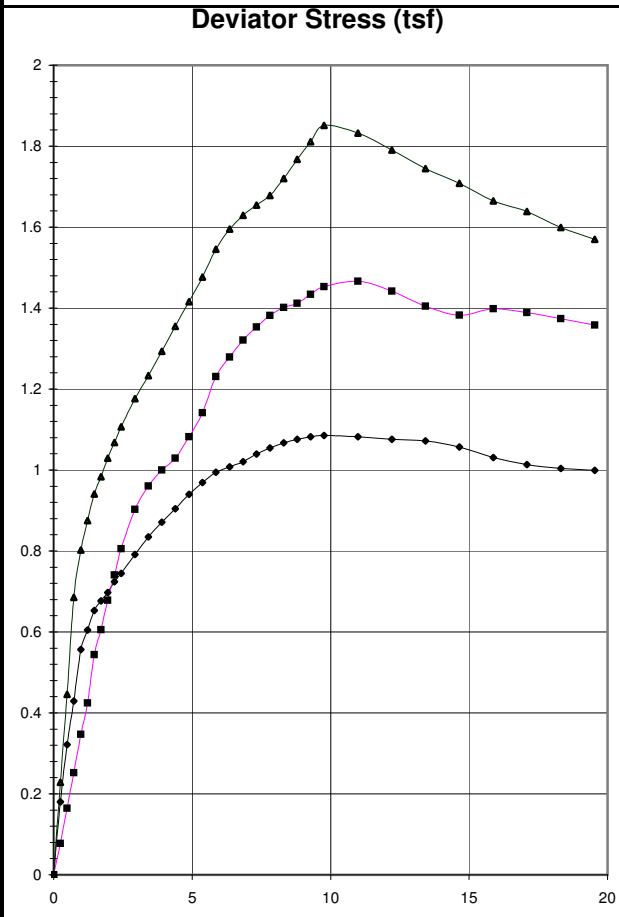
Sample 3	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.43
0.49	0.79
0.73	0.98
0.98	1.11
1.22	1.23
1.47	1.33
1.71	1.42
1.95	1.51
2.20	1.60
2.44	1.68
2.93	1.84
3.42	1.99
3.91	2.12
4.40	2.23
4.88	2.32
5.37	2.39
5.86	2.45
6.35	2.50
6.84	2.54
7.33	2.57
7.81	2.60
8.30	2.62
8.79	2.63
9.28	2.65
9.77	2.66
10.99	2.68
12.21	2.70
13.43	2.72
14.65	2.73
15.87	2.72
17.09	2.72
18.32	2.72
19.54	2.71

TRIAXIAL TEST ASTM: D 2850

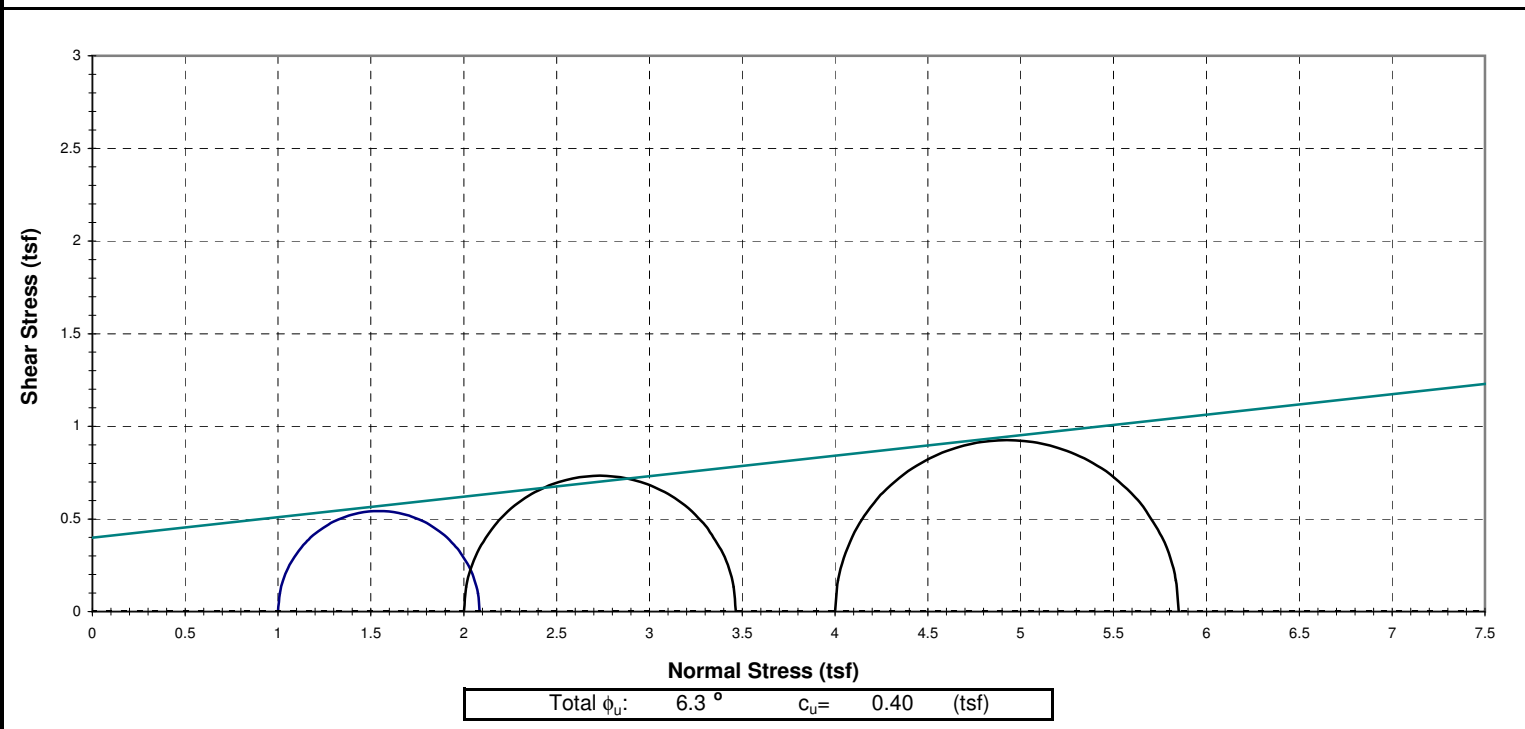
Job No. 7577
Date: 10/4/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi_u = 6.3^\circ$	
Apparent Cohesion, $c_u = 0.40$ (tsf)	
Test Date: 8/24/10	Liquid Limit: 28.2
Test Type: U-U	Plastic Limit: 17.1
Strain Rate (in/min): 0.05	Plasticity Index: 11.1
Strain Rate (%/min): 1.221	Spec. Gravity (Assumed): 2.67
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10 4.10 4.10
Dry Density (pcf)	27.7 26.7 25.9 25.9 25.9
Void Ratio	94.9 96.8 98.1 98.1 98.1
After Consolidation	
Diameter (in)	0.76 0.72 0.70 0.70 0.70
Height (in)	
Water Content (%)	
Dry Density (pcf)	
Void Ratio	
Back Pressure (tsf)	
Minor Principal Stress (tsf)	1.00 2.00 4.00 4.00 4.00
Max. Deviator Stress (tsf)	1.09 1.47 1.85 1.85 1.85
Ultimate Deviator Stress (tsf)	1.00 1.36 1.57 1.57 1.57
Deviator Stress at Failure (tsf)	1.09 1.47 1.85 1.85 1.85
Max. Pore Pressure Buildup (tsf)	----- ----- ----- ----- -----
Pore Pressure Parameter "B"	----- ----- ----- ----- -----
Pct. Axial Strain at Failure	9.8 11.0 9.8 9.8 9.8

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

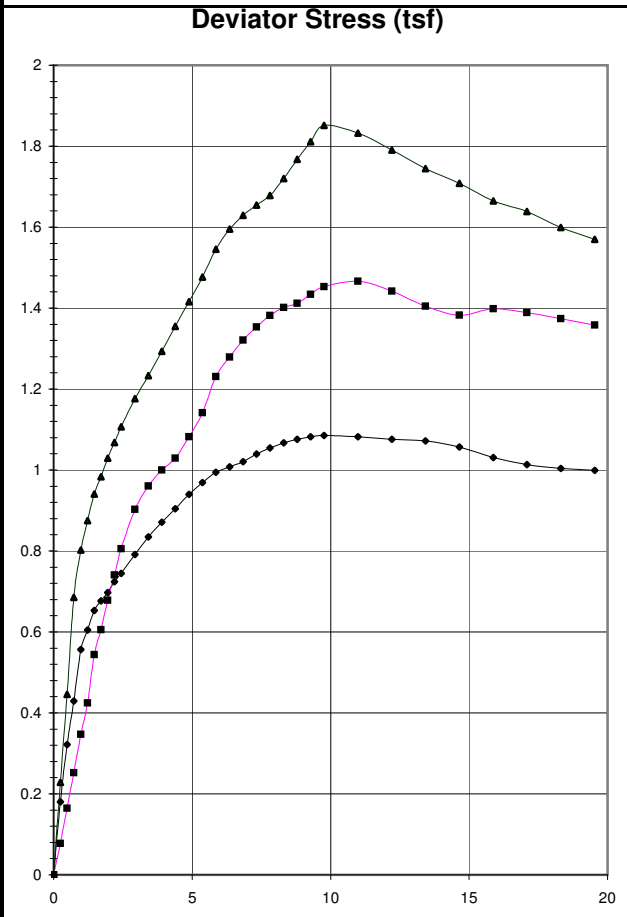


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

Date: 10/4/10

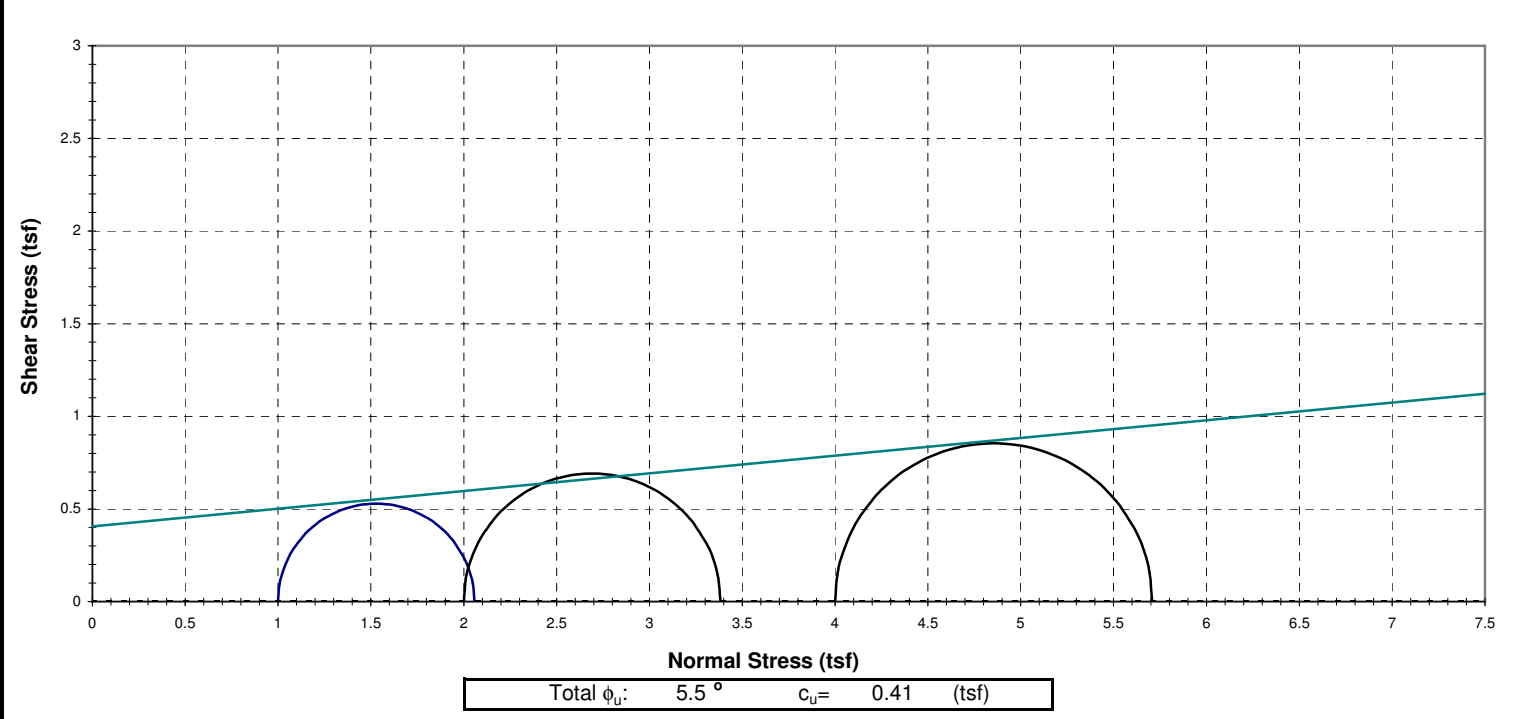
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **1** Type: **5T** Depth (ft): **23 - 25**
 Soil Type: **Silty Clay w/a few pockets of Silty Sand (CL-ML) Alluvium**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 5.5^\circ$				
		Apparent Cohesion, $c_u = 0.41$ (tsf)				
Test Date:	8/24/10	Liquid Limit:	28.2			
Test Type:	U-U	Plastic Limit:	17.1			
Strain Rate (in/min):	0.05	Plasticity Index:	11.1			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.67			
Before Consolidation		A	B	C	D	E
Diameter (in)	1.94	1.94	1.94			
Height (in)	4.10	4.10	4.10			
Water Content (%)	27.7	26.7	25.9			
Dry Density (pcf)	94.9	96.8	98.1			
Void Ratio	0.76	0.72	0.70			
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)	1.00	2.00	4.00			
Max. Deviator Stress (tsf)	1.09	1.47	1.85			
Ultimate Deviator Stress (tsf)	1.00	1.36	1.57			
Deviator Stress at Failure (tsf)	1.06	1.38	1.71			
Max. Pore Pressure Buildup (tsf)	-----	-----	-----			
Pore Pressure Parameter "B"	-----	-----	-----			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-80MU, Sample No.: 1, Depth (ft.): 23 - 25

Sample 1	
Strain (%)	Deviator Stress (tsf)

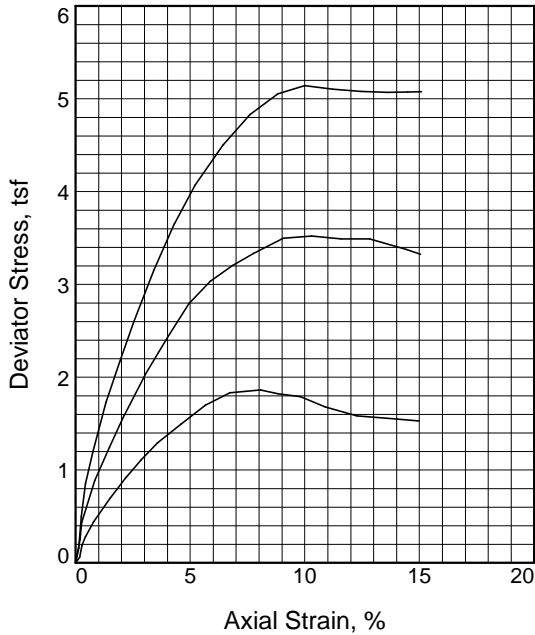
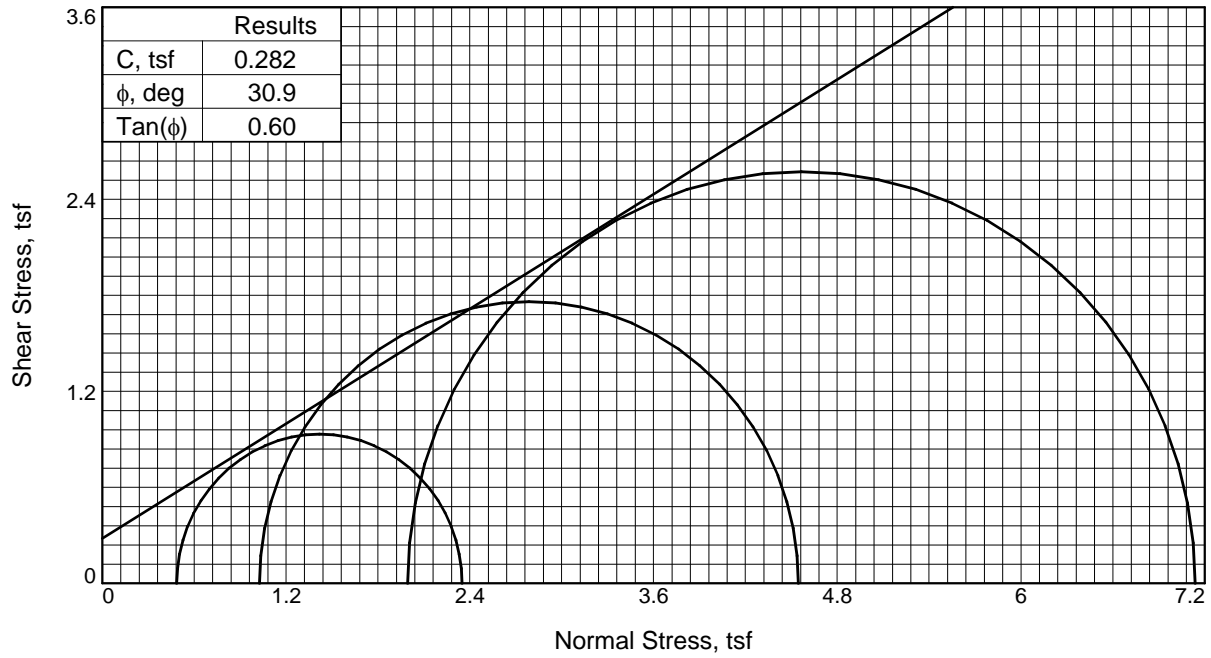
0.00	0.00
0.24	0.18
0.49	0.32
0.73	0.43
0.98	0.56
1.22	0.60
1.47	0.65
1.71	0.68
1.95	0.70
2.20	0.72
2.44	0.74
2.93	0.79
3.42	0.83
3.91	0.87
4.40	0.90
4.88	0.94
5.37	0.97
5.86	0.99
6.35	1.01
6.84	1.02
7.33	1.04
7.81	1.05
8.30	1.07
8.79	1.08
9.28	1.08
9.77	1.09
10.99	1.08
12.21	1.08
13.43	1.07
14.65	1.06
15.87	1.03
17.09	1.01
18.32	1.00
19.54	1.00

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.08
0.49	0.16
0.73	0.25
0.98	0.35
1.22	0.42
1.47	0.54
1.71	0.61
1.95	0.68
2.20	0.74
2.44	0.81
2.93	0.90
3.42	0.96
3.91	1.00
4.40	1.03
4.88	1.08
5.37	1.14
5.86	1.23
6.35	1.28
6.84	1.32
7.33	1.35
7.81	1.38
8.30	1.40
8.79	1.41
9.28	1.43
9.77	1.45
10.99	1.47
12.21	1.44
13.43	1.40
14.65	1.38
15.87	1.40
17.09	1.39
18.32	1.37
19.54	1.36

Sample 3	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.23
0.49	0.45
0.73	0.69
0.98	0.80
1.22	0.88
1.47	0.94
1.71	0.98
1.95	1.03
2.20	1.07
2.44	1.11
2.93	1.18
3.42	1.23
3.91	1.29
4.40	1.35
4.88	1.42
5.37	1.48
5.86	1.55
6.35	1.60
6.84	1.63
7.33	1.65
7.81	1.68
8.30	1.72
8.79	1.77
9.28	1.81
9.77	1.85
10.99	1.83
12.21	1.79
13.43	1.74
14.65	1.71
15.87	1.67
17.09	1.64
18.32	1.60
19.54	1.57



Sample No.	1	2	3	
Initial	Water Content, %	29.4	30.6	29.5
	Dry Density, pcf	94.4	92.7	94.8
	Saturation, %	98.9	98.9	100.0
	Void Ratio	0.8183	0.8513	0.8116
	Diameter, in.	1.43	1.43	1.43
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	29.8	31.0	29.5
	Dry Density, pcf	94.4	92.7	94.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8183	0.8513	0.8116
	Diameter, in.	1.43	1.43	1.43
	Height, in.	2.80	2.80	2.80
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.49	1.03	1.99	
Fail. Stress, tsf	1.86	3.52	5.14	
Ult. Stress, tsf	1.53	3.33	5.08	
σ_1 Failure, tsf	2.35	4.55	7.14	
σ_3 Failure, tsf	0.49	1.03	1.99	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: SILT, brown (ML)

LL= 31 PL= 23 PI= 8

Assumed Specific Gravity= 2.75

Remarks:

Figure UU Triax ASTM D2850

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

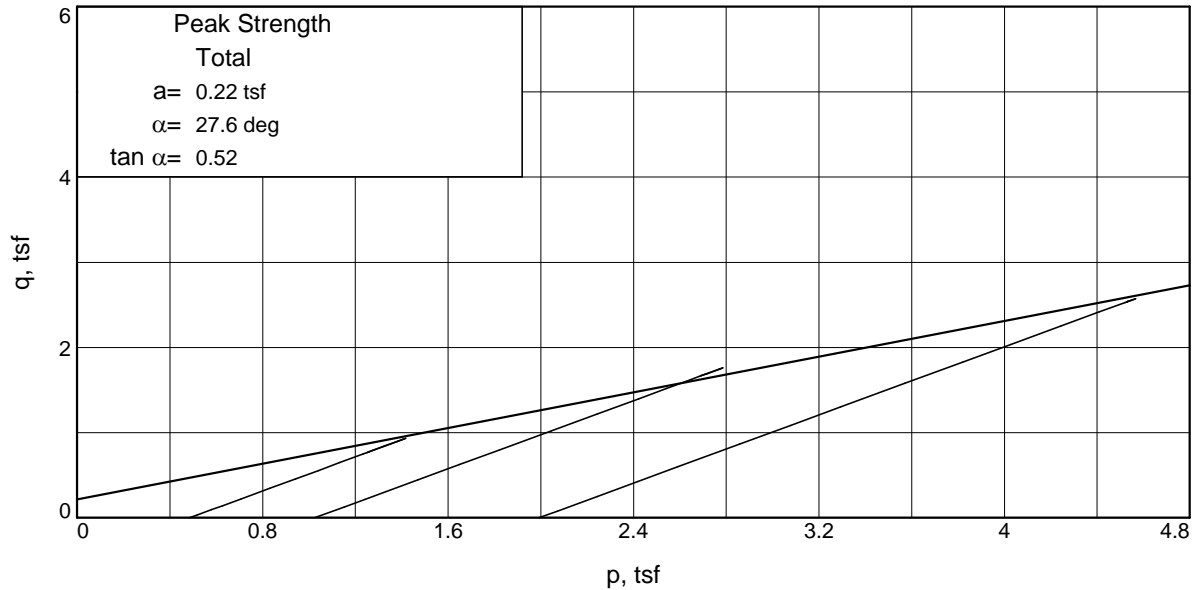
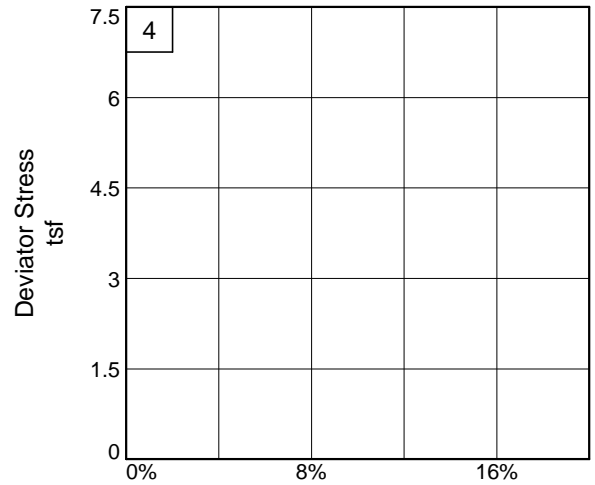
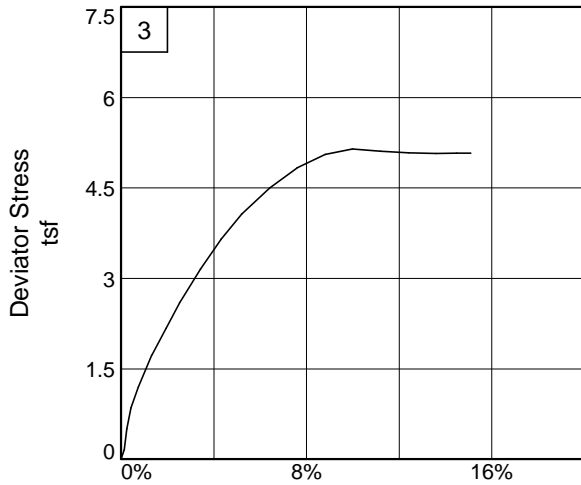
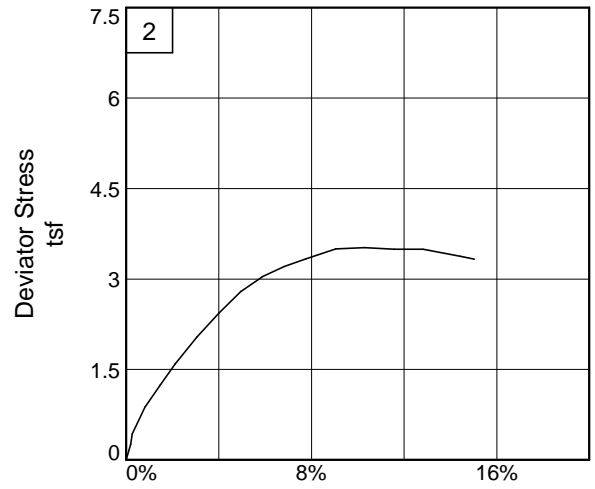
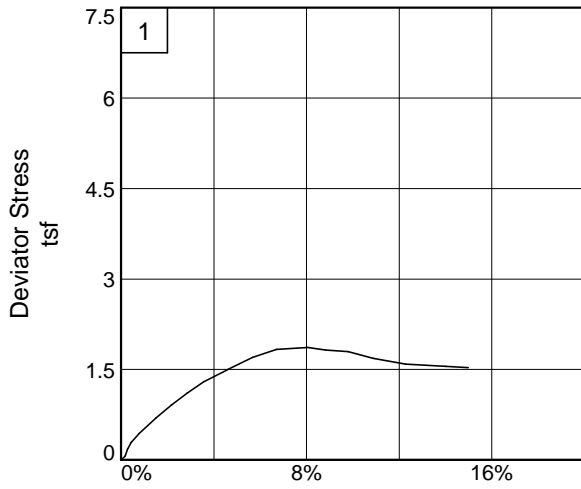
Sample Number: Boring 09-23MU, #3 **Depth:** 20-22'

Poplar River - West Fargo

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 20-22' **Sample Number:** Boring 09-23MU, #3

Project No.: BL-09-03127

Figure _____

Poplar River - West Fargo

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:48 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Fargo**
Depth: 20-22' **Sample Number:** Boring 09-23MU, #3
Description: SILT, brown (ML) **Poplar River - West Fargo**
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**31 **PL=**23 **PI=**8
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	105.030		172.980
Moisture content: Dry soil+tare, gms.	88.020		142.280
Moisture content: Tare, gms.	30.190		30.880
Moisture, %	29.4	29.8	27.6
Moist specimen weight, gms.	144.3		
Diameter, in.	1.43	1.43	
Area, in. ²	1.61	1.61	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	122.2	122.5	
Dry density, pcf	94.4	94.4	
Void ratio	0.8183	0.8183	
Saturation, %	98.9	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.486 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.863 tsf at reading no. 12
Ult. Stress = 1.529 tsf at reading no. 18

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6050	-0.310	0.0	0.0	0.000	0.486	0.486	1.00	0.486	0.000
1	-1.6000	1.100	1.4	0.2	0.063	0.486	0.549	1.13	0.518	0.032
2	-1.5970	3.900	4.2	0.3	0.188	0.486	0.674	1.39	0.580	0.094
3	-1.5930	6.060	6.4	0.4	0.284	0.486	0.770	1.59	0.628	0.142
4	-1.5830	9.640	10.0	0.8	0.443	0.486	0.929	1.91	0.707	0.221
5	-1.5630	15.400	15.7	1.5	0.694	0.486	1.180	2.43	0.833	0.347
6	-1.5440	20.550	20.9	2.2	0.915	0.486	1.401	2.88	0.943	0.457
7	-1.5250	25.200	25.5	2.9	1.111	0.486	1.597	3.29	1.041	0.555
8	-1.5050	29.600	29.9	3.6	1.293	0.486	1.779	3.66	1.133	0.647
9	-1.4760	34.700	35.0	4.6	1.497	0.486	1.983	4.08	1.235	0.749
10	-1.4460	39.900	40.2	5.7	1.700	0.486	2.186	4.50	1.336	0.850
11	-1.4170	43.500	43.8	6.7	1.832	0.486	2.318	4.77	1.402	0.916
12	-1.3790	44.900	45.2	8.1	1.863	0.486	2.349	4.83	1.418	0.932
13	-1.3575	44.300	44.6	8.8	1.823	0.486	2.309	4.75	1.398	0.912
14	-1.3300	44.000	44.3	9.8	1.791	0.486	2.277	4.69	1.382	0.896
15	-1.3000	41.800	42.1	10.9	1.682	0.486	2.168	4.46	1.327	0.841
16	-1.2610	40.000	40.3	12.3	1.585	0.486	2.071	4.26	1.279	0.793
17	-1.2120	39.900	40.2	14.0	1.550	0.486	2.036	4.19	1.261	0.775
18	-1.1850	39.800	40.1	15.0	1.529	0.486	2.015	4.15	1.250	0.764

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	80.800		169.360
Moisture content: Dry soil+tare, gms.	68.980		139.790
Moisture content: Tare, gms.	30.390		30.230
Moisture, %	30.6	31.0	27.0
Moist specimen weight, gms.	143.1		
Diameter, in.	1.43	1.43	
Area, in. ²	1.61	1.61	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	121.1	121.4	
Dry density, pcf	92.7	92.7	
Void ratio	0.8513	0.8513	
Saturation, %	98.9	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.026 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 3.521 tsf at reading no. 13

Ult. Stress = 3.327 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.3065	1.250	0.0	0.0	0.000	1.026	1.026	1.00	1.026	0.000
1	-1.3010	6.900	5.7	0.2	0.253	1.026	1.279	1.25	1.152	0.126
2	-1.2990	10.900	9.7	0.3	0.431	1.026	1.457	1.42	1.242	0.216
3	-1.2830	21.200	20.0	0.8	0.887	1.026	1.913	1.86	1.469	0.443
4	-1.2650	29.500	28.3	1.5	1.248	1.026	2.274	2.22	1.650	0.624
5	-1.2470	37.500	36.3	2.1	1.591	1.026	2.617	2.55	1.821	0.795
6	-1.2210	48.200	47.0	3.1	2.041	1.026	3.067	2.99	2.046	1.020
7	-1.1940	57.900	56.7	4.0	2.438	1.026	3.464	3.38	2.245	1.219
8	-1.1680	66.800	65.6	4.9	2.793	1.026	3.819	3.72	2.423	1.397
9	-1.1420	73.200	72.0	5.9	3.036	1.026	4.062	3.96	2.544	1.518
10	-1.1150	78.000	76.8	6.8	3.206	1.026	4.232	4.12	2.629	1.603
11	-1.0890	81.900	80.7	7.8	3.335	1.026	4.361	4.25	2.693	1.667
12	-1.0530	87.000	85.7	9.0	3.496	1.026	4.522	4.41	2.774	1.748
13	-1.0180	88.800	87.5	10.3	3.521	1.026	4.547	4.43	2.786	1.760
14	-0.9820	89.300	88.1	11.6	3.490	1.026	4.516	4.40	2.771	1.745
15	-0.9470	90.600	89.3	12.8	3.492	1.026	4.518	4.40	2.772	1.746
16	-0.9020	89.300	88.1	14.4	3.377	1.026	4.403	4.29	2.715	1.689
17	-0.8850	88.600	87.4	15.0	3.327	1.026	4.353	4.24	2.689	1.663

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	101.940		170.190
Moisture content: Dry soil+tare, gms.	85.750		141.450
Moisture content: Tare, gms.	30.890		30.260
Moisture, %	29.5	29.5	25.8
Moist specimen weight, gms.	145.8		
Diameter, in.	1.43	1.43	
Area, in. ²	1.62	1.62	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	122.7	122.7	
Dry density, pcf	94.8	94.8	
Void ratio	0.8116	0.8116	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 3

Cell pressure = 1.994 tsf

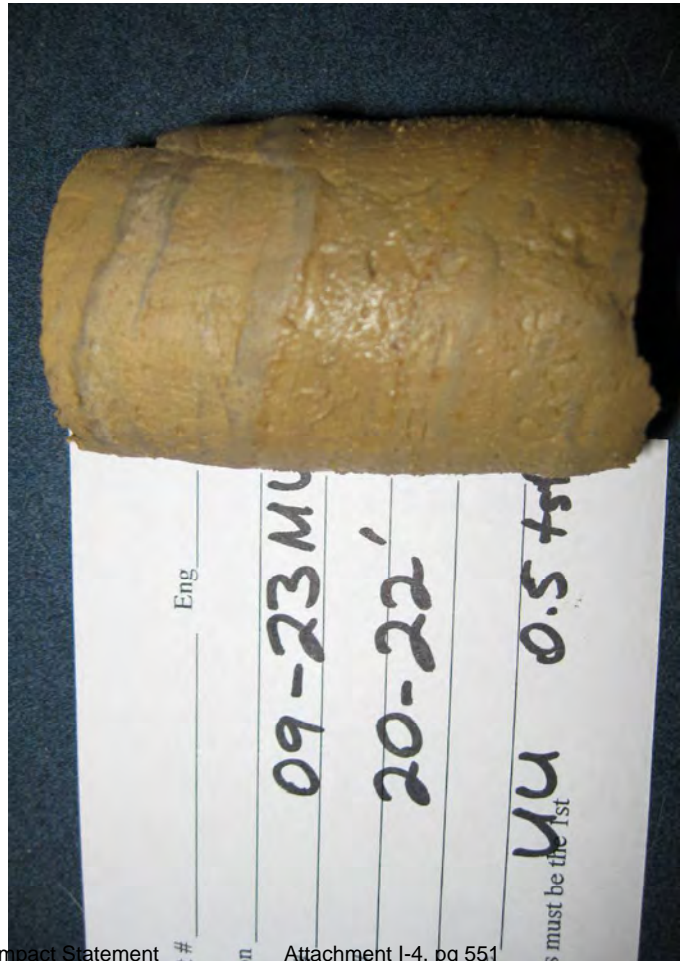
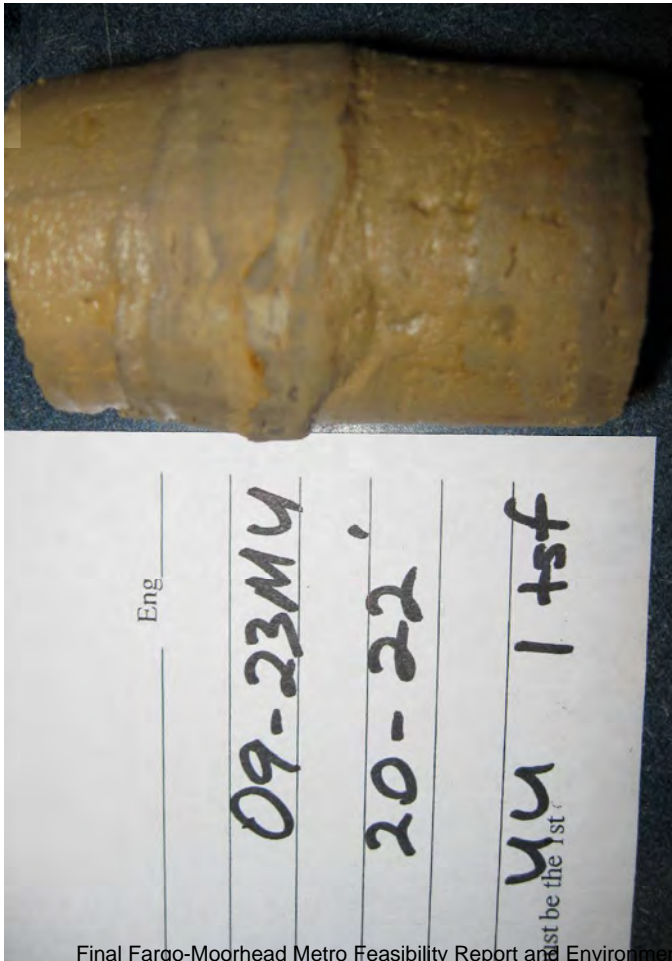
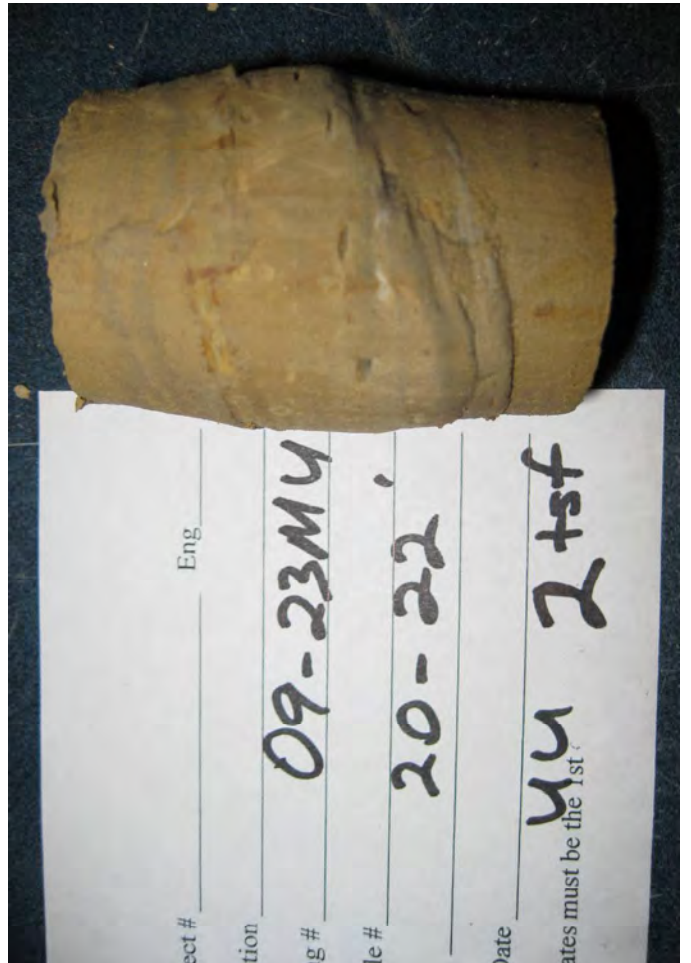
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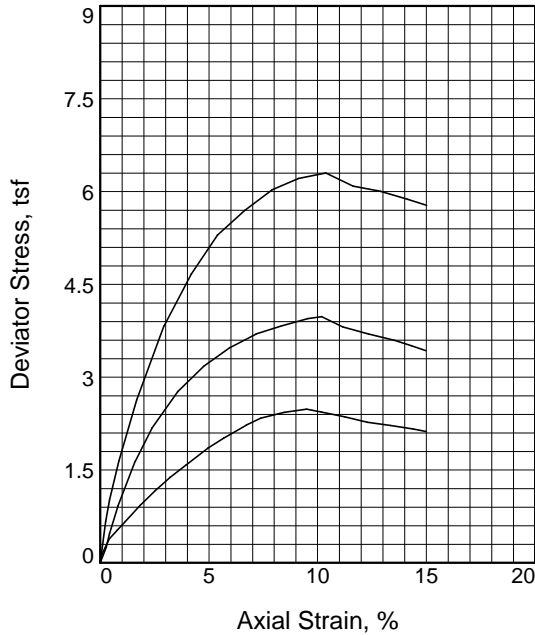
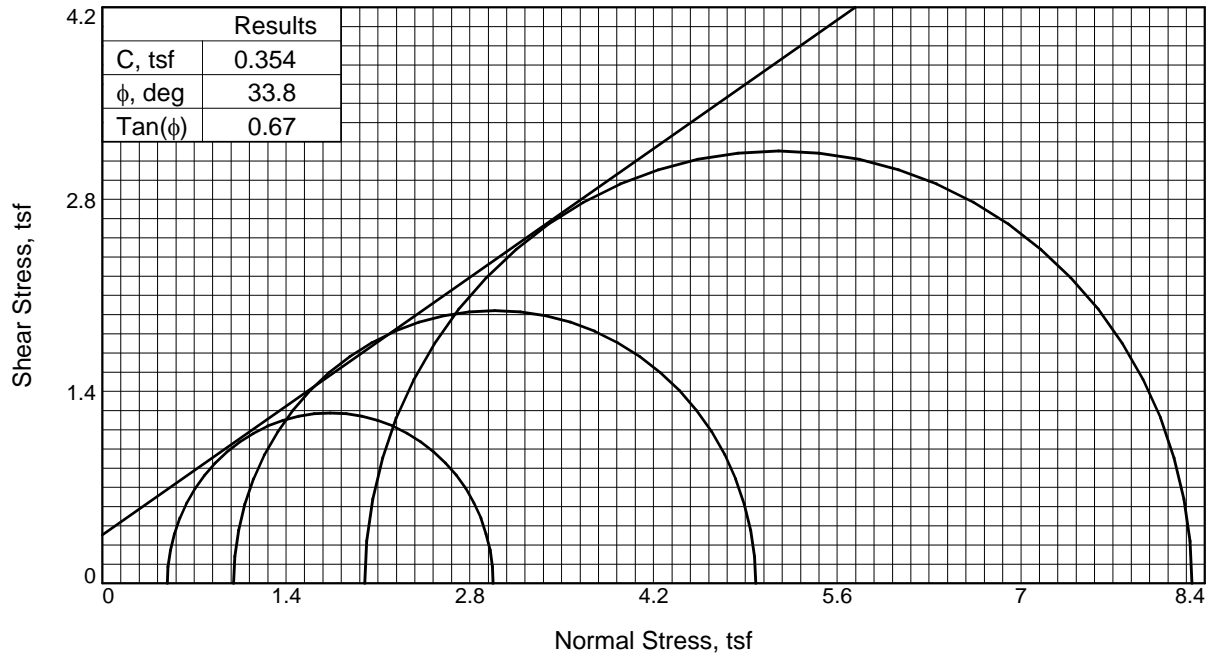
Strain rate, in./min. = 0.03

Fail. Stress = 5.144 tsf at reading no. 14

Ult. Stress = 5.076 tsf at reading no. 19

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.4990	3.900	0.0	0.0	0.000	1.994	1.994	1.00	1.994	0.000
1	-1.4950	7.400	3.5	0.1	0.156	1.994	2.150	1.08	2.072	0.078
2	-1.4920	15.200	11.3	0.2	0.503	1.994	2.497	1.25	2.245	0.251
3	-1.4870	23.100	19.2	0.4	0.852	1.994	2.846	1.43	2.420	0.426
4	-1.4780	30.900	27.0	0.7	1.195	1.994	3.189	1.60	2.591	0.597
5	-1.4620	43.200	39.3	1.3	1.729	1.994	3.723	1.87	2.858	0.864
6	-1.4450	53.500	49.6	1.9	2.169	1.994	4.163	2.09	3.078	1.084
7	-1.4280	63.700	59.8	2.5	2.598	1.994	4.592	2.30	3.293	1.299
8	-1.4030	77.200	73.3	3.4	3.156	1.994	5.150	2.58	3.572	1.578
9	-1.3780	89.600	85.7	4.3	3.656	1.994	5.650	2.83	3.822	1.828
10	-1.3530	100.200	96.3	5.2	4.069	1.994	6.063	3.04	4.029	2.035
11	-1.3190	111.800	107.9	6.4	4.501	1.994	6.495	3.26	4.245	2.251
12	-1.2860	121.200	117.3	7.6	4.832	1.994	6.826	3.42	4.410	2.416
13	-1.2520	128.200	124.3	8.8	5.053	1.994	7.047	3.53	4.520	2.526
14	-1.2190	132.100	128.2	10.0	5.144	1.994	7.138	3.58	4.566	2.572
15	-1.1850	132.900	129.0	11.2	5.106	1.994	7.100	3.56	4.547	2.553
16	-1.1510	134.000	130.1	12.4	5.080	1.994	7.074	3.55	4.534	2.540
17	-1.1180	135.500	131.6	13.6	5.069	1.994	7.063	3.54	4.529	2.535
18	-1.0930	137.000	133.1	14.5	5.074	1.994	7.068	3.54	4.531	2.537
19	-1.0760	138.000	134.1	15.1	5.076	1.994	7.070	3.55	4.532	2.538





Sample No.	1	2	3	
Initial	Water Content, %	30.8	30.1	28.5
	Dry Density, pcf	92.6	93.4	94.3
	Saturation, %	99.3	98.8	95.3
	Void Ratio	0.8543	0.8383	0.8213
	Diameter, in.	1.42	1.43	1.42
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	31.1	30.5	29.9
	Dry Density, pcf	92.6	93.4	94.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8543	0.8383	0.8213
	Diameter, in.	1.42	1.43	1.42
	Height, in.	2.80	2.81	2.80
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Fail. Stress, tsf	2.48	3.98	6.30	
Ult. Stress, tsf	2.12	3.43	5.78	
σ_1 Failure, tsf	2.98	4.98	8.30	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Top of sample

Description: SILT with layers of Clay, gray-brown (ML)

LL= 30 PL= 24 PI= 6

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #2 **Depth:** 21-23'

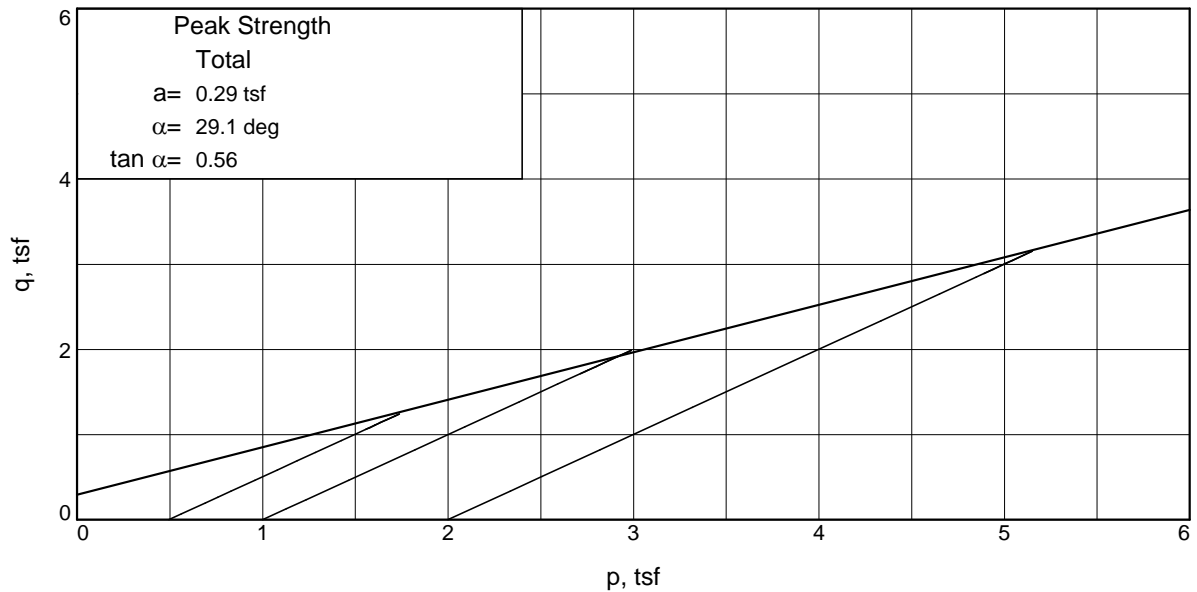
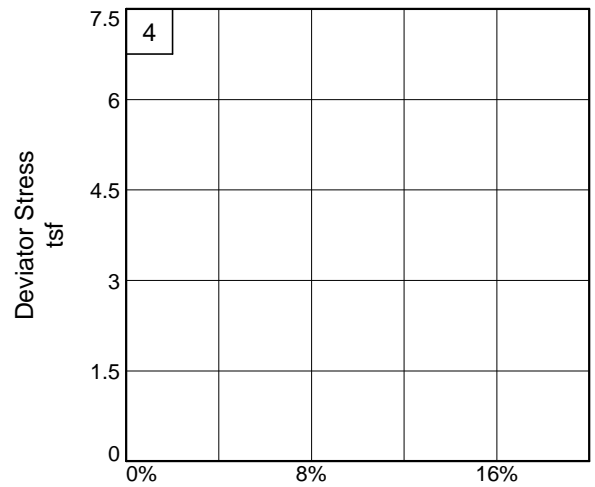
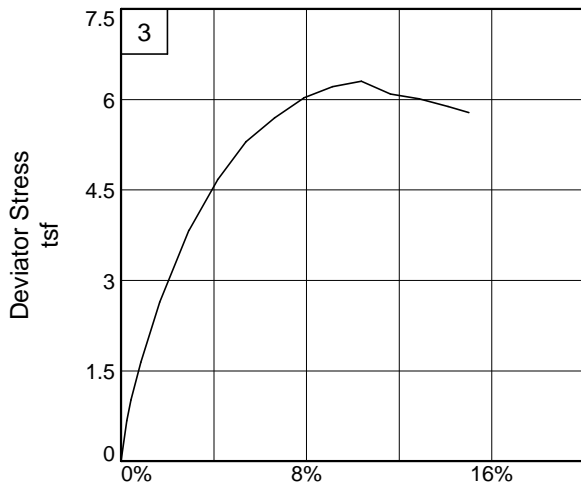
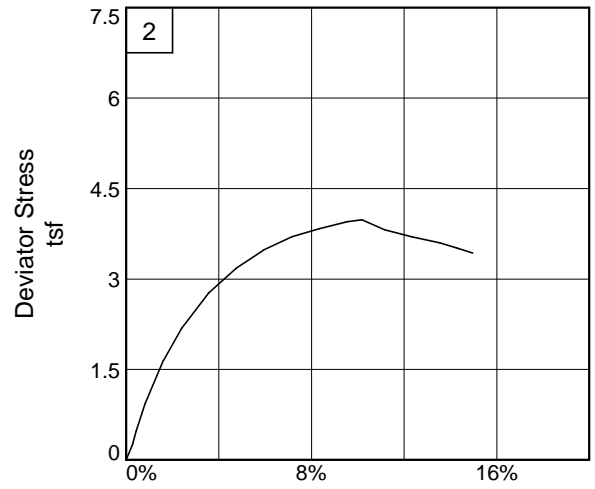
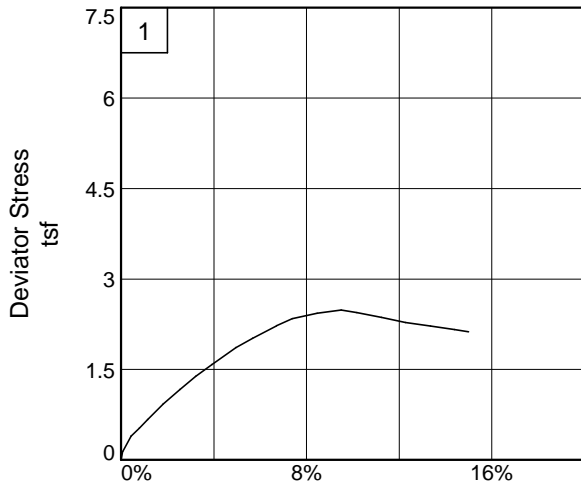
Poplar River - West Fargo

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 21-23' **Sample Number:** Boring 09-25MU, #2

Project No.: BL-09-03127

Figure _____

Poplar River - West Fargo

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:44 AM

Date:**Client:** US Army Corps of Engineers**Project:** Fargo-Moorhead Metro Feasibility Study**Project No.:** BL-09-03127**Depth:** 21-23'**Sample Number:** Boring 09-25MU, #2**Description:** SILT with layers of Clay, gray-brown (ML)**Remarks:****Type of Sample:** Thinwall, 5", Top of sample**Assumed Specific Gravity=**2.75**LL=**30**PL=**24**PI=**6**Test Method:** COE uniform strain**Moorhead****Poplar River - West Fargo****Parameters for Specimen No. 1**

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	95.240		172.420
Moisture content: Dry soil+tare, gms.	79.880		141.140
Moisture content: Tare, gms.	30.080		31.270
Moisture, %	30.8	31.1	28.5
Moist specimen weight, gms.	141.1		
Diameter, in.	1.42	1.42	
Area, in. ²	1.58	1.58	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	121.1	121.3	
Dry density, pcf	92.6	92.6	
Void ratio	0.8543	0.8543	
Saturation, %	99.3	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.495 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 2.483 tsf at reading no. 14

Ult. Stress = 2.124 tsf at reading no. 20

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.5450	0.600	0.0	0.0	0.000	0.495	0.495	1.00	0.495	0.000
1	-1.5430	3.600	3.0	0.1	0.136	0.495	0.631	1.28	0.563	0.068
2	-1.5330	9.300	8.7	0.4	0.394	0.495	0.889	1.80	0.692	0.197
3	-1.5230	12.300	11.7	0.8	0.527	0.495	1.022	2.07	0.759	0.264
4	-1.5130	15.500	14.9	1.1	0.669	0.495	1.164	2.35	0.830	0.335
5	-1.4940	21.400	20.8	1.8	0.928	0.495	1.423	2.87	0.959	0.464
6	-1.4740	27.000	26.4	2.5	1.169	0.495	1.664	3.36	1.079	0.584
7	-1.4550	32.100	31.5	3.2	1.385	0.495	1.880	3.80	1.188	0.693
8	-1.4350	36.800	36.2	3.9	1.580	0.495	2.075	4.19	1.285	0.790
9	-1.4060	43.700	43.1	5.0	1.861	0.495	2.356	4.76	1.425	0.930
10	-1.3860	47.700	47.1	5.7	2.018	0.495	2.513	5.08	1.504	1.009
11	-1.3570	53.100	52.5	6.7	2.225	0.495	2.720	5.49	1.608	1.113
12	-1.3380	56.200	55.6	7.4	2.339	0.495	2.834	5.73	1.665	1.170
13	-1.3080	59.100	58.5	8.5	2.433	0.495	2.928	5.91	1.711	1.216
14	-1.2790	61.000	60.4	9.5	2.483	0.495	2.978	6.02	1.737	1.242
15	-1.2600	60.400	59.8	10.2	2.440	0.495	2.935	5.93	1.715	1.220
16	-1.2300	59.200	58.6	11.2	2.363	0.495	2.858	5.77	1.676	1.181
17	-1.2010	57.700	57.1	12.3	2.275	0.495	2.770	5.60	1.633	1.138
18	-1.1710	57.000	56.4	13.4	2.220	0.495	2.715	5.49	1.605	1.110
19	-1.1420	56.200	55.6	14.4	2.162	0.495	2.657	5.37	1.576	1.081
20	-1.1250	55.600	55.0	15.0	2.124	0.495	2.619	5.29	1.557	1.062

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	107.800		173.760
Moisture content: Dry soil+tare, gms.	89.880		142.120
Moisture content: Tare, gms.	30.380		31.230
Moisture, %	30.1	30.5	28.5
Moist specimen weight, gms.	143.2		
Diameter, in.	1.43	1.43	
Area, in. ²	1.60	1.60	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	121.5	121.9	
Dry density, pcf	93.4	93.4	
Void ratio	0.8383	0.8383	
Saturation, %	98.8	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 3.978 tsf at reading no. 12

Ult. Stress = 3.430 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6380	1.300	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.6300	7.000	5.7	0.3	0.256	1.000	1.256	1.26	1.128	0.128
2	-1.6260	11.800	10.5	0.4	0.471	1.000	1.471	1.47	1.235	0.235
3	-1.6150	22.100	20.8	0.8	0.929	1.000	1.929	1.93	1.464	0.464
4	-1.5930	38.400	37.1	1.6	1.643	1.000	2.643	2.64	1.822	0.822
5	-1.5710	51.000	49.7	2.4	2.184	1.000	3.184	3.18	2.092	1.092
6	-1.5380	65.100	63.8	3.6	2.770	1.000	3.770	3.77	2.385	1.385
7	-1.5040	75.600	74.3	4.8	3.185	1.000	4.185	4.19	2.593	1.593
8	-1.4710	83.500	82.2	6.0	3.480	1.000	4.480	4.48	2.740	1.740
9	-1.4370	89.800	88.5	7.2	3.699	1.000	4.699	4.70	2.849	1.849
10	-1.4040	94.100	92.8	8.3	3.829	1.000	4.829	4.83	2.915	1.915
11	-1.3700	98.300	97.0	9.5	3.950	1.000	4.950	4.95	2.975	1.975
12	-1.3520	99.700	98.4	10.2	3.978	1.000	4.978	4.98	2.989	1.989
13	-1.3250	96.700	95.4	11.2	3.816	1.000	4.816	4.82	2.908	1.908
14	-1.2920	95.000	93.7	12.3	3.698	1.000	4.698	4.70	2.849	1.849
15	-1.2580	93.700	92.4	13.5	3.597	1.000	4.597	4.60	2.798	1.798
16	-1.2360	92.300	91.0	14.3	3.510	1.000	4.510	4.51	2.755	1.755
17	-1.2180	90.900	89.6	15.0	3.430	1.000	4.430	4.43	2.715	1.715

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	124.800		169.740
Moisture content: Dry soil+tare, gms.	103.850		138.960
Moisture content: Tare, gms.	30.260		30.650
Moisture, %	28.5	29.9	28.4
Moist specimen weight, gms.	141.1		
Diameter, in.	1.42	1.42	
Area, in. ²	1.58	1.58	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	121.1	122.4	
Dry density, pcf	94.3	94.3	
Void ratio	0.8213	0.8213	
Saturation, %	95.3	100.0	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

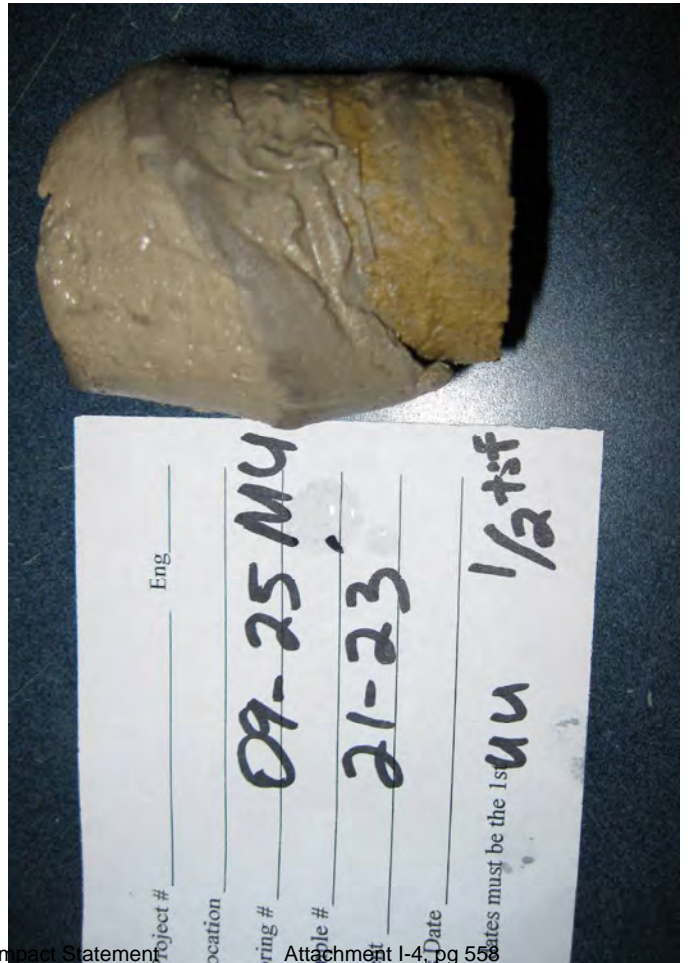
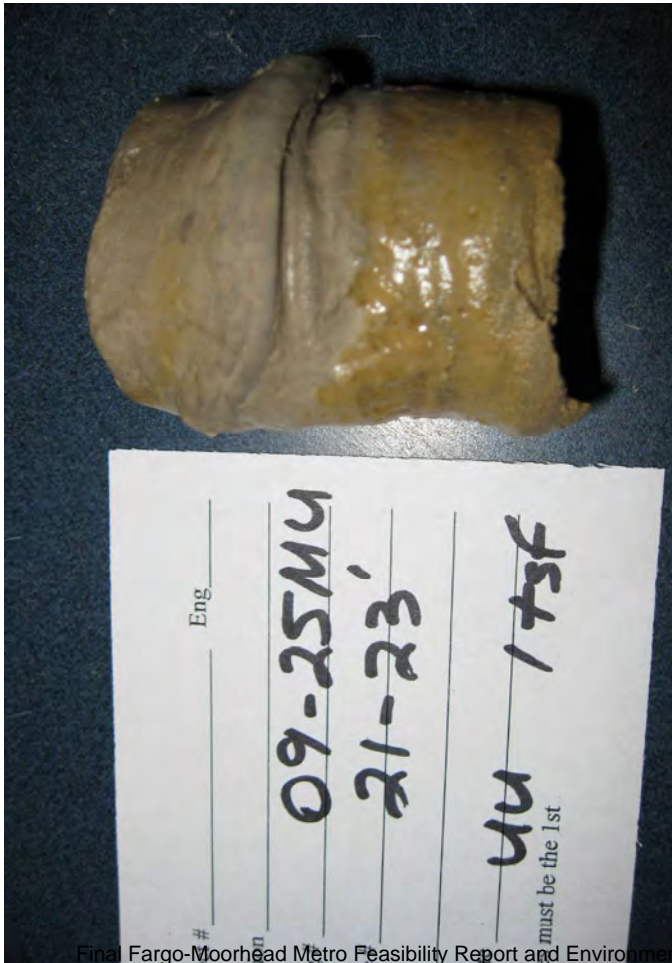
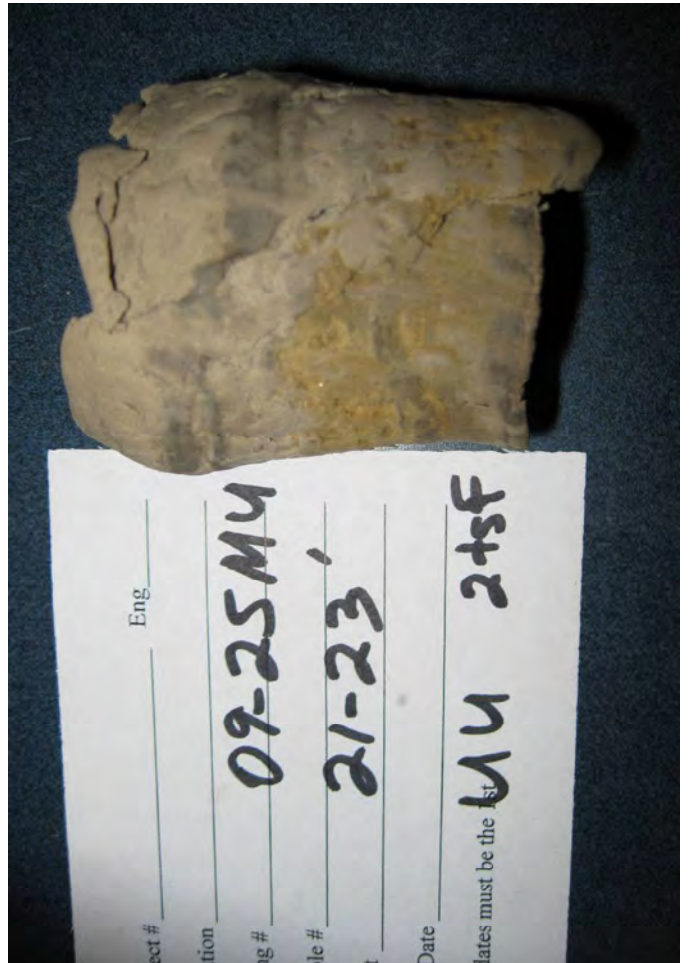
Back pressure = 0.000 tsf

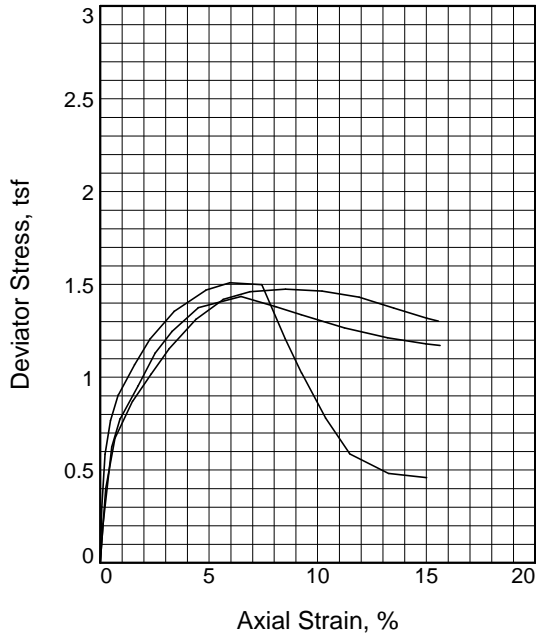
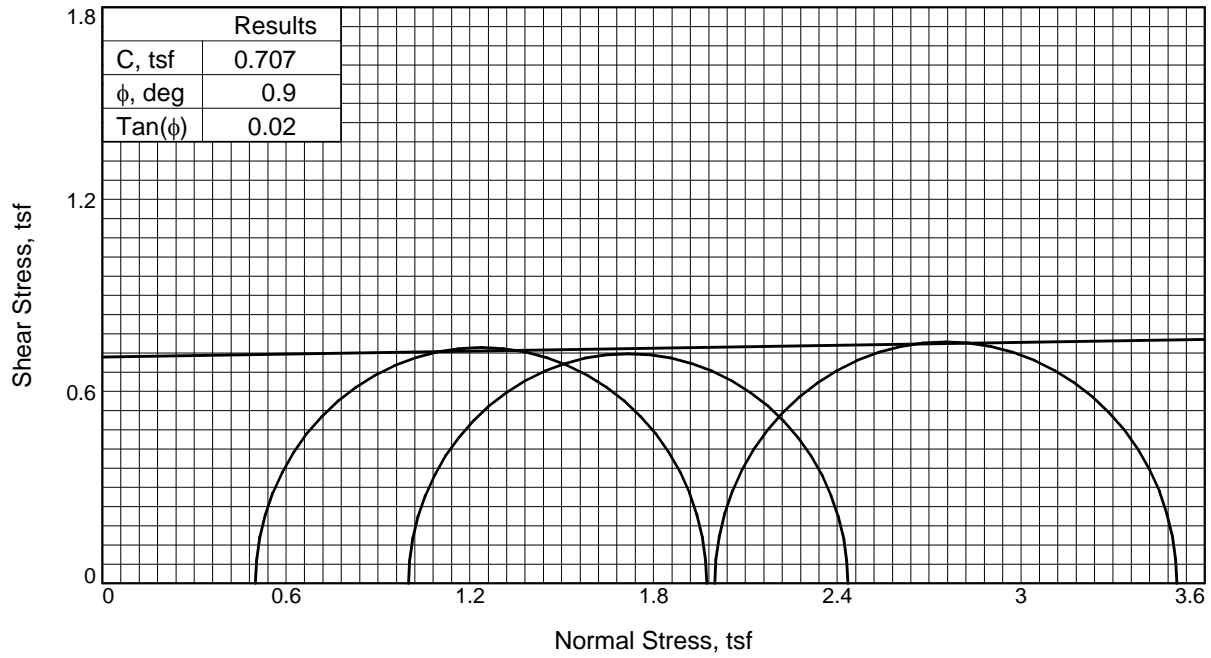
Strain rate, in./min. = 0.03

Fail. Stress = 6.303 tsf at reading no. 11

Ult. Stress = 5.780 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6160	4.400	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.6090	19.200	14.8	0.2	0.671	2.000	2.671	1.34	2.336	0.336
2	-1.6040	26.800	22.4	0.4	1.014	2.000	3.014	1.51	2.507	0.507
3	-1.5920	40.800	36.4	0.9	1.641	2.000	3.641	1.82	2.820	0.820
4	-1.5690	63.400	59.0	1.7	2.637	2.000	4.637	2.32	3.319	1.319
5	-1.5340	91.200	86.8	2.9	3.831	2.000	5.831	2.92	3.915	1.915
6	-1.4990	111.600	107.2	4.2	4.670	2.000	6.670	3.34	4.335	2.335
7	-1.4650	127.600	123.2	5.4	5.299	2.000	7.299	3.65	4.650	2.650
8	-1.4300	138.600	134.2	6.6	5.696	2.000	7.696	3.85	4.848	2.848
9	-1.3950	148.300	143.9	7.9	6.026	2.000	8.026	4.01	5.013	3.013
10	-1.3600	154.800	150.4	9.1	6.213	2.000	8.213	4.11	5.107	3.107
11	-1.3250	159.100	154.7	10.4	6.303	2.000	8.303	4.15	5.152	3.152
12	-1.2900	156.000	151.6	11.6	6.091	2.000	8.091	4.05	5.045	3.045
13	-1.2550	156.100	151.7	12.9	6.009	2.000	8.009	4.00	5.004	3.004
14	-1.2200	155.000	150.6	14.1	5.880	2.000	7.880	3.94	4.940	2.940
15	-1.1950	154.000	149.6	15.0	5.780	2.000	7.780	3.89	4.890	2.890





Sample No.	1	2	3	
Initial	Water Content, %	37.8	37.3	37.6
	Dry Density, pcf	82.9	83.8	83.6
	Saturation, %	96.9	97.9	98.2
	Void Ratio	1.0715	1.0474	1.0545
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.81	2.82	2.80
At Test	Water Content, %	36.6	36.4	36.8
	Dry Density, pcf	82.9	83.8	83.6
	Saturation, %	93.9	95.6	95.8
	Void Ratio	1.0715	1.0474	1.0545
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.81	2.82	2.80
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Fail. Stress, tsf	1.47	1.43	1.51	
Ult. Stress, tsf	1.32	1.18	0.46	
σ_1 Failure, tsf	1.97	2.43	3.51	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5"

Description: FAT CLAY with layers of Silt, brown (CH)

LL= 83 **PL=** 20 **PI=** 63

Assumed Specific Gravity= 2.75

Remarks: Tested bottom portion of 5" thinwall.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #4

Depth: 28-30'

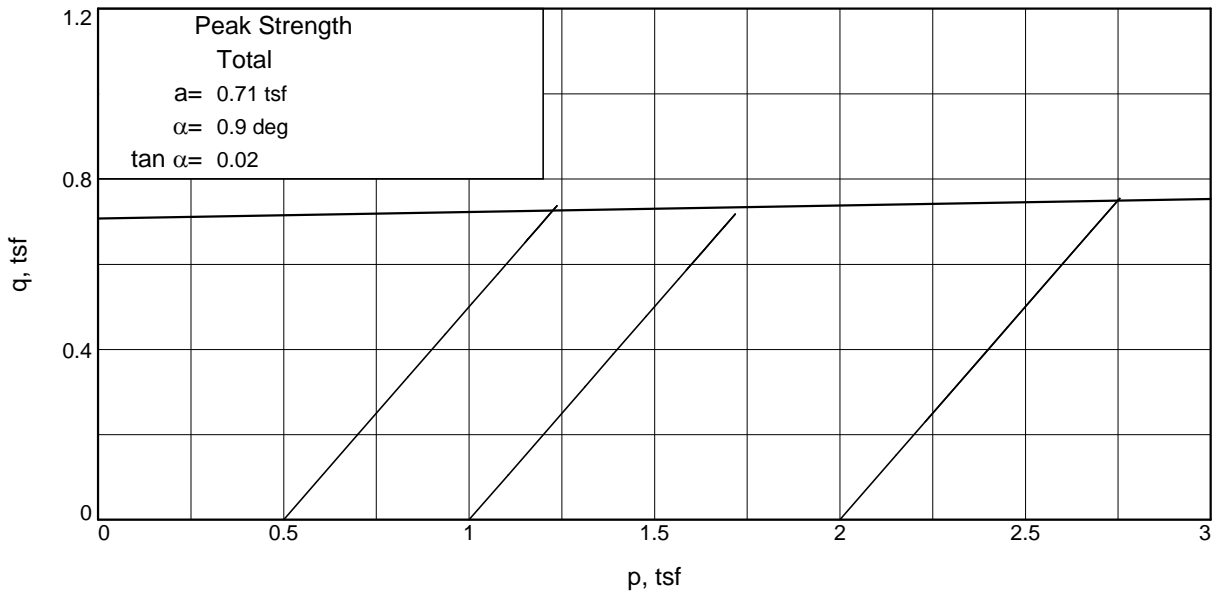
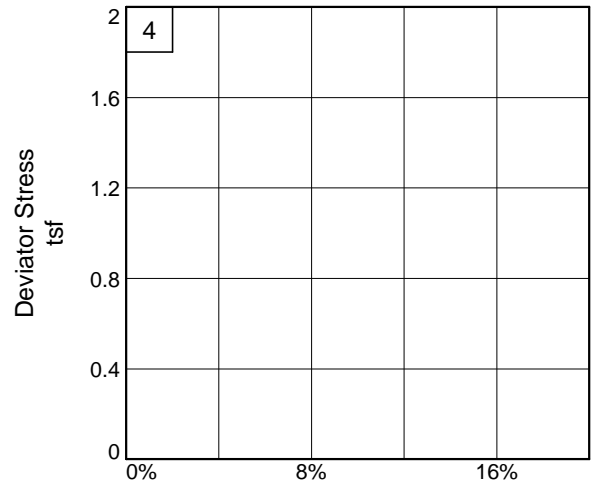
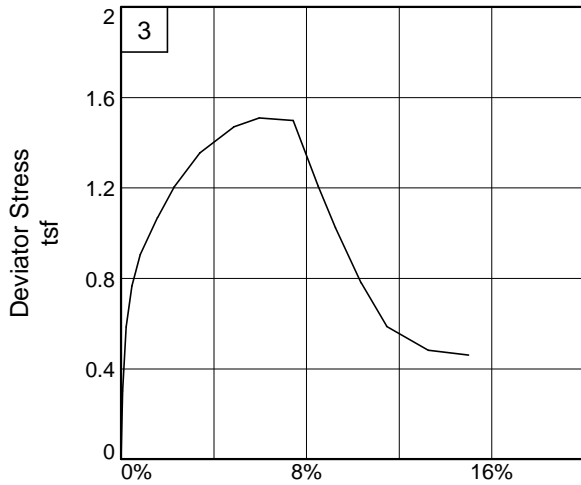
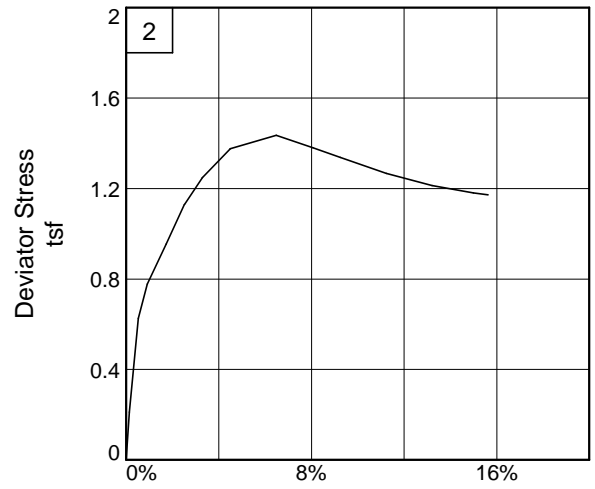
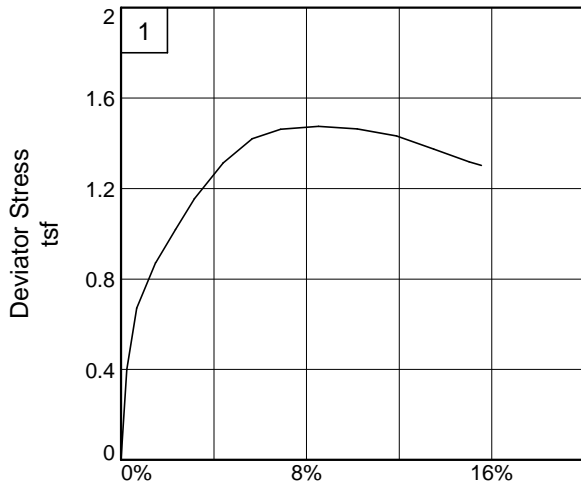
Poplar River - Harwood

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 28-30' **Sample Number:** Boring 09-23MU, #4

Project No.: BL-09-03127

Figure _____

Poplar River - Harwood

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:42 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Fargo**
Depth: 28-30' **Sample Number:** Boring 09-23MU, #4
Description: FAT CLAY with layers of Silt, brown (CH) **Poplar River - Harwood**
Remarks: Tested bottom portion of 5" thinwall.
Type of Sample: Thinwall, 5"
Assumed Specific Gravity=2.75 **LL=**83 **PL=**20 **PI=**63
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	112.760	160.460
Moisture content: Dry soil+tare, gms.	90.510	125.640
Moisture content: Tare, gms.	31.580	30.500
Moisture, %	37.8	36.6
Moist specimen weight, gms.	130.4	
Diameter, in.	1.40	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	114.2	
Dry density, pcf	82.9	
Void ratio	1.0715	
Saturation, %	96.9	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.474 tsf **at reading no. 9**
Ult. Stress = 1.318 tsf **at reading no. 13**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7280	1.099	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	-1.7210	9.700	8.6	0.2	0.400	0.500	0.900	1.80	0.700	0.200
2	-1.7090	15.600	14.5	0.7	0.671	0.500	1.171	2.34	0.835	0.335
3	-1.6860	20.100	19.0	1.5	0.872	0.500	1.372	2.74	0.936	0.436
4	-1.6620	23.500	22.4	2.3	1.019	0.500	1.519	3.04	1.009	0.509
5	-1.6390	26.700	25.6	3.2	1.155	0.500	1.655	3.31	1.077	0.577
6	-1.6040	30.600	29.5	4.4	1.313	0.500	1.813	3.63	1.157	0.657
7	-1.5690	33.400	32.3	5.6	1.419	0.500	1.919	3.84	1.210	0.710
8	-1.5340	34.800	33.7	6.9	1.461	0.500	1.961	3.92	1.231	0.731
9	-1.4880	35.700	34.6	8.5	1.474	0.500	1.974	3.95	1.237	0.737
10	-1.4410	36.100	35.0	10.2	1.464	0.500	1.964	3.93	1.232	0.732
11	-1.3930	36.000	34.9	11.9	1.432	0.500	1.932	3.86	1.216	0.716
12	-1.3480	35.200	34.1	13.5	1.374	0.500	1.874	3.75	1.187	0.687
13	-1.3050	34.400	33.3	15.0	1.318	0.500	1.818	3.64	1.159	0.659
14	-1.2900	34.200	33.1	15.6	1.302	0.500	1.802	3.60	1.151	0.651

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	100.570	161.300
Moisture content: Dry soil+tare, gms.	81.520	126.520
Moisture content: Tare, gms.	30.450	30.990
Moisture, %	37.3	36.4
Moist specimen weight, gms.	130.9	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.82	
Wet Density, pcf	115.1	
Dry density, pcf	83.8	
Void ratio	1.0474	
Saturation, %	97.9	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.435 tsf at reading no. 8

Ult. Stress = 1.181 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7329	2.790	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.7290	7.300	4.5	0.1	0.211	1.000	1.211	1.21	1.106	0.106
2	-1.7180	16.200	13.4	0.5	0.626	1.000	1.626	1.63	1.313	0.313
3	-1.7070	19.500	16.7	0.9	0.777	1.000	1.777	1.78	1.388	0.388
4	-1.6840	23.500	20.7	1.7	0.955	1.000	1.955	1.95	1.477	0.477
5	-1.6620	27.500	24.7	2.5	1.130	1.000	2.130	2.13	1.565	0.565
6	-1.6400	30.300	27.5	3.3	1.248	1.000	2.248	2.25	1.624	0.624
7	-1.6060	33.500	30.7	4.5	1.376	1.000	2.376	2.38	1.688	0.688
8	-1.5500	35.500	32.7	6.5	1.435	1.000	2.435	2.43	1.717	0.717
9	-1.5050	34.800	32.0	8.1	1.380	1.000	2.380	2.38	1.690	0.690
10	-1.4720	34.200	31.4	9.2	1.337	1.000	2.337	2.34	1.669	0.669
11	-1.4160	33.200	30.4	11.2	1.266	1.000	2.266	2.27	1.633	0.633
12	-1.3600	32.600	29.8	13.2	1.213	1.000	2.213	2.21	1.607	0.607
13	-1.3100	32.400	29.6	15.0	1.181	1.000	2.181	2.18	1.590	0.590
14	-1.2920	32.400	29.6	15.6	1.172	1.000	2.172	2.17	1.586	0.586

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	135.510	163.010
Moisture content: Dry soil+tare, gms.	106.750	127.390
Moisture content: Tare, gms.	30.360	30.470
Moisture, %	37.6	36.8
Moist specimen weight, gms.	132.7	
Diameter, in.	1.41	
Area, in. ²	1.57	
Height, in.	2.80	
Wet Density, pcf	115.0	
Dry density, pcf	83.6	
Void ratio	1.0545	
Saturation, %	98.2	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

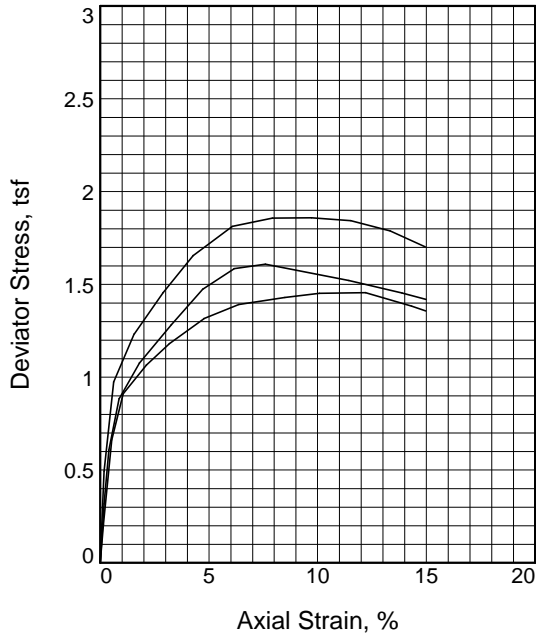
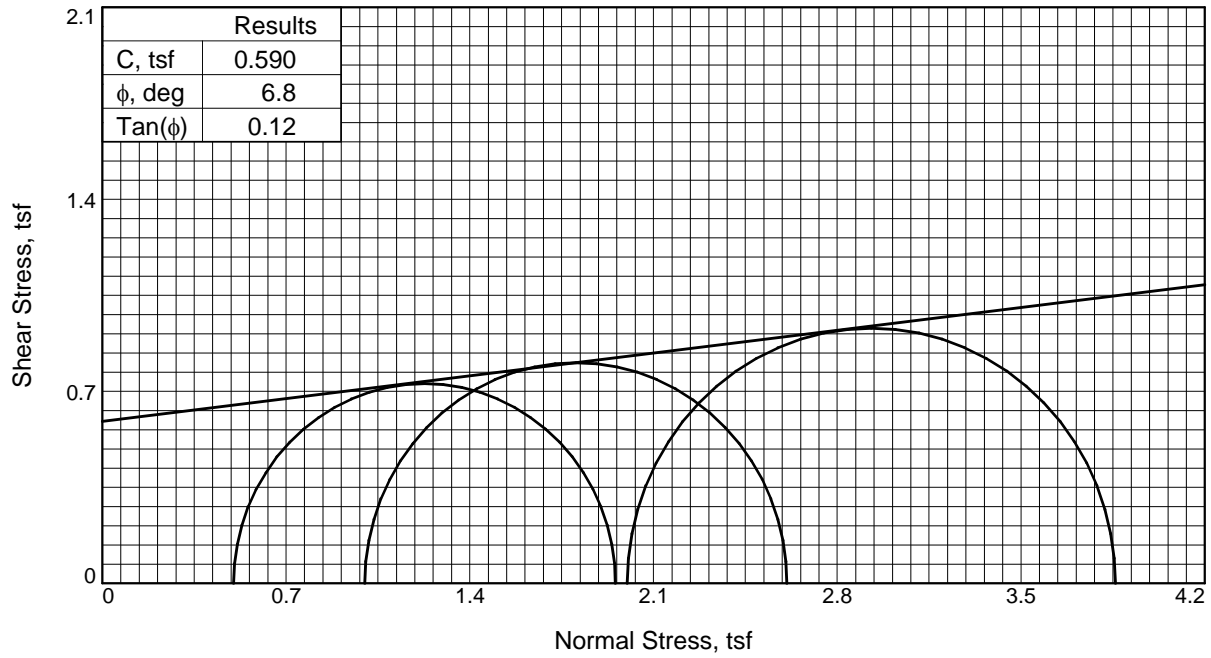
Strain rate, in./min. = 0.03

Fail. Stress = 1.509 tsf at reading no. 9

Ult. Stress = 0.460 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6980	5.300	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.6960	11.900	6.6	0.1	0.302	2.000	2.302	1.15	2.151	0.151
2	-1.6920	18.100	12.8	0.2	0.586	2.000	2.586	1.29	2.293	0.293
3	-1.6850	22.100	16.8	0.5	0.767	2.000	2.767	1.38	2.383	0.383
4	-1.6750	25.200	19.9	0.8	0.905	2.000	2.905	1.45	2.452	0.452
5	-1.6540	28.980	23.7	1.6	1.069	2.000	3.069	1.53	2.534	0.534
6	-1.6340	32.200	26.9	2.3	1.205	2.000	3.205	1.60	2.603	0.603
7	-1.6030	35.900	30.6	3.4	1.355	2.000	3.355	1.68	2.678	0.678
8	-1.5620	39.000	33.7	4.9	1.470	2.000	3.470	1.74	2.735	0.735
9	-1.5310	40.300	35.0	6.0	1.509	2.000	3.509	1.75	2.755	0.755
10	-1.4900	40.600	35.3	7.4	1.498	2.000	3.498	1.75	2.749	0.749
11	-1.4600	34.100	28.8	8.5	1.208	2.000	3.208	1.60	2.604	0.604
12	-1.4390	29.900	24.6	9.3	1.024	2.000	3.024	1.51	2.512	0.512
13	-1.4080	24.300	19.0	10.4	0.781	2.000	2.781	1.39	2.390	0.390
14	-1.3770	19.800	14.5	11.5	0.589	2.000	2.589	1.29	2.294	0.294
15	-1.3264	17.400	12.1	13.3	0.481	2.000	2.481	1.24	2.241	0.241
16	-1.2780	17.100	11.8	15.0	0.460	2.000	2.460	1.23	2.230	0.230





Sample No.	1	2	3	
Initial	Water Content, %	37.2	36.9	36.8
	Dry Density, pcf	84.4	83.9	84.4
	Saturation, %	98.9	96.9	97.9
	Void Ratio	1.0349	1.0472	1.0336
	Diameter, in.	1.39	1.40	1.38
	Height, in.	2.64	2.71	2.77
At Test	Water Content, %	37.6	38.1	37.6
	Dry Density, pcf	84.4	83.9	84.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0349	1.0472	1.0336
	Diameter, in.	1.39	1.40	1.38
	Height, in.	2.64	2.71	2.77
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Fail. Stress, tsf	1.46	1.61	1.86	
Ult. Stress, tsf	1.36	1.42	1.70	
σ_1 Failure, tsf	1.96	2.61	3.86	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 80 PL= 21 PI= 59

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #3 **Depth:** 25-27'

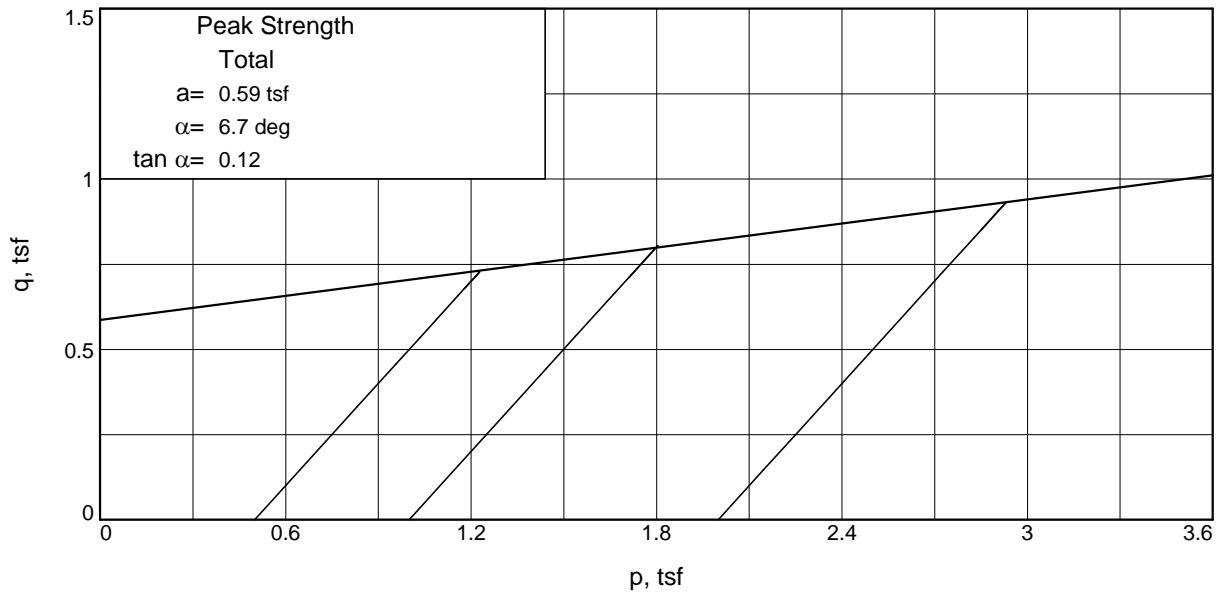
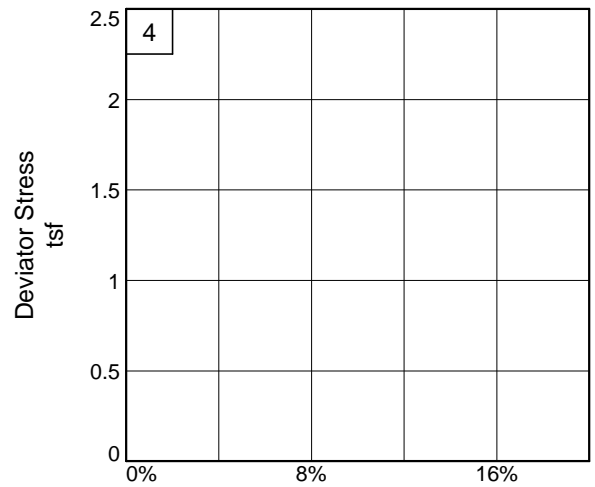
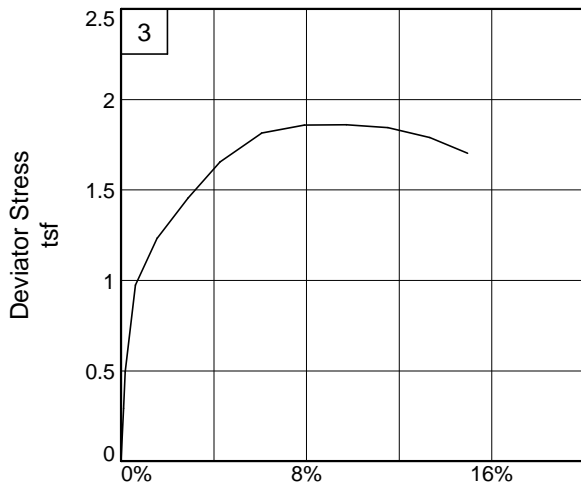
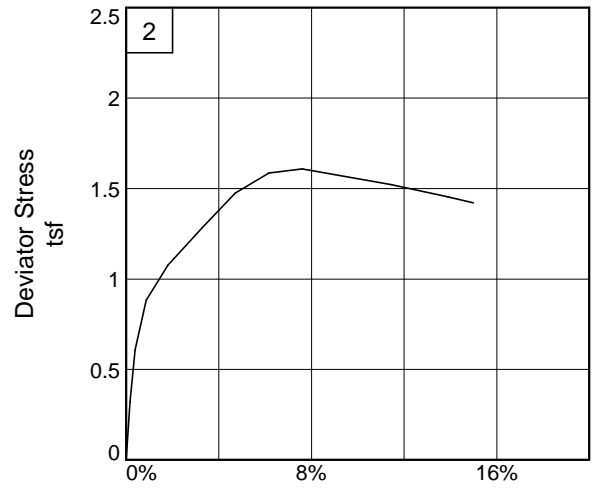
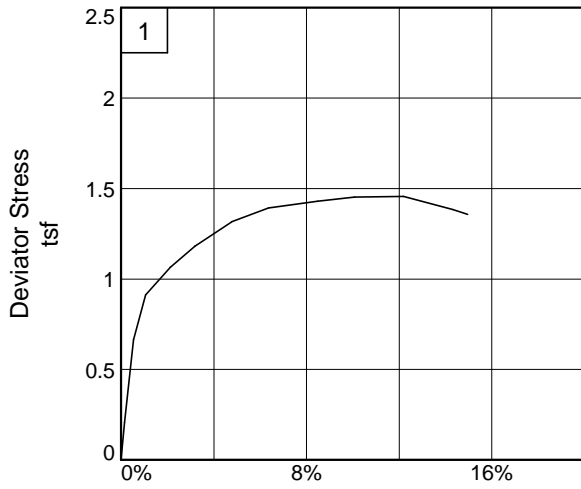
Poplar River - Harwood

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 25-27' **Sample Number:** Boring 09-25MU, #3

Project No.: BL-09-03127

Poplar River - Harwood

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:49 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 25-27' **Sample Number:** Boring 09-25MU, #3
Description: FAT CLAY, brown (CH) **Poplar River - Harwood**
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**80 **PL=**21 **PI=**59
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	99.980		152.290
Moisture content: Dry soil+tare, gms.	81.210		119.980
Moisture content: Tare, gms.	30.760		30.490
Moisture, %	37.2	37.6	36.1
Moist specimen weight, gms.	121.8		
Diameter, in.	1.39	1.39	
Area, in. ²	1.52	1.52	
Height, in.	2.64	2.64	
Net decrease in height, in.		0.00	
Wet Density, pcf	115.8	116.1	
Dry density, pcf	84.4	84.4	
Void ratio	1.0349	1.0349	
Saturation, %	98.9	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.455 tsf **at reading no. 10**
Ult. Stress = 1.357 tsf **at reading no. 12**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.5330	0.820	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	-1.5290	5.200	4.4	0.2	0.207	0.500	0.707	1.41	0.604	0.104
2	-1.5190	14.900	14.1	0.5	0.664	0.500	1.164	2.33	0.832	0.332
3	-1.5050	20.300	19.5	1.1	0.913	0.500	1.413	2.83	0.957	0.457
4	-1.4770	23.800	23.0	2.1	1.066	0.500	1.566	3.13	1.033	0.533
5	-1.4490	26.600	25.8	3.2	1.183	0.500	1.683	3.37	1.091	0.591
6	-1.4070	29.980	29.2	4.8	1.316	0.500	1.816	3.63	1.158	0.658
7	-1.3650	32.200	31.4	6.4	1.392	0.500	1.892	3.78	1.196	0.696
8	-1.3090	33.800	33.0	8.5	1.430	0.500	1.930	3.86	1.215	0.715
9	-1.2670	34.900	34.1	10.1	1.452	0.500	1.952	3.90	1.226	0.726
10	-1.2110	35.800	35.0	12.2	1.455	0.500	1.955	3.91	1.228	0.728
11	-1.1550	34.900	34.1	14.3	1.383	0.500	1.883	3.77	1.192	0.692
12	-1.1380	34.500	33.7	15.0	1.357	0.500	1.857	3.71	1.178	0.678

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	88.040		155.150
Moisture content: Dry soil+tare, gms.	72.680		122.350
Moisture content: Tare, gms.	31.060		30.580
Moisture, %	36.9	38.1	35.7
Moist specimen weight, gms.	124.6		
Diameter, in.	1.40	1.40	
Area, in. ²	1.53	1.53	
Height, in.	2.71	2.71	
Net decrease in height, in.		0.00	
Wet Density, pcf	114.8	115.8	
Dry density, pcf	83.9	83.9	
Void ratio	1.0472	1.0472	
Saturation, %	96.9	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 1.609 tsf at reading no. 8
 Ult. Stress = 1.420 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.5736	2.045	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.5690	8.800	6.8	0.2	0.318	1.000	1.318	1.32	1.159	0.159
2	-1.5630	15.000	13.0	0.4	0.608	1.000	1.608	1.61	1.304	0.304
3	-1.5500	21.000	19.0	0.9	0.885	1.000	1.885	1.89	1.443	0.443
4	-1.5250	25.300	23.3	1.8	1.076	1.000	2.076	2.08	1.538	0.538
5	-1.4850	30.200	28.2	3.3	1.283	1.000	2.283	2.28	1.641	0.641
6	-1.4460	34.900	32.9	4.7	1.475	1.000	2.475	2.47	1.737	0.737
7	-1.4070	37.900	35.9	6.2	1.585	1.000	2.585	2.59	1.793	0.793
8	-1.3680	39.000	37.0	7.6	1.609	1.000	2.609	2.61	1.804	0.804
9	-1.2640	38.500	36.5	11.4	1.521	1.000	2.521	2.52	1.760	0.760

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
10	-1.1980	37.900	35.9	13.9	1.455	1.000	2.455	2.45	1.727	0.727
11	-1.1680	37.500	35.5	15.0	1.420	1.000	2.420	2.42	1.710	0.710

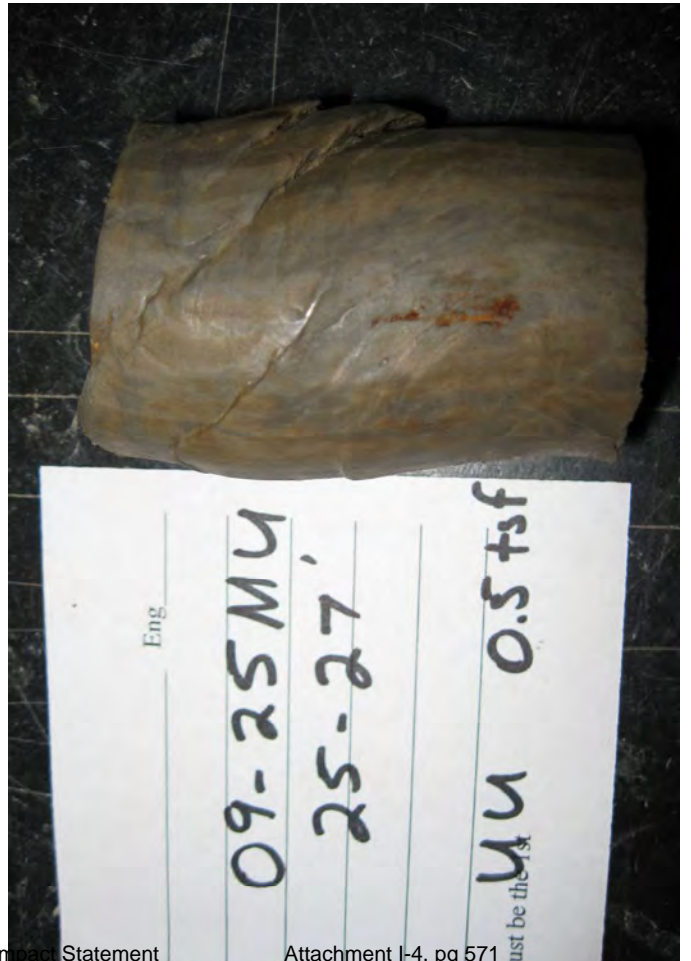
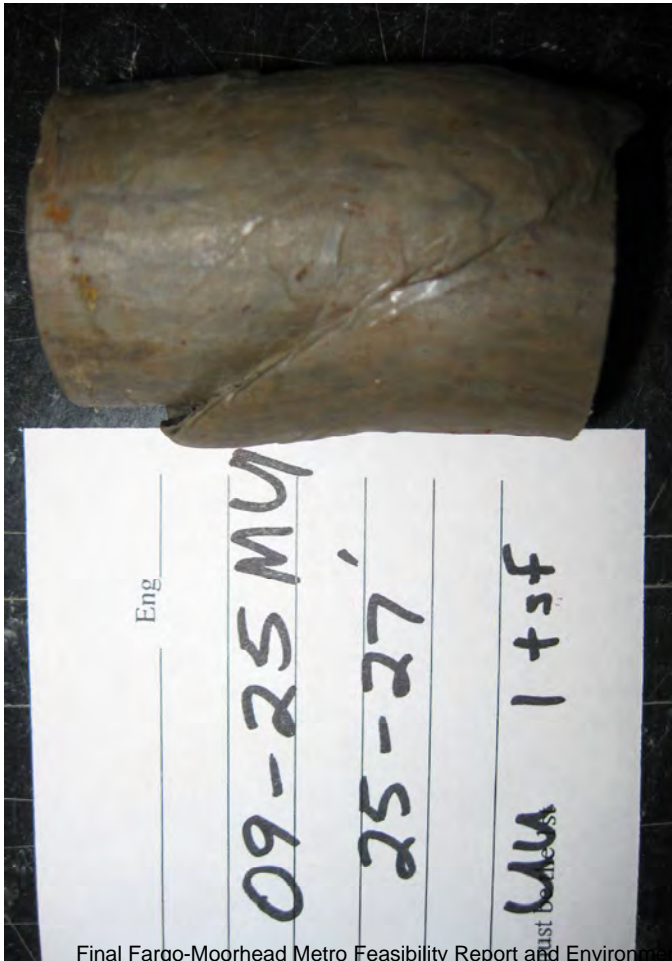
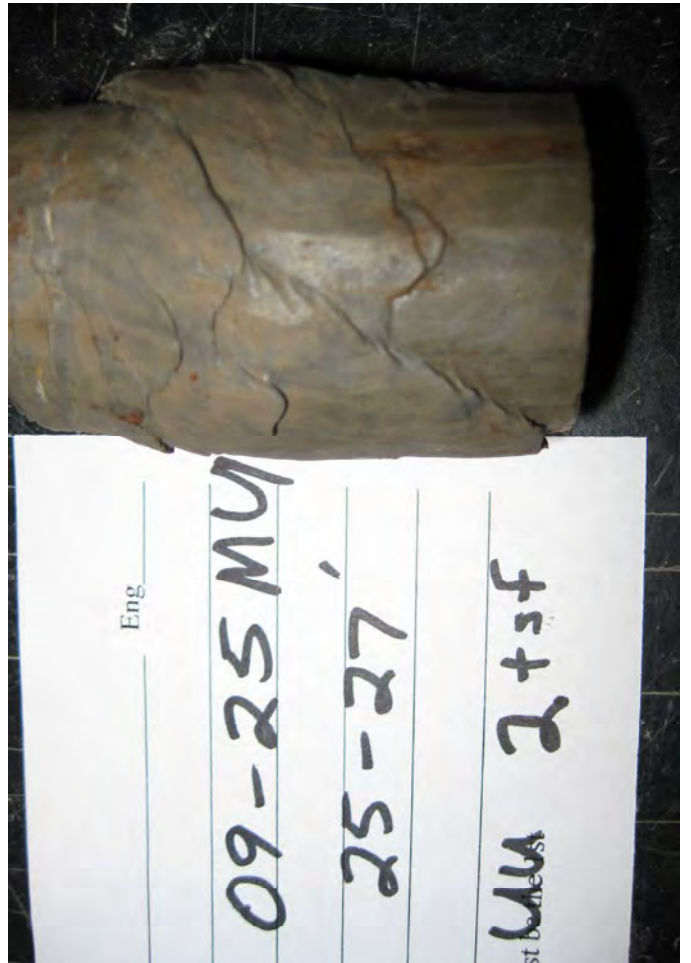
Parameters for Specimen No. 3

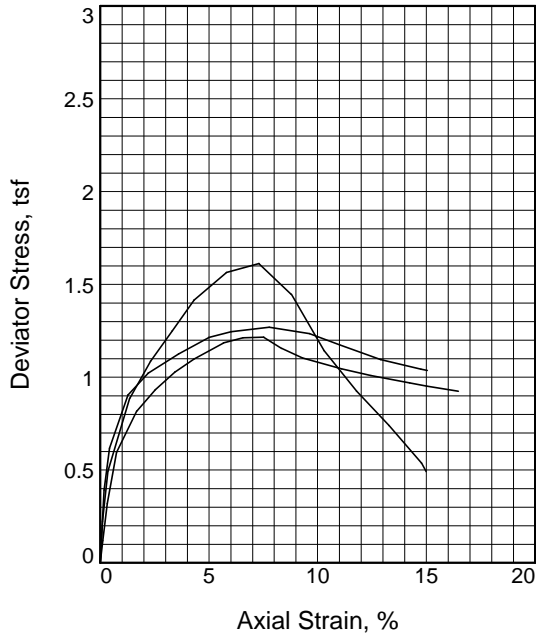
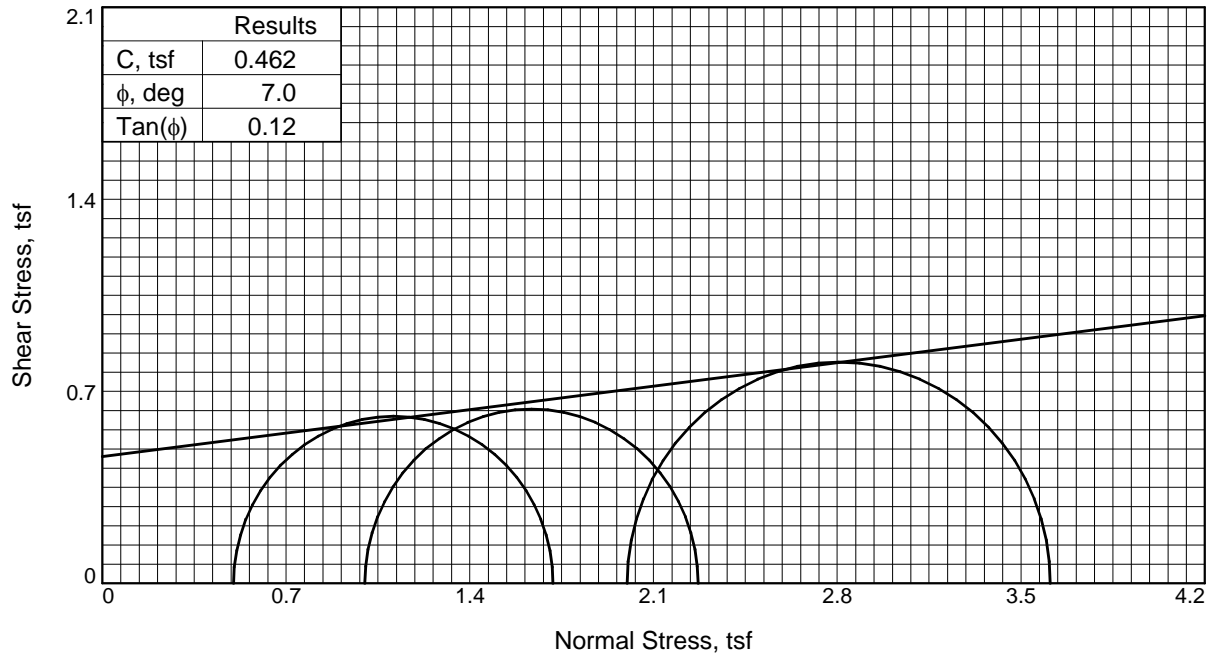
Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	118.460		155.620
Moisture content: Dry soil+tare, gms.	94.940		122.750
Moisture content: Tare, gms.	31.030		30.090
Moisture, %	36.8	37.6	35.5
Moist specimen weight, gms.	125.8		
Diameter, in.	1.38	1.38	
Area, in. ²	1.50	1.50	
Height, in.	2.77	2.77	
Net decrease in height, in.		0.00	
Wet Density, pcf	115.5	116.2	
Dry density, pcf	84.4	84.4	
Void ratio	1.0336	1.0336	
Saturation, %	97.9	100.0	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 1.860 tsf at reading no. 9
 Ult. Stress = 1.703 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6370	4.780	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.6340	10.900	6.1	0.1	0.293	2.000	2.293	1.15	2.147	0.147
2	-1.6320	15.100	10.3	0.2	0.494	2.000	2.494	1.25	2.247	0.247
3	-1.6200	25.200	20.4	0.6	0.974	2.000	2.974	1.49	2.487	0.487
4	-1.5940	30.900	26.1	1.6	1.234	2.000	3.234	1.62	2.617	0.617
5	-1.5570	36.000	31.2	2.9	1.455	2.000	3.455	1.73	2.728	0.728
6	-1.5190	40.800	36.0	4.3	1.655	2.000	3.655	1.83	2.828	0.828
7	-1.4690	45.000	40.2	6.1	1.813	2.000	3.813	1.91	2.907	0.907
8	-1.4180	46.800	42.0	7.9	1.857	2.000	3.857	1.93	2.929	0.929
9	-1.3680	47.700	42.9	9.7	1.860	2.000	3.860	1.93	2.930	0.930
10	-1.3180	48.200	43.4	11.5	1.844	2.000	3.844	1.92	2.922	0.922
11	-1.2680	47.800	43.0	13.3	1.790	2.000	3.790	1.89	2.895	0.895
12	-1.2230	46.500	41.7	15.0	1.703	2.000	3.703	1.85	2.851	0.851





Sample No.	1	2	3	
Initial	Water Content, %	37.3	36.4	37.9
	Dry Density, pcf	83.4	83.5	81.5
	Saturation, %	97.1	94.7	94.0
	Void Ratio	1.0574	1.0566	1.1072
	Diameter, in.	1.40	1.39	1.41
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	36.6	36.1	38.2
	Dry Density, pcf	83.4	83.5	81.5
	Saturation, %	95.3	93.8	94.9
	Void Ratio	1.0574	1.0566	1.1072
	Diameter, in.	1.40	1.39	1.41
	Height, in.	2.80	2.81	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Fail. Stress, tsf	1.22	1.27	1.61	
Ult. Stress, tsf	0.95	1.04	0.49	
σ_1 Failure, tsf	1.72	2.27	3.61	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5"

Description: FAT CLAY with layers of Silt, brown (CH)

LL= 84 PL= 20 PI= 64

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #2

Depth: 10-12'

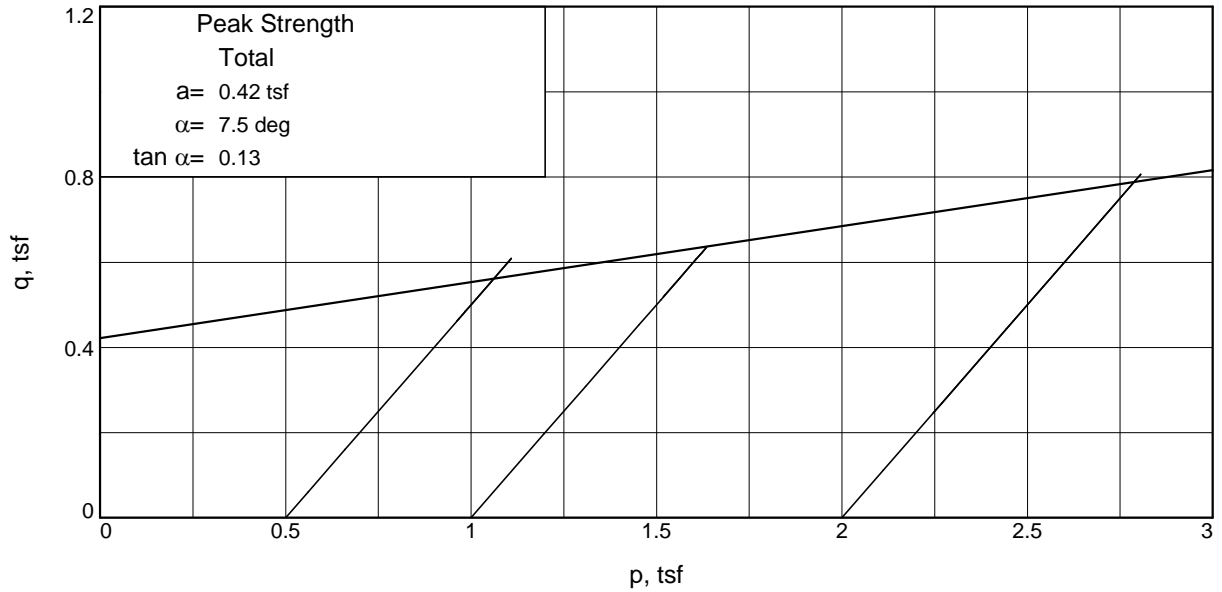
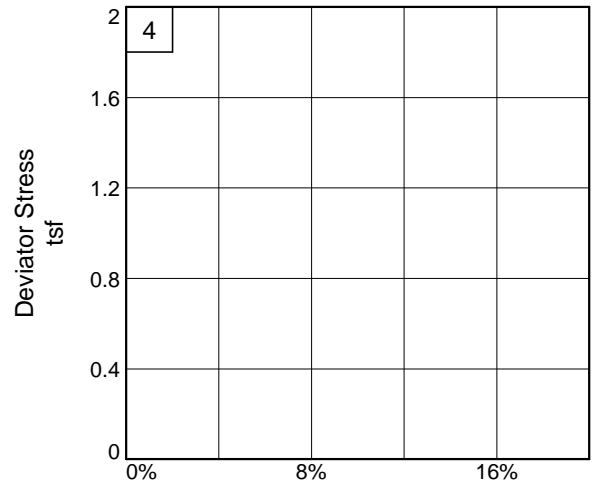
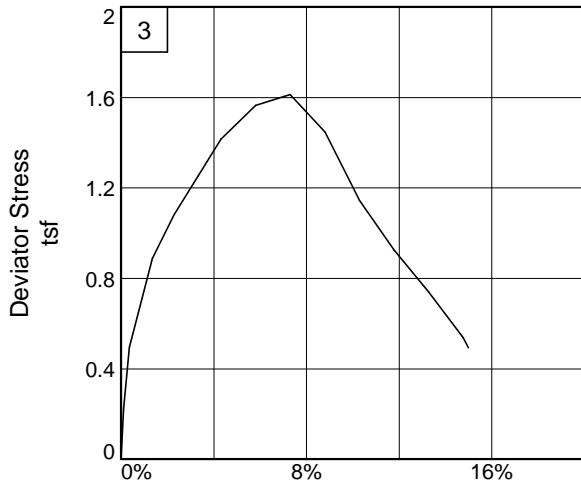
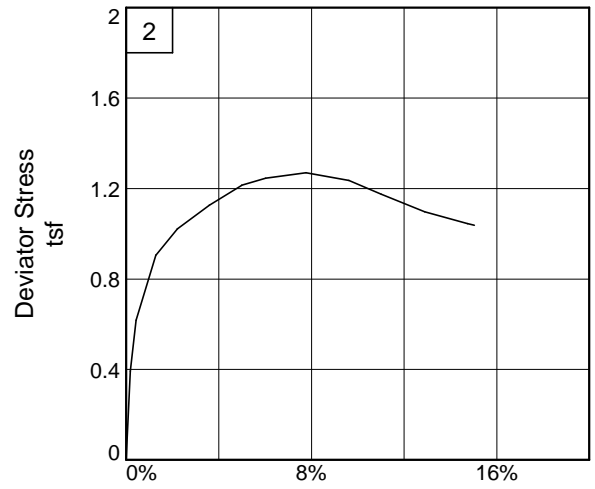
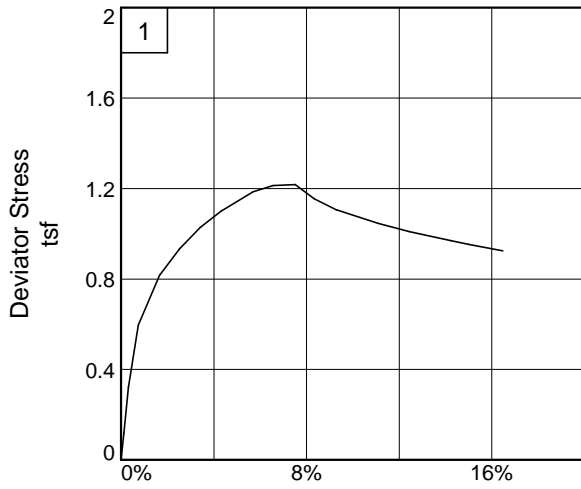
Sherack

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 10-12' **Sample Number:** Boring 09-23MU, #2

Project No.: BL-09-03127

Figure _____

Sherack

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:41 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Fargo**
Depth: 10-12' **Sample Number:** Boring 09-23MU, #2
Description: FAT CLAY with layers of Silt, brown (CH) **Sherack**
Remarks:
Type of Sample: Thinwall, 5"
Assumed Specific Gravity=2.75 **LL=**84 **PL=**20 **PI=**64
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	111.010	160.390
Moisture content: Dry soil+tare, gms.	89.250	125.420
Moisture content: Tare, gms.	30.990	29.940
Moisture, %	37.3	36.6
Moist specimen weight, gms.	130.6	
Diameter, in.	1.40	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	114.6	
Dry density, pcf	83.4	
Void ratio	1.0574	
Saturation, %	97.1	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.217 tsf **at reading no. 10**
Ult. Stress = 0.952 tsf **at reading no. 16**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7280	1.700	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	-1.7245	4.270	2.6	0.1	0.119	0.500	0.619	1.24	0.560	0.060
2	-1.7190	8.600	6.9	0.3	0.320	0.500	0.820	1.64	0.660	0.160
3	-1.7070	14.600	12.9	0.7	0.595	0.500	1.095	2.19	0.798	0.298
4	-1.6810	19.600	17.9	1.7	0.819	0.500	1.319	2.64	0.909	0.409
5	-1.6570	22.300	20.6	2.5	0.934	0.500	1.434	2.87	0.967	0.467
6	-1.6320	24.600	22.9	3.4	1.029	0.500	1.529	3.06	1.014	0.514
7	-1.6070	26.400	24.7	4.3	1.099	0.500	1.599	3.20	1.050	0.550
8	-1.5690	28.700	27.0	5.7	1.184	0.500	1.684	3.37	1.092	0.592
9	-1.5440	29.600	27.9	6.6	1.212	0.500	1.712	3.42	1.106	0.606
10	-1.5170	30.000	28.3	7.5	1.217	0.500	1.717	3.43	1.109	0.609
11	-1.4940	28.800	27.1	8.3	1.155	0.500	1.655	3.31	1.078	0.578
12	-1.4670	27.900	26.2	9.3	1.105	0.500	1.605	3.21	1.053	0.553
13	-1.4170	27.000	25.3	11.1	1.046	0.500	1.546	3.09	1.023	0.523
14	-1.3790	26.500	24.8	12.4	1.010	0.500	1.510	3.02	1.005	0.505
15	-1.3290	26.000	24.3	14.2	0.969	0.500	1.469	2.94	0.985	0.485
16	-1.3070	25.800	24.1	15.0	0.952	0.500	1.452	2.90	0.976	0.476
17	-1.2660	25.500	23.8	16.5	0.924	0.500	1.424	2.85	0.962	0.462

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	123.660	157.650
Moisture content: Dry soil+tare, gms.	98.730	123.910
Moisture content: Tare, gms.	30.180	30.320
Moisture, %	36.4	36.1
Moist specimen weight, gms.	127.6	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	113.8	
Dry density, pcf	83.5	
Void ratio	1.0566	
Saturation, %	94.7	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.270 tsf at reading no. 8

Ult. Stress = 1.037 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7070	0.000	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.7020	8.300	8.3	0.2	0.392	1.000	1.392	1.39	1.196	0.196
2	-1.6950	13.100	13.1	0.4	0.617	1.000	1.617	1.62	1.309	0.309
3	-1.6710	19.400	19.4	1.3	0.906	1.000	1.906	1.91	1.453	0.453
4	-1.6450	22.100	22.1	2.2	1.022	1.000	2.022	2.02	1.511	0.511
5	-1.6060	24.700	24.7	3.6	1.127	1.000	2.127	2.13	1.563	0.563
6	-1.5670	27.000	27.0	5.0	1.214	1.000	2.214	2.21	1.607	0.607
7	-1.5380	28.000	28.0	6.0	1.245	1.000	2.245	2.24	1.622	0.622
8	-1.4890	29.100	29.1	7.8	1.270	1.000	2.270	2.27	1.635	0.635
9	-1.4370	28.900	28.9	9.6	1.236	1.000	2.236	2.24	1.618	0.618
10	-1.3980	27.900	27.9	11.0	1.175	1.000	2.175	2.17	1.587	0.587
11	-1.3450	26.600	26.6	12.9	1.096	1.000	2.096	2.10	1.548	0.548
12	-1.2930	25.900	25.9	14.8	1.045	1.000	2.045	2.04	1.522	0.522
13	-1.2850	25.800	25.8	15.0	1.037	1.000	2.037	2.04	1.519	0.519

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	115.160	158.620
Moisture content: Dry soil+tare, gms.	92.060	123.190
Moisture content: Tare, gms.	31.050	30.480
Moisture, %	37.9	38.2
Moist specimen weight, gms.	128.6	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	112.3	
Dry density, pcf	81.5	
Void ratio	1.1072	
Saturation, %	94.0	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

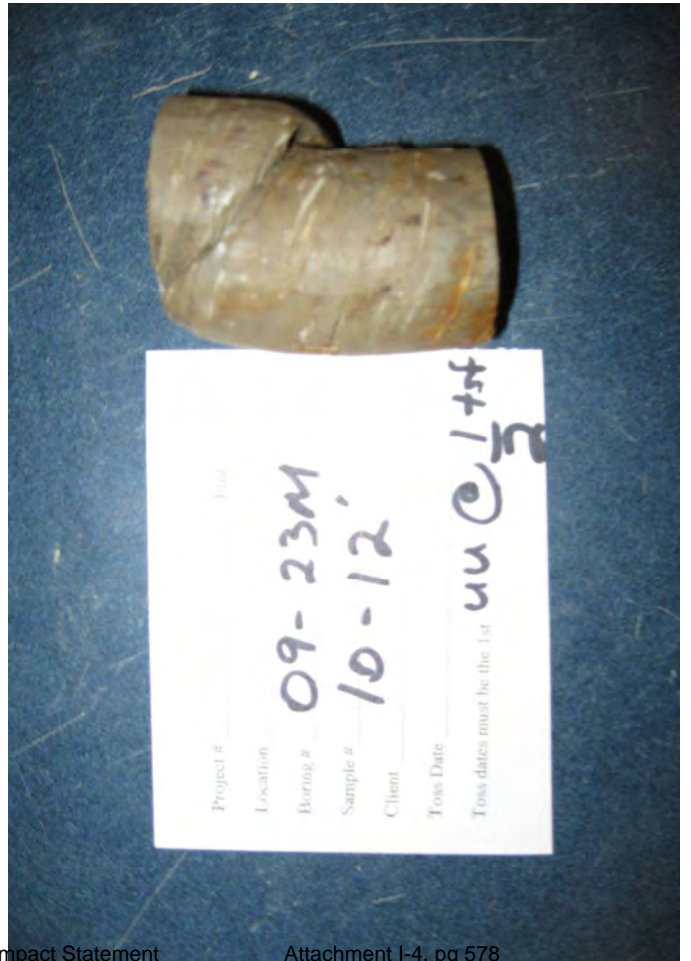
Back pressure = 0.000 tsf

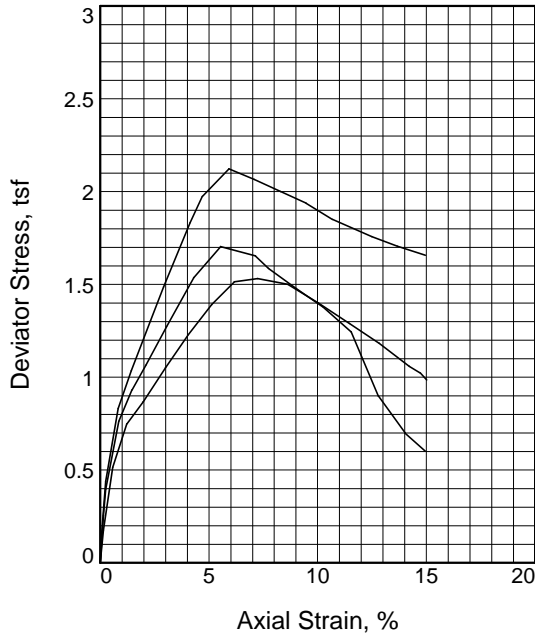
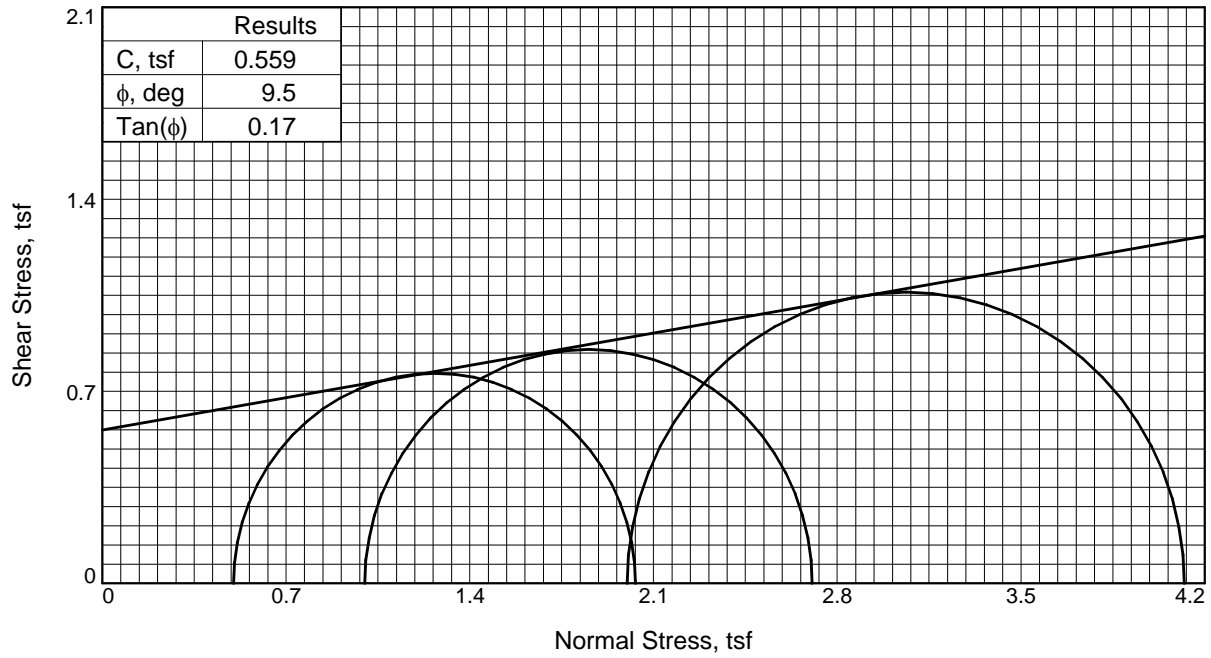
Strain rate, in./min. = 0.03

Fail. Stress = 1.612 tsf at reading no. 8

Ult. Stress = 0.493 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.6940	5.500	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.6910	10.300	4.8	0.1	0.222	2.000	2.222	1.11	2.111	0.111
2	-1.6840	16.200	10.7	0.4	0.494	2.000	2.494	1.25	2.247	0.247
3	-1.6560	24.900	19.4	1.4	0.887	2.000	2.887	1.44	2.444	0.444
4	-1.6290	29.500	24.0	2.3	1.087	2.000	3.087	1.54	2.544	0.544
5	-1.6010	33.400	27.9	3.3	1.251	2.000	3.251	1.63	2.625	0.625
6	-1.5730	37.400	31.9	4.3	1.416	2.000	3.416	1.71	2.708	0.708
7	-1.5310	41.300	35.8	5.8	1.564	2.000	3.564	1.78	2.782	0.782
8	-1.4890	43.000	37.5	7.3	1.612	2.000	3.612	1.81	2.806	0.806
9	-1.4470	39.700	34.2	8.8	1.446	2.000	3.446	1.72	2.723	0.723
10	-1.4050	33.000	27.5	10.3	1.144	2.000	3.144	1.57	2.572	0.572
11	-1.3630	28.100	22.6	11.8	0.925	2.000	2.925	1.46	2.462	0.462
12	-1.3210	23.900	18.4	13.3	0.740	2.000	2.740	1.37	2.370	0.370
13	-1.2790	19.100	13.6	14.8	0.537	2.000	2.537	1.27	2.269	0.269
14	-1.2730	18.000	12.5	15.0	0.493	2.000	2.493	1.25	2.246	0.246





Sample No.	1	2	3	
Initial	Water Content, %	37.4	37.9	37.8
	Dry Density, pcf	82.1	81.7	82.0
	Saturation, %	94.1	94.7	95.0
	Void Ratio	1.0923	1.1012	1.0930
	Diameter, in.	1.39	1.39	1.41
	Height, in.	2.79	2.82	2.81
At Test	Water Content, %	38.4	37.6	36.5
	Dry Density, pcf	82.1	81.7	82.0
	Saturation, %	96.8	94.0	91.7
	Void Ratio	1.0923	1.1012	1.0930
	Diameter, in.	1.39	1.39	1.41
	Height, in.	2.79	2.82	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Fail. Stress, tsf	1.53	1.70	2.12	
Ult. Stress, tsf	0.99	0.60	1.66	
σ_1 Failure, tsf	2.03	2.70	4.12	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5"

Description: FAT CLAY with layers of Silt, brown (CH)

LL= 82 PL= 20 PI= 62

Assumed Specific Gravity= 2.75

Remarks: Tested bottom portion of 5" thinwall.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #1

Depth: 8-10'

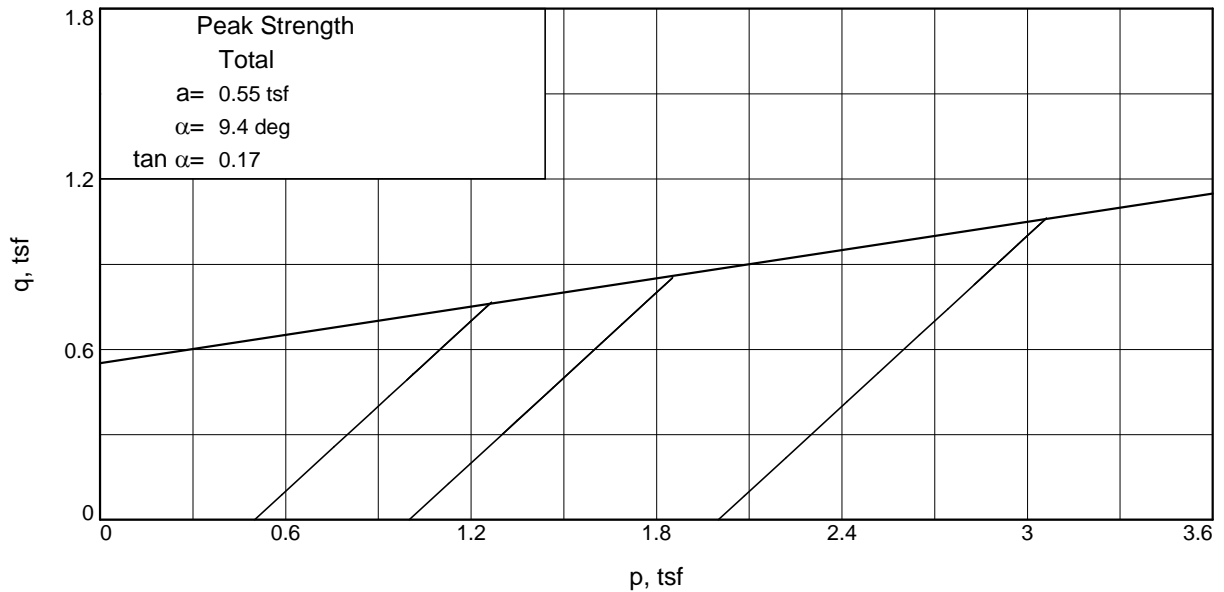
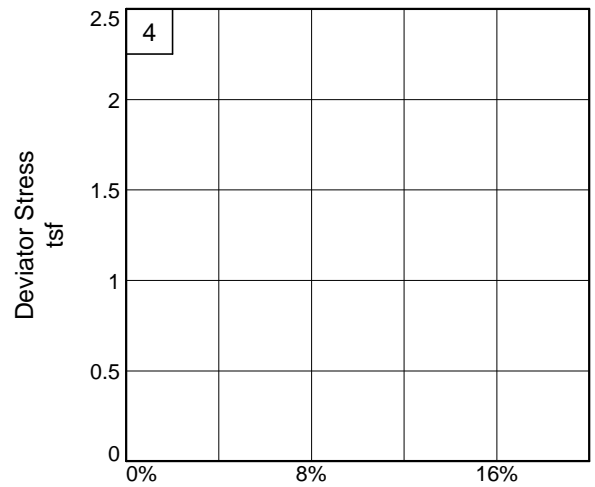
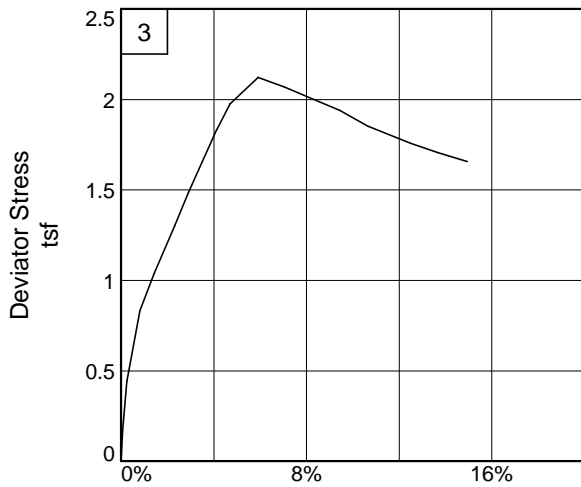
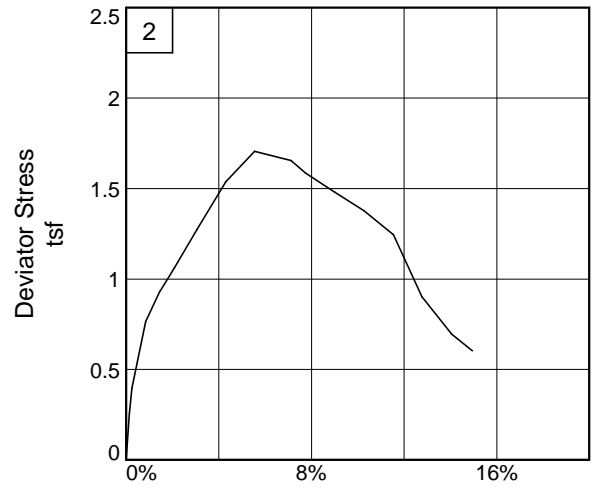
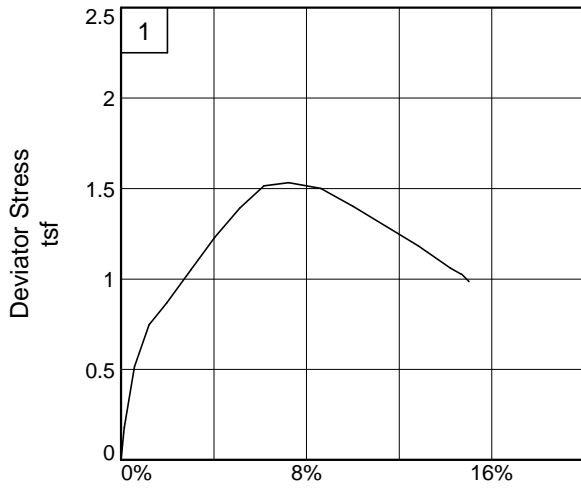
Sherack

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 8-10' **Sample Number:** Boring 09-25MU, #1

Project No.: BL-09-03127

Figure _____

Sherack

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:41 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 8-10' **Sample Number:** Boring 09-25MU, #1
Description: FAT CLAY with layers of Silt, brown (CH) **Sherack**
Remarks: Tested bottom portion of 5" thinwall.
Type of Sample: Thinwall, 5"
Assumed Specific Gravity=2.75 **LL=**82 **PL=**20 **PI=**62
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	94.120	156.280
Moisture content: Dry soil+tare, gms.	76.780	121.470
Moisture content: Tare, gms.	30.410	30.920
Moisture, %	37.4	38.4
Moist specimen weight, gms.	125.9	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.79	
Wet Density, pcf	112.7	
Dry density, pcf	82.1	
Void ratio	1.0923	
Saturation, %	94.1	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.532 tsf at reading no. 9
Ult. Stress = 0.986 tsf at reading no. 16

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7040	1.450	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	-1.7000	5.200	3.8	0.1	0.177	0.500	0.677	1.35	0.588	0.088
2	-1.6880	12.400	11.0	0.6	0.514	0.500	1.014	2.03	0.757	0.257
3	-1.6700	17.500	16.1	1.2	0.749	0.500	1.249	2.50	0.875	0.375
4	-1.6490	20.200	18.8	2.0	0.868	0.500	1.368	2.74	0.934	0.434
5	-1.6200	24.400	23.0	3.0	1.052	0.500	1.552	3.10	1.026	0.526
6	-1.5910	28.600	27.2	4.0	1.231	0.500	1.731	3.46	1.115	0.615
7	-1.5610	32.500	31.1	5.1	1.392	0.500	1.892	3.78	1.196	0.696
8	-1.5320	35.600	34.2	6.2	1.514	0.500	2.014	4.03	1.257	0.757
9	-1.5020	36.400	34.9	7.2	1.532	0.500	2.032	4.06	1.266	0.766
10	-1.4630	36.200	34.8	8.6	1.500	0.500	2.000	4.00	1.250	0.750
11	-1.4240	34.400	32.9	10.0	1.400	0.500	1.900	3.80	1.200	0.700
12	-1.3840	32.300	30.9	11.5	1.290	0.500	1.790	3.58	1.145	0.645
13	-1.3460	30.200	28.8	12.8	1.184	0.500	1.684	3.37	1.092	0.592
14	-1.3070	27.600	26.2	14.2	1.060	0.500	1.560	3.12	1.030	0.530
15	-1.2937	26.900	25.5	14.7	1.026	0.500	1.526	3.05	1.013	0.513
16	-1.2850	26.000	24.6	15.0	0.986	0.500	1.486	2.97	0.993	0.493

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	125.880	156.400
Moisture content: Dry soil+tare, gms.	99.610	121.920
Moisture content: Tare, gms.	30.360	30.280
Moisture, %	37.9	37.6
Moist specimen weight, gms.	126.9	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.82	
Wet Density, pcf	112.7	
Dry density, pcf	81.7	
Void ratio	1.1012	
Saturation, %	94.7	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.705 tsf at reading no. 8

Ult. Stress = 0.603 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7110	2.300	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.7070	7.700	5.4	0.1	0.255	1.000	1.255	1.25	1.127	0.127
2	-1.7040	10.700	8.4	0.2	0.396	1.000	1.396	1.40	1.198	0.198
3	-1.6870	18.600	16.3	0.9	0.764	1.000	1.764	1.76	1.382	0.382
4	-1.6700	22.300	20.0	1.5	0.931	1.000	1.931	1.93	1.466	0.466
5	-1.6520	25.300	23.0	2.1	1.064	1.000	2.064	2.06	1.532	0.532
6	-1.6250	30.100	27.8	3.1	1.273	1.000	2.273	2.27	1.637	0.637
7	-1.5900	36.300	34.0	4.3	1.537	1.000	2.537	2.54	1.769	0.769
8	-1.5550	40.500	38.2	5.5	1.705	1.000	2.705	2.70	1.852	0.852
9	-1.5100	40.000	37.7	7.1	1.654	1.000	2.654	2.65	1.827	0.827
10	-1.4930	38.700	36.4	7.7	1.587	1.000	2.587	2.59	1.793	0.793
11	-1.4570	36.700	34.4	9.0	1.479	1.000	2.479	2.48	1.739	0.739
12	-1.4220	34.800	32.5	10.3	1.378	1.000	2.378	2.38	1.689	0.689
13	-1.3860	32.100	29.8	11.5	1.245	1.000	2.245	2.25	1.623	0.623
14	-1.3510	24.100	21.8	12.8	0.898	1.000	1.898	1.90	1.449	0.449
15	-1.3160	19.500	17.2	14.0	0.699	1.000	1.699	1.70	1.349	0.349
16	-1.2900	17.300	15.0	15.0	0.603	1.000	1.603	1.60	1.301	0.301

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	81.240	160.790
Moisture content: Dry soil+tare, gms.	67.440	125.990
Moisture content: Tare, gms.	30.890	30.540
Moisture, %	37.8	36.5
Moist specimen weight, gms.	130.8	
Diameter, in.	1.41	
Area, in. ²	1.57	
Height, in.	2.81	
Wet Density, pcf	113.0	
Dry density, pcf	82.0	
Void ratio	1.0930	
Saturation, %	95.0	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

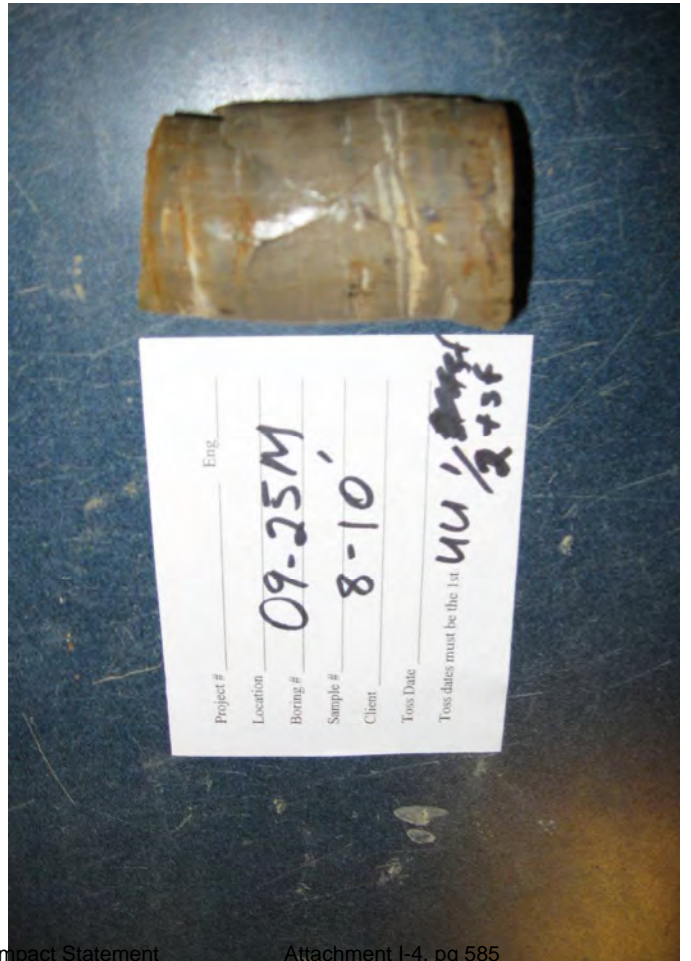
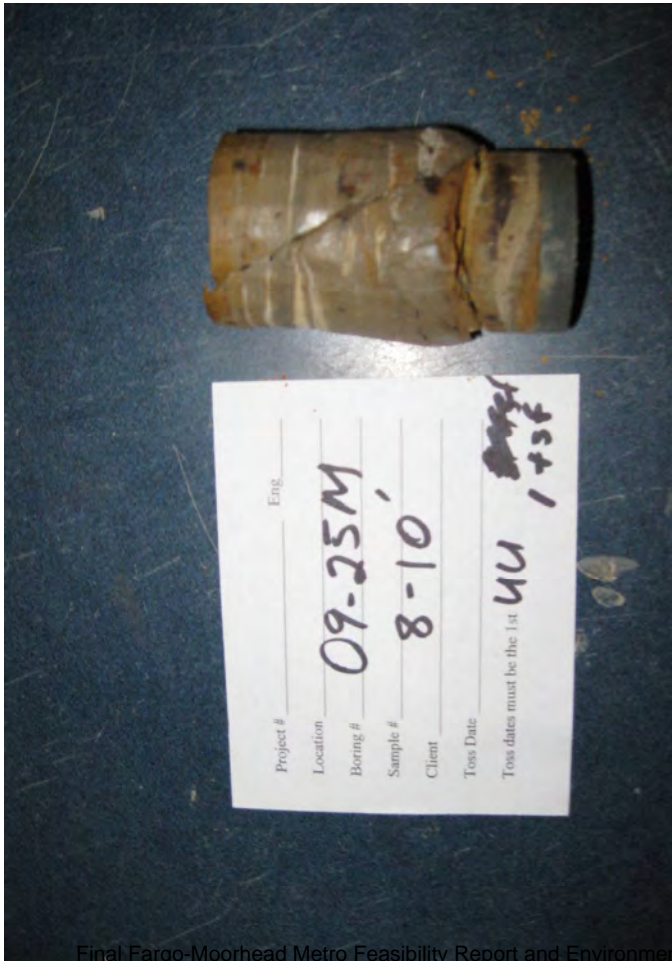
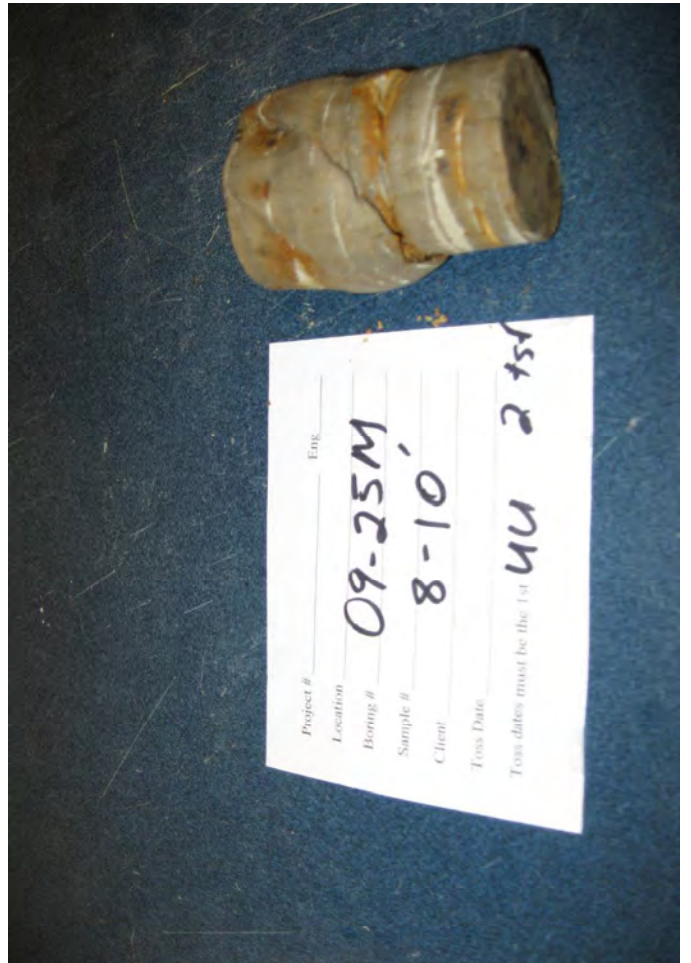
Back pressure = 0.000 tsf

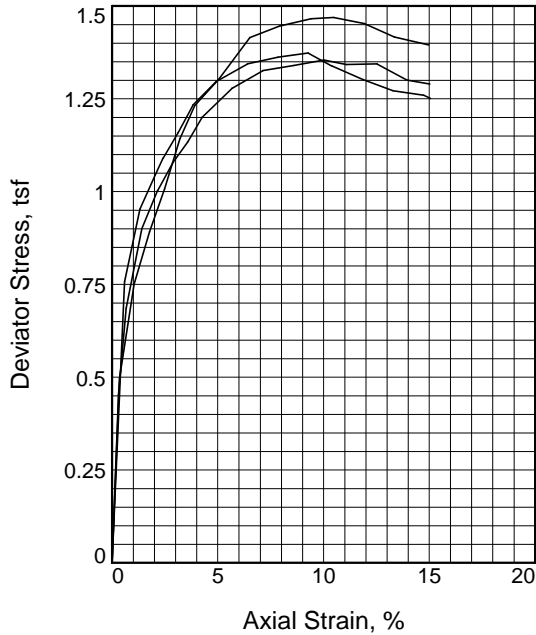
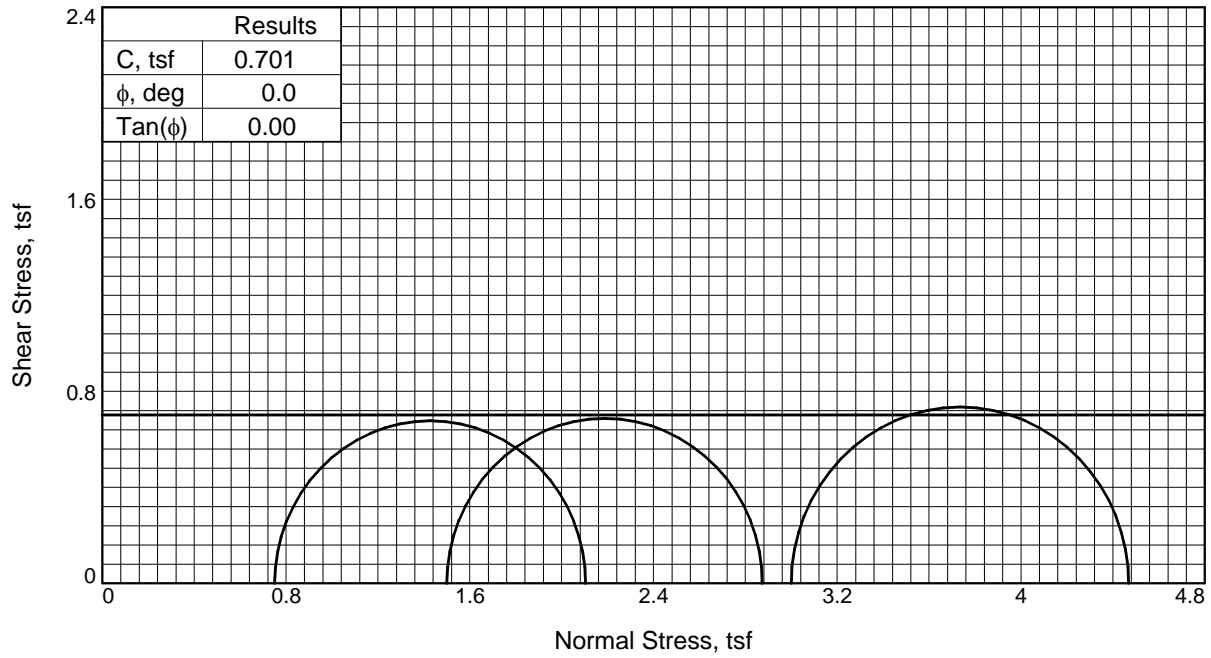
Strain rate, in./min. = 0.03

Fail. Stress = 2.123 tsf at reading no. 9

Ult. Stress = 1.657 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7000	5.300	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.6980	9.000	3.7	0.1	0.170	2.000	2.170	1.08	2.085	0.085
2	-1.6930	14.900	9.6	0.2	0.439	2.000	2.439	1.22	2.220	0.220
3	-1.6770	23.600	18.3	0.8	0.832	2.000	2.832	1.42	2.416	0.416
4	-1.6600	28.200	22.9	1.4	1.035	2.000	3.035	1.52	2.518	0.518
5	-1.6350	34.400	29.1	2.3	1.303	2.000	3.303	1.65	2.652	0.652
6	-1.6180	38.700	33.4	2.9	1.487	2.000	3.487	1.74	2.743	0.743
7	-1.5840	47.000	41.7	4.1	1.833	2.000	3.833	1.92	2.916	0.916
8	-1.5680	50.500	45.2	4.7	1.975	2.000	3.975	1.99	2.988	0.988
9	-1.5340	54.500	49.2	5.9	2.123	2.000	4.123	2.06	3.061	1.061
10	-1.5010	53.800	48.5	7.1	2.066	2.000	4.066	2.03	3.033	1.033
11	-1.4670	52.900	47.6	8.3	2.001	2.000	4.001	2.00	3.001	1.001
12	-1.4340	52.000	46.7	9.5	1.938	2.000	3.938	1.97	2.969	0.969
13	-1.4000	50.500	45.2	10.7	1.851	2.000	3.851	1.93	2.926	0.926
14	-1.3490	49.100	43.8	12.5	1.757	2.000	3.757	1.88	2.879	0.879
15	-1.3160	48.400	43.1	13.7	1.706	2.000	3.706	1.85	2.853	0.853
16	-1.2800	47.800	42.5	15.0	1.657	2.000	3.657	1.83	2.829	0.829





Sample No.	1	2	3	
Initial	Water Content, %	40.3	40.1	38.7
	Dry Density, pcf	81.4	81.7	83.1
	Saturation, %	99.9	100.0	100.0
	Void Ratio	1.1097	1.1018	1.0650
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	40.1	39.0	37.8
	Dry Density, pcf	81.4	81.7	83.1
	Saturation, %	99.3	97.2	97.6
	Void Ratio	1.1097	1.1018	1.0650
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.80	2.81	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Fail. Stress, tsf	1.35	1.37	1.47	
Ult. Stress, tsf	1.29	1.25	1.39	
σ_1 Failure, tsf	2.10	2.87	4.47	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 89 **PL=** 21 **PI=** 68

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

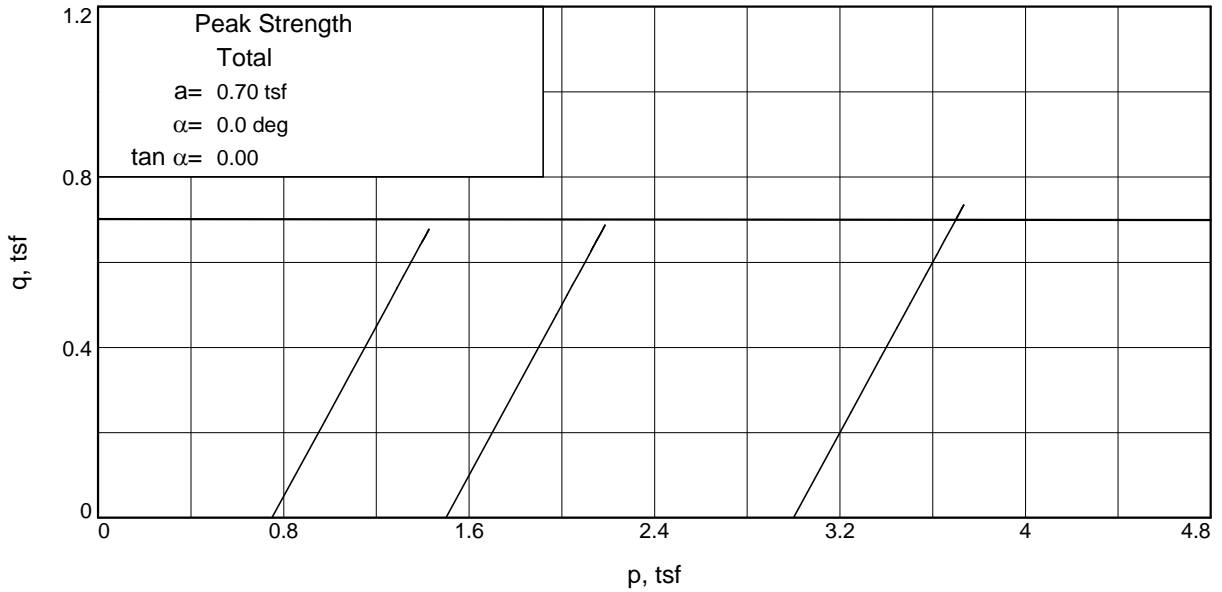
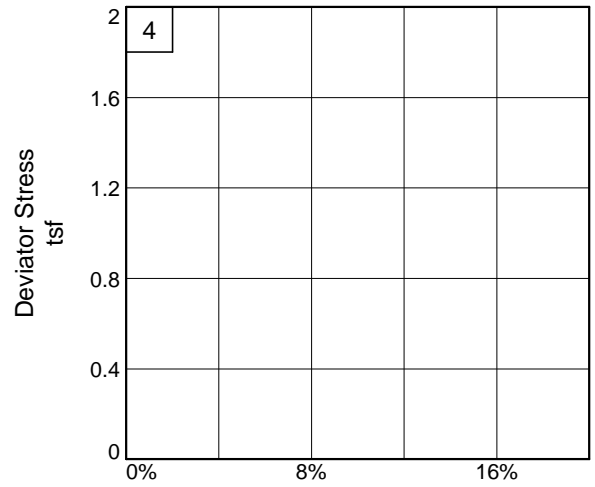
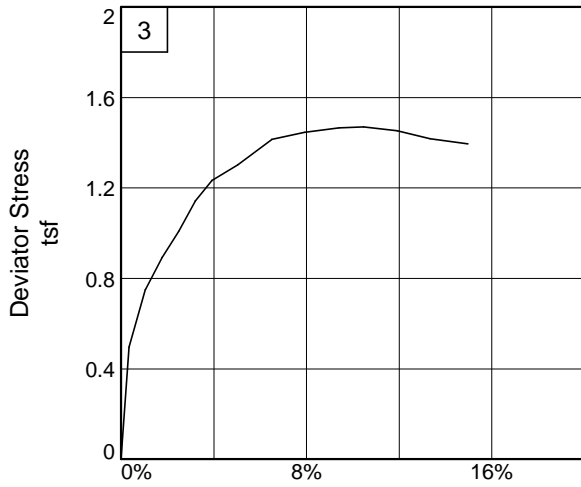
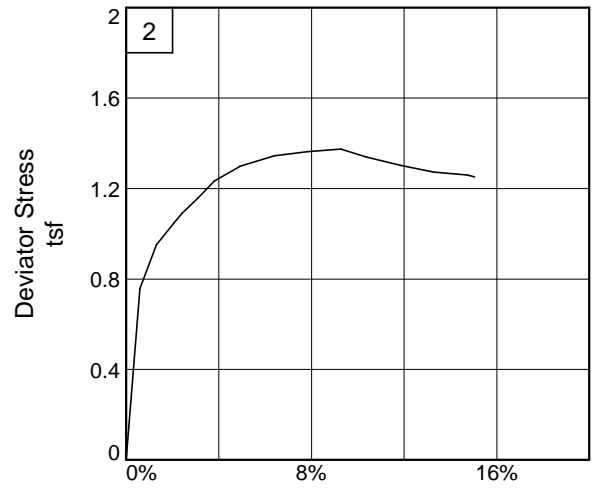
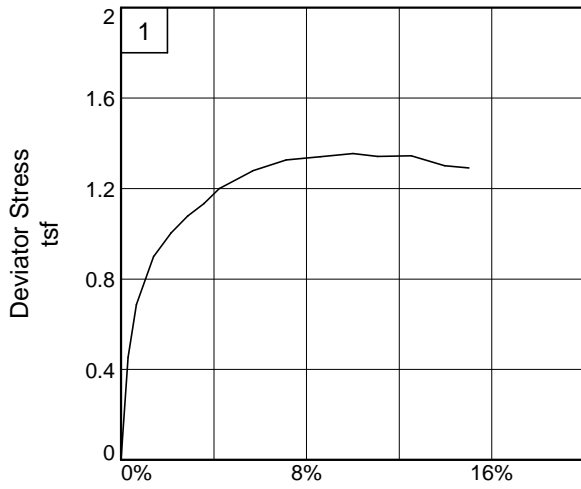
Location: WD-28, ND Div **Oxidized Brenna**

Sample Number: Boring 09-59MU, #1 **Depth:** 10-12'

Proj. No.: BL0903127A **Date Sampled:**

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Location: WD-28, ND Div

Depth: 10-12'

Sample Number: Boring 09-59MU, #1

Project No.: BL0903127A

Figure _____

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

2/23/2010

11:26 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-28, ND Div **Fargo**
Depth: 10-12' **Sample Number:** Boring 09-59MU, #1
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks:
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=89** **PL=21** **PI=68**
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	176.600	158.910
Moisture content: Dry soil+tare, gms.	134.620	122.100
Moisture content: Tare, gms.	30.500	30.200
Moisture, %	40.3	40.1
Moist specimen weight, gms.	129.1	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	114.2	
Dry density, pcf	81.4	
Void ratio	1.1097	
Saturation, %	99.9	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.354 tsf at reading no. 11
Ult. Stress = 1.290 tsf at reading no. 15

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	0.630	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0147	10.340	9.7	0.3	0.453	0.750	1.203	1.60	0.977	0.227
2	0.0248	15.370	14.7	0.7	0.686	0.750	1.436	1.91	1.093	0.343
3	0.0456	20.130	19.5	1.4	0.900	0.750	1.650	2.20	1.200	0.450
4	0.0664	22.520	21.9	2.2	1.003	0.750	1.753	2.34	1.252	0.502
5	0.0866	24.350	23.7	2.9	1.079	0.750	1.829	2.44	1.290	0.540
6	0.1062	25.740	25.1	3.6	1.134	0.750	1.884	2.51	1.317	0.567
7	0.1251	27.390	26.8	4.2	1.200	0.750	1.950	2.60	1.350	0.600
8	0.1652	29.570	28.9	5.7	1.279	0.750	2.029	2.70	1.389	0.639
9	0.2060	31.120	30.5	7.1	1.326	0.750	2.076	2.77	1.413	0.663
10	0.2469	31.930	31.3	8.6	1.340	0.750	2.090	2.79	1.420	0.670
11	0.2866	32.760	32.1	10.0	1.354	0.750	2.104	2.81	1.427	0.677
12	0.3166	32.860	32.2	11.1	1.342	0.750	2.092	2.79	1.421	0.671
13	0.3572	33.440	32.8	12.5	1.344	0.750	2.094	2.79	1.422	0.672
14	0.3974	32.890	32.3	14.0	1.300	0.750	2.050	2.73	1.400	0.650
15	0.4270	33.050	32.4	15.0	1.290	0.750	2.040	2.72	1.395	0.645

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	154.900	158.010
Moisture content: Dry soil+tare, gms.	119.550	122.200
Moisture content: Tare, gms.	31.300	30.280
Moisture, %	40.1	39.0
Moist specimen weight, gms.	128.1	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	114.4	
Dry density, pcf	81.7	
Void ratio	1.1018	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.374 tsf at reading no. 10

Ult. Stress = 1.251 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	2.010	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0228	18.060	16.0	0.6	0.757	1.500	2.257	1.50	1.879	0.379
2	0.0430	22.360	20.4	1.3	0.953	1.500	2.453	1.64	1.976	0.476
3	0.0635	24.500	22.5	2.0	1.045	1.500	2.545	1.70	2.023	0.523
4	0.0736	25.550	23.5	2.4	1.090	1.500	2.590	1.73	2.045	0.545
5	0.0935	27.230	25.2	3.1	1.159	1.500	2.659	1.77	2.080	0.580
6	0.1135	29.050	27.0	3.8	1.234	1.500	2.734	1.82	2.117	0.617
7	0.1442	30.760	28.8	4.9	1.297	1.500	2.797	1.86	2.149	0.649
8	0.1860	32.290	30.3	6.4	1.345	1.500	2.845	1.90	2.172	0.672
9	0.2266	33.170	31.2	7.8	1.362	1.500	2.862	1.91	2.181	0.681
10	0.2668	33.930	31.9	9.3	1.374	1.500	2.874	1.92	2.187	0.687
11	0.2977	33.500	31.5	10.4	1.339	1.500	2.839	1.89	2.170	0.670
12	0.3395	33.140	31.1	11.9	1.302	1.500	2.802	1.87	2.151	0.651
13	0.3793	32.920	30.9	13.3	1.272	1.500	2.772	1.85	2.136	0.636
14	0.4203	33.160	31.2	14.7	1.260	1.500	2.760	1.84	2.130	0.630
15	0.4290	33.050	31.0	15.0	1.251	1.500	2.751	1.83	2.126	0.626

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	132.300	160.680
Moisture content: Dry soil+tare, gms.	103.850	124.900
Moisture content: Tare, gms.	30.410	30.280
Moisture, %	38.7	37.8
Moist specimen weight, gms.	130.9	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	115.3	
Dry density, pcf	83.1	
Void ratio	1.0650	
Saturation, %	100.0	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

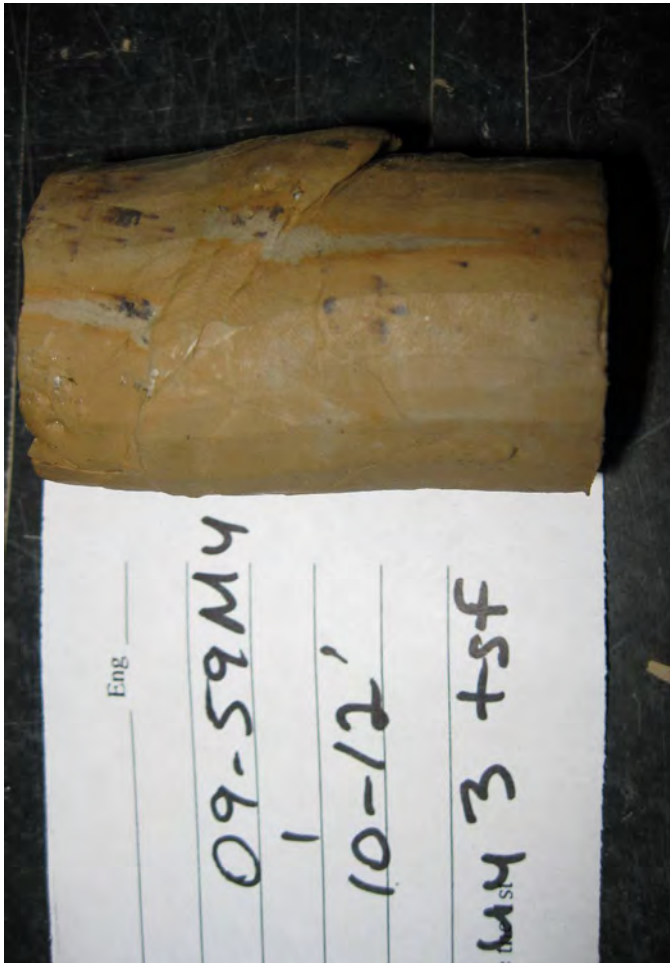
Back pressure = 0.000 tsf

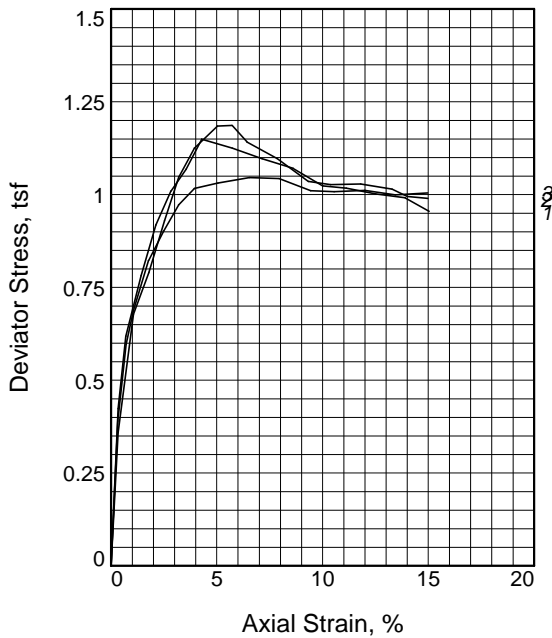
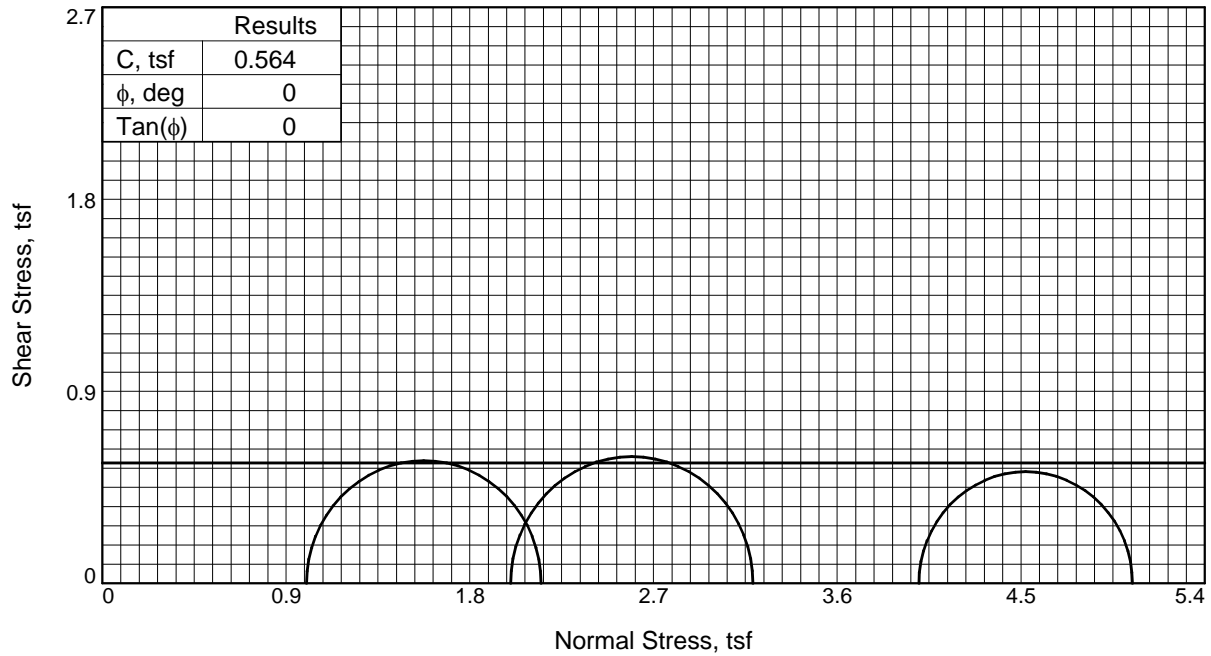
Strain rate, in./min. = 0.03

Fail. Stress = 1.469 tsf at reading no. 11

Ult. Stress = 1.395 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	8.450	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0159	19.070	10.6	0.3	0.496	3.000	3.496	1.17	3.248	0.248
2	0.0356	24.660	16.2	1.0	0.751	3.000	3.751	1.25	3.376	0.376
3	0.0559	27.830	19.4	1.8	0.892	3.000	3.892	1.30	3.446	0.446
4	0.0760	30.510	22.1	2.5	1.008	3.000	4.008	1.34	3.504	0.504
5	0.0964	33.660	25.2	3.2	1.143	3.000	4.143	1.38	3.571	0.571
6	0.1165	35.850	27.4	3.9	1.233	3.000	4.233	1.41	3.617	0.617
7	0.1479	37.750	29.3	5.0	1.303	3.000	4.303	1.43	3.652	0.652
8	0.1890	40.760	32.3	6.5	1.415	3.000	4.415	1.47	3.707	0.707
9	0.2289	41.970	33.5	7.9	1.446	3.000	4.446	1.48	3.723	0.723
10	0.2707	42.990	34.5	9.4	1.466	3.000	4.466	1.49	3.733	0.733
11	0.3005	43.480	35.0	10.5	1.469	3.000	4.469	1.49	3.735	0.735
12	0.3413	43.670	35.2	11.9	1.453	3.000	4.453	1.48	3.727	0.727
13	0.3814	43.360	34.9	13.3	1.417	3.000	4.417	1.47	3.708	0.708
14	0.4275	43.480	35.0	15.0	1.395	3.000	4.395	1.46	3.697	0.697





Sample No.		1	2	3
Initial	Water Content, %	46.4	46.5	47.3
	Dry Density, pcf	75.4	75.3	73.8
	Saturation, %	100.0	100.0	98.0
	Void Ratio	1.2756	1.2795	1.3268
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	44.6	46.2	48.2
	Dry Density, pcf	75.4	75.3	73.8
	Saturation, %	96.2	99.4	99.9
	Void Ratio	1.2756	1.2795	1.3268
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.80	2.81	2.81
Strain rate, in./min.		0.03	0.03	0.03
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.00	2.00	4.00
Fail. Stress, tsf		1.15	1.19	1.05
Ult. Stress, tsf		0.96	0.99	1.01
σ_1 Failure, tsf		2.15	3.19	5.05
σ_3 Failure, tsf		1.00	2.00	4.00

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 92 PL= 19 PI= 73

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

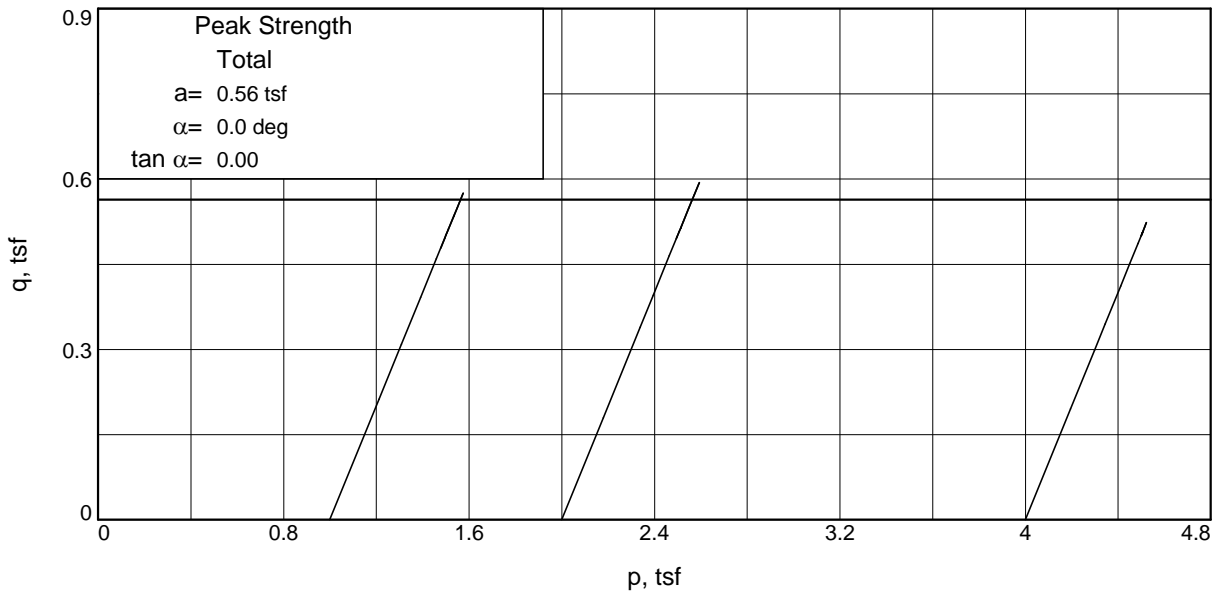
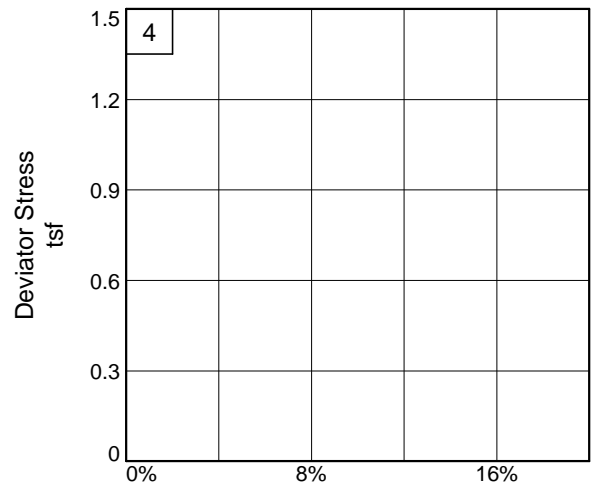
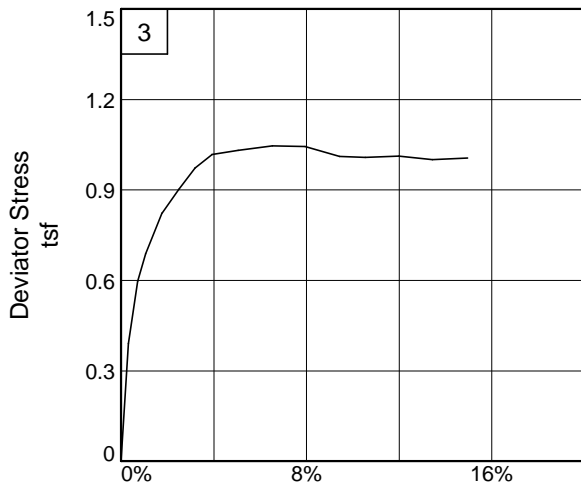
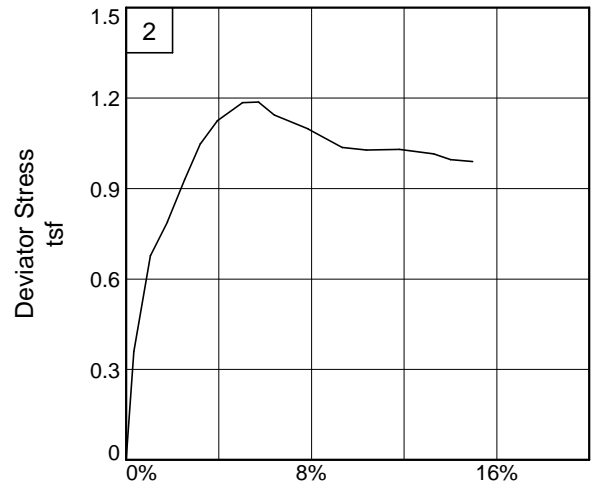
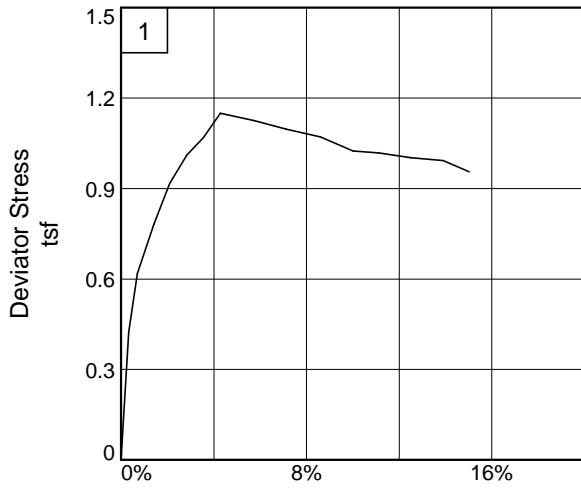
Location: WD-28, ND Div **Oxidized Brenna**

Sample Number: Boring 09-59MU, #2 **Depth:** 20-22'

Proj. No.: BL0903127A **Date Sampled:**

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Location: WD-28, ND Div

Depth: 20-22'

Sample Number: Boring 09-59MU, #2

Project No.: BL0903127A

Figure _____

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

2/23/2010

11:24 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-28, ND Div **Fargo**
Depth: 20-22' **Sample Number:** Boring 09-59MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks:
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=92** **PL=19** **PI=73**
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	124.110	155.200
Moisture content: Dry soil+tare, gms.	94.350	116.910
Moisture content: Tare, gms.	30.200	31.100
Moisture, %	46.4	44.6
Moist specimen weight, gms.	124.6	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	110.4	
Dry density, pcf	75.4	
Void ratio	1.2756	
Saturation, %	100.0	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.149 tsf at reading no. 7
Ult. Stress = 0.956 tsf at reading no. 15

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0060	0.970	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0152	10.030	9.1	0.3	0.424	1.000	1.424	1.42	1.212	0.212
2	0.0255	14.240	13.3	0.7	0.618	1.000	1.618	1.62	1.309	0.309
3	0.0457	17.880	16.9	1.4	0.782	1.000	1.782	1.78	1.391	0.391
4	0.0653	20.980	20.0	2.1	0.919	1.000	1.919	1.92	1.459	0.459
5	0.0851	23.130	22.2	2.8	1.010	1.000	2.010	2.01	1.505	0.505
6	0.1053	24.590	23.6	3.5	1.069	1.000	2.069	2.07	1.534	0.534
7	0.1260	26.570	25.6	4.3	1.149	1.000	2.149	2.15	1.575	0.575
8	0.1668	26.420	25.5	5.7	1.125	1.000	2.125	2.13	1.563	0.563
9	0.2058	26.150	25.2	7.1	1.097	1.000	2.097	2.10	1.548	0.548
10	0.2469	25.960	25.0	8.6	1.071	1.000	2.071	2.07	1.536	0.536
11	0.2866	25.230	24.3	10.0	1.024	1.000	2.024	2.02	1.512	0.512
12	0.3173	25.380	24.4	11.1	1.018	1.000	2.018	2.02	1.509	0.509
13	0.3564	25.380	24.4	12.5	1.002	1.000	2.002	2.00	1.501	0.501
14	0.3955	25.540	24.6	13.9	0.992	1.000	1.992	1.99	1.496	0.496
15	0.4270	24.950	24.0	15.0	0.956	1.000	1.956	1.96	1.478	0.478

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	178.590	154.470
Moisture content: Dry soil+tare, gms.	131.530	115.170
Moisture content: Tare, gms.	30.410	30.190
Moisture, %	46.5	46.2
Moist specimen weight, gms.	124.8	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	110.4	
Dry density, pcf	75.3	
Void ratio	1.2795	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.187 tsf at reading no. 8

Ult. Stress = 0.990 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0082	4.080	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0177	11.740	7.7	0.3	0.359	2.000	2.359	1.18	2.179	0.179
2	0.0378	18.670	14.6	1.1	0.678	2.000	2.678	1.34	2.339	0.339
3	0.0582	21.200	17.1	1.8	0.790	2.000	2.790	1.39	2.395	0.395
4	0.0793	24.380	20.3	2.5	0.929	2.000	2.929	1.46	2.465	0.465
5	0.0985	27.150	23.1	3.2	1.049	2.000	3.049	1.52	2.524	0.524
6	0.1189	29.020	24.9	3.9	1.125	2.000	3.125	1.56	2.563	0.563
7	0.1492	30.630	26.5	5.0	1.185	2.000	3.185	1.59	2.592	0.592
8	0.1690	30.880	26.8	5.7	1.187	2.000	3.187	1.59	2.593	0.593
9	0.1885	30.080	26.0	6.4	1.143	2.000	3.143	1.57	2.571	0.571
10	0.2291	29.440	25.4	7.9	1.098	2.000	3.098	1.55	2.549	0.549
11	0.2707	28.410	24.3	9.3	1.036	2.000	3.036	1.52	2.518	0.518
12	0.2998	28.480	24.4	10.4	1.027	2.000	3.027	1.51	2.514	0.514
13	0.3397	28.920	24.8	11.8	1.029	2.000	3.029	1.51	2.515	0.515
14	0.3814	28.990	24.9	13.3	1.015	2.000	3.015	1.51	2.507	0.507
15	0.4019	28.720	24.6	14.0	0.995	2.000	2.995	1.50	2.498	0.498
16	0.4290	28.860	24.8	15.0	0.990	2.000	2.990	1.49	2.495	0.495

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	123.490	152.010
Moisture content: Dry soil+tare, gms.	93.600	112.340
Moisture content: Tare, gms.	30.380	30.050
Moisture, %	47.3	48.2
Moist specimen weight, gms.	122.4	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	108.7	
Dry density, pcf	73.8	
Void ratio	1.3268	
Saturation, %	98.0	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

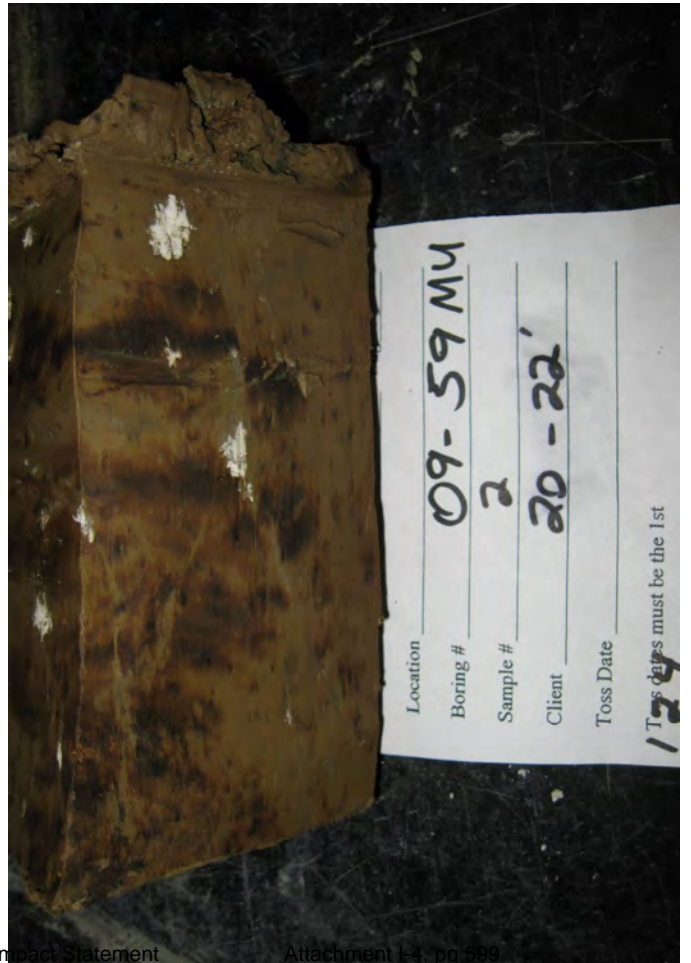
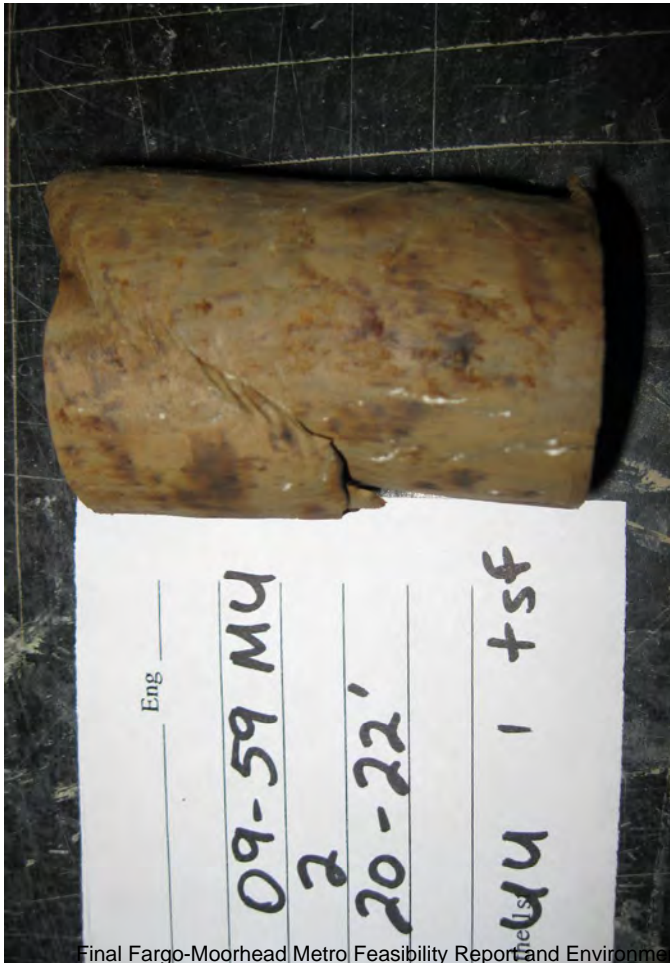
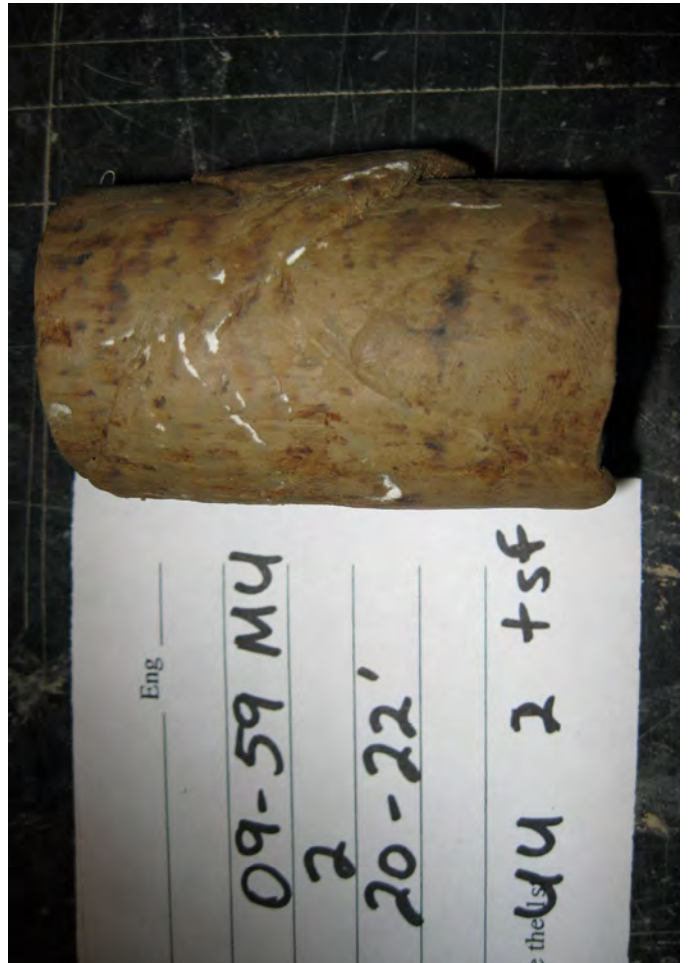
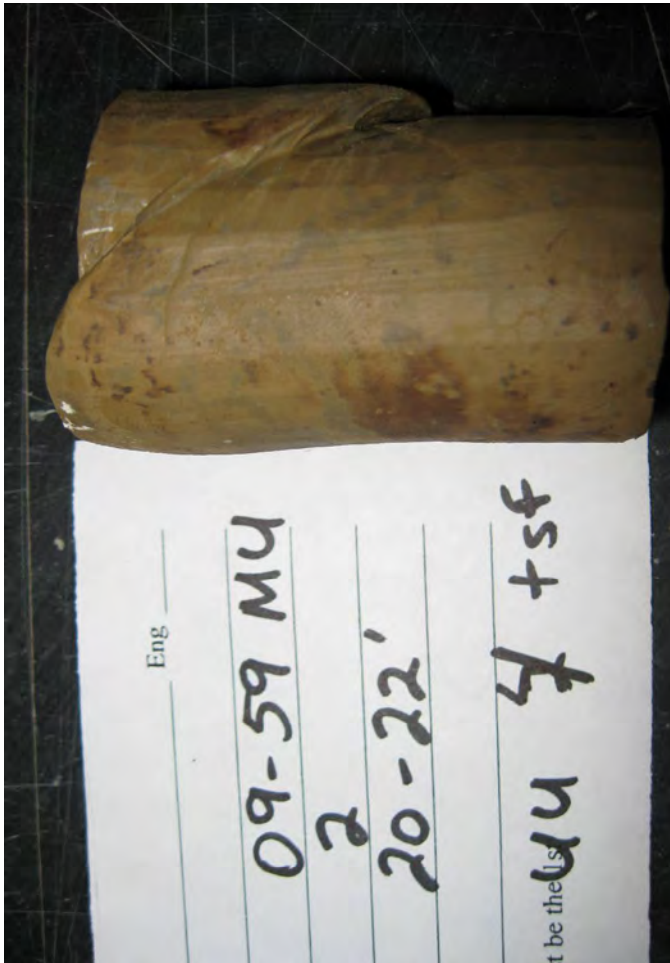
Back pressure = 0.000 tsf

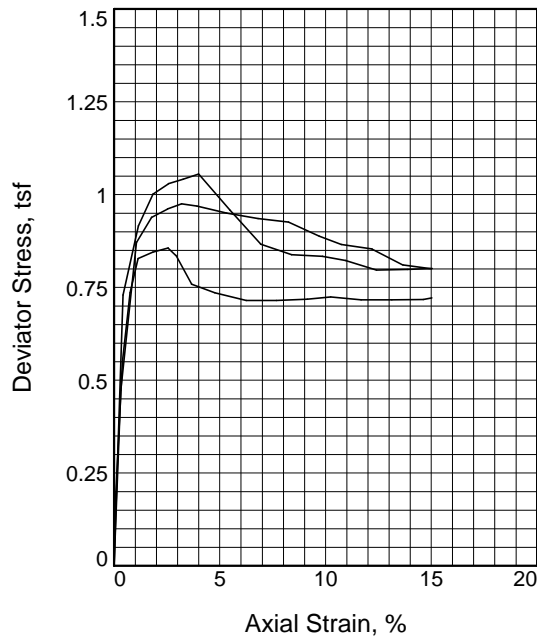
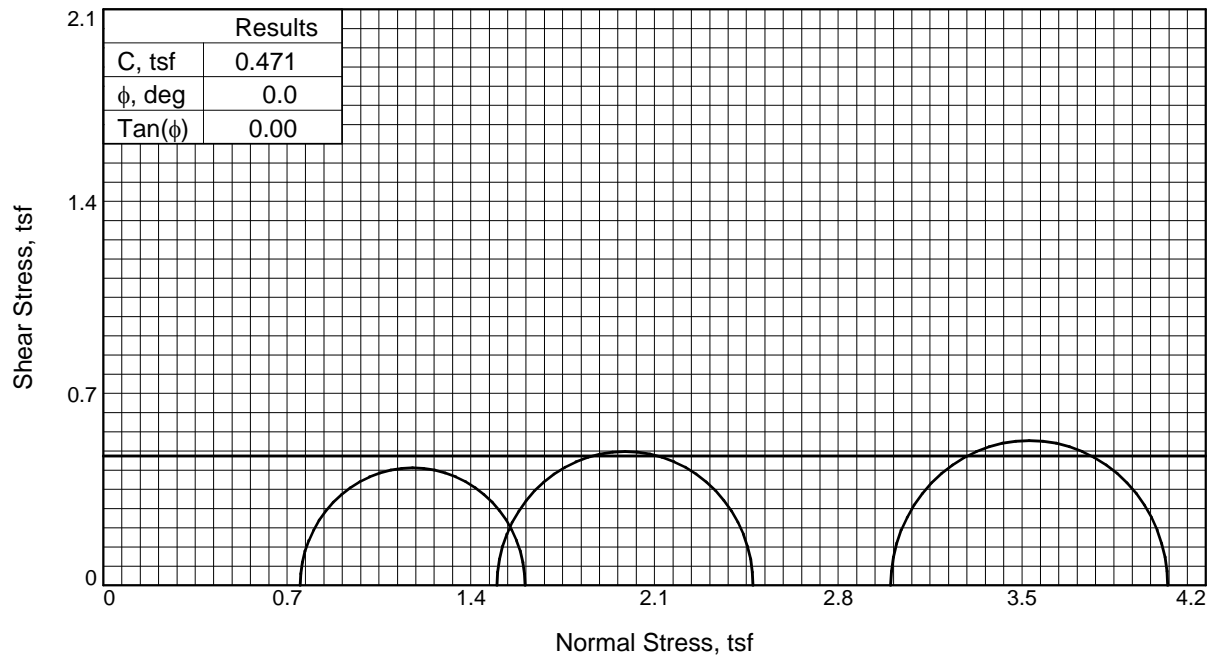
Strain rate, in./min. = 0.03

Fail. Stress = 1.046 tsf at reading no. 9

Ult. Stress = 1.005 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0079	9.450	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0169	17.750	8.3	0.3	0.390	4.000	4.390	1.10	4.195	0.195
2	0.0279	22.210	12.8	0.7	0.597	4.000	4.597	1.15	4.298	0.298
3	0.0377	24.220	14.8	1.1	0.688	4.000	4.688	1.17	4.344	0.344
4	0.0577	27.230	17.8	1.8	0.823	4.000	4.823	1.21	4.411	0.411
5	0.0777	29.080	19.6	2.5	0.902	4.000	4.902	1.23	4.451	0.451
6	0.0976	30.790	21.3	3.2	0.973	4.000	4.973	1.24	4.487	0.487
7	0.1182	31.920	22.5	3.9	1.017	4.000	5.017	1.25	4.508	0.508
8	0.1497	32.500	23.1	5.1	1.031	4.000	5.031	1.26	4.515	0.515
9	0.1913	33.210	23.8	6.5	1.046	4.000	5.046	1.26	4.523	0.523
10	0.2311	33.510	24.1	8.0	1.043	4.000	5.043	1.26	4.522	0.522
11	0.2728	33.140	23.7	9.4	1.011	4.000	5.011	1.25	4.505	0.505
12	0.3039	33.370	23.9	10.5	1.008	4.000	5.008	1.25	4.504	0.504
13	0.3447	33.860	24.4	12.0	1.012	4.000	5.012	1.25	4.506	0.506
14	0.3852	33.970	24.5	13.4	1.000	4.000	5.000	1.25	4.500	0.500
15	0.4280	34.540	25.1	15.0	1.005	4.000	5.005	1.25	4.503	0.503





	1	2	3
Sample No.			
Initial			
Water Content, %	59.8	59.4	60.0
Dry Density, pcf	64.0	64.4	64.3
Saturation, %	98.9	99.2	100.0
Void Ratio	1.6328	1.6167	1.6205
Diameter, in.	1.41	1.39	1.39
Height, in.	2.79	2.80	2.81
At Test			
Water Content, %	58.0	57.0	59.7
Dry Density, pcf	64.0	64.4	64.3
Saturation, %	95.9	95.1	99.4
Void Ratio	1.6328	1.6167	1.6205
Diameter, in.	1.41	1.39	1.39
Height, in.	2.79	2.80	2.81
Strain rate, in./min.	0.03	0.03	0.03
Back Pressure, tsf	0.00	0.00	0.00
Cell Pressure, tsf	0.75	1.50	3.00
Fail. Stress, tsf	0.86	0.98	1.06
Ult. Stress, tsf	0.72	0.80	0.80
σ_1 Failure, tsf	1.61	2.48	4.06
σ_3 Failure, tsf	0.75	1.50	3.00

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 113 **PL=** 26 **PI=** 87

Assumed Specific Gravity= 2.70

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Oxidized Brenna

Location: WD-05, ND Div, ~~Sherack Formation~~

Sample Number: Boring 09-60MU, #1

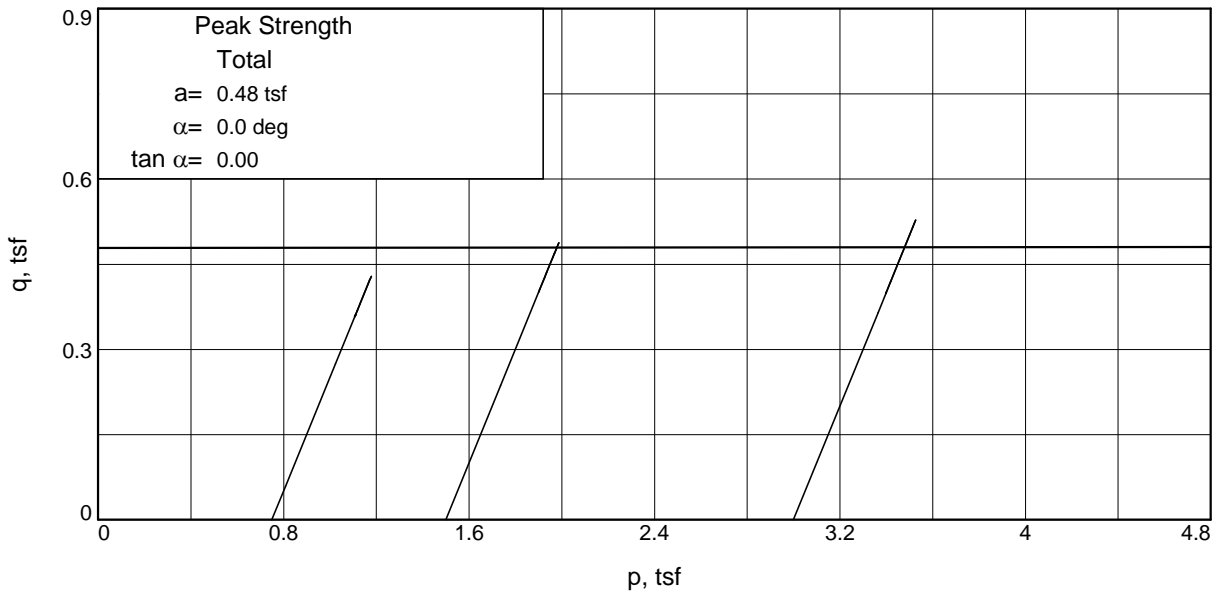
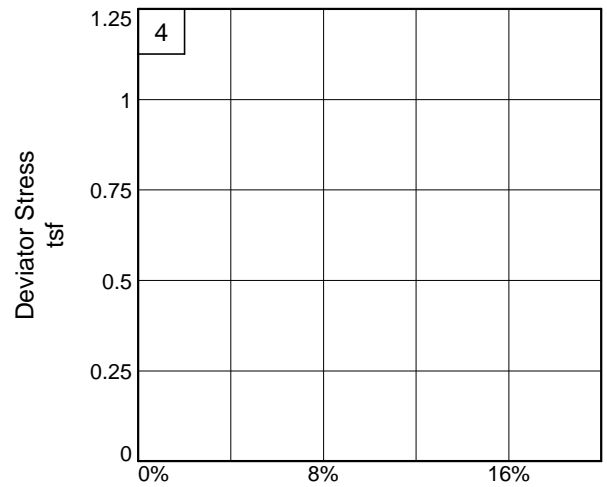
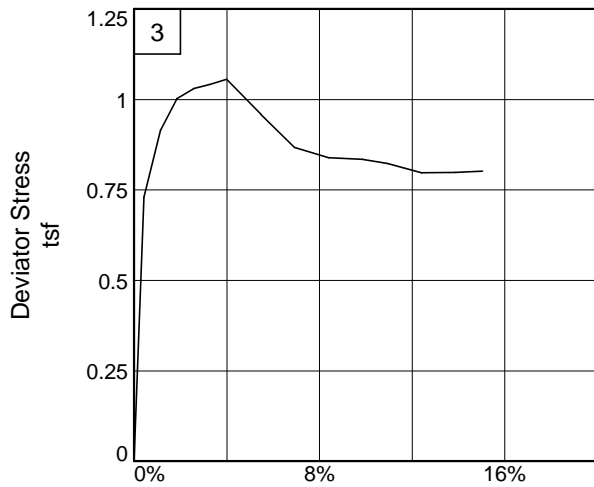
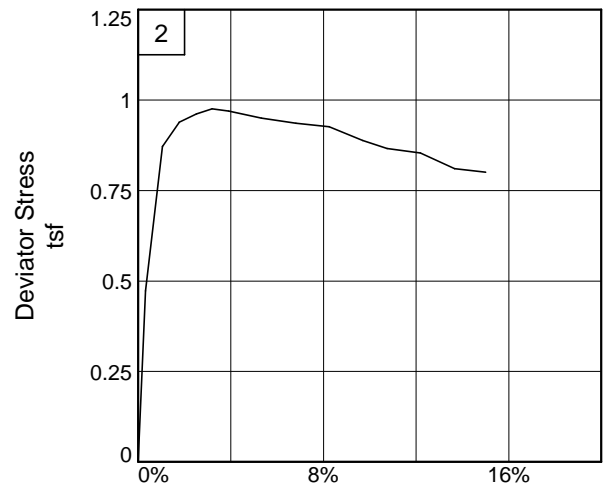
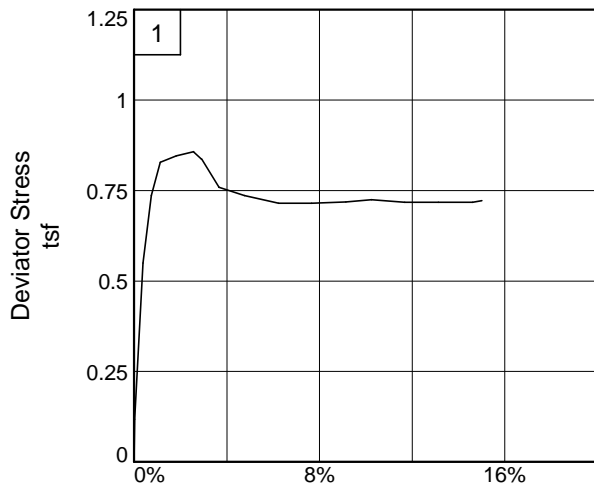
Depth: 15-17'

Proj. No.: BL0903127A

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Loc.: WD-05, ND Div, Sherack Formation **Depth:** 15-17'

Sample No.: Boring 09-60MU, #1

Project No.: BL0903127A **Figure** _____

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

2/23/2010

11:23 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-05, ND Div, Sherack Formation **Fargo**
Depth: 15-17' **Sample Number:** Boring 09-60MU, #1
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks:
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.70 **LL=**113 **PL=**26 **PI=**87
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	125.500	147.000
Moisture content: Dry soil+tare, gms.	89.790	104.350
Moisture content: Tare, gms.	30.100	30.800
Moisture, %	59.8	58.0
Moist specimen weight, gms.	116.8	
Diameter, in.	1.41	
Area, in. ²	1.56	
Height, in.	2.79	
Wet Density, pcf	102.3	
Dry density, pcf	64.0	
Void ratio	1.6328	
Saturation, %	98.9	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 0.857 tsf **at reading no. 6**
Ult. Stress = 0.722 tsf **at reading no. 17**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	-0.220	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0072	2.340	2.6	0.0	0.118	0.750	0.868	1.16	0.809	0.059
2	0.0174	11.740	12.0	0.4	0.549	0.750	1.299	1.73	1.025	0.275
3	0.0275	15.860	16.1	0.8	0.736	0.750	1.486	1.98	1.118	0.368
4	0.0381	17.940	18.2	1.1	0.828	0.750	1.578	2.10	1.164	0.414
5	0.0574	18.450	18.7	1.8	0.845	0.750	1.595	2.13	1.173	0.423
6	0.0780	18.850	19.1	2.6	0.857	0.750	1.607	2.14	1.178	0.428
7	0.0878	18.470	18.7	2.9	0.837	0.750	1.587	2.12	1.168	0.418
8	0.1087	16.860	17.1	3.7	0.759	0.750	1.509	2.01	1.129	0.379
9	0.1395	16.530	16.8	4.8	0.736	0.750	1.486	1.98	1.118	0.368
10	0.1805	16.310	16.5	6.2	0.715	0.750	1.465	1.95	1.107	0.357
11	0.2202	16.570	16.8	7.7	0.715	0.750	1.465	1.95	1.107	0.357
12	0.2612	16.930	17.2	9.1	0.719	0.750	1.469	1.96	1.109	0.359
13	0.2920	17.290	17.5	10.2	0.725	0.750	1.475	1.97	1.112	0.362
14	0.3320	17.390	17.6	11.7	0.717	0.750	1.467	1.96	1.109	0.359
15	0.3725	17.680	17.9	13.1	0.717	0.750	1.467	1.96	1.108	0.358
16	0.4136	18.010	18.2	14.6	0.718	0.750	1.468	1.96	1.109	0.359
17	0.4250	18.200	18.4	15.0	0.722	0.750	1.472	1.96	1.111	0.361

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	139.600	144.800
Moisture content: Dry soil+tare, gms.	99.240	103.170
Moisture content: Tare, gms.	31.300	30.100
Moisture, %	59.4	57.0
Moist specimen weight, gms.	115.1	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	102.7	
Dry density, pcf	64.4	
Void ratio	1.6167	
Saturation, %	99.2	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 0.975 tsf at reading no. 5

Ult. Stress = 0.801 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	0.230	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0154	10.280	10.0	0.3	0.473	1.500	1.973	1.32	1.736	0.236
2	0.0361	18.910	18.7	1.1	0.872	1.500	2.372	1.58	1.936	0.436
3	0.0562	20.490	20.3	1.8	0.939	1.500	2.439	1.63	1.969	0.469
4	0.0771	21.140	20.9	2.5	0.962	1.500	2.462	1.64	1.981	0.481
5	0.0960	21.590	21.4	3.2	0.975	1.500	2.475	1.65	1.988	0.488
6	0.1160	21.620	21.4	3.9	0.970	1.500	2.470	1.65	1.985	0.485
7	0.1556	21.500	21.3	5.3	0.950	1.500	2.450	1.63	1.975	0.475
8	0.1971	21.510	21.3	6.8	0.936	1.500	2.436	1.62	1.968	0.468
9	0.2373	21.630	21.4	8.2	0.926	1.500	2.426	1.62	1.963	0.463
10	0.2779	21.080	20.9	9.7	0.888	1.500	2.388	1.59	1.944	0.444
11	0.3072	20.790	20.6	10.7	0.866	1.500	2.366	1.58	1.933	0.433
12	0.3477	20.840	20.6	12.2	0.854	1.500	2.354	1.57	1.927	0.427
13	0.3888	20.130	19.9	13.7	0.811	1.500	2.311	1.54	1.905	0.405
14	0.4266	20.200	20.0	15.0	0.801	1.500	2.301	1.53	1.900	0.400

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	127.700	145.500
Moisture content: Dry soil+tare, gms.	91.550	102.630
Moisture content: Tare, gms.	31.300	30.800
Moisture, %	60.0	59.7
Moist specimen weight, gms.	115.4	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	102.9	
Dry density, pcf	64.3	
Void ratio	1.6205	
Saturation, %	100.0	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

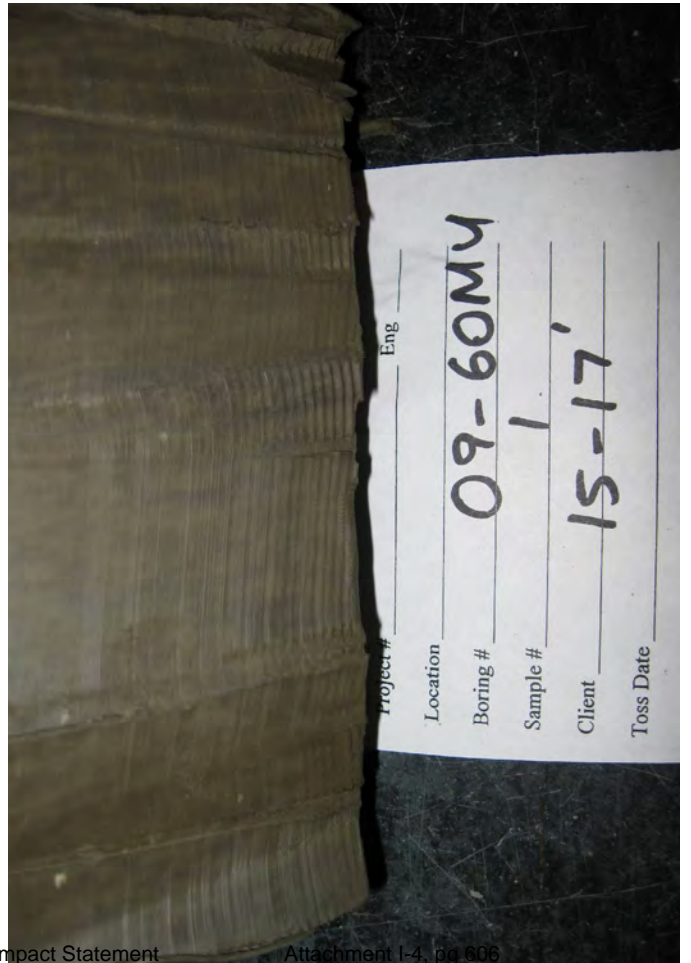
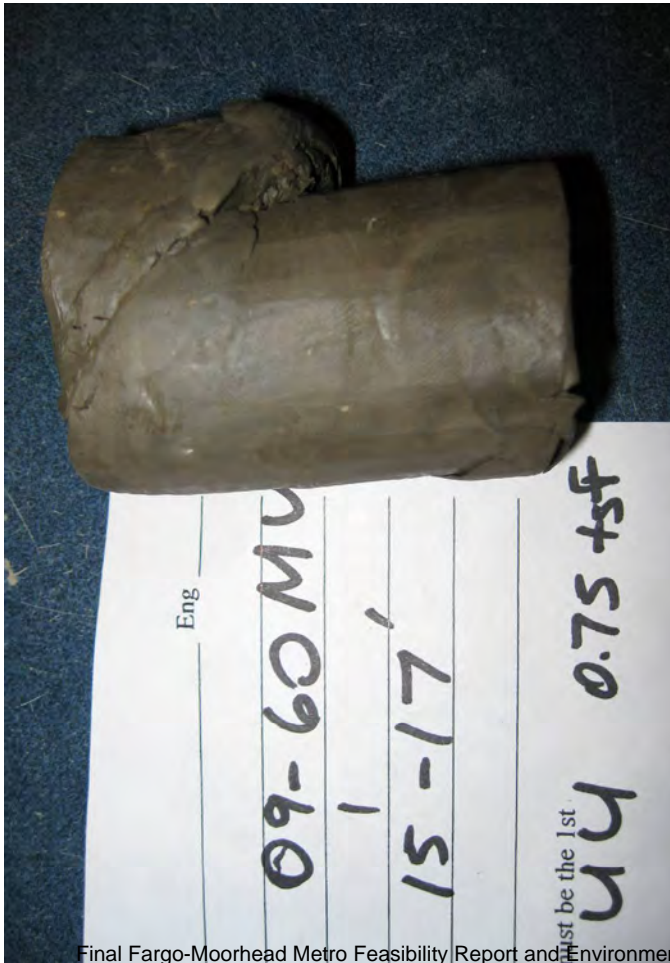
Back pressure = 0.000 tsf

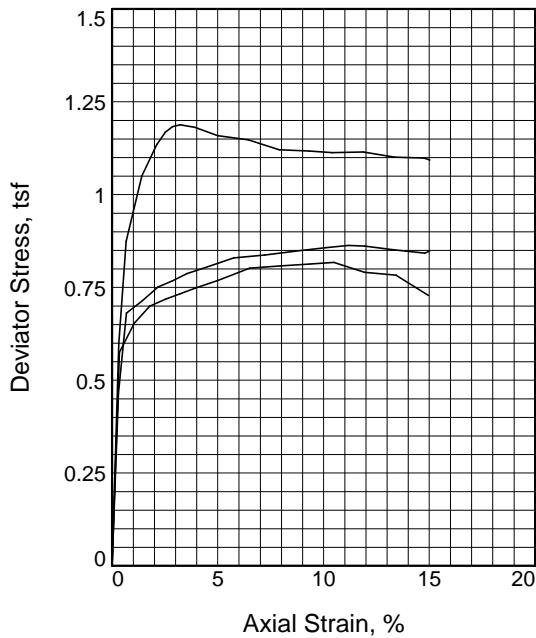
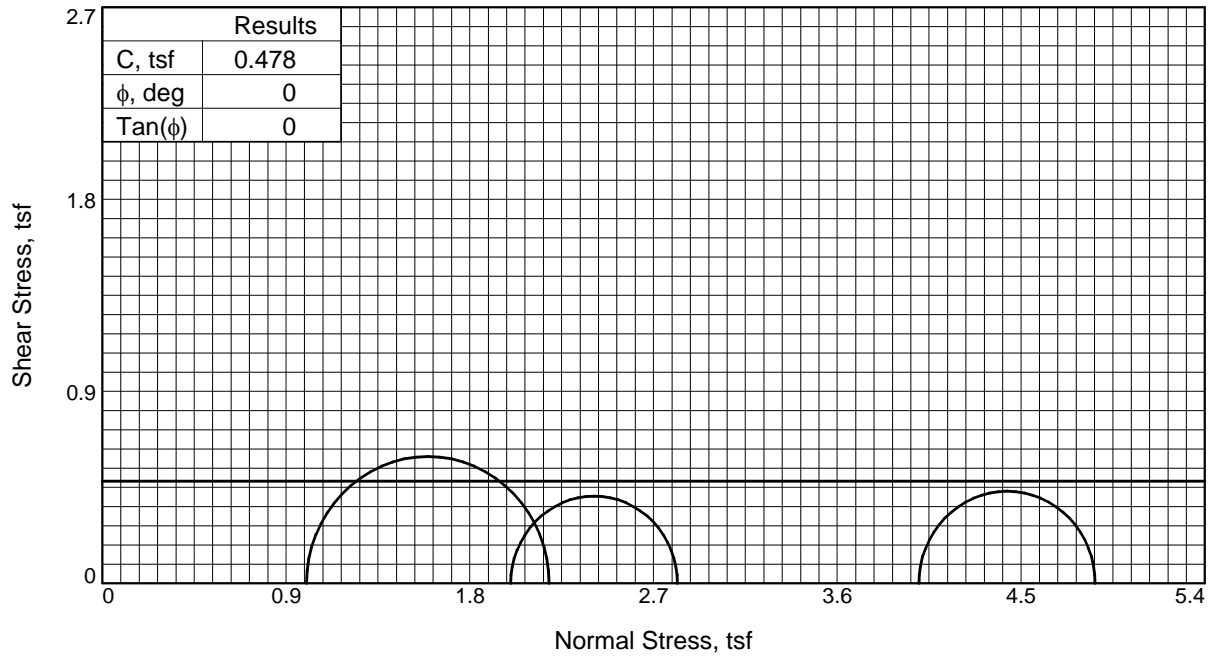
Strain rate, in./min. = 0.03

Fail. Stress = 1.055 tsf at reading no. 6

Ult. Stress = 0.801 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	5.820	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0180	21.290	15.5	0.4	0.730	3.000	3.730	1.24	3.365	0.365
2	0.0383	25.380	19.6	1.1	0.916	3.000	3.916	1.31	3.458	0.458
3	0.0582	27.370	21.6	1.9	1.002	3.000	4.002	1.33	3.501	0.501
4	0.0784	28.130	22.3	2.6	1.030	3.000	4.030	1.34	3.515	0.515
5	0.0980	28.550	22.7	3.3	1.042	3.000	4.042	1.35	3.521	0.521
6	0.1182	29.020	23.2	4.0	1.055	3.000	4.055	1.35	3.528	0.528
7	0.1603	27.220	21.4	5.5	0.958	3.000	3.958	1.32	3.479	0.479
8	0.2011	25.480	19.7	6.9	0.867	3.000	3.867	1.29	3.433	0.433
9	0.2422	25.140	19.3	8.4	0.838	3.000	3.838	1.28	3.419	0.419
10	0.2831	25.350	19.5	9.9	0.834	3.000	3.834	1.28	3.417	0.417
11	0.3138	25.320	19.5	10.9	0.823	3.000	3.823	1.27	3.411	0.411
12	0.3549	25.030	19.2	12.4	0.797	3.000	3.797	1.27	3.399	0.399
13	0.3956	25.380	19.6	13.9	0.798	3.000	3.798	1.27	3.399	0.399
14	0.4290	25.730	19.9	15.0	0.801	3.000	3.801	1.27	3.401	0.401





Sample No.	1	2	3	
Initial	Water Content, %	55.7	57.0	57.9
	Dry Density, pcf	67.2	66.4	65.5
	Saturation, %	99.7	100.0	99.4
	Void Ratio	1.5080	1.5397	1.5727
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.81	2.80	2.80
At Test	Water Content, %	53.9	56.9	58.0
	Dry Density, pcf	67.2	66.4	65.5
	Saturation, %	96.6	99.7	99.5
	Void Ratio	1.5080	1.5397	1.5727
	Diameter, in.	1.41	1.40	1.40
	Height, in.	2.81	2.80	2.80
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Fail. Stress, tsf	1.19	0.82	0.86	
Ult. Stress, tsf	1.09	0.73	0.85	
σ_1 Failure, tsf	2.19	2.82	4.86	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, brown (CH)

LL= 106 **PL=** 24 **PI=** 82

Assumed Specific Gravity= 2.70

Remarks:

Figure UU Triax ASTM D 2850

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Oxidized Brenna

Location: WD-05, ND Div, ~~Sherack Formation~~

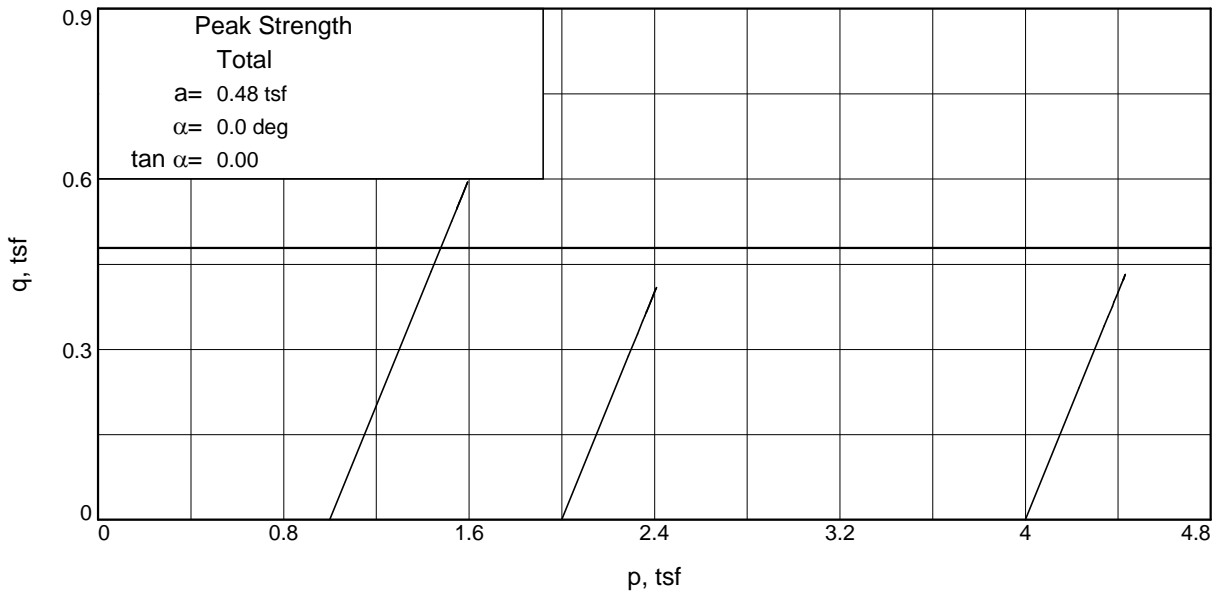
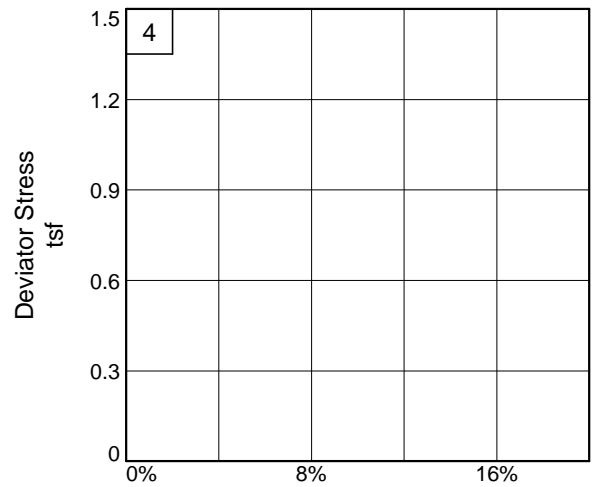
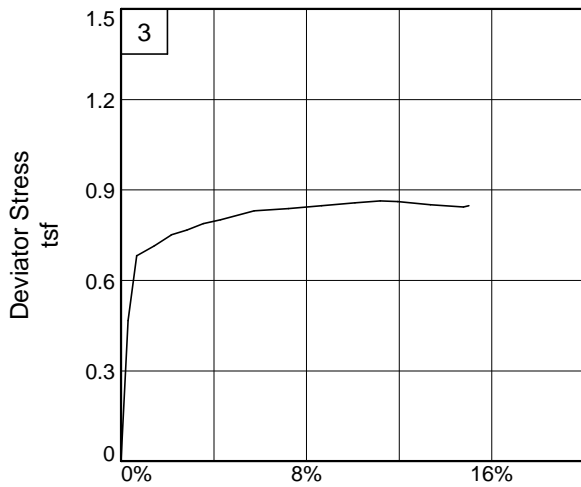
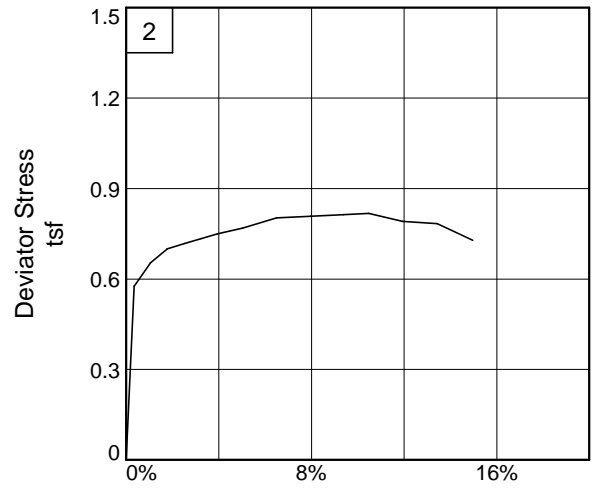
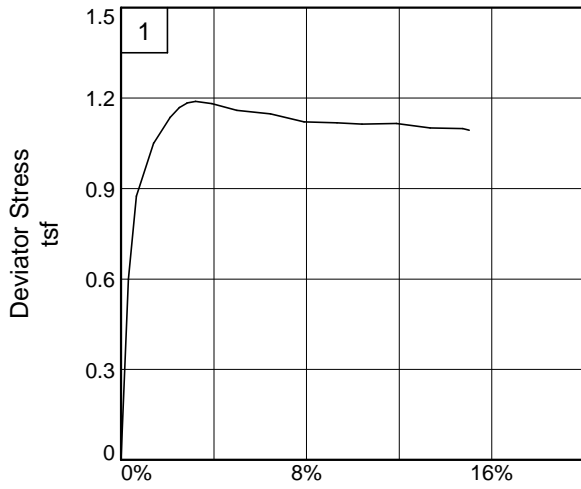
Sample Number: Boring 09-60MU, #2

Depth: 25-27'

Proj. No.: BL0903127A

Date Sampled:

BRAUNSM
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Oxidized Brenna

Loc.: WD-05, ND Div, Sherack Formation **Depth:** 25-27'

Sample No.: Boring 09-60MU, #2

Project No.: BL0903127A

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

2/23/2010

11:26 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-05, ND Div, Sherack Formation **Fargo**
Depth: 25-27' **Sample Number:** Boring 09-60MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks:
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.70 **LL=**106 **PL=**24 **PI=**82
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	159.490	151.290
Moisture content: Dry soil+tare, gms.	113.510	109.170
Moisture content: Tare, gms.	30.900	31.090
Moisture, %	55.7	53.9
Moist specimen weight, gms.	120.7	
Diameter, in.	1.41	
Area, in. ²	1.57	
Height, in.	2.81	
Wet Density, pcf	104.6	
Dry density, pcf	67.2	
Void ratio	1.5080	
Saturation, %	99.7	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.189 tsf **at reading no. 7**
Ult. Stress = 1.094 tsf **at reading no. 17**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	1.360	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0150	14.430	13.1	0.3	0.599	1.000	1.599	1.60	1.300	0.300
2	0.0246	20.500	19.1	0.7	0.874	1.000	1.874	1.87	1.437	0.437
3	0.0457	24.530	23.2	1.4	1.050	1.000	2.050	2.05	1.525	0.525
4	0.0655	26.590	25.2	2.1	1.136	1.000	2.136	2.14	1.568	0.568
5	0.0766	27.430	26.1	2.5	1.169	1.000	2.169	2.17	1.584	0.584
6	0.0860	27.850	26.5	2.8	1.183	1.000	2.183	2.18	1.592	0.592
7	0.0965	28.070	26.7	3.2	1.189	1.000	2.189	2.19	1.594	0.594
8	0.1161	28.100	26.7	3.9	1.181	1.000	2.181	2.18	1.591	0.591
9	0.1463	27.890	26.5	5.0	1.159	1.000	2.159	2.16	1.579	0.579
10	0.1871	28.040	26.7	6.4	1.148	1.000	2.148	2.15	1.574	0.574
11	0.2279	27.830	26.5	7.9	1.121	1.000	2.121	2.12	1.560	0.560
12	0.2678	28.160	26.8	9.3	1.117	1.000	2.117	2.12	1.559	0.559
13	0.2983	28.380	27.0	10.4	1.113	1.000	2.113	2.11	1.557	0.557
14	0.3396	28.880	27.5	11.9	1.115	1.000	2.115	2.12	1.558	0.558
15	0.3806	28.990	27.6	13.3	1.101	1.000	2.101	2.10	1.550	0.550
16	0.4203	29.380	28.0	14.8	1.098	1.000	2.098	2.10	1.549	0.549
17	0.4280	29.350	28.0	15.0	1.094	1.000	2.094	2.09	1.547	0.547

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	148.600	148.810
Moisture content: Dry soil+tare, gms.	105.820	106.200
Moisture content: Tare, gms.	30.810	31.280
Moisture, %	57.0	56.9
Moist specimen weight, gms.	118.0	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	104.2	
Dry density, pcf	66.4	
Void ratio	1.5397	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 0.817 tsf at reading no. 11

Ult. Stress = 0.729 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0059	3.620	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0156	15.980	12.4	0.3	0.576	2.000	2.576	1.29	2.288	0.288
2	0.0353	17.750	14.1	1.0	0.654	2.000	2.654	1.33	2.327	0.327
3	0.0557	18.850	15.2	1.8	0.700	2.000	2.700	1.35	2.350	0.350
4	0.0767	19.370	15.8	2.5	0.718	2.000	2.718	1.36	2.359	0.359
5	0.0964	19.820	16.2	3.2	0.733	2.000	2.733	1.37	2.367	0.367
6	0.1165	20.290	16.7	3.9	0.749	2.000	2.749	1.37	2.374	0.374
7	0.1468	20.930	17.3	5.0	0.769	2.000	2.769	1.38	2.384	0.384
8	0.1881	21.970	18.3	6.5	0.802	2.000	2.802	1.40	2.401	0.401
9	0.2291	22.390	18.8	8.0	0.808	2.000	2.808	1.40	2.404	0.404
10	0.2690	22.810	19.2	9.4	0.813	2.000	2.813	1.41	2.407	0.407
11	0.2996	23.140	19.5	10.5	0.817	2.000	2.817	1.41	2.409	0.409
12	0.3405	22.820	19.2	11.9	0.791	2.000	2.791	1.40	2.395	0.395
13	0.3824	22.970	19.3	13.4	0.783	2.000	2.783	1.39	2.392	0.392
14	0.4252	21.940	18.3	15.0	0.729	2.000	2.729	1.36	2.364	0.364

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	131.090	146.010
Moisture content: Dry soil+tare, gms.	93.940	103.250
Moisture content: Tare, gms.	29.800	29.490
Moisture, %	57.9	58.0
Moist specimen weight, gms.	117.0	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	103.5	
Dry density, pcf	65.5	
Void ratio	1.5727	
Saturation, %	99.4	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

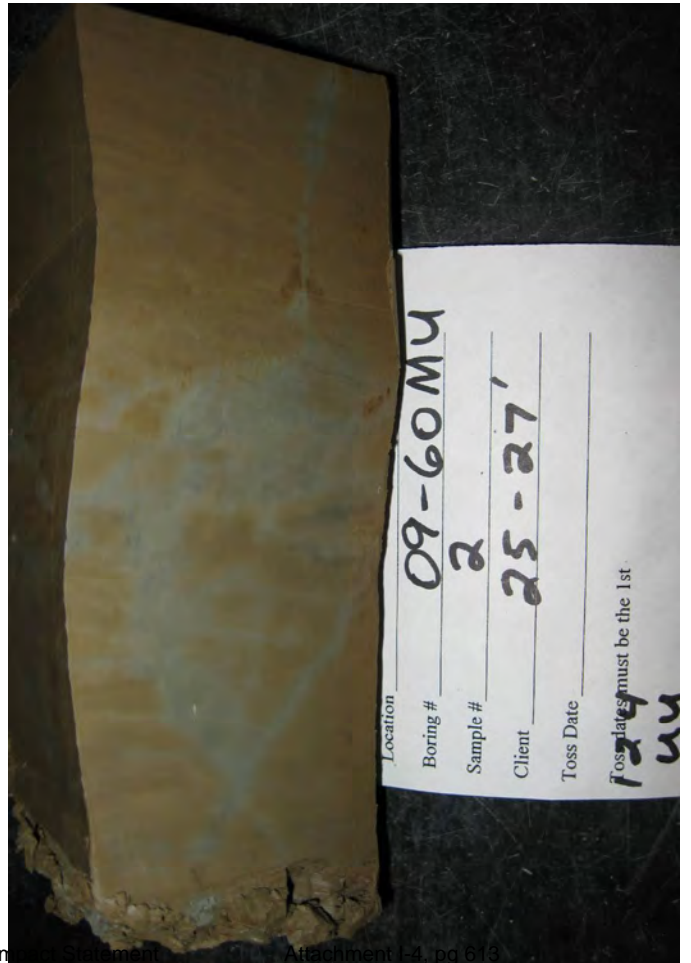
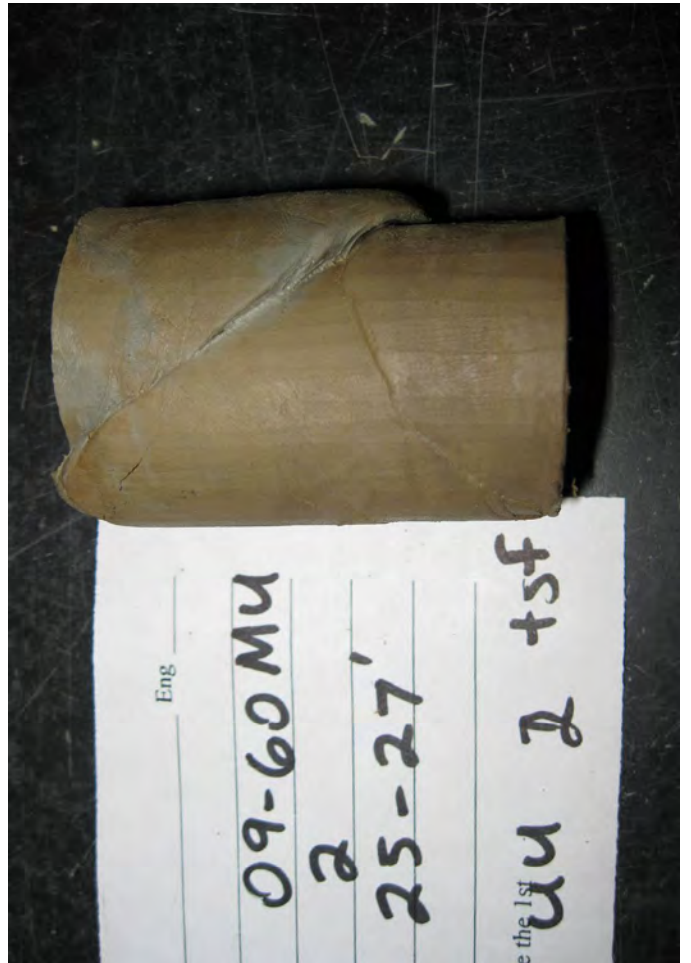
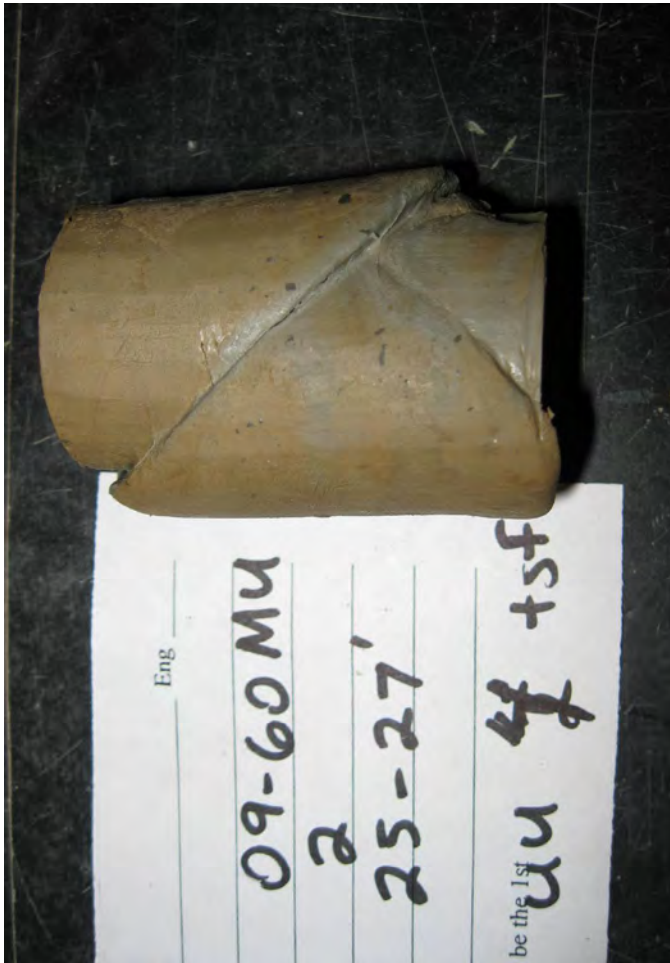
Back pressure = 0.000 tsf

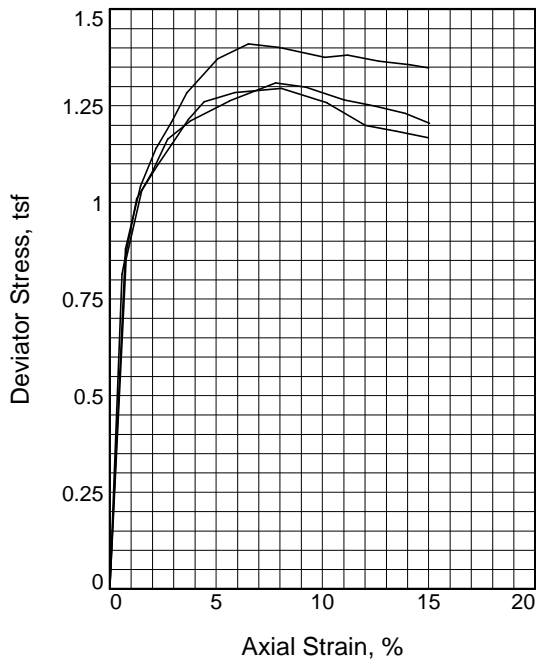
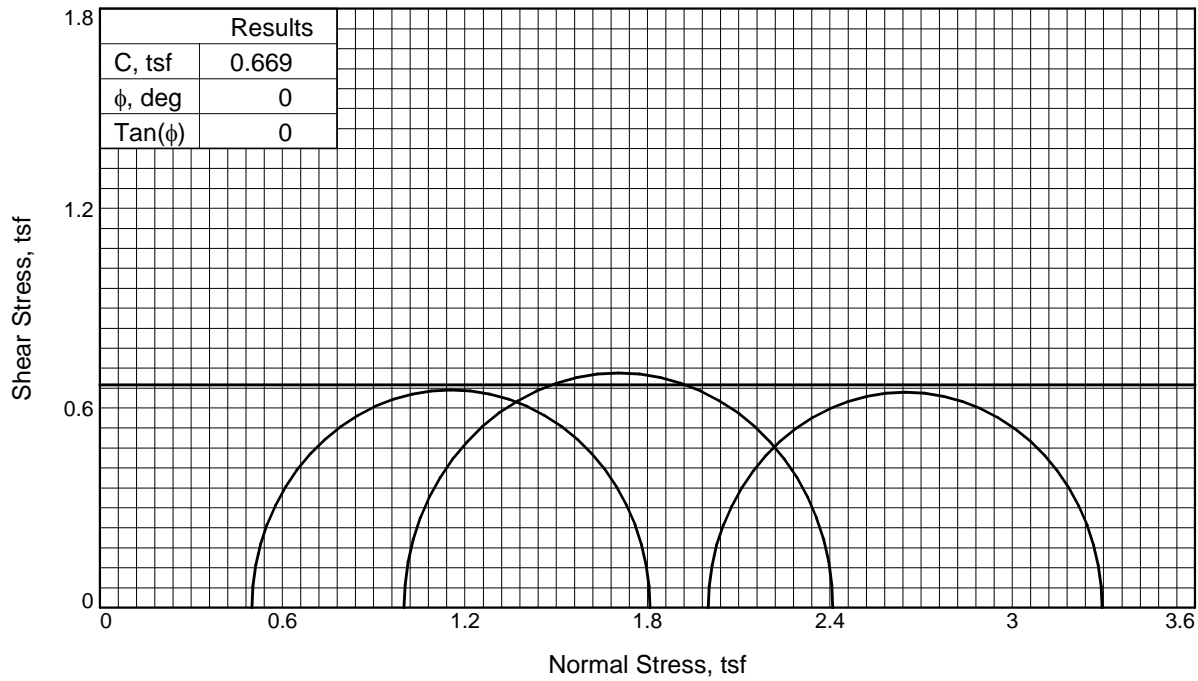
Strain rate, in./min. = 0.03

Fail. Stress = 0.864 tsf at reading no. 12

Ult. Stress = 0.847 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	8.870	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0145	18.850	10.0	0.3	0.466	4.000	4.466	1.12	4.233	0.233
2	0.0251	23.520	14.7	0.7	0.682	4.000	4.682	1.17	4.341	0.341
3	0.0464	24.350	15.5	1.4	0.715	4.000	4.715	1.18	4.357	0.357
4	0.0667	25.260	16.4	2.2	0.751	4.000	4.751	1.19	4.376	0.376
5	0.0859	25.730	16.9	2.8	0.767	4.000	4.767	1.19	4.384	0.384
6	0.1054	26.300	17.4	3.5	0.787	4.000	4.787	1.20	4.394	0.394
7	0.1263	26.740	17.9	4.3	0.801	4.000	4.801	1.20	4.401	0.401
8	0.1673	27.670	18.8	5.8	0.830	4.000	4.830	1.21	4.415	0.415
9	0.2086	28.150	19.3	7.2	0.838	4.000	4.838	1.21	4.419	0.419
10	0.2487	28.680	19.8	8.7	0.848	4.000	4.848	1.21	4.424	0.424
11	0.2892	29.230	20.4	10.1	0.857	4.000	4.857	1.21	4.429	0.429
12	0.3196	29.630	20.8	11.2	0.864	4.000	4.864	1.22	4.432	0.432
13	0.3406	29.750	20.9	11.9	0.861	4.000	4.861	1.22	4.431	0.431
14	0.3806	29.840	21.0	13.4	0.851	4.000	4.851	1.21	4.425	0.425
15	0.4204	29.990	21.1	14.8	0.843	4.000	4.843	1.21	4.421	0.421
16	0.4270	30.160	21.3	15.0	0.847	4.000	4.847	1.21	4.424	0.424





Sample No.	1	2	3	
Initial	Water Content, %	50.7	50.5	50.4
	Dry Density, pcf	70.9	71.5	71.8
	Saturation, %	97.6	98.3	98.8
	Void Ratio	1.4435	1.4260	1.4148
	Diameter, in.	1.41	1.41	1.40
	Height, in.	2.81	2.80	2.80
At Test	Water Content, %	50.7	50.5	50.4
	Dry Density, pcf	70.9	71.5	71.8
	Saturation, %	97.6	98.3	98.8
	Void Ratio	1.4435	1.4260	1.4148
	Diameter, in.	1.41	1.41	1.40
	Height, in.	2.81	2.80	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Peak Stress, tsf	1.31	1.41	1.30	
Ult. Stress, tsf	1.20	1.35	1.17	
σ_1 Failure, tsf	1.81	2.41	3.30	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 113 **PL=** 32 **PI=** 81

Specific Gravity= 2.777

Remarks:

Client: W912ES-11-P-0024

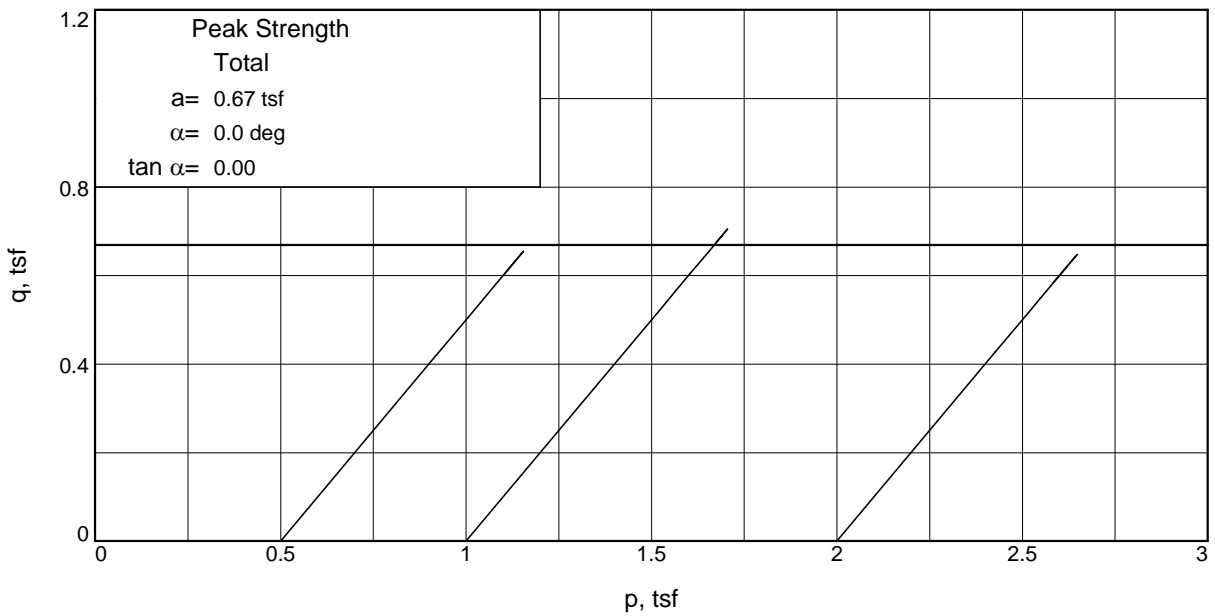
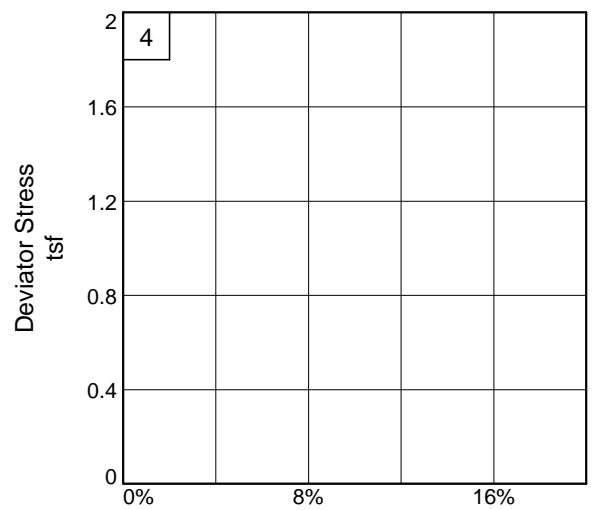
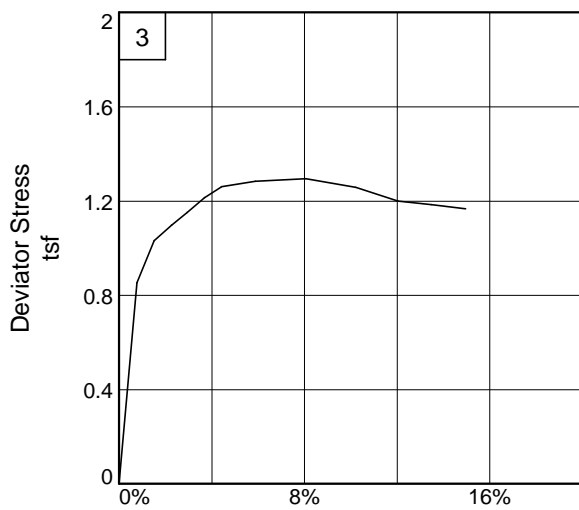
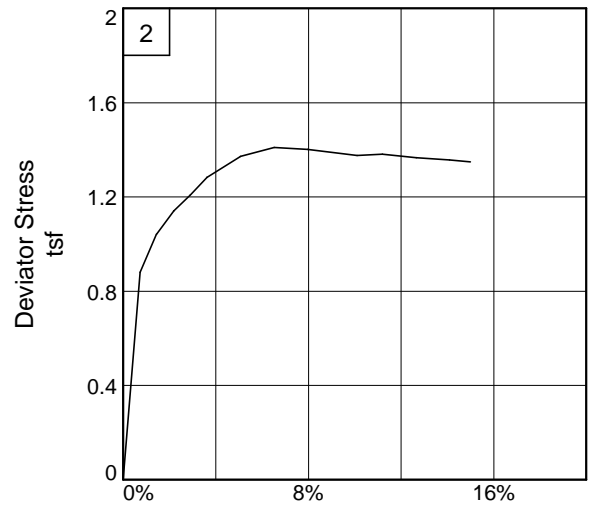
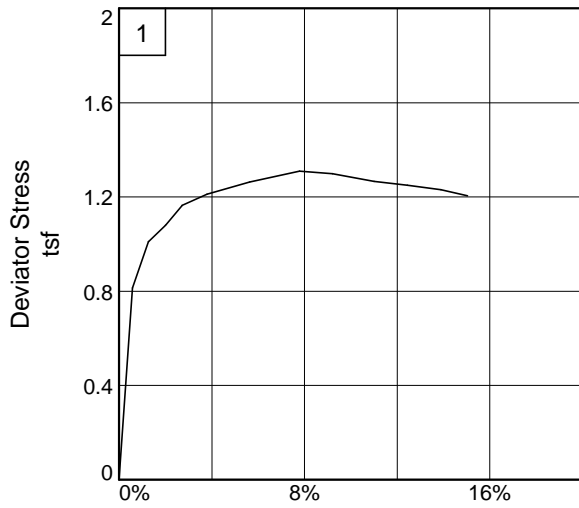
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Maple River, Dessicated Brenna Formation

Sample Number: Boring10-105MU, #1 **Depth:** 15-17'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Dessicated Brenna Formation

Depth: 15-17'

Sample No.: Boring10-105MU, #1

Project No.: B-10-105MU Feasibility Report and Environmental Impact Statement
 July 2014

Figure

Braun Intertec
 Geotechnical Design and Geology

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

12:04 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Dessicated Brenna Formation
Depth: 15-17' **Sample Number:** Boring10-105MU, #1
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.777 **LL=**113 **PL=**32 **PI=**81
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	153.040	153.040
Moisture content: Dry soil+tare, gms.	111.800	111.800
Moisture content: Tare, gms.	30.520	30.520
Moisture, %	50.7	50.7
Moist specimen weight, gms.	123.3	
Diameter, in.	1.41	
Area, in. ²	1.56	
Height, in.	2.81	
Wet Density, pcf	106.9	
Dry density, pcf	70.9	
Void ratio	1.4435	
Saturation, %	97.6	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.309 tsf at reading no. 7
Ult. Stress = 1.205 tsf at reading no. 12

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	0.000	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0228	17.780	17.8	0.6	0.814	0.500	1.314	2.63	0.907	0.407
2	0.0423	22.210	22.2	1.3	1.010	0.500	1.510	3.02	1.005	0.505
3	0.0630	23.920	23.9	2.0	1.079	0.500	1.579	3.16	1.040	0.540
4	0.0831	25.990	26.0	2.7	1.164	0.500	1.664	3.33	1.082	0.582
5	0.1131	27.340	27.3	3.8	1.211	0.500	1.711	3.42	1.106	0.606
6	0.1648	29.050	29.1	5.6	1.262	0.500	1.762	3.52	1.131	0.631
7	0.2254	30.820	30.8	7.8	1.309	0.500	1.809	3.62	1.154	0.654
8	0.2652	31.060	31.1	9.2	1.298	0.500	1.798	3.60	1.149	0.649
9	0.3159	30.880	30.9	11.0	1.265	0.500	1.765	3.53	1.133	0.633
10	0.3563	31.000	31.0	12.5	1.250	0.500	1.750	3.50	1.125	0.625
11	0.3969	31.030	31.0	13.9	1.230	0.500	1.730	3.46	1.115	0.615
12	0.4290	30.800	30.8	15.0	1.205	0.500	1.705	3.41	1.102	0.602

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	151.980	151.980
Moisture content: Dry soil+tare, gms.	110.950	110.950
Moisture content: Tare, gms.	29.680	29.680
Moisture, %	50.5	50.5
Moist specimen weight, gms.	123.0	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	107.5	
Dry density, pcf	71.5	
Void ratio	1.4260	
Saturation, %	98.3	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.410 tsf at reading no. 7
 Ult. Stress = 1.348 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0097	0.660	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0303	19.800	19.1	0.7	0.880	1.000	1.880	1.88	1.440	0.440
2	0.0502	23.490	22.8	1.4	1.042	1.000	2.042	2.04	1.521	0.521
3	0.0708	25.840	25.2	2.2	1.141	1.000	2.141	2.14	1.570	0.570
4	0.0911	27.540	26.9	2.9	1.209	1.000	2.209	2.21	1.604	0.604
5	0.1111	29.410	28.8	3.6	1.283	1.000	2.283	2.28	1.642	0.642
6	0.1516	31.850	31.2	5.1	1.371	1.000	2.371	2.37	1.686	0.686
7	0.1925	33.230	32.6	6.5	1.410	1.000	2.410	2.41	1.705	0.705
8	0.2328	33.530	32.9	8.0	1.401	1.000	2.401	2.40	1.700	0.700
9	0.2930	33.690	33.0	10.1	1.375	1.000	2.375	2.37	1.687	0.687
10	0.3233	34.230	33.6	11.2	1.381	1.000	2.381	2.38	1.690	0.690

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
11	0.3644	34.420	33.8	12.7	1.365	1.000	2.365	2.37	1.683	0.683
12	0.4048	34.750	34.1	14.1	1.356	1.000	2.356	2.36	1.678	0.678
13	0.4300	34.910	34.3	15.0	1.348	1.000	2.348	2.35	1.674	0.674

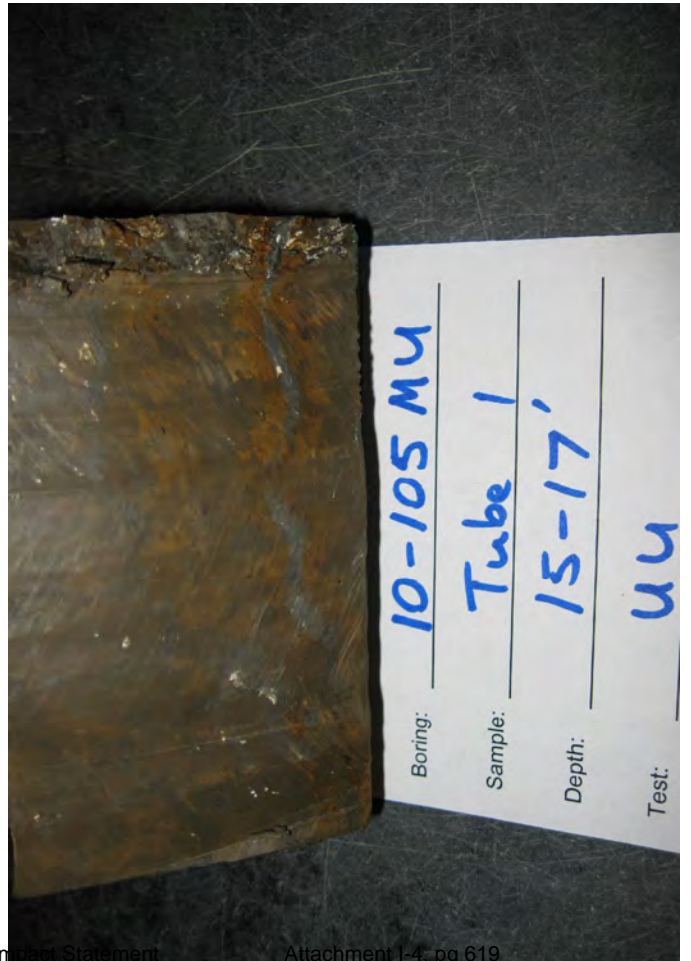
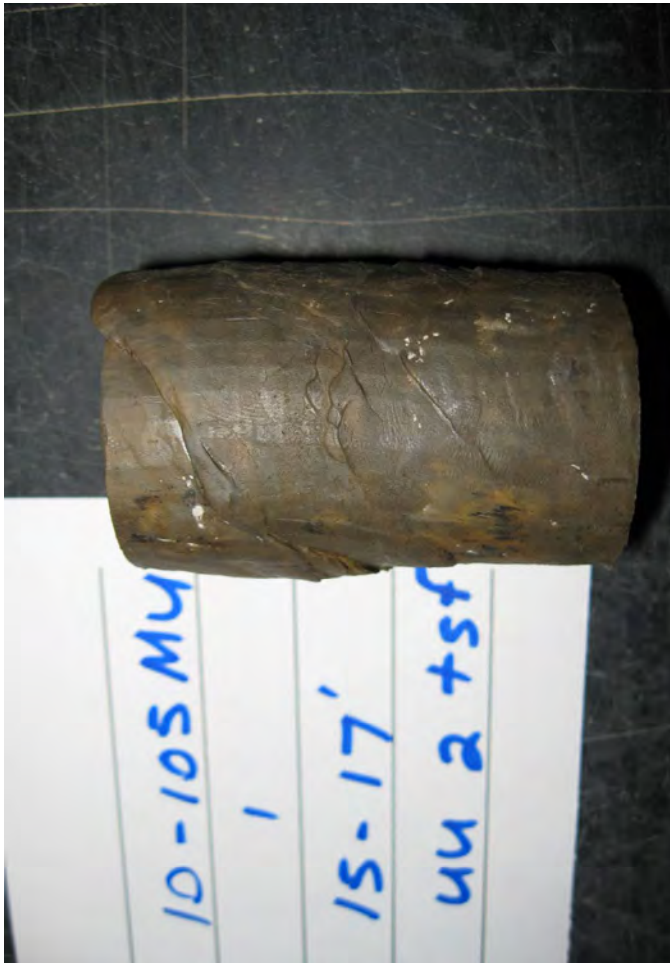
Parameters for Specimen No. 3

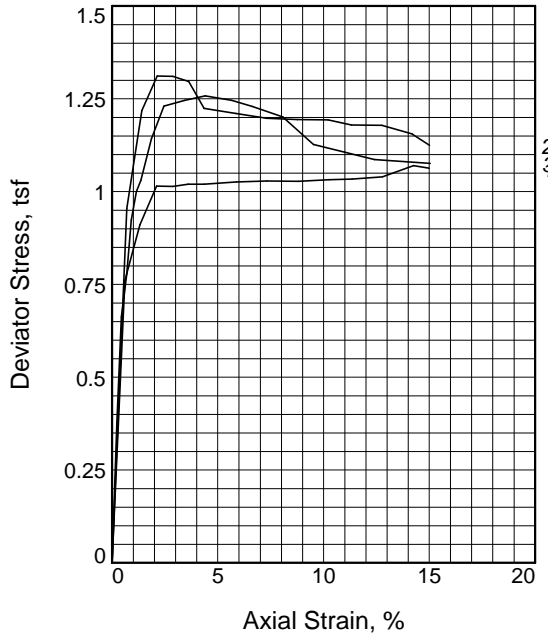
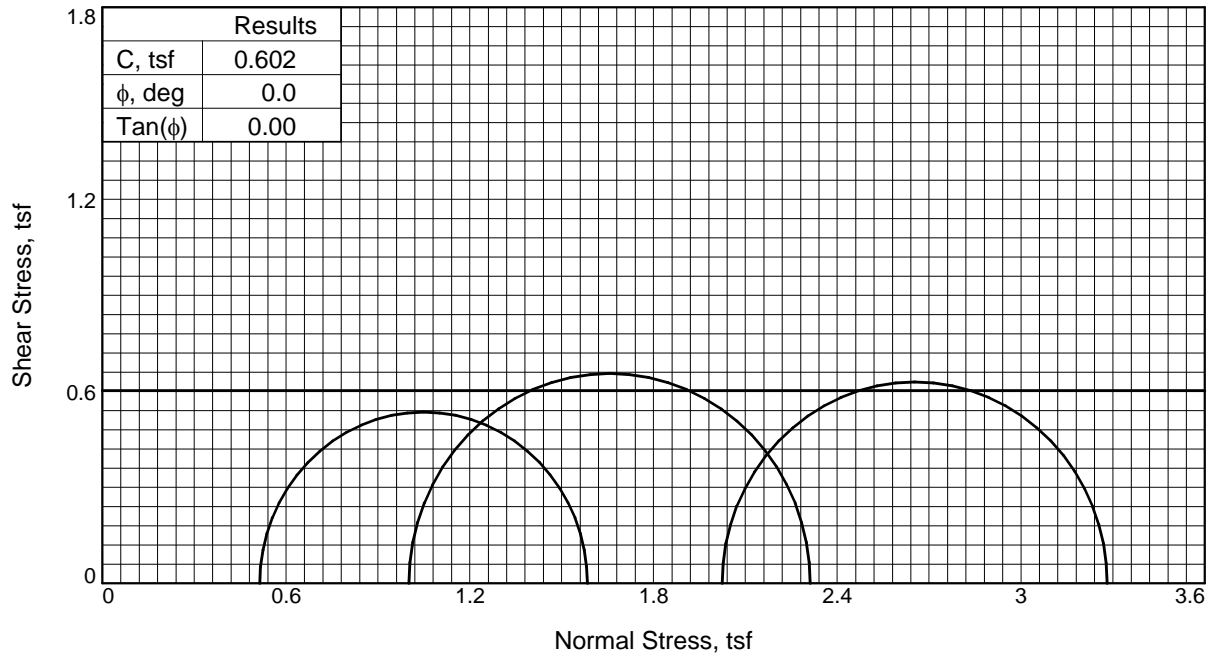
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	151.870	151.870
Moisture content: Dry soil+tare, gms.	111.160	111.160
Moisture content: Tare, gms.	30.320	30.320
Moisture, %	50.4	50.4
Moist specimen weight, gms.	122.2	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	107.9	
Dry density, pcf	71.8	
Void ratio	1.4148	
Saturation, %	98.8	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.295 tsf at reading no. 8
Ult. Stress = 1.167 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0088	4.690	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0305	23.100	18.4	0.8	0.853	2.000	2.853	1.43	2.427	0.427
2	0.0511	27.120	22.4	1.5	1.032	2.000	3.032	1.52	2.516	0.516
3	0.0720	28.740	24.0	2.3	1.098	2.000	3.098	1.55	2.549	0.549
4	0.0911	30.110	25.4	2.9	1.152	2.000	3.152	1.58	2.576	0.576
5	0.1121	31.700	27.0	3.7	1.215	2.000	3.215	1.61	2.607	0.607
6	0.1325	32.920	28.2	4.4	1.260	2.000	3.260	1.63	2.630	0.630
7	0.1735	33.900	29.2	5.9	1.284	2.000	3.284	1.64	2.642	0.642
8	0.2344	34.850	30.2	8.1	1.295	2.000	3.295	1.65	2.648	0.648
9	0.2950	34.690	30.0	10.2	1.258	2.000	3.258	1.63	2.629	0.629
10	0.3459	33.870	29.2	12.0	1.199	2.000	3.199	1.60	2.599	0.599
11	0.3861	33.990	29.3	13.5	1.184	2.000	3.184	1.59	2.592	0.592
12	0.4277	34.080	29.4	15.0	1.167	2.000	3.167	1.58	2.584	0.584





Sample No.	1	2	3	
Initial	Water Content, %	43.4	44.0	43.0
	Dry Density, pcf	78.0	77.5	78.2
	Saturation, %	99.5	99.6	99.2
	Void Ratio	1.1968	1.2110	1.1894
	Diameter, in.	1.41	1.39	1.40
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	43.4	44.0	43.0
	Dry Density, pcf	78.0	77.5	78.2
	Saturation, %	99.5	99.6	99.2
	Void Ratio	1.1968	1.2110	1.1894
	Diameter, in.	1.41	1.39	1.40
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.51	1.00	2.02	
Peak Stress, tsf	1.07	1.31	1.26	
Ult. Stress, tsf	1.06	1.13	1.08	
σ_1 Failure, tsf	1.58	2.31	3.28	
σ_3 Failure, tsf	0.51	1.00	2.02	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 82

PL= 23

PI= 59

Specific Gravity= 2.744

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, OX Brenna Formation

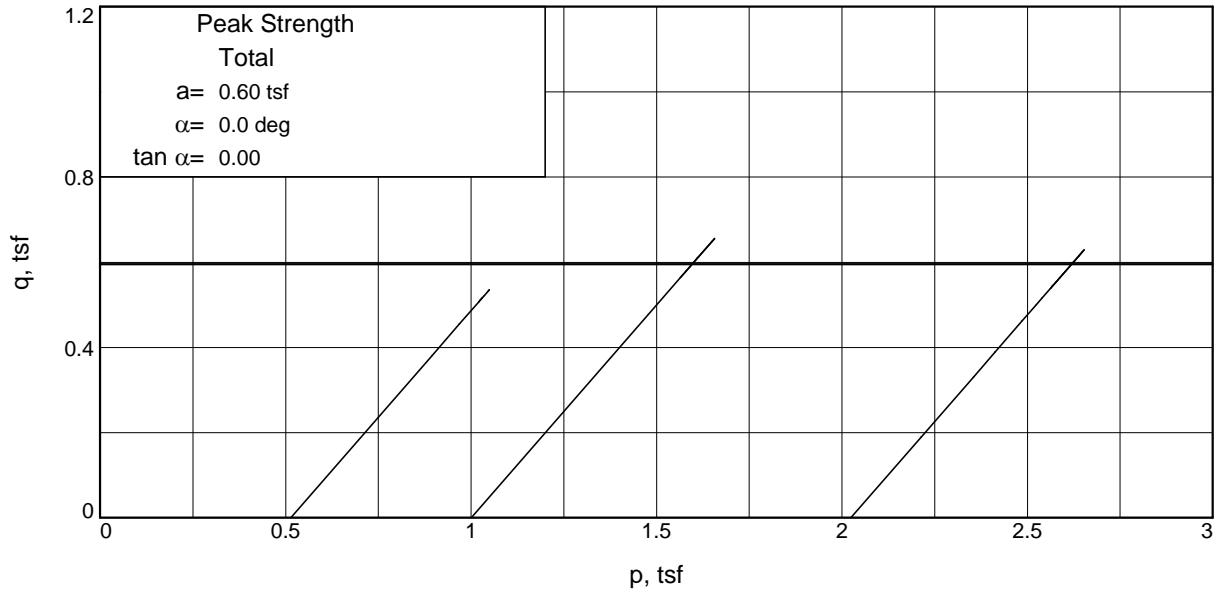
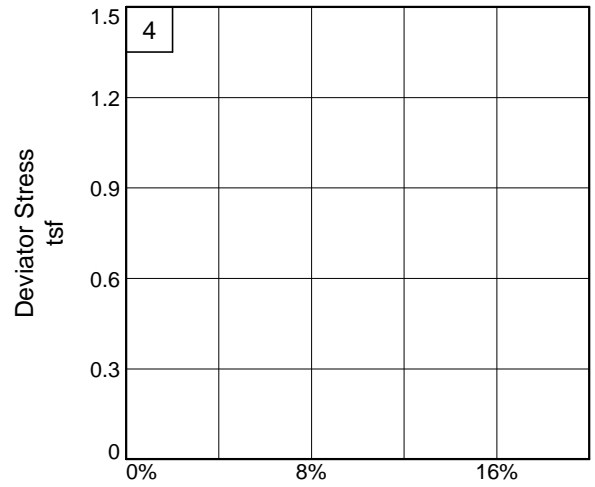
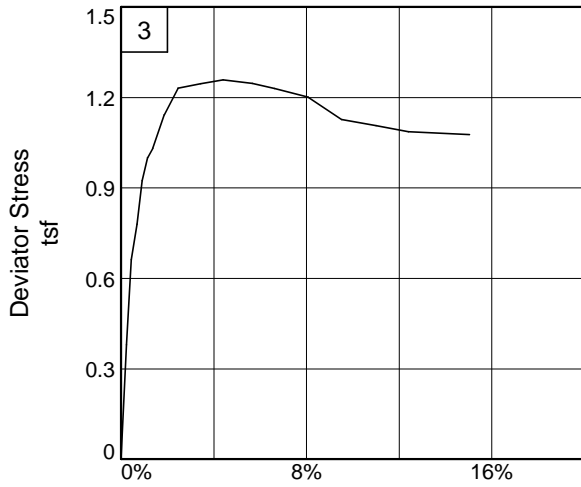
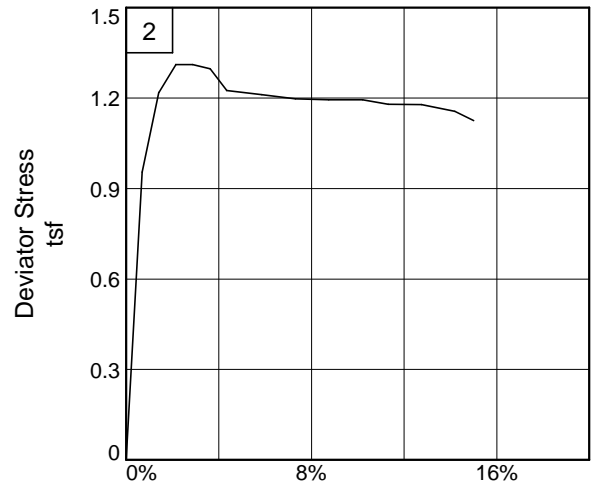
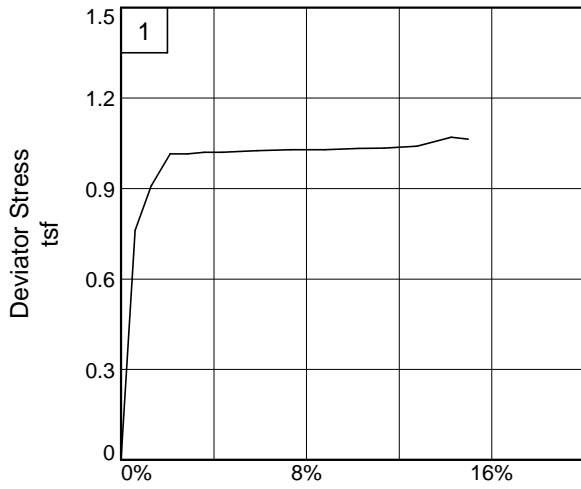
Sample Number: Boring11-110MU, #1 **Depth:** 25-27'

Proj. No.: BL-10-10065

Date Sampled:



Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, OX Brenna Formation

Depth: 25-27'

Sample No.: Boring11-110MU, #1

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:10 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, OX Brenna Formation
Depth: 25-27' **Sample Number:** Boring11-110MU, #1
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.744 **LL**=82 **PL**=23 **PI**=59
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	158.060	158.060
Moisture content: Dry soil+tare, gms.	119.370	119.370
Moisture content: Tare, gms.	30.210	30.210
Moisture, %	43.4	43.4
Moist specimen weight, gms.	128.1	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	111.8	
Dry density, pcf	78.0	
Void ratio	1.1968	
Saturation, %	99.5	

Test Readings for Specimen No. 1

Cell pressure = 0.514 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.070 tsf at reading no. 13
Ult. Stress = 1.063 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0075	0.000	0.0	0.0	0.000	0.514	0.514	1.00	0.514	0.000
1	0.0244	16.500	16.5	0.6	0.761	0.514	1.275	2.48	0.894	0.380
2	0.0443	19.890	19.9	1.3	0.910	0.514	1.424	2.77	0.969	0.455
3	0.0668	22.360	22.4	2.1	1.015	0.514	1.529	2.97	1.022	0.508
4	0.0882	22.520	22.5	2.9	1.014	0.514	1.528	2.97	1.021	0.507
5	0.1089	22.820	22.8	3.6	1.020	0.514	1.534	2.98	1.024	0.510
6	0.1298	23.000	23.0	4.4	1.020	0.514	1.534	2.98	1.024	0.510
7	0.1724	23.500	23.5	5.9	1.026	0.514	1.540	3.00	1.027	0.513
8	0.2134	23.930	23.9	7.3	1.028	0.514	1.542	3.00	1.028	0.514
9	0.2550	24.310	24.3	8.8	1.028	0.514	1.542	3.00	1.028	0.514
10	0.2959	24.810	24.8	10.3	1.032	0.514	1.546	3.01	1.030	0.516
11	0.3266	25.150	25.1	11.4	1.034	0.514	1.548	3.01	1.031	0.517
12	0.3669	25.720	25.7	12.8	1.040	0.514	1.554	3.02	1.034	0.520
13	0.4084	26.910	26.9	14.3	1.070	0.514	1.584	3.08	1.049	0.535
14	0.4289	26.970	27.0	15.0	1.063	0.514	1.577	3.07	1.046	0.532

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	154.570	154.570
Moisture content: Dry soil+tare, gms.	116.400	116.400
Moisture content: Tare, gms.	29.560	29.560
Moisture, %	44.0	44.0
Moist specimen weight, gms.	125.2	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	111.5	
Dry density, pcf	77.5	
Void ratio	1.2110	
Saturation, %	99.6	

Test Readings for Specimen No. 2

Cell pressure = 1.001 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.311 tsf at reading no. 3
 Ult. Stress = 1.125 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	0.720	0.0	0.0	0.000	1.001	1.001	1.00	1.001	0.000
1	0.0263	21.020	20.3	0.7	0.954	1.001	1.955	1.95	1.478	0.477
2	0.0464	26.820	26.1	1.4	1.218	1.001	2.219	2.22	1.610	0.609
3	0.0668	29.020	28.3	2.1	1.311	1.001	2.312	2.31	1.657	0.656
4	0.0875	29.220	28.5	2.9	1.311	1.001	2.312	2.31	1.656	0.655
5	0.1085	29.140	28.4	3.6	1.297	1.001	2.298	2.30	1.649	0.648
6	0.1287	27.760	27.0	4.3	1.225	1.001	2.226	2.22	1.613	0.612
7	0.1713	27.890	27.2	5.9	1.211	1.001	2.212	2.21	1.607	0.606
8	0.2122	28.010	27.3	7.3	1.198	1.001	2.199	2.20	1.600	0.599
9	0.2529	28.370	27.7	8.8	1.194	1.001	2.195	2.19	1.598	0.597
10	0.2938	28.800	28.1	10.2	1.194	1.001	2.195	2.19	1.598	0.597
11	0.3250	28.810	28.1	11.3	1.179	1.001	2.180	2.18	1.591	0.590
12	0.3655	29.250	28.5	12.8	1.178	1.001	2.179	2.18	1.590	0.589
13	0.4057	29.170	28.5	14.2	1.156	1.001	2.157	2.15	1.579	0.578
14	0.4288	28.680	28.0	15.0	1.125	1.001	2.126	2.12	1.564	0.563

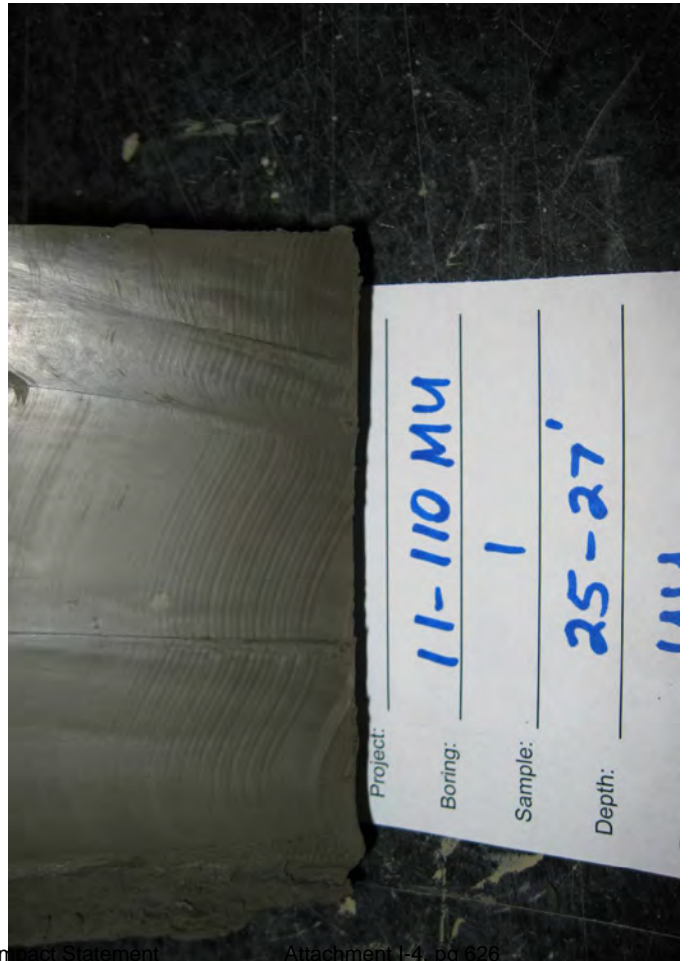
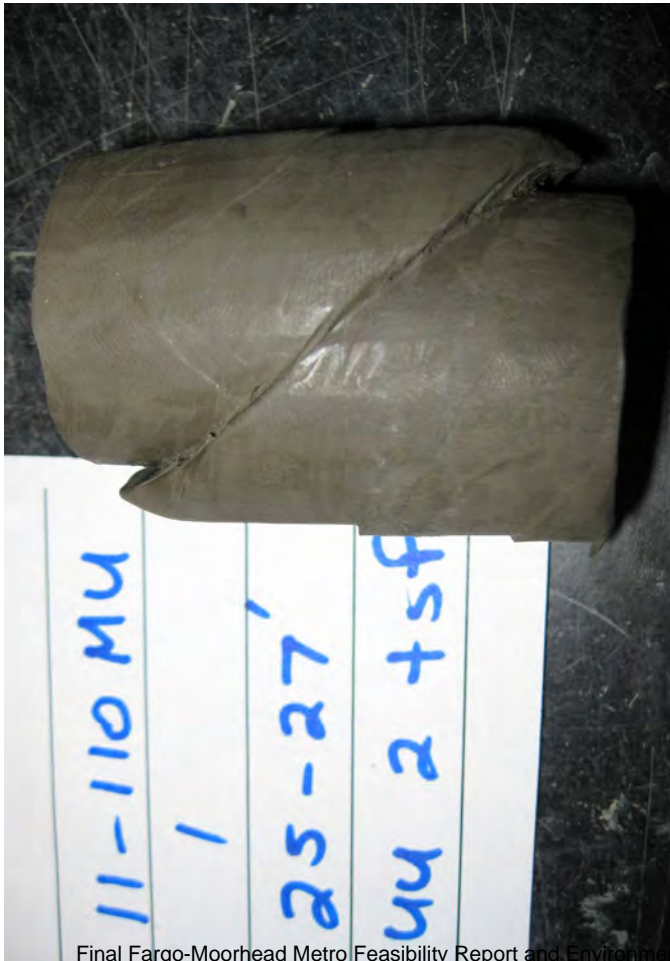
Parameters for Specimen No. 3

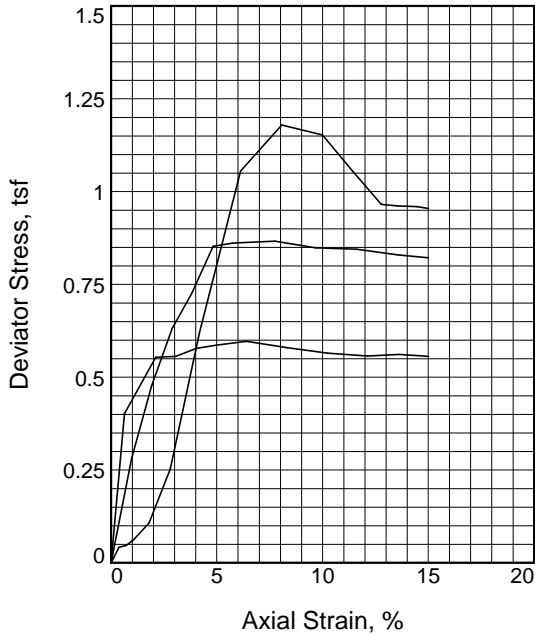
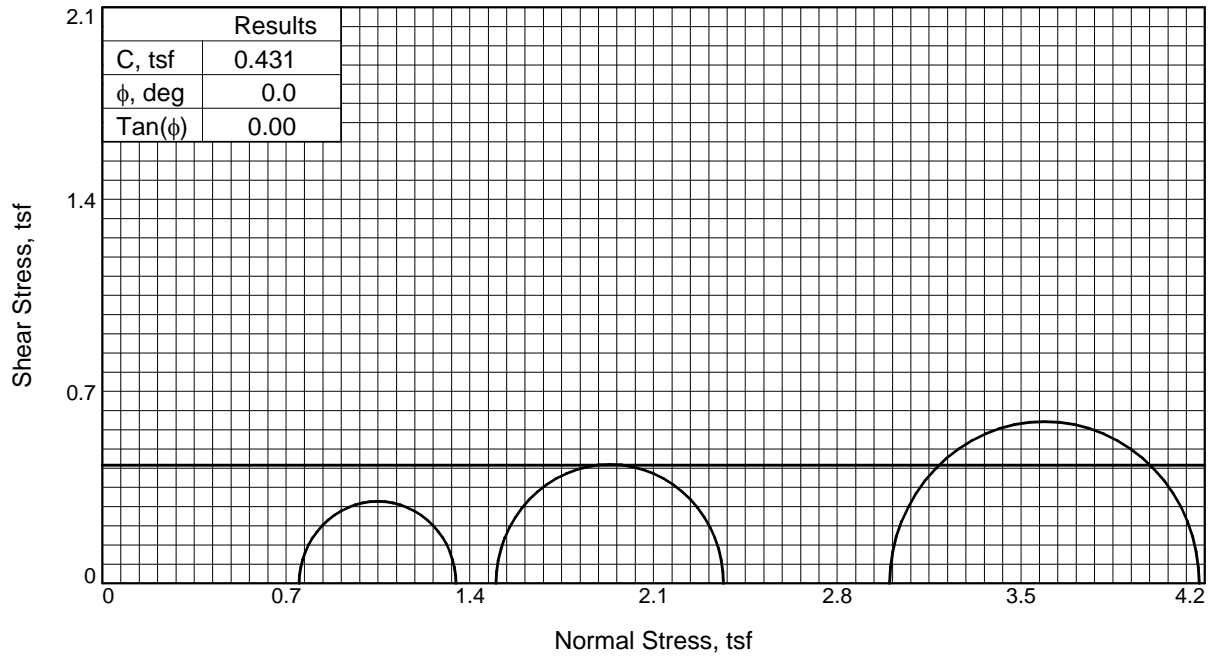
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	157.550	157.550
Moisture content: Dry soil+tare, gms.	119.260	119.260
Moisture content: Tare, gms.	30.230	30.230
Moisture, %	43.0	43.0
Moist specimen weight, gms.	127.6	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	111.9	
Dry density, pcf	78.2	
Void ratio	1.1894	
Saturation, %	99.2	

Test Readings for Specimen No. 3

Cell pressure = 2.024 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.258 tsf at reading no. 10
 Ult. Stress = 1.077 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	4.260	0.0	0.0	0.000	2.024	2.024	1.00	2.024	0.000
1	0.0132	12.410	8.2	0.2	0.379	2.024	2.403	1.19	2.214	0.190
2	0.0192	18.520	14.3	0.4	0.662	2.024	2.686	1.33	2.355	0.331
3	0.0261	21.080	16.8	0.7	0.779	2.024	2.803	1.38	2.414	0.390
4	0.0322	24.250	20.0	0.9	0.924	2.024	2.948	1.46	2.486	0.462
5	0.0390	25.960	21.7	1.1	1.000	2.024	3.024	1.49	2.524	0.500
6	0.0452	26.670	22.4	1.4	1.031	2.024	3.055	1.51	2.539	0.515
7	0.0590	29.230	25.0	1.9	1.143	2.024	3.167	1.56	2.595	0.571
8	0.0758	31.310	27.0	2.5	1.231	2.024	3.255	1.61	2.639	0.615
9	0.1035	31.920	27.7	3.4	1.246	2.024	3.270	1.62	2.647	0.623
10	0.1305	32.470	28.2	4.4	1.258	2.024	3.282	1.62	2.653	0.629
11	0.1661	32.590	28.3	5.7	1.246	2.024	3.270	1.62	2.647	0.623
12	0.1932	32.500	28.2	6.6	1.230	2.024	3.254	1.61	2.639	0.615
13	0.2342	32.280	28.0	8.1	1.201	2.024	3.225	1.59	2.625	0.601
14	0.2751	30.970	26.7	9.5	1.127	2.024	3.151	1.56	2.587	0.563
15	0.3164	30.910	26.7	11.0	1.106	2.024	3.130	1.55	2.577	0.553
16	0.3557	30.850	26.6	12.4	1.086	2.024	3.110	1.54	2.567	0.543
17	0.4300	31.430	27.2	15.0	1.077	2.024	3.101	1.53	2.562	0.538





Sample No.	1	2	3	
Initial	Water Content, %	49.1	48.0	45.1
	Dry Density, pcf	71.8	73.9	76.2
	Saturation, %	96.7	99.3	98.6
	Void Ratio	1.4044	1.3373	1.2659
	Diameter, in.	1.40	1.39	1.39
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	49.1	48.0	45.1
	Dry Density, pcf	71.8	73.9	76.2
	Saturation, %	96.7	99.3	98.6
	Void Ratio	1.4044	1.3373	1.2659
	Diameter, in.	1.40	1.39	1.39
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	0.60	0.87	1.18	
Ult. Stress, tsf	0.56	0.82	0.95	
σ_1 Failure, tsf	1.35	2.37	4.18	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 91

PL= 24

PI= 67

Specific Gravity= 2.767

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Wild Rice, Ox Brenna Formation

Sample Number: Boring11-118MU, #1

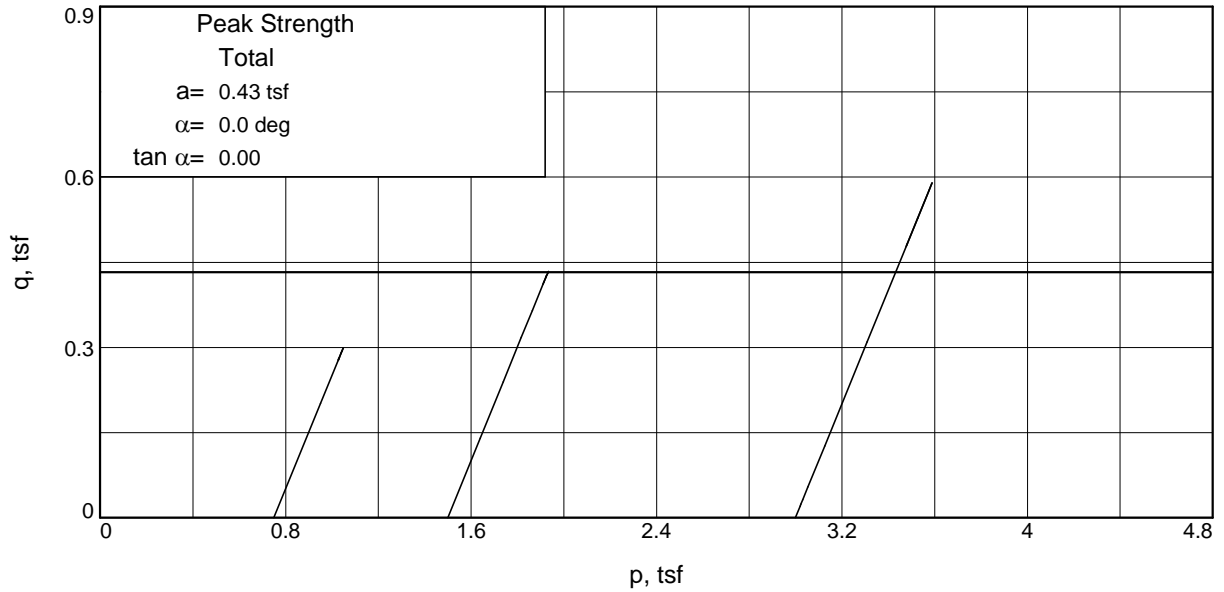
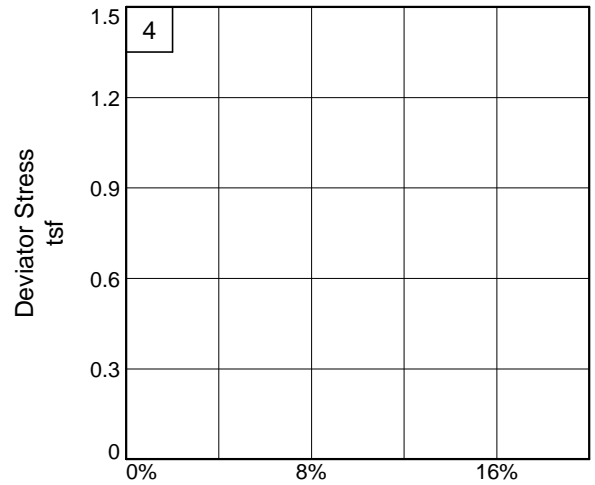
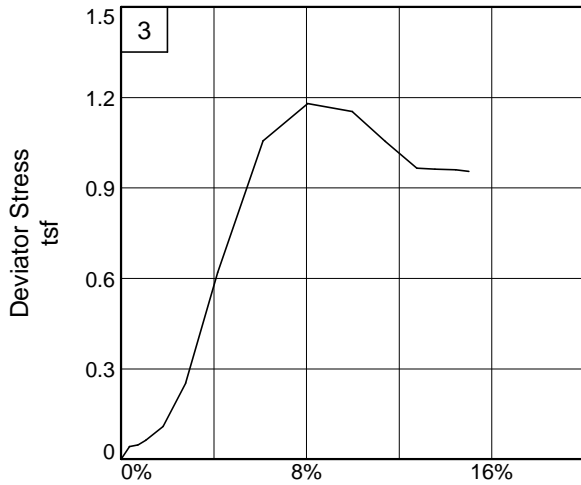
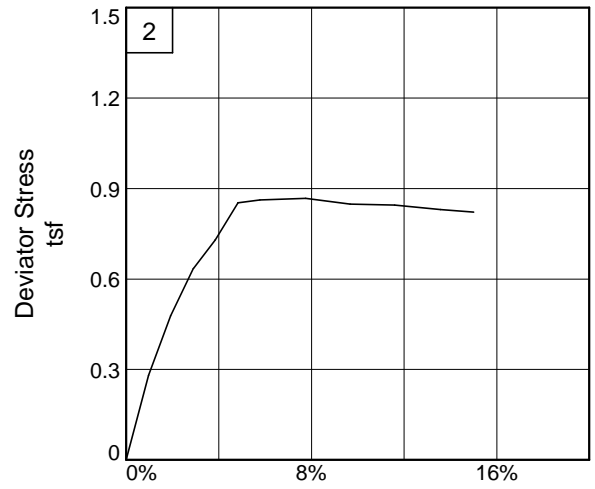
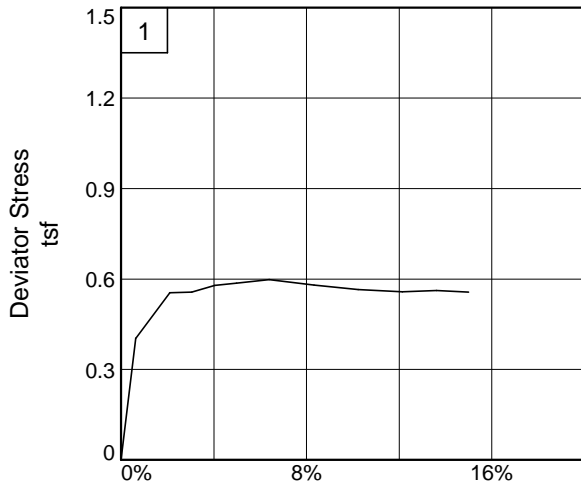
Depth: 20-21'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Ox Brenna Formation

Depth: 20-21'

Sample Number: Boring11-118MU, #1

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/15/2011

11:39 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Ox Brenna Formation
Depth: 20-21' **Sample Number:** Boring11-118MU, #1
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.767 **LL**=91 **PL**=24 **PI**=67
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	151.020	151.020
Moisture content: Dry soil+tare, gms.	111.200	111.200
Moisture content: Tare, gms.	30.090	30.090
Moisture, %	49.1	49.1
Moist specimen weight, gms.	121.7	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	107.1	
Dry density, pcf	71.8	
Void ratio	1.4044	
Saturation, %	96.7	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 0.597 tsf at reading no. 6
Ult. Stress = 0.557 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	2.370	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0245	11.040	8.7	0.6	0.403	0.750	1.153	1.54	0.951	0.201
2	0.0655	14.460	12.1	2.1	0.554	0.750	1.304	1.74	1.027	0.277
3	0.0925	14.640	12.3	3.1	0.556	0.750	1.306	1.74	1.028	0.278
4	0.1203	15.250	12.9	4.0	0.578	0.750	1.328	1.77	1.039	0.289
5	0.1467	15.560	13.2	5.0	0.586	0.750	1.336	1.78	1.043	0.293
6	0.1864	16.010	13.6	6.4	0.597	0.750	1.347	1.80	1.049	0.299
7	0.2409	15.890	13.5	8.3	0.580	0.750	1.330	1.77	1.040	0.290
8	0.2946	15.830	13.5	10.2	0.565	0.750	1.315	1.75	1.033	0.283
9	0.3480	15.940	13.6	12.1	0.558	0.750	1.308	1.74	1.029	0.279
10	0.3896	16.270	13.9	13.6	0.562	0.750	1.312	1.75	1.031	0.281
11	0.4287	16.370	14.0	15.0	0.557	0.750	1.307	1.74	1.028	0.278

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.580	152.580
Moisture content: Dry soil+tare, gms.	112.950	112.950
Moisture content: Tare, gms.	30.400	30.400
Moisture, %	48.0	48.0
Moist specimen weight, gms.	122.8	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	109.4	
Dry density, pcf	73.9	
Void ratio	1.3373	
Saturation, %	99.3	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 0.867 tsf at reading no. 7
 Ult. Stress = 0.822 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0103	4.840	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0376	10.830	6.0	1.0	0.280	1.500	1.780	1.19	1.640	0.140
2	0.0642	15.160	10.3	1.9	0.478	1.500	1.978	1.32	1.739	0.239
3	0.0918	18.670	13.8	2.9	0.634	1.500	2.134	1.42	1.817	0.317
4	0.1182	20.900	16.1	3.8	0.730	1.500	2.230	1.49	1.865	0.365
5	0.1456	23.800	19.0	4.8	0.853	1.500	2.353	1.57	1.926	0.426
6	0.1723	24.190	19.4	5.8	0.861	1.500	2.361	1.57	1.931	0.431
7	0.2278	24.730	19.9	7.7	0.867	1.500	2.367	1.58	1.933	0.433
8	0.2819	24.720	19.9	9.7	0.848	1.500	2.348	1.57	1.924	0.424
9	0.3357	25.070	20.2	11.6	0.845	1.500	2.345	1.56	1.922	0.422
10	0.3914	25.170	20.3	13.6	0.830	1.500	2.330	1.55	1.915	0.415
11	0.4315	25.310	20.5	15.0	0.822	1.500	2.322	1.55	1.911	0.411

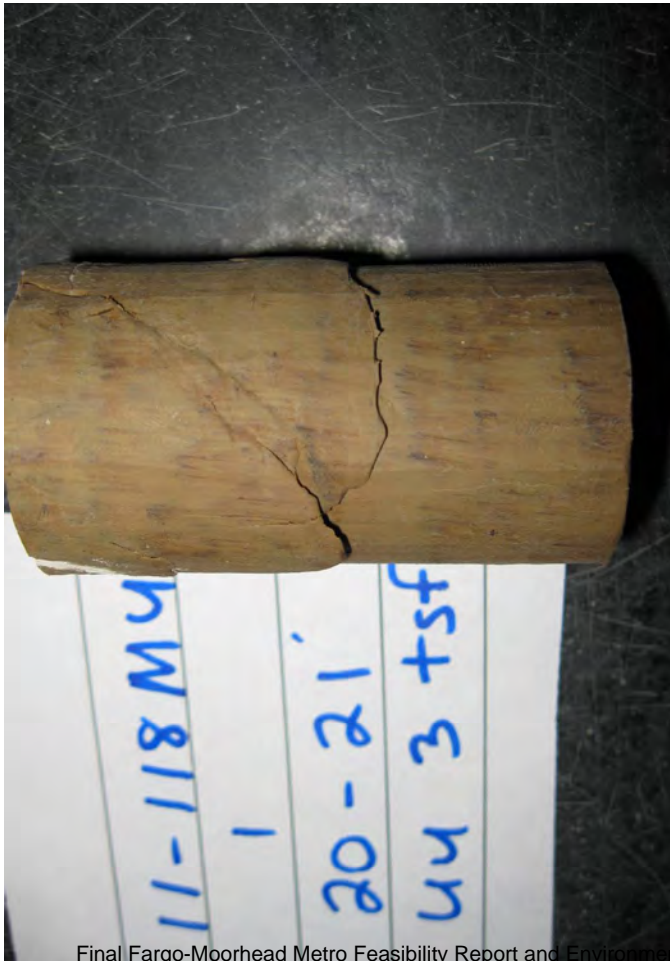
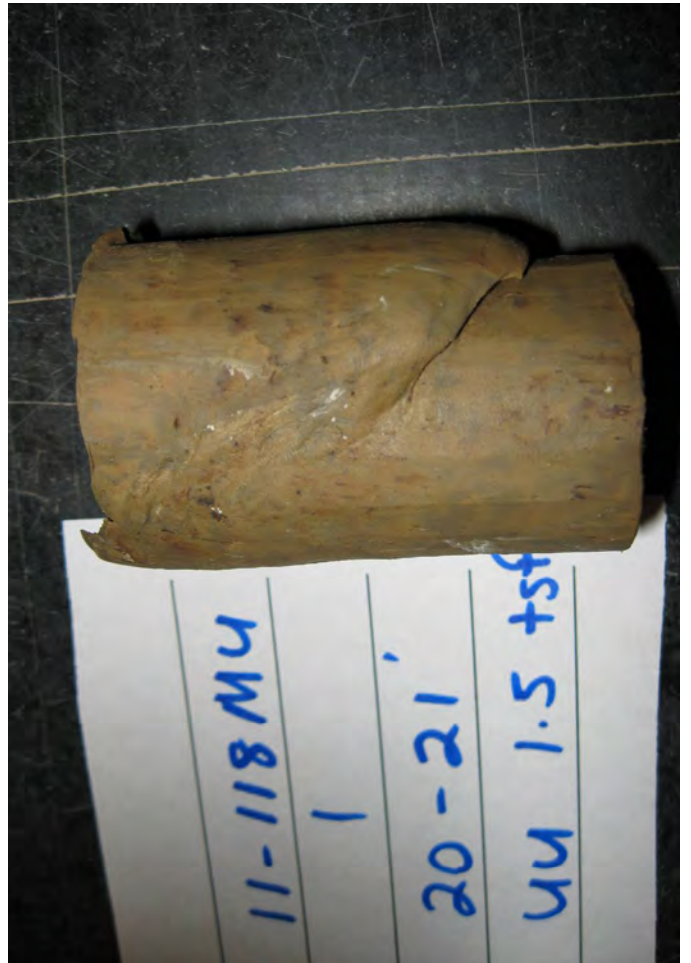
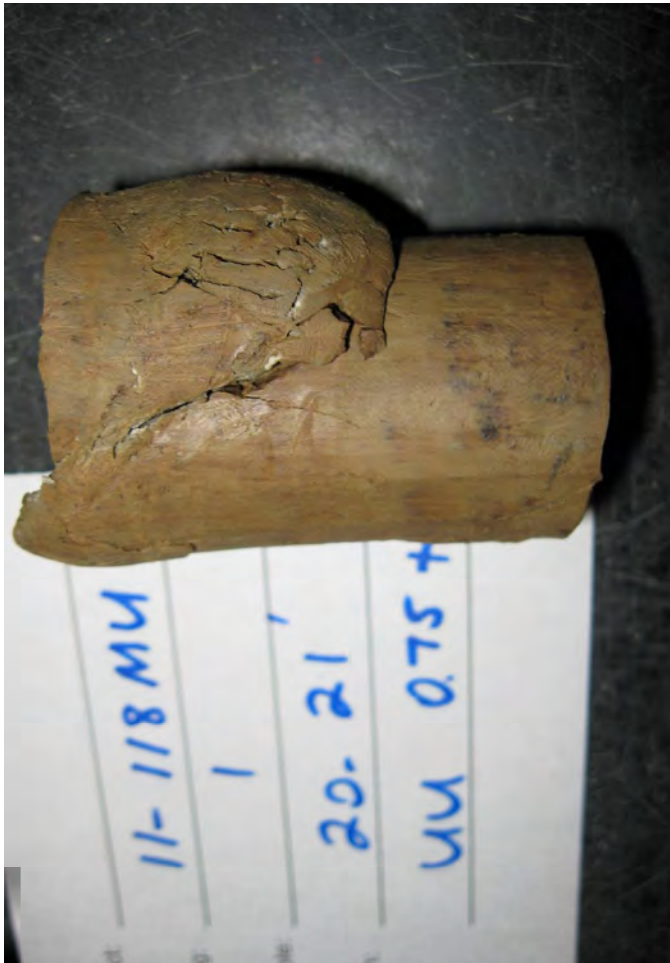
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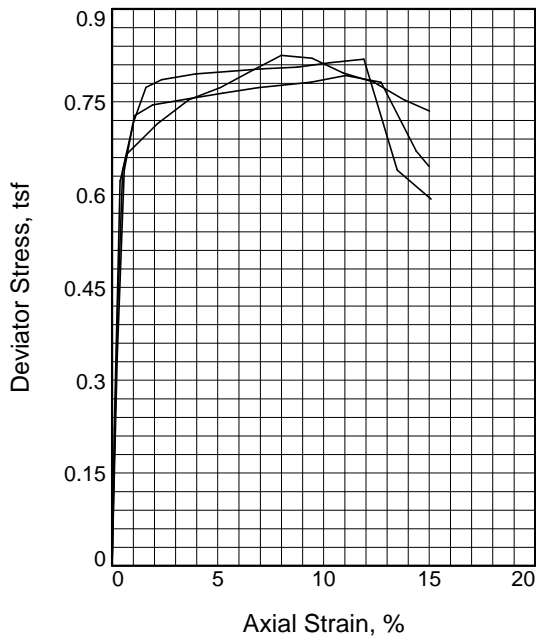
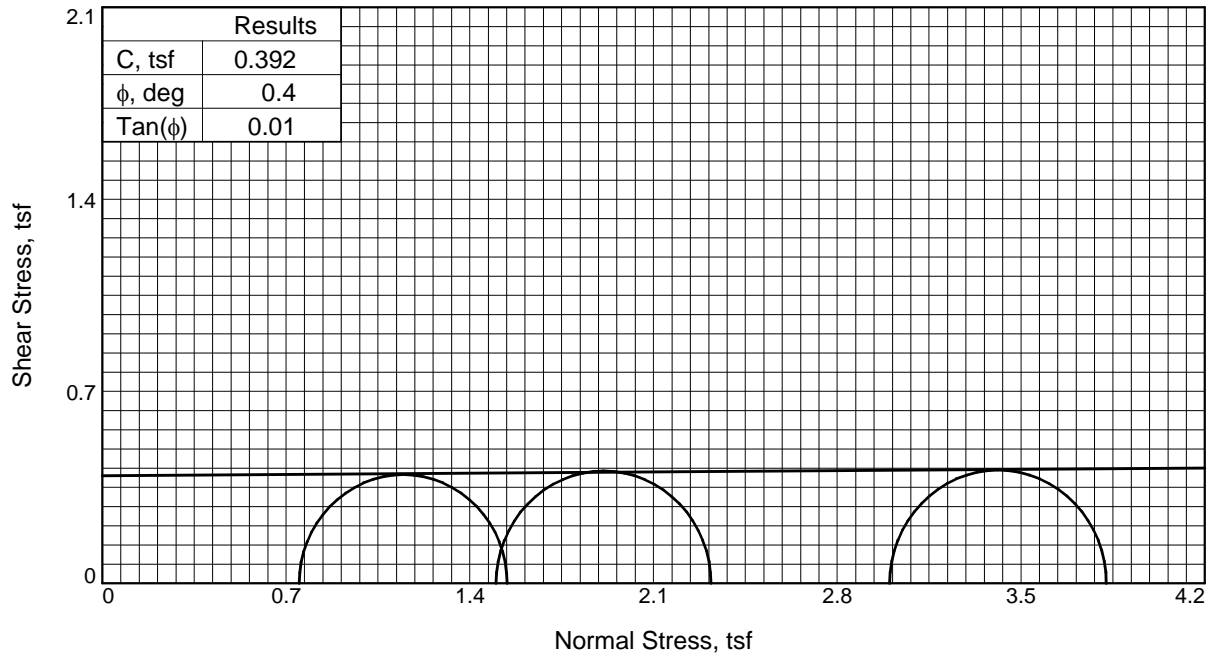
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	154.150	154.150
Moisture content: Dry soil+tare, gms.	115.640	115.640
Moisture content: Tare, gms.	30.280	30.280
Moisture, %	45.1	45.1
Moist specimen weight, gms.	124.6	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	110.6	
Dry density, pcf	76.2	
Void ratio	1.2659	
Saturation, %	98.6	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.179 tsf at reading no. 8
 Ult. Stress = 0.955 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0700	9.000	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0800	9.880	0.9	0.4	0.041	3.000	3.041	1.01	3.021	0.021
2	0.0900	10.010	1.0	0.7	0.047	3.000	3.047	1.02	3.024	0.024
3	0.1000	10.360	1.4	1.1	0.063	3.000	3.063	1.02	3.032	0.032
4	0.1207	11.340	2.3	1.8	0.108	3.000	3.108	1.04	3.054	0.054
5	0.1485	14.520	5.5	2.8	0.253	3.000	3.253	1.08	3.127	0.127
6	0.1874	22.700	13.7	4.2	0.619	3.000	3.619	1.21	3.310	0.310
7	0.2422	32.860	23.9	6.1	1.057	3.000	4.057	1.35	3.528	0.528
8	0.2965	36.190	27.2	8.1	1.179	3.000	4.179	1.39	3.590	0.590
9	0.3507	36.160	27.2	10.0	1.153	3.000	4.153	1.38	3.577	0.577
10	0.3909	34.240	25.2	11.4	1.055	3.000	4.055	1.35	3.527	0.527
11	0.4291	32.470	23.5	12.8	0.966	3.000	3.966	1.32	3.483	0.483
12	0.4511	32.580	23.6	13.6	0.962	3.000	3.962	1.32	3.481	0.481
13	0.4761	32.790	23.8	14.4	0.960	3.000	3.960	1.32	3.480	0.480
14	0.4921	32.810	23.8	15.0	0.955	3.000	3.955	1.32	3.477	0.477





Sample No.	1	2	3	
Initial	Water Content, %	70.2	71.2	73.7
	Dry Density, pcf	57.8	57.0	55.8
	Saturation, %	98.0	97.2	97.6
	Void Ratio	1.9693	2.0124	2.0750
	Diameter, in.	1.40	1.41	1.41
	Height, in.	2.82	2.82	2.81
At Test	Water Content, %	71.6	73.2	75.5
	Dry Density, pcf	57.8	57.0	55.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.9693	2.0124	2.0750
	Diameter, in.	1.40	1.41	1.41
	Height, in.	2.82	2.82	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Fail. Stress, tsf	0.79	0.82	0.83	
Ult. Stress, tsf	0.65	0.59	0.73	
σ_1 Failure, tsf	1.54	2.32	3.83	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, gray (CH)

LL= 111 PL= 25 PI= 86

Assumed Specific Gravity= 2.75

Remarks:

Figure UU Triax ASTM D2850

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #5

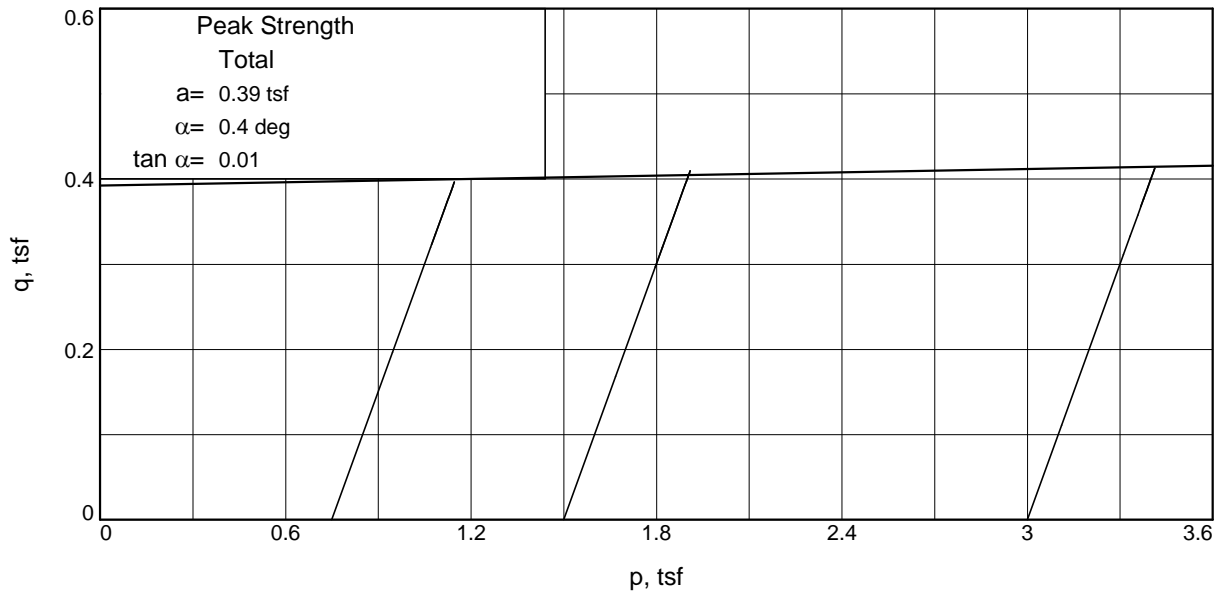
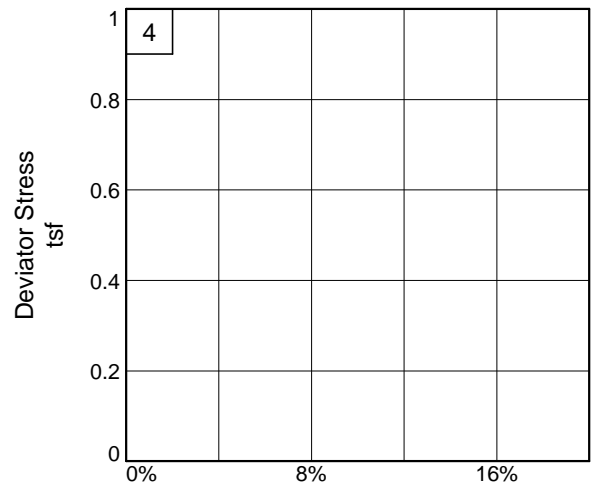
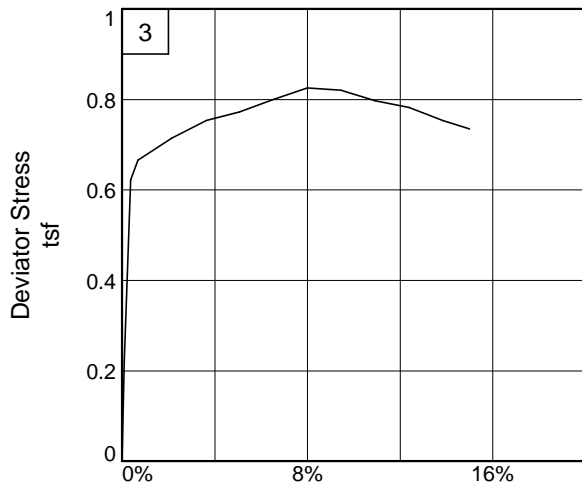
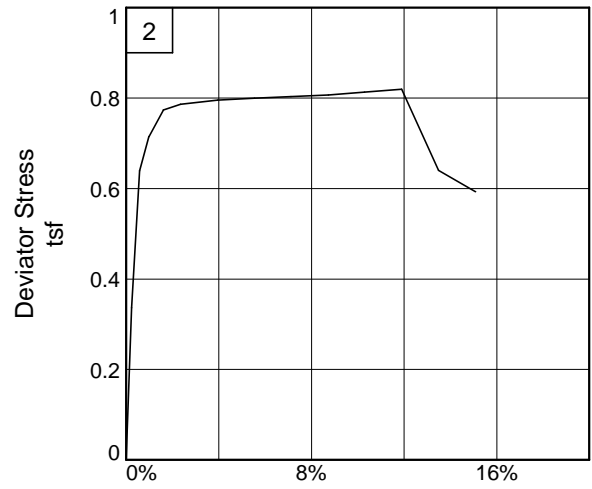
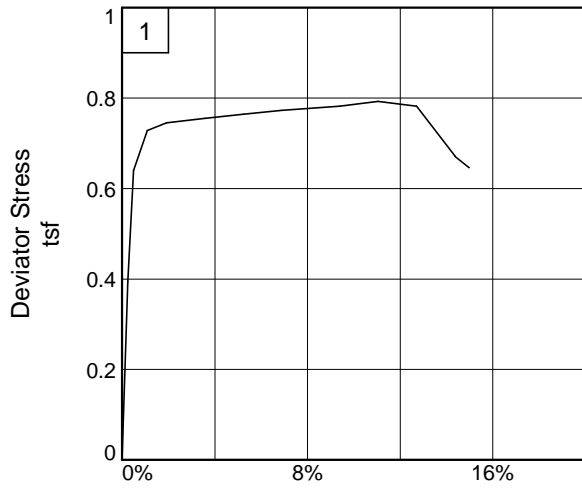
Depth: 38-40'

Brenna

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 38-40' **Sample Number:** Boring 09-23MU, #5

Project No.: BL-09-03127

Figure _____

Brenna

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

10:17 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Fargo**
Depth: 38-40' **Sample Number:** Boring 09-23MU, #5
Description: FAT CLAY, gray (CH) **Brenna**
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**111 **PL=**25 **PI=**86
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	109.770		141.590
Moisture content: Dry soil+tare, gms.	77.060		95.980
Moisture content: Tare, gms.	30.440		30.270
Moisture, %	70.2	71.6	69.4
Moist specimen weight, gms.	111.8		
Diameter, in.	1.40	1.40	
Area, in. ²	1.54	1.54	
Height, in.	2.82	2.82	
Net decrease in height, in.		0.00	
Wet Density, pcf	98.4	99.2	
Dry density, pcf	57.8	57.8	
Void ratio	1.9693	1.9693	
Saturation, %	98.0	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 0.792 tsf **at reading no. 9**
Ult. Stress = 0.646 tsf **at reading no. 12**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2709	0.780	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	-1.2640	9.200	8.4	0.2	0.393	0.750	1.143	1.52	0.947	0.197
2	-1.2568	14.500	13.7	0.5	0.639	0.750	1.389	1.85	1.070	0.320
3	-1.2402	16.500	15.7	1.1	0.728	0.750	1.478	1.97	1.114	0.364
4	-1.2170	17.000	16.2	1.9	0.745	0.750	1.495	1.99	1.123	0.373
5	-1.1700	17.500	16.7	3.6	0.755	0.750	1.505	2.01	1.128	0.378
6	-1.1230	18.000	17.2	5.3	0.764	0.750	1.514	2.02	1.132	0.382
7	-1.0768	18.500	17.7	6.9	0.773	0.750	1.523	2.03	1.136	0.386
8	-1.0065	19.200	18.4	9.4	0.782	0.750	1.532	2.04	1.141	0.391
9	-0.9598	19.800	19.0	11.0	0.792	0.750	1.542	2.06	1.146	0.396
10	-0.9132	19.900	19.1	12.7	0.782	0.750	1.532	2.04	1.141	0.391
11	-0.8660	17.500	16.7	14.4	0.671	0.750	1.421	1.89	1.085	0.335
12	-0.8490	17.000	16.2	15.0	0.646	0.750	1.396	1.86	1.073	0.323

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	117.220		141.880
Moisture content: Dry soil+tare, gms.	81.040		95.880
Moisture content: Tare, gms.	30.190		30.620
Moisture, %	71.2	73.2	70.5
Moist specimen weight, gms.	112.2		
Diameter, in.	1.41	1.41	
Area, in. ²	1.55	1.55	
Height, in.	2.82	2.82	
Net decrease in height, in.		0.00	
Wet Density, pcf	97.5	98.7	
Dry density, pcf	57.0	57.0	
Void ratio	2.0124	2.0124	
Saturation, %	97.2	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 0.819 tsf at reading no. 11
 Ult. Stress = 0.593 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2653	2.420	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	-1.2585	9.700	7.3	0.2	0.336	1.500	1.836	1.22	1.668	0.168
2	-1.2490	16.300	13.9	0.6	0.639	1.500	2.139	1.43	1.820	0.320
3	-1.2377	18.000	15.6	1.0	0.714	1.500	2.214	1.48	1.857	0.357
4	-1.2200	19.400	17.0	1.6	0.774	1.500	2.274	1.52	1.887	0.387
5	-1.1990	19.800	17.4	2.4	0.786	1.500	2.286	1.52	1.893	0.393
6	-1.1540	20.300	17.9	4.0	0.795	1.500	2.295	1.53	1.898	0.398
7	-1.1090	20.700	18.3	5.5	0.800	1.500	2.300	1.53	1.900	0.400
8	-1.0646	21.100	18.7	7.1	0.803	1.500	2.303	1.54	1.902	0.402
9	-1.0190	21.500	19.1	8.7	0.806	1.500	2.306	1.54	1.903	0.403

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
10	-0.9750	22.000	19.6	10.3	0.813	1.500	2.313	1.54	1.907	0.407
11	-0.9299	22.500	20.1	11.9	0.819	1.500	2.319	1.55	1.910	0.410
12	-0.8854	18.400	16.0	13.5	0.640	1.500	2.140	1.43	1.820	0.320
13	-0.8401	17.500	15.1	15.1	0.593	1.500	2.093	1.40	1.796	0.296

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	127.150		140.760
Moisture content: Dry soil+tare, gms.	86.040		95.010
Moisture content: Tare, gms.	30.240		30.410
Moisture, %	73.7	75.5	70.8
Moist specimen weight, gms.	111.3		
Diameter, in.	1.41	1.41	
Area, in. ²	1.56	1.56	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	97.0	98.0	
Dry density, pcf	55.8	55.8	
Void ratio	2.0750	2.0750	
Saturation, %	97.6	100.0	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

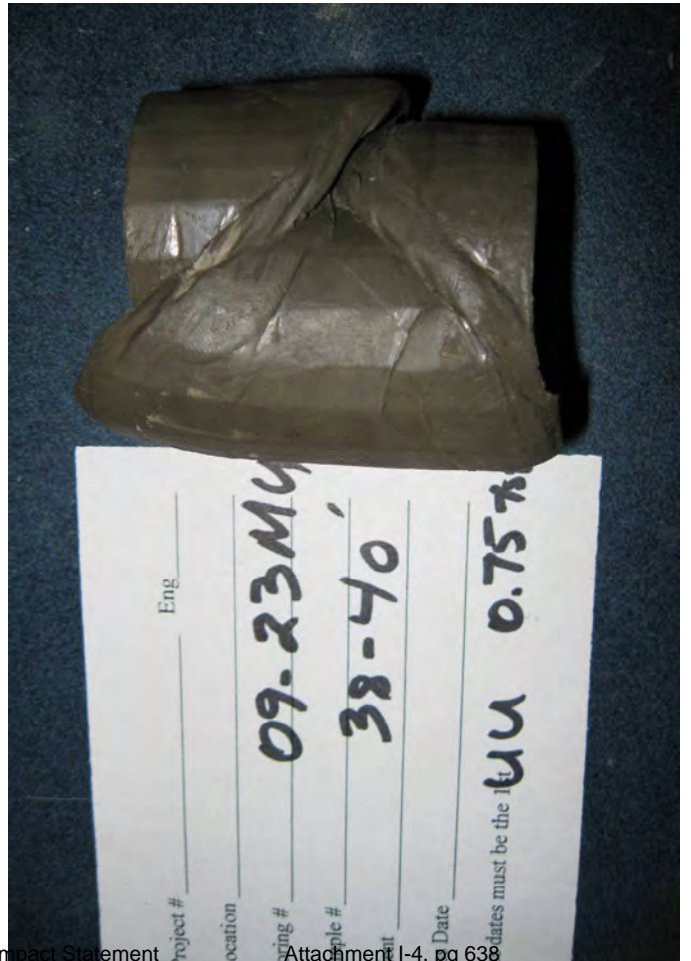
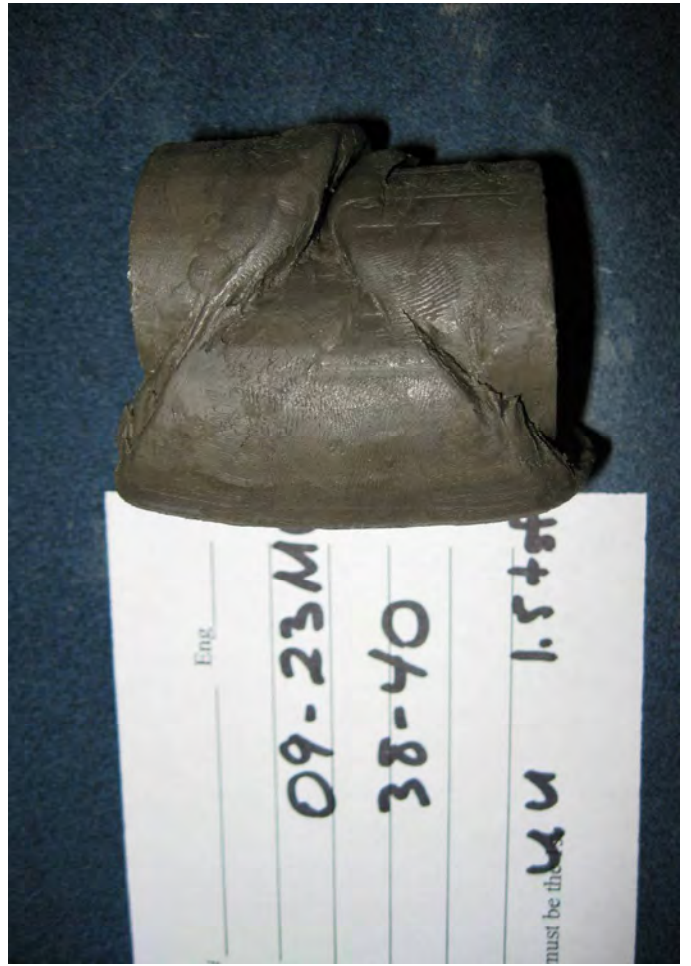
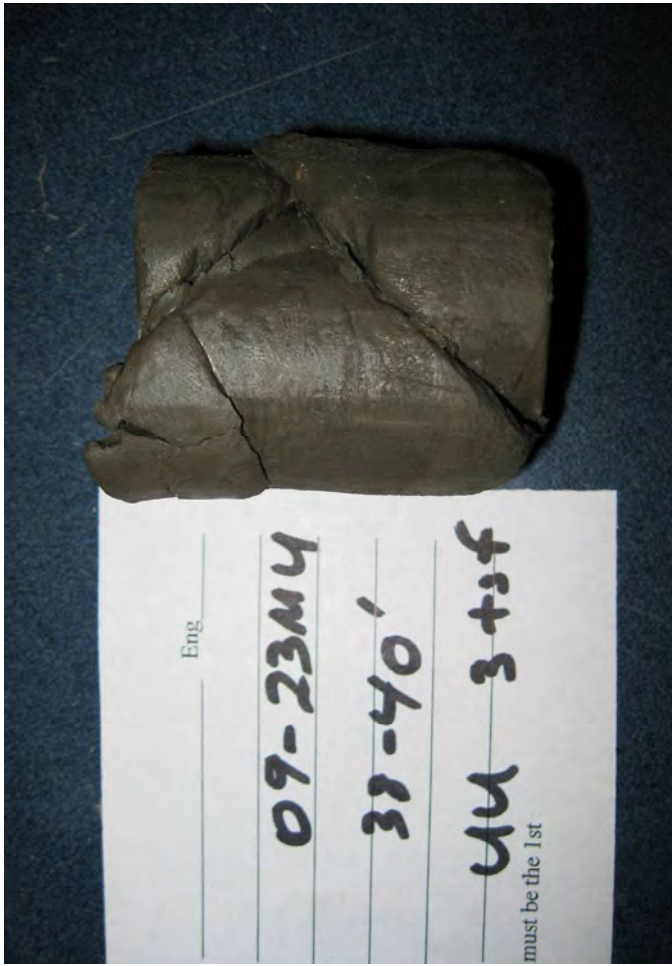
Back pressure = 0.000 tsf

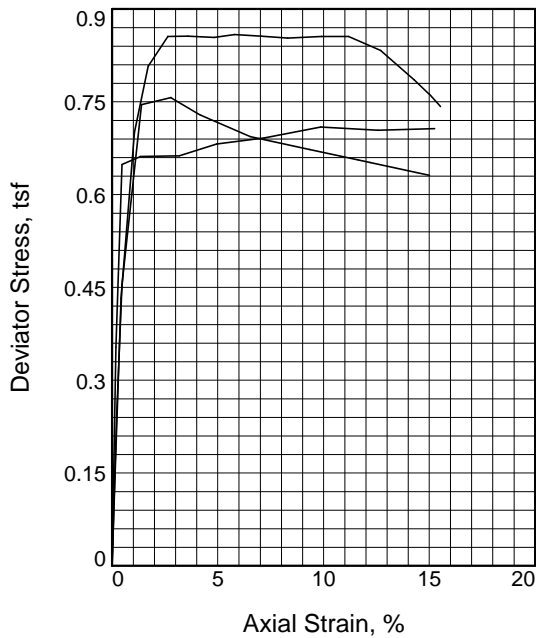
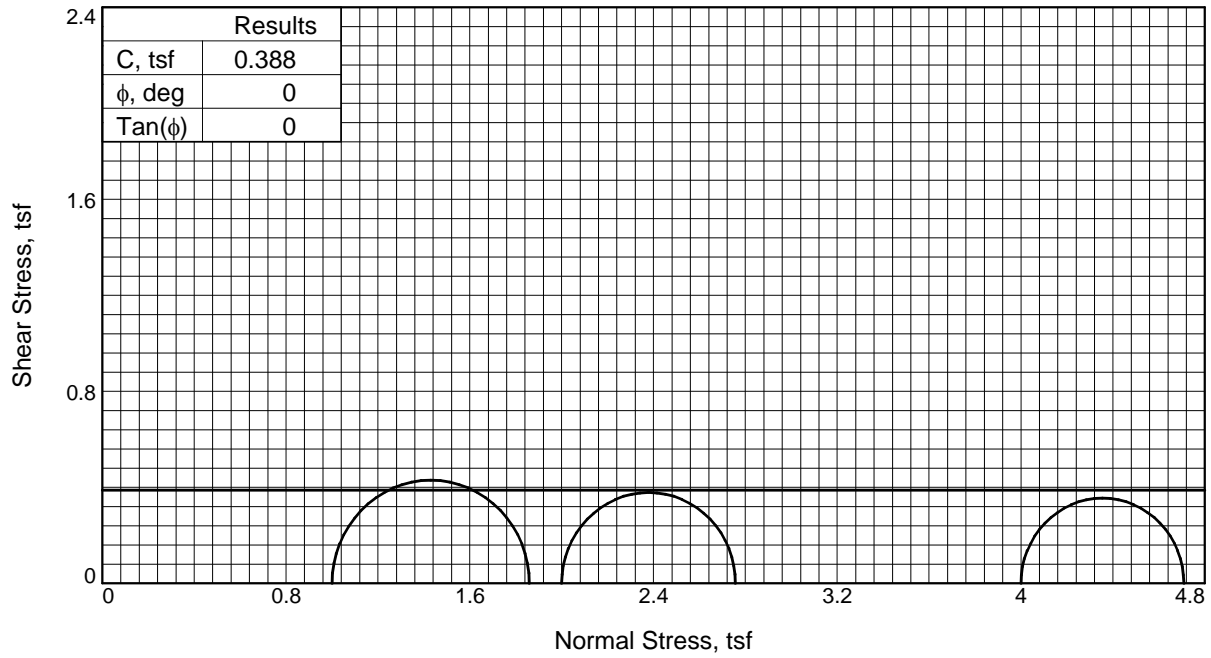
Strain rate, in./min. = 0.03

Fail. Stress = 0.825 tsf at reading no. 8

Ult. Stress = 0.735 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2595	6.500	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	-1.2567	11.300	4.8	0.1	0.222	3.000	3.222	1.07	3.111	0.111
2	-1.2490	20.000	13.5	0.4	0.622	3.000	3.622	1.21	3.311	0.311
3	-1.2400	21.000	14.5	0.7	0.666	3.000	3.666	1.22	3.333	0.333
4	-1.1990	22.300	15.8	2.2	0.715	3.000	3.715	1.24	3.357	0.357
5	-1.1580	23.400	16.9	3.6	0.753	3.000	3.753	1.25	3.377	0.377
6	-1.1170	24.100	17.6	5.1	0.773	3.000	3.773	1.26	3.386	0.386
7	-1.0760	25.000	18.5	6.5	0.800	3.000	3.800	1.27	3.400	0.400
8	-1.0349	25.900	19.4	8.0	0.825	3.000	3.825	1.28	3.413	0.413
9	-0.9940	26.100	19.6	9.5	0.821	3.000	3.821	1.27	3.410	0.410
10	-0.9525	25.848	19.3	10.9	0.797	3.000	3.797	1.27	3.398	0.398
11	-0.9115	25.800	19.3	12.4	0.782	3.000	3.782	1.26	3.391	0.391
12	-0.8704	25.400	18.9	13.9	0.753	3.000	3.753	1.25	3.376	0.376
13	-0.8380	25.200	18.7	15.0	0.735	3.000	3.735	1.24	3.367	0.367





Sample No.	1	2	3	
Initial	Water Content, %	53.9	54.1	56.0
	Dry Density, pcf	68.5	67.5	65.2
	Saturation, %	98.4	96.3	94.3
	Void Ratio	1.5048	1.5448	1.6339
	Diameter, in.	1.39	1.42	1.40
	Height, in.	2.82	2.80	2.81
At Test	Water Content, %	53.3	56.8	61.8
	Dry Density, pcf	68.5	67.5	65.2
	Saturation, %	97.4	101.1	104.0
	Void Ratio	1.5048	1.5448	1.6339
	Diameter, in.	1.39	1.42	1.40
	Height, in.	2.82	2.80	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Fail. Stress, tsf	0.86	0.76	0.71	
Ult. Stress, tsf	0.76	0.63	0.71	
σ_1 Failure, tsf	1.86	2.76	4.71	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5"

Description: FAT CLAY, gray (CH)

LL= 92 PL= 22 PI= 70

Assumed Specific Gravity= 2.75

Remarks: Tested bottom portion of 5" thinwall.

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Fargo

Sample Number: Boring 09-23MU, #6

Depth: 80-82'

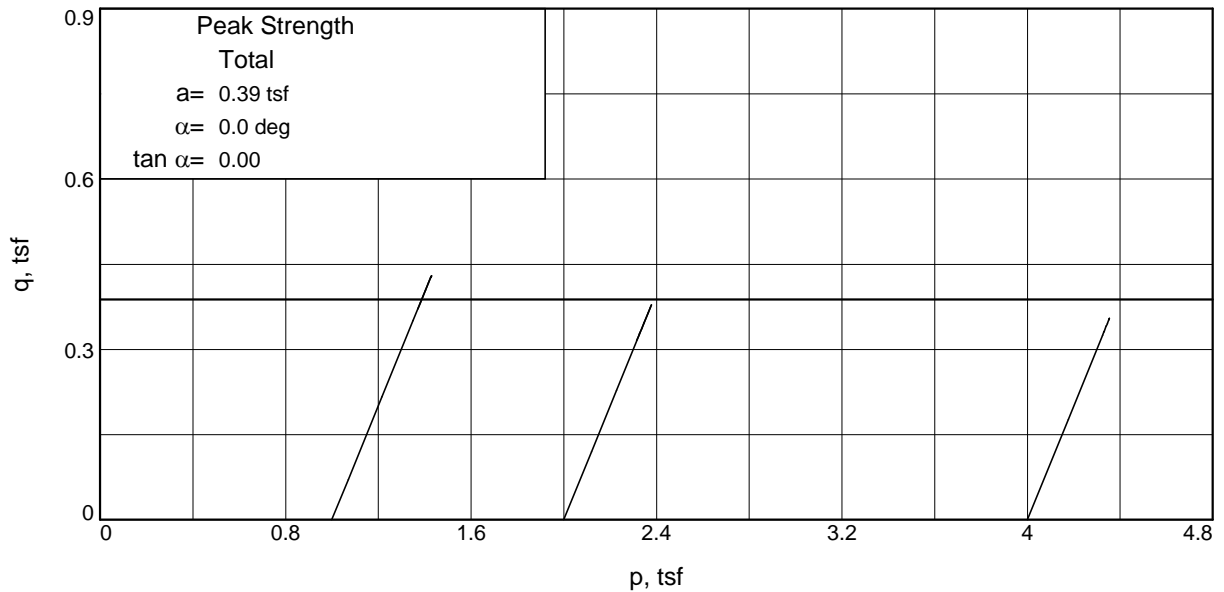
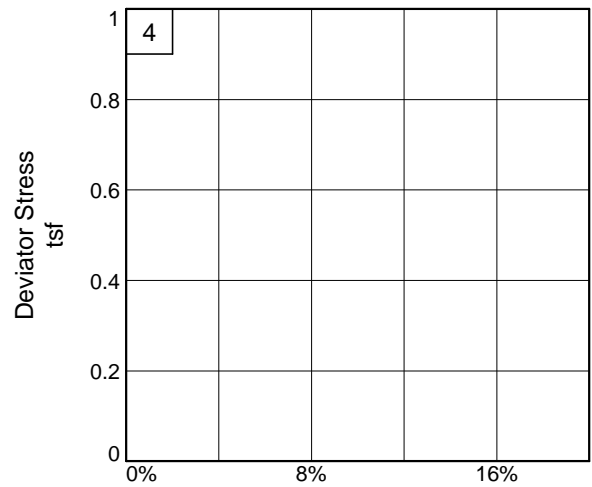
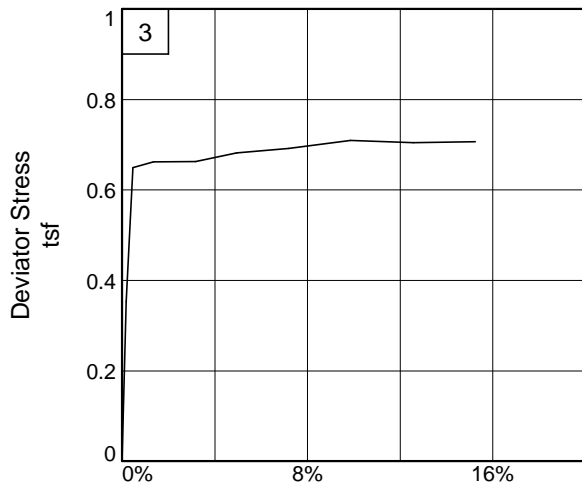
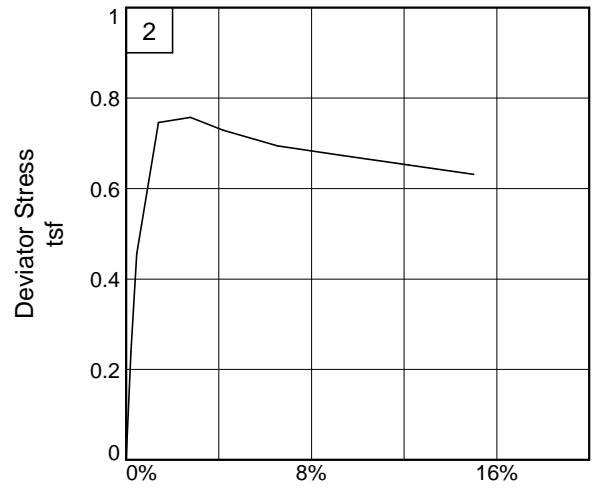
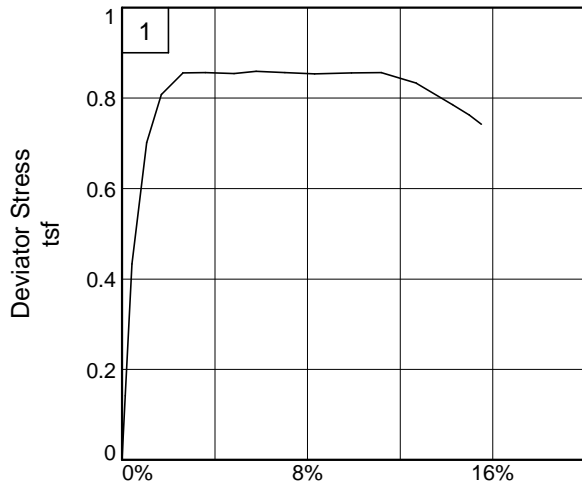
Brenna

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Depth: 80-82' **Sample Number:** Boring 09-23MU, #6

Project No.: BL-09-03127

Figure _____

Brenna

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

9:43 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Fargo**
Depth: 80-82' **Sample Number:** Boring 09-23MU, #6
Description: FAT CLAY, gray (CH) **Brenna**
Remarks: Tested bottom portion of 5" thinwall.
Type of Sample: Thinwall, 5"
Assumed Specific Gravity=2.75 **LL=**92 **PL=**22 **PI=**70
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	135.440	148.820
Moisture content: Dry soil+tare, gms.	98.770	107.650
Moisture content: Tare, gms.	30.690	30.420
Moisture, %	53.9	53.3
Moist specimen weight, gms.	118.8	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.82	
Wet Density, pcf	105.5	
Dry density, pcf	68.5	
Void ratio	1.5048	
Saturation, %	98.4	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 0.859 tsf **at reading no. 8**
Ult. Stress = 0.763 tsf **at reading no. 15**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7320	5.000	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.7280	8.000	3.0	0.1	0.142	1.000	1.142	1.14	1.071	0.071
2	-1.7200	14.200	9.2	0.4	0.433	1.000	1.433	1.43	1.216	0.216
3	-1.7020	20.000	15.0	1.1	0.701	1.000	1.701	1.70	1.351	0.351
4	-1.6840	22.400	17.4	1.7	0.808	1.000	1.808	1.81	1.404	0.404
5	-1.6580	23.600	18.6	2.6	0.856	1.000	1.856	1.86	1.428	0.428
6	-1.6310	23.800	18.8	3.6	0.856	1.000	1.856	1.86	1.428	0.428
7	-1.5960	24.000	19.0	4.8	0.854	1.000	1.854	1.85	1.427	0.427
8	-1.5690	24.300	19.3	5.8	0.859	1.000	1.859	1.86	1.430	0.430
9	-1.5340	24.500	19.5	7.0	0.856	1.000	1.856	1.86	1.428	0.428
10	-1.4980	24.700	19.7	8.3	0.853	1.000	1.853	1.85	1.427	0.427
11	-1.4530	25.100	20.1	9.9	0.855	1.000	1.855	1.86	1.428	0.428
12	-1.4170	25.400	20.4	11.2	0.856	1.000	1.856	1.86	1.428	0.428
13	-1.3740	25.200	20.2	12.7	0.833	1.000	1.833	1.83	1.416	0.416
14	-1.3300	24.400	19.4	14.3	0.786	1.000	1.786	1.79	1.393	0.393
15	-1.3100	24.000	19.0	15.0	0.763	1.000	1.763	1.76	1.382	0.382
16	-1.2950	23.600	18.6	15.5	0.742	1.000	1.742	1.74	1.371	0.371

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	118.480	152.260
Moisture content: Dry soil+tare, gms.	87.510	108.310
Moisture content: Tare, gms.	30.260	30.960
Moisture, %	54.1	56.8
Moist specimen weight, gms.	121.5	
Diameter, in.	1.42	
Area, in. ²	1.59	
Height, in.	2.80	
Wet Density, pcf	104.0	
Dry density, pcf	67.5	
Void ratio	1.5448	
Saturation, %	96.3	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 0.757 tsf at reading no. 4

Ult. Stress = 0.631 tsf at reading no. 10

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7170	4.000	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.7110	9.300	5.3	0.2	0.239	2.000	2.239	1.12	2.120	0.120
2	-1.7040	14.100	10.1	0.5	0.455	2.000	2.455	1.23	2.228	0.228
3	-1.6780	20.700	16.7	1.4	0.746	2.000	2.746	1.37	2.373	0.373
4	-1.6390	21.200	17.2	2.8	0.757	2.000	2.757	1.38	2.378	0.378
5	-1.5997	20.800	16.8	4.2	0.729	2.000	2.729	1.36	2.364	0.364
6	-1.5340	20.400	16.4	6.5	0.694	2.000	2.694	1.35	2.347	0.347
7	-1.4560	20.400	16.4	9.3	0.673	2.000	2.673	1.34	2.337	0.337
8	-1.3910	20.400	16.4	11.6	0.656	2.000	2.656	1.33	2.328	0.328
9	-1.3750	20.400	16.4	12.2	0.652	2.000	2.652	1.33	2.326	0.326
10	-1.2970	20.400	16.4	15.0	0.631	2.000	2.631	1.32	2.316	0.316

Parameters for Specimen No. 3

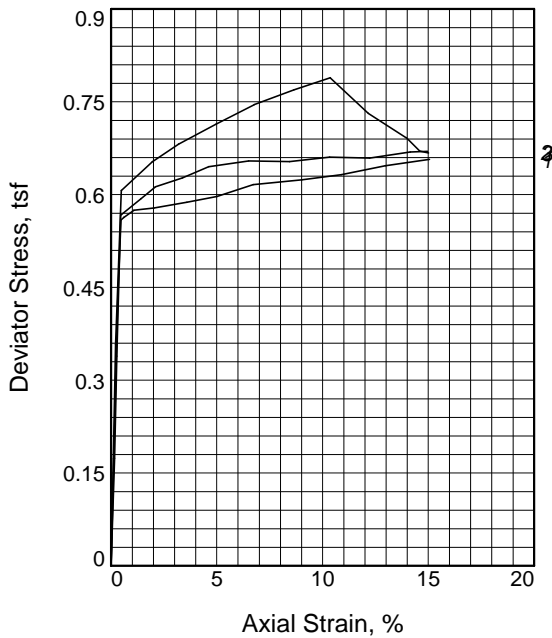
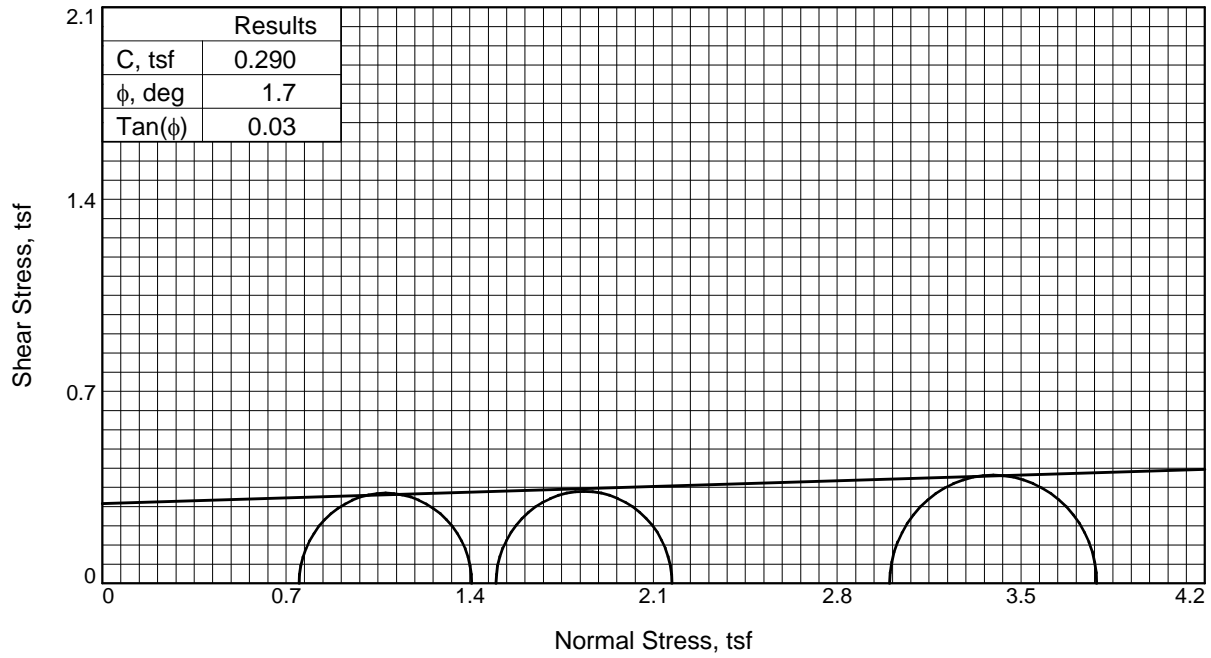
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	111.230	146.430
Moisture content: Dry soil+tare, gms.	82.220	102.510
Moisture content: Tare, gms.	30.420	31.420
Moisture, %	56.0	61.8
Moist specimen weight, gms.	115.8	
Diameter, in.	1.40	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	101.7	
Dry density, pcf	65.2	
Void ratio	1.6339	
Saturation, %	94.3	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 0.709 tsf at reading no. 7
 Ult. Stress = 0.707 tsf at reading no. 9

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.7140	7.000	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	-1.7090	14.600	7.6	0.2	0.353	4.000	4.353	1.09	4.177	0.177
2	-1.7010	21.000	14.0	0.5	0.649	4.000	4.649	1.16	4.324	0.324
3	-1.6760	21.400	14.4	1.4	0.662	4.000	4.662	1.17	4.331	0.331
4	-1.6250	21.700	14.7	3.2	0.663	4.000	4.663	1.17	4.331	0.331
5	-1.5750	22.400	15.4	5.0	0.682	4.000	4.682	1.17	4.341	0.341
6	-1.5120	23.000	16.0	7.2	0.692	4.000	4.692	1.17	4.346	0.346
7	-1.4370	23.900	16.9	9.9	0.709	4.000	4.709	1.18	4.355	0.355
8	-1.3610	24.300	17.3	12.6	0.704	4.000	4.704	1.18	4.352	0.352
9	-1.2860	24.900	17.9	15.2	0.707	4.000	4.707	1.18	4.353	0.353





Sample No.	1	2	3	
Initial	Water Content, %	70.1	70.2	70.0
	Dry Density, pcf	57.7	58.1	57.7
	Saturation, %	97.4	98.6	97.5
	Void Ratio	1.9776	1.9559	1.9728
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.82	2.80	2.81
At Test	Water Content, %	71.9	71.1	71.7
	Dry Density, pcf	57.7	58.1	57.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.9776	1.9559	1.9728
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.82	2.80	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Fail. Stress, tsf	0.66	0.67	0.79	
Ult. Stress, tsf	0.66	0.67	0.67	
σ_1 Failure, tsf	1.41	2.17	3.79	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, gray (CH)

LL= 116 **PL=** 25 **PI=** 91

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #4

Depth: 38-40'

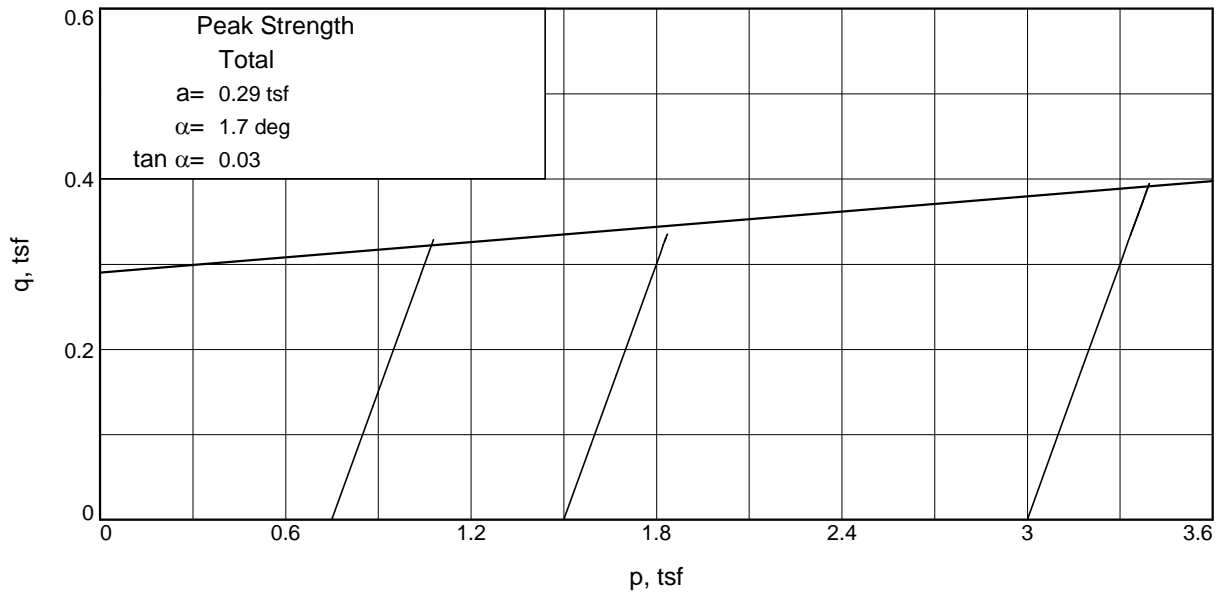
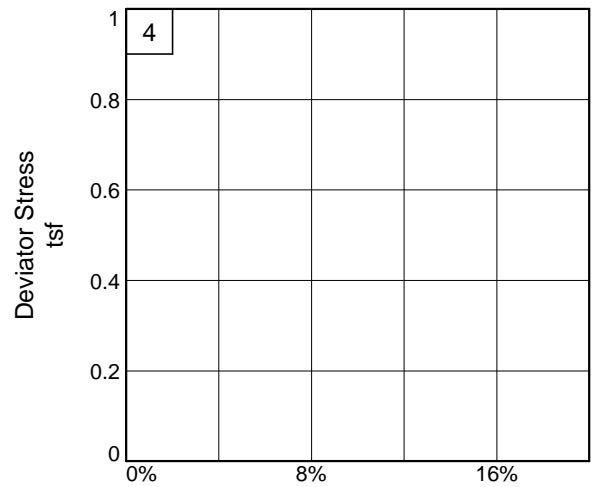
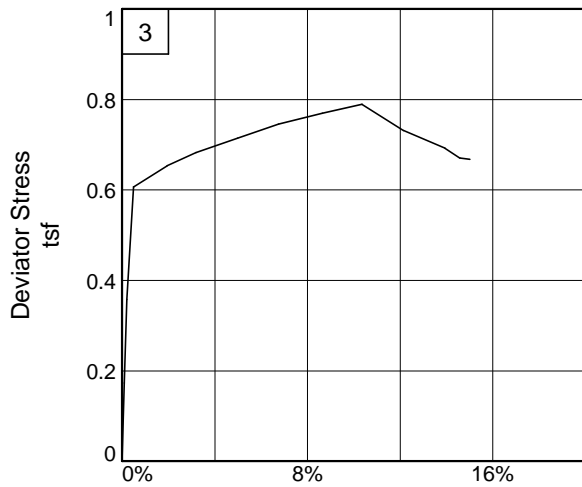
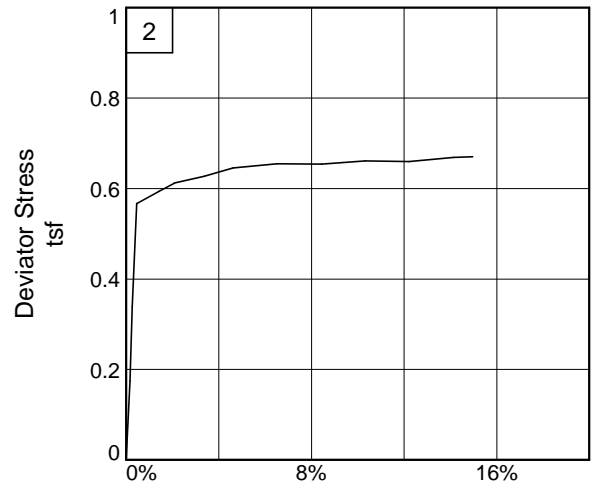
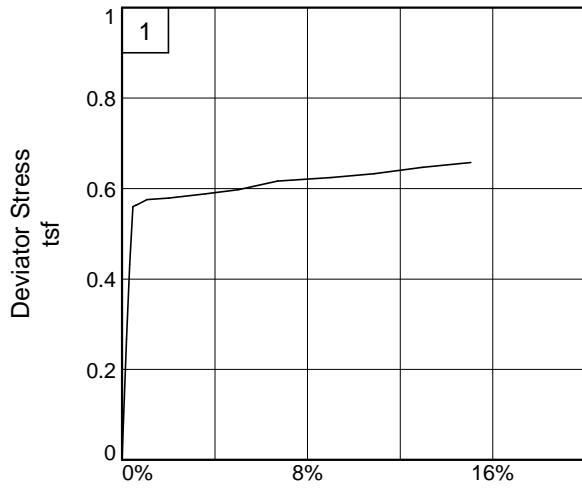
Brenna

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D2850



Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**
Depth: 38-40' **Sample Number:** Boring 09-25MU, #4
Project No.: BL-09-03127 **Figure** _____

Brenna

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

10:16 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL-09-03127 **Moorhead**
Depth: 38-40' **Sample Number:** Boring 09-25MU, #4
Description: FAT CLAY, gray (CH) **Brenna**
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**116 **PL=**25 **PI=**91
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	116.060		139.190
Moisture content: Dry soil+tare, gms.	80.690		95.380
Moisture content: Tare, gms.	30.210		30.400
Moisture, %	70.1	71.9	67.4
Moist specimen weight, gms.	109.7		
Diameter, in.	1.39	1.39	
Area, in. ²	1.51	1.51	
Height, in.	2.82	2.82	
Net decrease in height, in.		0.00	
Wet Density, pcf	98.1	99.1	
Dry density, pcf	57.7	57.7	
Void ratio	1.9776	1.9776	
Saturation, %	97.4	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 0.657 tsf **at reading no. 13**
Ult. Stress = 0.657 tsf **at reading no. 13**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2771	-0.214	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	-1.2717	5.400	5.6	0.2	0.267	0.750	1.017	1.36	0.883	0.133
2	-1.2680	8.900	9.1	0.3	0.432	0.750	1.182	1.58	0.966	0.216
3	-1.2640	11.600	11.8	0.5	0.560	0.750	1.310	1.75	1.030	0.280
4	-1.2600	11.700	11.9	0.6	0.563	0.750	1.313	1.75	1.032	0.282
5	-1.2470	12.000	12.2	1.1	0.575	0.750	1.325	1.77	1.037	0.287
6	-1.2200	12.200	12.4	2.0	0.579	0.750	1.329	1.77	1.039	0.289
7	-1.1760	12.600	12.8	3.6	0.588	0.750	1.338	1.78	1.044	0.294
8	-1.1360	13.000	13.2	5.0	0.597	0.750	1.347	1.80	1.049	0.299
9	-1.0880	13.670	13.9	6.7	0.616	0.750	1.366	1.82	1.058	0.308
10	-1.0230	14.200	14.4	9.0	0.624	0.750	1.374	1.83	1.062	0.312
11	-0.9707	14.700	14.9	10.9	0.632	0.750	1.382	1.84	1.066	0.316
12	-0.9120	15.400	15.6	13.0	0.647	0.750	1.397	1.86	1.073	0.323
13	-0.8530	16.050	16.3	15.1	0.657	0.750	1.407	1.88	1.079	0.329

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	75.650		142.410
Moisture content: Dry soil+tare, gms.	57.200		98.120
Moisture content: Tare, gms.	30.900		31.020
Moisture, %	70.2	71.1	66.0
Moist specimen weight, gms.	112.6		
Diameter, in.	1.40	1.40	
Area, in. ²	1.55	1.55	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	98.8	99.4	
Dry density, pcf	58.1	58.1	
Void ratio	1.9559	1.9559	
Saturation, %	98.6	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 0.670 tsf at reading no. 13
 Ult. Stress = 0.670 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.4696	1.950	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	-1.4650	5.700	3.8	0.2	0.174	1.500	1.674	1.12	1.587	0.087
2	-1.4620	9.260	7.3	0.3	0.339	1.500	1.839	1.23	1.670	0.170
3	-1.4567	14.200	12.3	0.5	0.567	1.500	2.067	1.38	1.784	0.284
4	-1.4300	14.900	13.0	1.4	0.594	1.500	2.094	1.40	1.797	0.297
5	-1.4110	15.400	13.5	2.1	0.612	1.500	2.112	1.41	1.806	0.306
6	-1.3750	15.900	14.0	3.4	0.627	1.500	2.127	1.42	1.813	0.313
7	-1.3400	16.500	14.6	4.6	0.645	1.500	2.145	1.43	1.823	0.323
8	-1.2870	17.000	15.1	6.5	0.654	1.500	2.154	1.44	1.827	0.327

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
9	-1.2330	17.300	15.4	8.4	0.654	1.500	2.154	1.44	1.827	0.327
10	-1.1800	17.800	15.9	10.3	0.661	1.500	2.161	1.44	1.830	0.330
11	-1.1270	18.100	16.2	12.2	0.659	1.500	2.159	1.44	1.830	0.330
12	-1.0730	18.700	16.8	14.1	0.669	1.500	2.169	1.45	1.834	0.334
13	-1.0500	18.900	17.0	15.0	0.670	1.500	2.170	1.45	1.835	0.335

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	78.160		140.060
Moisture content: Dry soil+tare, gms.	58.490		96.810
Moisture content: Tare, gms.	30.380		30.930
Moisture, %	70.0	71.7	65.6
Moist specimen weight, gms.	109.8		
Diameter, in.	1.39	1.39	
Area, in. ²	1.52	1.52	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	98.2	99.2	
Dry density, pcf	57.7	57.7	
Void ratio	1.9728	1.9728	
Saturation, %	97.5	100.0	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

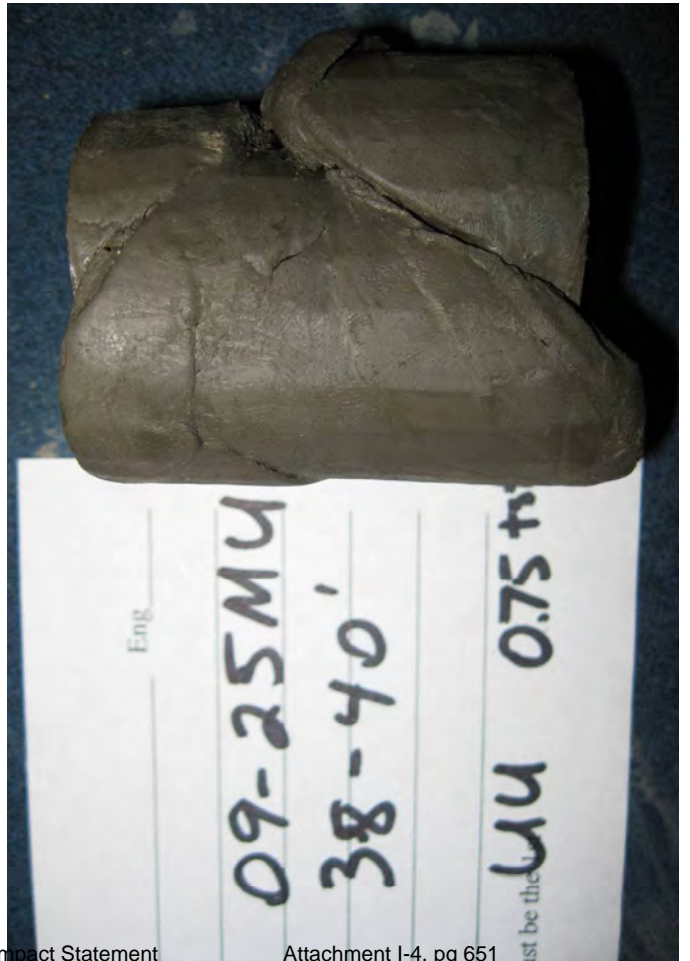
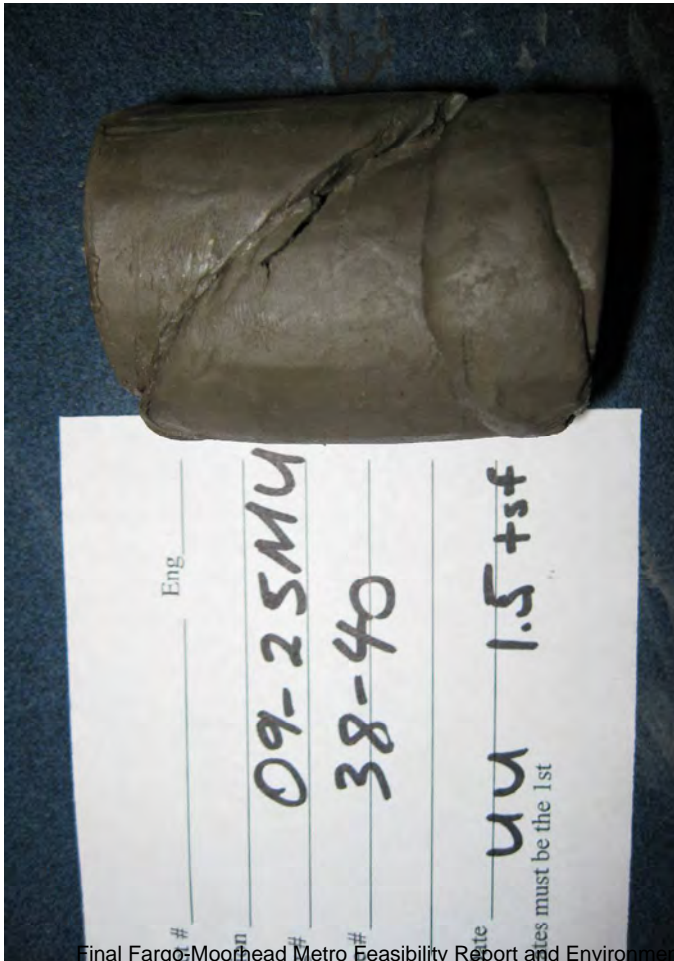
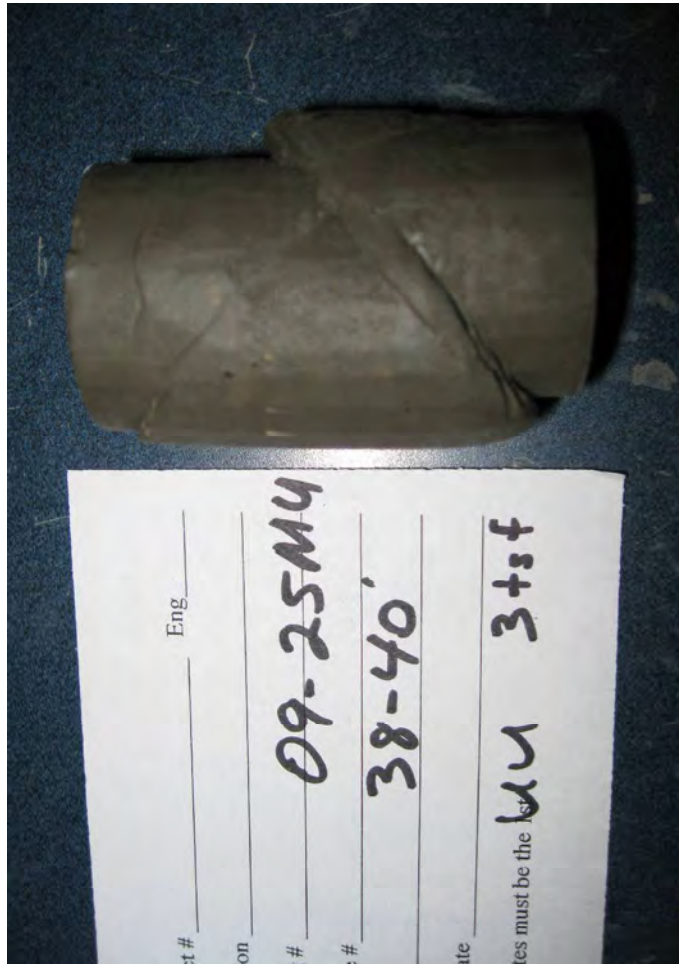
Back pressure = 0.000 tsf

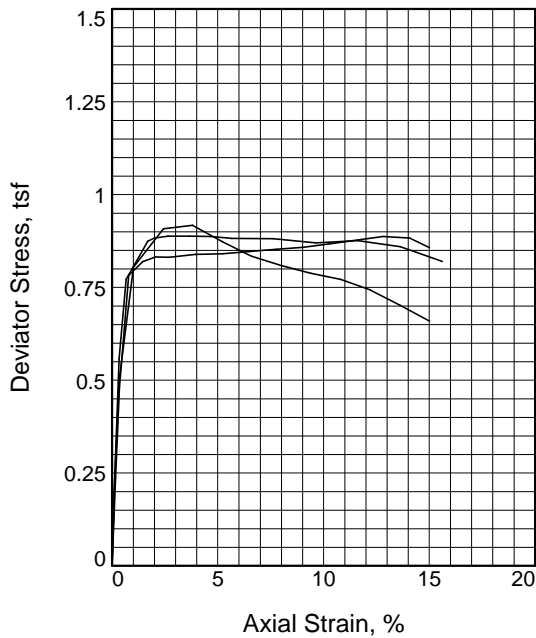
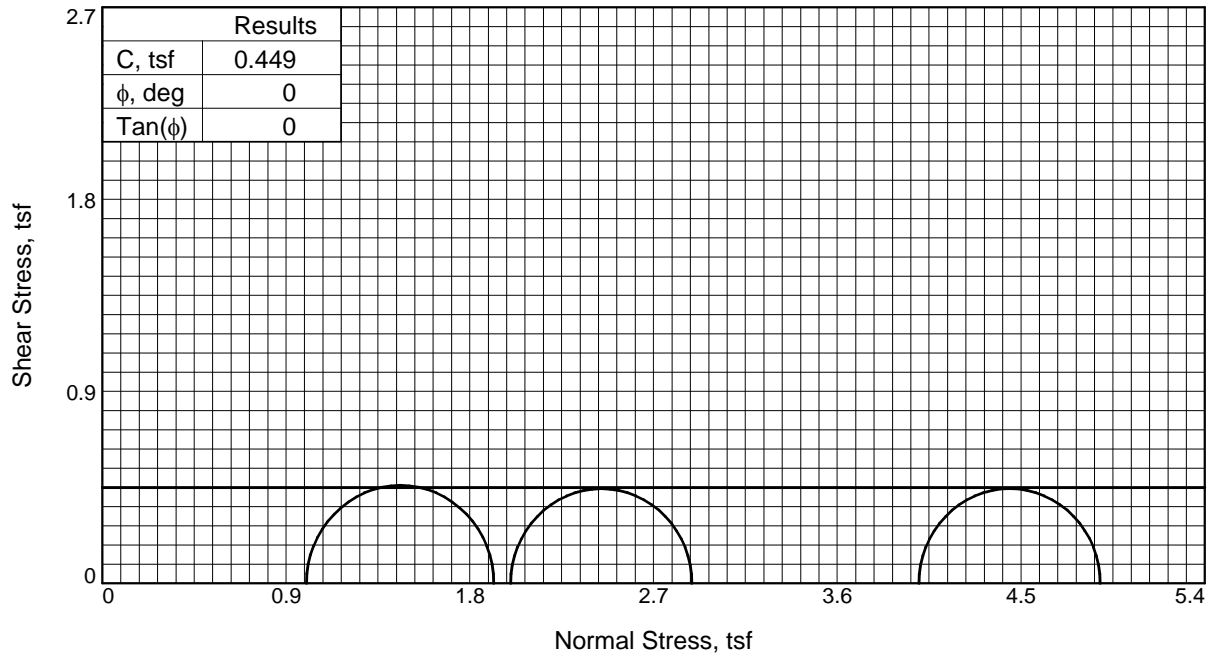
Strain rate, in./min. = 0.03

Fail. Stress = 0.789 tsf at reading no. 9

Ult. Stress = 0.667 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2518	6.150	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	-1.2490	9.800	3.7	0.1	0.173	3.000	3.173	1.06	3.087	0.087
2	-1.2460	13.700	7.5	0.2	0.357	3.000	3.357	1.12	3.179	0.179
3	-1.2380	19.000	12.9	0.5	0.607	3.000	3.607	1.20	3.303	0.303
4	-1.1970	20.200	14.1	2.0	0.654	3.000	3.654	1.22	3.327	0.327
5	-1.1620	21.000	14.9	3.2	0.682	3.000	3.682	1.23	3.341	0.341
6	-1.1118	22.000	15.9	5.0	0.715	3.000	3.715	1.24	3.357	0.357
7	-1.0620	23.000	16.9	6.8	0.745	3.000	3.745	1.25	3.373	0.373
8	-1.0090	23.900	17.8	8.6	0.769	3.000	3.769	1.26	3.385	0.385
9	-0.9606	24.700	18.5	10.4	0.789	3.000	3.789	1.26	3.394	0.394
10	-0.9102	23.700	17.5	12.2	0.731	3.000	3.731	1.24	3.366	0.366
11	-0.8600	23.100	17.0	13.9	0.692	3.000	3.692	1.23	3.346	0.346
12	-0.8419	22.700	16.5	14.6	0.671	3.000	3.671	1.22	3.335	0.335
13	-0.8300	22.700	16.5	15.0	0.667	3.000	3.667	1.22	3.334	0.334





Sample No.		1	2	3
Initial	Water Content, %	53.8	57.6	57.0
	Dry Density, pcf	69.2	66.2	66.0
	Saturation, %	99.9	99.4	97.7
	Void Ratio	1.4802	1.5937	1.6025
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	53.8	58.0	58.3
	Dry Density, pcf	69.2	66.2	66.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.4802	1.5937	1.6025
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.80	2.81	2.81
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Fail. Stress, tsf	0.92	0.89	0.89	
Ult. Stress, tsf	0.66	0.86	0.82	
σ_1 Failure, tsf	1.92	2.89	4.89	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, gray (CH)

LL= 87 PL= 22 PI= 65

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

Moorhead

Sample Number: Boring 09-25MU, #5 **Depth:** 68-70'

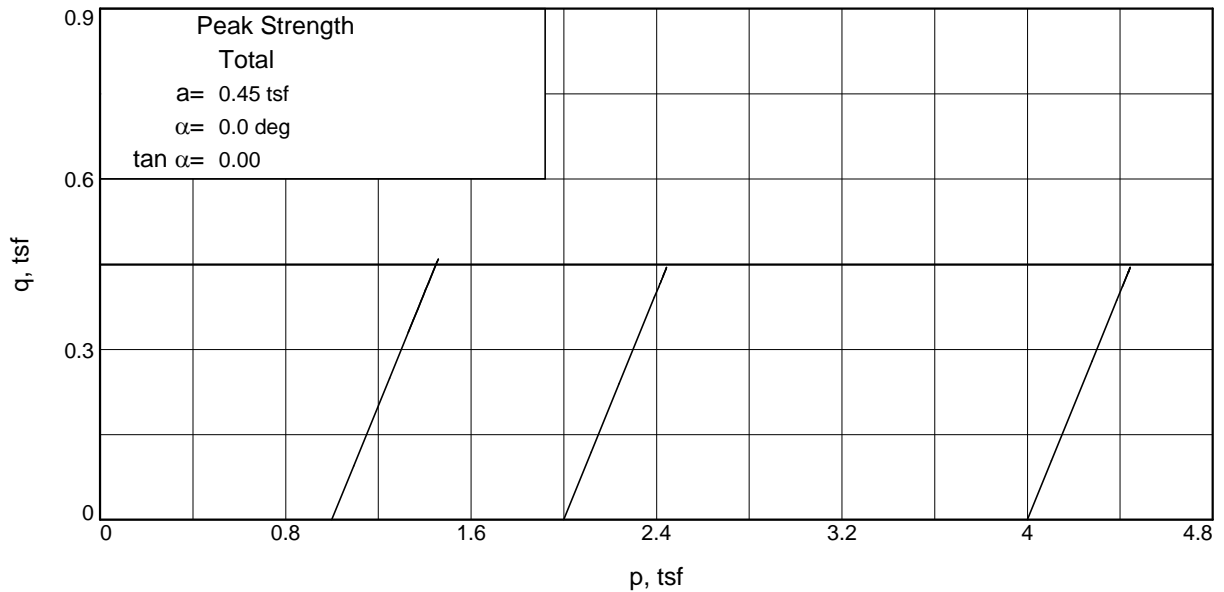
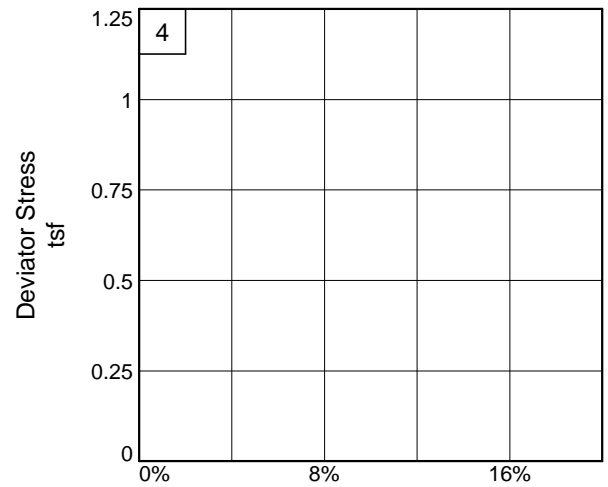
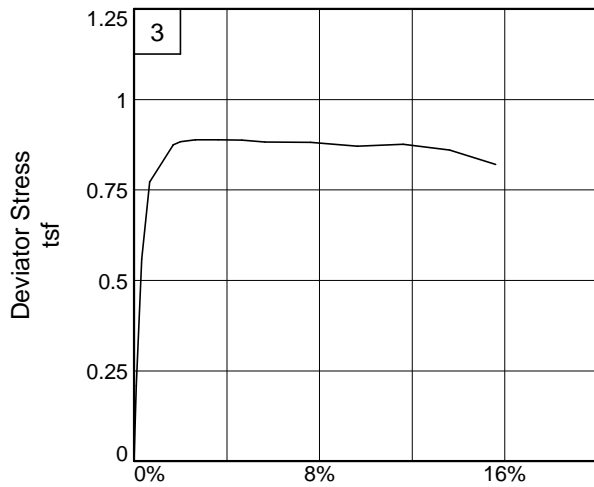
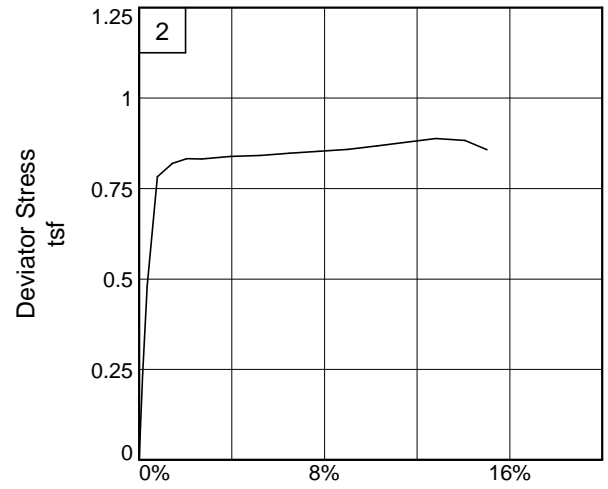
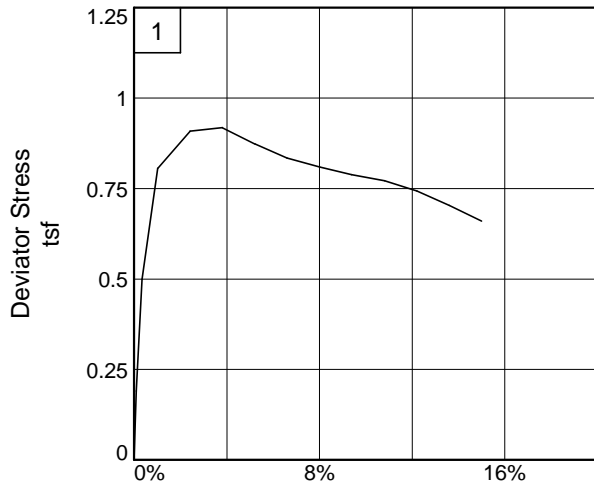
Brenna / Argusville Transition

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D2850



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Moorhead**

Depth: 68-70' **Sample Number:** Boring 09-25MU, #5

Project No.: BL-09-03127

Figure _____

Brenna / Argusville Transition

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

9/16/2009

10:18 AM

Date:**Client:** US Army Corps of Engineers**Project:** Fargo-Moorhead Metro Feasibility Study**Project No.:** BL-09-03127**Depth:** 68-70'**Sample Number:** Boring 09-25MU, #5**Description:** FAT CLAY, gray (CH)**Moorhead****Brenna / Argusville Transition****Remarks:****Type of Sample:** Thinwall, 5", Bottom of sample**Assumed Specific Gravity**=2.75**LL**=87**PL**=22**PI**=65**Test Method:** COE uniform strain**Parameters for Specimen No. 1**

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	148.670		150.350
Moisture content: Dry soil+tare, gms.	107.600		109.010
Moisture content: Tare, gms.	31.220		30.020
Moisture, %	53.8	53.8	52.3
Moist specimen weight, gms.	120.6		
Diameter, in.	1.40	1.40	
Area, in. ²	1.54	1.54	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	106.4	106.5	
Dry density, pcf	69.2	69.2	
Void ratio	1.4802	1.4802	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 1**Cell pressure** = 1.000 tsf**Back pressure** = 0.000 tsf**Strain rate, in./min.** = 0.03**Fail. Stress** = 0.918 tsf at reading no. 5**Ult. Stress** = 0.660 tsf at reading no. 13

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2675	0.900	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	-1.2650	4.970	4.1	0.1	0.190	1.000	1.190	1.19	1.095	0.095
2	-1.2580	11.600	10.7	0.3	0.499	1.000	1.499	1.50	1.249	0.249
3	-1.2390	18.300	17.4	1.0	0.806	1.000	1.806	1.81	1.403	0.403
4	-1.1996	20.800	19.9	2.4	0.908	1.000	1.908	1.91	1.454	0.454
5	-1.1605	21.300	20.4	3.8	0.918	1.000	1.918	1.92	1.459	0.459
6	-1.1212	20.600	19.7	5.2	0.873	1.000	1.873	1.87	1.437	0.437
7	-1.0823	20.000	19.1	6.6	0.834	1.000	1.834	1.83	1.417	0.417
8	-1.0430	19.700	18.8	8.0	0.809	1.000	1.809	1.81	1.404	0.404
9	-1.0040	19.500	18.6	9.4	0.788	1.000	1.788	1.79	1.394	0.394
10	-0.9644	19.400	18.5	10.8	0.772	1.000	1.772	1.77	1.386	0.386
11	-0.9250	19.000	18.1	12.2	0.743	1.000	1.743	1.74	1.372	0.372
12	-0.8860	18.300	17.4	13.6	0.703	1.000	1.703	1.70	1.352	0.352
13	-0.8467	17.500	16.6	15.0	0.660	1.000	1.660	1.66	1.330	0.330

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	108.070		148.740
Moisture content: Dry soil+tare, gms.	79.660		107.550
Moisture content: Tare, gms.	30.320		31.040
Moisture, %	57.6	58.0	53.8
Moist specimen weight, gms.	118.4		
Diameter, in.	1.40	1.40	
Area, in. ²	1.54	1.54	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	104.3	104.5	
Dry density, pcf	66.2	66.2	
Void ratio	1.5937	1.5937	
Saturation, %	99.4	100.0	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 0.888 tsf at reading no. 13
 Ult. Stress = 0.857 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.2577	3.800	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	-1.2532	8.900	5.1	0.2	0.238	2.000	2.238	1.12	2.119	0.119
2	-1.2480	14.100	10.3	0.3	0.479	2.000	2.479	1.24	2.240	0.240
3	-1.2355	20.700	16.9	0.8	0.783	2.000	2.783	1.39	2.392	0.392
4	-1.2175	21.600	17.8	1.4	0.819	2.000	2.819	1.41	2.410	0.410
5	-1.1998	22.000	18.2	2.1	0.832	2.000	2.832	1.42	2.416	0.416
6	-1.1820	22.100	18.3	2.7	0.832	2.000	2.832	1.42	2.416	0.416
7	-1.1467	22.500	18.7	4.0	0.839	2.000	2.839	1.42	2.419	0.419
8	-1.1110	22.800	19.0	5.2	0.841	2.000	2.841	1.42	2.420	0.420

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
9	-1.0757	23.200	19.4	6.5	0.847	2.000	2.847	1.42	2.424	0.424
10	-1.0400	23.600	19.8	7.8	0.853	2.000	2.853	1.43	2.427	0.427
11	-1.0048	24.000	20.2	9.0	0.858	2.000	2.858	1.43	2.429	0.429
12	-0.9690	24.500	20.7	10.3	0.867	2.000	2.867	1.43	2.434	0.434
13	-0.8983	25.600	21.8	12.8	0.888	2.000	2.888	1.44	2.444	0.444
14	-0.8630	25.800	22.0	14.1	0.883	2.000	2.883	1.44	2.441	0.441
15	-0.8364	25.400	21.6	15.0	0.857	2.000	2.857	1.43	2.429	0.429

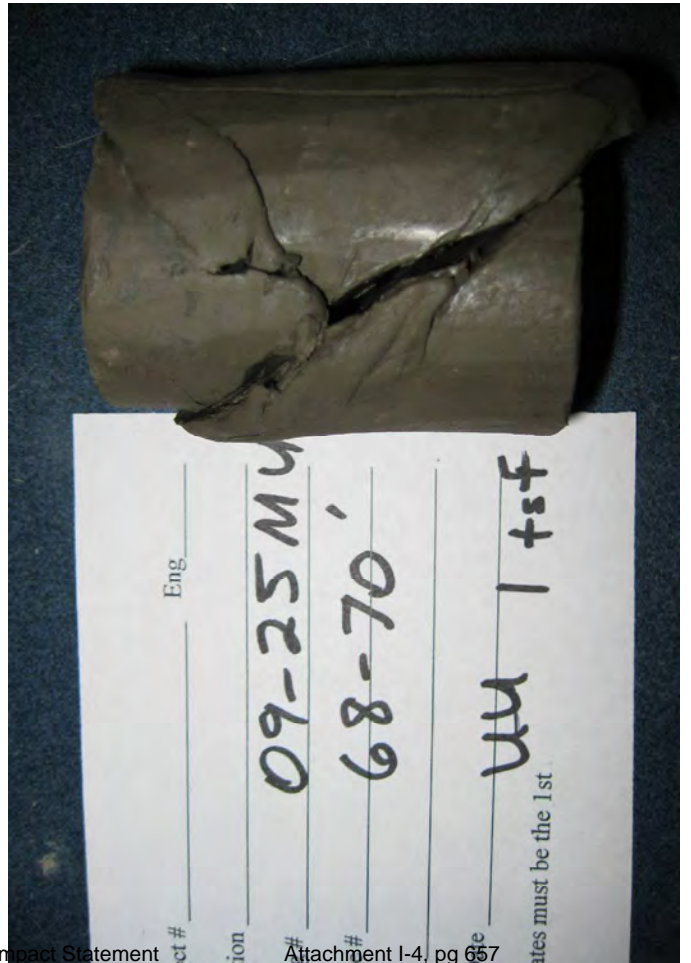
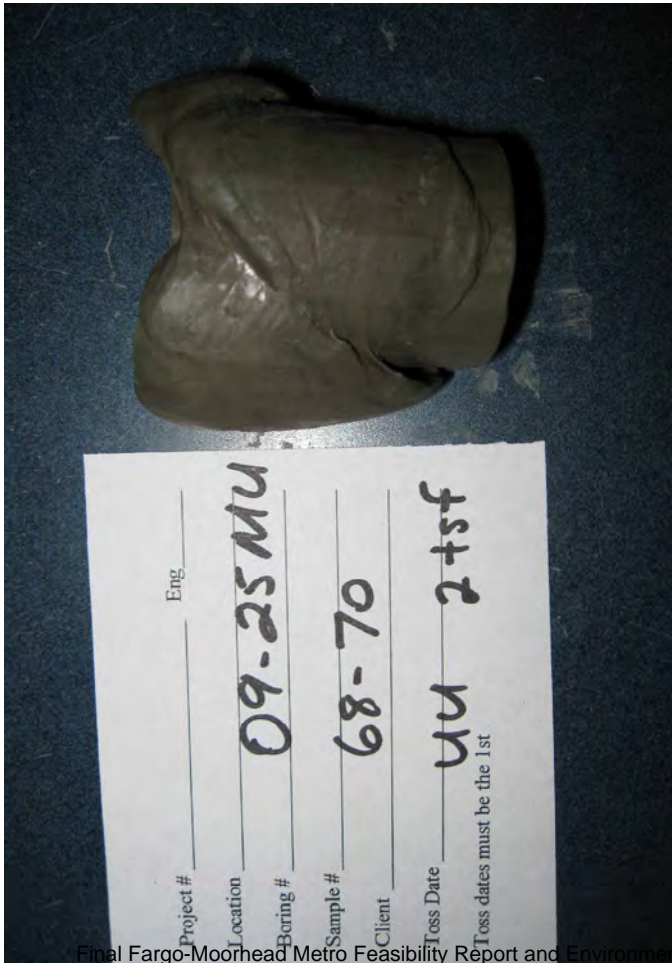
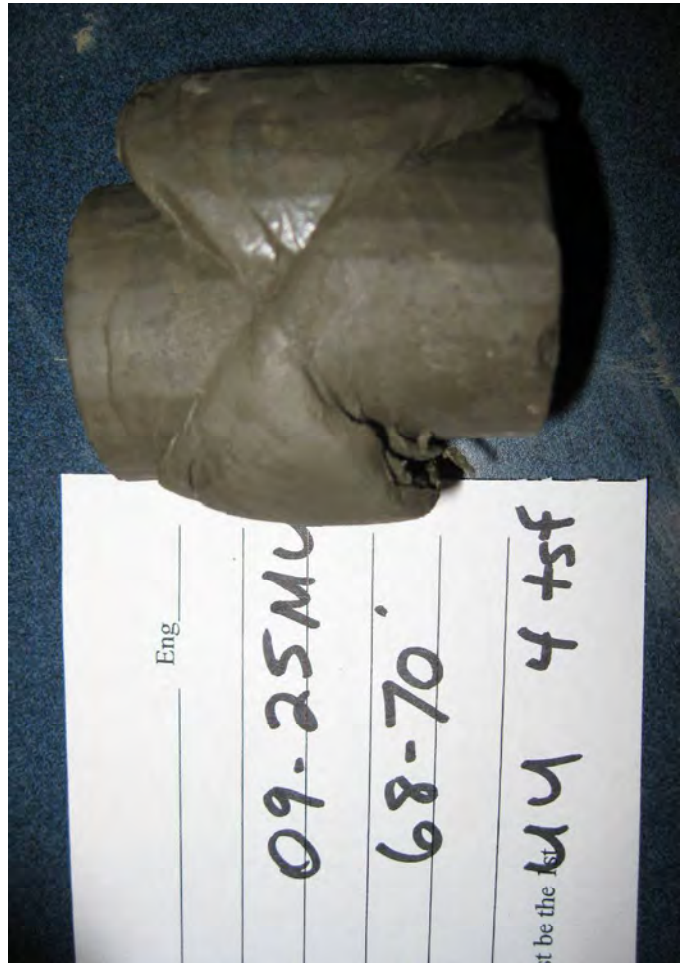
Parameters for Specimen No. 3

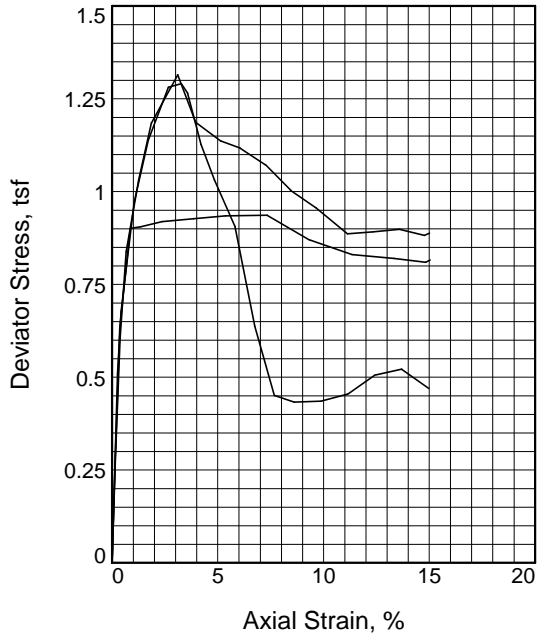
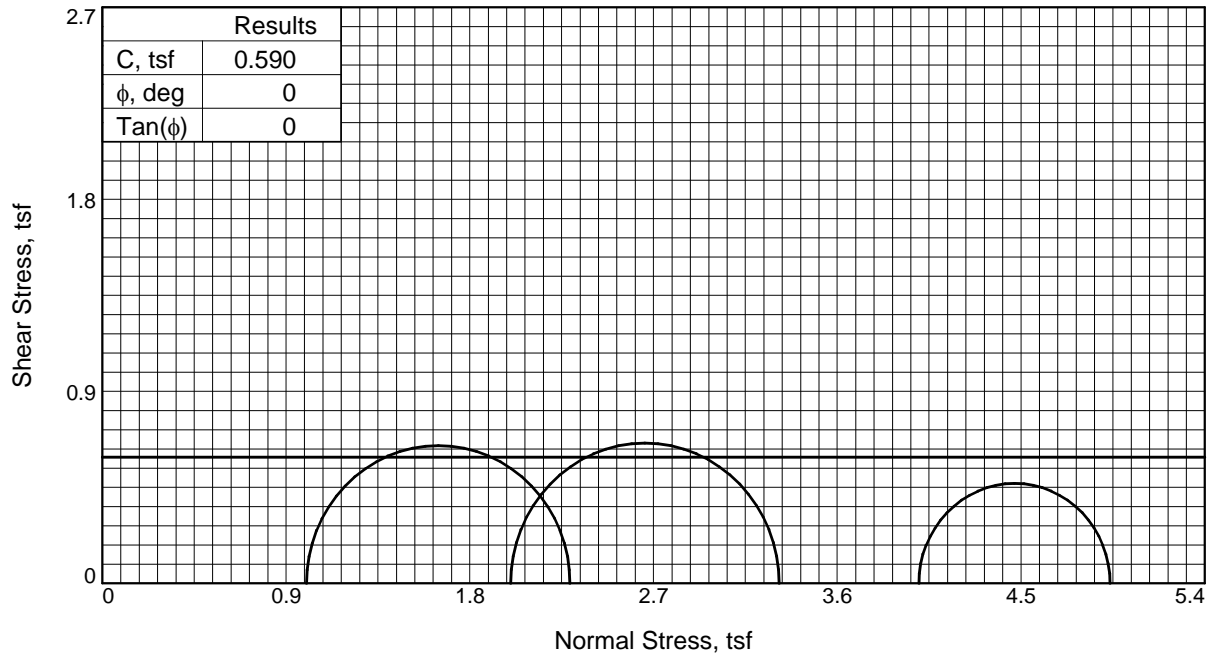
Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	90.880		149.060
Moisture content: Dry soil+tare, gms.	68.980		107.120
Moisture content: Tare, gms.	30.530		31.490
Moisture, %	57.0	58.3	55.5
Moist specimen weight, gms.	118.7		
Diameter, in.	1.41	1.41	
Area, in. ²	1.55	1.55	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	103.5	104.4	
Dry density, pcf	66.0	66.0	
Void ratio	1.6025	1.6025	
Saturation, %	97.7	100.0	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, in./min. = 0.03
 Fail. Stress = 0.888 tsf at reading no. 6
 Ult. Stress = 0.821 tsf at reading no. 15

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	-1.4493	9.300	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	-1.4465	13.800	4.5	0.1	0.208	4.000	4.208	1.05	4.104	0.104
2	-1.4399	21.400	12.1	0.3	0.558	4.000	4.558	1.14	4.279	0.279
3	-1.4304	26.100	16.8	0.7	0.773	4.000	4.773	1.19	4.386	0.386
4	-1.4020	28.500	19.2	1.7	0.874	4.000	4.874	1.22	4.437	0.437
5	-1.3930	28.760	19.5	2.0	0.883	4.000	4.883	1.22	4.442	0.442
6	-1.3750	29.000	19.7	2.6	0.888	4.000	4.888	1.22	4.444	0.444
7	-1.3750	29.000	19.7	2.6	0.888	4.000	4.888	1.22	4.444	0.444
8	-1.3470	29.200	19.9	3.6	0.888	4.000	4.888	1.22	4.444	0.444
9	-1.3185	29.400	20.1	4.7	0.887	4.000	4.887	1.22	4.444	0.444
10	-1.2905	29.500	20.2	5.7	0.883	4.000	4.883	1.22	4.441	0.441
11	-1.2350	29.900	20.6	7.6	0.881	4.000	4.881	1.22	4.441	0.441
12	-1.1785	30.100	20.8	9.6	0.870	4.000	4.870	1.22	4.435	0.435
13	-1.1230	30.700	21.4	11.6	0.876	4.000	4.876	1.22	4.438	0.438
14	-1.0665	30.800	21.5	13.6	0.860	4.000	4.860	1.21	4.430	0.430
15	-1.0106	30.300	21.0	15.6	0.821	4.000	4.821	1.21	4.410	0.410





Sample No.	1	2	3	
Initial	Water Content, %	54.2	53.6	54.4
	Dry Density, pcf	68.8	68.9	68.5
	Saturation, %	99.7	98.8	99.1
	Void Ratio	1.4957	1.4928	1.5080
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	54.7	54.8	66.7
	Dry Density, pcf	68.8	68.9	68.5
	Saturation, %	100.5	100.9	121.6
	Void Ratio	1.4957	1.4928	1.5080
	Diameter, in.	1.40	1.40	1.41
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Peak Stress, tsf	1.29	1.32	0.94	
Ult. Stress, tsf	0.43	0.88	0.81	
σ_1 Failure, tsf	2.29	3.32	4.94	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 110 **PL=** 24 **PI=** 86

Assumed Specific Gravity= 2.75

Remarks:

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study
W912ES-09-P-0115

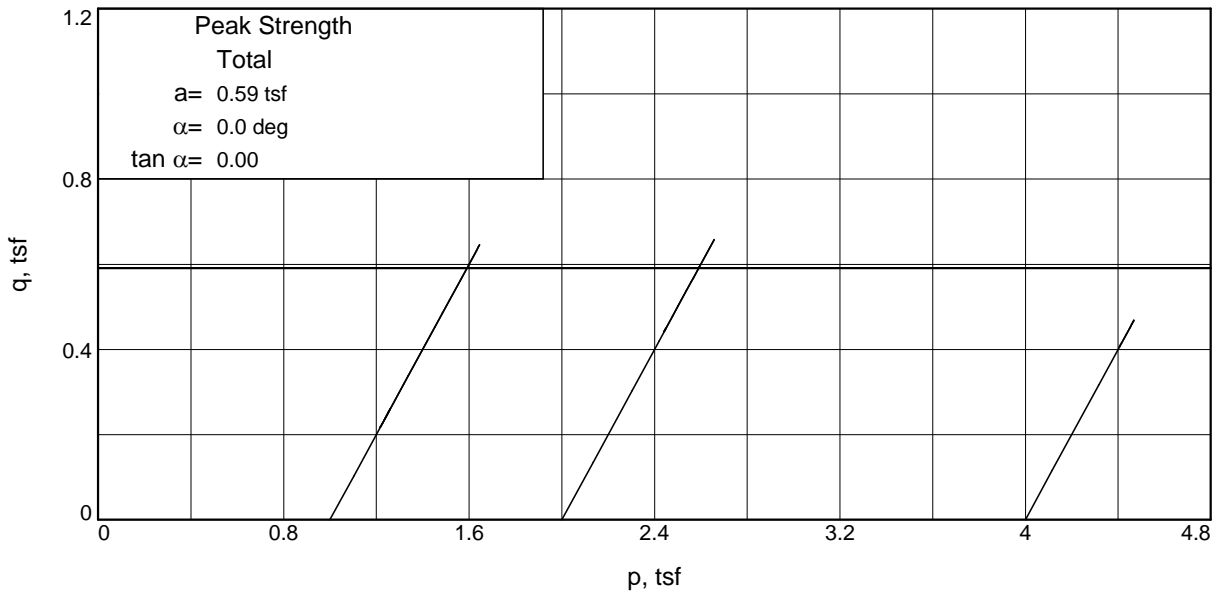
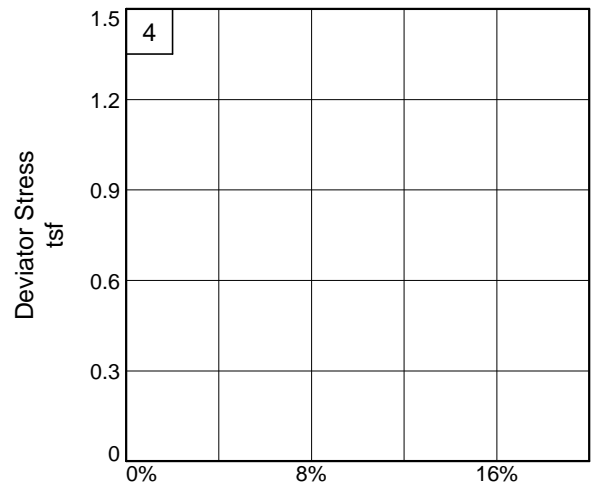
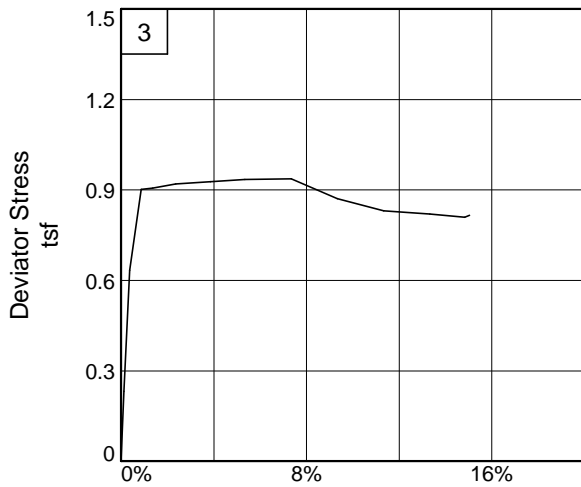
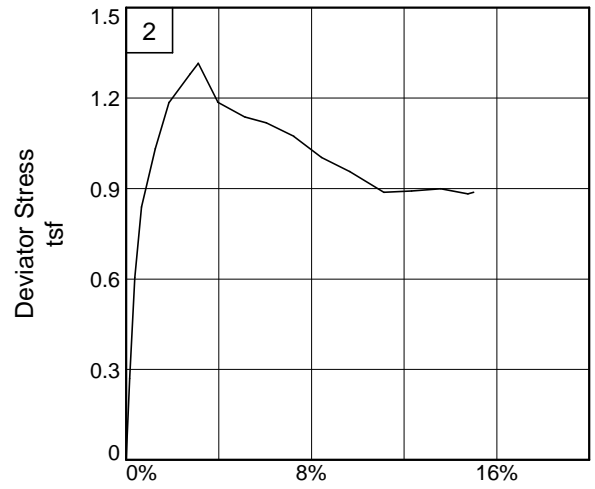
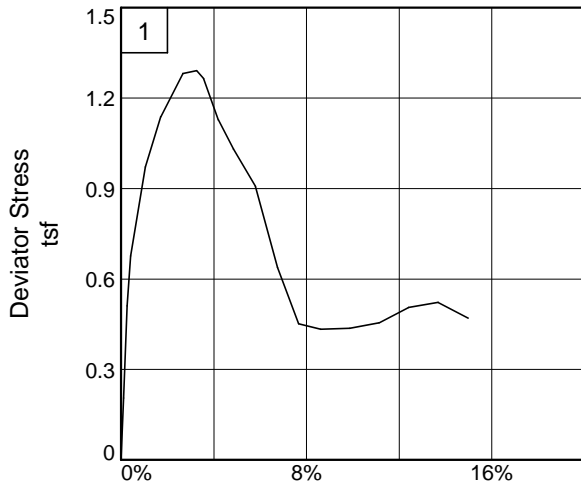
Location: SE-F-15, Fargo, Brenna Formation

Sample Number: Boring 09-26MU, #3 **Depth:** 28-30'

Proj. No.: BL-09-03127 **Date Sampled:**



Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
Loc.: SE-F-15, Fargo, Brenna Formation
Project No.: BL-09-03127

Depth: 28-30'
Figure _____

Sample No.: Boring 09-26MU, #3

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/16/2009

3:07 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-26MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**110 **PL=**24 **PI=**86
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	108.460	148.300
Moisture content: Dry soil+tare, gms.	81.270	106.530
Moisture content: Tare, gms.	31.130	30.130
Moisture, %	54.2	54.7
Moist specimen weight, gms.	120.6	
Diameter, in.	1.40	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	106.1	
Dry density, pcf	68.8	
Void ratio	1.4957	
Saturation, %	99.7	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 0.03
Peak Stress = 1.291 tsf at reading no. 7
Ult. Stress = 0.433 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2653	1.900	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.2682	6.300	4.4	0.1	0.204	1.000	1.204	1.20	1.102	0.102
2	0.2727	12.900	11.0	0.3	0.510	1.000	1.510	1.51	1.255	0.255
3	0.2770	16.500	14.6	0.4	0.676	1.000	1.676	1.68	1.338	0.338
4	0.2947	23.000	21.1	1.1	0.971	1.000	1.971	1.97	1.485	0.485
5	0.3130	26.800	24.9	1.7	1.138	1.000	2.138	2.14	1.569	0.569
6	0.3397	30.200	28.3	2.7	1.281	1.000	2.281	2.28	1.641	0.641
7	0.3566	30.600	28.7	3.3	1.291	1.000	2.291	2.29	1.646	0.646
8	0.3651	30.100	28.2	3.6	1.265	1.000	2.265	2.26	1.632	0.632
9	0.3828	27.200	25.3	4.2	1.127	1.000	2.127	2.13	1.564	0.564
10	0.4009	25.200	23.3	4.8	1.031	1.000	2.031	2.03	1.516	0.516
11	0.4276	22.600	20.7	5.8	0.907	1.000	1.907	1.91	1.453	0.453
12	0.4540	16.600	14.7	6.7	0.637	1.000	1.637	1.64	1.319	0.319
13	0.4797	12.400	10.5	7.7	0.451	1.000	1.451	1.45	1.225	0.225
14	0.5062	12.100	10.2	8.6	0.433	1.000	1.433	1.43	1.217	0.217
15	0.5416	12.300	10.4	9.9	0.436	1.000	1.436	1.44	1.218	0.218
16	0.5768	12.900	11.0	11.1	0.455	1.000	1.455	1.45	1.227	0.227
17	0.6122	14.300	12.4	12.4	0.505	1.000	1.505	1.51	1.253	0.253
18	0.6480	14.900	13.0	13.7	0.522	1.000	1.522	1.52	1.261	0.261
19	0.6843	13.800	11.9	15.0	0.470	1.000	1.470	1.47	1.235	0.235

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	135.840	148.960
Moisture content: Dry soil+tare, gms.	99.150	106.990
Moisture content: Tare, gms.	30.710	30.340
Moisture, %	53.6	54.8
Moist specimen weight, gms.	120.1	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	105.8	
Dry density, pcf	68.9	
Void ratio	1.4928	
Saturation, %	98.8	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

Strain rate, %/min. = 0.03

Peak Stress = 1.315 tsf at reading no. 7

Ult. Stress = 0.883 tsf at reading no. 17

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2643	4.300	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.2686	10.100	5.8	0.2	0.270	2.000	2.270	1.14	2.135	0.135
2	0.2747	17.300	13.0	0.4	0.604	2.000	2.604	1.30	2.302	0.302
3	0.2828	22.400	18.1	0.7	0.839	2.000	2.839	1.42	2.419	0.419
4	0.2996	26.700	22.4	1.3	1.032	2.000	3.032	1.52	2.516	0.516
5	0.3163	30.200	25.9	1.9	1.186	2.000	3.186	1.59	2.593	0.593
6	0.3414	32.500	28.2	2.8	1.279	2.000	3.279	1.64	2.640	0.640
7	0.3514	33.400	29.1	3.1	1.315	2.000	3.315	1.66	2.658	0.658
8	0.3752	30.800	26.5	4.0	1.187	2.000	3.187	1.59	2.594	0.594
9	0.4084	30.000	25.7	5.1	1.137	2.000	3.137	1.57	2.568	0.568
10	0.4340	29.800	25.5	6.1	1.117	2.000	3.117	1.56	2.559	0.559
11	0.4673	29.100	24.8	7.2	1.073	2.000	3.073	1.54	2.536	0.536
12	0.5010	27.800	23.5	8.4	1.003	2.000	3.003	1.50	2.502	0.502
13	0.5349	27.000	22.7	9.7	0.956	2.000	2.956	1.48	2.478	0.478
14	0.5764	25.700	21.4	11.1	0.887	2.000	2.887	1.44	2.443	0.443
15	0.6099	26.100	21.8	12.3	0.891	2.000	2.891	1.45	2.446	0.446
16	0.6451	26.600	22.3	13.6	0.899	2.000	2.899	1.45	2.449	0.449
17	0.6780	26.500	22.2	14.8	0.883	2.000	2.883	1.44	2.441	0.441
18	0.6850	26.700	22.4	15.0	0.888	2.000	2.888	1.44	2.444	0.444

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	126.100	150.190
Moisture content: Dry soil+tare, gms.	92.380	102.210
Moisture content: Tare, gms.	30.350	30.240
Moisture, %	54.4	66.7
Moist specimen weight, gms.	120.8	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	105.7	
Dry density, pcf	68.5	
Void ratio	1.5080	
Saturation, %	99.1	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

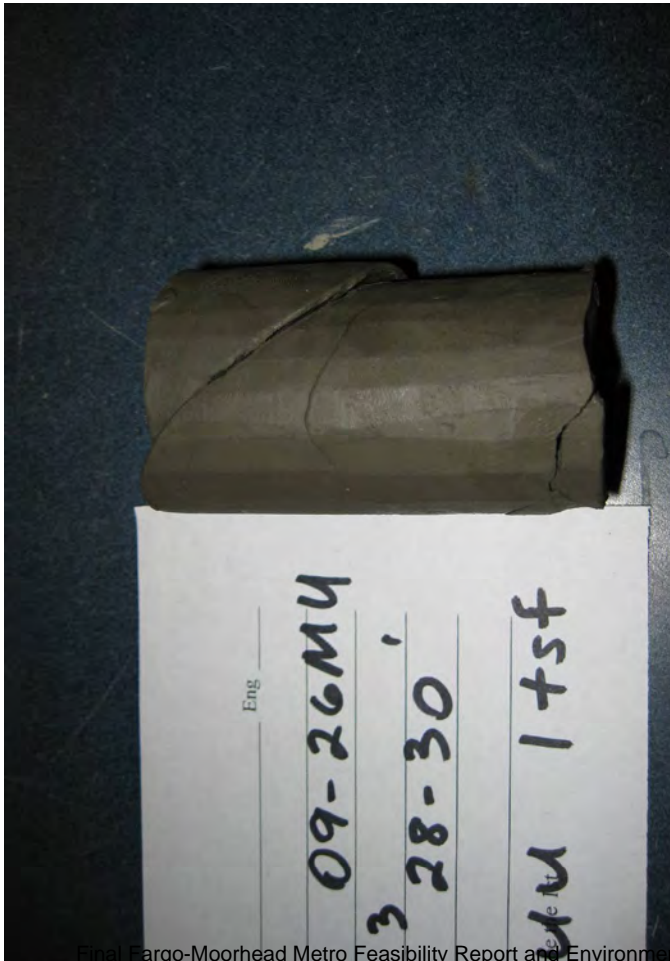
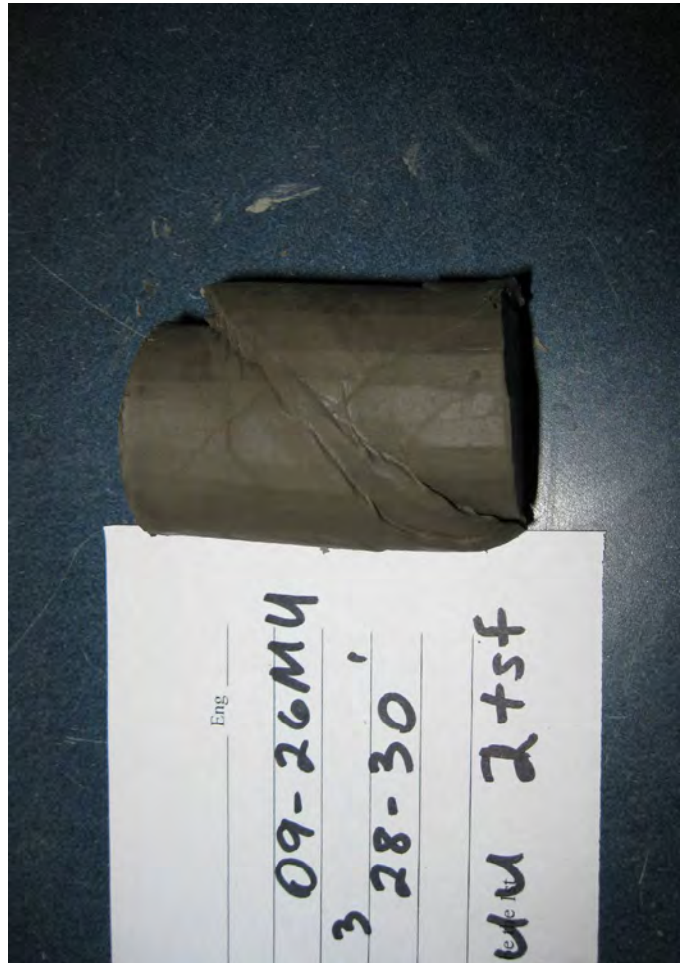
Back pressure = 0.000 tsf

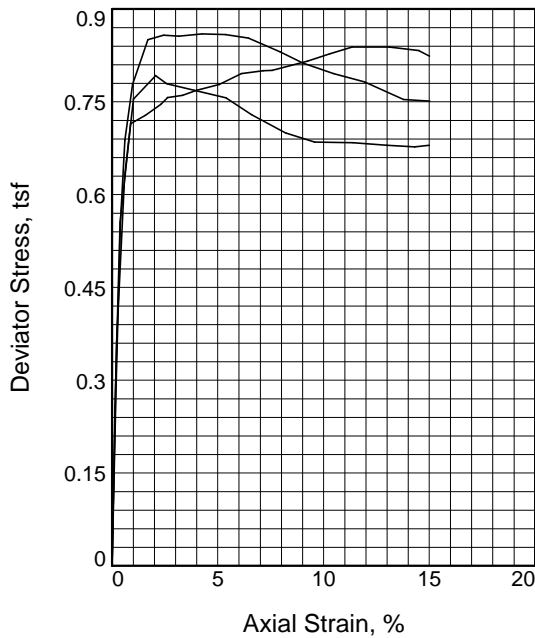
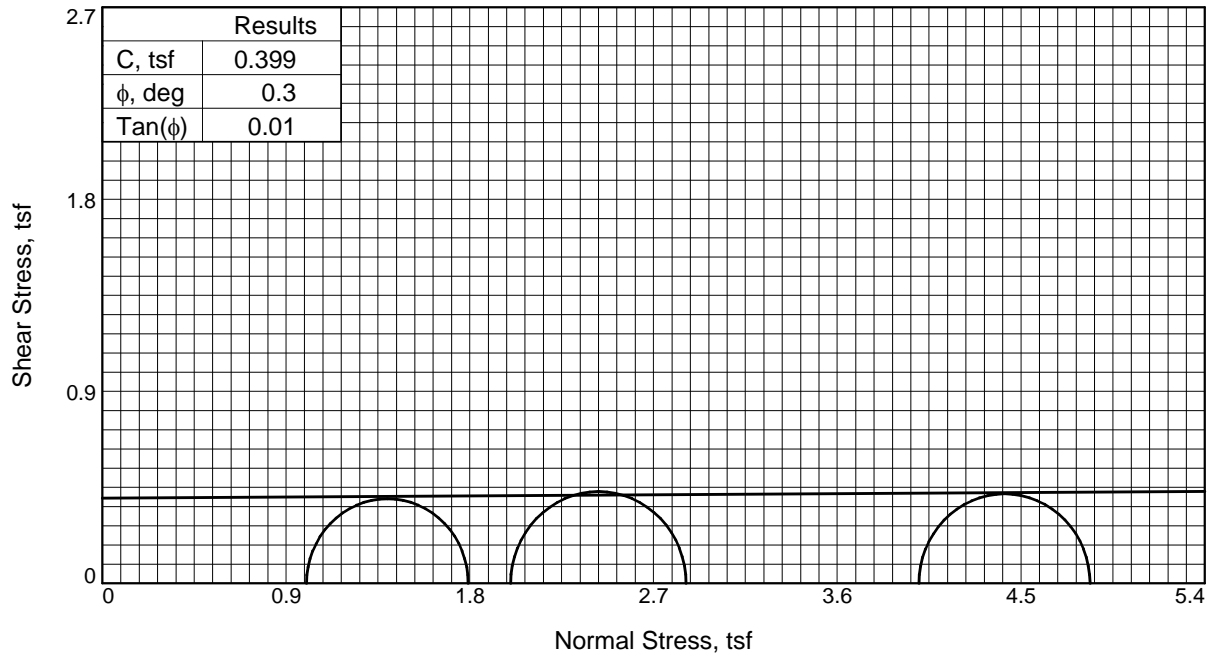
Strain rate, %/min. = 0.03

Peak Stress = 0.937 tsf at reading no. 8

Ult. Stress = 0.810 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2660	10.700	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.2694	15.700	5.0	0.1	0.232	4.000	4.232	1.06	4.116	0.116
2	0.2764	24.400	13.7	0.4	0.633	4.000	4.633	1.16	4.316	0.316
3	0.2903	30.300	19.6	0.9	0.901	4.000	4.901	1.23	4.451	0.451
4	0.3042	30.500	19.8	1.4	0.906	4.000	4.906	1.23	4.453	0.453
5	0.3323	31.000	20.3	2.4	0.919	4.000	4.919	1.23	4.460	0.460
6	0.3740	31.500	20.8	3.9	0.927	4.000	4.927	1.23	4.464	0.464
7	0.4161	32.000	21.3	5.4	0.935	4.000	4.935	1.23	4.467	0.467
8	0.4720	32.500	21.8	7.3	0.937	4.000	4.937	1.23	4.468	0.468
9	0.5280	31.400	20.7	9.3	0.870	4.000	4.870	1.22	4.435	0.435
10	0.5841	30.900	20.2	11.3	0.830	4.000	4.830	1.21	4.415	0.415
11	0.6400	31.100	20.4	13.3	0.820	4.000	4.820	1.20	4.410	0.410
12	0.6820	31.200	20.5	14.8	0.810	4.000	4.810	1.20	4.405	0.405
13	0.6880	31.400	20.7	15.0	0.815	4.000	4.815	1.20	4.408	0.408





Sample No.	1	2	3	
Initial	Water Content, %	55.4	56.6	58.6
	Dry Density, pcf	67.1	65.4	64.4
	Saturation, %	98.9	96.7	97.7
	Void Ratio	1.5145	1.5822	1.6208
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	57.2	58.7	49.1
	Dry Density, pcf	67.1	65.4	64.4
	Saturation, %	102.2	100.4	81.8
	Void Ratio	1.5145	1.5822	1.6208
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Peak Stress, tsf	0.79	0.86	0.84	
Ult. Stress, tsf	0.68	0.75	0.82	
σ_1 Failure, tsf	1.79	2.86	4.84	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Bottom of sample

Description: FAT CLAY, gray (CH)

LL= 89 **PL=** 20 **PI=** 69

Assumed Specific Gravity= 2.704

Remarks:

Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115 **Brenna**

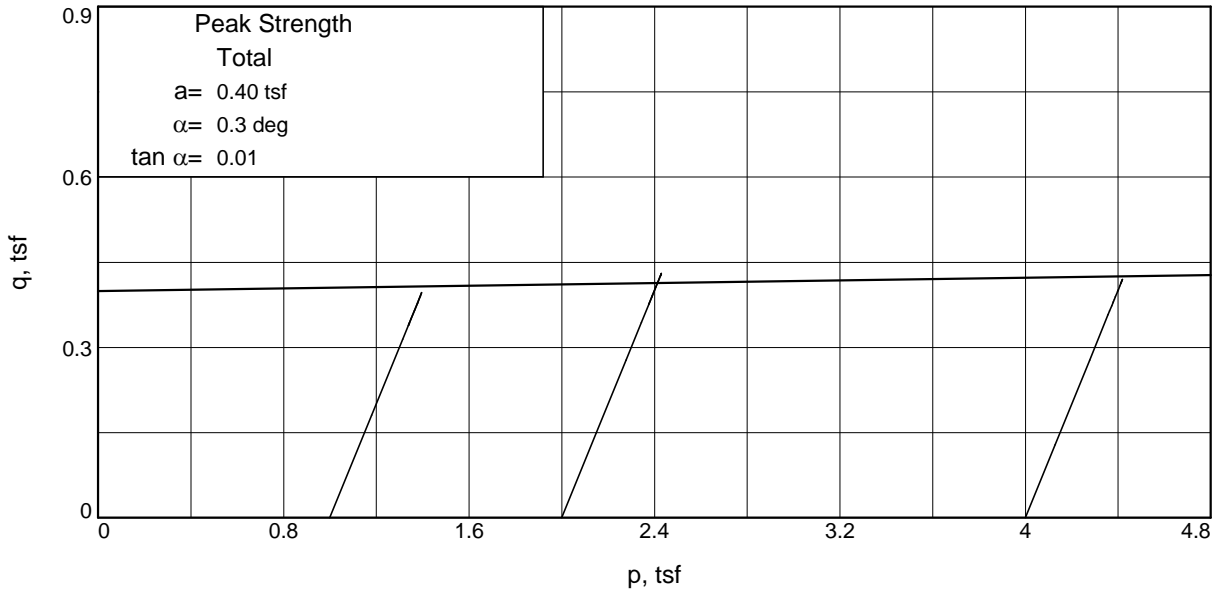
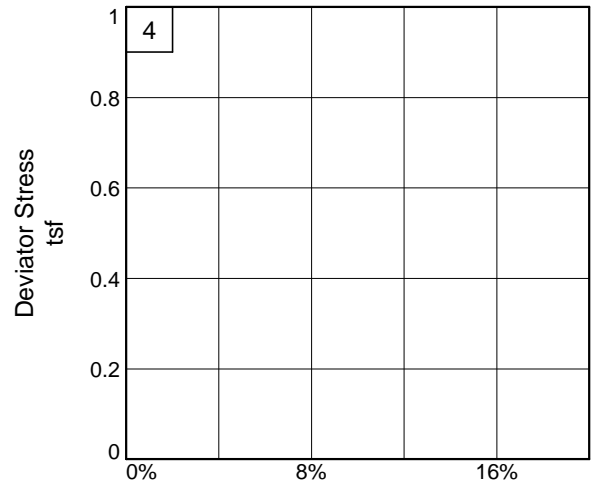
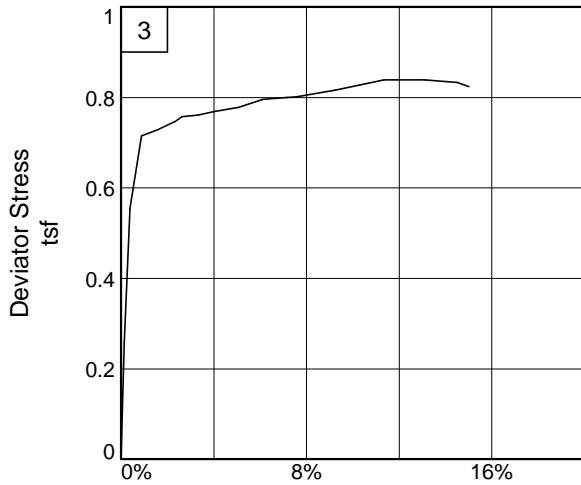
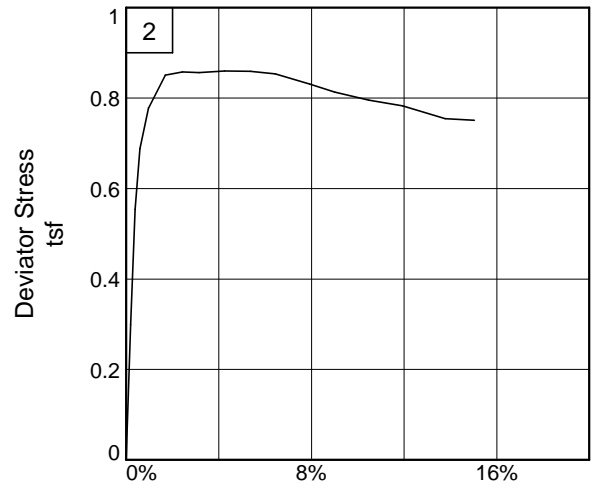
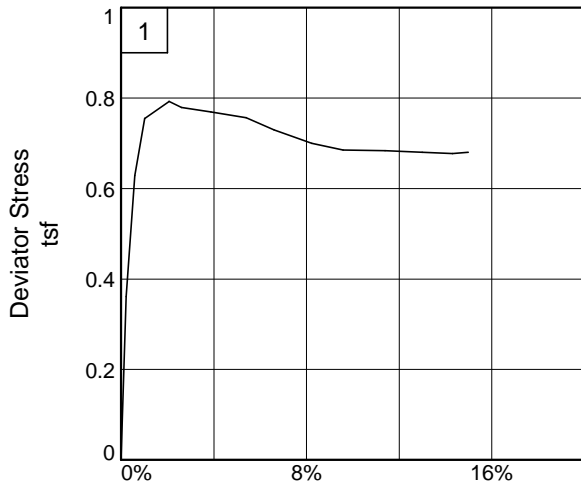
Location: SE-F-19, Fargo, ~~Argusville Formation~~

Sample Number: Boring 09-27MU, #4 **Depth:** 64-66'

Proj. No.: BL-09-03127 **Date Sampled:**

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: US Army Corps of Engineer

Project: Fargo-Moorhead Feasibility Study

Loc.: SE-F-19, Fargo, ~~Argusville Formation~~

Project No.: BL-09-03127

Depth: 64-66'

Figure _____

Brenna

Sample No.: Boring 09-27MU, #4

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

11/16/2009

3:06 PM

Date:
Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, ~~Argusville Formation~~
Depth: 64-66' **Sample Number:** Boring 09-27MU, #4
Description: FAT CLAY, gray (CH) **Brenna**
Remarks:
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.704 **LL**=89 **PL**=20 **PI**=69
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	133.610	147.290
Moisture content: Dry soil+tare, gms.	97.060	105.130
Moisture content: Tare, gms.	31.080	31.480
Moisture, %	55.4	57.2
Moist specimen weight, gms.	118.4	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	104.3	
Dry density, pcf	67.1	
Void ratio	1.5145	
Saturation, %	98.9	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 0.03
Peak Stress = 0.792 tsf at reading no. 4
Ult. Stress = 0.680 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2672	1.950	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.2733	9.700	7.7	0.2	0.361	1.000	1.361	1.36	1.180	0.180
2	0.2839	15.500	13.6	0.6	0.628	1.000	1.628	1.63	1.314	0.314
3	0.2957	18.300	16.4	1.0	0.755	1.000	1.755	1.75	1.377	0.377
4	0.3250	19.300	17.4	2.1	0.792	1.000	1.792	1.79	1.396	0.396
5	0.3402	19.100	17.2	2.6	0.779	1.000	1.779	1.78	1.390	0.390
6	0.3757	19.100	17.2	3.9	0.769	1.000	1.769	1.77	1.384	0.384
7	0.4186	19.100	17.2	5.4	0.757	1.000	1.757	1.76	1.378	0.378
8	0.4520	18.700	16.8	6.6	0.730	1.000	1.730	1.73	1.365	0.365
9	0.4979	18.300	16.4	8.2	0.700	1.000	1.700	1.70	1.350	0.350
10	0.5355	18.200	16.3	9.6	0.685	1.000	1.685	1.69	1.343	0.343
11	0.5864	18.500	16.6	11.4	0.684	1.000	1.684	1.68	1.342	0.342
12	0.6311	18.700	16.8	13.0	0.680	1.000	1.680	1.68	1.340	0.340
13	0.6680	18.900	17.0	14.3	0.677	1.000	1.677	1.68	1.339	0.339
14	0.6870	19.100	17.2	15.0	0.680	1.000	1.680	1.68	1.340	0.340

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	135.960	144.330
Moisture content: Dry soil+tare, gms.	98.040	101.950
Moisture content: Tare, gms.	31.020	29.780
Moisture, %	56.6	58.7
Moist specimen weight, gms.	116.0	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	102.4	
Dry density, pcf	65.4	
Void ratio	1.5822	
Saturation, %	96.7	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 0.03
 Peak Stress = 0.860 tsf at reading no. 8
 Ult. Stress = 0.751 tsf at reading no. 16

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2646	4.700	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.2701	11.100	6.4	0.2	0.299	2.000	2.299	1.15	2.149	0.149
2	0.2756	16.600	11.9	0.4	0.554	2.000	2.554	1.28	2.277	0.277
3	0.2815	19.500	14.8	0.6	0.688	2.000	2.688	1.34	2.344	0.344
4	0.2919	21.500	16.8	1.0	0.778	2.000	2.778	1.39	2.389	0.389
5	0.3121	23.200	18.5	1.7	0.851	2.000	2.851	1.43	2.425	0.425
6	0.3328	23.500	18.8	2.4	0.858	2.000	2.858	1.43	2.429	0.429
7	0.3531	23.600	18.9	3.2	0.856	2.000	2.856	1.43	2.428	0.428
8	0.3840	23.900	19.2	4.3	0.860	2.000	2.860	1.43	2.430	0.430
9	0.4148	24.100	19.4	5.4	0.859	2.000	2.859	1.43	2.429	0.429
10	0.4453	24.200	19.5	6.4	0.853	2.000	2.853	1.43	2.427	0.427
11	0.4872	24.000	19.3	7.9	0.831	2.000	2.831	1.42	2.416	0.416
12	0.5173	23.800	19.1	9.0	0.813	2.000	2.813	1.41	2.406	0.406
13	0.5582	23.700	19.0	10.5	0.796	2.000	2.796	1.40	2.398	0.398
14	0.5994	23.700	19.0	11.9	0.783	2.000	2.783	1.39	2.391	0.391
15	0.6510	23.400	18.7	13.8	0.754	2.000	2.754	1.38	2.377	0.377
16	0.6860	23.600	18.9	15.0	0.751	2.000	2.751	1.38	2.376	0.376

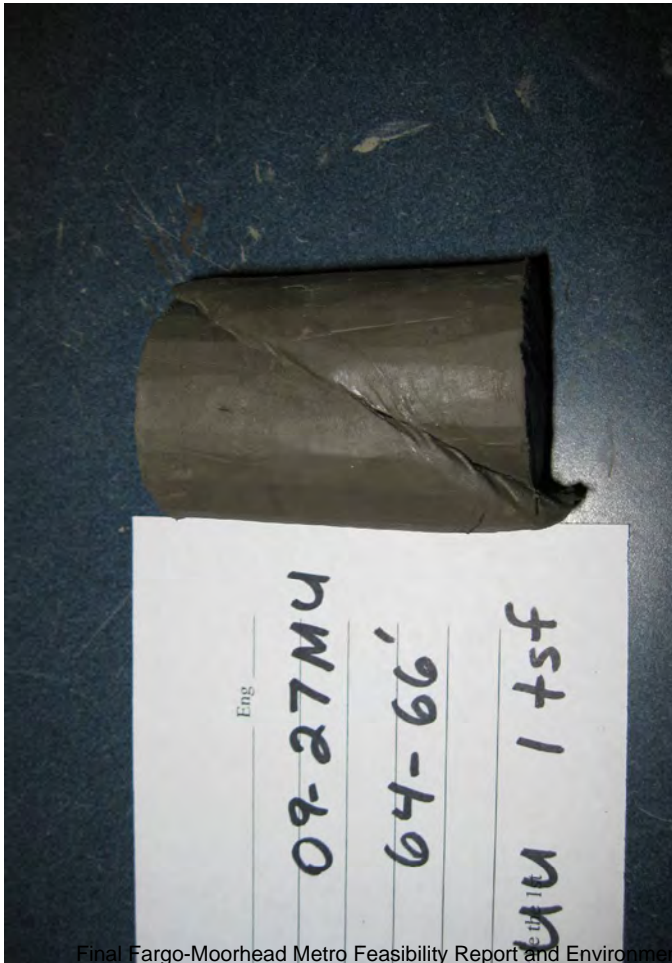
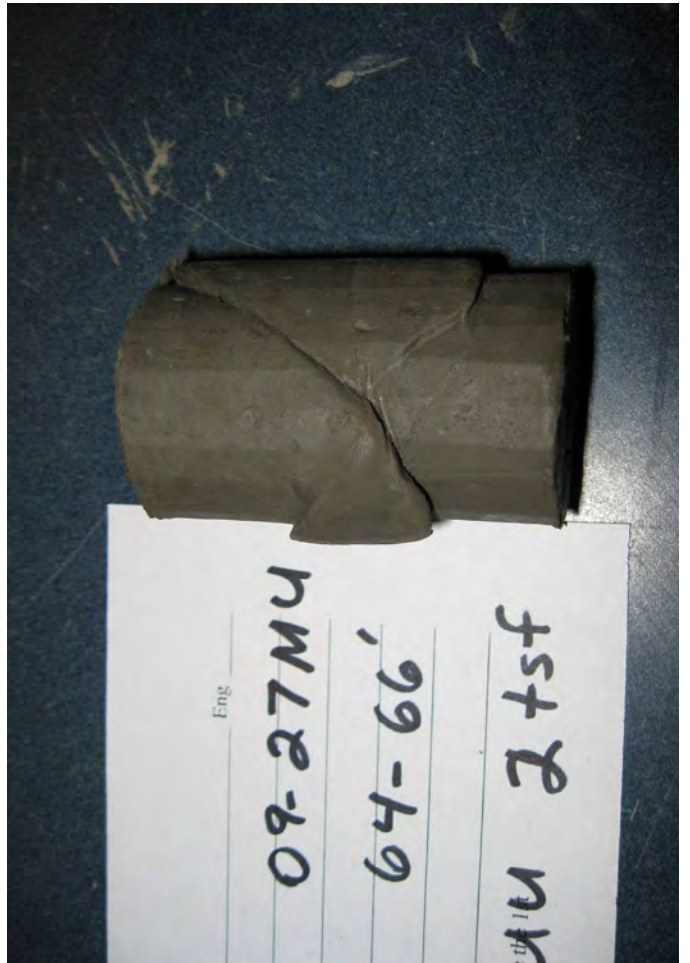
Parameters for Specimen No. 3

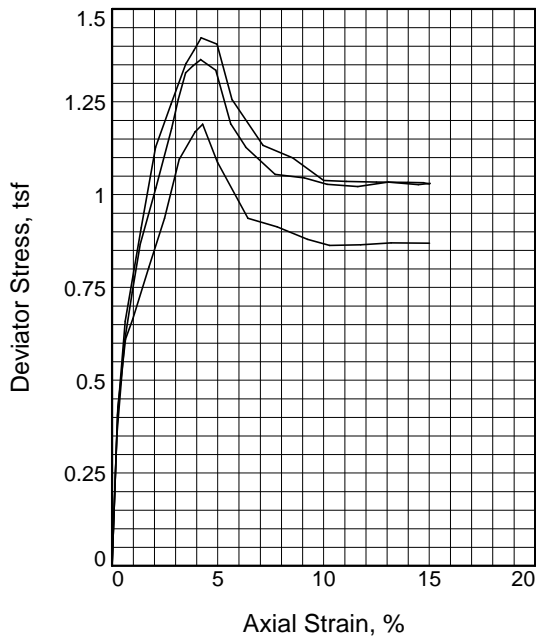
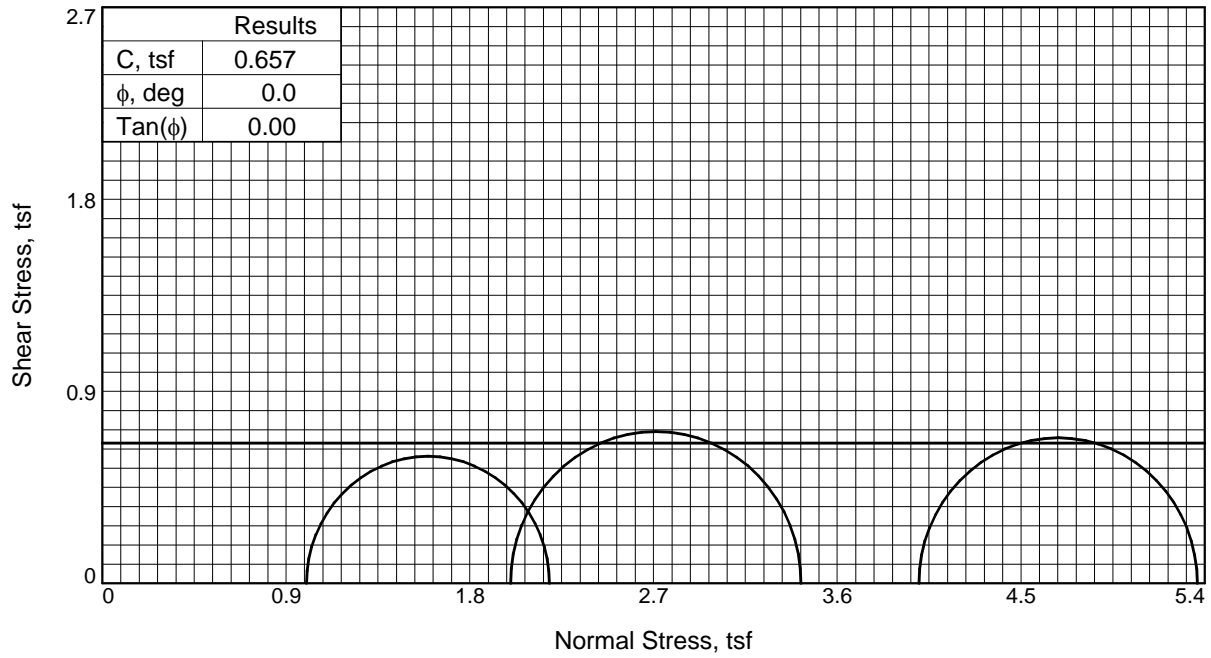
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	141.830	145.330
Moisture content: Dry soil+tare, gms.	100.670	107.700
Moisture content: Tare, gms.	30.420	30.990
Moisture, %	58.6	49.1
Moist specimen weight, gms.	115.6	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	102.1	
Dry density, pcf	64.4	
Void ratio	1.6208	
Saturation, %	97.7	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 0.03
 Peak Stress = 0.839 tsf at reading no. 15
 Ult. Stress = 0.824 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.2670	10.600	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.2708	16.100	5.5	0.1	0.257	4.000	4.257	1.06	4.129	0.129
2	0.2778	22.500	11.9	0.4	0.555	4.000	4.555	1.14	4.278	0.278
3	0.2917	26.000	15.4	0.9	0.715	4.000	4.715	1.18	4.357	0.357
4	0.3110	26.400	15.8	1.6	0.728	4.000	4.728	1.18	4.364	0.364
5	0.3317	26.900	16.3	2.3	0.746	4.000	4.746	1.19	4.373	0.373
6	0.3405	27.200	16.6	2.6	0.757	4.000	4.757	1.19	4.379	0.379
7	0.3602	27.400	16.8	3.3	0.761	4.000	4.761	1.19	4.380	0.380
8	0.3796	27.700	17.1	4.0	0.769	4.000	4.769	1.19	4.384	0.384
9	0.4090	28.100	17.5	5.1	0.778	4.000	4.778	1.19	4.389	0.389
10	0.4385	28.700	18.1	6.1	0.796	4.000	4.796	1.20	4.398	0.398
11	0.4676	29.000	18.4	7.2	0.800	4.000	4.800	1.20	4.400	0.400
12	0.4792	29.100	18.5	7.6	0.801	4.000	4.801	1.20	4.400	0.400
13	0.5264	29.800	19.2	9.3	0.816	4.000	4.816	1.20	4.408	0.408
14	0.5558	30.300	19.7	10.3	0.828	4.000	4.828	1.21	4.414	0.414
15	0.5853	30.800	20.2	11.4	0.839	4.000	4.839	1.21	4.419	0.419
16	0.6344	31.200	20.6	13.1	0.838	4.000	4.838	1.21	4.419	0.419
17	0.6737	31.400	20.8	14.5	0.833	4.000	4.833	1.21	4.416	0.416
18	0.6880	31.300	20.7	15.0	0.824	4.000	4.824	1.21	4.412	0.412





Sample No.	1	2	3	
Initial	Water Content, %	57.2	57.0	56.8
	Dry Density, pcf	66.2	65.8	66.0
	Saturation, %	99.9	98.6	98.9
	Void Ratio	1.5461	1.5600	1.5522
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.80	2.81	2.82
At Test	Water Content, %	56.9	56.5	56.5
	Dry Density, pcf	66.2	65.8	66.0
	Saturation, %	99.3	97.7	98.3
	Void Ratio	1.5461	1.5600	1.5522
	Diameter, in.	1.39	1.40	1.39
	Height, in.	2.80	2.81	2.82
Strain rate, in./min.	0.03	0.03	0.03	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Fail. Stress, tsf	1.19	1.42	1.36	
Ult. Stress, tsf	0.87	1.03	1.03	
σ_1 Failure, tsf	2.19	3.42	5.36	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: Thinwall, 5", Middle of sample

Description: FAT CLAY, gray (CH)

LL= 111 PL= 26 PI= 85

Assumed Specific Gravity= 2.70

Remarks:

Figure UU Triax ASTM D 2850

Client: US Army Corps of Engineers

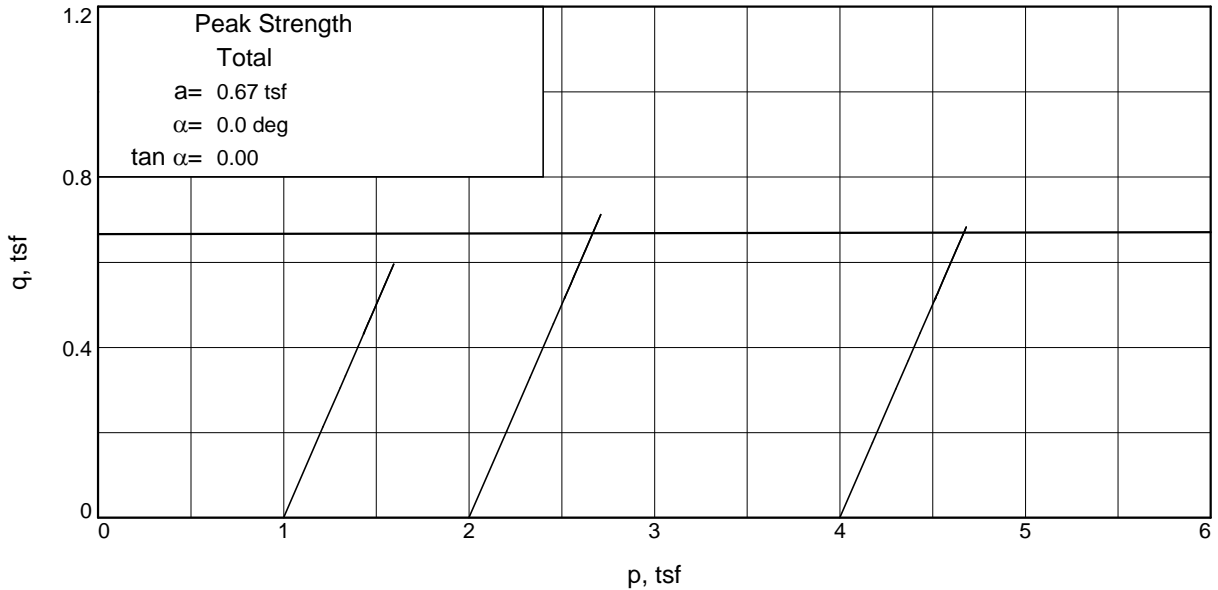
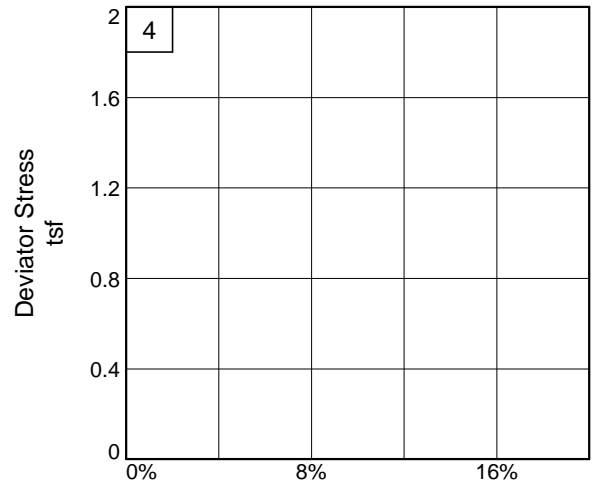
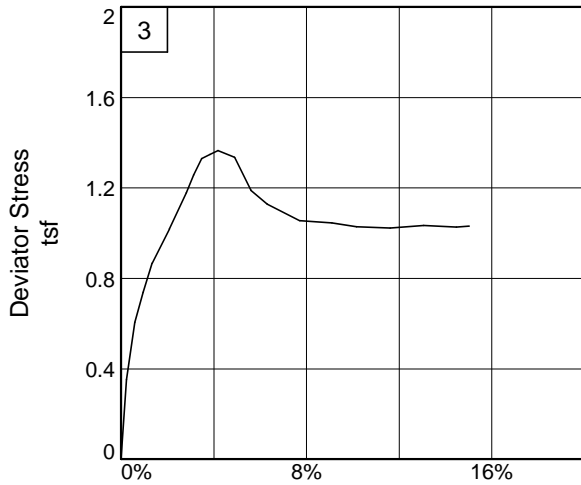
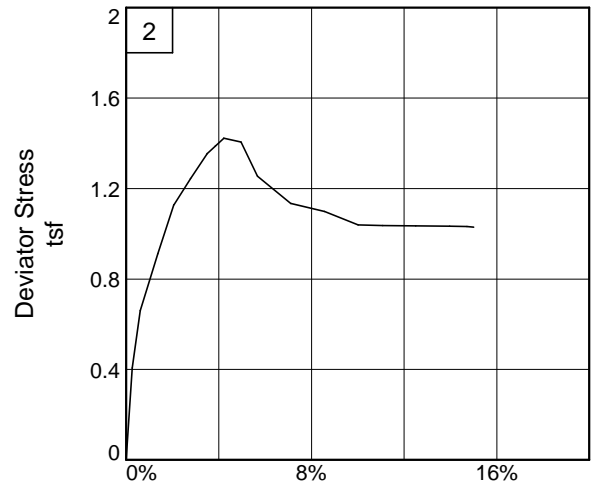
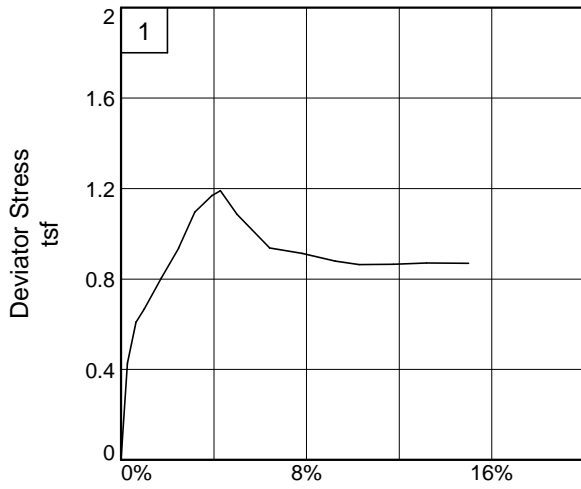
Project: Fargo-Moorhead Metro Feasibility Study
Fargo

Location: WD-05, ND Div, Brenna Formation

Sample Number: Boring 09-60MU, #3 **Depth:** 35-37'

Proj. No.: BL0903127A **Date Sampled:**

BRAUNSM
INTERTEC



Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study **Fargo**

Loc.: WD-05, ND Div, Brenna Formation

Depth: 35-37'

Sample No.: Boring 09-60MU, #3

Project No.: BL0903127A

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

2/23/2010

11:25 AM

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project No.: BL0903127A
Location: WD-05, ND Div, Brenna Formation **Fargo**
Depth: 35-37' **Sample Number:** Boring 09-60MU, #3
Description: FAT CLAY, gray (CH)
Remarks:
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.70 **LL=**111 **PL=**26 **PI=**85
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	178.810	147.320
Moisture content: Dry soil+tare, gms.	124.820	105.220
Moisture content: Tare, gms.	30.400	31.200
Moisture, %	57.2	56.9
Moist specimen weight, gms.	116.4	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	104.1	
Dry density, pcf	66.2	
Void ratio	1.5461	
Saturation, %	99.9	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, in./min. = 0.03
Fail. Stress = 1.190 tsf **at reading no. 8**
Ult. Stress = 0.869 tsf **at reading no. 16**

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0070	1.240	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0147	10.280	9.0	0.3	0.427	1.000	1.427	1.43	1.214	0.214
2	0.0250	14.210	13.0	0.6	0.611	1.000	1.611	1.61	1.305	0.305
3	0.0348	15.440	14.2	1.0	0.666	1.000	1.666	1.67	1.333	0.333
4	0.0556	18.530	17.3	1.7	0.805	1.000	1.805	1.80	1.402	0.402
5	0.0766	21.510	20.3	2.5	0.937	1.000	1.937	1.94	1.468	0.468
6	0.0963	25.140	23.9	3.2	1.096	1.000	2.096	2.10	1.548	0.548
7	0.1169	26.920	25.7	3.9	1.169	1.000	2.169	2.17	1.585	0.585
8	0.1272	27.480	26.2	4.3	1.190	1.000	2.190	2.19	1.595	0.595
9	0.1471	25.370	24.1	5.0	1.086	1.000	2.086	2.09	1.543	0.543
10	0.1868	22.360	21.1	6.4	0.936	1.000	1.936	1.94	1.468	0.468
11	0.2262	22.150	20.9	7.8	0.913	1.000	1.913	1.91	1.457	0.457
12	0.2664	21.690	20.5	9.2	0.879	1.000	1.879	1.88	1.440	0.440
13	0.2954	21.540	20.3	10.3	0.863	1.000	1.863	1.86	1.431	0.431
14	0.3366	21.920	20.7	11.8	0.865	1.000	1.865	1.86	1.432	0.432
15	0.3772	22.400	21.2	13.2	0.870	1.000	1.870	1.87	1.435	0.435
16	0.4280	22.820	21.6	15.0	0.869	1.000	1.869	1.87	1.434	0.434

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	142.490	146.790
Moisture content: Dry soil+tare, gms.	101.900	104.850
Moisture content: Tare, gms.	30.680	30.590
Moisture, %	57.0	56.5
Moist specimen weight, gms.	116.7	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	103.4	
Dry density, pcf	65.8	
Void ratio	1.5600	
Saturation, %	98.6	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf

Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.423 tsf at reading no. 8

Ult. Stress = 1.029 tsf at reading no. 18

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	3.470	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0135	12.140	8.7	0.3	0.407	2.000	2.407	1.20	2.203	0.203
2	0.0234	17.570	14.1	0.6	0.659	2.000	2.659	1.33	2.330	0.330
3	0.0446	23.100	19.6	1.4	0.911	2.000	2.911	1.46	2.455	0.455
4	0.0641	27.950	24.5	2.1	1.128	2.000	3.128	1.56	2.564	0.564
5	0.0842	30.660	27.2	2.8	1.243	2.000	3.243	1.62	2.622	0.622
6	0.1044	33.290	29.8	3.5	1.354	2.000	3.354	1.68	2.677	0.677
7	0.1145	34.160	30.7	3.9	1.388	2.000	3.388	1.69	2.694	0.694
8	0.1245	35.050	31.6	4.2	1.423	2.000	3.423	1.71	2.711	0.711
9	0.1456	34.910	31.4	5.0	1.406	2.000	3.406	1.70	2.703	0.703
10	0.1655	31.760	28.3	5.7	1.255	2.000	3.255	1.63	2.628	0.628
11	0.2062	29.410	25.9	7.1	1.133	2.000	3.133	1.57	2.567	0.567
12	0.2468	29.020	25.6	8.6	1.099	2.000	3.099	1.55	2.549	0.549
13	0.2877	28.000	24.5	10.0	1.038	2.000	3.038	1.52	2.519	0.519
14	0.3177	28.240	24.8	11.1	1.036	2.000	3.036	1.52	2.518	0.518
15	0.3575	28.590	25.1	12.5	1.034	2.000	3.034	1.52	2.517	0.517
16	0.3988	29.010	25.5	14.0	1.034	2.000	3.034	1.52	2.517	0.517
17	0.4199	29.200	25.7	14.7	1.032	2.000	3.032	1.52	2.516	0.516
18	0.4280	29.200	25.7	15.0	1.029	2.000	3.029	1.51	2.514	0.514

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	148.290	144.810
Moisture content: Dry soil+tare, gms.	105.670	103.130
Moisture content: Tare, gms.	30.690	29.400
Moisture, %	56.8	56.5
Moist specimen weight, gms.	116.0	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.82	
Wet Density, pcf	103.6	
Dry density, pcf	66.0	
Void ratio	1.5522	
Saturation, %	98.9	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

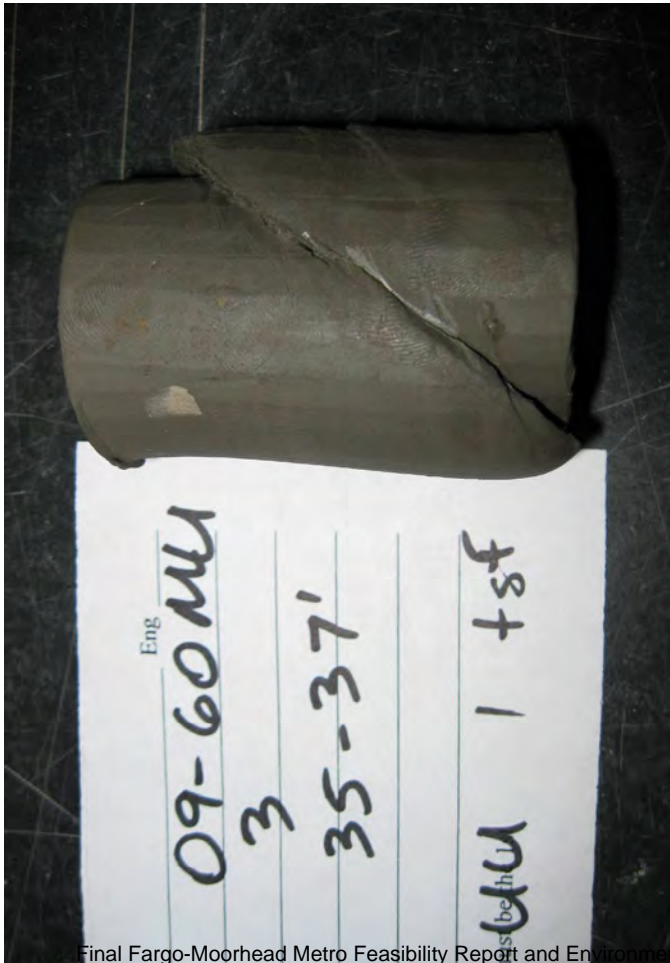
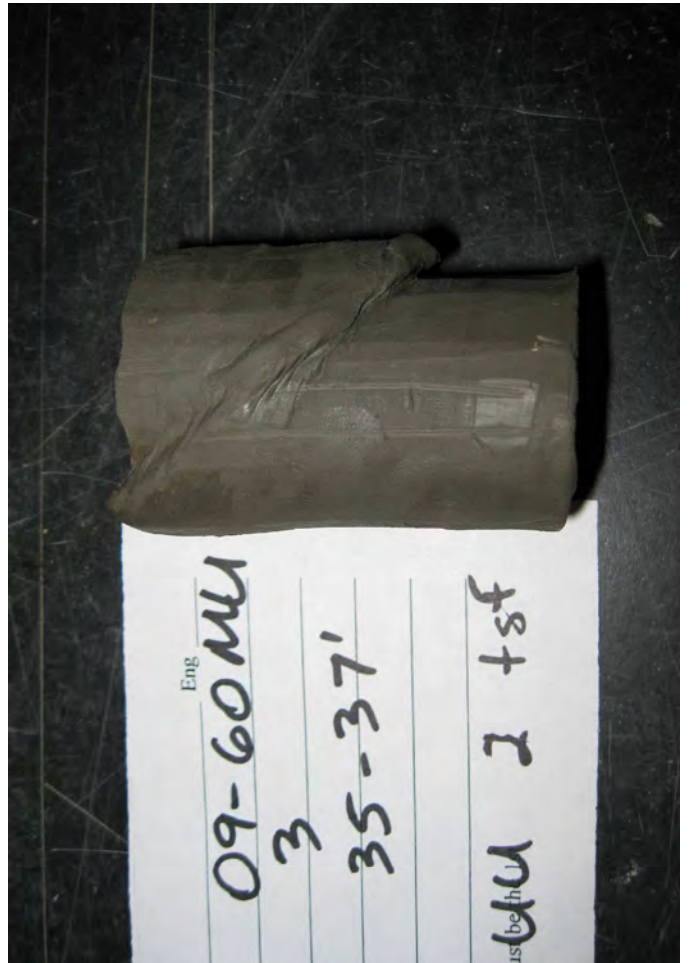
Back pressure = 0.000 tsf

Strain rate, in./min. = 0.03

Fail. Stress = 1.364 tsf at reading no. 10

Ult. Stress = 1.030 tsf at reading no. 20

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	9.730	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0125	17.140	7.4	0.2	0.352	4.000	4.352	1.09	4.176	0.176
2	0.0228	22.520	12.8	0.6	0.605	4.000	4.605	1.15	4.302	0.302
3	0.0329	25.380	15.6	1.0	0.738	4.000	4.738	1.18	4.369	0.369
4	0.0437	28.190	18.5	1.3	0.867	4.000	4.867	1.22	4.433	0.433
5	0.0647	31.580	21.8	2.1	1.018	4.000	5.018	1.25	4.509	0.509
6	0.0855	35.210	25.5	2.8	1.178	4.000	5.178	1.29	4.589	0.589
7	0.0945	37.010	27.3	3.1	1.257	4.000	5.257	1.31	4.629	0.629
8	0.1041	38.660	28.9	3.5	1.329	4.000	5.329	1.33	4.664	0.664
9	0.1142	39.180	29.5	3.8	1.348	4.000	5.348	1.34	4.674	0.674
10	0.1241	39.650	29.9	4.2	1.364	4.000	5.364	1.34	4.682	0.682
11	0.1443	39.240	29.5	4.9	1.335	4.000	5.335	1.33	4.668	0.668
12	0.1643	36.220	26.5	5.6	1.190	4.000	5.190	1.30	4.595	0.595
13	0.1842	35.060	25.3	6.3	1.129	4.000	5.129	1.28	4.565	0.565
14	0.2238	33.740	24.0	7.7	1.054	4.000	5.054	1.26	4.527	0.527
15	0.2627	33.900	24.2	9.1	1.045	4.000	5.045	1.26	4.523	0.523
16	0.2929	33.770	24.0	10.2	1.028	4.000	5.028	1.26	4.514	0.514
17	0.3336	34.030	24.3	11.6	1.022	4.000	5.022	1.26	4.511	0.511
18	0.3745	34.730	25.0	13.1	1.034	4.000	5.034	1.26	4.517	0.517
19	0.4144	34.970	25.2	14.5	1.027	4.000	5.027	1.26	4.514	0.514
20	0.4300	35.210	25.5	15.0	1.030	4.000	5.030	1.26	4.515	0.515

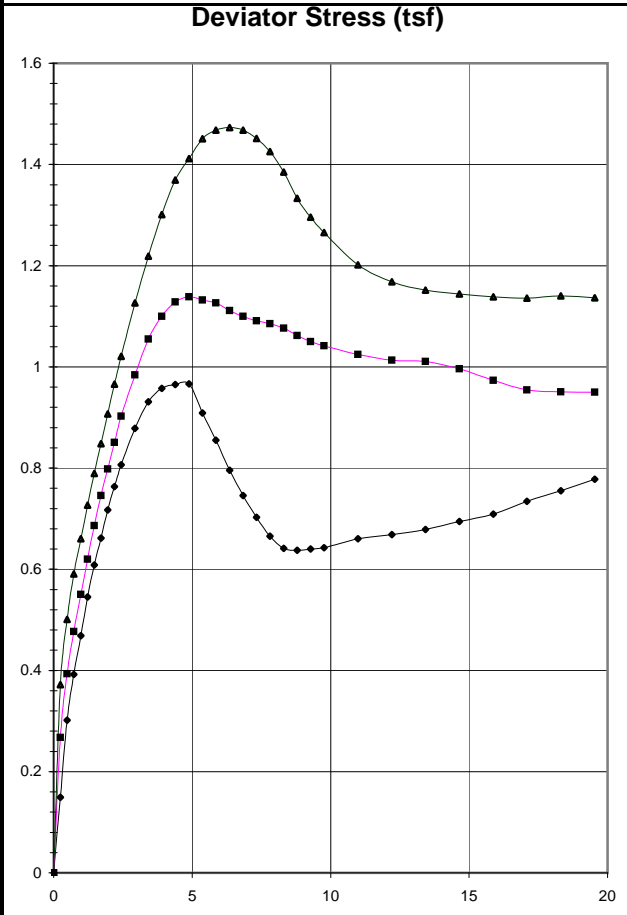


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

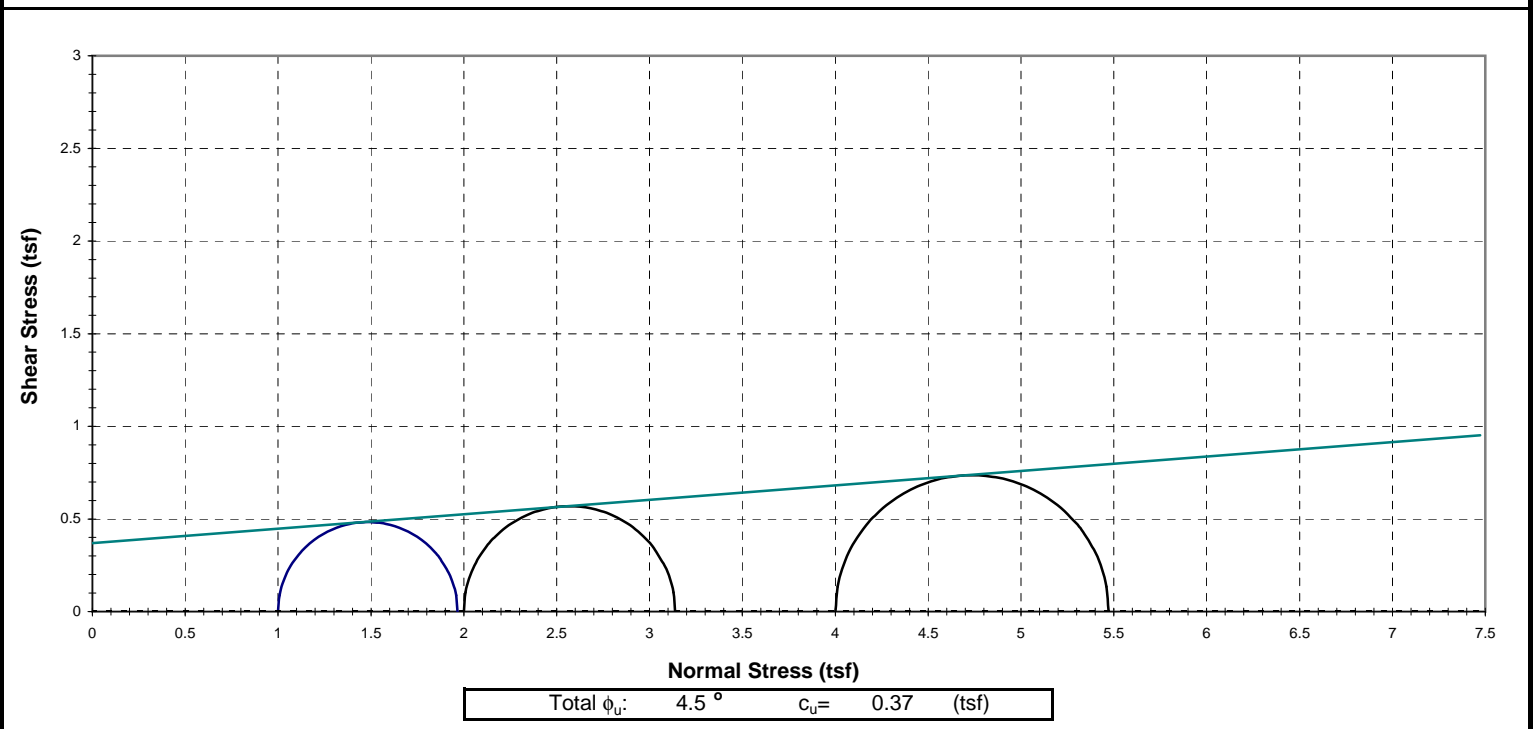
Date: 8/24/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Mid-Top)**
 Soil Type: **Fat Clay (CH) Brenna**



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi_u = 4.5^\circ$	
Apparent Cohesion, $c_u = 0.37$ (tsf)	
Test Date: 8/18/10	Liquid Limit: 63.8
Test Type: U-U	Plastic Limit: 23.1
Strain Rate (in/min): 0.05	Plasticity Index: 40.7
Strain Rate (%/min): 1.221	Spec. Gravity (Assumed): 2.76
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	41.6 42.9 42.6
Dry Density (pcf)	79.3 78.5 78.3
Void Ratio	1.17 1.20 1.20
After Consolidation	
Diameter (in)	
Height (in)	
Water Content (%)	
Dry Density (pcf)	
Void Ratio	
Back Pressure (tsf)	
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.97 1.14 1.47
Ultimate Deviator Stress (tsf)	0.78 0.95 1.14
Deviator Stress at Failure (tsf)	0.97 1.14 1.47
Max. Pore Pressure Buildup (tsf)	-----
Pore Pressure Parameter "B"	-----
Pct. Axial Strain at Failure	4.9 4.9 6.3

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

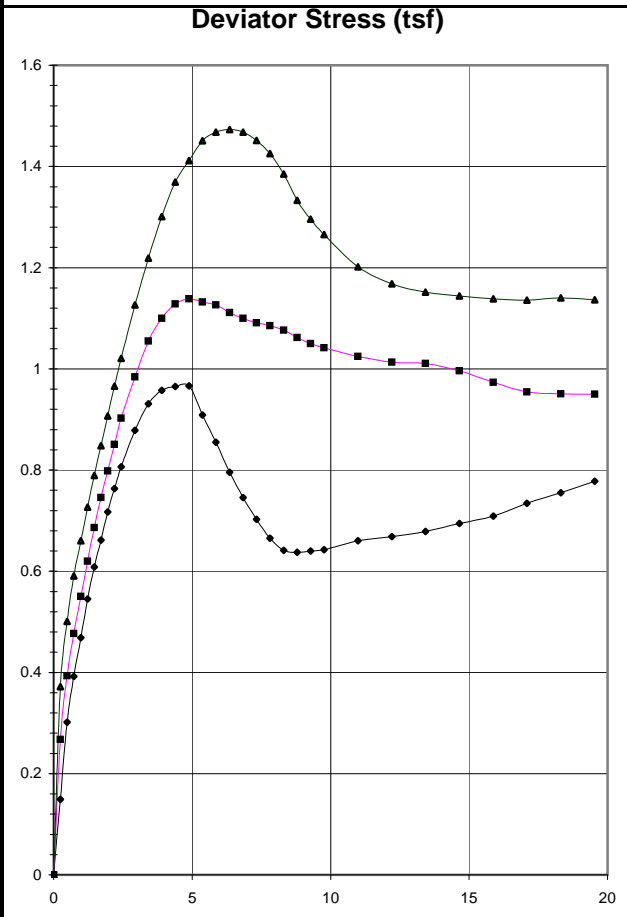


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

Date: 8/24/10

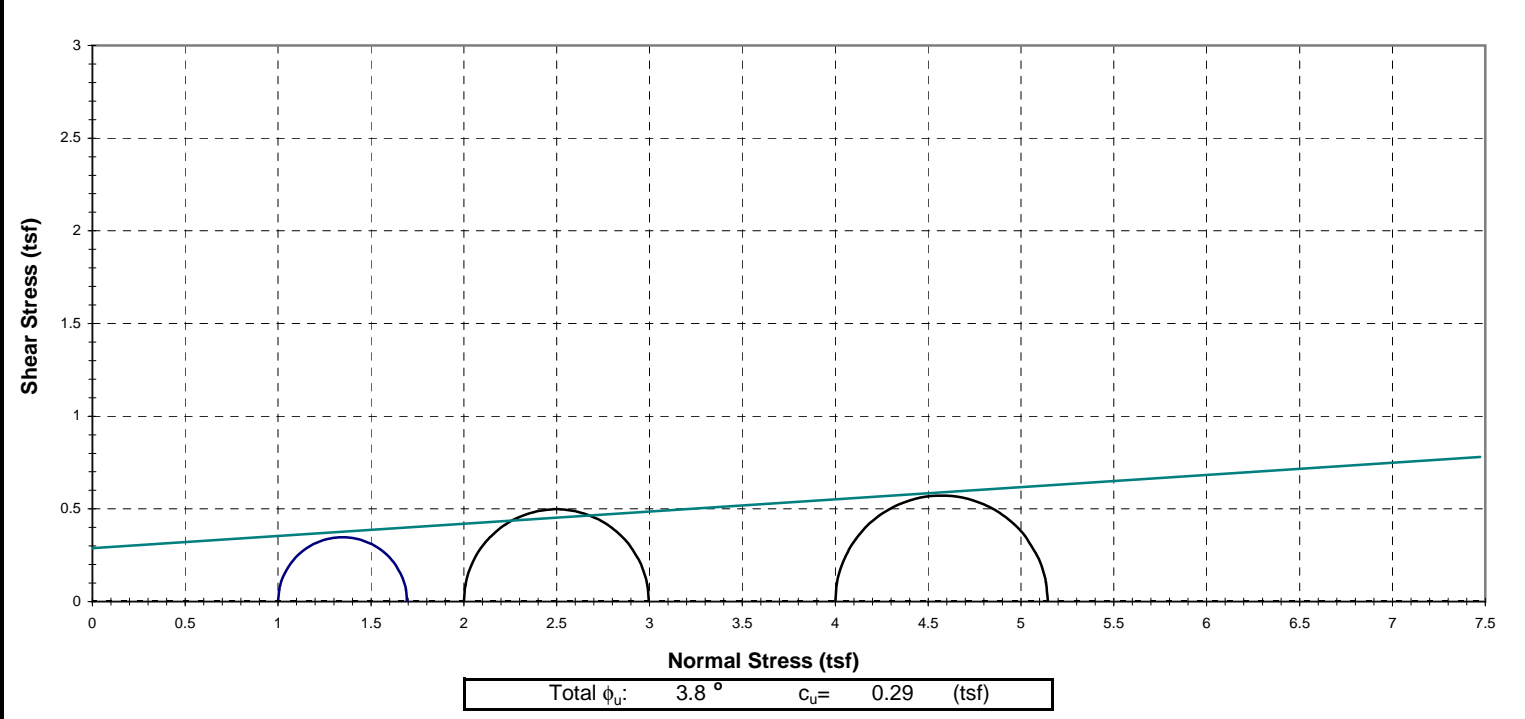
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **25 - 27 (Mid-Top)**
 Soil Type: **Fat Clay (CH) Brenna**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 3.8^\circ$				
		Apparent Cohesion, $c_u = 0.29$ (tsf)				
Test Date:	8/18/10	Liquid Limit:	63.8			
Test Type:	U-U	Plastic Limit:	23.1			
Strain Rate (in/min):	0.05	Plasticity Index:	40.7			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.76			
Before Consolidation		A	B	C	D	E
Diameter (in)		1.94	1.94	1.94		
Height (in)		4.10	4.10	4.10		
Water Content (%)		41.6	42.9	42.6		
Dry Density (pcf)		79.3	78.5	78.3		
Void Ratio		1.17	1.20	1.20		
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)		1.00	2.00	4.00		
Max. Deviator Stress (tsf)		0.97	1.14	1.47		
Ultimate Deviator Stress (tsf)		0.78	0.95	1.14		
Deviator Stress at Failure (tsf)		0.69	1.00	1.14		
Max. Pore Pressure Buildup (tsf)		-----	-----	-----		
Pore Pressure Parameter "B"		-----	-----	-----		
Pct. Axial Strain at Failure		15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-78MU, Sample No.: 2, Depth (ft.): 25 - 27 (Mid-Top)

Sample 1	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.15
0.49	0.30
0.73	0.39
0.98	0.47
1.22	0.55
1.47	0.61
1.71	0.66
1.95	0.72
2.20	0.76
2.44	0.81
2.93	0.88
3.42	0.93
3.91	0.96
4.40	0.97
4.88	0.97
5.37	0.91
5.86	0.86
6.35	0.80
6.84	0.75
7.33	0.70
7.81	0.67
8.30	0.64
8.79	0.64
9.28	0.64
9.77	0.64
10.99	0.66
12.21	0.67
13.43	0.68
14.65	0.69
15.87	0.71
17.09	0.73
18.32	0.76
19.54	0.78

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.27
0.49	0.39
0.73	0.48
0.98	0.55
1.22	0.62
1.47	0.69
1.71	0.75
1.95	0.80
2.20	0.85
2.44	0.90
2.93	0.98
3.42	1.05
3.91	1.10
4.40	1.13
4.88	1.14
5.37	1.13
5.86	1.13
6.35	1.11
6.84	1.10
7.33	1.09
7.81	1.08
8.30	1.08
8.79	1.06
9.28	1.05
9.77	1.04
10.99	1.02
12.21	1.01
13.43	1.01
14.65	1.00
15.87	0.97
17.09	0.95
18.32	0.95
19.54	0.95

Sample 3	
Strain (%)	Deviator Stress (tsf)

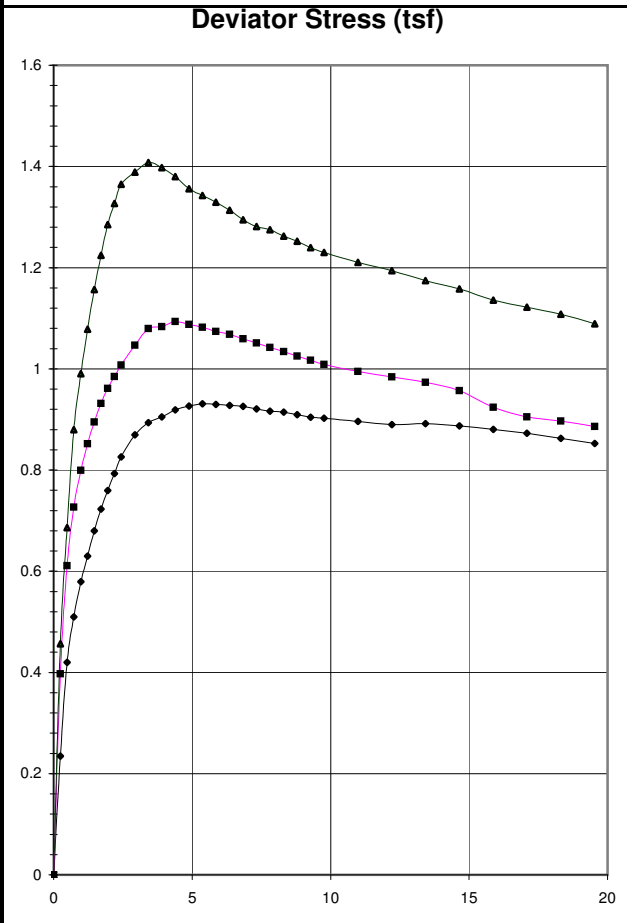
0.00	0.00
0.24	0.37
0.49	0.50
0.73	0.59
0.98	0.66
1.22	0.73
1.47	0.79
1.71	0.85
1.95	0.91
2.20	0.97
2.44	1.02
2.93	1.13
3.42	1.22
3.91	1.30
4.40	1.37
4.88	1.41
5.37	1.45
5.86	1.47
6.35	1.47
6.84	1.47
7.33	1.45
7.81	1.43
8.30	1.38
8.79	1.33
9.28	1.30
9.77	1.27
10.99	1.20
12.21	1.17
13.43	1.15
14.65	1.14
15.87	1.14
17.09	1.14
18.32	1.14
19.54	1.14

TRIAXIAL TEST ASTM: D 2850

Job No. 7577

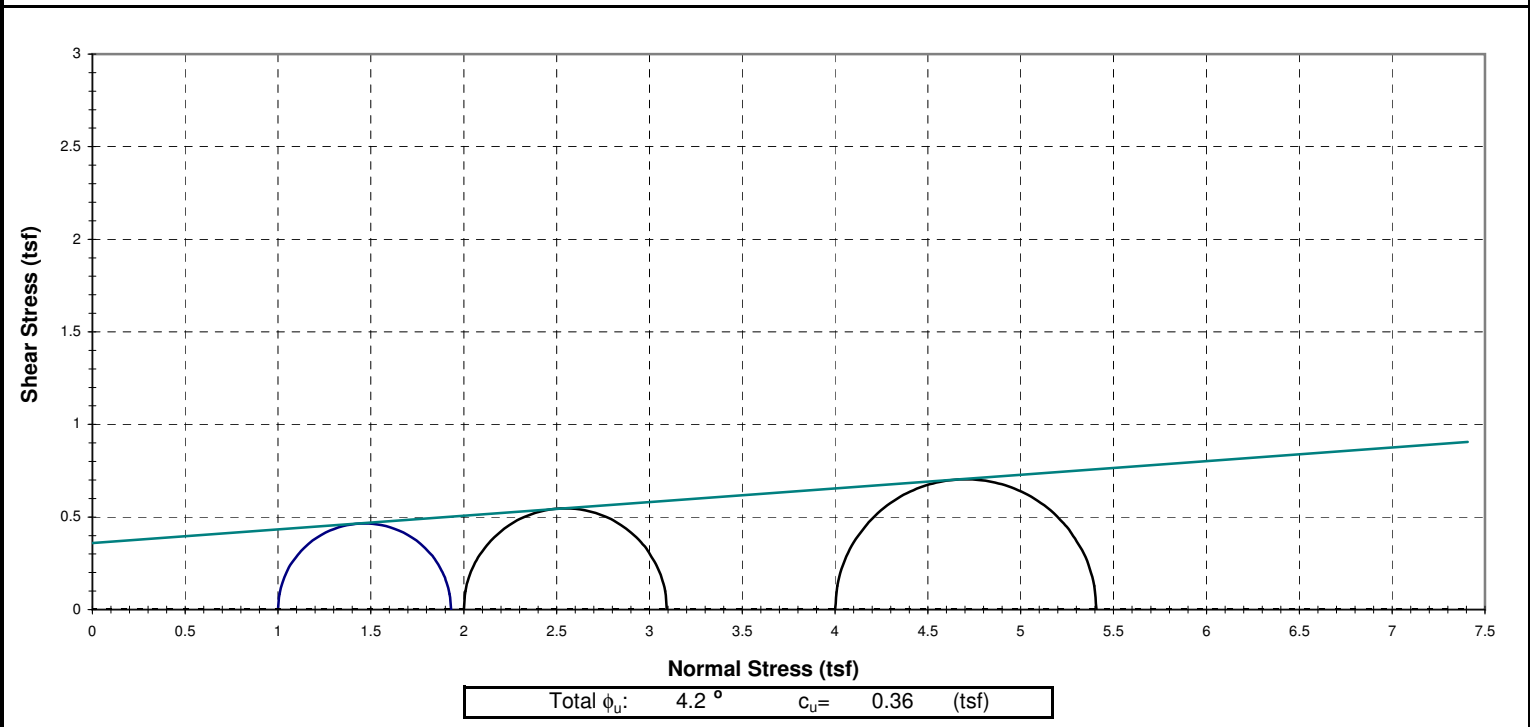
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Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid.)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi_u = 4.2^\circ$	
Apparent Cohesion, $c_u = 0.36$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 90.7
Test Type: U-U	Plastic Limit: 29.1
Strain Rate (in/min): 0.05	Plasticity Index: 61.6
Strain Rate (%/min): 1.221	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	4.10 4.10 4.10
Dry Density (pcf)	36.3 36.4 37.9
Void Ratio	84.6 84.5 83.1
After Consolidation	
Diameter (in)	
Height (in)	
Water Content (%)	
Dry Density (pcf)	
Void Ratio	
Back Pressure (tsf)	
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	0.93 1.09 1.41
Ultimate Deviator Stress (tsf)	0.85 0.89 1.09
Deviator Stress at Failure (tsf)	0.93 1.09 1.41
Max. Pore Pressure Buildup (tsf)	-----
Pore Pressure Parameter "B"	-----
Pct. Axial Strain at Failure	5.4 4.4 3.4

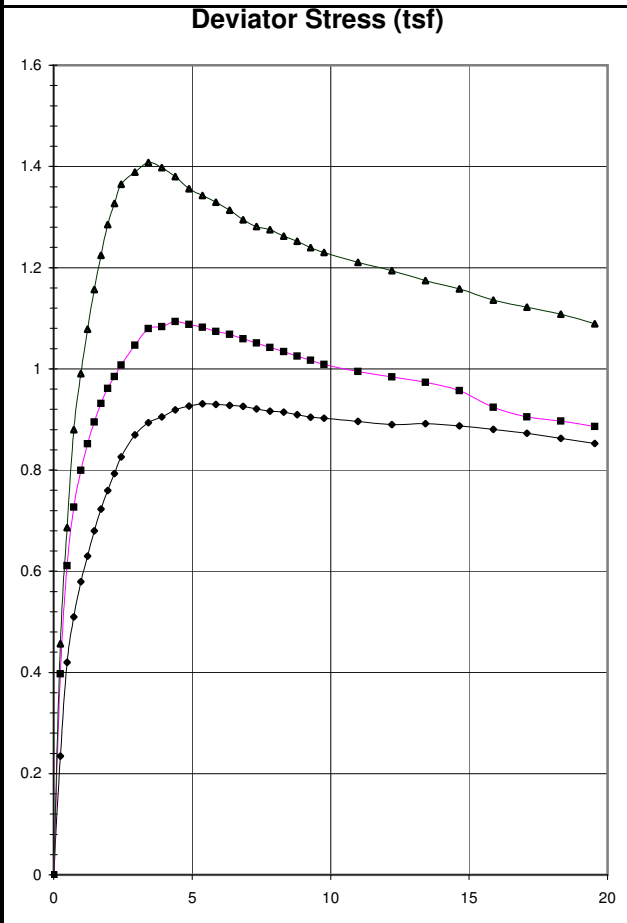
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



TRIAXIAL TEST ASTM: D 2850

Job No. 7577
Date: 8/24/10

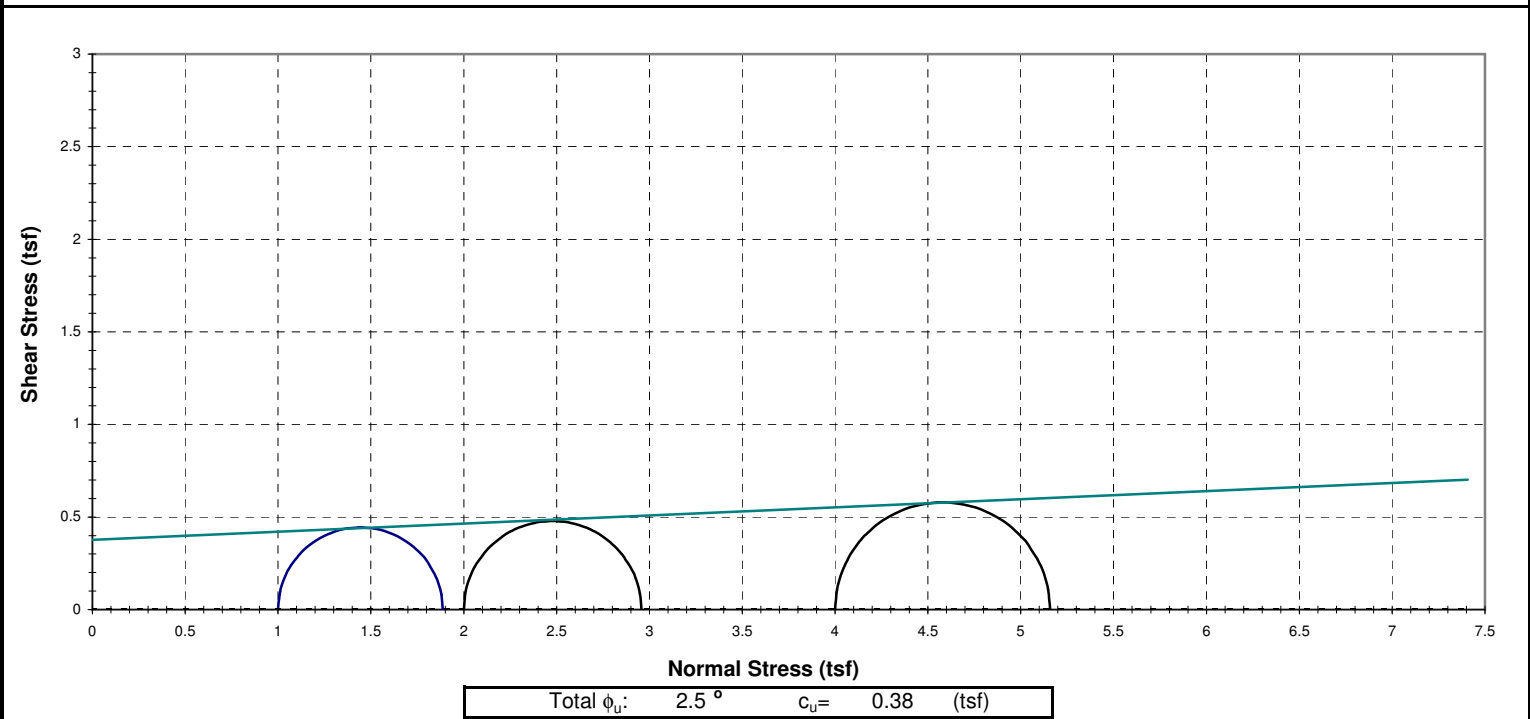
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **35 - 37 (Mid.)**
 Soil Type: **Fat Clay w/Laminations of Silt (CH) Brenna**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 2.5^\circ$				
		Apparent Cohesion, $c_u = 0.38$ (tsf)				
Test Date:	8/20/10	Liquid Limit:	90.7			
Test Type:	U-U	Plastic Limit:	29.1			
Strain Rate (in/min):	0.05	Plasticity Index:	61.6			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.78			
Before Consolidation		A	B	C	D	E
Diameter (in)		1.94	1.94	1.94		
Height (in)		4.10	4.10	4.10		
Water Content (%)		36.3	36.4	37.9		
Dry Density (pcf)		84.6	84.5	83.1		
Void Ratio		1.05	1.05	1.09		
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)		1.00	2.00	4.00		
Max. Deviator Stress (tsf)		0.93	1.09	1.41		
Ultimate Deviator Stress (tsf)		0.85	0.89	1.09		
Deviator Stress at Failure (tsf)		0.89	0.96	1.16		
Max. Pore Pressure Buildup (tsf)		-----	-----	-----		
Pore Pressure Parameter "B"		-----	-----	-----		
Pct. Axial Strain at Failure		15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-80MU, Sample No.: 2, Depth (ft.): 35 - 37 (Mid.)

Sample 1	
Strain (%)	Deviator Stress (tsf)

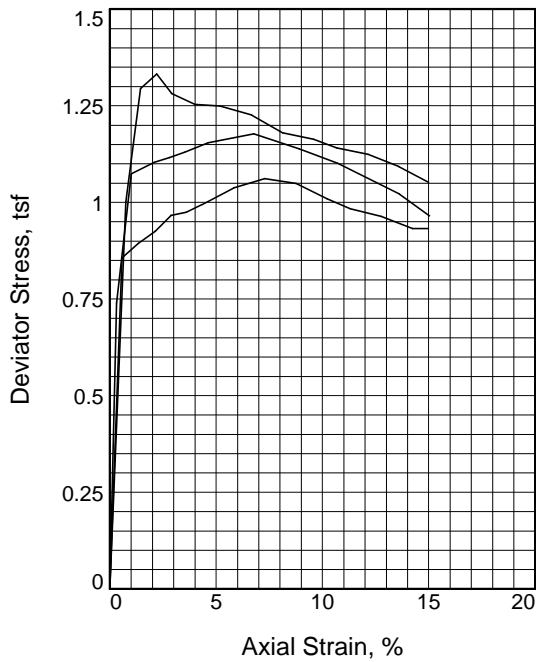
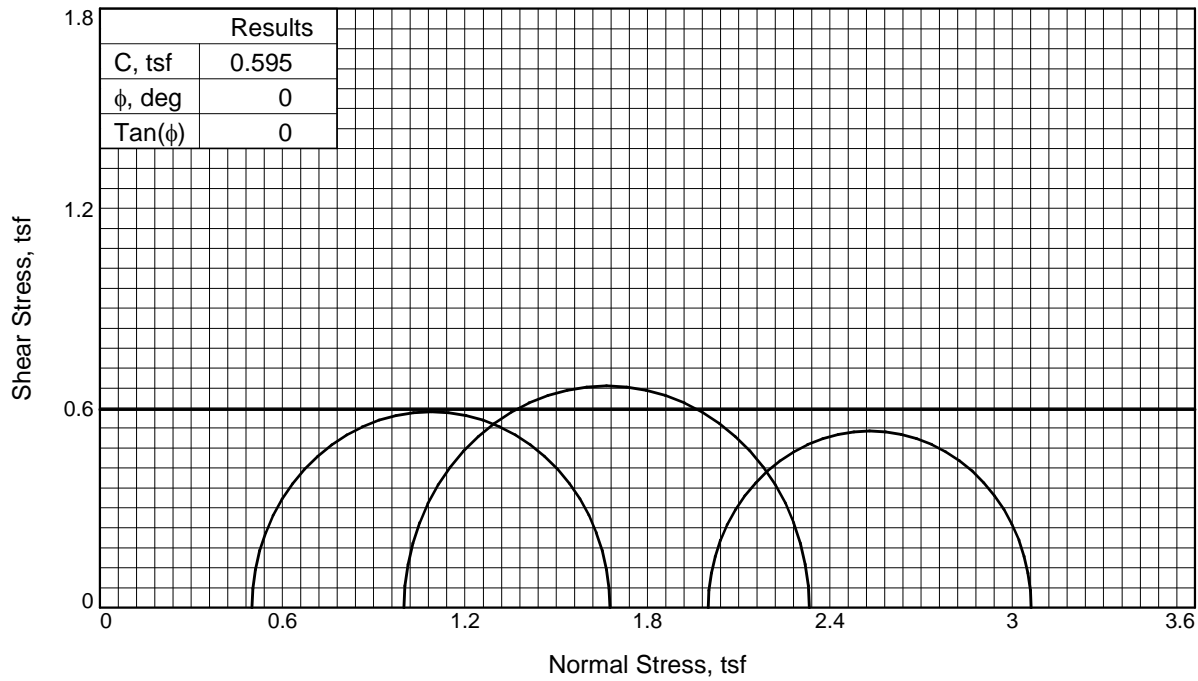
Sample 2	
Strain (%)	Deviator Stress (tsf)

Sample 3	
Strain (%)	Deviator Stress (tsf)

0.00 0.00
 0.24 0.23
 0.49 0.42
 0.73 0.51
 0.98 0.58
 1.22 0.63
 1.47 0.68
 1.71 0.72
 1.95 0.76
 2.20 0.79
 2.44 0.83
 2.93 0.87
 3.42 0.89
 3.91 0.90
 4.40 0.92
 4.88 0.93
 5.37 0.93
 5.86 0.93
 6.35 0.93
 6.84 0.93
 7.33 0.92
 7.81 0.92
 8.30 0.91
 8.79 0.91
 9.28 0.90
 9.77 0.90
 10.99 0.90
 12.21 0.89
 13.43 0.89
 14.65 0.89
 15.87 0.88
 17.09 0.87
 18.32 0.86
 19.54 0.85

0.00 0.00
 0.24 0.40
 0.49 0.61
 0.73 0.73
 0.98 0.80
 1.22 0.85
 1.47 0.90
 1.71 0.93
 1.95 0.96
 2.20 0.98
 2.44 1.01
 2.93 1.05
 3.42 1.08
 3.91 1.08
 4.40 1.09
 4.88 1.09
 5.37 1.08
 5.86 1.07
 6.35 1.07
 6.84 1.06
 7.33 1.05
 7.81 1.04
 8.30 1.03
 8.79 1.03
 9.28 1.02
 9.77 1.01
 10.99 0.99
 12.21 0.98
 13.43 0.97
 14.65 0.96
 15.87 0.92
 17.09 0.90
 18.32 0.90
 19.54 0.89

0.00 0.00
 0.24 0.46
 0.49 0.69
 0.73 0.88
 0.98 0.99
 1.22 1.08
 1.47 1.16
 1.71 1.22
 1.95 1.29
 2.20 1.33
 2.44 1.37
 2.93 1.39
 3.42 1.41
 3.91 1.40
 4.40 1.38
 4.88 1.36
 5.37 1.34
 5.86 1.33
 6.35 1.31
 6.84 1.29
 7.33 1.28
 7.81 1.27
 8.30 1.26
 8.79 1.25
 9.28 1.24
 9.77 1.23
 10.99 1.21
 12.21 1.19
 13.43 1.17
 14.65 1.16
 15.87 1.14
 17.09 1.12
 18.32 1.11
 19.54 1.09



Sample No.	1	2	3	
Initial	Water Content, %	57.2	55.6	56.8
	Dry Density, pcf	66.1	67.2	66.1
	Saturation, %	99.2	99.0	98.5
	Void Ratio	1.5685	1.5257	1.5672
	Diameter, in.	1.40	1.42	1.41
	Height, in.	2.81	2.80	2.80
At Test	Water Content, %	57.2	55.6	56.8
	Dry Density, pcf	66.1	67.2	66.1
	Saturation, %	99.2	99.0	98.5
	Void Ratio	1.5685	1.5257	1.5672
	Diameter, in.	1.40	1.42	1.41
	Height, in.	2.81	2.80	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Peak Stress, tsf	1.18	1.33	1.06	
Ult. Stress, tsf	0.97	1.05	0.93	
σ_1 Failure, tsf	1.68	2.33	3.06	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 119 **PL=** 32 **PI=** 87

Specific Gravity= 2.720

Remarks:

Client: W912ES-11-P-0024

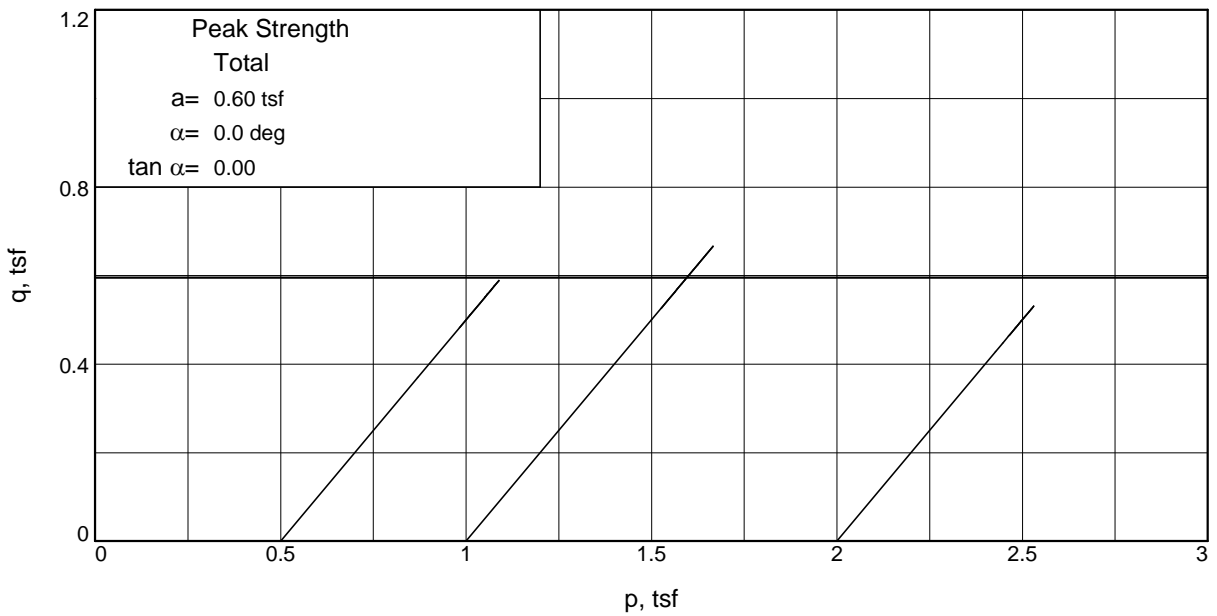
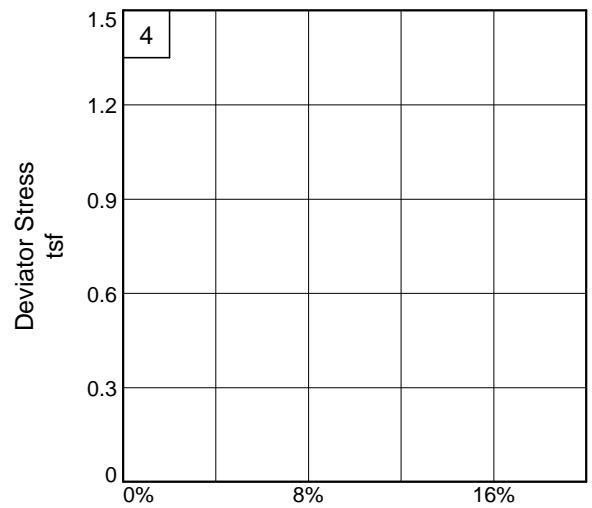
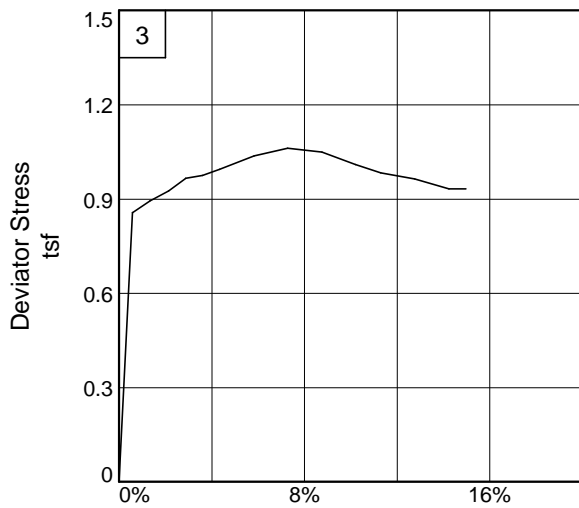
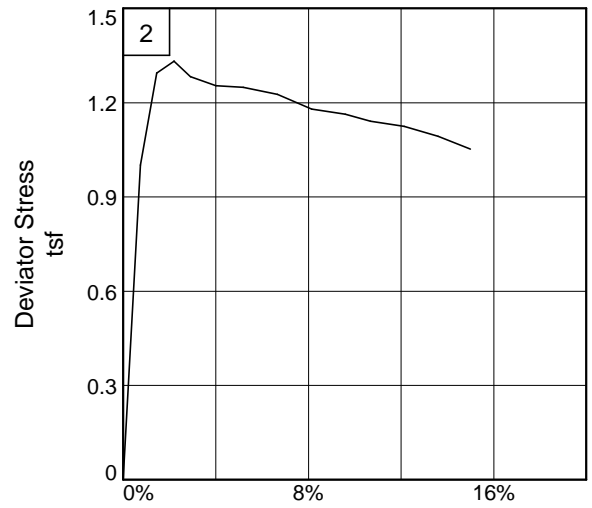
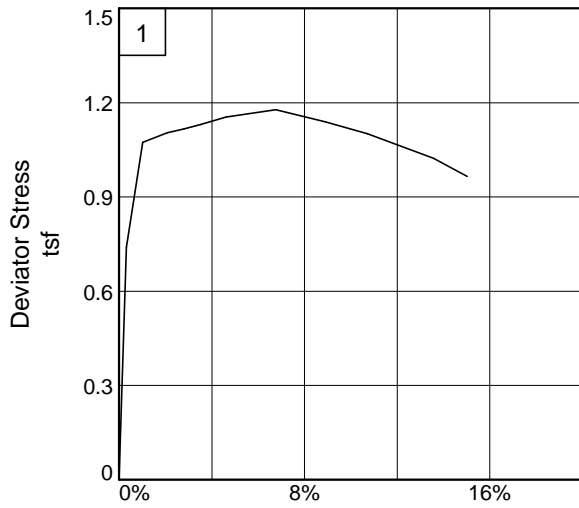
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Maple River, Brenna Formation

Sample Number: Boring10-105MU, #2 **Depth:** 25-27'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Brenna Formation

Depth: 25-27'

Sample Number: Boring10-105MU, #2

Project No.: B-10-105MU Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec
Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

12:04 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Brenna Formation
Depth: 25-27' **Sample Number:** Boring10-105MU, #2
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.720 **LL**=119 **PL**=32 **PI**=87
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	148.270	148.270
Moisture content: Dry soil+tare, gms.	105.800	105.800
Moisture content: Tare, gms.	31.590	31.590
Moisture, %	57.2	57.2
Moist specimen weight, gms.	117.5	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	103.9	
Dry density, pcf	66.1	
Void ratio	1.5685	
Saturation, %	99.2	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.177 tsf at reading no. 7
Ult. Stress = 0.965 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0062	1.000	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0150	16.790	15.8	0.3	0.739	0.500	1.239	2.48	0.870	0.370
2	0.0347	24.090	23.1	1.0	1.074	0.500	1.574	3.15	1.037	0.537
3	0.0648	25.000	24.0	2.1	1.104	0.500	1.604	3.21	1.052	0.552
4	0.0851	25.450	24.5	2.8	1.116	0.500	1.616	3.23	1.058	0.558
5	0.1054	25.940	24.9	3.5	1.130	0.500	1.630	3.26	1.065	0.565
6	0.1359	26.760	25.8	4.6	1.154	0.500	1.654	3.31	1.077	0.577
7	0.1965	27.880	26.9	6.8	1.177	0.500	1.677	3.35	1.089	0.589
8	0.2566	27.600	26.6	8.9	1.138	0.500	1.638	3.28	1.069	0.569
9	0.3074	27.260	26.3	10.7	1.101	0.500	1.601	3.20	1.051	0.551
10	0.3887	26.170	25.2	13.6	1.021	0.500	1.521	3.04	1.011	0.511
11	0.4286	25.190	24.2	15.0	0.965	0.500	1.465	2.93	0.983	0.483

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	150.600	150.600
Moisture content: Dry soil+tare, gms.	107.620	107.620
Moisture content: Tare, gms.	30.260	30.260
Moisture, %	55.6	55.6
Moist specimen weight, gms.	121.1	
Diameter, in.	1.42	
Area, in. ²	1.57	
Height, in.	2.80	
Wet Density, pcf	104.6	
Dry density, pcf	67.2	
Void ratio	1.5257	
Saturation, %	99.0	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.332 tsf at reading no. 3
 Ult. Stress = 1.052 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0094	1.520	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0304	23.550	22.0	0.7	1.001	1.000	2.001	2.00	1.501	0.501
2	0.0501	30.210	28.7	1.5	1.295	1.000	2.295	2.29	1.647	0.647
3	0.0711	31.270	29.8	2.2	1.332	1.000	2.332	2.33	1.666	0.666
4	0.0911	30.360	28.8	2.9	1.282	1.000	2.282	2.28	1.641	0.641
5	0.1219	30.050	28.5	4.0	1.254	1.000	2.254	2.25	1.627	0.627
6	0.1547	30.290	28.8	5.2	1.249	1.000	2.249	2.25	1.625	0.625
7	0.1964	30.210	28.7	6.7	1.226	1.000	2.226	2.23	1.613	0.613
8	0.2378	29.570	28.1	8.1	1.180	1.000	2.180	2.18	1.590	0.590
9	0.2783	29.620	28.1	9.6	1.163	1.000	2.163	2.16	1.582	0.582
10	0.3089	29.410	27.9	10.7	1.141	1.000	2.141	2.14	1.570	0.570
11	0.3499	29.470	28.0	12.1	1.124	1.000	2.124	2.12	1.562	0.562

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
12	0.3908	29.140	27.6	13.6	1.093	1.000	2.093	2.09	1.546	0.546
13	0.4300	28.560	27.0	15.0	1.052	1.000	2.052	2.05	1.526	0.526

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	149.820	149.820
Moisture content: Dry soil+tare, gms.	106.960	106.960
Moisture content: Tare, gms.	31.450	31.450
Moisture, %	56.8	56.8
Moist specimen weight, gms.	119.1	
Diameter, in.	1.41	
Area, in. ²	1.56	
Height, in.	2.80	
Wet Density, pcf	103.7	
Dry density, pcf	66.1	
Void ratio	1.5672	
Saturation, %	98.5	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

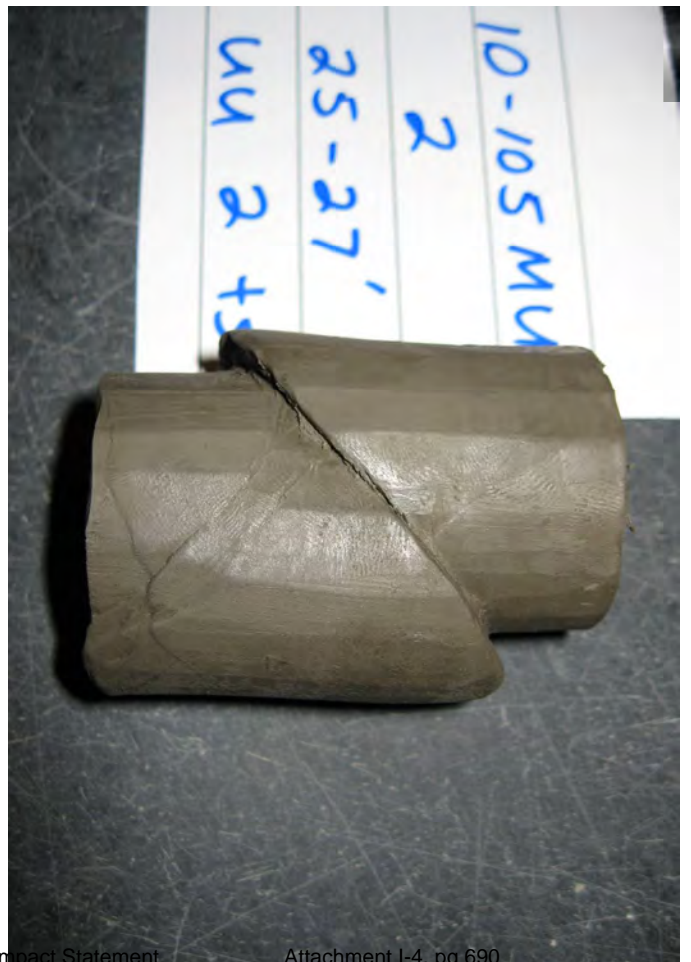
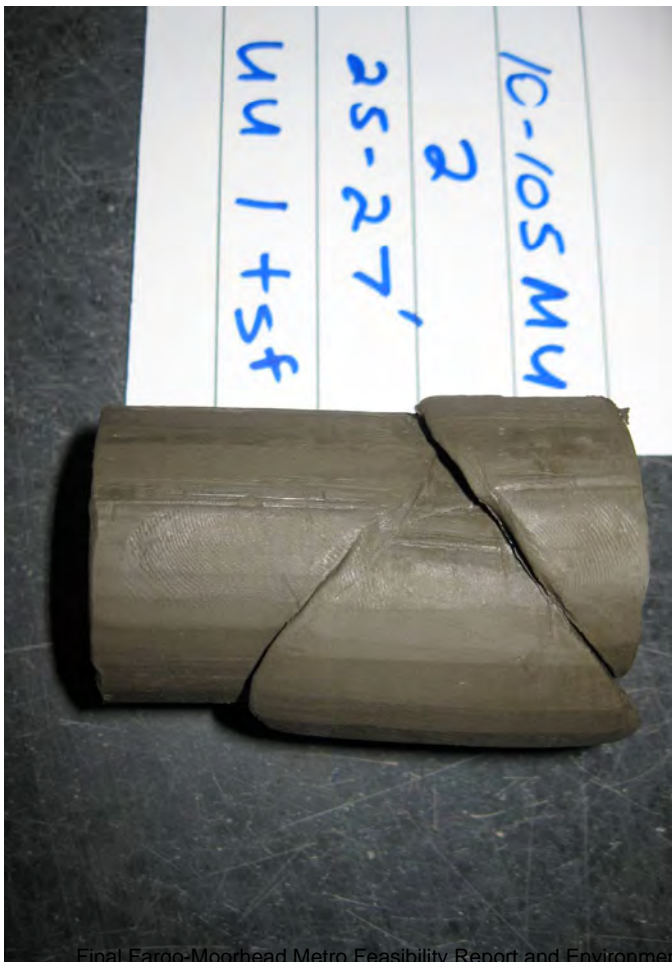
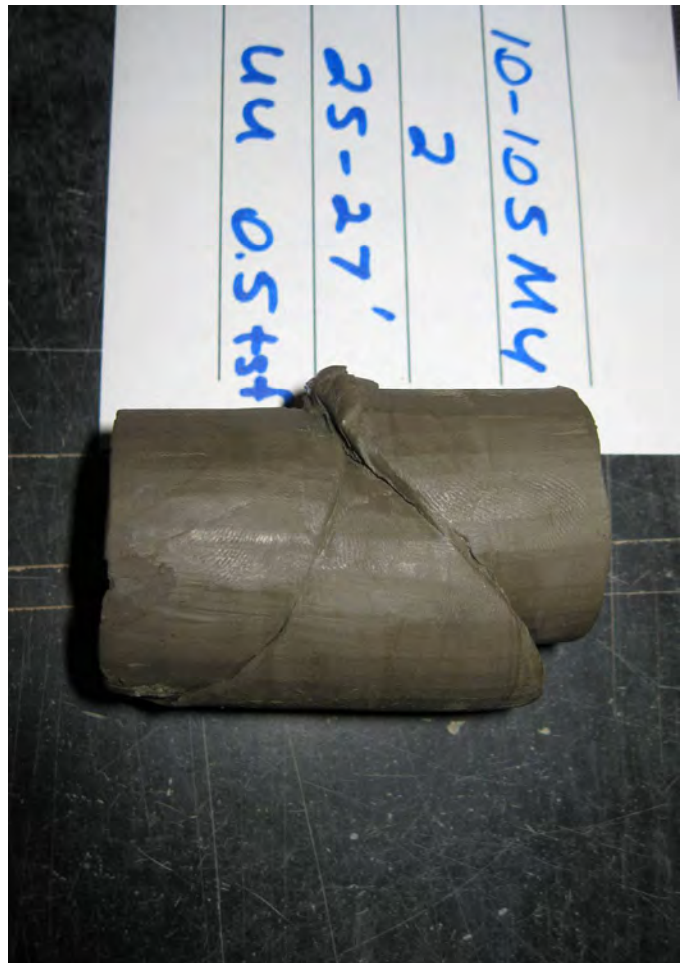
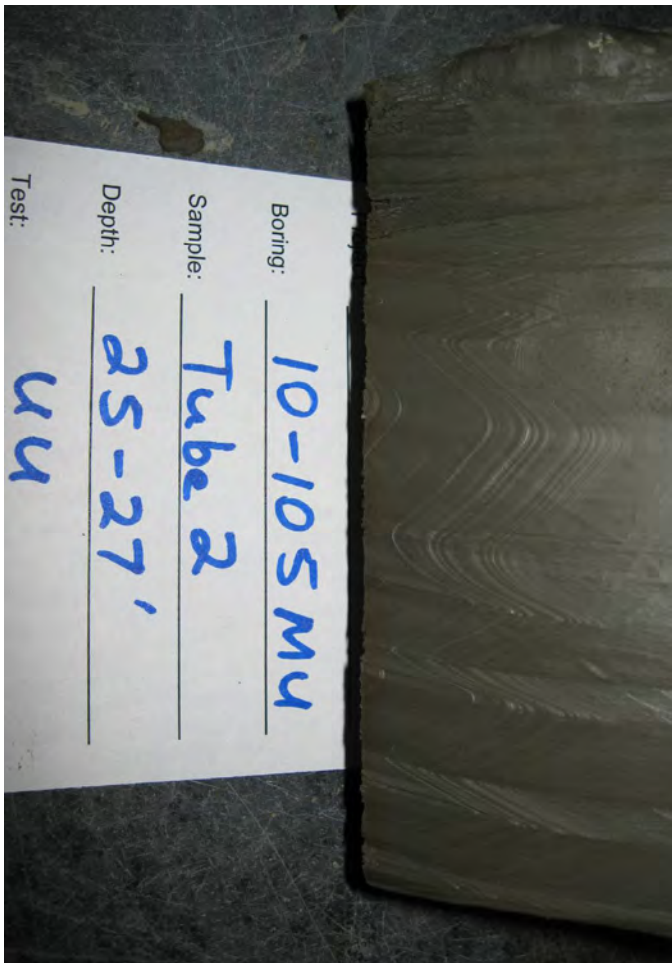
Back pressure = 0.000 tsf

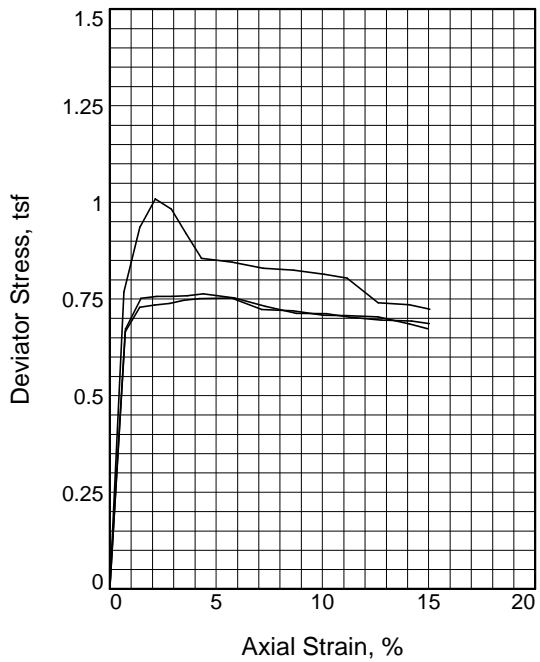
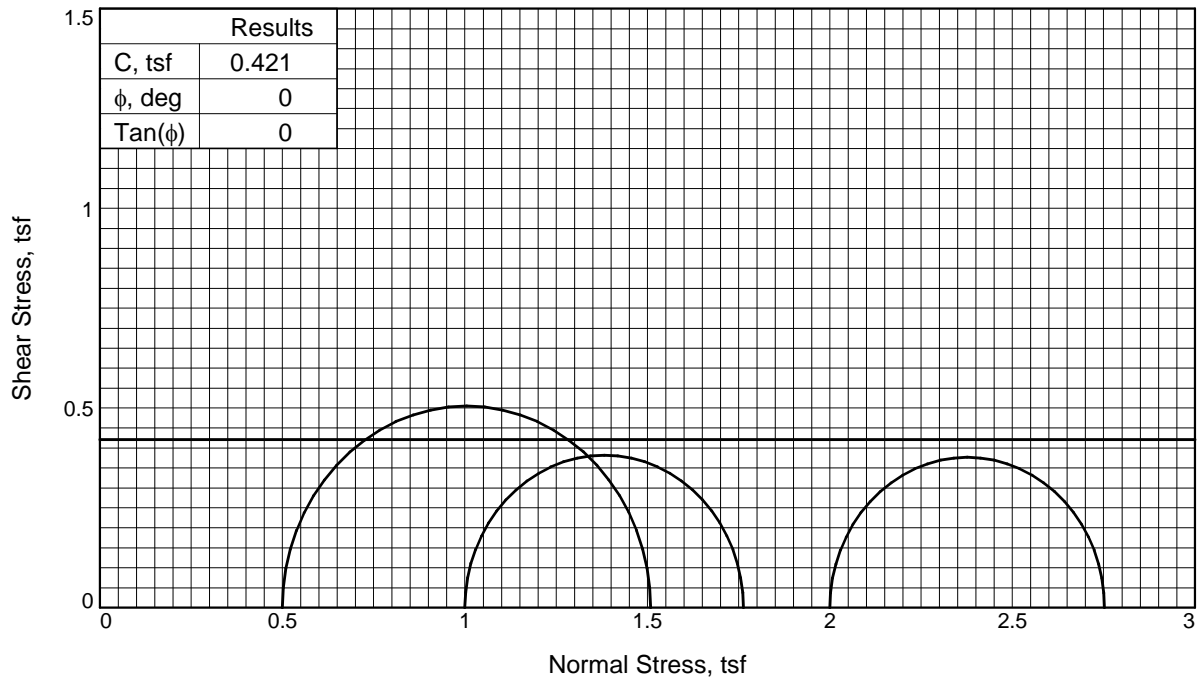
Strain rate, %/min. = 1.00

Peak Stress = 1.062 tsf at reading no. 8

Ult. Stress = 0.932 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	3.990	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0228	22.700	18.7	0.6	0.857	2.000	2.857	1.43	2.428	0.428
2	0.0443	23.670	19.7	1.3	0.894	2.000	2.894	1.45	2.447	0.447
3	0.0666	24.530	20.5	2.1	0.926	2.000	2.926	1.46	2.463	0.463
4	0.0871	25.590	21.6	2.9	0.966	2.000	2.966	1.48	2.483	0.483
5	0.1075	25.950	22.0	3.6	0.975	2.000	2.975	1.49	2.487	0.487
6	0.1279	26.570	22.6	4.3	0.995	2.000	2.995	1.50	2.497	0.497
7	0.1699	27.910	23.9	5.8	1.037	2.000	3.037	1.52	2.519	0.519
8	0.2106	28.860	24.9	7.3	1.062	2.000	3.062	1.53	2.531	0.531
9	0.2520	28.960	25.0	8.8	1.049	2.000	3.049	1.52	2.524	0.524
10	0.2926	28.410	24.4	10.2	1.010	2.000	3.010	1.50	2.505	0.505
11	0.3230	28.070	24.1	11.3	0.983	2.000	2.983	1.49	2.492	0.492
12	0.3640	27.980	24.0	12.8	0.964	2.000	2.964	1.48	2.482	0.482
13	0.4052	27.600	23.6	14.2	0.932	2.000	2.932	1.47	2.466	0.466
14	0.4257	27.800	23.8	15.0	0.932	2.000	2.932	1.47	2.466	0.466





Sample No.		1	2	3
Initial	Water Content, %	62.6	63.3	63.9
	Dry Density, pcf	62.5	62.6	62.1
	Saturation, %	98.3	99.7	99.2
	Void Ratio	1.7616	1.7555	1.7801
	Diameter, in.	1.42	1.41	1.40
	Height, in.	2.80	2.81	2.82
At Test	Water Content, %	62.6	63.3	63.9
	Dry Density, pcf	62.5	62.6	62.1
	Saturation, %	98.3	99.7	99.2
	Void Ratio	1.7616	1.7555	1.7801
	Diameter, in.	1.42	1.41	1.40
	Height, in.	2.80	2.81	2.82
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		0.50	1.00	2.00
Peak Stress, tsf		1.01	0.76	0.75
Ult. Stress, tsf		0.72	0.69	0.67
σ_1 Failure, tsf		1.51	1.76	2.75
σ_3 Failure, tsf		0.50	1.00	2.00

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 106 **PL=** 29 **PI=** 77

Specific Gravity= 2.764

Remarks:

Client: W912ES-11-P-0024

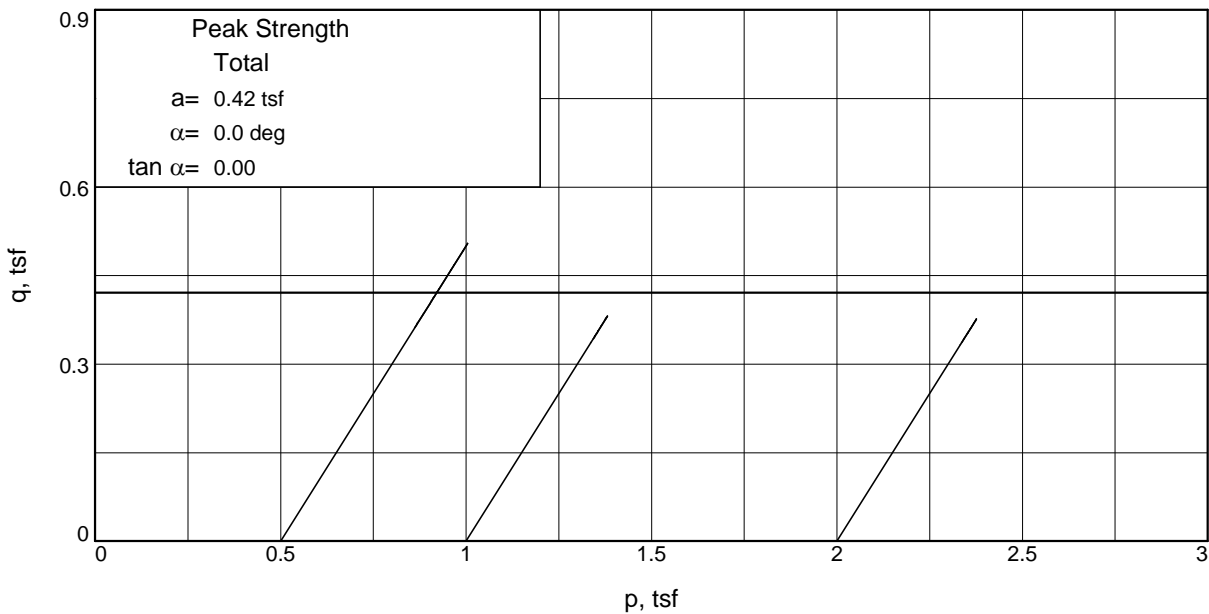
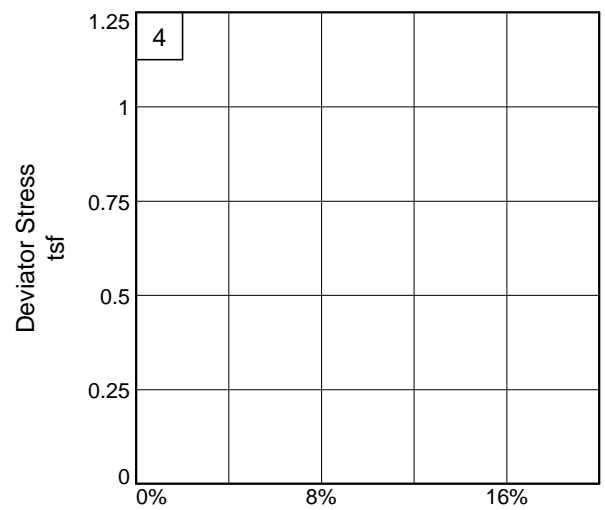
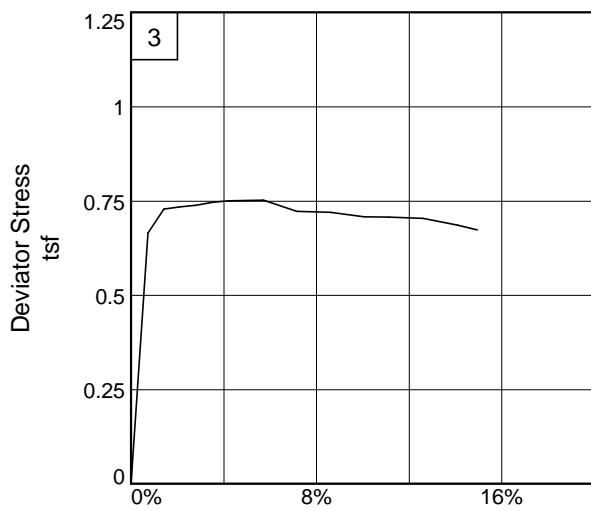
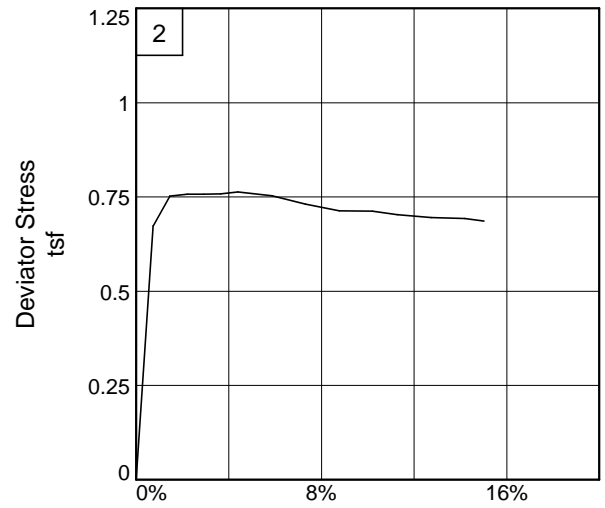
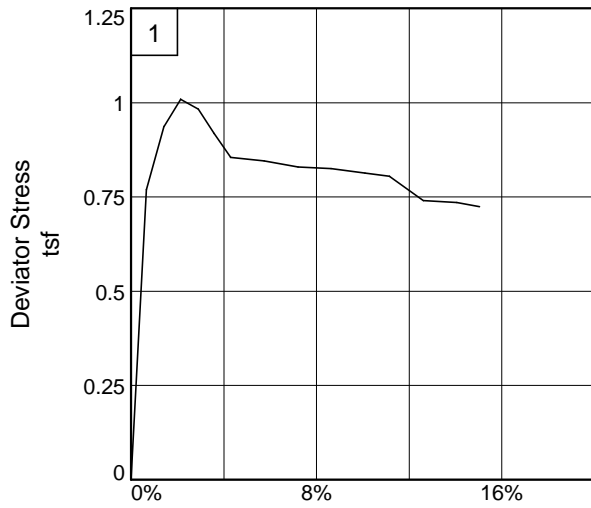
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Maple River, Brenna Formation

Sample Number: Boring10-105MU, #3 **Depth:** 35-37'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Brenna Formation

Depth: 35-37'

Sample Number: Boring10-105MU, #3

Project No.: B-10-0065 Feasibility Report and Environmental Impact Statement

Figure

Braun Intertec
Geotechnical Design and Geology

July 2014

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

1:19 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Brenna Formation
Depth: 35-37' **Sample Number:** Boring10-105MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.764 **LL**=106 **PL**=29 **PI**=77
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	147.440	147.440
Moisture content: Dry soil+tare, gms.	102.320	102.320
Moisture content: Tare, gms.	30.290	30.290
Moisture, %	62.6	62.6
Moist specimen weight, gms.	117.5	
Diameter, in.	1.42	
Area, in. ²	1.57	
Height, in.	2.80	
Wet Density, pcf	101.6	
Dry density, pcf	62.5	
Void ratio	1.7616	
Saturation, %	98.3	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.009 tsf at reading no. 3
Ult. Stress = 0.724 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0063	0.000	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0250	16.900	16.9	0.7	0.769	0.500	1.269	2.54	0.884	0.384
2	0.0461	20.750	20.8	1.4	0.937	0.500	1.437	2.87	0.968	0.468
3	0.0662	22.520	22.5	2.1	1.009	0.500	1.509	3.02	1.005	0.505
4	0.0870	22.120	22.1	2.9	0.984	0.500	1.484	2.97	0.992	0.492
5	0.1067	20.810	20.8	3.6	0.919	0.500	1.419	2.84	0.959	0.459
6	0.1268	19.510	19.5	4.3	0.855	0.500	1.355	2.71	0.927	0.427
7	0.1674	19.590	19.6	5.7	0.845	0.500	1.345	2.69	0.923	0.423
8	0.2084	19.520	19.5	7.2	0.829	0.500	1.329	2.66	0.915	0.415
9	0.2482	19.710	19.7	8.6	0.825	0.500	1.325	2.65	0.912	0.412
10	0.2892	19.760	19.8	10.1	0.813	0.500	1.313	2.63	0.907	0.407
11	0.3191	19.770	19.8	11.2	0.804	0.500	1.304	2.61	0.902	0.402
12	0.3600	18.500	18.5	12.6	0.740	0.500	1.240	2.48	0.870	0.370
13	0.4005	18.690	18.7	14.1	0.735	0.500	1.235	2.47	0.868	0.368
14	0.4280	18.610	18.6	15.0	0.724	0.500	1.224	2.45	0.862	0.362

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	146.540	146.540
Moisture content: Dry soil+tare, gms.	101.340	101.340
Moisture content: Tare, gms.	29.950	29.950
Moisture, %	63.3	63.3
Moist specimen weight, gms.	117.1	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	102.3	
Dry density, pcf	62.6	
Void ratio	1.7555	
Saturation, %	99.7	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 0.763 tsf at reading no. 6
 Ult. Stress = 0.686 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0079	1.520	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0285	16.140	14.6	0.7	0.673	1.000	1.673	1.67	1.337	0.337
2	0.0488	17.970	16.5	1.5	0.752	1.000	1.752	1.75	1.376	0.376
3	0.0699	18.210	16.7	2.2	0.757	1.000	1.757	1.76	1.378	0.378
4	0.0900	18.330	16.8	2.9	0.757	1.000	1.757	1.76	1.378	0.378
5	0.1103	18.490	17.0	3.6	0.758	1.000	1.758	1.76	1.379	0.379
6	0.1313	18.730	17.2	4.4	0.763	1.000	1.763	1.76	1.382	0.382
7	0.1728	18.760	17.2	5.9	0.753	1.000	1.753	1.75	1.376	0.376
8	0.2135	18.520	17.0	7.3	0.731	1.000	1.731	1.73	1.365	0.365
9	0.2545	18.370	16.9	8.8	0.713	1.000	1.713	1.71	1.356	0.356
10	0.2943	18.610	17.1	10.2	0.712	1.000	1.712	1.71	1.356	0.356
11	0.3248	18.610	17.1	11.3	0.703	1.000	1.703	1.70	1.352	0.352
12	0.3660	18.700	17.2	12.7	0.695	1.000	1.695	1.70	1.348	0.348
13	0.4067	18.930	17.4	14.2	0.693	1.000	1.693	1.69	1.346	0.346
14	0.4298	18.930	17.4	15.0	0.686	1.000	1.686	1.69	1.343	0.343

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	145.940	145.940
Moisture content: Dry soil+tare, gms.	100.950	100.950
Moisture content: Tare, gms.	30.500	30.500
Moisture, %	63.9	63.9
Moist specimen weight, gms.	115.9	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.82	
Wet Density, pcf	101.7	
Dry density, pcf	62.1	
Void ratio	1.7801	
Saturation, %	99.2	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

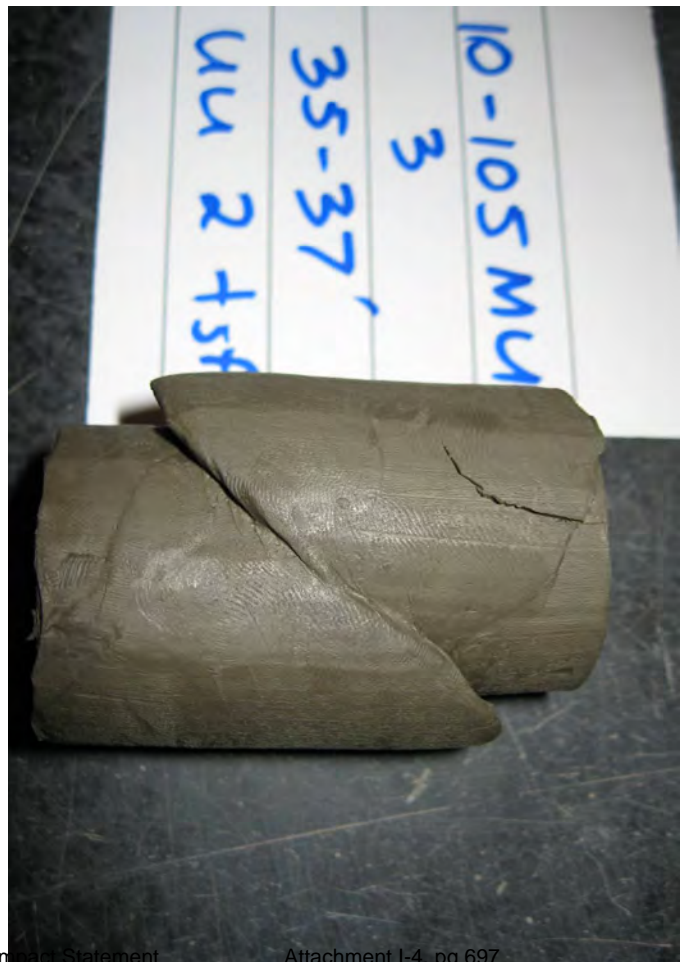
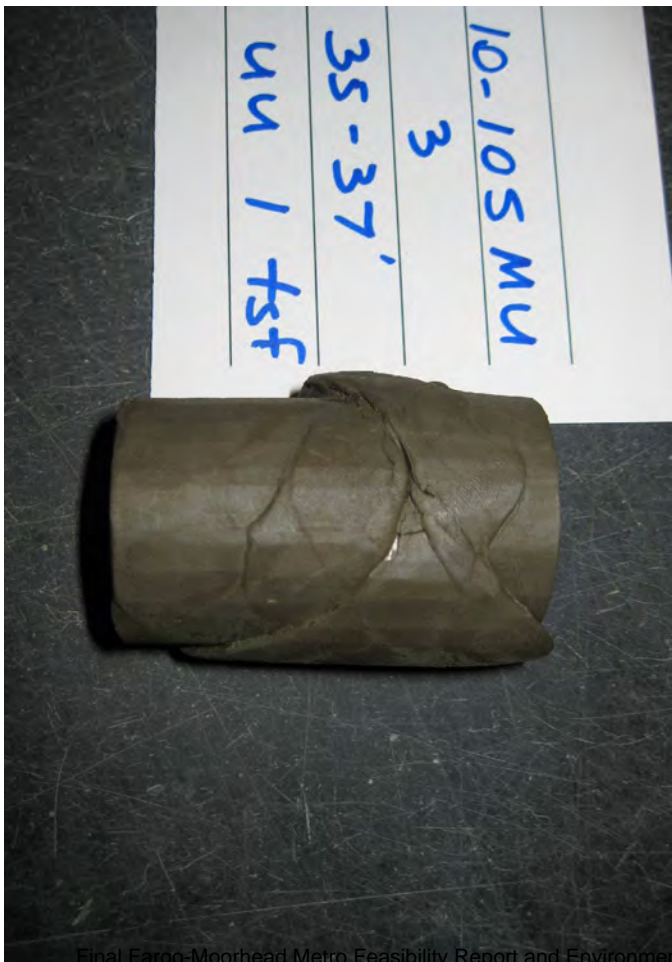
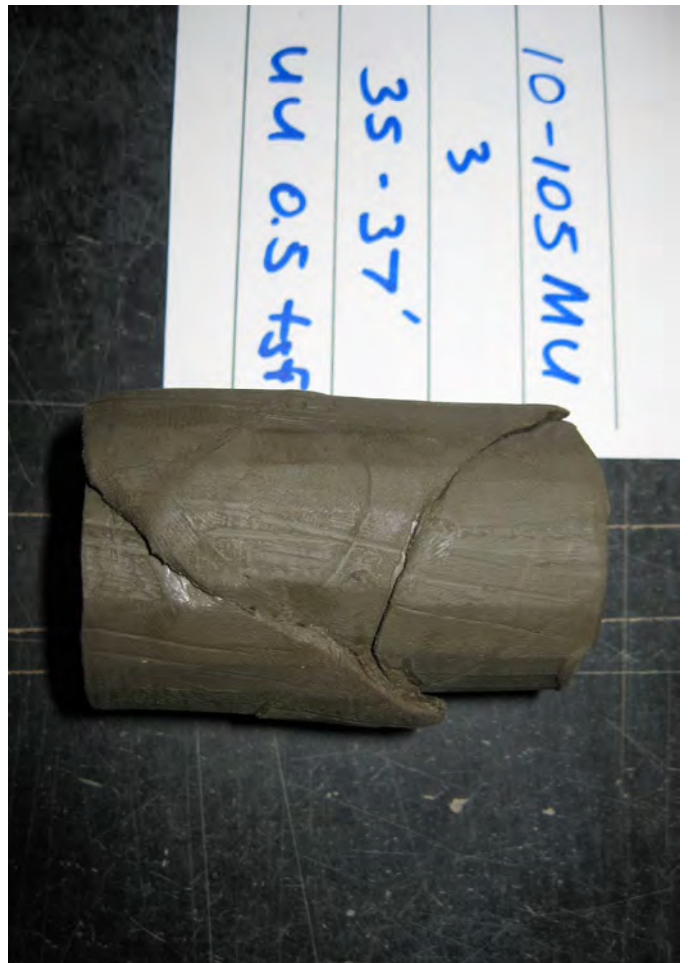
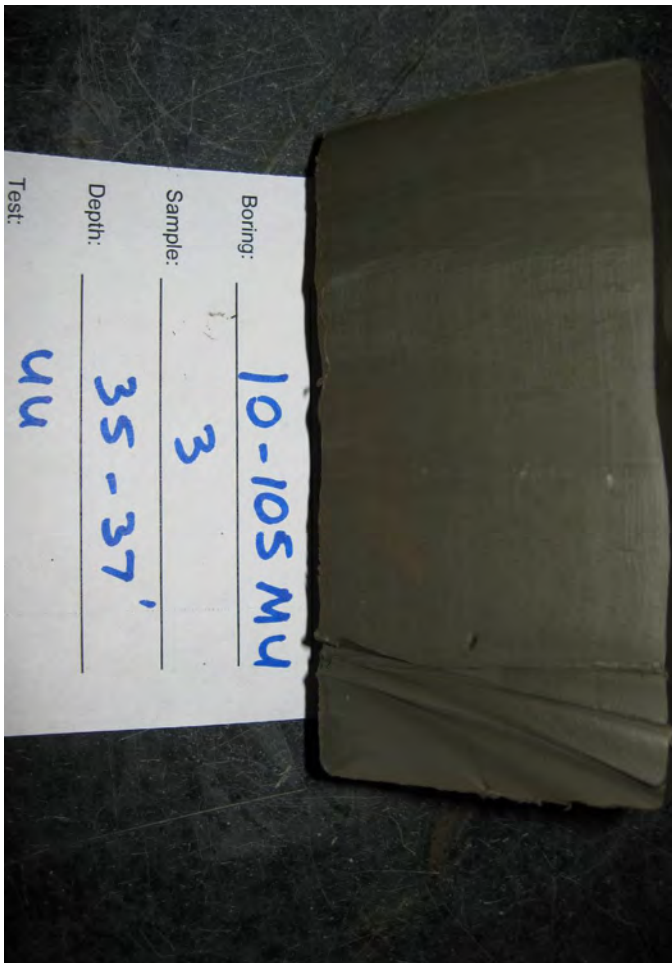
Back pressure = 0.000 tsf

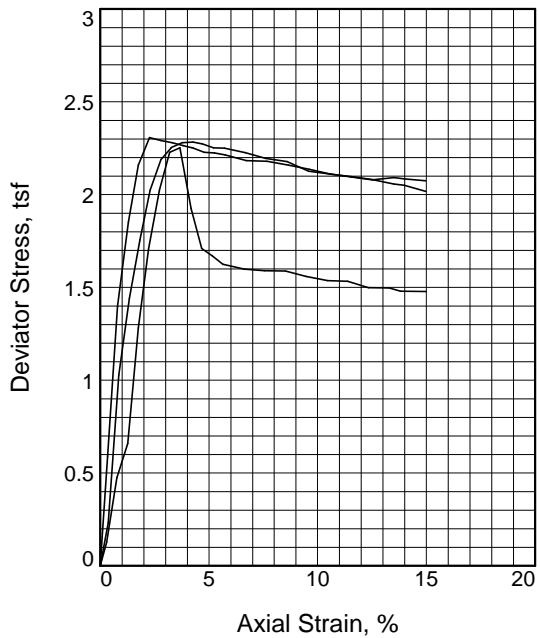
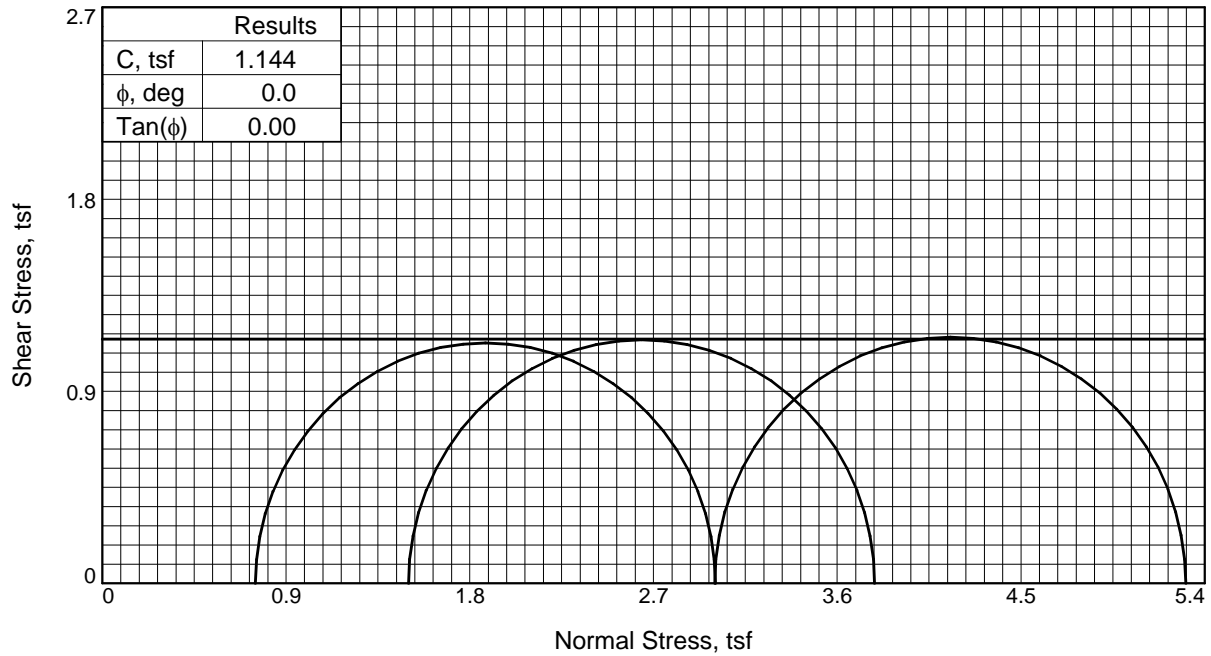
Strain rate, %/min. = 1.00

Peak Stress = 0.753 tsf at reading no. 7

Ult. Stress = 0.673 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0100	4.540	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0305	18.900	14.4	0.7	0.666	2.000	2.666	1.33	2.333	0.333
2	0.0495	20.360	15.8	1.4	0.729	2.000	2.729	1.36	2.364	0.364
3	0.0695	20.600	16.1	2.1	0.734	2.000	2.734	1.37	2.367	0.367
4	0.0891	20.810	16.3	2.8	0.739	2.000	2.739	1.37	2.369	0.369
5	0.1085	21.100	16.6	3.5	0.746	2.000	2.746	1.37	2.373	0.373
6	0.1289	21.320	16.8	4.2	0.751	2.000	2.751	1.38	2.375	0.375
7	0.1710	21.630	17.1	5.7	0.753	2.000	2.753	1.38	2.376	0.376
8	0.2115	21.200	16.7	7.2	0.722	2.000	2.722	1.36	2.361	0.361
9	0.2525	21.400	16.9	8.6	0.720	2.000	2.720	1.36	2.360	0.360
10	0.2932	21.390	16.9	10.1	0.708	2.000	2.708	1.35	2.354	0.354
11	0.3237	21.570	17.0	11.1	0.707	2.000	2.707	1.35	2.353	0.353
12	0.3651	21.780	17.2	12.6	0.704	2.000	2.704	1.35	2.352	0.352
13	0.4068	21.630	17.1	14.1	0.686	2.000	2.686	1.34	2.343	0.343
14	0.4310	21.480	16.9	15.0	0.673	2.000	2.673	1.34	2.336	0.336





Sample No.	1	2	3	
Initial	Water Content, %	37.3	37.5	37.4
	Dry Density, pcf	78.5	83.9	84.1
	Saturation, %	86.6	98.8	99.2
	Void Ratio	1.1802	1.0405	1.0340
	Diameter, in.	1.43	1.39	1.40
	Height, in.	2.81	2.80	2.81
At Test	Water Content, %	37.3	37.5	37.4
	Dry Density, pcf	78.5	83.9	84.1
	Saturation, %	86.6	98.8	99.2
	Void Ratio	1.1802	1.0405	1.0340
	Diameter, in.	1.43	1.39	1.40
	Height, in.	2.81	2.80	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	2.25	2.28	2.31	
Ult. Stress, tsf	1.48	2.02	2.08	
σ_1 Failure, tsf	3.00	3.78	5.31	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 71

PL= 19

PI= 52

Specific Gravity= 2.741

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Brenna Formation

Sample Number: Boring11-107MU, #1

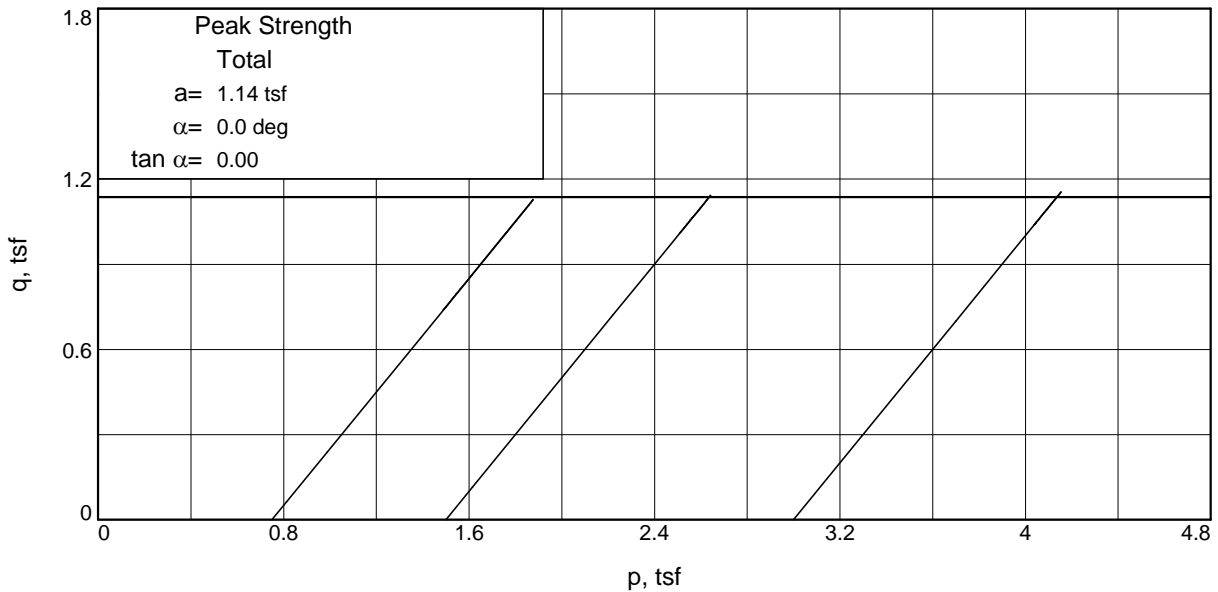
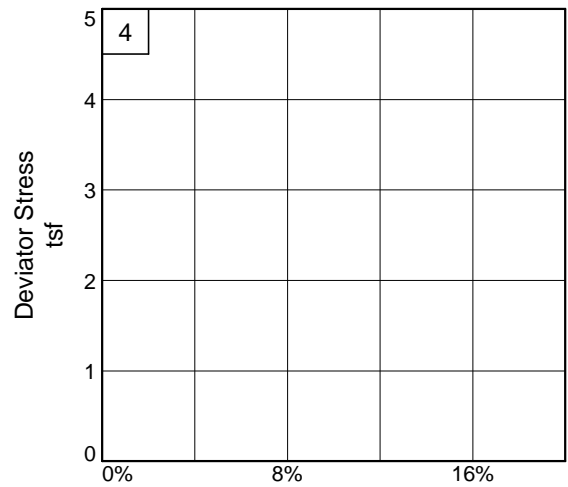
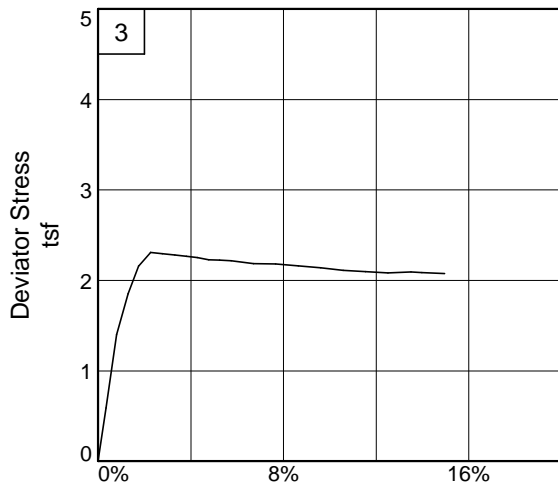
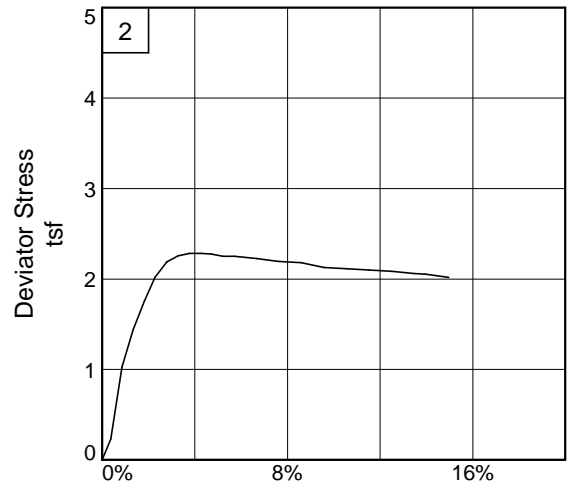
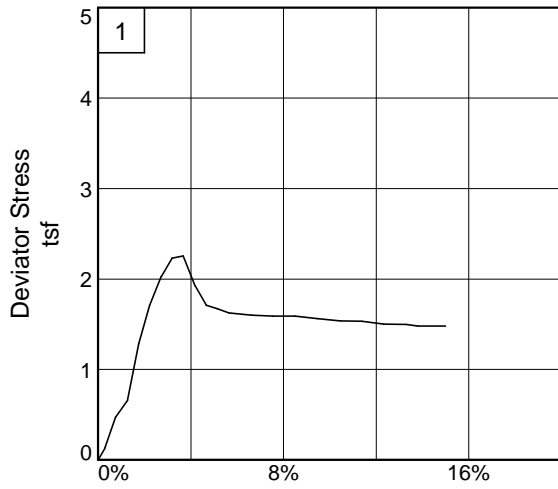
Depth: 20-22'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Brenna Formation

Project No.: BL-10-10065

Depth: 20-22'

Figure _____

Sample No.: Boring11-107MU, #1

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:13 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Brenna Formation
Depth: 20-22' **Sample Number:** Boring11-107MU, #1
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.741 **LL**=71 **PL**=19 **PI**=52
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	157.860	157.860
Moisture content: Dry soil+tare, gms.	123.290	123.290
Moisture content: Tare, gms.	30.600	30.600
Moisture, %	37.3	37.3
Moist specimen weight, gms.	127.6	
Diameter, in.	1.43	
Area, in. ²	1.61	
Height, in.	2.81	
Wet Density, pcf	107.8	
Dry density, pcf	78.5	
Void ratio	1.1802	
Saturation, %	86.6	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.253 tsf at reading no. 8
Ult. Stress = 1.479 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	2.130	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0148	4.970	2.8	0.3	0.127	0.750	0.877	1.17	0.813	0.063
2	0.0280	12.810	10.7	0.8	0.474	0.750	1.224	1.63	0.987	0.237
3	0.0422	17.050	14.9	1.3	0.659	0.750	1.409	1.88	1.080	0.330
4	0.0560	31.270	29.1	1.8	1.282	0.750	2.032	2.71	1.391	0.641
5	0.0690	41.130	39.0	2.2	1.707	0.750	2.457	3.28	1.604	0.854
6	0.0829	48.610	46.5	2.7	2.024	0.750	2.774	3.70	1.762	1.012
7	0.0963	53.560	51.4	3.2	2.229	0.750	2.979	3.97	1.864	1.114
8	0.1096	54.380	52.2	3.7	2.253	0.750	3.003	4.00	1.877	1.127
9	0.1241	46.990	44.9	4.2	1.924	0.750	2.674	3.57	1.712	0.962
10	0.1378	42.210	40.1	4.7	1.710	0.750	2.460	3.28	1.605	0.855
11	0.1511	41.490	39.4	5.1	1.671	0.750	2.421	3.23	1.586	0.836
12	0.1653	40.620	38.5	5.7	1.626	0.750	2.376	3.17	1.563	0.813
13	0.1924	40.380	38.3	6.6	1.599	0.750	2.349	3.13	1.549	0.799
14	0.2187	40.560	38.4	7.6	1.590	0.750	2.340	3.12	1.545	0.795
15	0.2456	40.940	38.8	8.5	1.589	0.750	2.339	3.12	1.545	0.795
16	0.2728	40.620	38.5	9.5	1.560	0.750	2.310	3.08	1.530	0.780
17	0.3001	40.460	38.3	10.5	1.536	0.750	2.286	3.05	1.518	0.768
18	0.3259	40.770	38.6	11.4	1.533	0.750	2.283	3.04	1.516	0.766
19	0.3529	40.350	38.2	12.3	1.500	0.750	2.250	3.00	1.500	0.750
20	0.3800	40.720	38.6	13.3	1.498	0.750	2.248	3.00	1.499	0.749
21	0.3939	40.500	38.4	13.8	1.481	0.750	2.231	2.97	1.490	0.740
22	0.4275	40.990	38.9	15.0	1.479	0.750	2.229	2.97	1.489	0.739

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	159.300	159.300
Moisture content: Dry soil+tare, gms.	124.430	124.430
Moisture content: Tare, gms.	31.440	31.440
Moisture, %	37.5	37.5
Moist specimen weight, gms.	128.2	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.80	
Wet Density, pcf	115.3	
Dry density, pcf	83.9	
Void ratio	1.0405	
Saturation, %	98.8	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf

Back pressure = 0.000 tsf

Strain rate, %/min. = 1.00

Peak Stress = 2.283 tsf at reading no. 9

Ult. Stress = 2.018 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	2.340	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0171	7.220	4.9	0.4	0.231	1.500	1.731	1.15	1.616	0.116
2	0.0306	24.130	21.8	0.9	1.028	1.500	2.528	1.69	2.014	0.514
3	0.0441	33.010	30.7	1.3	1.440	1.500	2.940	1.96	2.220	0.720
4	0.0578	39.940	37.6	1.8	1.756	1.500	3.256	2.17	2.378	0.878
5	0.0710	45.890	43.5	2.3	2.025	1.500	3.525	2.35	2.512	1.012
6	0.0849	49.680	47.3	2.8	2.190	1.500	3.690	2.46	2.595	1.095
7	0.0980	51.300	49.0	3.3	2.254	1.500	3.754	2.50	2.627	1.127
8	0.1123	52.150	49.8	3.8	2.281	1.500	3.781	2.52	2.640	1.140
9	0.1261	52.460	50.1	4.3	2.283	1.500	3.783	2.52	2.642	1.142
10	0.1387	52.490	50.2	4.7	2.274	1.500	3.774	2.52	2.637	1.137
11	0.1526	52.270	49.9	5.2	2.252	1.500	3.752	2.50	2.626	1.126
12	0.1664	52.510	50.2	5.7	2.251	1.500	3.751	2.50	2.626	1.126
13	0.1933	52.460	50.1	6.7	2.226	1.500	3.726	2.48	2.613	1.113
14	0.2195	52.270	49.9	7.6	2.195	1.500	3.695	2.46	2.598	1.098
15	0.2472	52.430	50.1	8.6	2.179	1.500	3.679	2.45	2.589	1.089
16	0.2750	51.780	49.4	9.6	2.127	1.500	3.627	2.42	2.564	1.064
17	0.3028	51.970	49.6	10.6	2.112	1.500	3.612	2.41	2.556	1.056
18	0.3299	52.150	49.8	11.5	2.097	1.500	3.597	2.40	2.548	1.048
19	0.3567	52.360	50.0	12.5	2.083	1.500	3.583	2.39	2.541	1.041
20	0.3845	52.340	50.0	13.5	2.058	1.500	3.558	2.37	2.529	1.029
21	0.3980	52.460	50.1	14.0	2.052	1.500	3.552	2.37	2.526	1.026
22	0.4257	52.210	49.9	15.0	2.018	1.500	3.518	2.35	2.509	1.009

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	161.210	161.210
Moisture content: Dry soil+tare, gms.	125.520	125.520
Moisture content: Tare, gms.	30.180	30.180
Moisture, %	37.4	37.4
Moist specimen weight, gms.	131.1	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	115.6	
Dry density, pcf	84.1	
Void ratio	1.0340	
Saturation, %	99.2	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

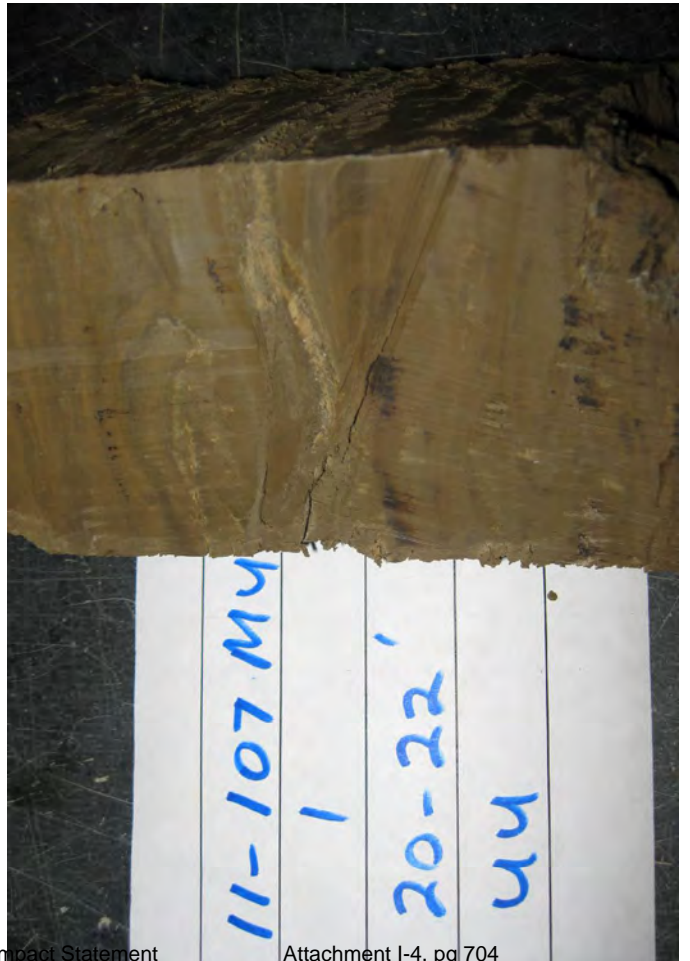
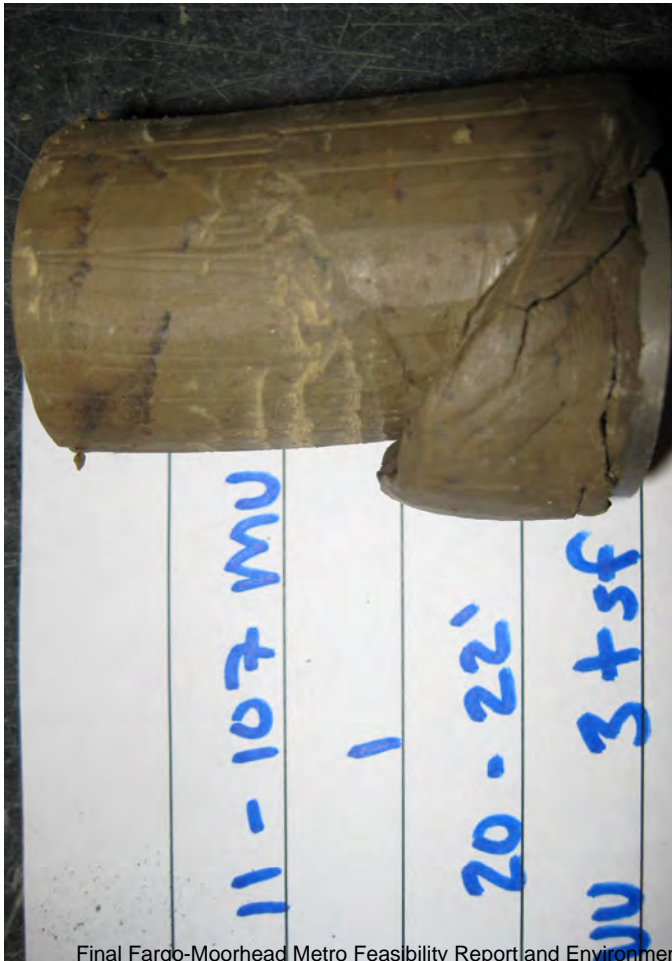
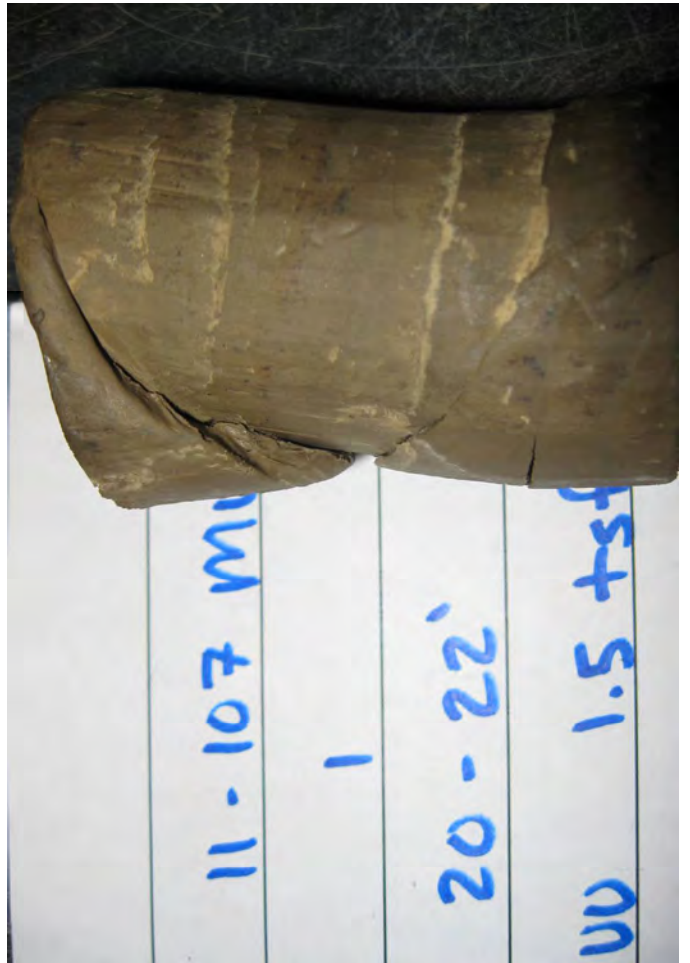
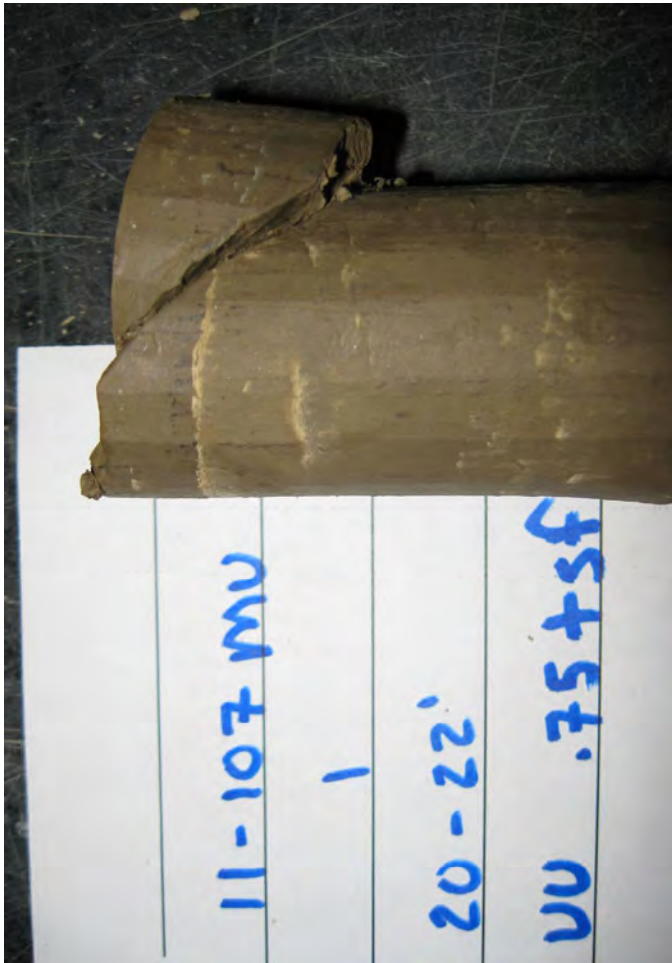
Back pressure = 0.000 tsf

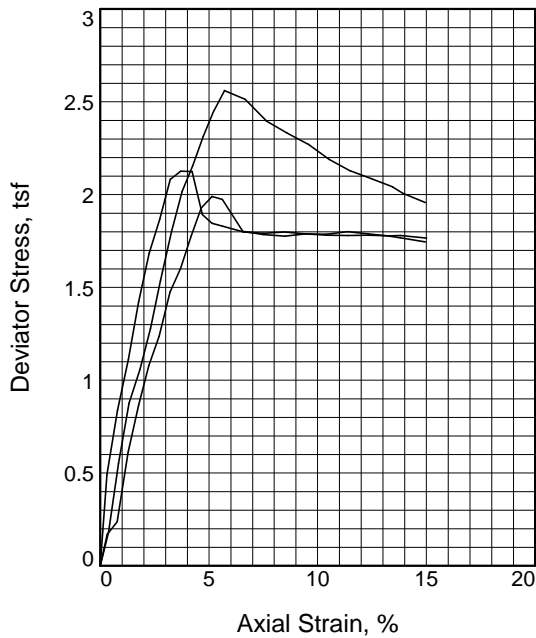
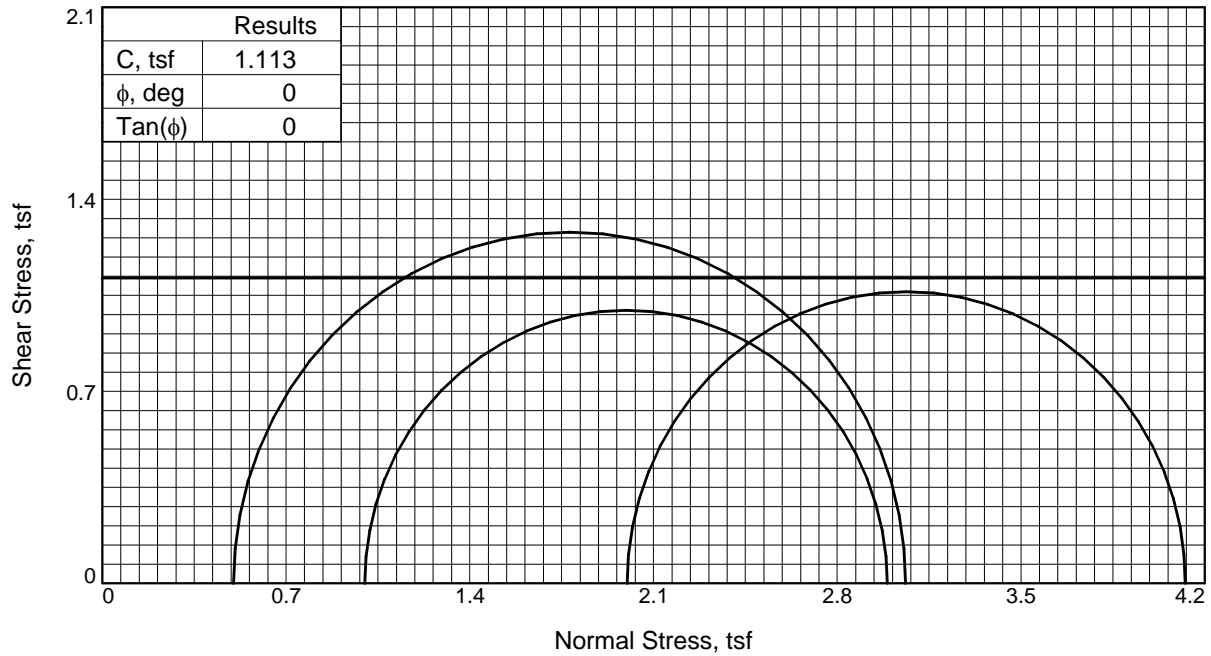
Strain rate, %/min. = 1.00

Peak Stress = 2.308 tsf at reading no. 5

Ult. Stress = 2.075 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	6.400	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0161	19.070	12.7	0.3	0.591	3.000	3.591	1.20	3.295	0.295
2	0.0289	36.550	30.2	0.8	1.399	3.000	4.399	1.47	3.699	0.699
3	0.0430	46.540	40.1	1.3	1.853	3.000	4.853	1.62	3.927	0.927
4	0.0557	53.400	47.0	1.8	2.160	3.000	5.160	1.72	4.080	1.080
5	0.0701	56.880	50.5	2.3	2.308	3.000	5.308	1.77	4.154	1.154
6	0.0844	56.820	50.4	2.8	2.293	3.000	5.293	1.76	4.146	1.146
7	0.0993	56.830	50.4	3.3	2.281	3.000	5.281	1.76	4.140	1.140
8	0.1135	56.750	50.4	3.8	2.265	3.000	5.265	1.76	4.133	1.133
9	0.1268	56.690	50.3	4.3	2.251	3.000	5.251	1.75	4.126	1.126
10	0.1406	56.420	50.0	4.8	2.228	3.000	5.228	1.74	4.114	1.114
11	0.1539	56.590	50.2	5.3	2.224	3.000	5.224	1.74	4.112	1.112
12	0.1676	56.650	50.3	5.7	2.215	3.000	5.215	1.74	4.108	1.108
13	0.1950	56.440	50.0	6.7	2.183	3.000	5.183	1.73	4.092	1.092
14	0.2216	56.870	50.5	7.7	2.180	3.000	5.180	1.73	4.090	1.090
15	0.2492	56.940	50.5	8.7	2.159	3.000	5.159	1.72	4.080	1.080
16	0.2762	56.960	50.6	9.6	2.137	3.000	5.137	1.71	4.069	1.069
17	0.3032	56.870	50.5	10.6	2.111	3.000	5.111	1.70	4.055	1.055
18	0.3304	57.050	50.6	11.5	2.095	3.000	5.095	1.70	4.048	1.048
19	0.3576	57.250	50.9	12.5	2.081	3.000	5.081	1.69	4.040	1.040
20	0.3856	58.130	51.7	13.5	2.093	3.000	5.093	1.70	4.046	1.046
21	0.3988	58.230	51.8	14.0	2.085	3.000	5.085	1.70	4.043	1.043
22	0.4264	58.580	52.2	15.0	2.075	3.000	5.075	1.69	4.038	1.038





Sample No.	1	2	3	
Initial	Water Content, %	36.9	39.5	40.1
	Dry Density, pcf	84.5	81.9	80.7
	Saturation, %	97.9	98.9	97.6
	Void Ratio	1.0393	1.1037	1.1347
	Diameter, in.	1.40	1.40	1.39
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	36.9	39.5	40.1
	Dry Density, pcf	84.5	81.9	80.7
	Saturation, %	97.9	98.9	97.6
	Void Ratio	1.0393	1.1037	1.1347
	Diameter, in.	1.40	1.40	1.39
	Height, in.	2.80	2.81	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Peak Stress, tsf	2.56	1.99	2.13	
Ult. Stress, tsf	1.96	1.75	1.77	
σ_1 Failure, tsf	3.06	2.99	4.13	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 52

PL= 21

PI= 31

Specific Gravity= 2.760

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Brenna Formation

Sample Number: Boring11-107MU, #2

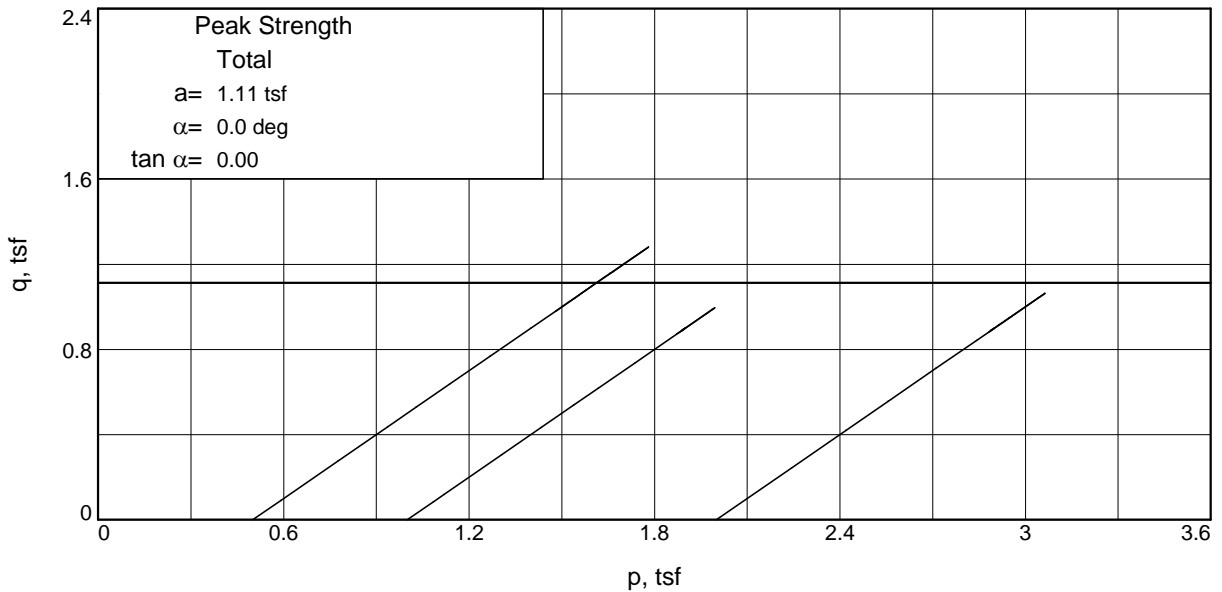
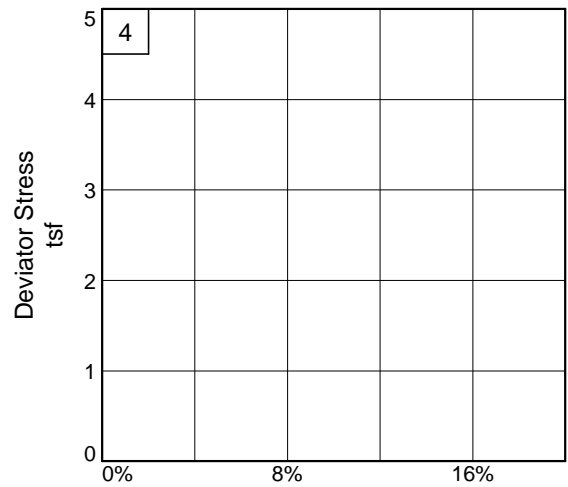
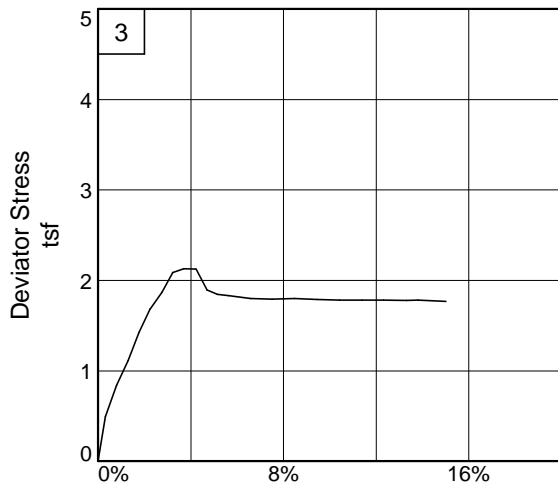
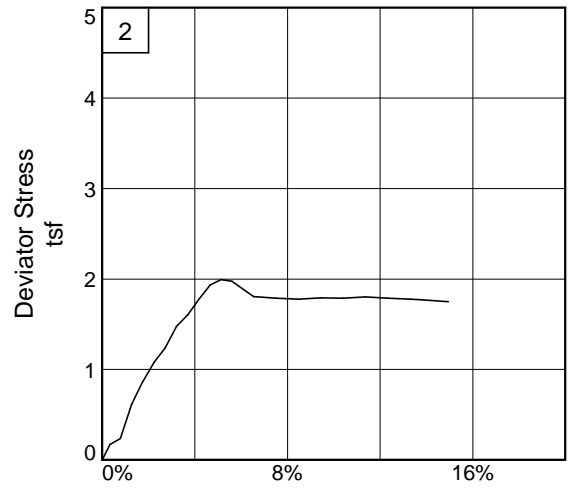
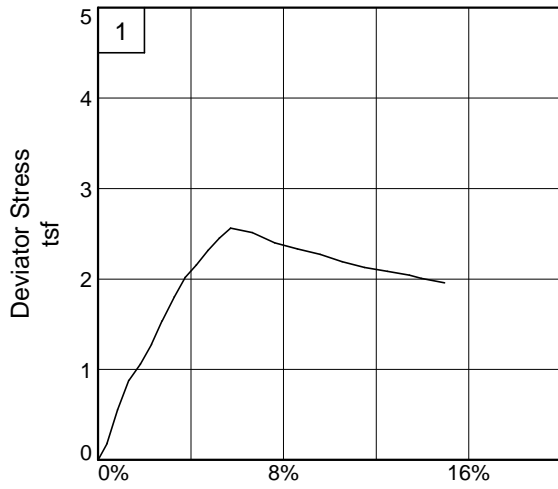
Depth: 30-32'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Brenna Formation

Project No.: BL-10-10065

Depth: 30-32'

Figure _____

Sample No.: Boring11-107MU, #2

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:14 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Brenna Formation
Depth: 30-32' **Sample Number:** Boring11-107MU, #2
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.760 **LL**=52 **PL**=21 **PI**=31
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	161.360	161.360
Moisture content: Dry soil+tare, gms.	126.140	126.140
Moisture content: Tare, gms.	30.570	30.570
Moisture, %	36.9	36.9
Moist specimen weight, gms.	131.2	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	115.6	
Dry density, pcf	84.5	
Void ratio	1.0393	
Saturation, %	97.9	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.561 tsf at reading no. 12
Ult. Stress = 1.958 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0063	0.780	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0170	4.690	3.9	0.4	0.182	0.500	0.682	1.36	0.591	0.091
2	0.0300	12.690	11.9	0.8	0.552	0.500	1.052	2.10	0.776	0.276
3	0.0436	19.800	19.0	1.3	0.877	0.500	1.377	2.75	0.938	0.438
4	0.0573	23.860	23.1	1.8	1.058	0.500	1.558	3.12	1.029	0.529
5	0.0710	28.800	28.0	2.3	1.278	0.500	1.778	3.56	1.139	0.639
6	0.0839	34.600	33.8	2.8	1.536	0.500	2.036	4.07	1.268	0.768
7	0.0983	40.680	39.9	3.3	1.802	0.500	2.302	4.60	1.401	0.901
8	0.1118	45.680	44.9	3.8	2.018	0.500	2.518	5.04	1.509	1.009
9	0.1254	48.980	48.2	4.2	2.156	0.500	2.656	5.31	1.578	1.078
10	0.1392	52.790	52.0	4.7	2.314	0.500	2.814	5.63	1.657	1.157
11	0.1530	56.180	55.4	5.2	2.452	0.500	2.952	5.90	1.726	1.226
12	0.1666	58.930	58.2	5.7	2.561	0.500	3.061	6.12	1.780	1.280
13	0.1930	58.440	57.7	6.7	2.514	0.500	3.014	6.03	1.757	1.257
14	0.2202	56.390	55.6	7.6	2.399	0.500	2.899	5.80	1.700	1.200
15	0.2476	55.390	54.6	8.6	2.331	0.500	2.831	5.66	1.666	1.166
16	0.2751	54.590	53.8	9.6	2.272	0.500	2.772	5.54	1.636	1.136
17	0.3019	53.220	52.4	10.5	2.191	0.500	2.691	5.38	1.596	1.096
18	0.3289	52.270	51.5	11.5	2.128	0.500	2.628	5.26	1.564	1.064
19	0.3566	51.780	51.0	12.5	2.084	0.500	2.584	5.17	1.542	1.042
20	0.3834	51.300	50.5	13.4	2.042	0.500	2.542	5.08	1.521	1.021
21	0.3976	50.690	49.9	14.0	2.006	0.500	2.506	5.01	1.503	1.003
22	0.4257	50.080	49.3	15.0	1.958	0.500	2.458	4.92	1.479	0.979

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	159.030	159.030
Moisture content: Dry soil+tare, gms.	122.660	122.660
Moisture content: Tare, gms.	30.680	30.680
Moisture, %	39.5	39.5
Moist specimen weight, gms.	128.9	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	114.3	
Dry density, pcf	81.9	
Void ratio	1.1037	
Saturation, %	98.9	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.990 tsf at reading no. 11
 Ult. Stress = 1.746 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0063	1.940	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0155	5.580	3.6	0.3	0.171	1.000	1.171	1.17	1.085	0.085
2	0.0283	7.040	5.1	0.8	0.238	1.000	1.238	1.24	1.119	0.119
3	0.0421	15.100	13.2	1.3	0.611	1.000	1.611	1.61	1.306	0.306
4	0.0558	20.680	18.7	1.8	0.866	1.000	1.866	1.87	1.433	0.433
5	0.0690	25.410	23.5	2.2	1.079	1.000	2.079	2.08	1.540	0.540
6	0.0822	28.960	27.0	2.7	1.237	1.000	2.237	2.24	1.618	0.618
7	0.0964	34.330	32.4	3.2	1.475	1.000	2.475	2.47	1.737	0.737
8	0.1100	37.320	35.4	3.7	1.603	1.000	2.603	2.60	1.801	0.801
9	0.1236	41.350	39.4	4.2	1.776	1.000	2.776	2.78	1.888	0.888
10	0.1370	44.980	43.0	4.7	1.930	1.000	2.930	2.93	1.965	0.965
11	0.1503	46.540	44.6	5.1	1.990	1.000	2.990	2.99	1.995	0.995
12	0.1638	46.410	44.5	5.6	1.974	1.000	2.974	2.97	1.987	0.987
13	0.1901	42.960	41.0	6.6	1.803	1.000	2.803	2.80	1.902	0.902
14	0.2170	42.990	41.1	7.5	1.786	1.000	2.786	2.79	1.893	0.893
15	0.2445	43.210	41.3	8.5	1.777	1.000	2.777	2.78	1.888	0.888
16	0.2711	43.940	42.0	9.4	1.789	1.000	2.789	2.79	1.895	0.895
17	0.2984	44.360	42.4	10.4	1.788	1.000	2.788	2.79	1.894	0.894
18	0.3255	45.120	43.2	11.4	1.800	1.000	2.800	2.80	1.900	0.900
19	0.3526	45.310	43.4	12.3	1.788	1.000	2.788	2.79	1.894	0.894
20	0.3796	45.500	43.6	13.3	1.776	1.000	2.776	2.78	1.888	0.888
21	0.3933	45.550	43.6	13.8	1.769	1.000	2.769	2.77	1.884	0.884
22	0.4258	45.590	43.7	15.0	1.746	1.000	2.746	2.75	1.873	0.873

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	155.840	155.840
Moisture content: Dry soil+tare, gms.	119.890	119.890
Moisture content: Tare, gms.	30.290	30.290
Moisture, %	40.1	40.1
Moist specimen weight, gms.	126.3	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	113.1	
Dry density, pcf	80.7	
Void ratio	1.1347	
Saturation, %	97.6	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

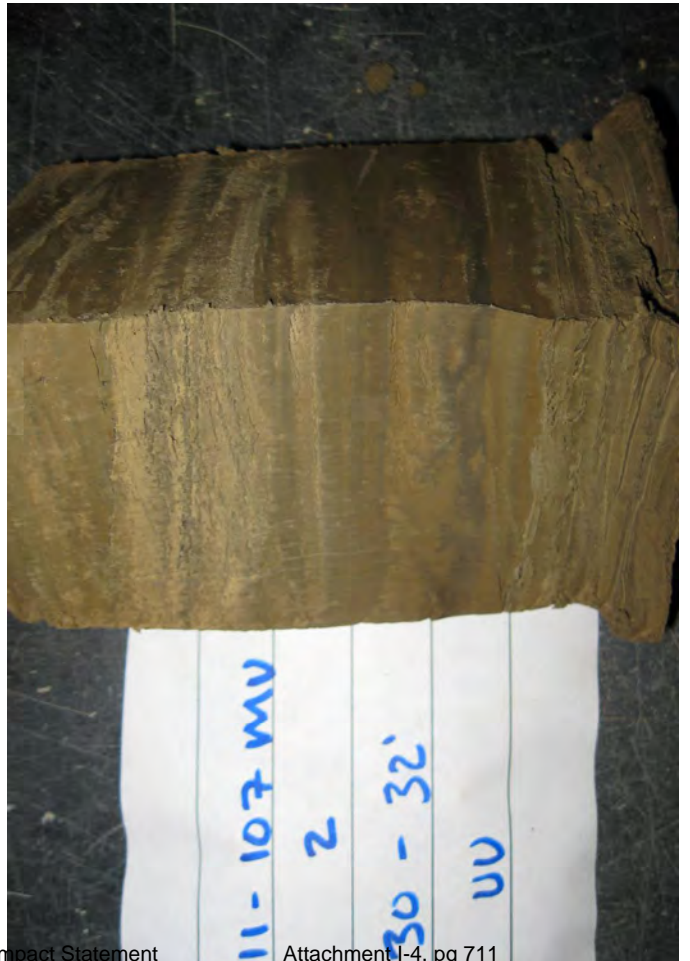
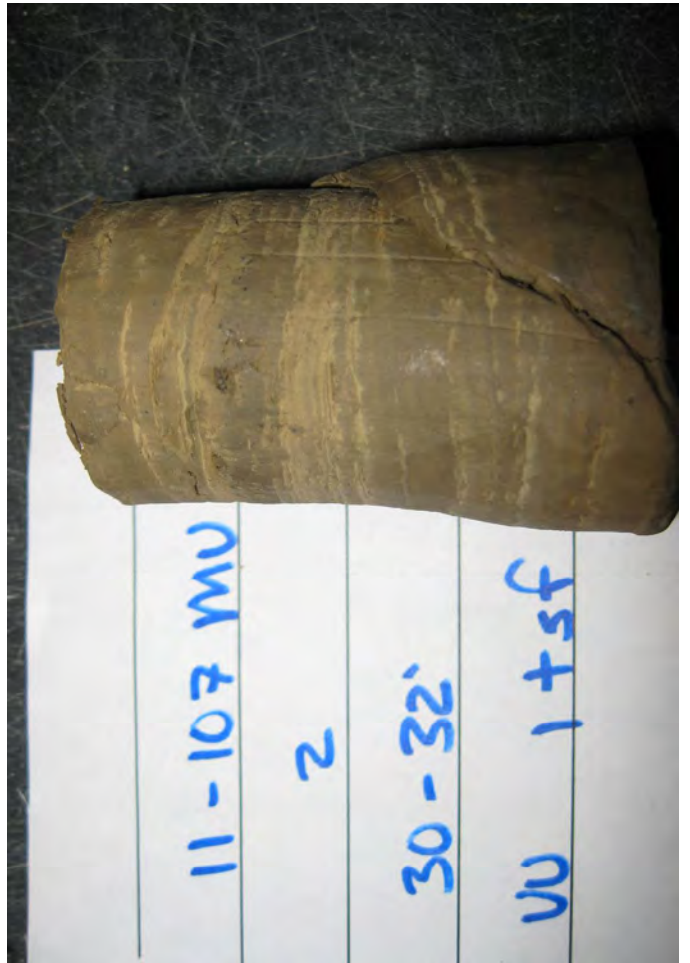
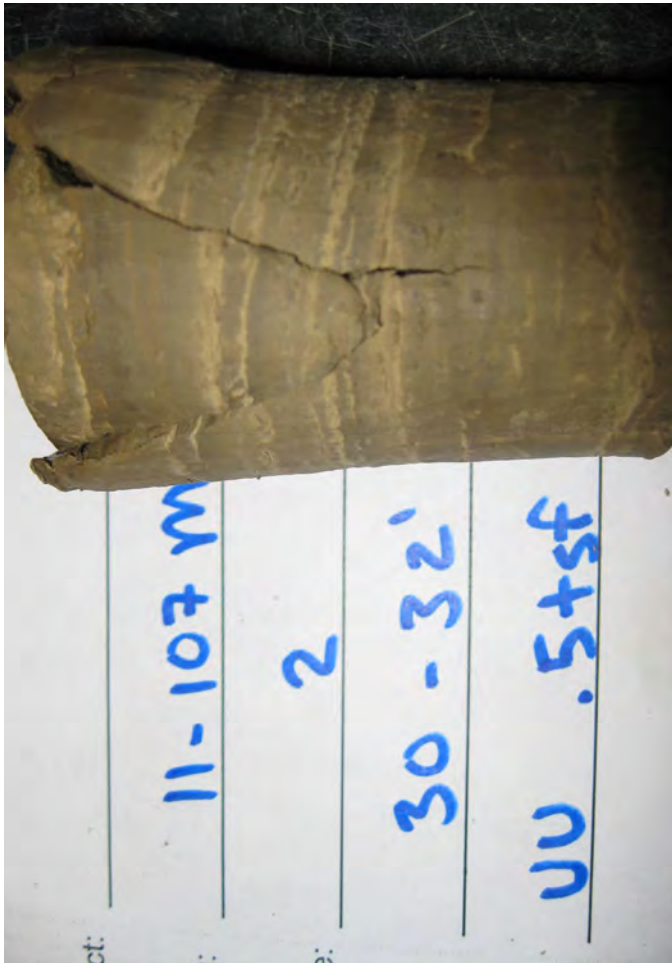
Back pressure = 0.000 tsf

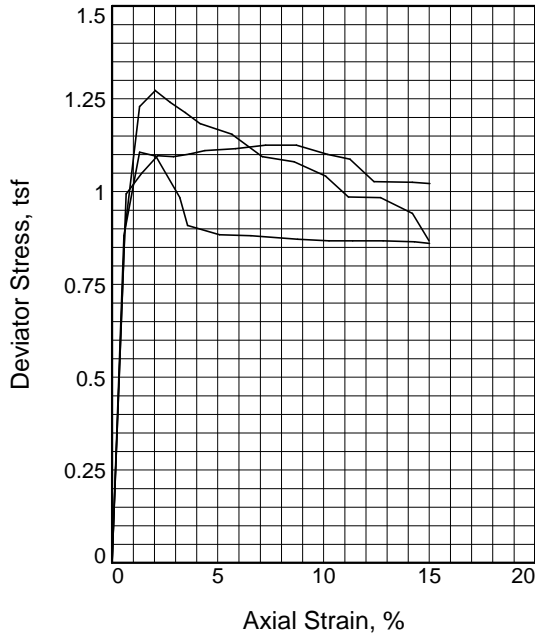
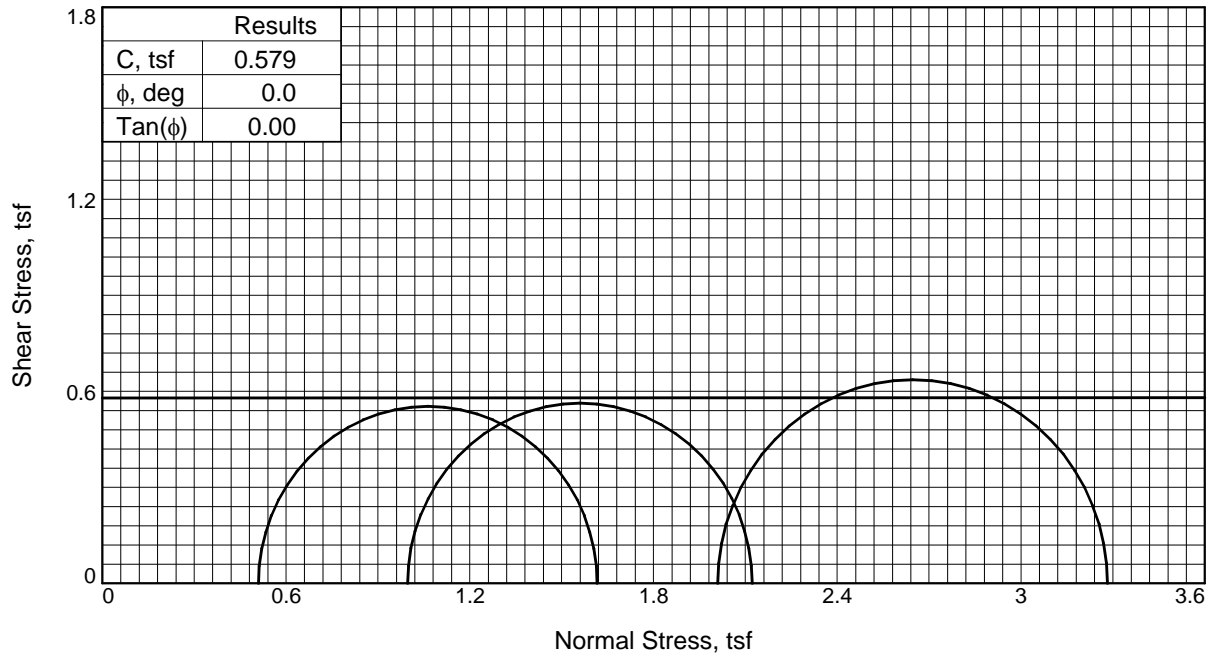
Strain rate, %/min. = 1.00

Peak Stress = 2.127 tsf at reading no. 8

Ult. Stress = 1.766 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	3.870	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0152	14.270	10.4	0.3	0.492	2.000	2.492	1.25	2.246	0.246
2	0.0288	21.690	17.8	0.8	0.839	2.000	2.839	1.42	2.419	0.419
3	0.0427	27.640	23.8	1.3	1.113	2.000	3.113	1.56	2.557	0.557
4	0.0560	34.420	30.6	1.8	1.424	2.000	3.424	1.71	2.712	0.712
5	0.0695	40.190	36.3	2.3	1.684	2.000	3.684	1.84	2.842	0.842
6	0.0833	44.340	40.5	2.7	1.868	2.000	3.868	1.93	2.934	0.934
7	0.0967	49.250	45.4	3.2	2.084	2.000	4.084	2.04	3.042	1.042
8	0.1101	50.410	46.5	3.7	2.127	2.000	4.127	2.06	3.063	1.063
9	0.1247	50.630	46.8	4.2	2.125	2.000	4.125	2.06	3.063	1.063
10	0.1381	45.740	41.9	4.7	1.893	2.000	3.893	1.95	2.947	0.947
11	0.1510	44.900	41.0	5.2	1.846	2.000	3.846	1.92	2.923	0.923
12	0.1645	44.740	40.9	5.6	1.830	2.000	3.830	1.91	2.915	0.915
13	0.1911	44.480	40.6	6.6	1.800	2.000	3.800	1.90	2.900	0.900
14	0.2171	44.730	40.9	7.5	1.793	2.000	3.793	1.90	2.896	0.896
15	0.2442	45.300	41.4	8.5	1.799	2.000	3.799	1.90	2.899	0.899
16	0.2715	45.490	41.6	9.5	1.788	2.000	3.788	1.89	2.894	0.894
17	0.2988	45.800	41.9	10.4	1.782	2.000	3.782	1.89	2.891	0.891
18	0.3258	46.230	42.4	11.4	1.781	2.000	3.781	1.89	2.890	0.890
19	0.3520	46.720	42.9	12.3	1.782	2.000	3.782	1.89	2.891	0.891
20	0.3798	47.120	43.3	13.3	1.779	2.000	3.779	1.89	2.889	0.889
21	0.3936	47.420	43.6	13.8	1.781	2.000	3.781	1.89	2.890	0.890
22	0.4273	47.660	43.8	15.0	1.766	2.000	3.766	1.88	2.883	0.883





Sample No.	1	2	3	
Initial	Water Content, %	53.3	51.6	53.2
	Dry Density, pcf	68.5	69.6	68.5
	Saturation, %	98.1	97.5	97.9
	Void Ratio	1.4759	1.4381	1.4774
	Diameter, in.	1.41	1.41	1.41
	Height, in.	2.80	2.82	2.81
At Test	Water Content, %	54.3	52.9	54.4
	Dry Density, pcf	68.5	69.6	68.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.4759	1.4381	1.4774
	Diameter, in.	1.41	1.41	1.41
	Height, in.	2.80	2.82	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.51	1.00	2.01	
Peak Stress, tsf	1.11	1.13	1.27	
Ult. Stress, tsf	0.86	1.02	0.87	
σ_1 Failure, tsf	1.62	2.12	3.28	
σ_3 Failure, tsf	0.51	1.00	2.01	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 95

PL= 28

PI= 67

Specific Gravity= 2.718

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Sheyenne River, Brenna Formation

Sample Number: Boring11-110MU, #2

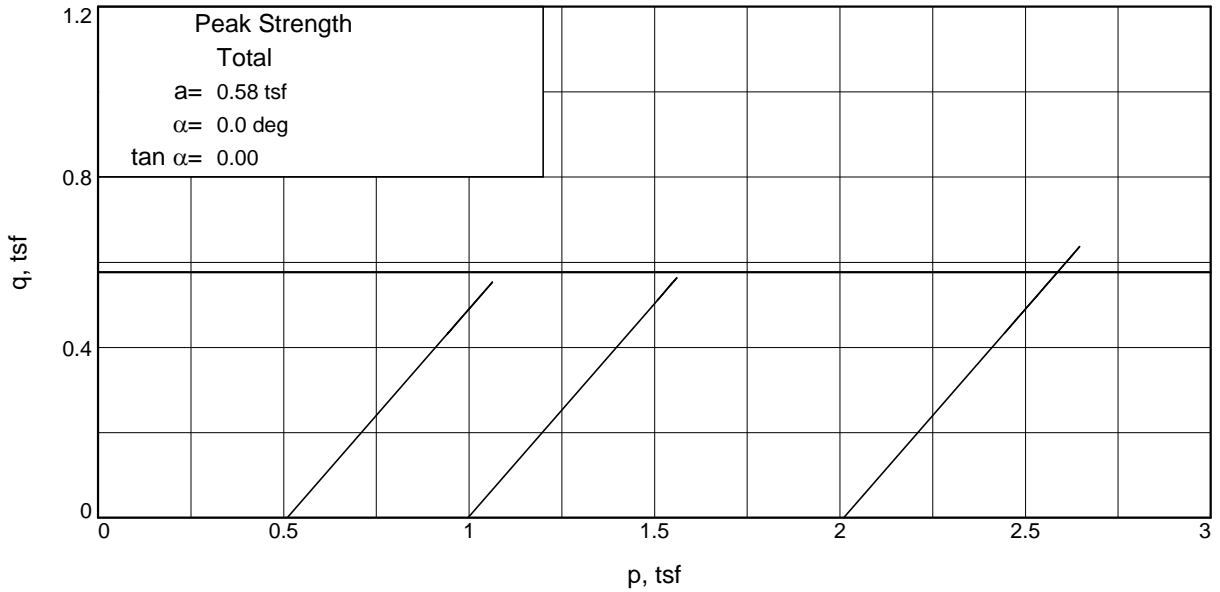
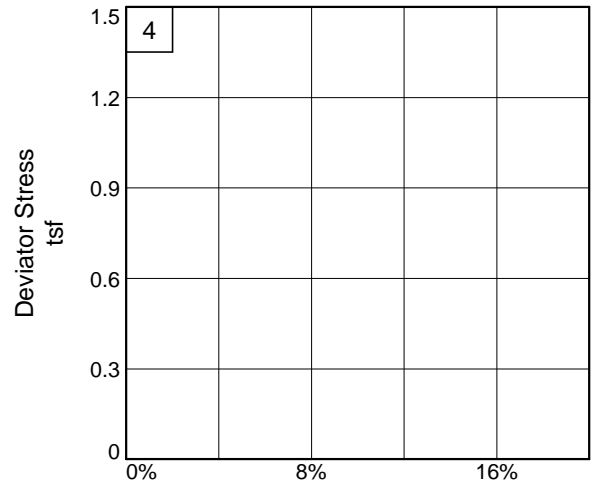
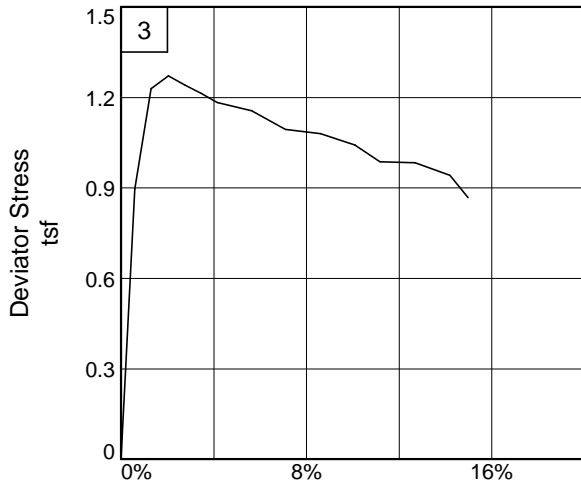
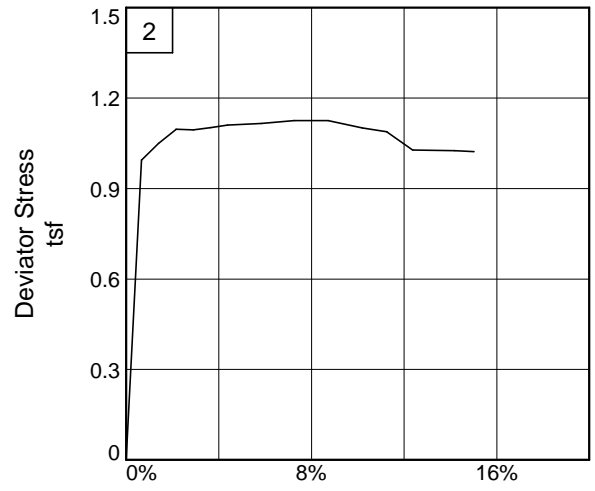
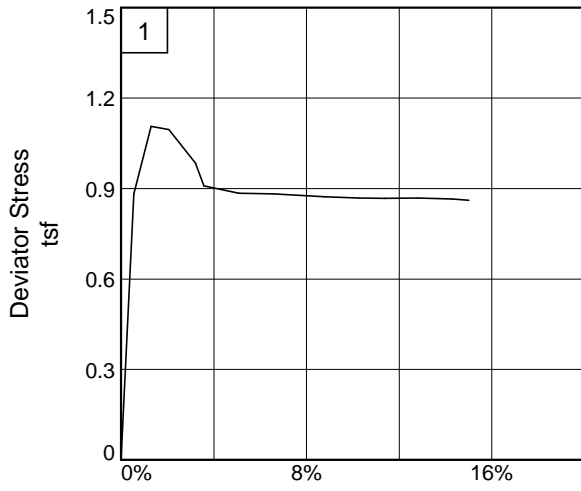
Depth: 35-37'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Brenna Formation

Depth: 35-37'

Sample No.: Boring11-110MU, #2

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:12 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Brenna Formation
Depth: 35-37' **Sample Number:** Boring11-110MU, #2
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.718 **LL**=95 **PL**=28 **PI**=67
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	152.140		152.140
Moisture content: Dry soil+tare, gms.	110.130		110.130
Moisture content: Tare, gms.	31.260		31.260
Moisture, %	53.3	54.3	53.3
Moist specimen weight, gms.	121.1		
Diameter, in.	1.41	1.41	
Area, in. ²	1.57	1.57	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	105.0	105.7	
Dry density, pcf	68.5	68.5	
Void ratio	1.4759	1.4759	
Saturation, %	98.1	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.510 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.106 tsf at reading no. 2
Ult. Stress = 0.860 tsf at reading no. 13

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0076	0.000	0.0	0.0	0.000	0.510	0.510	1.00	0.510	0.000
1	0.0232	19.340	19.3	0.6	0.882	0.510	1.392	2.73	0.951	0.441
2	0.0440	24.440	24.4	1.3	1.106	0.510	1.616	3.17	1.063	0.553
3	0.0650	24.400	24.4	2.1	1.096	0.510	1.606	3.15	1.058	0.548
4	0.0975	22.150	22.2	3.2	0.983	0.510	1.493	2.93	1.001	0.491
5	0.1077	20.560	20.6	3.6	0.909	0.510	1.419	2.78	0.964	0.454
6	0.1498	20.320	20.3	5.1	0.884	0.510	1.394	2.73	0.952	0.442
7	0.1915	20.580	20.6	6.6	0.882	0.510	1.392	2.73	0.951	0.441
8	0.2532	20.850	20.9	8.8	0.872	0.510	1.382	2.71	0.946	0.436
9	0.2946	21.090	21.1	10.3	0.868	0.510	1.378	2.70	0.944	0.434
10	0.3259	21.350	21.4	11.4	0.868	0.510	1.378	2.70	0.944	0.434
11	0.3663	21.710	21.7	12.8	0.868	0.510	1.378	2.70	0.944	0.434
12	0.4074	22.020	22.0	14.3	0.865	0.510	1.375	2.70	0.943	0.433
13	0.4276	22.080	22.1	15.0	0.860	0.510	1.370	2.69	0.940	0.430

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	151.720		151.720
Moisture content: Dry soil+tare, gms.	110.630		110.630
Moisture content: Tare, gms.	30.950		30.950
Moisture, %	51.6	52.9	51.6
Moist specimen weight, gms.	121.1		
Diameter, in.	1.41	1.41	
Area, in. ²	1.55	1.55	
Height, in.	2.82	2.82	
Net decrease in height, in.		0.00	
Wet Density, pcf	105.5	106.4	
Dry density, pcf	69.6	69.6	
Void ratio	1.4381	1.4381	
Saturation, %	97.5	100.0	

Test Readings for Specimen No. 2

Cell pressure = 0.997 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.125 tsf at reading no. 9
 Ult. Stress = 1.022 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	1.060	0.0	0.0	0.000	0.997	0.997	1.00	0.997	0.000
1	0.0255	22.640	21.6	0.7	0.994	0.997	1.991	2.00	1.494	0.497
2	0.0461	24.010	23.0	1.4	1.049	0.997	2.046	2.05	1.522	0.525
3	0.0673	25.230	24.2	2.2	1.097	0.997	2.094	2.10	1.545	0.548
4	0.0885	25.370	24.3	2.9	1.095	0.997	2.092	2.10	1.544	0.547
5	0.1095	25.710	24.7	3.6	1.101	0.997	2.098	2.10	1.548	0.551
6	0.1302	26.110	25.1	4.4	1.111	0.997	2.108	2.11	1.552	0.555
7	0.1712	26.610	25.6	5.8	1.116	0.997	2.113	2.12	1.555	0.558
8	0.2111	27.220	26.2	7.3	1.125	0.997	2.122	2.13	1.560	0.563

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
9	0.2522	27.640	26.6	8.7	1.125	0.997	2.122	2.13	1.560	0.563
10	0.2939	27.480	26.4	10.2	1.100	0.997	2.097	2.10	1.547	0.550
11	0.3240	27.490	26.4	11.3	1.088	0.997	2.085	2.09	1.541	0.544
12	0.3556	26.340	25.3	12.4	1.027	0.997	2.024	2.03	1.511	0.514
13	0.4063	26.820	25.8	14.2	1.025	0.997	2.022	2.03	1.510	0.513
14	0.4300	27.000	25.9	15.0	1.022	0.997	2.019	2.03	1.508	0.511

Parameters for Specimen No. 3

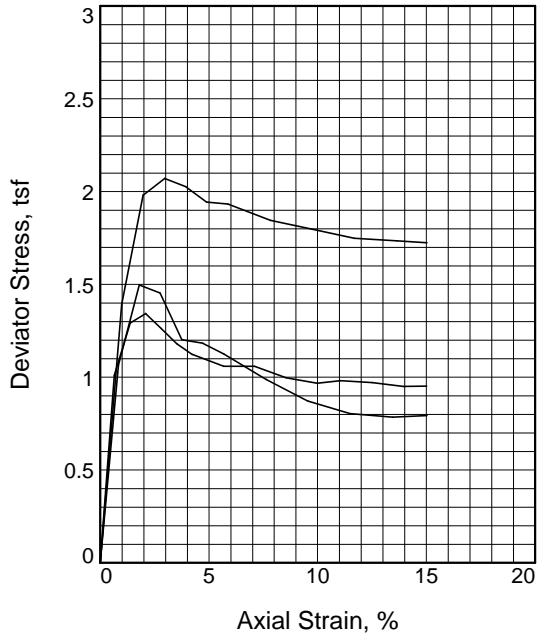
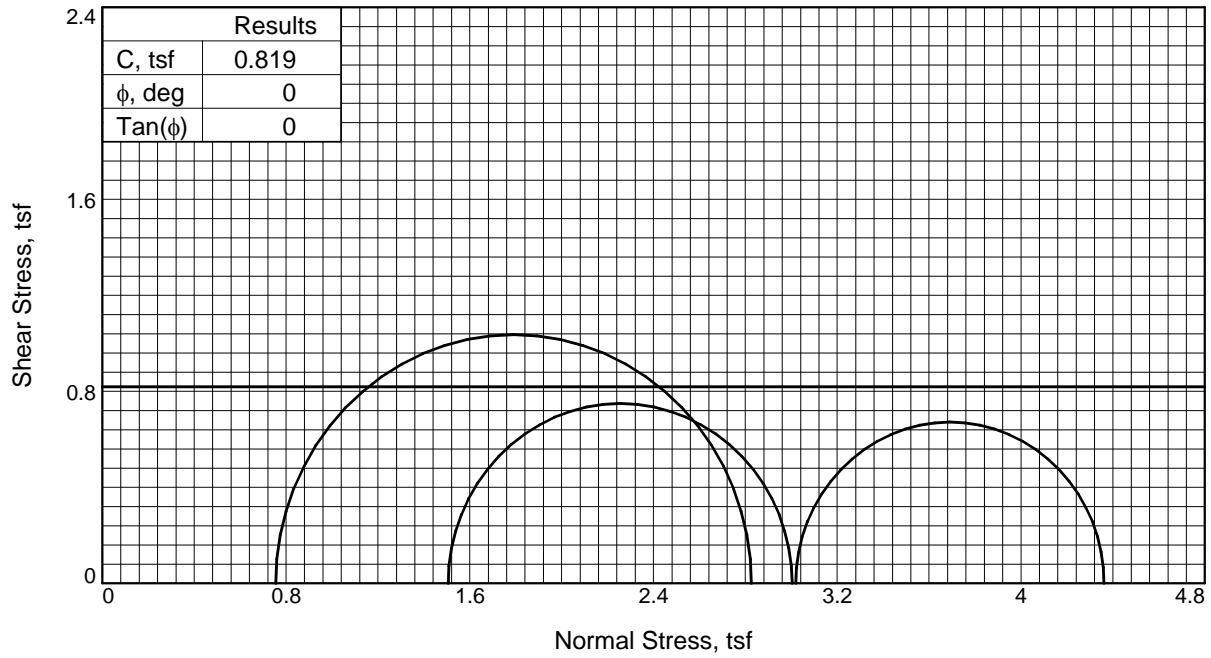
Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	149.930		149.930
Moisture content: Dry soil+tare, gms.	108.380		108.380
Moisture content: Tare, gms.	30.320		30.320
Moisture, %	53.2	54.4	53.2
Moist specimen weight, gms.	120.0		
Diameter, in.	1.41	1.41	
Area, in. ²	1.55	1.55	
Height, in.	2.81	2.81	
Net decrease in height, in.		0.00	
Wet Density, pcf	104.9	105.7	
Dry density, pcf	68.5	68.5	
Void ratio	1.4774	1.4774	
Saturation, %	97.9	100.0	

Test Readings for Specimen No. 3

Cell pressure = 2.010 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.272 tsf at reading no. 3
 Ult. Stress = 0.868 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	4.170	0.0	0.0	0.000	2.010	2.010	1.00	2.010	0.000
1	0.0232	23.610	19.4	0.6	0.896	2.010	2.906	1.45	2.458	0.448
2	0.0430	31.030	26.9	1.3	1.229	2.010	3.239	1.61	2.625	0.615
3	0.0637	32.180	28.0	2.0	1.272	2.010	3.282	1.63	2.646	0.636
4	0.0839	31.690	27.5	2.8	1.241	2.010	3.251	1.62	2.630	0.620
5	0.1036	31.270	27.1	3.5	1.213	2.010	3.223	1.60	2.617	0.607
6	0.1236	30.790	26.6	4.2	1.183	2.010	3.193	1.59	2.601	0.591
7	0.1655	30.570	26.4	5.7	1.155	2.010	3.165	1.57	2.587	0.577
8	0.2060	29.570	25.4	7.1	1.094	2.010	3.104	1.54	2.557	0.547
9	0.2480	29.660	25.5	8.6	1.080	2.010	3.090	1.54	2.550	0.540
10	0.2903	29.170	25.0	10.1	1.042	2.010	3.052	1.52	2.531	0.521
11	0.3204	28.110	23.9	11.2	0.986	2.010	2.996	1.49	2.503	0.493
12	0.3629	28.470	24.3	12.7	0.984	2.010	2.994	1.49	2.502	0.492
13	0.4047	27.830	23.7	14.2	0.941	2.010	2.951	1.47	2.481	0.471
14	0.4268	26.180	22.0	15.0	0.868	2.010	2.878	1.43	2.444	0.434





Sample No.	1	2	3	
Initial	Water Content, %	40.8	55.1	59.2
	Dry Density, pcf	80.3	67.4	64.6
	Saturation, %	100.0	98.9	99.1
	Void Ratio	1.1059	1.5087	1.6180
	Diameter, in.	1.40	1.41	1.41
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	40.8	55.1	59.2
	Dry Density, pcf	80.3	67.4	64.6
	Saturation, %	100.0	98.9	99.1
	Void Ratio	1.1059	1.5087	1.6180
	Diameter, in.	1.40	1.41	1.41
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.76	1.51	3.02	
Peak Stress, tsf	2.07	1.50	1.34	
Ult. Stress, tsf	1.72	0.78	0.95	
σ_1 Failure, tsf	2.83	3.00	4.36	
σ_3 Failure, tsf	0.76	1.51	3.02	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 86 **PL=** 22 **PI=** 64

Specific Gravity= 2.71

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

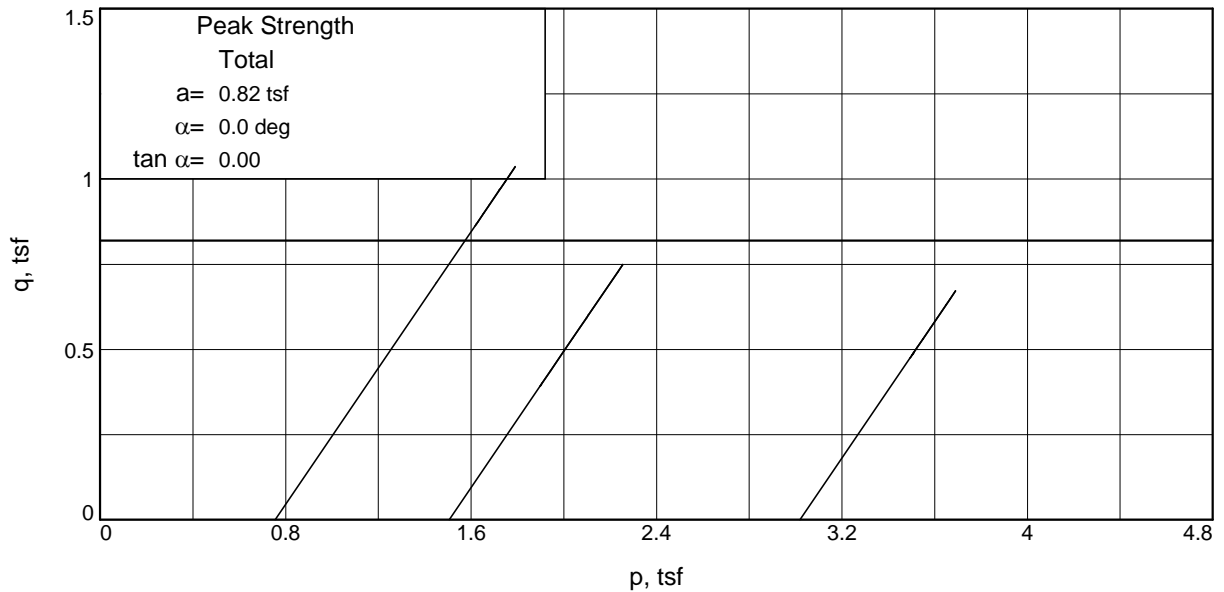
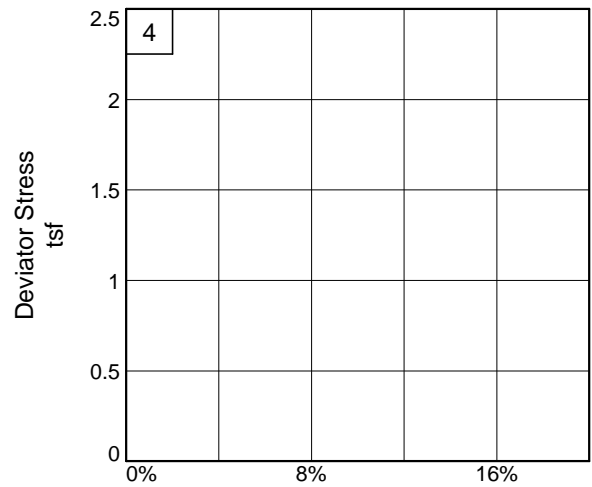
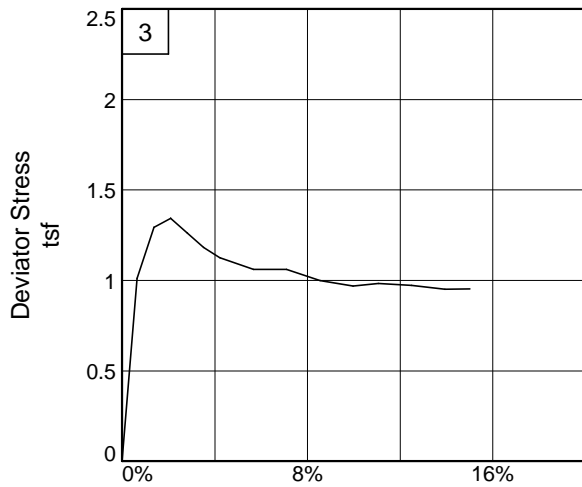
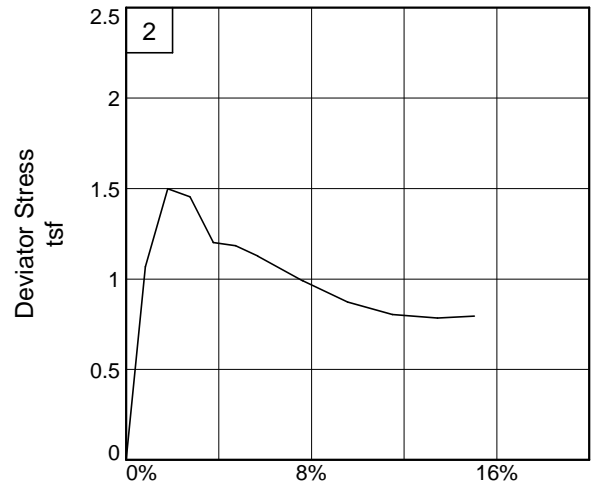
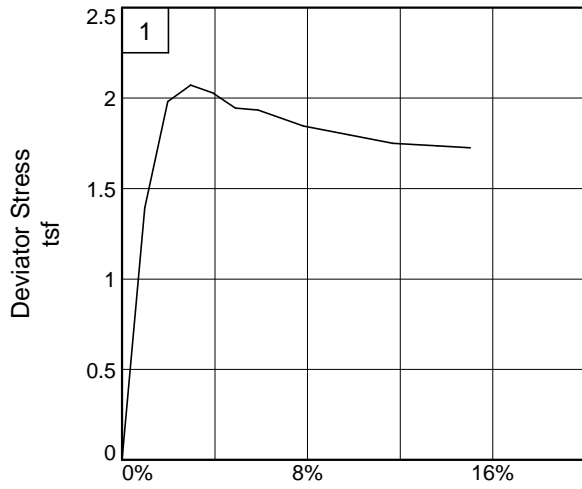
Location: Sheyenne River, Brenna Formation

Sample Number: Boring11-110MU, #3 **Depth:** 48-50'

Proj. No.: BL-10-10065 **Date Sampled:**



Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Brenna Formation

Depth: 48-50'

Sample No.: Boring11-110MU, #3

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:13 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Brenna Formation
Depth: 48-50' **Sample Number:** Boring11-110MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.71 **LL=**86 **PL=**22 **PI=**64
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	156.960	156.960
Moisture content: Dry soil+tare, gms.	120.220	120.220
Moisture content: Tare, gms.	30.230	30.230
Moisture, %	40.8	40.8
Moist specimen weight, gms.	127.5	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	113.1	
Dry density, pcf	80.3	
Void ratio	1.1059	
Saturation, %	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.755 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.072 tsf at reading no. 3
Ult. Stress = 1.725 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0085	0.630	0.0	0.0	0.000	0.755	0.755	1.00	0.755	0.000
1	0.0360	30.600	30.0	1.0	1.392	0.755	2.147	2.84	1.451	0.696
2	0.0637	43.730	43.1	2.0	1.982	0.755	2.737	3.62	1.746	0.991
3	0.0911	46.140	45.5	3.0	2.072	0.755	2.827	3.74	1.791	1.036
4	0.1187	45.620	45.0	3.9	2.027	0.755	2.782	3.68	1.769	1.014
5	0.1457	44.220	43.6	4.9	1.944	0.755	2.699	3.58	1.727	0.972
6	0.1726	44.430	43.8	5.9	1.934	0.755	2.689	3.56	1.722	0.967
7	0.2275	43.300	42.7	7.8	1.845	0.755	2.600	3.44	1.677	0.922
8	0.2818	43.090	42.5	9.8	1.797	0.755	2.552	3.38	1.654	0.899
9	0.3356	42.870	42.2	11.7	1.750	0.755	2.505	3.32	1.630	0.875
10	0.3900	43.480	42.8	13.6	1.736	0.755	2.491	3.30	1.623	0.868
11	0.4290	43.910	43.3	15.0	1.725	0.755	2.480	3.28	1.617	0.862

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	149.130	149.130
Moisture content: Dry soil+tare, gms.	107.190	107.190
Moisture content: Tare, gms.	31.030	31.030
Moisture, %	55.1	55.1
Moist specimen weight, gms.	119.3	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	104.6	
Dry density, pcf	67.4	
Void ratio	1.5087	
Saturation, %	98.9	

Test Readings for Specimen No. 2

Cell pressure = 1.506 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.498 tsf at reading no. 2
 Ult. Stress = 0.785 tsf at reading no. 10

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	2.860	0.0	0.0	0.000	1.506	1.506	1.00	1.506	0.000
1	0.0301	26.030	23.2	0.8	1.067	1.506	2.573	1.71	2.039	0.533
2	0.0570	35.700	32.8	1.8	1.498	1.506	3.004	1.99	2.255	0.749
3	0.0839	35.060	32.2	2.8	1.454	1.506	2.960	1.97	2.233	0.727
4	0.1120	29.750	26.9	3.8	1.202	1.506	2.708	1.80	2.107	0.601
5	0.1390	29.600	26.7	4.7	1.183	1.506	2.689	1.79	2.098	0.592
6	0.1659	28.590	25.7	5.7	1.127	1.506	2.633	1.75	2.069	0.563
7	0.2207	25.930	23.1	7.6	0.990	1.506	2.496	1.66	2.001	0.495
8	0.2746	23.610	20.8	9.6	0.871	1.506	2.377	1.58	1.942	0.436
9	0.3290	22.420	19.6	11.5	0.804	1.506	2.310	1.53	1.908	0.402
10	0.3836	22.380	19.5	13.5	0.785	1.506	2.291	1.52	1.898	0.392
11	0.4280	23.000	20.1	15.0	0.795	1.506	2.301	1.53	1.903	0.397

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	147.910	147.910
Moisture content: Dry soil+tare, gms.	104.490	104.490
Moisture content: Tare, gms.	31.130	31.130
Moisture, %	59.2	59.2
Moist specimen weight, gms.	117.4	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.80	
Wet Density, pcf	102.9	
Dry density, pcf	64.6	
Void ratio	1.6180	
Saturation, %	99.1	

Test Readings for Specimen No. 3

Cell pressure = 3.019 tsf

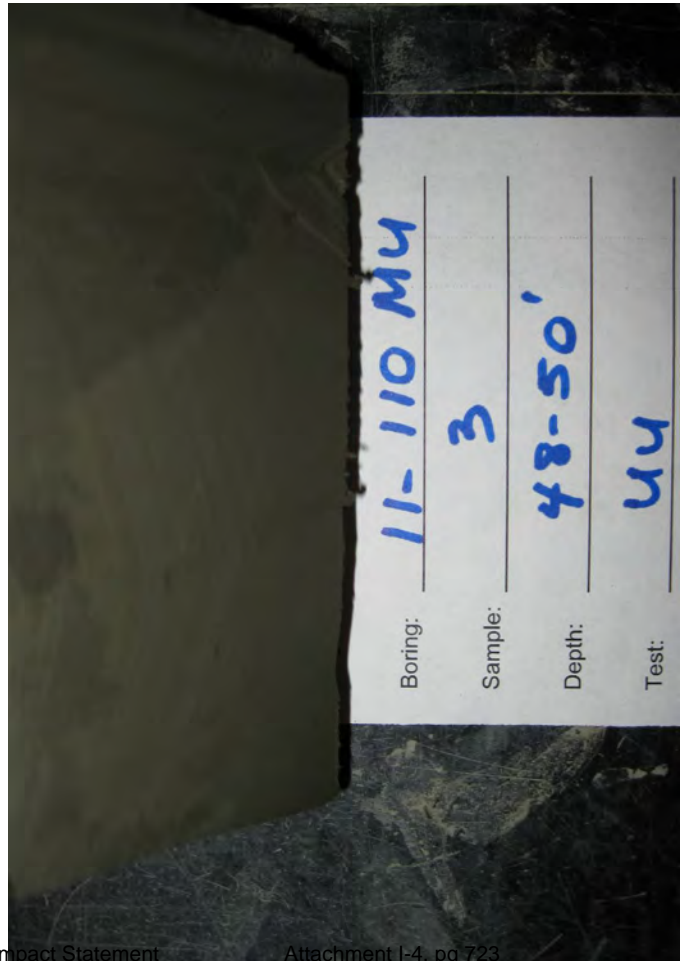
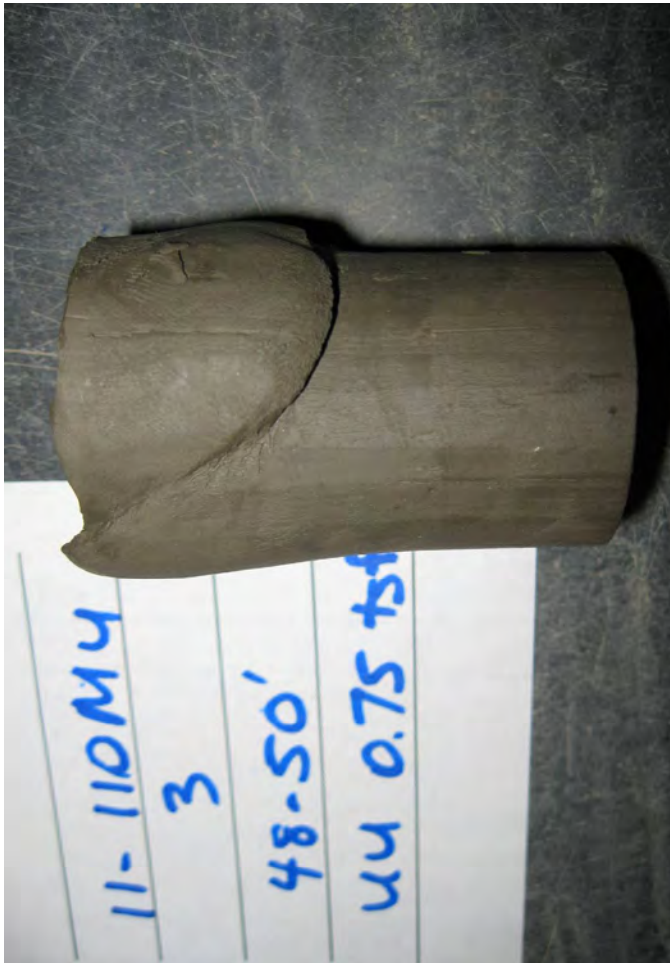
Back pressure = 0.000 tsf

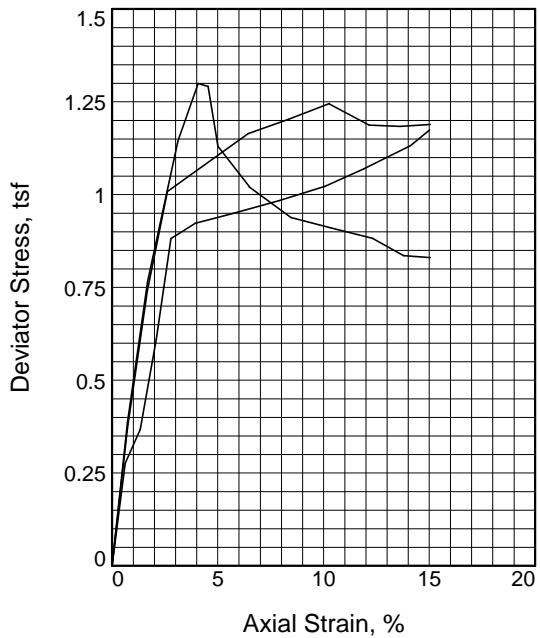
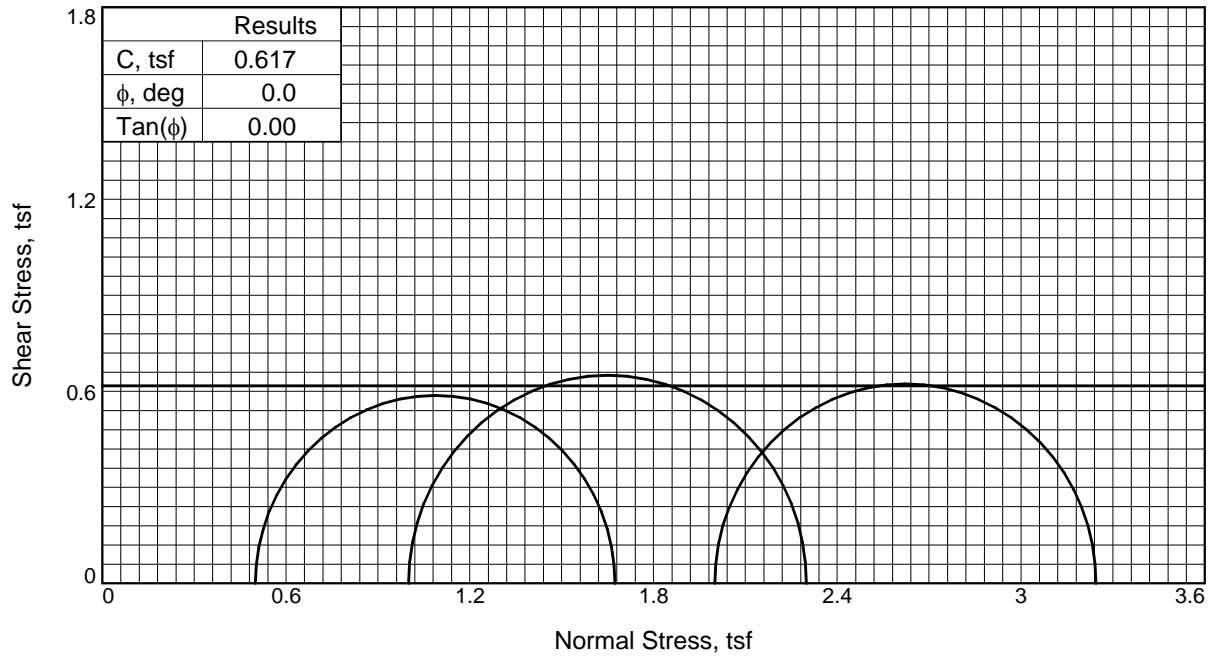
Strain rate, %/min. = 1.00

Peak Stress = 1.343 tsf at reading no. 3

Ult. Stress = 0.952 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0063	6.460	0.0	0.0	0.000	3.019	3.019	1.00	3.019	0.000
1	0.0244	28.410	22.0	0.6	1.011	3.019	4.030	1.33	3.525	0.506
2	0.0450	34.750	28.3	1.4	1.294	3.019	4.313	1.43	3.666	0.647
3	0.0650	36.040	29.6	2.1	1.343	3.019	4.362	1.44	3.690	0.671
4	0.0851	34.480	28.0	2.8	1.263	3.019	4.282	1.42	3.650	0.631
5	0.1049	32.890	26.4	3.5	1.183	3.019	4.202	1.39	3.610	0.591
6	0.1252	31.760	25.3	4.2	1.123	3.019	4.142	1.37	3.581	0.562
7	0.1655	30.690	24.2	5.7	1.060	3.019	4.079	1.35	3.549	0.530
8	0.2052	31.060	24.6	7.1	1.060	3.019	4.079	1.35	3.549	0.530
9	0.2458	29.990	23.5	8.6	0.998	3.019	4.017	1.33	3.518	0.499
10	0.2857	29.660	23.2	10.0	0.969	3.019	3.988	1.32	3.503	0.484
11	0.3161	30.270	23.8	11.1	0.982	3.019	4.001	1.33	3.510	0.491
12	0.3567	30.420	24.0	12.5	0.972	3.019	3.991	1.32	3.505	0.486
13	0.3969	30.300	23.8	13.9	0.951	3.019	3.970	1.32	3.495	0.476
14	0.4270	30.610	24.2	15.0	0.952	3.019	3.971	1.32	3.495	0.476





Sample No.	1	2	3	
Initial	Water Content, %	48.5	51.6	49.6
	Dry Density, pcf	72.9	70.4	71.8
	Saturation, %	99.7	100.0	99.4
	Void Ratio	1.3118	1.3939	1.3487
	Diameter, in.	1.40	1.39	1.41
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	48.5	51.6	49.6
	Dry Density, pcf	72.9	70.4	71.8
	Saturation, %	99.7	100.0	99.4
	Void Ratio	1.3118	1.3939	1.3487
	Diameter, in.	1.40	1.39	1.41
	Height, in.	2.80	2.80	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Peak Stress, tsf	1.17	1.30	1.25	
Ult. Stress, tsf	1.17	0.83	1.19	
σ_1 Failure, tsf	1.67	2.30	3.25	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 72

PL= 19

PI= 53

Specific Gravity= 2.70

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Wild Rice, Brenna Formation

Sample Number: Boring11-118MU, #2

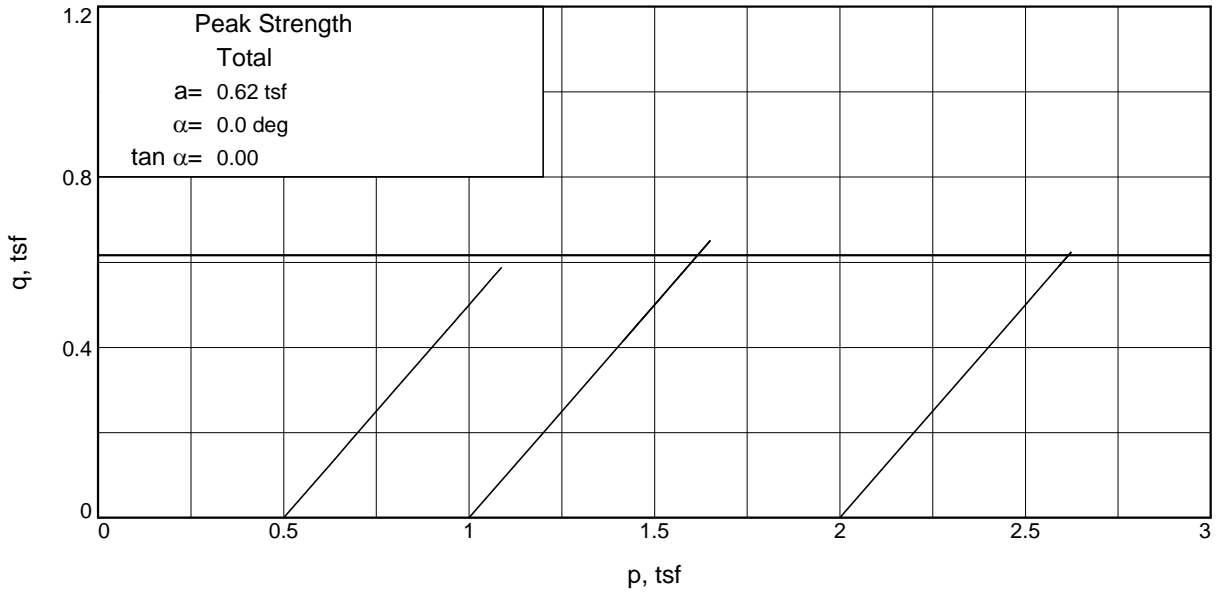
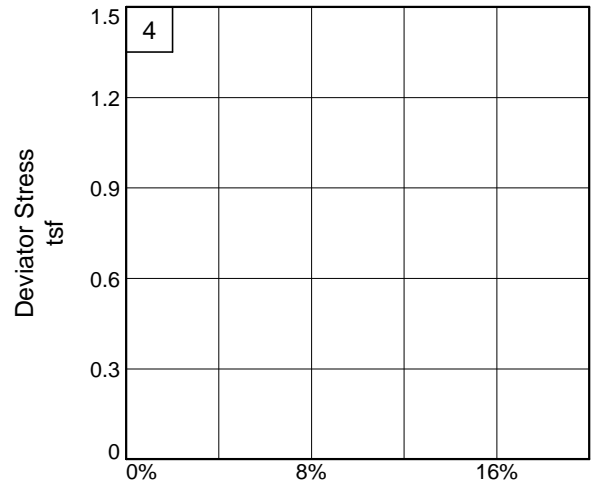
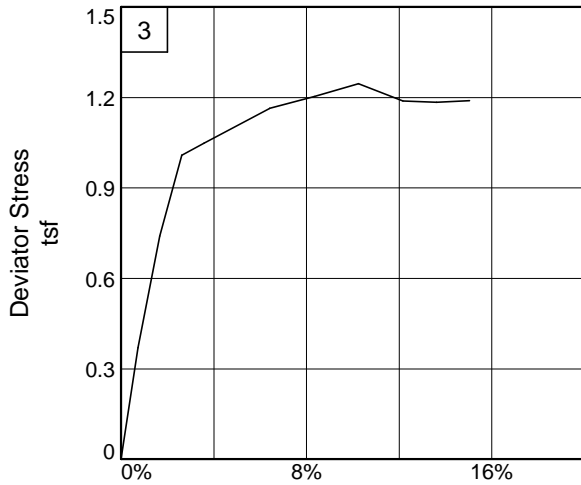
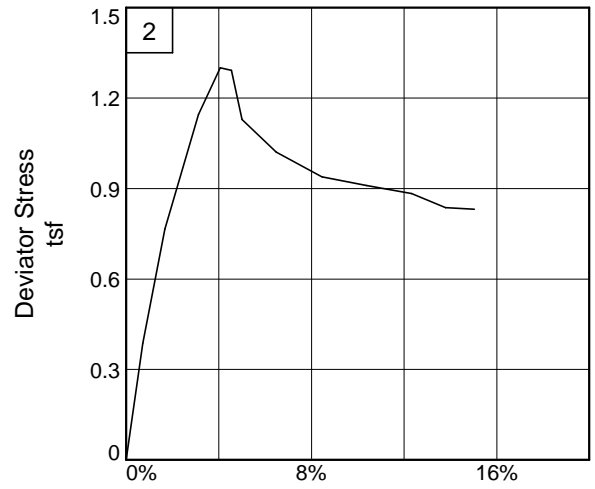
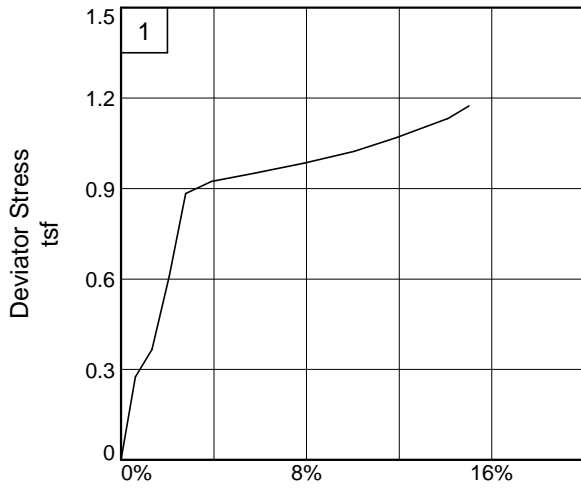
Depth: 33-35'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Traix ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Brenna Formation

Project No.: BL-10-10065

Depth: 33-35'

Figure _____

Sample Number: Boring11-118MU, #2

Braun Intertec

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

5/15/2011

11:39 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Brenna Formation
Depth: 33-35' **Sample Number:** Boring11-118MU, #2
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.70 **LL**=72 **PL**=19 **PI**=53
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.890	152.890
Moisture content: Dry soil+tare, gms.	113.010	113.010
Moisture content: Tare, gms.	30.710	30.710
Moisture, %	48.5	48.5
Moist specimen weight, gms.	122.5	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	108.2	
Dry density, pcf	72.9	
Void ratio	1.3118	
Saturation, %	99.7	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.174 tsf at reading no. 11
Ult. Stress = 1.174 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	0.630	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0239	6.580	6.0	0.6	0.276	0.500	0.776	1.55	0.638	0.138
2	0.0438	8.600	8.0	1.3	0.367	0.500	0.867	1.73	0.684	0.184
3	0.0650	13.970	13.3	2.1	0.610	0.500	1.110	2.22	0.805	0.305
4	0.0845	20.070	19.4	2.8	0.883	0.500	1.383	2.77	0.941	0.441
5	0.1160	21.200	20.6	3.9	0.923	0.500	1.423	2.85	0.962	0.462
6	0.1666	22.200	21.6	5.7	0.950	0.500	1.450	2.90	0.975	0.475
7	0.2276	23.500	22.9	7.9	0.984	0.500	1.484	2.97	0.992	0.492
8	0.2882	24.980	24.4	10.1	1.023	0.500	1.523	3.05	1.011	0.511
9	0.3391	26.610	26.0	11.9	1.069	0.500	1.569	3.14	1.035	0.535
10	0.4007	28.830	28.2	14.1	1.131	0.500	1.631	3.26	1.066	0.566
11	0.4265	30.210	29.6	15.0	1.174	0.500	1.674	3.35	1.087	0.587

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	148.190	148.190
Moisture content: Dry soil+tare, gms.	108.050	108.050
Moisture content: Tare, gms.	30.270	30.270
Moisture, %	51.6	51.6
Moist specimen weight, gms.	119.8	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	106.7	
Dry density, pcf	70.4	
Void ratio	1.3939	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.300 tsf at reading no. 4
 Ult. Stress = 0.831 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	2.980	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0270	11.220	8.2	0.7	0.386	1.000	1.386	1.39	1.193	0.193
2	0.0536	19.490	16.5	1.7	0.766	1.000	1.766	1.77	1.383	0.383
3	0.0941	28.040	25.1	3.1	1.145	1.000	2.145	2.15	1.573	0.573
4	0.1207	31.700	28.7	4.1	1.300	1.000	2.300	2.30	1.650	0.650
5	0.1339	31.670	28.7	4.5	1.292	1.000	2.292	2.29	1.646	0.646
6	0.1469	28.190	25.2	5.0	1.130	1.000	2.130	2.13	1.565	0.565
7	0.1884	26.120	23.1	6.5	1.021	1.000	2.021	2.02	1.510	0.510
8	0.2440	24.710	21.7	8.5	0.938	1.000	1.938	1.94	1.469	0.469
9	0.2979	24.500	21.5	10.4	0.910	1.000	1.910	1.91	1.455	0.455
10	0.3520	24.320	21.3	12.3	0.883	1.000	1.883	1.88	1.441	0.441
11	0.3931	23.540	20.6	13.8	0.836	1.000	1.836	1.84	1.418	0.418

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
12	0.4279	23.710	20.7	15.0	0.831	1.000	1.831	1.83	1.415	0.415

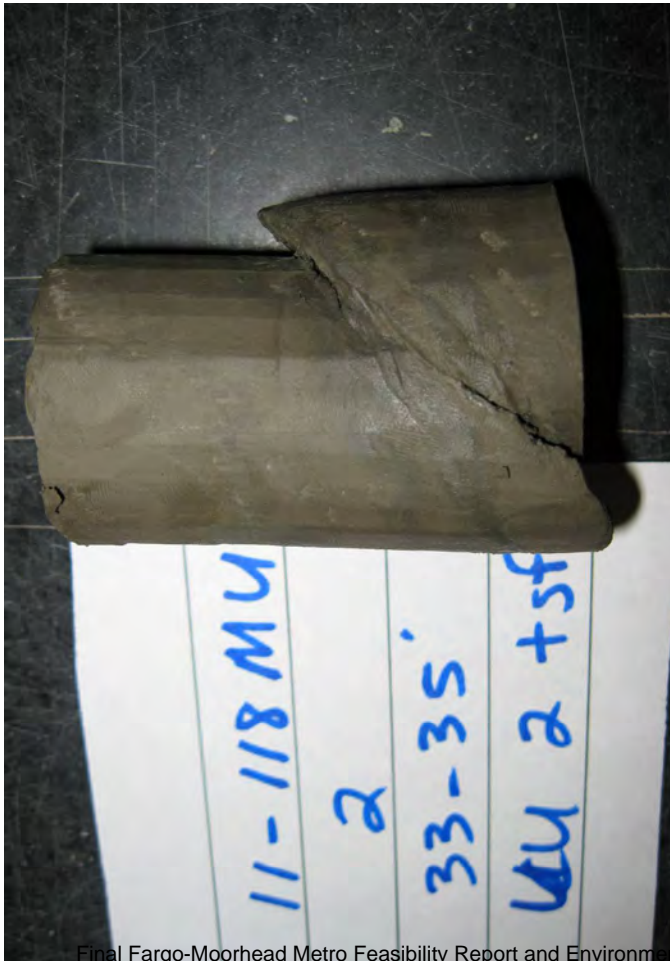
Parameters for Specimen No. 3

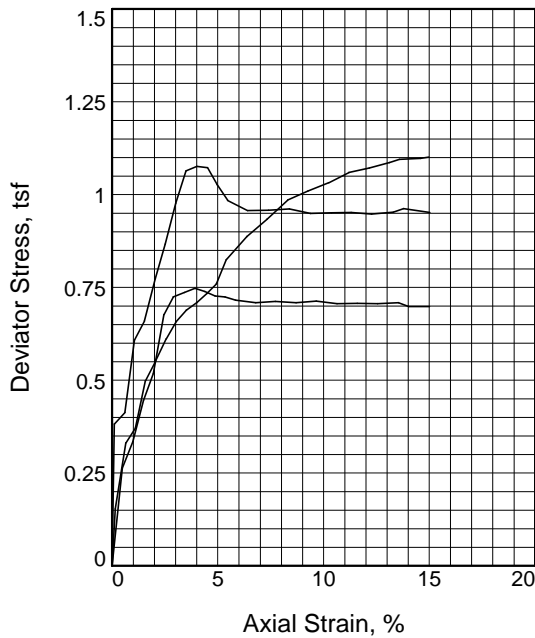
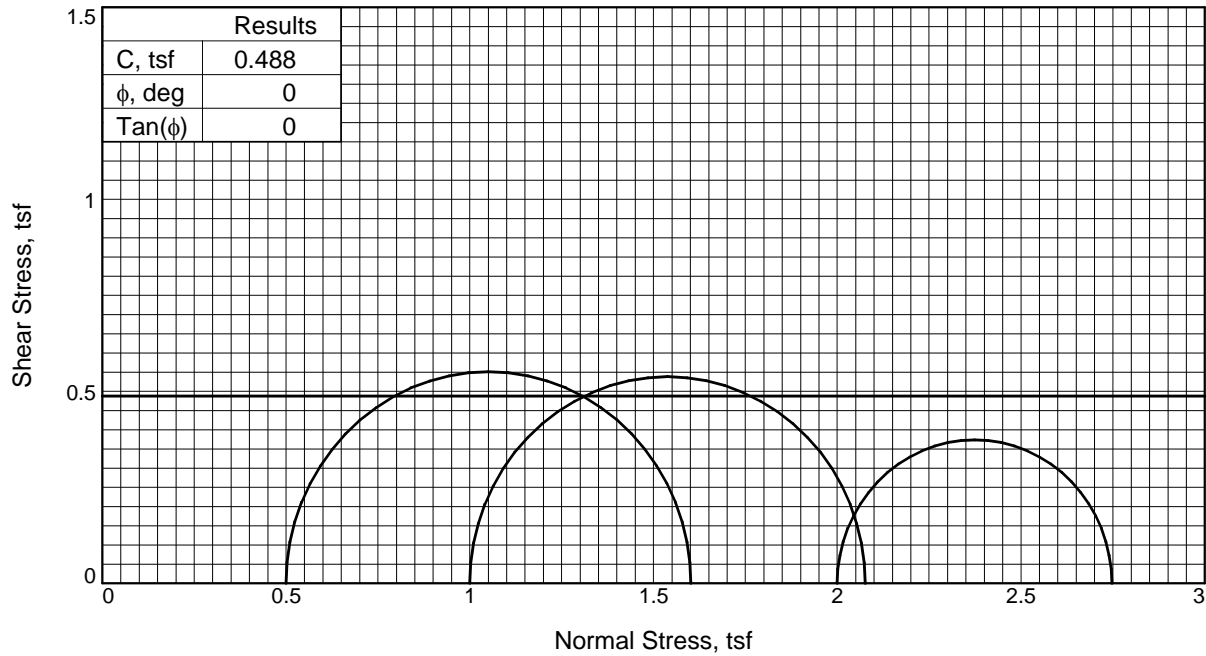
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.490	152.490
Moisture content: Dry soil+tare, gms.	111.990	111.990
Moisture content: Tare, gms.	30.410	30.410
Moisture, %	49.6	49.6
Moist specimen weight, gms.	123.1	
Diameter, in.	1.41	
Area, in. ²	1.56	
Height, in.	2.81	
Wet Density, pcf	107.4	
Dry density, pcf	71.8	
Void ratio	1.3487	
Saturation, %	99.4	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.245 tsf at reading no. 7
 Ult. Stress = 1.190 tsf at reading no. 10

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	4.660	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0265	12.720	8.1	0.7	0.370	2.000	2.370	1.19	2.185	0.185
2	0.0530	20.930	16.3	1.7	0.740	2.000	2.740	1.37	2.370	0.370
3	0.0797	27.060	22.4	2.6	1.009	2.000	3.009	1.50	2.504	0.504
4	0.1067	28.190	23.5	3.6	1.049	2.000	3.049	1.52	2.525	0.525
5	0.1861	31.560	26.9	6.4	1.164	2.000	3.164	1.58	2.582	0.582
6	0.2401	33.040	28.4	8.3	1.203	2.000	3.203	1.60	2.601	0.601
7	0.2939	34.670	30.0	10.3	1.245	2.000	3.245	1.62	2.623	0.623
8	0.3475	33.900	29.2	12.2	1.188	2.000	3.188	1.59	2.594	0.594
9	0.3883	34.300	29.6	13.6	1.184	2.000	3.184	1.59	2.592	0.592
10	0.4281	34.940	30.3	15.0	1.190	2.000	3.190	1.59	2.595	0.595





Sample No.	1	2	3	
Initial	Water Content, %	45.2	45.8	47.1
	Dry Density, pcf	75.9	75.0	74.0
	Saturation, %	99.9	98.9	99.4
	Void Ratio	1.2235	1.2521	1.2819
	Diameter, in.	1.42	1.41	1.38
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	45.2	45.8	47.1
	Dry Density, pcf	75.9	75.0	74.0
	Saturation, %	99.9	98.9	99.4
	Void Ratio	1.2235	1.2521	1.2819
	Diameter, in.	1.42	1.41	1.38
	Height, in.	2.80	2.80	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.50	1.00	2.00	
Peak Stress, tsf	1.10	1.08	0.75	
Ult. Stress, tsf	1.10	0.95	0.70	
σ_1 Failure, tsf	1.60	2.08	2.75	
σ_3 Failure, tsf	0.50	1.00	2.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 56 **PL=** 19 **PI=** 37

Specific Gravity= 2.704

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 3

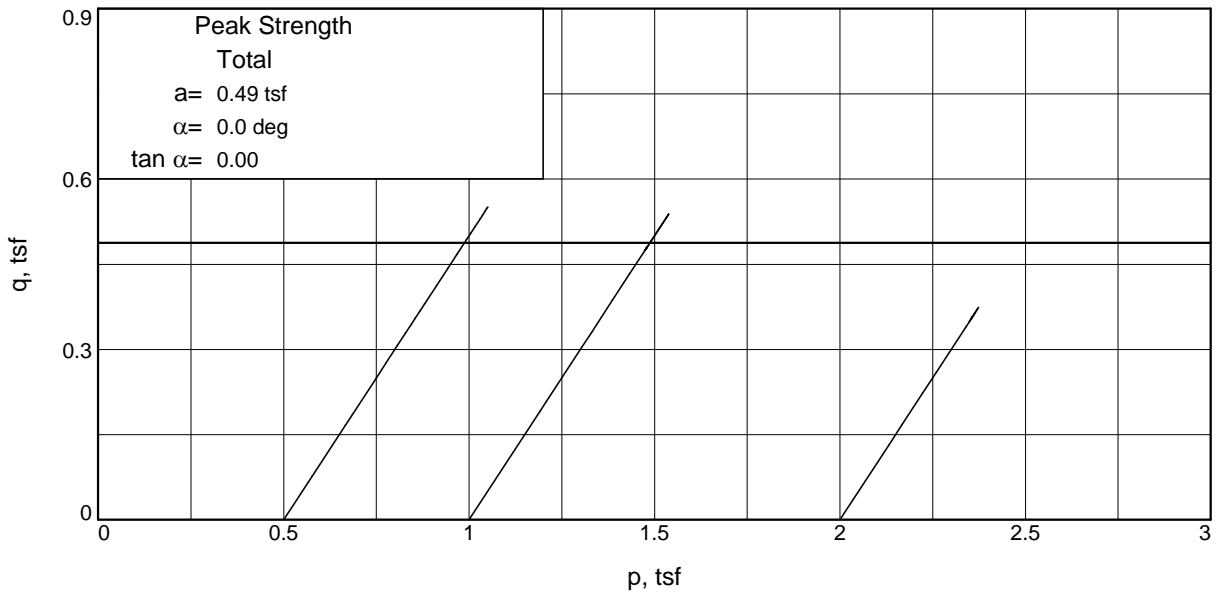
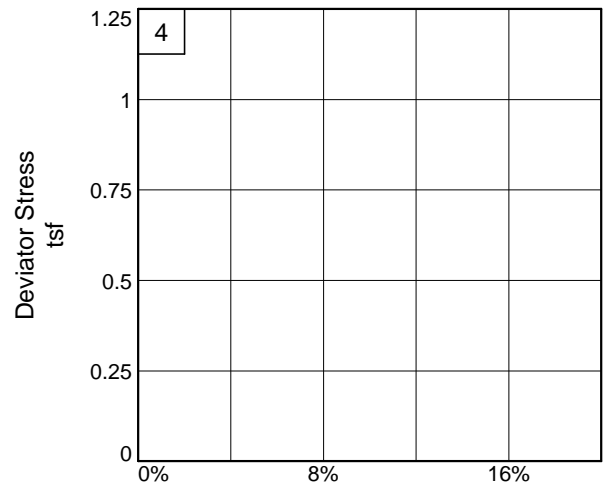
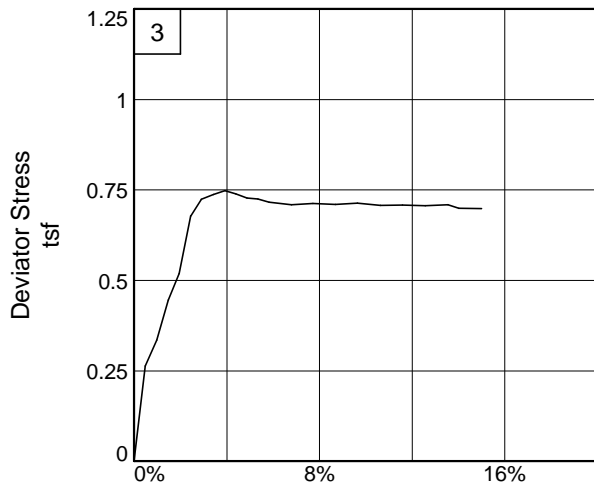
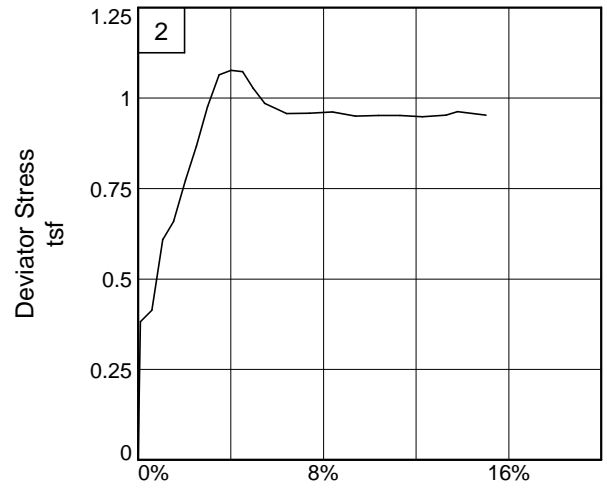
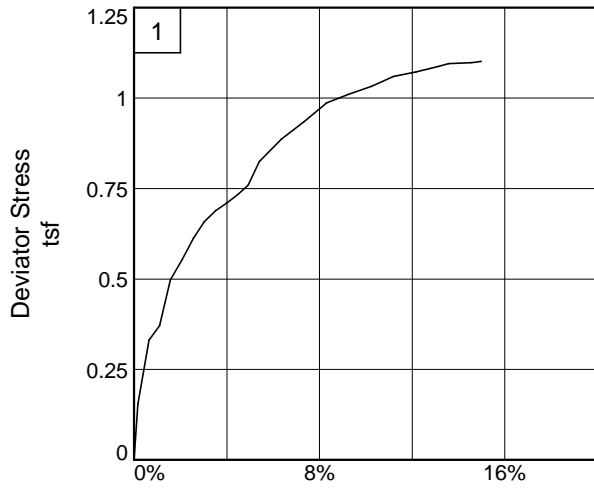
Location: Fargo Pile Load Test, Brenna Formation

Sample Number: Boring11-119MU, #1 **Depth:** 30-32'

Proj. No.: BL-10-10065 **Date Sampled:**

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Brenna Formation

Depth: 30-32'

Sample No.: Boring11-119MU, #1

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:10 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Brenna Formation
Depth: 30-32' **Sample Number:** Boring11-119MU, #1
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.704 **LL=**56 **PL=**19 **PI=**37
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	157.300	157.300
Moisture content: Dry soil+tare, gms.	117.710	117.710
Moisture content: Tare, gms.	30.160	30.160
Moisture, %	45.2	45.2
Moist specimen weight, gms.	127.7	
Diameter, in.	1.42	
Area, in. ²	1.58	
Height, in.	2.80	
Wet Density, pcf	110.3	
Dry density, pcf	75.9	
Void ratio	1.2235	
Saturation, %	99.9	

Test Readings for Specimen No. 1

Cell pressure = 0.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.102 tsf at reading no. 23
Ult. Stress = 1.102 tsf at reading no. 23

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0061	0.360	0.0	0.0	0.000	0.500	0.500	1.00	0.500	0.000
1	0.0105	3.740	3.4	0.2	0.154	0.500	0.654	1.31	0.577	0.077
2	0.0243	7.680	7.3	0.7	0.332	0.500	0.832	1.66	0.666	0.166
3	0.0370	8.600	8.2	1.1	0.372	0.500	0.872	1.74	0.686	0.186
4	0.0499	11.470	11.1	1.6	0.499	0.500	0.999	2.00	0.749	0.249
5	0.0635	12.720	12.4	2.1	0.552	0.500	1.052	2.10	0.776	0.276
6	0.0775	14.130	13.8	2.6	0.612	0.500	1.112	2.22	0.806	0.306
7	0.0908	15.250	14.9	3.0	0.658	0.500	1.158	2.32	0.829	0.329
8	0.1044	16.020	15.7	3.5	0.689	0.500	1.189	2.38	0.844	0.344
9	0.1181	16.580	16.2	4.0	0.710	0.500	1.210	2.42	0.855	0.355
10	0.1314	17.210	16.9	4.5	0.734	0.500	1.234	2.47	0.867	0.367
11	0.1441	17.900	17.5	4.9	0.760	0.500	1.260	2.52	0.880	0.380
12	0.1573	19.500	19.1	5.4	0.825	0.500	1.325	2.65	0.913	0.413
13	0.1842	21.150	20.8	6.4	0.887	0.500	1.387	2.77	0.944	0.444
14	0.2108	22.470	22.1	7.3	0.934	0.500	1.434	2.87	0.967	0.467
15	0.2381	23.940	23.6	8.3	0.986	0.500	1.486	2.97	0.993	0.493
16	0.2650	24.770	24.4	9.3	1.010	0.500	1.510	3.02	1.005	0.505
17	0.2925	25.580	25.2	10.2	1.032	0.500	1.532	3.06	1.016	0.516
18	0.3191	26.540	26.2	11.2	1.060	0.500	1.560	3.12	1.030	0.530
19	0.3462	27.120	26.8	12.2	1.072	0.500	1.572	3.14	1.036	0.536
20	0.3729	27.800	27.4	13.1	1.087	0.500	1.587	3.17	1.043	0.543
21	0.3858	28.160	27.8	13.6	1.095	0.500	1.595	3.19	1.048	0.548
22	0.4136	28.540	28.2	14.6	1.097	0.500	1.597	3.19	1.049	0.549
23	0.4250	28.780	28.4	15.0	1.102	0.500	1.602	3.20	1.051	0.551

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	155.530	155.530
Moisture content: Dry soil+tare, gms.	116.180	116.180
Moisture content: Tare, gms.	30.290	30.290
Moisture, %	45.8	45.8
Moist specimen weight, gms.	125.7	
Diameter, in.	1.41	
Area, in. ²	1.57	
Height, in.	2.80	
Wet Density, pcf	109.3	
Dry density, pcf	75.0	
Void ratio	1.2521	
Saturation, %	98.9	

Test Readings for Specimen No. 2

Cell pressure = 1.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.076 tsf at reading no. 9
 Ult. Stress = 0.952 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	38.000	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0096	46.320	8.3	0.1	0.382	1.000	1.382	1.38	1.191	0.191
2	0.0235	47.050	9.0	0.6	0.414	1.000	1.414	1.41	1.207	0.207
3	0.0364	51.390	13.4	1.1	0.609	1.000	1.609	1.61	1.305	0.305
4	0.0496	52.580	14.6	1.5	0.660	1.000	1.660	1.66	1.330	0.330
5	0.0639	55.170	17.2	2.0	0.773	1.000	1.773	1.77	1.387	0.387
6	0.0772	57.340	19.3	2.5	0.867	1.000	1.867	1.87	1.433	0.433
7	0.0908	59.900	21.9	3.0	0.977	1.000	1.977	1.98	1.488	0.488
8	0.1047	61.980	24.0	3.5	1.064	1.000	2.064	2.06	1.532	0.532
9	0.1188	62.380	24.4	4.0	1.076	1.000	2.076	2.08	1.538	0.538
10	0.1327	62.440	24.4	4.5	1.073	1.000	2.073	2.07	1.537	0.537
11	0.1457	61.510	23.5	5.0	1.027	1.000	2.027	2.03	1.514	0.514
12	0.1595	60.660	22.7	5.5	0.985	1.000	1.985	1.99	1.493	0.493
13	0.1862	60.250	22.3	6.4	0.957	1.000	1.957	1.96	1.479	0.479
14	0.2138	60.500	22.5	7.4	0.958	1.000	1.958	1.96	1.479	0.479
15	0.2413	60.830	22.8	8.4	0.962	1.000	1.962	1.96	1.481	0.481
16	0.2694	60.800	22.8	9.4	0.950	1.000	1.950	1.95	1.475	0.475
17	0.2970	61.090	23.1	10.4	0.952	1.000	1.952	1.95	1.476	0.476
18	0.3230	61.340	23.3	11.3	0.952	1.000	1.952	1.95	1.476	0.476
19	0.3502	61.500	23.5	12.3	0.948	1.000	1.948	1.95	1.474	0.474
20	0.3787	61.900	23.9	13.3	0.953	1.000	1.953	1.95	1.476	0.476
21	0.3925	62.280	24.3	13.8	0.962	1.000	1.962	1.96	1.481	0.481
22	0.4270	62.370	24.4	15.0	0.952	1.000	1.952	1.95	1.476	0.476

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	150.520	150.520
Moisture content: Dry soil+tare, gms.	112.110	112.110
Moisture content: Tare, gms.	30.620	30.620
Moisture, %	47.1	47.1
Moist specimen weight, gms.	120.4	
Diameter, in.	1.38	
Area, in. ²	1.50	
Height, in.	2.81	
Wet Density, pcf	108.8	
Dry density, pcf	74.0	
Void ratio	1.2819	
Saturation, %	99.4	

Test Readings for Specimen No. 3

Cell pressure = 2.000 tsf

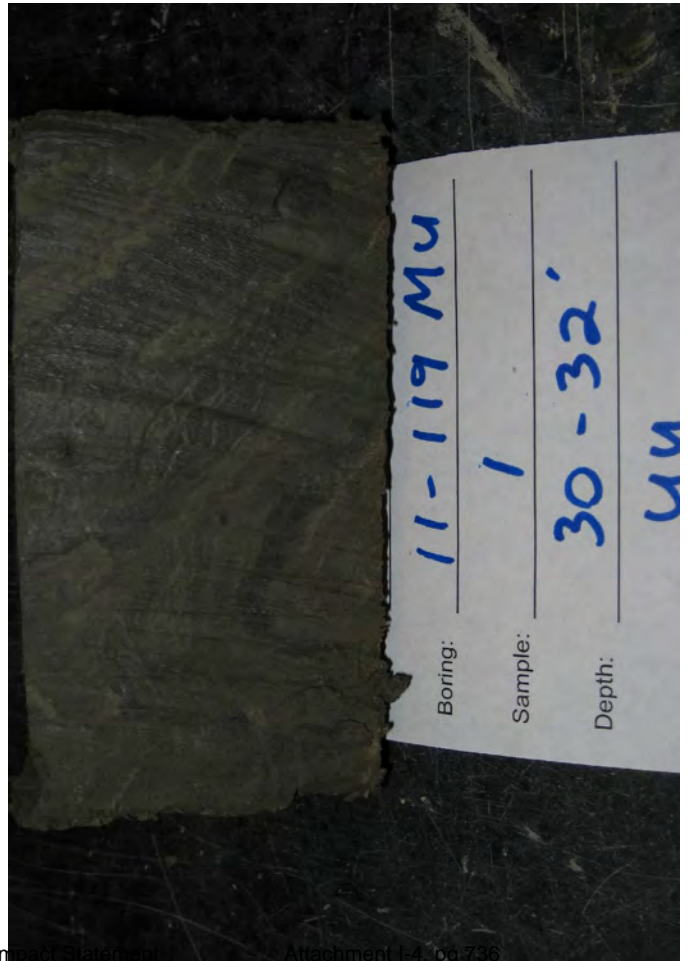
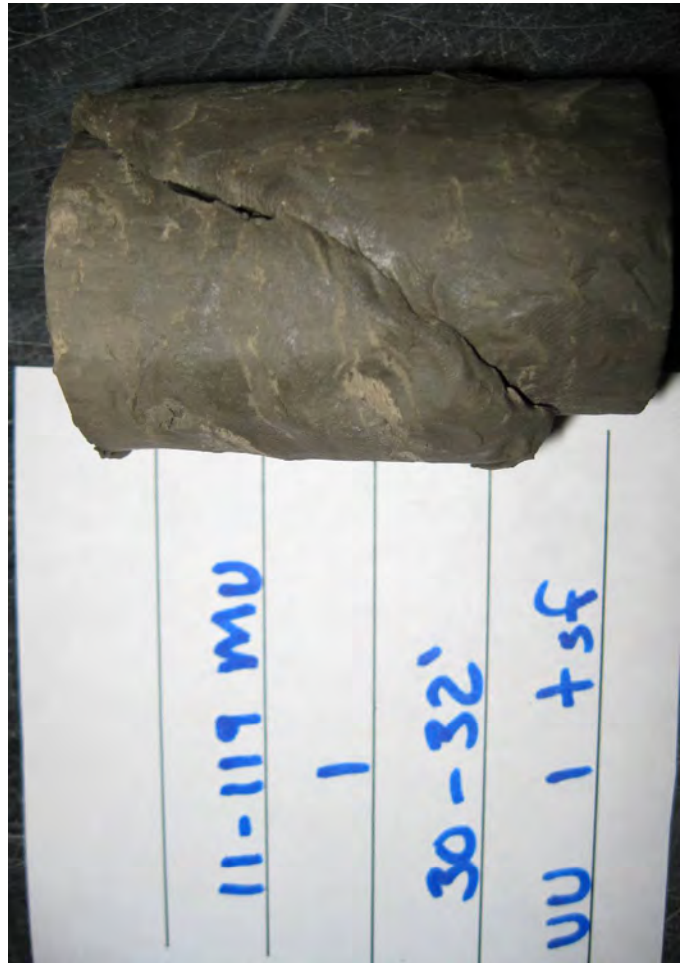
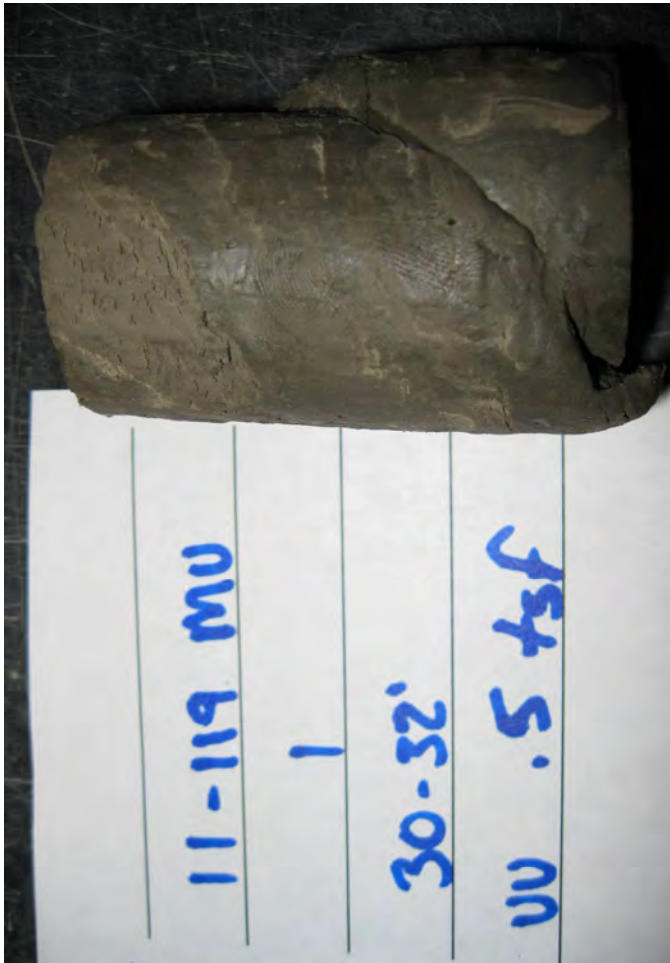
Back pressure = 0.000 tsf

Strain rate, %/min. = 1.00

Peak Stress = 0.747 tsf at reading no. 8

Ult. Stress = 0.698 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	1.430	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0203	6.950	5.5	0.5	0.263	2.000	2.263	1.13	2.132	0.132
2	0.0340	8.480	7.1	1.0	0.335	2.000	2.335	1.17	2.167	0.167
3	0.0480	10.860	9.4	1.5	0.445	2.000	2.445	1.22	2.223	0.223
4	0.0613	12.470	11.0	2.0	0.519	2.000	2.519	1.26	2.259	0.259
5	0.0753	15.920	14.5	2.4	0.677	2.000	2.677	1.34	2.339	0.339
6	0.0878	16.990	15.6	2.9	0.724	2.000	2.724	1.36	2.362	0.362
7	0.1027	17.350	15.9	3.4	0.737	2.000	2.737	1.37	2.368	0.368
8	0.1165	17.660	16.2	3.9	0.747	2.000	2.747	1.37	2.374	0.374
9	0.1298	17.560	16.1	4.4	0.739	2.000	2.739	1.37	2.370	0.370
10	0.1433	17.380	16.0	4.9	0.727	2.000	2.727	1.36	2.364	0.364
11	0.1566	17.400	16.0	5.3	0.724	2.000	2.724	1.36	2.362	0.362
12	0.1703	17.300	15.9	5.8	0.716	2.000	2.716	1.36	2.358	0.358
13	0.1973	17.300	15.9	6.8	0.709	2.000	2.709	1.35	2.354	0.354
14	0.2232	17.530	16.1	7.7	0.712	2.000	2.712	1.36	2.356	0.356
15	0.2505	17.640	16.2	8.7	0.709	2.000	2.709	1.35	2.355	0.355
16	0.2772	17.900	16.5	9.6	0.713	2.000	2.713	1.36	2.357	0.357
17	0.3050	17.930	16.5	10.6	0.707	2.000	2.707	1.35	2.353	0.353
18	0.3317	18.130	16.7	11.6	0.708	2.000	2.708	1.35	2.354	0.354
19	0.3591	18.280	16.9	12.6	0.706	2.000	2.706	1.35	2.353	0.353
20	0.3867	18.540	17.1	13.6	0.709	2.000	2.709	1.35	2.354	0.354
21	0.3999	18.390	17.0	14.0	0.699	2.000	2.699	1.35	2.349	0.349
22	0.4275	18.570	17.1	15.0	0.698	2.000	2.698	1.35	2.349	0.349

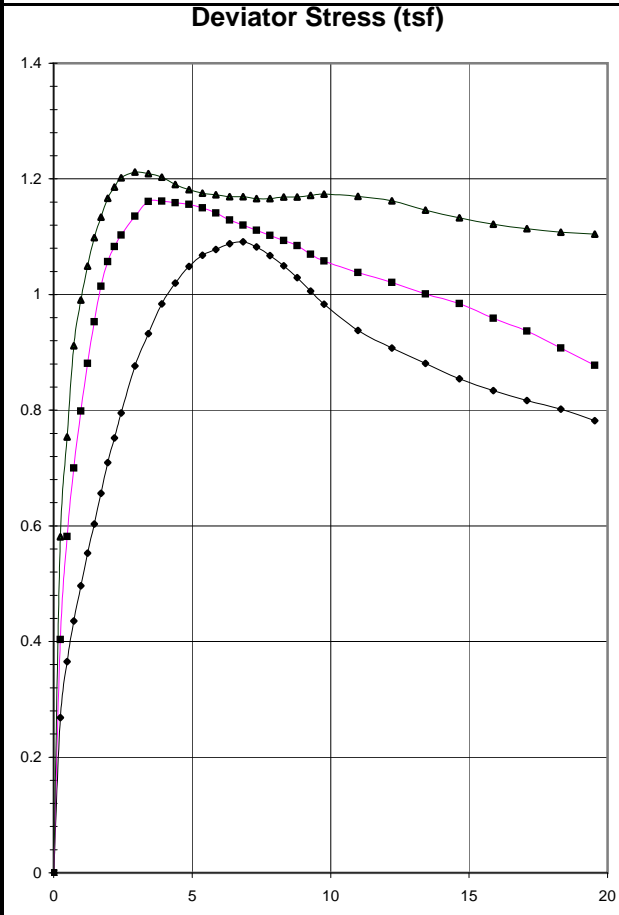


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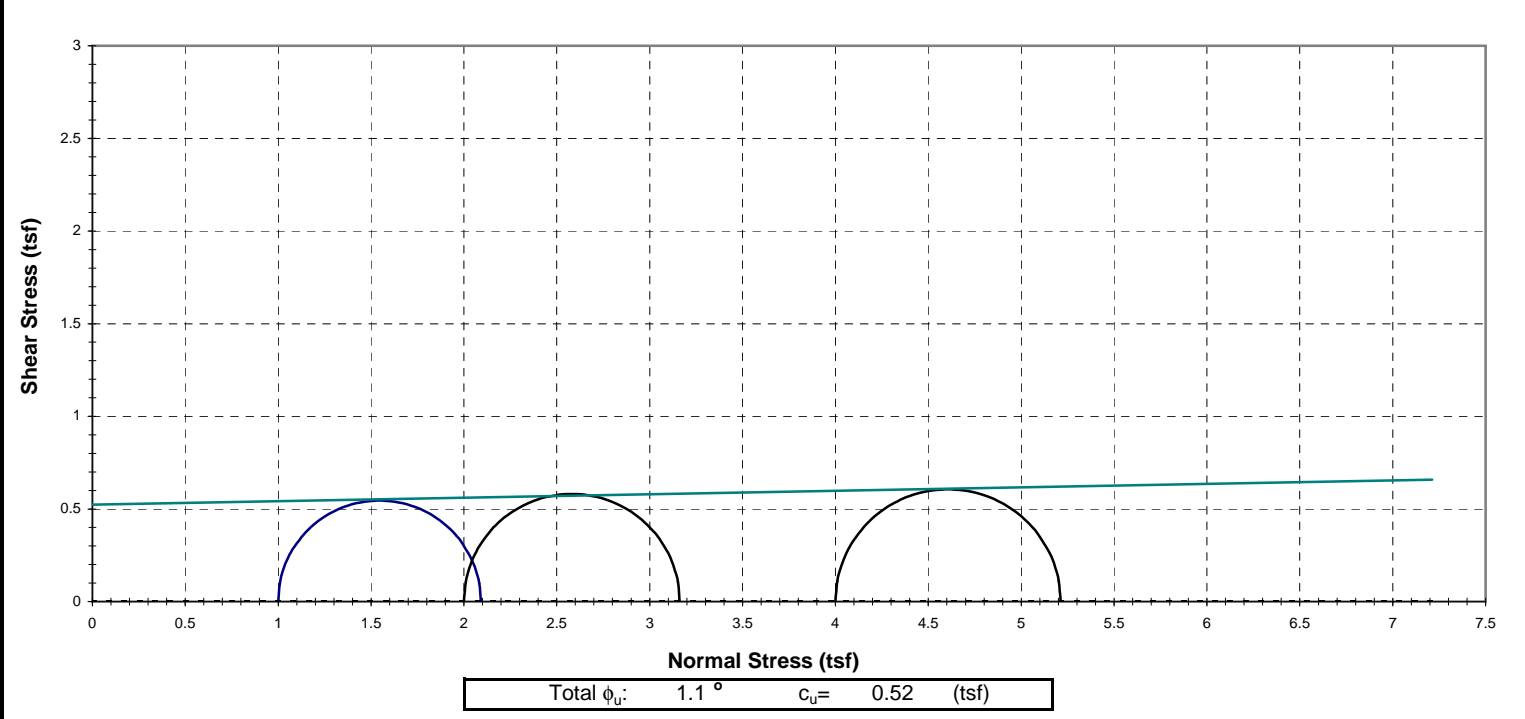
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Mid-Bot)**
 Soil Type: **Fat Clay w/a few pockets of Silt (CH) Argusville**



Failure Criterion:		Max. Deviator Stress				
Angle of internal friction, $\phi_u =$		1.1°				
Apparent Cohesion, $c_u =$		0.52 (tsf)				
Test Date:	8/18/10	Liquid Limit:	71.8			
Test Type:	U-U	Plastic Limit:	22.4			
Strain Rate (in/min):	0.05	Plasticity Index:	49.4			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.77			
Before Consolidation		A	B	C	D	E
Diameter (in)		1.94	1.94	1.94		
Height (in)		4.10	4.10	4.10		
Water Content (%)		44.8	46.0	46.6		
Dry Density (pcf)		75.9	75.0	74.4		
Void Ratio		1.28	1.30	1.32		
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)		1.00	2.00	4.00		
Max. Deviator Stress (tsf)		1.09	1.16	1.21		
Ultimate Deviator Stress (tsf)		0.78	0.88	1.10		
Deviator Stress at Failure (tsf)		1.09	1.16	1.21		
Max. Pore Pressure Buildup (tsf)		-----	-----	-----		
Pore Pressure Parameter "B"		-----	-----	-----		
Pct. Axial Strain at Failure		6.8	3.9	2.9		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Total ϕ_u : 1.1° $c_u =$ 0.52 (tsf)

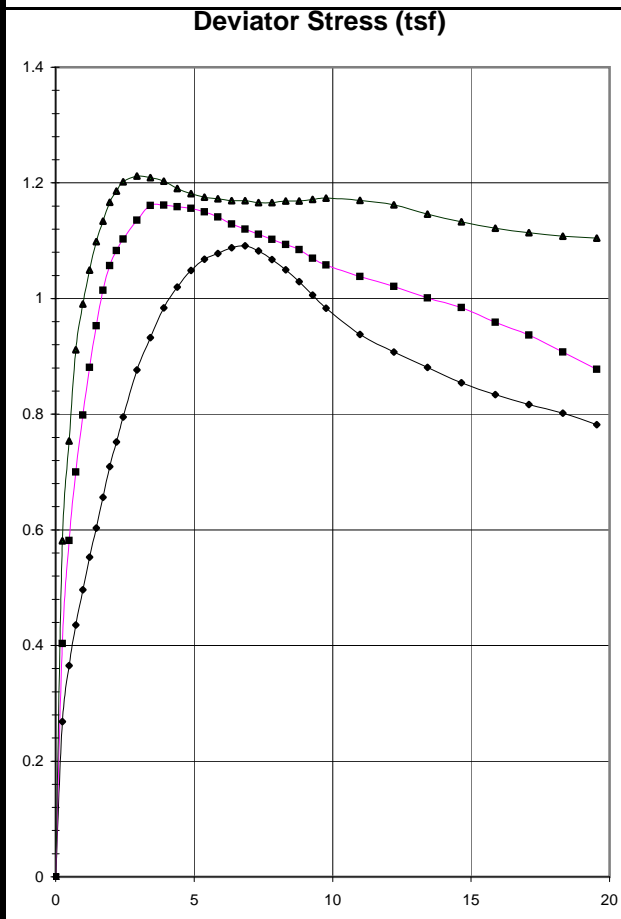


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Job No. 7577

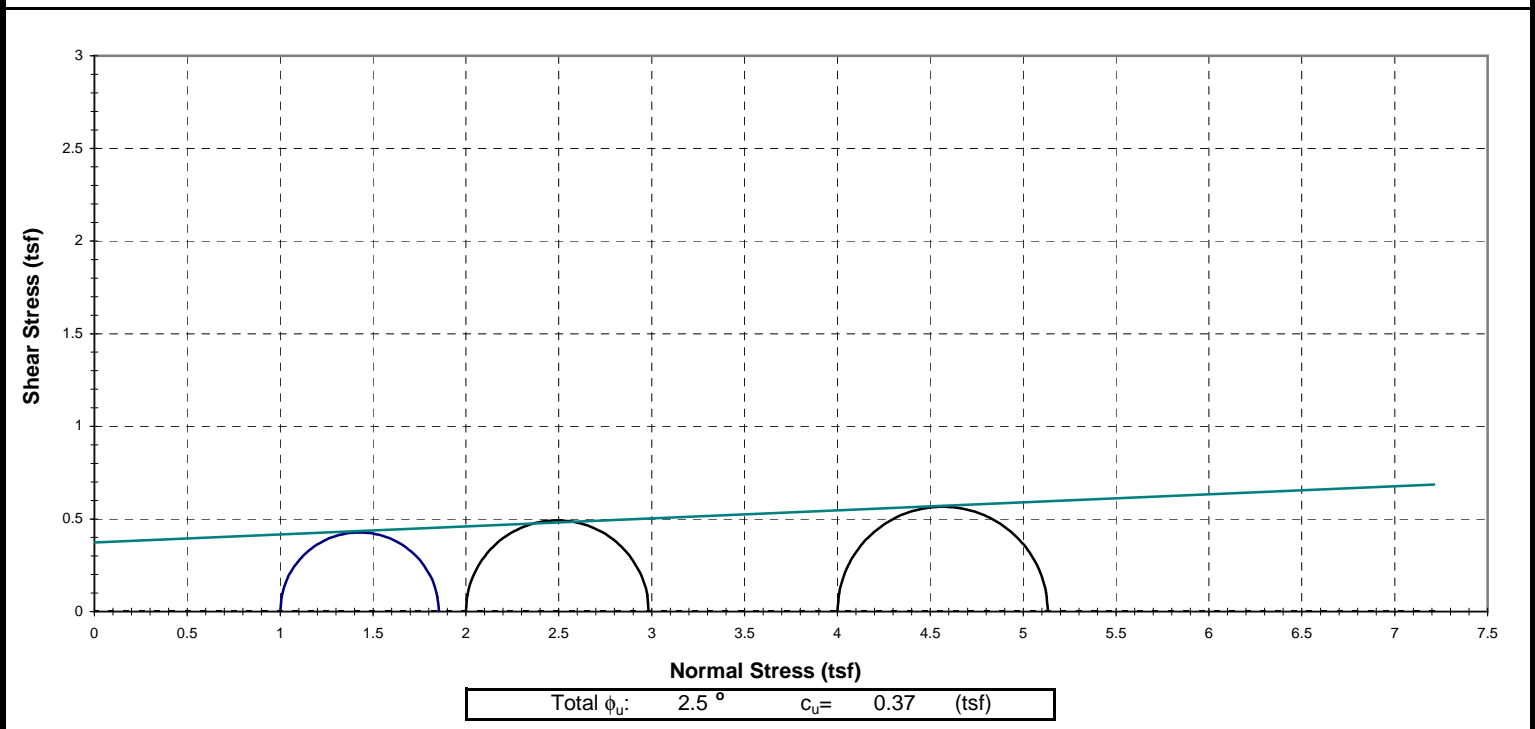
Date: 8/24/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-78MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57 (Mid-Bot)**
 Soil Type: **Fat Clay w/a few pockets of Silt (CH) Argusville**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 2.5^\circ$				
		Apparent Cohesion, $c_u = 0.37$ (tsf)				
Test Date:	8/18/10	Liquid Limit:	71.8			
Test Type:	U-U	Plastic Limit:	22.4			
Strain Rate (in/min):	0.05	Plasticity Index:	49.4			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.77			
Before Consolidation		A	B	C	D	E
Diameter (in)	1.94	1.94	1.94			
Height (in)	4.10	4.10	4.10			
Water Content (%)	44.8	46.0	46.6			
Dry Density (pcf)	75.9	75.0	74.4			
Void Ratio	1.28	1.30	1.32			
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)	1.00	2.00	4.00			
Max. Deviator Stress (tsf)	1.09	1.16	1.21			
Ultimate Deviator Stress (tsf)	0.78	0.88	1.10			
Deviator Stress at Failure (tsf)	0.85	0.98	1.13			
Max. Pore Pressure Buildup (tsf)	-----	-----	-----			
Pore Pressure Parameter "B"	-----	-----	-----			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-78MU, Sample No.: 3, Depth (ft.): 55 - 57 (Mid-Bot)

Sample 1	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.27
0.49	0.37
0.73	0.44
0.98	0.50
1.22	0.55
1.47	0.60
1.71	0.66
1.95	0.71
2.20	0.75
2.44	0.79
2.93	0.88
3.42	0.93
3.91	0.98
4.40	1.02
4.88	1.05
5.37	1.07
5.86	1.08
6.35	1.09
6.84	1.09
7.33	1.08
7.81	1.07
8.30	1.05
8.79	1.03
9.28	1.01
9.77	0.98
10.99	0.94
12.21	0.91
13.43	0.88
14.65	0.85
15.87	0.83
17.09	0.82
18.32	0.80
19.54	0.78

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.40
0.49	0.58
0.73	0.70
0.98	0.80
1.22	0.88
1.47	0.95
1.71	1.01
1.95	1.06
2.20	1.08
2.44	1.10
2.93	1.14
3.42	1.16
3.91	1.16
4.40	1.16
4.88	1.16
5.37	1.15
5.86	1.14
6.35	1.13
6.84	1.12
7.33	1.11
7.81	1.10
8.30	1.09
8.79	1.08
9.28	1.07
9.77	1.06
10.99	1.04
12.21	1.02
13.43	1.00
14.65	0.98
15.87	0.96
17.09	0.94
18.32	0.91
19.54	0.88

Sample 3	
Strain (%)	Deviator Stress (tsf)

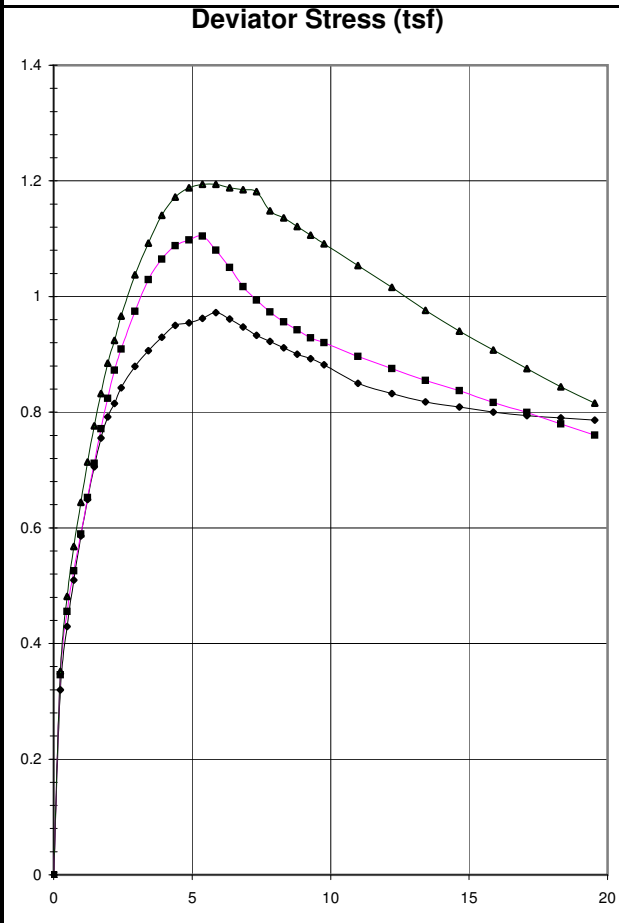
0.00	0.00
0.24	0.58
0.49	0.75
0.73	0.91
0.98	0.99
1.22	1.05
1.47	1.10
1.71	1.13
1.95	1.17
2.20	1.19
2.44	1.20
2.93	1.21
3.42	1.21
3.91	1.20
4.40	1.19
4.88	1.18
5.37	1.18
5.86	1.17
6.35	1.17
6.84	1.17
7.33	1.17
7.81	1.17
8.30	1.17
8.79	1.17
9.28	1.17
9.77	1.17
10.99	1.17
12.21	1.16
13.43	1.15
14.65	1.13
15.87	1.12
17.09	1.11
18.32	1.11
19.54	1.10

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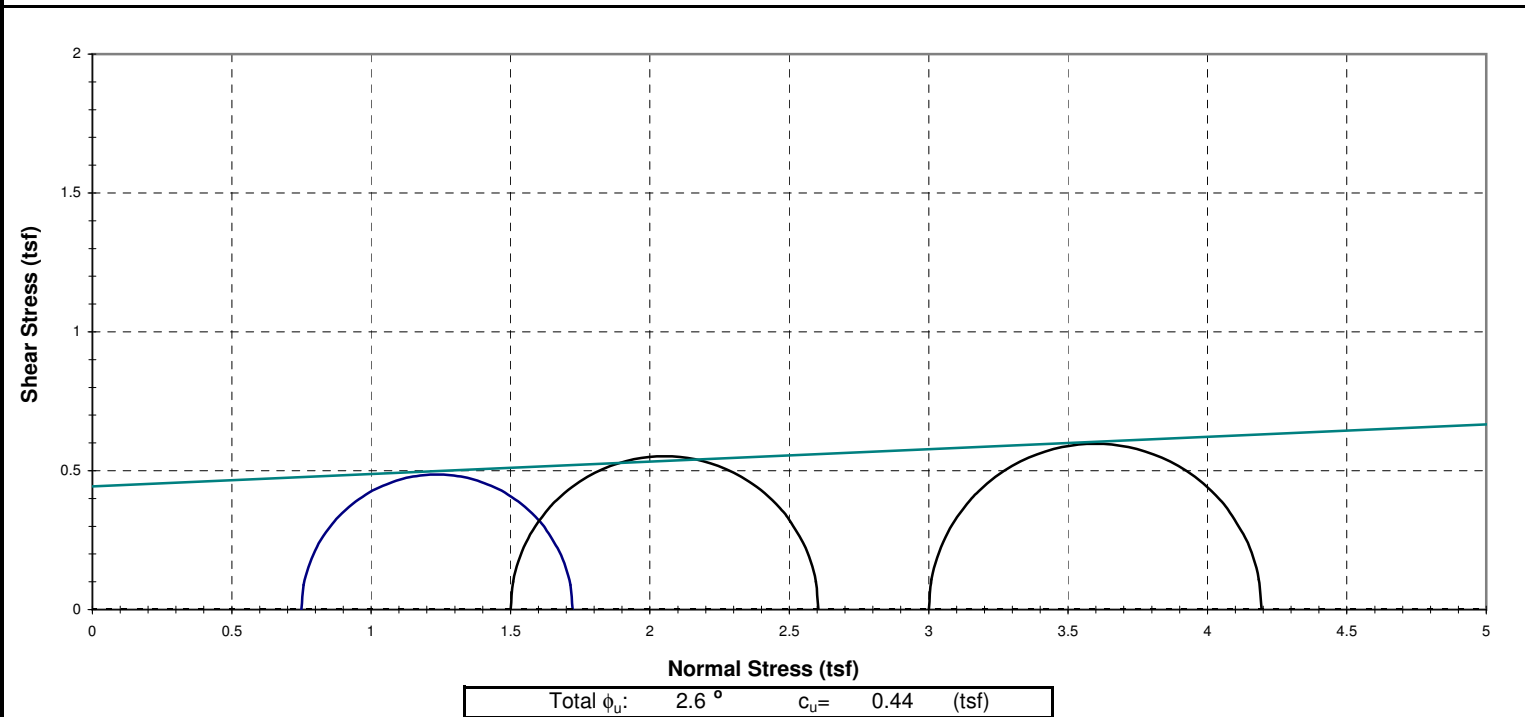
Date: 8/24/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid.)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argsuville**



Failure Criterion:		Max. Deviator Stress				
		Angle of internal friction, $\phi_u = 2.6^\circ$				
		Apparent Cohesion, $c_u = 0.44$ (tsf)				
Test Date:	8/19/10	Liquid Limit:	83.0			
Test Type:	U-U	Plastic Limit:	25.2			
Strain Rate (in/min):	0.05	Plasticity Index:	57.8			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.78			
Before Consolidation		A	B	C	D	E
Diameter (in)		1.94	1.94	1.94		
Height (in)		4.10	4.10	4.10		
Water Content (%)		42.0	42.4	43.7		
Dry Density (pcf)		78.8	78.3	77.0		
Void Ratio		1.20	1.22	1.25		
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)		0.75	1.50	3.00		
Max. Deviator Stress (tsf)		0.97	1.10	1.19		
Ultimate Deviator Stress (tsf)		0.79	0.76	0.82		
Deviator Stress at Failure (tsf)		0.97	1.10	1.19		
Max. Pore Pressure Buildup (tsf)		-----	-----	-----		
Pore Pressure Parameter "B"		-----	-----	-----		
Pct. Axial Strain at Failure		5.9	5.4	5.4		

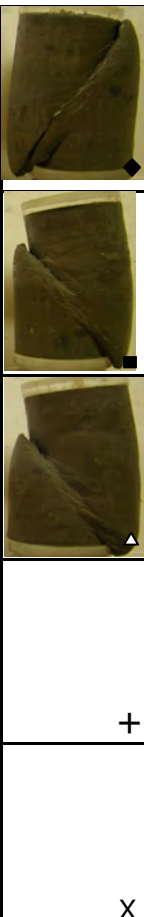
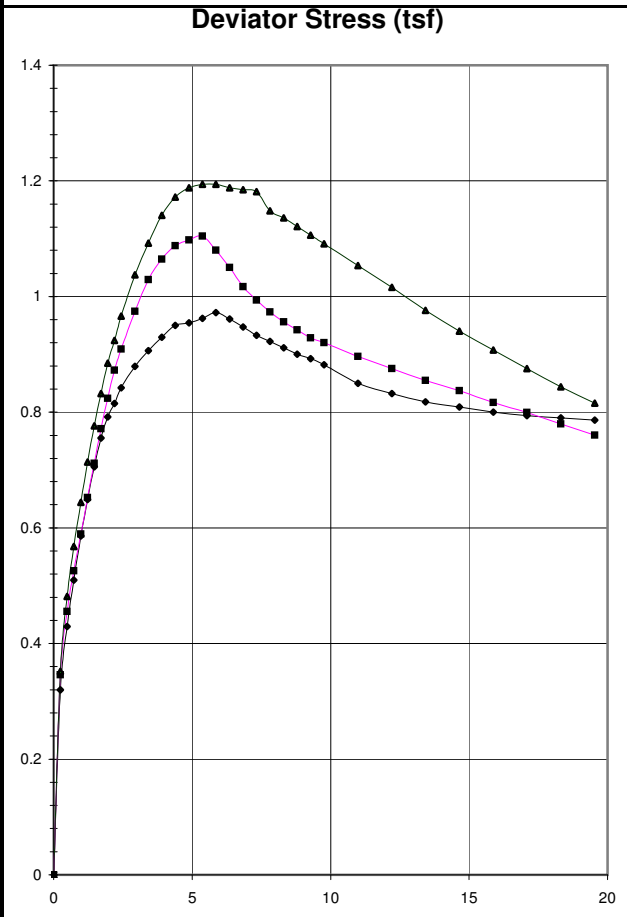
Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



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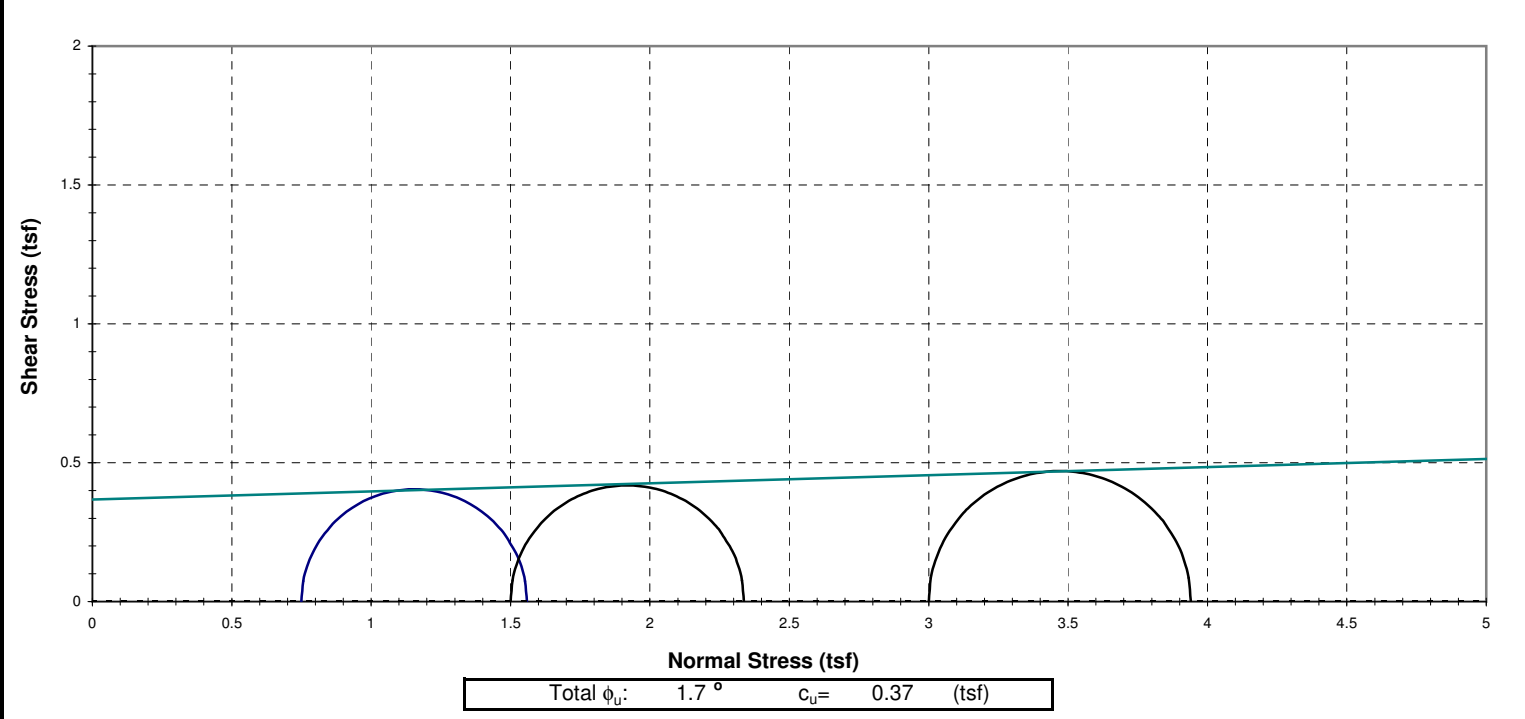
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-79MU Fargo** Sample #: **2** Type: **5T** Depth (ft): **40 - 42 (Mid.)**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argsuville**



Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 1.7^\circ$				
		Apparent Cohesion, $c_u = 0.37$ (tsf)				
Test Date:	8/19/10	Liquid Limit:	83.0			
Test Type:	U-U	Plastic Limit:	25.2			
Strain Rate (in/min):	0.05	Plasticity Index:	57.8			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.78			
Before Consolidation		A	B	C	D	E
Diameter (in)		1.94	1.94	1.94		
Height (in)		4.10	4.10	4.10		
Water Content (%)		42.0	42.4	43.7		
Dry Density (pcf)		78.8	78.3	77.0		
Void Ratio		1.20	1.22	1.25		
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)		0.75	1.50	3.00		
Max. Deviator Stress (tsf)		0.97	1.10	1.19		
Ultimate Deviator Stress (tsf)		0.79	0.76	0.82		
Deviator Stress at Failure (tsf)		0.81	0.84	0.94		
Max. Pore Pressure Buildup (tsf)		-----	-----	-----		
Pore Pressure Parameter "B"		-----	-----	-----		
Pct. Axial Strain at Failure		15.0	15.0	15.0		

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-79MU, Sample No.: 2, Depth (ft.): 40 - 42 (Mid.)

Sample 1	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.32
0.49	0.43
0.73	0.51
0.98	0.59
1.22	0.65
1.47	0.71
1.71	0.76
1.95	0.79
2.20	0.82
2.44	0.84
2.93	0.88
3.42	0.91
3.91	0.93
4.40	0.95
4.88	0.95
5.37	0.96
5.86	0.97
6.35	0.96
6.84	0.95
7.33	0.93
7.81	0.92
8.30	0.91
8.79	0.90
9.28	0.89
9.77	0.88
10.99	0.85
12.21	0.83
13.43	0.82
14.65	0.81
15.87	0.80
17.09	0.79
18.32	0.79
19.54	0.79

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.35
0.49	0.46
0.73	0.53
0.98	0.59
1.22	0.65
1.47	0.71
1.71	0.77
1.95	0.82
2.20	0.87
2.44	0.91
2.93	0.97
3.42	1.03
3.91	1.06
4.40	1.09
4.88	1.10
5.37	1.10
5.86	1.08
6.35	1.05
6.84	1.02
7.33	0.99
7.81	0.97
8.30	0.96
8.79	0.94
9.28	0.93
9.77	0.92
10.99	0.90
12.21	0.88
13.43	0.85
14.65	0.84
15.87	0.82
17.09	0.80
18.32	0.78
19.54	0.76

Sample 3	
Strain (%)	Deviator Stress (tsf)

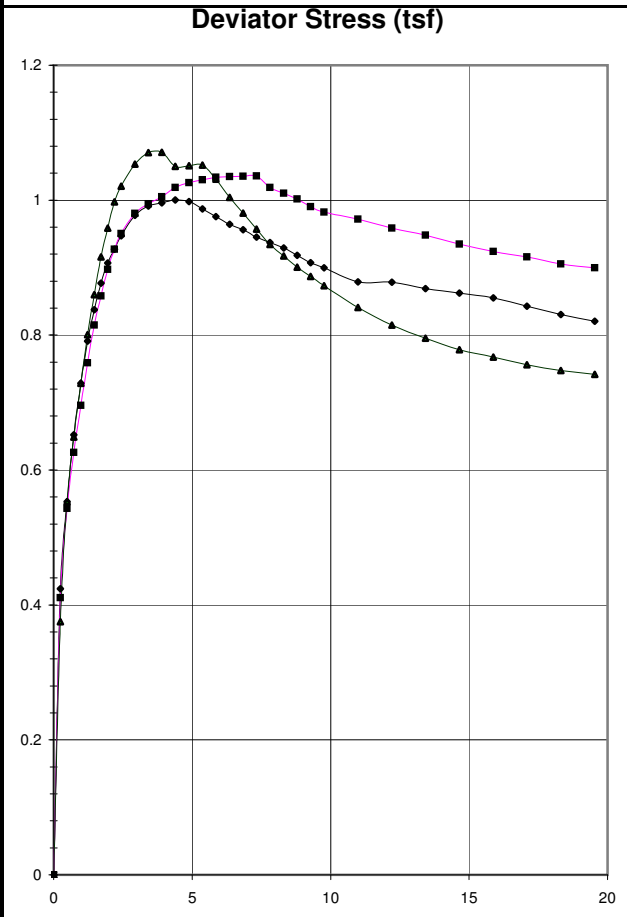
0.00	0.00
0.24	0.35
0.49	0.48
0.73	0.57
0.98	0.64
1.22	0.71
1.47	0.78
1.71	0.83
1.95	0.88
2.20	0.92
2.44	0.97
2.93	1.04
3.42	1.09
3.91	1.14
4.40	1.17
4.88	1.19
5.37	1.19
5.86	1.19
6.35	1.19
6.84	1.18
7.33	1.18
7.81	1.15
8.30	1.14
8.79	1.12
9.28	1.11
9.77	1.09
10.99	1.05
12.21	1.02
13.43	0.98
14.65	0.94
15.87	0.91
17.09	0.88
18.32	0.84
19.54	0.82

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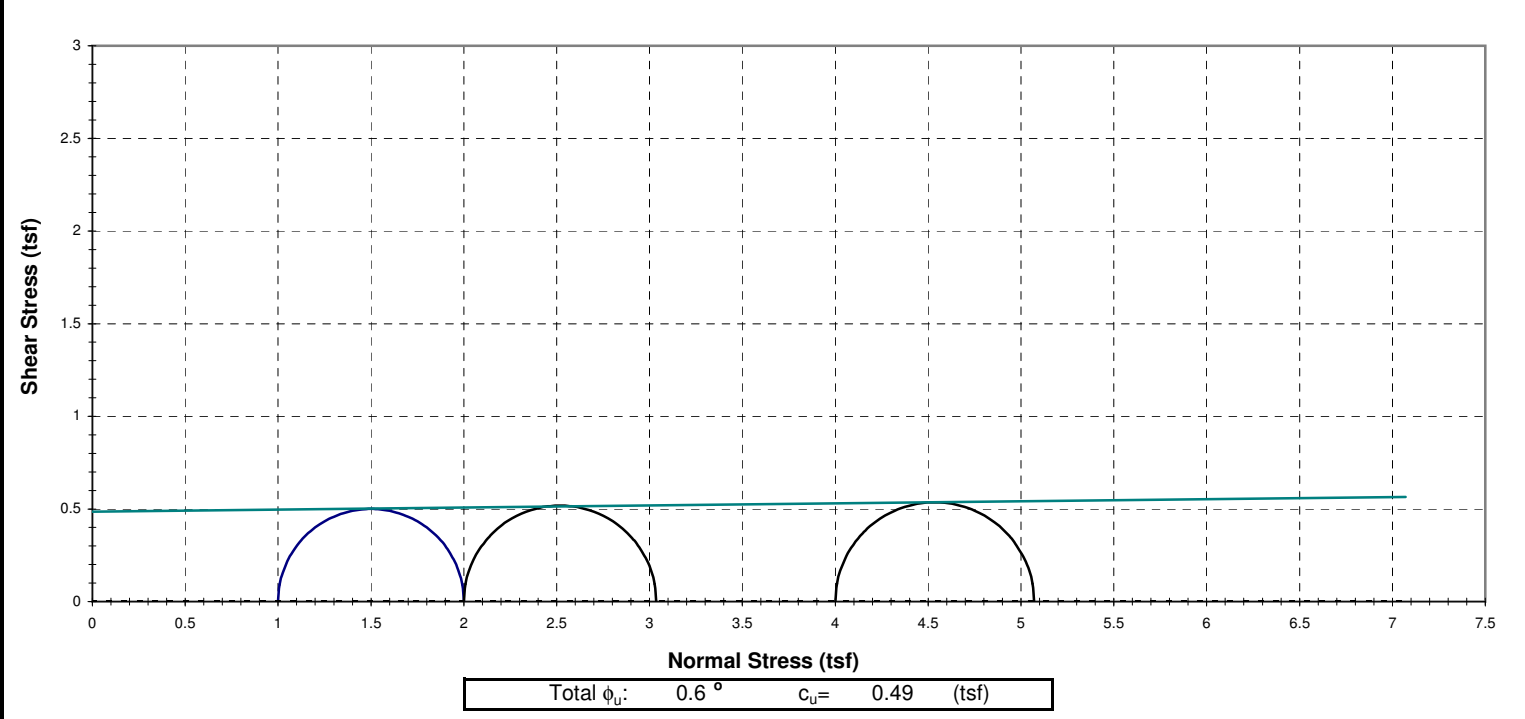
Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



Failure Criterion: Max. Deviator Stress	
Angle of internal friction, $\phi_u = 0.6^\circ$	
Apparent Cohesion, $c_u = 0.49$ (tsf)	
Test Date: 8/20/10	Liquid Limit: 78.1
Test Type: U-U	Plastic Limit: 26.8
Strain Rate (in/min): 0.05	Plasticity Index: 51.3
Strain Rate (%/min): 1.221	Spec. Gravity (Assumed): 2.78
Before Consolidation	
Diameter (in)	A B C D E
Height (in)	1.94 1.94 1.94
Water Content (%)	46.0 47.0 46.9
Dry Density (pcf)	74.4 73.8 73.8
Void Ratio	1.33 1.35 1.35
After Consolidation	
Diameter (in)	
Height (in)	
Water Content (%)	
Dry Density (pcf)	
Void Ratio	
Back Pressure (tsf)	
Minor Principal Stress (tsf)	1.00 2.00 4.00
Max. Deviator Stress (tsf)	1.00 1.04 1.07
Ultimate Deviator Stress (tsf)	0.82 0.90 0.74
Deviator Stress at Failure (tsf)	1.00 1.04 1.07
Max. Pore Pressure Buildup (tsf)	-----
Pore Pressure Parameter "B"	-----
Pct. Axial Strain at Failure	4.4 7.3 3.9

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.

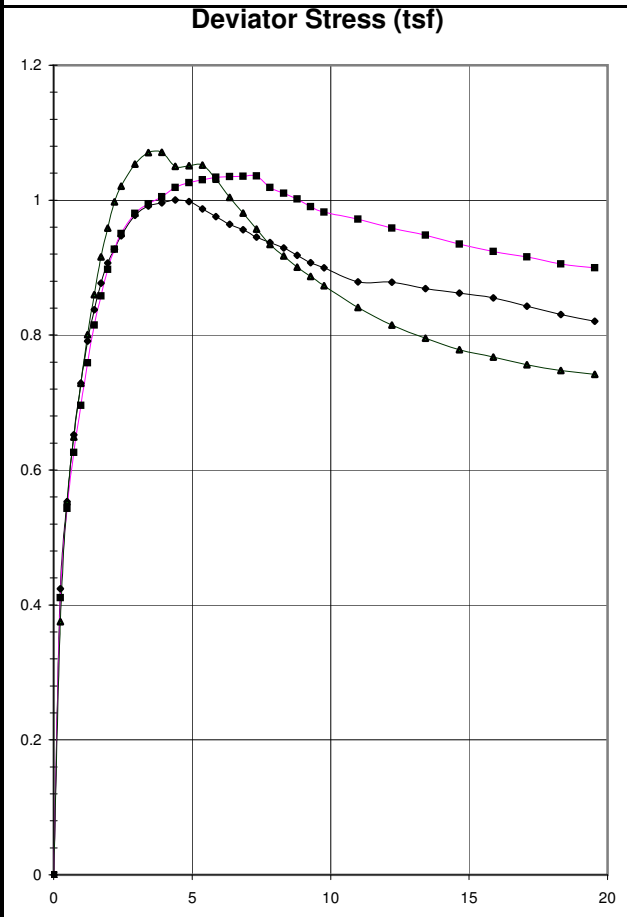


TRIAXIAL TEST ASTM: D 2850

Job No. 7577

Date: 8/24/10

Project: **FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095**
 Boring #: **10-80MU Fargo** Sample #: **3** Type: **5T** Depth (ft): **55 - 57**
 Soil Type: **Fat Clay w/a few pieces of Gravel & a few pockets of Silt (CH) Argusville**



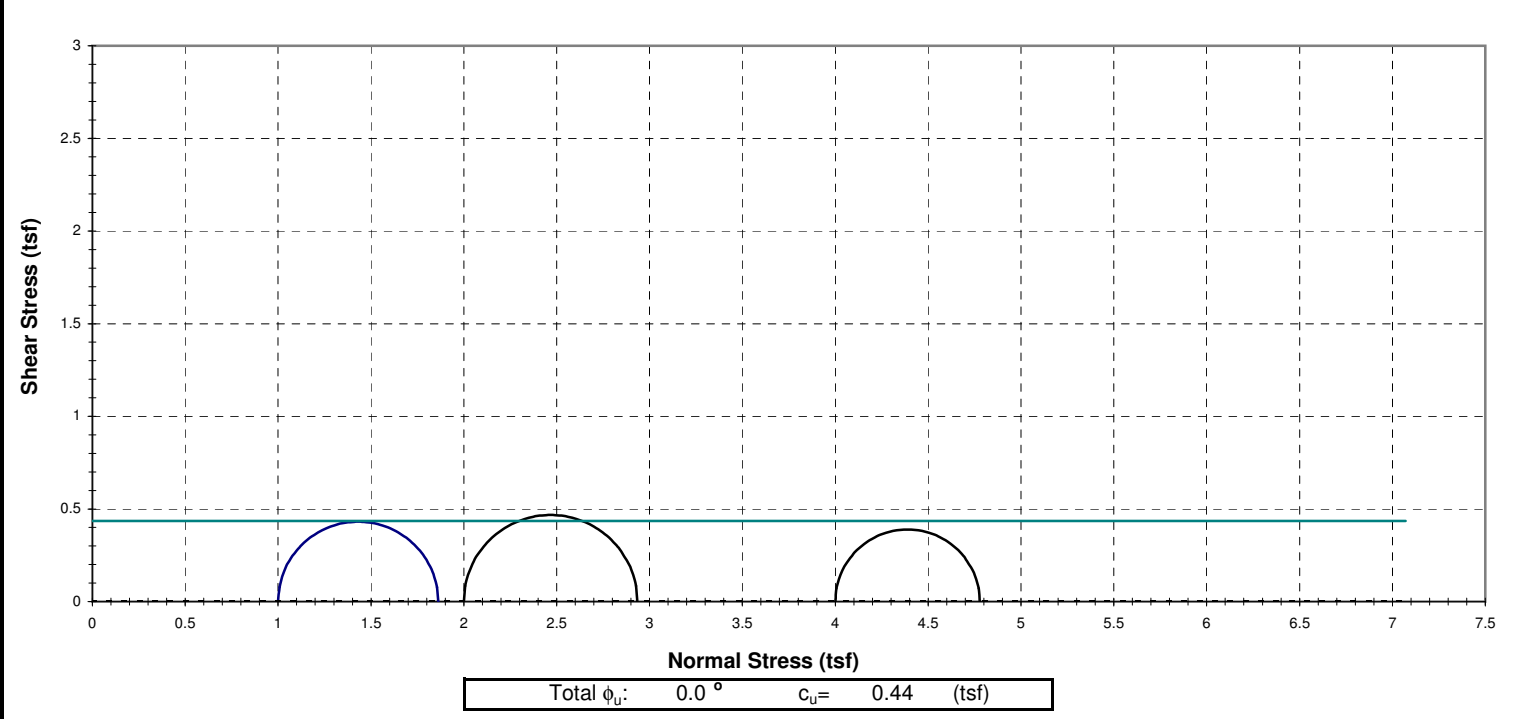
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Failure Criterion:		Given Strain of: 15%				
		Angle of internal friction, $\phi_u = 0.0^\circ$				
		Apparent Cohesion, $c_u = 0.44$ (tsf)				
Test Date:	8/20/10	Liquid Limit:	78.1			
Test Type:	U-U	Plastic Limit:	26.8			
Strain Rate (in/min):	0.05	Plasticity Index:	51.3			
Strain Rate (%/min):	1.221	Spec. Gravity (Assumed):	2.78			
Before Consolidation		A	B	C	D	E
Diameter (in)	1.94	1.94	1.94			
Height (in)	4.10	4.10	4.10			
Water Content (%)	46.0	47.0	46.9			
Dry Density (pcf)	74.4	73.8	73.8			
Void Ratio	1.33	1.35	1.35			
After Consolidation						
Diameter (in)						
Height (in)						
Water Content (%)						
Dry Density (pcf)						
Void Ratio						
Back Pressure (tsf)						
Minor Principal Stress (tsf)	1.00	2.00	4.00			
Max. Deviator Stress (tsf)	1.00	1.04	1.07			
Ultimate Deviator Stress (tsf)	0.82	0.90	0.74			
Deviator Stress at Failure (tsf)	0.86	0.93	0.78			
Max. Pore Pressure Buildup (tsf)	-----	-----	-----			
Pore Pressure Parameter "B"	-----	-----	-----			
Pct. Axial Strain at Failure	15.0	15.0	15.0			

"These test results are for informational purposes only and must be reviewed by a qualified professional engineer to verify that the test parameters shown are appropriate for any particular design"

Remarks: Specimens trimmed to given sizes; Allowed to adjust under applied confining pressures for about 10 minutes.



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - # W912ES-10-T-0095

Boring No.: 10-80MU, Sample No.: 3, Depth (ft.): 55 - 57

Sample 1	
Strain (%)	Deviator Stress (tsf)

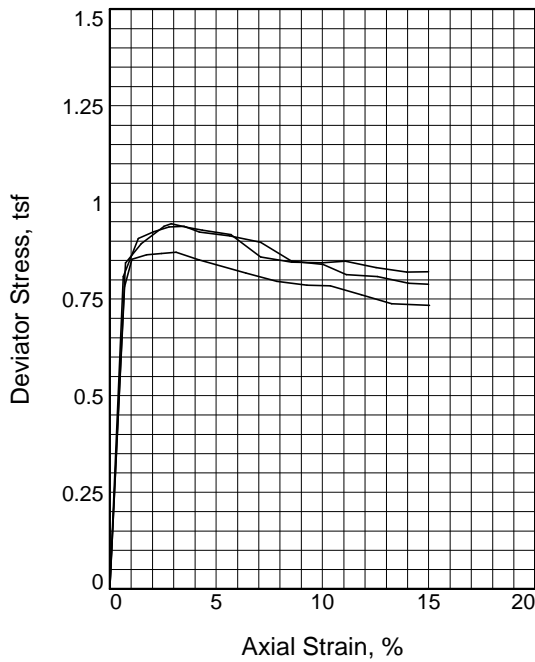
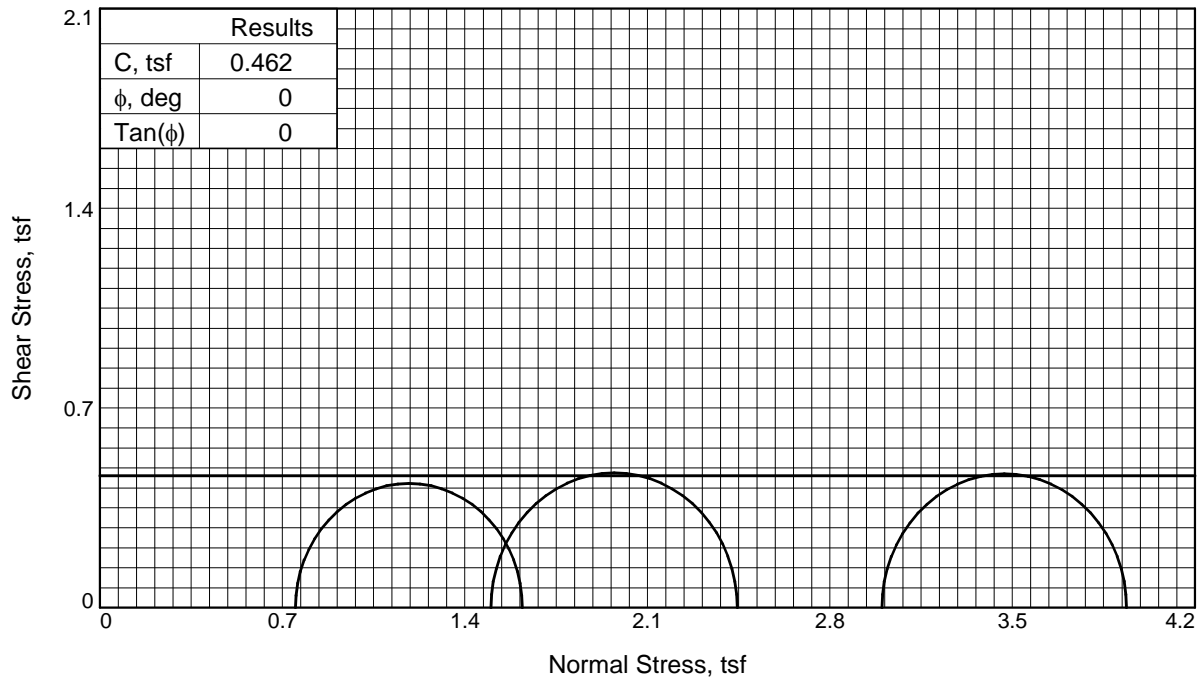
0.00	0.00
0.24	0.42
0.49	0.55
0.73	0.65
0.98	0.73
1.22	0.79
1.47	0.84
1.71	0.88
1.95	0.91
2.20	0.93
2.44	0.95
2.93	0.98
3.42	0.99
3.91	1.00
4.40	1.00
4.88	1.00
5.37	0.99
5.86	0.98
6.35	0.96
6.84	0.96
7.33	0.95
7.81	0.94
8.30	0.93
8.79	0.92
9.28	0.91
9.77	0.90
10.99	0.88
12.21	0.88
13.43	0.87
14.65	0.86
15.87	0.86
17.09	0.84
18.32	0.83
19.54	0.82

Sample 2	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.41
0.49	0.54
0.73	0.63
0.98	0.70
1.22	0.76
1.47	0.81
1.71	0.86
1.95	0.90
2.20	0.93
2.44	0.95
2.93	0.98
3.42	0.99
3.91	1.01
4.40	1.02
4.88	1.03
5.37	1.03
5.86	1.03
6.35	1.03
6.84	1.04
7.33	1.04
7.81	1.02
8.30	1.01
8.79	1.00
9.28	0.99
9.77	0.98
10.99	0.97
12.21	0.96
13.43	0.95
14.65	0.93
15.87	0.92
17.09	0.92
18.32	0.91
19.54	0.90

Sample 3	
Strain (%)	Deviator Stress (tsf)

0.00	0.00
0.24	0.38
0.49	0.55
0.73	0.65
0.98	0.73
1.22	0.80
1.47	0.86
1.71	0.92
1.95	0.96
2.20	1.00
2.44	1.02
2.93	1.05
3.42	1.07
3.91	1.07
4.40	1.05
4.88	1.05
5.37	1.05
5.86	1.03
6.35	1.00
6.84	0.98
7.33	0.96
7.81	0.93
8.30	0.92
8.79	0.90
9.28	0.89
9.77	0.87
10.99	0.84
12.21	0.82
13.43	0.80
14.65	0.78
15.87	0.77
17.09	0.76
18.32	0.75
19.54	0.74



Sample No.		1	2	3
Initial	Water Content, %	70.4	70.8	66.2
	Dry Density, pcf	57.9	57.5	60.1
	Saturation, %	99.2	98.8	99.0
	Void Ratio	1.9222	1.9432	1.8131
	Diameter, in.	1.40	1.41	1.39
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	70.4	70.8	66.2
	Dry Density, pcf	57.9	57.5	60.1
	Saturation, %	99.2	98.8	99.0
	Void Ratio	1.9222	1.9432	1.8131
	Diameter, in.	1.40	1.40	1.39
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		0.75	1.50	3.00
Peak Stress, tsf		0.87	0.94	0.94
Ult. Stress, tsf		0.73	0.82	0.79
σ_1 Failure, tsf		1.62	2.44	3.94
σ_3 Failure, tsf		0.75	1.50	3.00

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 90 PL= 27 PI= 63

Specific Gravity= 2.709

Remarks:

Client: W912ES-11-P-0024

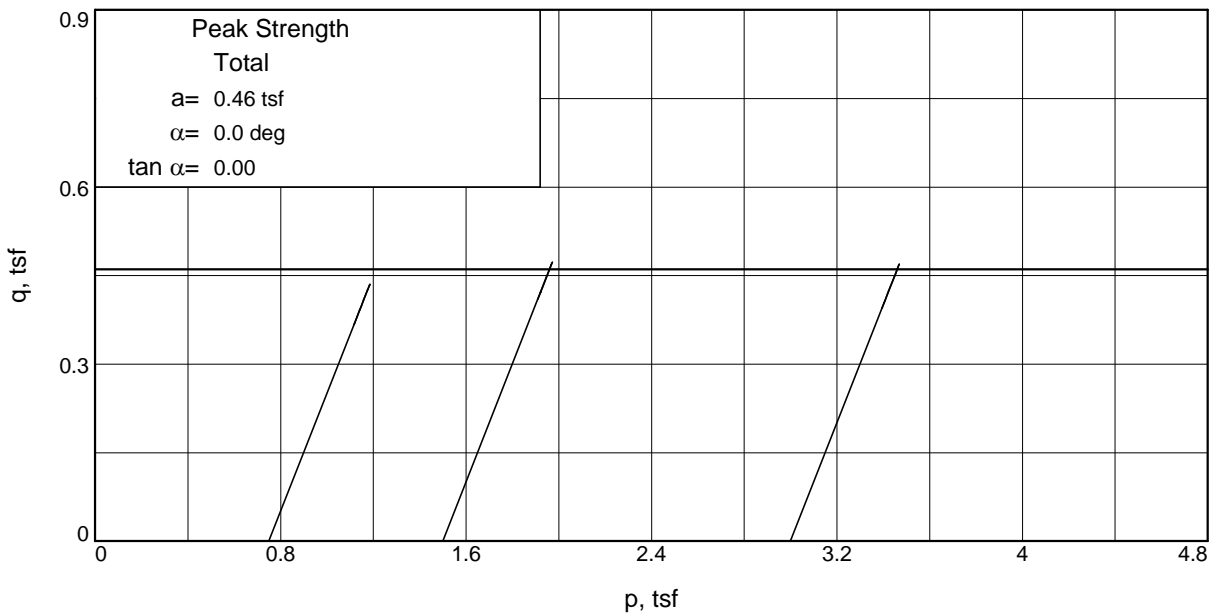
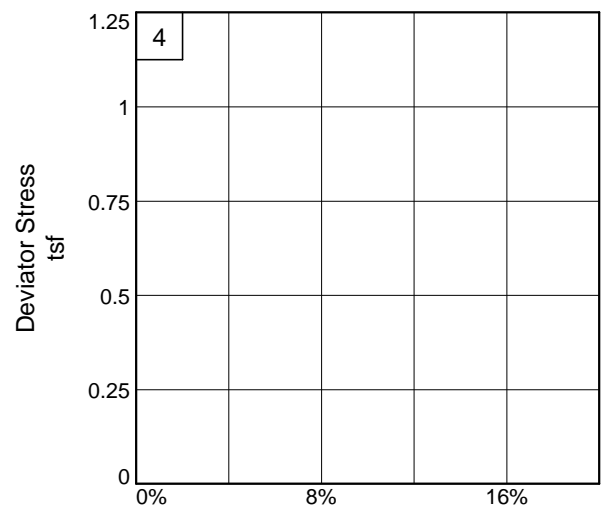
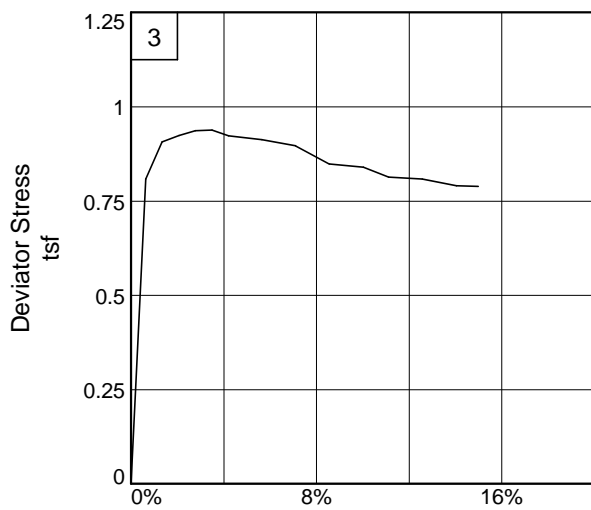
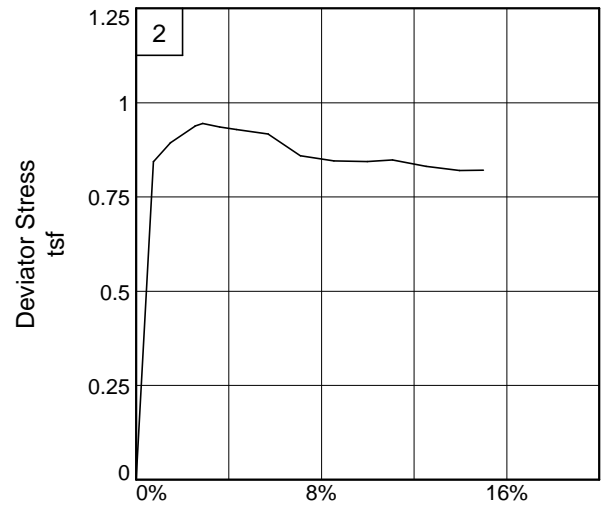
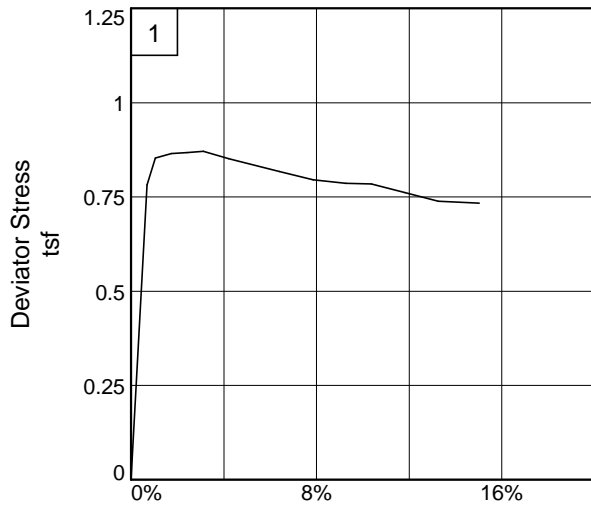
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Maple River, Argusville Formation

Sample Number: Boring10-105MU, #4 **Depth:** 45-47'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Argusville Formation

Depth: 45-47'

Sample No.: Boring10-105MU, #4

Project No.: Boring10-105MU Feasibility Report and Environmental Impact Statement

Braun Intertec
Geotechnical Design and Geology

July 2014

Figure

TRIAxIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

12:05 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Argusville Formation
Depth: 45-47' **Sample Number:** Boring10-105MU, #4
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.709 **LL**=90 **PL**=27 **PI**=63
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	142.120	142.120
Moisture content: Dry soil+tare, gms.	96.060	96.060
Moisture content: Tare, gms.	30.630	30.630
Moisture, %	70.4	70.4
Moist specimen weight, gms.	112.1	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	98.6	
Dry density, pcf	57.9	
Void ratio	1.9222	
Saturation, %	99.2	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 0.871 tsf at reading no. 5
Ult. Stress = 0.733 tsf at reading no. 13

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0062	0.066	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0255	16.900	16.8	0.7	0.782	0.750	1.532	2.04	1.141	0.391
2	0.0356	18.490	18.4	1.0	0.853	0.750	1.603	2.14	1.176	0.426
3	0.0550	18.880	18.8	1.7	0.865	0.750	1.615	2.15	1.182	0.432
4	0.0742	19.080	19.0	2.4	0.868	0.750	1.618	2.16	1.184	0.434
5	0.0938	19.280	19.2	3.1	0.871	0.750	1.621	2.16	1.185	0.435
6	0.1245	19.070	19.0	4.2	0.851	0.750	1.601	2.14	1.176	0.426
7	0.1861	18.730	18.7	6.4	0.817	0.750	1.567	2.09	1.158	0.408
8	0.2272	18.530	18.5	7.9	0.796	0.750	1.546	2.06	1.148	0.398
9	0.2670	18.580	18.5	9.3	0.786	0.750	1.536	2.05	1.143	0.393
10	0.2980	18.780	18.7	10.4	0.784	0.750	1.534	2.05	1.142	0.392
11	0.3390	18.520	18.5	11.8	0.761	0.750	1.511	2.01	1.130	0.380
12	0.3793	18.260	18.2	13.3	0.738	0.750	1.488	1.98	1.119	0.369
13	0.4290	18.520	18.5	15.0	0.733	0.750	1.483	1.98	1.117	0.367

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	142.100	142.100
Moisture content: Dry soil+tare, gms.	95.940	95.940
Moisture content: Tare, gms.	30.780	30.780
Moisture, %	70.8	70.8
Moist specimen weight, gms.	112.1	
Diameter, in.	1.41	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	98.2	
Dry density, pcf	57.5	
Void ratio	1.9432	
Saturation, %	98.8	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 0.945 tsf at reading no. 4
 Ult. Stress = 0.821 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0073	2.070	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0282	20.380	18.3	0.7	0.844	1.500	2.344	1.56	1.922	0.422
2	0.0487	21.600	19.5	1.5	0.894	1.500	2.394	1.60	1.947	0.447
3	0.0786	22.790	20.7	2.5	0.938	1.500	2.438	1.63	1.969	0.469
4	0.0882	23.020	20.9	2.9	0.945	1.500	2.445	1.63	1.972	0.472
5	0.1087	22.970	20.9	3.6	0.936	1.500	2.436	1.62	1.968	0.468
6	0.1293	22.970	20.9	4.3	0.928	1.500	2.428	1.62	1.964	0.464
7	0.1674	23.000	20.9	5.7	0.917	1.500	2.417	1.61	1.958	0.458
8	0.2066	21.970	19.9	7.1	0.859	1.500	2.359	1.57	1.929	0.429
9	0.2471	21.980	19.9	8.5	0.846	1.500	2.346	1.56	1.923	0.423

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
10	0.2873	22.240	20.2	10.0	0.843	1.500	2.343	1.56	1.922	0.422
11	0.3180	22.600	20.5	11.1	0.848	1.500	2.348	1.57	1.924	0.424
12	0.3585	22.530	20.5	12.5	0.831	1.500	2.331	1.55	1.916	0.416
13	0.3993	22.590	20.5	14.0	0.820	1.500	2.320	1.55	1.910	0.410
14	0.4280	22.860	20.8	15.0	0.821	1.500	2.321	1.55	1.910	0.410

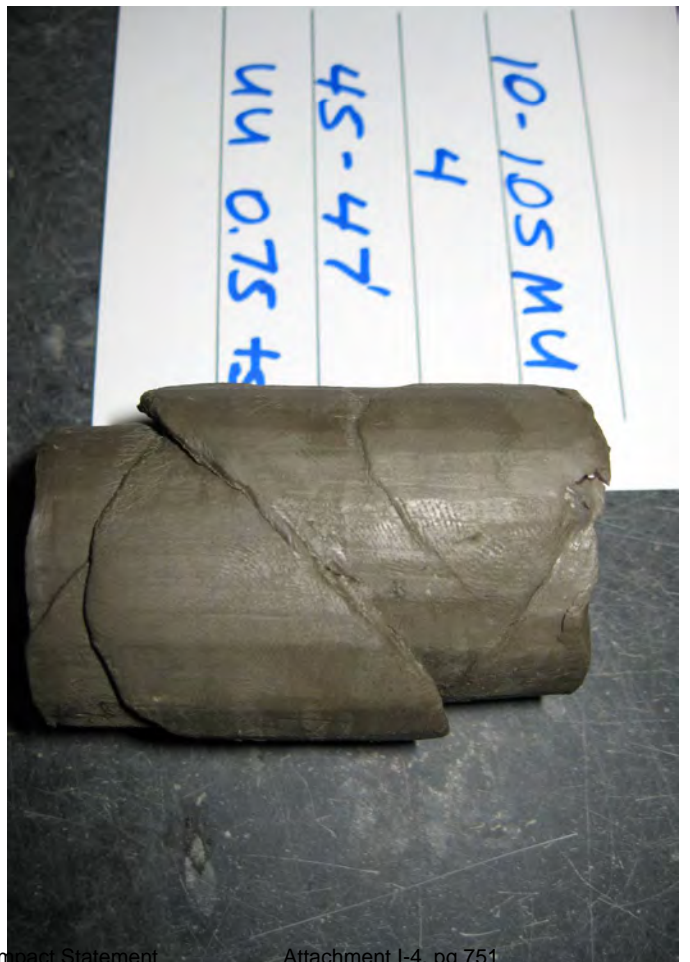
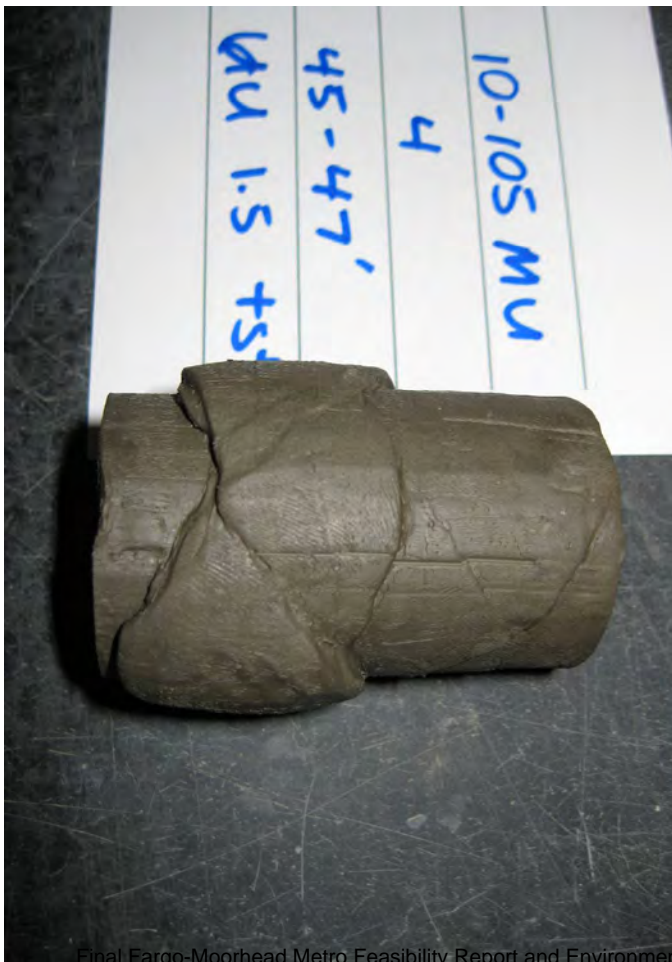
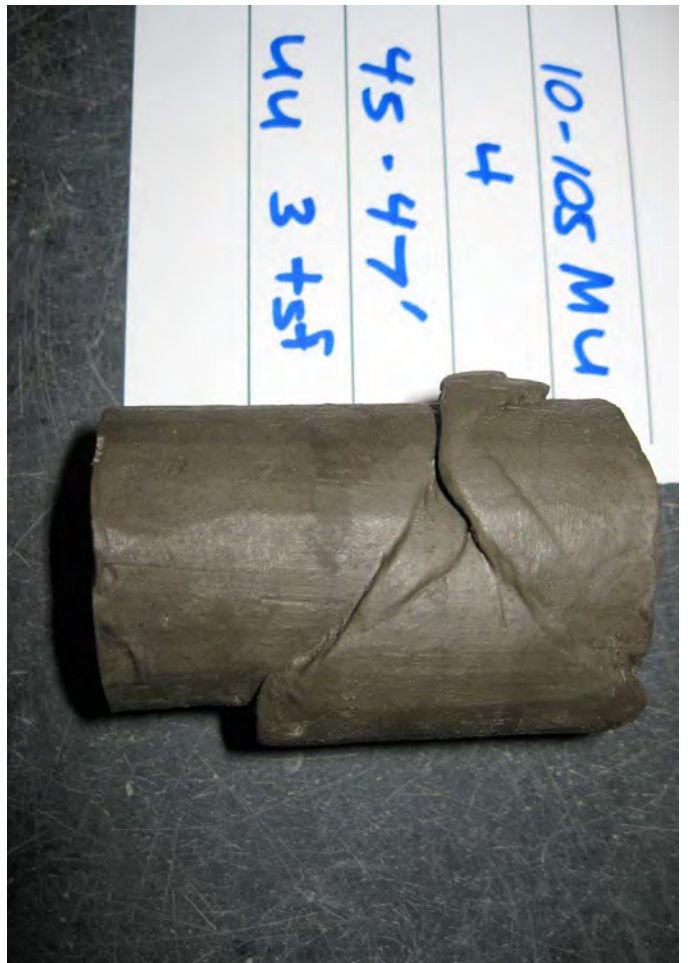
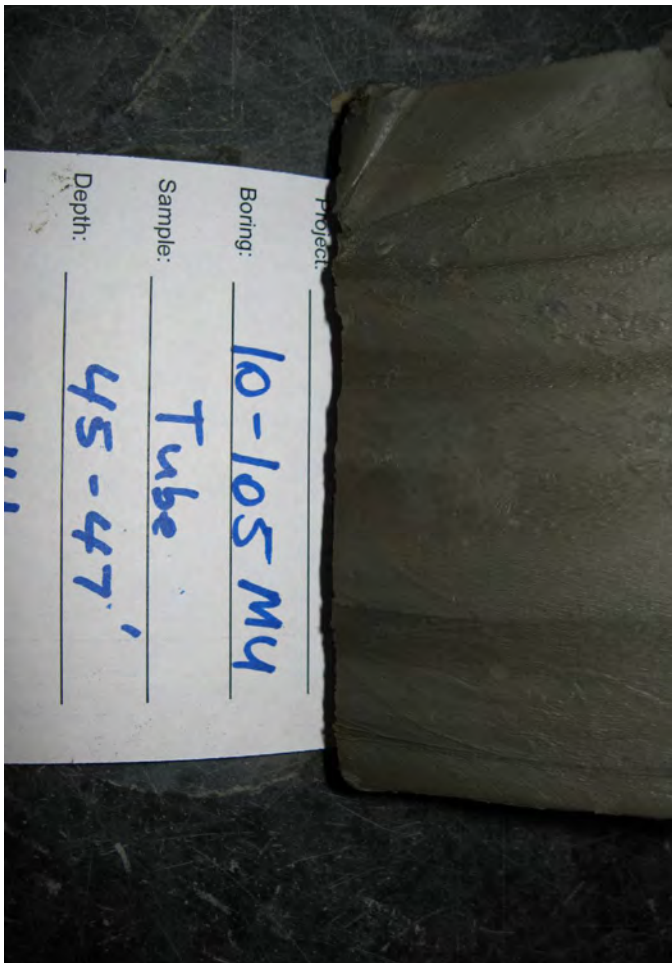
Parameters for Specimen No. 3

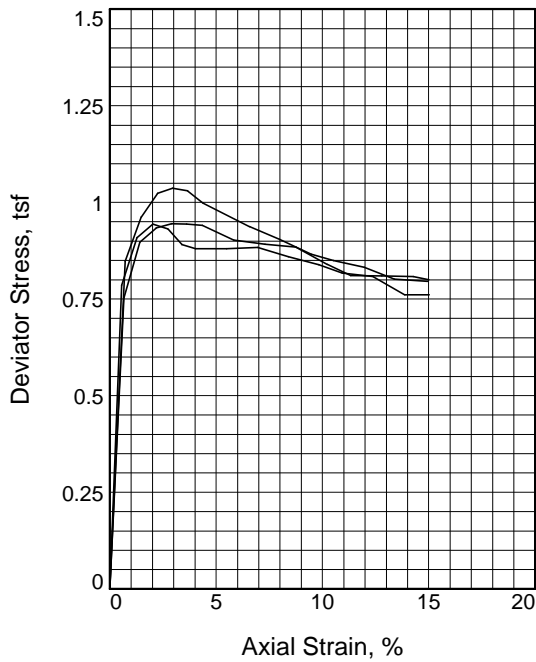
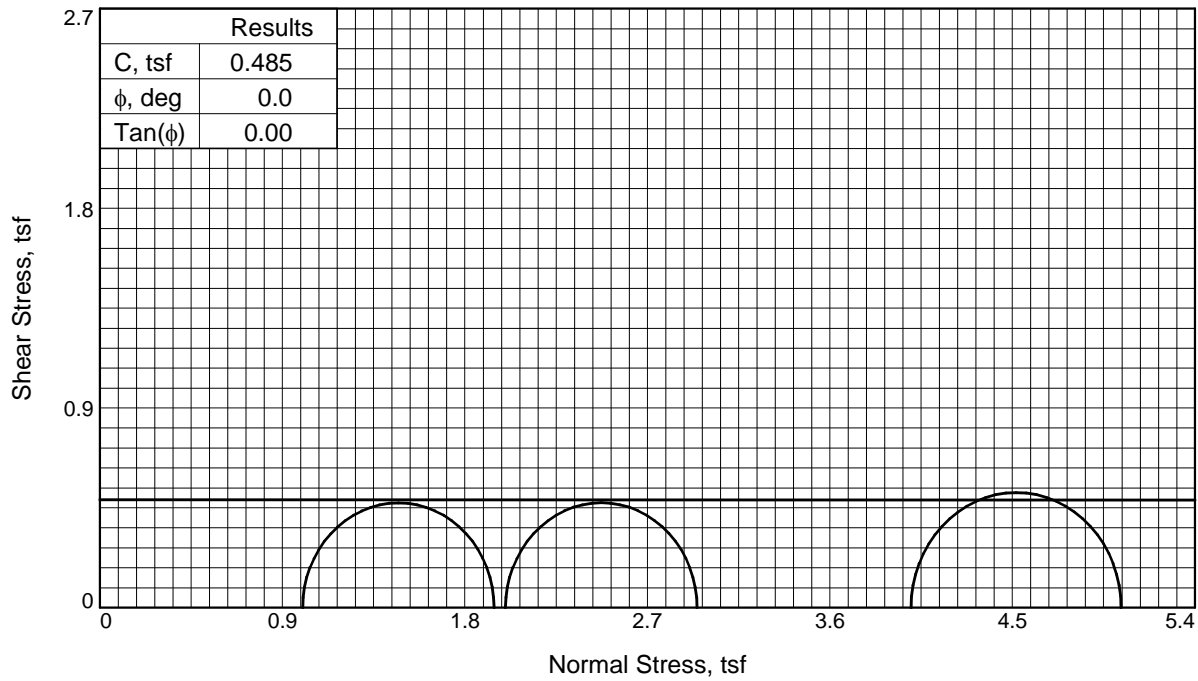
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	142.020	142.020
Moisture content: Dry soil+tare, gms.	97.520	97.520
Moisture content: Tare, gms.	30.330	30.330
Moisture, %	66.2	66.2
Moist specimen weight, gms.	112.4	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	99.9	
Dry density, pcf	60.1	
Void ratio	1.8131	
Saturation, %	99.0	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 0.938 tsf at reading no. 5
 Ult. Stress = 0.788 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	6.980	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0242	24.190	17.2	0.6	0.808	3.000	3.808	1.27	3.404	0.404
2	0.0442	26.430	19.5	1.3	0.907	3.000	3.907	1.30	3.453	0.453
3	0.0646	26.950	20.0	2.1	0.924	3.000	3.924	1.31	3.462	0.462
4	0.0846	27.370	20.4	2.8	0.936	3.000	3.936	1.31	3.468	0.468
5	0.1045	27.550	20.6	3.5	0.938	3.000	3.938	1.31	3.469	0.469
6	0.1248	27.370	20.4	4.2	0.923	3.000	3.923	1.31	3.461	0.461
7	0.1653	27.460	20.5	5.7	0.913	3.000	3.913	1.30	3.456	0.456
8	0.2061	27.410	20.4	7.1	0.897	3.000	3.897	1.30	3.448	0.448
9	0.2472	26.610	19.6	8.6	0.848	3.000	3.848	1.28	3.424	0.424
10	0.2883	26.730	19.8	10.0	0.840	3.000	3.840	1.28	3.420	0.420
11	0.3190	26.340	19.4	11.1	0.813	3.000	3.813	1.27	3.406	0.406
12	0.3600	26.540	19.6	12.6	0.808	3.000	3.808	1.27	3.404	0.404
13	0.4015	26.450	19.5	14.1	0.791	3.000	3.791	1.26	3.395	0.395
14	0.4280	26.610	19.6	15.0	0.788	3.000	3.788	1.26	3.394	0.394





Sample No.		1	2	3
Initial	Water Content, %	53.8	57.4	54.5
	Dry Density, pcf	68.9	66.1	68.3
	Saturation, %	100.4	100.1	100.1
	Void Ratio	1.4443	1.5465	1.4674
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	53.8	57.4	54.5
	Dry Density, pcf	68.9	66.1	68.3
	Saturation, %	100.4	100.1	100.1
	Void Ratio	1.4443	1.5465	1.4674
	Diameter, in.	1.40	1.39	1.40
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.00	2.00	4.00
Peak Stress, tsf		0.94	0.94	1.04
Ult. Stress, tsf		0.76	0.80	0.80
σ_1 Failure, tsf		1.94	2.94	5.04
σ_3 Failure, tsf		1.00	2.00	4.00

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 91

PL= 25

PI= 66

Specific Gravity= 2.698

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

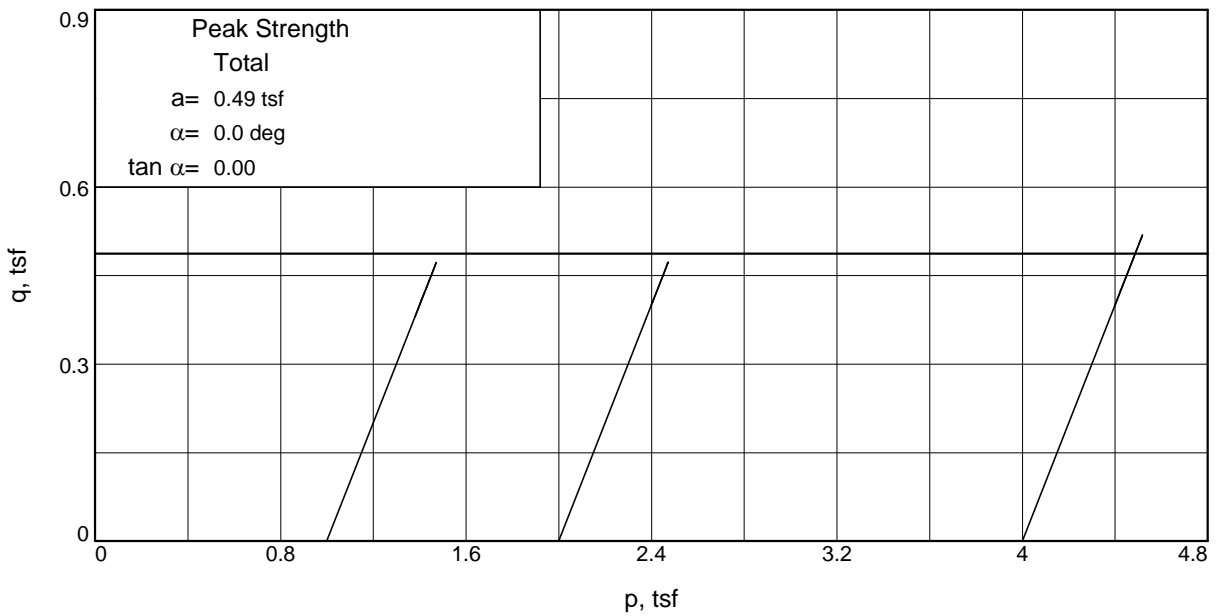
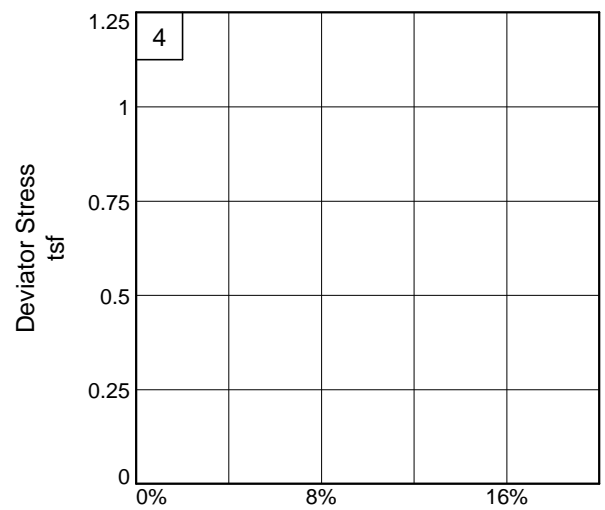
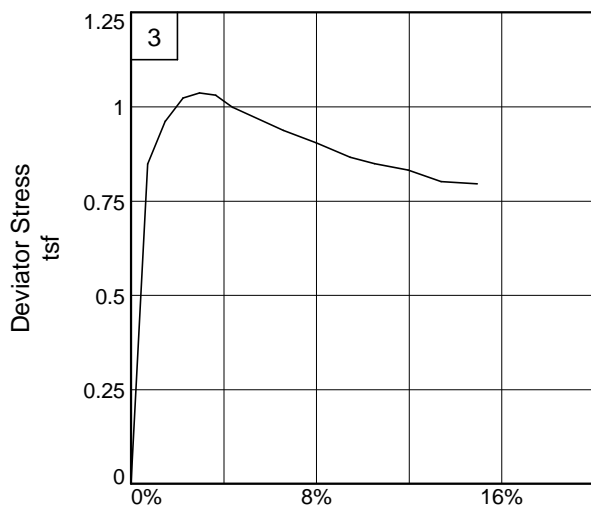
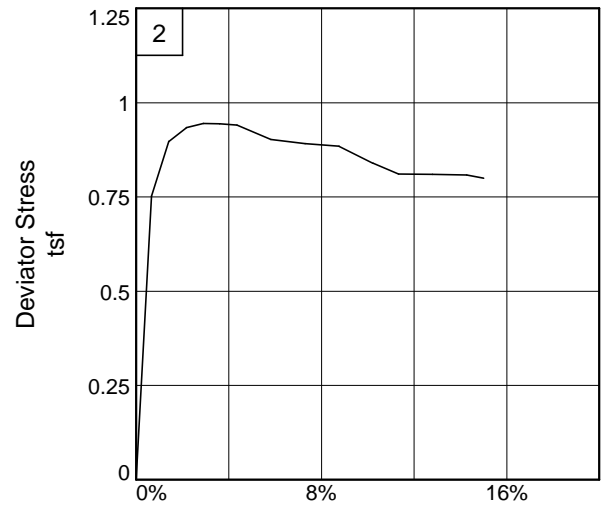
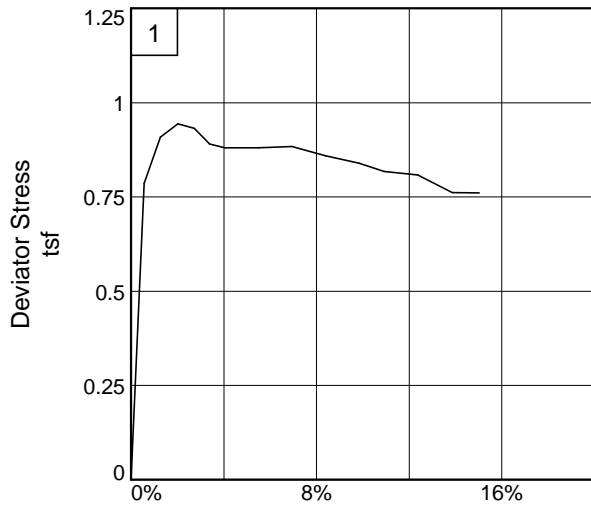
Location: Maple River, Argusville Formation

Sample Number: Boring10-105MU, #5 **Depth:** 55-57'

Proj. No.: BL-10-10065

Date Sampled:





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Maple River, Argusville Formation

Depth: 55-57'

Sample No.: Boring10-105MU, #5

Project No.: Boring10-105MU Feasibility Report and Environmental Impact Statement

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Geotechnical Design and Geology

July 2014

Figure

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

12:06 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Argusville Formation
Depth: 55-57' **Sample Number:** Boring10-105MU, #5
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.698 **LL**=91 **PL**=25 **PI**=66
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	149.320	149.320
Moisture content: Dry soil+tare, gms.	107.720	107.720
Moisture content: Tare, gms.	30.330	30.330
Moisture, %	53.8	53.8
Moist specimen weight, gms.	119.5	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	105.9	
Dry density, pcf	68.9	
Void ratio	1.4443	
Saturation, %	100.4	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 0.944 tsf at reading no. 3
Ult. Stress = 0.761 tsf at reading no. 14

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	1.970	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0224	18.790	16.8	0.6	0.786	1.000	1.786	1.79	1.393	0.393
2	0.0423	21.570	19.6	1.3	0.909	1.000	1.909	1.91	1.454	0.454
3	0.0630	22.480	20.5	2.0	0.944	1.000	1.944	1.94	1.472	0.472
4	0.0830	22.360	20.4	2.7	0.932	1.000	1.932	1.93	1.466	0.466
5	0.1014	21.590	19.6	3.4	0.890	1.000	1.890	1.89	1.445	0.445
6	0.1199	21.500	19.5	4.0	0.880	1.000	1.880	1.88	1.440	0.440
7	0.1606	21.800	19.8	5.5	0.880	1.000	1.880	1.88	1.440	0.440
8	0.2015	22.180	20.2	7.0	0.883	1.000	1.883	1.88	1.442	0.442
9	0.2423	21.940	20.0	8.4	0.859	1.000	1.859	1.86	1.430	0.430
10	0.2824	21.780	19.8	9.8	0.839	1.000	1.839	1.84	1.420	0.420
11	0.3130	21.500	19.5	10.9	0.817	1.000	1.817	1.82	1.409	0.409
12	0.3540	21.600	19.6	12.4	0.808	1.000	1.808	1.81	1.404	0.404
13	0.3959	20.780	18.8	13.9	0.761	1.000	1.761	1.76	1.380	0.380
14	0.4280	21.030	19.1	15.0	0.761	1.000	1.761	1.76	1.380	0.380

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	146.420	146.420
Moisture content: Dry soil+tare, gms.	103.950	103.950
Moisture content: Tare, gms.	29.940	29.940
Moisture, %	57.4	57.4
Moist specimen weight, gms.	117.0	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	104.1	
Dry density, pcf	66.1	
Void ratio	1.5465	
Saturation, %	100.1	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 0.945 tsf at reading no. 4
 Ult. Stress = 0.800 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	4.420	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0253	20.470	16.0	0.7	0.752	2.000	2.752	1.38	2.376	0.376
2	0.0462	23.710	19.3	1.4	0.897	2.000	2.897	1.45	2.449	0.449
3	0.0678	24.650	20.2	2.2	0.934	2.000	2.934	1.47	2.467	0.467
4	0.0881	25.050	20.6	2.9	0.945	2.000	2.945	1.47	2.472	0.472
5	0.1080	25.170	20.8	3.6	0.944	2.000	2.944	1.47	2.472	0.472
6	0.1289	25.260	20.8	4.4	0.940	2.000	2.940	1.47	2.470	0.470
7	0.1701	24.730	20.3	5.8	0.902	2.000	2.902	1.45	2.451	0.451
8	0.2113	24.800	20.4	7.3	0.891	2.000	2.891	1.45	2.446	0.446
9	0.2526	24.960	20.5	8.8	0.884	2.000	2.884	1.44	2.442	0.442
10	0.2937	24.250	19.8	10.2	0.840	2.000	2.840	1.42	2.420	0.420
11	0.3247	23.800	19.4	11.3	0.811	2.000	2.811	1.41	2.405	0.405
12	0.3656	24.100	19.7	12.8	0.810	2.000	2.810	1.40	2.405	0.405
13	0.4070	24.400	20.0	14.3	0.808	2.000	2.808	1.40	2.404	0.404
14	0.4275	24.360	19.9	15.0	0.800	2.000	2.800	1.40	2.400	0.400

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	148.370	148.370
Moisture content: Dry soil+tare, gms.	106.710	106.710
Moisture content: Tare, gms.	30.200	30.200
Moisture, %	54.5	54.5
Moist specimen weight, gms.	118.8	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.80	
Wet Density, pcf	105.4	
Dry density, pcf	68.3	
Void ratio	1.4674	
Saturation, %	100.1	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

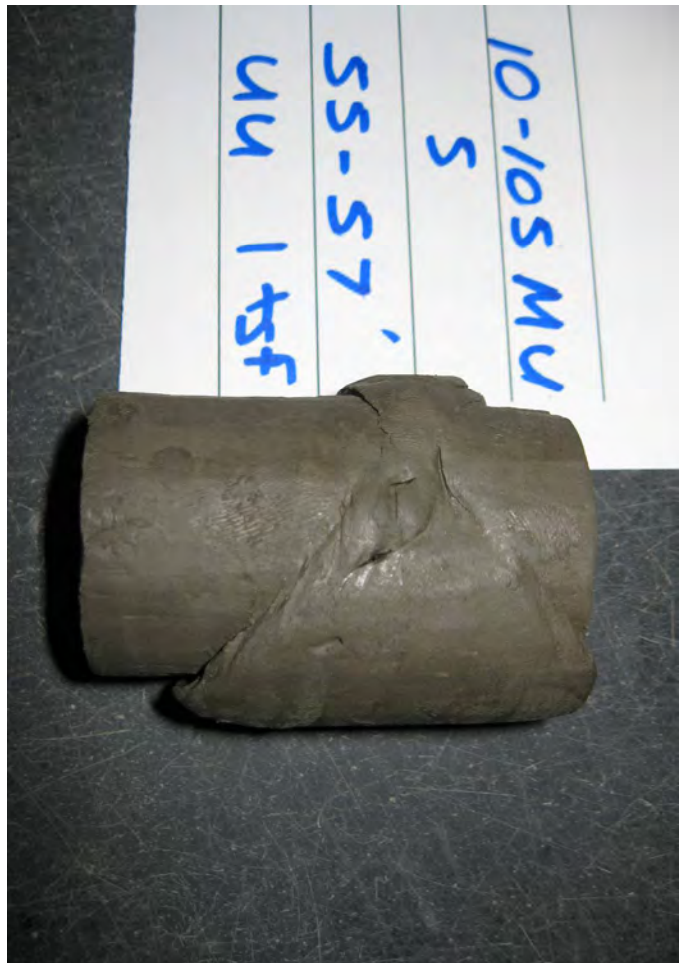
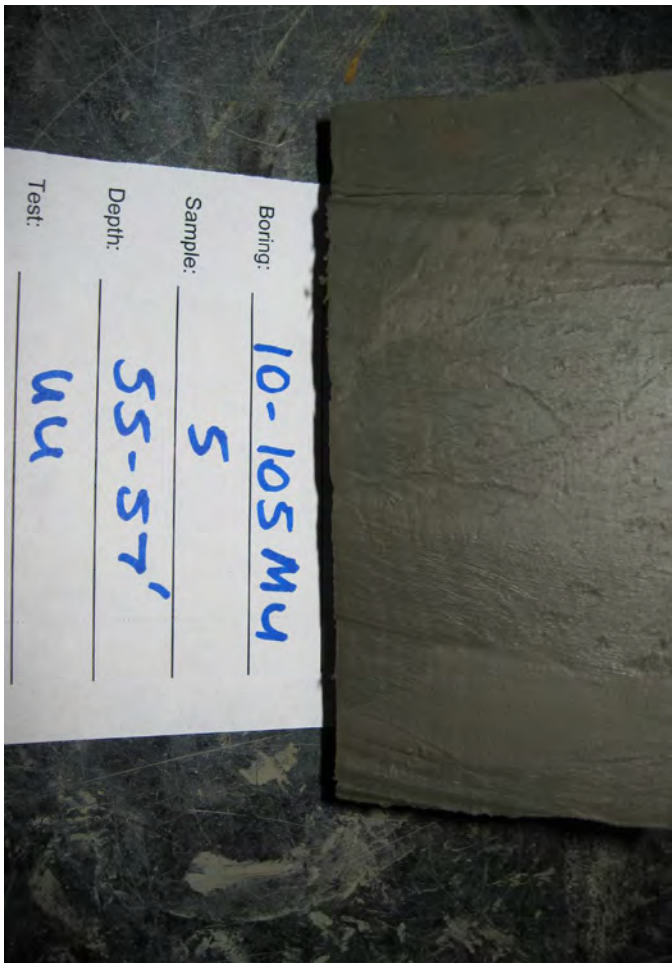
Back pressure = 0.000 tsf

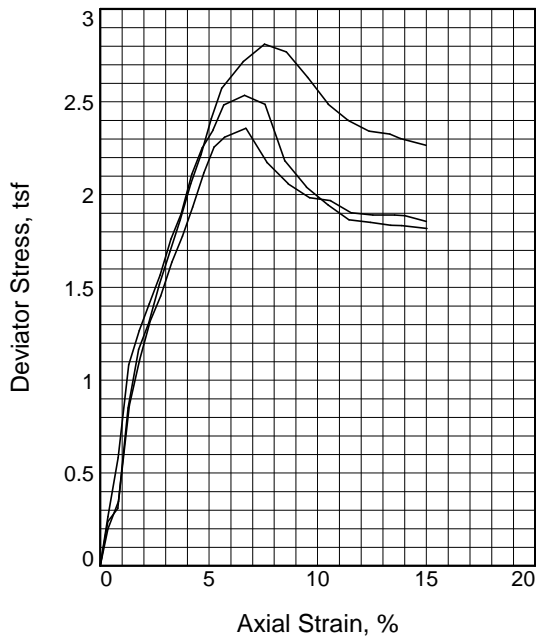
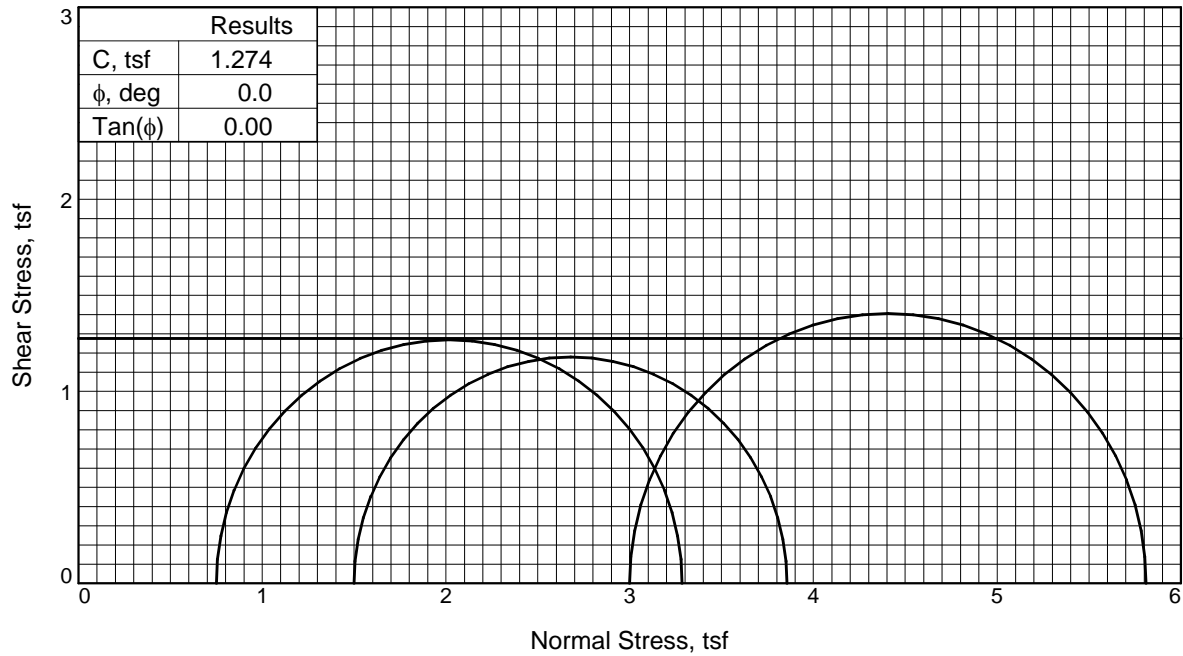
Strain rate, %/min. = 1.00

Peak Stress = 1.037 tsf at reading no. 4

Ult. Stress = 0.796 tsf at reading no. 13

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0082	10.520	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0284	28.680	18.2	0.7	0.848	4.000	4.848	1.21	4.424	0.424
2	0.0498	31.270	20.8	1.5	0.962	4.000	4.962	1.24	4.481	0.481
3	0.0710	32.770	22.3	2.2	1.023	4.000	5.023	1.26	4.512	0.512
4	0.0911	33.230	22.7	3.0	1.037	4.000	5.037	1.26	4.518	0.518
5	0.1108	33.253	22.7	3.7	1.030	4.000	5.030	1.26	4.515	0.515
6	0.1312	32.710	22.2	4.4	0.998	4.000	4.998	1.25	4.499	0.499
7	0.1926	31.850	21.3	6.6	0.937	4.000	4.937	1.23	4.469	0.469
8	0.2324	31.400	20.9	8.0	0.904	4.000	4.904	1.23	4.452	0.452
9	0.2738	30.850	20.3	9.5	0.866	4.000	4.866	1.22	4.433	0.433
10	0.3031	30.690	20.2	10.5	0.849	4.000	4.849	1.21	4.425	0.425
11	0.3437	30.600	20.1	12.0	0.832	4.000	4.832	1.21	4.416	0.416
12	0.3837	30.180	19.7	13.4	0.801	4.000	4.801	1.20	4.400	0.400
13	0.4275	30.410	19.9	15.0	0.796	4.000	4.796	1.20	4.398	0.398





Sample No.	1	2	3	
Initial	Water Content, %	39.3	40.1	36.2
	Dry Density, pcf	81.4	80.5	84.8
	Saturation, %	99.8	99.5	99.8
	Void Ratio	1.0555	1.0791	0.9734
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.81
At Test	Water Content, %	39.3	40.1	36.2
	Dry Density, pcf	81.4	80.5	84.8
	Saturation, %	99.8	99.5	99.8
	Void Ratio	1.0555	1.0791	0.9734
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.80	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	2.54	2.36	2.81	
Ult. Stress, tsf	1.82	1.86	2.27	
σ_1 Failure, tsf	3.29	3.86	5.81	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 60

PL= 18

PI= 42

Specific Gravity= 2.681

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Argusville Formation

Sample Number: Boring11-107MU, #3

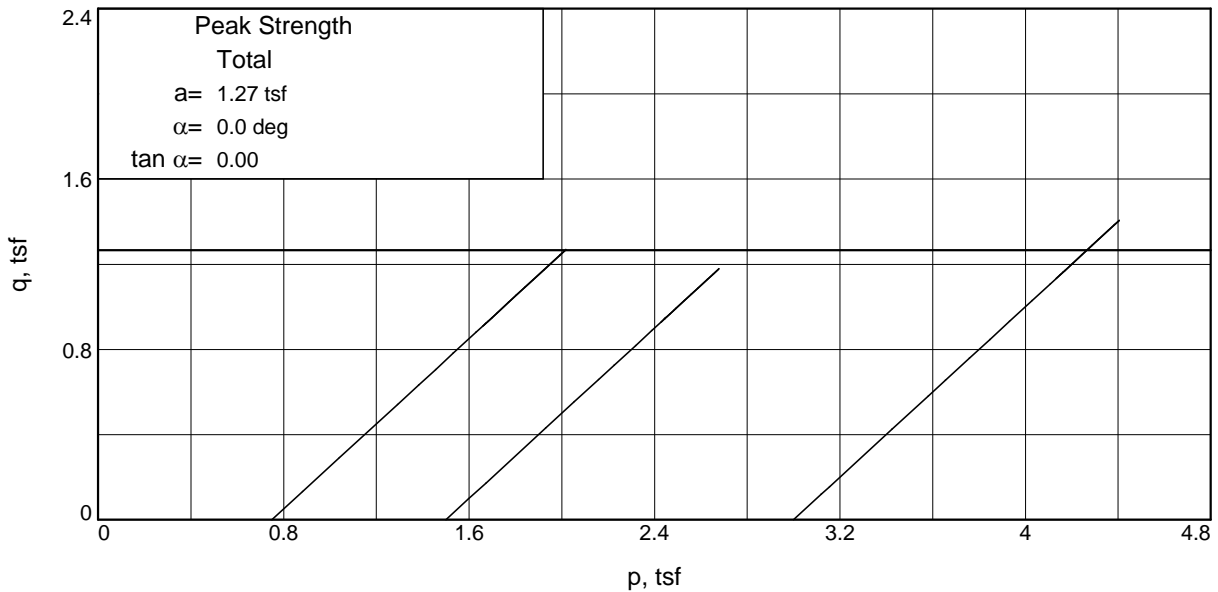
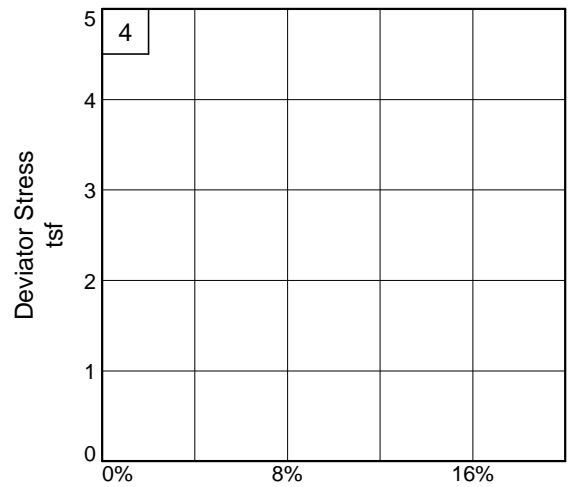
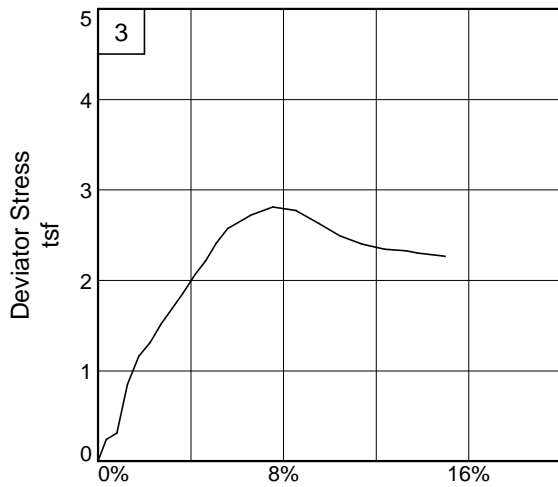
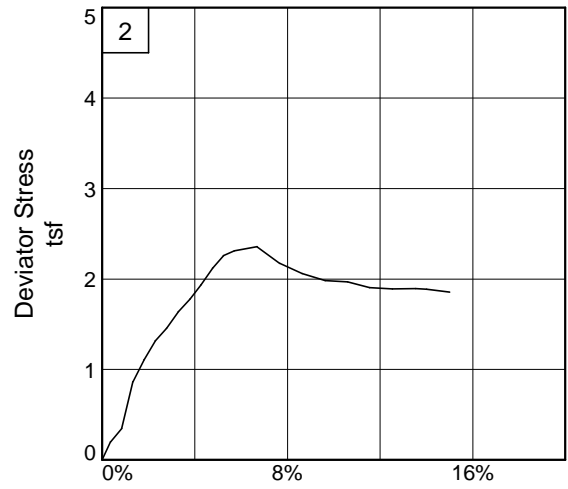
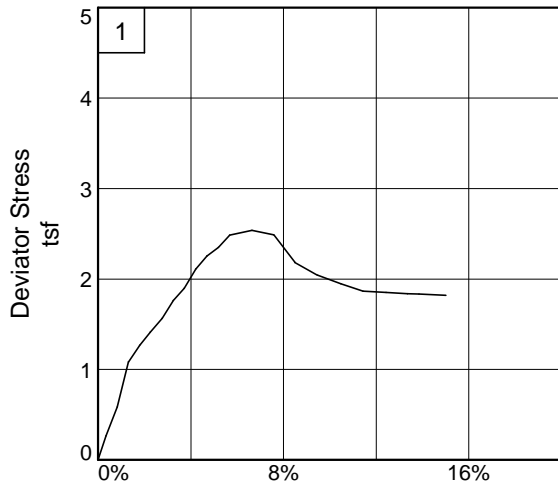
Depth: 40-42'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Argusville Formation

Depth: 40-42'

Sample No.: Boring11-107MU, #3

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:15 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Argusville Formation
Depth: 40-42' **Sample Number:** Boring11-107MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.681 **LL=**60 **PL=**18 **PI=**42
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	157.130	157.130
Moisture content: Dry soil+tare, gms.	121.370	121.370
Moisture content: Tare, gms.	30.390	30.390
Moisture, %	39.3	39.3
Moist specimen weight, gms.	126.9	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	113.4	
Dry density, pcf	81.4	
Void ratio	1.0555	
Saturation, %	99.8	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.536 tsf at reading no. 13
Ult. Stress = 1.819 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	1.060	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0163	6.670	5.6	0.3	0.264	0.750	1.014	1.35	0.882	0.132
2	0.0295	13.480	12.4	0.8	0.583	0.750	1.333	1.78	1.041	0.291
3	0.0432	24.250	23.2	1.3	1.083	0.750	1.833	2.44	1.291	0.541
4	0.0567	28.340	27.3	1.8	1.268	0.750	2.018	2.69	1.384	0.634
5	0.0697	31.580	30.5	2.3	1.411	0.750	2.161	2.88	1.456	0.706
6	0.0838	35.090	34.0	2.8	1.566	0.750	2.316	3.09	1.533	0.783
7	0.0975	39.550	38.5	3.2	1.762	0.750	2.512	3.35	1.631	0.881
8	0.1107	42.720	41.7	3.7	1.898	0.750	2.648	3.53	1.699	0.949
9	0.1245	47.600	46.5	4.2	2.109	0.750	2.859	3.81	1.805	1.055
10	0.1381	51.050	50.0	4.7	2.254	0.750	3.004	4.01	1.877	1.127
11	0.1518	53.400	52.3	5.2	2.348	0.750	3.098	4.13	1.924	1.174
12	0.1655	56.700	55.6	5.7	2.483	0.750	3.233	4.31	1.991	1.241
13	0.1926	58.470	57.4	6.6	2.536	0.750	3.286	4.38	2.018	1.268
14	0.2189	57.950	56.9	7.6	2.487	0.750	3.237	4.32	1.994	1.244
15	0.2445	51.450	50.4	8.5	2.181	0.750	2.931	3.91	1.841	1.091
16	0.2720	48.760	47.7	9.5	2.043	0.750	2.793	3.72	1.771	1.021
17	0.3001	46.990	45.9	10.5	1.945	0.750	2.695	3.59	1.723	0.973
18	0.3271	45.580	44.5	11.4	1.865	0.750	2.615	3.49	1.683	0.933
19	0.3548	45.720	44.7	12.4	1.850	0.750	2.600	3.47	1.675	0.925
20	0.3809	45.830	44.8	13.4	1.835	0.750	2.585	3.45	1.668	0.918
21	0.3948	46.060	45.0	13.9	1.834	0.750	2.584	3.45	1.667	0.917
22	0.4273	46.300	45.2	15.0	1.819	0.750	2.569	3.43	1.659	0.909

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	155.880	155.880
Moisture content: Dry soil+tare, gms.	119.820	119.820
Moisture content: Tare, gms.	29.810	29.810
Moisture, %	40.1	40.1
Moist specimen weight, gms.	126.3	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	112.8	
Dry density, pcf	80.5	
Void ratio	1.0791	
Saturation, %	99.5	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf

Back pressure = 0.000 tsf

Strain rate, %/min. = 1.00

Peak Stress = 2.357 tsf at reading no. 13

Ult. Stress = 1.855 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	3.470	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0165	7.680	4.2	0.4	0.198	1.500	1.698	1.13	1.599	0.099
2	0.0300	10.890	7.4	0.8	0.348	1.500	1.848	1.23	1.674	0.174
3	0.0438	22.000	18.5	1.3	0.864	1.500	2.364	1.58	1.932	0.432
4	0.0571	27.370	23.9	1.8	1.109	1.500	2.609	1.74	2.054	0.554
5	0.0707	32.010	28.5	2.3	1.317	1.500	2.817	1.88	2.159	0.659
6	0.0844	35.120	31.7	2.8	1.454	1.500	2.954	1.97	2.227	0.727
7	0.0986	39.300	35.8	3.3	1.637	1.500	3.137	2.09	2.318	0.818
8	0.1125	42.570	39.1	3.8	1.777	1.500	3.277	2.18	2.389	0.889
9	0.1257	46.200	42.7	4.3	1.933	1.500	3.433	2.29	2.466	0.966
10	0.1398	50.560	47.1	4.8	2.119	1.500	3.619	2.41	2.559	1.059
11	0.1533	53.890	50.4	5.2	2.257	1.500	3.757	2.50	2.629	1.129
12	0.1663	55.330	51.9	5.7	2.310	1.500	3.810	2.54	2.655	1.155
13	0.1939	56.940	53.5	6.7	2.357	1.500	3.857	2.57	2.678	1.178
14	0.2211	53.280	49.8	7.7	2.173	1.500	3.673	2.45	2.586	1.086
15	0.2484	51.170	47.7	8.6	2.059	1.500	3.559	2.37	2.529	1.029
16	0.2762	49.920	46.5	9.6	1.983	1.500	3.483	2.32	2.492	0.992
17	0.3033	50.050	46.6	10.6	1.967	1.500	3.467	2.31	2.484	0.984
18	0.3301	49.010	45.5	11.6	1.903	1.500	3.403	2.27	2.451	0.951
19	0.3576	49.220	45.8	12.5	1.890	1.500	3.390	2.26	2.445	0.945
20	0.3855	49.770	46.3	13.5	1.891	1.500	3.391	2.26	2.446	0.946
21	0.3989	49.940	46.5	14.0	1.888	1.500	3.388	2.26	2.444	0.944
22	0.4266	49.680	46.2	15.0	1.855	1.500	3.355	2.24	2.428	0.928

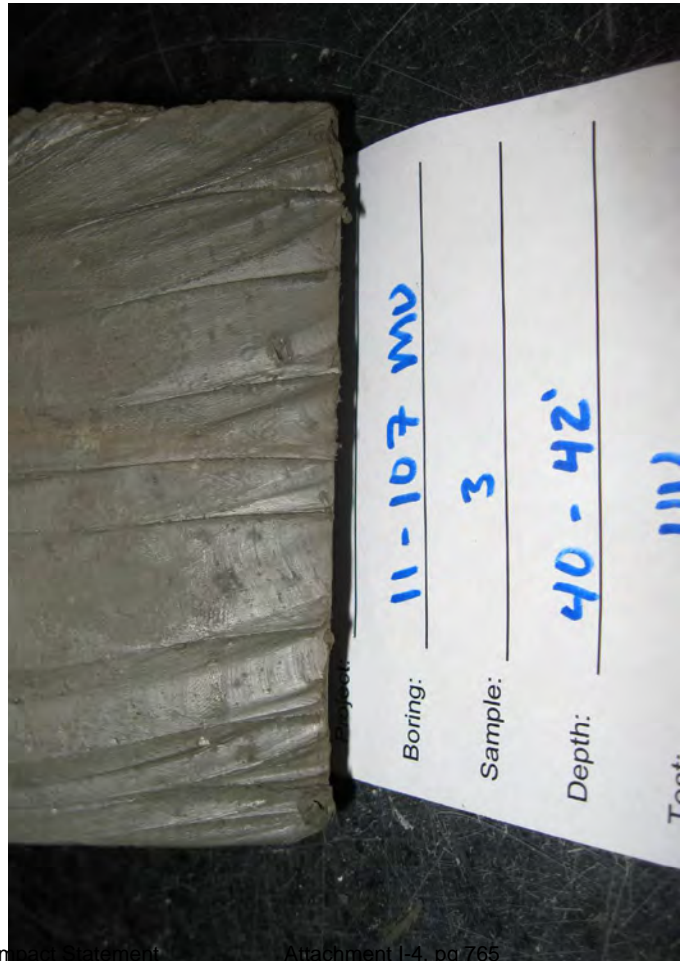
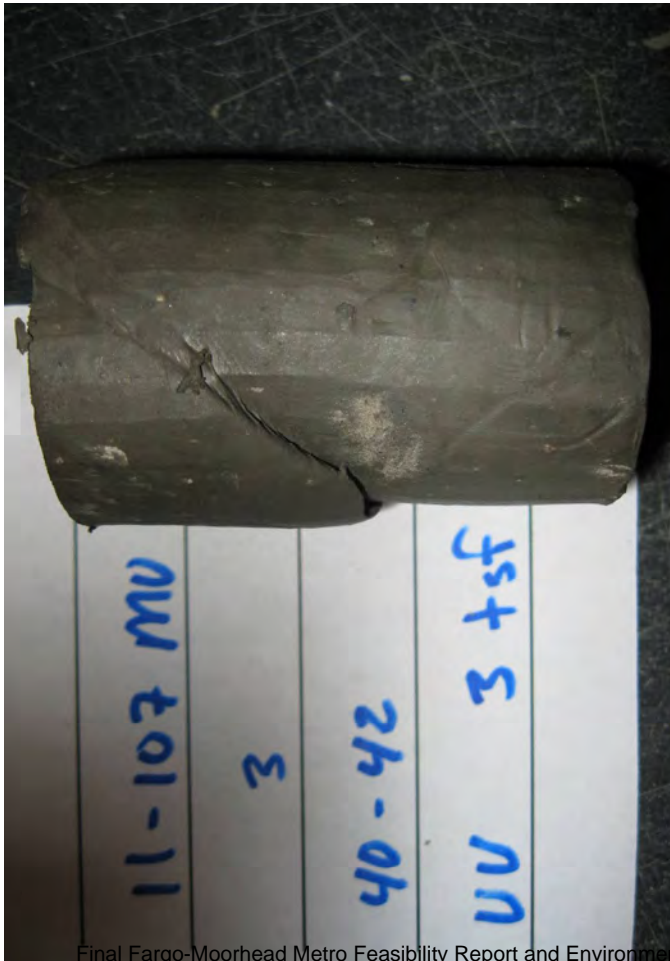
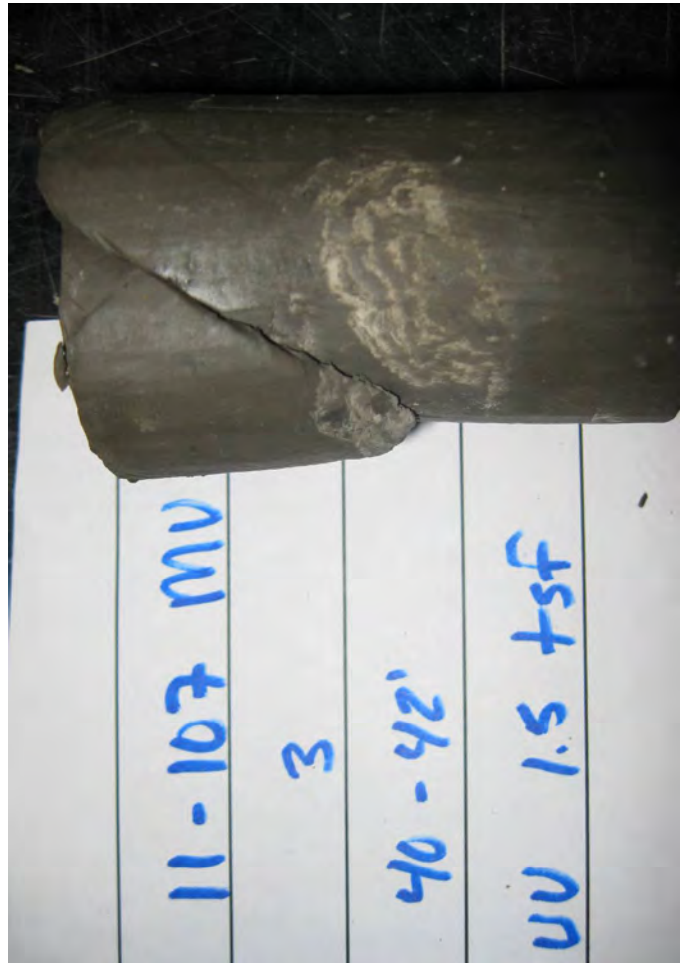
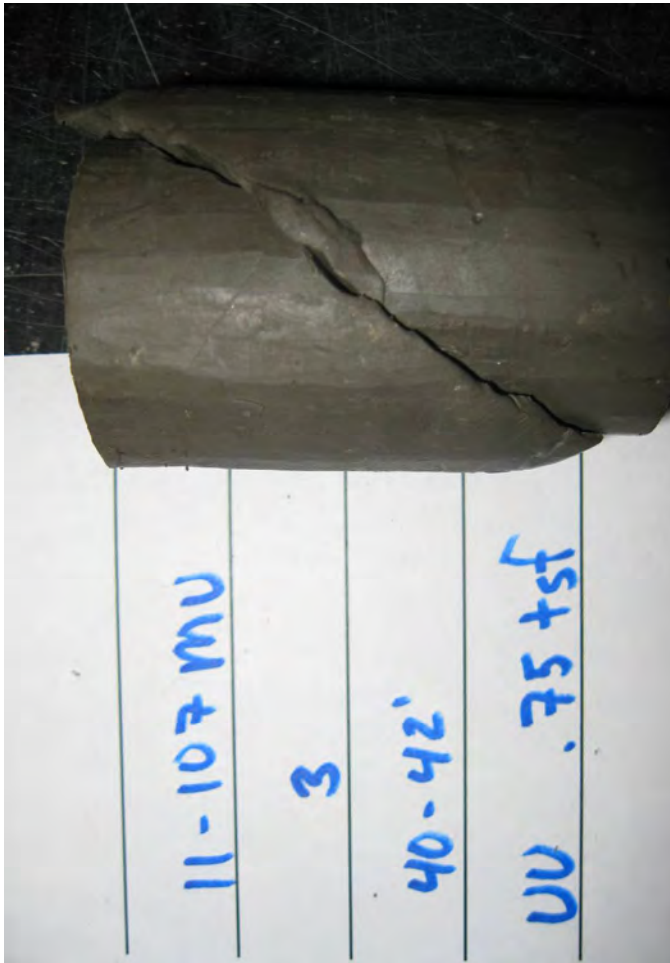
Parameters for Specimen No. 3

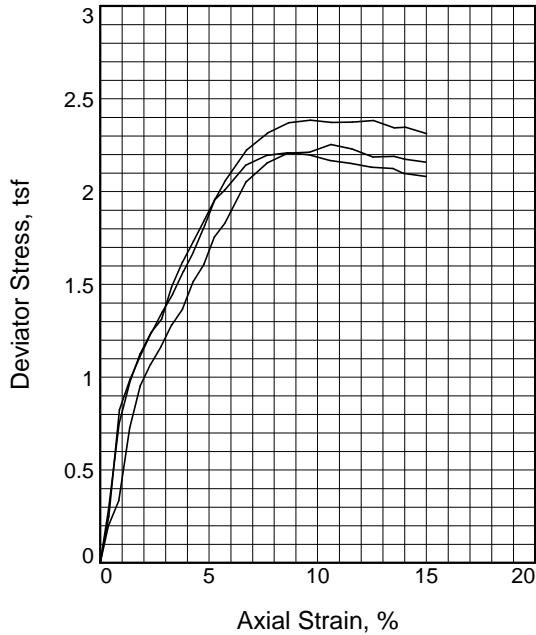
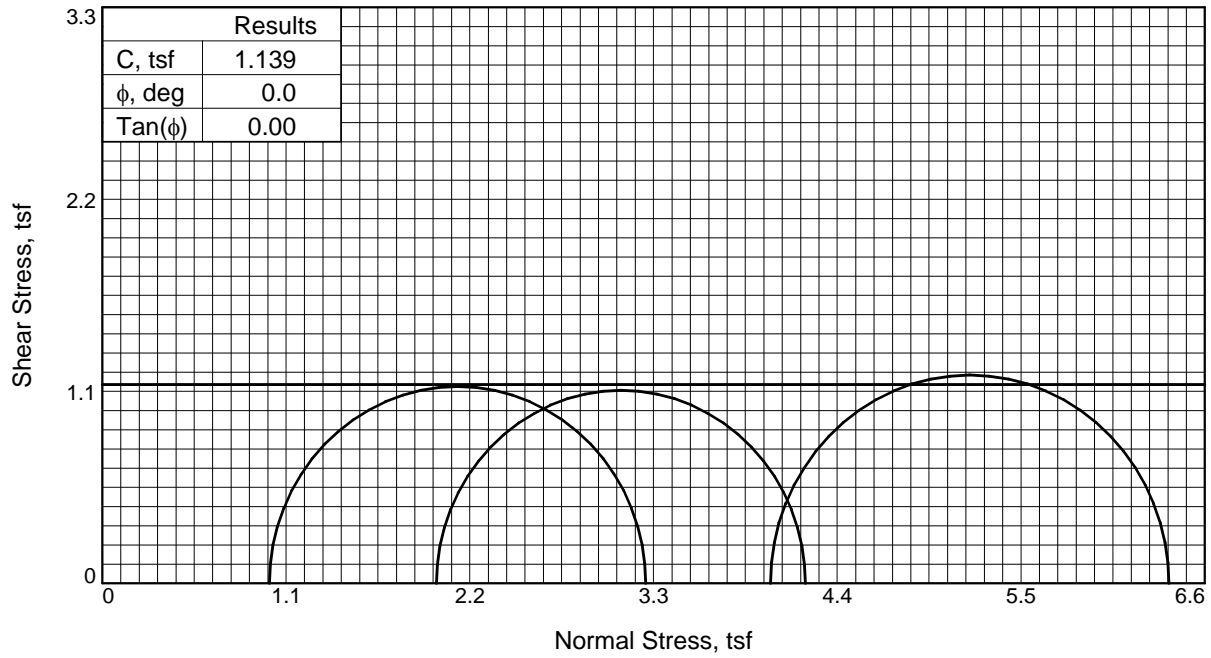
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	161.200	161.200
Moisture content: Dry soil+tare, gms.	126.460	126.460
Moisture content: Tare, gms.	30.580	30.580
Moisture, %	36.2	36.2
Moist specimen weight, gms.	130.8	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.81	
Wet Density, pcf	115.5	
Dry density, pcf	84.8	
Void ratio	0.9734	
Saturation, %	99.8	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 2.811 tsf at reading no. 14
 Ult. Stress = 2.266 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	6.860	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0163	12.020	5.2	0.4	0.241	3.000	3.241	1.08	3.120	0.120
2	0.0292	13.570	6.7	0.8	0.312	3.000	3.312	1.10	3.156	0.156
3	0.0422	25.260	18.4	1.3	0.851	3.000	3.851	1.28	3.425	0.425
4	0.0560	32.190	25.3	1.8	1.165	3.000	4.165	1.39	3.583	0.583
5	0.0690	35.490	28.6	2.2	1.311	3.000	4.311	1.44	3.656	0.656
6	0.0827	40.190	33.3	2.7	1.519	3.000	4.519	1.51	3.759	0.759
7	0.0965	44.220	37.4	3.2	1.694	3.000	4.694	1.56	3.847	0.847
8	0.1096	48.180	41.3	3.7	1.864	3.000	4.864	1.62	3.932	0.932
9	0.1235	52.760	45.9	4.2	2.060	3.000	5.060	1.69	4.030	1.030
10	0.1365	56.490	49.6	4.6	2.217	3.000	5.217	1.74	4.108	1.108
11	0.1496	61.060	54.2	5.1	2.409	3.000	5.409	1.80	4.205	1.205
12	0.1635	65.090	58.2	5.6	2.575	3.000	5.575	1.86	4.287	1.287
13	0.1911	68.970	62.1	6.6	2.718	3.000	5.718	1.91	4.359	1.359
14	0.2182	71.780	64.9	7.5	2.811	3.000	5.811	1.94	4.406	1.406
15	0.2463	71.530	64.7	8.5	2.770	3.000	5.770	1.92	4.385	1.385
16	0.2740	68.970	62.1	9.5	2.632	3.000	5.632	1.88	4.316	1.316
17	0.3003	66.190	59.3	10.5	2.488	3.000	5.488	1.83	4.244	1.244
18	0.3264	64.700	57.8	11.4	2.400	3.000	5.400	1.80	4.200	1.200
19	0.3536	63.930	57.1	12.4	2.342	3.000	5.342	1.78	4.171	1.171
20	0.3803	64.150	57.3	13.3	2.326	3.000	5.326	1.78	4.163	1.163
21	0.3938	63.900	57.0	13.8	2.303	3.000	5.303	1.77	4.151	1.151
22	0.4270	63.780	56.9	15.0	2.266	3.000	5.266	1.76	4.133	1.133





Sample No.	1	2	3	
Initial	Water Content, %	34.0	34.1	33.2
	Dry Density, pcf	87.6	87.8	89.0
	Saturation, %	99.4	99.9	99.8
	Void Ratio	0.9267	0.9227	0.8984
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.80	2.81	2.80
At Test	Water Content, %	34.0	34.1	33.2
	Dry Density, pcf	87.6	87.8	89.0
	Saturation, %	99.4	99.9	99.8
	Void Ratio	0.9267	0.9227	0.8984
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.80	2.81	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.00	2.00	4.00	
Peak Stress, tsf	2.25	2.21	2.39	
Ult. Stress, tsf	2.16	2.08	2.31	
σ_1 Failure, tsf	3.25	4.21	6.39	
σ_3 Failure, tsf	1.00	2.00	4.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 63

PL= 19

PI= 44

Specific Gravity= 2.705

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: ND RRCS, MN, Argusville Formation

Sample Number: Boring11-107MU, #4

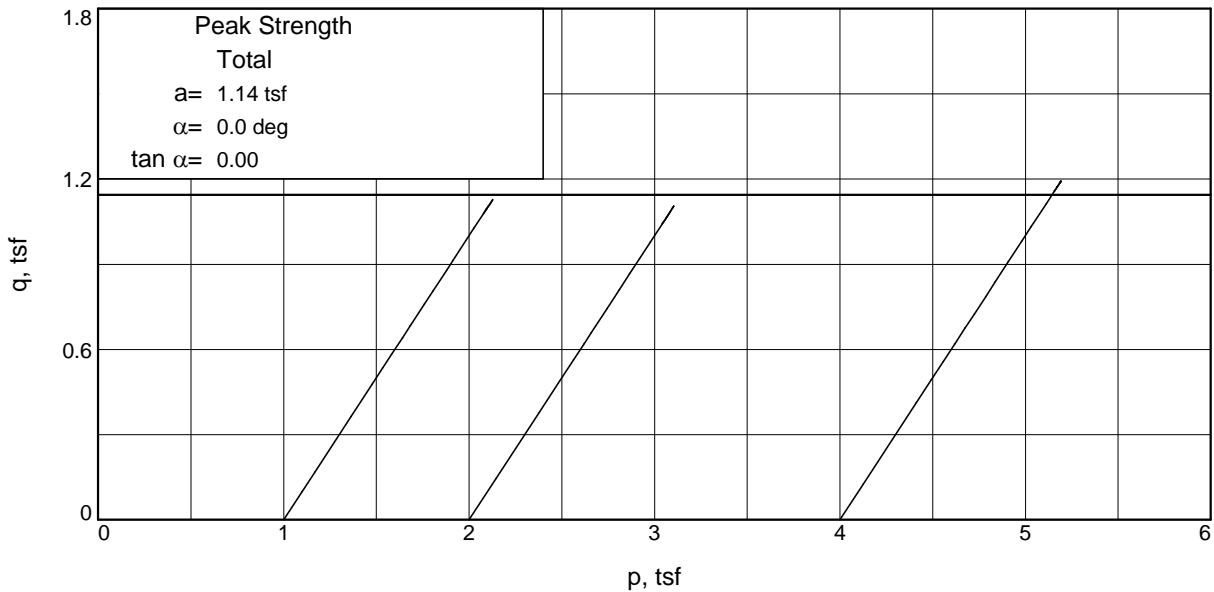
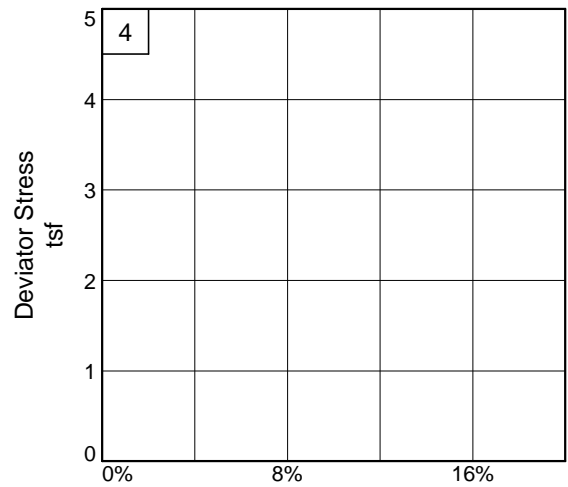
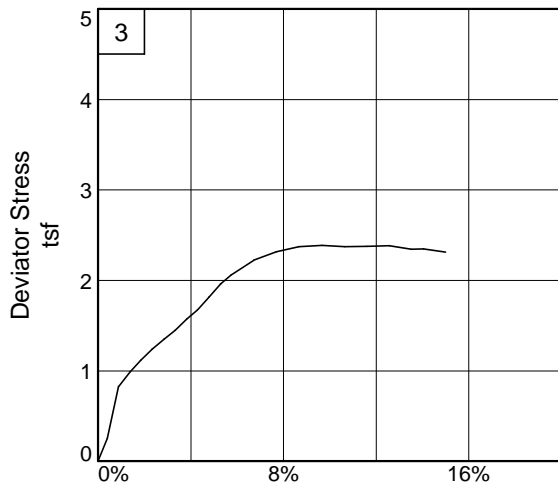
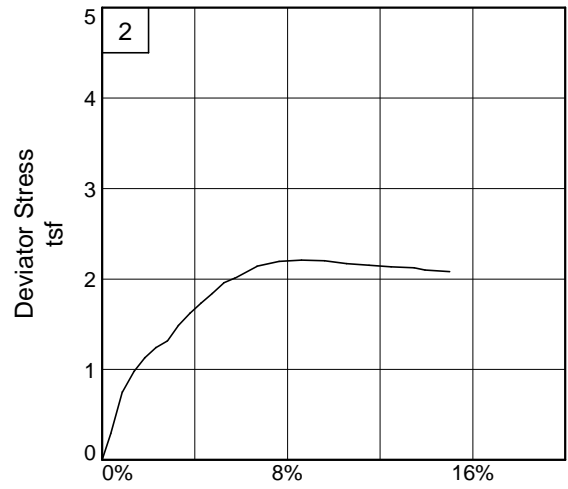
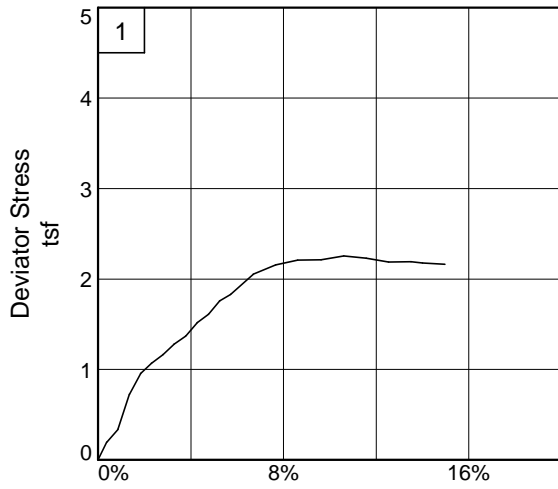
Depth: 50-52'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: ND RRCS, MN, Argusville Formation

Depth: 50-52'

Sample No.: Boring11-107MU, #4

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:16 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: ND RRCS, MN, Argusville Formation
Depth: 50-52' **Sample Number:** Boring11-107MU, #4
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.705 **LL**=63 **PL**=19 **PI**=44
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	161.080	161.080
Moisture content: Dry soil+tare, gms.	127.870	127.870
Moisture content: Tare, gms.	30.300	30.300
Moisture, %	34.0	34.0
Moist specimen weight, gms.	131.0	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	117.5	
Dry density, pcf	87.6	
Void ratio	0.9267	
Saturation, %	99.4	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.254 tsf at reading no. 17
Ult. Stress = 2.160 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0063	0.940	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0168	5.090	4.2	0.4	0.196	1.000	1.196	1.20	1.098	0.098
2	0.0303	8.050	7.1	0.9	0.335	1.000	1.335	1.33	1.167	0.167
3	0.0441	16.440	15.5	1.3	0.727	1.000	1.727	1.73	1.363	0.363
4	0.0579	21.390	20.5	1.8	0.954	1.000	1.954	1.95	1.477	0.477
5	0.0711	23.980	23.0	2.3	1.069	1.000	2.069	2.07	1.535	0.535
6	0.0849	26.180	25.2	2.8	1.166	1.000	2.166	2.17	1.583	0.583
7	0.0985	28.830	27.9	3.3	1.282	1.000	2.282	2.28	1.641	0.641
8	0.1125	30.880	29.9	3.8	1.369	1.000	2.369	2.37	1.684	0.684
9	0.1263	34.300	33.4	4.3	1.517	1.000	2.517	2.52	1.759	0.759
10	0.1398	36.520	35.6	4.8	1.610	1.000	2.610	2.61	1.805	0.805
11	0.1536	39.970	39.0	5.3	1.757	1.000	2.757	2.76	1.879	0.879
12	0.1667	41.800	40.9	5.7	1.830	1.000	2.830	2.83	1.915	0.915
13	0.1940	47.240	46.3	6.7	2.053	1.000	3.053	3.05	2.026	1.026
14	0.2211	50.050	49.1	7.7	2.155	1.000	3.155	3.15	2.077	1.077
15	0.2481	51.780	50.8	8.6	2.207	1.000	3.207	3.21	2.104	1.104
16	0.2763	52.460	51.5	9.6	2.212	1.000	3.212	3.21	2.106	1.106
17	0.3039	54.010	53.1	10.6	2.254	1.000	3.254	3.25	2.127	1.127
18	0.3309	54.010	53.1	11.6	2.230	1.000	3.230	3.23	2.115	1.115
19	0.3578	53.560	52.6	12.5	2.187	1.000	3.187	3.19	2.093	1.093
20	0.3852	54.260	53.3	13.5	2.191	1.000	3.191	3.19	2.096	1.096
21	0.3990	54.190	53.3	14.0	2.176	1.000	3.176	3.18	2.088	1.088
22	0.4261	54.410	53.5	15.0	2.160	1.000	3.160	3.16	2.080	1.080

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	162.370	162.370
Moisture content: Dry soil+tare, gms.	129.000	129.000
Moisture content: Tare, gms.	31.050	31.050
Moisture, %	34.1	34.1
Moist specimen weight, gms.	131.5	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	117.8	
Dry density, pcf	87.8	
Void ratio	0.9227	
Saturation, %	99.9	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 2.209 tsf at reading no. 15
 Ult. Stress = 2.082 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	3.380	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0172	9.480	6.1	0.4	0.289	2.000	2.289	1.14	2.144	0.144
2	0.0309	19.310	15.9	0.9	0.750	2.000	2.750	1.38	2.375	0.375
3	0.0450	24.220	20.8	1.4	0.977	2.000	2.977	1.49	2.488	0.488
4	0.0583	27.580	24.2	1.8	1.129	2.000	3.129	1.56	2.564	0.564
5	0.0719	30.110	26.7	2.3	1.241	2.000	3.241	1.62	2.620	0.620
6	0.0857	31.850	28.5	2.8	1.315	2.000	3.315	1.66	2.657	0.657
7	0.0988	35.730	32.3	3.3	1.487	2.000	3.487	1.74	2.743	0.743
8	0.1128	38.840	35.5	3.8	1.621	2.000	3.621	1.81	2.811	0.811
9	0.1266	41.500	38.1	4.3	1.734	2.000	3.734	1.87	2.867	0.867
10	0.1400	44.030	40.6	4.8	1.840	2.000	3.840	1.92	2.920	0.920
11	0.1540	46.840	43.5	5.3	1.957	2.000	3.957	1.98	2.978	0.978
12	0.1674	48.240	44.9	5.7	2.009	2.000	4.009	2.00	3.005	1.005
13	0.1943	51.690	48.3	6.7	2.142	2.000	4.142	2.07	3.071	1.071
14	0.2212	53.400	50.0	7.6	2.195	2.000	4.195	2.10	3.097	1.097
15	0.2482	54.260	50.9	8.6	2.209	2.000	4.209	2.10	3.105	1.105
16	0.2761	54.590	51.2	9.6	2.200	2.000	4.200	2.10	3.100	1.100
17	0.3031	54.380	51.0	10.6	2.167	2.000	4.167	2.08	3.084	1.084
18	0.3300	54.590	51.2	11.5	2.153	2.000	4.153	2.08	3.076	1.076
19	0.3567	54.650	51.3	12.5	2.132	2.000	4.132	2.07	3.066	1.066
20	0.3847	55.050	51.7	13.5	2.124	2.000	4.124	2.06	3.062	1.062
21	0.3978	54.710	51.3	13.9	2.099	2.000	4.099	2.05	3.049	1.049
22	0.4277	54.930	51.5	15.0	2.082	2.000	4.082	2.04	3.041	1.041

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	159.980	159.980
Moisture content: Dry soil+tare, gms.	127.650	127.650
Moisture content: Tare, gms.	30.140	30.140
Moisture, %	33.2	33.2
Moist specimen weight, gms.	130.0	
Diameter, in.	1.38	
Area, in. ²	1.49	
Height, in.	2.80	
Wet Density, pcf	118.4	
Dry density, pcf	89.0	
Void ratio	0.8984	
Saturation, %	99.8	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

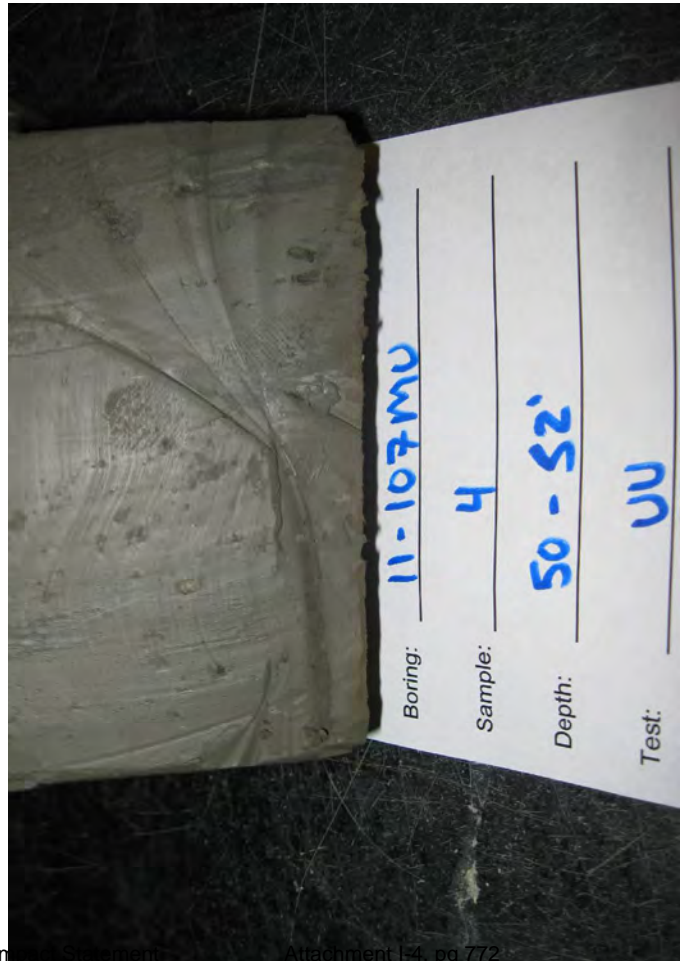
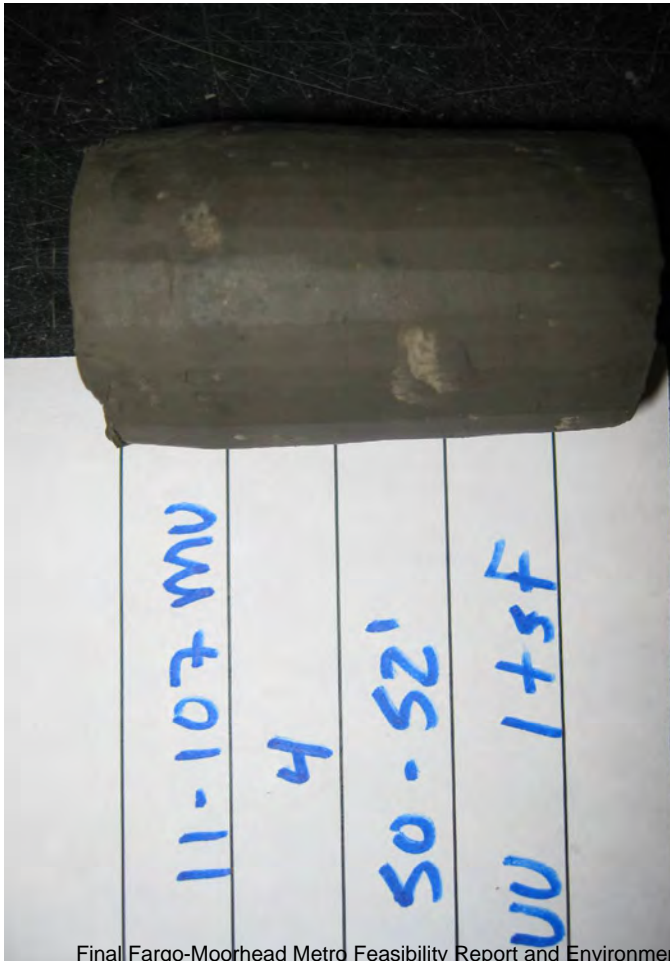
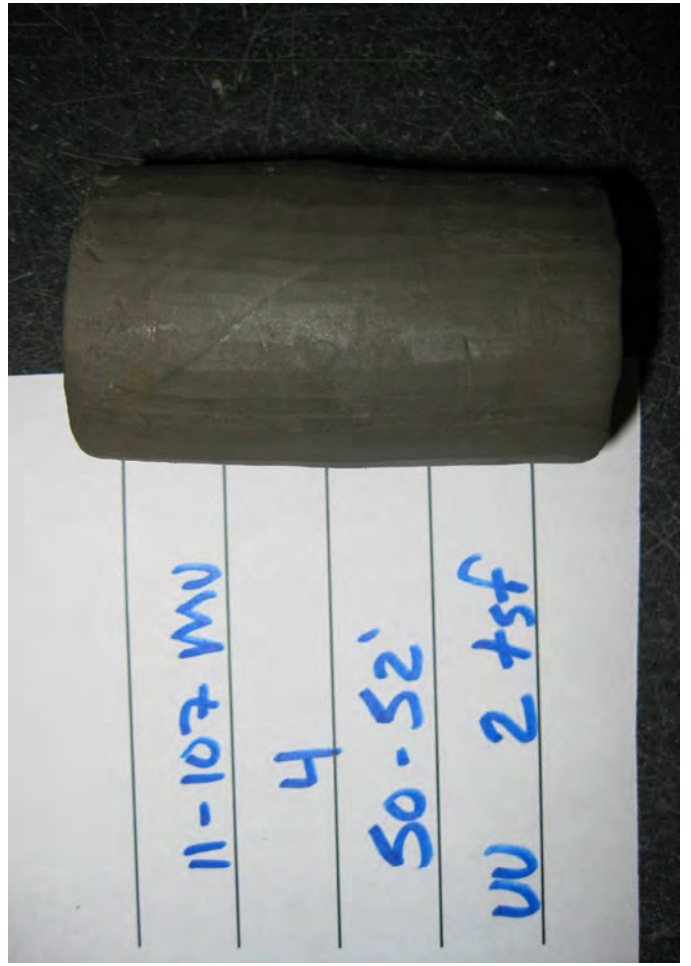
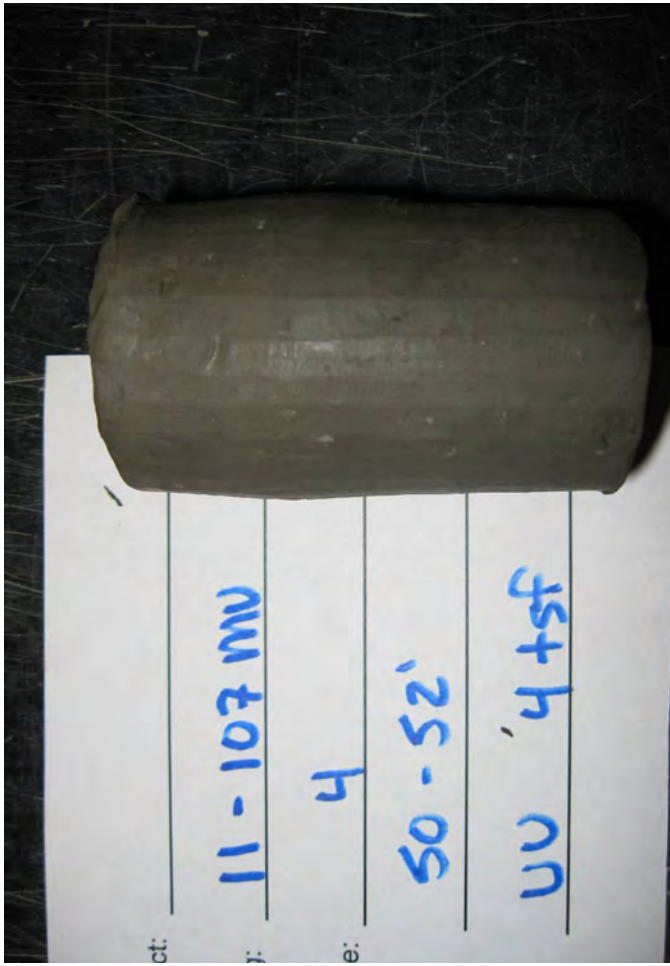
Back pressure = 0.000 tsf

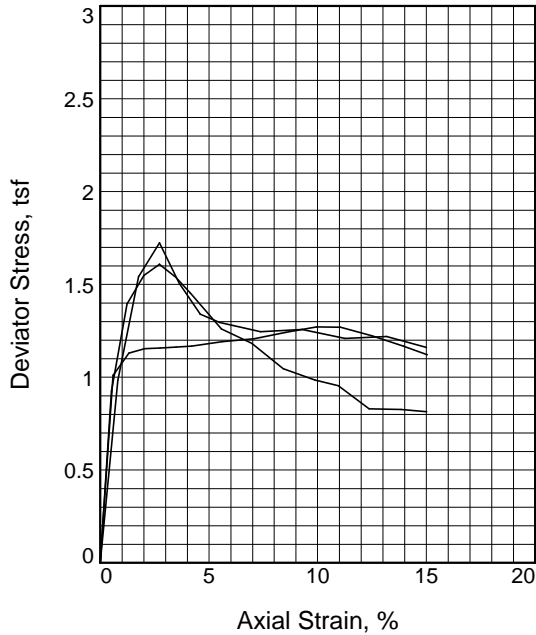
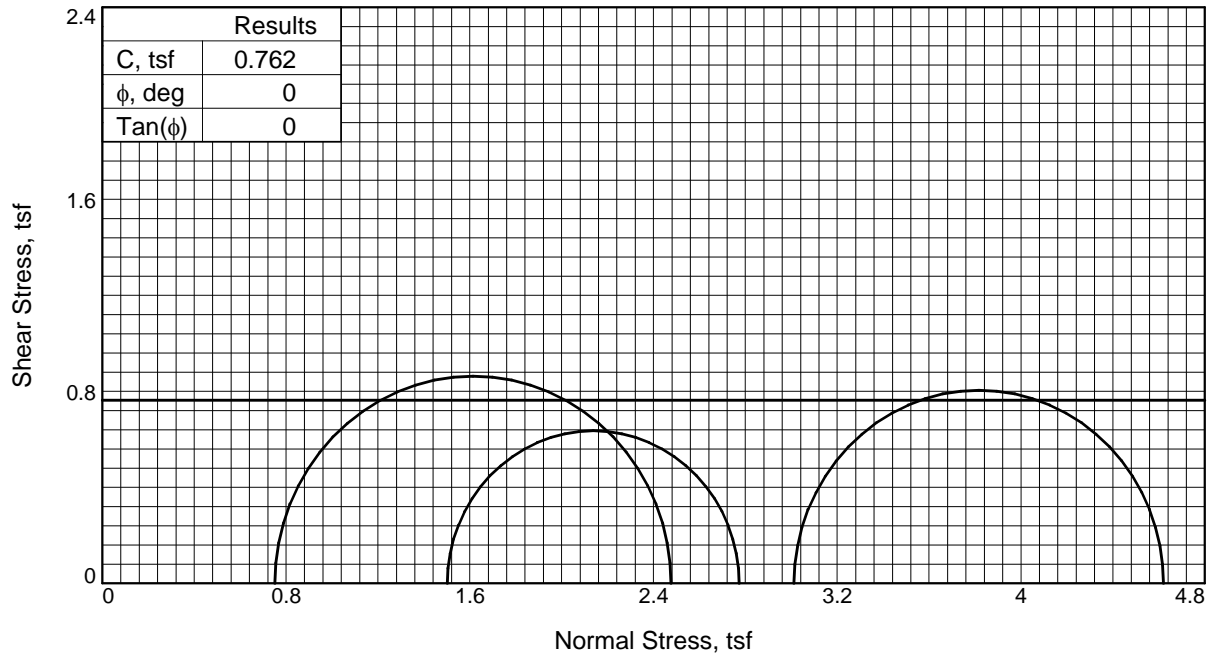
Strain rate, %/min. = 1.00

Peak Stress = 2.385 tsf at reading no. 16

Ult. Stress = 2.312 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	9.850	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0178	15.100	5.3	0.4	0.252	4.000	4.252	1.06	4.126	0.126
2	0.0312	27.120	17.3	0.9	0.825	4.000	4.825	1.21	4.413	0.413
3	0.0450	30.630	20.8	1.4	0.988	4.000	4.988	1.25	4.494	0.494
4	0.0579	33.410	23.6	1.8	1.115	4.000	5.115	1.28	4.557	0.557
5	0.0720	36.160	26.3	2.3	1.239	4.000	5.239	1.31	4.619	0.619
6	0.0860	38.690	28.8	2.8	1.351	4.000	5.351	1.34	4.675	0.675
7	0.0997	40.920	31.1	3.3	1.448	4.000	5.448	1.36	4.724	0.724
8	0.1135	43.760	33.9	3.8	1.572	4.000	5.572	1.39	4.786	0.786
9	0.1266	46.140	36.3	4.3	1.674	4.000	5.674	1.42	4.837	0.837
10	0.1407	49.430	39.6	4.8	1.817	4.000	5.817	1.45	4.908	0.908
11	0.1545	52.790	42.9	5.3	1.961	4.000	5.961	1.49	4.980	0.980
12	0.1676	55.230	45.4	5.8	2.062	4.000	6.062	1.52	5.031	1.031
13	0.1950	59.320	49.5	6.7	2.224	4.000	6.224	1.56	5.112	1.112
14	0.2220	61.920	52.1	7.7	2.317	4.000	6.317	1.58	5.158	1.158
15	0.2493	63.710	53.9	8.7	2.371	4.000	6.371	1.59	5.186	1.186
16	0.2772	64.630	54.8	9.7	2.385	4.000	6.385	1.60	5.193	1.193
17	0.3046	64.930	55.1	10.6	2.373	4.000	6.373	1.59	5.186	1.186
18	0.3313	65.580	55.7	11.6	2.375	4.000	6.375	1.59	5.187	1.187
19	0.3585	66.400	56.6	12.6	2.383	4.000	6.383	1.60	5.192	1.192
20	0.3851	66.070	56.2	13.5	2.344	4.000	6.344	1.59	5.172	1.172
21	0.3998	66.480	56.6	14.0	2.347	4.000	6.347	1.59	5.173	1.173
22	0.4268	66.280	56.4	15.0	2.312	4.000	6.312	1.58	5.156	1.156





Sample No.	1	2	3	
Initial	Water Content, %	51.3	50.3	52.7
	Dry Density, pcf	70.1	70.8	69.3
	Saturation, %	98.7	98.5	99.4
	Void Ratio	1.3990	1.3738	1.4260
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	51.3	50.3	52.7
	Dry Density, pcf	70.1	70.8	69.3
	Saturation, %	98.7	98.5	99.4
	Void Ratio	1.3990	1.3738	1.4260
	Diameter, in.	1.40	1.40	1.40
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.01	
Peak Stress, tsf	1.73	1.27	1.61	
Ult. Stress, tsf	1.16	1.12	0.81	
σ_1 Failure, tsf	2.48	2.77	4.62	
σ_3 Failure, tsf	0.75	1.50	3.01	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 85 PL= 21 PI= 64

Specific Gravity= 2.693

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

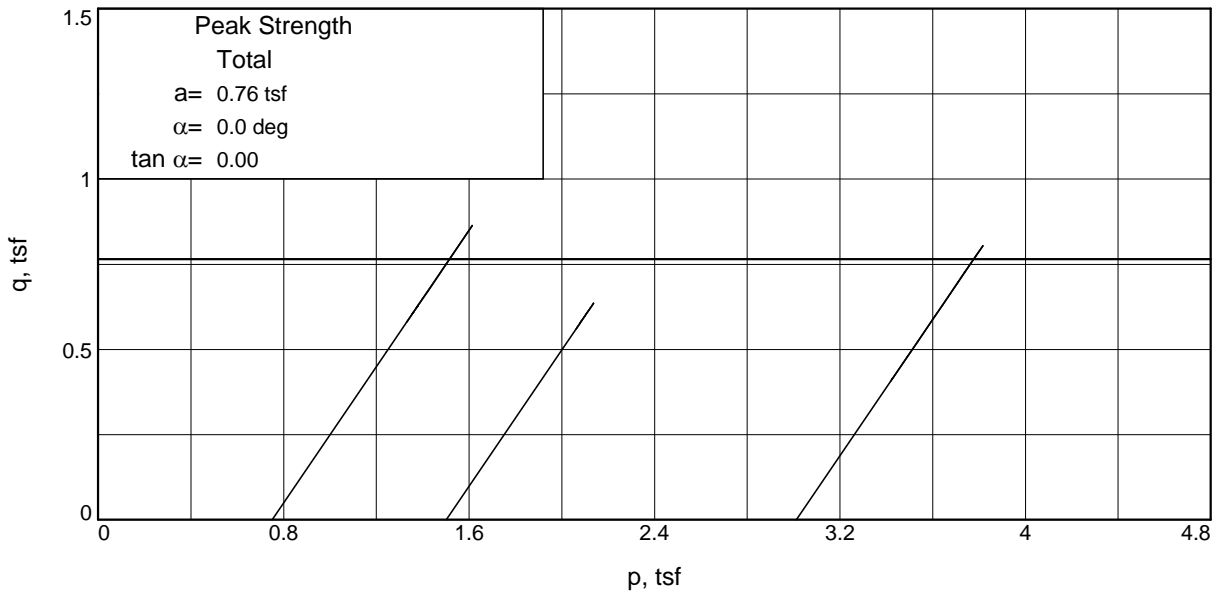
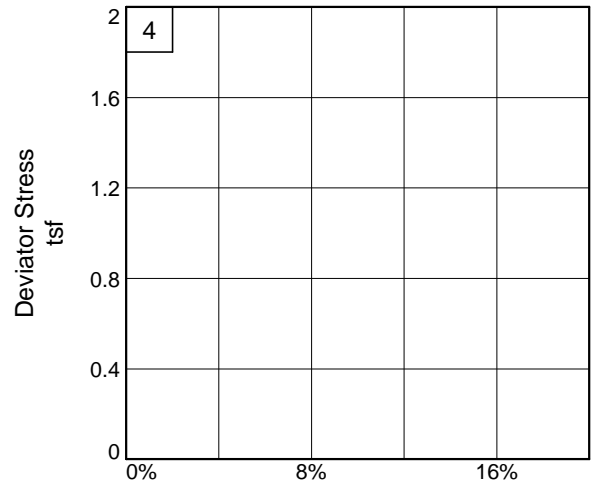
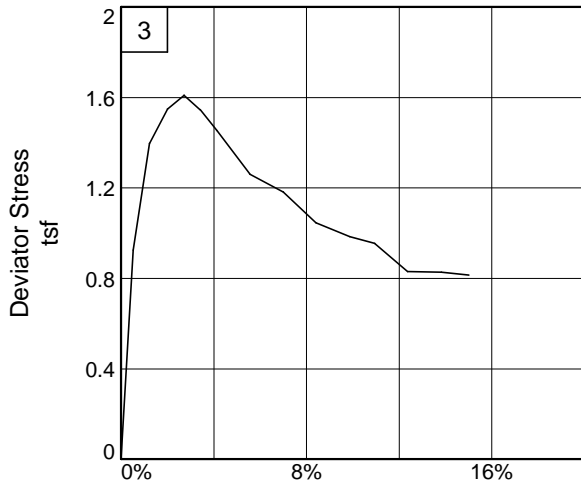
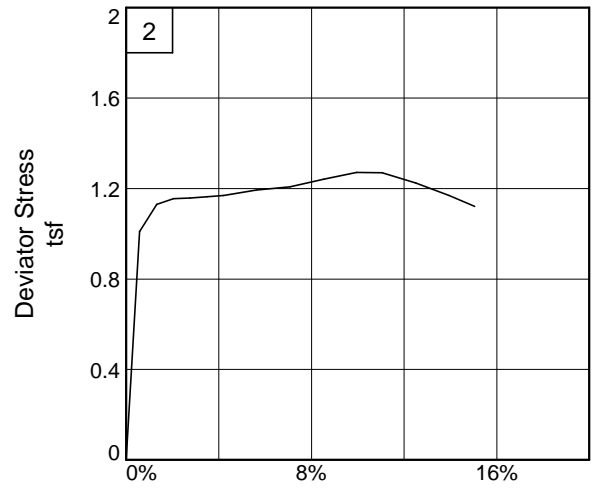
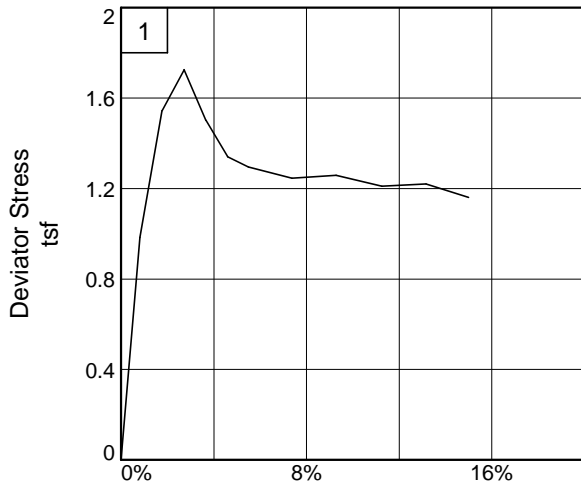
Location: Sheyenne River, Argusville Formation

Sample Number: Boring11-110MU, #4 **Depth:** 55-57'

Proj. No.: BL-10-10065 **Date Sampled:**



Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Argusville Formation

Depth: 55-57'

Sample No.: Boring11-110MU, #4

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:14 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Argusville Formation
Depth: 55-57' **Sample Number:** Boring11-110MU, #4
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.693 **LL**=85 **PL**=21 **PI**=64
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	149.710	149.710
Moisture content: Dry soil+tare, gms.	109.300	109.300
Moisture content: Tare, gms.	30.480	30.480
Moisture, %	51.3	51.3
Moist specimen weight, gms.	119.6	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	106.0	
Dry density, pcf	70.1	
Void ratio	1.3990	
Saturation, %	98.7	

Test Readings for Specimen No. 1

Cell pressure = 0.751 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.726 tsf at reading no. 3
Ult. Stress = 1.160 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	0.000	0.0	0.0	0.000	0.751	0.751	1.00	0.751	0.000
1	0.0292	21.080	21.1	0.8	0.984	0.751	1.735	2.31	1.243	0.492
2	0.0561	33.410	33.4	1.8	1.544	0.751	2.295	3.06	1.523	0.772
3	0.0829	37.710	37.7	2.7	1.726	0.751	2.477	3.30	1.614	0.863
4	0.1092	33.140	33.1	3.7	1.502	0.751	2.253	3.00	1.502	0.751
5	0.1357	29.870	29.9	4.6	1.340	0.751	2.091	2.78	1.421	0.670
6	0.1608	29.140	29.1	5.5	1.295	0.751	2.046	2.72	1.399	0.648
7	0.2138	28.590	28.6	7.4	1.246	0.751	1.997	2.66	1.374	0.623
8	0.2674	29.470	29.5	9.3	1.258	0.751	2.009	2.67	1.380	0.629
9	0.3229	28.990	29.0	11.3	1.210	0.751	1.961	2.61	1.356	0.605
10	0.3764	29.870	29.9	13.2	1.220	0.751	1.971	2.62	1.361	0.610
11	0.4280	29.020	29.0	15.0	1.160	0.751	1.911	2.54	1.331	0.580

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	151.160	151.160
Moisture content: Dry soil+tare, gms.	110.750	110.750
Moisture content: Tare, gms.	30.360	30.360
Moisture, %	50.3	50.3
Moist specimen weight, gms.	121.2	
Diameter, in.	1.40	
Area, in. ²	1.55	
Height, in.	2.81	
Wet Density, pcf	106.4	
Dry density, pcf	70.8	
Void ratio	1.3738	
Saturation, %	98.5	

Test Readings for Specimen No. 2

Cell pressure = 1.502 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.271 tsf at reading no. 10
 Ult. Stress = 1.121 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	2.980	0.0	0.0	0.000	1.502	1.502	1.00	1.502	0.000
1	0.0231	24.800	21.8	0.6	1.010	1.502	2.512	1.67	2.007	0.505
2	0.0435	27.550	24.6	1.3	1.129	1.502	2.631	1.75	2.067	0.565
3	0.0640	28.280	25.3	2.0	1.154	1.502	2.656	1.77	2.079	0.577
4	0.0840	28.540	25.6	2.8	1.158	1.502	2.660	1.77	2.081	0.579
5	0.1047	28.860	25.9	3.5	1.163	1.502	2.665	1.77	2.084	0.582
6	0.1249	29.170	26.2	4.2	1.168	1.502	2.670	1.78	2.086	0.584
7	0.1646	30.110	27.1	5.6	1.192	1.502	2.694	1.79	2.098	0.596
8	0.2052	30.880	27.9	7.1	1.207	1.502	2.709	1.80	2.106	0.604
9	0.2462	32.130	29.2	8.5	1.242	1.502	2.744	1.83	2.123	0.621
10	0.2861	33.290	30.3	10.0	1.271	1.502	2.773	1.85	2.138	0.636
11	0.3168	33.620	30.6	11.1	1.269	1.502	2.771	1.85	2.137	0.635

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
12	0.3578	33.010	30.0	12.5	1.224	1.502	2.726	1.81	2.114	0.612
13	0.3979	32.130	29.2	13.9	1.168	1.502	2.670	1.78	2.086	0.584
14	0.4290	31.310	28.3	15.0	1.121	1.502	2.623	1.75	2.062	0.560

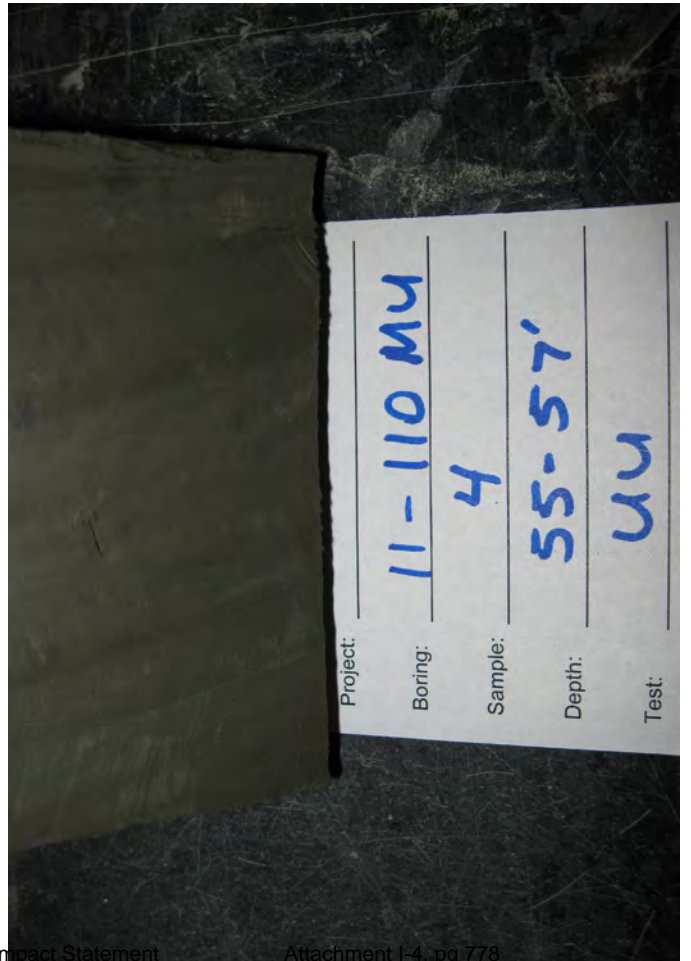
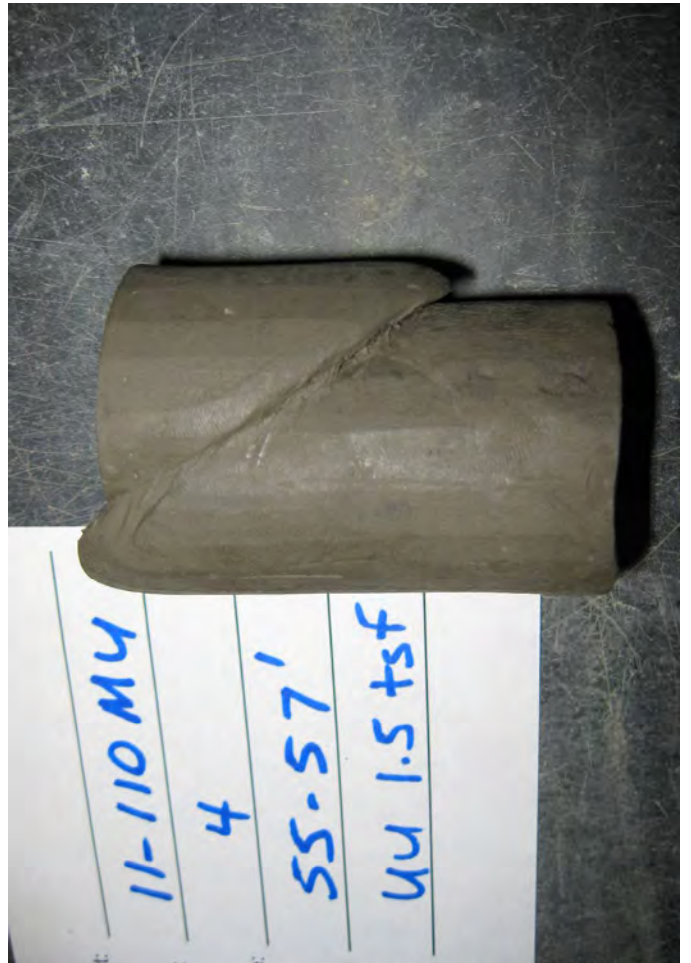
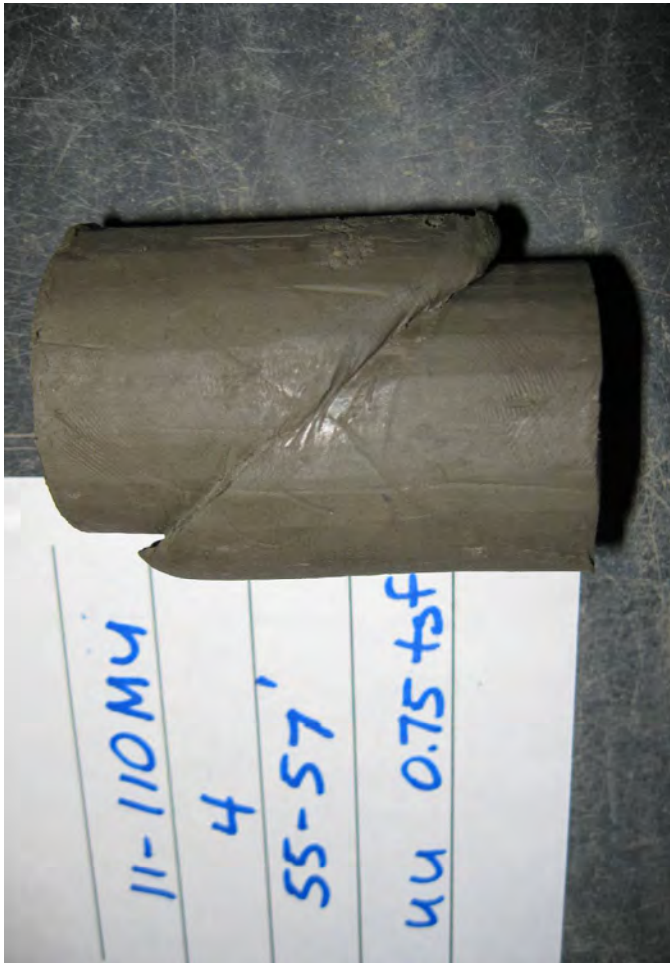
Parameters for Specimen No. 3

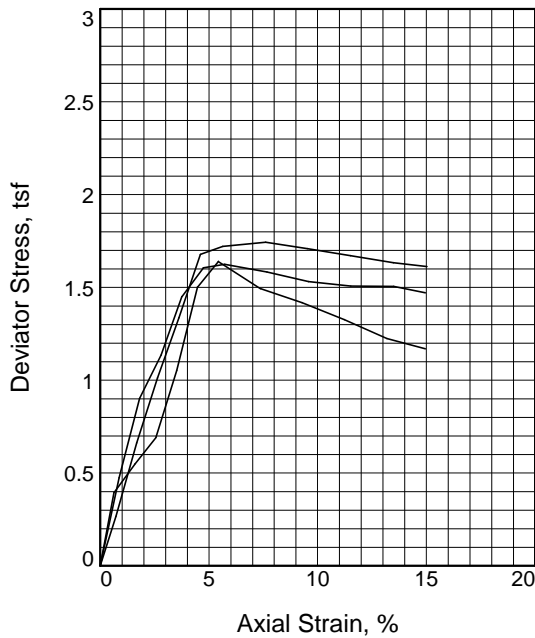
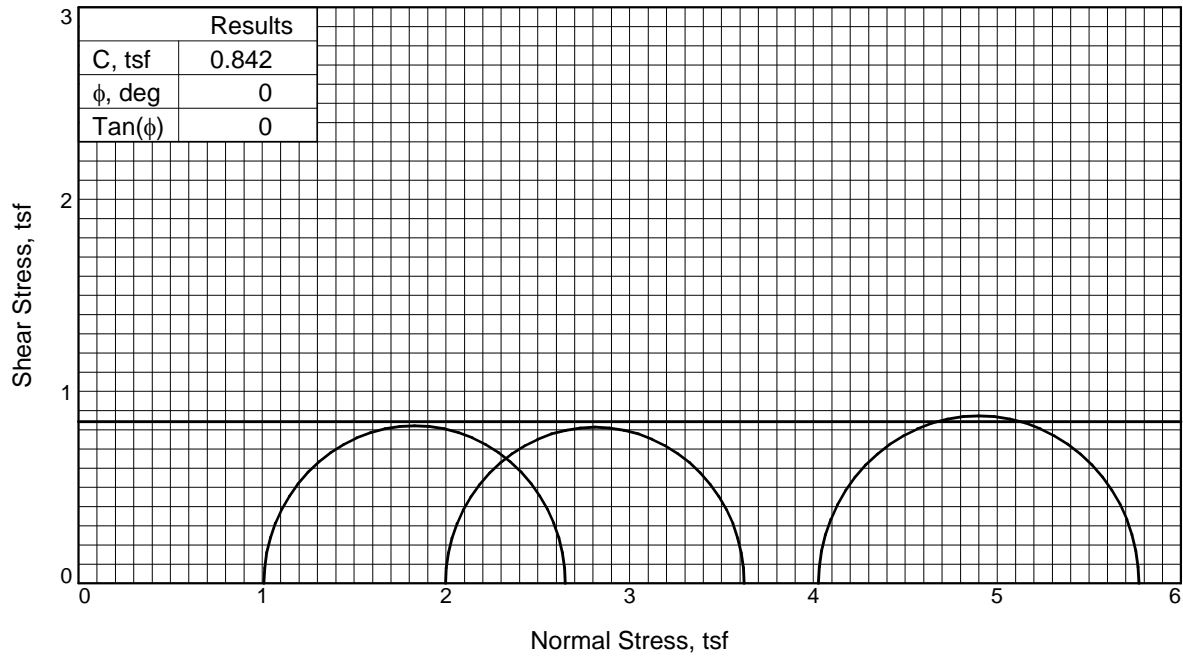
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	150.030	150.030
Moisture content: Dry soil+tare, gms.	109.070	109.070
Moisture content: Tare, gms.	31.280	31.280
Moisture, %	52.7	52.7
Moist specimen weight, gms.	119.2	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	105.8	
Dry density, pcf	69.3	
Void ratio	1.4260	
Saturation, %	99.4	

Test Readings for Specimen No. 3

Cell pressure = 3.012 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.609 tsf at reading no. 4
 Ult. Stress = 0.814 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	7.040	0.0	0.0	0.000	3.012	3.012	1.00	3.012	0.000
1	0.0212	26.790	19.8	0.5	0.924	3.012	3.936	1.31	3.474	0.462
2	0.0412	37.100	30.1	1.2	1.397	3.012	4.409	1.46	3.710	0.698
3	0.0628	40.640	33.6	2.0	1.549	3.012	4.561	1.51	3.786	0.774
4	0.0829	42.200	35.2	2.7	1.609	3.012	4.621	1.53	3.817	0.805
5	0.1024	41.070	34.0	3.4	1.546	3.012	4.558	1.51	3.785	0.773
6	0.1227	39.270	32.2	4.1	1.453	3.012	4.465	1.48	3.739	0.727
7	0.1626	35.430	28.4	5.6	1.261	3.012	4.273	1.42	3.643	0.631
8	0.2030	34.050	27.0	7.0	1.182	3.012	4.194	1.39	3.603	0.591
9	0.2431	31.310	24.3	8.4	1.045	3.012	4.057	1.35	3.535	0.523
10	0.2839	30.270	23.2	9.9	0.985	3.012	3.997	1.33	3.504	0.492
11	0.3142	29.840	22.8	11.0	0.955	3.012	3.967	1.32	3.489	0.477
12	0.3540	27.190	20.2	12.4	0.831	3.012	3.843	1.28	3.427	0.415
13	0.3948	27.430	20.4	13.8	0.826	3.012	3.838	1.27	3.425	0.413
14	0.4280	27.400	20.4	15.0	0.814	3.012	3.826	1.27	3.419	0.407





Sample No.		1	2	3
Initial	Water Content, %	46.9	45.3	43.5
	Dry Density, pcf	73.9	75.4	76.4
	Saturation, %	99.3	99.7	98.1
	Void Ratio	1.2646	1.2180	1.1897
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.79	2.80
At Test	Water Content, %	47.2	45.5	44.4
	Dry Density, pcf	73.9	75.4	76.4
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2646	1.2180	1.1897
	Diameter, in.	1.39	1.39	1.40
	Height, in.	2.80	2.79	2.80
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.01	2.00	4.03
Peak Stress, tsf		1.64	1.63	1.74
Ult. Stress, tsf		1.17	1.47	1.61
σ_1 Failure, tsf		2.65	3.62	5.77
σ_3 Failure, tsf		1.01	2.00	4.03

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 70

PL= 22

PI= 48

Specific Gravity= 2.679

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Sheyenne River, Argusville Formation

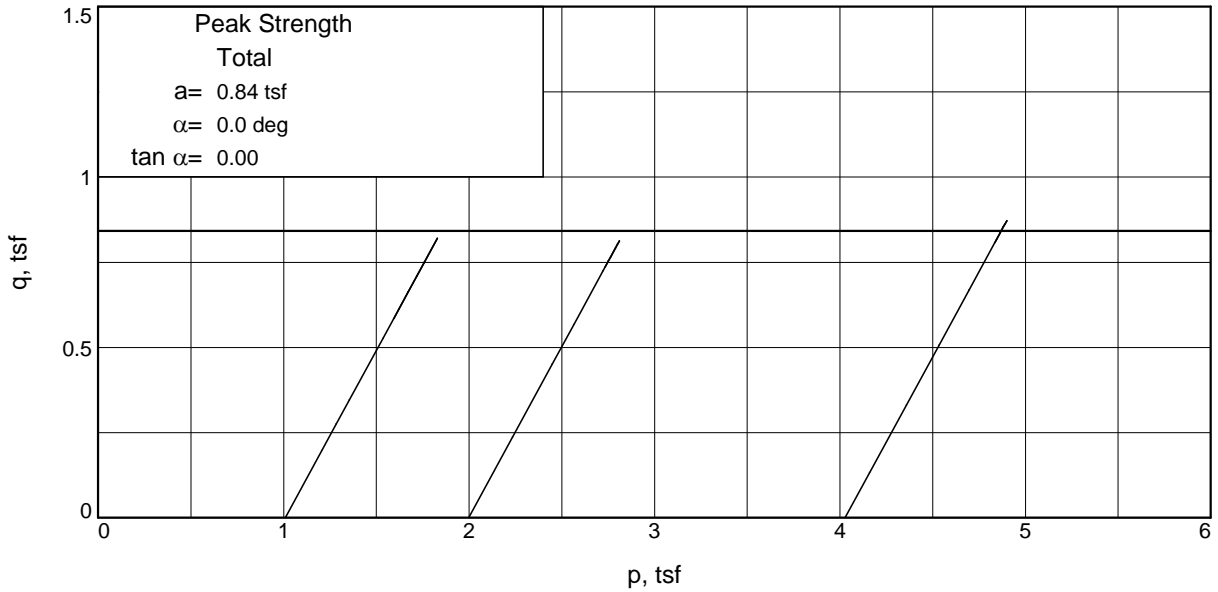
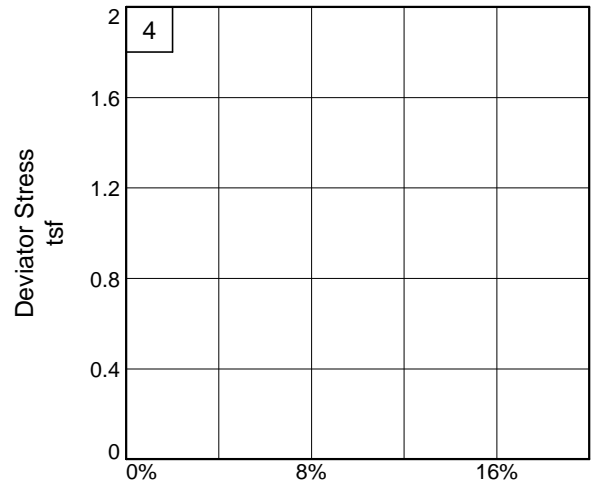
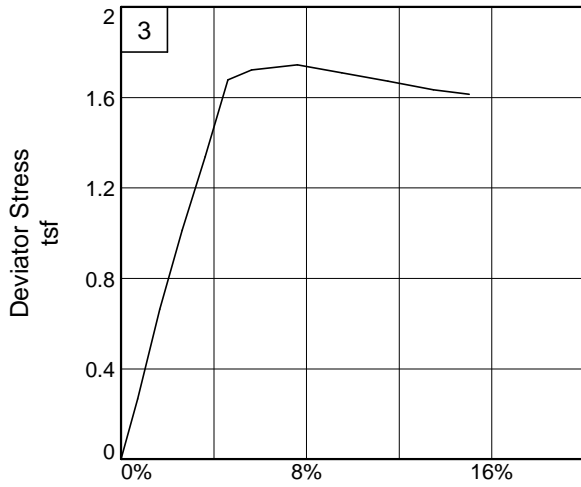
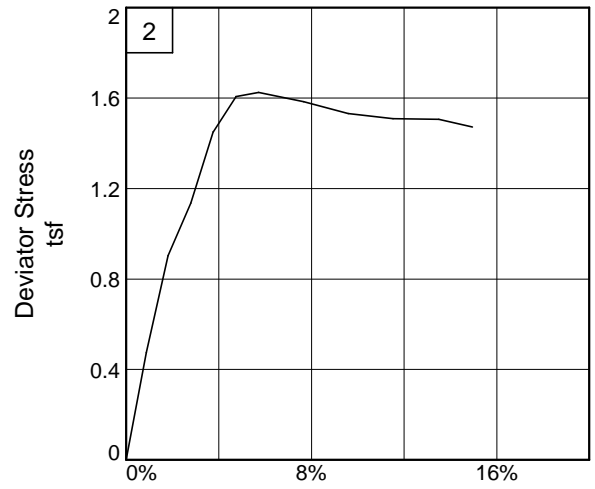
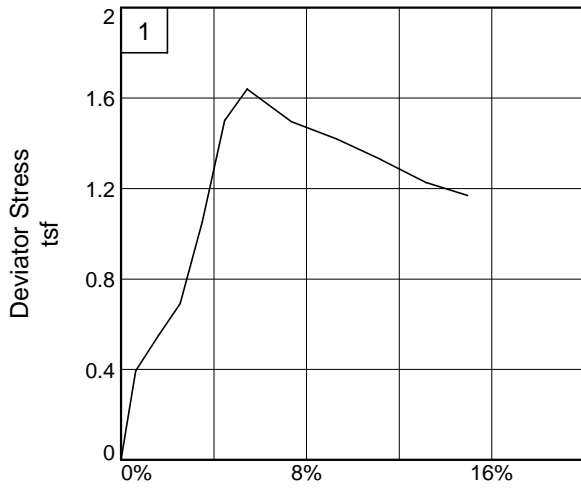
Sample Number: Boring11-110MU, #5 **Depth:** 60-62'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Sheyenne River, Argusville Formation

Depth: 60-62'

Sample No.: Boring11-110MU, #5

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:14 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Argusville Formation
Depth: 60-62' **Sample Number:** Boring11-110MU, #5
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.679 **LL**=70 **PL**=22 **PI**=48
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	153.830		153.830
Moisture content: Dry soil+tare, gms.	115.330		115.330
Moisture content: Tare, gms.	33.170		33.170
Moisture, %	46.9	47.2	46.9
Moist specimen weight, gms.	121.4		
Diameter, in.	1.39	1.39	
Area, in. ²	1.52	1.52	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	108.5	108.7	
Dry density, pcf	73.9	73.9	
Void ratio	1.2646	1.2646	
Saturation, %	99.3	100.0	

Test Readings for Specimen No. 1

Cell pressure = 1.009 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.640 tsf at reading no. 6
Ult. Stress = 1.170 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	2.010	0.0	0.0	0.000	1.009	1.009	1.00	1.009	0.000
1	0.0243	10.430	8.4	0.6	0.395	1.009	1.404	1.39	1.207	0.198
2	0.0515	13.860	11.9	1.6	0.551	1.009	1.560	1.55	1.284	0.275
3	0.0780	17.050	15.0	2.6	0.692	1.009	1.701	1.69	1.355	0.346
4	0.1047	25.110	23.1	3.5	1.053	1.009	2.062	2.04	1.535	0.526
5	0.1318	35.300	33.3	4.5	1.502	1.009	2.511	2.49	1.760	0.751
6	0.1585	38.720	36.7	5.4	1.640	1.009	2.649	2.63	1.829	0.820
7	0.2129	36.160	34.2	7.4	1.494	1.009	2.503	2.48	1.756	0.747
8	0.2665	35.120	33.1	9.3	1.419	1.009	2.428	2.41	1.718	0.709
9	0.3208	33.660	31.7	11.2	1.327	1.009	2.336	2.32	1.673	0.664
10	0.3756	31.890	29.9	13.2	1.225	1.009	2.234	2.21	1.622	0.613
11	0.4250	31.120	29.1	15.0	1.170	1.009	2.179	2.16	1.594	0.585

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	152.320		152.320
Moisture content: Dry soil+tare, gms.	114.310		114.310
Moisture content: Tare, gms.	30.430		30.430
Moisture, %	45.3	45.5	45.3
Moist specimen weight, gms.	122.7		
Diameter, in.	1.39	1.39	
Area, in. ²	1.53	1.53	
Height, in.	2.79	2.79	
Net decrease in height, in.		0.00	
Wet Density, pcf	109.6	109.7	
Dry density, pcf	75.4	75.4	
Void ratio	1.2180	1.2180	
Saturation, %	99.7	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.998 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.625 tsf at reading no. 6
 Ult. Stress = 1.472 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	6.000	0.0	0.0	0.000	1.998	1.998	1.00	1.998	0.000
1	0.0310	16.140	10.1	0.9	0.474	1.998	2.472	1.24	2.235	0.237
2	0.0571	25.480	19.5	1.8	0.902	1.998	2.900	1.45	2.449	0.451
3	0.0847	30.760	24.8	2.8	1.135	1.998	3.133	1.57	2.566	0.568
4	0.1116	37.960	32.0	3.8	1.451	1.998	3.449	1.73	2.724	0.726
5	0.1391	41.740	35.7	4.7	1.606	1.998	3.604	1.80	2.801	0.803
6	0.1664	42.540	36.5	5.7	1.625	1.998	3.623	1.81	2.811	0.813
7	0.2208	42.350	36.4	7.7	1.583	1.998	3.581	1.79	2.790	0.792
8	0.2745	41.900	35.9	9.6	1.531	1.998	3.529	1.77	2.764	0.766
9	0.3288	42.140	36.1	11.5	1.508	1.998	3.506	1.75	2.752	0.754
10	0.3837	42.890	36.9	13.5	1.505	1.998	3.503	1.75	2.751	0.753

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
11	0.4245	42.690	36.7	15.0	1.472	1.998	3.470	1.74	2.734	0.736

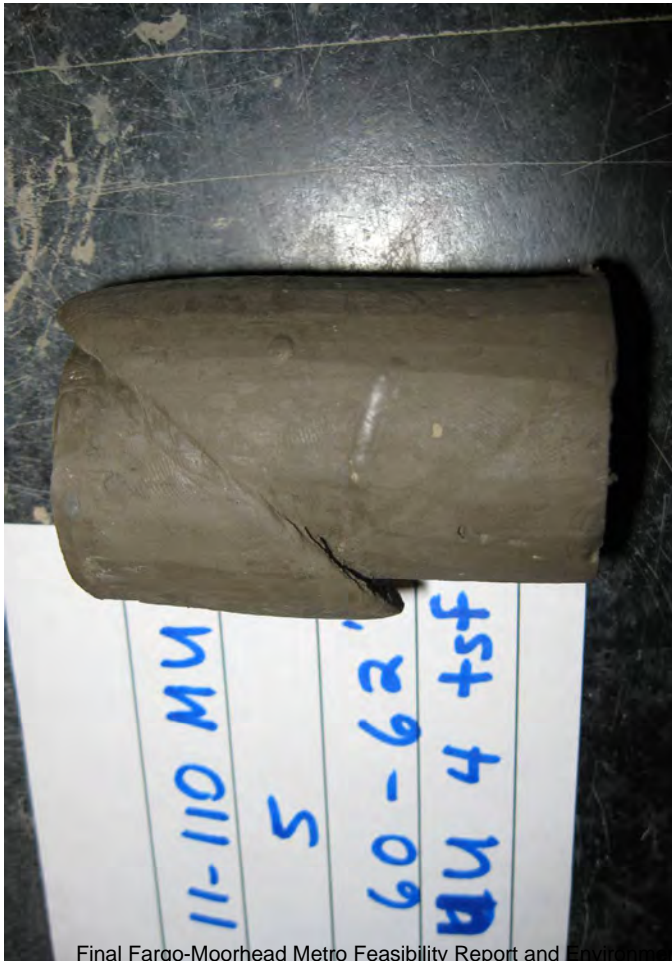
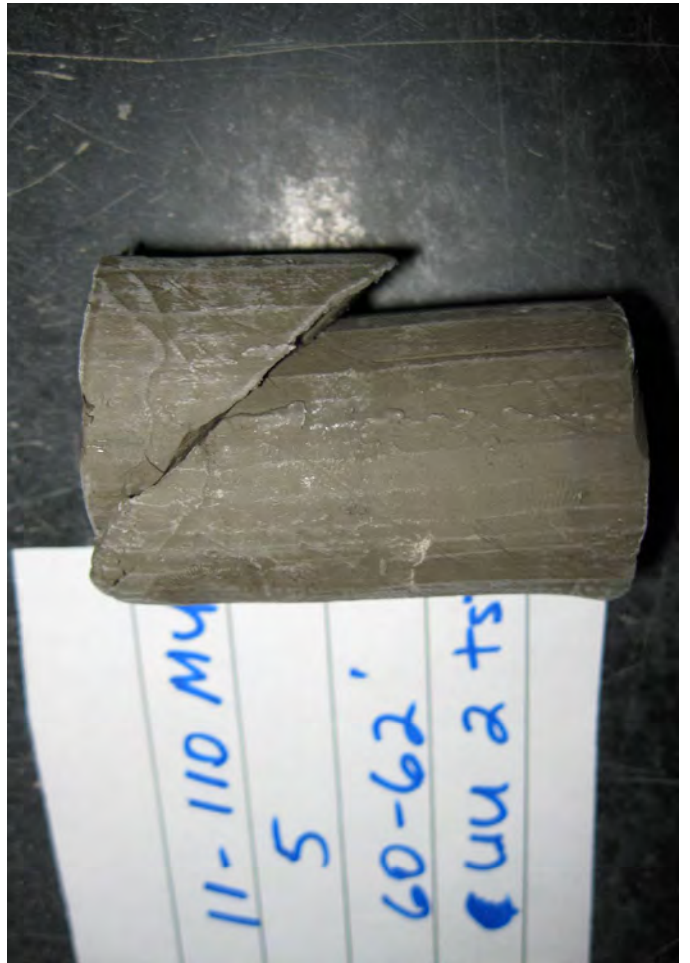
Parameters for Specimen No. 3

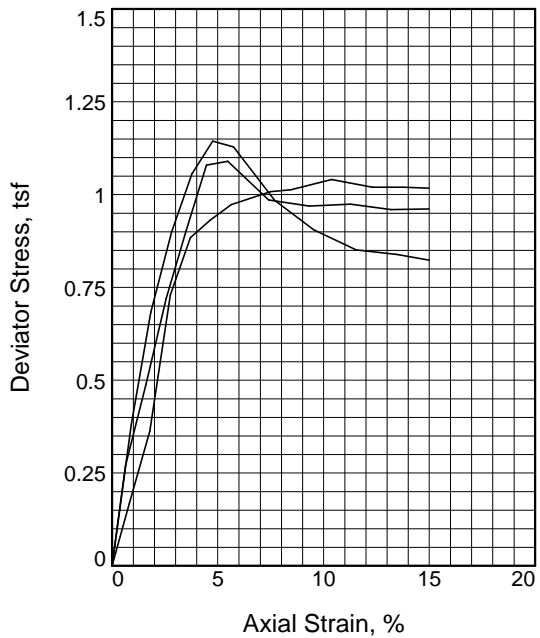
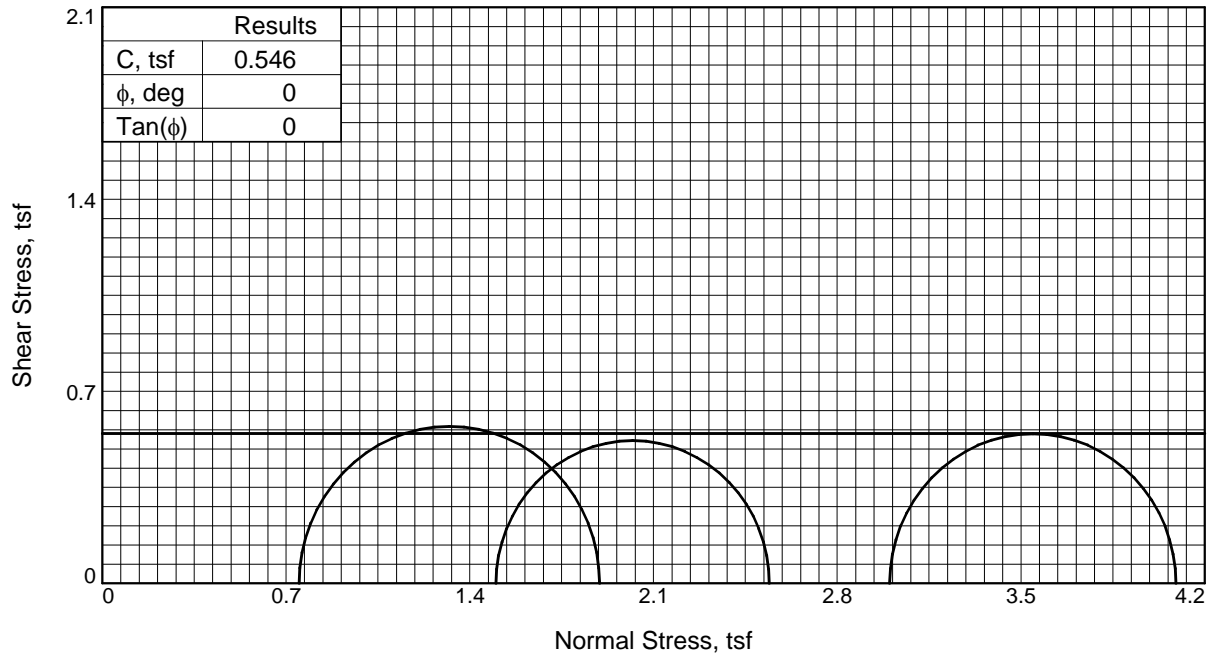
Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.	153.630		153.630
Moisture content: Dry soil+tare, gms.	116.500		116.500
Moisture content: Tare, gms.	31.240		31.240
Moisture, %	43.5	44.4	43.5
Moist specimen weight, gms.	123.3		
Diameter, in.	1.40	1.40	
Area, in. ²	1.53	1.53	
Height, in.	2.80	2.80	
Net decrease in height, in.		0.00	
Wet Density, pcf	109.6	110.3	
Dry density, pcf	76.4	76.4	
Void ratio	1.1897	1.1897	
Saturation, %	98.1	100.0	

Test Readings for Specimen No. 3

Cell pressure = 4.028 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.744 tsf at reading no. 7
 Ult. Stress = 1.613 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	9.790	0.0	0.0	0.000	4.028	4.028	1.00	4.028	0.000
1	0.0267	15.500	5.7	0.7	0.266	4.028	4.294	1.07	4.161	0.133
2	0.0534	24.130	14.3	1.7	0.662	4.028	4.690	1.16	4.359	0.331
3	0.0802	31.920	22.1	2.6	1.012	4.028	5.040	1.25	4.534	0.506
4	0.1080	39.330	29.5	3.6	1.337	4.028	5.365	1.33	4.697	0.669
5	0.1355	47.240	37.5	4.6	1.678	4.028	5.706	1.42	4.867	0.839
6	0.1641	48.610	38.8	5.6	1.721	4.028	5.749	1.43	4.888	0.860
7	0.2193	49.980	40.2	7.6	1.744	4.028	5.772	1.43	4.900	0.872
8	0.2730	50.000	40.2	9.5	1.709	4.028	5.737	1.42	4.882	0.854
9	0.3286	50.000	40.2	11.5	1.671	4.028	5.699	1.41	4.864	0.836
10	0.3836	50.000	40.2	13.5	1.634	4.028	5.662	1.41	4.845	0.817
11	0.4270	50.210	40.4	15.0	1.613	4.028	5.641	1.40	4.835	0.807





Sample No.	1	2	3	
Initial	Water Content, %	43.3	46.7	45.8
	Dry Density, pcf	77.6	74.5	75.2
	Saturation, %	100.0	100.0	99.9
	Void Ratio	1.1658	1.2581	1.2347
	Diameter, in.	1.39	1.39	1.39
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	43.3	46.7	45.8
	Dry Density, pcf	77.6	74.5	75.2
	Saturation, %	100.0	100.0	99.9
	Void Ratio	1.1658	1.2581	1.2347
	Diameter, in.	1.39	1.39	1.39
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	1.14	1.04	1.09	
Ult. Stress, tsf	0.82	1.02	0.96	
σ_1 Failure, tsf	1.89	2.54	4.09	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 60 **PL=** 17 **PI=** 43

Specific Gravity= 2.693

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

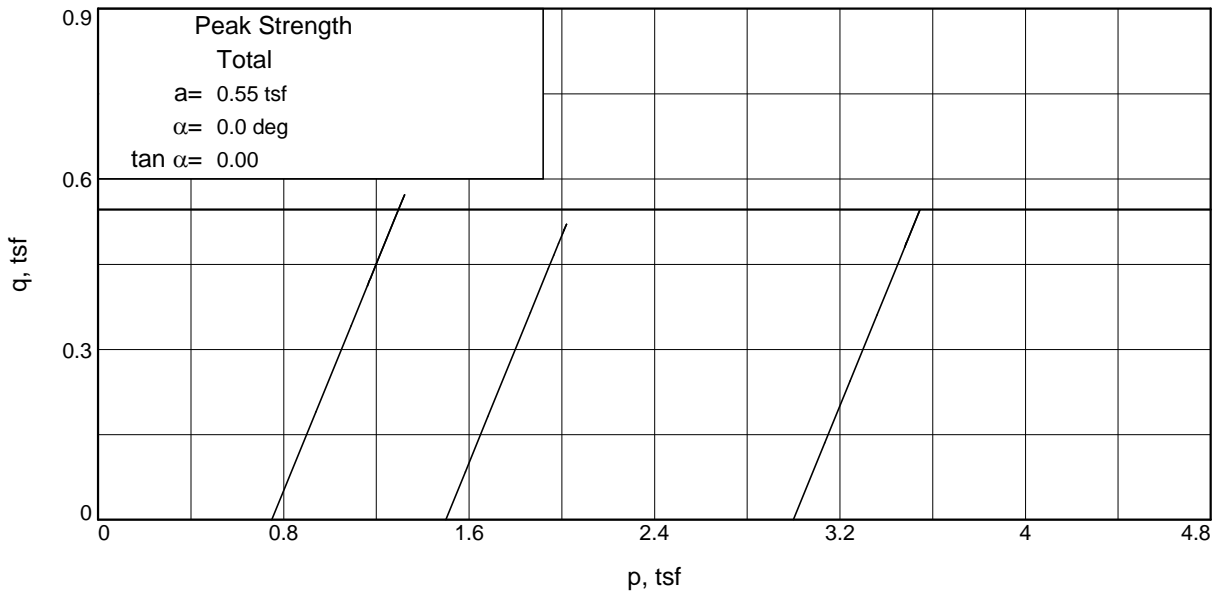
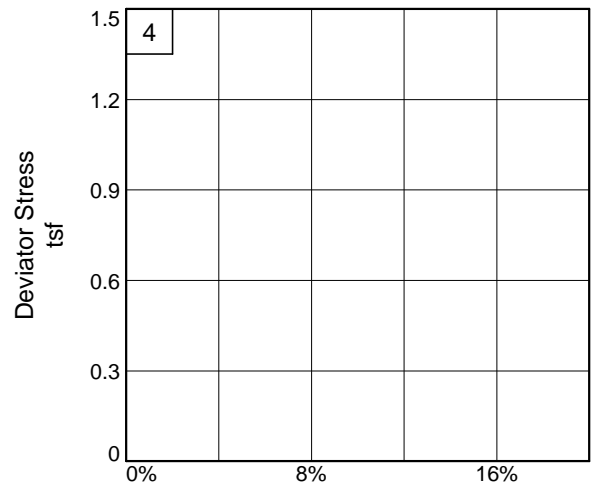
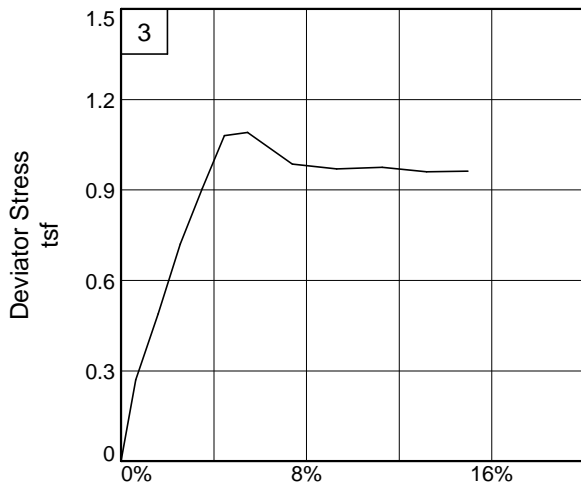
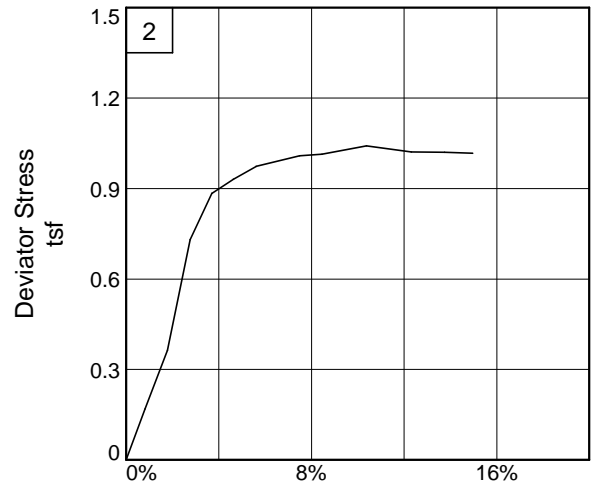
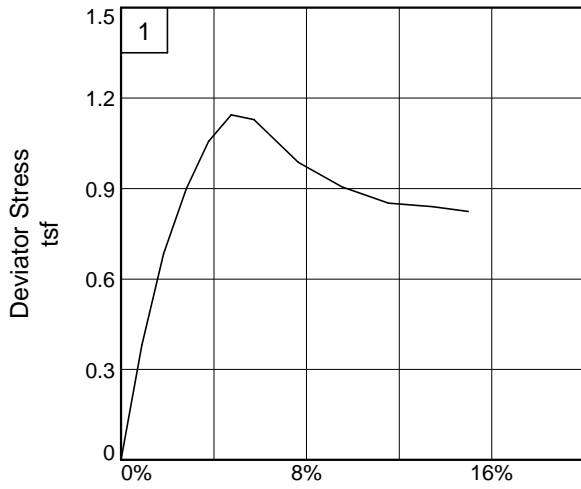
Location: Wild Rice, Argusville Formation

Sample Number: Boring11-118MU, #3 **Depth:** 45-47'

Proj. No.: BL-10-10065 **Date Sampled:**

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusville Formation

Project No.: BL-10-10065

Depth: 45-47'

Figure _____

Sample Number: Boring11-118MU, #3

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/15/2011

11:40 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusville Formation
Depth: 45-47' **Sample Number:** Boring11-118MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.693 **LL**=60 **PL**=17 **PI**=43
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	155.280	155.280
Moisture content: Dry soil+tare, gms.	117.750	117.750
Moisture content: Tare, gms.	31.070	31.070
Moisture, %	43.3	43.3
Moist specimen weight, gms.	124.4	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	111.2	
Dry density, pcf	77.6	
Void ratio	1.1658	
Saturation, %	100.0	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.144 tsf at reading no. 5
Ult. Stress = 0.823 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	0.085	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0319	8.170	8.1	0.9	0.380	0.750	1.130	1.51	0.940	0.190
2	0.0582	14.760	14.7	1.8	0.683	0.750	1.433	1.91	1.092	0.342
3	0.0855	19.590	19.5	2.8	0.899	0.750	1.649	2.20	1.200	0.450
4	0.1129	23.240	23.2	3.8	1.057	0.750	1.807	2.41	1.279	0.529
5	0.1401	25.410	25.3	4.8	1.144	0.750	1.894	2.53	1.322	0.572
6	0.1677	25.320	25.2	5.7	1.129	0.750	1.879	2.50	1.314	0.564
7	0.2215	22.610	22.5	7.7	0.987	0.750	1.737	2.32	1.243	0.493
8	0.2752	21.170	21.1	9.6	0.905	0.750	1.655	2.21	1.202	0.452
9	0.3307	20.370	20.3	11.5	0.851	0.750	1.601	2.14	1.176	0.426
10	0.3843	20.530	20.4	13.5	0.840	0.750	1.590	2.12	1.170	0.420
11	0.4275	20.500	20.4	15.0	0.823	0.750	1.573	2.10	1.162	0.412

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.270	152.270
Moisture content: Dry soil+tare, gms.	113.180	113.180
Moisture content: Tare, gms.	29.540	29.540
Moisture, %	46.7	46.7
Moist specimen weight, gms.	123.1	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	109.2	
Dry density, pcf	74.5	
Void ratio	1.2581	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.041 tsf at reading no. 9
Ult. Stress = 1.017 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	2.650	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0295	6.250	3.6	0.8	0.168	1.500	1.668	1.11	1.584	0.084
2	0.0566	10.490	7.8	1.8	0.363	1.500	1.863	1.24	1.682	0.182
3	0.0840	18.560	15.9	2.8	0.730	1.500	2.230	1.49	1.865	0.365
4	0.1107	22.120	19.5	3.7	0.884	1.500	2.384	1.59	1.942	0.442
5	0.1366	23.350	20.7	4.6	0.931	1.500	2.431	1.62	1.966	0.466
6	0.1642	24.500	21.9	5.6	0.973	1.500	2.473	1.65	1.986	0.486
7	0.2172	25.750	23.1	7.5	1.008	1.500	2.508	1.67	2.004	0.504
8	0.2443	26.120	23.5	8.5	1.014	1.500	2.514	1.68	2.007	0.507
9	0.2982	27.270	24.6	10.4	1.041	1.500	2.541	1.69	2.020	0.520
10	0.3525	27.320	24.7	12.3	1.021	1.500	2.521	1.68	2.010	0.510
11	0.3930	27.720	25.1	13.8	1.020	1.500	2.520	1.68	2.010	0.510

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
12	0.4273	28.010	25.4	15.0	1.017	1.500	2.517	1.68	2.009	0.509

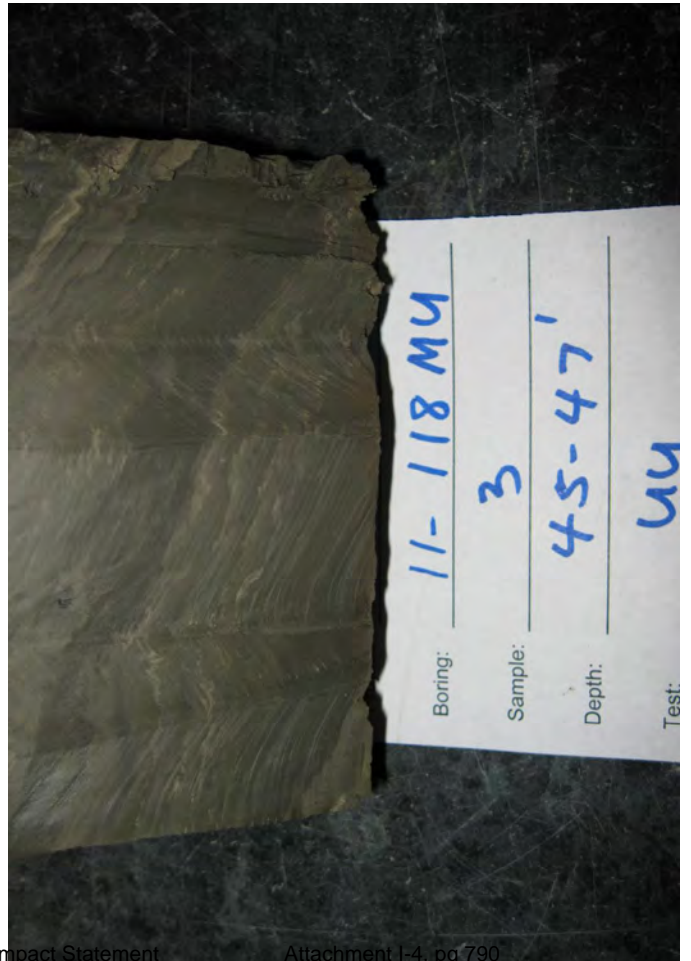
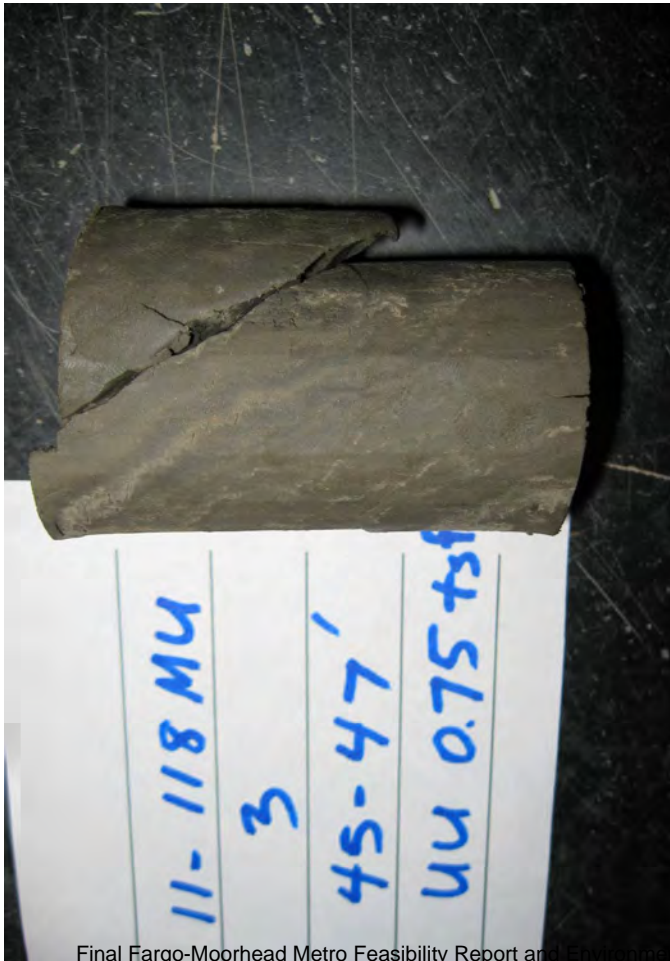
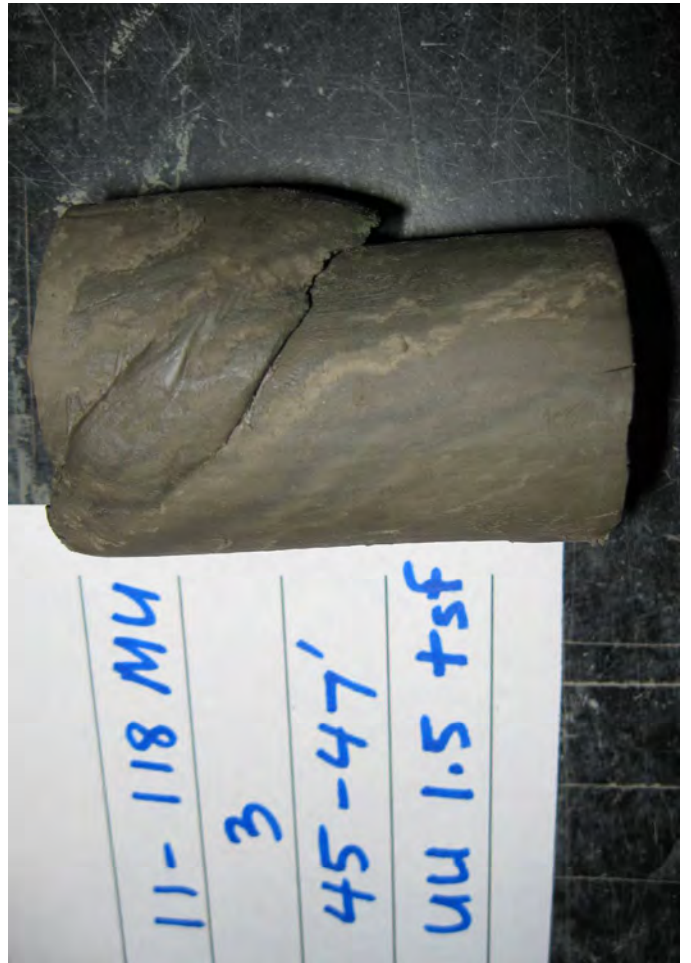
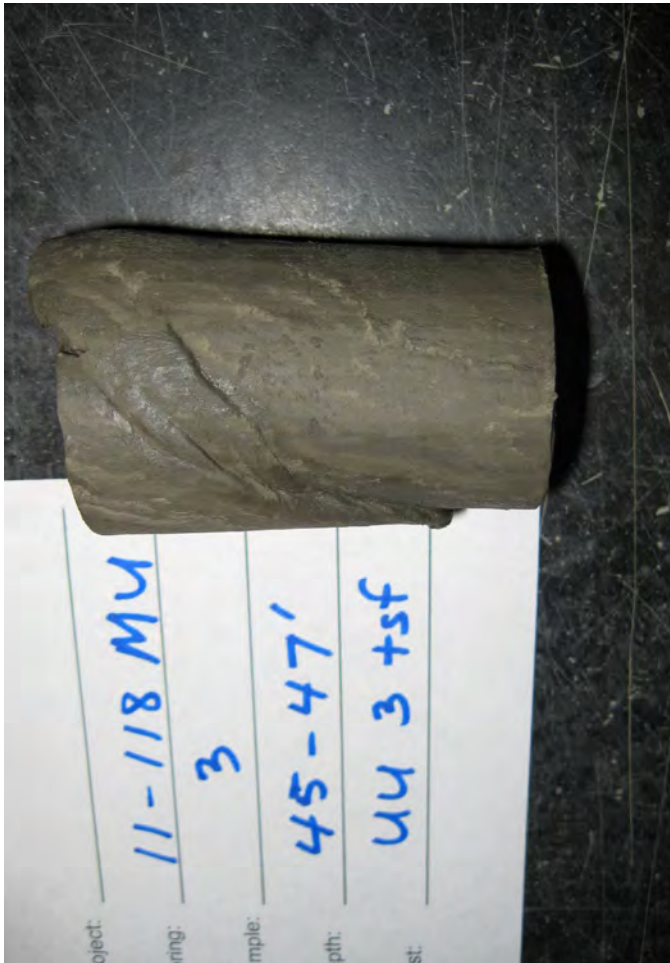
Parameters for Specimen No. 3

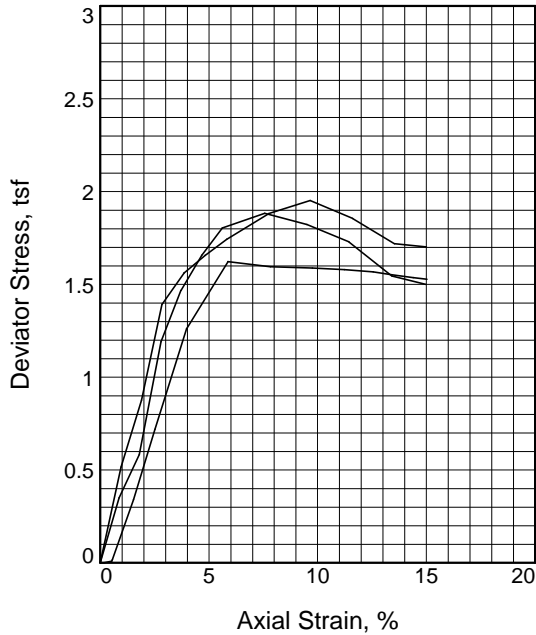
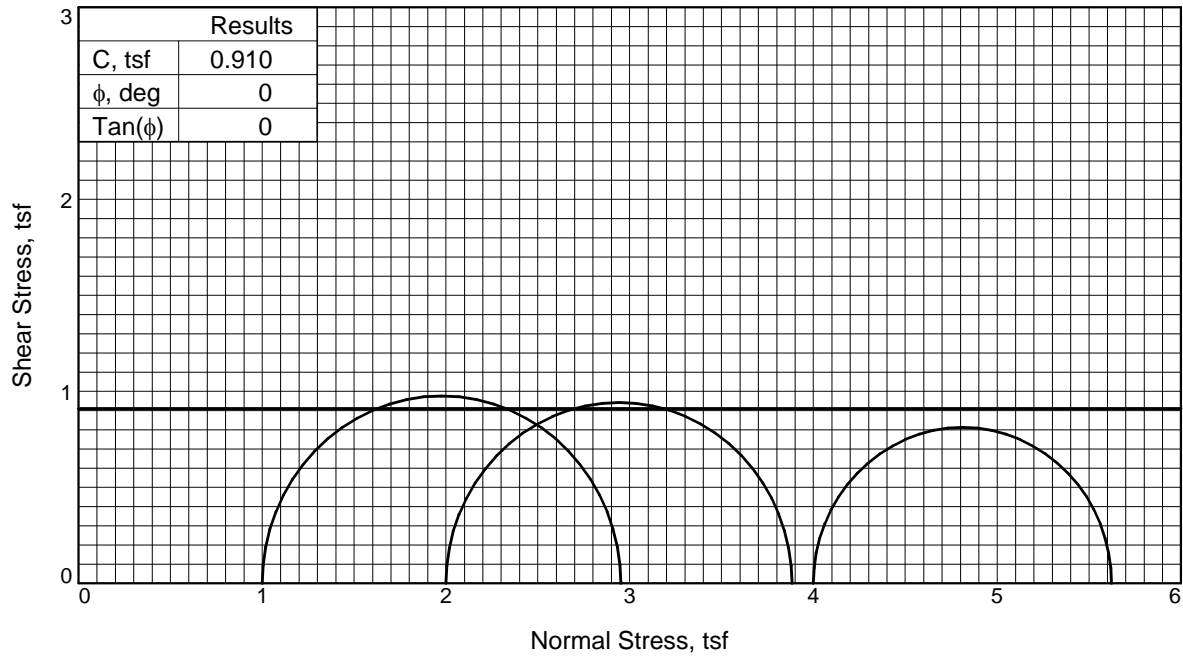
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	153.430	153.430
Moisture content: Dry soil+tare, gms.	114.780	114.780
Moisture content: Tare, gms.	30.410	30.410
Moisture, %	45.8	45.8
Moist specimen weight, gms.	123.3	
Diameter, in.	1.39	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	109.7	
Dry density, pcf	75.2	
Void ratio	1.2347	
Saturation, %	99.9	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.090 tsf at reading no. 6
 Ult. Stress = 0.962 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	6.310	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0243	12.080	5.8	0.6	0.270	3.000	3.270	1.09	3.135	0.135
2	0.0513	16.840	10.5	1.6	0.489	3.000	3.489	1.16	3.244	0.244
3	0.0781	21.970	15.7	2.6	0.720	3.000	3.720	1.24	3.360	0.360
4	0.1048	26.180	19.9	3.5	0.905	3.000	3.905	1.30	3.452	0.452
5	0.1318	30.270	24.0	4.5	1.080	3.000	4.080	1.36	3.540	0.540
6	0.1601	30.760	24.5	5.5	1.090	3.000	4.090	1.36	3.545	0.545
7	0.2144	28.870	22.6	7.4	0.985	3.000	3.985	1.33	3.493	0.493
8	0.2679	28.970	22.7	9.3	0.969	3.000	3.969	1.32	3.485	0.485
9	0.3227	29.600	23.3	11.3	0.975	3.000	3.975	1.32	3.487	0.487
10	0.3767	29.750	23.4	13.2	0.960	3.000	3.960	1.32	3.480	0.480
11	0.4268	30.290	24.0	15.0	0.962	3.000	3.962	1.32	3.481	0.481





Sample No.		1	2	3
Initial	Water Content, %	46.1	45.4	46.7
	Dry Density, pcf	75.0	75.6	74.4
	Saturation, %	100.0	99.9	100.0
	Void Ratio	1.2378	1.2201	1.2543
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.81	2.80	2.81
At Test	Water Content, %	46.1	45.4	46.7
	Dry Density, pcf	75.0	75.6	74.4
	Saturation, %	100.0	99.9	100.0
	Void Ratio	1.2378	1.2201	1.2543
	Diameter, in.	1.39	1.39	1.38
	Height, in.	2.81	2.80	2.81
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.00	2.00	4.00
Peak Stress, tsf		1.95	1.88	1.62
Ult. Stress, tsf		1.70	1.50	
σ_1 Failure, tsf		2.95	3.88	5.62
σ_3 Failure, tsf		1.00	2.00	4.00

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 77

PL= 22

PI= 55

Specific Gravity= 2.687

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

Location: Wild Rice, Argusville Formation

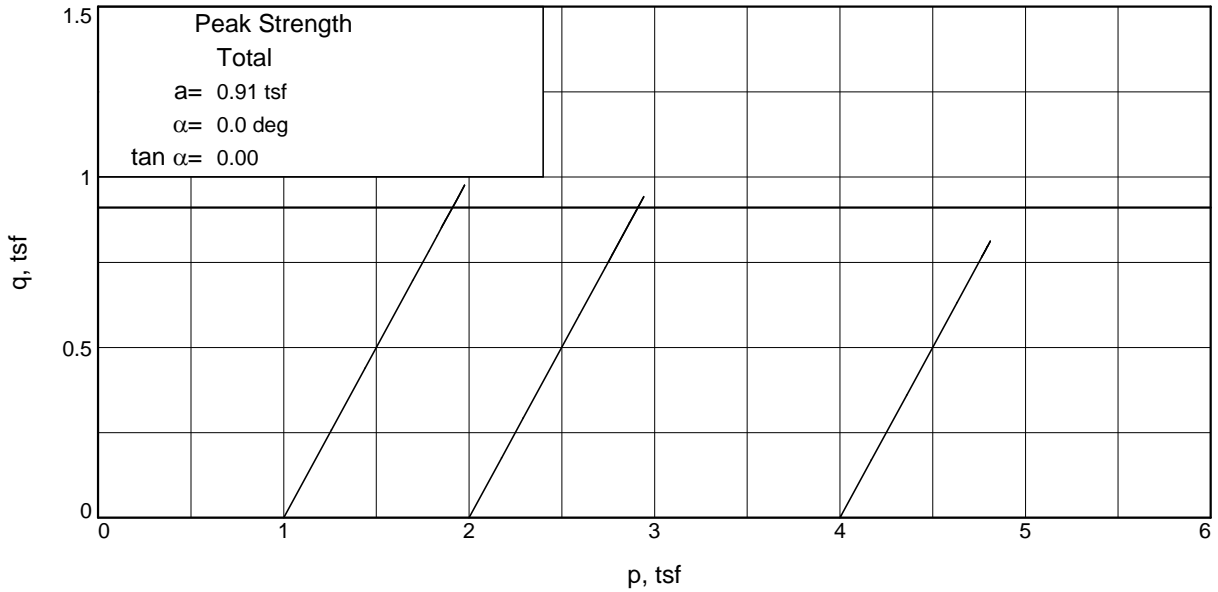
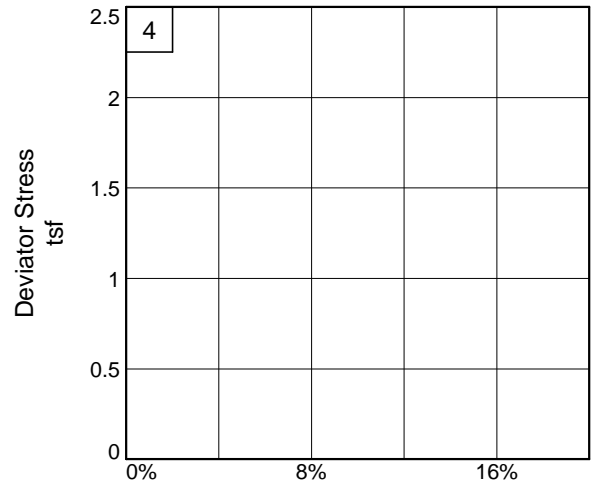
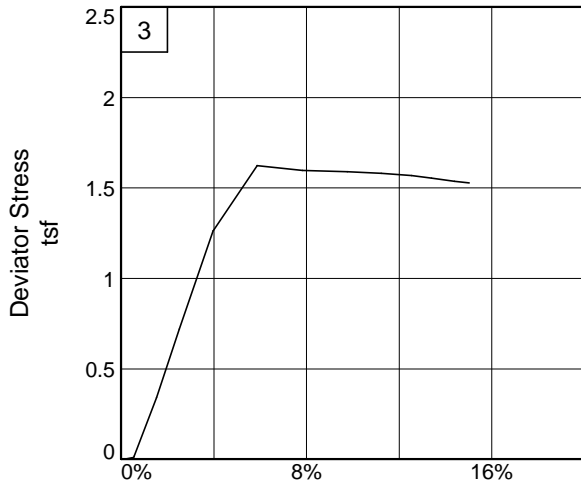
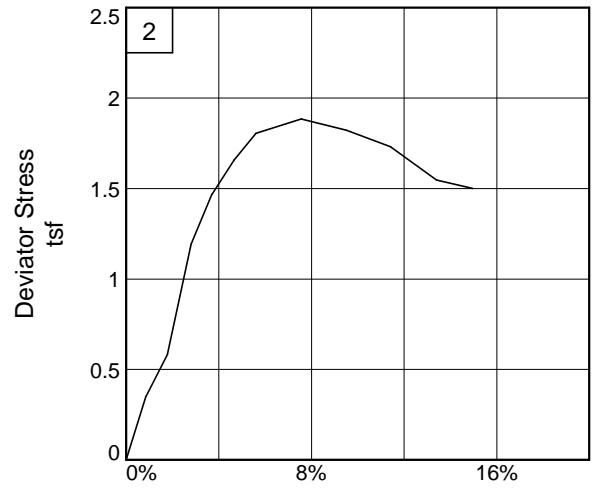
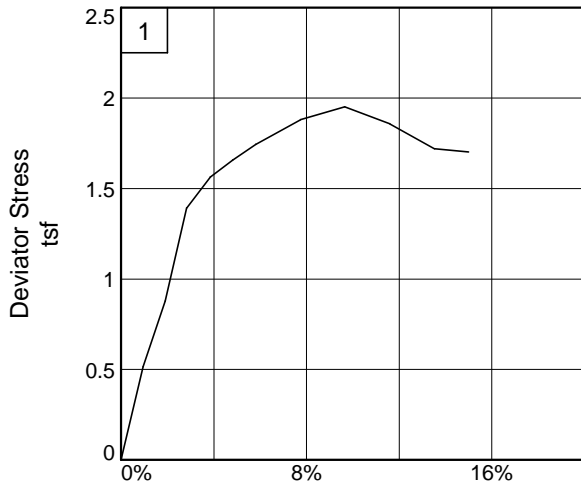
Sample Number: Boring11-118MU, #4 **Depth:** 55-57'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusville Formation

Depth: 55-57'

Sample Number: Boring11-118MU, #4

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/15/2011

11:41 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusville Formation
Depth: 55-57' **Sample Number:** Boring11-118MU, #4
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.687 **LL**=77 **PL**=22 **PI**=55
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.610	152.610
Moisture content: Dry soil+tare, gms.	114.360	114.360
Moisture content: Tare, gms.	31.310	31.310
Moisture, %	46.1	46.1
Moist specimen weight, gms.	121.6	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.81	
Wet Density, pcf	109.5	
Dry density, pcf	75.0	
Void ratio	1.2378	
Saturation, %	100.0	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.952 tsf at reading no. 8
Ult. Stress = 1.702 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0212	1.640	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0480	12.530	10.9	1.0	0.515	1.000	1.515	1.52	1.258	0.258
2	0.0746	20.350	18.7	1.9	0.877	1.000	1.877	1.88	1.439	0.439
3	0.1009	31.640	30.0	2.8	1.393	1.000	2.393	2.39	1.697	0.697
4	0.1294	35.670	34.0	3.9	1.564	1.000	2.564	2.56	1.782	0.782
5	0.1566	38.080	36.4	4.8	1.658	1.000	2.658	2.66	1.829	0.829
6	0.1845	40.400	38.8	5.8	1.745	1.000	2.745	2.74	1.872	0.872
7	0.2388	44.310	42.7	7.7	1.881	1.000	2.881	2.88	1.941	0.941
8	0.2923	46.840	45.2	9.7	1.952	1.000	2.952	2.95	1.976	0.976
9	0.3472	45.590	44.0	11.6	1.857	1.000	2.857	2.86	1.928	0.928
10	0.4015	43.270	41.6	13.5	1.720	1.000	2.720	2.72	1.860	0.860
11	0.4425	43.540	41.9	15.0	1.702	1.000	2.702	2.70	1.851	0.851

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.240	152.240
Moisture content: Dry soil+tare, gms.	114.240	114.240
Moisture content: Tare, gms.	30.470	30.470
Moisture, %	45.4	45.4
Moist specimen weight, gms.	122.0	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.80	
Wet Density, pcf	109.8	
Dry density, pcf	75.6	
Void ratio	1.2201	
Saturation, %	99.9	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.884 tsf at reading no. 7
 Ult. Stress = 1.500 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	3.840	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0308	11.280	7.4	0.9	0.351	2.000	2.351	1.18	2.176	0.176
2	0.0567	16.320	12.5	1.8	0.584	2.000	2.584	1.29	2.292	0.292
3	0.0851	29.570	25.7	2.8	1.192	2.000	3.192	1.60	2.596	0.596
4	0.1105	35.850	32.0	3.7	1.469	2.000	3.469	1.73	2.734	0.734
5	0.1372	40.340	36.5	4.7	1.658	2.000	3.658	1.83	2.829	0.829
6	0.1635	43.940	40.1	5.6	1.804	2.000	3.804	1.90	2.902	0.902
7	0.2184	46.600	42.8	7.6	1.884	2.000	3.884	1.94	2.942	0.942
8	0.2727	46.110	42.3	9.5	1.823	2.000	3.823	1.91	2.911	0.911
9	0.3268	44.830	41.0	11.4	1.730	2.000	3.730	1.86	2.865	0.865
10	0.3825	41.320	37.5	13.4	1.546	2.000	3.546	1.77	2.773	0.773
11	0.4256	40.860	37.0	15.0	1.500	2.000	3.500	1.75	2.750	0.750

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	150.990	150.990
Moisture content: Dry soil+tare, gms.	112.610	112.610
Moisture content: Tare, gms.	30.380	30.380
Moisture, %	46.7	46.7
Moist specimen weight, gms.	120.9	
Diameter, in.	1.38	
Area, in. ²	1.50	
Height, in.	2.81	
Wet Density, pcf	109.1	
Dry density, pcf	74.4	
Void ratio	1.2543	
Saturation, %	100.0	

Test Readings for Specimen No. 3

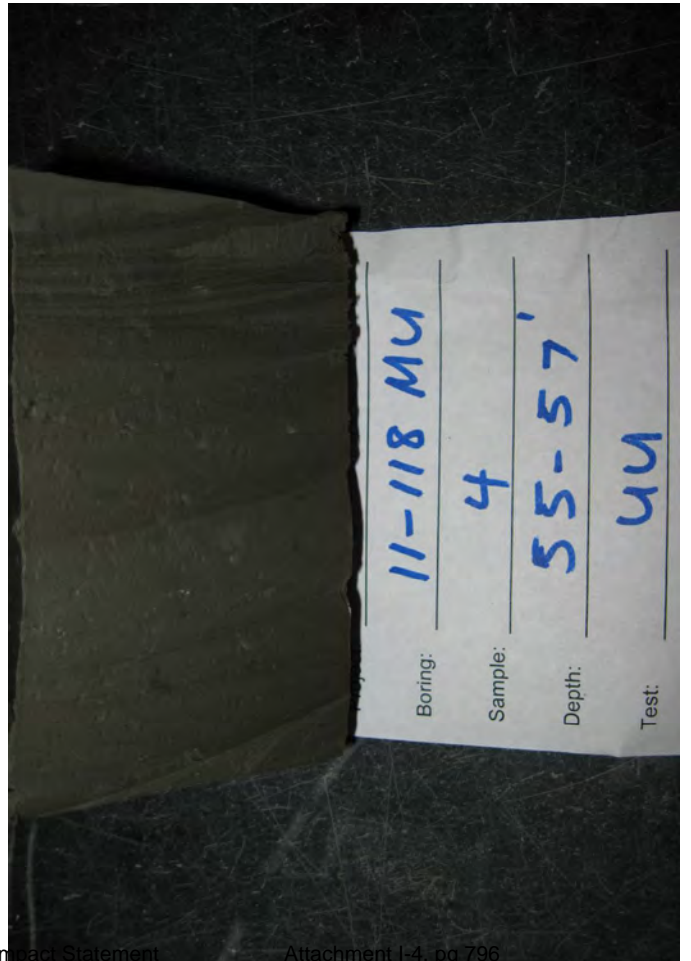
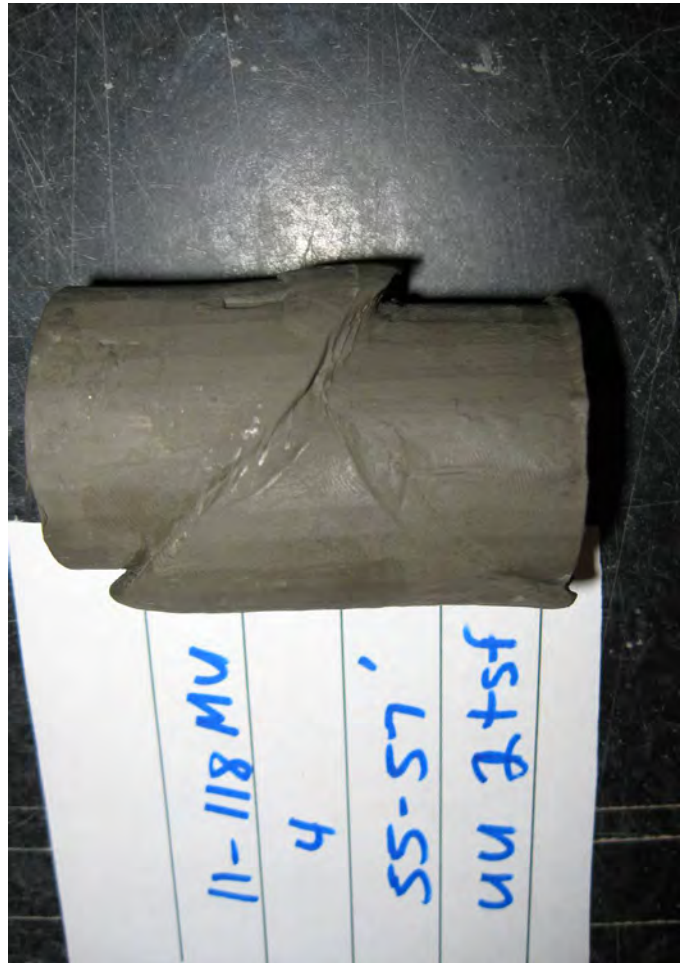
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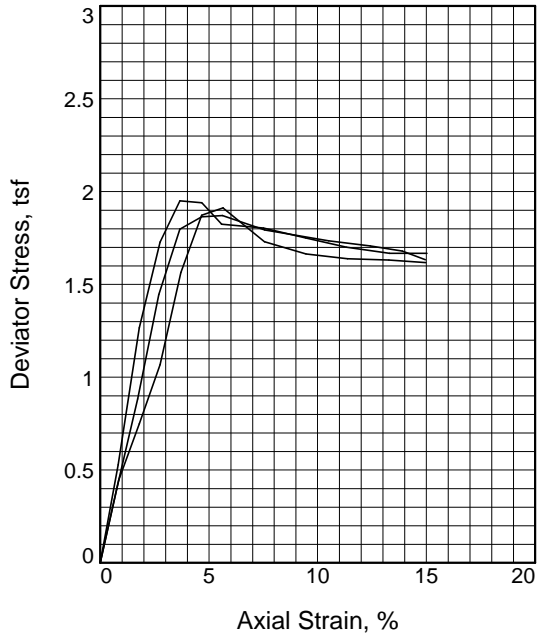
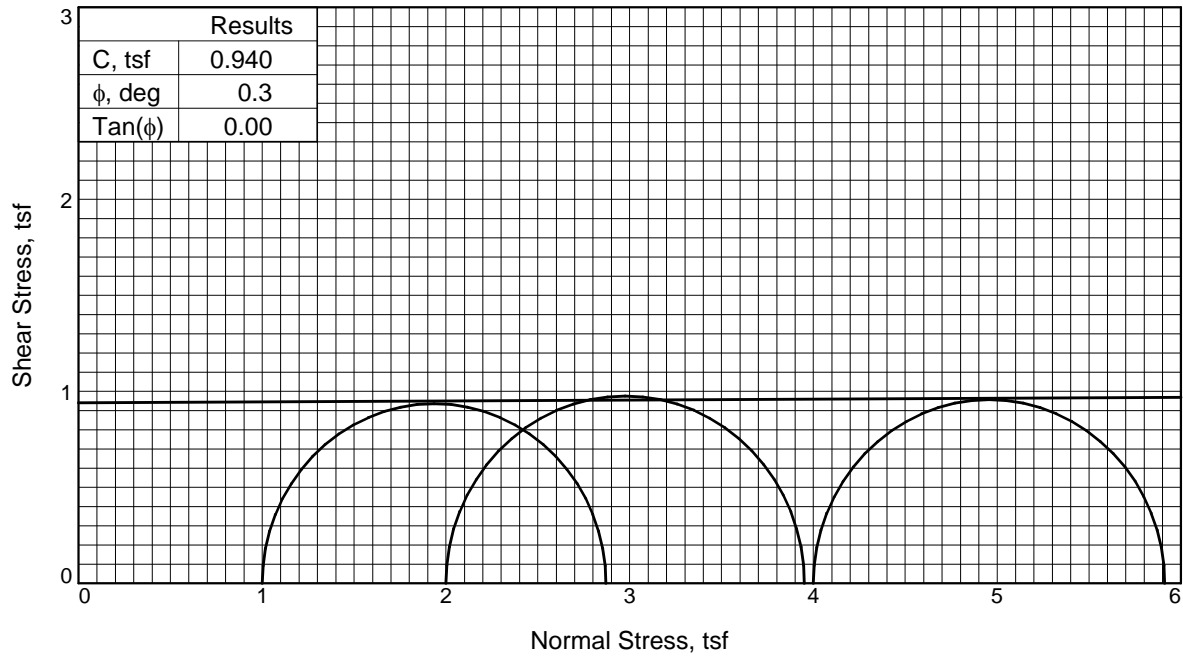
Back pressure = 0.000 tsf

Strain rate, %/min. = 1.00

Peak Stress = 1.623 tsf at reading no. 7

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0750	13.820	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0800	13.820	0.0	0.2	0.000	4.000	4.000	1.00	4.000	0.000
2	0.0900	14.030	0.2	0.5	0.010	4.000	4.010	1.00	4.005	0.005
3	0.0909	14.180	0.4	0.6	0.017	4.000	4.017	1.00	4.009	0.009
4	0.1178	21.020	7.2	1.5	0.340	4.000	4.340	1.08	4.170	0.170
5	0.1456	29.230	15.4	2.5	0.719	4.000	4.719	1.18	4.360	0.360
6	0.1865	41.290	27.5	4.0	1.263	4.000	5.263	1.32	4.632	0.632
7	0.2399	49.830	36.0	5.9	1.623	4.000	5.623	1.41	4.812	0.812
8	0.2949	49.970	36.2	7.8	1.596	4.000	5.596	1.40	4.798	0.798
9	0.3490	50.590	36.8	9.8	1.589	4.000	5.589	1.40	4.795	0.795
10	0.3901	50.990	37.2	11.2	1.580	4.000	5.580	1.40	4.790	0.790
11	0.4272	51.240	37.4	12.6	1.567	4.000	5.567	1.39	4.784	0.784
12	0.4511	51.270	37.5	13.4	1.553	4.000	5.553	1.39	4.777	0.777
13	0.4791	51.290	37.5	14.4	1.536	4.000	5.536	1.38	4.768	0.768
14	0.4967	51.370	37.6	15.0	1.528	4.000	5.528	1.38	4.764	0.764





Sample No.		1	2	3
Initial	Water Content, %	36.6	36.8	36.7
	Dry Density, pcf	84.2	83.7	84.5
	Saturation, %	98.8	98.1	99.7
	Void Ratio	0.9992	1.0107	0.9913
	Diameter, in.	1.39	1.43	1.41
	Height, in.	2.80	2.81	2.81
At Test	Water Content, %	36.6	36.8	36.7
	Dry Density, pcf	84.2	83.7	84.5
	Saturation, %	98.8	98.1	99.7
	Void Ratio	0.9992	1.0107	0.9913
	Diameter, in.	1.39	1.43	1.41
	Height, in.	2.80	2.81	2.81
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, tsf		0.00	0.00	0.00
Cell Pressure, tsf		1.00	2.00	4.00
Peak Stress, tsf		1.87	1.95	1.91
Ult. Stress, tsf		1.63	1.67	1.62
σ_1 Failure, tsf		2.87	3.95	5.91
σ_3 Failure, tsf		1.00	2.00	4.00

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 61

PL= 20

PI= 41

Specific Gravity= 2.695

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing Request NO. 2

Location: Wild Rice, Argusville Formation

Sample Number: Boring11-118MU, #5

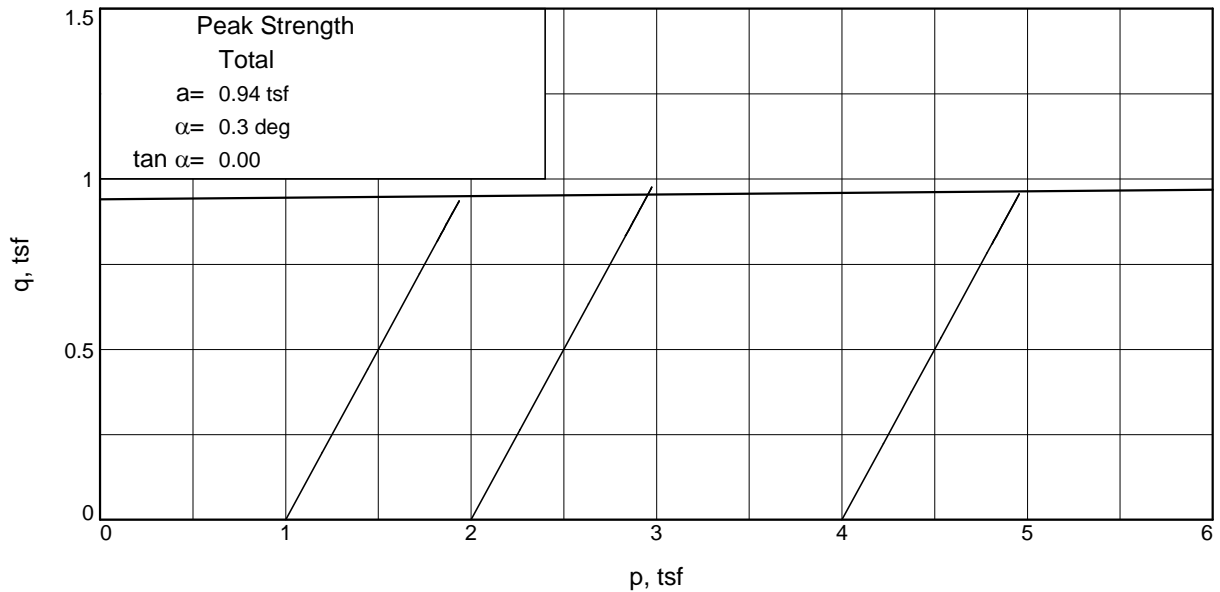
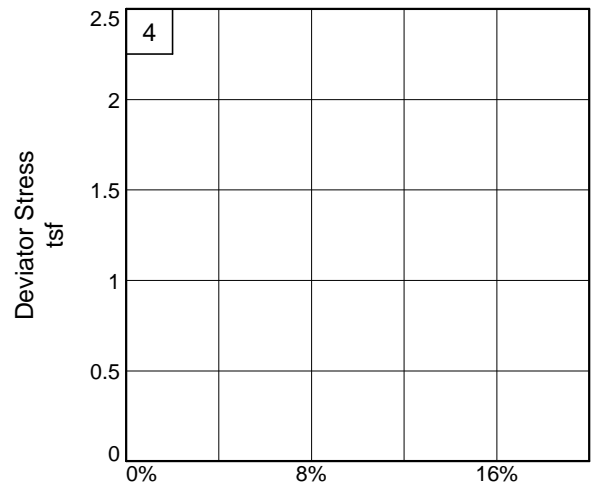
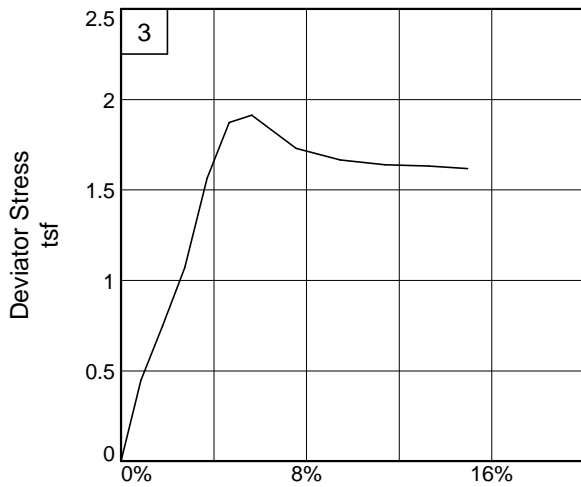
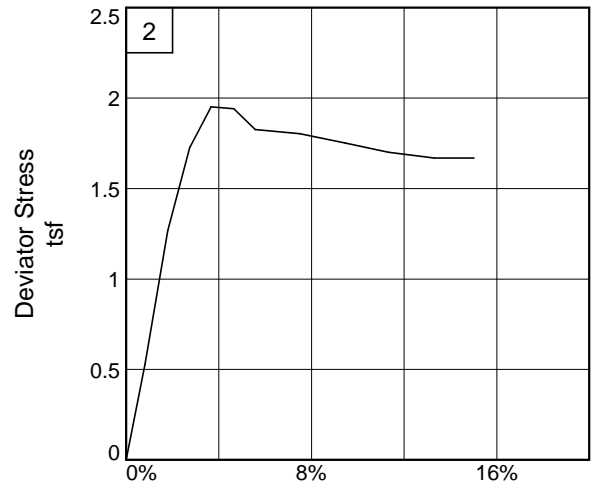
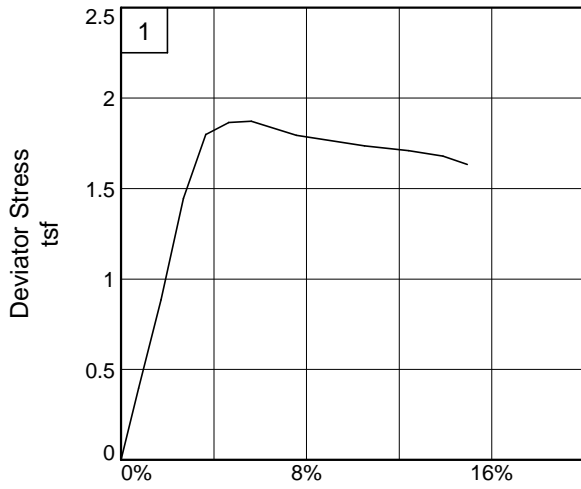
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Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Wild Rice, Argusville Formation

Project No.: BL-10-10065

Depth: 65-67'

Figure _____

Sample Number: Boring11-118MU, #5

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/15/2011

11:41 AM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project No.: BL-10-10065
Location: Wild Rice, Argusville Formation
Depth: 65-67' **Sample Number:** Boring11-118MU, #5
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.695 **LL**=61 **PL**=20 **PI**=41
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	157.320	157.320
Moisture content: Dry soil+tare, gms.	123.170	123.170
Moisture content: Tare, gms.	29.910	29.910
Moisture, %	36.6	36.6
Moist specimen weight, gms.	127.8	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.80	
Wet Density, pcf	115.0	
Dry density, pcf	84.2	
Void ratio	0.9992	
Saturation, %	98.8	

Test Readings for Specimen No. 1

Cell pressure = 1.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.871 tsf at reading no. 6
Ult. Stress = 1.633 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	1.360	0.0	0.0	0.000	1.000	1.000	1.00	1.000	0.000
1	0.0276	9.730	8.4	0.8	0.396	1.000	1.396	1.40	1.198	0.198
2	0.0548	20.230	18.9	1.7	0.884	1.000	1.884	1.88	1.442	0.442
3	0.0819	32.530	31.2	2.7	1.445	1.000	2.445	2.45	1.723	0.723
4	0.1091	40.550	39.2	3.7	1.799	1.000	2.799	2.80	1.900	0.900
5	0.1367	42.380	41.0	4.6	1.864	1.000	2.864	2.86	1.932	0.932
6	0.1641	42.960	41.6	5.6	1.871	1.000	2.871	2.87	1.935	0.935
7	0.2186	42.080	40.7	7.6	1.794	1.000	2.794	2.79	1.897	0.897
8	0.3011	42.050	40.7	10.5	1.735	1.000	2.735	2.74	1.868	0.868
9	0.3545	42.290	40.9	12.4	1.708	1.000	2.708	2.71	1.854	0.854
10	0.3958	42.290	40.9	13.9	1.679	1.000	2.679	2.68	1.840	0.840
11	0.4254	41.650	40.3	15.0	1.633	1.000	2.633	2.63	1.816	0.816

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	164.120	164.120
Moisture content: Dry soil+tare, gms.	127.930	127.930
Moisture content: Tare, gms.	29.550	29.550
Moisture, %	36.8	36.8
Moist specimen weight, gms.	135.0	
Diameter, in.	1.43	
Area, in. ²	1.60	
Height, in.	2.81	
Wet Density, pcf	114.5	
Dry density, pcf	83.7	
Void ratio	1.0107	
Saturation, %	98.1	

Test Readings for Specimen No. 2

Cell pressure = 2.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.951 tsf at reading no. 4
 Ult. Stress = 1.669 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	4.200	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0295	16.040	11.8	0.8	0.529	2.000	2.529	1.26	2.264	0.264
2	0.0569	32.860	28.7	1.8	1.267	2.000	3.267	1.63	2.634	0.634
3	0.0838	43.670	39.5	2.8	1.728	2.000	3.728	1.86	2.864	0.864
4	0.1096	49.190	45.0	3.7	1.951	2.000	3.951	1.98	2.976	0.976
5	0.1375	49.400	45.2	4.7	1.940	2.000	3.940	1.97	2.970	0.970
6	0.1634	47.150	43.0	5.6	1.826	2.000	3.826	1.91	2.913	0.913
7	0.2173	47.510	43.3	7.5	1.803	2.000	3.803	1.90	2.902	0.902
8	0.2719	47.150	43.0	9.4	1.751	2.000	3.751	1.88	2.875	0.875
9	0.3250	46.810	42.6	11.3	1.701	2.000	3.701	1.85	2.850	0.850
10	0.3802	46.920	42.7	13.3	1.667	2.000	3.667	1.83	2.834	0.834
11	0.4285	47.820	43.6	15.0	1.669	2.000	3.669	1.83	2.834	0.834

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	163.380	163.380
Moisture content: Dry soil+tare, gms.	127.620	127.620
Moisture content: Tare, gms.	30.140	30.140
Moisture, %	36.7	36.7
Moist specimen weight, gms.	133.6	
Diameter, in.	1.41	
Area, in. ²	1.57	
Height, in.	2.81	
Wet Density, pcf	115.5	
Dry density, pcf	84.5	
Void ratio	0.9913	
Saturation, %	99.7	

Test Readings for Specimen No. 3

Cell pressure = 4.000 tsf

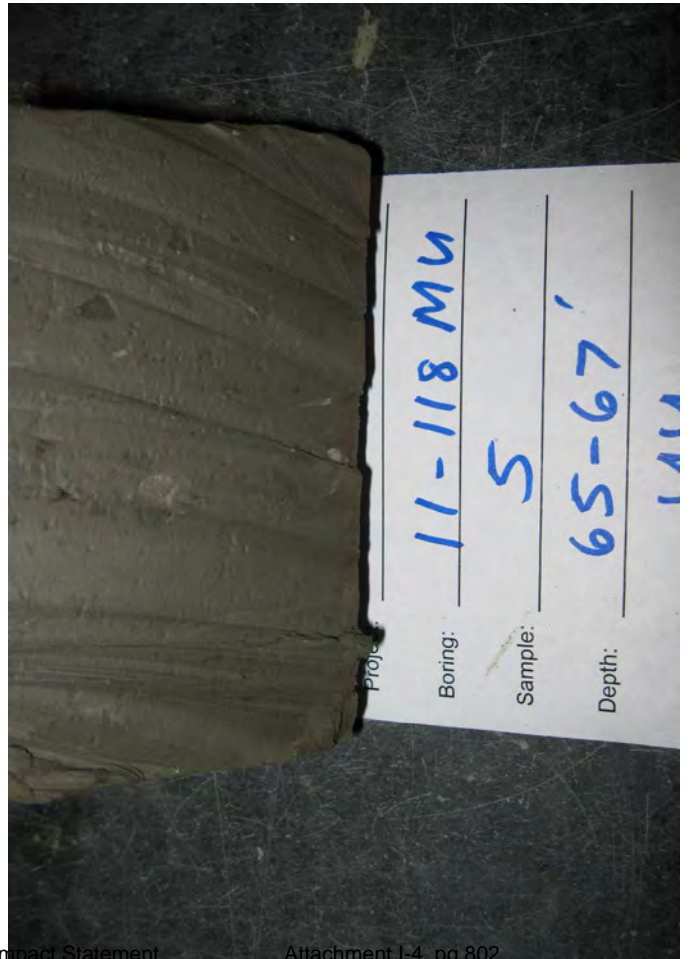
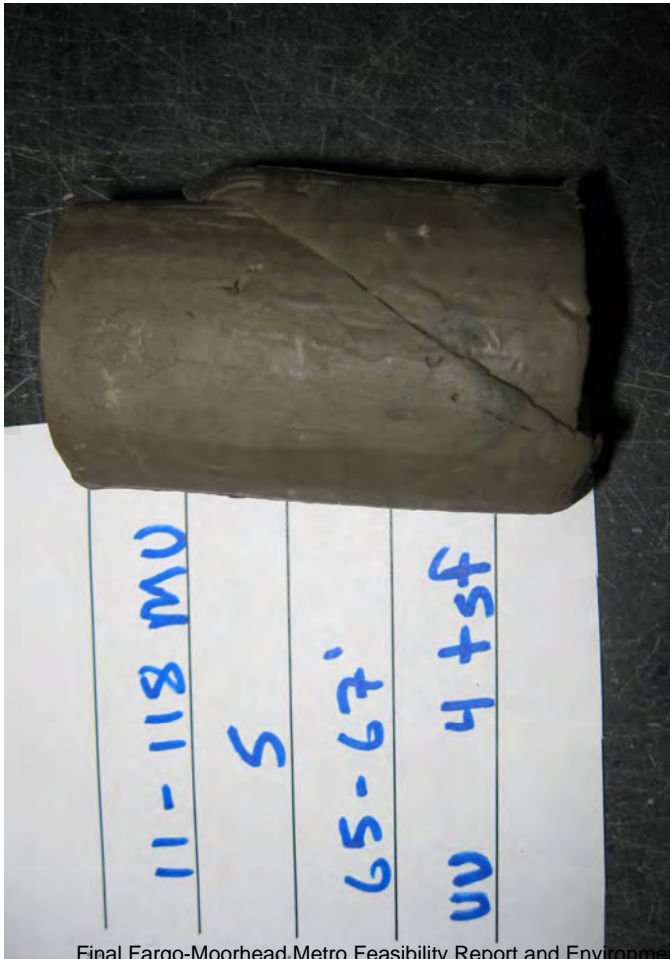
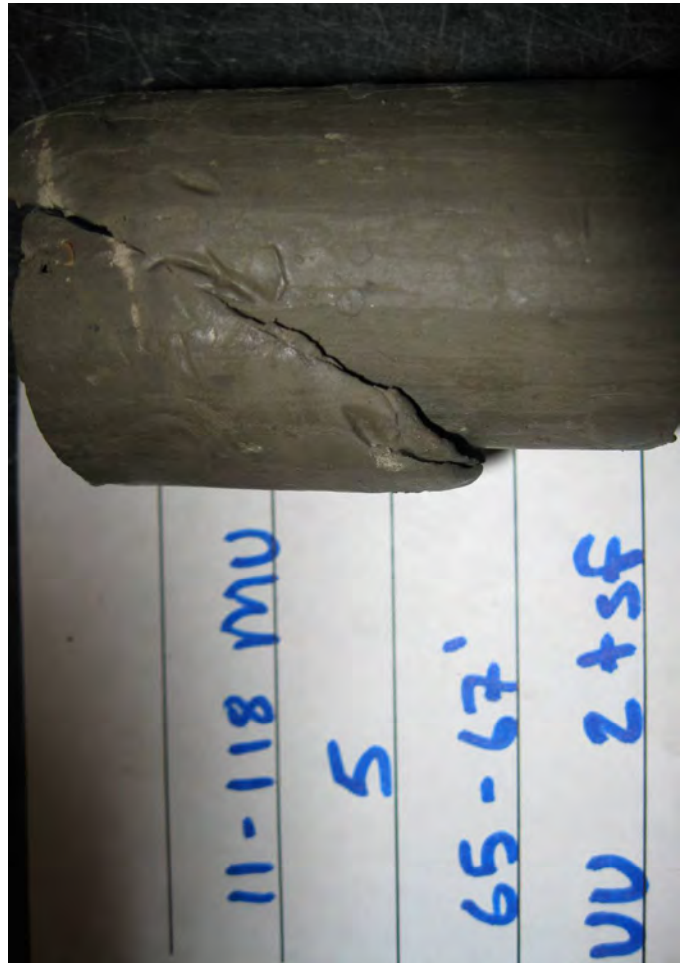
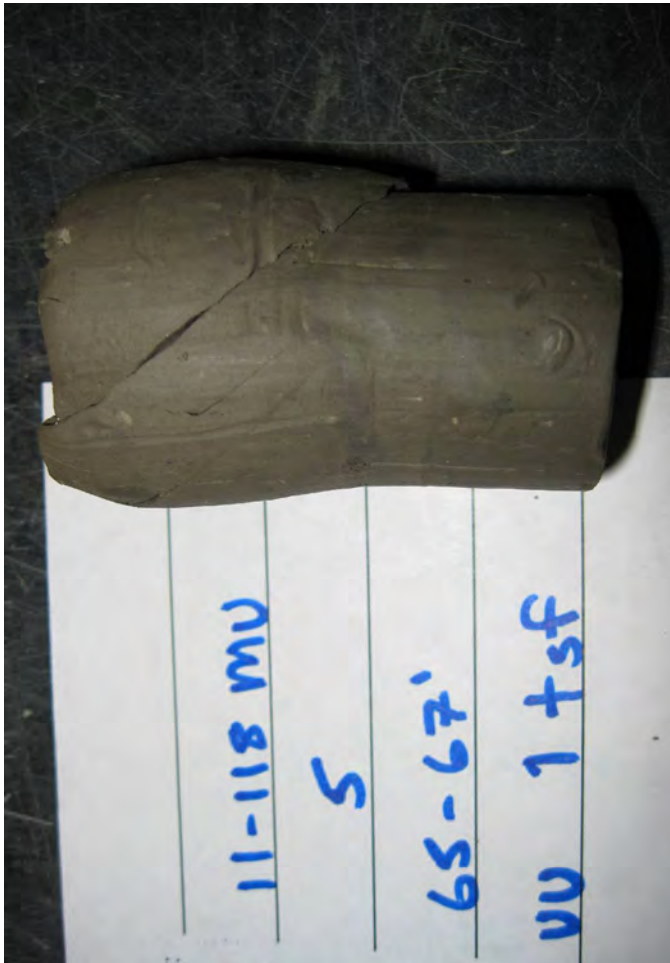
Back pressure = 0.000 tsf

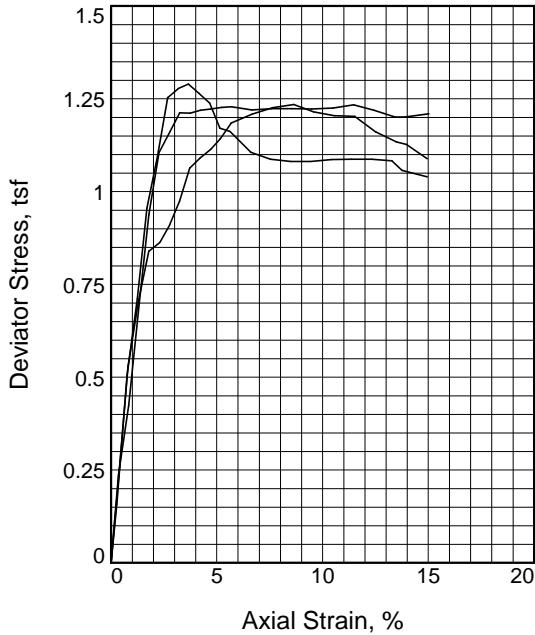
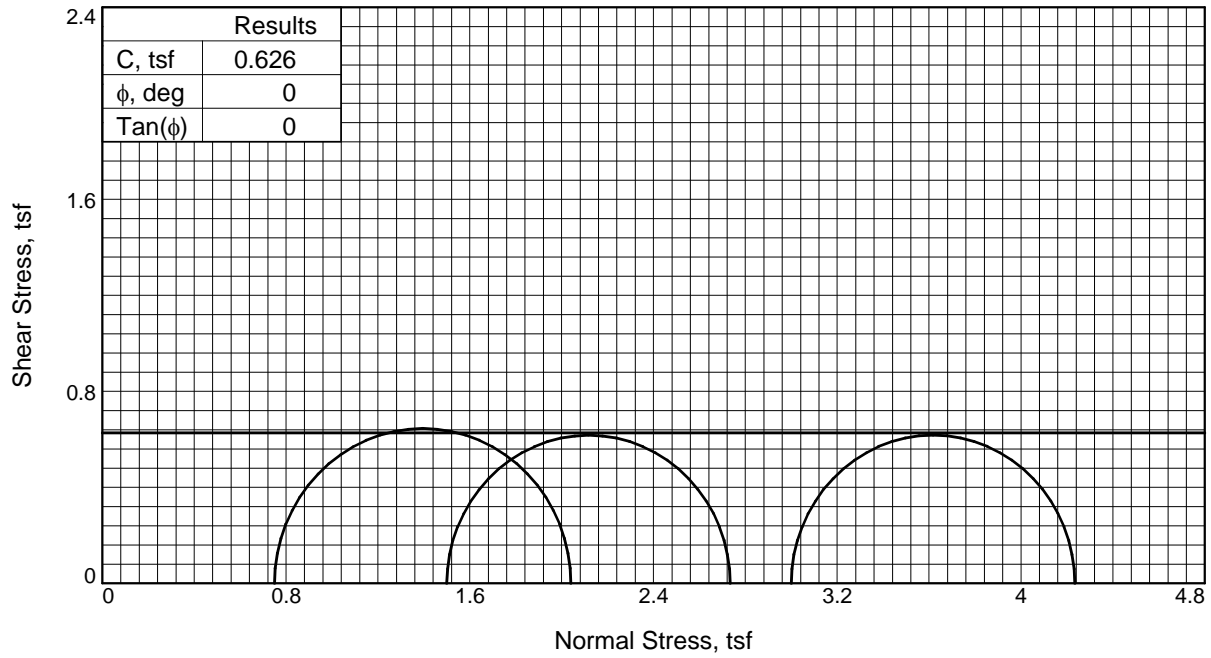
Strain rate, %/min. = 1.00

Peak Stress = 1.912 tsf at reading no. 6

Ult. Stress = 1.617 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0064	1.180	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0303	11.010	9.8	0.9	0.447	4.000	4.447	1.11	4.223	0.223
2	0.0569	17.820	16.6	1.8	0.749	4.000	4.749	1.19	4.375	0.375
3	0.0835	25.140	24.0	2.7	1.068	4.000	5.068	1.27	4.534	0.534
4	0.1105	36.620	35.4	3.7	1.565	4.000	5.565	1.39	4.782	0.782
5	0.1374	44.030	42.9	4.7	1.873	4.000	5.873	1.47	4.937	0.937
6	0.1650	45.380	44.2	5.7	1.912	4.000	5.912	1.48	4.956	0.956
7	0.2189	41.990	40.8	7.6	1.730	4.000	5.730	1.43	4.865	0.865
8	0.2719	41.290	40.1	9.5	1.665	4.000	5.665	1.42	4.833	0.833
9	0.3260	41.530	40.4	11.4	1.639	4.000	5.639	1.41	4.820	0.820
10	0.3791	42.200	41.0	13.3	1.631	4.000	5.631	1.41	4.816	0.816
11	0.4266	42.660	41.5	15.0	1.617	4.000	5.617	1.40	4.809	0.809





Sample No.	1	2	3	
Initial	Water Content, %	43.7	44.1	44.1
	Dry Density, pcf	76.9	76.6	76.8
	Saturation, %	99.0	99.3	99.9
	Void Ratio	1.1915	1.1988	1.1923
	Diameter, in.	1.39	1.37	1.38
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	43.7	44.1	44.1
	Dry Density, pcf	76.9	76.6	76.8
	Saturation, %	99.0	99.3	99.9
	Void Ratio	1.1915	1.1988	1.1923
	Diameter, in.	1.39	1.37	1.38
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	1.29	1.23	1.23	
Ult. Stress, tsf	1.04	1.21	1.09	
σ_1 Failure, tsf	2.04	2.73	4.23	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 56

PL= 22

PI= 34

Specific Gravity= 2.698

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Fargo Pile Load Test, Argusville Formation

Sample Number: Boring11-119MU, #2

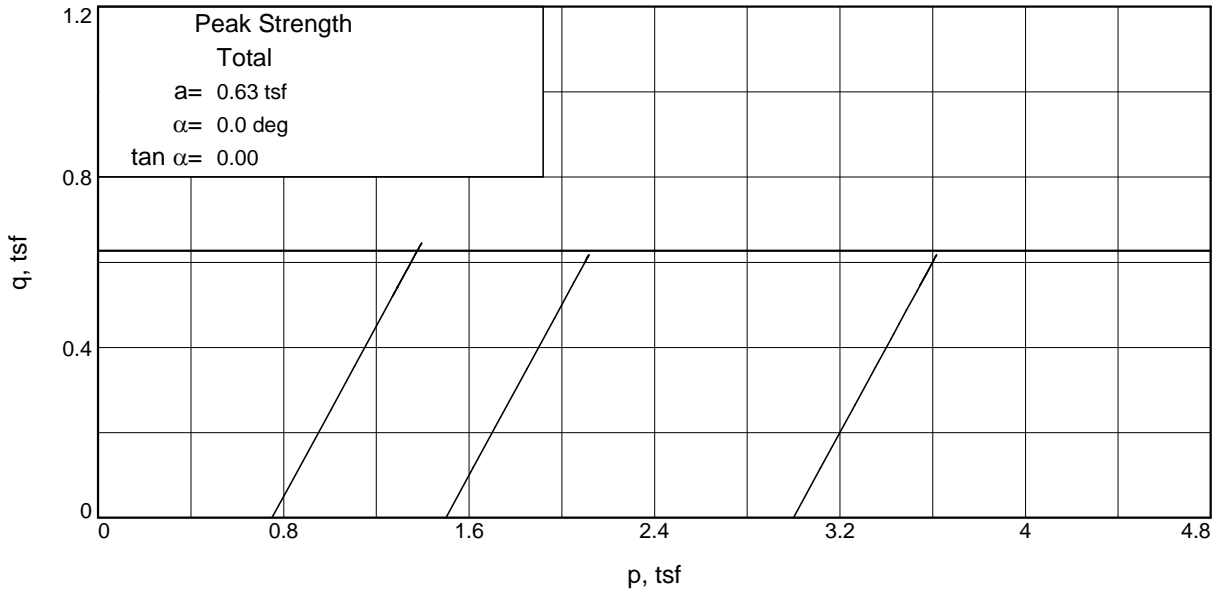
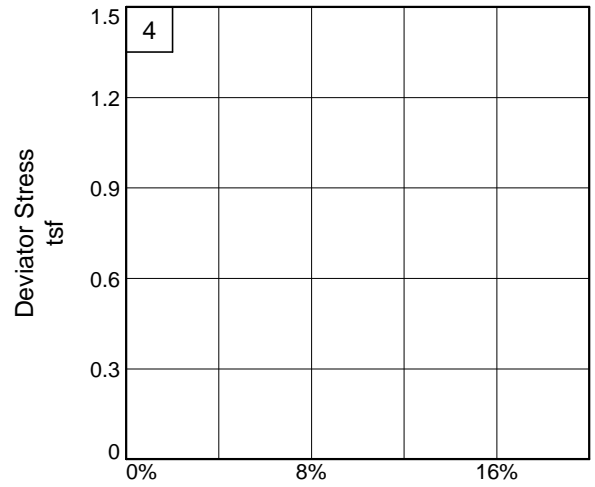
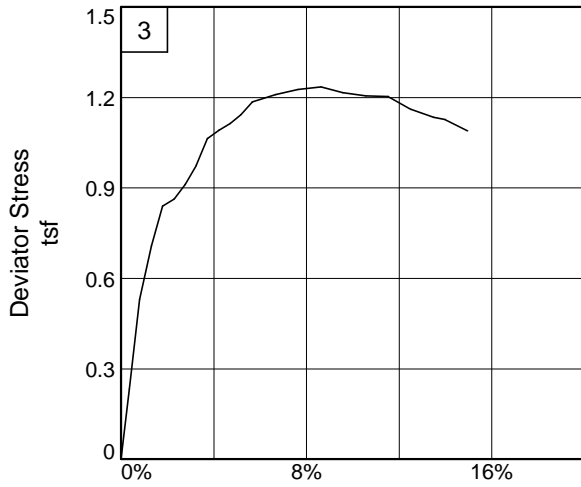
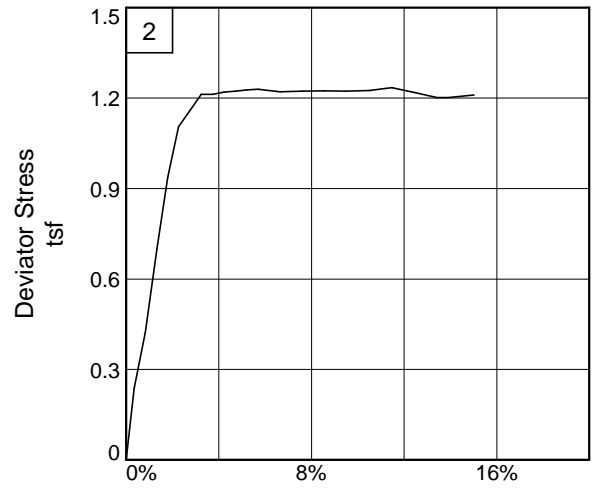
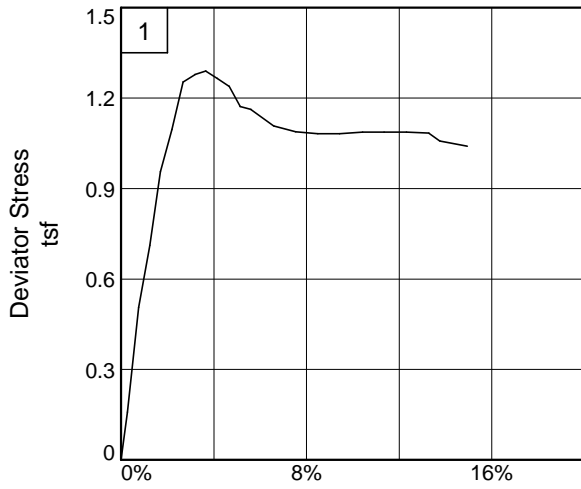
Depth: 40-42'

Proj. No.: BL-10-10065

Date Sampled:

BRAUNSM
INTERTEC

Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Argusville Formation

Depth: 40-42'

Sample No.: Boring11-119MU, #2

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:11 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Argusville Formation
Depth: 40-42' **Sample Number:** Boring11-119MU, #2
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.698 **LL**=56 **PL**=22 **PI**=34
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	153.410	153.410
Moisture content: Dry soil+tare, gms.	116.180	116.180
Moisture content: Tare, gms.	31.040	31.040
Moisture, %	43.7	43.7
Moist specimen weight, gms.	122.8	
Diameter, in.	1.39	
Area, in. ²	1.51	
Height, in.	2.80	
Wet Density, pcf	110.5	
Dry density, pcf	76.9	
Void ratio	1.1915	
Saturation, %	99.0	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.290 tsf at reading no. 8
Ult. Stress = 1.040 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	1.120	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0143	4.450	3.3	0.3	0.158	0.750	0.908	1.21	0.829	0.079
2	0.0279	11.830	10.7	0.8	0.506	0.750	1.256	1.67	1.003	0.253
3	0.0415	16.260	15.1	1.2	0.711	0.750	1.461	1.95	1.106	0.356
4	0.0541	21.540	20.4	1.7	0.955	0.750	1.705	2.27	1.228	0.478
5	0.0679	24.650	23.5	2.2	1.095	0.750	1.845	2.46	1.298	0.548
6	0.0815	28.190	27.1	2.7	1.254	0.750	2.004	2.67	1.377	0.627
7	0.0957	28.860	27.7	3.2	1.278	0.750	2.028	2.70	1.389	0.639
8	0.1091	29.260	28.1	3.7	1.290	0.750	2.040	2.72	1.395	0.645
9	0.1229	28.860	27.7	4.2	1.265	0.750	2.015	2.69	1.383	0.633
10	0.1370	28.440	27.3	4.7	1.239	0.750	1.989	2.65	1.370	0.620
11	0.1505	27.070	25.9	5.1	1.171	0.750	1.921	2.56	1.336	0.586
12	0.1637	27.000	25.9	5.6	1.162	0.750	1.912	2.55	1.331	0.581
13	0.1913	26.020	24.9	6.6	1.107	0.750	1.857	2.48	1.303	0.553
14	0.2176	25.840	24.7	7.5	1.088	0.750	1.838	2.45	1.294	0.544
15	0.2445	25.960	24.8	8.5	1.081	0.750	1.831	2.44	1.291	0.541
16	0.2707	26.210	25.1	9.4	1.081	0.750	1.831	2.44	1.291	0.541
17	0.2983	26.610	25.5	10.4	1.086	0.750	1.836	2.45	1.293	0.543
18	0.3245	26.900	25.8	11.4	1.087	0.750	1.837	2.45	1.294	0.544
19	0.3514	27.180	26.1	12.3	1.087	0.750	1.837	2.45	1.294	0.544
20	0.3785	27.380	26.3	13.3	1.083	0.750	1.833	2.44	1.292	0.542
21	0.3921	26.890	25.8	13.8	1.057	0.750	1.807	2.41	1.279	0.529
22	0.4250	26.830	25.7	15.0	1.040	0.750	1.790	2.39	1.270	0.520

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	149.300	149.300
Moisture content: Dry soil+tare, gms.	112.770	112.770
Moisture content: Tare, gms.	30.000	30.000
Moisture, %	44.1	44.1
Moist specimen weight, gms.	119.9	
Diameter, in.	1.37	
Area, in. ²	1.48	
Height, in.	2.80	
Wet Density, pcf	110.4	
Dry density, pcf	76.6	
Void ratio	1.1988	
Saturation, %	99.3	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.234 tsf at reading no. 18
 Ult. Stress = 1.210 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	2.130	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0162	7.010	4.9	0.3	0.236	1.500	1.736	1.16	1.618	0.118
2	0.0300	10.920	8.8	0.8	0.424	1.500	1.924	1.28	1.712	0.212
3	0.0439	16.690	14.6	1.3	0.699	1.500	2.199	1.47	1.849	0.349
4	0.0567	21.750	19.6	1.8	0.937	1.500	2.437	1.62	1.969	0.469
5	0.0702	25.410	23.3	2.3	1.106	1.500	2.606	1.74	2.053	0.553
6	0.0838	26.670	24.5	2.8	1.160	1.500	2.660	1.77	2.080	0.580
7	0.0970	27.890	25.8	3.2	1.212	1.500	2.712	1.81	2.106	0.606
8	0.1110	28.020	25.9	3.7	1.212	1.500	2.712	1.81	2.106	0.606
9	0.1248	28.320	26.2	4.2	1.220	1.500	2.720	1.81	2.110	0.610
10	0.1387	28.520	26.4	4.7	1.223	1.500	2.723	1.82	2.111	0.611
11	0.1528	28.760	26.6	5.2	1.227	1.500	2.727	1.82	2.114	0.614
12	0.1658	28.930	26.8	5.7	1.229	1.500	2.729	1.82	2.115	0.615
13	0.1926	29.020	26.9	6.7	1.221	1.500	2.721	1.81	2.110	0.610
14	0.2191	29.354	27.2	7.6	1.223	1.500	2.723	1.82	2.112	0.612
15	0.2454	29.640	27.5	8.5	1.224	1.500	2.724	1.82	2.112	0.612
16	0.2720	29.910	27.8	9.5	1.223	1.500	2.723	1.82	2.111	0.611
17	0.3001	30.280	28.2	10.5	1.225	1.500	2.725	1.82	2.113	0.613
18	0.3271	30.790	28.7	11.5	1.234	1.500	2.734	1.82	2.117	0.617
19	0.3544	30.760	28.6	12.4	1.219	1.500	2.719	1.81	2.110	0.610
20	0.3818	30.660	28.5	13.4	1.201	1.500	2.701	1.80	2.101	0.601
21	0.3955	30.820	28.7	13.9	1.201	1.500	2.701	1.80	2.101	0.601
22	0.4265	31.400	29.3	15.0	1.210	1.500	2.710	1.81	2.105	0.605

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	152.120	152.120
Moisture content: Dry soil+tare, gms.	114.850	114.850
Moisture content: Tare, gms.	30.400	30.400
Moisture, %	44.1	44.1
Moist specimen weight, gms.	122.0	
Diameter, in.	1.38	
Area, in. ²	1.50	
Height, in.	2.80	
Wet Density, pcf	110.7	
Dry density, pcf	76.8	
Void ratio	1.1923	
Saturation, %	99.9	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

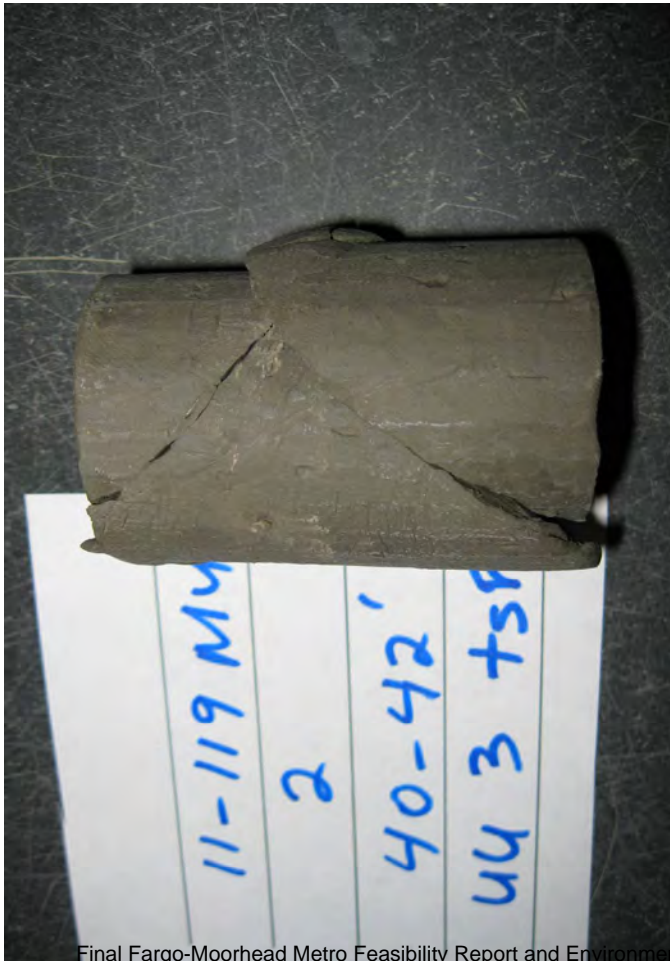
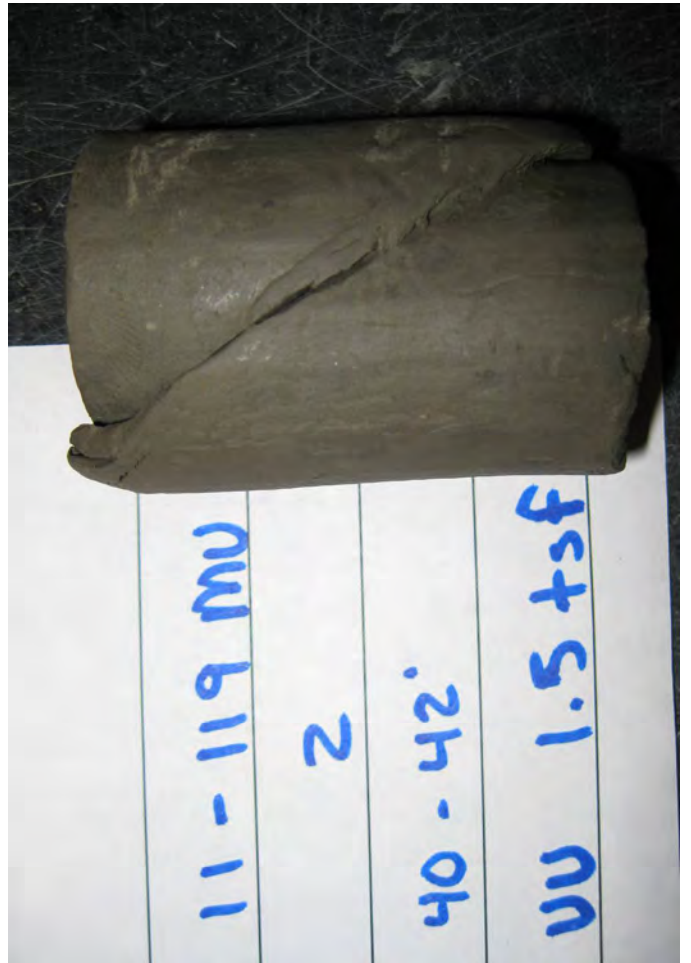
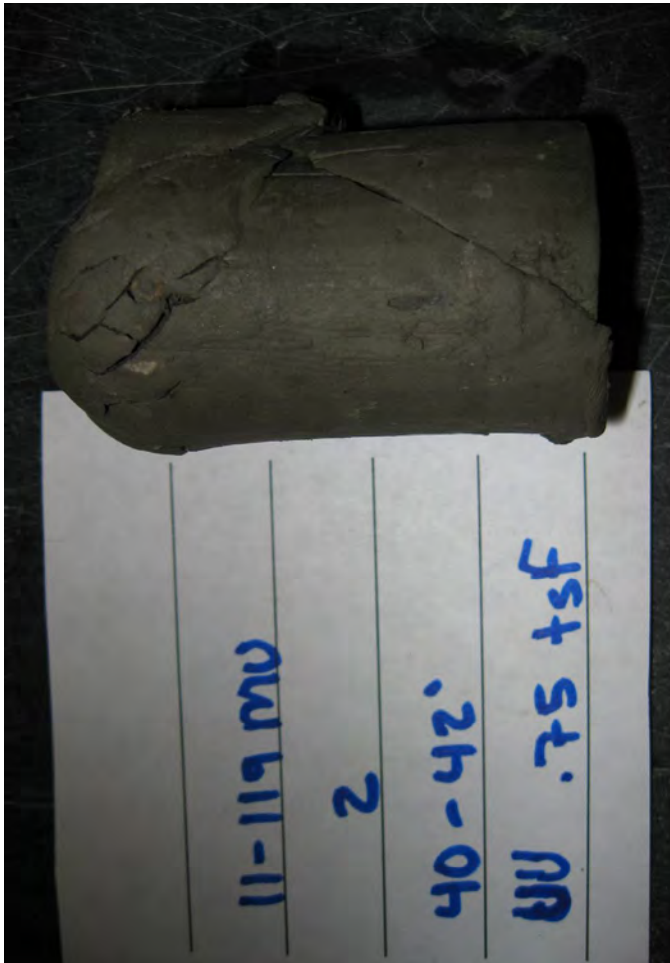
Back pressure = 0.000 tsf

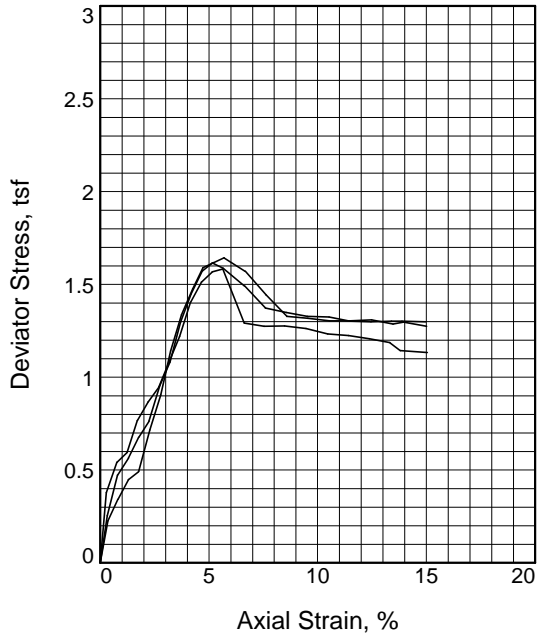
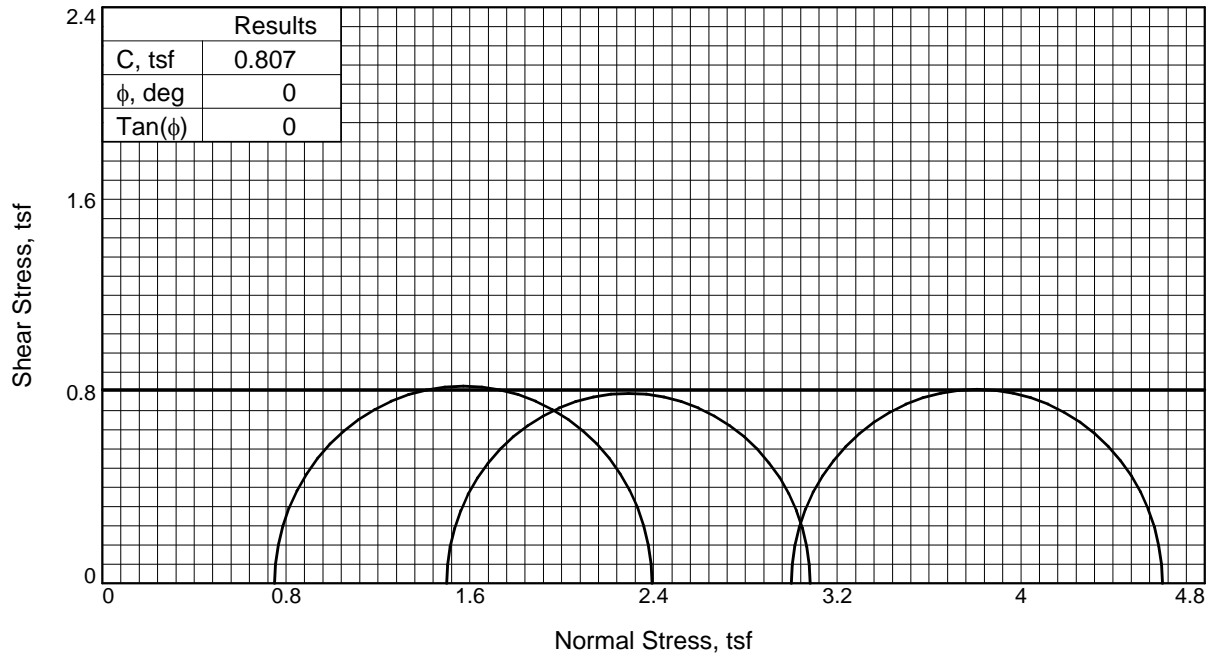
Strain rate, %/min. = 1.00

Peak Stress = 1.234 tsf at reading no. 15

Ult. Stress = 1.089 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	6.640	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0168	11.500	4.9	0.4	0.233	3.000	3.233	1.08	3.116	0.116
2	0.0293	17.750	11.1	0.8	0.530	3.000	3.530	1.18	3.265	0.265
3	0.0433	21.540	14.9	1.3	0.707	3.000	3.707	1.24	3.353	0.353
4	0.0569	24.440	17.8	1.8	0.840	3.000	3.840	1.28	3.420	0.420
5	0.0710	25.020	18.4	2.3	0.863	3.000	3.863	1.29	3.432	0.432
6	0.0842	26.130	19.5	2.8	0.911	3.000	3.911	1.30	3.455	0.455
7	0.0976	27.600	21.0	3.2	0.975	3.000	3.975	1.32	3.487	0.487
8	0.1111	29.630	23.0	3.7	1.064	3.000	4.064	1.35	3.532	0.532
9	0.1251	30.360	23.7	4.2	1.092	3.000	4.092	1.36	3.546	0.546
10	0.1385	30.960	24.3	4.7	1.114	3.000	4.114	1.37	3.557	0.557
11	0.1515	31.700	25.1	5.2	1.142	3.000	4.142	1.38	3.571	0.571
12	0.1655	32.770	26.1	5.7	1.185	3.000	4.185	1.39	3.592	0.592
13	0.1936	33.590	27.0	6.7	1.209	3.000	4.209	1.40	3.605	0.605
14	0.2208	34.270	27.6	7.6	1.227	3.000	4.227	1.41	3.613	0.613
15	0.2487	34.750	28.1	8.6	1.234	3.000	4.234	1.41	3.617	0.617
16	0.2750	34.600	28.0	9.6	1.215	3.000	4.215	1.41	3.608	0.608
17	0.3027	34.670	28.0	10.6	1.205	3.000	4.205	1.40	3.603	0.603
18	0.3300	34.940	28.3	11.5	1.203	3.000	4.203	1.40	3.602	0.602
19	0.3576	34.240	27.6	12.5	1.161	3.000	4.161	1.39	3.580	0.580
20	0.3849	33.910	27.3	13.5	1.134	3.000	4.134	1.38	3.567	0.567
21	0.3987	33.900	27.3	14.0	1.127	3.000	4.127	1.38	3.564	0.564
22	0.4258	33.290	26.7	15.0	1.089	3.000	4.089	1.36	3.545	0.545





Sample No.	1	2	3	
Initial	Water Content, %	48.3	49.8	50.9
	Dry Density, pcf	73.1	72.0	71.0
	Saturation, %	99.6	100.0	99.8
	Void Ratio	1.3171	1.3508	1.3838
	Diameter, in.	1.37	1.37	1.38
	Height, in.	2.80	2.80	2.80
At Test	Water Content, %	48.3	49.8	50.9
	Dry Density, pcf	73.1	72.0	71.0
	Saturation, %	99.6	100.0	99.8
	Void Ratio	1.3171	1.3508	1.3838
	Diameter, in.	1.37	1.37	1.38
	Height, in.	2.80	2.80	2.80
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	0.75	1.50	3.00	
Peak Stress, tsf	1.64	1.58	1.62	
Ult. Stress, tsf	1.27	1.13	1.30	
σ_1 Failure, tsf	2.39	3.08	4.62	
σ_3 Failure, tsf	0.75	1.50	3.00	

Type of Test:

Unconsolidated Undrained

Sample Type: 5" Thinwall, Bottom of sample

Description: FAT CLAY, brown (CH)

LL= 62

PL= 19

PI= 43

Specific Gravity= 2.712

Remarks:

Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Fargo Pile Load Test, Argusville Formation

Sample Number: Boring11-119MU, #3

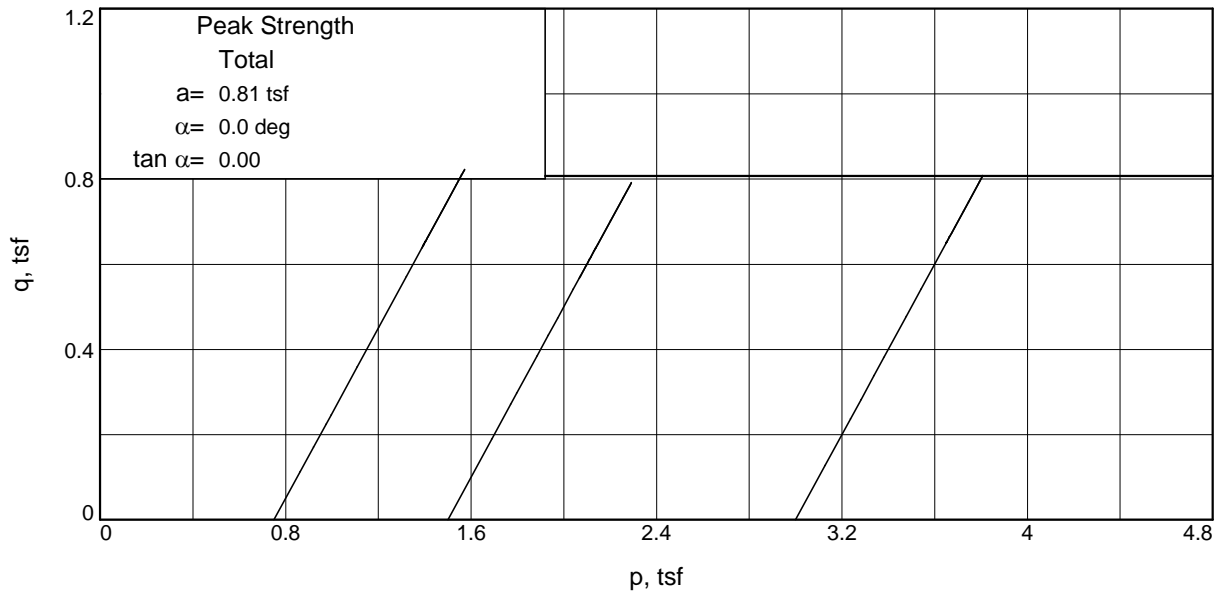
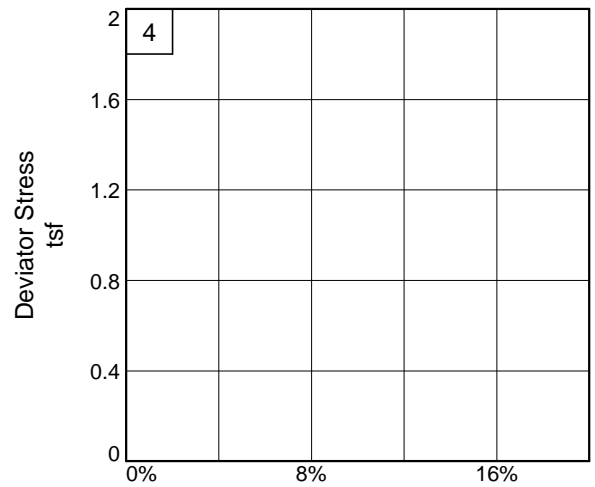
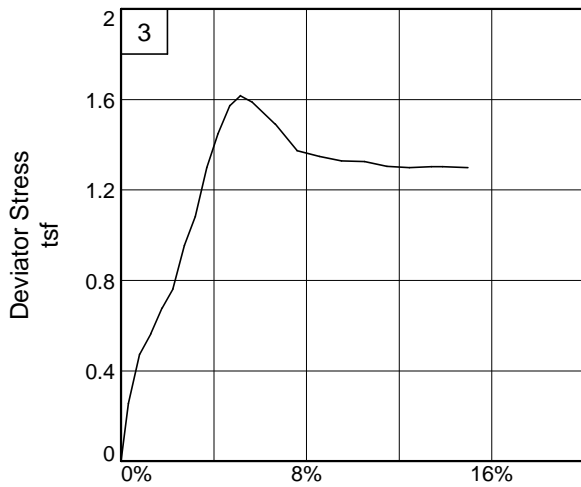
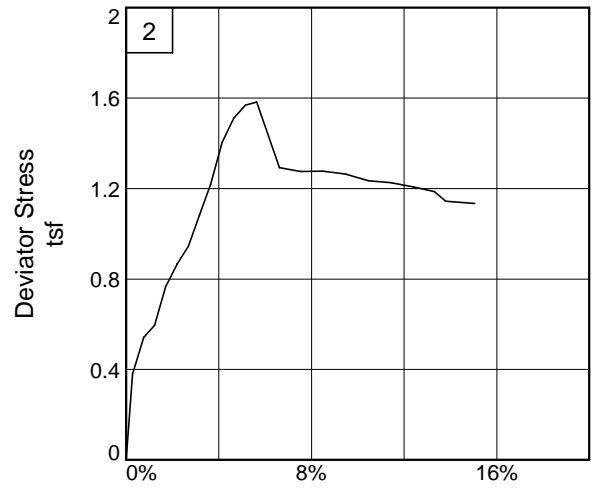
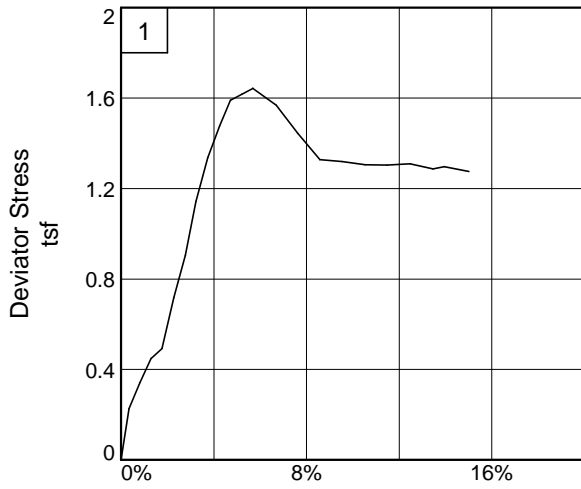
Depth: 50-52'

Proj. No.: BL-10-10065

Date Sampled:



Figure UU Triax ASTM D 2850



Client: USACE W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Loc.: Fargo Pile Load Test, Argusville Formation

Depth: 50-52'

Sample No.: Boring11-119MU, #3

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

5/30/2011

12:12 PM

Date:
Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project No.: BL-10-10065
Location: Fargo Pile Load Test, Argusville Formation
Depth: 50-52' **Sample Number:** Boring11-119MU, #3
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: 5" Thinwall, Bottom of sample
Specific Gravity=2.712 **LL**=62 **PL**=19 **PI**=43
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	147.880	147.880
Moisture content: Dry soil+tare, gms.	109.710	109.710
Moisture content: Tare, gms.	30.760	30.760
Moisture, %	48.3	48.3
Moist specimen weight, gms.	117.4	
Diameter, in.	1.37	
Area, in. ²	1.47	
Height, in.	2.80	
Wet Density, pcf	108.4	
Dry density, pcf	73.1	
Void ratio	1.3171	
Saturation, %	99.6	

Test Readings for Specimen No. 1

Cell pressure = 0.750 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.643 tsf at reading no. 12
Ult. Stress = 1.275 tsf at reading no. 22

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	1.760	0.0	0.0	0.000	0.750	0.750	1.00	0.750	0.000
1	0.0165	6.400	4.6	0.4	0.226	0.750	0.976	1.30	0.863	0.113
2	0.0295	8.810	7.1	0.8	0.342	0.750	1.092	1.46	0.921	0.171
3	0.0429	11.070	9.3	1.3	0.449	0.750	1.199	1.60	0.974	0.224
4	0.0561	12.020	10.3	1.8	0.492	0.750	1.242	1.66	0.996	0.246
5	0.0705	16.780	15.0	2.3	0.717	0.750	1.467	1.96	1.108	0.358
6	0.0844	20.810	19.0	2.8	0.905	0.750	1.655	2.21	1.202	0.452
7	0.0973	25.930	24.2	3.2	1.142	0.750	1.892	2.52	1.321	0.571
8	0.1113	30.180	28.4	3.7	1.336	0.750	2.086	2.78	1.418	0.668
9	0.1257	33.320	31.6	4.3	1.476	0.750	2.226	2.97	1.488	0.738
10	0.1390	35.940	34.2	4.7	1.591	0.750	2.341	3.12	1.545	0.795
11	0.1528	36.710	35.0	5.2	1.618	0.750	2.368	3.16	1.559	0.809
12	0.1661	37.440	35.7	5.7	1.643	0.750	2.393	3.19	1.572	0.822
13	0.1933	36.220	34.5	6.7	1.571	0.750	2.321	3.09	1.535	0.785
14	0.2200	33.750	32.0	7.6	1.443	0.750	2.193	2.92	1.472	0.722
15	0.2469	31.490	29.7	8.6	1.327	0.750	2.077	2.77	1.414	0.664
16	0.2741	31.610	29.9	9.6	1.319	0.750	2.069	2.76	1.409	0.659
17	0.3017	31.610	29.9	10.5	1.304	0.750	2.054	2.74	1.402	0.652
18	0.3281	31.910	30.2	11.5	1.304	0.750	2.054	2.74	1.402	0.652
19	0.3559	32.370	30.6	12.5	1.309	0.750	2.059	2.74	1.404	0.654
20	0.3836	32.200	30.4	13.5	1.287	0.750	2.037	2.72	1.393	0.643
21	0.3974	32.620	30.9	14.0	1.297	0.750	2.047	2.73	1.398	0.648
22	0.4269	32.470	30.7	15.0	1.275	0.750	2.025	2.70	1.387	0.637

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	146.490	146.490
Moisture content: Dry soil+tare, gms.	107.950	107.950
Moisture content: Tare, gms.	30.550	30.550
Moisture, %	49.8	49.8
Moist specimen weight, gms.	116.3	
Diameter, in.	1.37	
Area, in. ²	1.47	
Height, in.	2.80	
Wet Density, pcf	107.9	
Dry density, pcf	72.0	
Void ratio	1.3508	
Saturation, %	100.0	

Test Readings for Specimen No. 2

Cell pressure = 1.500 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 1.583 tsf at reading no. 12
 Ult. Stress = 1.134 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	4.200	0.0	0.0	0.000	1.500	1.500	1.00	1.500	0.000
1	0.0145	11.950	7.7	0.3	0.379	1.500	1.879	1.25	1.690	0.190
2	0.0280	15.340	11.1	0.8	0.542	1.500	2.042	1.36	1.771	0.271
3	0.0413	16.500	12.3	1.2	0.596	1.500	2.096	1.40	1.798	0.298
4	0.0546	20.130	15.9	1.7	0.768	1.500	2.268	1.51	1.884	0.384
5	0.0681	22.240	18.0	2.2	0.866	1.500	2.366	1.58	1.933	0.433
6	0.0820	24.040	19.8	2.7	0.947	1.500	2.447	1.63	1.974	0.474
7	0.0951	26.970	22.8	3.2	1.082	1.500	2.582	1.72	2.041	0.541
8	0.1089	29.990	25.8	3.7	1.219	1.500	2.719	1.81	2.109	0.609
9	0.1229	34.050	29.9	4.2	1.404	1.500	2.904	1.94	2.202	0.702
10	0.1369	36.550	32.3	4.7	1.513	1.500	3.013	2.01	2.257	0.757
11	0.1507	37.900	33.7	5.1	1.568	1.500	3.068	2.05	2.284	0.784
12	0.1644	38.390	34.2	5.6	1.583	1.500	3.083	2.06	2.291	0.791
13	0.1919	32.400	28.2	6.6	1.292	1.500	2.792	1.86	2.146	0.646
14	0.2174	32.310	28.1	7.5	1.275	1.500	2.775	1.85	2.138	0.638
15	0.2440	32.640	28.4	8.5	1.277	1.500	2.777	1.85	2.138	0.638
16	0.2715	32.650	28.4	9.5	1.264	1.500	2.764	1.84	2.132	0.632
17	0.2993	32.290	28.1	10.5	1.234	1.500	2.734	1.82	2.117	0.617
18	0.3263	32.400	28.2	11.4	1.225	1.500	2.725	1.82	2.113	0.613
19	0.3529	32.280	28.1	12.4	1.207	1.500	2.707	1.80	2.104	0.604
20	0.3794	32.100	27.9	13.3	1.186	1.500	2.686	1.79	2.093	0.593
21	0.3930	31.240	27.0	13.8	1.143	1.500	2.643	1.76	2.072	0.572
22	0.4276	31.400	27.2	15.0	1.134	1.500	2.634	1.76	2.067	0.567

Parameters for Specimen No. 3

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	147.220	147.220
Moisture content: Dry soil+tare, gms.	107.810	107.810
Moisture content: Tare, gms.	30.430	30.430
Moisture, %	50.9	50.9
Moist specimen weight, gms.	117.1	
Diameter, in.	1.38	
Area, in. ²	1.49	
Height, in.	2.80	
Wet Density, pcf	107.2	
Dry density, pcf	71.0	
Void ratio	1.3838	
Saturation, %	99.8	

Test Readings for Specimen No. 3

Cell pressure = 3.000 tsf

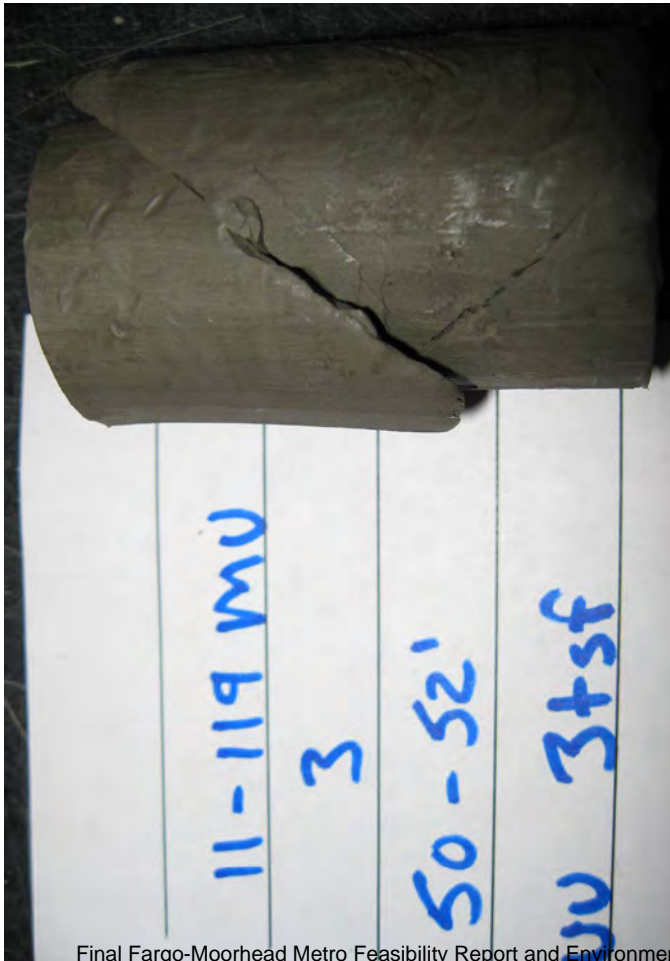
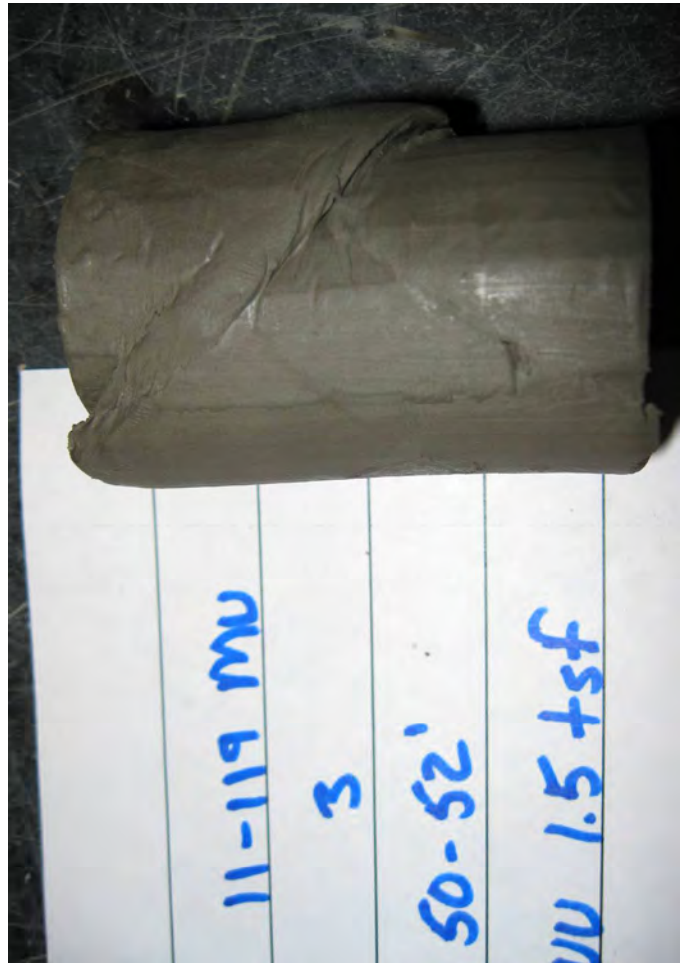
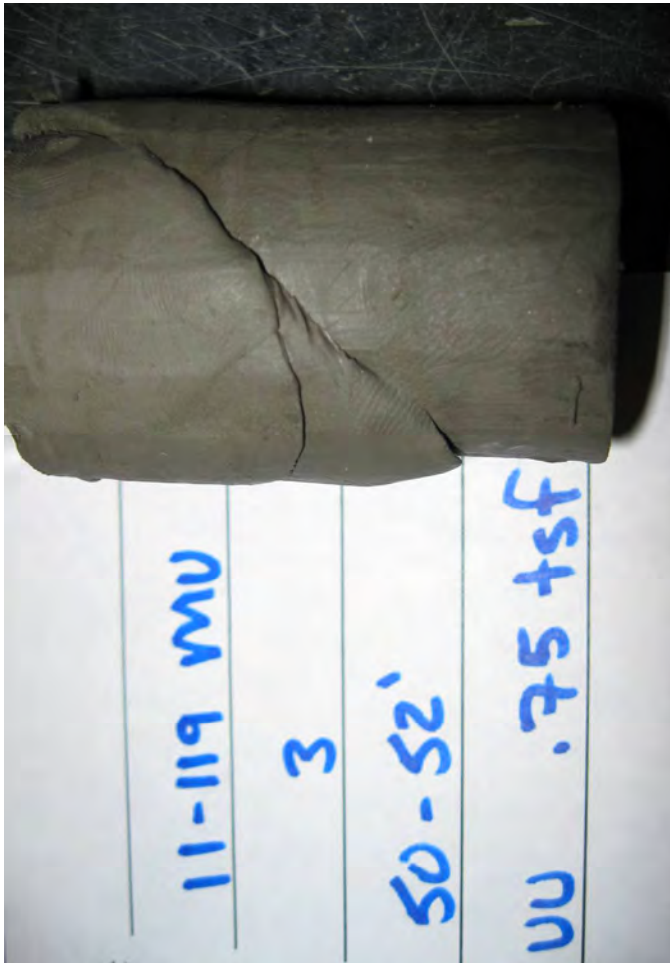
Back pressure = 0.000 tsf

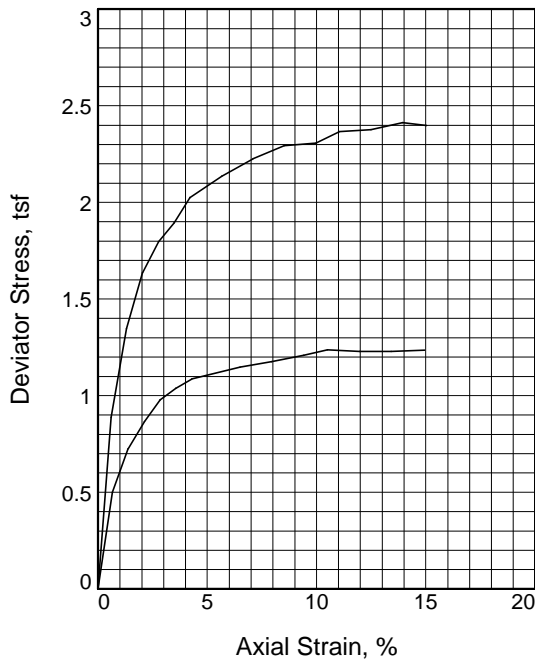
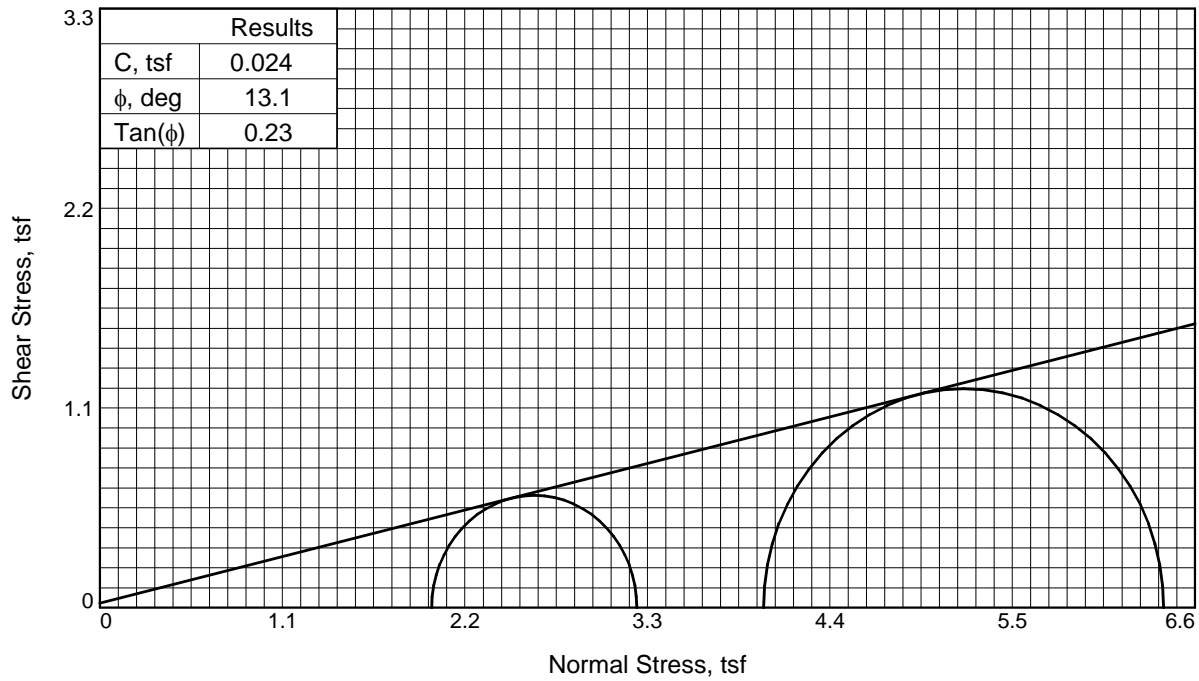
Strain rate, %/min. = 1.00

Peak Stress = 1.616 tsf at reading no. 11

Ult. Stress = 1.299 tsf at reading no. 22

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	7.320	0.0	0.0	0.000	3.000	3.000	1.00	3.000	0.000
1	0.0156	12.600	5.3	0.3	0.255	3.000	3.255	1.08	3.127	0.127
2	0.0291	17.170	9.9	0.8	0.473	3.000	3.473	1.16	3.237	0.237
3	0.0428	19.130	11.8	1.3	0.564	3.000	3.564	1.19	3.282	0.282
4	0.0562	21.550	14.2	1.8	0.677	3.000	3.677	1.23	3.338	0.338
5	0.0693	23.420	16.1	2.2	0.762	3.000	3.762	1.25	3.381	0.381
6	0.0833	27.580	20.3	2.7	0.954	3.000	3.954	1.32	3.477	0.477
7	0.0964	30.410	23.1	3.2	1.082	3.000	4.082	1.36	3.541	0.541
8	0.1102	35.150	27.8	3.7	1.298	3.000	4.298	1.43	3.649	0.649
9	0.1238	38.540	31.2	4.2	1.448	3.000	4.448	1.48	3.724	0.724
10	0.1380	41.410	34.1	4.7	1.573	3.000	4.573	1.52	3.787	0.787
11	0.1509	42.510	35.2	5.2	1.616	3.000	4.616	1.54	3.808	0.808
12	0.1652	42.080	34.8	5.7	1.588	3.000	4.588	1.53	3.794	0.794
13	0.1926	40.340	33.0	6.6	1.493	3.000	4.493	1.50	3.746	0.746
14	0.2194	38.020	30.7	7.6	1.373	3.000	4.373	1.46	3.687	0.687
15	0.2464	37.780	30.5	8.6	1.349	3.000	4.349	1.45	3.674	0.674
16	0.2733	37.650	30.3	9.5	1.329	3.000	4.329	1.44	3.664	0.664
17	0.3011	37.900	30.6	10.5	1.325	3.000	4.325	1.44	3.662	0.662
18	0.3282	37.730	30.4	11.5	1.303	3.000	4.303	1.43	3.652	0.652
19	0.3551	37.950	30.6	12.4	1.298	3.000	4.298	1.43	3.649	0.649
20	0.3818	38.390	31.1	13.4	1.303	3.000	4.303	1.43	3.651	0.651
21	0.3952	38.550	31.2	13.9	1.302	3.000	4.302	1.43	3.651	0.651
22	0.4258	38.870	31.6	15.0	1.299	3.000	4.299	1.43	3.649	0.649





Sample No.		1	2
Initial	Water Content, %	19.8	16.9
	Dry Density, pcf	108.8	113.6
	Saturation, %	99.1	96.2
	Void Ratio	0.5357	0.4706
	Diameter, in.	1.39	1.40
	Height, in.	2.80	2.80
At Test	Water Content, %	19.8	16.9
	Dry Density, pcf	108.8	113.6
	Saturation, %	99.1	96.2
	Void Ratio	0.5357	0.4706
	Diameter, in.	1.39	1.40
	Height, in.	2.80	2.80
Strain rate, %/min.		1.00	1.00
Back Pressure, tsf		0.00	0.00
Cell Pressure, tsf		2.00	4.00
Peak Stress, tsf		1.24	2.41
Ult. Stress, tsf		1.23	2.40
σ_1 Failure, tsf		3.24	6.41
σ_3 Failure, tsf		2.00	4.00

Type of Test:

Unconsolidated Undrained

Sample Type: 3" Thinwall, Top and Middle

Description: SANDY LEAN CLAY, brown (CL)

LL= 31 **PL=** 15 **PI=** 16

Specific Gravity= 2.676

Remarks:

Client: W912ES-11-P-0024

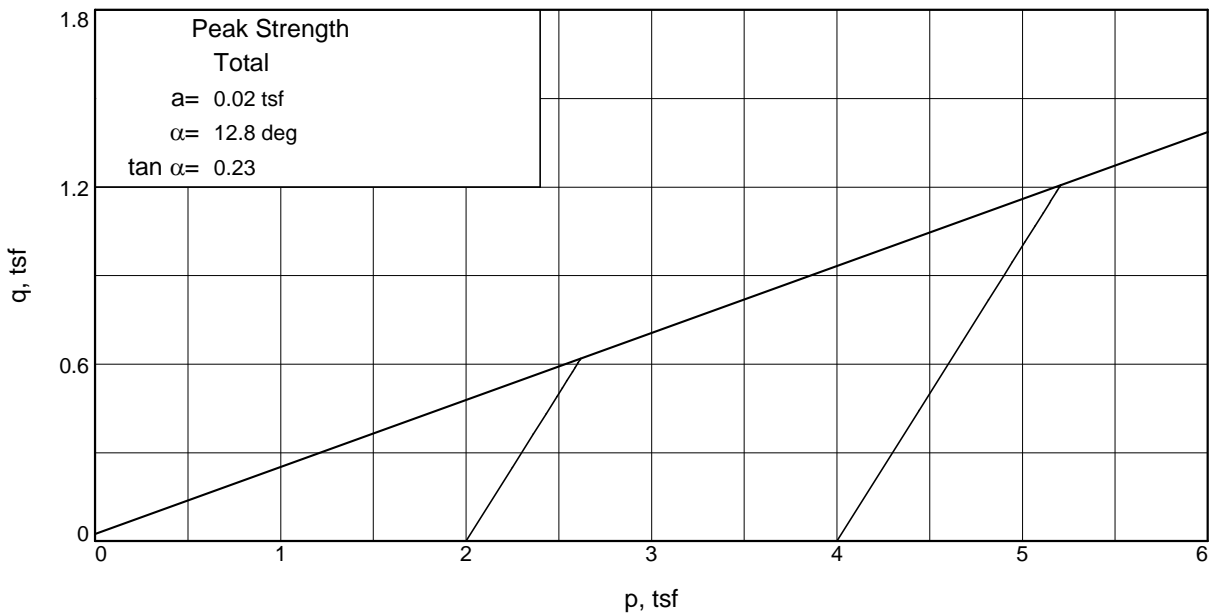
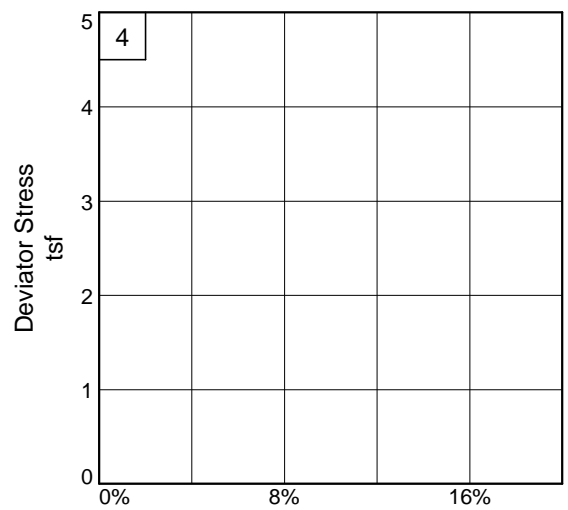
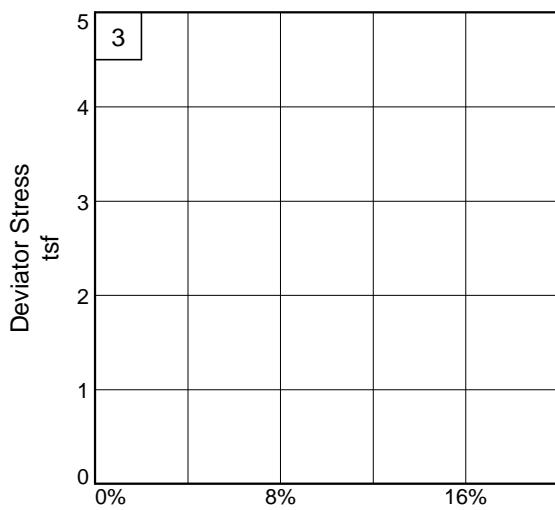
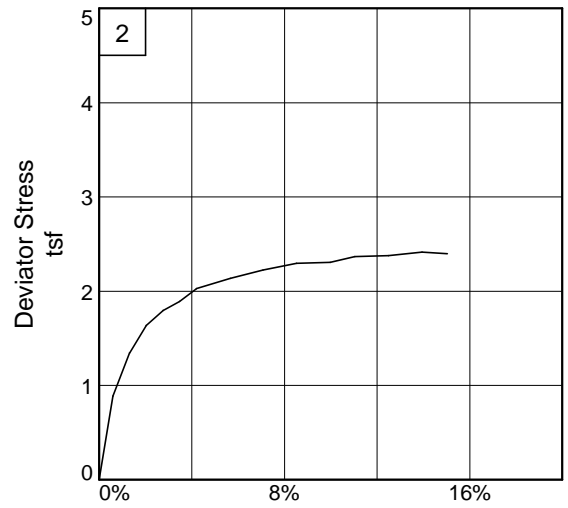
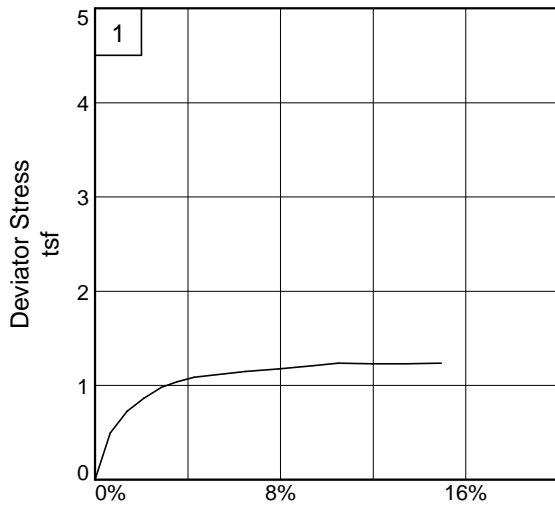
Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

Location: Maple River, Till Formation

Sample Number: Boring10-105MU, #6 **Depth:** 67-69'

Proj. No.: BL-10-10065 **Date Sampled:**





Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Maple River, Till Formation

Depth: 67-69'

Sample Number: Boring10-105MU, #6

Project No. B1010065 Feasibility Report and Environmental Impact Statement
July 2014

Figure

Braun Intertec
Geotechnical Design and Geology

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

3/4/2011

12:06 PM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Maple River, Till Formation
Depth: 67-69' **Sample Number:** Boring10-105MU, #6
Description: SANDY LEAN CLAY, brown (CL)
Remarks:
Type of Sample: 3" Thinwall, Top and Middle
Specific Gravity=2.676 **LL=**31 **PL=**15 **PI=**16
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	176.600	176.600
Moisture content: Dry soil+tare, gms.	152.540	152.540
Moisture content: Tare, gms.	31.250	31.250
Moisture, %	19.8	19.8
Moist specimen weight, gms.	145.8	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.80	
Wet Density, pcf	130.4	
Dry density, pcf	108.8	
Void ratio	0.5357	
Saturation, %	99.1	

Test Readings for Specimen No. 1

Cell pressure = 2.000 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 1.237 tsf at reading no. 10
Ult. Stress = 1.235 tsf at reading no. 13

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0065	4.450	0.0	0.0	0.000	2.000	2.000	1.00	2.000	0.000
1	0.0252	15.070	10.6	0.7	0.500	2.000	2.500	1.25	2.250	0.250
2	0.0453	19.980	15.5	1.4	0.726	2.000	2.726	1.36	2.363	0.363
3	0.0659	23.100	18.7	2.1	0.865	2.000	2.865	1.43	2.432	0.432
4	0.0862	25.720	21.3	2.8	0.979	2.000	2.979	1.49	2.490	0.490
5	0.1061	27.150	22.7	3.6	1.037	2.000	3.037	1.52	2.519	0.519
6	0.1267	28.410	24.0	4.3	1.087	2.000	3.087	1.54	2.543	0.543
7	0.1886	30.360	25.9	6.5	1.148	2.000	3.148	1.57	2.574	0.574
8	0.2288	31.400	27.0	7.9	1.176	2.000	3.176	1.59	2.588	0.588
9	0.2703	32.590	28.1	9.4	1.208	2.000	3.208	1.60	2.604	0.604
10	0.3010	33.620	29.2	10.5	1.237	2.000	3.237	1.62	2.618	0.618
11	0.3420	33.900	29.5	12.0	1.228	2.000	3.228	1.61	2.614	0.614
12	0.3827	34.390	29.9	13.4	1.228	2.000	3.228	1.61	2.614	0.614
13	0.4257	35.090	30.6	15.0	1.235	2.000	3.235	1.62	2.617	0.617

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	179.440	179.440
Moisture content: Dry soil+tare, gms.	157.820	157.820
Moisture content: Tare, gms.	30.030	30.030
Moisture, %	16.9	16.9
Moist specimen weight, gms.	150.0	
Diameter, in.	1.40	
Area, in. ²	1.54	
Height, in.	2.80	
Wet Density, pcf	132.8	
Dry density, pcf	113.6	
Void ratio	0.4706	
Saturation, %	96.2	

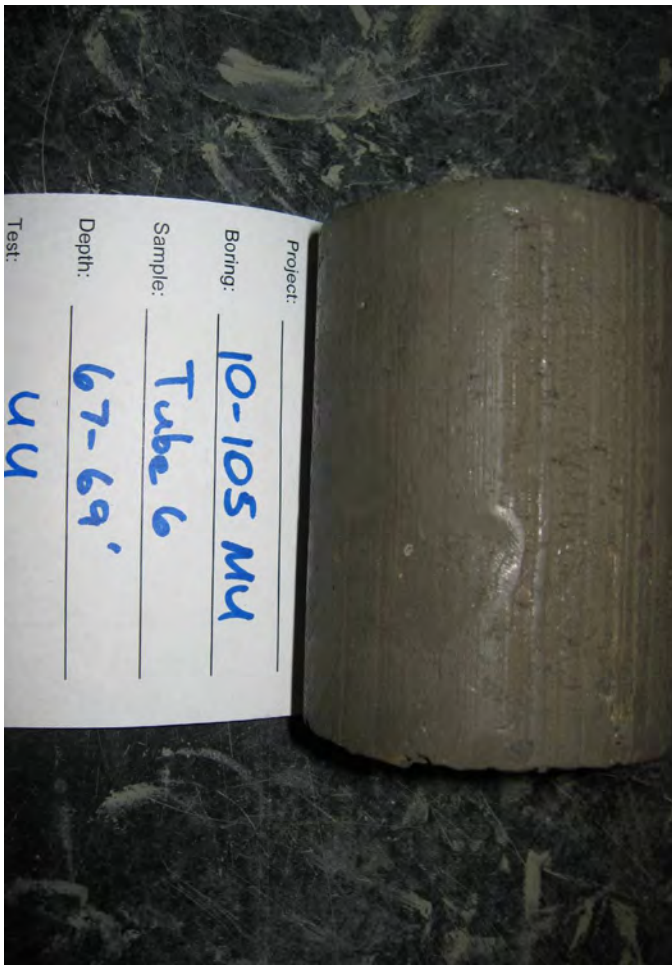
Test Readings for Specimen No. 2

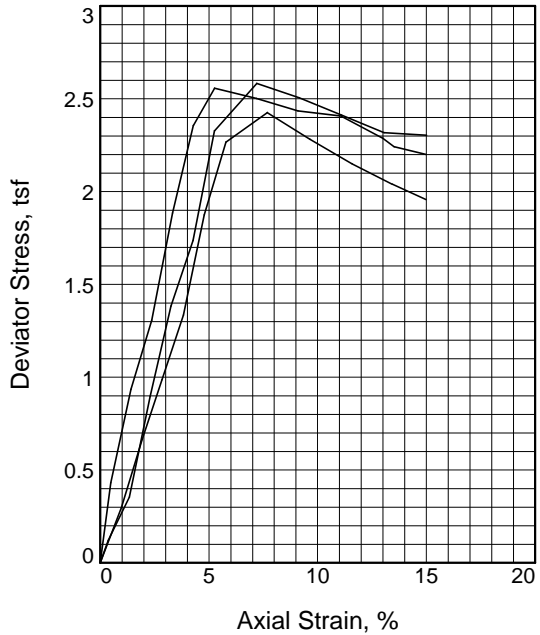
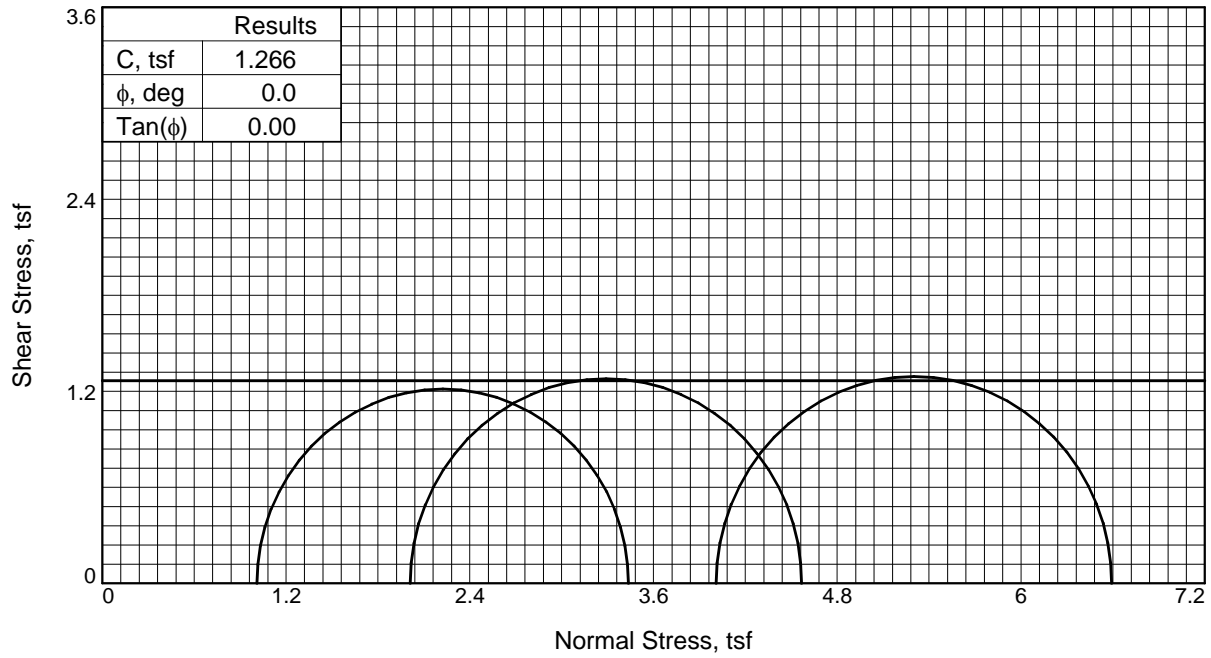
Cell pressure = 4.000 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 2.412 tsf at reading no. 13
 Ult. Stress = 2.398 tsf at reading no. 14

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	9.180	0.0	0.0	0.000	4.000	4.000	1.00	4.000	0.000
1	0.0234	28.220	19.0	0.6	0.886	4.000	4.886	1.22	4.443	0.443
2	0.0433	38.290	29.1	1.3	1.346	4.000	5.346	1.34	4.673	0.673
3	0.0637	44.830	35.7	2.0	1.636	4.000	5.636	1.41	4.818	0.818
4	0.0840	48.640	39.5	2.8	1.797	4.000	5.797	1.45	4.899	0.899
5	0.1038	51.020	41.8	3.5	1.892	4.000	5.892	1.47	4.946	0.946
6	0.1243	54.320	45.1	4.2	2.025	4.000	6.025	1.51	5.013	1.013
7	0.1653	57.520	48.3	5.7	2.136	4.000	6.136	1.53	5.068	1.068
8	0.2049	60.300	51.1	7.1	2.225	4.000	6.225	1.56	5.112	1.112
9	0.2452	62.710	53.5	8.5	2.294	4.000	6.294	1.57	5.147	1.147

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
10	0.2858	63.870	54.7	10.0	2.306	4.000	6.306	1.58	5.153	1.153
11	0.3159	65.980	56.8	11.1	2.366	4.000	6.366	1.59	5.183	1.183
12	0.3564	67.170	58.0	12.5	2.377	4.000	6.377	1.59	5.188	1.188
13	0.3969	69.030	59.9	13.9	2.412	4.000	6.412	1.60	5.206	1.206
14	0.4276	69.430	60.3	15.0	2.398	4.000	6.398	1.60	5.199	1.199





Sample No.	1	2	3	
Initial	Water Content, %	21.5	24.4	22.9
	Dry Density, pcf	104.1	100.3	102.3
	Saturation, %	94.1	97.6	96.2
	Void Ratio	0.6133	0.6735	0.6404
	Diameter, in.	1.40	1.38	1.39
	Height, in.	2.81	2.81	2.81
At Test	Water Content, %	21.5	24.4	22.9
	Dry Density, pcf	104.1	100.3	102.3
	Saturation, %	94.1	97.6	96.2
	Void Ratio	0.6133	0.6735	0.6404
	Diameter, in.	1.40	1.38	1.39
	Height, in.	2.81	2.81	2.81
Strain rate, %/min.	1.00	1.00	1.00	
Back Pressure, tsf	0.00	0.00	0.00	
Cell Pressure, tsf	1.01	2.01	4.01	
Peak Stress, tsf	2.43	2.56	2.58	
Ult. Stress, tsf	1.96	2.20	2.31	
σ_1 Failure, tsf	3.44	4.57	6.59	
σ_3 Failure, tsf	1.01	2.01	4.01	

Type of Test:

Unconsolidated Undrained

Sample Type: Undisturbed, 5" Thinwall, Bottom

Description: FAT CLAY, brown (CH)

LL= 66 **PL=** 20 **PI=** 46

Specific Gravity= 2.689

Remarks:

Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

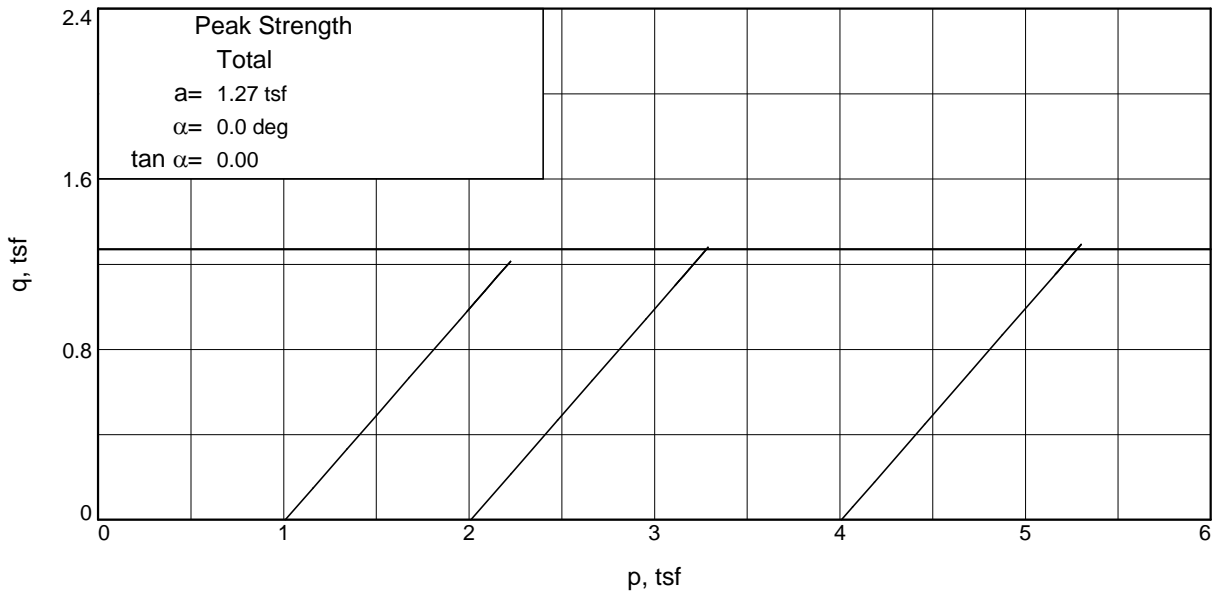
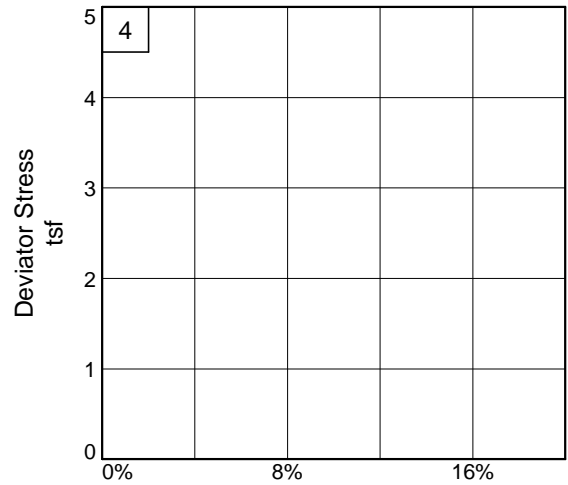
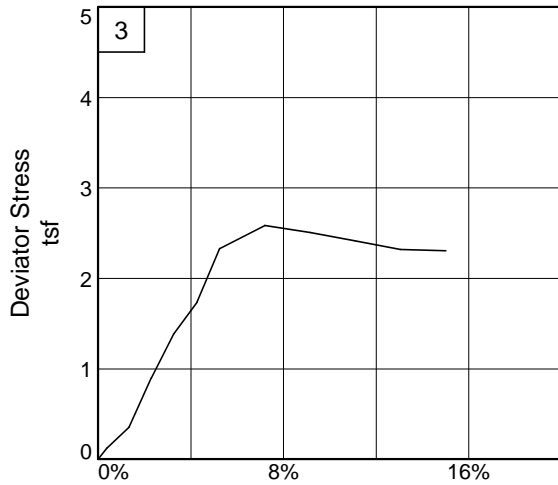
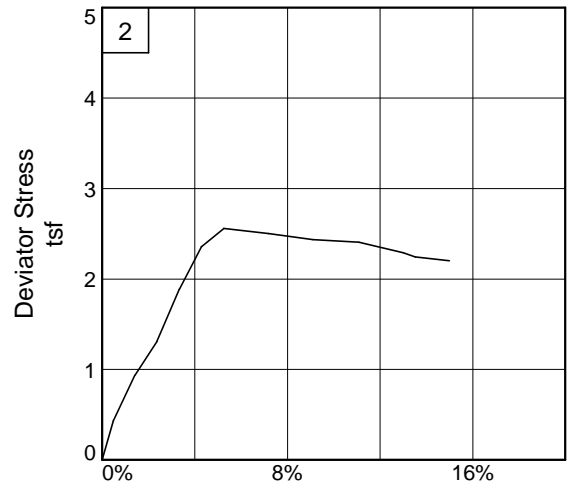
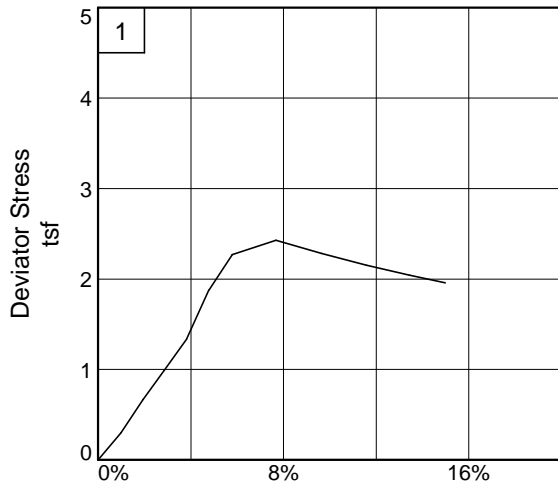
Location: Sheyenne River, Till Formation

Sample Number: Boring11-110MU, #6 **Depth:** 65-67'

Proj. No.: BL-10-10065 **Date Sampled:**



Figure UU Triax ASTM D 2850



Client: W912ES-11-P-0024

Project: Fargo-Moorhead Metro Feasibility Study

Location: Sheyenne River, Till Formation

Depth: 65-67'

Sample Number: Boring11-110MU, #6

Project No.: BL-10-10065

Figure _____

Braun Intertec

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

4/26/2011

8:15 AM

Date:
Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project No.: BL-10-10065
Location: Sheyenne River, Till Formation
Depth: 65-67' **Sample Number:** Boring11-110MU, #6
Description: FAT CLAY, brown (CH)
Remarks:
Type of Sample: Undisturbed, 5" Thinwall, Bottom
Specific Gravity=2.689 **LL**=66 **PL**=20 **PI**=46
Test Method: ASTM D 2850

Parameters for Specimen No. 1

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	172.890	172.890
Moisture content: Dry soil+tare, gms.	147.770	147.770
Moisture content: Tare, gms.	30.720	30.720
Moisture, %	21.5	21.5
Moist specimen weight, gms.	142.9	
Diameter, in.	1.40	
Area, in. ²	1.53	
Height, in.	2.81	
Wet Density, pcf	126.4	
Dry density, pcf	104.1	
Void ratio	0.6133	
Saturation, %	94.1	

Test Readings for Specimen No. 1

Cell pressure = 1.010 tsf
Back pressure = 0.000 tsf
Strain rate, %/min. = 1.00
Peak Stress = 2.427 tsf at reading no. 7
Ult. Stress = 1.958 tsf at reading no. 11

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0087	2.310	0.0	0.0	0.000	1.010	1.010	1.00	1.010	0.000
1	0.0361	8.720	6.4	1.0	0.298	1.010	1.308	1.29	1.159	0.149
2	0.0628	16.750	14.4	1.9	0.664	1.010	1.674	1.66	1.342	0.332
3	0.0886	23.980	21.7	2.8	0.988	1.010	1.998	1.98	1.504	0.494
4	0.1160	31.920	29.6	3.8	1.336	1.010	2.346	2.32	1.678	0.668
5	0.1429	44.280	42.0	4.8	1.875	1.010	2.885	2.86	1.947	0.937
6	0.1710	53.620	51.3	5.8	2.268	1.010	3.278	3.25	2.144	1.134
7	0.2242	58.350	56.0	7.7	2.427	1.010	3.437	3.40	2.223	1.213
8	0.2792	56.180	53.9	9.6	2.283	1.010	3.293	3.26	2.152	1.142
9	0.3339	54.170	51.9	11.6	2.151	1.010	3.161	3.13	2.085	1.075
10	0.3860	52.580	50.3	13.4	2.041	1.010	3.051	3.02	2.030	1.020
11	0.4293	51.420	49.1	15.0	1.958	1.010	2.968	2.94	1.989	0.979

Parameters for Specimen No. 2

Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	166.930	166.930
Moisture content: Dry soil+tare, gms.	140.010	140.010
Moisture content: Tare, gms.	29.890	29.890
Moisture, %	24.4	24.4
Moist specimen weight, gms.	137.8	
Diameter, in.	1.38	
Area, in. ²	1.50	
Height, in.	2.81	
Wet Density, pcf	124.8	
Dry density, pcf	100.3	
Void ratio	0.6735	
Saturation, %	97.6	

Test Readings for Specimen No. 2

Cell pressure = 2.011 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 2.557 tsf at reading no. 6
 Ult. Stress = 2.201 tsf at reading no. 12

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0066	4.420	0.0	0.0	0.000	2.011	2.011	1.00	2.011	0.000
1	0.0203	13.450	9.0	0.5	0.433	2.011	2.444	1.22	2.227	0.216
2	0.0463	24.130	19.7	1.4	0.935	2.011	2.946	1.47	2.479	0.468
3	0.0731	32.250	27.8	2.4	1.308	2.011	3.319	1.65	2.665	0.654
4	0.1002	44.920	40.5	3.3	1.885	2.011	3.896	1.94	2.953	0.942
5	0.1269	55.570	51.2	4.3	2.357	2.011	4.368	2.17	3.189	1.178
6	0.1543	60.480	56.1	5.3	2.557	2.011	4.568	2.27	3.289	1.278
7	0.2086	60.420	56.0	7.2	2.502	2.011	4.513	2.24	3.262	1.251
8	0.2625	60.060	55.6	9.1	2.435	2.011	4.446	2.21	3.228	1.217
9	0.3182	60.670	56.3	11.1	2.408	2.011	4.419	2.20	3.215	1.204
10	0.3721	59.080	54.7	13.0	2.289	2.011	4.300	2.14	3.156	1.145
11	0.3867	58.290	53.9	13.5	2.243	2.011	4.254	2.12	3.132	1.121

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
12	0.4280	58.210	53.8	15.0	2.201	2.011	4.212	2.09	3.112	1.101

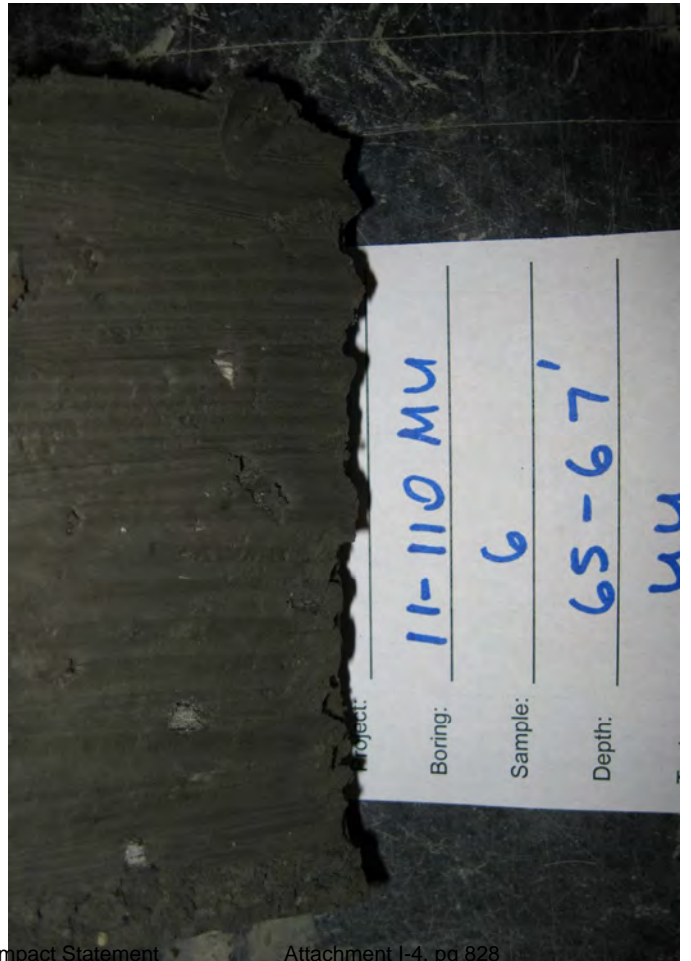
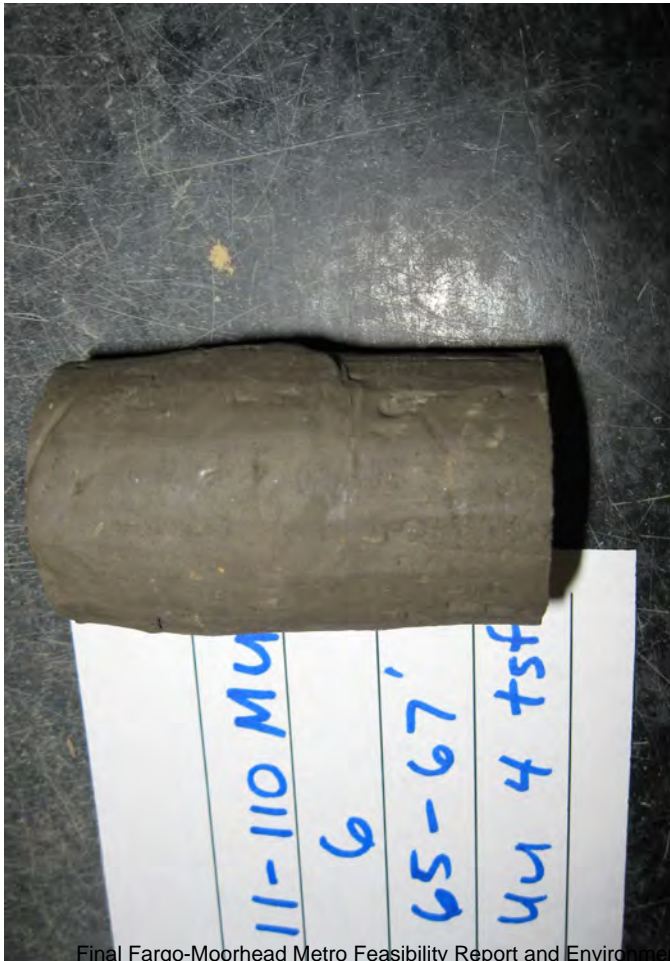
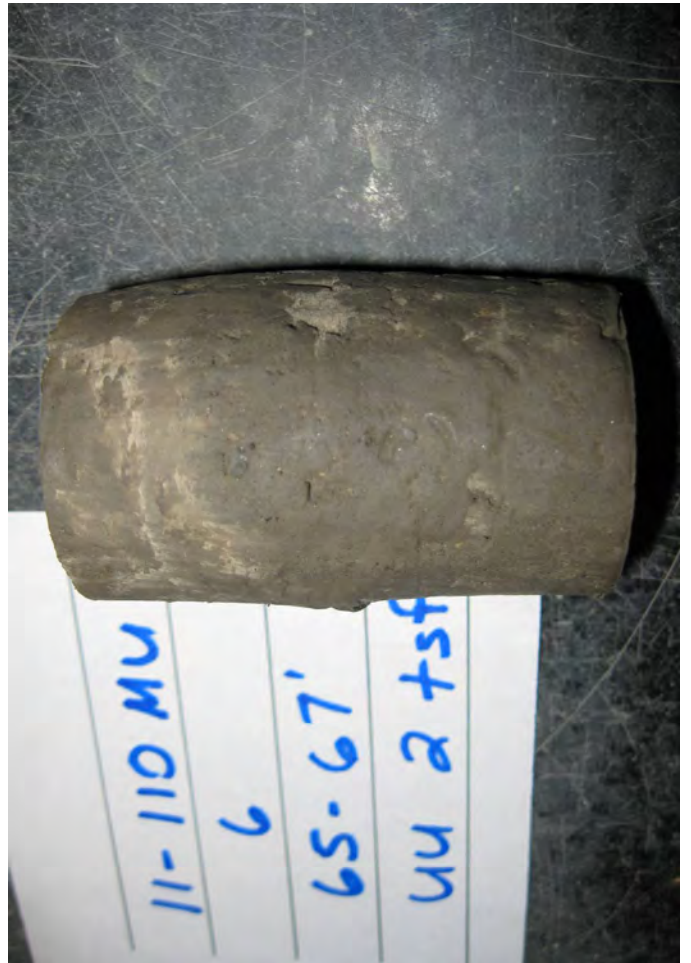
Parameters for Specimen No. 3

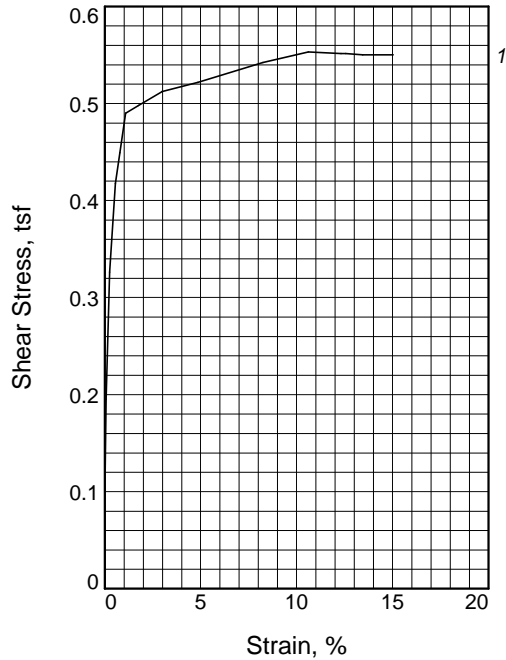
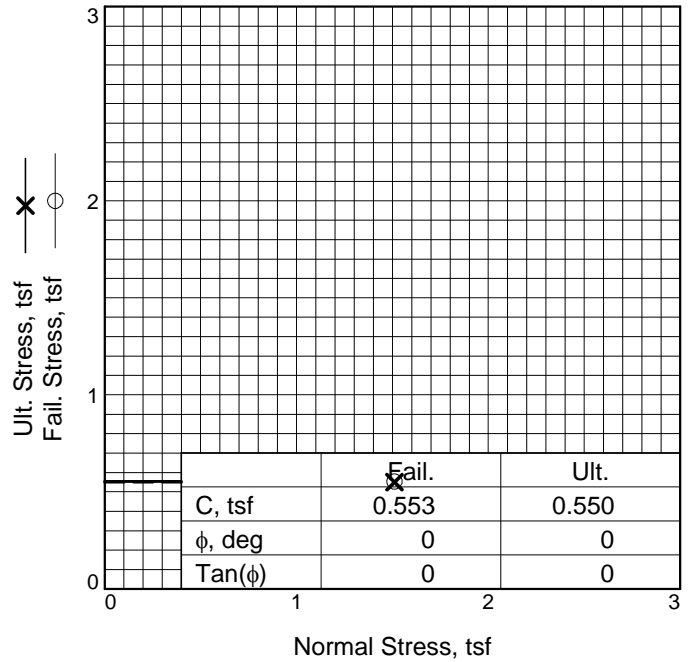
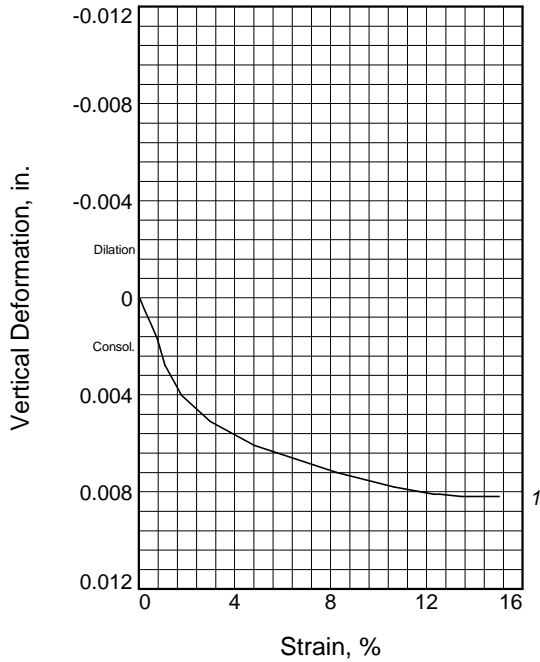
Specimen Parameter	Initial	Final
Moisture content: Moist soil+tare, gms.	170.900	170.900
Moisture content: Dry soil+tare, gms.	144.680	144.680
Moisture content: Tare, gms.	30.280	30.250
Moisture, %	22.9	22.9
Moist specimen weight, gms.	141.2	
Diameter, in.	1.39	
Area, in. ²	1.52	
Height, in.	2.81	
Wet Density, pcf	125.8	
Dry density, pcf	102.3	
Void ratio	0.6404	
Saturation, %	96.2	

Test Readings for Specimen No. 3

Cell pressure = 4.009 tsf
 Back pressure = 0.000 tsf
 Strain rate, %/min. = 1.00
 Peak Stress = 2.584 tsf at reading no. 7
 Ult. Stress = 2.305 tsf at reading no. 11

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress tsf	Minor Princ. Stress tsf	Major Princ. Stress tsf	1:3 Ratio	P tsf	Q tsf
0	0.0067	8.900	0.0	0.0	0.000	4.009	4.009	1.00	4.009	0.000
1	0.0172	11.470	2.6	0.4	0.121	4.009	4.130	1.03	4.069	0.060
2	0.0443	16.500	7.6	1.3	0.354	4.009	4.363	1.09	4.186	0.177
3	0.0711	28.340	19.4	2.3	0.897	4.009	4.906	1.22	4.458	0.449
4	0.0981	39.180	30.3	3.3	1.384	4.009	5.393	1.35	4.701	0.692
5	0.1265	47.300	38.4	4.3	1.737	4.009	5.746	1.43	4.877	0.868
6	0.1541	60.910	52.0	5.3	2.328	4.009	6.337	1.58	5.173	1.164
7	0.2086	67.840	58.9	7.2	2.584	4.009	6.593	1.64	5.301	1.292
8	0.2638	67.290	58.4	9.2	2.506	4.009	6.515	1.63	5.262	1.253
9	0.3182	66.370	57.5	11.1	2.414	4.009	6.423	1.60	5.216	1.207
10	0.3729	65.340	56.4	13.1	2.318	4.009	6.327	1.58	5.168	1.159
11	0.4280	66.310	57.4	15.0	2.305	4.009	6.314	1.57	5.162	1.153





Sample No.		1
Initial	Water Content, %	31.6
	Dry Density, pcf	88.2
	Saturation, %	91.7
	Void Ratio	0.9471
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	32.2
	Dry Density, pcf	91.0
	Saturation, %	99.9
	Void Ratio	0.8866
	Diameter, in.	2.41
	Height, in.	0.97
Normal Stress, tsf		1.511
Fail. Stress, tsf		0.553
Strain, %		10.6
Ult. Stress, tsf		0.550
Strain, %		15.0
Strain rate, in./min.		0.00

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Figure Residual Direct Shear

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-F-13, Fargo, Alluvium Formation
Sample Number: Boring 09-25MU, #1 **Depth:** 14-16'
Proj. No.: BL-09-03127 **Date Sampled:**
BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Alluvium Formation
Depth: 14-16' **Sample Number:** Boring 09-25MU, #1
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	119.000		167.670
Moisture content: Dry soil+tare, gms.	97.780		134.300
Moisture content: Tare, gms.	30.610		30.720
Moisture, %	31.6	32.2	32.2
Moist specimen weight, gms.	139.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	116.0	120.3	
Dry density, pcf	88.2	91.0	
Void ratio	0.9471	0.8866	
Saturation, %	91.7	99.9	

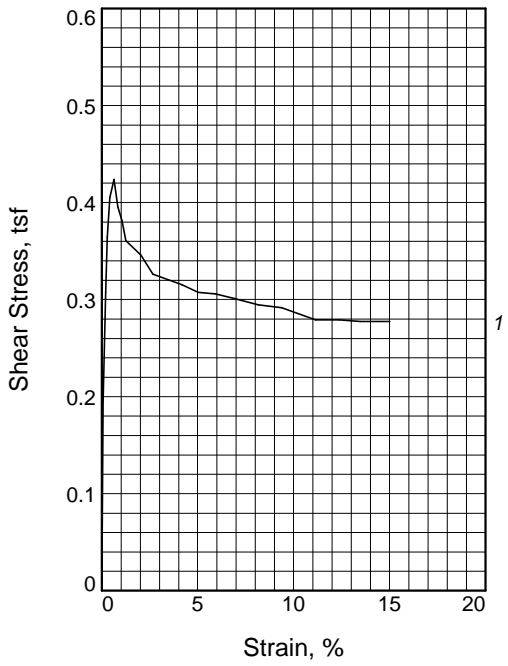
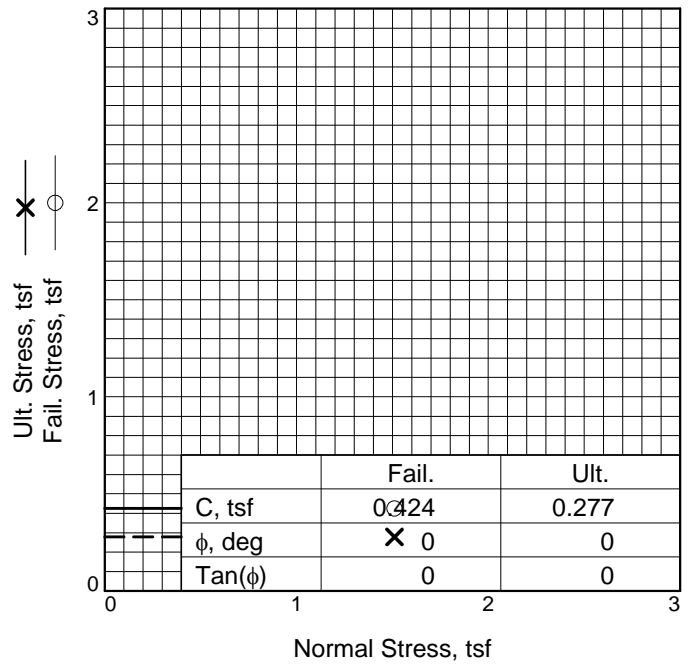
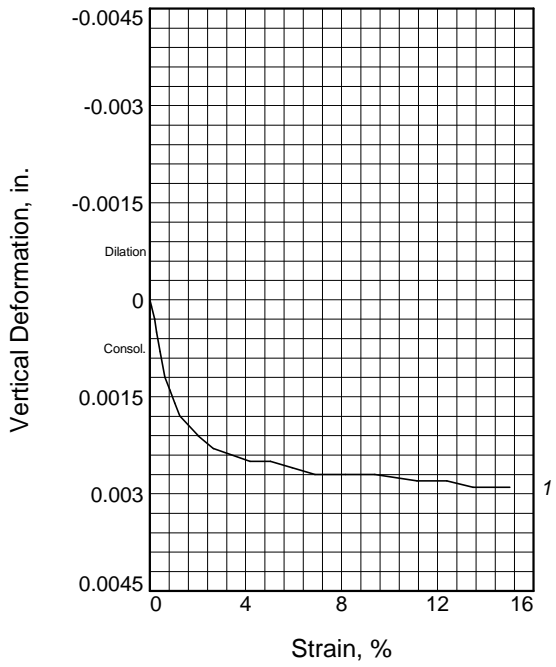
Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.553 tsf **at reading no. 11**
Ult. Stress = 0.550 tsf **at reading no. 15**

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0056	0.000	0.0	0.0	0.000	0.1389
1	0.0058	5.900	5.9	0.0	0.093	0.1389
2	0.0073	12.400	12.4	0.1	0.195	0.1388
3	0.0115	20.700	20.7	0.2	0.326	0.1384
4	0.0190	26.500	26.5	0.6	0.418	0.1377
5	0.0244	28.500	28.5	0.8	0.449	0.1372
6	0.0319	31.100	31.1	1.1	0.490	0.1361
7	0.0480	31.600	31.6	1.8	0.498	0.1349
8	0.0774	32.500	32.5	3.0	0.512	0.1338
9	0.1226	33.100	33.1	4.9	0.522	0.1328
10	0.2045	34.400	34.4	8.2	0.542	0.1317
11	0.2617	35.100	35.1	10.6	0.553	0.1311
12	0.3025	35.000	35.0	12.3	0.552	0.1308

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.3085	35.000	35.0	12.6	0.552	0.1308
14	0.3300	34.900	34.9	13.5	0.550	0.1307
15	0.3680	34.900	34.9	15.0	0.550	0.1307



Sample No.		1
Initial	Water Content, %	29.7
	Dry Density, pcf	91.6
	Saturation, %	94.9
	Void Ratio	0.8492
	Diameter, in.	2.41
At Test	Height, in.	1.01
	Water Content, %	29.4
	Dry Density, pcf	94.2
	Saturation, %	100.0
	Void Ratio	0.7982
	Diameter, in.	2.41
	Height, in.	0.98
	Normal Stress, tsf	1.511
	Fail. Stress, tsf	0.424
	Strain, %	0.6
	Ult. Stress, tsf	0.277
	Strain, %	15.0
	Strain rate, in./min.	0.00

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, brown (CH)
LL= 75 PL= 18 PI= 57
Assumed Specific Gravity= 2.712
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-F-19, Fargo, Alluvium Formation
Sample Number: Boring 09-27MU, #1 **Depth:** 6-8'
Proj. No.: BL-09-03127 **Date Sampled:**

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DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, Alluvium Formation
Depth: 6-8' **Sample Number:** Boring 09-27MU, #1
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.712 **LL=75** **PL=18** **PI=57**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	107.520		172.450
Moisture content: Dry soil+tare, gms.	89.750		140.110
Moisture content: Tare, gms.	29.950		30.250
Moisture, %	29.7	29.4	29.4
Moist specimen weight, gms.	143.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.01	0.98	
Net decrease in height, in.		0.03	
Wet Density, pcf	118.8	121.9	
Dry density, pcf	91.6	94.2	
Void ratio	0.8492	0.7982	
Saturation, %	94.9	100.0	

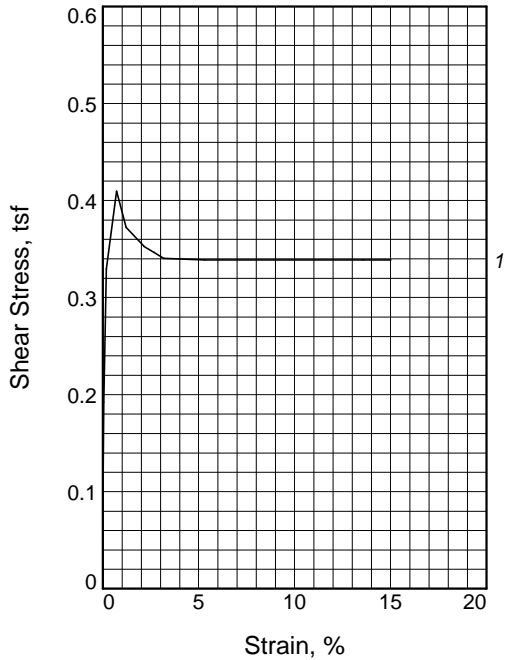
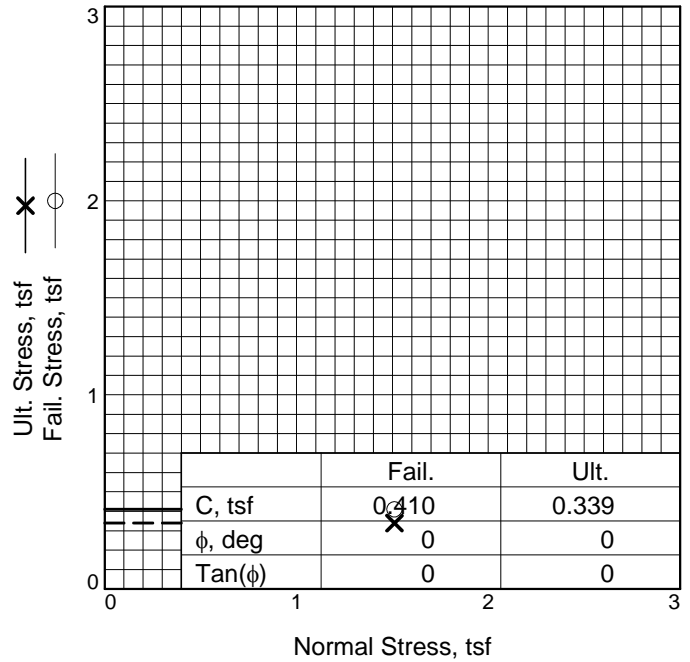
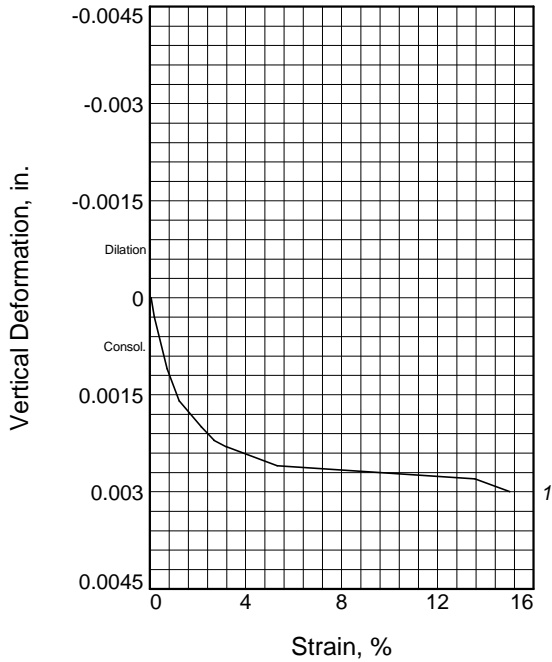
Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.424 tsf at reading no. 5
Ult. Stress = 0.277 tsf at reading no. 20

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0197	0.000	0.0	0.0	0.000	0.1397
1	0.0213	12.400	12.4	0.1	0.195	0.1396
2	0.0245	19.500	19.5	0.2	0.307	0.1394
3	0.0266	23.100	23.1	0.3	0.364	0.1392
4	0.0300	25.700	25.7	0.4	0.405	0.1389
5	0.0350	26.900	26.9	0.6	0.424	0.1385
6	0.0400	25.100	25.1	0.8	0.396	0.1383
7	0.0450	24.200	24.2	1.0	0.381	0.1381
8	0.0500	22.900	22.9	1.3	0.361	0.1379
9	0.0682	22.000	22.0	2.0	0.347	0.1376
10	0.0839	20.700	20.7	2.7	0.326	0.1374
11	0.1204	20.000	20.0	4.2	0.315	0.1372
12	0.1410	19.500	19.5	5.0	0.307	0.1372

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.1631	19.400	19.4	5.9	0.306	0.1371
14	0.1860	19.100	19.1	6.9	0.301	0.1370
15	0.2164	18.700	18.7	8.2	0.295	0.1370
16	0.2460	18.500	18.5	9.4	0.292	0.1370
17	0.2885	17.700	17.7	11.1	0.279	0.1369
18	0.3185	17.700	17.7	12.4	0.279	0.1369
19	0.3450	17.600	17.6	13.5	0.277	0.1368
20	0.3820	17.600	17.6	15.0	0.277	0.1368



Sample No.		1
Initial	Water Content, %	34.8
	Dry Density, pcf	86.3
	Saturation, %	97.2
	Void Ratio	0.9807
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	33.4
	Dry Density, pcf	89.3
	Saturation, %	100.0
	Void Ratio	0.9143
	Diameter, in.	2.41
	Height, in.	0.97
Normal Stress, tsf		1.511
Fail. Stress, tsf		0.410
Strain, %		0.7
Ult. Stress, tsf		0.339
Strain, %		15.0
Strain rate, in./min.		0.00

Sample Type: Thinwall, 5", Top of sample
Description: FAT CLAY, gray (CH)

LL= 67 **PL=** 17 **PI=** 50

Assumed Specific Gravity= 2.738

Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-15, Fargo, Sherack Formation

Sample Number: Boring 09-26MU, #1 **Depth:** 8-10'

Proj. No.: BL-09-03127

Date Sampled:

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DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Sherack Formation
Depth: 8-10' **Sample Number:** Boring 09-26MU, #1
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Top of sample
Assumed Specific Gravity=2.738 **LL=**67 **PL=**17 **PI=**50

Parameters for Specimen No. 1

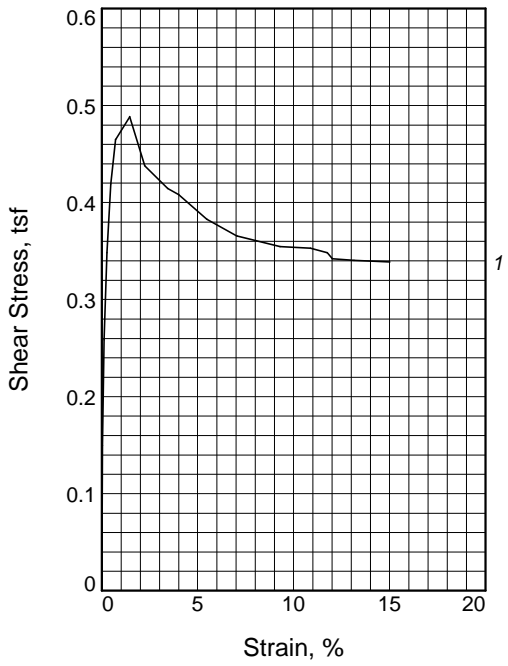
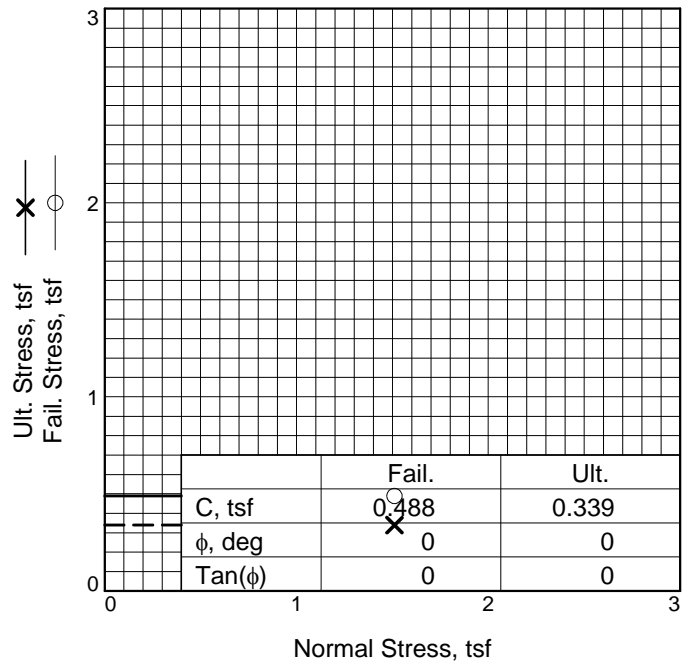
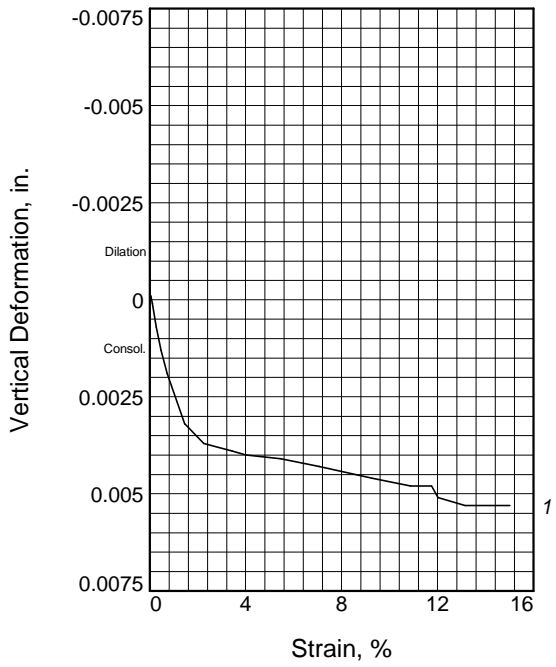
Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	127.730		167.120
Moisture content: Dry soil+tare, gms.	102.610		133.150
Moisture content: Tare, gms.	30.480		31.440
Moisture, %	34.8	33.4	33.4
Moist specimen weight, gms.	139.3		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	116.3	119.1	
Dry density, pcf	86.3	89.3	
Void ratio	0.9807	0.9143	
Saturation, %	97.2	100.0	

Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.410 tsf at reading no. 4
Ult. Stress = 0.339 tsf at reading no. 11

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0229	0.000	0.0	0.0	0.000	0.1107
1	0.0231	5.000	5.0	0.0	0.079	0.1107
2	0.0242	12.200	12.2	0.1	0.192	0.1107
3	0.0275	20.900	20.9	0.2	0.329	0.1104
4	0.0404	26.000	26.0	0.7	0.410	0.1096
5	0.0525	23.600	23.6	1.2	0.372	0.1091
6	0.0747	22.400	22.4	2.1	0.353	0.1087
7	0.0874	22.000	22.0	2.7	0.347	0.1085
8	0.0997	21.600	21.6	3.2	0.340	0.1084
9	0.1510	21.500	21.5	5.3	0.339	0.1081
10	0.3500	21.500	21.5	13.6	0.339	0.1079
11	0.3850	21.500	21.5	15.0	0.339	0.1077

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Sample No.		1
Initial	Water Content, %	40.5
	Dry Density, pcf	79.2
	Saturation, %	95.4
	Void Ratio	1.1669
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	38.9
	Dry Density, pcf	83.0
	Saturation, %	100.0
	Void Ratio	1.0687
	Diameter, in.	2.41
	Height, in.	0.95
	Normal Stress, tsf	1.511
	Fail. Stress, tsf	0.488
	Strain, %	1.5
	Ult. Stress, tsf	0.339
	Strain, %	15.0
	Strain rate, in./min.	0.00

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY with layers of silt, brown-gray (CH)
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-M-18, Moorhead, Sherack Formation
Sample Number: Boring 09-34MU, #1 **Depth:** 8-10'
Proj. No.: BL-09-03127 **Date Sampled:**

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DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, Sherack Formation
Depth: 8-10' **Sample Number:** Boring 09-34MU, #1
Description: FAT CLAY with layers of silt, brown-gray (CH)
Remarks: The rate of strain is 0.00096 in./min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=** **PL=** **PI=**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	153.200		160.280
Moisture content: Dry soil+tare, gms.	118.070		123.750
Moisture content: Tare, gms.	31.270		29.750
Moisture, %	40.5	38.9	38.9
Moist specimen weight, gms.	133.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.95	
Net decrease in height, in.		0.05	
Wet Density, pcf	111.3	115.2	
Dry density, pcf	79.2	83.0	
Void ratio	1.1669	1.0687	
Saturation, %	95.4	100.0	

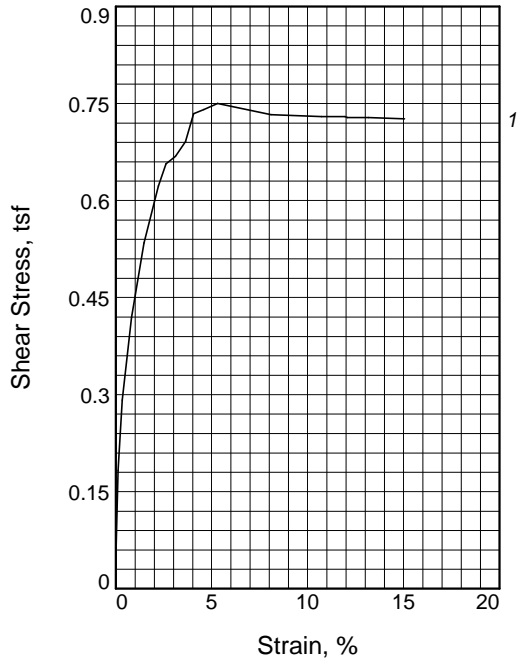
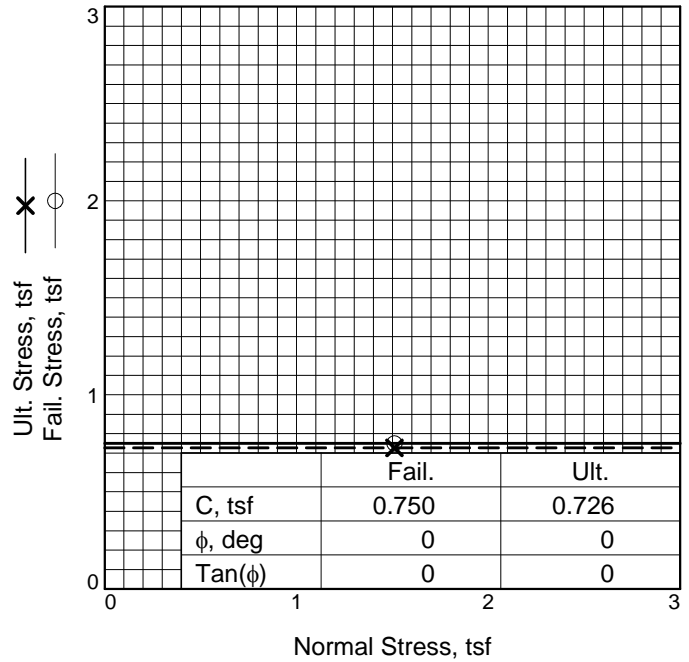
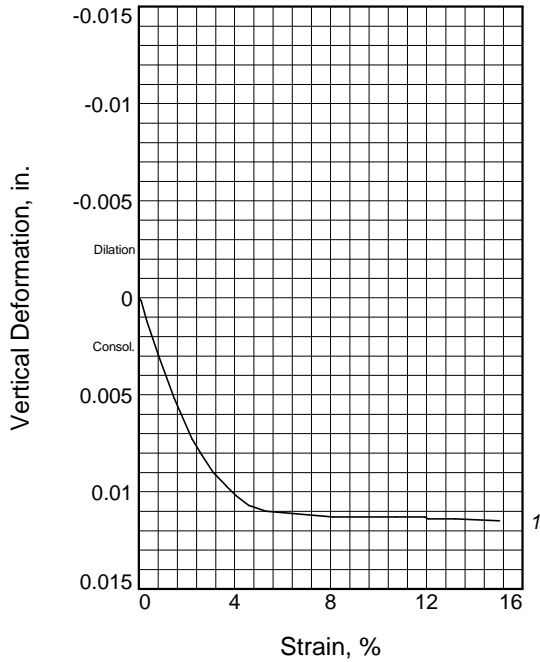
Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.488 tsf at reading no. 6
Ult. Stress = 0.339 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0128	0.000	0.0	0.0	0.000	0.0647
1	0.0138	9.500	9.5	0.0	0.150	0.0648
2	0.0156	16.400	16.4	0.1	0.258	0.0646
3	0.0193	22.100	22.1	0.3	0.348	0.0640
4	0.0242	26.600	26.6	0.5	0.419	0.0634
5	0.0304	29.500	29.5	0.7	0.465	0.0628
6	0.0479	31.000	31.0	1.5	0.488	0.0615
7	0.0670	27.800	27.8	2.2	0.438	0.0610
8	0.0959	26.300	26.3	3.4	0.414	0.0608
9	0.1095	25.900	25.9	4.0	0.408	0.0607
10	0.1450	24.300	24.3	5.5	0.383	0.0606
11	0.1830	23.200	23.2	7.1	0.366	0.0604
12	0.2370	22.500	22.5	9.3	0.355	0.0601

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.2753	22.400	22.4	10.9	0.353	0.0599
14	0.2960	22.100	22.1	11.7	0.348	0.0599
15	0.3026	21.700	21.7	12.0	0.342	0.0596
16	0.3300	21.600	21.6	13.2	0.340	0.0594
17	0.3750	21.500	21.5	15.0	0.339	0.0594



Sample No.		1
Initial	Water Content, %	40.3
	Dry Density, pcf	80.4
	Saturation, %	97.8
	Void Ratio	1.1343
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	37.6
	Dry Density, pcf	84.2
	Saturation, %	99.6
	Void Ratio	1.0385
	Diameter, in.	2.41
	Height, in.	0.96
Normal Stress, tsf		1.511
Fail. Stress, tsf		0.750
Strain, %		5.3
Ult. Stress, tsf		0.726
Strain, %		15.0
Strain rate, in./min.		0.00

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 55 PL= 21 PI= 34

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in./min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-M-11, Moorhead, ~~PL Sherack Formation~~ **Sherack**

Sample Number: Boring 09-53MU, #1 **Depth:** 18-20'

Proj. No.: BL-09-03127 **Date Sampled:**

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DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-11, Moorhead, ~~PL Sherack Formation~~
Depth: 18-20' **Sample Number:** Boring 09-53MU, #1
Description: FAT CLAY, gray (CH) **Sherack**
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**55 **PL=**21 **PI=**34

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	148.590		163.120
Moisture content: Dry soil+tare, gms.	114.910		126.940
Moisture content: Tare, gms.	31.420		30.790
Moisture, %	40.3	37.6	37.6
Moist specimen weight, gms.	135.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.05	
Wet Density, pcf	112.9	115.9	
Dry density, pcf	80.4	84.2	
Void ratio	1.1343	1.0385	
Saturation, %	97.8	99.6	

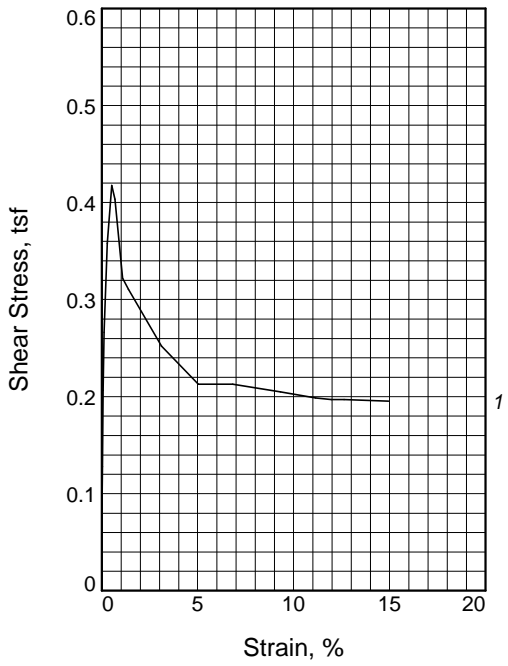
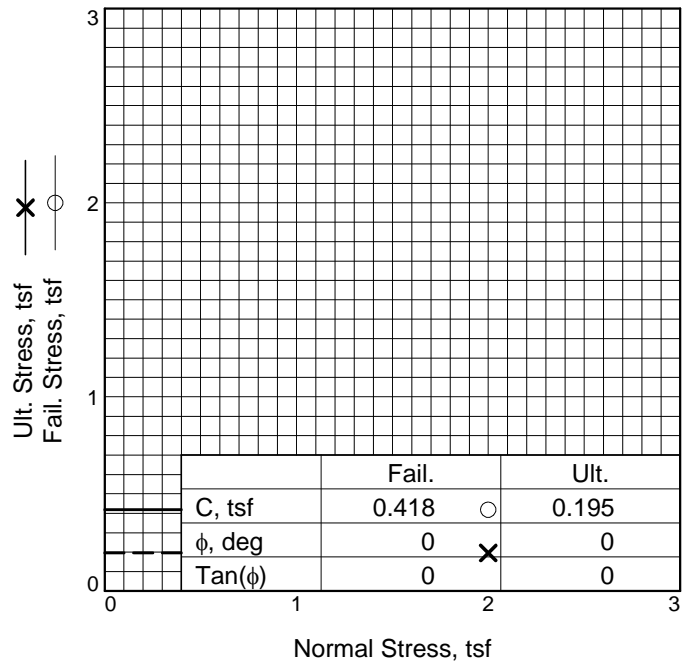
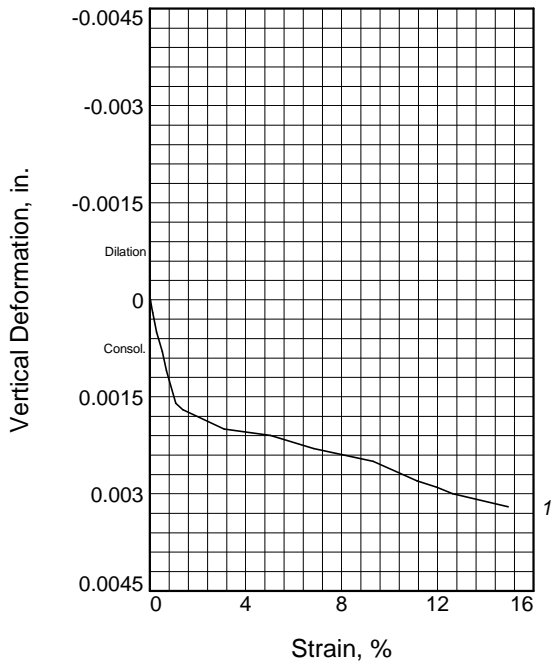
Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.750 tsf at reading no. 12
Ult. Stress = 0.726 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0120	0.000	0.0	0.0	0.000	0.1424
1	0.0124	4.100	4.1	0.0	0.065	0.1424
2	0.0148	11.600	11.6	0.1	0.183	0.1422
3	0.0201	18.500	18.5	0.3	0.292	0.1412
4	0.0319	26.600	26.6	0.8	0.419	0.1394
5	0.0477	33.900	33.9	1.5	0.534	0.1372
6	0.0658	39.500	39.5	2.2	0.622	0.1351
7	0.0751	41.700	41.7	2.6	0.657	0.1343
8	0.0868	42.400	42.4	3.1	0.668	0.1334
9	0.0998	43.900	43.9	3.6	0.692	0.1327
10	0.1100	46.600	46.6	4.1	0.734	0.1322
11	0.1229	47.000	47.0	4.6	0.741	0.1317

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
12	0.1400	47.600	47.6	5.3	0.750	0.1314
13	0.2071	46.500	46.5	8.1	0.733	0.1311
14	0.2710	46.300	46.3	10.7	0.730	0.1311
15	0.3000	46.300	46.3	11.9	0.730	0.1311
16	0.3033	46.200	46.2	12.1	0.728	0.1310
17	0.3300	46.200	46.2	13.2	0.728	0.1310
18	0.3750	46.100	46.1	15.0	0.726	0.1309



Sample No.		1
Initial	Water Content, %	62.5
	Dry Density, pcf	62.7
	Saturation, %	99.8
	Void Ratio	1.6925
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	60.2
	Dry Density, pcf	64.2
	Saturation, %	100.0
	Void Ratio	1.6295
	Diameter, in.	2.41
	Height, in.	0.98
Normal Stress, tsf	2.000	
Fail. Stress, tsf	0.418	
Strain, %	0.5	
Ult. Stress, tsf	0.195	
Strain, %	15.0	
Strain rate, in./min.	0.00	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)

LL= 114 **PL=** 24 **PI=** 90
Assumed Specific Gravity= 2.704

Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115 **Oxidized Brenna**

Location: SE-M-18, Moorhead, ~~PL Sherak Formation~~

Sample Number: Boring 09-34MU, #2 **Depth:** 16-18'

Proj. No.: BL-09-03127 **Date Sampled:**

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DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, PL ~~Sherack Formation~~
Depth: 16-18' **Sample Number:** Boring 09-34MU, #2
Description: FAT CLAY, brown (CH) **Oxidized Brenna**
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.704 **LL=**114 **PL=**24 **PI=**90

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	85.650		150.320
Moisture content: Dry soil+tare, gms.	64.880		105.190
Moisture content: Tare, gms.	31.630		30.280
Moisture, %	62.5	60.2	60.2
Moist specimen weight, gms.	122.8		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	101.9	102.9	
Dry density, pcf	62.7	64.2	
Void ratio	1.6925	1.6295	
Saturation, %	99.8	100.0	

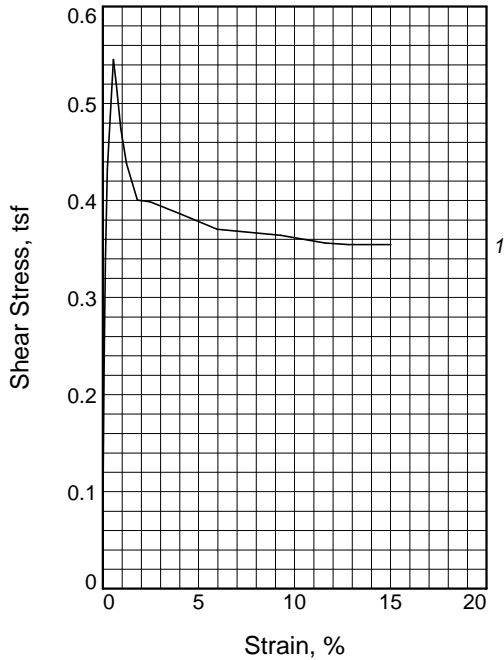
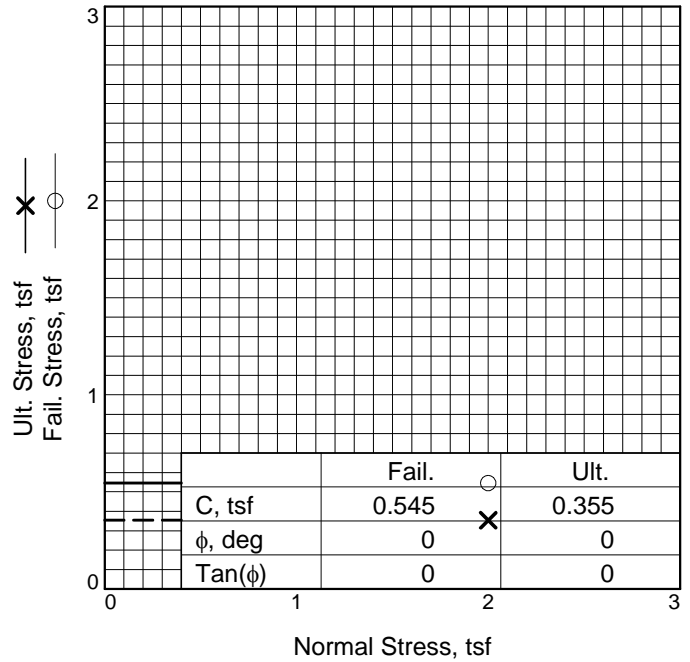
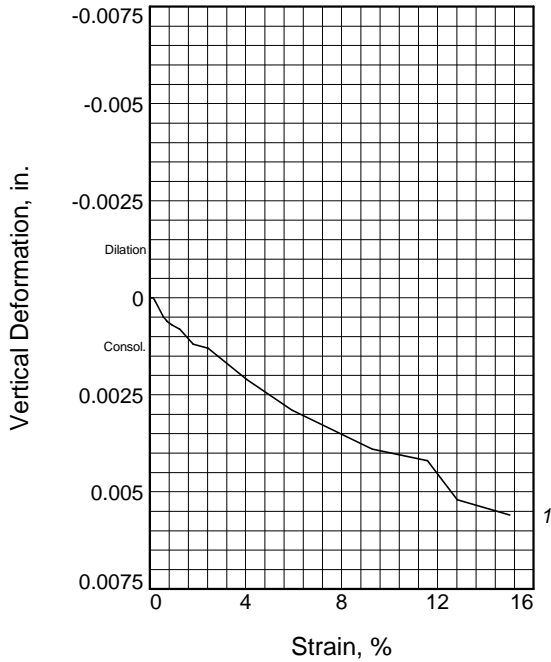
Test Readings for Specimen No. 1

Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.418 tsf at reading no. 6
Ult. Stress = 0.195 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0253	0.000	0.0	0.0	0.000	0.1223
1	0.0255	4.500	4.5	0.0	0.071	0.1223
2	0.0260	8.100	8.1	0.0	0.128	0.1223
3	0.0270	13.100	13.1	0.1	0.206	0.1222
4	0.0283	16.900	16.9	0.1	0.266	0.1221
5	0.0320	22.700	22.7	0.3	0.358	0.1218
6	0.0380	26.500	26.5	0.5	0.418	0.1215
7	0.0420	25.600	25.6	0.7	0.403	0.1212
8	0.0514	20.400	20.4	1.1	0.321	0.1207
9	0.0588	19.700	19.7	1.4	0.310	0.1206
10	0.1000	16.000	16.0	3.1	0.252	0.1203
11	0.1466	13.500	13.5	5.0	0.213	0.1202
12	0.1900	13.500	13.5	6.8	0.213	0.1200

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.2500	13.000	13.0	9.3	0.205	0.1198
14	0.2940	12.600	12.6	11.1	0.199	0.1195
15	0.3140	12.500	12.5	12.0	0.197	0.1194
16	0.3300	12.500	12.5	12.6	0.197	0.1193
17	0.3860	12.400	12.4	15.0	0.195	0.1191



Sample No.		1
Initial	Water Content, %	57.7
	Dry Density, pcf	66.0
	Saturation, %	99.1
	Void Ratio	1.6016
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	55.0
	Dry Density, pcf	68.0
	Saturation, %	99.1
	Void Ratio	1.5262
	Diameter, in.	2.41
	Height, in.	0.97
Normal Stress, tsf	2.000	
Fail. Stress, tsf	0.545	
Strain, %	0.6	
Ult. Stress, tsf	0.355	
Strain, %	15.0	
Strain rate, in./min.	0.00	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)
LL= 108 **PL=** 22 **PI=** 86
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Figure Residual Direct Shear

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-F-13, Fargo, Brenna Formation
Sample Number: Boring 09-25MU, # **Depth:** 50-52'
Proj. No.: BL-09-03127 **Date Sampled:**
BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Brenna Formation
Depth: 50-52' **Sample Number:** Boring 09-25MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=**108 **PL=**22 **PI=**86

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	116.580		151.960
Moisture content: Dry soil+tare, gms.	84.990		108.930
Moisture content: Tare, gms.	30.270		30.670
Moisture, %	57.7	55.0	55.0
Moist specimen weight, gms.	125.1		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	104.1	105.3	
Dry density, pcf	66.0	68.0	
Void ratio	1.6016	1.5262	
Saturation, %	99.1	99.1	

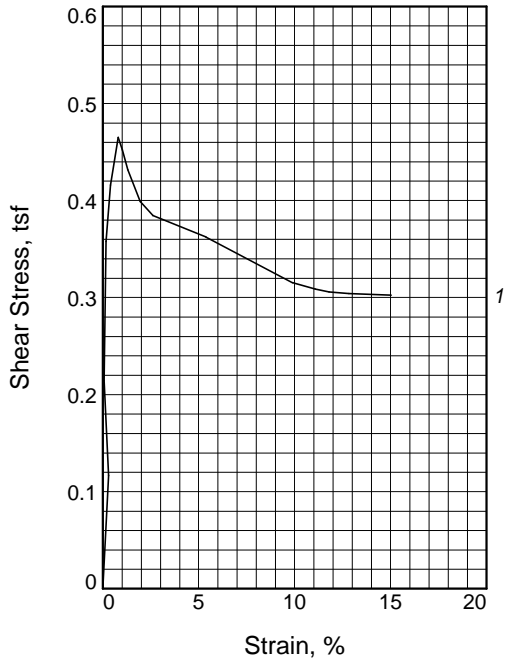
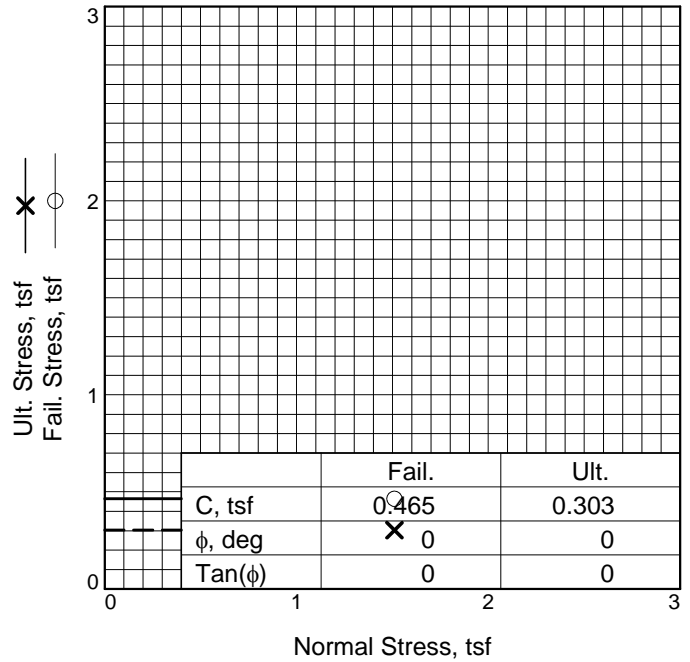
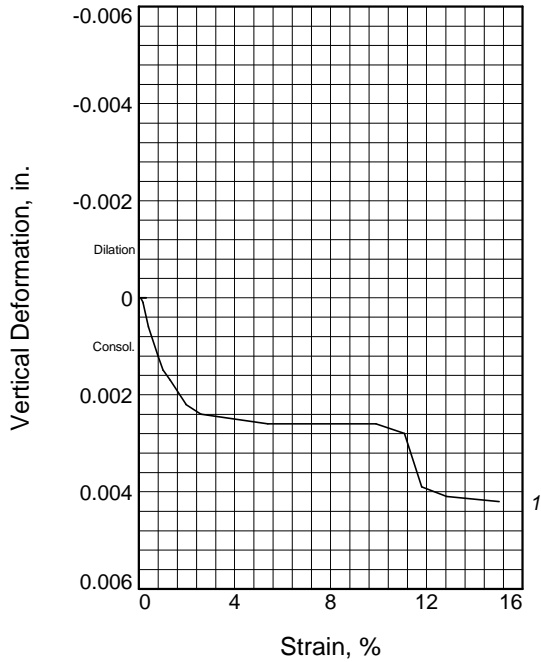
Test Readings for Specimen No. 1

Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.545 tsf at reading no. 5
Ult. Stress = 0.355 tsf at reading no. 16

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0208	0.000	0.0	0.0	0.000	0.1266
1	0.0210	4.500	4.5	0.0	0.071	0.1266
2	0.0225	14.500	14.5	0.1	0.228	0.1266
3	0.0240	21.400	21.4	0.1	0.337	0.1266
4	0.0265	27.400	27.4	0.2	0.432	0.1265
5	0.0343	34.600	34.6	0.6	0.545	0.1261
6	0.0380	33.000	33.0	0.7	0.520	0.1260
7	0.0434	30.100	30.1	0.9	0.474	0.1259
8	0.0506	27.800	27.8	1.2	0.438	0.1258
9	0.0644	25.400	25.4	1.8	0.400	0.1254
10	0.0799	25.300	25.3	2.4	0.399	0.1253
11	0.1185	24.500	24.5	4.0	0.386	0.1245

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
12	0.1646	23.500	23.5	6.0	0.370	0.1237
13	0.2447	23.100	23.1	9.3	0.364	0.1227
14	0.3000	22.600	22.6	11.6	0.356	0.1224
15	0.3300	22.500	22.5	12.8	0.355	0.1214
16	0.3830	22.500	22.5	15.0	0.355	0.1210



Sample No.		1
Initial	Water Content, %	52.1
	Dry Density, pcf	70.0
	Saturation, %	98.6
	Void Ratio	1.4523
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	50.2
	Dry Density, pcf	72.0
	Saturation, %	99.7
	Void Ratio	1.3838
	Diameter, in.	2.41
	Height, in.	0.97
	Normal Stress, tsf	1.511
	Fail. Stress, tsf	0.465
	Strain, %	0.8
	Ult. Stress, tsf	0.303
	Strain, %	15.0
	Strain rate, in./min.	0.00

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)
LL= 110 **PL=** 24 **PI=** 86
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in./min. The test specimen was precut before testing. ASTM D 3080.

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-F-15, Fargo, Brenna Formation
Sample Number: Boring 09-26MU **Depth:** 28-30'
Proj. No.: BL-09-03127 **Date Sampled:**

Figure Residual Direct Shear



DIRECT SHEAR TEST

11/24/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-26MU
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=110** **PL=24** **PI=86**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	105.340		157.500
Moisture content: Dry soil+tare, gms.	79.720		115.050
Moisture content: Tare, gms.	30.520		30.460
Moisture, %	52.1	50.2	50.2
Moist specimen weight, gms.	127.5		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	106.5	108.2	
Dry density, pcf	70.0	72.0	
Void ratio	1.4523	1.3838	
Saturation, %	98.6	99.7	

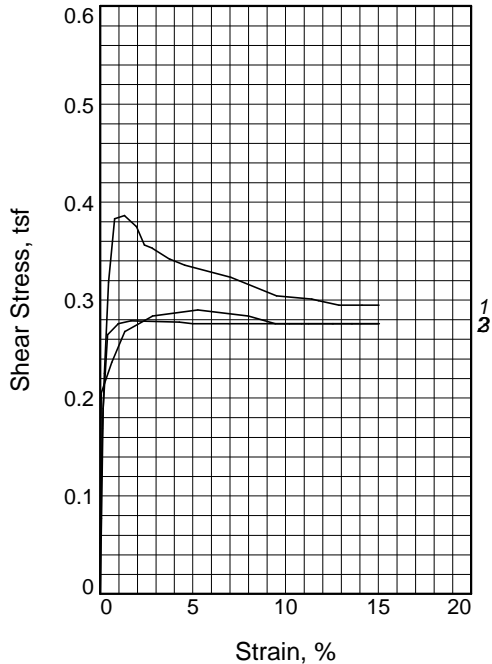
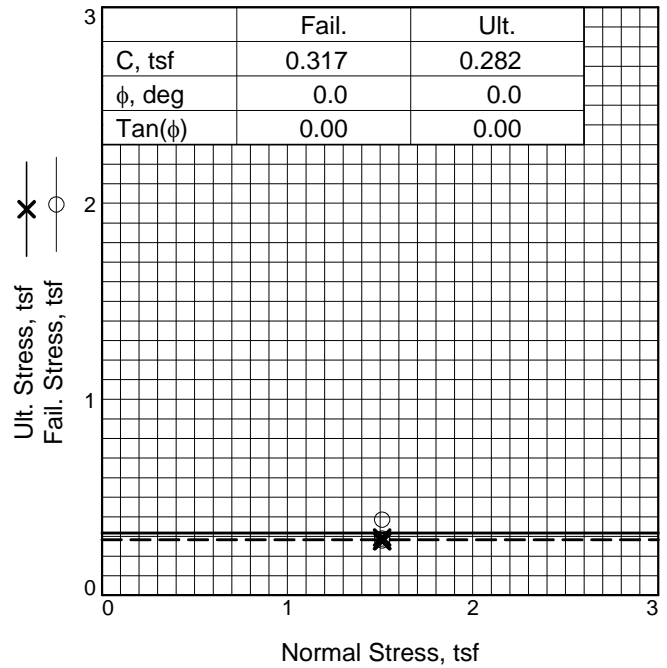
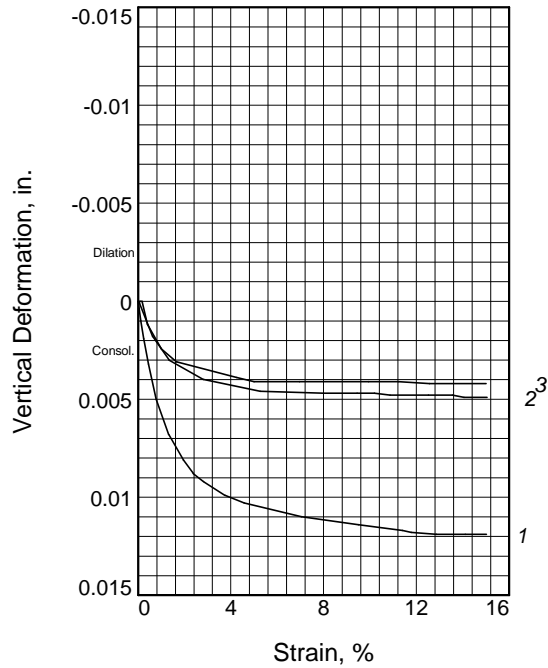
Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.465 tsf at reading no. 5
Ult. Stress = 0.303 tsf at reading no. 15

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0204	0.000	0.0	0.0	0.000	0.1714
1	0.0277	7.400	7.4	0.3	0.117	0.1714
2	0.0220	13.600	13.6	0.1	0.214	0.1714
3	0.0246	22.700	22.7	0.2	0.358	0.1713
4	0.0300	26.400	26.4	0.4	0.416	0.1708
5	0.0398	29.500	29.5	0.8	0.465	0.1702
6	0.0450	28.700	28.7	1.0	0.452	0.1699
7	0.0520	27.400	27.4	1.3	0.432	0.1697
8	0.0676	25.300	25.3	2.0	0.399	0.1692
9	0.0832	24.400	24.4	2.6	0.384	0.1690
10	0.1500	23.000	23.0	5.4	0.362	0.1688
11	0.2590	20.000	20.0	9.9	0.315	0.1688
12	0.2875	19.600	19.6	11.1	0.309	0.1686

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.3050	19.400	19.4	11.8	0.306	0.1675
14	0.3300	19.300	19.3	12.8	0.304	0.1673
15	0.3830	19.200	19.2	15.0	0.303	0.1672



Sample No.	1	2	3	
Initial	Water Content, %	52.2	52.2	52.2
	Dry Density, pcf	70.3	70.3	70.3
	Saturation, %	99.6	99.6	99.6
	Void Ratio	1.4406	1.4406	1.4406
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	50.3	50.3	50.3
	Dry Density, pcf	72.0	72.0	72.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.3835	1.3835	1.3835
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.98	0.98	0.98
Normal Stress, tsf	1.511	1.511	1.511	
Fail. Stress, tsf	0.386	0.290	0.279	
Strain, %	1.3	5.3	1.7	
Ult. Stress, tsf	0.295	0.276	0.276	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	0.00	0.00	0.00	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, gray (CH)

LL= 110 **PL=** 24 **PI=** 86

Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min.

The test specimen was precut before testing then run 2 additional times after re-setting the sample in the shear box. ASTM D 3080

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115

Location: SE-F-15, Fargo, Brenna Formation

Sample Number: Boring 09-26MU, #3 **Depth:** 28-30'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

12/3/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-15, Fargo, Brenna Formation
Depth: 28-30' **Sample Number:** Boring 09-26MU, #3
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in./min. The test specimen was precut before testing then run 2 additional times after re-setting the sample in the shear box. ASTM D 3080
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=**110 **PL=**24 **PI=**86

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.050		151.900
Moisture content: Dry soil+tare, gms.	103.190		111.500
Moisture content: Tare, gms.	30.600		31.230
Moisture, %	52.2	50.3	50.3
Moist specimen weight, gms.	128.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	107.0	108.3	
Dry density, pcf	70.3	72.0	
Void ratio	1.4406	1.3835	
Saturation, %	99.6	100.0	

Test Readings for Specimen No. 1

Normal stress = 1.511 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.386 tsf at reading no. 7
Ult. Stress = 0.295 tsf at reading no. 19

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0125	0.000	0.0	0.0	0.000	0.1562
1	0.0128	3.300	3.3	0.0	0.052	0.1561
2	0.0135	6.400	6.4	0.0	0.101	0.1558
3	0.0154	10.700	10.7	0.1	0.169	0.1552
4	0.0182	14.300	14.3	0.2	0.225	0.1543
5	0.0234	20.200	20.2	0.5	0.318	0.1530
6	0.0314	24.300	24.3	0.8	0.383	0.1512
7	0.0443	24.500	24.5	1.3	0.386	0.1494
8	0.0596	23.800	23.8	2.0	0.375	0.1481
9	0.0700	22.600	22.6	2.4	0.356	0.1474
10	0.0807	22.400	22.4	2.8	0.353	0.1470
11	0.1029	21.700	21.7	3.7	0.342	0.1463

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
12	0.1227	21.300	21.3	4.6	0.336	0.1459
13	0.1825	20.500	20.5	7.0	0.323	0.1452
14	0.2418	19.300	19.3	9.5	0.304	0.1448
15	0.2878	19.100	19.1	11.4	0.301	0.1445
16	0.2966	19.000	19.0	11.8	0.299	0.1444
17	0.3230	18.700	18.7	12.9	0.295	0.1443
18	0.3530	18.700	18.7	14.1	0.295	0.1443
19	0.3750	18.700	18.7	15.0	0.295	0.1443

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.050		151.900
Moisture content: Dry soil+tare, gms.	103.190		111.500
Moisture content: Tare, gms.	30.600		31.230
Moisture, %	52.2	50.3	50.3
Moist specimen weight, gms.	128.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	107.0	108.3	
Dry density, pcf	70.3	72.0	
Void ratio	1.4406	1.3835	
Saturation, %	99.6	100.0	

Test Readings for Specimen No. 2

Normal stress = 1.511 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.290 tsf at reading no. 5

Ult. Stress = 0.276 tsf at reading no. 13

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0320	0.000	0.0	0.0	0.000	0.1374
1	0.0335	13.000	13.0	0.1	0.205	0.1373
2	0.0470	15.000	15.0	0.6	0.236	0.1356
3	0.0641	17.000	17.0	1.3	0.268	0.1344
4	0.1001	18.000	18.0	2.8	0.284	0.1334
5	0.1591	18.400	18.4	5.3	0.290	0.1328
6	0.2250	18.000	18.0	8.0	0.284	0.1327
7	0.2600	17.500	17.5	9.5	0.276	0.1327
8	0.2780	17.500	17.5	10.2	0.276	0.1327
9	0.2940	17.500	17.5	10.9	0.276	0.1326
10	0.3340	17.500	17.5	12.5	0.276	0.1326
11	0.3590	17.500	17.5	13.6	0.276	0.1326
12	0.3710	17.500	17.5	14.1	0.276	0.1325
13	0.3950	17.500	17.5	15.0	0.276	0.1325

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	141.050		151.900
Moisture content: Dry soil+tare, gms.	103.190		111.500
Moisture content: Tare, gms.	30.600		31.230
Moisture, %	52.2	50.3	50.3
Moist specimen weight, gms.	128.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.98	
Net decrease in height, in.		0.02	
Wet Density, pcf	107.0	108.3	
Dry density, pcf	70.3	72.0	
Void ratio	1.4406	1.3835	
Saturation, %	99.6	100.0	

Test Readings for Specimen No. 3

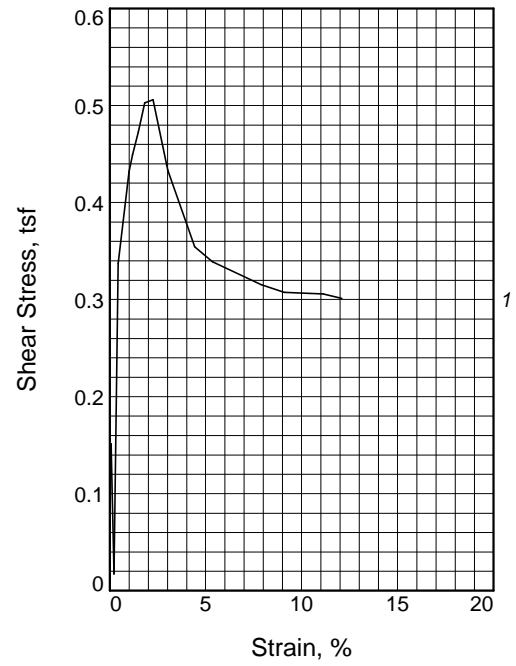
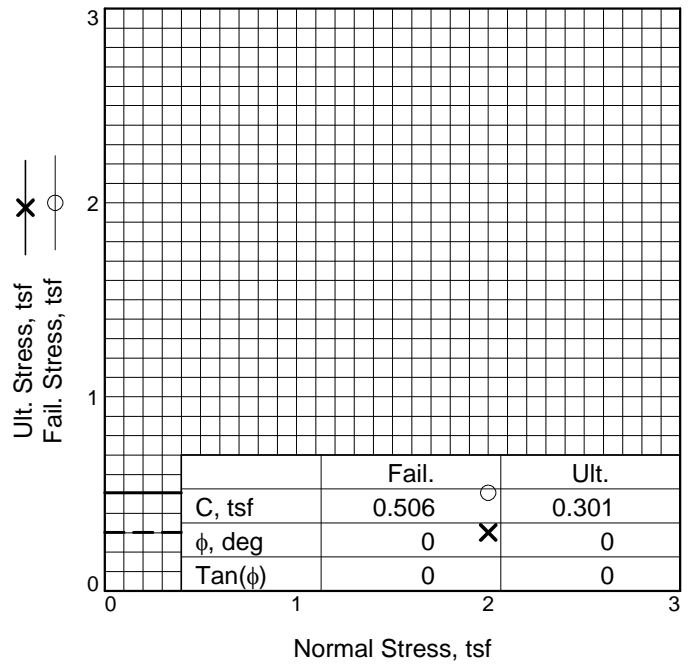
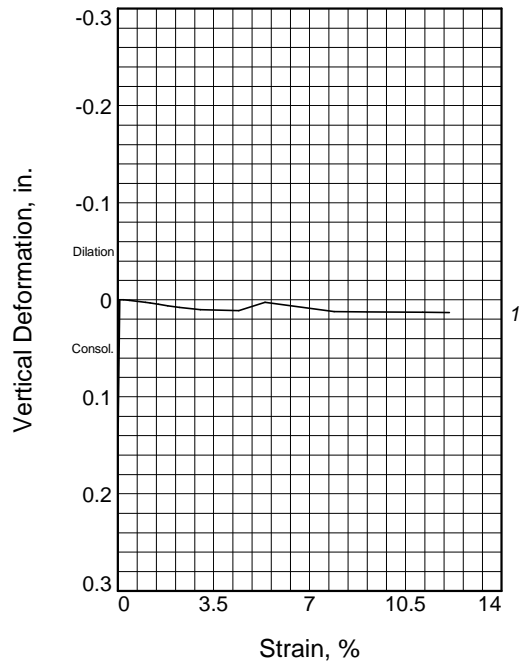
Normal stress = 1.511 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.279 tsf at reading no. 5

Ult. Stress = 0.276 tsf at reading no. 13

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0310	0.000	0.0	0.0	0.000	0.1054
1	0.0330	4.900	4.9	0.1	0.077	0.1054
2	0.0350	12.000	12.0	0.2	0.189	0.1054
3	0.0409	16.800	16.8	0.4	0.265	0.1042
4	0.0546	17.500	17.5	1.0	0.276	0.1030
5	0.0710	17.700	17.7	1.7	0.279	0.1023
6	0.1338	17.600	17.6	4.3	0.277	0.1015
7	0.1515	17.500	17.5	5.0	0.276	0.1013
8	0.1990	17.500	17.5	7.0	0.276	0.1013
9	0.2710	17.500	17.5	10.0	0.276	0.1013
10	0.3023	17.500	17.5	11.2	0.276	0.1013
11	0.3342	17.500	17.5	12.6	0.276	0.1012
12	0.3591	17.500	17.5	13.6	0.276	0.1012
13	0.3930	17.500	17.5	15.0	0.276	0.1012



Sample No.		1
Initial	Water Content, %	65.0
	Dry Density, pcf	60.7
	Saturation, %	97.9
	Void Ratio	1.8271
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	62.1
	Dry Density, pcf	63.4
	Saturation, %	99.9
	Void Ratio	1.7095
	Diameter, in.	2.41
	Height, in.	0.96
Normal Stress, tsf	2.000	
Fail. Stress, tsf	0.506	
Strain, %	2.3	
Ult. Stress, tsf	0.301	
Strain, %	12.1	
Strain rate, in./min.	0.00	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, brown (CH)

LL= 117 **PL=** 25 **PI=** 92
Assumed Specific Gravity= 2.75

Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-19, Fargo, Brenna Formation

Sample Number: Boring 09-27MU, #3 **Depth:** 32-34'

Proj. No.: BL-09-03127 **Date Sampled:**

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, Brenna Formation
Depth: 32-34' **Sample Number:** Boring 09-27MU, #3
Description: FAT CLAY, brown (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.75 **LL=117** **PL=25** **PI=92**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	110.120		145.310
Moisture content: Dry soil+tare, gms.	78.770		101.350
Moisture content: Tare, gms.	30.560		30.560
Moisture, %	65.0	62.1	62.1
Moist specimen weight, gms.	120.6		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.96	
Net decrease in height, in.		0.04	
Wet Density, pcf	100.2	102.7	
Dry density, pcf	60.7	63.4	
Void ratio	1.8271	1.7095	
Saturation, %	97.9	99.9	

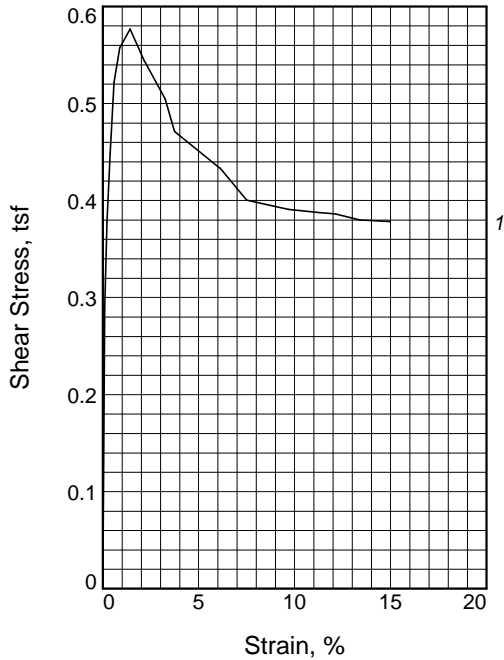
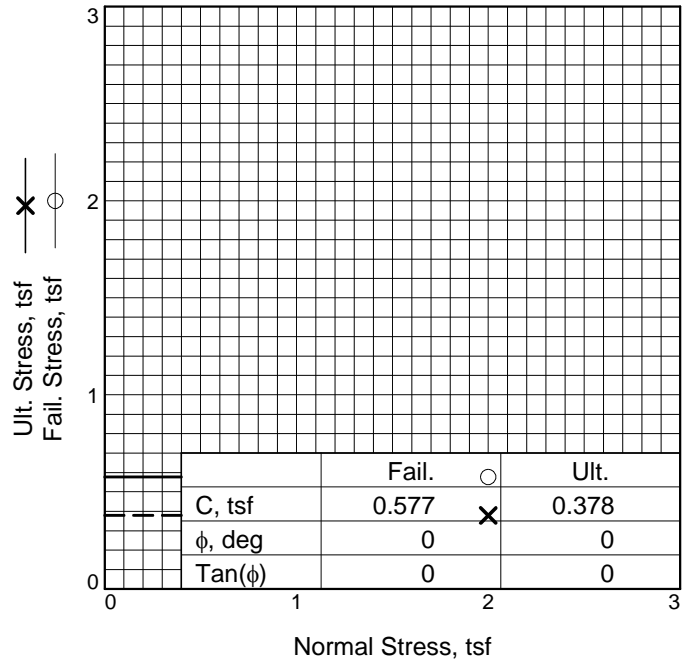
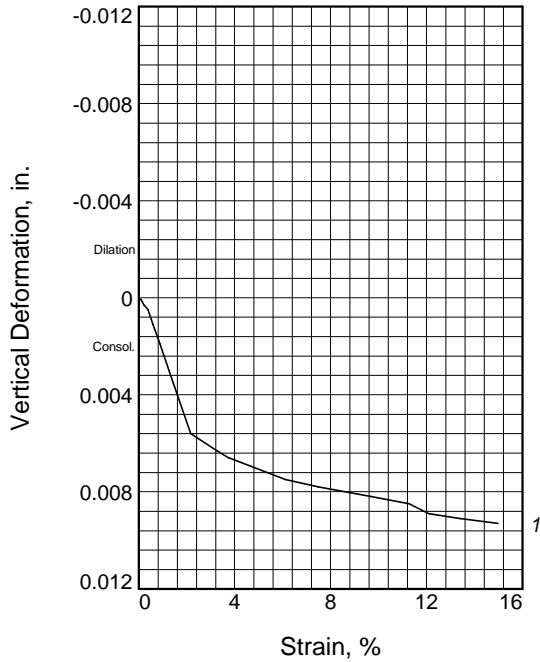
Test Readings for Specimen No. 1

Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.506 tsf at reading no. 9
Ult. Stress = 0.301 tsf at reading no. 16

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0085	0.000	0.0	0.0	0.000	0.1463
1	0.0087	4.000	4.0	0.0	0.063	0.0146
2	0.0101	9.600	9.6	0.1	0.151	0.1463
3	0.0136	1.100	1.1	0.2	0.017	0.1463
4	0.0190	21.400	21.4	0.4	0.337	0.1457
5	0.0327	27.400	27.4	1.0	0.432	0.1437
6	0.0370	28.500	28.5	1.2	0.449	0.1430
7	0.0442	30.000	30.0	1.5	0.473	0.1417
8	0.0525	31.900	31.9	1.8	0.503	0.1401
9	0.0628	32.100	32.1	2.3	0.506	0.1383
10	0.0812	27.500	27.5	3.0	0.433	0.1359
11	0.1150	22.500	22.5	4.4	0.355	0.1349
12	0.1380	21.500	21.5	5.4	0.339	0.1436

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.1990	20.000	20.0	7.9	0.315	0.1340
14	0.2280	19.500	19.5	9.1	0.307	0.1337
15	0.2770	19.400	19.4	11.1	0.306	0.1334
16	0.3004	19.100	19.1	12.1	0.301	0.1330



Sample No.		1
Initial	Water Content, %	52.2
	Dry Density, pcf	69.5
	Saturation, %	98.9
	Void Ratio	1.4271
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	49.7
	Dry Density, pcf	72.1
	Saturation, %	100.0
	Void Ratio	1.3423
	Diameter, in.	2.41
	Height, in.	0.97
Normal Stress, tsf	2.000	
Fail. Stress, tsf	0.577	
Strain, %	1.4	
Ult. Stress, tsf	0.378	
Strain, %	15.0	
Strain rate, in./min.	0.00	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, gray (CH)

LL= 111 **PL=** 25 **PI=** 86
Assumed Specific Gravity= 2.704

Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115 **Brenna / Argusville Transition**

Location: SE-F-19, Fargo, ~~Argusville Formation~~

Sample Number: Boring 09-27MU, #4 **Depth:** 64-66'

Proj. No.: BL-09-03127 **Date Sampled:**

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, ~~Argusville Formation~~
Depth: 64-66' **Sample Number:** Boring 09-27MU, #4
Description: FAT CLAY, gray (CH) **Brenna / Argusville Transition**
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.704 **LL=**111 **PL=**25 **PI=**86

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	93.660		155.020
Moisture content: Dry soil+tare, gms.	72.310		114.000
Moisture content: Tare, gms.	31.420		31.410
Moisture, %	52.2	49.7	49.7
Moist specimen weight, gms.	127.3		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.04	
Wet Density, pcf	105.9	107.9	
Dry density, pcf	69.5	72.1	
Void ratio	1.4271	1.3423	
Saturation, %	98.9	100.0	

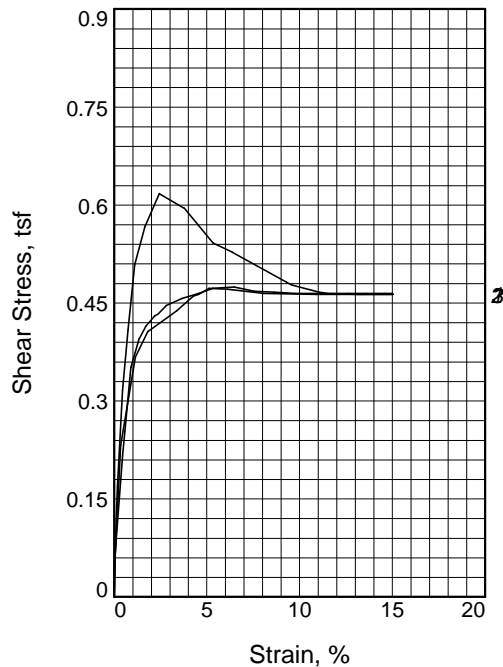
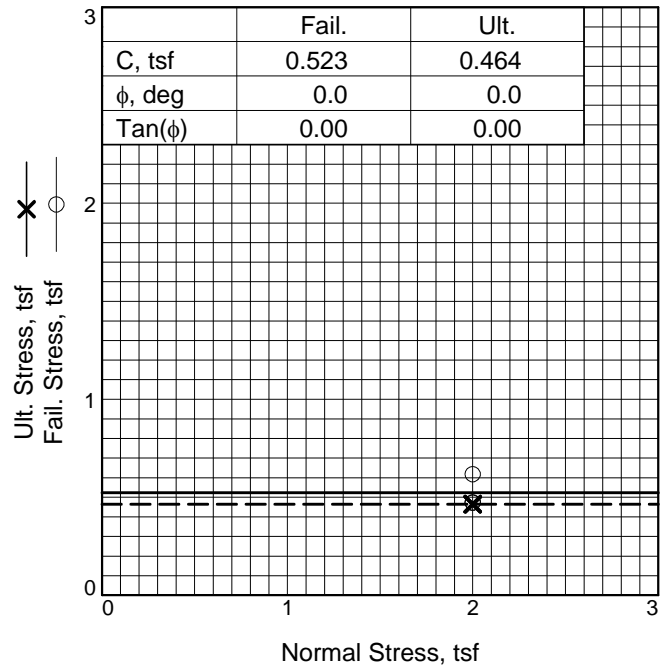
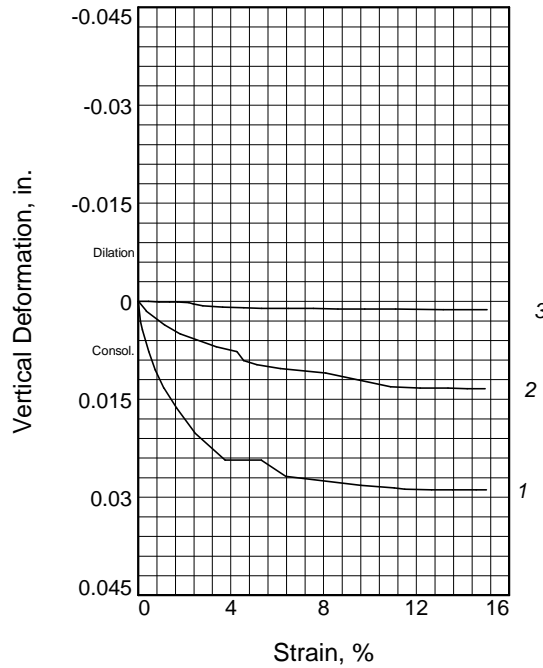
Test Readings for Specimen No. 1

Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.577 tsf at reading no. 6
Ult. Stress = 0.378 tsf at reading no. 16

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0276	0.000	0.0	0.0	0.000	0.1086
1	0.0302	18.500	18.5	0.1	0.292	0.1085
2	0.0330	24.000	24.0	0.2	0.378	0.1083
3	0.0370	28.500	28.5	0.4	0.449	0.1081
4	0.0420	33.100	33.1	0.6	0.522	0.1075
5	0.0490	35.400	35.4	0.9	0.558	0.1067
6	0.0620	36.600	36.6	1.4	0.577	0.1051
7	0.0800	34.500	34.5	2.2	0.544	0.1030
8	0.1060	32.000	32.0	3.2	0.504	0.1023
9	0.1180	29.900	29.9	3.7	0.471	0.1020
10	0.1750	27.500	27.5	6.1	0.433	0.1011
11	0.2083	25.400	25.4	7.5	0.400	0.1008
12	0.2610	24.800	24.8	9.7	0.391	0.1004

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.3000	24.600	24.6	11.3	0.388	0.1001
14	0.3200	24.500	24.5	12.1	0.386	0.0997
15	0.3510	24.100	24.1	13.4	0.380	0.0995
16	0.3890	24.000	24.0	15.0	0.378	0.0993



Sample No.	1	2	3	
Initial	Water Content, %	49.8	49.8	49.8
	Dry Density, pcf	71.9	71.9	71.9
	Saturation, %	99.9	99.9	99.9
	Void Ratio	1.3482	1.3482	1.3482
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	45.9	45.9	45.9
	Dry Density, pcf	75.3	75.3	75.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.2412	1.2412	1.2412
	Diameter, in.	2.41	2.41	2.41
	Height, in.	0.95	0.95	0.95
Normal Stress, tsf	2.000	2.000	2.000	
Fail. Stress, tsf	0.618	0.473	0.474	
Strain, %	2.4	5.1	6.5	
Ult. Stress, tsf	0.465	0.463	0.463	
Strain, %	15.0	15.0	15.0	
Strain rate, in./min.	0.00	0.00	0.00	

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 111 **PL=** 25 **PI=** 86

Assumed Specific Gravity= 2.704

Remarks: The rate of strain is 0.00096 in./min.

The test specimen was precut before testing then run 2 additional times after re-setting the sample in the shear box. ASTM D 3080

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study

W912ES-09-P-0115 Brenna / Argusville Transition

Location: SE-F-19, Fargo, ~~Argusville Formation~~

Sample Number: Boring 09-27MU, #4 **Depth:** 64-66'

Proj. No.: BL-09-03127

Date Sampled:

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

12/3/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-19, Fargo, ~~Argusville Formation~~
Depth: 64-66' **Sample Number:** Boring 09-27MU, #4
Description: FAT CLAY, gray (CH) **Brenna / Argusville Transition**
Remarks: The rate of strain is 0.00096 in./min. The test specimen was precut before testing then run 2 additional times after re-setting the sample in the shear box. ASTM D 3080
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.704 **LL=**111 **PL=**25 **PI=**86

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.750		152.380
Moisture content: Dry soil+tare, gms.	97.420		113.810
Moisture content: Tare, gms.	30.490		29.780
Moisture, %	49.8	45.9	45.9
Moist specimen weight, gms.	129.0		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.95	
Net decrease in height, in.		0.05	
Wet Density, pcf	107.7	109.9	
Dry density, pcf	71.9	75.3	
Void ratio	1.3482	1.2412	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 1

Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.618 tsf at reading no. 7
Ult. Stress = 0.465 tsf at reading no. 17

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0157	0.000	0.0	0.0	0.000	0.1687
1	0.0182	7.400	7.4	0.1	0.117	0.1656
2	0.0200	10.700	10.7	0.2	0.169	0.1643
3	0.0266	20.100	20.1	0.5	0.317	0.1610
4	0.0335	25.900	25.9	0.7	0.408	0.1582
5	0.0425	32.300	32.3	1.1	0.509	0.1554
6	0.0556	36.000	36.0	1.7	0.567	0.1523
7	0.0743	39.200	39.2	2.4	0.618	0.1486
8	0.1064	37.800	37.8	3.8	0.596	0.1444
9	0.1438	34.400	34.4	5.3	0.542	0.1444
10	0.1695	33.500	33.5	6.4	0.528	0.1419
11	0.2474	30.300	30.3	9.6	0.477	0.1405

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
12	0.2823	29.600	29.6	11.1	0.466	0.1401
13	0.2931	29.500	29.5	11.5	0.465	0.1399
14	0.3210	29.500	29.5	12.7	0.465	0.1398
15	0.3432	29.500	29.5	13.6	0.465	0.1398
16	0.3673	29.500	29.5	14.6	0.465	0.1398
17	0.3780	29.500	29.5	15.0	0.465	0.1398

Parameters for Specimen No. 2

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.750		152.380
Moisture content: Dry soil+tare, gms.	97.420		113.810
Moisture content: Tare, gms.	30.490		29.780
Moisture, %	49.8	45.9	45.9
Moist specimen weight, gms.	129.0		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.95	
Net decrease in height, in.		0.05	
Wet Density, pcf	107.7	109.9	
Dry density, pcf	71.9	75.3	
Void ratio	1.3482	1.2412	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 2

Normal stress = 2 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.473 tsf at reading no. 8

Ult. Stress = 0.463 tsf at reading no. 15

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0285	0.000	0.0	0.0	0.000	0.1348
1	0.0293	3.500	3.5	0.0	0.055	0.1347
2	0.0369	14.700	14.7	0.3	0.232	0.1333
3	0.0560	23.300	23.3	1.1	0.367	0.1312
4	0.0724	25.800	25.8	1.8	0.407	0.1298
5	0.1099	27.800	27.8	3.4	0.438	0.1278
6	0.1310	29.200	29.2	4.2	0.460	0.1271
7	0.1380	29.400	29.4	4.5	0.463	0.1257
8	0.1520	30.000	30.0	5.1	0.473	0.1251
9	0.1765	29.900	29.9	6.1	0.471	0.1245
10	0.2236	29.500	29.5	8.1	0.465	0.1238
11	0.2912	29.400	29.4	10.9	0.463	0.1217
12	0.3220	29.400	29.4	12.2	0.463	0.1215
13	0.3510	29.400	29.4	13.4	0.463	0.1215
14	0.3710	29.400	29.4	14.2	0.463	0.1214
15	0.3895	29.400	29.4	15.0	0.463	0.1214

Parameters for Specimen No. 3

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	130.750		152.380
Moisture content: Dry soil+tare, gms.	97.420		113.810
Moisture content: Tare, gms.	30.490		29.780
Moisture, %	49.8	45.9	45.9
Moist specimen weight, gms.	129.0		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.95	
Net decrease in height, in.		0.05	
Wet Density, pcf	107.7	109.9	
Dry density, pcf	71.9	75.3	
Void ratio	1.3482	1.2412	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 3

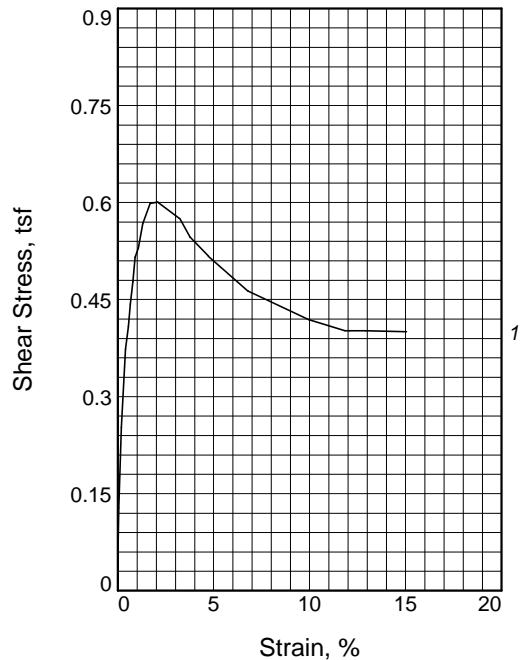
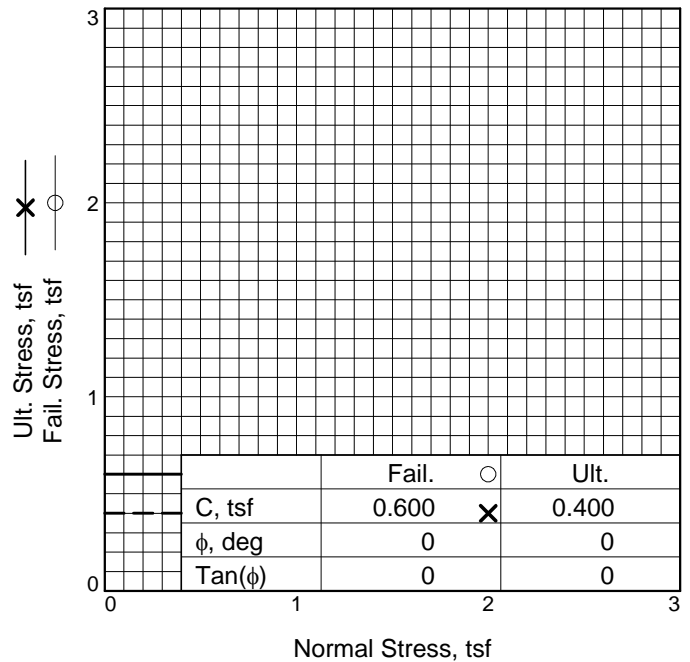
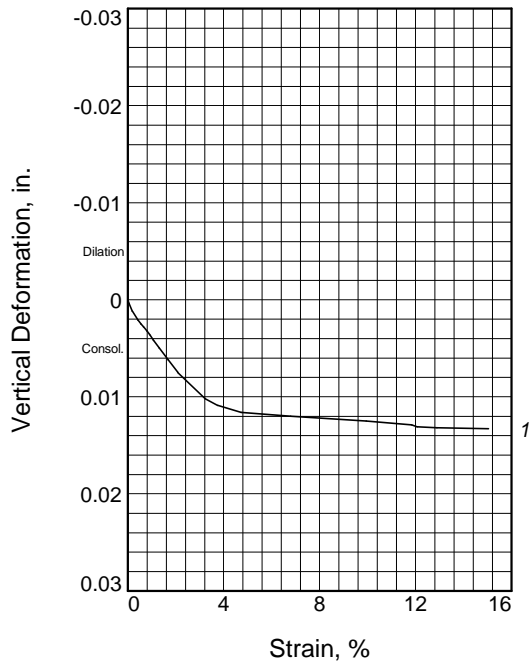
Normal stress = 2 tsf

Strain rate, in./min. = 0.00

Fail. Stress = 0.474 tsf at reading no. 12

Ult. Stress = 0.463 tsf at reading no. 18

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0151	0.000	0.0	0.0	0.000	0.0616
1	0.0153	3.100	3.1	0.0	0.049	0.0616
2	0.0259	13.700	13.7	0.4	0.216	0.0616
3	0.0369	22.300	22.3	0.9	0.351	0.0615
4	0.0478	25.100	25.1	1.4	0.396	0.0615
5	0.0561	26.300	26.3	1.7	0.414	0.0615
6	0.0677	27.300	27.3	2.2	0.430	0.0614
7	0.0724	27.500	27.5	2.4	0.433	0.0612
8	0.0825	28.300	28.3	2.8	0.446	0.0609
9	0.1031	29.000	29.0	3.6	0.457	0.0607
10	0.1252	29.500	29.5	4.6	0.465	0.0606
11	0.1436	30.000	30.0	5.3	0.473	0.0605
12	0.1712	30.100	30.1	6.5	0.474	0.0605
13	0.1973	29.700	29.7	7.6	0.468	0.0605
14	0.2230	29.600	29.6	8.6	0.466	0.0604
15	0.2510	29.500	29.5	9.8	0.465	0.0604
16	0.2830	29.500	29.5	11.1	0.465	0.0604
17	0.3324	29.400	29.4	13.2	0.463	0.0603
18	0.3780	29.400	29.4	15.0	0.463	0.0603



Sample No.		1
Initial	Water Content, %	52.1
	Dry Density, pcf	70.2
	Saturation, %	100.0
	Void Ratio	1.4127
	Diameter, in.	2.41
	Height, in.	1.00
At Test	Water Content, %	49.5
	Dry Density, pcf	72.3
	Saturation, %	100.0
	Void Ratio	1.3441
	Diameter, in.	2.41
	Height, in.	0.97
Normal Stress, tsf		2.000
Fail. Stress, tsf		0.600
Strain, %		2.1
Ult. Stress, tsf		0.400
Strain, %		15.0
Strain rate, in./min.		0.00

Sample Type: Thinwall, 5", Bottom of sample
Description: FAT CLAY, gray (CH)

LL= 81 PL= 20 PI= 61
Assumed Specific Gravity= 2.714

Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Figure Residual Direct Shear

Client: US Army Corps of Engineers

Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115

Location: SE-F-13, Fargo, Argusvill Formation

Sample Number: Boring 09-25MU, #5 **Depth:** 66-68'

Proj. No.: BL-09-03127 **Date Sampled:**

BRAUNSM
INTERTEC

DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-F-13, Fargo, Argusvill Formation
Depth: 66-68' **Sample Number:** Boring 09-25MU, #5
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Bottom of sample
Assumed Specific Gravity=2.714 **LL=**81 **PL=**20 **PI=**61

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	115.380		155.680
Moisture content: Dry soil+tare, gms.	86.100		114.290
Moisture content: Tare, gms.	29.850		30.720
Moisture, %	52.1	49.5	49.5
Moist specimen weight, gms.	127.4		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	1.00	0.97	
Net decrease in height, in.		0.03	
Wet Density, pcf	106.8	108.1	
Dry density, pcf	70.2	72.3	
Void ratio	1.4127	1.3441	
Saturation, %	100.0	100.0	

Test Readings for Specimen No. 1

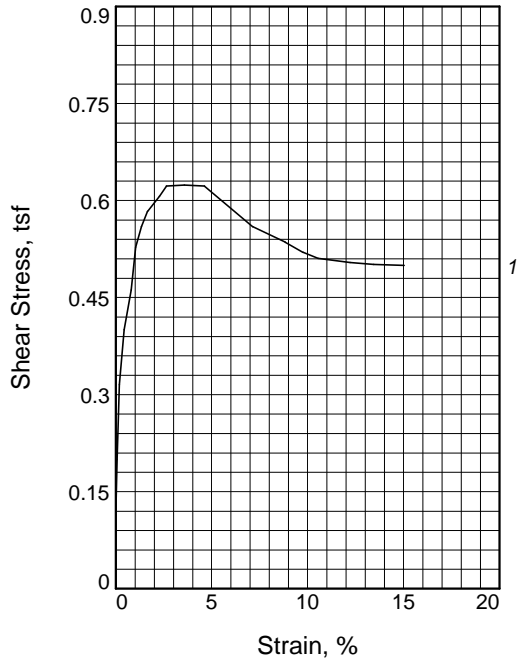
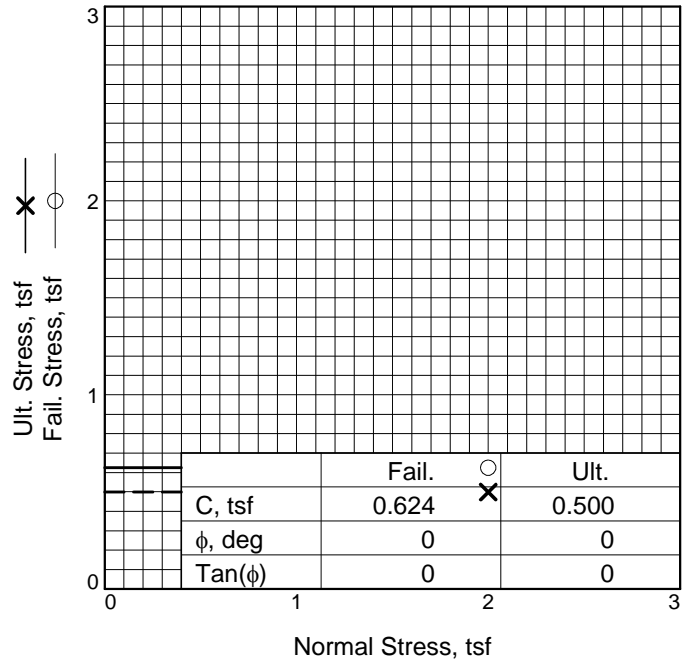
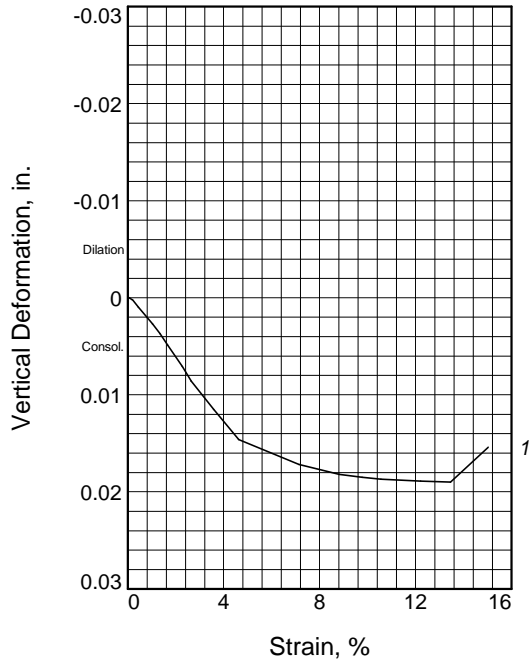
Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.600 tsf at reading no. 12
Ult. Stress = 0.400 tsf at reading no. 21

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0191	0.000	0.0	0.0	0.000	0.1045
1	0.0194	4.700	4.7	0.0	0.074	0.1044
2	0.0203	8.100	8.1	0.1	0.128	0.1041
3	0.0236	16.000	16.0	0.2	0.252	0.1033
4	0.0290	23.700	23.7	0.4	0.373	0.1024
5	0.0325	25.900	25.9	0.6	0.408	0.1020
6	0.0350	28.100	28.1	0.7	0.443	0.1017
7	0.0380	30.300	30.3	0.8	0.477	0.1013
8	0.0410	32.700	32.7	0.9	0.515	0.1009
9	0.0450	33.600	33.6	1.1	0.529	0.1003
10	0.0506	36.000	36.0	1.3	0.567	0.0995
11	0.0598	38.000	38.0	1.7	0.599	0.0983

Braun Intertec

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
12	0.0694	38.100	38.1	2.1	0.600	0.0970
13	0.0970	36.500	36.5	3.2	0.575	0.0943
14	0.1096	34.700	34.7	3.8	0.547	0.0936
15	0.1330	32.800	32.8	4.7	0.517	0.0929
16	0.1830	29.400	29.4	6.8	0.463	0.0925
17	0.2590	26.600	26.6	9.9	0.419	0.0920
18	0.3048	25.500	25.5	11.8	0.402	0.0916
19	0.3100	25.500	25.5	12.1	0.402	0.0914
20	0.3300	25.500	25.5	12.9	0.402	0.0913
21	0.3820	25.400	25.4	15.0	0.400	0.0912



Sample No.		1
Initial	Water Content, %	48.5
	Dry Density, pcf	72.6
	Saturation, %	97.6
	Void Ratio	1.3652
	Diameter, in.	2.41
	Height, in.	0.99
At Test	Water Content, %	47.0
	Dry Density, pcf	74.8
	Saturation, %	99.8
	Void Ratio	1.2937
	Diameter, in.	2.41
	Height, in.	0.96
Normal Stress, tsf	2.000	
Fail. Stress, tsf	0.624	
Strain, %	3.6	
Ult. Stress, tsf	0.500	
Strain, %	15.0	
Strain rate, in./min.	0.00	

Sample Type: Thinwall, 5", Middle of sample
Description: FAT CLAY, gray (CH)
LL= 79 **PL=** 21 **PI=** 58
Assumed Specific Gravity= 2.75
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
W912ES-09-P-0115
Location: SE-M-18, Moorhead, Argusville
Sample Number: Boring 09-34MU, # **Depth:** 56-58'
Proj. No.: BL-09-03127 **Date Sampled:**

Figure Residual Direct Shear



DIRECT SHEAR TEST

11/9/2009

Date:
Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
 W912ES-09-P-0115
Project No.: BL-09-03127
Location: SE-M-18, Moorhead, Argusville
Depth: 56-58' **Sample Number:** Boring 09-34MU, #4
Description: FAT CLAY, gray (CH)
Remarks: The rate of strain is 0.00096 in/min. The test specimen was precut before testing. ASTM D 3080.
Type of Sample: Thinwall, 5", Middle of sample
Assumed Specific Gravity=2.75 **LL=79** **PL=21** **PI=58**

Parameters for Specimen No. 1

Specimen Parameter	Initial	Consolidated	Final
Moisture content: Moist soil+tare, gms.	129.930		155.280
Moisture content: Dry soil+tare, gms.	97.340		115.650
Moisture content: Tare, gms.	30.100		31.260
Moisture, %	48.5	47.0	47.0
Moist specimen weight, gms.	128.2		
Diameter, in.	2.41	2.41	
Area, in. ²	4.57	4.57	
Height, in.	0.99	0.96	
Net decrease in height, in.		0.03	
Wet Density, pcf	107.8	110.0	
Dry density, pcf	72.6	74.8	
Void ratio	1.3652	1.2937	
Saturation, %	97.6	99.8	

Test Readings for Specimen No. 1

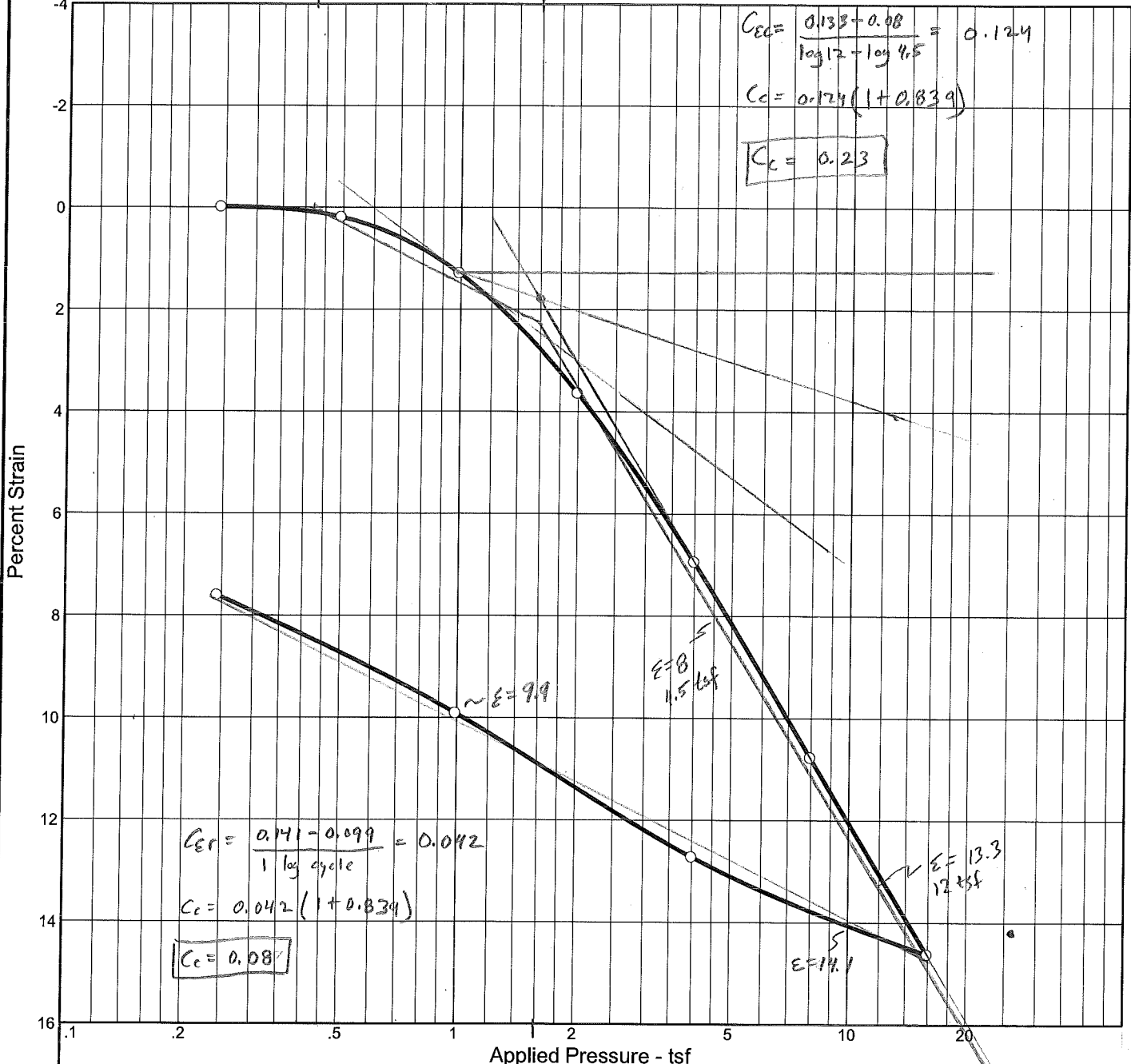
Normal stress = 2 tsf
Strain rate, in./min. = 0.00
Fail. Stress = 0.624 tsf at reading no. 12
Ult. Stress = 0.500 tsf at reading no. 20

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
0	0.0154	0.000	0.0	0.0	0.000	0.1405
1	0.0156	4.700	4.7	0.0	0.074	0.1405
2	0.0161	8.700	8.7	0.0	0.137	0.1405
3	0.0170	12.700	12.7	0.1	0.200	0.1405
4	0.0200	20.000	20.0	0.2	0.315	0.1403
5	0.0260	25.400	25.4	0.4	0.400	0.1395
6	0.0350	29.300	29.3	0.8	0.462	0.1384
7	0.0404	33.500	33.5	1.0	0.528	0.1378
8	0.0476	35.500	35.5	1.3	0.559	0.1368
9	0.0554	37.000	37.0	1.7	0.583	0.1356
10	0.0703	38.500	38.5	2.3	0.607	0.1334
11	0.0793	39.500	39.5	2.6	0.622	0.1319
12	0.1017	39.600	39.6	3.6	0.624	0.1290

Test Readings for Specimen No. 1

No.	Horizontal Def. Dial in.	Load Dial	Load lbs.	Strain %	Shear Stress tsf	Vertical Def. Dial in.
13	0.1270	39.500	39.5	4.6	0.622	0.1259
14	0.1876	35.500	35.5	7.1	0.559	0.1233
15	0.2282	34.000	34.0	8.8	0.536	0.1223
16	0.2510	33.000	33.0	9.8	0.520	0.1220
17	0.2700	32.400	32.4	10.6	0.511	0.1218
18	0.3100	32.000	32.0	12.2	0.504	0.1216
19	0.3400	31.800	31.8	13.5	0.501	0.1215
20	0.3780	31.700	31.7	15.0	0.500	0.1251

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e _o
Sat.	Moist.											
95.9 %	29.7 %	92.1	75	57	2.712		1.40	0.24	0.07			0.839

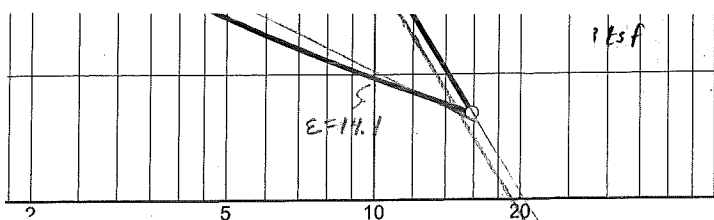
MATERIAL DESCRIPTION										USCS	AASHTO
20 Boring 09-27MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435										CH	

Project No. BL-09-03127 **Client:** US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Location: SE-F-19, Fargo, Alluvium Formation, #1, 6-8'

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Remarks:
Fargo
09-27MU, #1, 6' - 8'
Alluvium

Figure

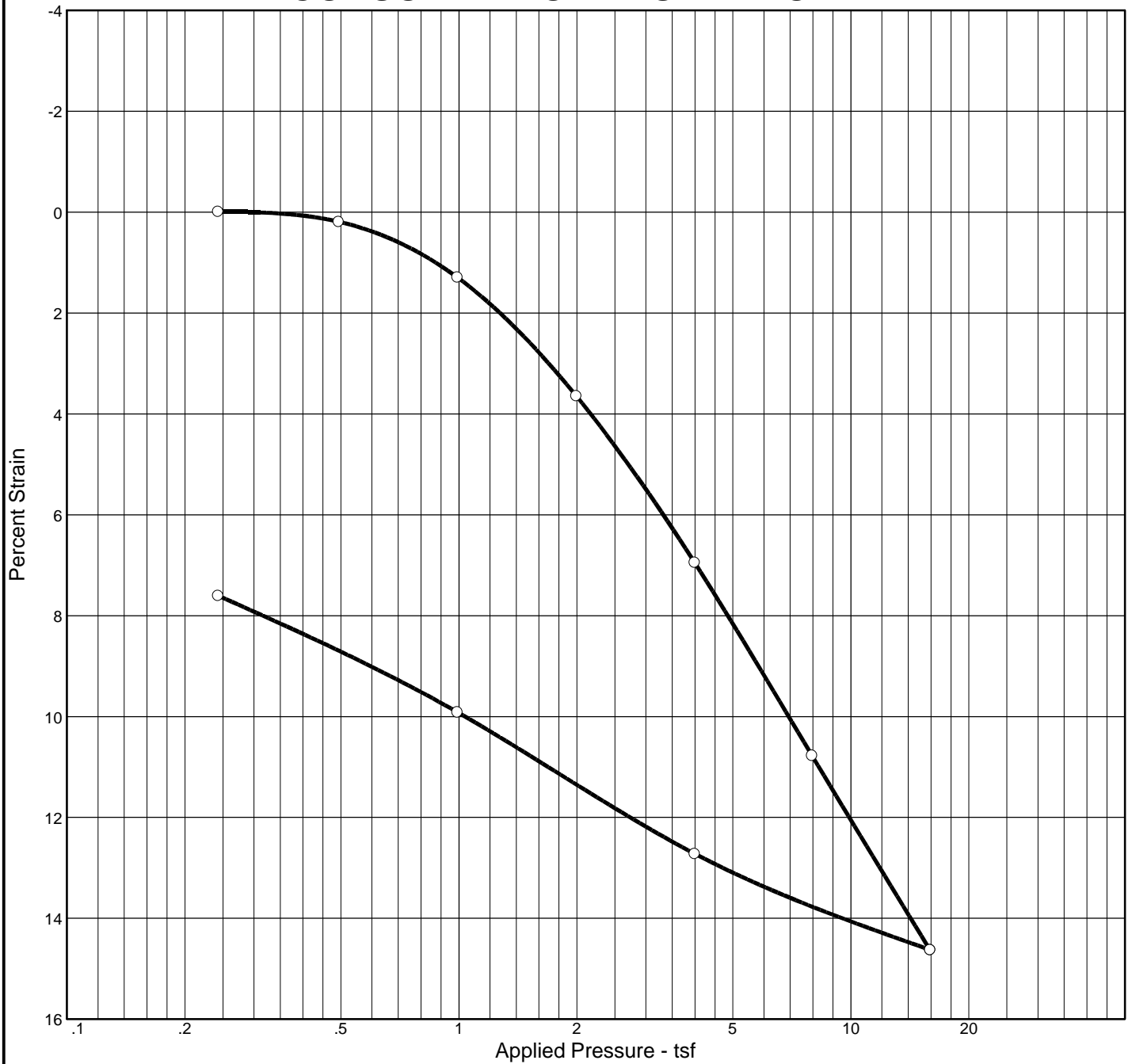


COMPUTED BY:	DATE:	SHEET:
CHECKED BY:	DATE:	CONTRACT NO.:

Pressure - tsf						
den	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
	1.40	0.24	0.07			0.839
N				USCS	AASHTO	
own (CH), ASTM D2435				CH		
ineer			Remarks:			
			Figure			

$0.4e_0 \Rightarrow 27.4$
 27
 28

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
95.9 %	29.7 %	92.1	75	57	2.712		1.40	0.24	0.07			0.839

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-27MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-F-19, Fargo, Alluvium Formation, #1, 6-8'</p> <p style="text-align: center;">BRAUN INTERTEC</p>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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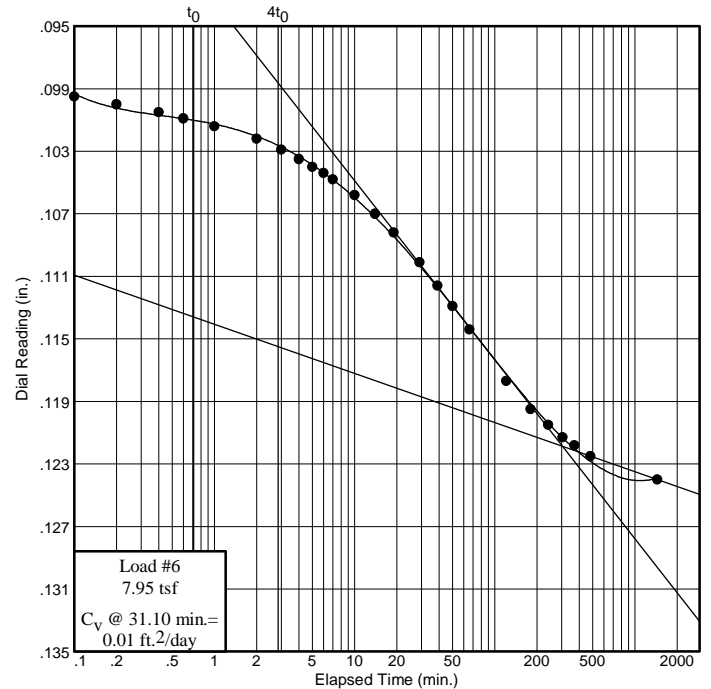
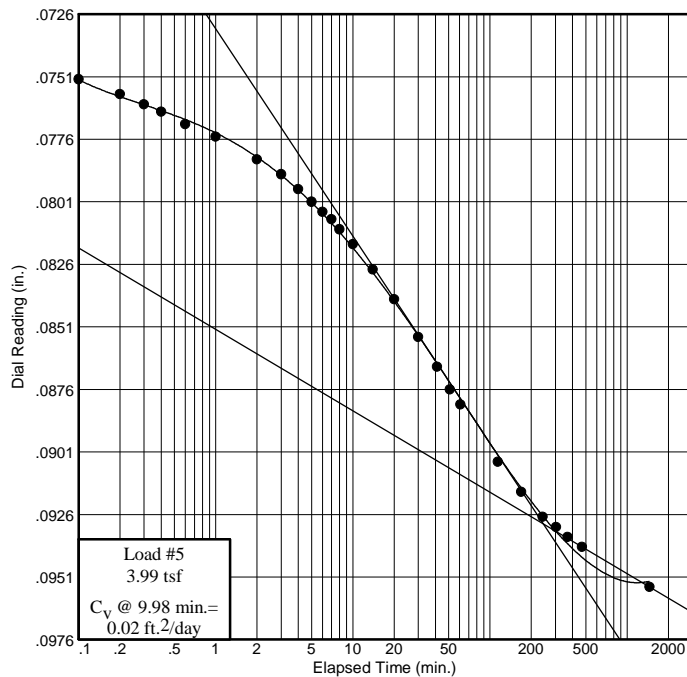
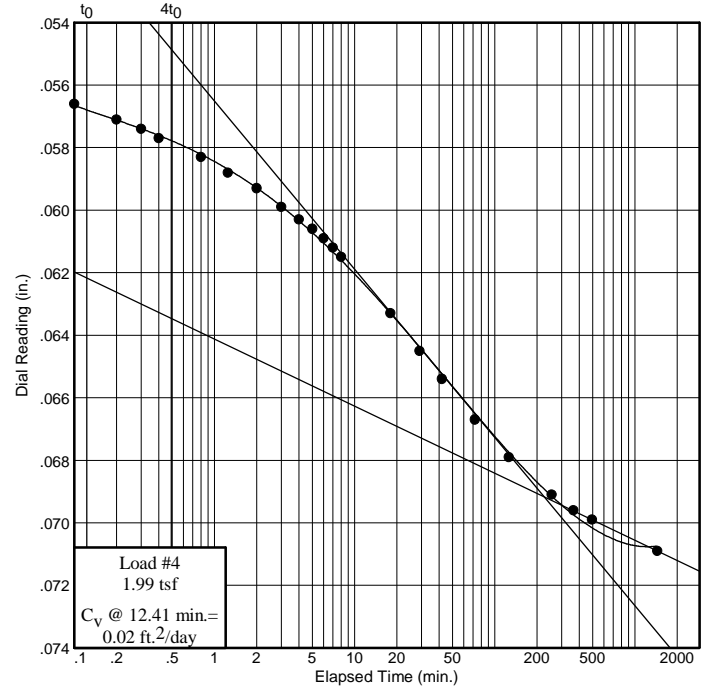
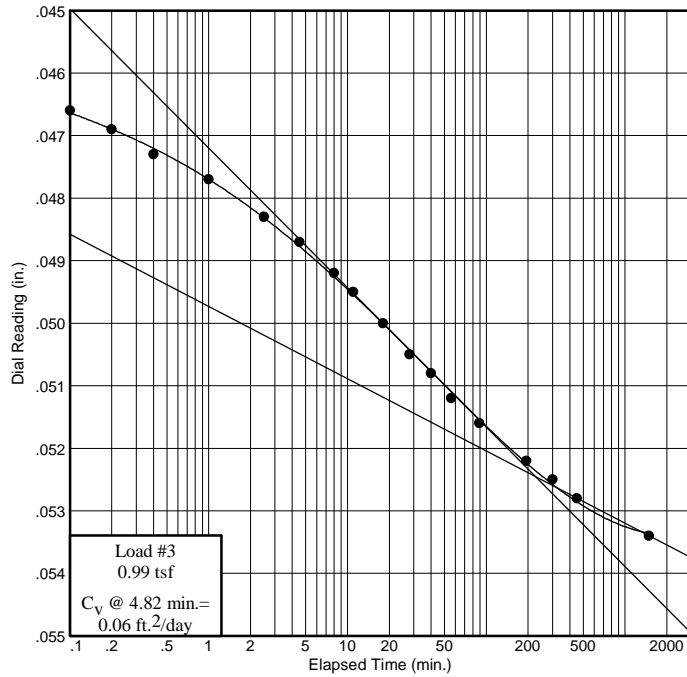
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-19, Fargo, Alluvium Formation, #1, 6-8'



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INTERTEC

Figure

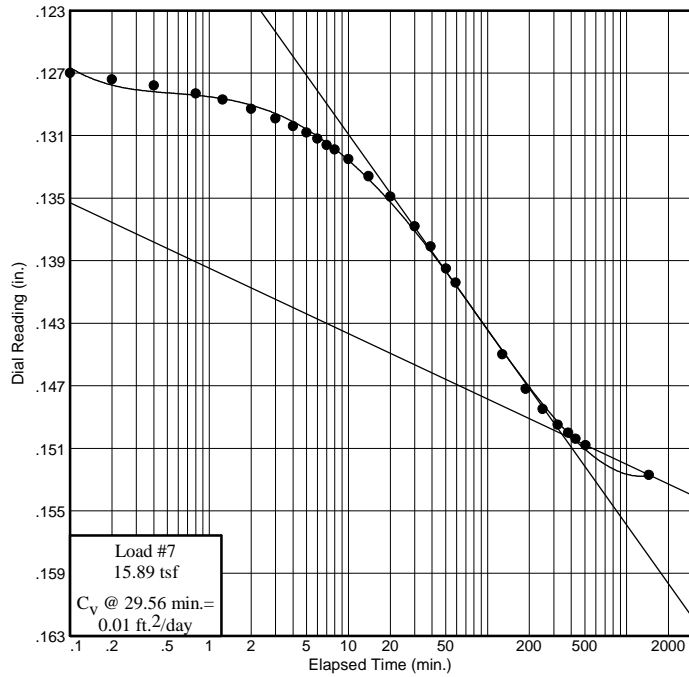
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-19, Fargo, Alluvium Formation, #1, 6-8'



BRAUN[™]
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #1
Elev. or Depth: 6-8' **Sample Length(in./cm.):**
Location: SE-F-19, Fargo, Alluvium Formation, #1, 6-8'
Description: Boring 09-27MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435
Liquid Limit: 75 **Plasticity Index:** 57
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 122.62 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 101.45 g.		Dry w+t =
Tare Wt. = 30.11 g.	Spec. Gravity = 2.712	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 114.37 g.	Defl. Table = #3-2008	
Moisture = 29.7 %	Ht. Solids = 0.4049 in.	Moisture = %
Wet Den. = 119.4 pcf	Dry Wt. = 88.20 g.*	Dry Wt. = n/a
Dry Den. = 92.1 pcf	Void Ratio = 0.839	Void Ratio = 0.699
	Saturation = 95.9 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression /Swell
start	0.04380				0.839	
0.24	0.04400	0.00030			0.839	0.0 Swell
0.49	0.04570	0.00050			0.836	0.2 Compr.
0.99	0.05410	0.00070	0.06	0.002	0.815	1.3 Compr.
1.99	0.07190	0.00100	0.02	0.003	0.772	3.6 Compr.
3.99	0.09700	0.00150	0.02	0.005	0.711	6.9 Compr.
7.95	0.12600	0.00200	0.01	0.005	0.641	10.8 Compr.
15.89	0.15560	0.00290	0.01	0.006	0.570	14.6 Compr.
3.99	0.14000	0.00150			0.605	12.7 Compr.
0.99	0.11830	0.00070			0.657	9.9 Compr.
0.24	0.10070	0.00030			0.699	7.6 Compr.

$C_c = 0.24$ $P_c = 1.40$ tsf $C_r = 0.07$

Pressure: 0.49 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.04400
2	1.00	0.04430
3	5.00	0.04460
4	24.00	0.04490
5	66.00	0.04520
6	301.00	0.04550
7	1392.00	0.04570

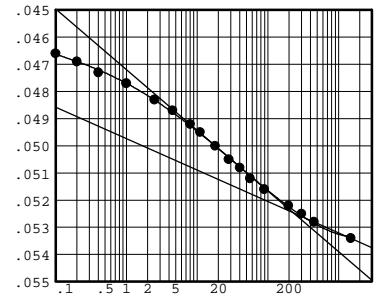
Void Ratio = 0.836 Compression = 0.2 %

Pressure: 0.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.04570	11	28.00	0.05120
2	0.10	0.04730	12	40.00	0.05150
3	0.20	0.04760	13	56.00	0.05190
4	0.40	0.04800	14	89.00	0.05230
5	1.00	0.04840	15	195.00	0.05290
6	2.50	0.04900	16	301.00	0.05320
7	4.50	0.04940	17	450.00	0.05350
8	8.00	0.04990	18	1487.00	0.05410
9	11.00	0.05020			
10	18.00	0.05070			



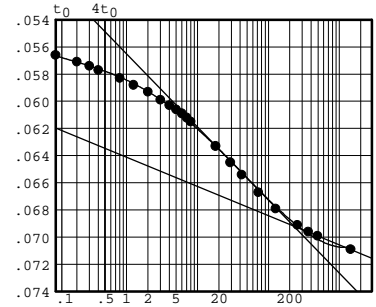
Void Ratio = 0.815 Compression = 1.3 %
 $D_0 = 0.04520$ $D_{50} = 0.04883$ $D_{100} = 0.05246$
 C_v at 4.8 min. = 0.06 ft.²/day $C_\alpha = 0.002$

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.05410	13	7.00	0.06220
2	0.10	0.05760	14	8.00	0.06250
3	0.20	0.05810	15	18.00	0.06430
4	0.30	0.05840	16	29.00	0.06550
5	0.40	0.05870	17	42.00	0.06640
6	0.80	0.05930	18	72.00	0.06770
7	1.25	0.05980	19	126.00	0.06890
8	2.00	0.06030	20	255.00	0.07010
9	3.00	0.06090	21	364.00	0.07060
10	4.00	0.06130	22	492.50	0.07090
11	5.00	0.06160	23	1440.00	0.07190
12	6.00	0.06190			



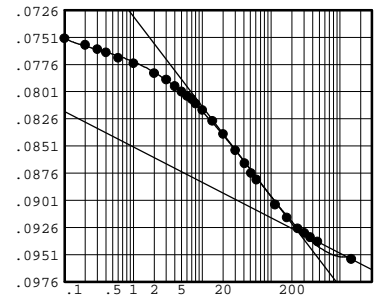
Void Ratio = 0.772 Compression = 3.6 %
 $D_0 = 0.05581$ $D_{50} = 0.06249$ $D_{100} = 0.06917$
 C_v at 12.4 min. = 0.02 ft.²/day $C_\alpha = 0.003$

Pressure: 3.99 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07190	15	10.00	0.08330
2	0.10	0.07670	16	14.00	0.08430
3	0.20	0.07730	17	20.00	0.08550
4	0.30	0.07770	18	30.00	0.08700
5	0.40	0.07800	19	41.20	0.08820
6	0.60	0.07850	20	51.00	0.08910
7	1.00	0.07900	21	61.00	0.08970
8	2.00	0.07990	22	114.00	0.09200
9	3.00	0.08050	23	169.00	0.09320
10	4.00	0.08110	24	243.00	0.09420
11	5.00	0.08160	25	303.00	0.09460
12	6.00	0.08200	26	369.00	0.09500
13	7.00	0.08230	27	469.00	0.09540
14	8.00	0.08270	28	1455.00	0.09700



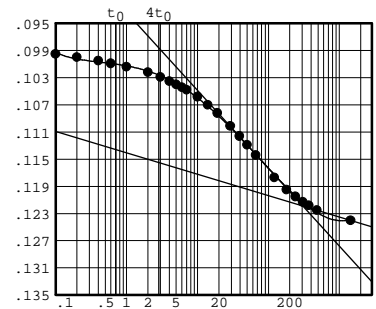
Void Ratio = 0.711 Compression = 6.9 %
 $D_0 = 0.07090$ $D_{50} = 0.08194$ $D_{100} = 0.09298$
 C_v at 10.0 min. = 0.02 ft.²/day $C_\alpha = 0.005$

Pressure: 7.95 tsf

TEST READINGS

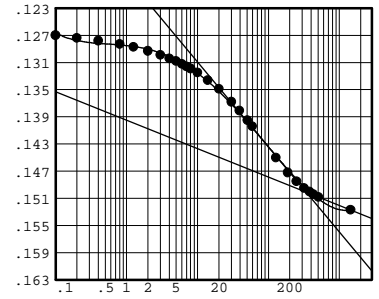
Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09700	14	14.00	0.10900
2	0.10	0.10150	15	19.00	0.11020
3	0.20	0.10200	16	29.00	0.11210
4	0.40	0.10250	17	39.00	0.11360
5	0.60	0.10290	18	50.00	0.11490
6	1.00	0.10340	19	66.00	0.11640
7	2.00	0.10420	20	121.00	0.11970
8	3.00	0.10490	21	180.00	0.12150
9	4.00	0.10550	22	240.00	0.12250
10	5.00	0.10600	23	304.00	0.12330
11	6.00	0.10640	24	369.00	0.12380
12	7.00	0.10680	25	480.00	0.12450
13	10.00	0.10780	26	1440.00	0.12600



Void Ratio = 0.641 Compression = 10.8 %
 $D_0 = 0.09940$ $D_{50} = 0.11064$ $D_{100} = 0.12187$
 C_v at 31.1 min. = 0.01 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12600	15	14.00	0.13650
2	0.10	0.12990	16	20.00	0.13780
3	0.20	0.13030	17	30.00	0.13970
4	0.40	0.13070	18	39.00	0.14100
5	0.80	0.13120	19	50.50	0.14240
6	1.25	0.13160	20	59.00	0.14330
7	2.00	0.13220	21	128.00	0.14790
8	3.00	0.13280	22	188.00	0.15010
9	4.00	0.13330	23	249.00	0.15140
10	5.00	0.13370	24	319.00	0.15240
11	6.00	0.13410	25	380.00	0.15290
12	7.00	0.13450	26	431.00	0.15330
13	8.00	0.13480	27	507.00	0.15370
14	10.00	0.13540	28	1442.00	0.15560



Void Ratio = 0.570 Compression = 14.6 %
 $D_0 = 0.12400$ $D_{50} = 0.13704$ $D_{100} = 0.15008$
 C_v at 29.6 min. = 0.01 ft.²/day $C_\alpha = 0.006$

Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

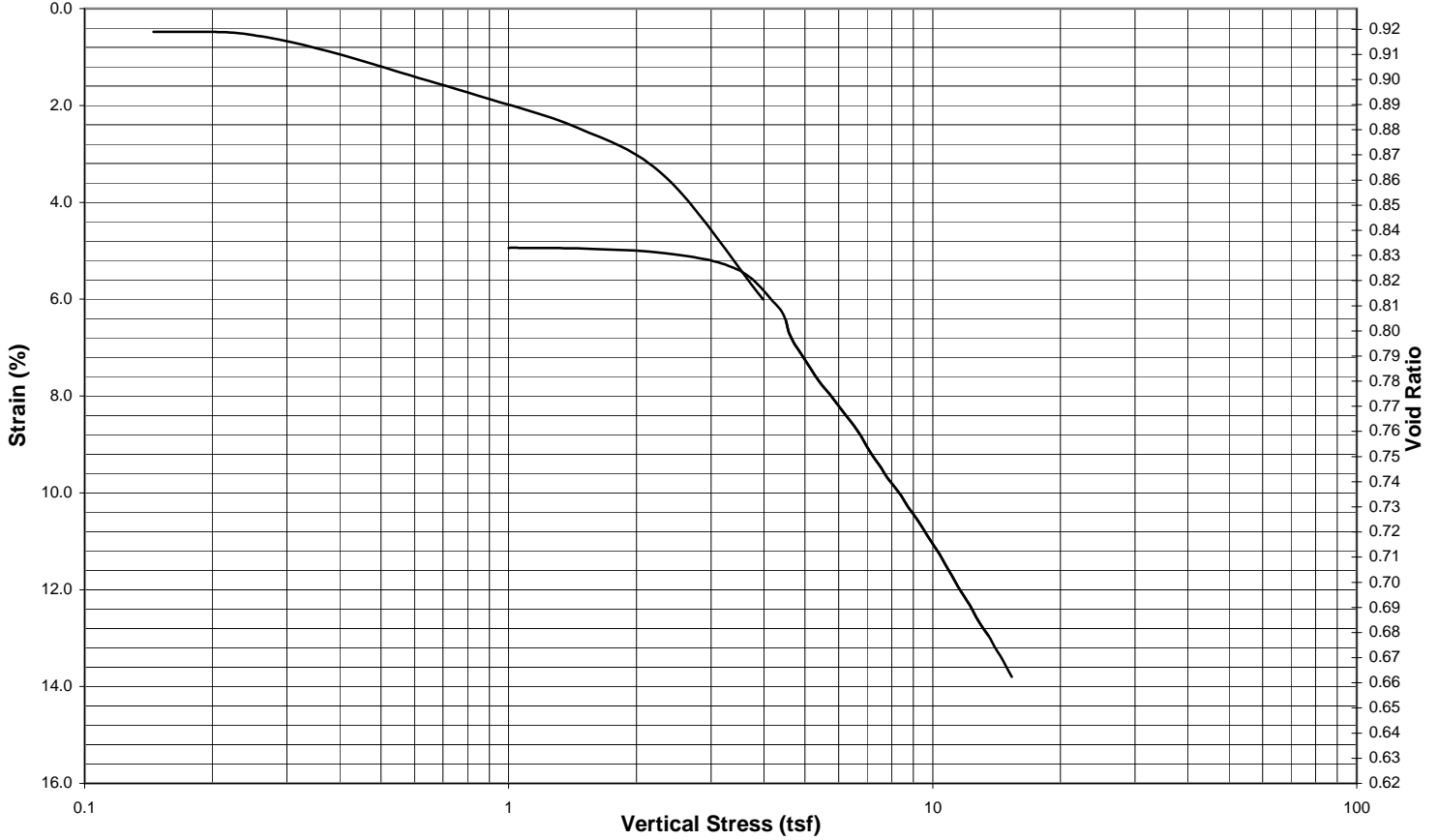
Project: FARGOMOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

Boring: FAR 10-78MU Sample: 1 Depth: 13-15 Type: 5T
 Soil Type: Fat Clay w/a few laminations of silt (CH) Alluvium

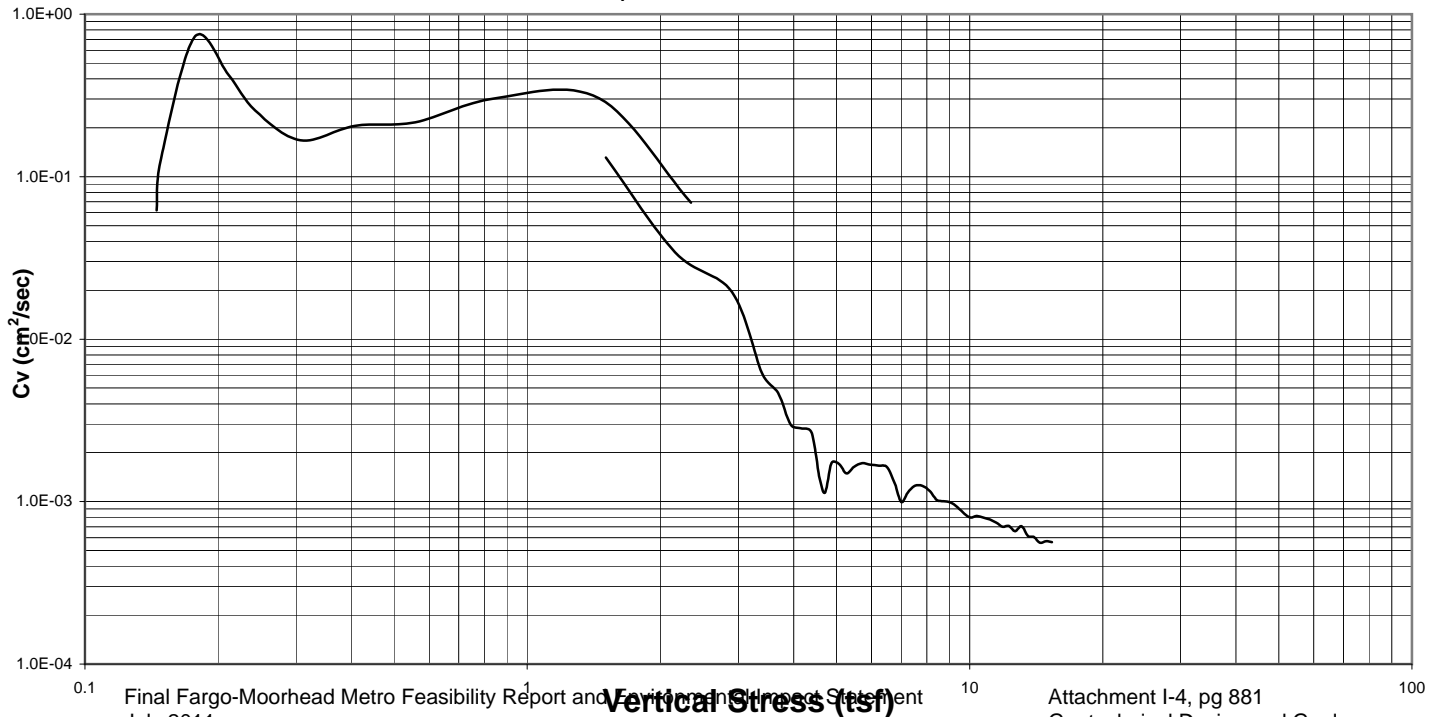
Initial Conditions: Dry Density (pcf): 89.5 Moisture Content (%): 29.8% e_o 0.926

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	3.0 tsf	Cc	0.28	Cr	0.03
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/27/10

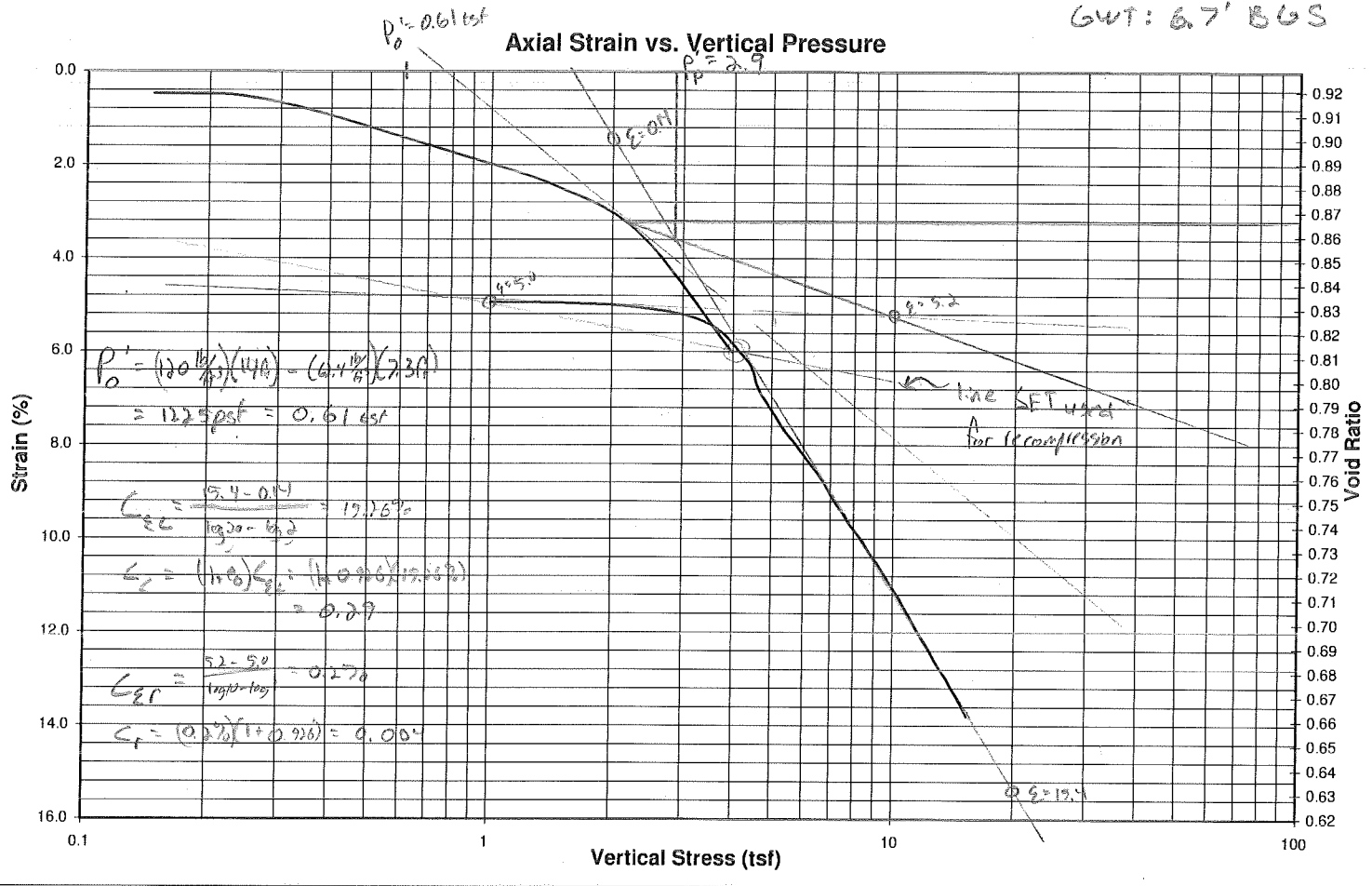
Job: 7577

Project: FARGOMOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

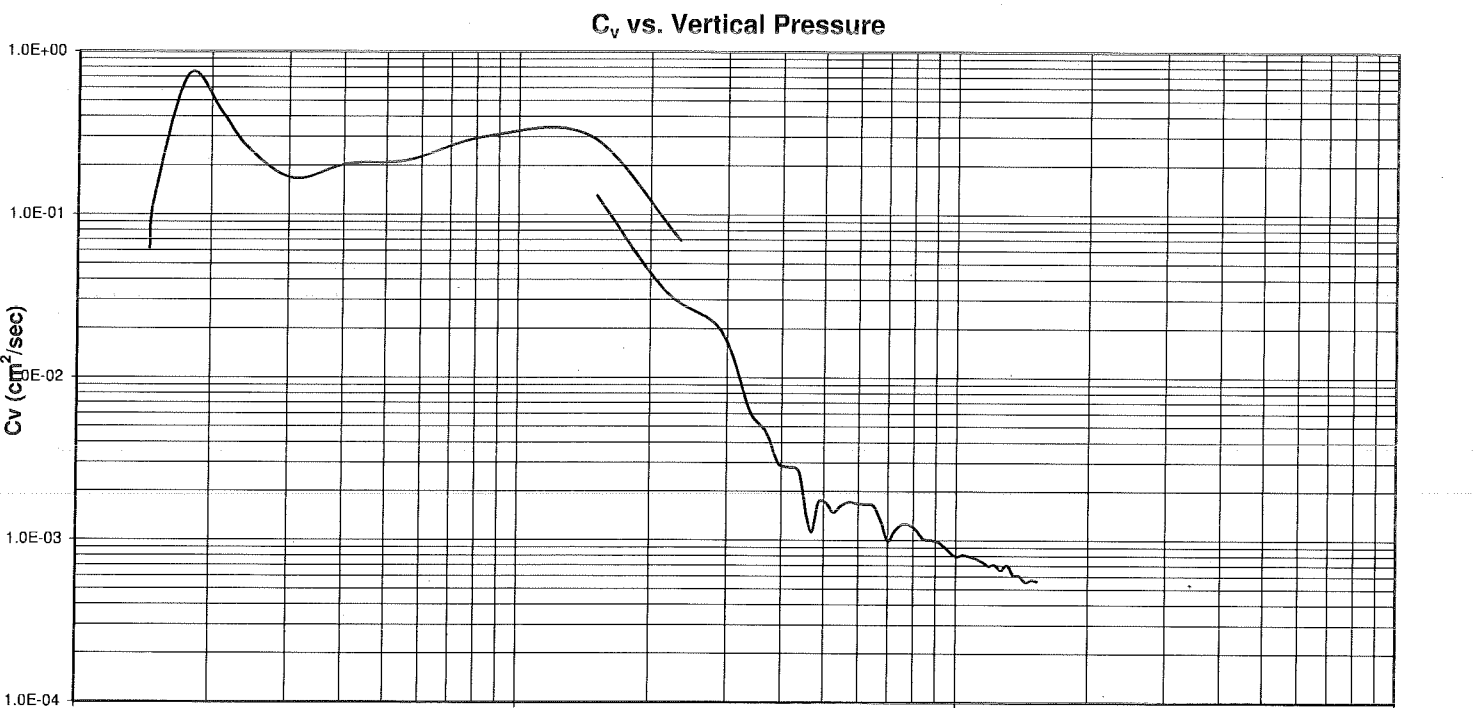
Specimen Information

Boring: FAR 10-78MU Sample: 1 Depth: 13-15 Type: 5T
 Soil Type: Fat Clay w/a few laminations of silt (CH) Alluvium

Initial Conditions: Dry Density (pcf): 89.5 Moisture Content (%): 29.8% e_0 0.926



Calculated Consolidation Coefficients	Pc	3.0 tsf	Cc	0.28 ✓	Cr	0.03
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Constant Rate of Strain Data Table

Project: OORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL
 Boring: 10-78MU Sample 1 Depth: 13-15

Date: 10/27/10
 Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.48%	0.177	0.002	0.011	0.175	7.20E-01	8.18E-07	0.917
1.79%	0.847	0.007	0.008	0.842	3.04E-01	4.18E-06	0.892
2.46%	1.454	0.014	0.010	1.444	3.04E-01	3.06E-06	0.879
3.48%	2.345	0.070	0.030	2.298	6.91E-02	9.01E-07	0.859
6.00%	3.979	0.612	0.154	3.560			0.811
4.94%	0.999	-0.048	-0.048	1.031			0.831
5.02%	2.159	0.110	0.051	2.085	3.42E-02	4.83E-08	0.830
5.35%	3.396	0.228	0.067	3.242	6.16E-03	3.38E-08	0.823
5.54%	3.690	0.284	0.077	3.498	4.67E-03	3.52E-08	0.820
5.77%	3.939	0.323	0.082	3.721	2.98E-03	3.60E-08	0.815
6.43%	4.500	0.414	0.092	4.219	1.91E-03	2.14E-08	0.802
6.69%	4.579	0.454	0.099	4.271	1.39E-03	3.20E-08	0.797
7.57%	5.271	0.557	0.106	4.893	1.49E-03	1.99E-08	0.780
8.39%	6.230	0.695	0.112	5.758	1.66E-03	1.35E-08	0.765
9.25%	7.238	0.934	0.129	6.601	1.13E-03	8.05E-09	0.748
9.87%	8.126	1.082	0.133	7.388	1.16E-03	5.13E-09	0.736
10.67%	9.389	1.425	0.152	8.414	9.24E-04	6.37E-09	0.721
11.27%	10.382	1.666	0.160	9.239	8.16E-04	5.54E-09	0.709
12.15%	11.871	2.065	0.174	10.452	6.98E-04	2.99E-09	0.692
12.79%	13.112	2.424	0.185	11.441	7.06E-04	2.35E-09	0.680
13.58%	14.886	2.957	0.199	12.843	5.70E-04	3.42E-09	0.665
13.80%	15.362	3.081	0.201	13.232	5.63E-04	2.04E-09	0.660

Constant Rate of Strain Consolidation Test

Date: 10/26/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

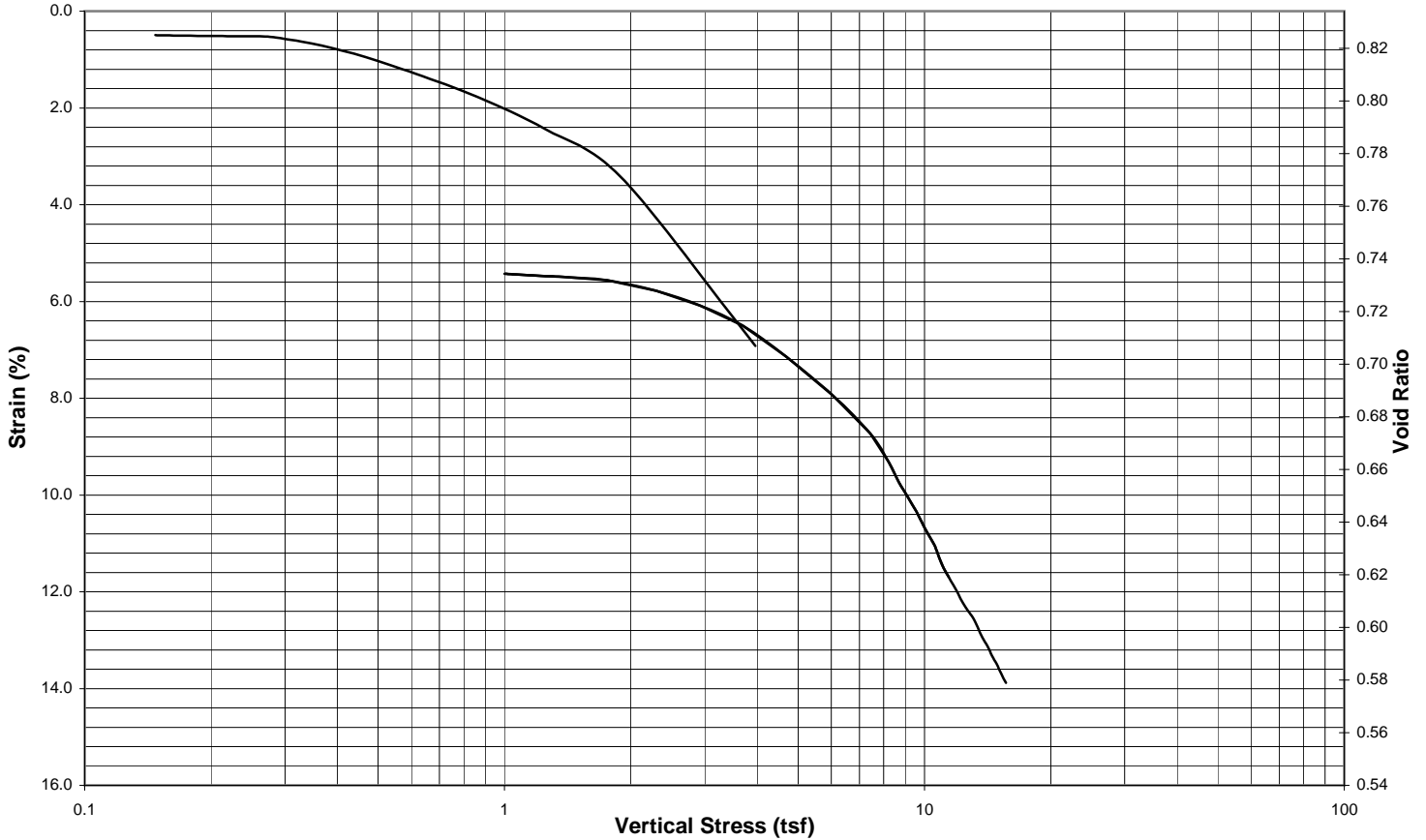
Specimen Information

Boring: FAR 10-79MU Sample: 1 Depth: 20-22 (Top) Type: 5T

Soil Type: Fat Clay w/a few laminations of silt (CH) Alluvium

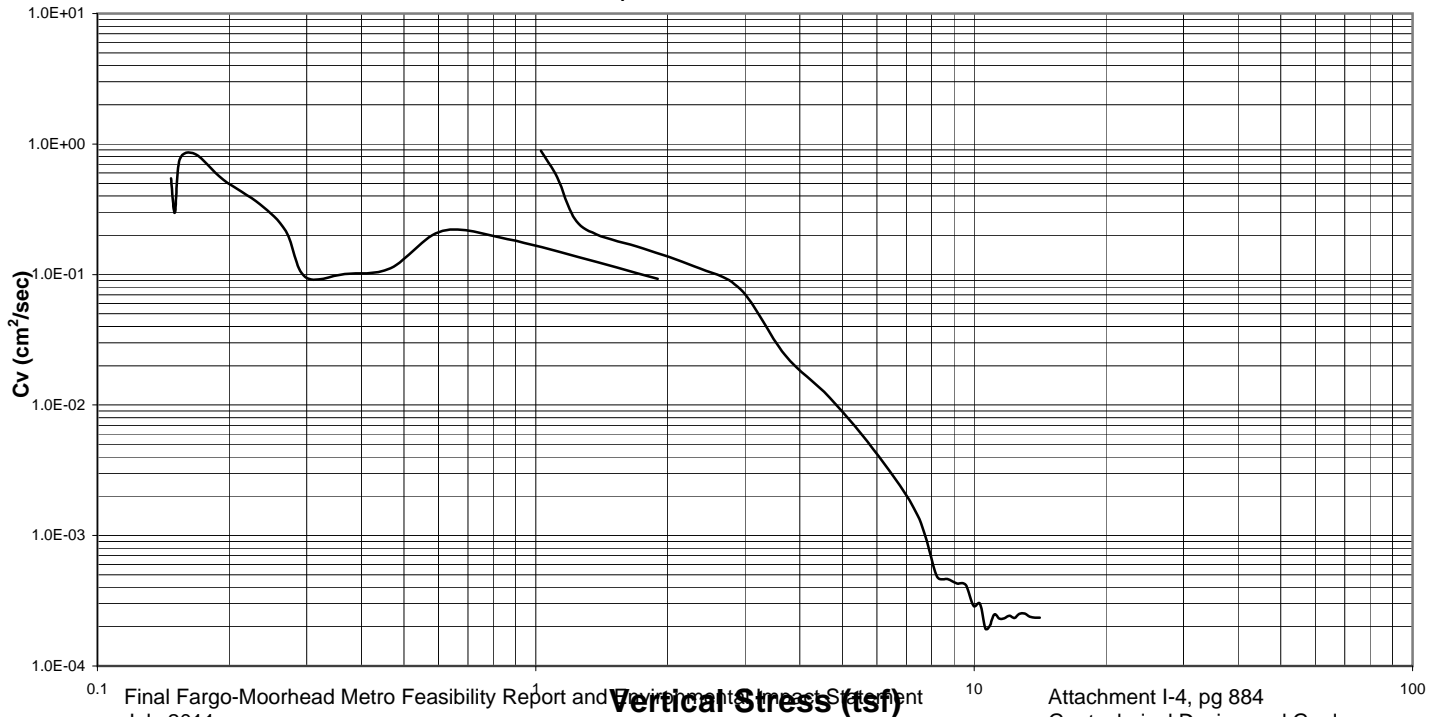
Initial Conditions: Dry Density (pcf): 91.7 Moisture Content (%): 30.3% e_o 0.839

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	4.0 tsf	Cc	0.31	Cr	0.05
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/26/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

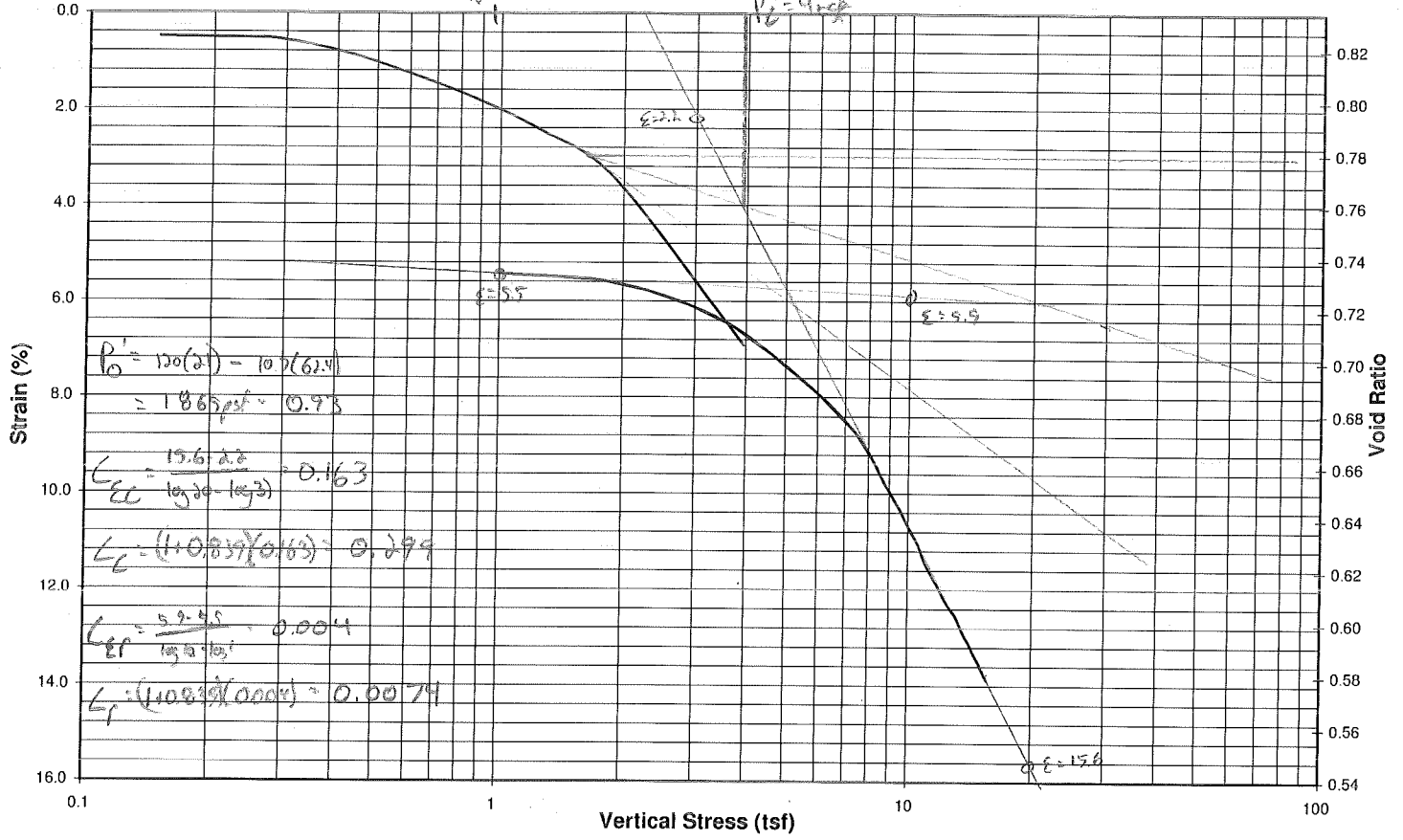
Boring: FAR 10-79MU Sample: 1 Depth: 20-22 (Top) Type: 5T

Soil Type: Fat Clay w/a few laminations of silt (CH) Alluvium

Initial Conditions: Dry Density (pcf): 91.7 Moisture Content (%): 30.3% e_0 0.839

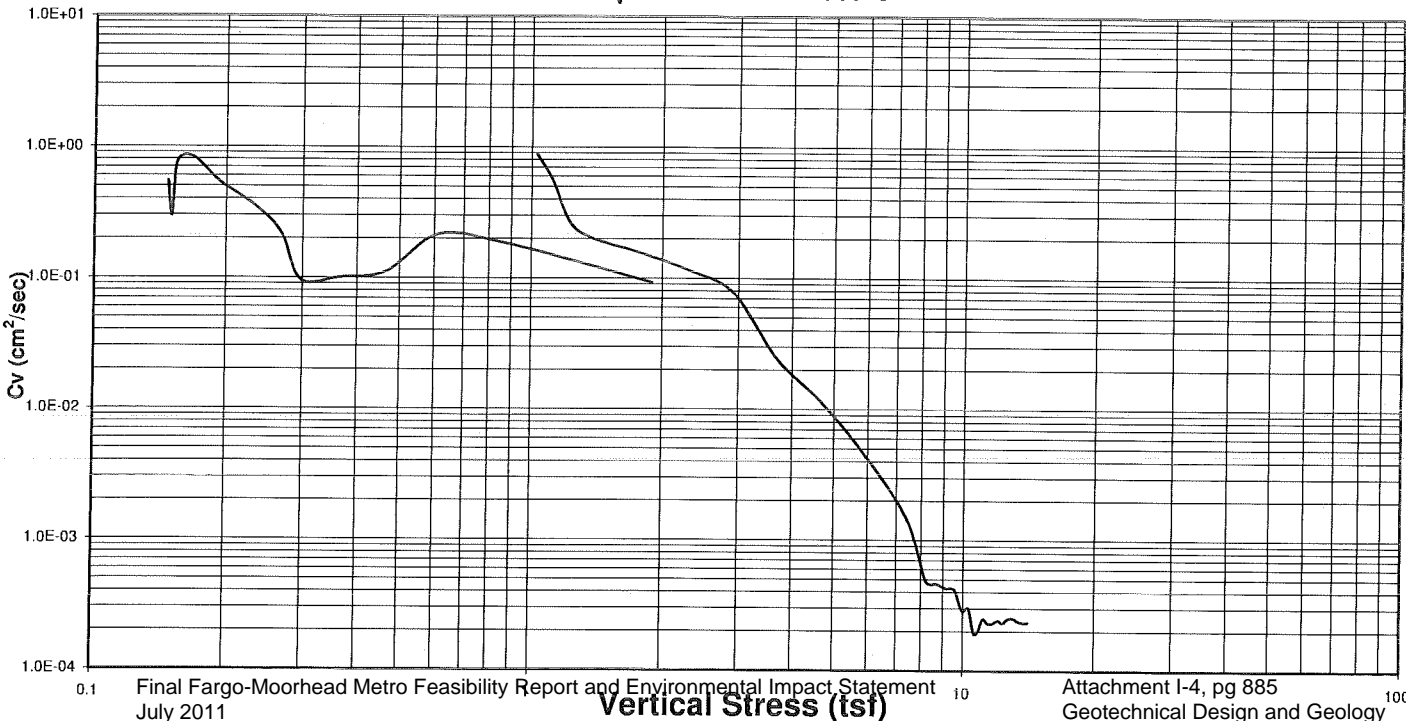
$P_0 = 0.93 \text{ tsf}$ $GWT = 10.7' BGS$

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	4.0 tsf	Cc	0.31	Cr	0.05
---------------------------------------	----	---------	----	------	----	------

C_v vs. Vertical Pressure



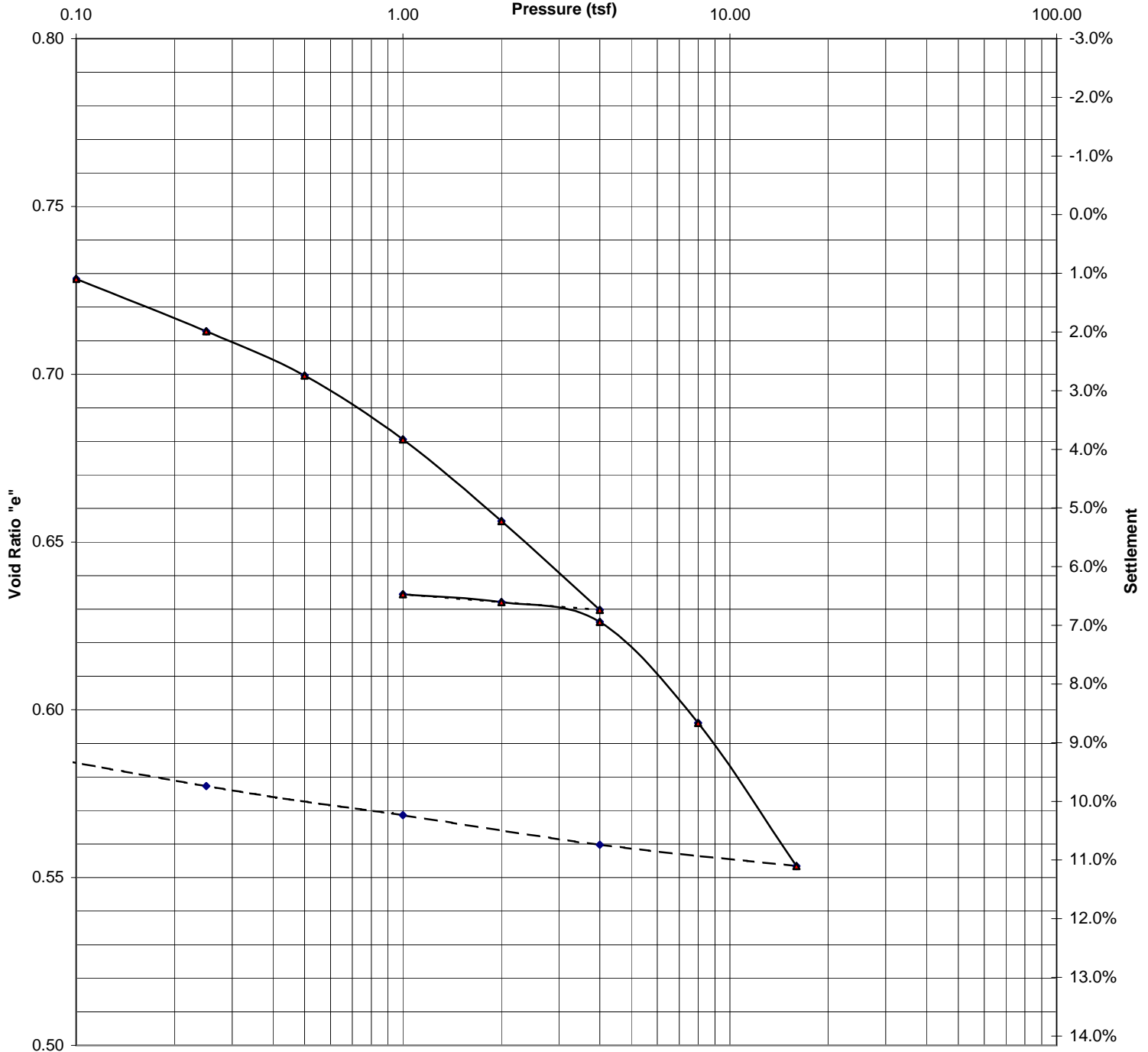
Constant Rate of Strain Data Table

Project: IOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL
 Boring: 10-79MU Sample 1 Depth: 20-22 (Top)

Date: 10/26/10
 Job: 7577

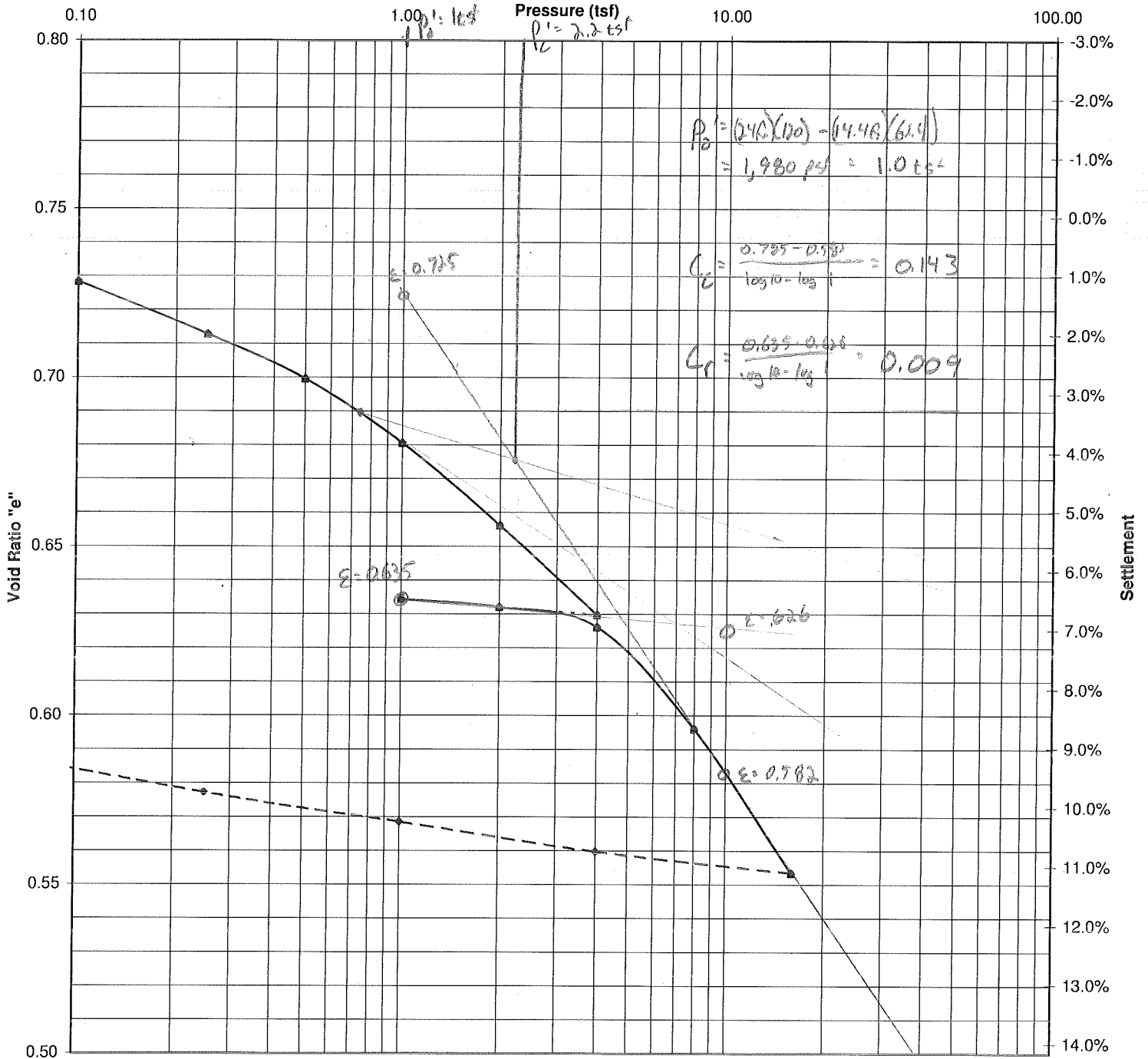
Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.51%	0.167	0.002	0.012	0.166	8.40E-01	3.96E-06	0.829
1.29%	0.614	0.003	0.006	0.611	2.16E-01	4.86E-06	0.815
1.77%	0.861	0.006	0.007	0.857	1.87E-01	3.35E-06	0.806
2.44%	1.251	0.013	0.010	1.242	1.36E-01	2.36E-06	0.794
3.44%	1.898	0.032	0.017	1.876	9.25E-02	1.38E-06	0.775
5.43%	1.028	0.001	0.001	1.027	8.88E-01	1.05E-07	0.739
5.78%	2.298	0.017	0.007	2.287	1.15E-01	6.60E-07	0.732
6.09%	2.927	0.031	0.010	2.906	7.73E-02	3.34E-07	0.727
6.50%	3.696	0.117	0.032	3.618	2.43E-02	1.58E-07	0.719
7.14%	4.690	0.327	0.070	4.469	1.13E-02	7.60E-08	0.707
7.95%	6.058	1.179	0.195	5.244	4.03E-03	2.24E-08	0.692
8.73%	7.429	2.194	0.295	5.883	1.43E-03	8.78E-09	0.678
9.33%	8.230	2.518	0.306	6.452	4.83E-04	5.57E-09	0.667
9.73%	8.683	2.590	0.298	6.857	4.64E-04	3.20E-09	0.660
10.34%	9.571	2.851	0.298	7.561	4.18E-04	2.71E-09	0.649
11.06%	10.600	3.152	0.297	8.378	1.94E-04	1.88E-09	0.635
11.86%	11.719	3.325	0.284	9.382	2.32E-04	1.36E-09	0.621
12.39%	12.684	3.551	0.280	10.190	2.51E-04	1.16E-09	0.611
13.12%	14.125	3.952	0.280	11.350	2.35E-04	1.42E-09	0.597
13.70%	15.246	4.255	0.279	12.258	2.24E-04	1.51E-09	0.587
13.88%	15.632	4.362	0.279	12.569	2.18E-04	6.89E-10	0.583

Void Ratio and % Settlement vs. Log of Pressure



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING						Date: 10/26/10	
Sample #: 1		Boring #: 10-80MU FAR		Depth ft: 23-25		Job #: 7577	
Soil Type: Sandy Lean Clay w/lenses and pockets of Silty Sand (CL & SM) Alluvium							
Initial W/C (%): 28.7		Dry Density (pcf): 95.3		LL: 28.2	PL: 17.1	PI: 11.1	Gs: 2.67
Organic Content (%):		Initial Height (in.): 0.746		Diameter (in.): 2.507		e _o = 0.748	
Preconsolidation Pressure (Pc): 2.0 tsf		Compression Index (Cc): 0.14		Recompression Index (Cr): 0.015			
Remarks:							

Void Ratio and % Settlement vs. Log of Pressure



Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING						Date: 10/26/10
Sample #: 1	Boring #: 10-80MU	FAR	Depth ft: 23-25	Job #: 7577		
Soil Type: Sandy Lean Clay w/lenses and pockets of Silty Sand (CL & SM)				Aluminum		
Initial W/C (%): 28.7	Dry Density (pcf): 95.3	LL: 28.2	PL: 17.1	PI: 11.1	Gs: 2.67	
Organic Content (%):	Initial Height (in.): 0.746	Diameter (in.): 2.507	e ₀ = 0.748			
Preconsolidation Pressure (Pc): 2.0 tsf	Compression Index (Cc): 0.14	Recompression Index (Cr): 0.015				

Remarks: **GWT = 9.6' BGS**

Hydraulic Conductivity Test Data

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING Date: 10/4/2010

Reported To: USACE -Geotech. & Geology Section Job No.: 7577

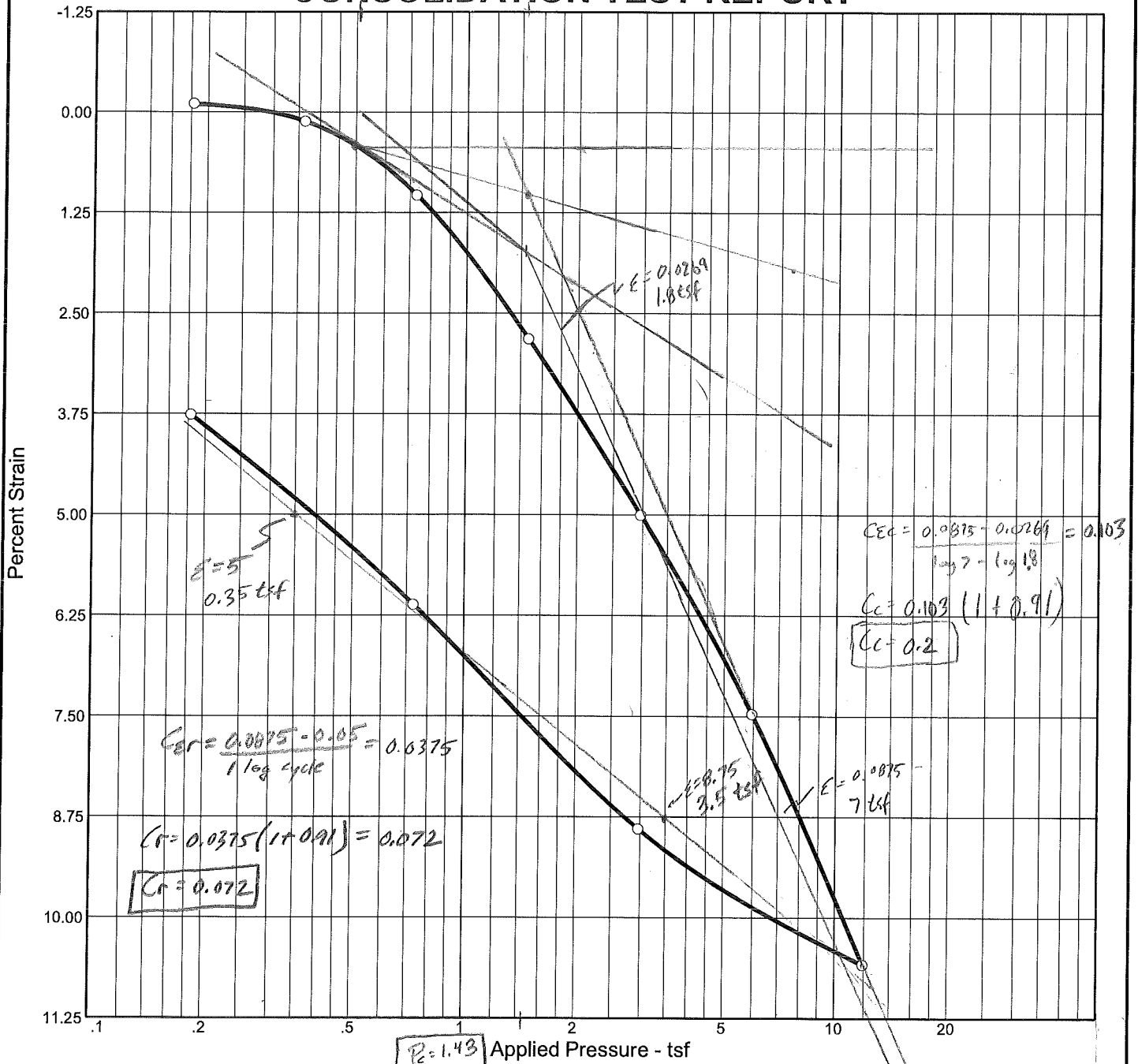
Boring No.:	10-80MU						
Sample No.:	1						
Depth (ft)	23-25 Bottom						
Location:	ND Sheyenne						
Sample Type:	5" Tube						
Soil Type:	Sandy Lean Clay with a few pockets of silty sand (CL)						
Atterberg Limits							
LL	28.2						
PL	17.1						
PI	11.1						
Permeability Test	Undisturbed						
Before Test Conditions:	Saturation %:						
	Porosity:						
	Ht. (in):	3.17					
	Dia. (in):	4.02					
	Dry Density (pcf):	87.2					
	Water Content:	34.9%					
Test Type:	Falling						
Max Head (ft):	5.0						
Confining press. (Effective-psi):	2.0						
Trial No.:	16-20						
Water Temp °C:	20.0						
% Compaction							
% Saturation (After Test)	95.7%						

Coefficient of Permeability

K @ 20 °C (cm/sec)	1.6 x 10⁻⁷						
K @ 20 °C (ft/min)	3.2 x 10⁻⁷						

Notes:

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
Sat.	Moist.											
97.5 %	32.4 %	89.5	67	50	2.738		1.52	0.20	0.07			0.910

MATERIAL DESCRIPTION										USCS	AASHTO
Boring 09-26MU, Bottom of sample, FAT CLAY with silt layers, brown (CH), ASTM D2435										CH	

Project No. BL-09-03127 Client: US Army Corps of Engineer Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115 Location: SE-F-15, Fargo, Sherack Formation, #1, 8'-10' <div style="text-align: center;">BRAUN INTERTEC</div>	Remarks: Fargo 09-26MU, #1, 8' - 10' Sherack
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Figure

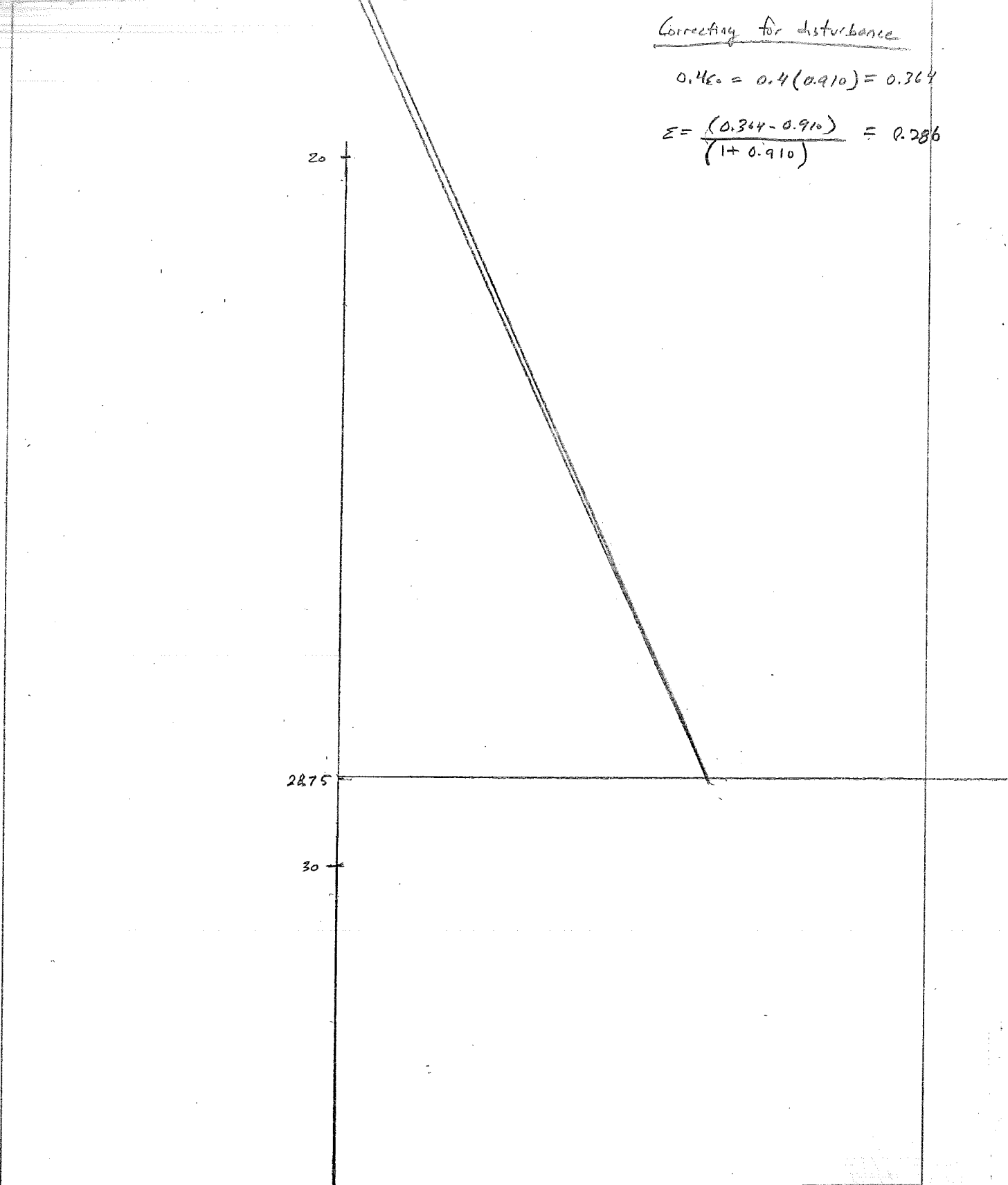
Figure

COMPUTED BY:	DATE:	SHEET:
CHECKED BY:	DATE:	CONTRACT NO.:

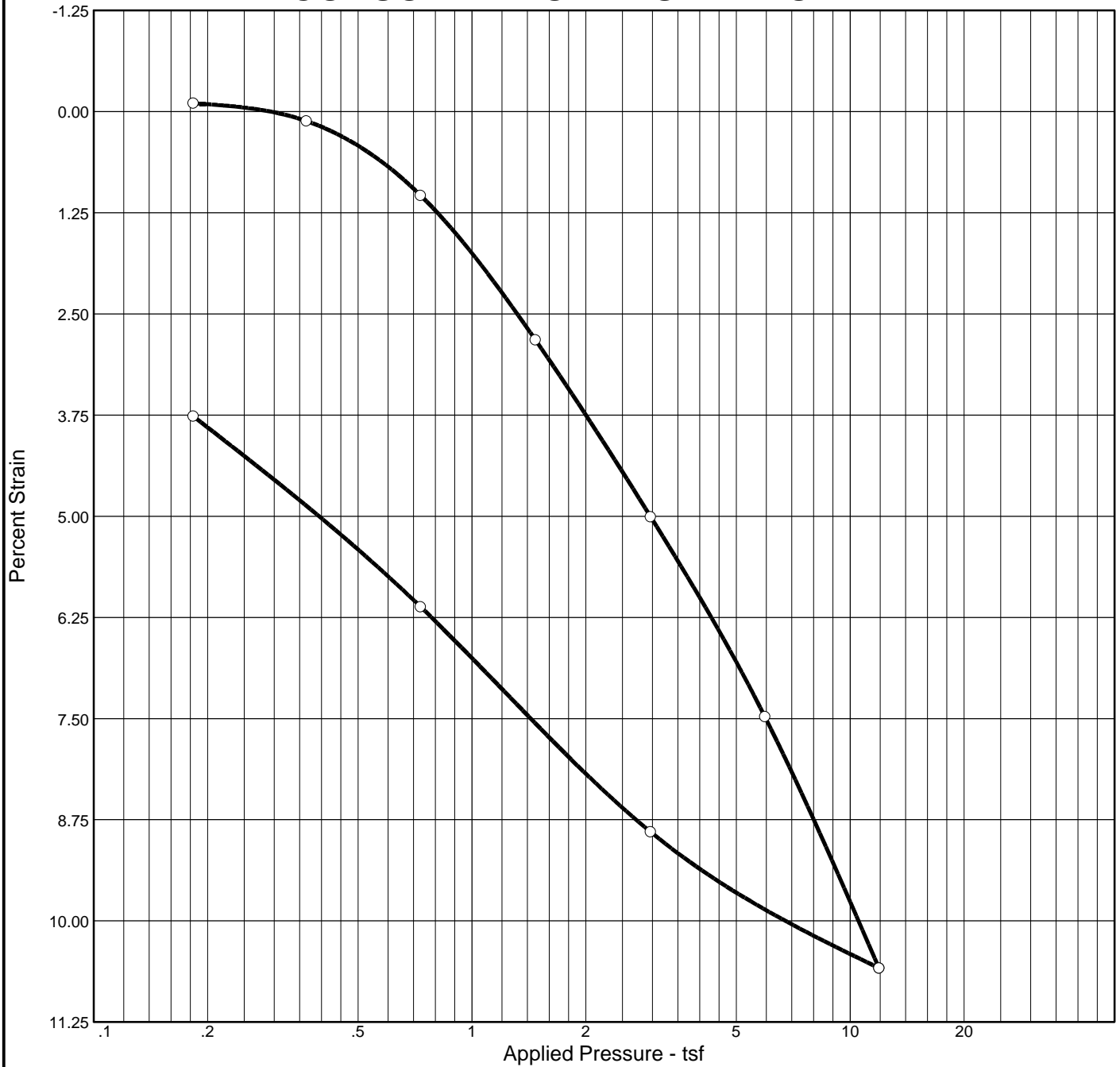
Correcting for disturbance

$$0.460 = 0.4(0.910) = 0.364$$

$$\epsilon = \frac{(0.364 - 0.910)}{(1 + 0.910)} = 0.286$$



CONSOLIDATION TEST REPORT



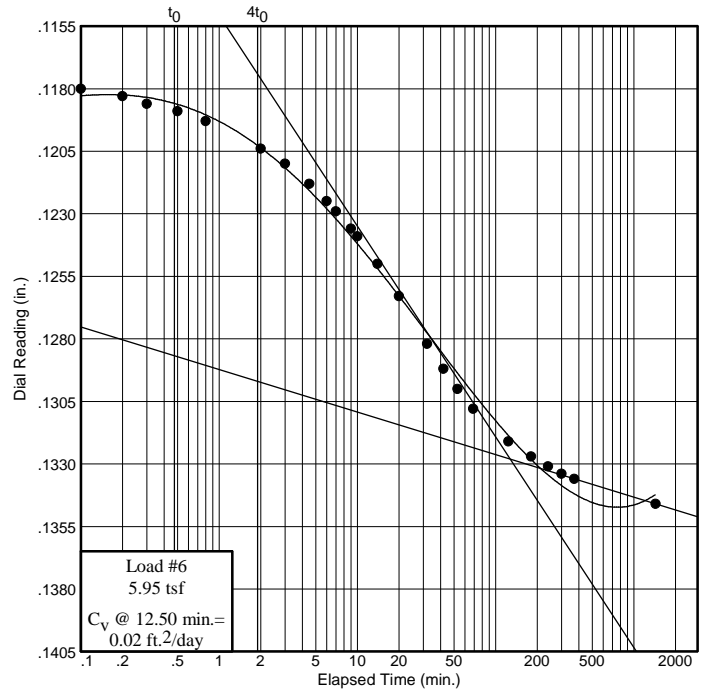
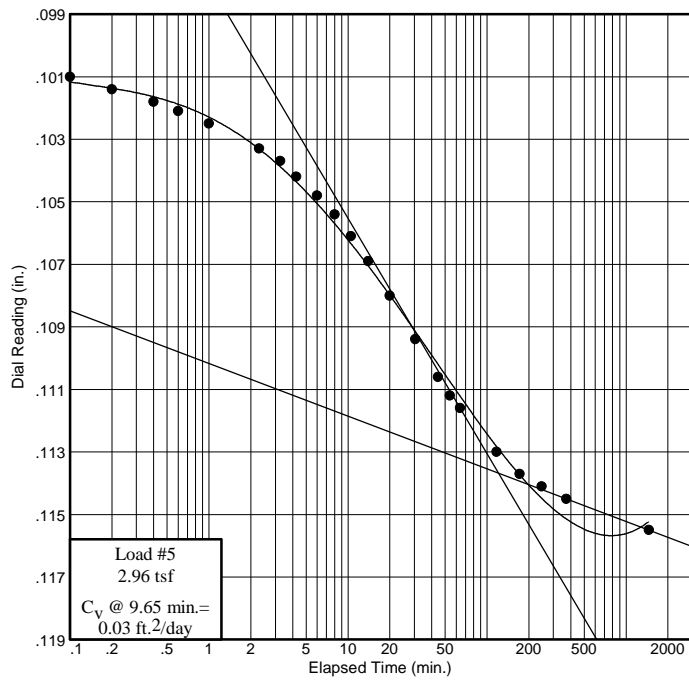
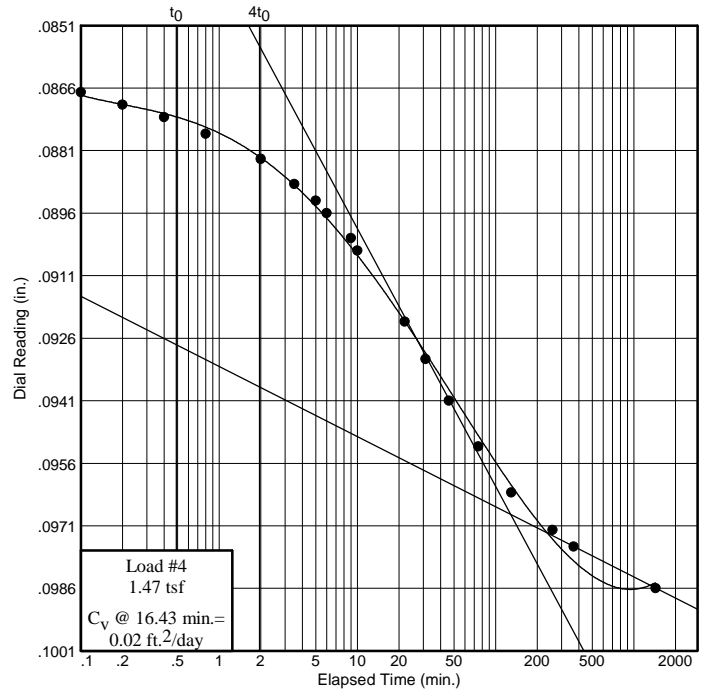
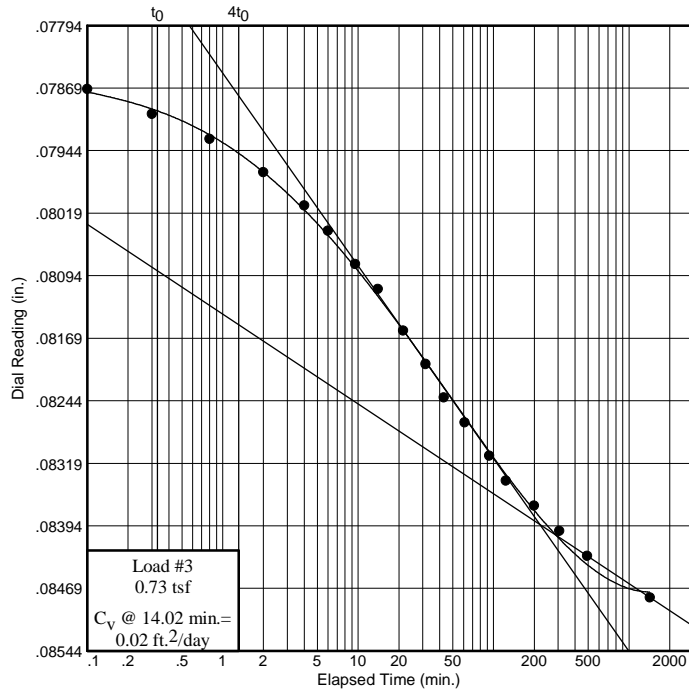
Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
97.5 %	32.4 %	89.5	67	50	2.738		1.52	0.20	0.07			0.910

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-26MU, Bottom of sample, FAT CLAY with silt layers, brown (CH), ASTM D2435	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-F-15, Fargo, Sherack Formation, #1, 8-10'</p> <p style="text-align: center;">BRAUN INTERTEC</p>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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Dial Reading vs. Time

Project No.: BL-09-03127
 Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
 Location: SE-F-15, Fargo, Sherack Formation, #1, 8-10'



BRAUN[™]
INTERTEC

Figure

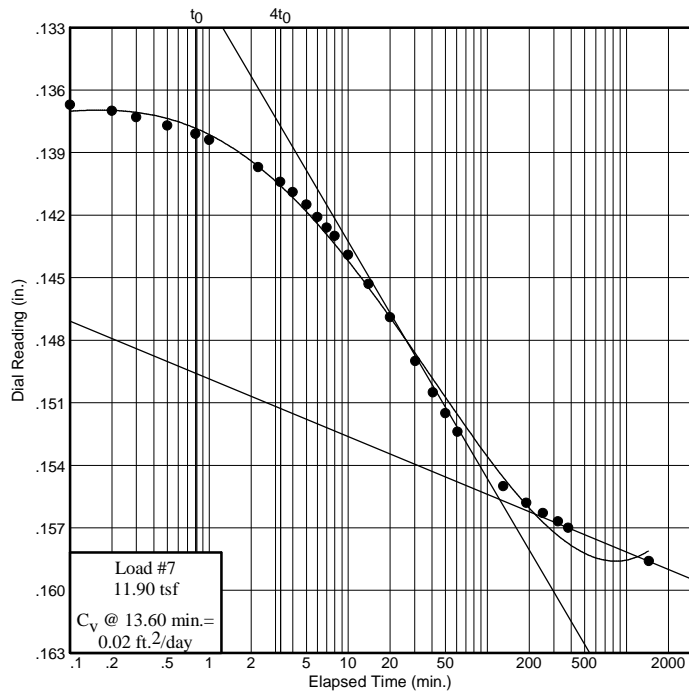
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-15, Fargo, Sherack Formation, #1, 8-10'



BRAUN[™]
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #1
Elev. or Depth: 8-10' **Sample Length(in./cm.):**
Location: SE-F-15, Fargo, Sherack Formation, #1, 8-10'
Description: Boring 09-26MU, Bottom of sample, FAT CLAY with silt layers, brown (CH),
 ASTM D2435
Liquid Limit: 67 **Plasticity Index:** 50
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 116.24 g.	Consolidometer # = 6	Wet w+t =
Dry w+t = 95.08 g.		Dry w+t =
Tare Wt. = 29.79 g.	Spec. Gravity = 2.738	Tare Wt. =
Height = .77 in.	Height = .77 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 118.19 g.	Defl. Table = #6-2008	
Moisture = 32.4 %	Ht. Solids = 0.4046 in.	Moisture = %
Wet Den. = 118.5 pcf	Dry Wt. = 89.26 g.*	Dry Wt. = n/a
Dry Den. = 89.5 pcf	Void Ratio = 0.910	Void Ratio = 0.838
	Saturation = 97.5 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.07680				0.910	
0.18	0.07700	0.00100			0.912	0.1 Swell
0.36	0.07920	0.00150			0.908	0.1 Comprs.
0.73	0.08700	0.00220	0.02	0.001	0.891	1.0 Comprs.
1.47	0.10190	0.00330	0.02	0.002	0.856	2.8 Comprs.
2.96	0.12010	0.00460	0.03	0.002	0.815	5.0 Comprs.
5.95	0.14080	0.00620	0.02	0.002	0.768	7.5 Comprs.
11.90	0.16680	0.00820	0.02	0.004	0.708	10.6 Comprs.
2.96	0.15020	0.00460			0.740	8.9 Comprs.
0.73	0.12630	0.00220			0.793	6.1 Comprs.
0.18	0.10690	0.00100			0.838	3.8 Comprs.

C_c = 0.20 P_c = 1.52 tsf C_r = 0.07

Pressure: 0.36 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.07700
2	0.10	0.07750
3	2.00	0.07780
4	9.00	0.07810
5	27.00	0.07840
6	145.00	0.07880
7	511.00	0.07900
8	1394.00	0.07920

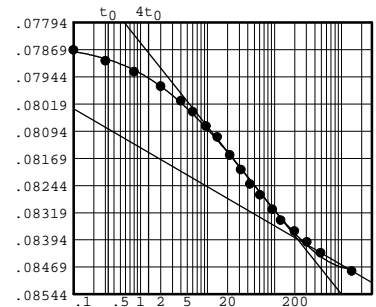
Void Ratio = 0.908 Compression = 0.1 %

Pressure: 0.73 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07920	11	31.50	0.08420
2	0.10	0.08090	12	43.00	0.08460
3	0.30	0.08120	13	61.00	0.08490
4	0.80	0.08150	14	93.00	0.08530
5	2.00	0.08190	15	123.50	0.08560
6	4.00	0.08230	16	199.00	0.08590
7	6.00	0.08260	17	306.00	0.08620
8	9.50	0.08300	18	490.50	0.08650
9	14.00	0.08330	19	1428.00	0.08700
10	21.50	0.08380			



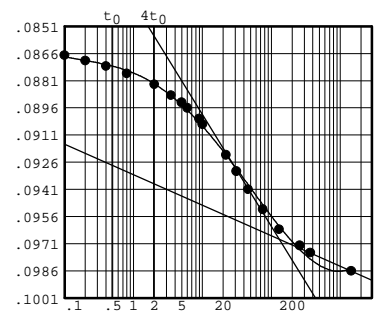
Void Ratio = 0.891 Compression = 1.0 %
 $D_0 = 0.07845$ $D_{50} = 0.08119$ $D_{100} = 0.08393$
 C_v at 14.0 min. = 0.02 ft.²/day $C_\alpha = 0.001$

Pressure: 1.47 tsf

TEST READINGS

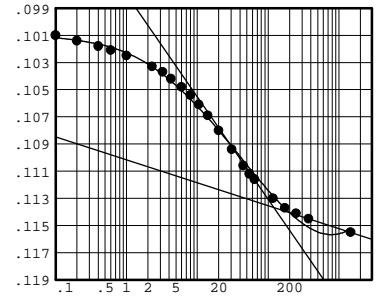
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08700	11	10.00	0.09380
2	0.10	0.09000	12	22.00	0.09550
3	0.20	0.09030	13	31.10	0.09640
4	0.40	0.09060	14	46.00	0.09740
5	0.80	0.09100	15	75.00	0.09850
6	2.00	0.09160	16	130.00	0.09960
7	3.50	0.09220	17	258.00	0.10050
8	5.00	0.09260	18	367.00	0.10090
9	6.00	0.09290	19	1441.00	0.10190
10	9.00	0.09350			



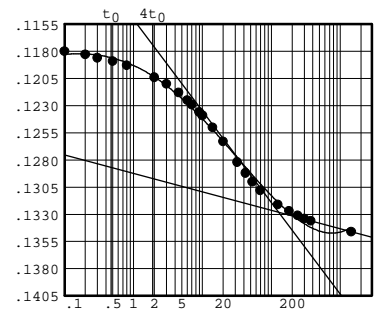
Void Ratio = 0.856 Compression = 2.8 %
 $D_0 = 0.08633$ $D_{50} = 0.09158$ $D_{100} = 0.09684$
 C_v at 16.4 min. = 0.02 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10190	13	14.00	0.11150
2	0.10	0.10560	14	20.00	0.11260
3	0.20	0.10600	15	30.50	0.11400
4	0.40	0.10640	16	44.50	0.11520
5	0.60	0.10670	17	54.00	0.11580
6	1.00	0.10710	18	64.00	0.11620
7	2.30	0.10790	19	117.00	0.11760
8	3.25	0.10830	20	172.00	0.11830
9	4.25	0.10880	21	247.00	0.11870
10	6.00	0.10940	22	372.00	0.11910
11	8.00	0.11000	23	1458.00	0.12010
12	10.50	0.11070			



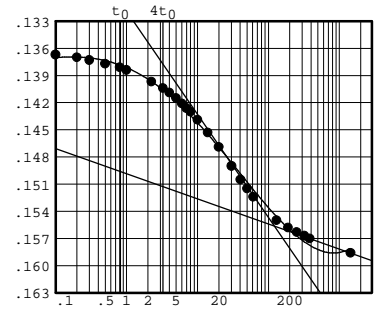
Void Ratio = 0.815 Compression = 5.0 %
 $D_0 = 0.09860$ $D_{50} = 0.10614$ $D_{100} = 0.11368$
 C_v at 9.7 min. = 0.03 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12010	14	14.00	0.13120
2	0.10	0.12420	15	20.00	0.13250
3	0.20	0.12450	16	32.00	0.13440
4	0.30	0.12480	17	42.00	0.13540
5	0.50	0.12510	18	53.00	0.13620
6	0.80	0.12550	19	69.00	0.13700
7	2.00	0.12660	20	124.00	0.13830
8	3.00	0.12720	21	181.00	0.13890
9	4.50	0.12800	22	240.00	0.13930
10	6.00	0.12870	23	300.00	0.13960
11	7.00	0.12910	24	372.00	0.13980
12	9.00	0.12980	25	1441.00	0.14080
13	10.00	0.13010			



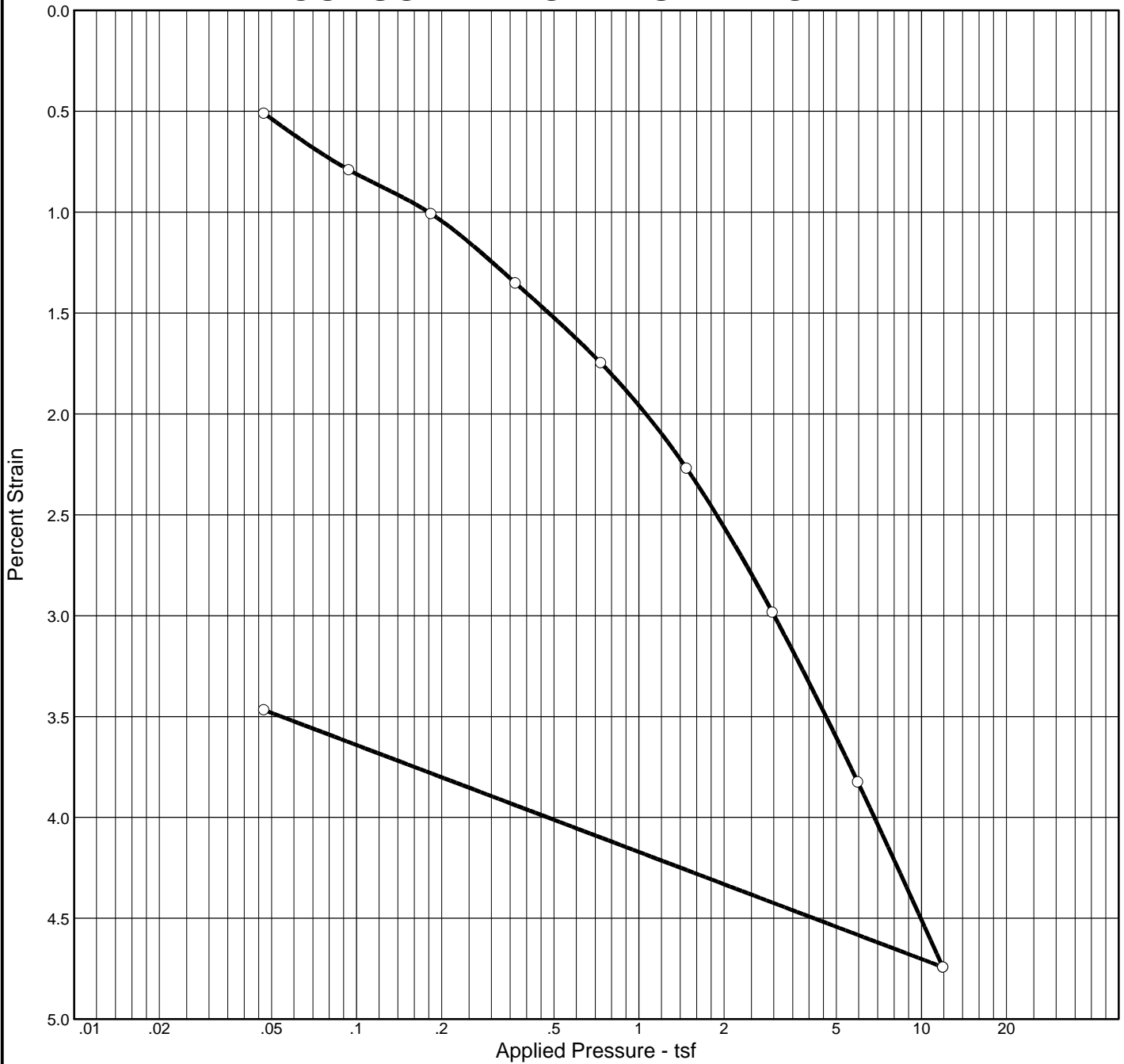
Void Ratio = 0.768 Compression = 7.5 %
 $D_0 = 0.11690$ $D_{50} = 0.12485$ $D_{100} = 0.13281$
 C_v at 12.5 min. = 0.02 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14080	15	10.00	0.15210
2	0.10	0.14490	16	14.00	0.15350
3	0.20	0.14520	17	20.00	0.15510
4	0.30	0.14550	18	30.30	0.15720
5	0.50	0.14590	19	40.50	0.15870
6	0.80	0.14630	20	50.00	0.15970
7	1.00	0.14660	21	61.00	0.16060
8	2.25	0.14790	22	130.00	0.16320
9	3.25	0.14860	23	190.00	0.16400
10	4.00	0.14910	24	251.00	0.16450
11	5.00	0.14970	25	321.00	0.16490
12	6.00	0.15030	26	382.00	0.16520
13	7.00	0.15080	27	1444.00	0.16680
14	8.00	0.15120			



Void Ratio = 0.708 Compression = 10.6 %
 $D_0 = 0.13512$ $D_{50} = 0.14537$ $D_{100} = 0.15563$
 C_v at 13.6 min. = 0.02 ft.²/day $C_\alpha = 0.004$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
100.1 %	28.3 %	96.6	30	6	2.75		1.70	0.05	0.01			0.778

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, SILT, layers of clay, gray-brown (ML), ASTM D2435	ML	

Project No. BL-09-03127 Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Source: Sample No.: #2 Elev./Depth: 21-23'	Remarks: Moorhead 09-25MU, #2, 21' - 23' Poplar River - West Fargo
Figure	

Dial Reading vs. Time

Project No.: BL-09-03127

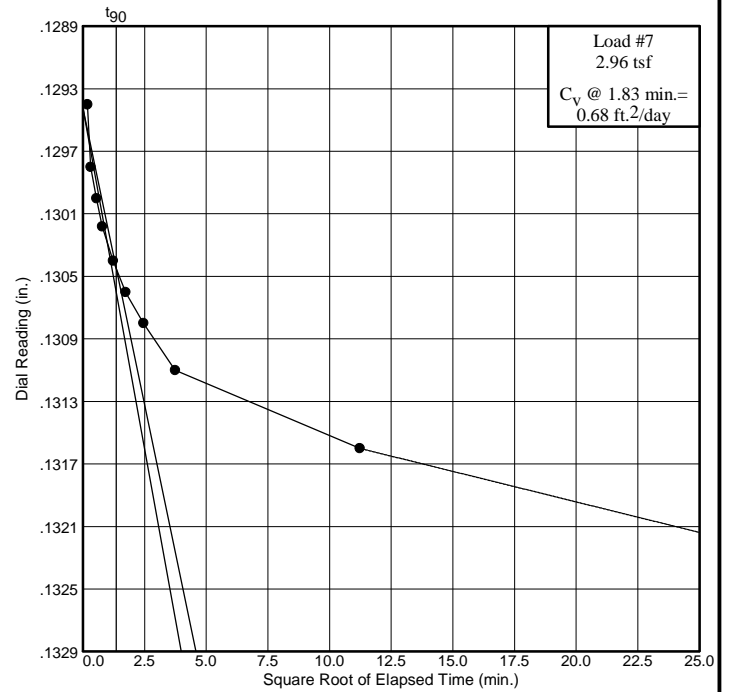
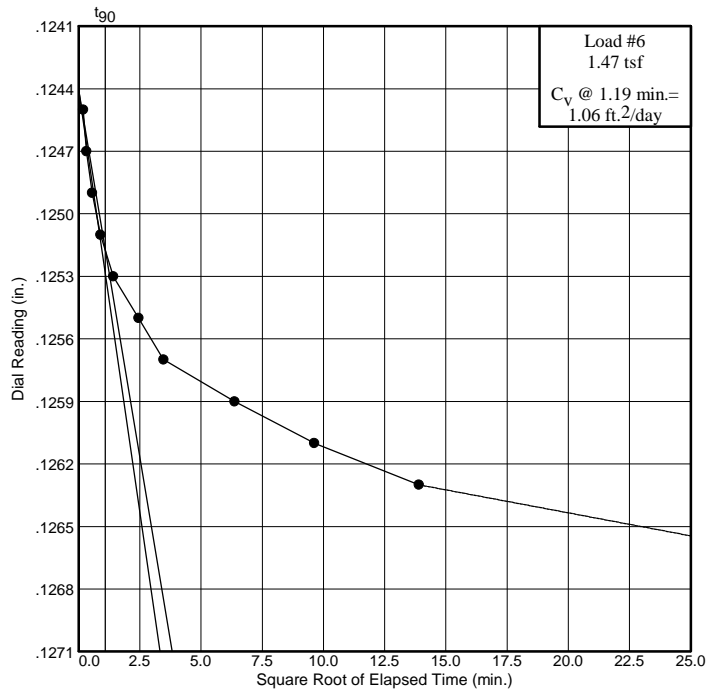
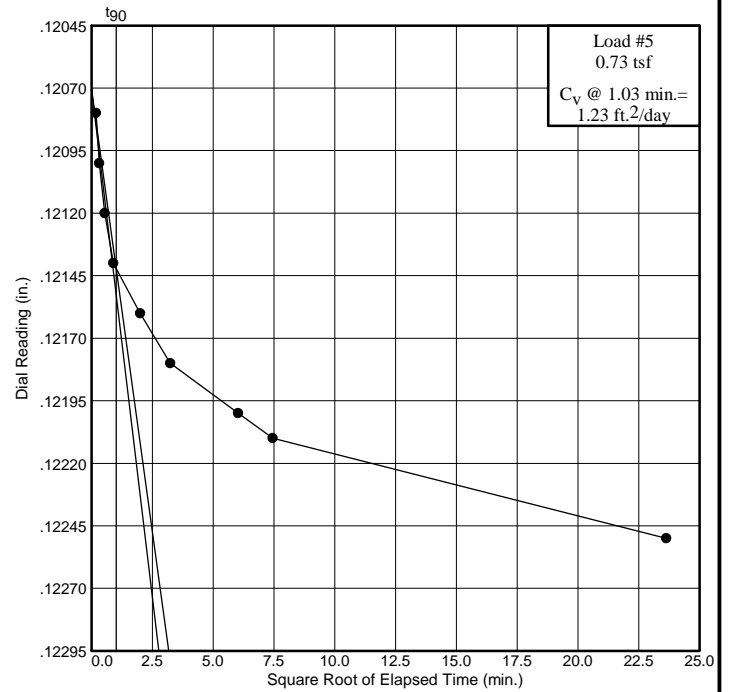
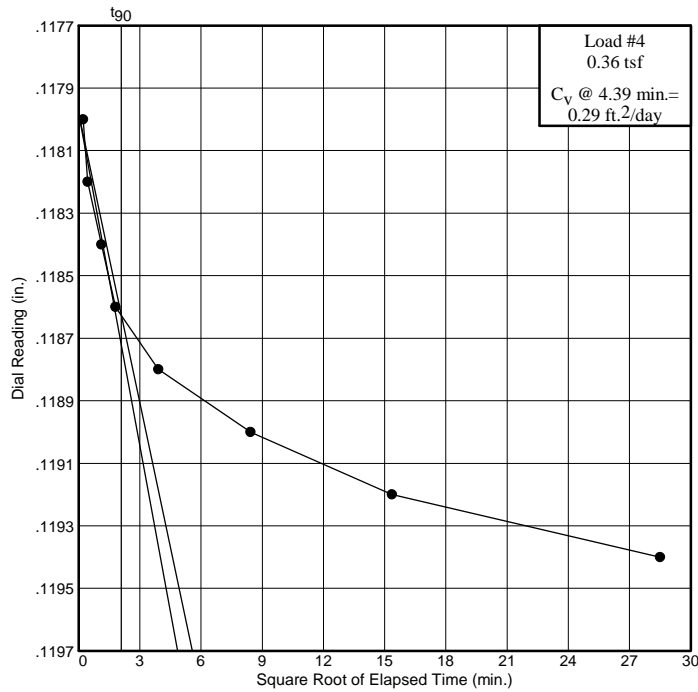
Project: Fargo-Moorhead Metro Feasibility Study

Poplar River - West Fargo

Source: Moorhead 09-25MU

Sample No.: #2

Elev./Depth: 21-23'



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INTERTEC

Figure

Dial Reading vs. Time

Project No.: BL-09-03127

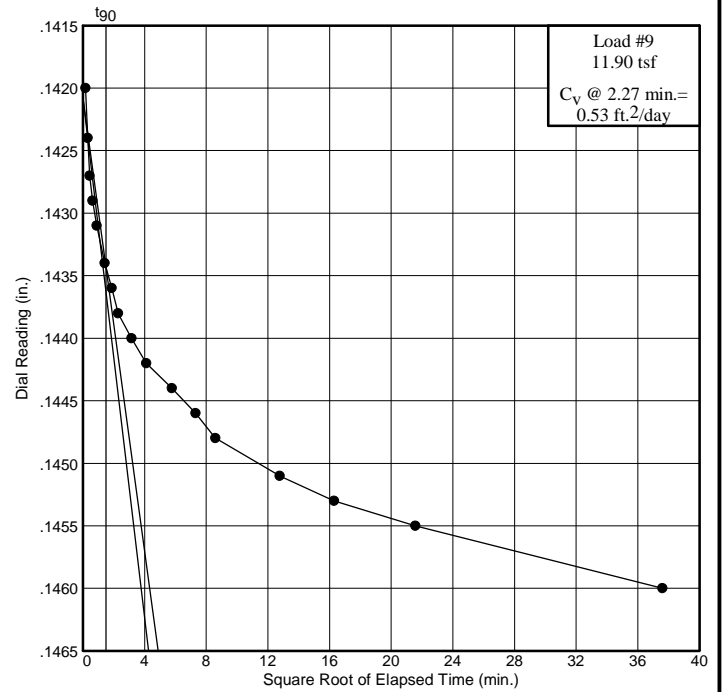
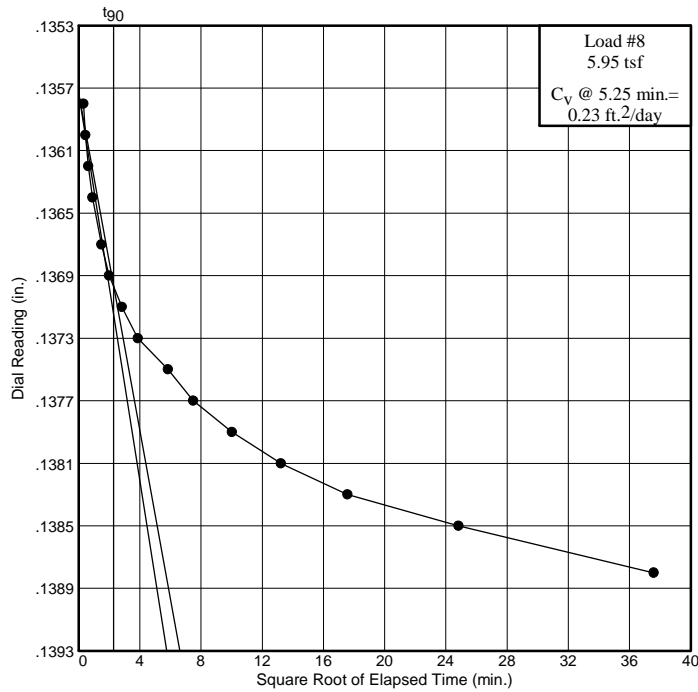
Project: Fargo-Moorhead Metro Feasibility Study

Poplar River - West Fargo

Source: Moorhead 09-25MU

Sample No.: #2

Elev./Depth: 21-23'



BRAUN[™]
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #2
Elev. or Depth: 21-23' **Sample Length(in./cm.):**
Location:
Description: Boring 09-25MU, Bottom of sample, SILT, layers of clay, gray-brown (ML),
 ASTM D2435 **Poplar River - West Fargo**
Liquid Limit: 30 **Plasticity Index:** 6
USCS: ML **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 170.77 g.	Consolidometer # = 6	Wet w+t =
Dry w+t = 139.96 g.		Dry w+t =
Tare Wt. = 31.15 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .78 in.	Height = .78 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 125.44 g.	Defl. Table = #6-2008	
Moisture = 28.3 %	Ht. Solids = 0.4412 in.	Moisture = %
Wet Den. = 123.9 pcf	Dry Wt. = 97.76 g.*	Dry Wt. = n/a
Dry Den. = 96.6 pcf	Void Ratio = 0.778	Void Ratio = 0.716
	Saturation = 100.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10880				0.778	
0.05	0.11310	0.00030			0.769	0.5 Compr.
0.09	0.11500	0.00000			0.764	0.8 Compr.
0.18	0.11770	0.00100			0.760	1.0 Compr.
0.36	0.12090	0.00150	0.29		0.754	1.4 Compr.
0.73	0.12470	0.00220	1.23		0.747	1.7 Compr.
1.47	0.12990	0.00330	1.06		0.738	2.3 Compr.
2.96	0.13680	0.00460	0.68		0.725	3.0 Compr.
5.95	0.14500	0.00620	0.23		0.710	3.8 Compr.
11.90	0.15420	0.00820	0.53		0.694	4.7 Compr.
0.05	0.13630	0.00030			0.716	3.5 Compr.

C_c = 0.05 P_c = 1.70 tsf C_r = 0.01

Pressure: 0.05 tsf

TEST READINGS

Load No. 1

No.	Elapsed Time	Dial Reading
1	0.00	0.10880
2	0.10	0.11220
3	5.50	0.11250
4	972.00	0.11310

Void Ratio = 0.769 Compression = 0.5 %

Pressure: 0.09 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.11310
2	0.10	0.11400
3	0.80	0.11420
4	8.50	0.11440
5	67.50	0.11460
6	289.00	0.11480
7	473.00	0.11490
8	750.00	0.11500

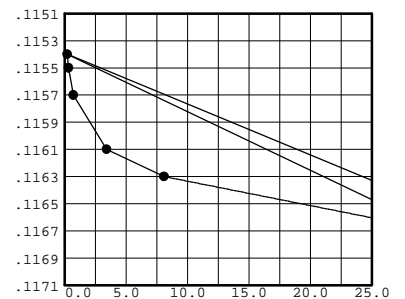
Void Ratio = 0.764 Compression = 0.8 %

Pressure: 0.18 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading
1	0.00	0.11510
2	0.05	0.11640
3	0.10	0.11650
4	0.50	0.11670
5	11.75	0.11710
6	65.50	0.11730
7	921.00	0.11770



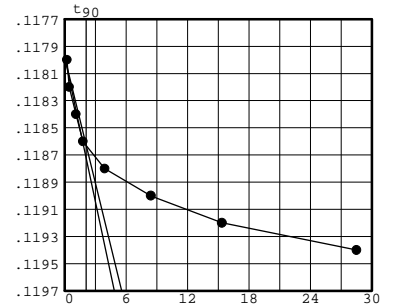
Void Ratio = 0.760 Compression = 1.0 %

Pressure: 0.36 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading
1	0.00	0.11770
2	0.05	0.11950
3	0.20	0.11970
4	1.25	0.11990
5	3.25	0.12010
6	15.30	0.12030
7	71.00	0.12050
8	236.00	0.12070
9	812.00	0.12090



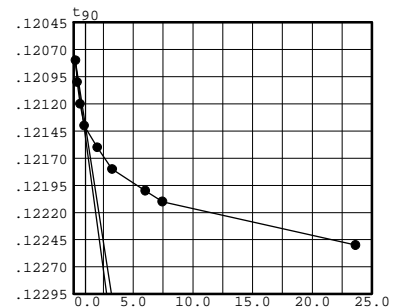
Void Ratio = 0.754 Compression = 1.4 %
 $D_0 = 0.11798$ $D_{90} = 0.11863$ $D_{100} = 0.11870$
 C_v at 4.4 min. = 0.29 ft.²/day

Pressure: 0.73 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading
1	0.00	0.12090
2	0.03	0.12300
3	0.10	0.12320
4	0.30	0.12340
5	0.80	0.12360
6	4.00	0.12380
7	10.50	0.12400
8	36.30	0.12420
9	55.50	0.12430
10	558.50	0.12470



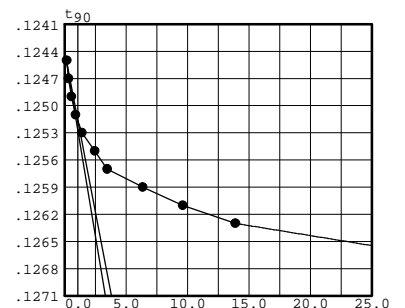
Void Ratio = 0.747 Compression = 1.7 %
 $D_0 = 0.12071$ $D_{90} = 0.12142$ $D_{100} = 0.12150$
 C_v at 1.0 min. = 1.23 ft.²/day

Pressure: 1.47 tsf

TEST READINGS

Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12470	11	193.00	0.12960
2	0.03	0.12780	12	754.00	0.12990
3	0.10	0.12800			
4	0.30	0.12820			
5	0.80	0.12840			
6	2.00	0.12860			
7	6.00	0.12880			
8	12.00	0.12900			
9	40.50	0.12920			
10	92.50	0.12940			



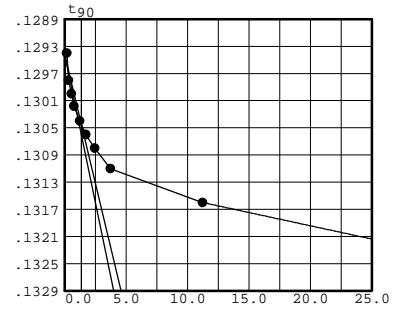
Void Ratio = 0.738 Compression = 2.3 %
 $D_0 = 0.12441$ $D_{90} = 0.12517$ $D_{100} = 0.12526$
 C_v at 1.2 min. = 1.06 ft.²/day

Pressure: 2.96 tsf

TEST READINGS

Load No. 7

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12990	11	707.00	0.13680
2	0.03	0.13400			
3	0.10	0.13440			
4	0.30	0.13460			
5	0.60	0.13478			
6	1.50	0.13500			
7	3.00	0.13520			
8	6.00	0.13540			
9	14.00	0.13570			
10	126.10	0.13620			



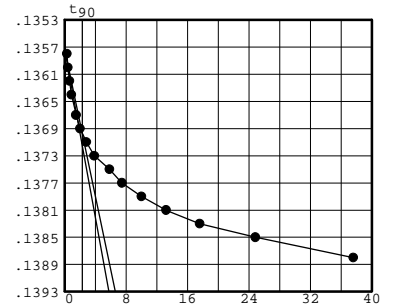
Void Ratio = 0.725 Compression = 3.0 %
 D₀ = 0.12943 D₉₀ = 0.13045 D₁₀₀ = 0.13056
 C_v at 1.8 min. = 0.68 ft.²/day

Pressure: 5.95 tsf

TEST READINGS

Load No. 8

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13680	11	56.00	0.14390
2	0.10	0.14200	12	100.50	0.14410
3	0.20	0.14220	13	175.00	0.14430
4	0.40	0.14240	14	309.00	0.14450
5	0.80	0.14260	15	616.50	0.14470
6	2.25	0.14290	16	1413.00	0.14500
7	4.00	0.14310			
8	8.00	0.14330			
9	15.00	0.14350			
10	34.00	0.14370			



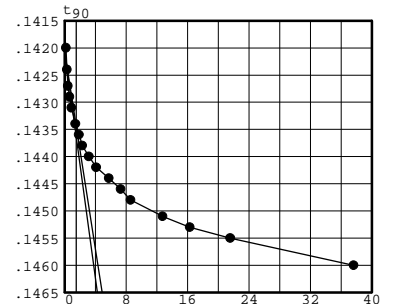
Void Ratio = 0.710 Compression = 3.8 %
 D₀ = 0.13573 D₉₀ = 0.13697 D₁₀₀ = 0.13711
 C_v at 5.2 min. = 0.23 ft.²/day

Pressure: 11.90 tsf

TEST READINGS

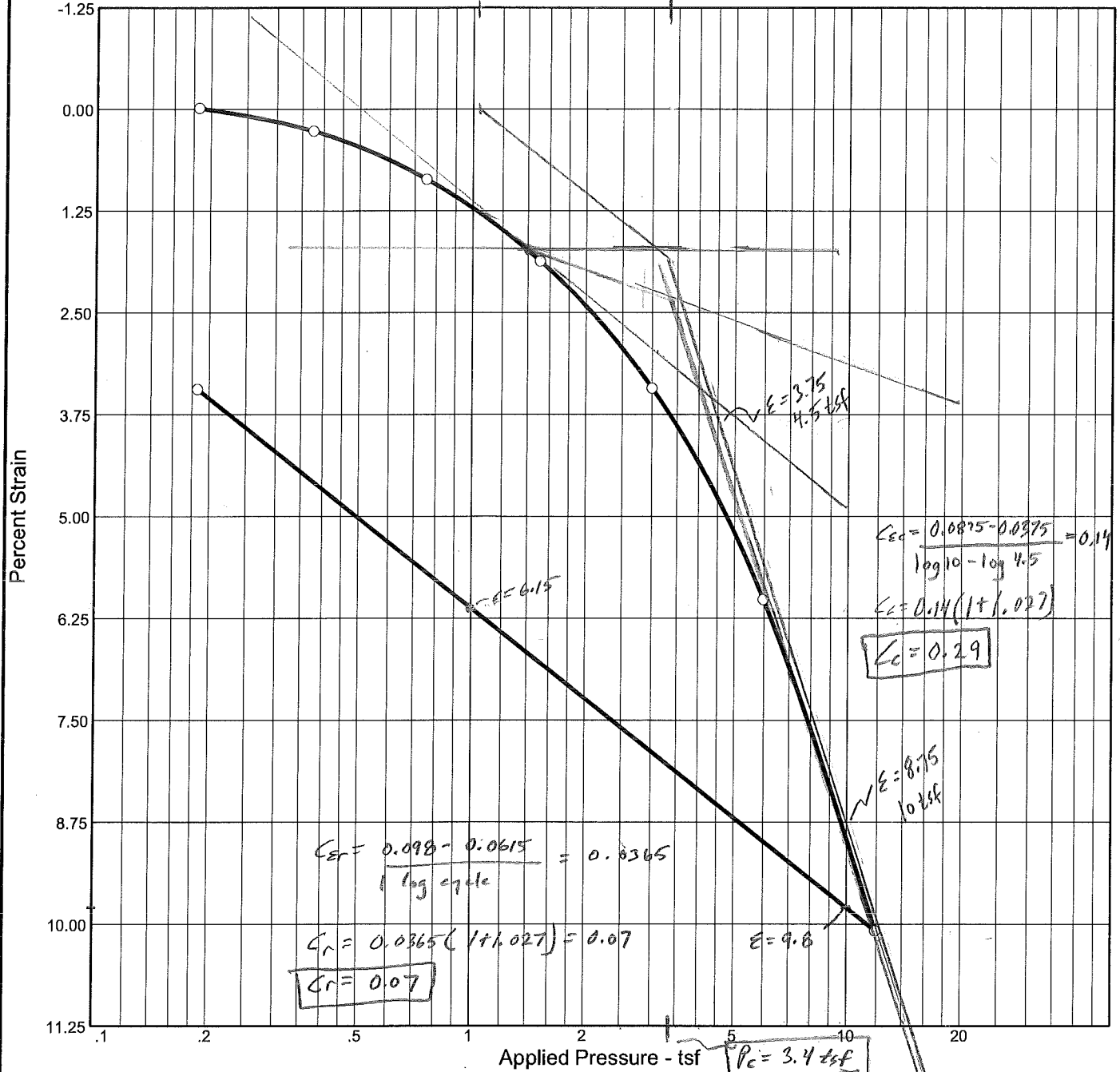
Load No. 9

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14500	11	17.00	0.15240
2	0.03	0.15020	12	33.30	0.15260
3	0.10	0.15060	13	53.50	0.15280
4	0.20	0.15090	14	73.80	0.15300
5	0.40	0.15110	15	163.00	0.15330
6	0.80	0.15130	16	266.00	0.15350
7	2.00	0.15160	17	465.00	0.15370
8	3.50	0.15180	18	1414.00	0.15420
9	5.25	0.15200			
10	10.00	0.15220			



Void Ratio = 0.694 Compression = 4.7 %
 D₀ = 0.14208 D₉₀ = 0.14344 D₁₀₀ = 0.14359
 C_v at 2.3 min. = 0.53 ft.²/day

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_o
Sat.	Moist.											
97.0 %	36.3 %	84.7	80	59	2.75	2.68	0.28	0.07				1.027

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435	CH	

Project No. BL-09-03127 Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Source: Sample No.: #3 Elev./Depth: 25-27'	Remarks: Boring 09-25MU, Bottom of sample Moorhead 09-25MU, #3, 25' - 27' Poplar River - Harwood Figure ASTM2435

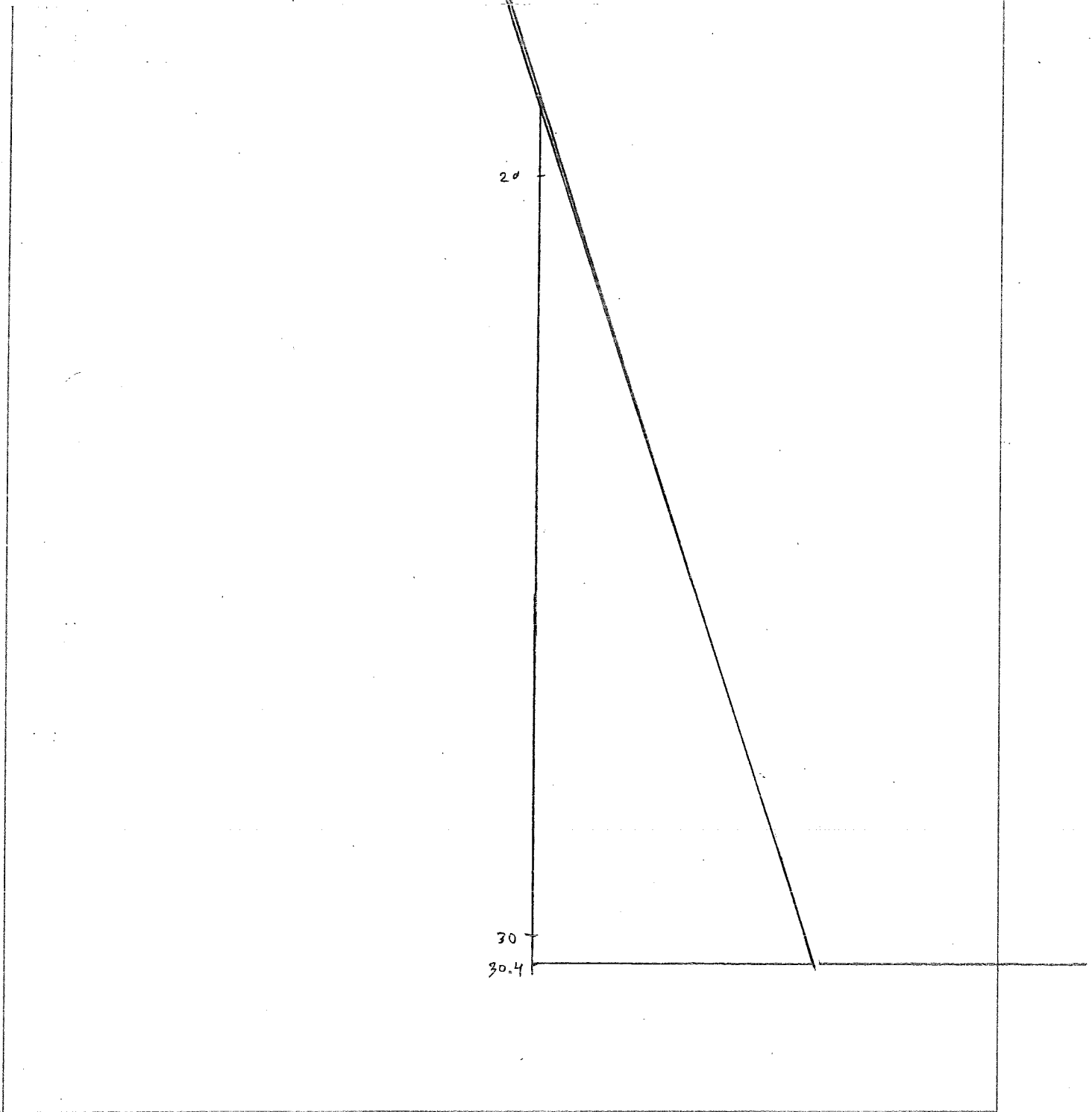
DESCRIPTION		USCS	AASHTO
T CLAY, brown (CH), ASTM D2435		CH	
Elev./Depth: 25-27'		Remarks: Boring 09-25MU, Bottom of sample	
Figure ASTM2435			

COMPUTED BY:	DATE:	SHEET:
CHECKED BY:	DATE:	CONTRACT NO.:

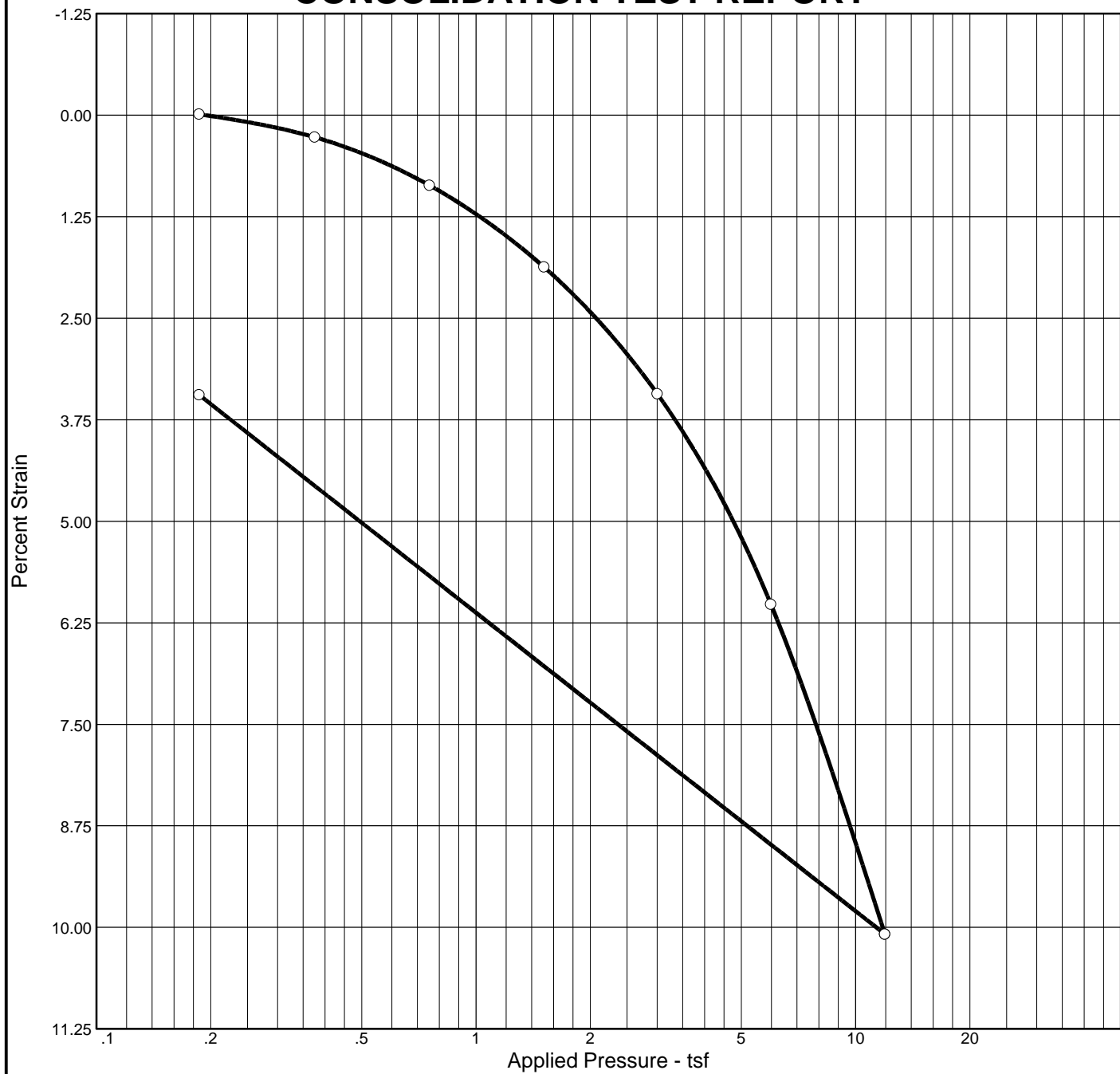
$$0.4e_1 = 0.4(1.027) = 0.4108$$

$$\epsilon = \left(\frac{e - e_0}{1 + e_0} \right) = \frac{0.4108 - 1.027}{1 + 1.027}$$

$$\epsilon = 0.304 = 30.4\%$$



CONSOLIDATION TEST REPORT



Natural	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat. Moist.	84.7			2.75		2.68	0.28	0.07			1.027
97.0 %	36.3 %										

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435	CH	

Project No. BL-09-03127 Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Source: Sample No.: #3 Elev./Depth: 25-27' <div style="text-align: center;">BRAUN[™] INTERTEC</div>	Remarks: Boring 09-25MU, Bottom of sample Moorhead 09-25MU, #3, 25' - 27' Poplar River - Harwood <p style="text-align: right;">Figure ASTM2435</p>
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Dial Reading vs. Time

Project No.: BL-09-03127

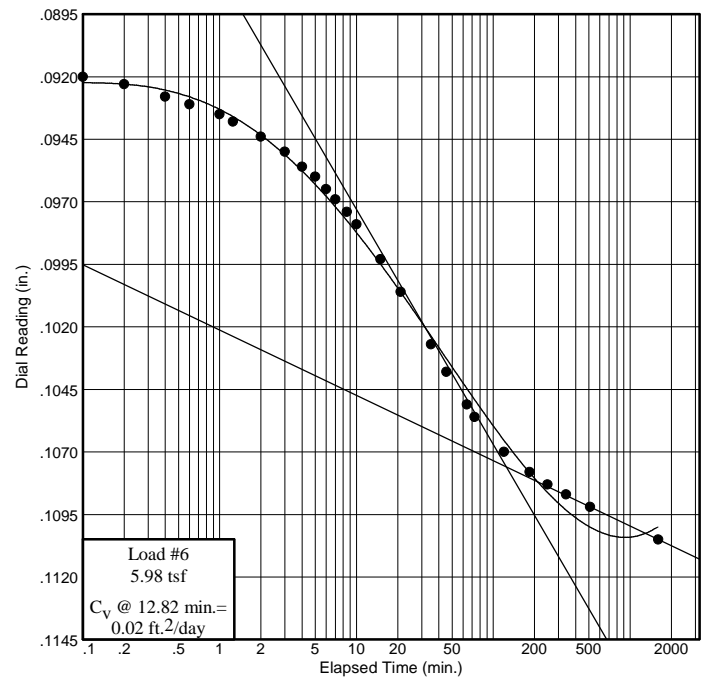
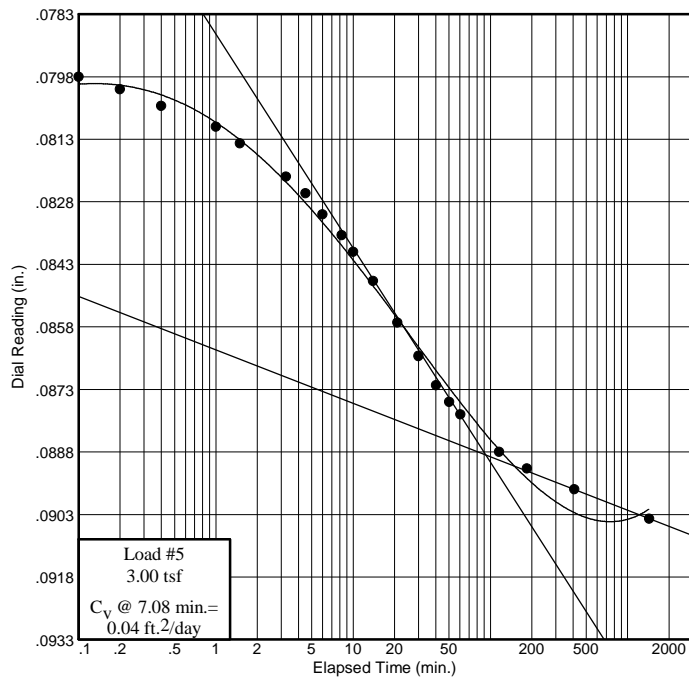
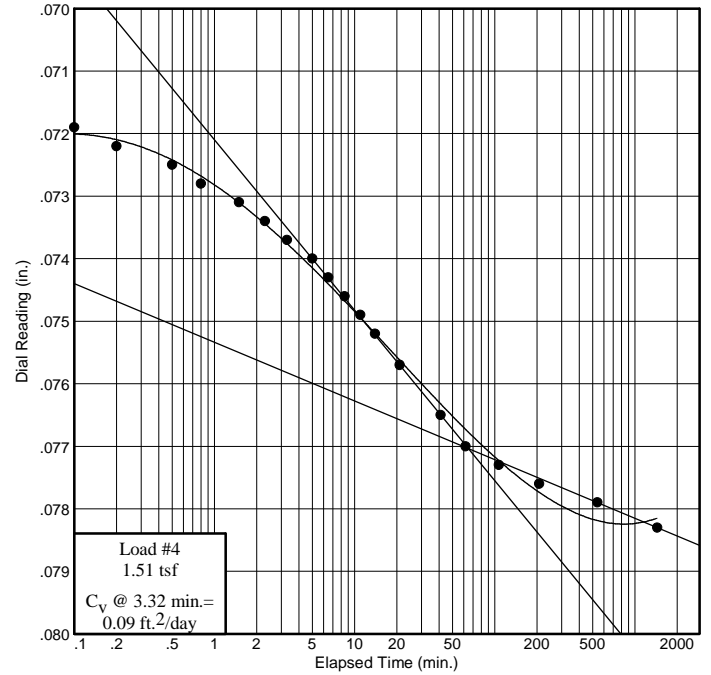
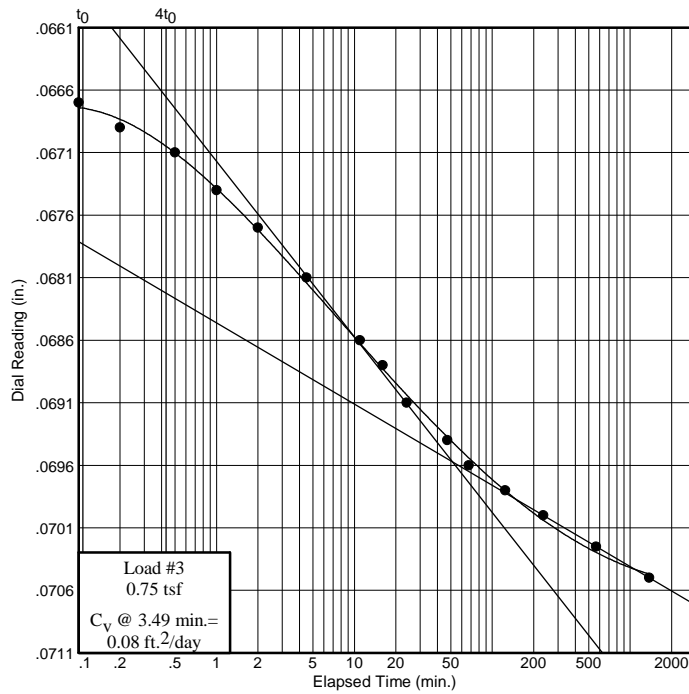
Project: Fargo-Moorhead Metro Feasibility Study

Poplar River - Harwood

Source: Moorhead 09-25MU

Sample No.: #3

Elev./Depth: 25-27'



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Figure AST2436

Dial Reading vs. Time

Project No.: BL-09-03127

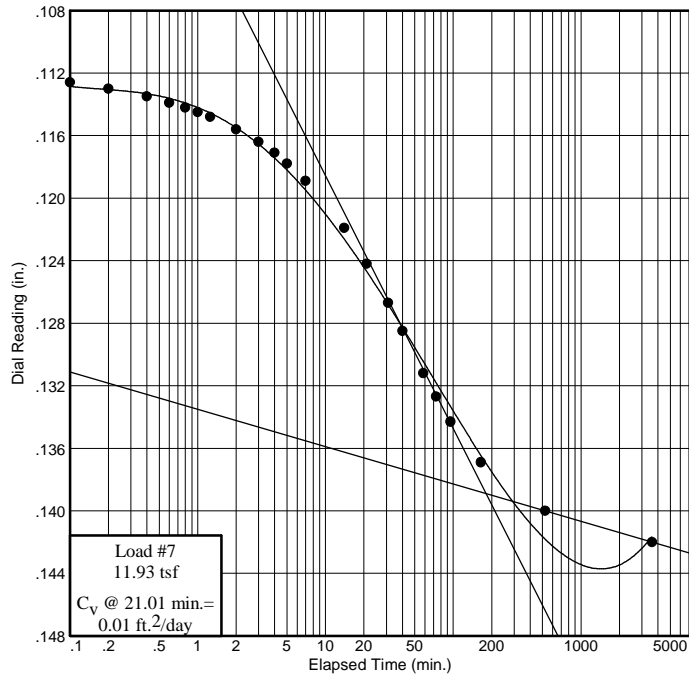
Project: Fargo-Moorhead Metro Feasibility Study

Poplar River - Harwood

Source: Moorhead 09-25MU

Sample No.: #3

Elev./Depth: 25-27'



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Figure AS2437

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #3
Elev. or Depth: 25-27' **Sample Length(in./cm.):**
Location: **Poplar River - Harwood**
Description: Boring 09-25MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435
Liquid Limit: **Plasticity Index:**
USCS: CH **AASHTO:** **Figure No.:** ASTM2435
Testing Remarks: Boring 09-25MU, Bottom of sample

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 121.84 g.	Consolidometer # = 5	Wet w+t =
Dry w+t = 97.53 g.		Dry w+t =
Tare Wt. = 30.47 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .78 in.	Height = .78 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 115.39 g.	Defl. Table = #5-2008	
Moisture = 36.3 %	Ht. Solids = 0.3825 in.	Moisture = %
Wet Den. = 115.4 pcf	Dry Wt. = 84.69 g.*	Dry Wt. = n/a
Dry Den. = 84.7 pcf	Void Ratio = 1.027	Void Ratio = 0.957
	Saturation = 97.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06380				1.027	
0.19	0.06440	0.00070			1.028	0.0 Swell
0.38	0.06700	0.00110			1.022	0.3 Compr.
0.75	0.07240	0.00190	0.08	0.001	1.010	0.9 Compr.
1.51	0.08130	0.00300	0.09	0.001	0.989	1.9 Compr.
3.00	0.09470	0.00430	0.04	0.002	0.958	3.4 Compr.
5.98	0.11650	0.00600	0.02	0.003	0.905	6.0 Compr.
11.93	0.15030	0.00830	0.01	0.003	0.823	10.1 Compr.
0.19	0.09120	0.00070			0.957	3.4 Compr.

C_c = 0.28 P_c = 2.68 tsf C_r = 0.07

Pressure: 0.38 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.06440
2	0.10	0.06550
3	0.80	0.06580
4	3.00	0.06600
5	6.00	0.06620
6	17.00	0.06640
7	46.00	0.06660
8	242.00	0.06680
9	1440.00	0.06700

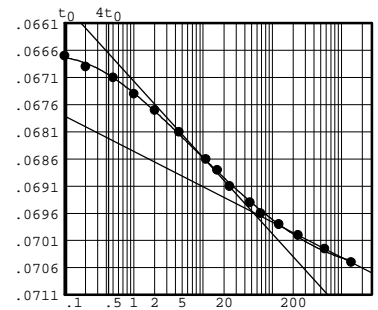
Void Ratio = 1.022 Compression = 0.3 %

Pressure: 0.75 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06700	11	47.30	0.07130
2	0.10	0.06860	12	67.50	0.07150
3	0.20	0.06880	13	124.00	0.07170
4	0.50	0.06900	14	235.00	0.07190
5	1.00	0.06930	15	566.00	0.07215
6	2.00	0.06960	16	1373.50	0.07240
7	4.50	0.07000			
8	11.00	0.07050			
9	16.00	0.07070			
10	24.00	0.07100			



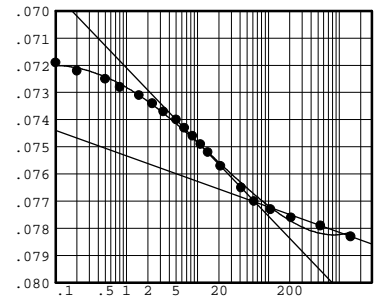
Void Ratio = 1.010 Compression = 0.9 %
 $D_0 = 0.06644$ $D_{50} = 0.06801$ $D_{100} = 0.06958$
 C_v at 3.5 min. = 0.08 ft.²/day $C_\alpha = 0.001$

Pressure: 1.51 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07240	11	8.50	0.07760
2	0.10	0.07490	12	11.00	0.07790
3	0.20	0.07520	13	14.00	0.07820
4	0.50	0.07550	14	21.00	0.07870
5	0.80	0.07580	15	41.00	0.07950
6	1.50	0.07610	16	62.00	0.08000
7	2.30	0.07640	17	107.00	0.08030
8	3.30	0.07670	18	207.00	0.08060
9	5.00	0.07700	19	539.50	0.08090
10	6.50	0.07730	20	1440.00	0.08130



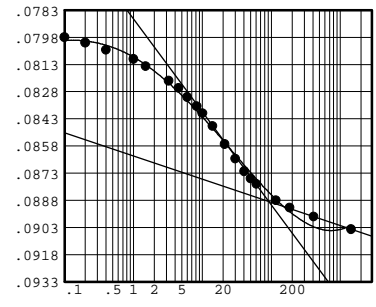
Void Ratio = 0.989 Compression = 1.9 %
 $D_0 = 0.07050$ $D_{50} = 0.07377$ $D_{100} = 0.07704$
 C_v at 3.3 min. = 0.09 ft.²/day $C_\alpha = 0.001$

Pressure: 3.00 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08130	12	14.00	0.08900
2	0.10	0.08410	13	21.00	0.09000
3	0.20	0.08440	14	30.00	0.09080
4	0.40	0.08480	15	40.30	0.09150
5	1.00	0.08530	16	50.10	0.09190
6	1.50	0.08570	17	60.50	0.09220
7	3.25	0.08650	18	116.00	0.09310
8	4.50	0.08690	19	184.50	0.09350
9	6.00	0.08740	20	410.00	0.09400
10	8.25	0.08790	21	1440.00	0.09470
11	10.00	0.08830			



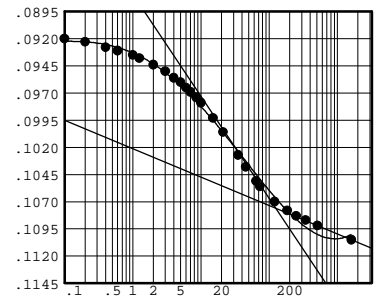
Void Ratio = 0.958 Compression = 3.4 %
 $D_0 = 0.07830$ $D_{50} = 0.08358$ $D_{100} = 0.08887$
 C_v at 7.1 min. = 0.04 ft.²/day $C_\alpha = 0.002$

Pressure: 5.98 tsf

TEST READINGS

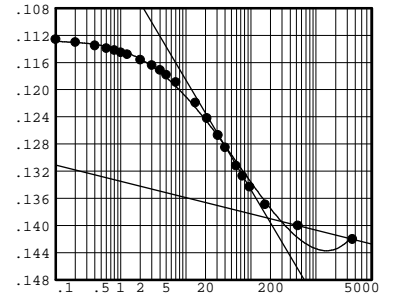
Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09470	15	10.00	0.10390
2	0.10	0.09800	16	15.00	0.10530
3	0.20	0.09830	17	21.00	0.10660
4	0.40	0.09880	18	35.00	0.10870
5	0.60	0.09910	19	45.50	0.10980
6	1.00	0.09950	20	64.30	0.11110
7	1.25	0.09980	21	73.00	0.11160
8	2.00	0.10040	22	120.00	0.11300
9	3.00	0.10100	23	184.00	0.11380
10	4.00	0.10160	24	249.00	0.11430
11	5.00	0.10200	25	341.00	0.11470
12	6.00	0.10250	26	510.00	0.11520
13	7.00	0.10290	27	1605.00	0.11650
14	8.50	0.10340			



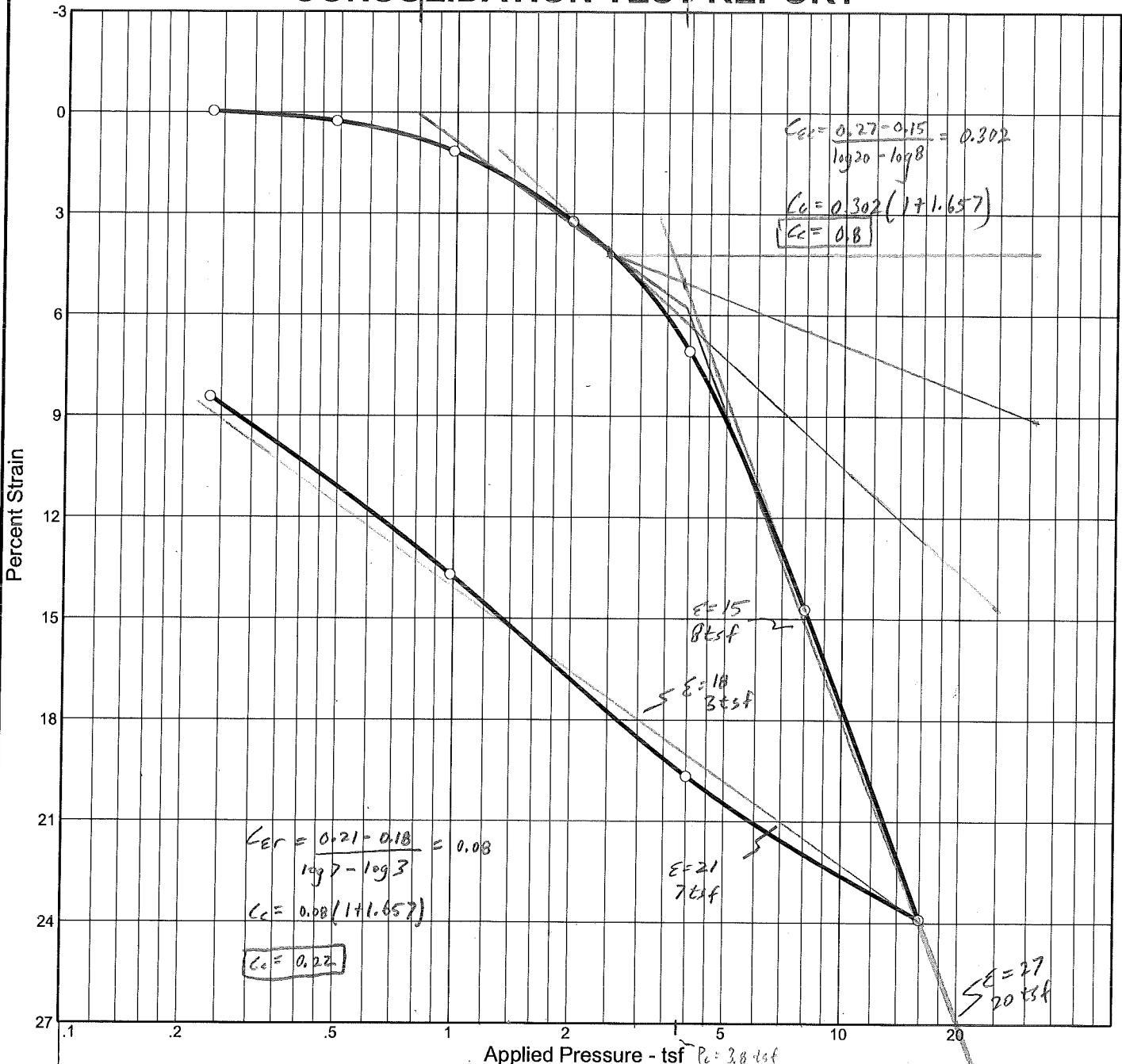
Void Ratio = 0.905 Compression = 6.0 %
 $D_0 = 0.09040$ $D_{50} = 0.09900$ $D_{100} = 0.10760$
 C_v at 12.8 min. = 0.02 ft.²/day $C_\alpha = 0.003$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11650	13	7.00	0.12720
2	0.10	0.12090	14	14.00	0.13020
3	0.20	0.12130	15	21.00	0.13250
4	0.40	0.12180	16	31.00	0.13500
5	0.60	0.12220	17	40.00	0.13680
6	0.80	0.12250	18	58.50	0.13950
7	1.00	0.12280	19	73.50	0.14100
8	1.25	0.12310	20	95.00	0.14260
9	2.00	0.12390	21	165.00	0.14520
10	3.00	0.12470	22	525.00	0.14830
11	4.00	0.12540	23	3613.00	0.15030
12	5.00	0.12610			



Void Ratio = 0.823 Compression = 10.1 %
 $D_0 = 0.11050$ $D_{50} = 0.12470$ $D_{100} = 0.13889$
 C_v at 21.0 min. = 0.01 ft.²/day $C_\alpha = 0.003$

CONSOLIDATION TEST REPORT

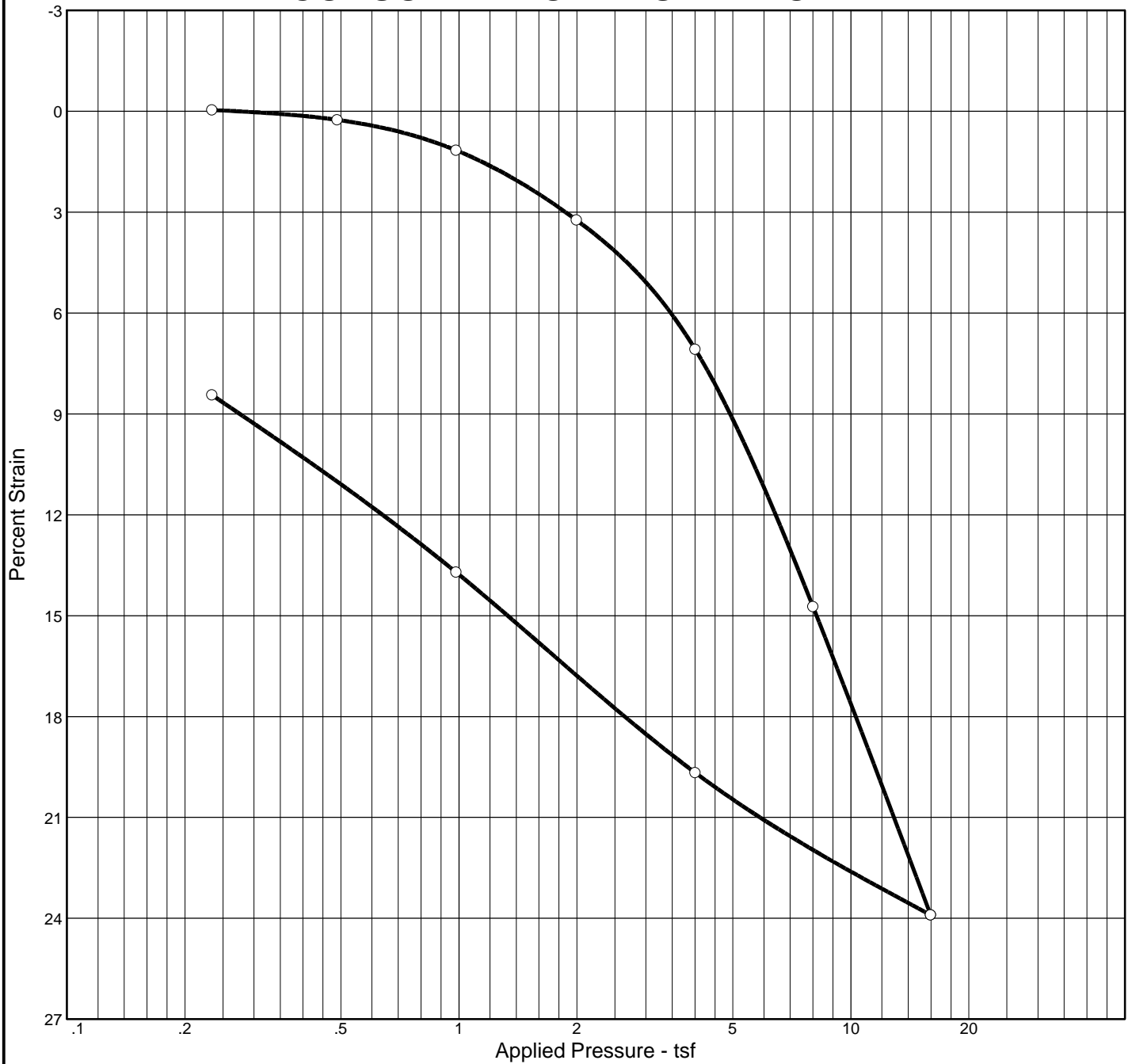


Natural	Dry Dens.	LL	PI	Sp. Gr.	Overburden	P _c	C _c	C _r	Swell Press.	Heave %	e ₀
Sat.	Moist.	(pcf)			(tsf)	(tsf)			(tsf)		
99.1 %	60.7 %	63.5	114	90	2.704	4.10	0.82	0.22			1.657

MATERIAL DESCRIPTION	USCS	AASHTO
33 Boring 09-34MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435	CH	

Project No. BL-09-03127 Client: US Army Corps of Engineer Project: Fargo-Moorhead Feasibility Study 36 W912ES-09-P-0115 Location: SE-M-18, Moorhead, PL Sherack Formation , #2, 16-18'	Remarks: Moorhead 09-34MU, #2, 16' - 18' Oxidized Brenna Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
99.1 %	60.7 %	63.5	114	90	2.704		4.10	0.82	0.22			1.657

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-34MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-M-18, Moorhead, PL Sherack Formation, #2, 16-18'</p>	<p>Remarks:</p> <p style="color: red;">Moorhead 09-34MU, #2, 16' - 18' Oxidized Brenna</p>

Figure

Dial Reading vs. Time

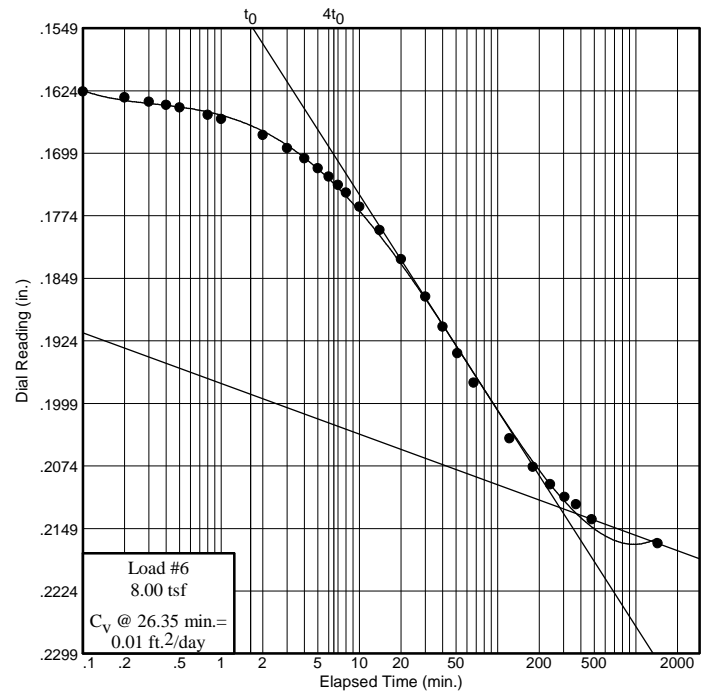
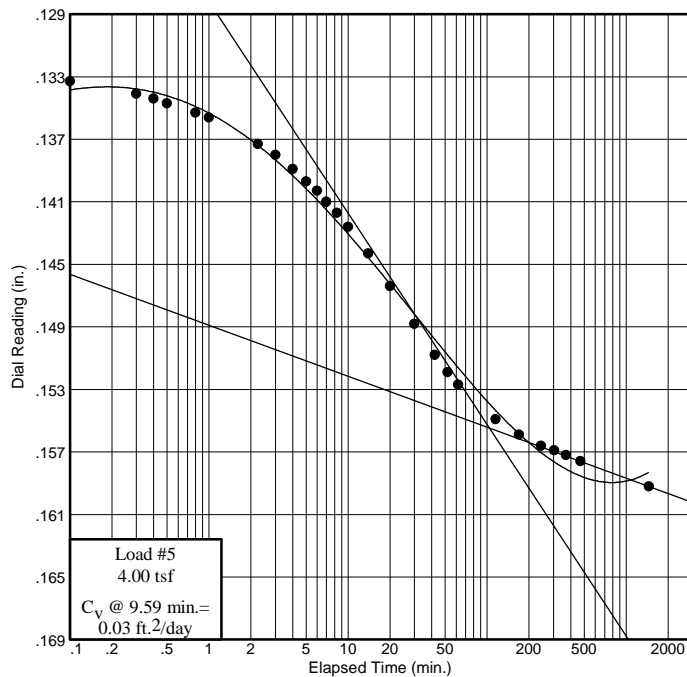
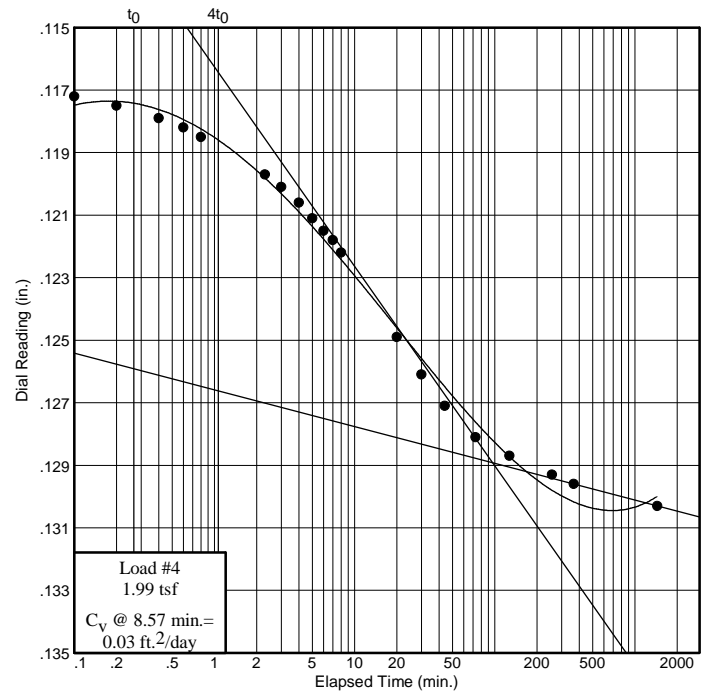
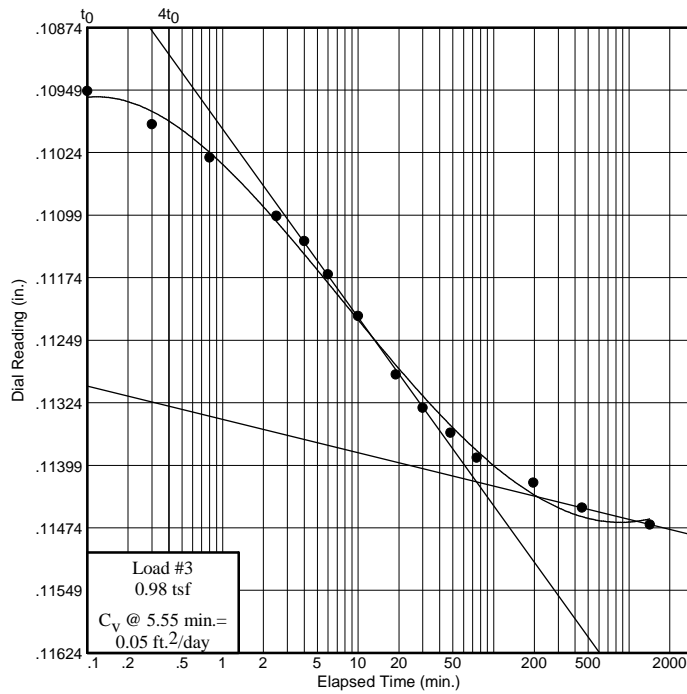
Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-M-18, Moorhead, ~~PL Sherack Formation~~, #2, 16-18'

Oxidized Brenna



BRAUN[™]
INTERTEC

Figure

Dial Reading vs. Time

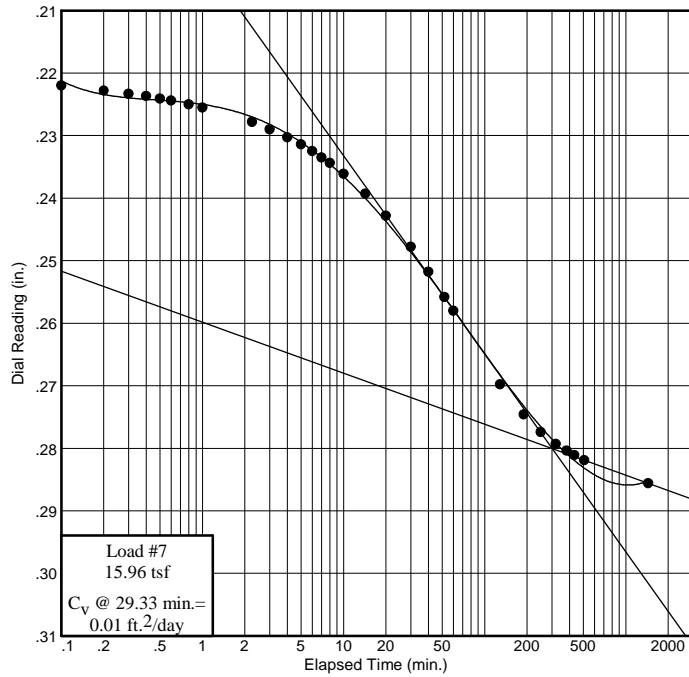
Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-M-18, Moorhead, ~~PL Sherack Formation~~, #2, 16-18'

Oxidized Brenna



BRAUN[™]
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #2
Elev. or Depth: 16-18' **Sample Length(in./cm.):**
Location: SE-M-18, Moorhead, ~~PL Sherack Formation~~, #2, 16-18' **Oxidized Brenna**
Description: Boring 09-34MU, Bottom of sample, FAT CLAY, brown (CH), ASTM D2435
Liquid Limit: 114 **Plasticity Index:** 90
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 123.25 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 88.25 g.		Dry w+t =
Tare Wt. = 30.61 g.	Spec. Gravity = 2.704	Tare Wt. =
Height = .75 in.	Height = .75 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 98.47 g.	Defl. Table = #4-2008	
Moisture = 60.7 %	Ht. Solids = 0.2828 in.	Moisture = %
Wet Den. = 102.1 pcf	Dry Wt. = 61.27 g.*	Dry Wt. = n/a
Dry Den. = 63.5 pcf	Void Ratio = 1.657	Void Ratio = 1.433
	Saturation = 99.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10600				1.657	
0.23	0.10620	0.00050			1.658	0.0 Swell
0.49	0.10870	0.00080			1.651	0.3 Compr.
0.98	0.11570	0.00100	0.05	0.001	1.627	1.2 Compr.
1.99	0.13180	0.00150	0.03	0.002	1.571	3.2 Compr.
4.00	0.16120	0.00200	0.03	0.004	1.469	7.1 Compr.
8.00	0.21940	0.00270	0.01	0.009	1.266	14.7 Compr.
15.96	0.28920	0.00360	0.01	0.013	1.022	23.9 Compr.
4.00	0.25580	0.00200			1.135	19.7 Compr.
0.98	0.21000	0.00100			1.293	13.7 Compr.
0.23	0.16990	0.00050			1.433	8.4 Compr.

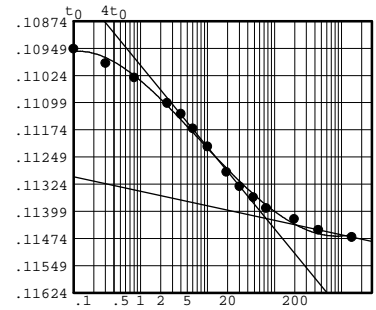
C_c = 0.82 P_c = 4.10 tsf C_r = 0.22

Pressure: 0.98 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10870	11	48.00	0.11460
2	0.10	0.11050	12	75.00	0.11490
3	0.30	0.11090	13	197.00	0.11520
4	0.80	0.11130	14	451.00	0.11550
5	2.50	0.11200	15	1426.00	0.11570
6	4.00	0.11230			
7	6.00	0.11270			
8	10.00	0.11320			
9	19.00	0.11390			
10	30.00	0.11430			



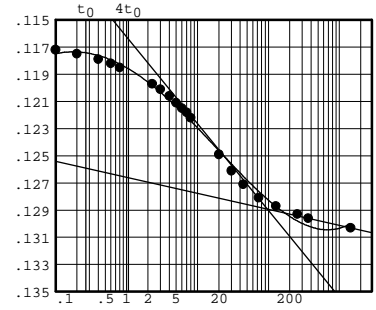
Void Ratio = 1.627 Compression = 1.2 %
 $D_0 = 0.10929$ $D_{50} = 0.11174$ $D_{100} = 0.11419$
 C_v at 5.5 min. = 0.05 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

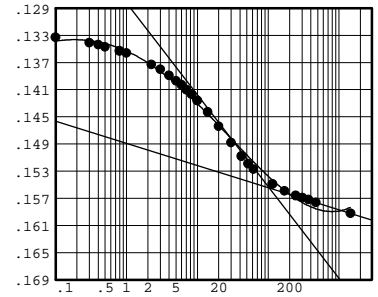
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11570	12	7.00	0.12330
2	0.10	0.11870	13	8.00	0.12370
3	0.20	0.11900	14	20.00	0.12640
4	0.40	0.11940	15	30.00	0.12760
5	0.60	0.11970	16	44.00	0.12860
6	0.80	0.12000	17	73.00	0.12960
7	2.30	0.12120	18	127.00	0.13020
8	3.00	0.12160	19	256.00	0.13080
9	4.00	0.12210	20	365.00	0.13110
10	5.00	0.12260	21	1440.00	0.13180
11	6.00	0.12300			



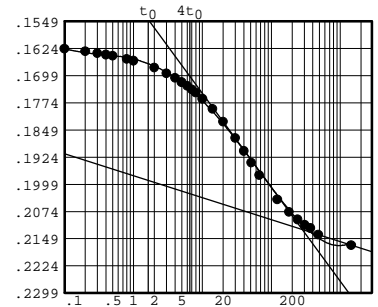
Void Ratio = 1.571 Compression = 3.2 %
 $D_0 = 0.11624$ $D_{50} = 0.12258$ $D_{100} = 0.12892$
 C_v at 8.6 min. = 0.03 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13180	15	10.00	0.14460
2	0.10	0.13530	16	14.00	0.14630
3	0.30	0.13610	17	20.00	0.14840
4	0.40	0.13640	18	30.00	0.15080
5	0.50	0.13670	19	42.00	0.15280
6	0.80	0.13730	20	52.00	0.15390
7	1.00	0.13760	21	62.00	0.15470
8	2.25	0.13930	22	115.00	0.15690
9	3.00	0.14000	23	170.00	0.15790
10	4.00	0.14090	24	244.00	0.15860
11	5.00	0.14170	25	304.00	0.15890
12	6.00	0.14230	26	370.00	0.15920
13	7.00	0.14300	27	470.00	0.15960
14	8.30	0.14370	28	1456.00	0.16120



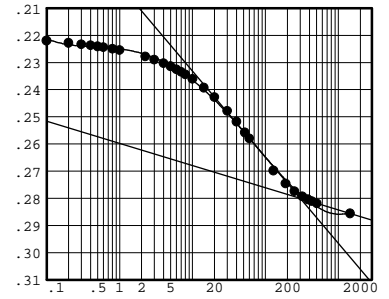
Void Ratio = 1.469 Compression = 7.1 %
 $D_0 = 0.13030$ $D_{50} = 0.14288$ $D_{100} = 0.15546$
 C_v at 9.6 min. = 0.03 ft.²/day $C_\alpha = 0.004$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16120	16	10.00	0.17900
2	0.10	0.16520	17	14.00	0.18180
3	0.20	0.16590	18	20.00	0.18530
4	0.30	0.16640	19	30.00	0.18980
5	0.40	0.16680	20	40.00	0.19340
6	0.50	0.16710	21	51.00	0.19660
7	0.80	0.16800	22	67.00	0.20010
8	1.00	0.16850	23	122.00	0.20680
9	2.00	0.17040	24	180.00	0.21020
10	3.00	0.17200	25	240.00	0.21230
11	4.00	0.17320	26	305.00	0.21380
12	5.00	0.17440	27	370.00	0.21470
13	6.00	0.17540	28	480.00	0.21650
14	7.00	0.17640	29	1441.00	0.21940
15	8.00	0.17730			



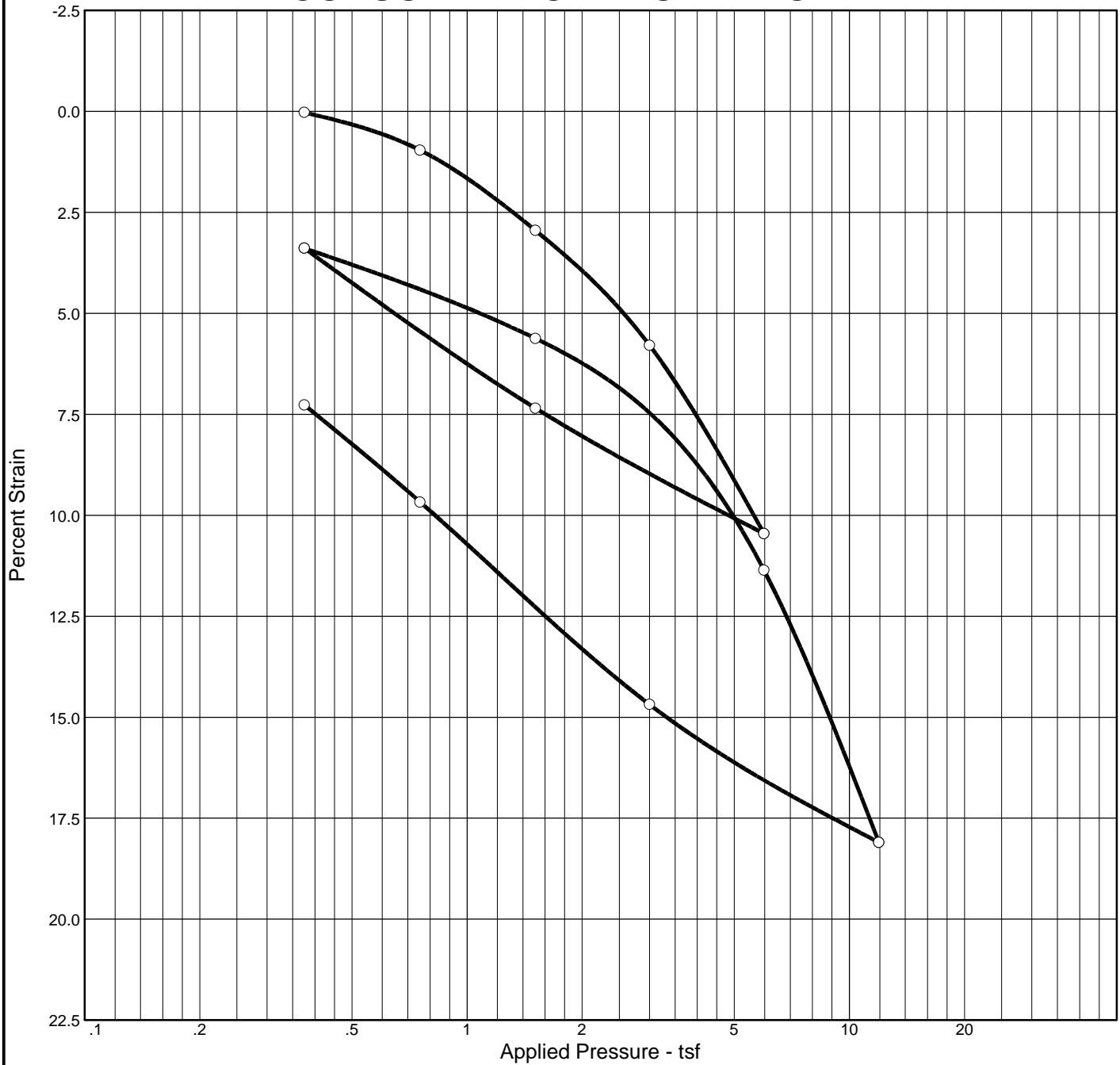
Void Ratio = 1.266 Compression = 14.7 %
 $D_0 = 0.15958$ $D_{50} = 0.18599$ $D_{100} = 0.21239$
 C_v at 26.3 min. = 0.01 ft.²/day $C_\alpha = 0.009$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.21940	17	10.00	0.23970
2	0.10	0.22560	18	14.30	0.24290
3	0.20	0.22640	19	20.00	0.24640
4	0.30	0.22690	20	30.00	0.25140
5	0.40	0.22730	21	40.00	0.25540
6	0.50	0.22770	22	52.00	0.25940
7	0.60	0.22800	23	60.00	0.26160
8	0.80	0.22860	24	129.00	0.27340
9	1.00	0.22910	25	189.00	0.27820
10	2.25	0.23140	26	250.00	0.28100
11	3.00	0.23260	27	320.00	0.28290
12	4.00	0.23390	28	381.00	0.28400
13	5.00	0.23500	29	432.00	0.28470
14	6.00	0.23610	30	508.00	0.28550
15	7.00	0.23710	31	1443.00	0.28920
16	8.00	0.23800			



Void Ratio = 1.022 Compression = 23.9 %
 $D_0 = 0.21670$ $D_{50} = 0.24838$ $D_{100} = 0.28006$
 C_v at 29.3 min. = 0.01 ft.²/day $C_\alpha = 0.013$

CONSOLIDATION TEST REPORT

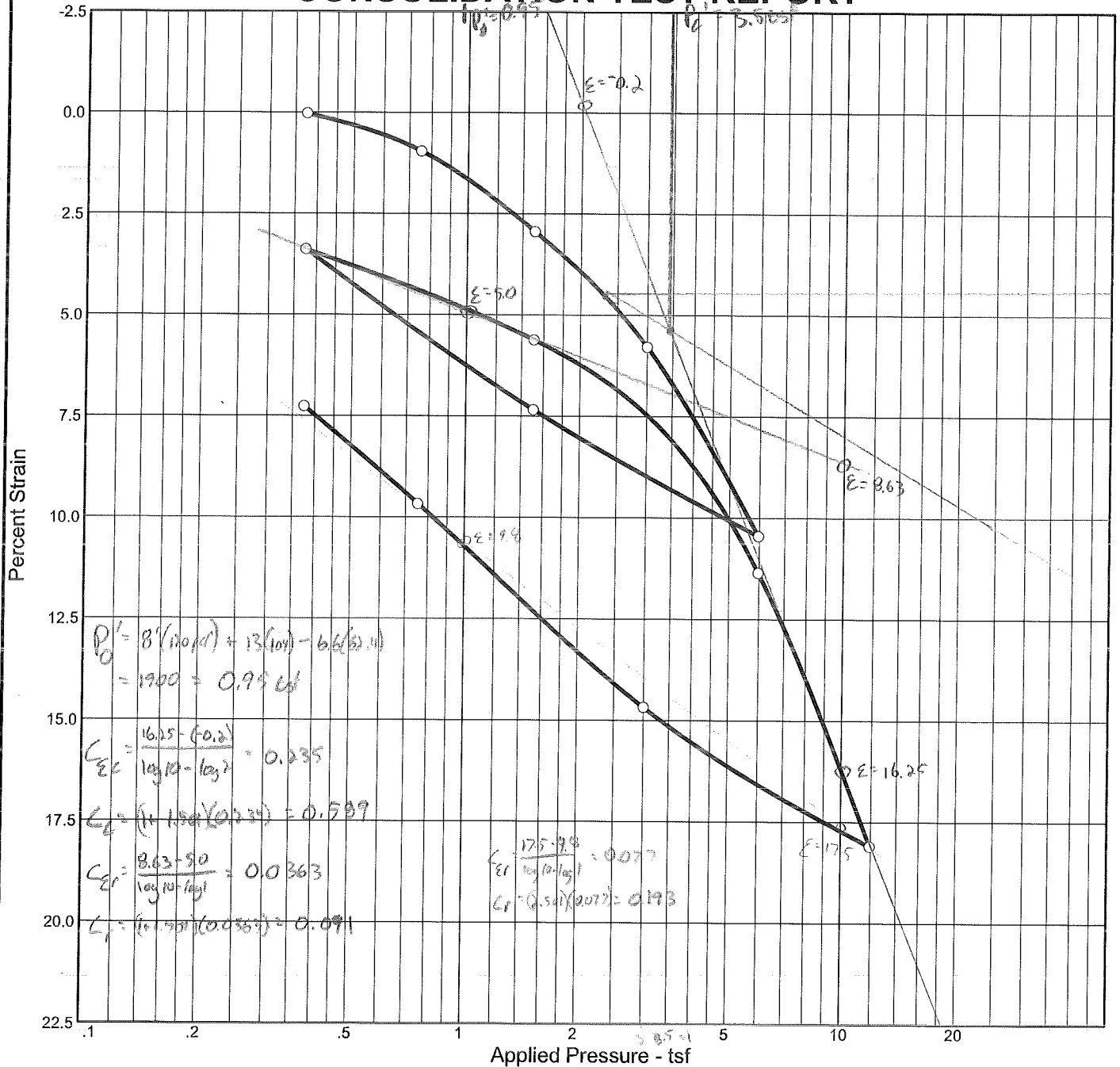


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
97.7 %	53.3 %	68.6	92	73	2.75		3.01	0.65	0.17			1.501

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH)	CH	

<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p>Location: Boring 09-59MU, #2, 20-22', WD-28, ND Div</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks: 5" Thinwall, Bottom of sample</p> <p style="color: red;">Fargo 09-59MU, #2, 20' - 22' Oxidized Brenna</p> <p style="text-align: right;">Figure</p>
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CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
97.7 %	53.3 %	68.6	92	73	2.75		3.01	0.65	0.17			1.501

MATERIAL DESCRIPTION										USCS	AASHTO
FAT CLAY, brown (CH)										CH	

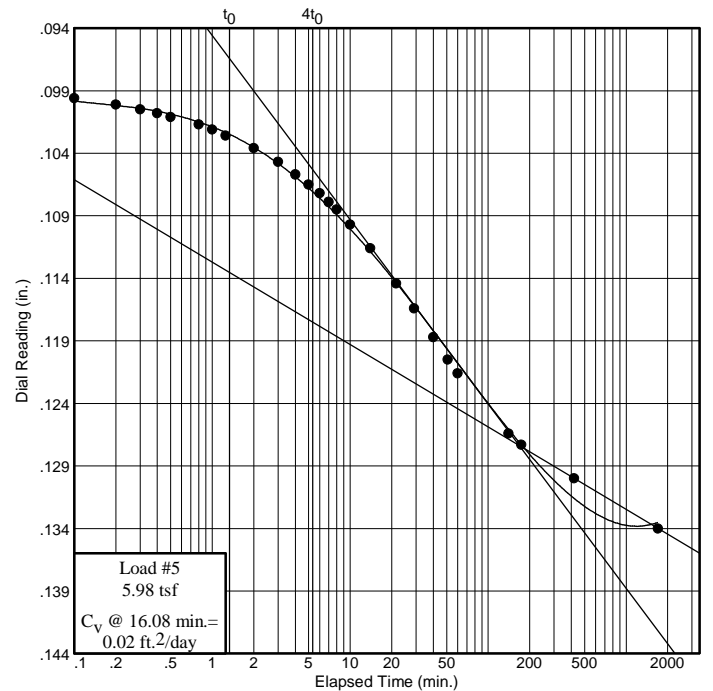
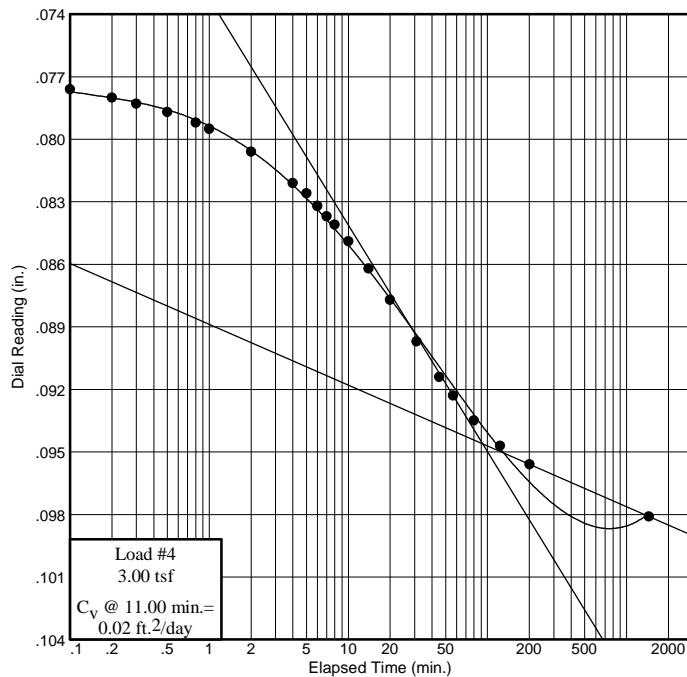
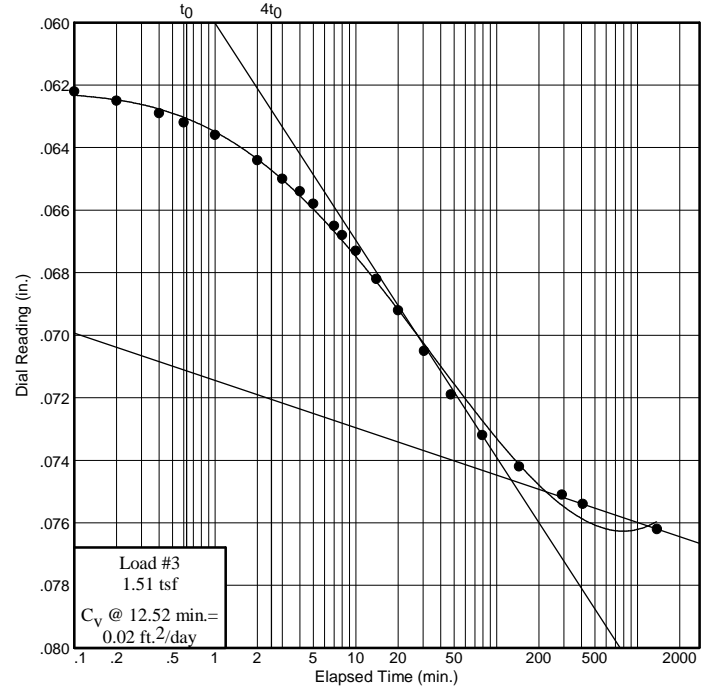
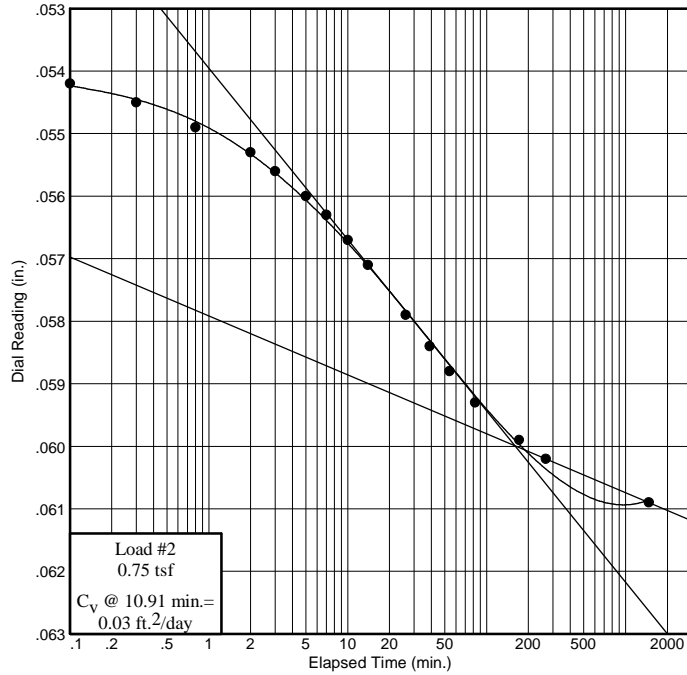
<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p style="text-align: center;">FAR</p> <p>Location: Boring 09-59MU, #2, 20-22', WD-28, ND Div</p> <p style="text-align: center;">BRAUN™ INTERTEC</p>	<p>Remarks:</p> <p>5" Thinwall, Bottom of sample</p> <p style="text-align: center;">Des. Bremen</p> <p>GWT = 14.4' BGS</p> <p style="text-align: right;">Figure</p>
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Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-59MU, #2, 20-22', WD-28, ND Div **Oxidized Brenna**



BRAUNSM
INTERTEC

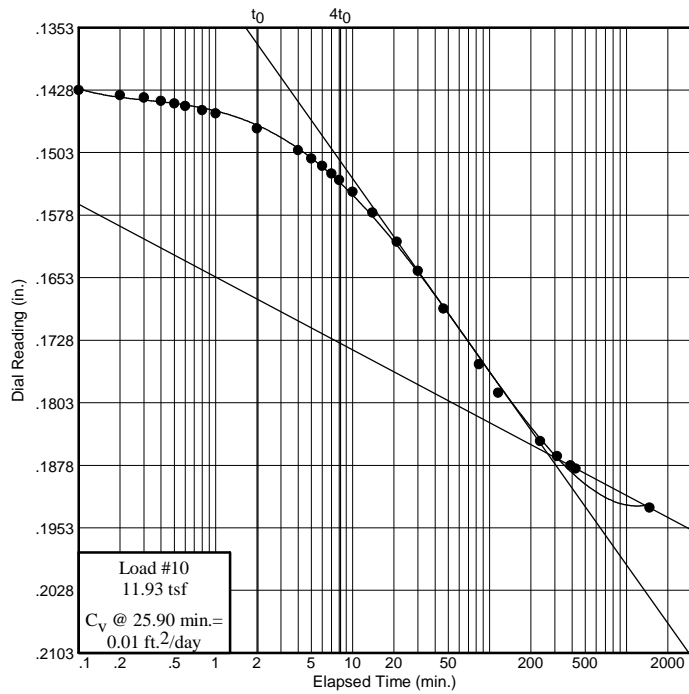
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-59MU, #2, 20-22', WD-28, ND Div **Oxidized Brenna**



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL0903127A

Sample Data

Source:

Sample No.: Boring 09-59MU, #2
Elev. or Depth: 20-22' **Sample Length(in./cm.):**
Location: Boring 09-59MU, #2, 20-22', WD-28, ND Div **Oxidized Brenna**
Description: FAT CLAY, brown (CH)
Liquid Limit: 92 **Plasticity Index:** 73
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks: 5" Thinwall, Bottom of sample

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 138.61 g.	Consolidometer # = 5	Wet w+t =
Dry w+t = 101.00 g.		Dry w+t =
Tare Wt. = 30.49 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .77 in.	Height = .77 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 104.55 g.	Defl. Table = Machine5-2009	
Moisture = 53.3 %	Ht. Solids = 0.3080 in.	Moisture = %
Wet Den. = 105.3 pcf	Dry Wt. = 68.18 g.*	Dry Wt. = n/a
Dry Den. = 68.6 pcf	Void Ratio = 1.501	Void Ratio = 1.319
	Saturation = 97.7 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.05350				1.501	
0.38	0.05480	0.00110			1.500	0.0 Compr.
0.75	0.06280	0.00190	0.03	0.001	1.477	1.0 Compr.
1.51	0.07920	0.00300	0.02	0.002	1.427	2.9 Compr.
3.00	0.10240	0.00430	0.02	0.004	1.356	5.8 Compr.
5.98	0.14000	0.00600	0.02	0.009	1.240	10.5 Compr.
1.51	0.11310	0.00300			1.317	7.3 Compr.
0.38	0.08070	0.00110			1.416	3.4 Compr.
1.51	0.09980	0.00300			1.360	5.6 Compr.
5.98	0.14700	0.00600			1.217	11.4 Compr.
11.93	0.20120	0.00830	0.01	0.013	1.048	18.1 Compr.
3.00	0.17090	0.00430			1.134	14.7 Compr.
0.75	0.12990	0.00190			1.259	9.7 Compr.
0.38	0.11060	0.00110			1.319	7.3 Compr.

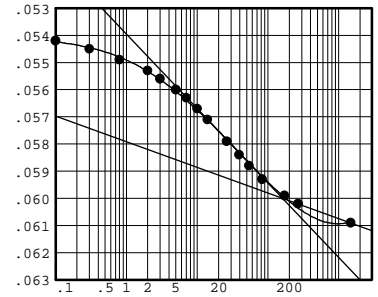
C_c = 0.65 P_c = 3.01 tsf C_r = 0.17

Pressure: 0.75 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.05480	11	26.20	0.05980
2	0.10	0.05610	12	39.00	0.06030
3	0.30	0.05640	13	54.00	0.06070
4	0.80	0.05680	14	82.50	0.06120
5	2.00	0.05720	15	171.50	0.06180
6	3.00	0.05750	16	266.50	0.06210
7	5.00	0.05790	17	1473.00	0.06280
8	7.00	0.05820			
9	10.00	0.05860			
10	14.00	0.05900			



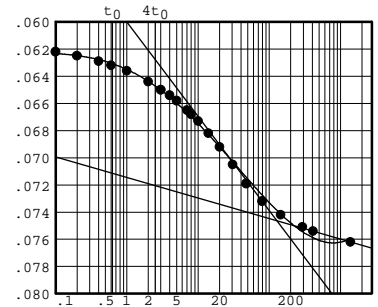
Void Ratio = 1.477 Compression = 1.0 %
 $D_0 = 0.05370$ $D_{50} = 0.05685$ $D_{100} = 0.05999$
 C_v at 10.9 min. = 0.03 ft.²/day $C_\alpha = 0.001$

Pressure: 1.51 tsf

TEST READINGS

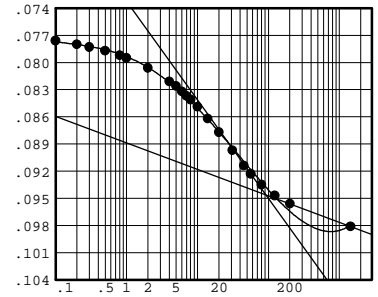
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06280	12	8.00	0.06980
2	0.10	0.06520	13	10.00	0.07030
3	0.20	0.06550	14	14.00	0.07120
4	0.40	0.06590	15	20.00	0.07220
5	0.60	0.06620	16	30.50	0.07350
6	1.00	0.06660	17	47.50	0.07490
7	2.00	0.06740	18	79.00	0.07620
8	3.00	0.06800	19	144.50	0.07720
9	4.00	0.06840	20	291.00	0.07810
10	5.00	0.06880	21	409.00	0.07840
11	7.00	0.06950	22	1379.50	0.07920



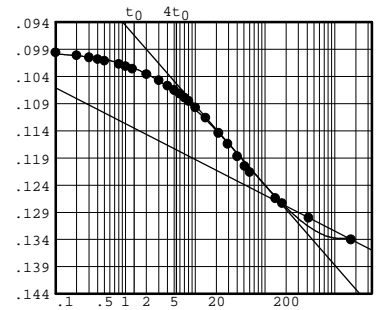
Void Ratio = 1.427 Compression = 2.9 %
 $D_0 = 0.06141$ $D_{50} = 0.06802$ $D_{100} = 0.07463$
 C_v at 12.5 min. = 0.02 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07920	13	8.00	0.08840
2	0.10	0.08190	14	10.00	0.08920
3	0.20	0.08230	15	14.00	0.09050
4	0.30	0.08260	16	20.00	0.09200
5	0.50	0.08300	17	31.00	0.09400
6	0.80	0.08350	18	45.00	0.09570
7	1.00	0.08380	19	56.50	0.09660
8	2.00	0.08490	20	80.00	0.09780
9	4.00	0.08640	21	123.00	0.09900
10	5.00	0.08690	22	201.00	0.09990
11	6.00	0.08750	23	1443.00	0.10240
12	7.00	0.08800			



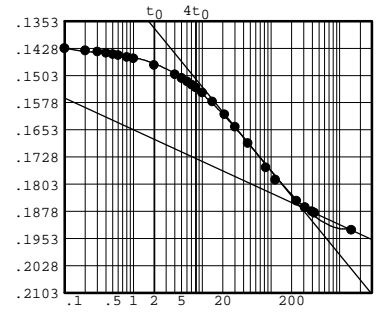
Void Ratio = 1.356 Compression = 5.8 %
 $D_0 = 0.07620$ $D_{50} = 0.08541$ $D_{100} = 0.09461$
 C_v at 11.0 min. = 0.02 ft.²/day $C_\alpha = 0.004$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10240	15	7.00	0.11390
2	0.10	0.10560	16	8.00	0.11450
3	0.20	0.10610	17	10.00	0.11570
4	0.30	0.10650	18	14.00	0.11760
5	0.40	0.10680	19	21.50	0.12040
6	0.50	0.10710	20	29.00	0.12240
7	0.80	0.10770	21	40.00	0.12470
8	1.00	0.10810	22	51.00	0.12650
9	1.25	0.10860	23	60.00	0.12760
10	2.00	0.10960	24	140.50	0.13240
11	3.00	0.11070	25	174.00	0.13330
12	4.00	0.11170	26	420.00	0.13600
13	5.00	0.11250	27	1699.00	0.14000
14	6.00	0.11320			



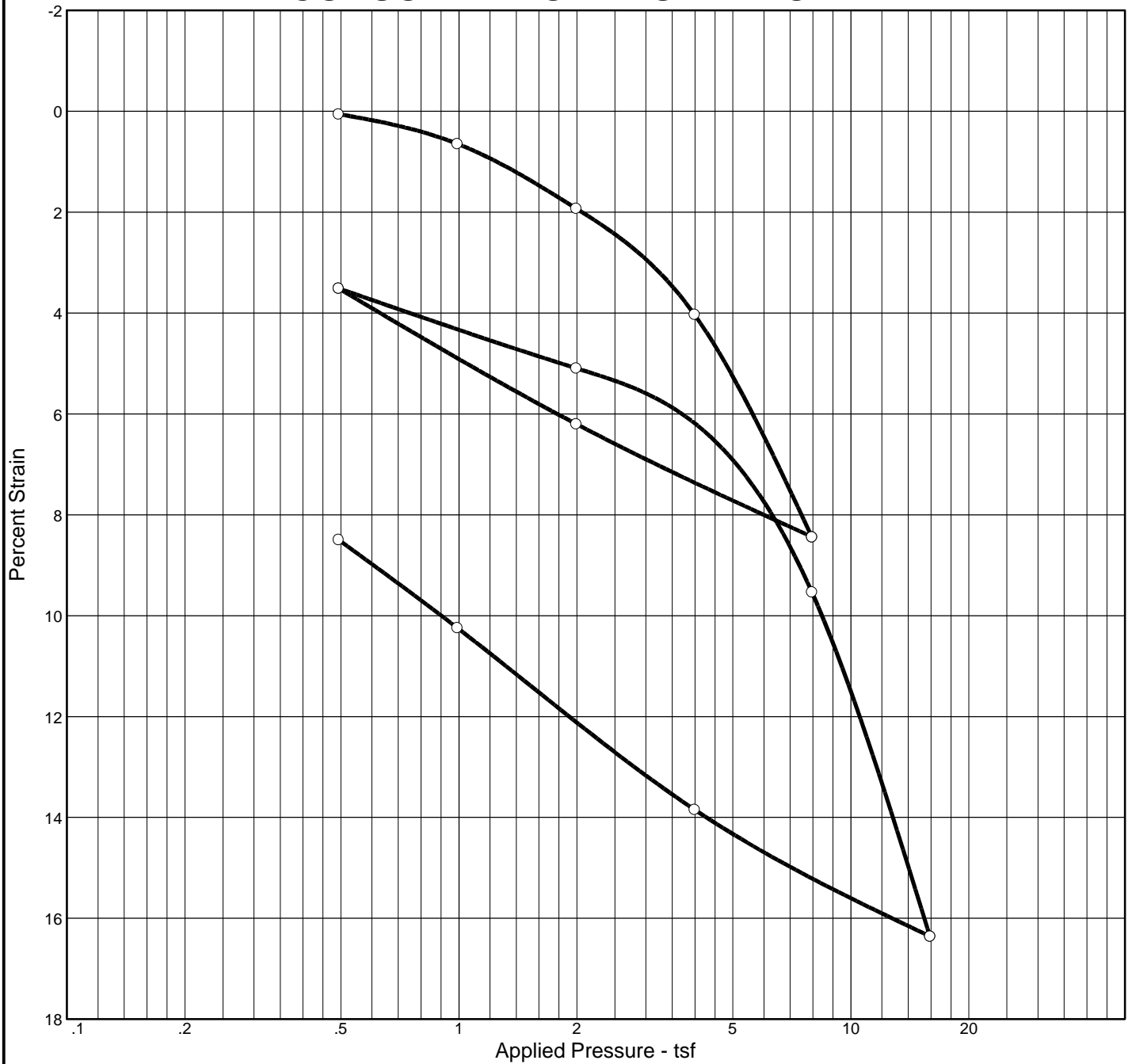
Void Ratio = 1.240 Compression = 10.5 %
 $D_0 = 0.09792$ $D_{50} = 0.11265$ $D_{100} = 0.12739$
 C_v at 16.1 min. = 0.02 ft.²/day $C_\alpha = 0.009$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14700	15	8.00	0.16190
2	0.10	0.15110	16	10.00	0.16330
3	0.20	0.15170	17	14.00	0.16580
4	0.30	0.15200	18	21.00	0.16930
5	0.40	0.15240	19	30.00	0.17280
6	0.50	0.15270	20	46.00	0.17730
7	0.60	0.15300	21	84.00	0.18400
8	0.80	0.15350	22	116.00	0.18740
9	1.00	0.15390	23	234.30	0.19320
10	2.00	0.15570	24	311.50	0.19500
11	4.00	0.15830	25	390.50	0.19610
12	5.00	0.15930	26	426.00	0.19650
13	6.00	0.16020	27	1471.00	0.20120
14	7.00	0.16110			



Void Ratio = 1.048 Compression = 18.1 %
 $D_0 = 0.14016$ $D_{50} = 0.16328$ $D_{100} = 0.18641$
 C_v at 25.9 min. = 0.01 ft.²/day $C_\alpha = 0.013$

CONSOLIDATION TEST REPORT

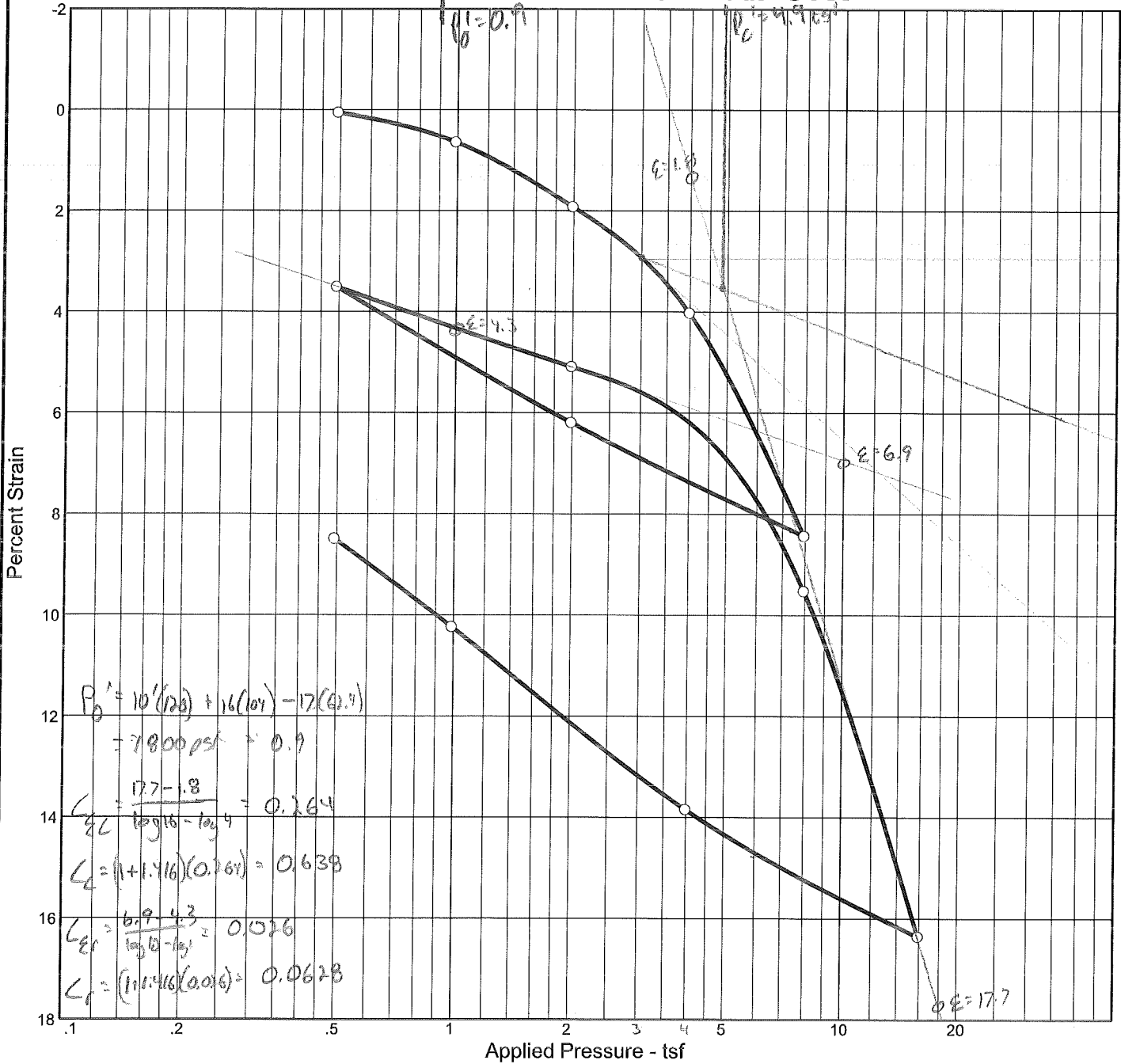


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
93.6 %	49.1 %	69.8	106	82	2.70		5.58	0.65	0.12			1.416

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH)	CH	

<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p>Location: Boring 09-60MU, #2, 25-27', WD-05, ND Div, Sherack Formation</p>	<p>Remarks:</p> <p>5" Thinwall, Bottom of sample</p> <p style="color: red;">Fargo</p> <p style="color: red;">09-60MU, #2, 25' - 27'</p> <p style="color: red;">Oxidized Brenna</p>
	<p>Figure</p>

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
93.6 %	49.1 %	69.8	106	82	2.70		5.58	0.65	0.12			1.416

MATERIAL DESCRIPTION										USCS	AASHTO
FAT CLAY, brown (CH)										CH	

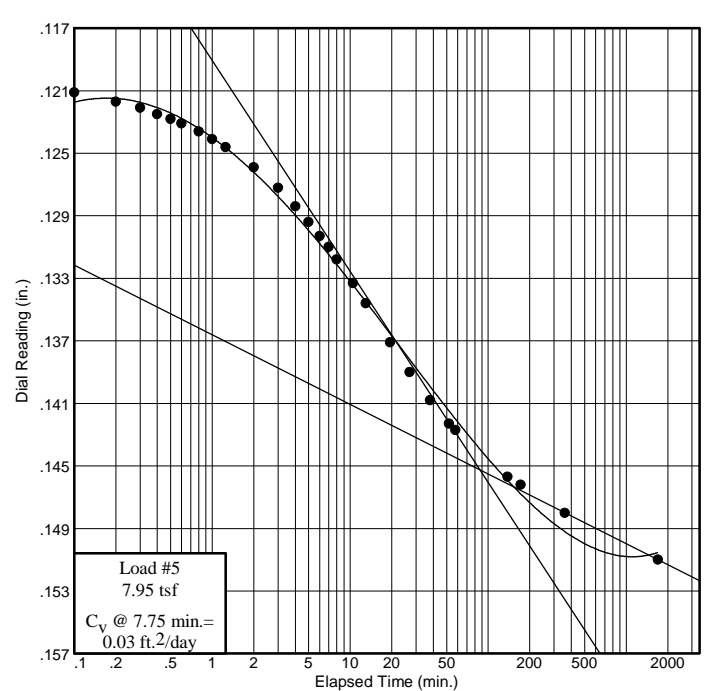
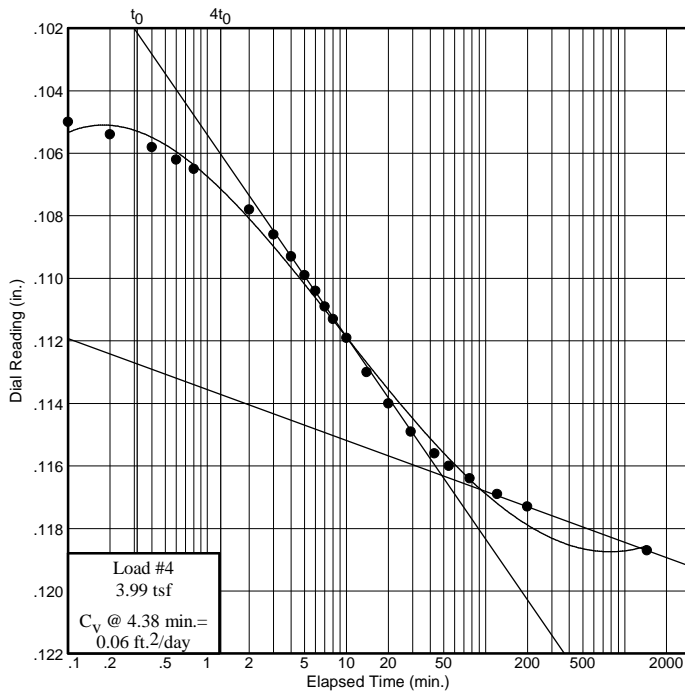
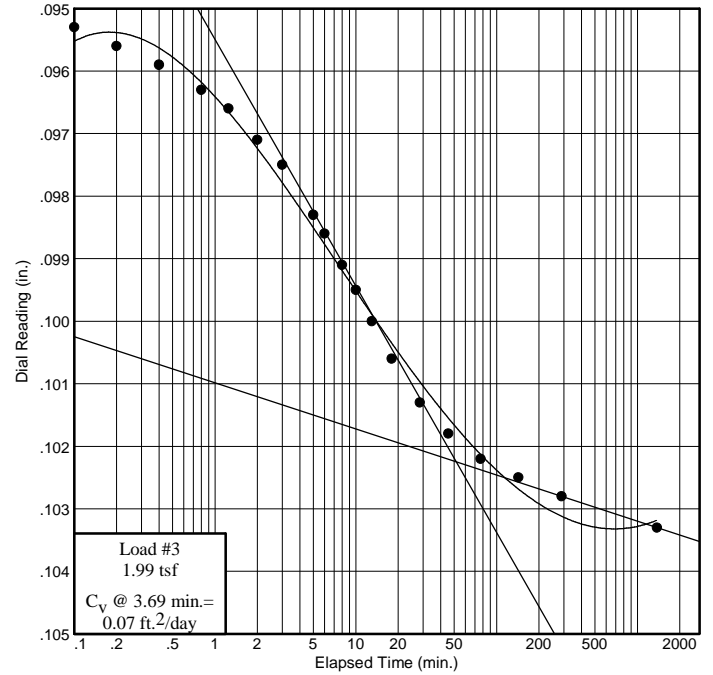
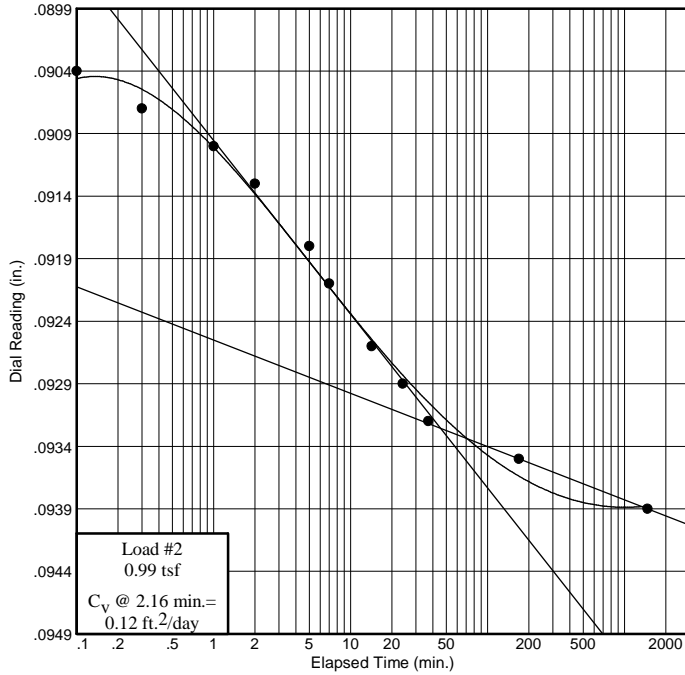
<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p>Location: Boring 09-60MU, #2, 25-27', WD-05, ND Div, <i>Des. Brenna</i> Sherack Formation</p>	<p>Remarks:</p> <p>5" Thinwall, Bottom of sample</p> <p><i>GW ~ 8' BGS</i></p>

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-60MU, #2, 25-27', WD-05, ND Div, ~~Shrinkage Formation~~ Oxidized Brenna



BRAUNSM
INTERTEC

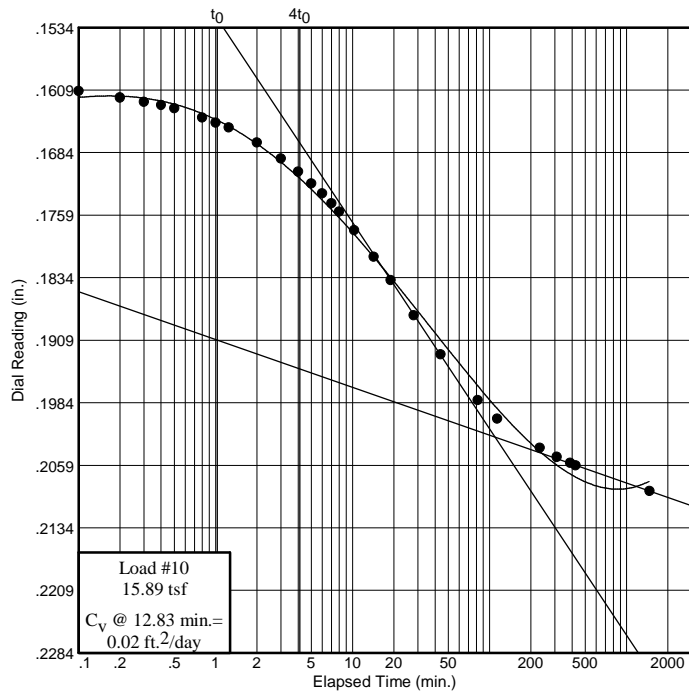
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-60MU, #2, 25-27', WD-05, ND Div, ~~Sherack Formation~~ Oxidized Brenna



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL0903127A

Sample Data

Source:

Sample No.: Boring 09-60MU, #2

Elev. or Depth: 25-27'

Sample Length(in./cm.):

Location: Boring 09-60MU, #2, 25-27', WD-05, ND Div, ~~Sherack Formation~~

Oxidized Brenna

Description: FAT CLAY, brown (CH)

Liquid Limit: 106

Plasticity Index: 82

USCS: CH

AASHTO:

Figure No.:

Testing Remarks: 5" Thinwall, Bottom of sample

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 154.86 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 114.23 g.		Dry w+t =
Tare Wt. = 31.41 g.	Spec. Gravity = 2.70	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 98.00 g.	Defl. Table = Machine3-2009	
Moisture = 49.1 %	Ht. Solids = 0.3032 in.	Moisture = %
Wet Den. = 104.0 pcf	Dry Wt. = 65.75 g.*	Dry Wt. = n/a
Dry Den. = 69.8 pcf	Void Ratio = 1.416	Void Ratio = 1.211
	Saturation = 93.6 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08920				1.416	
0.49	0.09010	0.00050			1.415	0.1 Compr.
0.99	0.09460	0.00070	0.12	0.001	1.400	0.6 Compr.
1.99	0.10430	0.00100	0.07	0.001	1.369	1.9 Compr.
3.99	0.12020	0.00150	0.06	0.002	1.319	4.0 Compr.
7.95	0.15300	0.00200	0.03	0.006	1.212	8.4 Compr.
1.99	0.13560	0.00100			1.266	6.2 Compr.
0.49	0.11540	0.00050			1.331	3.5 Compr.
1.99	0.12750	0.00100			1.293	5.1 Compr.
7.95	0.16100	0.00200			1.186	9.5 Compr.
15.89	0.21190	0.00290	0.02	0.009	1.021	16.4 Compr.
3.99	0.19210	0.00150			1.081	13.8 Compr.
0.99	0.16490	0.00070			1.169	10.2 Compr.
0.49	0.15190	0.00050			1.211	8.5 Compr.

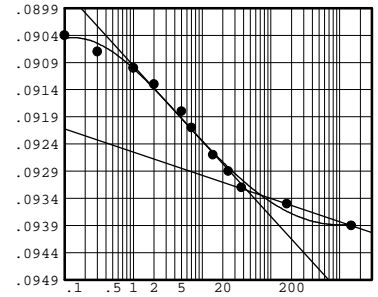
C_c = 0.65 P_c = 5.58 tsf C_r = 0.12

Pressure: 0.99 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09010	11	169.50	0.09420
2	0.10	0.09110	12	1472.00	0.09460
3	0.30	0.09140			
4	1.00	0.09170			
5	2.00	0.09200			
6	5.00	0.09250			
7	7.00	0.09280			
8	14.30	0.09330			
9	24.00	0.09360			
10	37.00	0.09390			



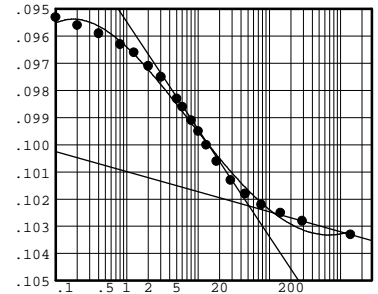
Void Ratio = 1.400 Compression = 0.6 %
 $D_0 = 0.08960$ $D_{50} = 0.09143$ $D_{100} = 0.09326$
 C_v at 2.2 min. = 0.12 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

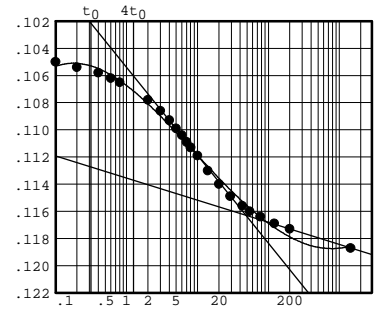
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09460	11	8.00	0.10010
2	0.10	0.09630	12	10.00	0.10050
3	0.20	0.09660	13	13.00	0.10100
4	0.40	0.09690	14	18.00	0.10160
5	0.80	0.09730	15	28.50	0.10230
6	1.25	0.09760	16	45.50	0.10280
7	2.00	0.09810	17	77.00	0.10320
8	3.00	0.09850	18	142.50	0.10350
9	5.00	0.09930	19	289.00	0.10380
10	6.00	0.09960	20	1378.00	0.10430



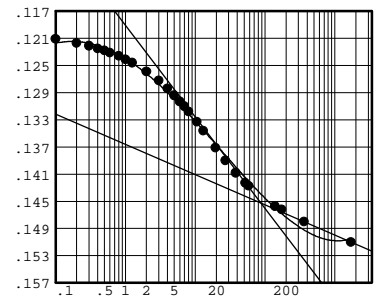
Void Ratio = 1.369 Compression = 1.9 %
 $D_0 = 0.09390$ $D_{50} = 0.09807$ $D_{100} = 0.10225$
 C_v at 3.7 min. = 0.07 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10430	13	8.00	0.11280
2	0.10	0.10650	14	10.00	0.11340
3	0.20	0.10690	15	14.00	0.11450
4	0.40	0.10730	16	20.00	0.11550
5	0.60	0.10770	17	29.00	0.11640
6	0.80	0.10800	18	43.00	0.11710
7	2.00	0.10930	19	54.50	0.11750
8	3.00	0.11010	20	77.00	0.11790
9	4.00	0.11080	21	121.00	0.11840
10	5.00	0.11140	22	199.00	0.11880
11	6.00	0.11190	23	1441.00	0.12020
12	7.00	0.11240			



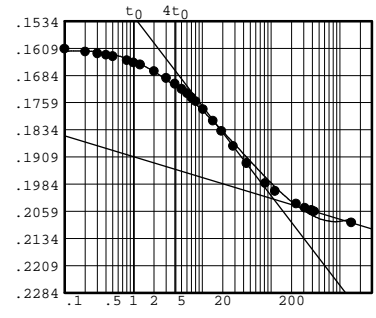
Void Ratio = 1.319 Compression = 4.0 %
 $D_0 = 0.10344$ $D_{50} = 0.10987$ $D_{100} = 0.11630$
 C_v at 4.4 min. = 0.06 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12020	15	6.00	0.13230
2	0.10	0.12310	16	7.00	0.13300
3	0.20	0.12370	17	8.00	0.13380
4	0.30	0.12410	18	10.50	0.13530
5	0.40	0.12450	19	13.00	0.13660
6	0.50	0.12480	20	19.50	0.13910
7	0.60	0.12510	21	27.00	0.14100
8	0.80	0.12560	22	38.00	0.14280
9	1.00	0.12610	23	52.00	0.14430
10	1.25	0.12660	24	58.00	0.14470
11	2.00	0.12790	25	138.50	0.14770
12	3.00	0.12920	26	172.00	0.14820
13	4.00	0.13040	27	360.00	0.15000
14	5.00	0.13140	28	1697.00	0.15300



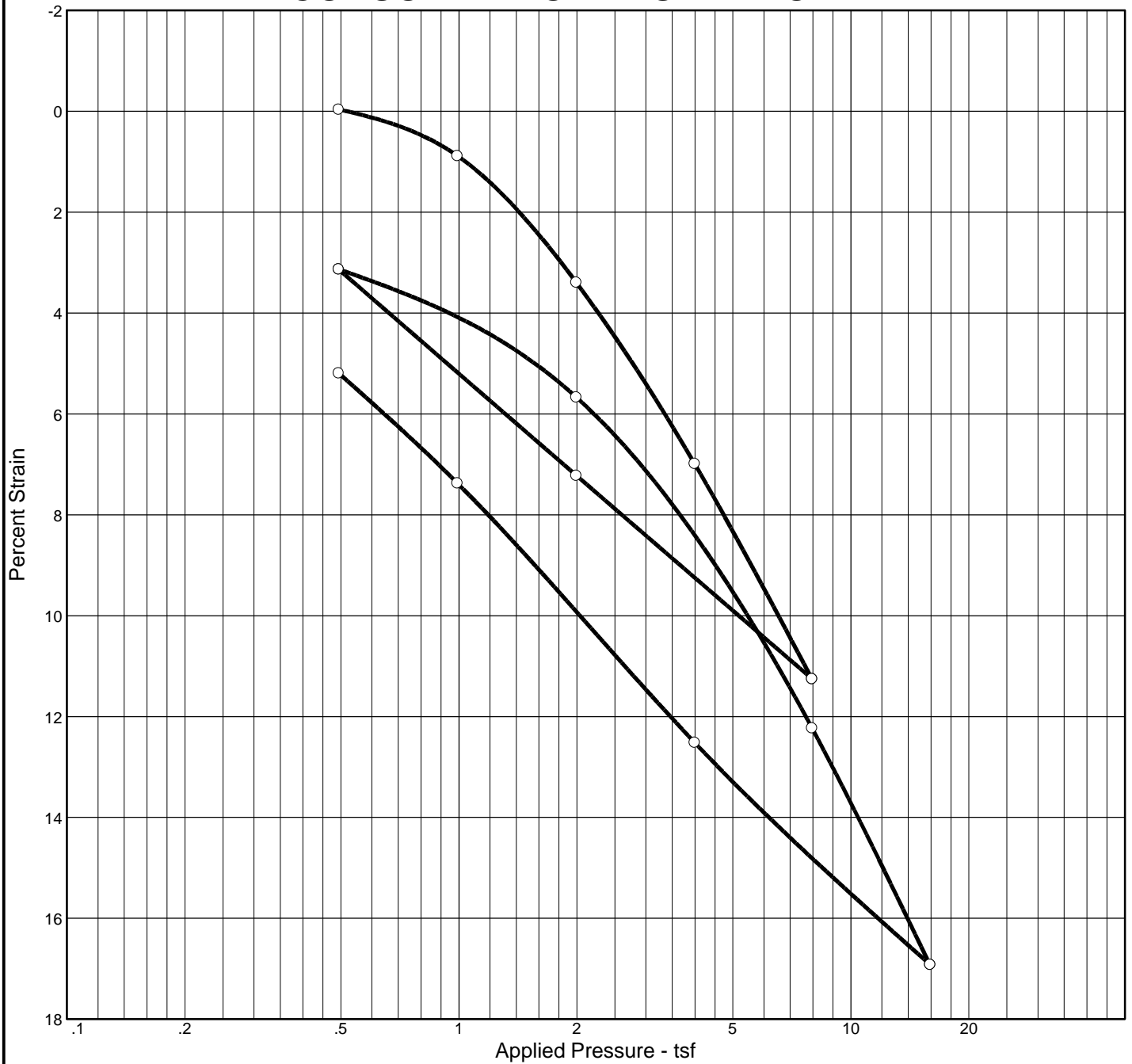
Void Ratio = 1.212 Compression = 8.4 %
 $D_0 = 0.11870$ $D_{50} = 0.13198$ $D_{100} = 0.14525$
 C_v at 7.7 min. = 0.03 ft.²/day $C_\alpha = 0.006$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16100	15	7.00	0.17740
2	0.10	0.16390	16	8.00	0.17840
3	0.20	0.16470	17	10.25	0.18060
4	0.30	0.16520	18	14.30	0.18380
5	0.40	0.16560	19	19.00	0.18660
6	0.50	0.16600	20	28.00	0.19080
7	0.80	0.16710	21	44.00	0.19550
8	1.00	0.16770	22	82.00	0.20100
9	1.25	0.16830	23	114.00	0.20320
10	2.00	0.17010	24	232.30	0.20670
11	3.00	0.17200	25	309.50	0.20780
12	4.00	0.17360	26	388.50	0.20850
13	5.00	0.17500	27	424.00	0.20880
14	6.00	0.17620	28	1469.00	0.21190



Void Ratio = 1.021 Compression = 16.4 %
 $D_0 = 0.15756$ $D_{50} = 0.18005$ $D_{100} = 0.20253$
 C_v at 12.8 min. = 0.02 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.0 %	48.0 %	73.9	113	81	2.777		1.69	0.37	0.17			1.346

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2850		

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 10-105MU, #1, 15-17', Maple River, Dessicated Brenna</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks:</p> <p>Load #3 C_v = 0.0050 ft/day Load #4 C_v = 0.0047 ft/day Load #5 C_v = 0.0047 ft/day Load #10 C_v = 0.0037 ft/day</p>
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Figure

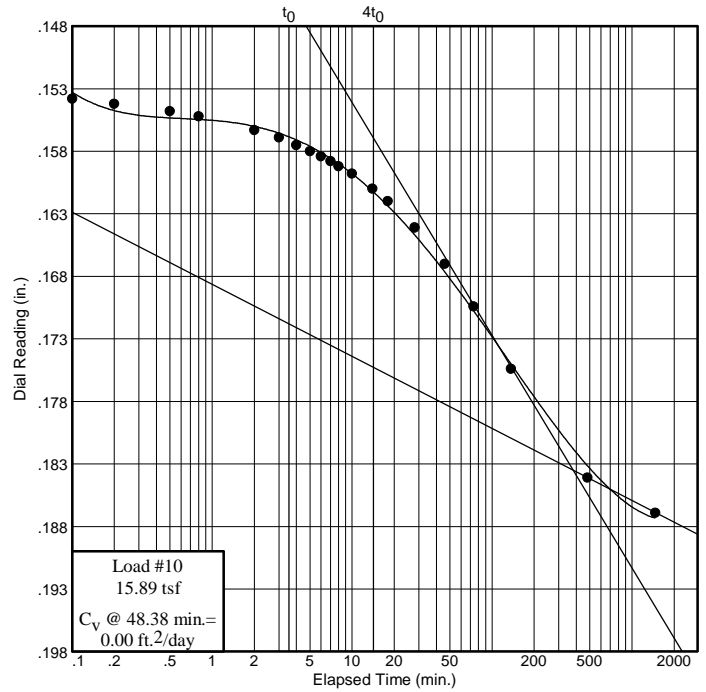
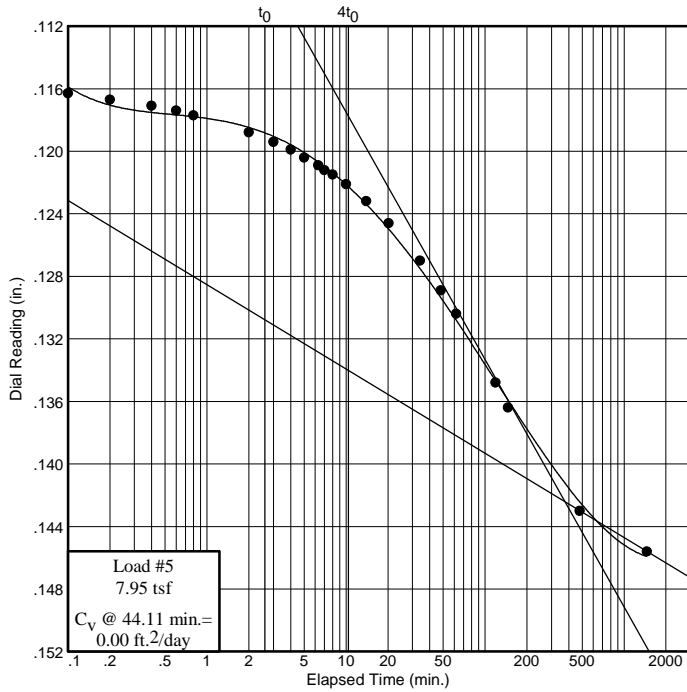
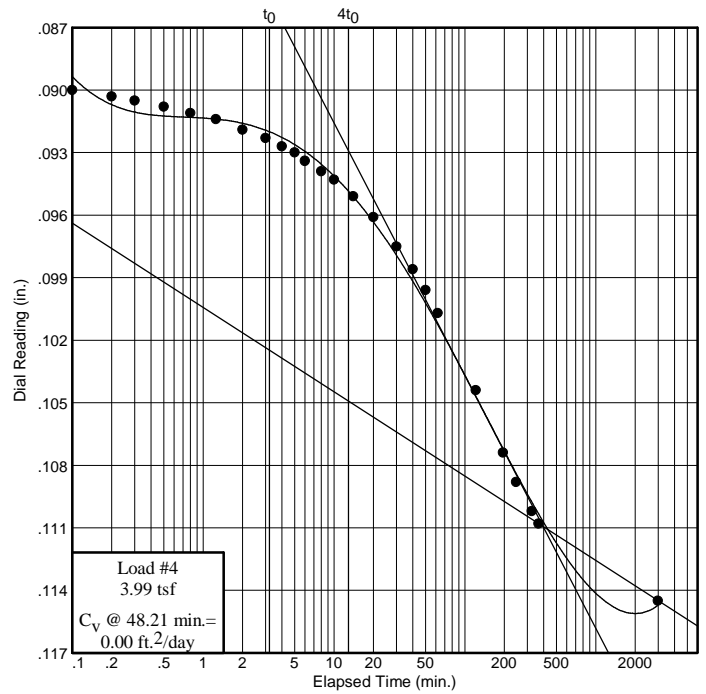
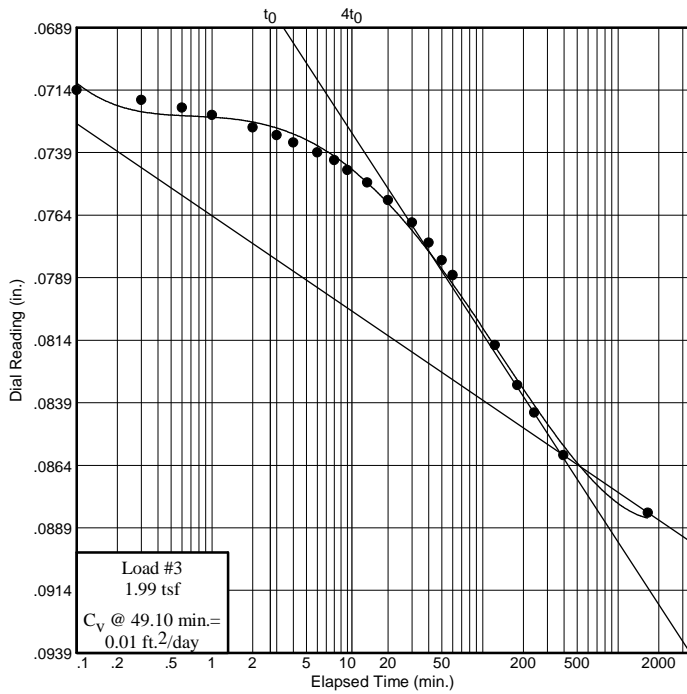
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring 10-105MU, #1, 15-17', Maple River, Dessicated Brenna



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring 10-105MU, #1
Elev. or Depth: 15-17' **Sample Length(in./cm.):**
Location: Boring 10-105MU, #1, 15-17', Maple River, Dessicated Brenna
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2850
Liquid Limit: 113 **Plasticity Index:** 81
USCS: **AASHTO:** **Figure No.:**

Testing Remarks: Load #3 Cv = 0.0050 ft²/day
 Load #4 Cv = 0.0047 ft²/day
 Load #5 Cv = 0.0047 ft²/day
 Load #10 Cv = 0.0037 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 143.26 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 106.79 g.		Dry w+t =
Tare Wt. = 30.80 g.	Spec. Gravity = 2.777	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 102.56 g.	Defl. Table = Machine3-2009	
Moisture = 48.0 %	Ht. Solids = 0.3107 in.	Moisture = %
Wet Den. = 109.4 pcf	Dry Wt. = 69.30 g.*	Dry Wt. = n/a
Dry Den. = 73.9 pcf	Void Ratio = 1.346	Void Ratio = 1.224
	Saturation = 99.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06360				1.346	
0.49	0.06380	0.00050			1.347	0.0 Swell
0.99	0.07070	0.00070			1.325	0.9 Compr.
1.99	0.08930	0.00100	0.01	0.005	1.267	3.4 Compr.
3.99	0.11600	0.00150	0.00	0.006	1.182	7.0 Compr.
7.95	0.14760	0.00200	0.00	0.008	1.082	11.2 Compr.
1.99	0.11720	0.00100			1.177	7.2 Compr.
0.49	0.08690	0.00050			1.273	3.1 Compr.
1.99	0.10590	0.00100			1.213	5.7 Compr.
7.95	0.15470	0.00200			1.059	12.2 Compr.
15.89	0.18980	0.00290	0.00	0.009	0.949	16.9 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression / Swell
3.99	0.15630	0.00150			1.053	12.5 Compr.
0.99	0.11800	0.00070			1.173	7.4 Compr.
0.49	0.10190	0.00050			1.224	5.2 Compr.

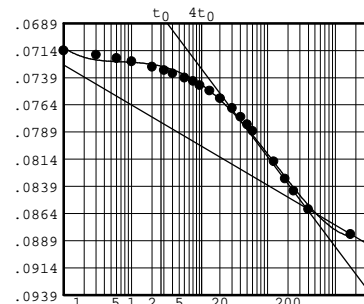
$C_c = 0.37$ $P_c = 1.69$ tsf $C_r = 0.17$

Pressure: 1.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07070	12	14.00	0.07610
2	0.10	0.07240	13	20.00	0.07680
3	0.30	0.07280	14	30.00	0.07770
4	0.60	0.07310	15	40.00	0.07850
5	1.00	0.07340	16	50.00	0.07920
6	2.00	0.07390	17	60.00	0.07980
7	3.00	0.07420	18	123.00	0.08260
8	4.00	0.07450	19	180.00	0.08420
9	6.00	0.07490	20	240.00	0.08530
10	8.00	0.07520	21	395.00	0.08700
11	10.00	0.07560	22	1662.00	0.08930



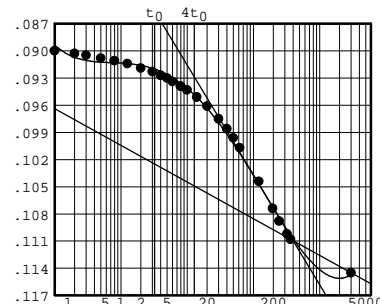
Void Ratio = 1.267 Compression = 3.4 %
 $D_0 = 0.07111$ $D_{50} = 0.07851$ $D_{100} = 0.08591$
 C_v at 49.1 min. = 0.01 ft.²/day $C_\alpha = 0.005$

Pressure: 3.99 tsf

TEST READINGS

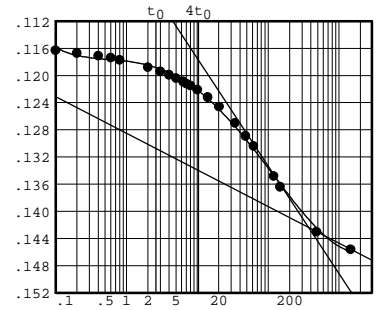
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08930	14	10.00	0.09580
2	0.10	0.09150	15	14.00	0.09660
3	0.20	0.09180	16	20.00	0.09760
4	0.30	0.09200	17	30.00	0.09900
5	0.50	0.09230	18	40.00	0.10010
6	0.80	0.09260	19	50.00	0.10110
7	1.25	0.09290	20	62.00	0.10220
8	2.00	0.09340	21	121.00	0.10590
9	3.00	0.09380	22	195.00	0.10890
10	4.00	0.09420	23	246.00	0.11030
11	5.00	0.09450	24	324.00	0.11170
12	6.00	0.09490	25	364.00	0.11230
13	8.00	0.09540	26	2985.00	0.11600



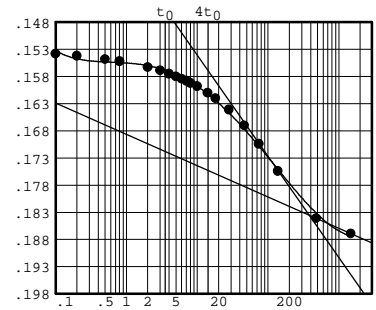
Void Ratio = 1.182 Compression = 7.0 %
 $D_0 = 0.08915$ $D_{50} = 0.10005$ $D_{100} = 0.11095$
 C_v at 48.2 min. = 0.00 ft.²/day $C_\alpha = 0.006$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11600	13	8.00	0.12350
2	0.10	0.11830	14	10.00	0.12410
3	0.20	0.11870	15	14.00	0.12520
4	0.40	0.11910	16	20.30	0.12660
5	0.60	0.11940	17	34.00	0.12900
6	0.80	0.11970	18	48.00	0.13090
7	2.00	0.12080	19	62.00	0.13240
8	3.00	0.12140	20	119.00	0.13680
9	4.00	0.12190	21	146.50	0.13840
10	5.00	0.12240	22	480.00	0.14500
11	6.30	0.12290	23	1457.00	0.14760
12	7.00	0.12320			



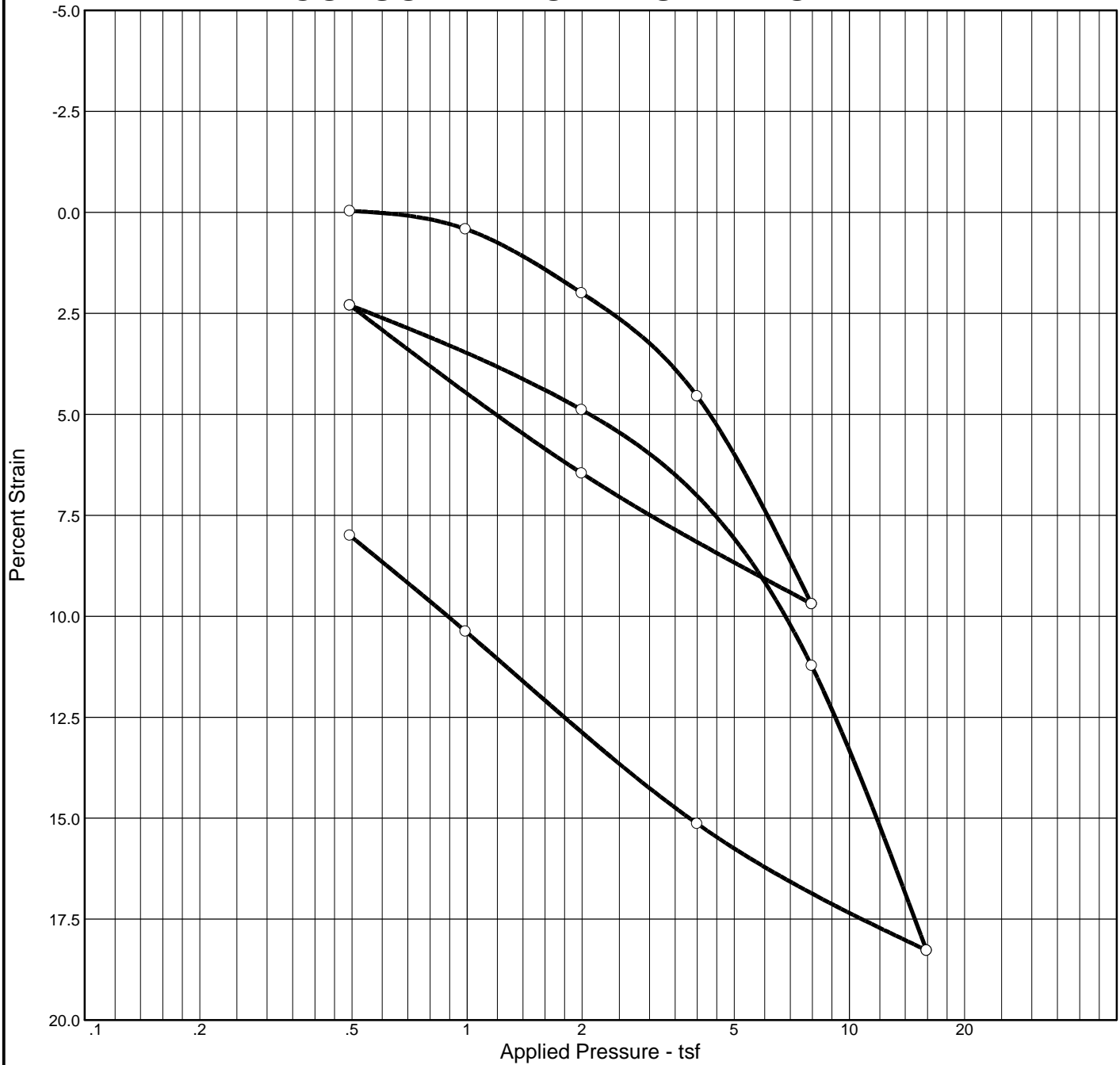
Void Ratio = 1.082 Compression = 11.2 %
 $D_0 = 0.11537$ $D_{50} = 0.12890$ $D_{100} = 0.14244$
 C_v at 44.1 min. = 0.00 ft.²/day $C_\alpha = 0.008$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.15470	12	8.00	0.16210
2	0.10	0.15670	13	10.00	0.16270
3	0.20	0.15710	14	14.00	0.16390
4	0.50	0.15770	15	18.00	0.16490
5	0.80	0.15810	16	28.00	0.16700
6	2.00	0.15920	17	46.00	0.16990
7	3.00	0.15980	18	74.00	0.17330
8	4.00	0.16040	19	137.00	0.17830
9	5.00	0.16090	20	480.00	0.18700
10	6.00	0.16130	21	1469.00	0.18980
11	7.00	0.16170			



Void Ratio = 0.949 Compression = 16.9 %
 $D_0 = 0.15245$ $D_{50} = 0.16799$ $D_{100} = 0.18352$
 C_v at 48.4 min. = 0.00 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.3 %	44.0 %	76.8	82	59	2.710		3.42	0.57	0.15			1.202

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 11-110MU, #1, 25-27', Sheyenne River, OX Brenna Formation</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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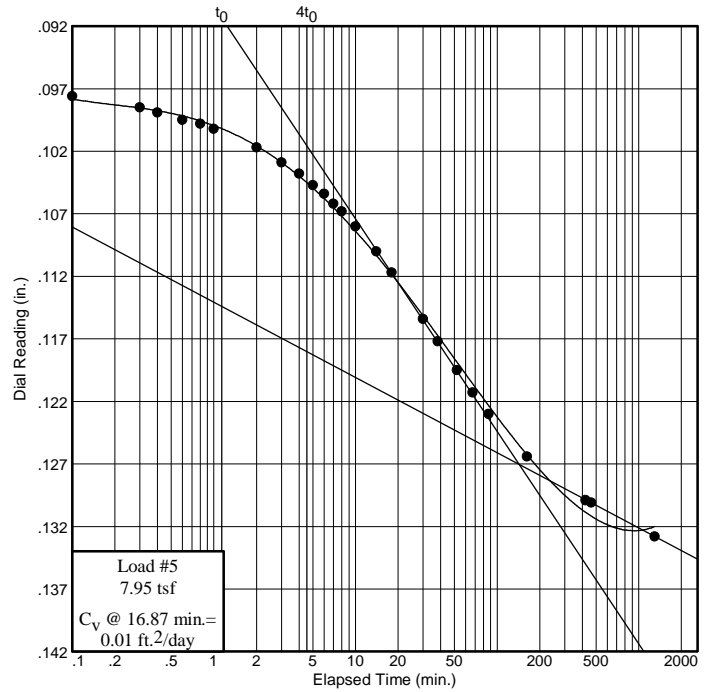
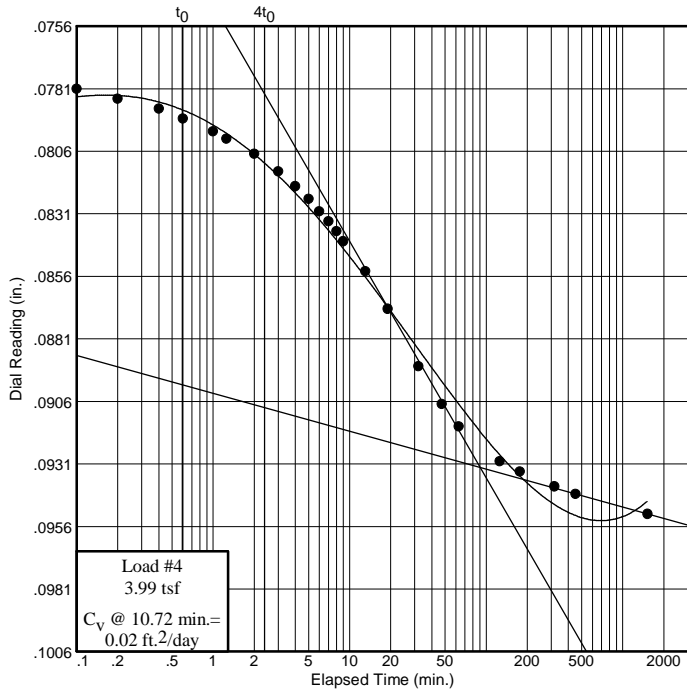
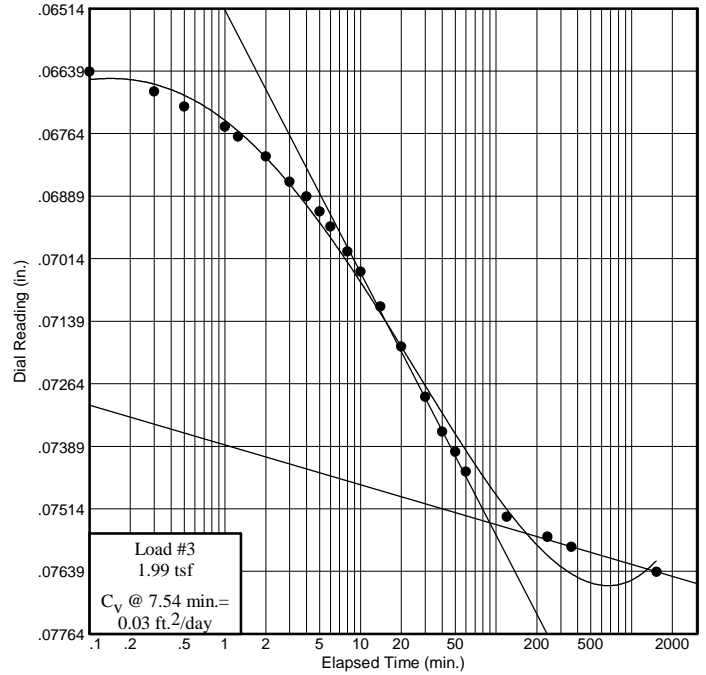
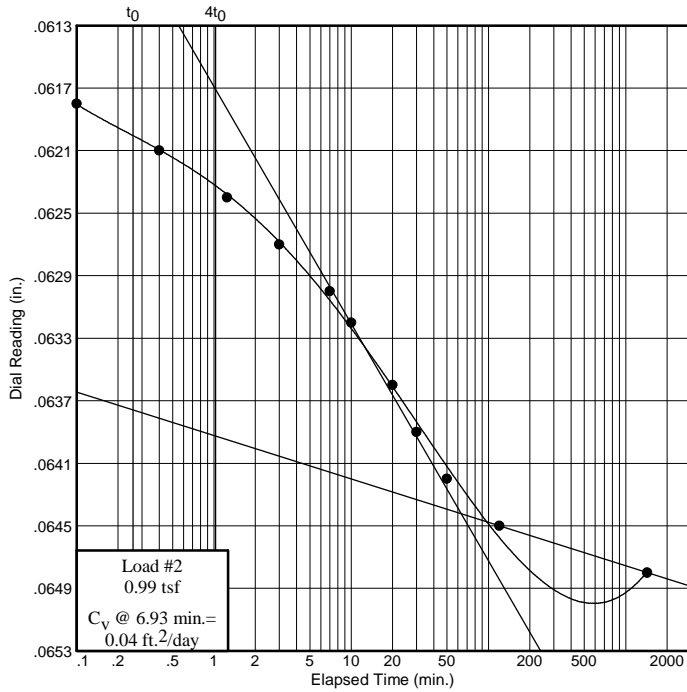
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #1, 25-27', Sheyenne River, OX Brenna Formation



BRAUNSM
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Figure

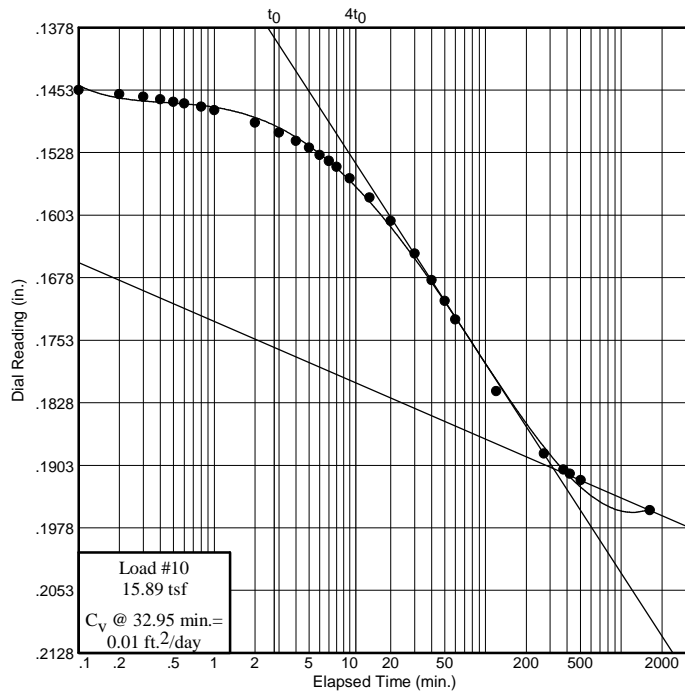
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #1, 25-27', Sheyenne River, OX Brenna Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #1
Elev. or Depth: 25-27
Location: Boring11-110MU, #1, 25-27', Sheyenne River, OX Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 82
Plasticity Index: 59
USCS: CH
AASHTO:
Figure No.:
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 142.37 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 108.25 g.		Dry w+t =
Tare Wt. = 30.78 g.	Spec. Gravity = 2.710	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 104.36 g.	Defl. Table = Machine3-2009	
Moisture = 44.0 %	Ht. Solids = 0.3329 in.	Moisture = %
Wet Den. = 110.7 pcf	Dry Wt. = 72.45 g.*	Dry Wt. = n/a
Dry Den. = 76.8 pcf	Void Ratio = 1.202	Void Ratio = 1.026
	Saturation = 99.3 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06180				1.202	
0.49	0.06200	0.00050			1.203	0.0 Swell
0.99	0.06550	0.00070	0.04	0.000	1.193	0.4 Compr.
1.99	0.07740	0.00100	0.03	0.001	1.158	2.0 Compr.
3.99	0.09660	0.00150	0.02	0.002	1.102	4.5 Compr.
7.95	0.13480	0.00200	0.01	0.009	0.989	9.7 Compr.
1.99	0.11010	0.00100			1.060	6.5 Compr.
0.49	0.07910	0.00050			1.151	2.3 Compr.
1.99	0.09860	0.00100			1.094	4.9 Compr.
7.95	0.14600	0.00200			0.955	11.2 Compr.
15.89	0.19860	0.00290	0.01	0.011	0.800	18.3 Compr.
3.99	0.17420	0.00150			0.869	15.1 Compr.
0.99	0.13850	0.00070			0.974	10.4 Compr.
0.49	0.12090	0.00050			1.026	8.0 Compr.

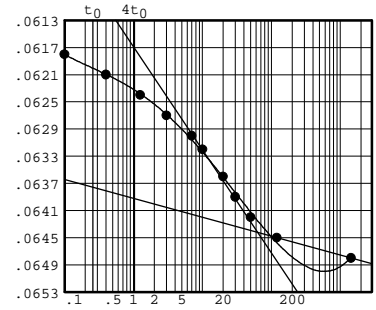
$C_c = 0.57$ $P_c = 3.42$ tsf $C_r = 0.15$

Pressure: 0.99 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06200	11	120.00	0.06520
2	0.10	0.06250	12	1439.00	0.06550
3	0.40	0.06280			
4	1.25	0.06310			
5	3.00	0.06340			
6	7.00	0.06370			
7	10.00	0.06390			
8	20.00	0.06430			
9	30.00	0.06460			
10	50.00	0.06490			



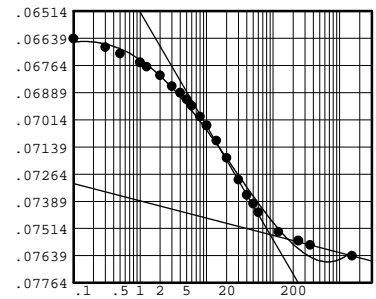
Void Ratio = 1.193 Compression = 0.4 %
 $D_0 = 0.06168$ $D_{50} = 0.06305$ $D_{100} = 0.06442$
 C_v at 6.9 min. = 0.04 ft.²/day $C_\alpha = 0.000$

Pressure: 1.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06550	13	10.00	0.07140
2	0.10	0.06740	14	14.00	0.07210
3	0.30	0.06780	15	20.00	0.07290
4	0.50	0.06810	16	30.00	0.07390
5	1.00	0.06850	17	40.00	0.07460
6	1.25	0.06870	18	50.00	0.07500
7	2.00	0.06910	19	60.00	0.07540
8	3.00	0.06960	20	120.00	0.07630
9	4.00	0.06990	21	240.00	0.07670
10	5.00	0.07020	22	360.00	0.07690
11	6.00	0.07050	23	1529.00	0.07740
12	8.00	0.07100			



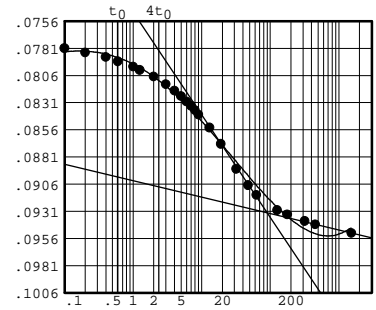
Void Ratio = 1.158 Compression = 2.0 %
 $D_0 = 0.06480$ $D_{50} = 0.07011$ $D_{100} = 0.07542$
 C_v at 7.5 min. = 0.03 ft.²/day $C_\alpha = 0.001$

Pressure: 3.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07740	14	8.00	0.08530
2	0.10	0.07960	15	9.00	0.08570
3	0.20	0.08000	16	13.00	0.08690
4	0.40	0.08040	17	19.00	0.08840
5	0.60	0.08080	18	32.00	0.09070
6	1.00	0.08130	19	47.30	0.09220
7	1.25	0.08160	20	63.00	0.09310
8	2.00	0.08220	21	126.00	0.09450
9	3.00	0.08290	22	177.00	0.09490
10	4.00	0.08350	23	317.00	0.09550
11	5.00	0.08400	24	452.00	0.09580
12	6.00	0.08450	25	1523.00	0.09660
13	7.00	0.08490			



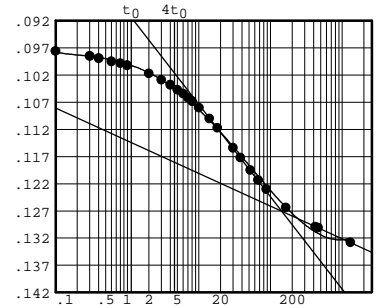
Void Ratio = 1.102 Compression = 4.5 %
 $D_0 = 0.07681$ $D_{50} = 0.08503$ $D_{100} = 0.09324$
 C_v at 10.7 min. = 0.02 ft.²/day $C_\alpha = 0.002$

Pressure: 7.95 tsf

TEST READINGS

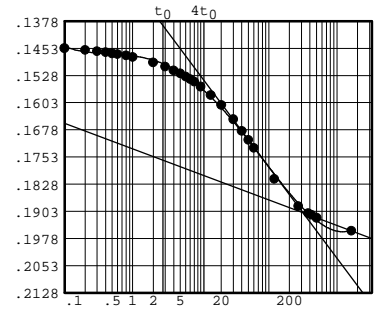
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09660	14	8.00	0.10880
2	0.10	0.09960	15	10.00	0.11000
3	0.30	0.10050	16	14.00	0.11200
4	0.40	0.10090	17	18.00	0.11370
5	0.60	0.10150	18	30.00	0.11740
6	0.80	0.10180	19	38.00	0.11920
7	1.00	0.10220	20	52.00	0.12150
8	2.00	0.10370	21	67.00	0.12330
9	3.00	0.10490	22	87.00	0.12500
10	4.00	0.10580	23	163.00	0.12840
11	5.00	0.10670	24	421.00	0.13190
12	6.00	0.10740	25	462.00	0.13210
13	7.00	0.10820	26	1299.00	0.13480



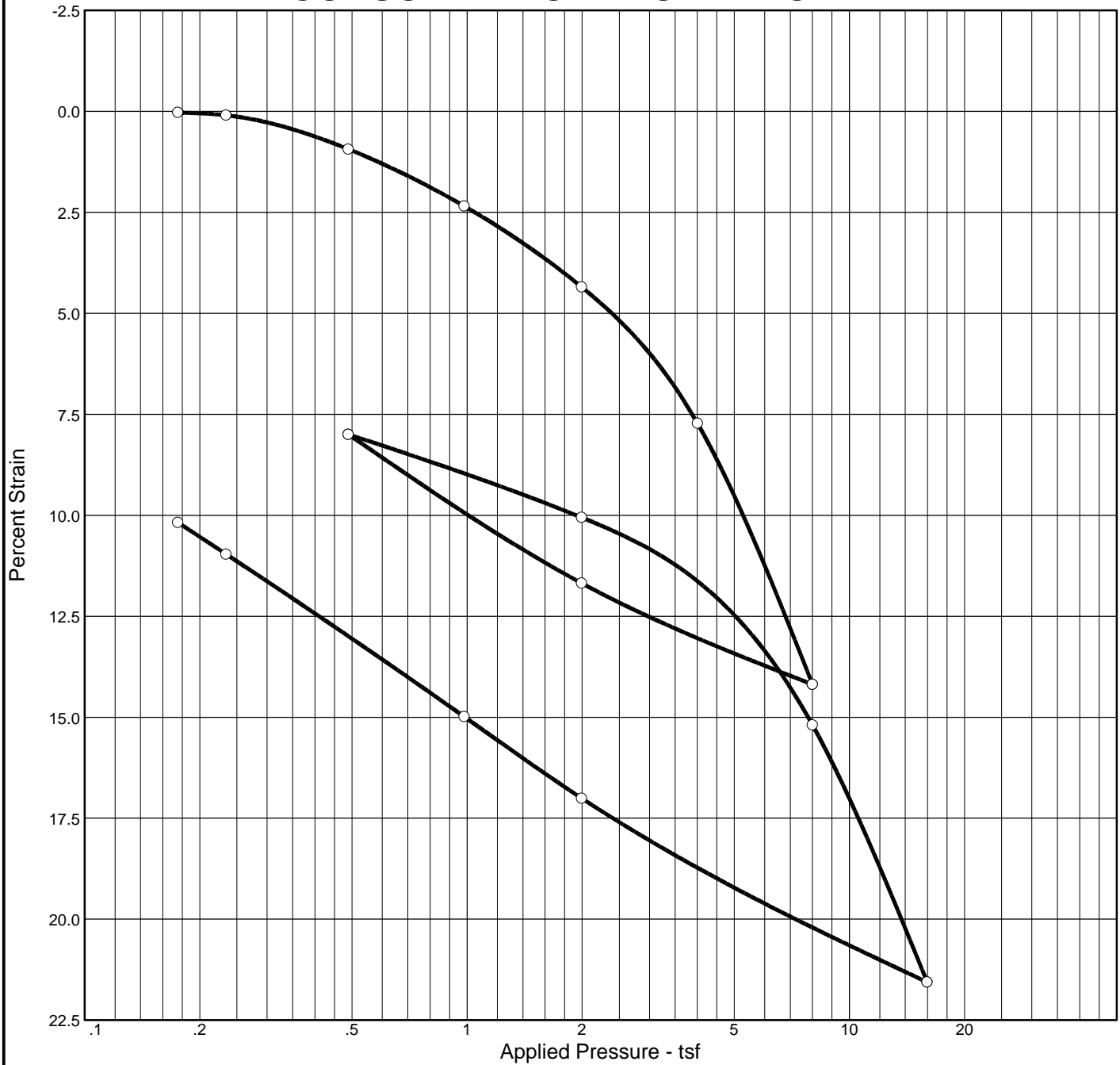
Void Ratio = 0.989 Compression = 9.7 %
 $D_0 = 0.09586$ $D_{50} = 0.11145$ $D_{100} = 0.12704$
 C_v at 16.9 min. = 0.01 ft.²/day $C_\alpha = 0.009$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14600	16	8.00	0.15740
2	0.10	0.14820	17	10.00	0.15880
3	0.20	0.14870	18	14.00	0.16110
4	0.30	0.14900	19	20.00	0.16390
5	0.40	0.14930	20	30.00	0.16780
6	0.50	0.14960	21	40.00	0.17100
7	0.60	0.14980	22	50.00	0.17350
8	0.80	0.15020	23	60.00	0.17570
9	1.00	0.15060	24	120.00	0.18430
10	2.00	0.15210	25	270.00	0.19180
11	3.00	0.15330	26	376.00	0.19370
12	4.00	0.15430	27	420.00	0.19420
13	5.00	0.15510	28	503.00	0.19500
14	6.00	0.15600	29	1629.00	0.19860
15	7.00	0.15670			



Void Ratio = 0.800 Compression = 18.3 %
 $D_0 = 0.14215$ $D_{50} = 0.16642$ $D_{100} = 0.19069$
 C_v at 32.9 min. = 0.01 ft.²/day $C_\alpha = 0.011$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.4 %	47.8 %	74.1	91	67	2.767		3.61	0.57	0.14			1.332

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 2</p> <p>Location: Boring11-118MU, #1, 20-21', Wild Rice, OX Brenna Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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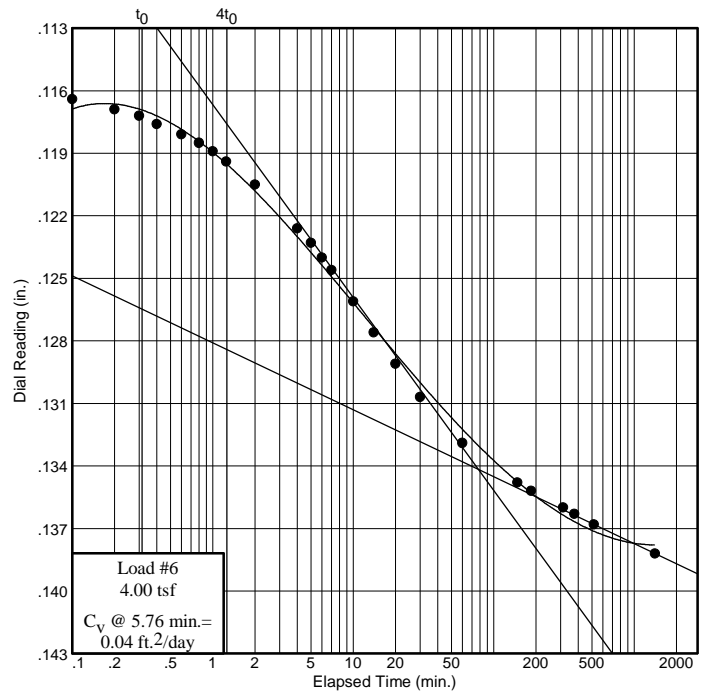
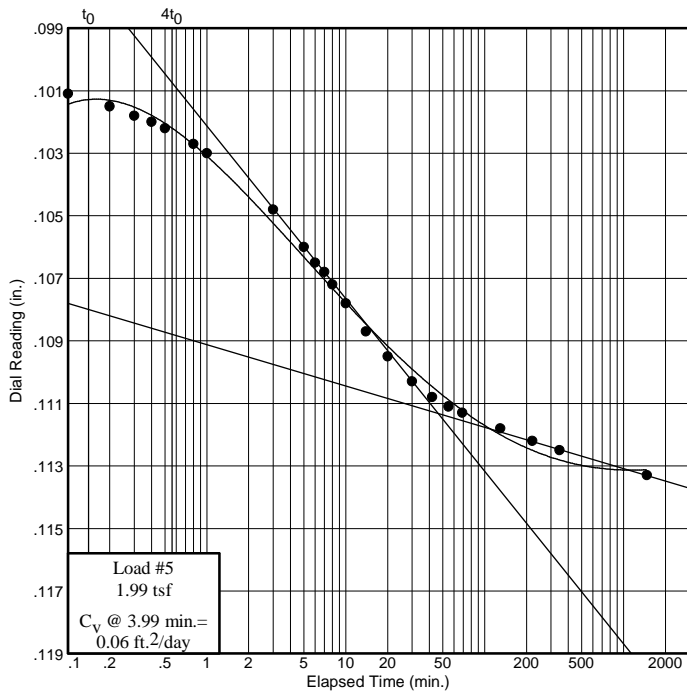
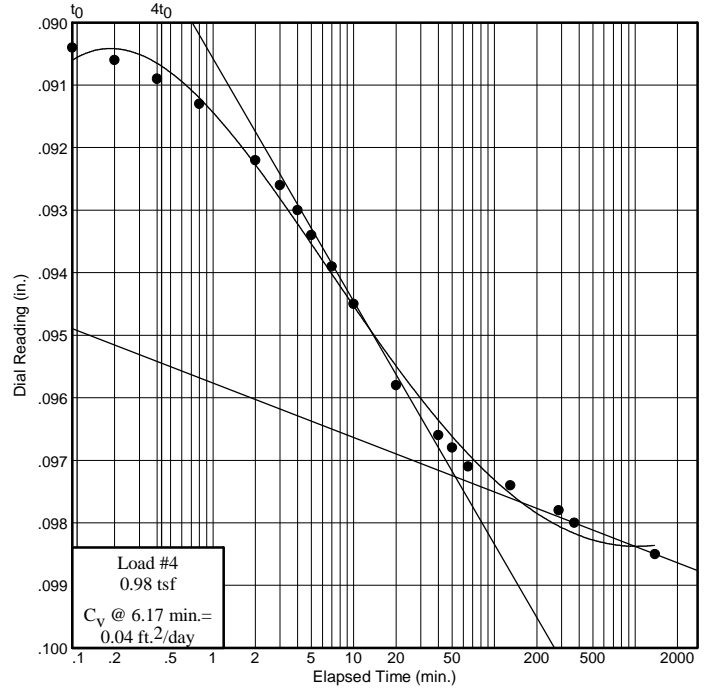
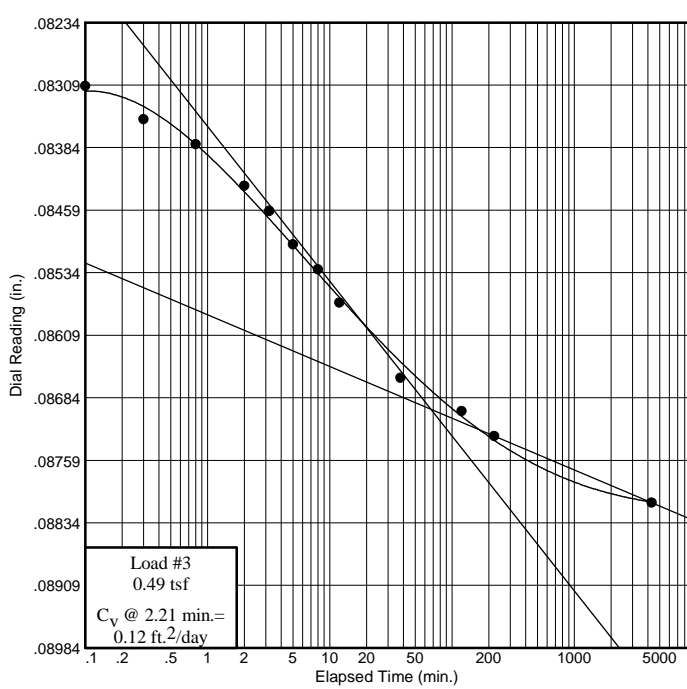
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #1, 20-21', Wild Rice, OX Brenna Formation



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Figure

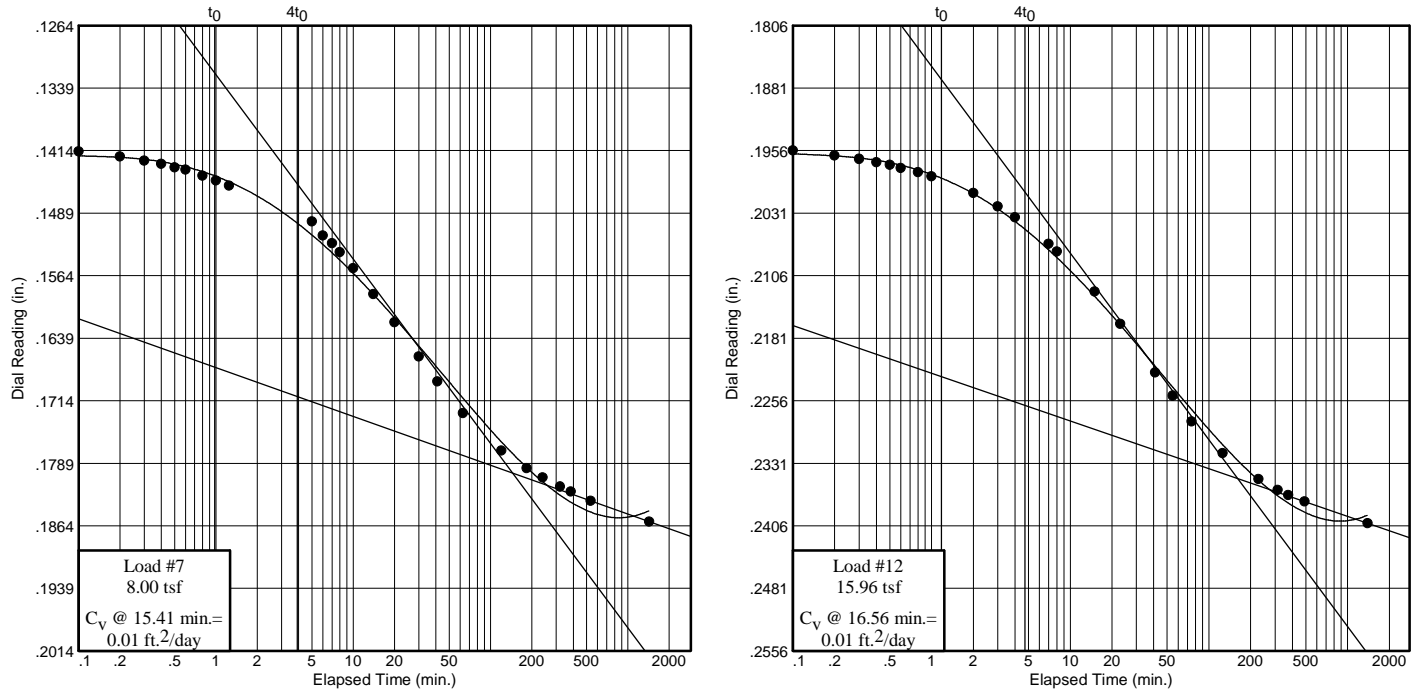
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #1, 20-21', Wild Rice, OX Brenna Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: Boring11-118MU, #1
Elev. or Depth: 20-21' **Sample Length(in./cm.):**
Location: Boring11-118MU, #1, 20-21', Wild Rice, OX Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 91 **Plasticity Index:** 67
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

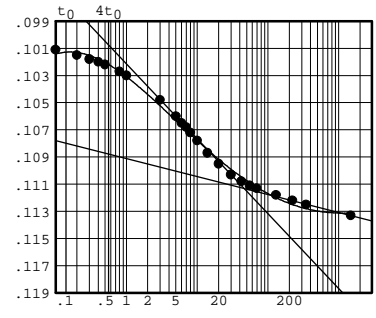
TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 166.81 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 122.73 g.		Dry w+t =
Tare Wt. = 30.56 g.	Spec. Gravity = 2.767	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 103.73 g.	Defl. Table = Machine4-2009	
Moisture = 47.8 %	Ht. Solids = 0.3165 in.	Moisture = %
Wet Den. = 109.5 pcf	Dry Wt. = 70.17 g.*	Dry Wt. = n/a
Dry Den. = 74.1 pcf	Void Ratio = 1.332	Void Ratio = 1.094
	Saturation = 99.4 %	

* Initial dry weight used in calculations

End-of-Load Summary

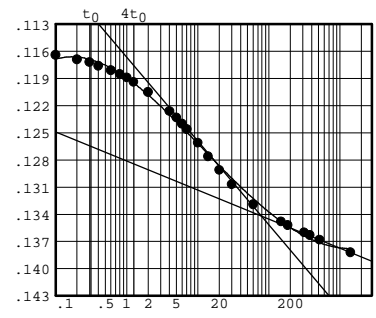
Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08120				1.332	
0.18	0.08140	0.00000			1.331	0.0 Compr.
0.23	0.08240	0.00050			1.329	0.1 Compr.
0.49	0.08890	0.00080	0.12	0.001	1.310	0.9 Compr.
0.98	0.09950	0.00100	0.04	0.001	1.277	2.3 Compr.
1.99	0.11480	0.00150	0.06	0.002	1.230	4.3 Compr.
4.00	0.14020	0.00200	0.04	0.005	1.151	7.7 Compr.
8.00	0.18860	0.00270	0.01	0.009	1.001	14.2 Compr.
1.99	0.16890	0.00150			1.059	11.7 Compr.
0.49	0.14100	0.00080			1.145	8.0 Compr.
1.99	0.15690	0.00150			1.097	10.1 Compr.
8.00	0.19600	0.00270			0.977	15.2 Compr.
15.96	0.24390	0.00360	0.01	0.009	0.829	21.6 Compr.
1.99	0.20820	0.00150			0.935	17.0 Compr.

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09950	13	8.00	0.10870
2	0.10	0.10260	14	10.00	0.10930
3	0.20	0.10300	15	14.00	0.11020
4	0.30	0.10330	16	20.00	0.11100
5	0.40	0.10350	17	30.00	0.11180
6	0.50	0.10370	18	42.00	0.11230
7	0.80	0.10420	19	55.00	0.11260
8	1.00	0.10450	20	69.00	0.11280
9	3.00	0.10630	21	130.00	0.11330
10	5.00	0.10750	22	221.00	0.11370
11	6.00	0.10800	23	346.00	0.11400
12	7.00	0.10830	24	1472.00	0.11480



Void Ratio = 1.230 Compression = 4.3 %
 $D_0 = 0.10037$ $D_{50} = 0.10584$ $D_{100} = 0.11132$
 C_v at 4.0 min. = 0.06 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11480	14	7.00	0.12660
2	0.10	0.11840	15	10.00	0.12810
3	0.20	0.11890	16	14.00	0.12960
4	0.30	0.11920	17	20.00	0.13110
5	0.40	0.11960	18	30.00	0.13270
6	0.60	0.12010	19	60.00	0.13490
7	0.80	0.12050	20	148.00	0.13680
8	1.00	0.12090	21	185.00	0.13720
9	1.25	0.12140	22	313.00	0.13800
10	2.00	0.12250	23	376.00	0.13830
11	4.00	0.12460	24	517.00	0.13880
12	5.00	0.12530	25	1412.00	0.14020
13	6.00	0.12600			



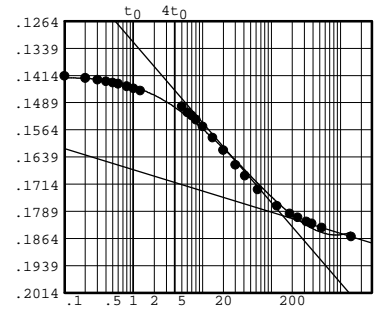
Void Ratio = 1.151 Compression = 7.7 %
 $D_0 = 0.11433$ $D_{50} = 0.12425$ $D_{100} = 0.13416$
 C_v at 5.8 min. = 0.04 ft.²/day $C_\alpha = 0.005$

Pressure: 8.00 tsf

TEST READINGS

Load No. 7

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14020	15	10.00	0.15820
2	0.10	0.14420	16	14.00	0.16130
3	0.20	0.14480	17	20.00	0.16470
4	0.30	0.14530	18	30.00	0.16880
5	0.40	0.14570	19	41.00	0.17180
6	0.50	0.14610	20	63.00	0.17560
7	0.60	0.14640	21	120.00	0.18010
8	0.80	0.14710	22	183.00	0.18220
9	1.00	0.14770	23	240.00	0.18330
10	1.25	0.14830	24	321.00	0.18440
11	5.00	0.15260	25	384.00	0.18500
12	6.00	0.15430	26	536.00	0.18610
13	7.00	0.15520	27	1433.00	0.18860
14	8.00	0.15630			



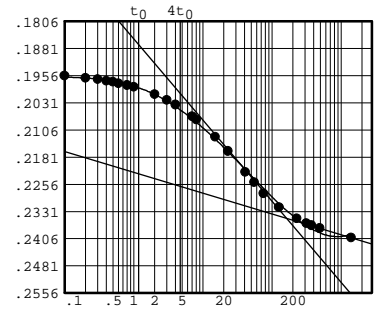
Void Ratio = 1.001 Compression = 14.2 %
 $D_0 = 0.13873$ $D_{50} = 0.15940$ $D_{100} = 0.18007$
 C_v at 15.4 min. = 0.01 ft.²/day $C_\alpha = 0.009$

Pressure: 15.96 tsf

TEST READINGS

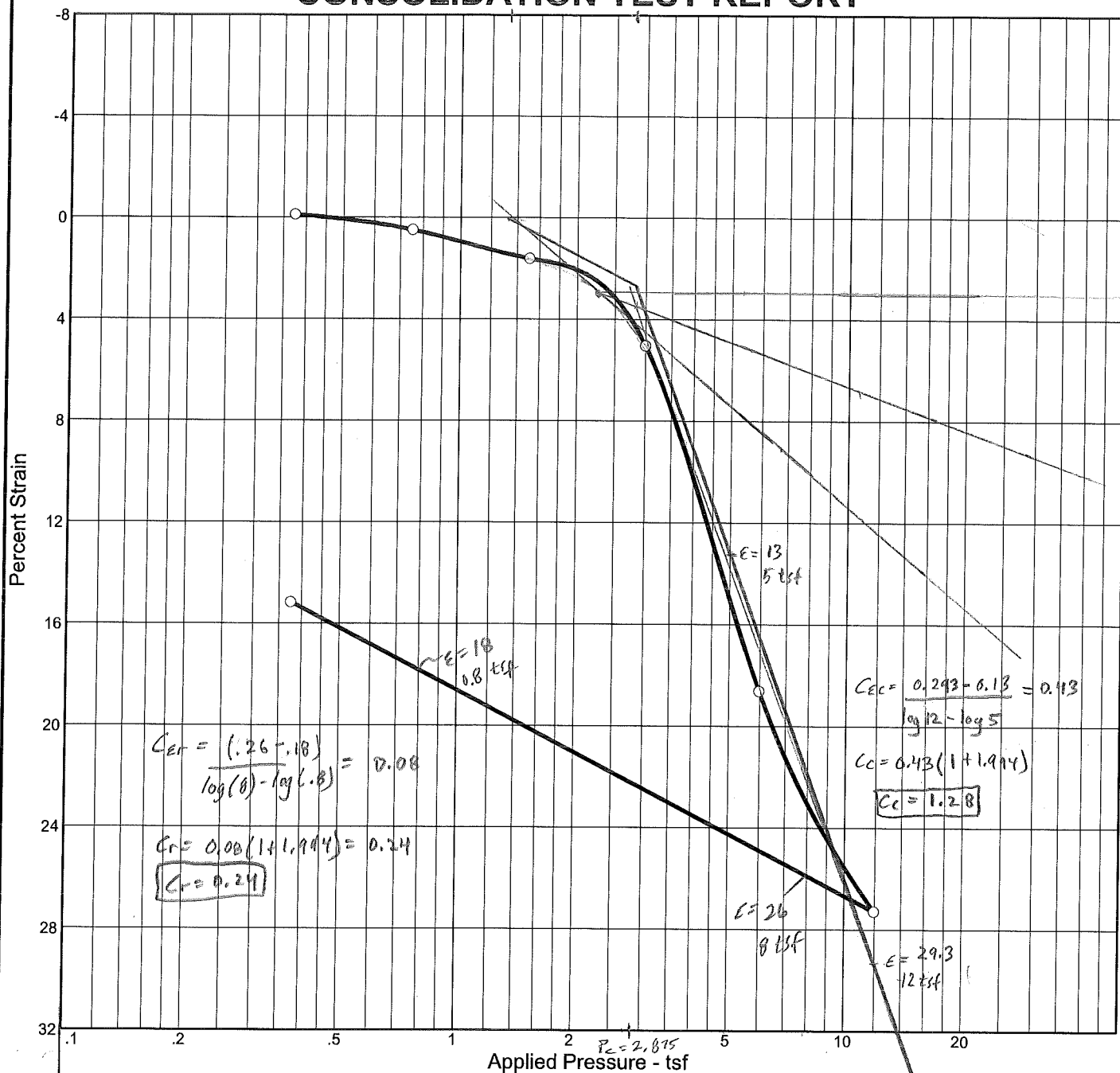
Load No. 12

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.19600	14	8.00	0.21130
2	0.10	0.19920	15	15.00	0.21610
3	0.20	0.19980	16	23.00	0.22000
4	0.30	0.20020	17	41.00	0.22580
5	0.40	0.20060	18	55.00	0.22860
6	0.50	0.20090	19	75.00	0.23170
7	0.60	0.20130	20	126.00	0.23550
8	0.80	0.20180	21	228.00	0.23860
9	1.00	0.20230	22	314.00	0.23990
10	2.00	0.20430	23	373.00	0.24050
11	3.00	0.20590	24	491.00	0.24130
12	4.00	0.20720	25	1397.00	0.24390
13	7.00	0.21040			



Void Ratio = 0.829 Compression = 21.6 %
 $D_0 = 0.19278$ $D_{50} = 0.21386$ $D_{100} = 0.23494$
 C_v at 16.6 min. = 0.01 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural Sat.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
97.2 %	70.5 %	57.3	116	91	2.75	2.85	1.28	0.24			1.994

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435	CH	

Project No. BL-09-03127 **Client:** US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Source: **Sample No.:** #4 **Elev./Depth:** 38-40'

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Remarks:
 Load #5 C_v=0.004 ft²/day
 Load #6 C_v=0.004 ft²/day
Moorhead
09-25MU, #4, 38' - 40'
Brenna
Figure

Dial Reading vs. Time

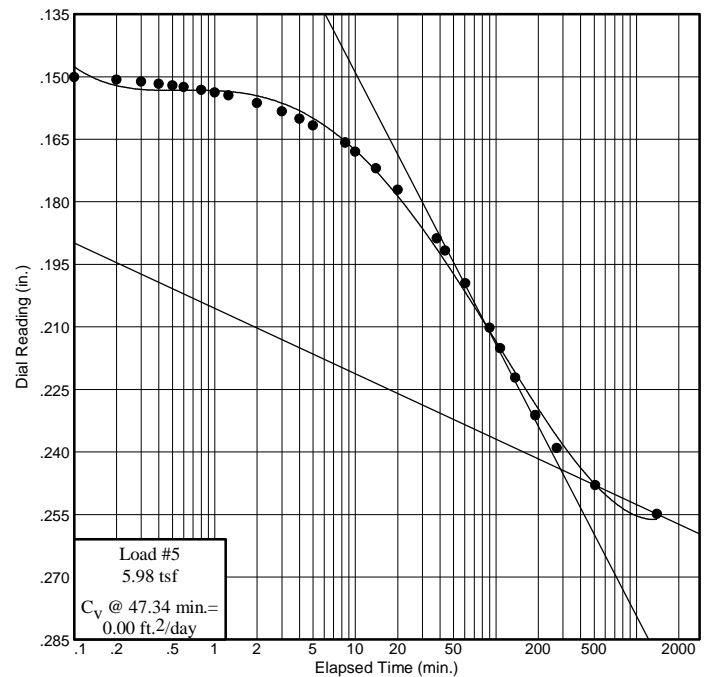
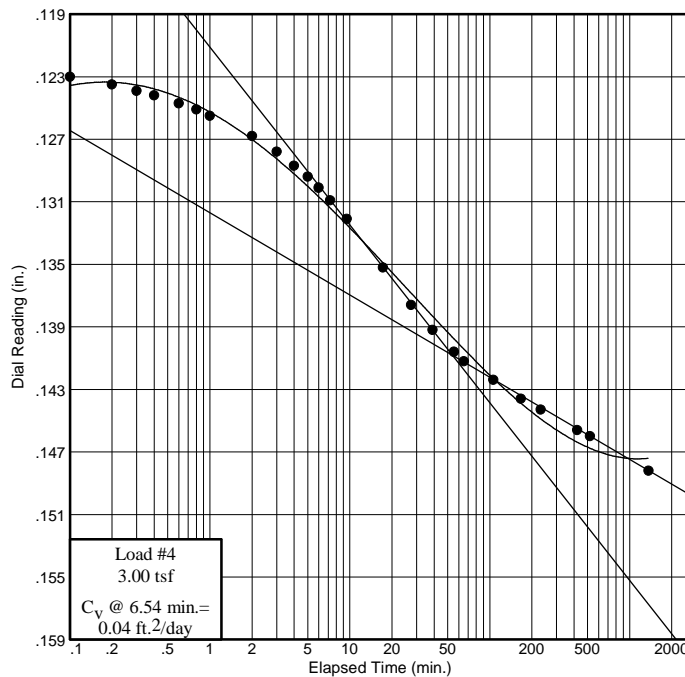
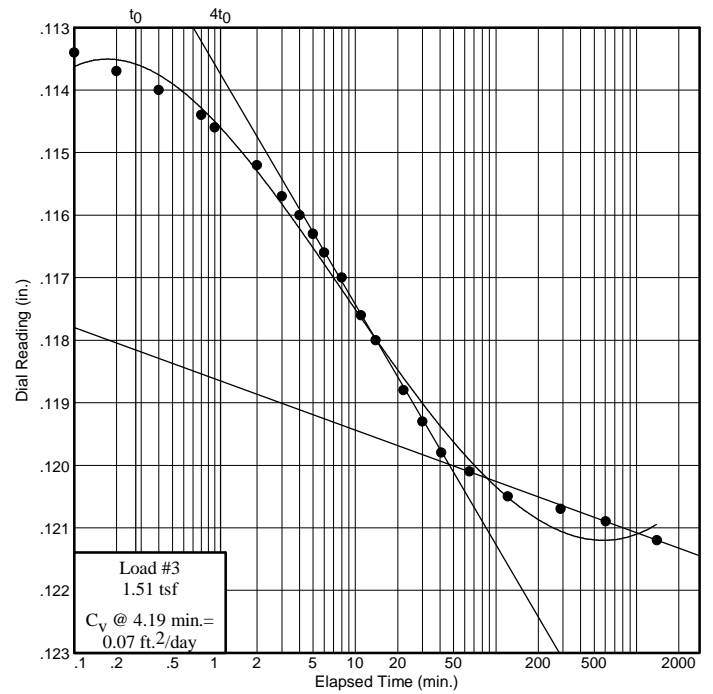
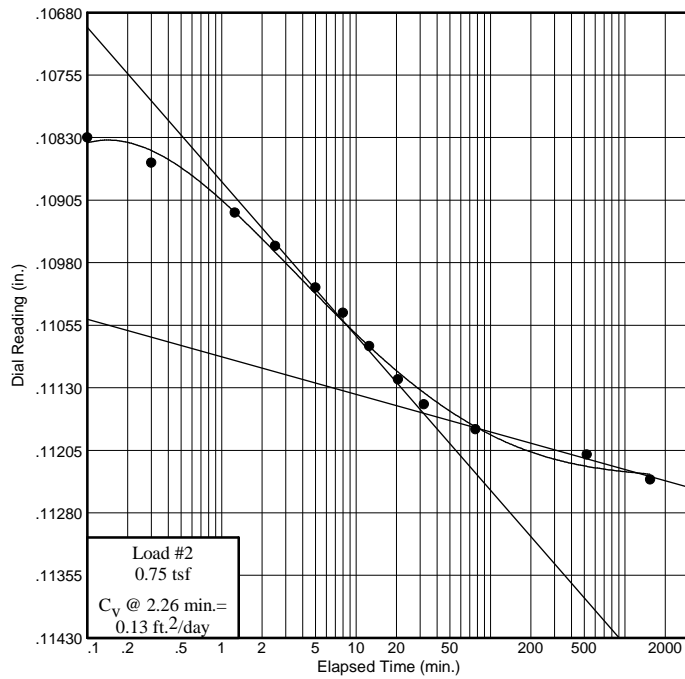
Project No.: BL-09-03127

Project: Fargo-Moorhead Metro Feasibility Study

Source: Moorhead 09-25MU

Sample No.: #4 Brenna

Elev./Depth: 38-40'



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Figure

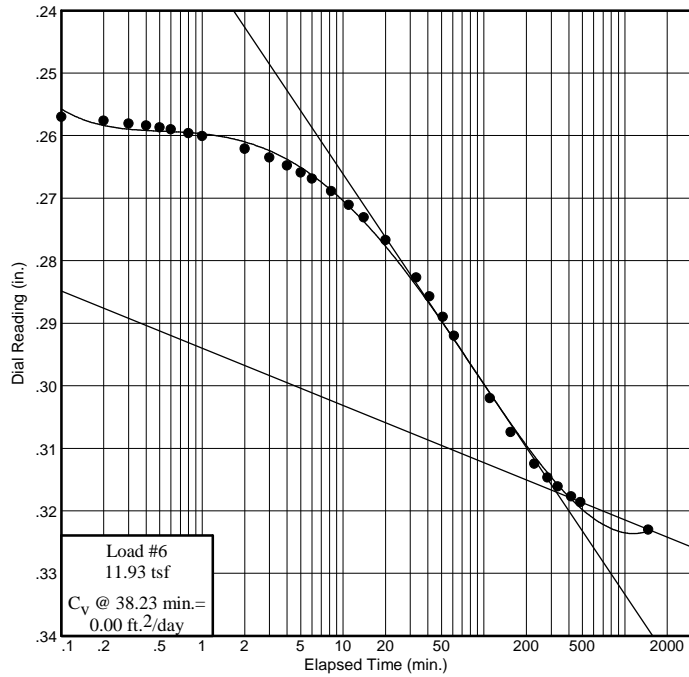
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Metro Feasibility Study

Source: Moorhead 09-25MU Sample No.: #4 **Brenna**

Elev./Depth: 38-40'



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Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #4
Elev. or Depth: 38-40' **Sample Length(in./cm.):**
Location: **Brenna**
Description: Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435
Liquid Limit: 116 **Plasticity Index:** 91
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks: Load #5 Cv=0.004 ft²/day
 Load #6 Cv=0.004 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 94.07 g.	Consolidometer # = 5	Wet w+t = 119.98 g.
Dry w+t = 67.90 g.		Dry w+t = 87.49 g.
Tare Wt. = 30.76 g.	Spec. Gravity = 2.75	Tare Wt. = 30.43 g.
Height = .79 in.	Height = .79 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 99.07 g.	Defl. Table = #5-2008	
Moisture = 70.5 %	Ht. Solids = 0.2625 in.	Moisture = 56.9 %
Wet Den. = 97.7 pcf	Dry Wt. = 58.12 g.*	Dry Wt. = 57.06 g.
Dry Den. = 57.3 pcf	Void Ratio = 1.994	Void Ratio = 1.540
	Saturation = 97.2 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10850				1.994	
0.38	0.10870	0.00110			1.997	0.1 Swell
0.75	0.11430	0.00190	0.13	0.001	1.979	0.5 Compr.
1.51	0.12420	0.00300	0.07	0.001	1.946	1.6 Compr.
3.00	0.15250	0.00430	0.04	0.007	1.843	5.1 Compr.
5.98	0.26090	0.00600	0.00	0.021	1.436	18.6 Compr.
11.93	0.33130	0.00830	0.00	0.014	1.177	27.3 Compr.
0.38	0.22880	0.00110			1.540	15.2 Compr.

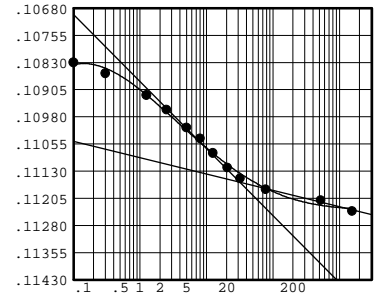
C_c = 1.28 P_c = 2.85 tsf C_r = 0.24

Pressure: 0.75 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10870	11	77.50	0.11370
2	0.10	0.11020	12	520.50	0.11400
3	0.30	0.11050	13	1543.00	0.11430
4	1.25	0.11110			
5	2.50	0.11150			
6	5.00	0.11200			
7	8.00	0.11230			
8	12.50	0.11270			
9	20.50	0.11310			
10	32.00	0.11340			



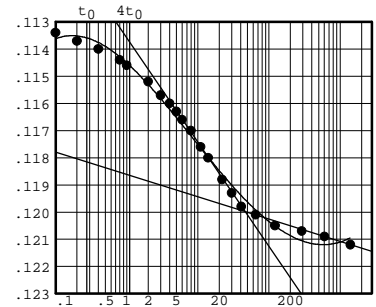
Void Ratio = 1.979 Compression = 0.5 %
 $D_0 = 0.10760$ $D_{50} = 0.10960$ $D_{100} = 0.11161$
 C_v at 2.3 min. = 0.13 ft.²/day $C_\alpha = 0.001$

Pressure: 1.51 tsf

TEST READINGS

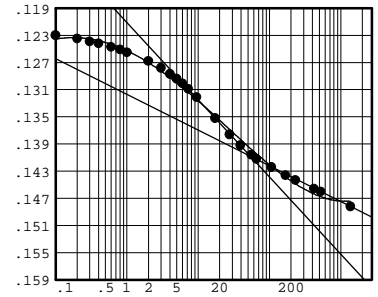
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11430	12	8.00	0.12000
2	0.10	0.11640	13	11.00	0.12060
3	0.20	0.11670	14	14.00	0.12100
4	0.40	0.11700	15	22.00	0.12180
5	0.80	0.11740	16	30.00	0.12230
6	1.00	0.11760	17	41.00	0.12280
7	2.00	0.11820	18	65.00	0.12310
8	3.00	0.11870	19	122.00	0.12350
9	4.00	0.11900	20	288.50	0.12370
10	5.00	0.11930	21	605.00	0.12390
11	6.00	0.11960	22	1403.00	0.12420



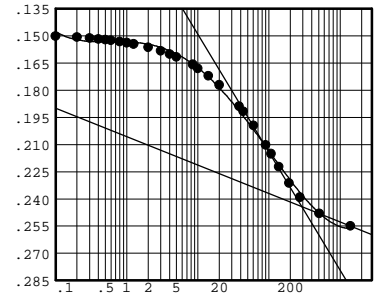
Void Ratio = 1.946 Compression = 1.6 %
 $D_0 = 0.11257$ $D_{50} = 0.11628$ $D_{100} = 0.11998$
 C_v at 4.2 min. = 0.07 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12420	14	7.25	0.13520
2	0.10	0.12730	15	9.50	0.13640
3	0.20	0.12780	16	17.30	0.13950
4	0.30	0.12820	17	27.50	0.14190
5	0.40	0.12850	18	39.00	0.14350
6	0.60	0.12900	19	55.50	0.14490
7	0.80	0.12940	20	65.30	0.14550
8	1.00	0.12980	21	106.00	0.14670
9	2.00	0.13110	22	167.50	0.14790
10	3.00	0.13210	23	231.00	0.14860
11	4.00	0.13300	24	421.30	0.14990
12	5.00	0.13370	25	521.20	0.15030
13	6.00	0.13440	26	1365.00	0.15250



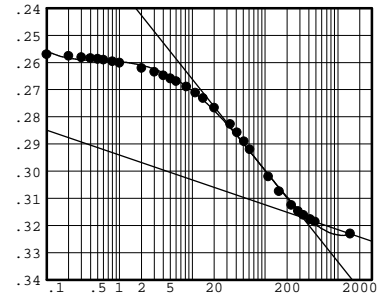
Void Ratio = 1.843 Compression = 5.1 %
 $D_0 = 0.12120$ $D_{50} = 0.13102$ $D_{100} = 0.14083$
 C_v at 6.5 min. = 0.04 ft.²/day $C_\alpha = 0.007$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.15250	15	8.50	0.17180
2	0.10	0.15610	16	10.00	0.17400
3	0.20	0.15670	17	14.00	0.17800
4	0.30	0.15720	18	20.00	0.18310
5	0.40	0.15770	19	38.00	0.19480
6	0.50	0.15810	20	43.50	0.19770
7	0.60	0.15850	21	60.50	0.20550
8	0.80	0.15920	22	90.00	0.21620
9	1.00	0.15980	23	107.00	0.22110
10	1.25	0.16050	24	137.00	0.22820
11	2.00	0.16230	25	191.00	0.23720
12	3.00	0.16430	26	272.00	0.24510
13	4.00	0.16610	27	509.00	0.25400
14	5.00	0.16770	28	1402.00	0.26090



Void Ratio = 1.436 Compression = 18.6 %
 $D_0 = 0.14820$ $D_{50} = 0.19616$ $D_{100} = 0.24413$
 C_v at 47.3 min. = 0.00 ft.²/day $C_\alpha = 0.021$

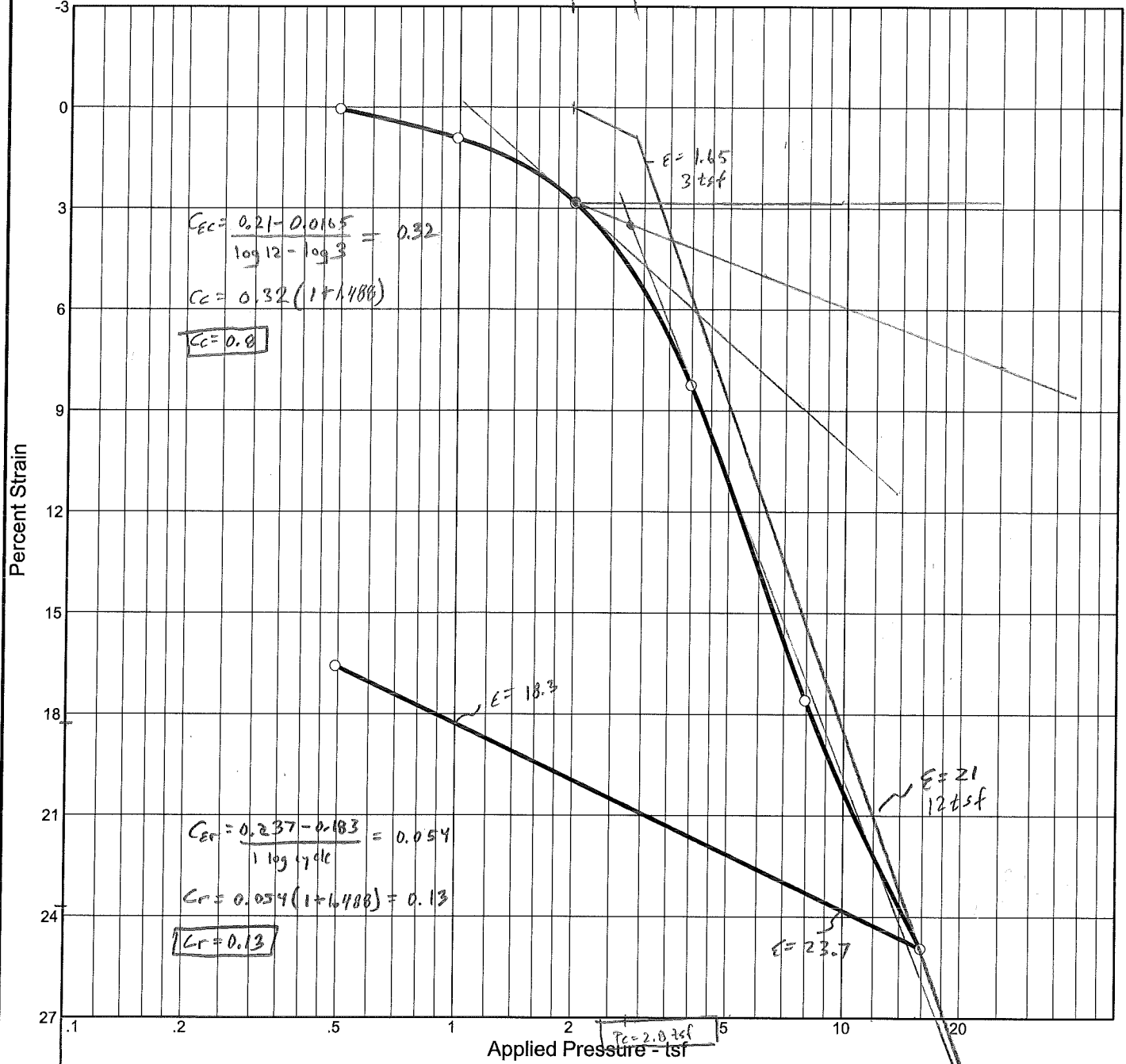
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.26090	16	11.00	0.27940
2	0.10	0.26530	17	14.00	0.28140
3	0.20	0.26590	18	20.00	0.28500
4	0.30	0.26640	19	33.00	0.29100
5	0.40	0.26670	20	41.00	0.29400
6	0.50	0.26700	21	51.00	0.29730
7	0.60	0.26730	22	61.30	0.30030
8	0.80	0.26790	23	110.30	0.31030
9	1.00	0.26840	24	155.00	0.31570
10	2.00	0.27040	25	228.00	0.32080
11	3.00	0.27180	26	282.00	0.32300
12	4.00	0.27310	27	334.00	0.32440
13	5.00	0.27420	28	416.00	0.32600
14	6.00	0.27520	29	485.00	0.32690
15	8.25	0.27720	30	1467.00	0.33130



Void Ratio = 1.177 Compression = 27.3 %
 $D_0 = 0.25490$ $D_{50} = 0.28597$ $D_{100} = 0.31704$
 C_v at 38.2 min. = 0.00 ft.²/day $C_\alpha = 0.014$

$P_0 = 1.95$ $P_U = 2.8 \text{ tsf}$

CONSOLIDATION TEST REPORT

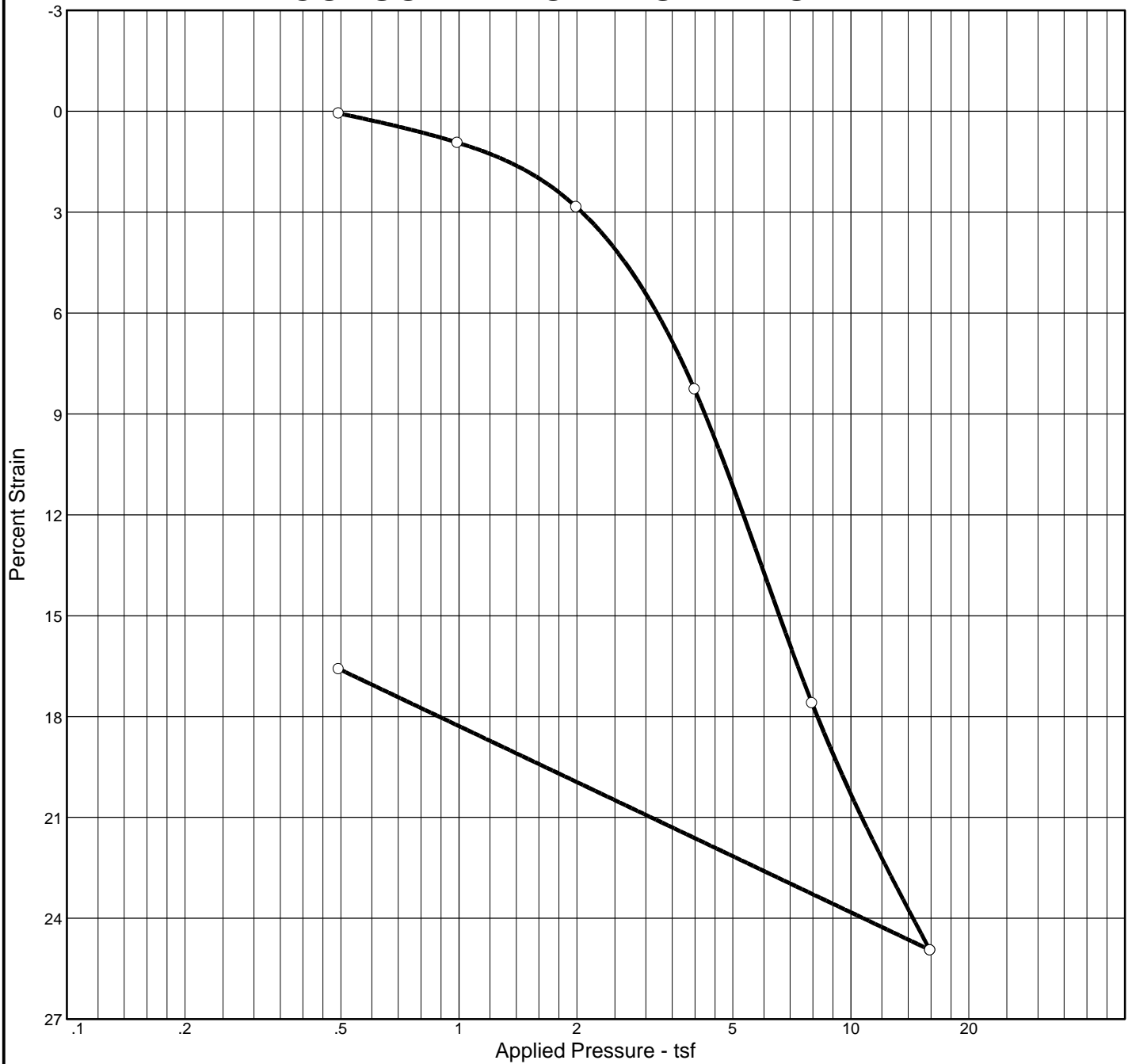


Natural Sat.	Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
101.6 %	55.0 %	69.0	87	65	2.75		2.88	0.80	0.14			1.488

MATERIAL DESCRIPTION										USCS	AASHTO
33 Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435										CH	

Project No. BL-09-03127 Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Source: 26 \leftarrow 0.4 e_0 Sample No.: #5 Elev./Depth: 68-70' BRAUN INTERTEC	Remarks: Moorhead 09-25MU, #5, 68' - 70' Brenna / Argusville Transition Figure
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CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
Sat.	Moist.											
101.6 %	55.0 %	69.0	87	65	2.75		2.88	0.80	0.14			1.488

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435	CH	

Project No. BL-09-03127 Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Source: Sample No.: #5 Elev./Depth: 68-70'	Remarks: Moorhead 09-25MU, #5, 68' - 70' Brenna / Argusville Transition <p style="text-align: right;">Figure</p>

Dial Reading vs. Time

Project No.: BL-09-03127

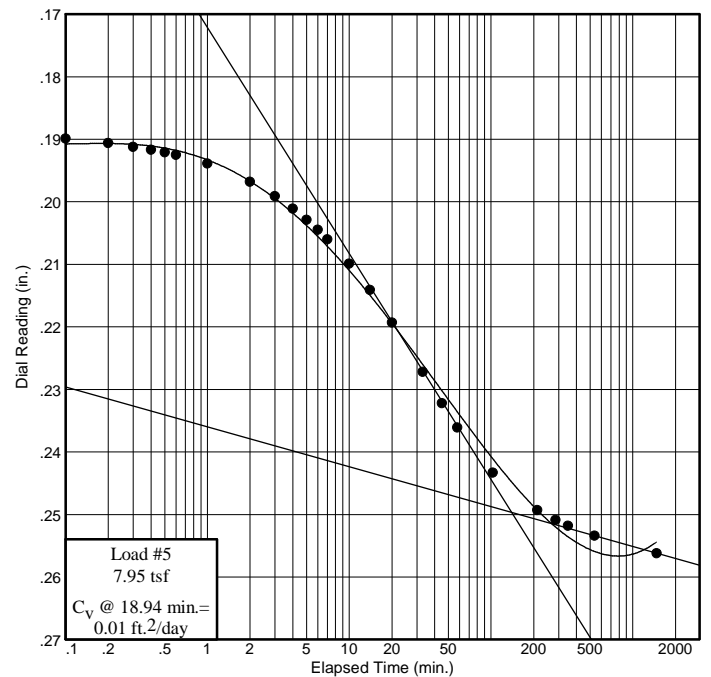
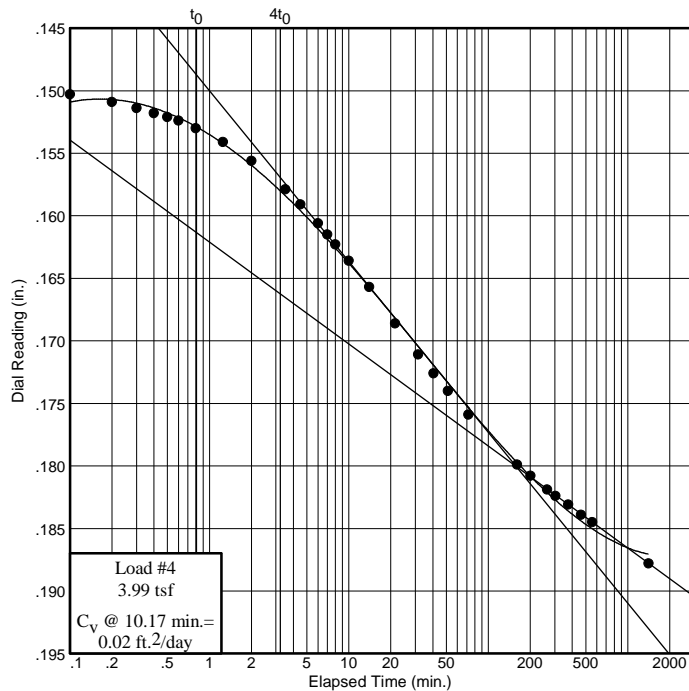
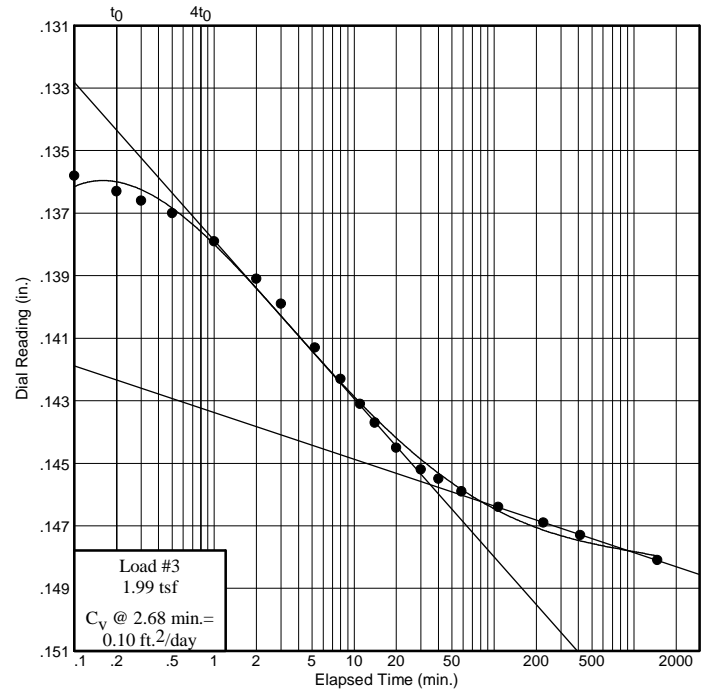
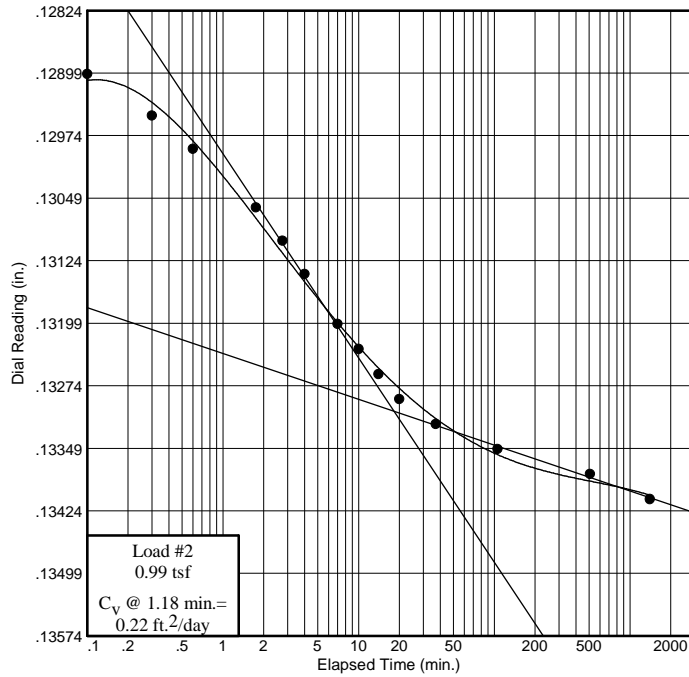
Project: Fargo-Moorhead Metro Feasibility Study

Brenna / Argusville Transition

Source: Moorhead 09-25MU

Sample No.: #5

Elev./Depth: 68-70'



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Figure

Dial Reading vs. Time

Project No.: BL-09-03127

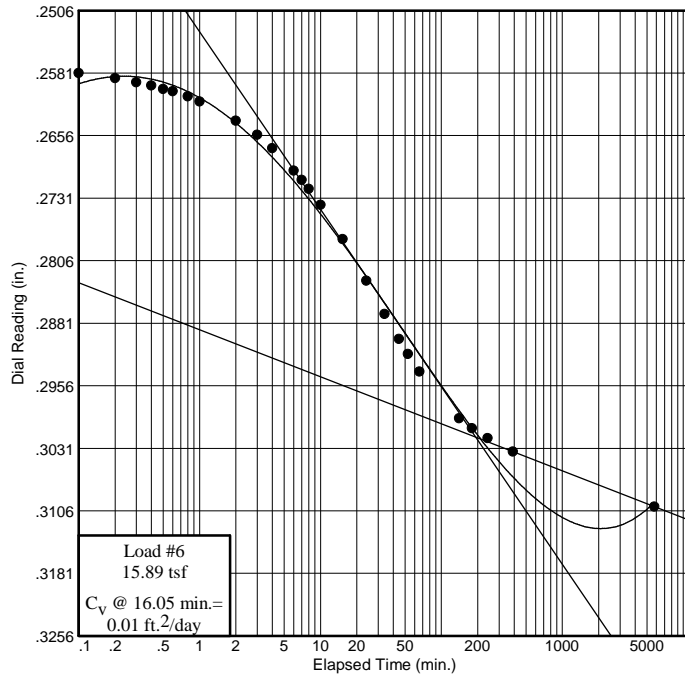
Project: Fargo-Moorhead Metro Feasibility Study

Brenna / Argusville Transition

Source: Moorhead 09-25MU

Sample No.: #5

Elev./Depth: 68-70'



BRAUN[™]
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #5
Elev. or Depth: 68-70'
Location: Brenna / Argusville Transition
Description: Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435
Liquid Limit: 87
Plasticity Index: 65
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 100.75 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 75.71 g.		Dry w+t =
Tare Wt. = 30.17 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 100.84 g.	Defl. Table = #3-2008	
Moisture = 55.0 %	Ht. Solids = 0.2946 in.	Moisture = %
Wet Den. = 106.9 pcf	Dry Wt. = 65.06 g.*	Dry Wt. = n/a
Dry Den. = 69.0 pcf	Void Ratio = 1.488	Void Ratio = 1.076
	Saturation = 101.6 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression / Swell
start	0.12730				1.488	
0.49	0.12820	0.00050			1.487	0.1 Compr.
0.99	0.13480	0.00070	0.22	0.001	1.465	0.9 Compr.
1.99	0.14910	0.00100	0.10	0.002	1.417	2.8 Compr.
3.99	0.18930	0.00150	0.02	0.011	1.283	8.3 Compr.
7.95	0.25820	0.00200	0.01	0.009	1.051	17.6 Compr.
15.89	0.31300	0.00290	0.01	0.009	0.868	24.9 Compr.
0.49	0.24930	0.00050			1.076	16.6 Compr.

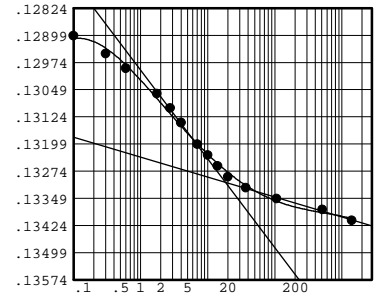
C_c = 0.80 P_c = 2.88 tsf C_r = 0.14

Pressure: 0.99 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12820	11	20.00	0.13360
2	0.10	0.12970	12	37.00	0.13390
3	0.30	0.13020	13	106.00	0.13420
4	0.60	0.13060	14	508.00	0.13450
5	1.75	0.13130	15	1402.00	0.13480
6	2.75	0.13170			
7	4.00	0.13210			
8	7.00	0.13270			
9	10.00	0.13300			
10	14.00	0.13330			



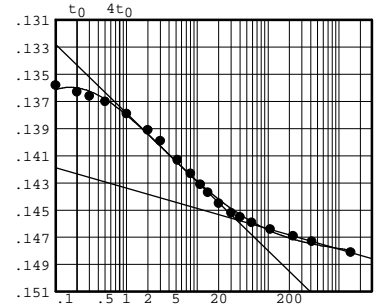
Void Ratio = 1.465 Compression = 0.9 %
 $D_0 = 0.12770$ $D_{50} = 0.13037$ $D_{100} = 0.13305$
 C_v at 1.2 min. = 0.22 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

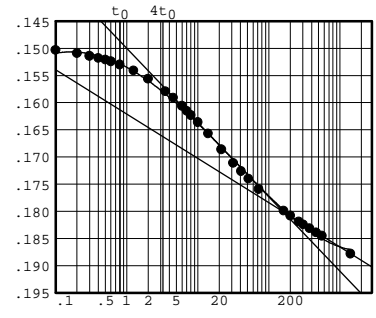
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13480	11	11.00	0.14410
2	0.10	0.13680	12	14.00	0.14470
3	0.20	0.13730	13	20.00	0.14550
4	0.30	0.13760	14	30.00	0.14620
5	0.50	0.13800	15	40.00	0.14650
6	1.00	0.13890	16	58.50	0.14690
7	2.00	0.14010	17	107.00	0.14740
8	3.00	0.14090	18	225.00	0.14790
9	5.25	0.14230	19	413.00	0.14830
10	8.00	0.14330	20	1464.00	0.14910



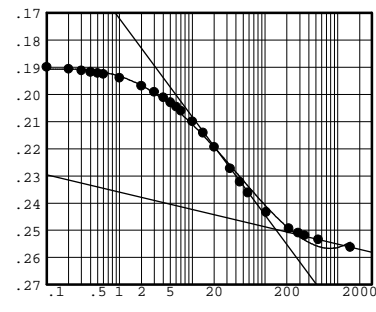
Void Ratio = 1.417 Compression = 2.8 %
 $D_0 = 0.13440$ $D_{50} = 0.14004$ $D_{100} = 0.14569$
 C_v at 2.7 min. = 0.10 ft.²/day $C_\alpha = 0.002$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14910	16	10.00	0.16510
2	0.10	0.15180	17	14.00	0.16720
3	0.20	0.15240	18	21.50	0.17010
4	0.30	0.15290	19	31.50	0.17260
5	0.40	0.15330	20	40.50	0.17410
6	0.50	0.15360	21	51.50	0.17550
7	0.60	0.15390	22	72.00	0.17740
8	0.80	0.15450	23	161.00	0.18140
9	1.25	0.15560	24	201.00	0.18230
10	2.00	0.15710	25	264.00	0.18340
11	3.50	0.15940	26	304.00	0.18390
12	4.50	0.16060	27	375.00	0.18460
13	6.00	0.16210	28	462.00	0.18540
14	7.00	0.16300	29	557.00	0.18600
15	8.00	0.16380	30	1414.00	0.18930



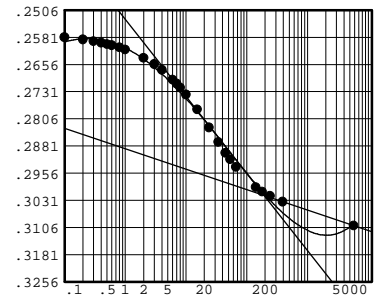
Void Ratio = 1.283 Compression = 8.3 %
 $D_0 = 0.14777$ $D_{50} = 0.16390$ $D_{100} = 0.18004$
 C_v at 10.2 min. = 0.02 ft.²/day $C_\alpha = 0.011$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.18930	14	7.00	0.20800
2	0.10	0.19190	15	10.00	0.21190
3	0.20	0.19260	16	14.00	0.21610
4	0.30	0.19320	17	20.00	0.22130
5	0.40	0.19370	18	33.00	0.22920
6	0.50	0.19410	19	45.00	0.23420
7	0.60	0.19450	20	58.00	0.23810
8	1.00	0.19590	21	103.00	0.24530
9	2.00	0.19880	22	212.00	0.25130
10	3.00	0.20110	23	285.00	0.25290
11	4.00	0.20310	24	349.00	0.25380
12	5.00	0.20490	25	537.00	0.25540
13	6.00	0.20650	26	1474.00	0.25820



Void Ratio = 1.051 Compression = 17.6 %
 $D_0 = 0.18780$ $D_{50} = 0.21873$ $D_{100} = 0.24967$
 C_v at 18.9 min. = 0.01 ft.²/day $C_\alpha = 0.009$

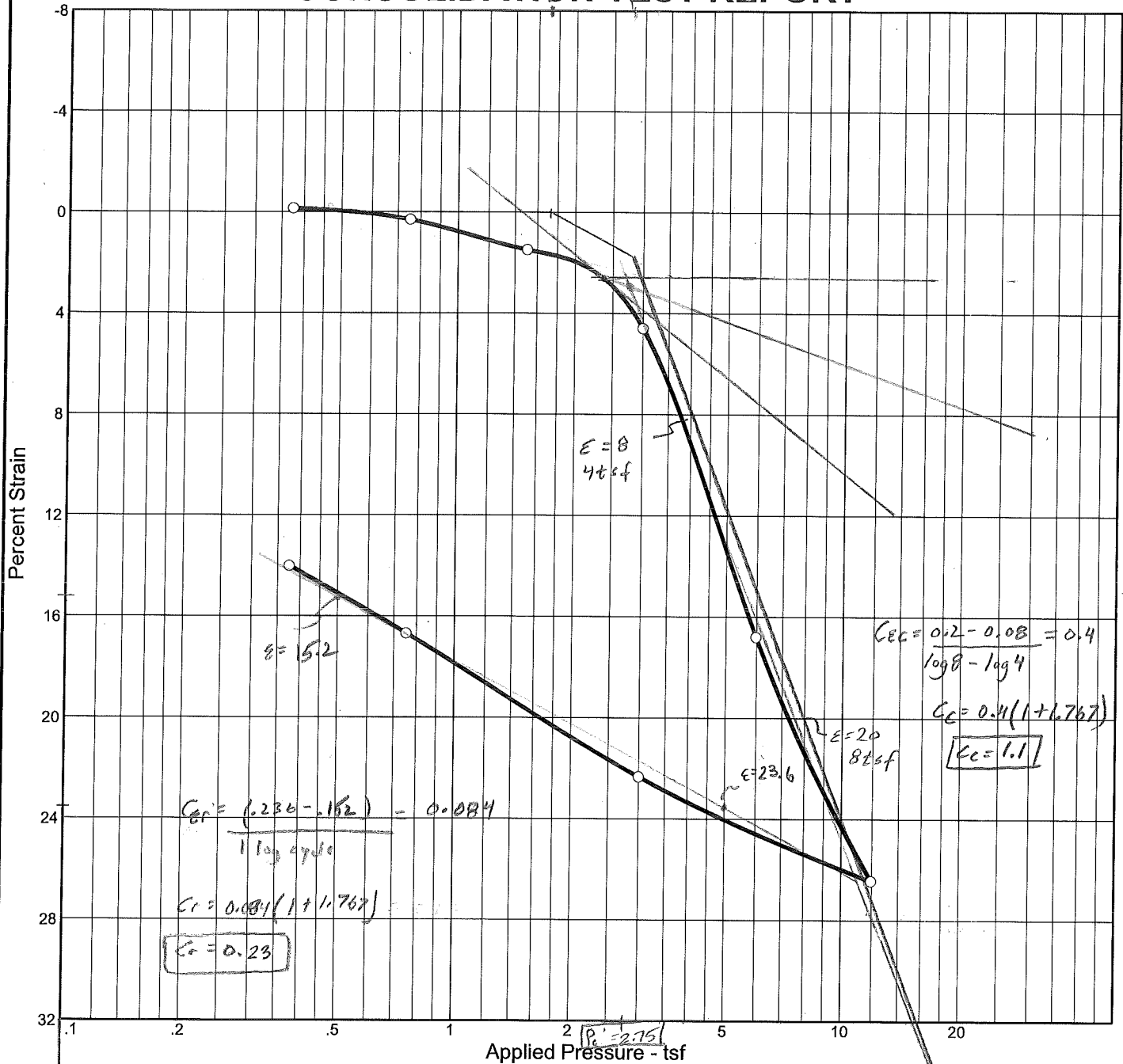
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.25820	15	8.00	0.27490
2	0.10	0.26100	16	10.00	0.27680
3	0.20	0.26160	17	15.25	0.28090
4	0.30	0.26210	18	24.00	0.28590
5	0.40	0.26250	19	34.00	0.28990
6	0.50	0.26290	20	44.50	0.29290
7	0.60	0.26320	21	53.00	0.29470
8	0.80	0.26380	22	66.00	0.29680
9	1.00	0.26440	23	140.00	0.30240
10	2.00	0.26670	24	179.00	0.30360
11	3.00	0.26840	25	241.00	0.30480
12	4.00	0.27000	26	390.00	0.30640
13	6.00	0.27270	27	5760.00	0.31300
14	7.00	0.27380			



Void Ratio = 0.868 Compression = 24.9 %
 $D_0 = 0.25620$ $D_{50} = 0.27899$ $D_{100} = 0.30178$
 C_v at 16.1 min. = 0.01 ft.²/day $C_\alpha = 0.009$

$P_c = 1.7 \text{ tsf}$
 P_c'

CONSOLIDATION TEST REPORT



Natural Sat.	Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
97.7 %	62.8 %	62.0	108	86	2.75		2.75	1.15	0.23			1.767

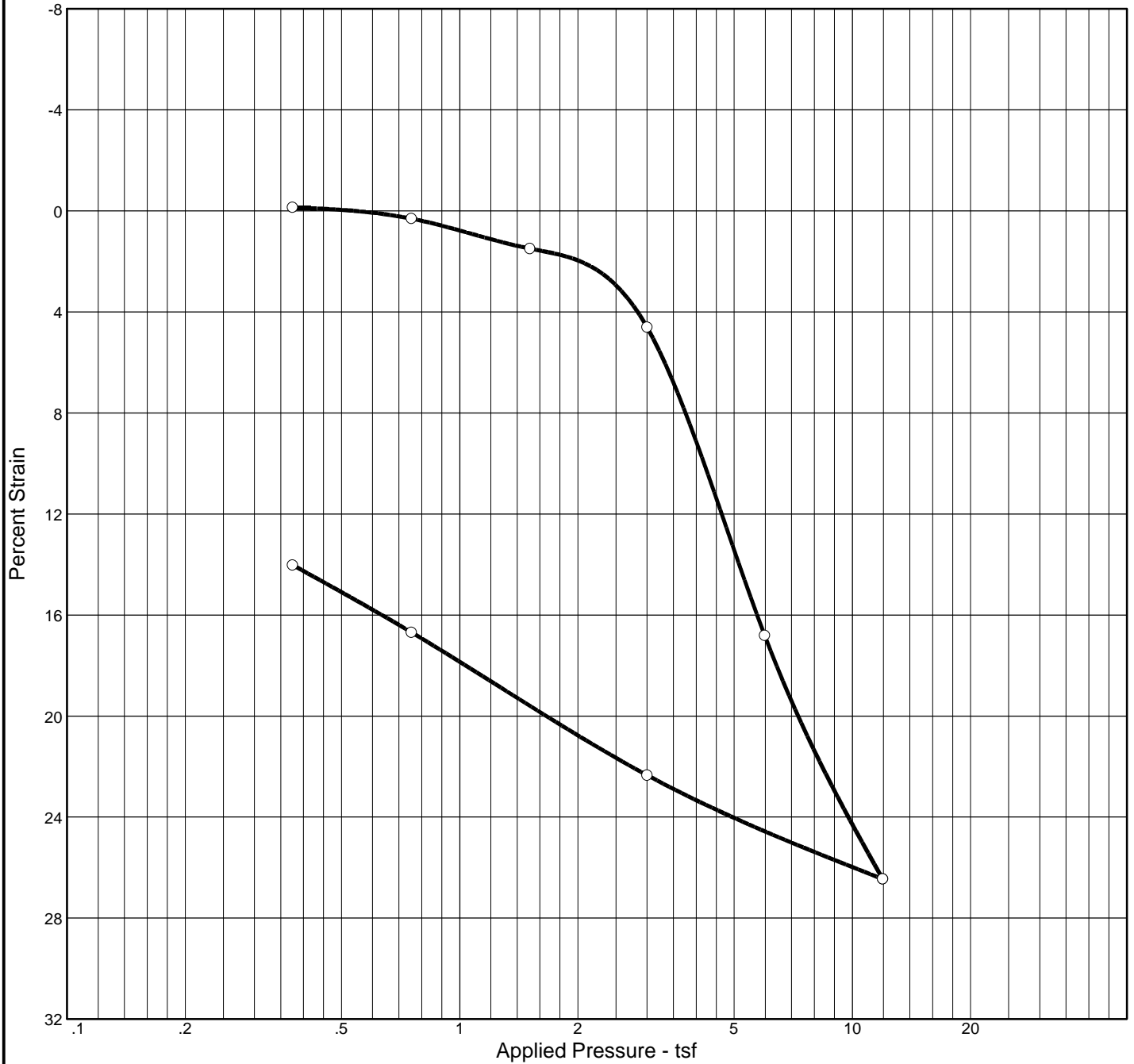
MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435	CH	

Project No. BL-09-03127 Client: US Army Corps of Engineer Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115 Location: SE-F-13, Fargo, Brenna Formation, #4, 50-52'	Remarks: Load #5 $C_v = 0.005 \text{ ft}^2/\text{day}$ Load #6 $C_v = 0.005 \text{ ft}^2/\text{day}$ Fargo 09-25MU, #4, 50' - 52' Brenna
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Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
97.7 %	62.8 %	62.0	108	86	2.75		2.75	1.15	0.23			1.767

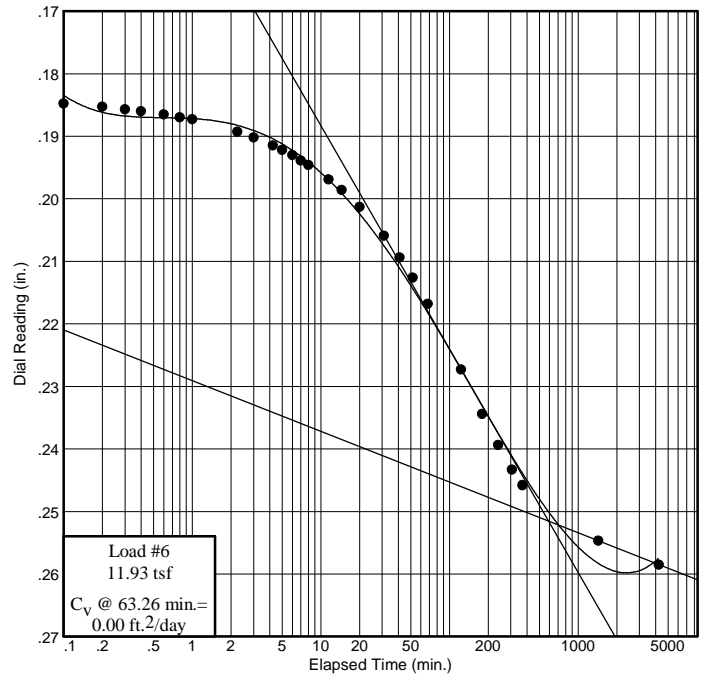
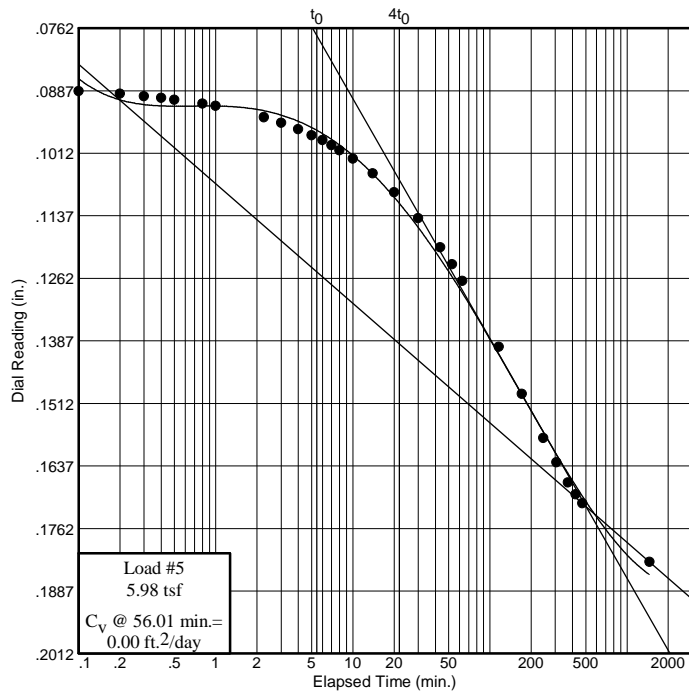
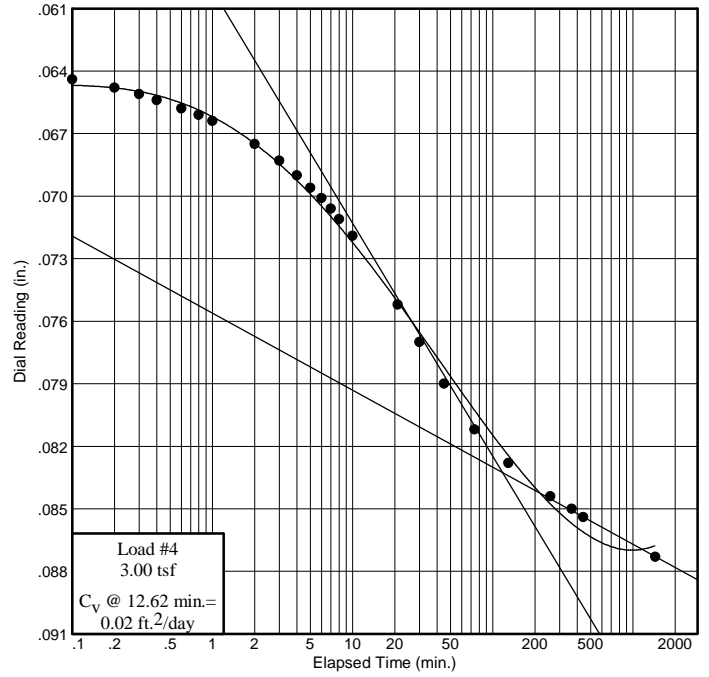
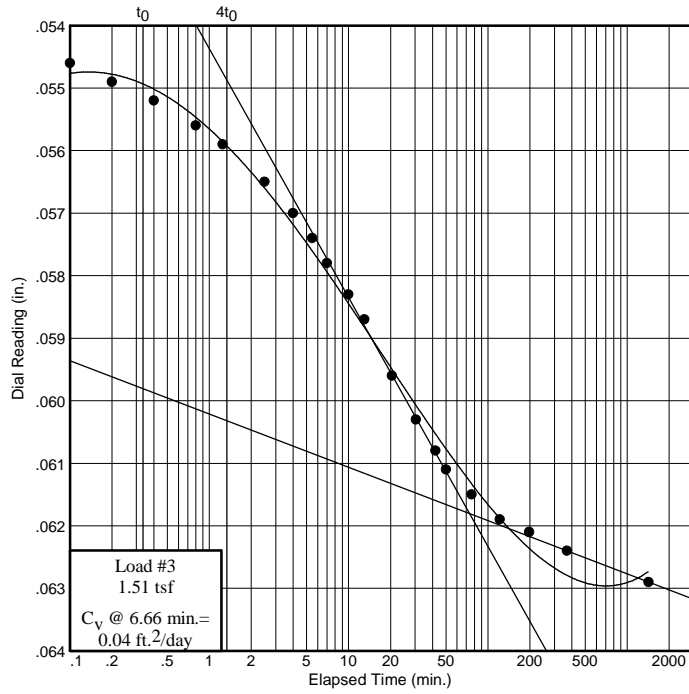
MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-F-13, Fargo, Brenna Formation, #4, 50-52'</p> <p style="text-align: center;">BRAUN INTERTEC</p>	<p>Remarks:</p> <p>Load #5 Cv=0.005 ft²/day Load #6 Cv=0.005 ft²/day</p>
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Figure

Dial Reading vs. Time

Project No.: BL-09-03127
 Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
 Location: SE-F-13, Fargo, Brenna Formation, #4, 50-52'



BRAUN[™]
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #4
Elev. or Depth: 50-52' **Sample Length(in./cm.):**
Location: SE-F-13, Fargo, Brenna Formation, #4, 50-52'
Description: Boring 09-25MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435
Liquid Limit: 108 **Plasticity Index:** 86
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks: Load #5 Cv=0.005 ft²/day
 Load #6 Cv=0.005 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 123.94 g.	Consolidometer # = 5	Wet w+t =
Dry w+t = 88.05 g.		Dry w+t =
Tare Wt. = 30.90 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .78 in.	Height = .78 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 102.07 g.	Defl. Table = #5-2008	
Moisture = 62.8 %	Ht. Solids = 0.2832 in.	Moisture = %
Wet Den. = 101.0 pcf	Dry Wt. = 62.70 g.*	Dry Wt. = n/a
Dry Den. = 62.0 pcf	Void Ratio = 1.767	Void Ratio = 1.379
	Saturation = 97.7 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.05120				1.767	
0.38	0.05120	0.00110			1.771	0.1 Swell
0.75	0.05550	0.00190			1.759	0.3 Compr.
1.51	0.06590	0.00300	0.04	0.001	1.726	1.5 Compr.
3.00	0.09160	0.00430	0.02	0.005	1.640	4.6 Compr.
5.98	0.18890	0.00600	0.00	0.032	1.302	16.8 Compr.
11.93	0.26680	0.00830	0.00	0.012	1.035	26.4 Compr.
3.00	0.23060	0.00430			1.149	22.3 Compr.
0.75	0.18390	0.00190			1.306	16.7 Compr.
0.38	0.16220	0.00110			1.379	14.0 Compr.

C_c = 1.15 P_c = 2.75 tsf C_r = 0.23

Pressure: 0.75 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.05120
2	0.10	0.05350
3	1.00	0.05380
4	4.00	0.05410
5	8.00	0.05440
6	26.00	0.05480
7	144.00	0.05510
8	510.00	0.05530
9	1393.00	0.05550

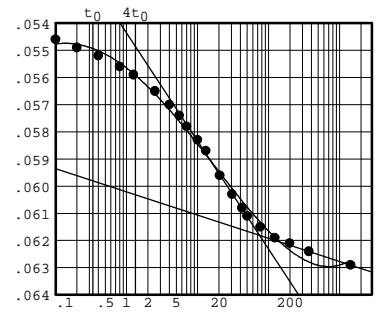
Void Ratio = 1.759 Compression = 0.3 %

Pressure: 1.51 tsf

TEST READINGS

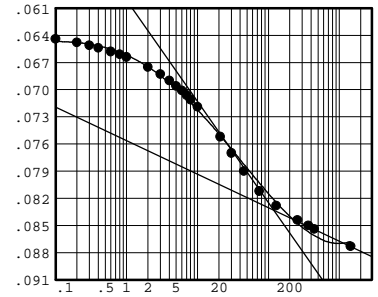
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.05550	12	13.00	0.06170
2	0.10	0.05760	13	20.50	0.06260
3	0.20	0.05790	14	30.50	0.06330
4	0.40	0.05820	15	42.00	0.06380
5	0.80	0.05860	16	50.00	0.06410
6	1.25	0.05890	17	76.50	0.06450
7	2.50	0.05950	18	122.00	0.06490
8	4.00	0.06000	19	198.00	0.06510
9	5.50	0.06040	20	369.50	0.06540
10	7.00	0.06080	21	1427.00	0.06590
11	10.00	0.06130			



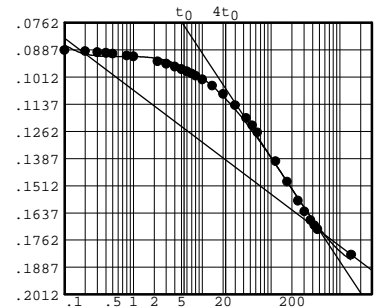
Void Ratio = 1.726 Compression = 1.5 %
 $D_0 = 0.05394$ $D_{50} = 0.05787$ $D_{100} = 0.06180$
 C_v at 6.7 min. = 0.04 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06590	14	7.00	0.07490
2	0.10	0.06870	15	8.00	0.07540
3	0.20	0.06910	16	10.00	0.07620
4	0.30	0.06940	17	21.00	0.07950
5	0.40	0.06970	18	30.00	0.08130
6	0.60	0.07010	19	45.00	0.08330
7	0.80	0.07040	20	74.00	0.08550
8	1.00	0.07070	21	129.00	0.08710
9	2.00	0.07180	22	257.00	0.08870
10	3.00	0.07260	23	366.00	0.08930
11	4.00	0.07330	24	441.50	0.08970
12	5.00	0.07390	25	1441.00	0.09160
13	6.00	0.07440			



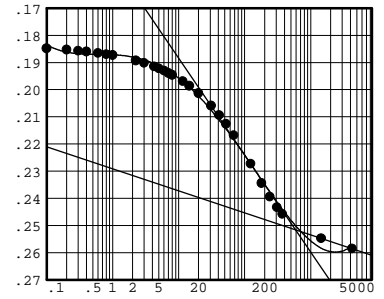
Void Ratio = 1.640 Compression = 4.6 %
 $D_0 = 0.06290$ $D_{50} = 0.07309$ $D_{100} = 0.08328$
 C_v at 12.6 min. = 0.02 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09160	16	10.00	0.10830
2	0.10	0.09480	17	14.00	0.11120
3	0.20	0.09530	18	20.00	0.11500
4	0.30	0.09580	19	30.00	0.12020
5	0.40	0.09610	20	43.50	0.12600
6	0.50	0.09650	21	53.00	0.12940
7	0.80	0.09730	22	63.00	0.13270
8	1.00	0.09770	23	116.00	0.14590
9	2.25	0.10000	24	171.00	0.15530
10	3.00	0.10110	25	245.00	0.16410
11	4.00	0.10240	26	305.00	0.16900
12	5.00	0.10360	27	371.00	0.17300
13	6.00	0.10460	28	423.00	0.17540
14	7.00	0.10560	29	472.00	0.17720
15	8.00	0.10660	30	1457.00	0.18890



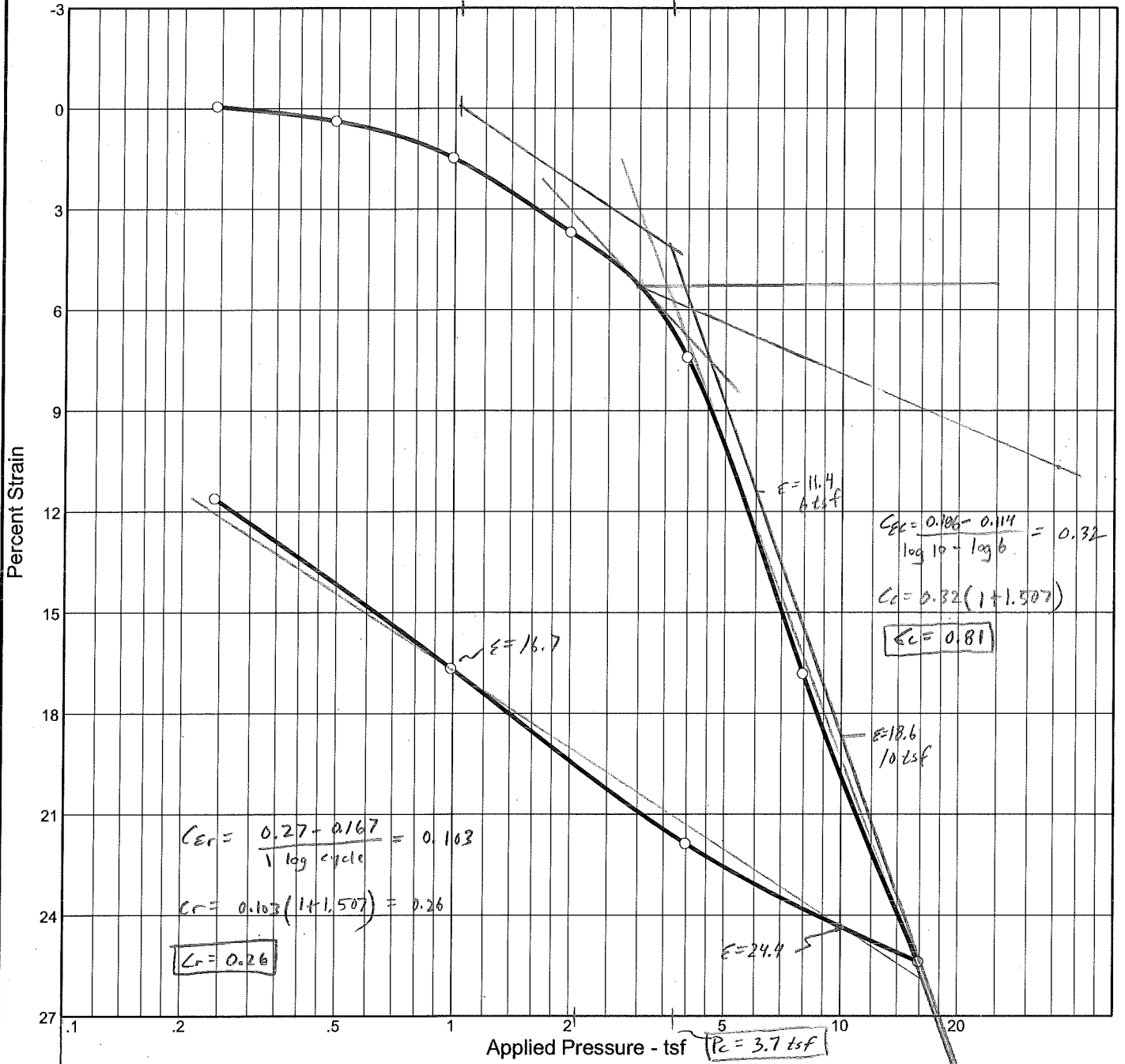
Void Ratio = 1.302 Compression = 16.8 %
 $D_0 = 0.08203$ $D_{50} = 0.12695$ $D_{100} = 0.17187$
 C_v at 56.0 min. = 0.00 ft.²/day $C_\alpha = 0.032$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.18890	16	11.50	0.20520
2	0.10	0.19310	17	14.50	0.20690
3	0.20	0.19360	18	20.00	0.20960
4	0.30	0.19400	19	31.00	0.21420
5	0.40	0.19430	20	41.00	0.21770
6	0.60	0.19480	21	52.00	0.22090
7	0.80	0.19530	22	68.00	0.22510
8	1.00	0.19560	23	123.00	0.23560
9	2.25	0.19760	24	180.00	0.24270
10	3.00	0.19850	25	240.00	0.24770
11	4.25	0.19980	26	306.00	0.25160
12	5.00	0.20050	27	371.00	0.25410
13	6.00	0.20130	28	1440.00	0.26300
14	7.00	0.20220	29	4236.00	0.26680
15	8.00	0.20290			



Void Ratio = 1.035 Compression = 26.4 %
 $D_0 = 0.18290$ $D_{50} = 0.21723$ $D_{100} = 0.25155$
 C_v at 63.3 min. = 0.00 ft.²/day $C_\alpha = 0.012$

CONSOLIDATION TEST REPORT



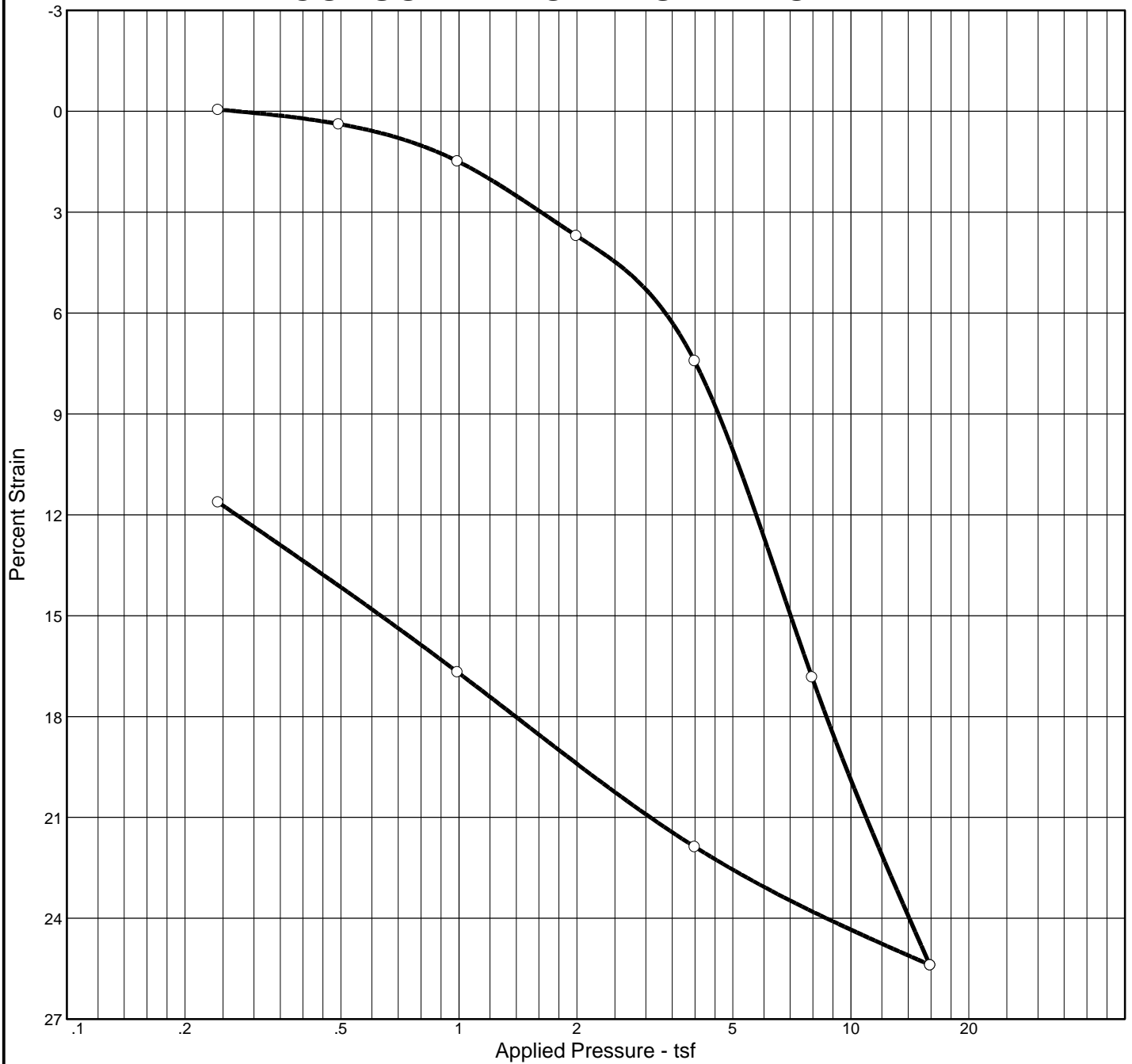
Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Heave %	e_0
Sat.	Moist.											
99.0 %	54.2 %	68.5	110	86	2.75		3.98	0.78	0.19			1.507

MATERIAL DESCRIPTION										USCS	AASHTO
Boring 09-26MU, Bottom of sample, FAT CLAY, brown (CH)										CH	

Project No. BL-09-03127 Client: US Army Corps of Engineer Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115 Location: SE-F-15, Fargo, Brenna Formation, #3, 28-30'	Remarks: Load #7 $C_v = 0.006 \text{ ft}^2/\text{day}$ Fargo 09-26MU, #3, 28' - 30' Brenna

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
99.0 %	54.2 %	68.5	110	86	2.75		3.98	0.78	0.19			1.507

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-26MU, Bottom of sample, FAT CLAY, brown (CH)	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-F-15, Fargo, Brenna Formation, #3, 28-30'</p> <p style="text-align: center;">BRAUN INTERTEC</p>	<p>Remarks: Load #7 C_v=0.006 ft²/day</p>
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Figure

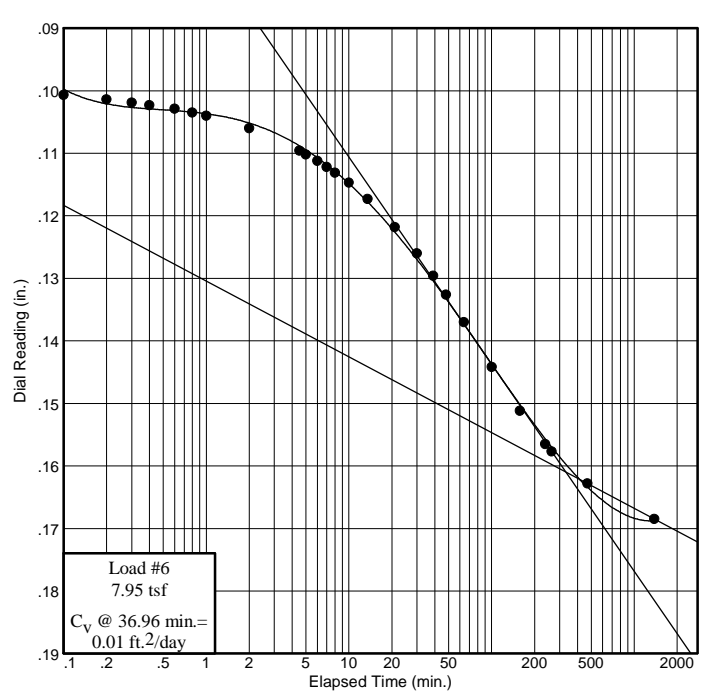
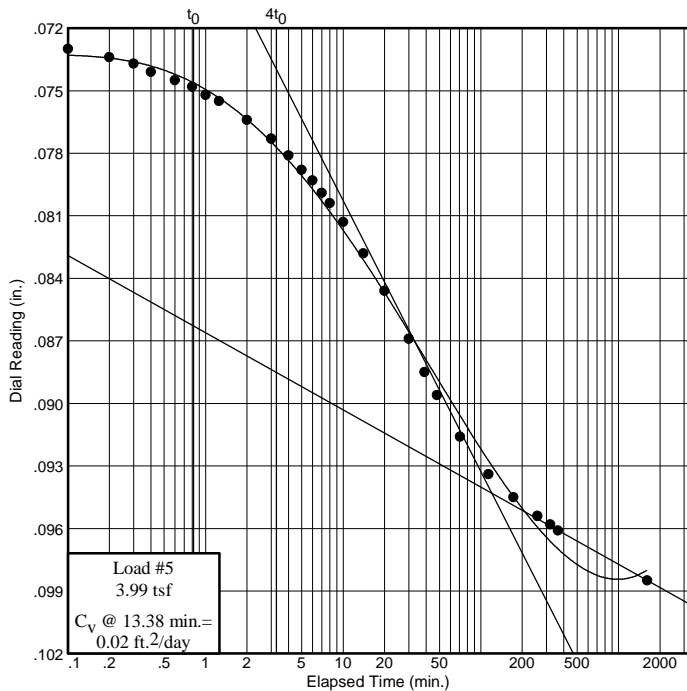
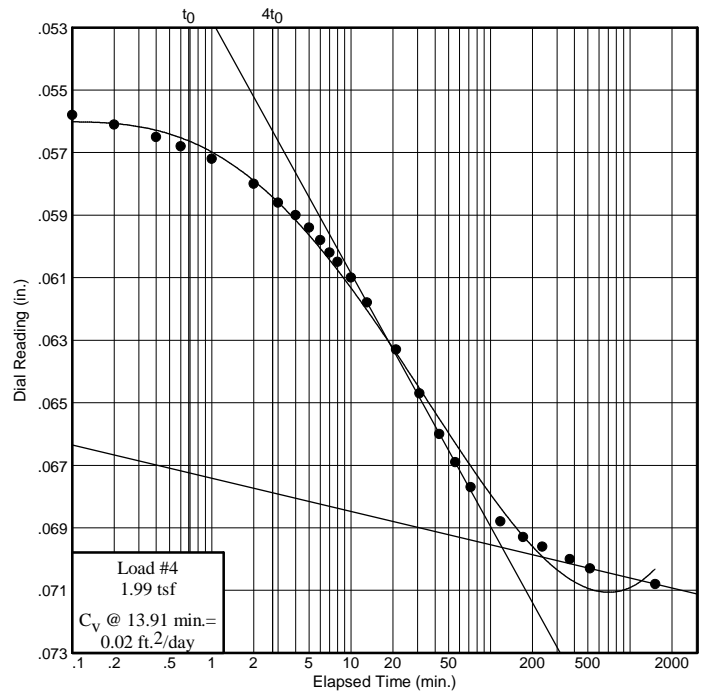
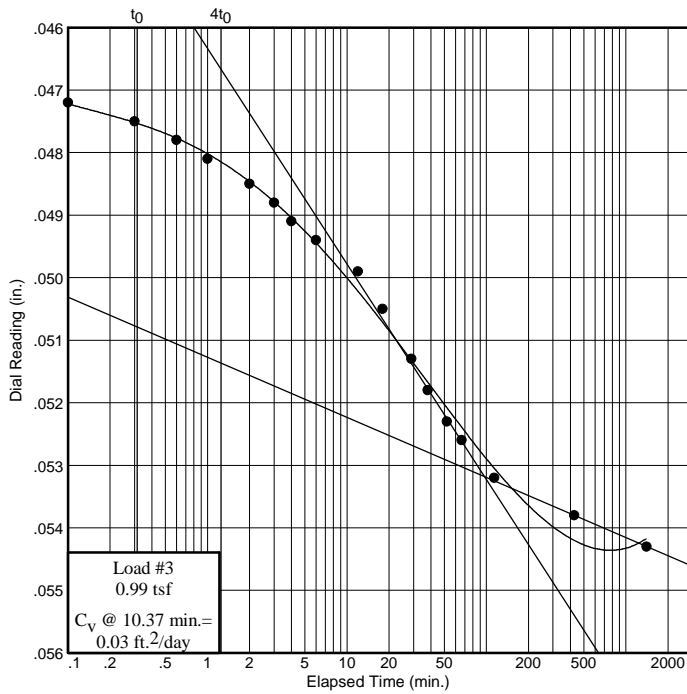
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-15, Fargo, Brenna Formation, #3, 28-30'



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Figure

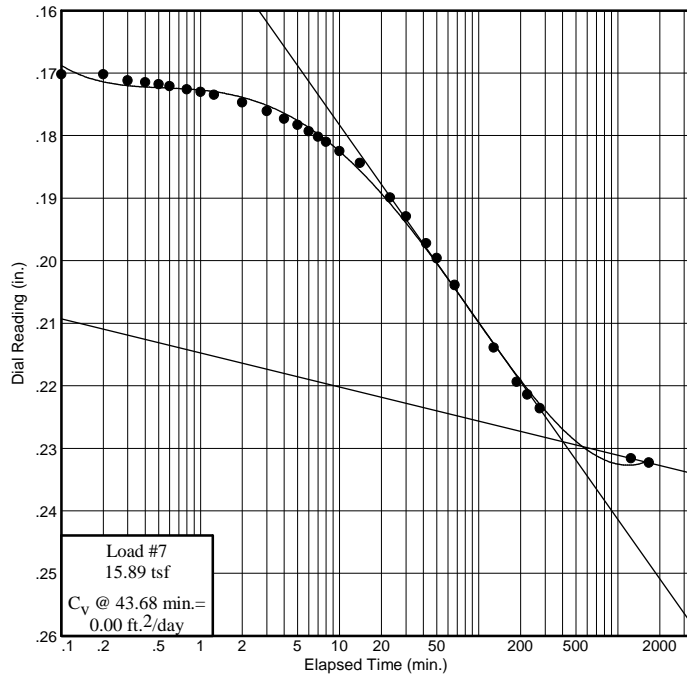
Dial Reading vs. Time

Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-15, Fargo, Brenna Formation, #3, 28-30'



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Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #3
Elev. or Depth: 28-30' **Sample Length(in./cm.):**
Location: SE-F-15, Fargo, Brenna Formation, #3, 28-30'
Description: Boring 09-26MU, Bottom of sample, FAT CLAY, brown (CH)
Liquid Limit: 110 **Plasticity Index:** 86
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks: Load #7 Cv=0.006 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 96.30 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 73.20 g.		Dry w+t =
Tare Wt. = 30.60 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 101.17 g.	Defl. Table = #3-2008	
Moisture = 54.2 %	Ht. Solids = 0.2970 in.	Moisture = %
Wet Den. = 105.6 pcf	Dry Wt. = 65.60 g.*	Dry Wt. = n/a
Dry Den. = 68.5 pcf	Void Ratio = 1.507	Void Ratio = 1.215
	Saturation = 99.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.04330				1.507	
0.24	0.04320	0.00030			1.508	0.1 Swell
0.49	0.04660	0.00050			1.497	0.4 Compr.
0.99	0.05500	0.00070	0.03	0.001	1.470	1.5 Compr.
1.99	0.07180	0.00100	0.02	0.001	1.414	3.7 Compr.
3.99	0.10000	0.00150	0.02	0.005	1.321	7.4 Compr.
7.95	0.17050	0.00200	0.01	0.018	1.085	16.8 Compr.
15.89	0.23520	0.00290	0.00	0.009	0.870	25.4 Compr.
3.99	0.20760	0.00150			0.958	21.9 Compr.
0.99	0.16810	0.00070			1.089	16.7 Compr.
0.24	0.13010	0.00030			1.215	11.6 Compr.

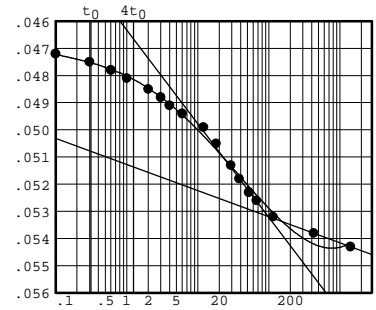
C_c = 0.78 P_c = 3.98 tsf C_r = 0.19

Pressure: 0.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.04660	11	18.00	0.05120
2	0.10	0.04790	12	29.00	0.05200
3	0.30	0.04820	13	38.00	0.05250
4	0.60	0.04850	14	52.00	0.05300
5	1.00	0.04880	15	66.50	0.05330
6	2.00	0.04920	16	114.00	0.05390
7	3.00	0.04950	17	425.50	0.05450
8	4.00	0.04980	18	1409.00	0.05500
9	6.00	0.05010			
10	12.00	0.05060			



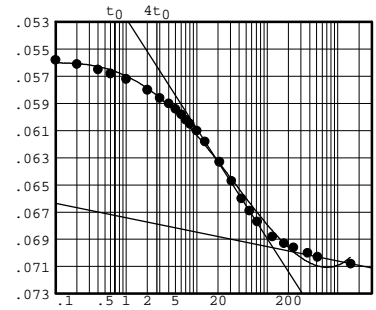
Void Ratio = 1.470 Compression = 1.5 %
 $D_0 = 0.04691$ $D_{50} = 0.05005$ $D_{100} = 0.05318$
 C_v at 10.4 min. = 0.03 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

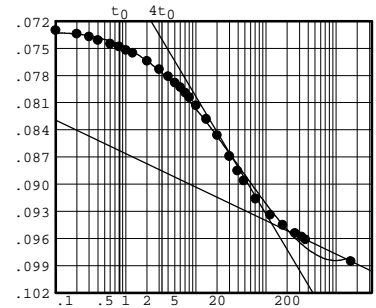
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.05500	14	10.00	0.06200
2	0.10	0.05680	15	13.00	0.06280
3	0.20	0.05710	16	21.00	0.06430
4	0.40	0.05750	17	31.00	0.06570
5	0.60	0.05780	18	43.00	0.06700
6	1.00	0.05820	19	56.00	0.06790
7	2.00	0.05900	20	72.00	0.06870
8	3.00	0.05960	21	118.00	0.06980
9	4.00	0.06000	22	172.00	0.07030
10	5.00	0.06040	23	236.00	0.07060
11	6.00	0.06080	24	372.00	0.07100
12	7.00	0.06120	25	517.00	0.07130
13	8.00	0.06150	26	1525.00	0.07180



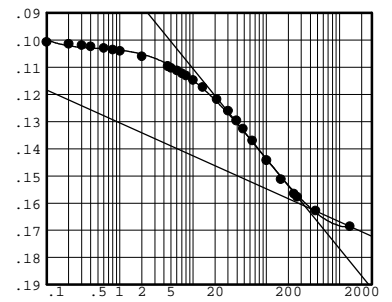
Void Ratio = 1.414 Compression = 3.7 %
 $D_0 = 0.05483$ $D_{50} = 0.06223$ $D_{100} = 0.06963$
 C_v at 13.9 min. = 0.02 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07180	16	8.00	0.08190
2	0.10	0.07450	17	10.00	0.08280
3	0.20	0.07490	18	14.00	0.08430
4	0.30	0.07520	19	20.00	0.08610
5	0.40	0.07560	20	30.00	0.08840
6	0.60	0.07600	21	39.00	0.09000
7	0.80	0.07630	22	48.00	0.09110
8	1.00	0.07670	23	70.50	0.09310
9	1.25	0.07700	24	114.00	0.09490
10	2.00	0.07790	25	173.00	0.09600
11	3.00	0.07880	26	258.00	0.09690
12	4.00	0.07960	27	320.00	0.09730
13	5.00	0.08030	28	364.00	0.09760
14	6.00	0.08080	29	1619.00	0.10000
15	7.00	0.08140			



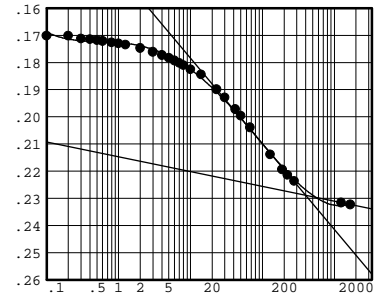
Void Ratio = 1.321 Compression = 7.4 %
 $D_0 = 0.07153$ $D_{50} = 0.08292$ $D_{100} = 0.09432$
 C_v at 13.4 min. = 0.02 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10000	15	10.00	0.11670
2	0.10	0.10270	16	13.50	0.11930
3	0.20	0.10340	17	21.00	0.12380
4	0.30	0.10390	18	30.00	0.12800
5	0.40	0.10430	19	39.00	0.13160
6	0.60	0.10490	20	48.00	0.13460
7	0.80	0.10550	21	64.00	0.13900
8	1.00	0.10600	22	100.50	0.14620
9	2.00	0.10800	23	158.00	0.15320
10	4.50	0.11160	24	238.00	0.15850
11	5.00	0.11220	25	264.00	0.15970
12	6.00	0.11320	26	469.00	0.16480
13	7.00	0.11420	27	1386.00	0.17050
14	8.00	0.11510			



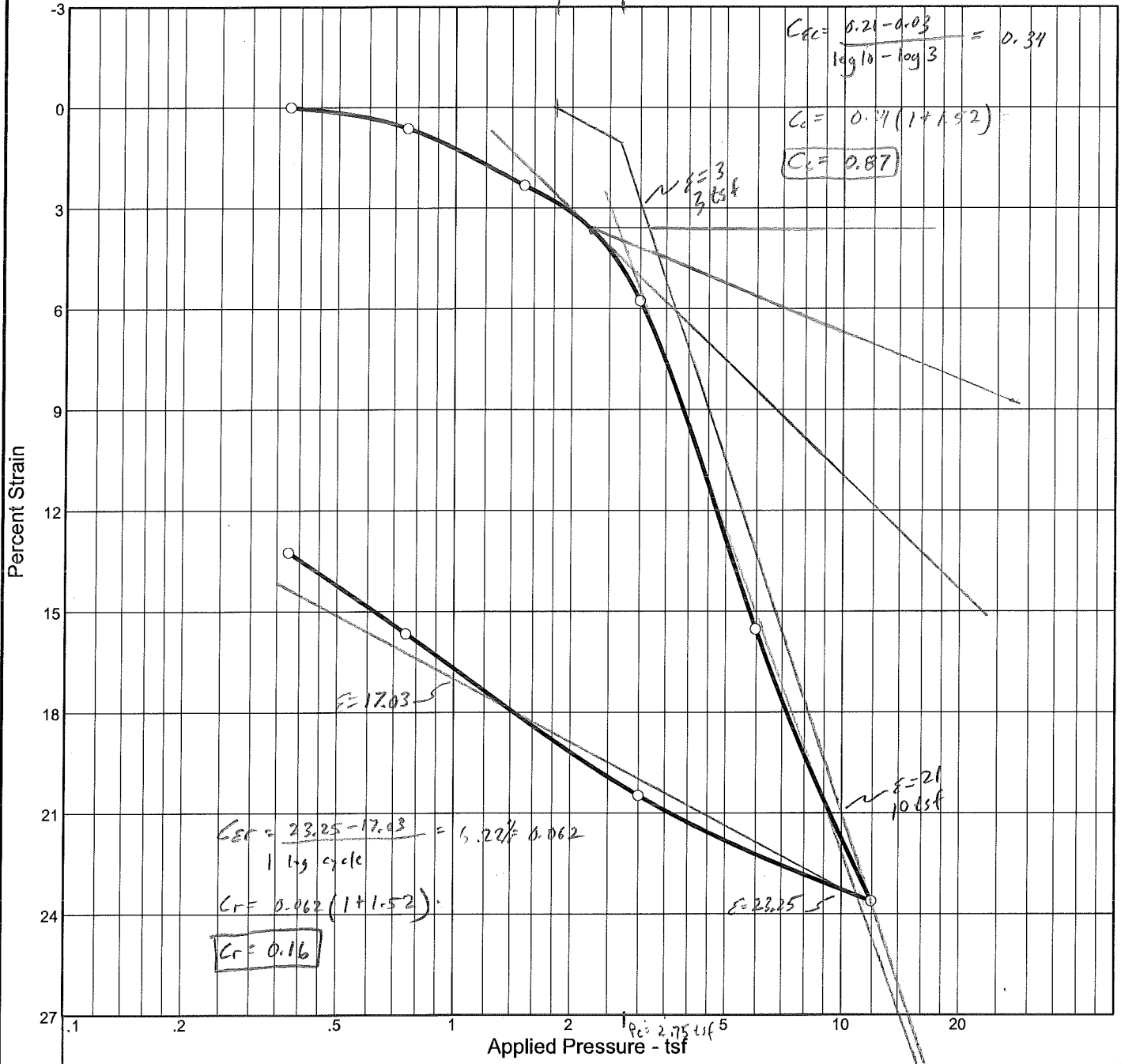
Void Ratio = 1.085 Compression = 16.8 %
 $D_0 = 0.09850$ $D_{50} = 0.12974$ $D_{100} = 0.16098$
 C_v at 37.0 min. = 0.01 ft.²/day $C_\alpha = 0.018$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.17050	16	7.00	0.18310
2	0.10	0.17310	17	8.00	0.18390
3	0.20	0.17310	18	10.00	0.18540
4	0.30	0.17410	19	14.00	0.18730
5	0.40	0.17440	20	23.00	0.19280
6	0.50	0.17470	21	30.00	0.19580
7	0.60	0.17500	22	42.00	0.20010
8	0.80	0.17550	23	50.00	0.20250
9	1.00	0.17590	24	67.00	0.20680
10	1.25	0.17640	25	128.00	0.21680
11	2.00	0.17760	26	188.00	0.22230
12	3.00	0.17900	27	223.00	0.22430
13	4.00	0.18020	28	275.00	0.22650
14	5.00	0.18120	29	1241.00	0.23450
15	6.00	0.18220	30	1668.00	0.23520



Void Ratio = 0.870 Compression = 25.4 %
 $D_0 = 0.16850$ $D_{50} = 0.19871$ $D_{100} = 0.22893$
 C_v at 43.7 min. = 0.00 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural Sat.		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
98.6 %	55.4 %	67.0	89	69	2.704		2.59	0.73	0.18			1.520

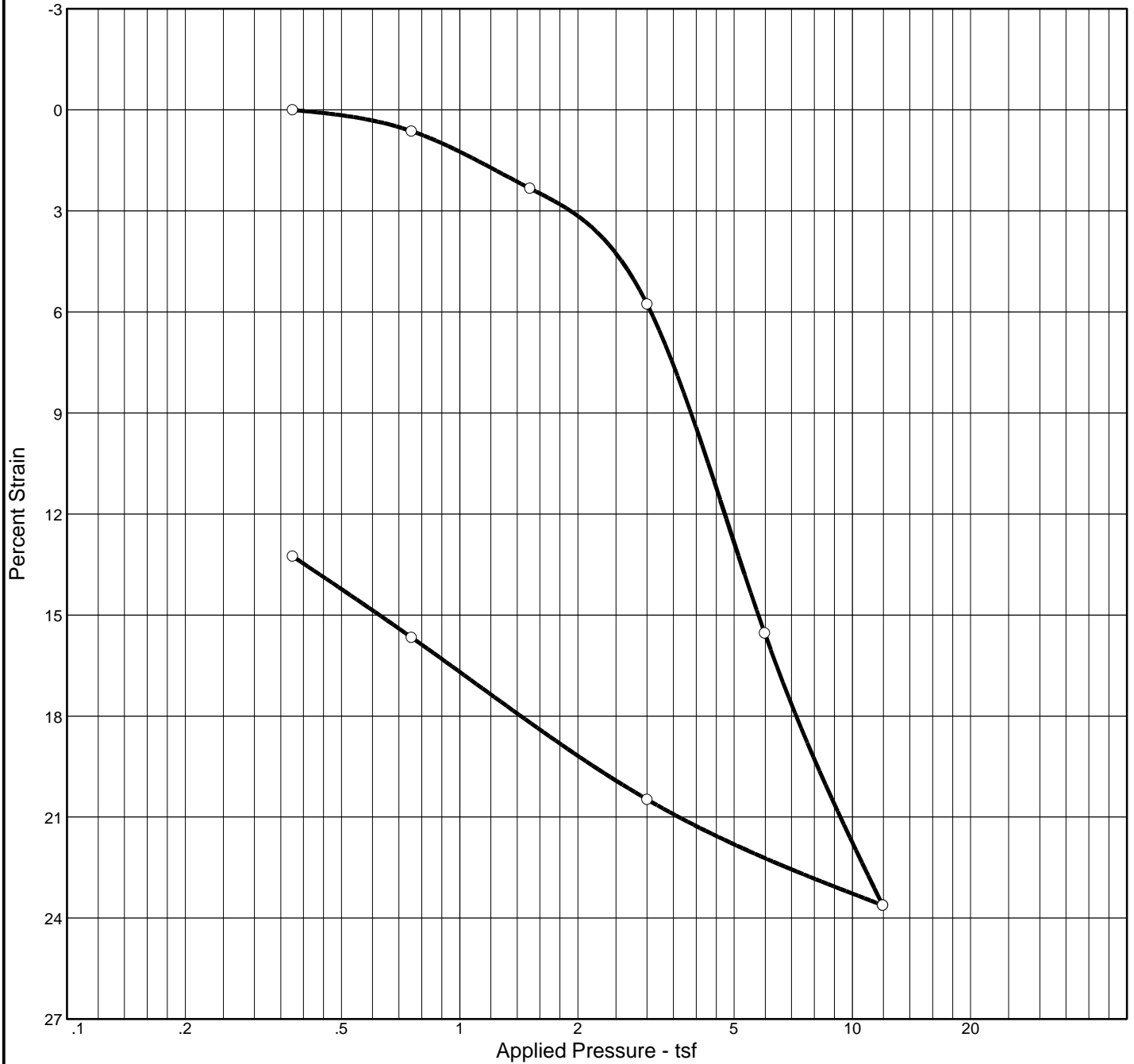
MATERIAL DESCRIPTION										USCS	AASHTO
33 Boring 09-27MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435										CH	

Project No. BL-09-03127 Client: US Army Corps of Engineer Project: Fargo-Moorhead Feasibility Study 36 W912ES-09-P-0115 Location: SE-F-19, Fargo, Argusville Formation , #4, 64-66'	Remarks: Fargo 09-27MU, #4, 64' - 66' Brenna
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Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Heave %	e ₀
Sat.	Moist.											
98.6 %	55.4 %	67.0	89	69	2.704		2.59	0.73	0.18			1.520

MATERIAL DESCRIPTION	USCS	AASHTO
Boring 09-27MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435	CH	

<p>Project No. BL-09-03127 Client: US Army Corps of Engineer</p> <p>Project: Fargo-Moorhead Feasibility Study W912ES-09-P-0115</p> <p>Location: SE-F-19, Fargo, Argusville Formation, #4, 64-66'</p>	<p>Remarks:</p> <p style="color: red;">Fargo 09-27MU, #4, 64' - 66' Brenna</p>

Figure

Dial Reading vs. Time

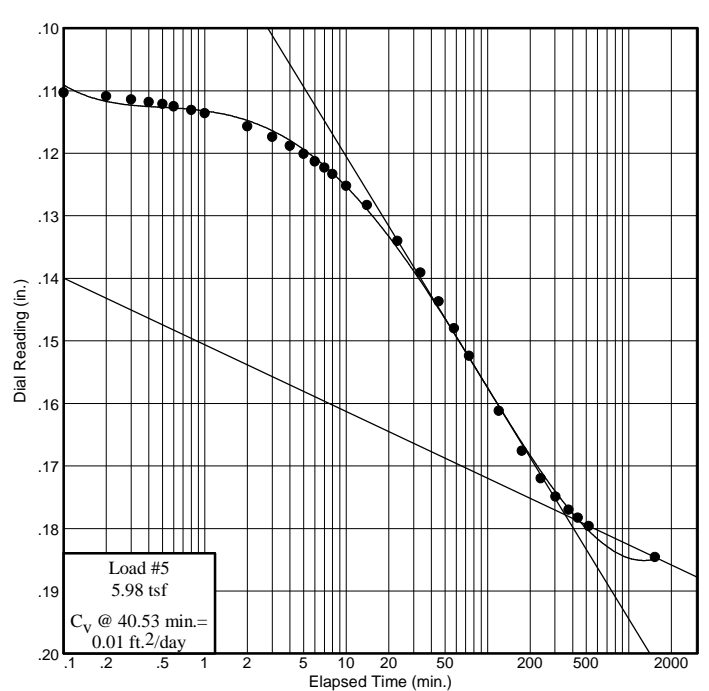
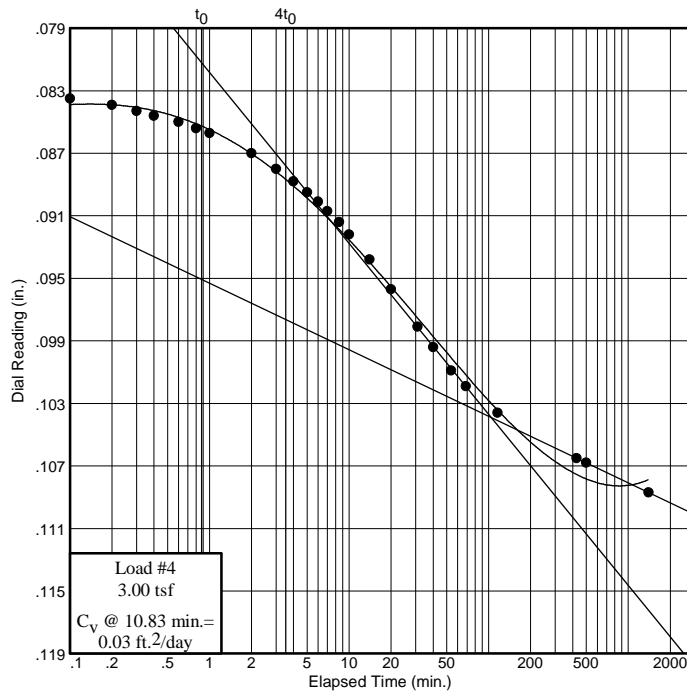
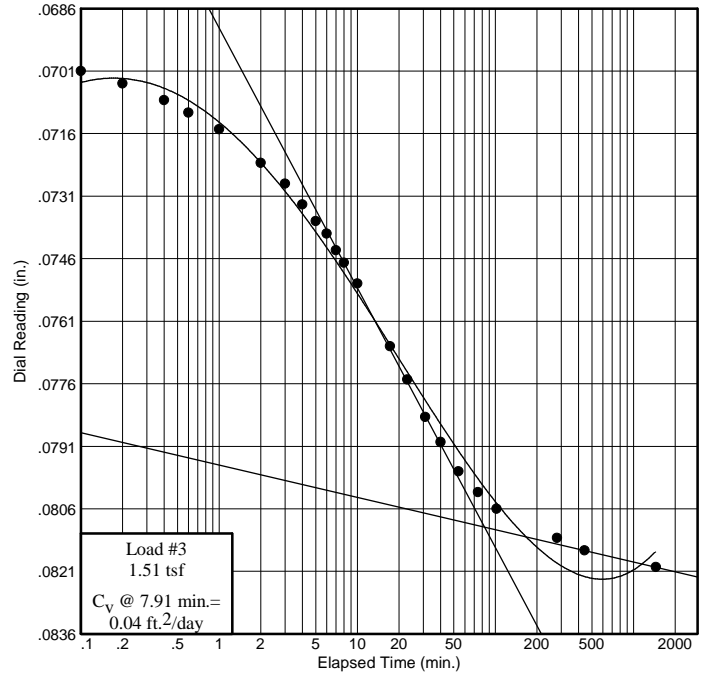
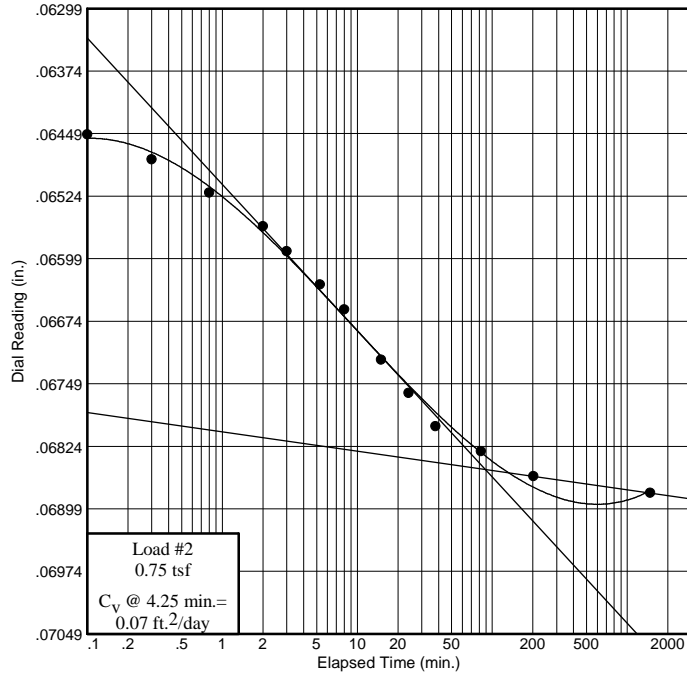
Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-19, Fargo, ~~Argusville Formation~~, #4, 64-66'

Brenna



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Figure

Dial Reading vs. Time

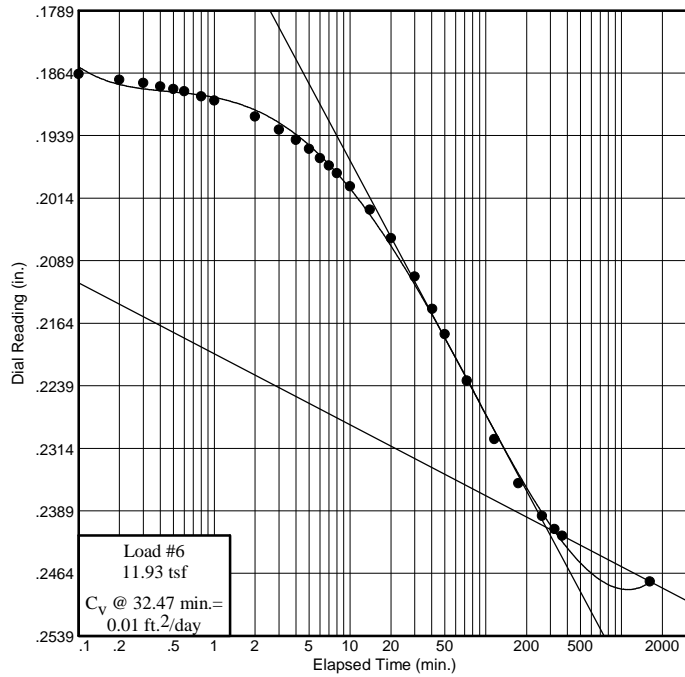
Project No.: BL-09-03127

Project: Fargo-Moorhead Feasibility Study

W912ES-09-P-0115

Location: SE-F-19, Fargo, ~~Argusville Formation~~, #4, 64-66'

Brenna



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Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineer
Project: Fargo-Moorhead Feasibility Study
 W912ES-09-P-0115
Project Number: BL-09-03127

Sample Data

Source:
Sample No.: #4
Elev. or Depth: 64-66' **Sample Length(in./cm.):**
Location: SE-F-19, Fargo, ~~Argusville Formation~~, #4, 64-66' **Brenna**
Description: Boring 09-27MU, Bottom of sample, FAT CLAY, gray (CH), ASTM D2435
Liquid Limit: 89 **Plasticity Index:** 69
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 79.14 g.	Consolidometer # = 5	Wet w+t =
Dry w+t = 61.71 g.		Dry w+t =
Tare Wt. = 30.26 g.	Spec. Gravity = 2.704	Tare Wt. =
Height = .78 in.	Height = .78 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 104.33 g.	Defl. Table = #5-2008	
Moisture = 55.4 %	Ht. Solids = 0.3084 in.	Moisture = %
Wet Den. = 104.1 pcf	Dry Wt. = 67.13 g.*	Dry Wt. = n/a
Dry Den. = 67.0 pcf	Void Ratio = 1.520	Void Ratio = 1.186
	Saturation = 98.6 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06390				1.520	
0.38	0.06500	0.00110			1.520	0.0 Compr.
0.75	0.07070	0.00190	0.07	0.000	1.504	0.6 Compr.
1.51	0.08500	0.00300	0.04	0.001	1.461	2.3 Compr.
3.00	0.11300	0.00430	0.03	0.006	1.374	5.8 Compr.
5.98	0.19060	0.00600	0.01	0.015	1.128	15.5 Compr.
11.93	0.25570	0.00830	0.01	0.013	0.925	23.6 Compr.
3.00	0.22730	0.00430			1.004	20.5 Compr.
0.75	0.18750	0.00190			1.125	15.7 Compr.
0.38	0.16800	0.00110			1.186	13.3 Compr.

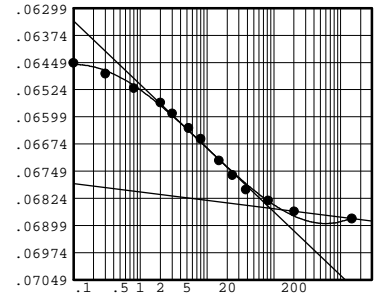
C_c = 0.73 P_c = 2.59 tsf C_r = 0.18

Pressure: 0.75 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06500	11	38.00	0.06990
2	0.10	0.06640	12	82.30	0.07020
3	0.30	0.06670	13	202.00	0.07050
4	0.80	0.06710	14	1475.00	0.07070
5	2.00	0.06750			
6	3.00	0.06780			
7	5.30	0.06820			
8	8.00	0.06850			
9	15.00	0.06910			
10	24.00	0.06950			



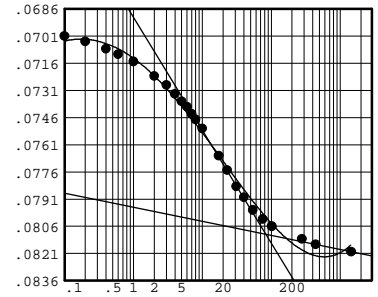
Void Ratio = 1.504 Compression = 0.6 %
 $D_0 = 0.06390$ $D_{50} = 0.06621$ $D_{100} = 0.06852$
 C_v at 4.2 min. = 0.07 ft.²/day $C_\alpha = 0.000$

Pressure: 1.51 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07070	14	10.00	0.07820
2	0.10	0.07310	15	17.30	0.07970
3	0.20	0.07340	16	23.00	0.08050
4	0.40	0.07380	17	31.00	0.08140
5	0.60	0.07410	18	40.00	0.08200
6	1.00	0.07450	19	54.00	0.08270
7	2.00	0.07530	20	75.00	0.08320
8	3.00	0.07580	21	102.00	0.08360
9	4.00	0.07630	22	0.00	0.00000
10	5.00	0.07670	23	279.00	0.08430
11	6.00	0.07700	24	441.50	0.08460
12	7.00	0.07740	25	1447.00	0.08500
13	8.00	0.07770			



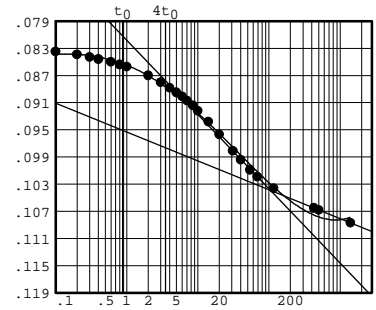
Void Ratio = 1.461 Compression = 2.3 %
 $D_0 = 0.06880$ $D_{50} = 0.07492$ $D_{100} = 0.08104$
 C_v at 7.9 min. = 0.04 ft.²/day $C_\alpha = 0.001$

Pressure: 3.00 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08500	14	7.00	0.09500
2	0.10	0.08780	15	8.50	0.09570
3	0.20	0.08820	16	10.00	0.09650
4	0.30	0.08860	17	14.00	0.09810
5	0.40	0.08890	18	20.00	0.10000
6	0.60	0.08930	19	31.00	0.10240
7	0.80	0.08970	20	40.00	0.10370
8	1.00	0.09000	21	54.00	0.10520
9	2.00	0.09130	22	68.50	0.10620
10	3.00	0.09230	23	116.00	0.10790
11	4.00	0.09310	24	427.50	0.11080
12	5.00	0.09380	25	501.00	0.11110
13	6.00	0.09440	26	1401.00	0.11300



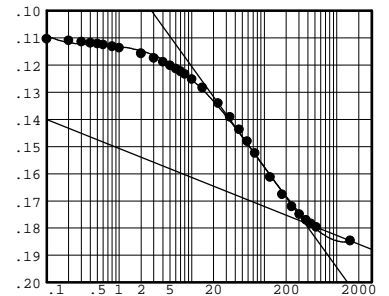
Void Ratio = 1.374 Compression = 5.8 %
 $D_0 = 0.08186$ $D_{50} = 0.09288$ $D_{100} = 0.10390$
 C_v at 10.8 min. = 0.03 ft.²/day $C_\alpha = 0.006$

Pressure: 5.98 tsf

TEST READINGS

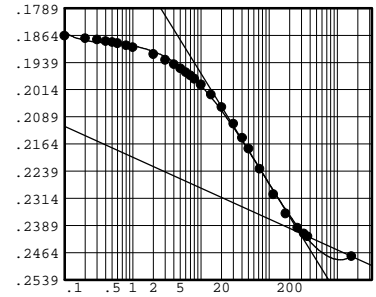
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11300	17	10.00	0.13120
2	0.10	0.11630	18	14.00	0.13430
3	0.20	0.11690	19	23.00	0.14000
4	0.30	0.11740	20	33.50	0.14510
5	0.40	0.11780	21	45.00	0.14970
6	0.50	0.11810	22	58.00	0.15400
7	0.60	0.11850	23	74.00	0.15840
8	0.80	0.11910	24	120.00	0.16720
9	1.00	0.11960	25	175.00	0.17360
10	2.00	0.12170	26	238.00	0.17800
11	3.00	0.12340	27	303.00	0.18090
12	4.00	0.12480	28	374.50	0.18300
13	5.00	0.12610	29	436.50	0.18430
14	6.00	0.12730	30	519.00	0.18560
15	7.00	0.12830	31	1527.00	0.19060
16	8.00	0.12930			



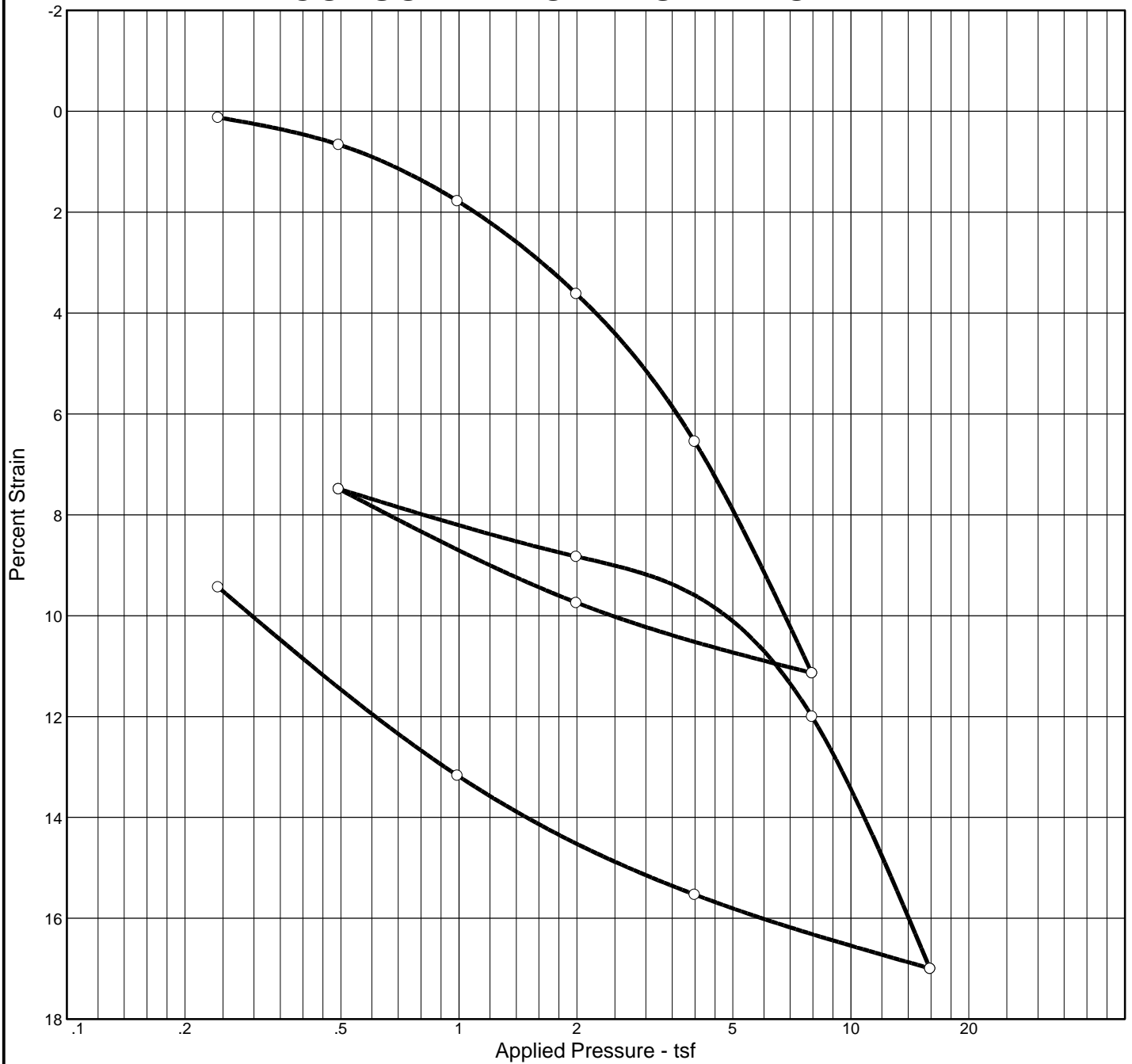
Void Ratio = 1.128 Compression = 15.5 %
 $D_0 = 0.10870$ $D_{50} = 0.14327$ $D_{100} = 0.17784$
 C_v at 40.5 min. = 0.01 ft.²/day $C_\alpha = 0.015$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.19060	16	8.00	0.20670
2	0.10	0.19480	17	10.00	0.20830
3	0.20	0.19550	18	14.00	0.21110
4	0.30	0.19590	19	20.00	0.21450
5	0.40	0.19630	20	30.00	0.21910
6	0.50	0.19660	21	40.30	0.22300
7	0.60	0.19690	22	50.00	0.22600
8	0.80	0.19750	23	72.50	0.23160
9	1.00	0.19800	24	116.00	0.23860
10	2.00	0.19990	25	174.00	0.24390
11	3.00	0.20150	26	260.00	0.24780
12	4.00	0.20270	27	322.00	0.24940
13	5.00	0.20380	28	366.00	0.25020
14	6.00	0.20490	29	1620.00	0.25570
15	7.00	0.20580			



Void Ratio = 0.925 Compression = 23.6 %
 $D_0 = 0.18460$ $D_{50} = 0.21275$ $D_{100} = 0.24091$
 C_v at 32.5 min. = 0.01 ft.²/day $C_\alpha = 0.013$

CONSOLIDATION TEST REPORT



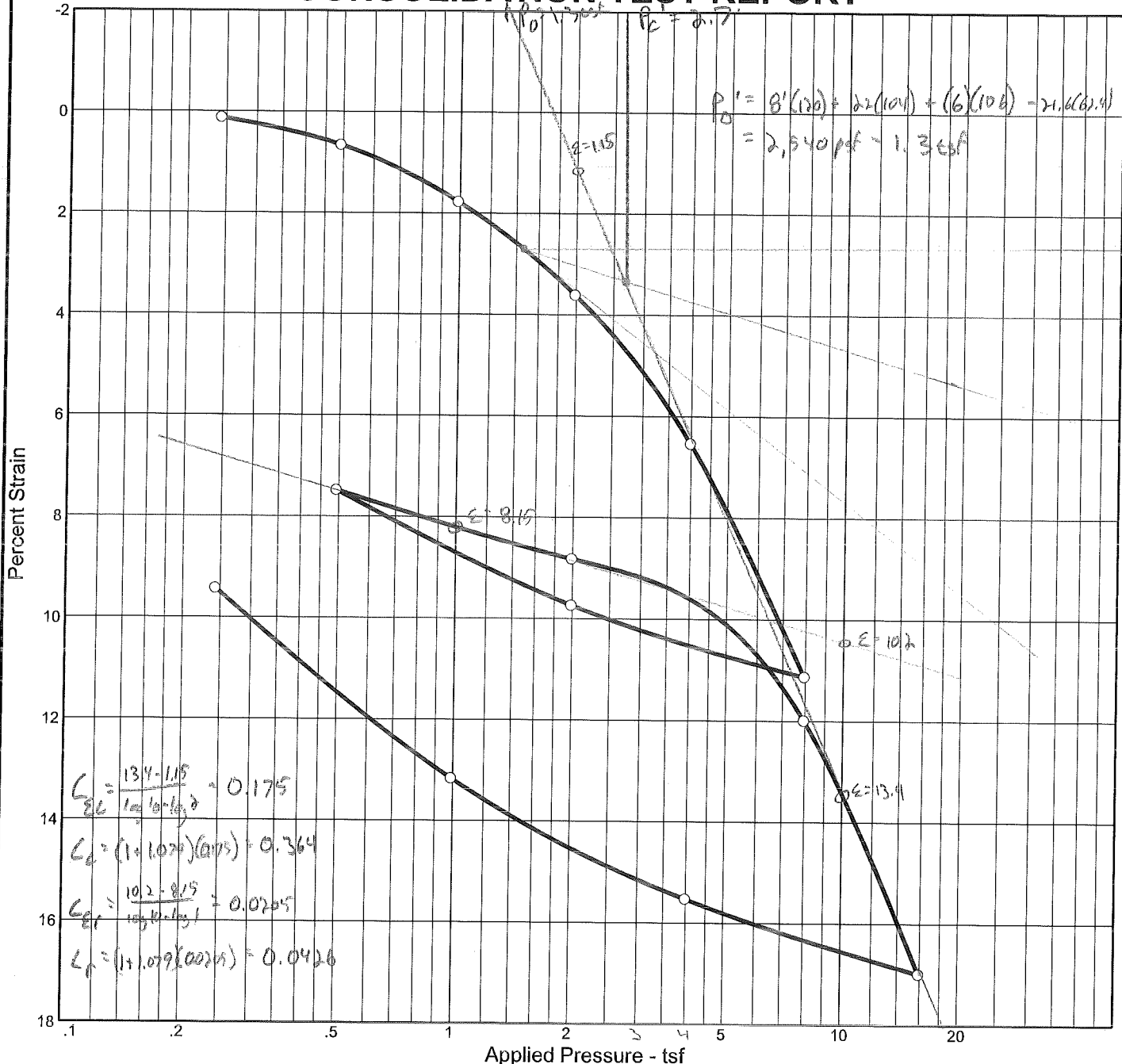
Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
97.7 %	38.3 %	82.6	64	47	2.75		2.81	0.41	0.08			1.079

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH)	CH	

<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p>Location: Boring 09-59MU, #3, 35-37', WD-28, ND Div, Brenna Formation</p>	<p>Remarks: 5" thinwall, Bottom of sample</p> <p style="color: red;">Fargo 09-59MU, #3, 35' - 37' Brenna / Argusville Transition</p>

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
97.7 %	38.3 %	82.6	64	47	2.75		2.81	0.41	0.08			1.079

MATERIAL DESCRIPTION										USCS	AASHTO
FAT CLAY, brown (CH)										CH	

Project No. BL0903127A **Client:** US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Location: Boring 09-59MU, #3, 35-37', WD-28, ND Div, Brenna Formation / *Argusville? / Transitioned*

BRAUN
INTERTEC

Remarks:
 5" thinwall, Bottom of sample
 GWT = 11.4' BGS

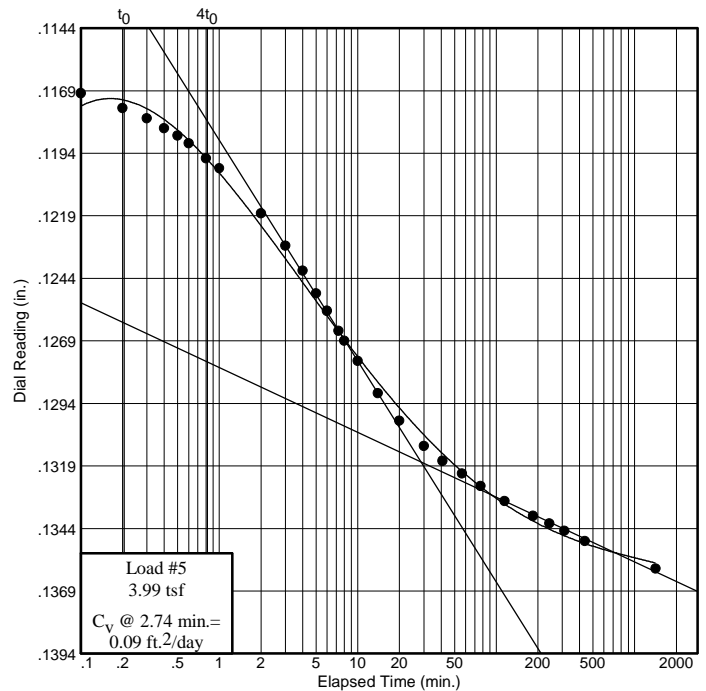
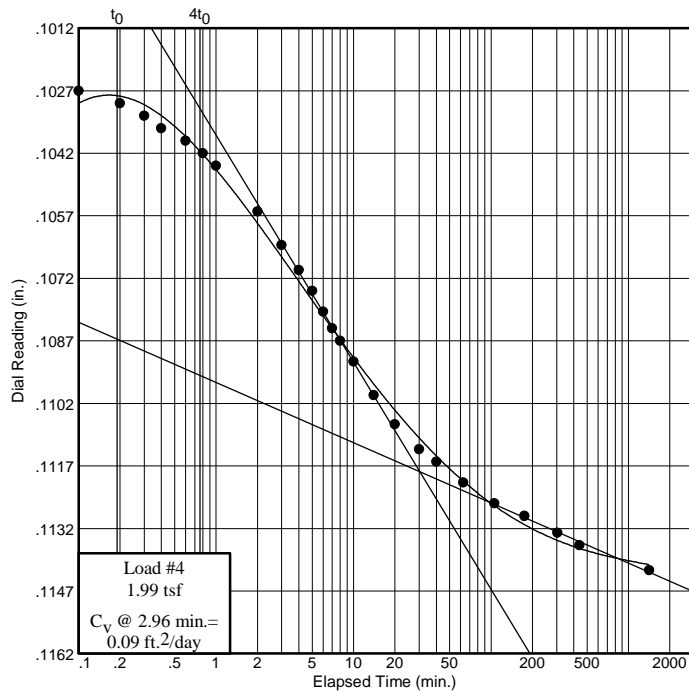
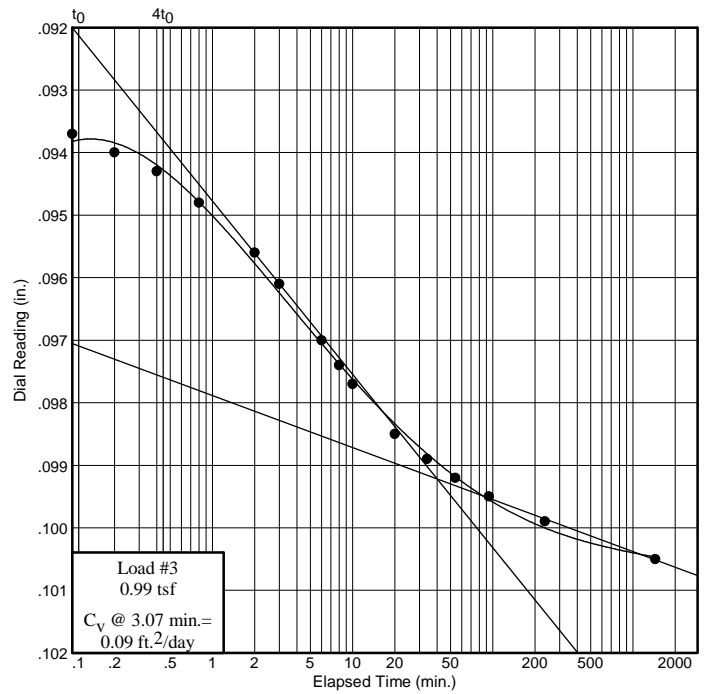
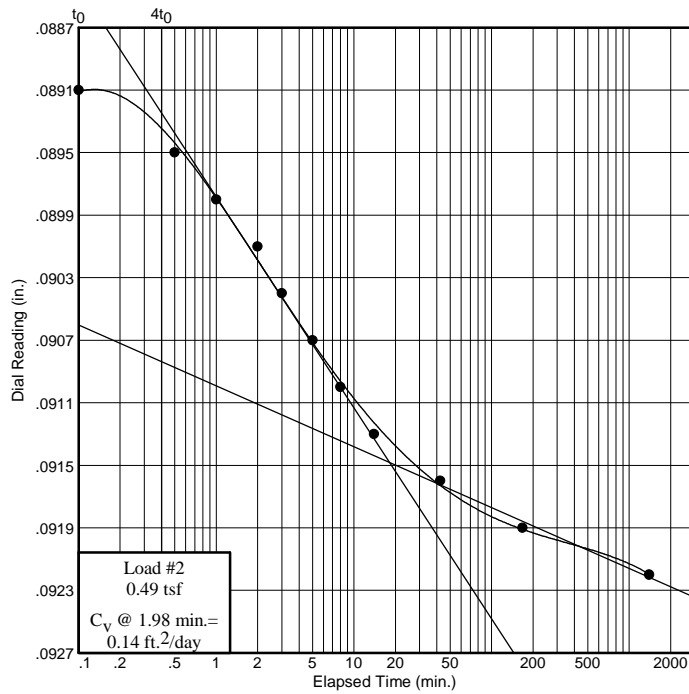
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-59MU, #3, 35-37', WD-28, ND Div, ~~Brenna Formation~~ Brenna / Argusville Transition



BRAUNSM
INTERTEC

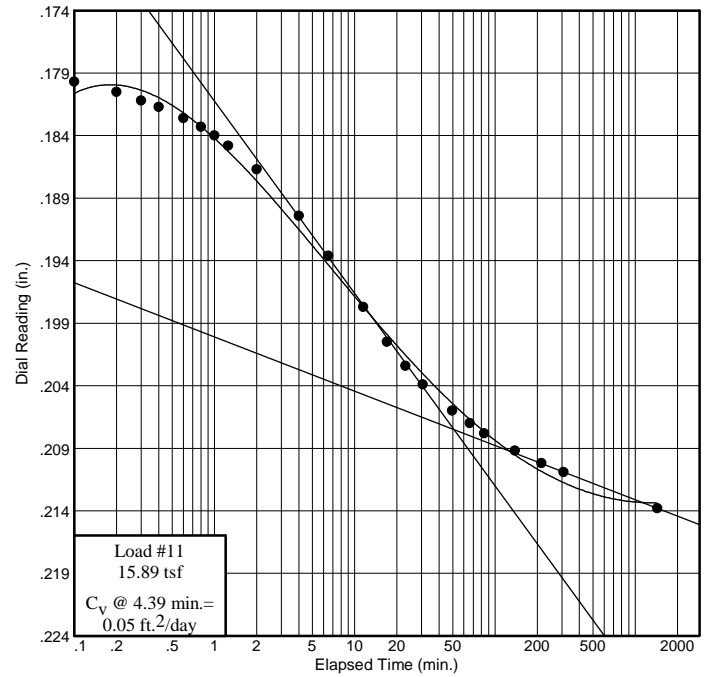
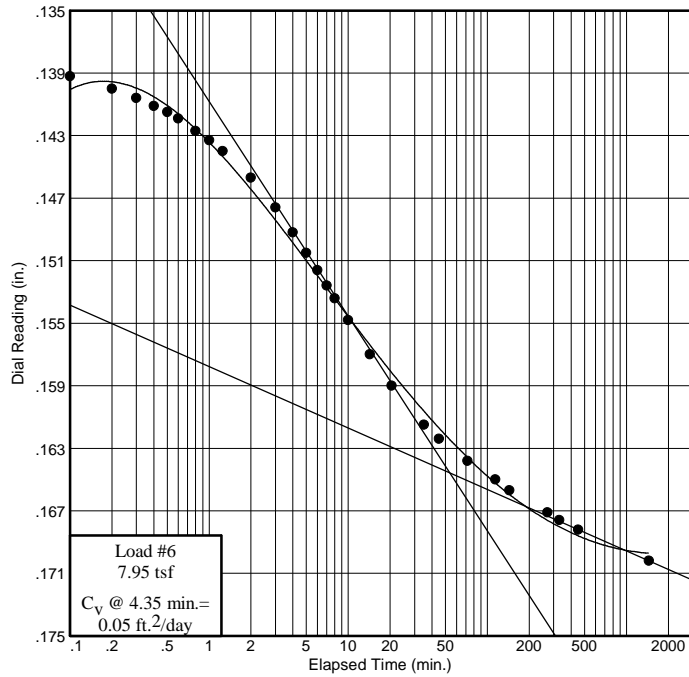
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-59MU, #3, 35-37', WD-28, ND Div, ~~Brenna Formation~~ Brenna / Argusville Transition



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL0903127A

Sample Data

Source:

Sample No.: Boring 09-59MU, #3

Elev. or Depth: 35-37'

Sample Length(in./cm.):

Location: Boring 09-59MU, #3, 35-37', WD-28, ND Div, ~~Brenna Formation~~

Brenna / Argusville Transition

Description: FAT CLAY, brown (CH)

Liquid Limit: 64

Plasticity Index: 47

USCS: CH

AASHTO:

Figure No.:

Testing Remarks: 5" thinwall, Bottom of sample

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 134.10 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 105.36 g.		Dry w+t =
Tare Wt. = 30.40 g.	Spec. Gravity = 2.75	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 109.40 g.	Defl. Table = n/a	
Moisture = 38.3 %	Ht. Solids = 0.3581 in.	Moisture = %
Wet Den. = 114.2 pcf	Dry Wt. = 79.08 g.*	Dry Wt. = n/a
Dry Den. = 82.6 pcf	Void Ratio = 1.079	Void Ratio = 0.883
	Saturation = 97.7 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08730				1.079	
0.24	0.08820	0.00000			1.077	0.1 Compr.
0.49	0.09220	0.00000	0.14	0.001	1.066	0.7 Compr.
0.99	0.10050	0.00000	0.09	0.001	1.042	1.8 Compr.
1.99	0.11420	0.00000	0.09	0.002	1.004	3.6 Compr.
3.99	0.13600	0.00000	0.09	0.004	0.943	6.5 Compr.
7.95	0.17020	0.00000	0.05	0.006	0.848	11.1 Compr.
1.99	0.15980	0.00000			0.877	9.7 Compr.
0.49	0.14300	0.00000			0.924	7.5 Compr.
1.99	0.15300	0.00000			0.896	8.8 Compr.
7.95	0.17660	0.00000			0.830	12.0 Compr.
15.89	0.21380	0.00000	0.05	0.007	0.726	17.0 Compr.
3.99	0.20290	0.00000			0.756	15.5 Compr.
0.99	0.18530	0.00000			0.806	13.2 Compr.
0.24	0.15750	0.00000			0.883	9.4 Compr.

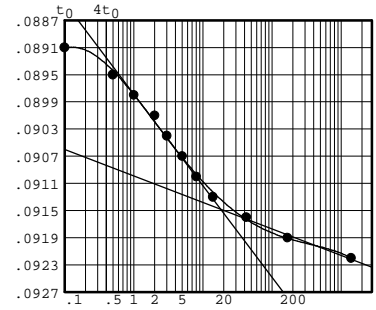
$C_c = 0.41$ $P_c = 2.81$ tsf $C_r = 0.08$

Pressure: 0.49 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08820	11	167.50	0.09190
2	0.10	0.08910	12	1399.00	0.09220
3	0.50	0.08950			
4	1.00	0.08980			
5	2.00	0.09010			
6	3.00	0.09040			
7	5.00	0.09070			
8	8.00	0.09100			
9	14.00	0.09130			
10	42.50	0.09160			



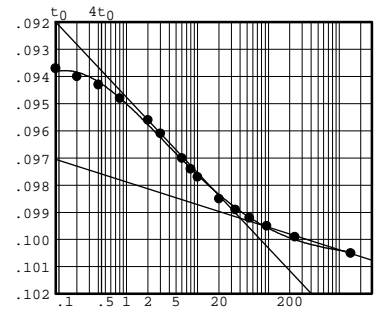
Void Ratio = 1.066 Compression = 0.7 %
 $D_0 = 0.08888$ $D_{50} = 0.09018$ $D_{100} = 0.09148$
 C_v at 2.0 min. = 0.14 ft.²/day $C_\alpha = 0.001$

Pressure: 0.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09220	11	20.00	0.09850
2	0.10	0.09370	12	34.00	0.09890
3	0.20	0.09400	13	54.00	0.09920
4	0.40	0.09430	14	94.00	0.09950
5	0.80	0.09480	15	235.00	0.09990
6	2.00	0.09560	16	1440.00	0.10050
7	3.00	0.09610			
8	6.00	0.09700			
9	8.00	0.09740			
10	10.00	0.09770			



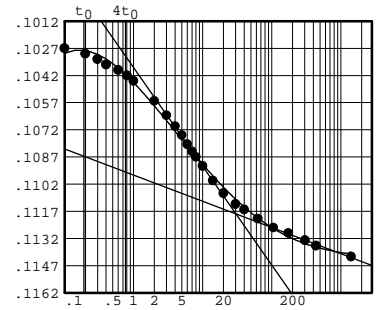
Void Ratio = 1.042 Compression = 1.8 %
 $D_0 = 0.09332$ $D_{50} = 0.09627$ $D_{100} = 0.09922$
 C_v at 3.1 min. = 0.09 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10080	14	7.00	0.10840
2	0.10	0.10270	15	8.00	0.10870
3	0.20	0.10300	16	10.00	0.10920
4	0.30	0.10330	17	14.00	0.11000
5	0.40	0.10360	18	20.00	0.11070
6	0.60	0.10390	19	30.00	0.11130
7	0.80	0.10420	20	40.00	0.11160
8	1.00	0.10450	21	63.00	0.11210
9	2.00	0.10560	22	106.00	0.11260
10	3.00	0.10640	23	175.00	0.11290
11	4.00	0.10700	24	304.00	0.11330
12	5.00	0.10750	25	439.00	0.11360
13	6.00	0.10800	26	1417.00	0.11420



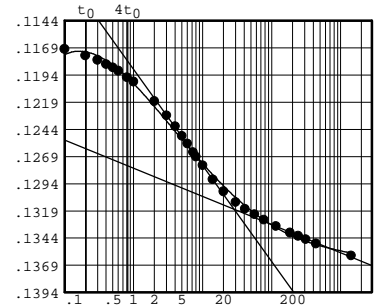
Void Ratio = 1.004 Compression = 3.6 %
 $D_0 = 0.10149$ $D_{50} = 0.10666$ $D_{100} = 0.11184$
 C_v at 3.0 min. = 0.09 ft.²/day $C_\alpha = 0.002$

Pressure: 3.99 tsf

TEST READINGS

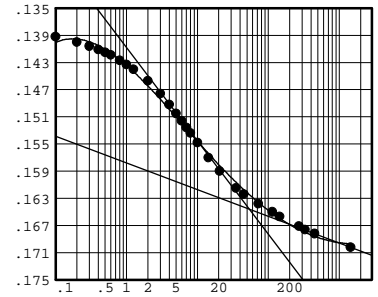
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11420	16	8.00	0.12690
2	0.10	0.11700	17	10.00	0.12770
3	0.20	0.11760	18	14.00	0.12900
4	0.30	0.11800	19	20.00	0.13010
5	0.40	0.11840	20	30.00	0.13110
6	0.50	0.11870	21	41.00	0.13170
7	0.60	0.11900	22	56.50	0.13220
8	0.80	0.11960	23	77.00	0.13270
9	1.00	0.12000	24	115.00	0.13330
10	2.00	0.12180	25	185.00	0.13390
11	3.00	0.12310	26	242.00	0.13420
12	4.00	0.12410	27	311.00	0.13450
13	5.00	0.12500	28	438.00	0.13490
14	6.00	0.12570	29	1420.00	0.13600
15	7.25	0.12650			



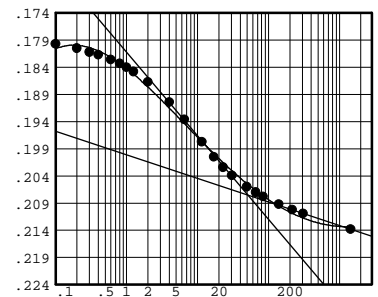
Void Ratio = 0.943 Compression = 6.5 %
 $D_0 = 0.11490$ $D_{50} = 0.12332$ $D_{100} = 0.13173$
 C_v at 2.7 min. = 0.09 ft.²/day $C_\alpha = 0.004$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13600	16	7.00	0.15260
2	0.10	0.13920	17	8.00	0.15340
3	0.20	0.14000	18	10.00	0.15480
4	0.30	0.14060	19	14.30	0.15700
5	0.40	0.14110	20	20.50	0.15900
6	0.50	0.14150	21	35.00	0.16150
7	0.60	0.14190	22	45.00	0.16240
8	0.80	0.14270	23	72.00	0.16380
9	1.00	0.14330	24	114.00	0.16500
10	1.25	0.14400	25	144.00	0.16570
11	2.00	0.14570	26	270.30	0.16710
12	3.00	0.14760	27	330.00	0.16760
13	4.00	0.14920	28	449.00	0.16820
14	5.00	0.15050	29	1448.00	0.17020
15	6.00	0.15160			



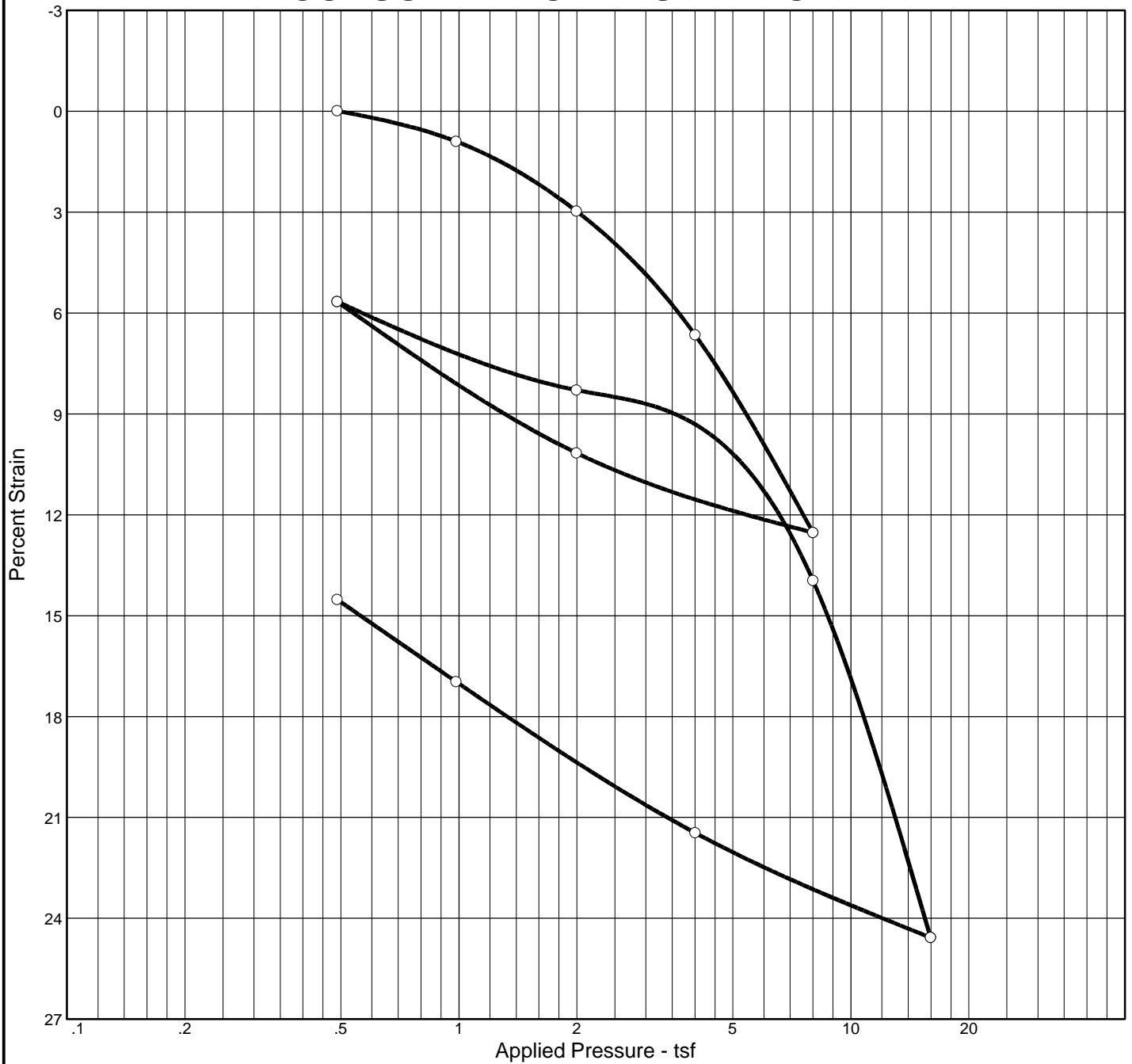
Void Ratio = 0.848 Compression = 11.1 %
 $D_0 = 0.13600$ $D_{50} = 0.15029$ $D_{100} = 0.16458$
 C_v at 4.3 min. = 0.05 ft.²/day $C_\alpha = 0.006$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.17660	13	11.50	0.19770
2	0.10	0.17970	14	17.00	0.20050
3	0.20	0.18050	15	23.00	0.20240
4	0.30	0.18120	16	30.50	0.20390
5	0.40	0.18170	17	49.50	0.20600
6	0.60	0.18260	18	66.00	0.20700
7	0.80	0.18330	19	84.00	0.20780
8	1.00	0.18400	20	139.00	0.20920
9	1.25	0.18480	21	215.00	0.21020
10	2.00	0.18670	22	308.00	0.21090
11	4.00	0.19040	23	1435.00	0.21380
12	6.50	0.19360			



Void Ratio = 0.726 Compression = 17.0 %
 $D_0 = 0.17660$ $D_{50} = 0.19206$ $D_{100} = 0.20752$
 C_v at 4.4 min. = 0.05 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT

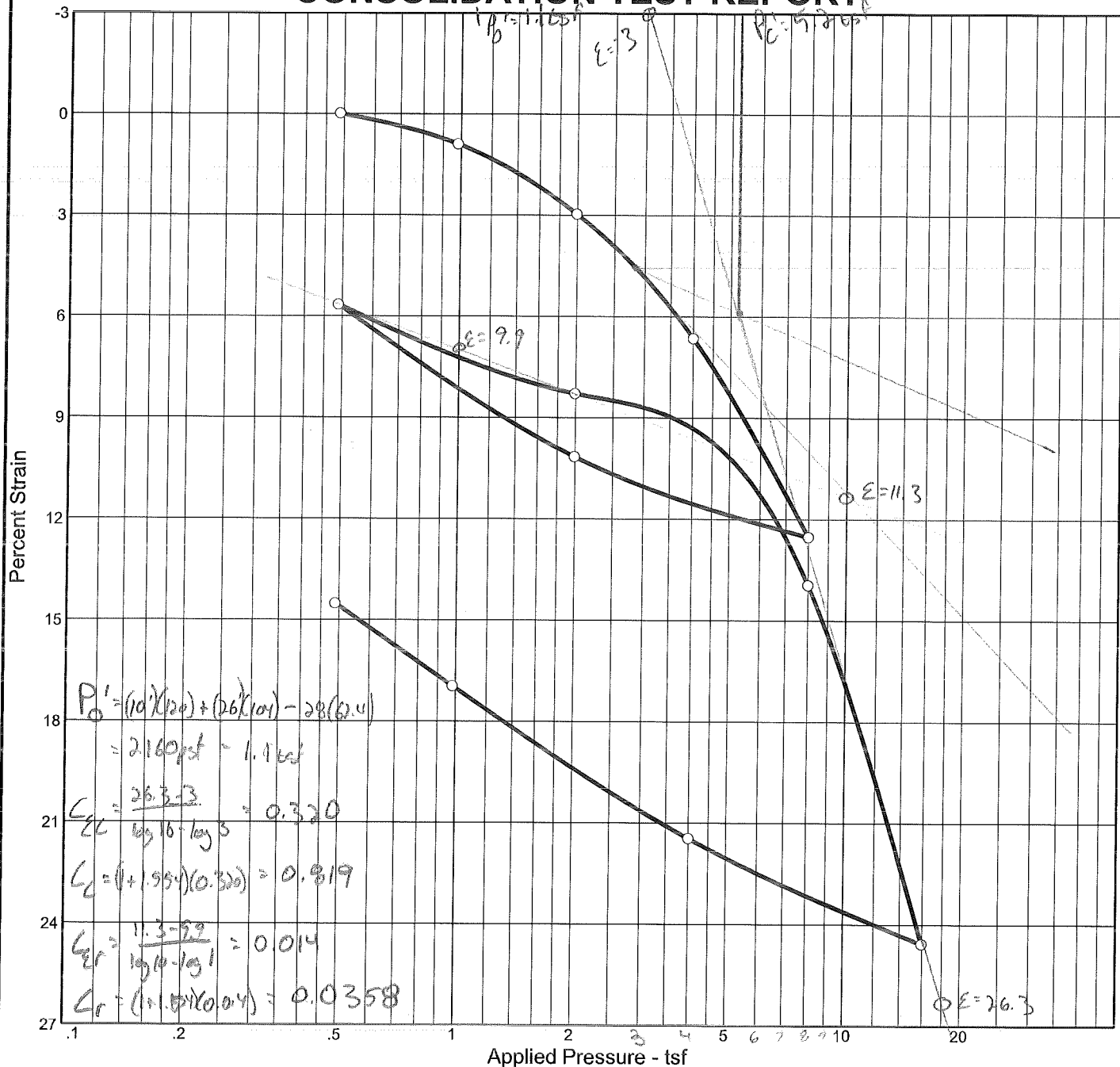


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
100.0 %	57.5 %	66.0	111	85	2.70		4.67	1.06	0.17			1.554

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, gray (CH)	CH	

<p>Project No. BL0903127A Client: US Army Corps of Engineers</p> <p>Project: Fargo-Moorhead Metro Feasibility Study</p> <p>Location: Boring 09-60MU, #3, 35-37', WD-05, ND Div, Brenna Formation</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks: 5" Thinwall, Bottom of sample Fargo 09-60MU, #3, 35' - 37' Brenna</p> <p style="text-align: right;">Figure</p>
--	--

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
100.0 %	57.5 %	66.0	111	85	2.70	4.67	1.06	0.17				1.554

MATERIAL DESCRIPTION								USCS	AASHTO
FAT CLAY, gray (CH)								CH	

Project No. BL0903127A Client: US Army Corps of Engineers Project: Fargo-Moorhead Metro Feasibility Study Location: Boring 09-60MU, #3, 35-37', WD-05, ND Div, Brenna Formation	Remarks: 5" Thinwall, Bottom of sample GWT ~ 8' BGS

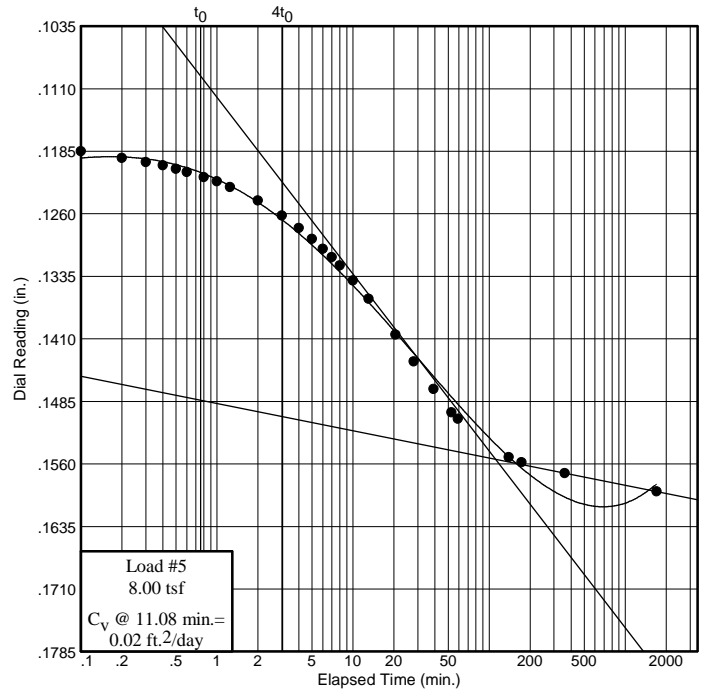
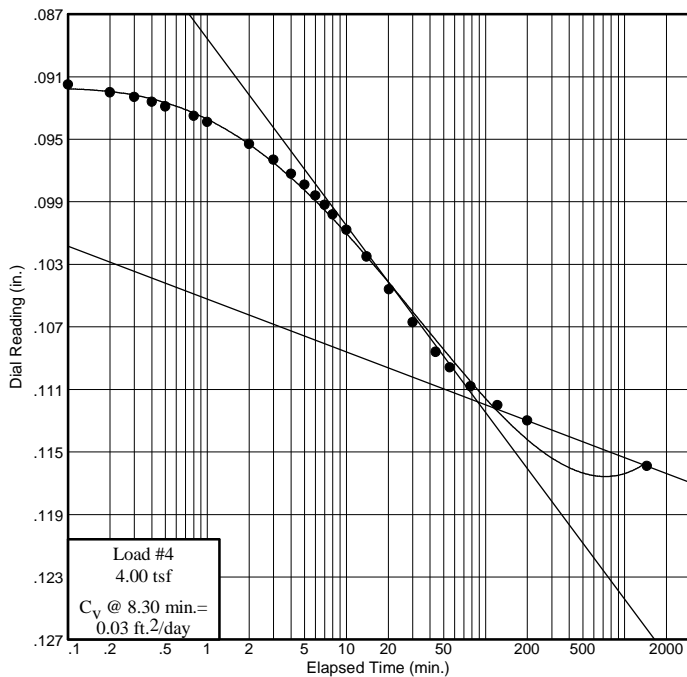
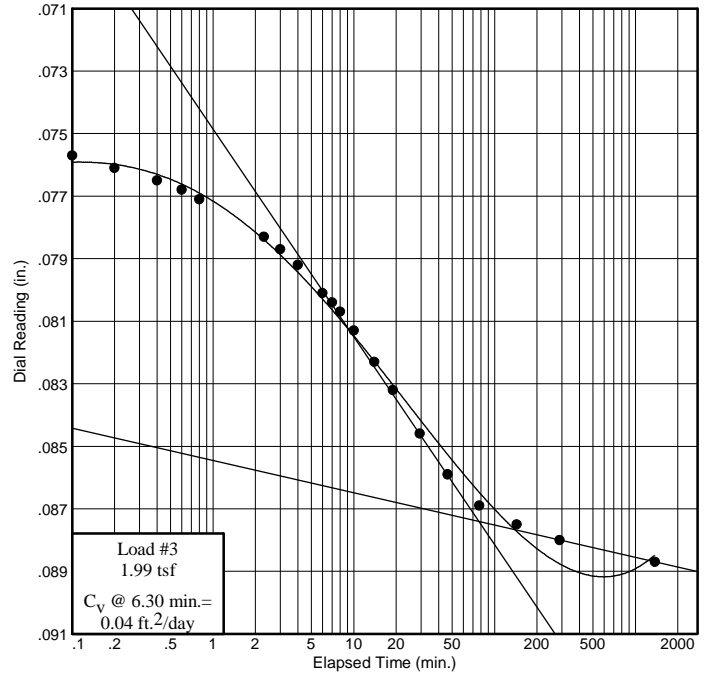
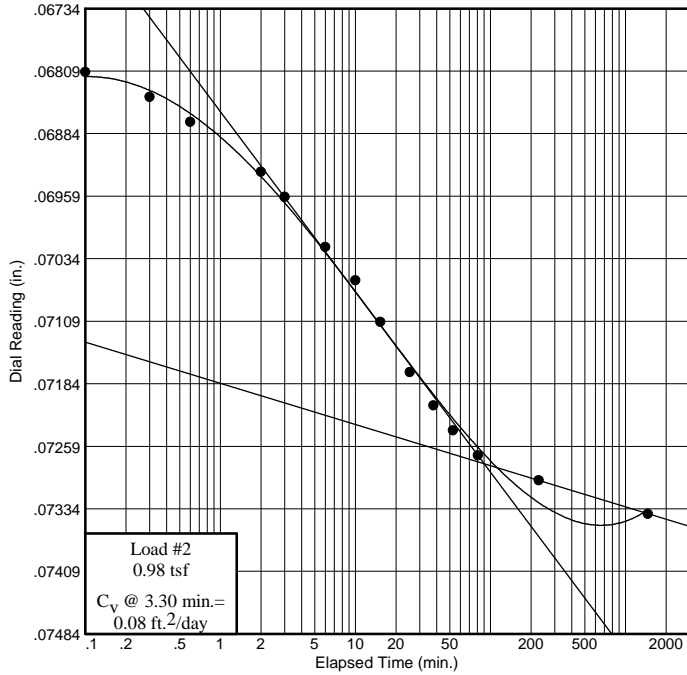
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-60MU, #3, 35-37', WD-05, ND Div, Brenna Formation



BRAUNSM
INTERTEC

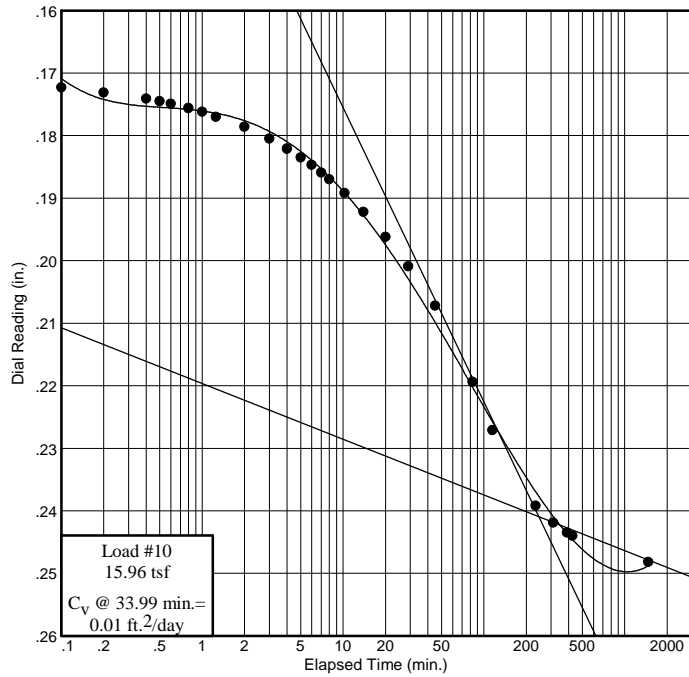
Figure

Dial Reading vs. Time

Project No.: BL0903127A

Project: Fargo-Moorhead Metro Feasibility Study

Location: Boring 09-60MU, #3, 35-37', WD-05, ND Div, Brenna Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: US Army Corps of Engineers
Project: Fargo-Moorhead Metro Feasibility Study
Project Number: BL0903127A

Sample Data

Source:

Sample No.: Boring 09-60MU, #3
Elev. or Depth: 35-37' **Sample Length(in./cm.):**
Location: Boring 09-60MU, #3, 35-37', WD-05, ND Div, Brenna Formation
Description: FAT CLAY, gray (CH)
Liquid Limit: 111 **Plasticity Index:** 85
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks: 5" Thinwall, Bottom of sample

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 157.92 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 111.50 g.		Dry w+t =
Tare Wt. = 30.81 g.	Spec. Gravity = 2.70	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 98.50 g.	Defl. Table = Machine4-2009	
Moisture = 57.5 %	Ht. Solids = 0.2891 in.	Moisture = %
Wet Den. = 104.0 pcf	Dry Wt. = 62.53 g.*	Dry Wt. = n/a
Dry Den. = 66.0 pcf	Void Ratio = 1.554	Void Ratio = 1.183
	Saturation = 100.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06680				1.554	
0.49	0.06750	0.00080			1.554	0.0 Swell
0.98	0.07440	0.00100	0.08	0.001	1.531	0.9 Comprs.
1.99	0.09020	0.00150	0.04	0.001	1.478	3.0 Comprs.
4.00	0.11790	0.00200	0.03	0.005	1.384	6.7 Comprs.
8.00	0.16200	0.00270	0.02	0.005	1.234	12.5 Comprs.
1.99	0.14330	0.00150			1.294	10.2 Comprs.
0.49	0.10940	0.00080			1.409	5.7 Comprs.
1.99	0.12950	0.00150			1.342	8.3 Comprs.
8.00	0.17250	0.00270			1.198	14.0 Comprs.
15.96	0.25180	0.00360	0.01	0.014	0.926	24.6 Comprs.
4.00	0.22720	0.00200			1.006	21.5 Comprs.
0.98	0.19300	0.00100			1.121	17.0 Comprs.
0.49	0.17480	0.00080			1.183	14.5 Comprs.

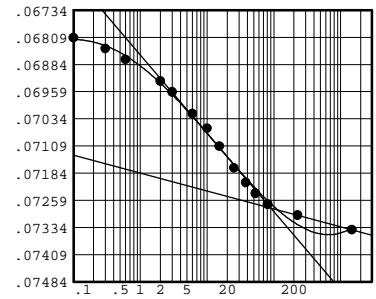
C_c = 1.06 P_c = 4.67 tsf C_r = 0.17

Pressure: 0.98 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06750	11	38.00	0.07310
2	0.10	0.06910	12	53.00	0.07340
3	0.30	0.06940	13	81.00	0.07370
4	0.60	0.06970	14	228.00	0.07400
5	2.00	0.07030	15	1473.00	0.07440
6	3.00	0.07060			
7	6.00	0.07120			
8	10.00	0.07160			
9	15.30	0.07210			
10	25.30	0.07270			



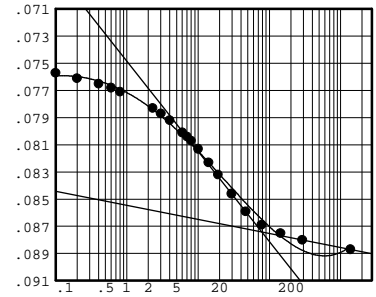
Void Ratio = 1.531 Compression = 0.9 %
 $D_0 = 0.06670$ $D_{50} = 0.06975$ $D_{100} = 0.07280$
 C_v at 3.3 min. = 0.08 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07440	12	8.00	0.08220
2	0.10	0.07720	13	10.00	0.08280
3	0.20	0.07760	14	14.00	0.08380
4	0.40	0.07800	15	19.00	0.08470
5	0.60	0.07830	16	29.50	0.08610
6	0.80	0.07860	17	46.50	0.08740
7	2.30	0.07980	18	78.00	0.08840
8	3.00	0.08020	19	143.50	0.08900
9	4.00	0.08070	20	290.00	0.08950
10	6.00	0.08160	21	1379.00	0.09020
11	7.00	0.08190			



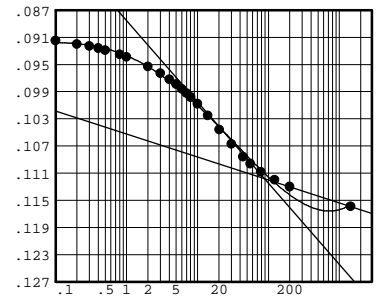
Void Ratio = 1.478 Compression = 3.0 %
 $D_0 = 0.07340$ $D_{50} = 0.08040$ $D_{100} = 0.08741$
 C_v at 6.3 min. = 0.04 ft.²/day $C_\alpha = 0.001$

Pressure: 4.00 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09020	14	7.00	0.10120
2	0.10	0.09350	15	8.00	0.10180
3	0.20	0.09400	16	10.00	0.10280
4	0.30	0.09430	17	14.00	0.10450
5	0.40	0.09460	18	20.30	0.10660
6	0.50	0.09490	19	30.00	0.10870
7	0.80	0.09550	20	44.00	0.11060
8	1.00	0.09590	21	55.50	0.11160
9	2.00	0.09730	22	78.00	0.11280
10	3.00	0.09830	23	122.00	0.11400
11	4.00	0.09920	24	200.00	0.11500
12	5.00	0.09990	25	1442.00	0.11790
13	6.00	0.10060			



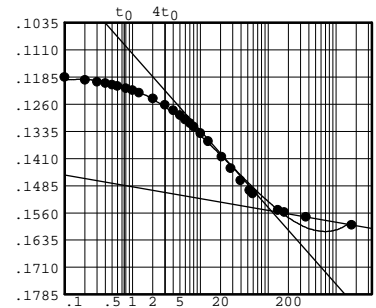
Void Ratio = 1.384 Compression = 6.7 %
 $D_0 = 0.08870$ $D_{50} = 0.10025$ $D_{100} = 0.11179$
 C_v at 8.3 min. = 0.03 ft.²/day $C_\alpha = 0.005$

Pressure: 8.00 tsf

TEST READINGS

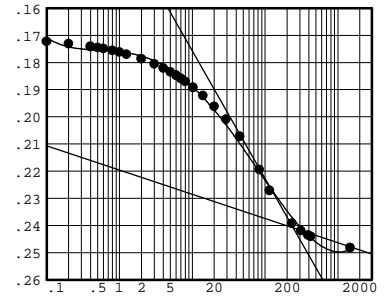
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11790	15	6.00	0.13290
2	0.10	0.12120	16	7.00	0.13390
3	0.20	0.12200	17	8.00	0.13490
4	0.30	0.12250	18	10.00	0.13670
5	0.40	0.12290	19	13.00	0.13890
6	0.50	0.12330	20	20.50	0.14320
7	0.60	0.12370	21	28.00	0.14640
8	0.80	0.12430	22	39.00	0.14970
9	1.00	0.12480	23	53.00	0.15250
10	1.25	0.12550	24	59.00	0.15330
11	2.00	0.12710	25	139.50	0.15790
12	3.00	0.12890	26	173.00	0.15850
13	4.00	0.13040	27	360.00	0.15980
14	5.00	0.13170	28	1698.00	0.16200



Void Ratio = 1.234 Compression = 12.5 %
 $D_0 = 0.11533$ $D_{50} = 0.13538$ $D_{100} = 0.15544$
 C_v at 11.1 min. = 0.02 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.17250	15	7.00	0.18950
2	0.10	0.17590	16	8.00	0.19060
3	0.20	0.17670	17	10.25	0.19280
4	0.40	0.17770	18	14.00	0.19580
5	0.50	0.17810	19	20.00	0.19980
6	0.60	0.17850	20	29.00	0.20450
7	0.80	0.17920	21	45.00	0.21080
8	1.00	0.17980	22	83.00	0.22300
9	1.25	0.18060	23	115.00	0.23070
10	2.00	0.18220	24	233.30	0.24280
11	3.00	0.18410	25	310.50	0.24550
12	4.00	0.18570	26	389.50	0.24710
13	5.00	0.18710	27	425.00	0.24760
14	6.00	0.18830	28	1470.00	0.25180



Void Ratio = 0.926 Compression = 24.6 %
 $D_0 = 0.16980$ $D_{50} = 0.20537$ $D_{100} = 0.24093$
 C_v at 34.0 min. = 0.01 ft.²/day $C_\alpha = 0.014$

Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

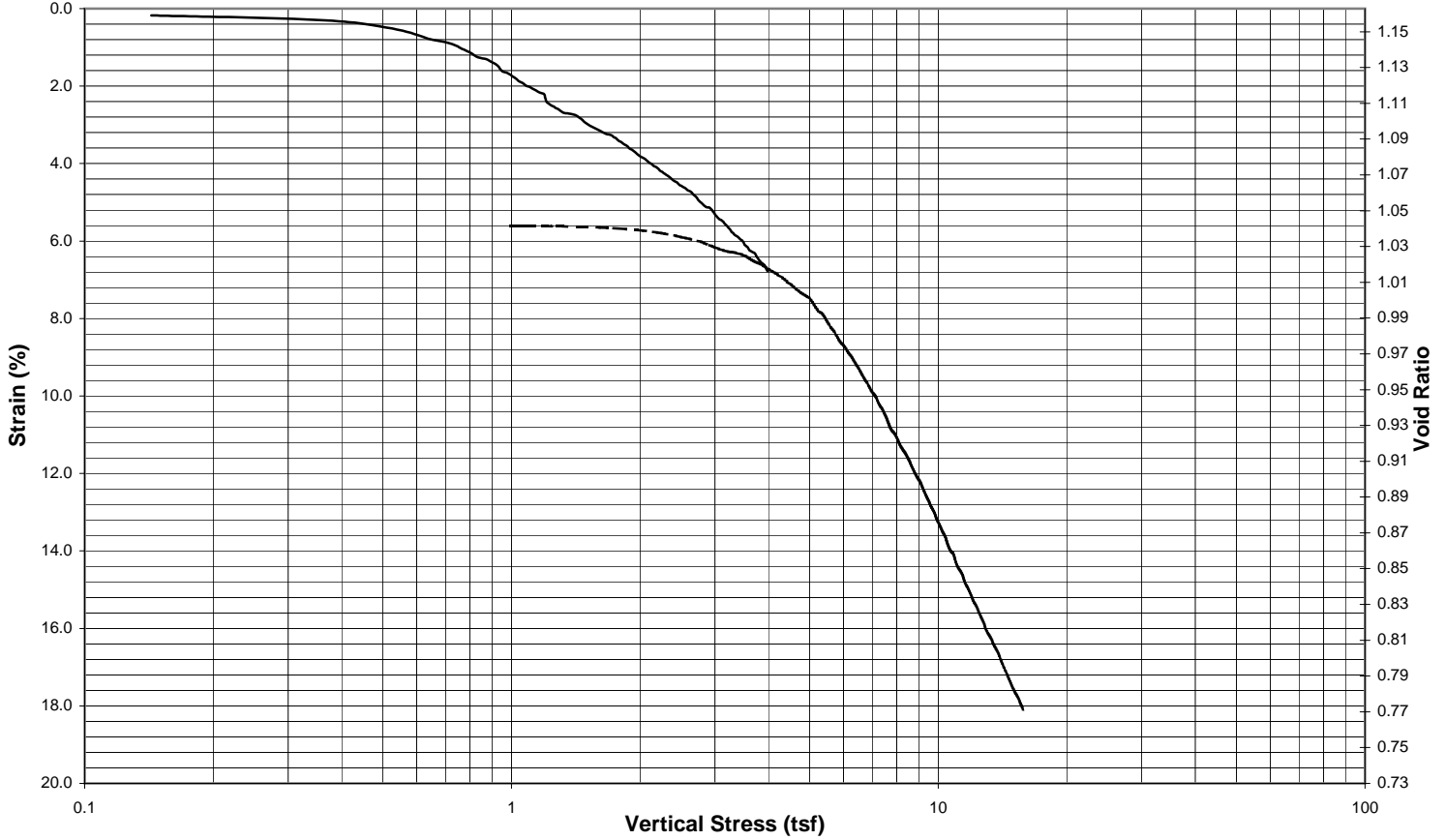
Project: FARGOMOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

Boring: FAR 10-78MU Sample: 2 Depth: 25-27 Type: 5T
 Soil Type: Fat Clay (CH) Brenna

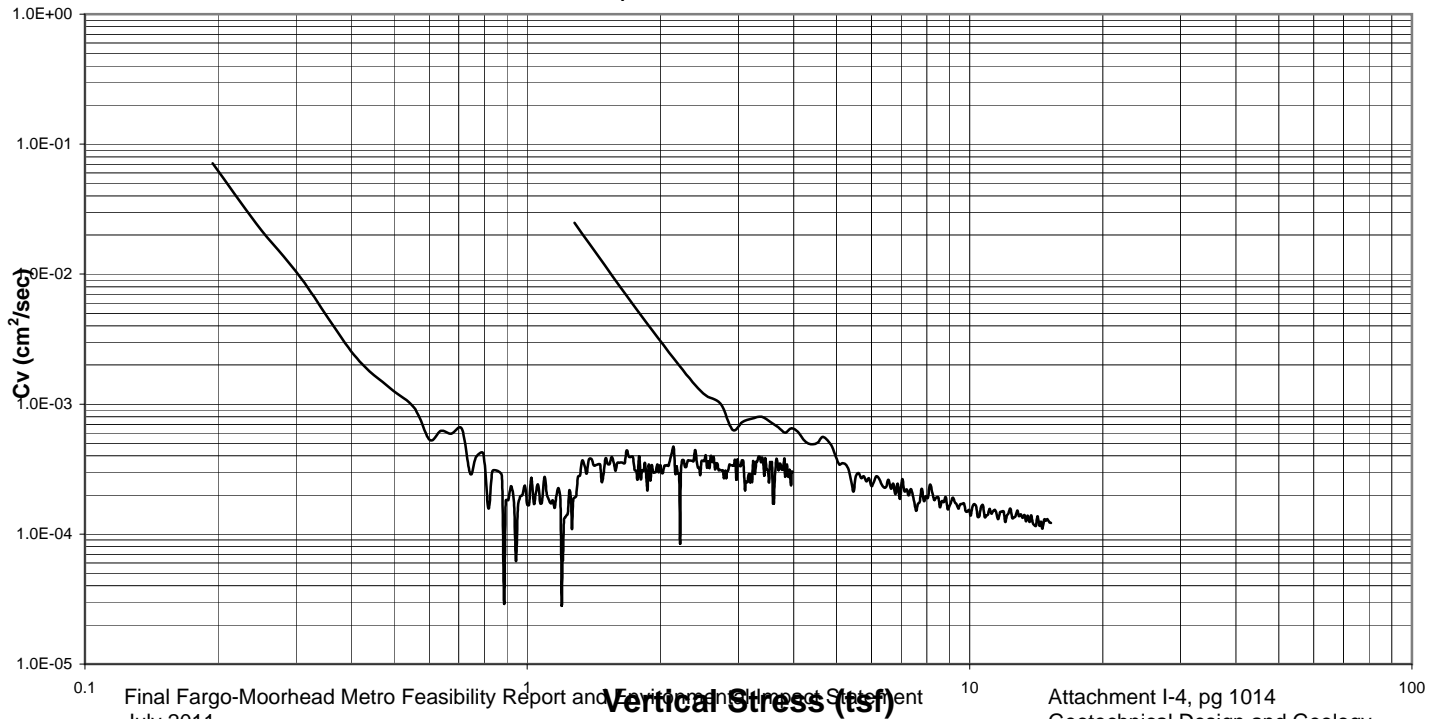
Initial Conditions: Dry Density (pcf): 79.6 Moisture Content (%): 42.2% e_o 1.165

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc 4.0 tsf	Cc 0.54	Cr 0.04
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

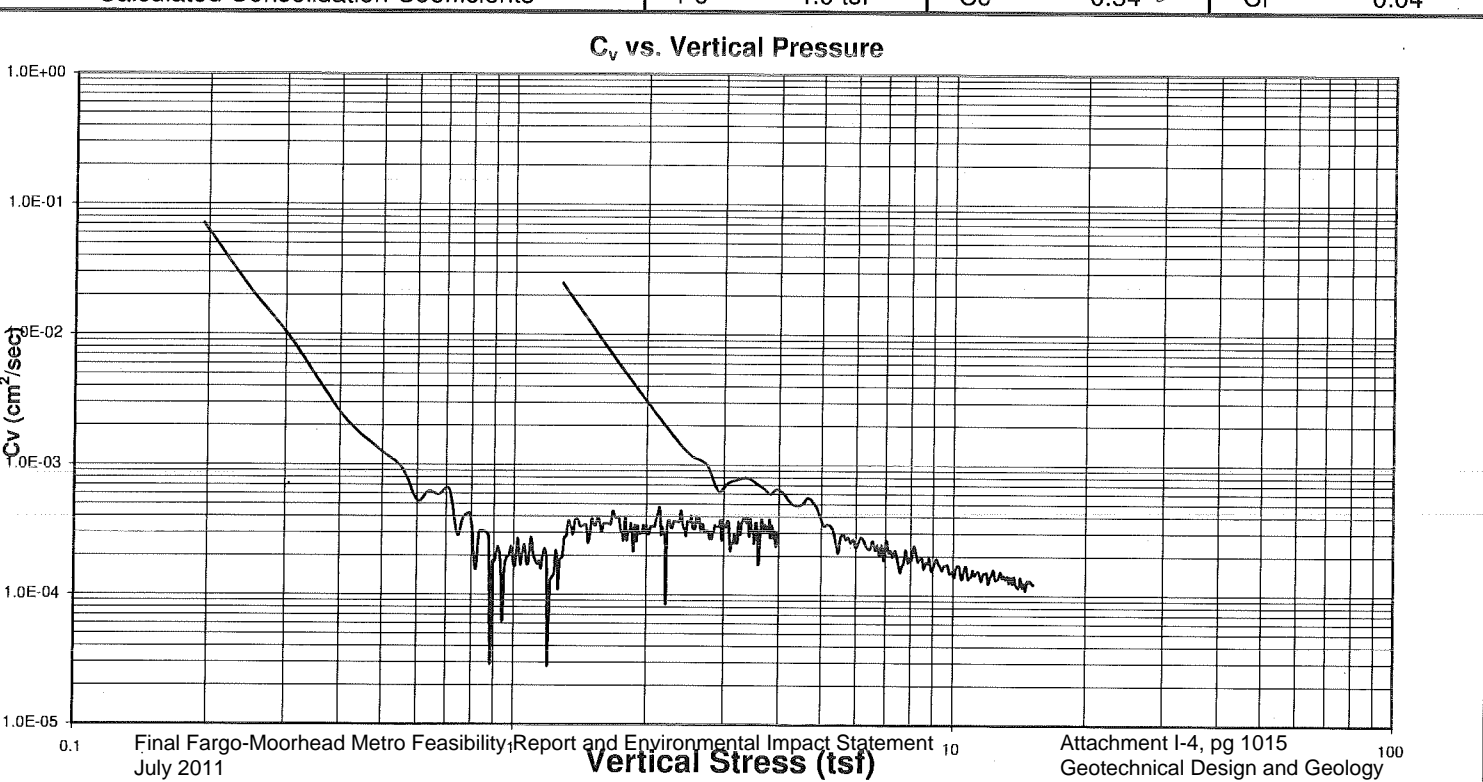
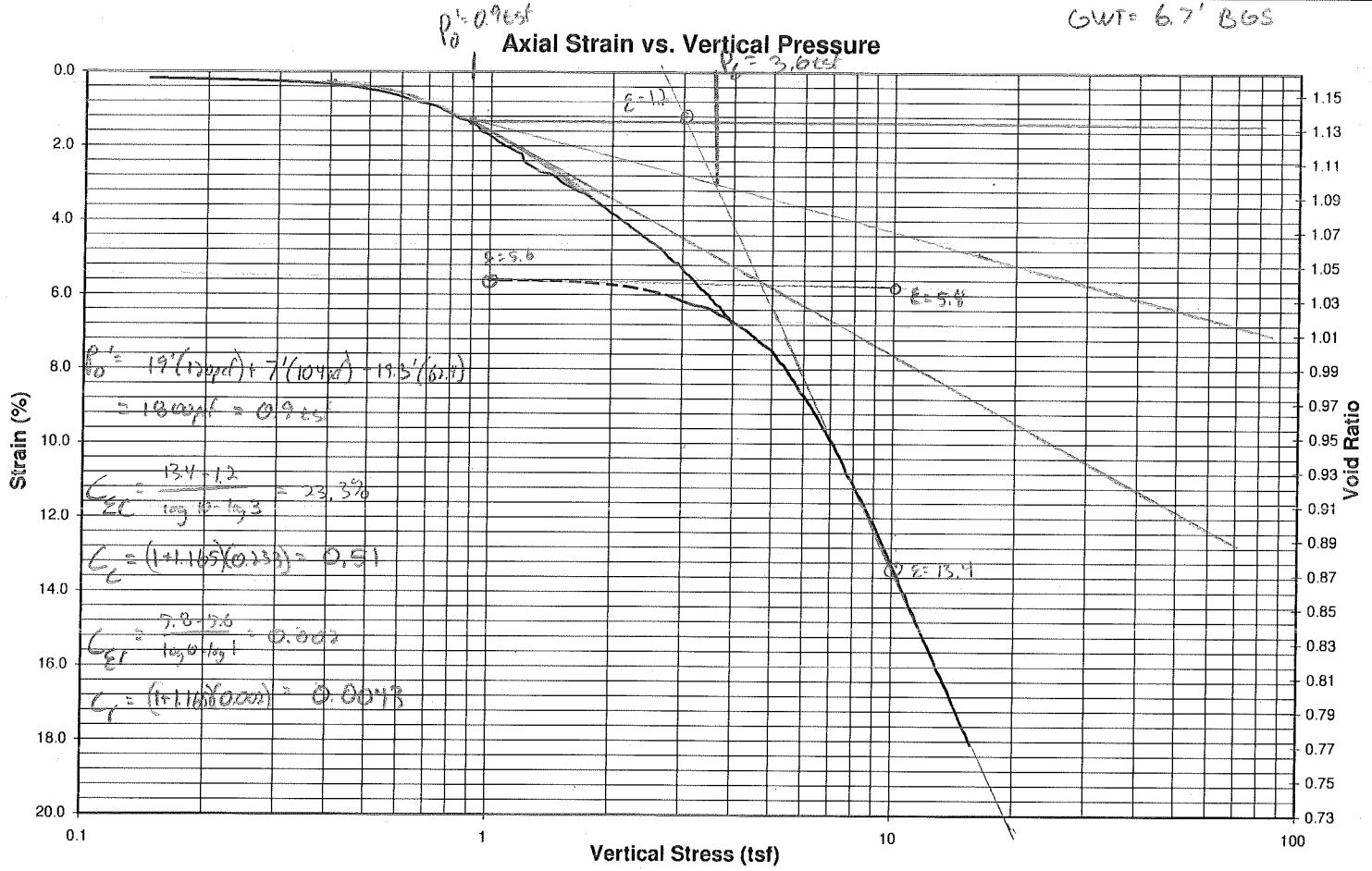
Project: FARGOMOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

Boring: FAR 10-78MU Sample: 2 Depth: 25-27 Type: 5T

Soil Type: Fat Clay (CH) Brenna

Initial Conditions: Dry Density (pcf): 79.6 Moisture Content (%): 42.2% e_0 1.165



Constant Rate of Strain Data Table

Project: OORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL
 Boring: 10-78MU Sample 2 Depth: 25-27

Date: 10/27/10
 Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.21%	0.194	0.025	0.126	0.178	7.11E-02	3.99E-07	1.160
0.45%	0.490	0.220	0.450	0.329	1.33E-03	2.59E-08	1.155
1.76%	1.009	0.262	0.260	0.825	1.68E-04	7.53E-09	1.126
3.83%	2.013	0.218	0.108	1.865	2.97E-04	3.66E-09	1.082
5.32%	3.004	0.243	0.081	2.840	3.37E-04	9.19E-09	1.049
6.77%	3.980	0.266	0.067	3.801	3.00E-04	4.36E-09	1.018
5.62%	1.280	0.126	0.099	1.194	2.48E-02	6.88E-09	1.043
5.90%	2.497	0.814	0.326	1.919	1.21E-03	4.69E-09	1.037
6.40%	3.548	0.868	0.245	2.943	7.27E-04	6.26E-09	1.026
7.14%	4.534	0.908	0.200	3.906	5.04E-04	3.50E-09	1.010
8.15%	5.531	1.119	0.202	4.757	2.78E-04	3.54E-09	0.988
9.35%	6.558	1.333	0.203	5.636	2.62E-04	3.13E-09	0.962
10.51%	7.515	1.524	0.203	6.461	1.69E-04	2.72E-09	0.937
11.26%	8.134	1.644	0.202	6.997	2.40E-04	2.30E-09	0.921
12.22%	9.075	1.852	0.204	7.794	1.73E-04	1.98E-09	0.900
13.31%	10.052	2.096	0.209	8.601	1.39E-04	1.40E-09	0.876
14.29%	11.000	2.350	0.214	9.371	1.41E-04	2.08E-09	0.855
15.25%	12.039	2.611	0.217	10.228	1.24E-04	1.41E-09	0.834
16.03%	12.939	2.836	0.219	10.971	1.38E-04	1.53E-09	0.818
16.71%	13.899	3.115	0.224	11.736	1.23E-04	1.08E-09	0.803
17.48%	14.871	3.365	0.226	12.533	1.26E-04	1.06E-09	0.786
18.10%	15.817	3.617	0.229	13.303	1.23E-04	1.20E-09	0.773

Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

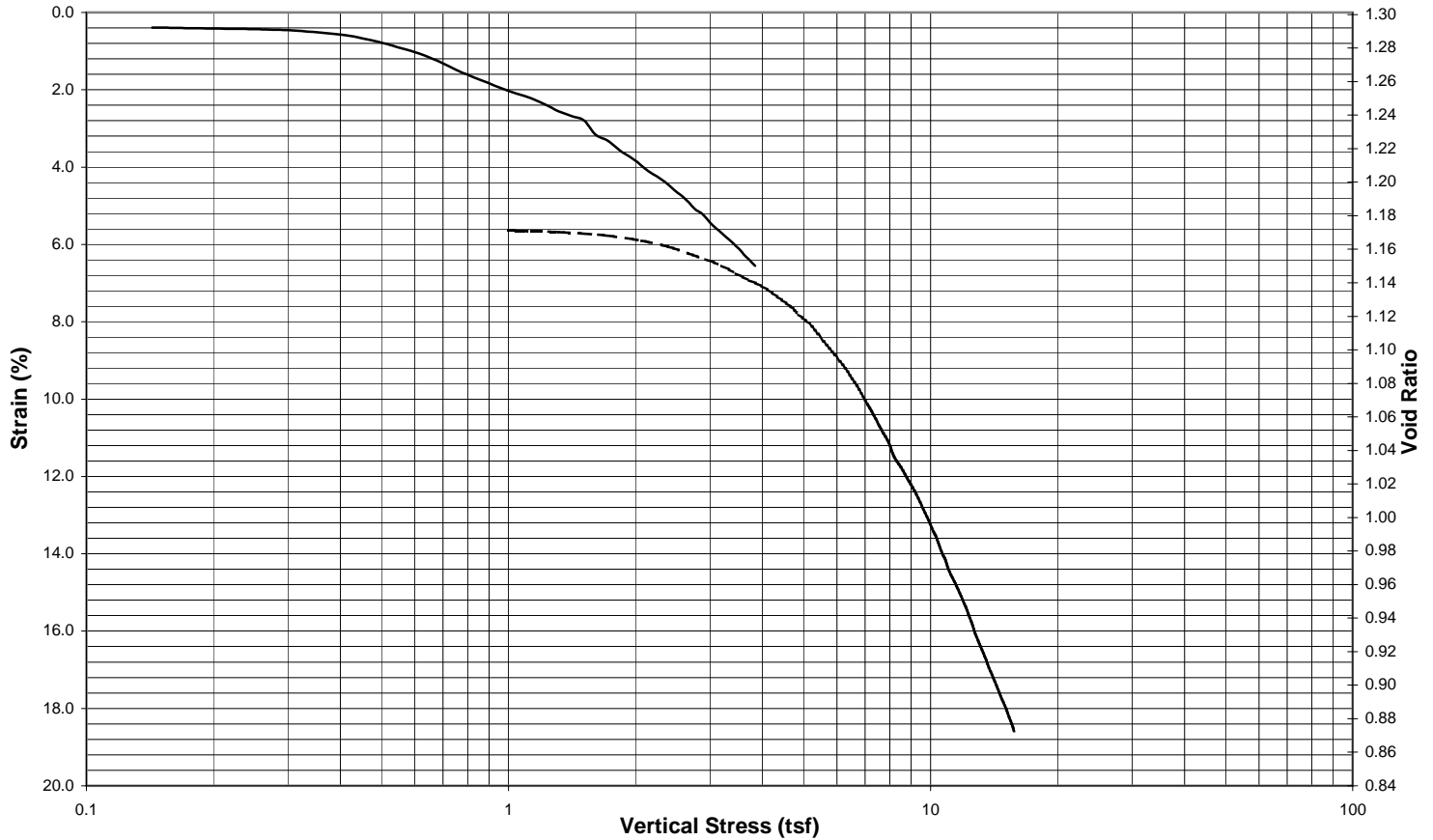
Specimen Information

Boring: FAR 10-80MU Sample: 2 Depth: 35-37 (M-B) Type: 5T

Soil Type: Fat Clay w/laminations of silt (CH) Brenna

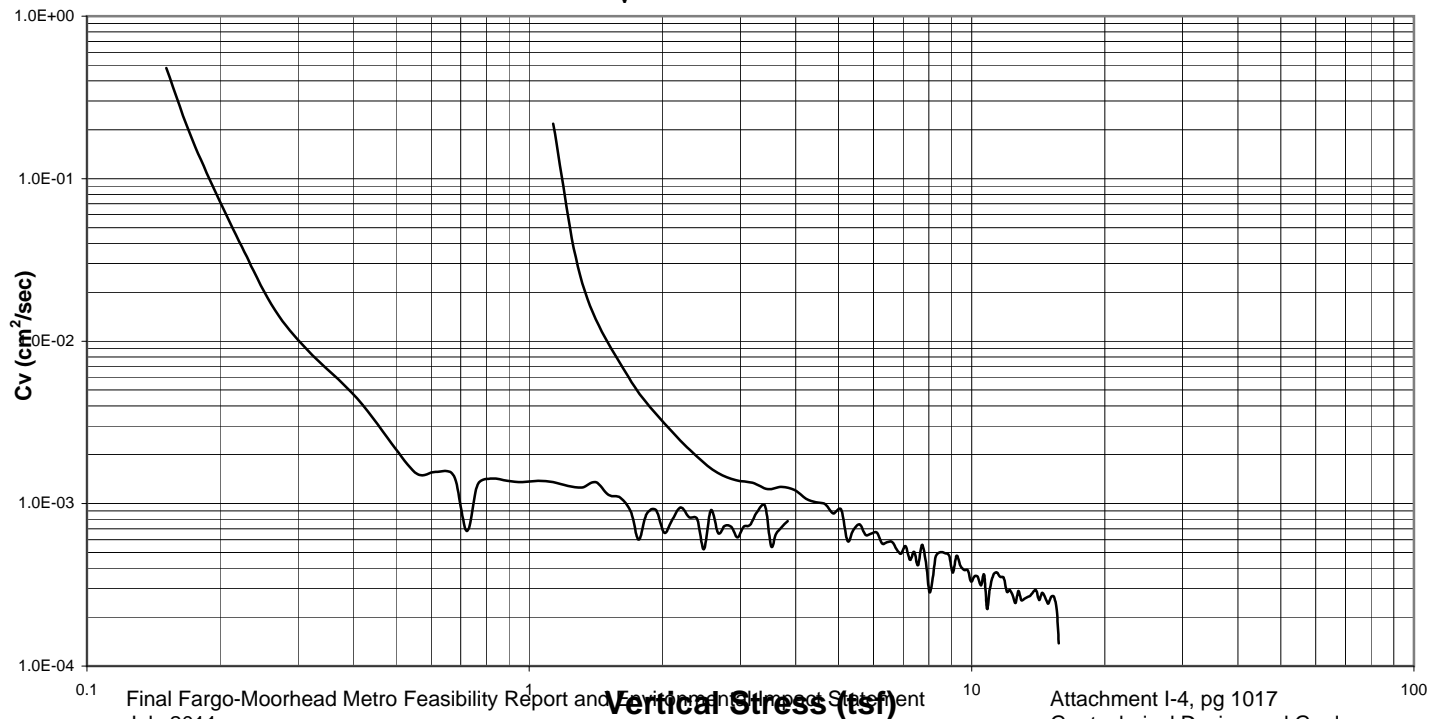
Initial Conditions: Dry Density (pcf): 75.3 Moisture Content (%): 46.1% e_o 1.306

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc 5.0 tsf	Cc 0.63	Cr 0.04
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

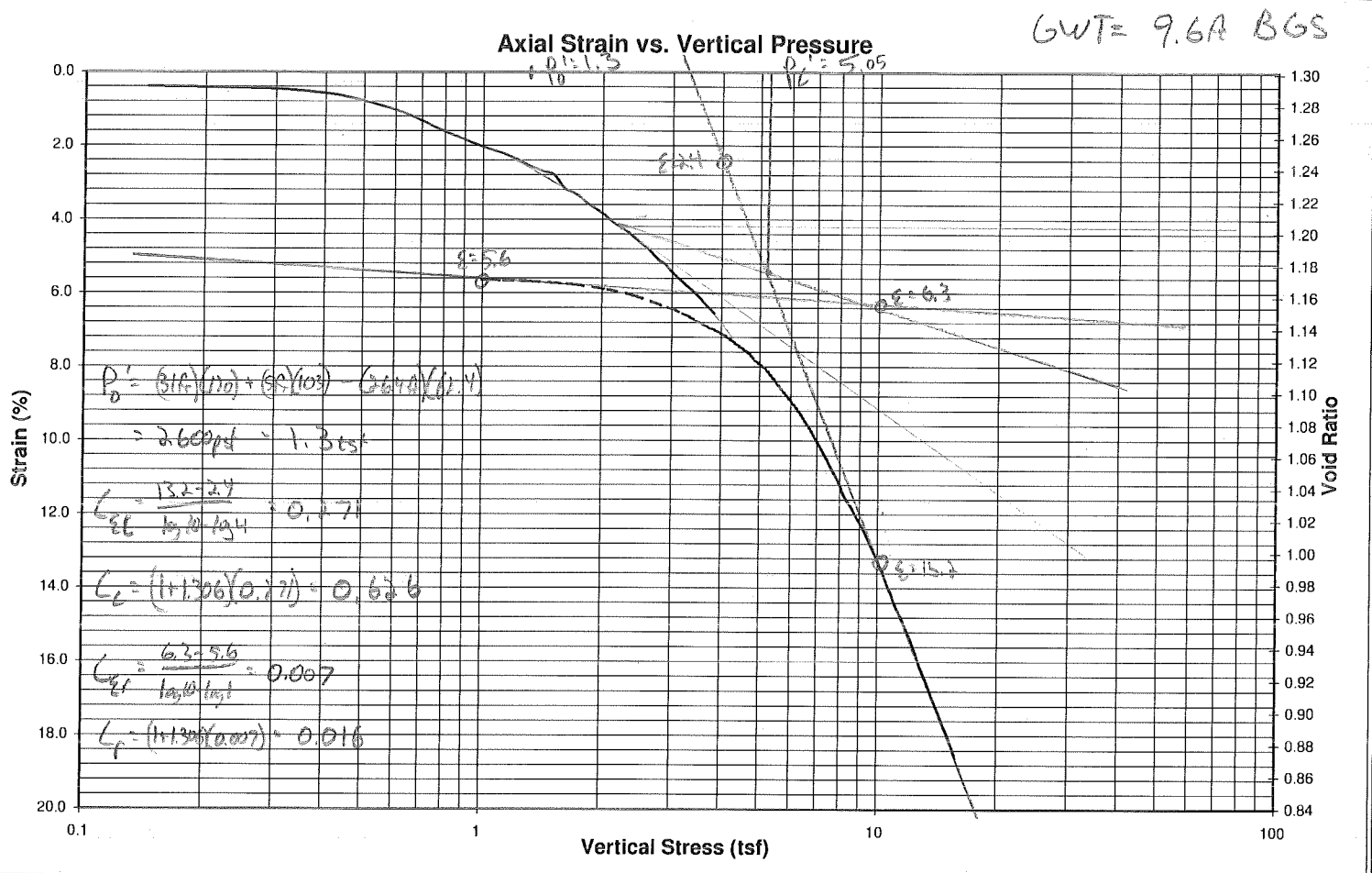
Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

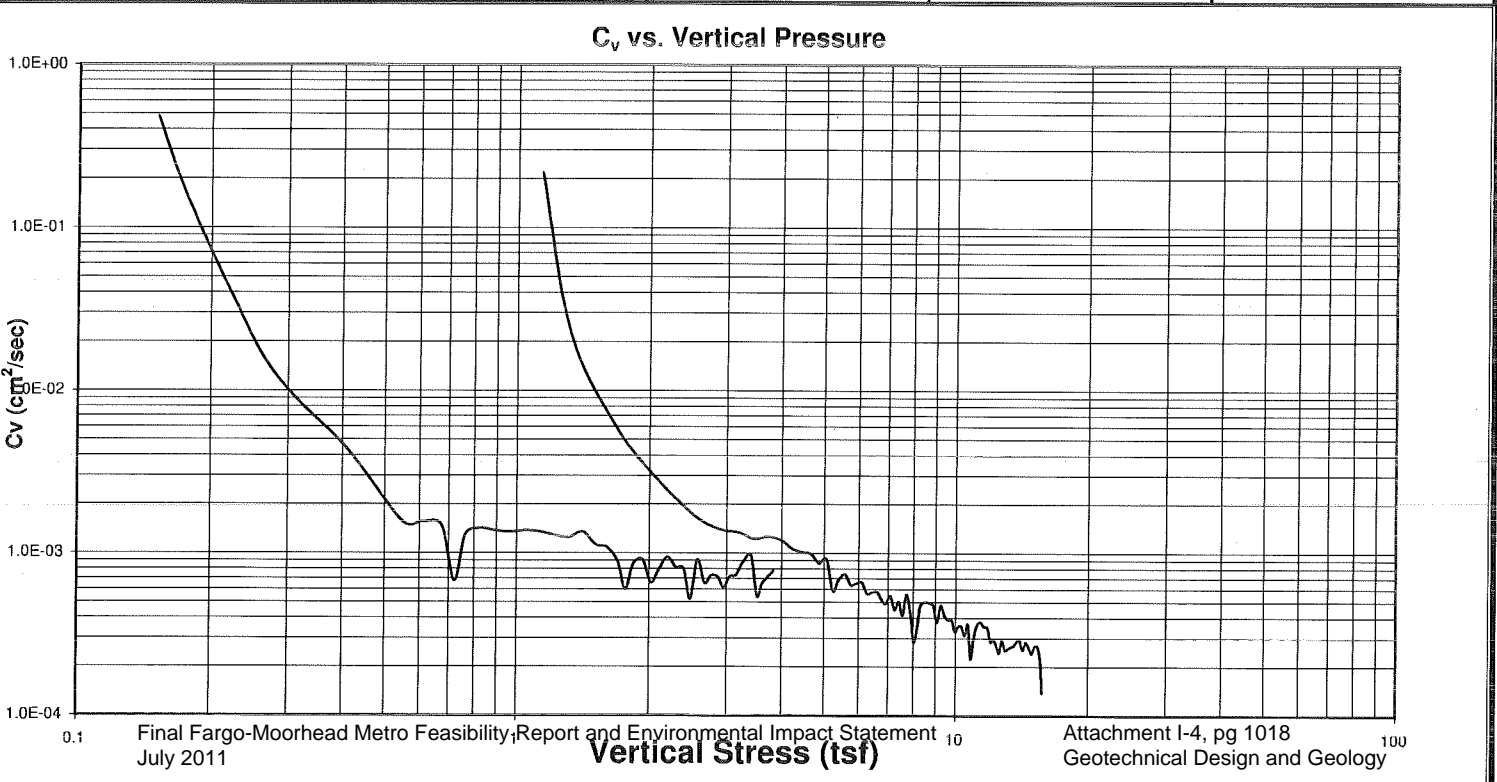
Boring: FAR 10-80MU Sample: 2 Depth: 35-37 (M-B) Type: 5T

Soil Type: Fat Clay w/laminations of silt (CH) Brenna

Initial Conditions: Dry Density (pcf): 75.3 Moisture Content (%): 46.1% e_0 1.306



Calculated Consolidation Coefficients	Pc	5.0 tsf	Cc	0.63	Cr	0.04
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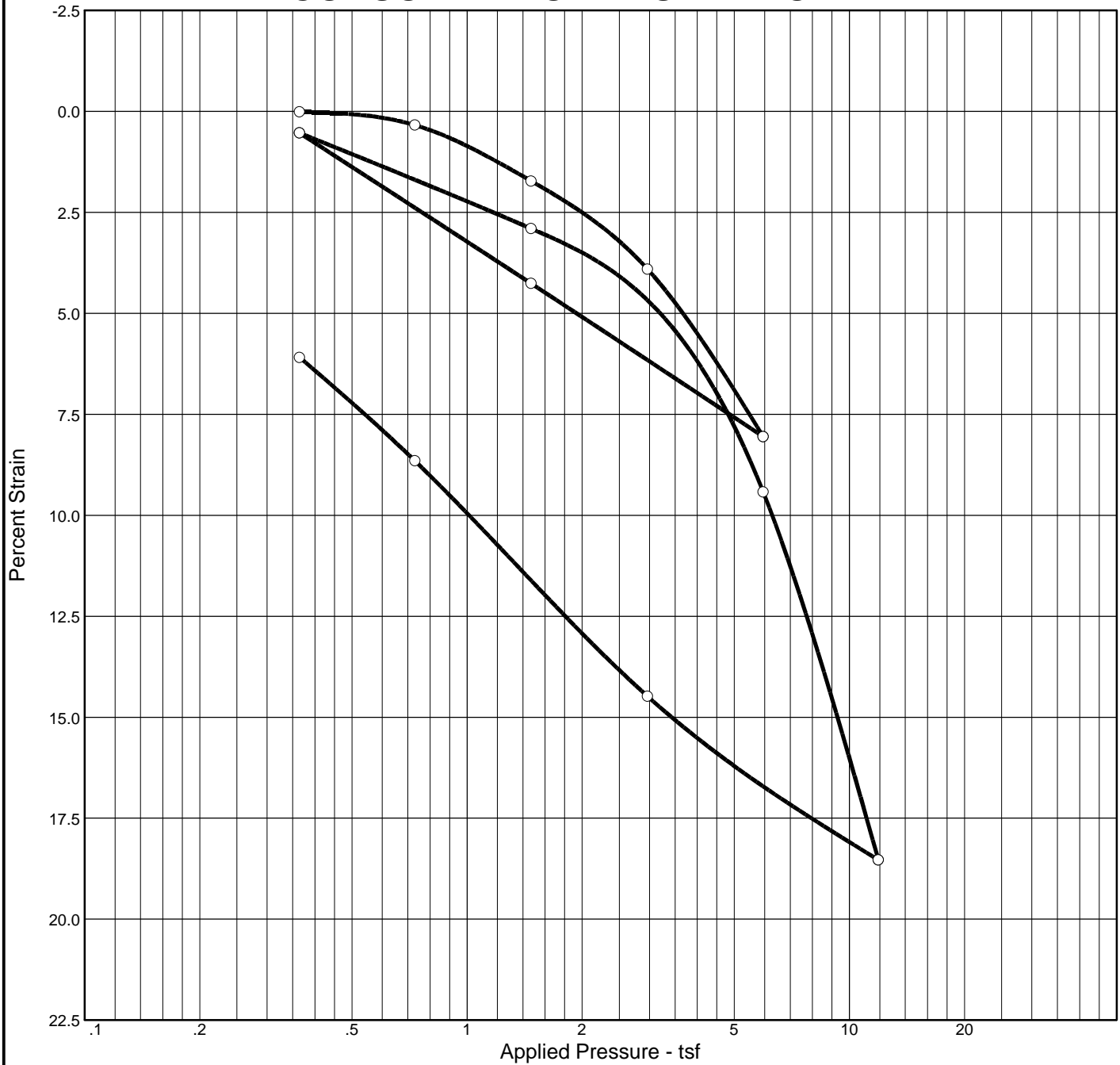
Constant Rate of Strain Data Table

Project: IOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL
 Boring: 10-80MU Sample 2 Depth: 35-37 (M-B)

Date: 10/27/10
 Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.39%	0.151	0.001	0.007	0.150	4.79E-01	2.59E-06	1.297
0.92%	0.558	0.157	0.281	0.448	1.52E-03	3.16E-08	1.285
2.10%	1.046	0.273	0.261	0.855	1.38E-03	2.05E-08	1.258
3.87%	2.018	0.479	0.237	1.685	6.62E-04	1.34E-08	1.217
5.51%	3.052	0.611	0.200	2.630	7.21E-04	8.64E-09	1.179
6.55%	3.837	0.679	0.177	3.369	7.79E-04	1.19E-08	1.155
5.66%	1.132	0.015	0.014	1.122	2.18E-01	2.19E-08	1.176
6.06%	2.385	0.616	0.258	1.955	1.97E-03	1.04E-08	1.166
6.55%	3.199	0.817	0.255	2.628	1.34E-03	1.27E-08	1.155
7.08%	3.981	0.870	0.219	3.378	1.21E-03	6.49E-09	1.143
7.98%	5.068	0.942	0.186	4.419	9.20E-04	4.35E-09	1.122
9.03%	6.106	1.101	0.180	5.348	6.63E-04	5.73E-09	1.098
10.14%	7.092	1.249	0.176	6.233	5.48E-04	6.11E-09	1.072
11.23%	8.030	1.456	0.181	7.027	2.85E-04	6.92E-09	1.047
12.29%	9.069	1.575	0.174	7.987	3.76E-04	3.24E-09	1.023
13.42%	10.149	1.833	0.181	8.887	3.57E-04	2.95E-09	0.997
14.36%	10.992	2.048	0.186	9.580	2.94E-04	4.55E-09	0.975
15.30%	12.021	2.209	0.184	10.499	2.86E-04	3.12E-09	0.953
16.25%	12.954	2.476	0.191	11.245	2.54E-04	1.65E-09	0.931
17.13%	13.988	2.664	0.190	12.150	2.92E-04	2.09E-09	0.911
17.85%	14.887	2.886	0.194	12.895	2.42E-04	1.65E-09	0.895
18.58%	15.751	2.984	0.189	13.692	1.38E-04	2.16E-09	0.878

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
101.7 %	61.6 %	64.1	119	87	2.720		3.15	0.83	0.20			1.649

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2850		

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 10-105MU, #2, 25-27', Maple River, Brenna Formation</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks:</p> <p>Load #3 C_v = 0.022 ft²/day Load #4 C_v = 0.021 ft²/day Load #5 C_v = 0.010 ft²/day Load #10 C_v = 0.0042 ft²/day</p>
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Figure

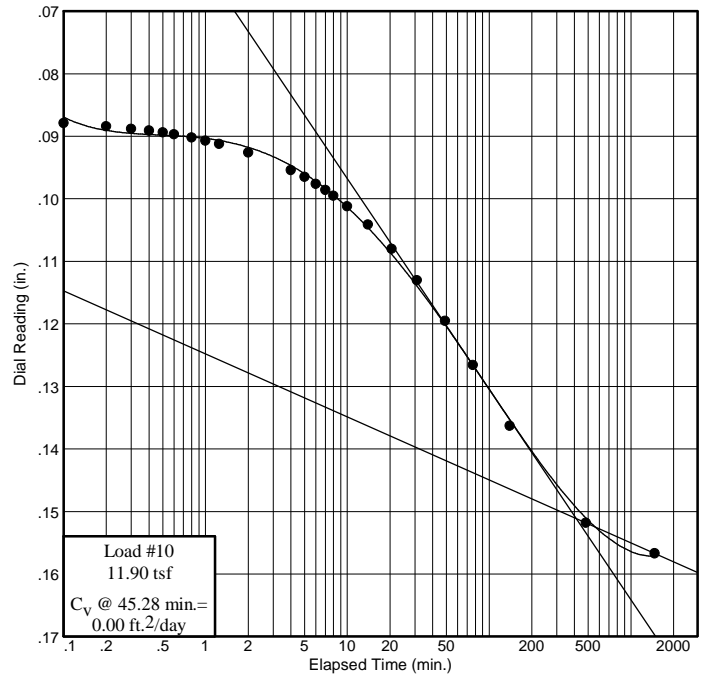
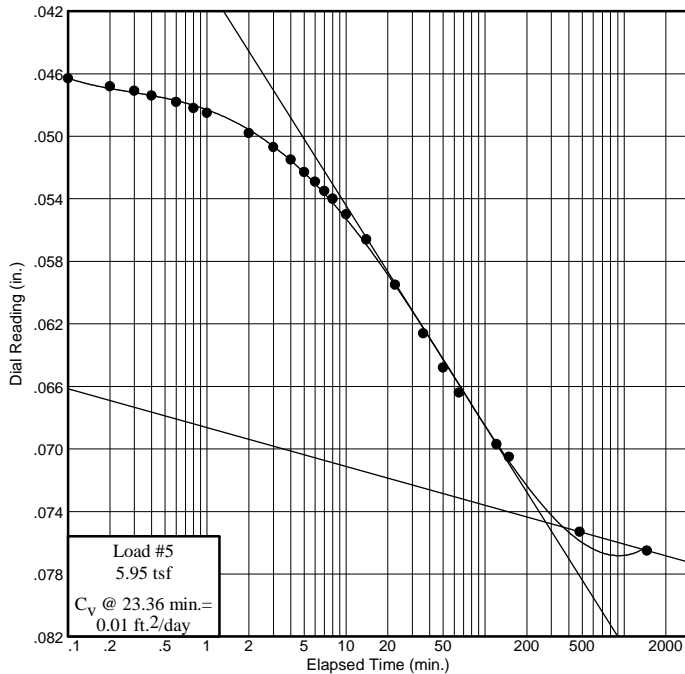
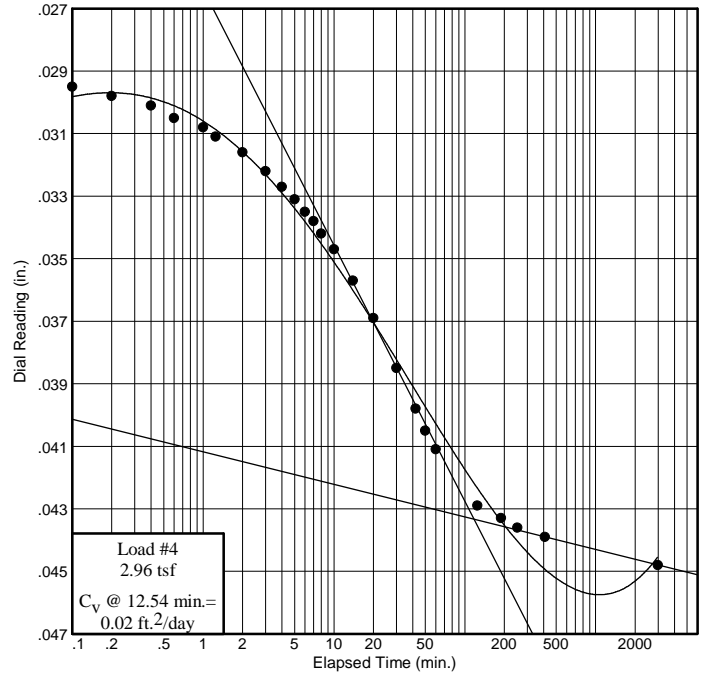
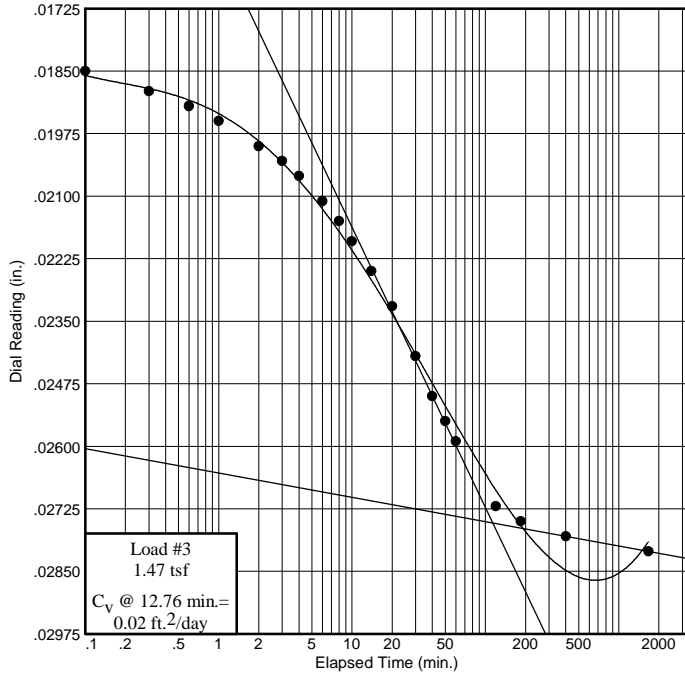
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring 10-105MU, #2, 25-27', Maple River, Brenna Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring 10-105MU, #2
Elev. or Depth: 25-27' **Sample Length(in./cm.):**
Location: Boring 10-105MU, #2, 25-27', Maple River, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2850
Liquid Limit: 119 **Plasticity Index:** 87
USCS: **AASHTO:** **Figure No.:**

Testing Remarks: Load #3 Cv = 0.022 ft²/day
 Load #4 Cv = 0.021 ft²/day
 Load #5 Cv = 0.010 ft²/day
 Load #10 Cv = 0.0042 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 105.75 g.	Consolidometer # = 6	Wet w+t =
Dry w+t = 76.95 g.		Dry w+t =
Tare Wt. = 30.23 g.	Spec. Gravity = 2.720	Tare Wt. =
Height = .76 in.	Height = .76 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 102.29 g.	Defl. Table = Machine6-2009	
Moisture = 61.6 %	Ht. Solids = 0.2888 in.	Moisture = %
Wet Den. = 103.6 pcf	Dry Wt. = 63.28 g.*	Dry Wt. = n/a
Dry Den. = 64.1 pcf	Void Ratio = 1.649	Void Ratio = 1.488
	Saturation = 101.7 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.01490				1.649	
0.36	0.01650	0.00150			1.649	0.0 Compr.
0.73	0.01970	0.00220			1.640	0.3 Compr.
1.47	0.03140	0.00330	0.02	0.001	1.604	1.7 Compr.
2.96	0.04940	0.00460	0.02	0.001	1.546	3.9 Compr.
5.95	0.08270	0.00620	0.01	0.003	1.436	8.1 Compr.
1.47	0.05080	0.00330			1.536	4.3 Compr.
0.36	0.02050	0.00150			1.635	0.5 Compr.
1.47	0.04040	0.00330			1.572	2.9 Compr.
5.95	0.09320	0.00620			1.400	9.4 Compr.
11.90	0.16490	0.00820	0.00	0.015	1.158	18.5 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression / Swell
2.96	0.13030	0.00460			1.266	14.5 Compr.
0.73	0.08330	0.00220			1.420	8.7 Compr.
0.36	0.06300	0.00150			1.488	6.1 Compr.

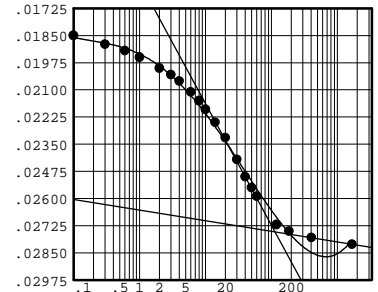
$C_c = 0.83$ $P_c = 3.15$ tsf $C_r = 0.20$

Pressure: 1.47 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.01970	12	14.00	0.02580
2	0.10	0.02180	13	20.00	0.02650
3	0.30	0.02220	14	30.00	0.02750
4	0.60	0.02250	15	40.00	0.02830
5	1.00	0.02280	16	50.00	0.02880
6	2.00	0.02330	17	60.00	0.02920
7	3.00	0.02360	18	120.00	0.03050
8	4.00	0.02390	19	184.00	0.03080
9	6.00	0.02440	20	403.00	0.03110
10	8.00	0.02480	21	1672.00	0.03140
11	10.00	0.02520			



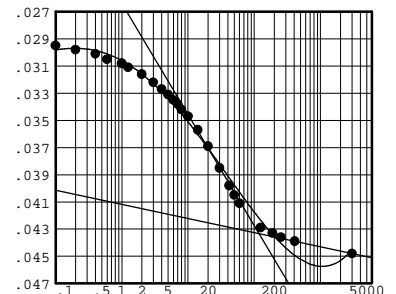
Void Ratio = 1.604 Compression = 1.7 %
 $D_0 = 0.01750$ $D_{50} = 0.02252$ $D_{100} = 0.02753$
 C_v at 12.8 min. = 0.02 ft.²/day $C_\alpha = 0.001$

Pressure: 2.96 tsf

TEST READINGS

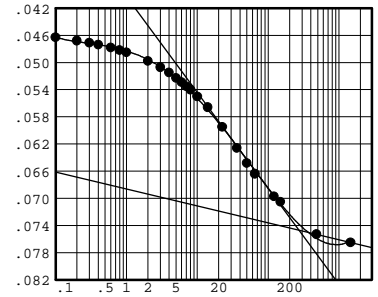
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.03140	14	8.00	0.03880
2	0.10	0.03410	15	10.00	0.03930
3	0.20	0.03440	16	14.00	0.04030
4	0.40	0.03470	17	20.00	0.04150
5	0.60	0.03510	18	30.00	0.04310
6	1.00	0.03540	19	42.00	0.04440
7	1.25	0.03570	20	50.00	0.04510
8	2.00	0.03620	21	60.00	0.04570
9	3.00	0.03680	22	125.00	0.04750
10	4.00	0.03730	23	189.00	0.04790
11	5.00	0.03770	24	253.00	0.04820
12	6.00	0.03810	25	410.00	0.04850
13	7.00	0.03840	26	2998.00	0.04940



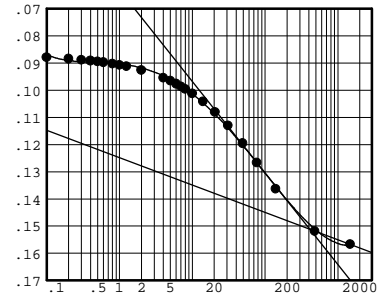
Void Ratio = 1.546 Compression = 3.9 %
 $D_0 = 0.02810$ $D_{50} = 0.03572$ $D_{100} = 0.04334$
 C_v at 12.5 min. = 0.02 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.04940	14	7.00	0.05970
2	0.10	0.05250	15	8.00	0.06020
3	0.20	0.05300	16	10.00	0.06120
4	0.30	0.05330	17	14.00	0.06280
5	0.40	0.05360	18	22.50	0.06570
6	0.60	0.05400	19	36.00	0.06880
7	0.80	0.05440	20	50.00	0.07100
8	1.00	0.05470	21	65.00	0.07260
9	2.00	0.05600	22	121.00	0.07590
10	3.00	0.05690	23	148.50	0.07670
11	4.00	0.05770	24	480.00	0.08150
12	5.00	0.05850	25	1458.00	0.08270
13	6.00	0.05910			



Void Ratio = 1.436 Compression = 8.1 %
 $D_0 = 0.04480$ $D_{50} = 0.05975$ $D_{100} = 0.07469$
 C_v at 23.4 min. = 0.01 ft.²/day $C_\alpha = 0.003$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09320	14	6.00	0.10580
2	0.10	0.09610	15	7.00	0.10680
3	0.20	0.09660	16	8.00	0.10770
4	0.30	0.09700	17	10.00	0.10940
5	0.40	0.09730	18	14.00	0.11230
6	0.50	0.09760	19	20.50	0.11620
7	0.60	0.09790	20	31.00	0.12120
8	0.80	0.09840	21	49.00	0.12770
9	1.00	0.09890	22	77.00	0.13480
10	1.25	0.09940	23	140.00	0.14450
11	2.00	0.10080	24	480.00	0.16000
12	4.00	0.10360	25	1471.00	0.16490
13	5.00	0.10470			



Void Ratio = 1.158 Compression = 18.5 %
 $D_0 = 0.08700$ $D_{50} = 0.11906$ $D_{100} = 0.15112$
 C_v at 45.3 min. = 0.00 ft.²/day $C_\alpha = 0.015$

Constant Rate of Strain Consolidation Test

Date: 5/12/11

Job: 7922

Project: Fargo Moorhead Metro Feasibility Project

Specimen Information

Boring: 10-105MU Sample: 3 Depth: 35-37 Type: 5T
 Soil Type: Fat Clay (CH)

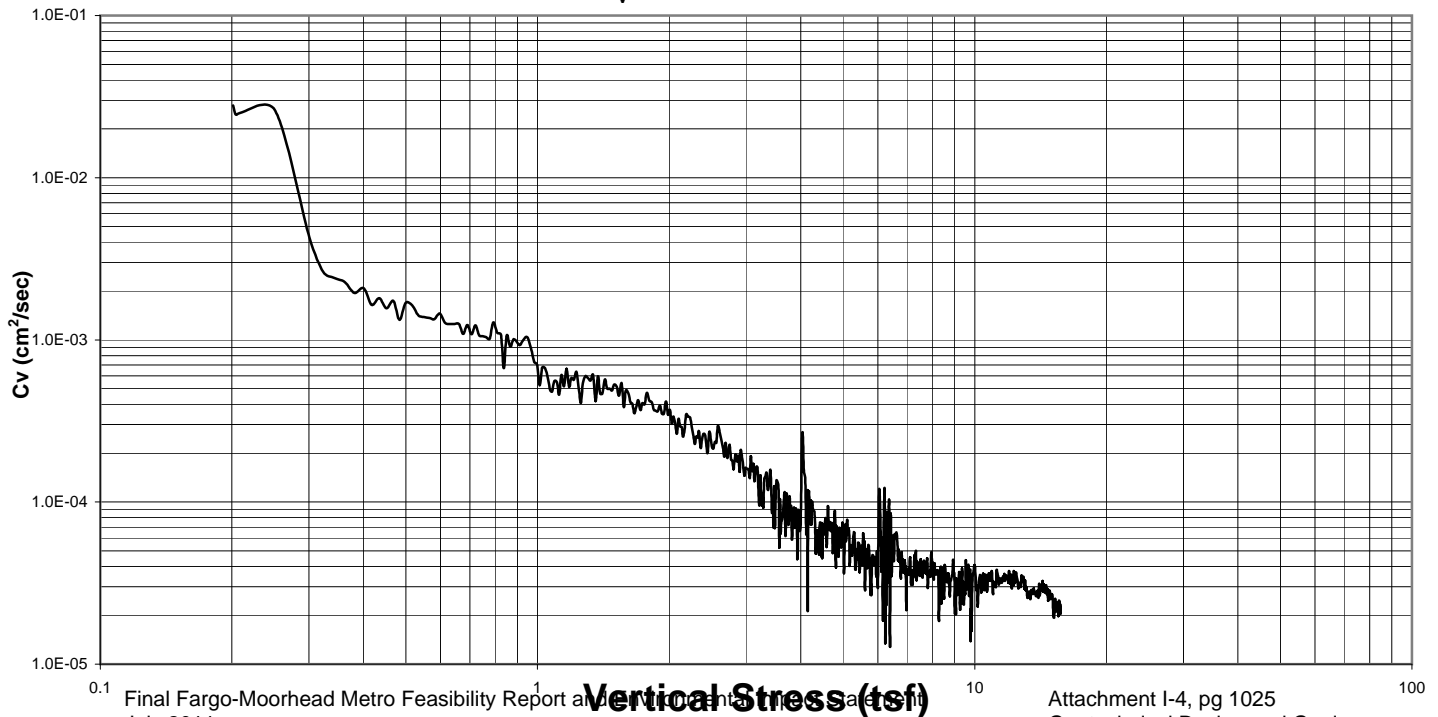
Initial Conditions: Dry Density (pcf): 62.1 Moisture Content (%): 62.1% e_o 1.765

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	3.1 tsf	Cc	0.94	Cr	0.20
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C_v vs. Vertical Pressure

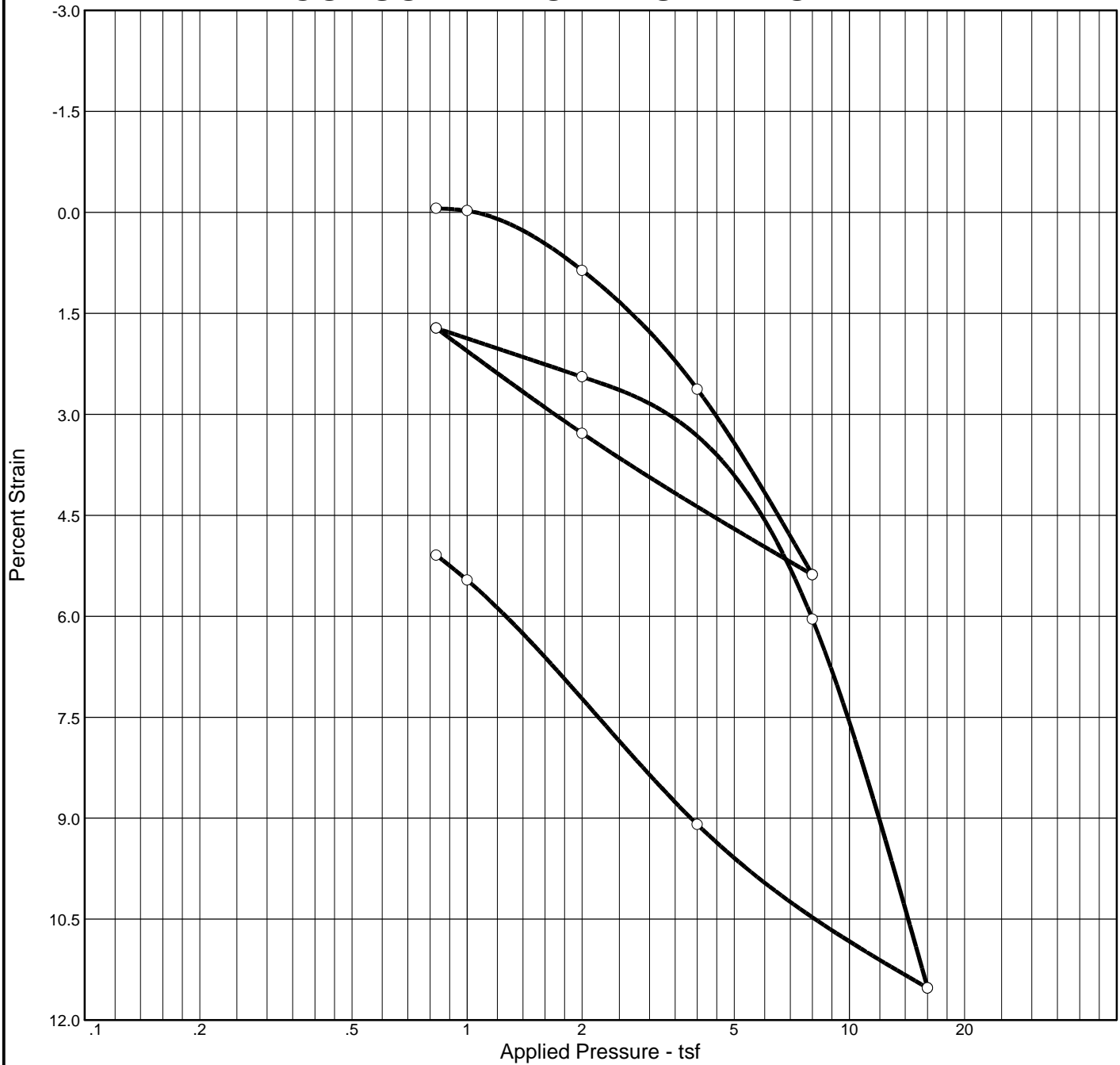


Constant Rate of Strain Data Table

Project: Fargo Moorhead Metro Feasibility Project Date: 5/12/11
 Boring: 10-105MU Sample 3 Depth: 35-37 Job: 7922

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.36%	0.252	0.012	0.049	0.243	2.58E-02	9.45E-08	1.755
0.90%	0.499	0.044	0.088	0.470	1.69E-03	2.42E-08	1.740
2.36%	1.012	0.092	0.091	0.949	5.23E-04	3.87E-08	1.700
3.96%	1.518	0.149	0.098	1.417	5.15E-04	1.76E-08	1.655
5.08%	2.009	0.220	0.110	1.859	3.71E-04	1.17E-08	1.624
6.37%	2.490	0.296	0.119	2.288	2.43E-04	7.16E-09	1.589
7.66%	3.006	0.389	0.129	2.741	1.61E-04	8.02E-09	1.553
9.22%	3.504	0.487	0.139	3.171	9.68E-05	3.39E-09	1.510
10.97%	3.987	0.582	0.146	3.589	6.65E-05	2.73E-09	1.461
12.76%	4.508	0.678	0.150	4.044	7.28E-05	8.49E-10	1.412
14.32%	5.013	0.806	0.161	4.460	5.12E-05	2.36E-09	1.369
17.29%	6.002	1.109	0.185	5.238	2.95E-05	1.83E-09	1.287
19.68%	7.009	1.416	0.202	6.031	3.57E-05	9.60E-10	1.221
21.68%	7.982	1.675	0.210	6.823	4.29E-05	8.27E-10	1.165
23.37%	8.919	1.965	0.220	7.555	4.39E-05	7.20E-10	1.119
25.28%	10.060	2.250	0.224	8.498	3.26E-05	7.07E-10	1.066
26.65%	11.078	2.474	0.223	9.361	3.03E-05	4.91E-10	1.028
27.72%	11.943	2.677	0.224	10.084	3.17E-05	3.62E-10	0.998
28.78%	12.995	2.964	0.228	10.935	2.91E-05	3.82E-10	0.969
29.73%	13.865	3.204	0.231	11.636	2.61E-05	4.03E-10	0.943
30.70%	14.868	3.503	0.236	12.430	2.74E-05	4.09E-10	0.916
31.48%	15.635	3.687	0.236	13.069	2.35E-05	3.81E-10	0.894
31.76%	15.882	3.747	0.236	13.274	2.58E-05	3.94E-10	0.887

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.9 %	40.2 %	81.4	71	52	2.741		3.93	0.39	0.09			1.102

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 3</p> <p>Location: Boring11-107MU, #1, 20-22', ND RRCS, MN, Brenna Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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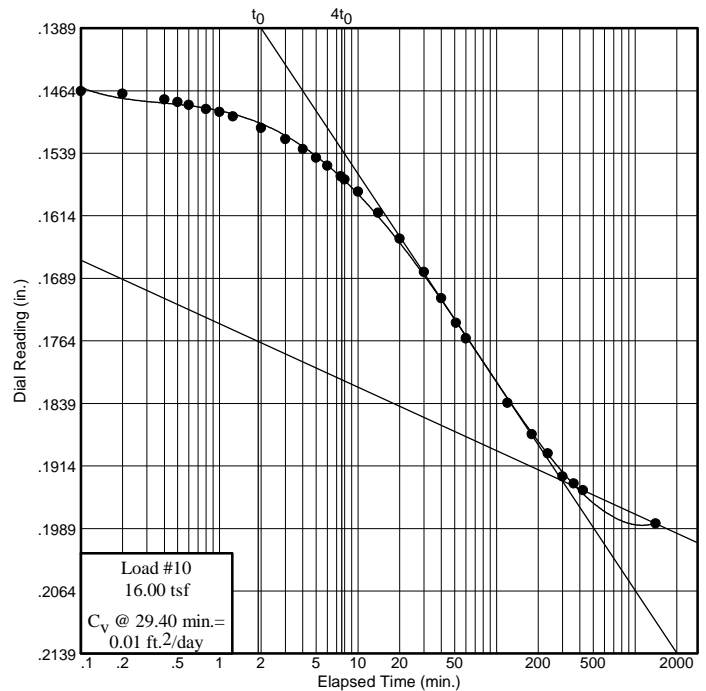
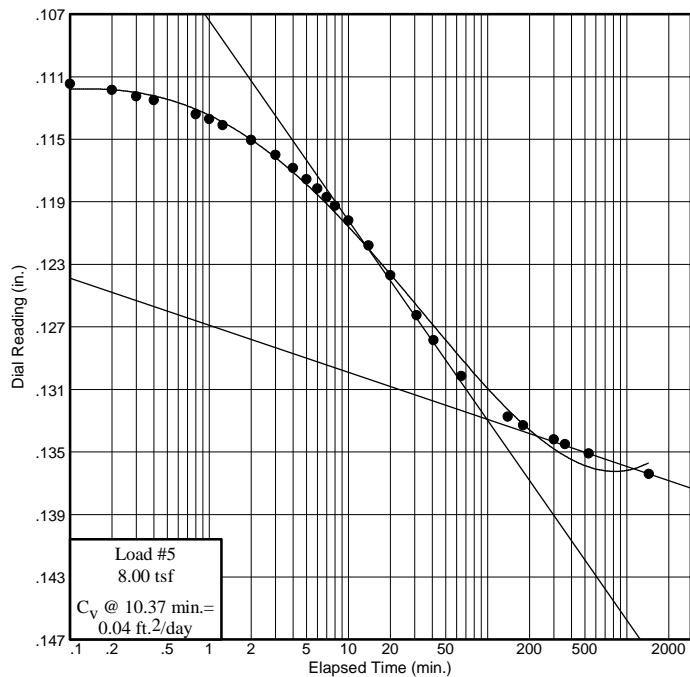
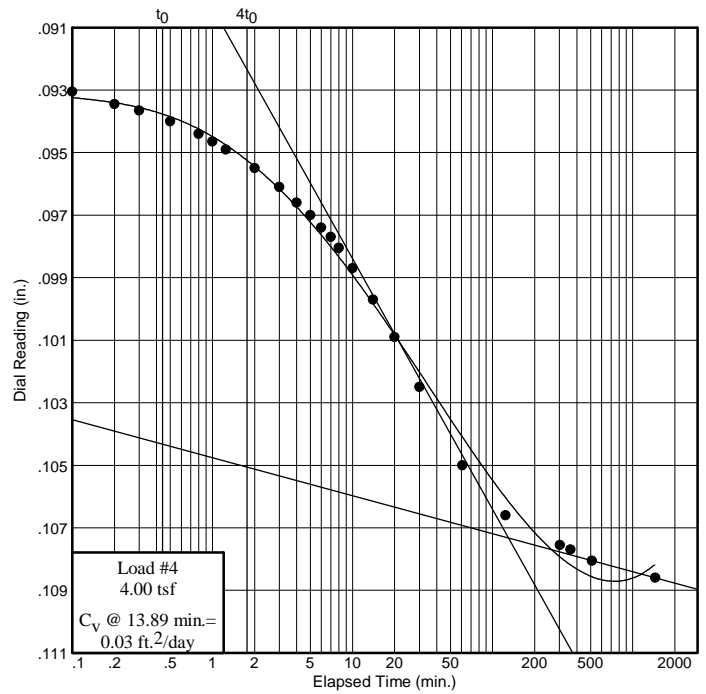
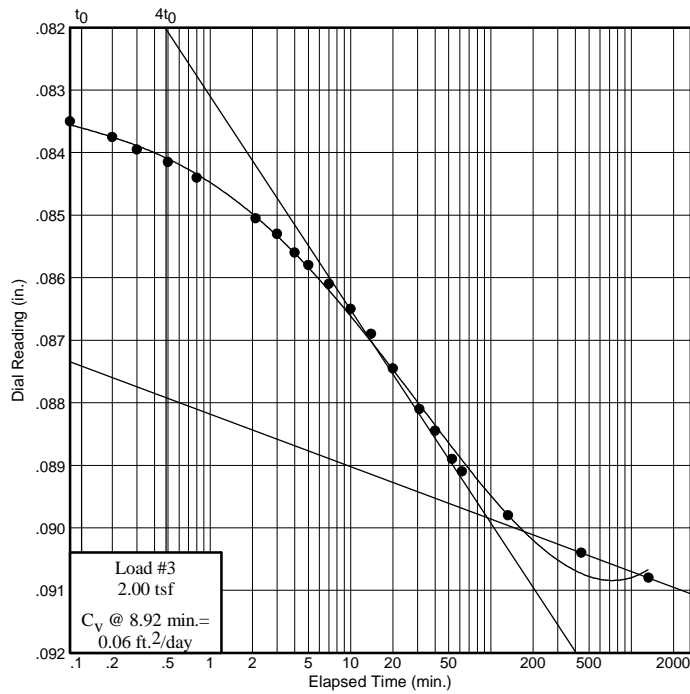
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-107MU, #1, 20-22', ND RRCS, MN, Brenna Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-107MU, #1
Elev. or Depth: 20-22' **Sample Length(in./cm.):**
Location: Boring11-107MU, #1, 20-22', ND RRCS, MN, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 71 **Plasticity Index:** 52
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 155.33 g.	Consolidometer # = 2	Wet w+t =
Dry w+t = 119.48 g.		Dry w+t =
Tare Wt. = 30.27 g.	Spec. Gravity = 2.741	Tare Wt. =
Height = 1.01 in.	Height = 1.01 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 147.91 g.	Defl. Table = Machine2-Air-2011	
Moisture = 40.2 %	Ht. Solids = 0.4797 in.	Moisture = %
Wet Den. = 114.1 pcf	Dry Wt. = 105.51 g.*	Dry Wt. = n/a
Dry Den. = 81.4 pcf	Void Ratio = 1.102	Void Ratio = 0.995
	Saturation = 99.9 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08210				1.102	
0.83	0.08150	0.00000			1.104	0.1 Swell
1.00	0.08340	0.00155			1.103	0.0 Swell
2.00	0.09305	0.00225	0.06	0.001	1.084	0.9 Compr.
4.00	0.11155	0.00295	0.03	0.001	1.047	2.6 Compr.
8.00	0.14020	0.00380	0.04	0.003	0.989	5.4 Compr.
2.00	0.11745	0.00225			1.033	3.3 Compr.
0.83	0.09945	0.00000			1.066	1.7 Compr.
2.00	0.10900	0.00225			1.051	2.4 Compr.
8.00	0.14685	0.00380			0.975	6.0 Compr.
16.00	0.20325	0.00495	0.01	0.008	0.860	11.5 Compr.
4.00	0.17675	0.00295			0.911	9.1 Compr.
1.00	0.13875	0.00155			0.988	5.5 Compr.
0.83	0.13345	0.00000			0.995	5.1 Compr.

$C_c = 0.39$ $P_c = 3.93$ tsf $C_r = 0.09$

Pressure: 1.00 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.08250
2	0.20	0.08265
3	10.00	0.08285
4	30.00	0.08305
5	483.00	0.08335
6	1434.00	0.08340

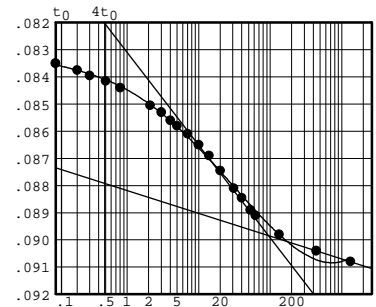
Void Ratio = 1.103 Swell = 0.0 %

Pressure: 2.00 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08340	12	10.00	0.08875
2	0.10	0.08575	13	14.00	0.08915
3	0.20	0.08600	14	20.00	0.08970
4	0.30	0.08620	15	31.00	0.09035
5	0.50	0.08640	16	40.00	0.09070
6	0.80	0.08665	17	53.00	0.09115
7	2.10	0.08730	18	62.30	0.09135
8	3.00	0.08755	19	133.00	0.09205
9	4.00	0.08785	20	442.00	0.09265
10	5.00	0.08805	21	1327.00	0.09305
11	7.00	0.08835			



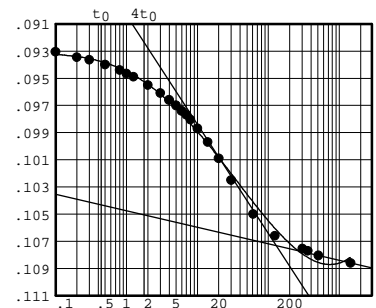
Void Ratio = 1.084 Compression = 0.9 %
 $D_0 = 0.08312$ $D_{50} = 0.08648$ $D_{100} = 0.08984$
 C_v at 8.9 min. = 0.06 ft.²/day $C_\alpha = 0.001$

Pressure: 4.00 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09305	14	7.00	0.10065
2	0.10	0.09600	15	8.00	0.10100
3	0.20	0.09640	16	10.00	0.10165
4	0.30	0.09660	17	14.00	0.10265
5	0.50	0.09695	18	20.00	0.10385
6	0.80	0.09735	19	30.00	0.10545
7	1.00	0.09760	20	61.00	0.10795
8	1.25	0.09785	21	124.00	0.10955
9	2.00	0.09845	22	303.00	0.11050
10	3.00	0.09905	23	360.00	0.11065
11	4.00	0.09955	24	511.00	0.11100
12	5.00	0.09995	25	1448.00	0.11155
13	6.00	0.10035			



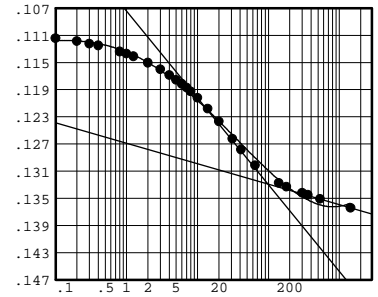
Void Ratio = 1.047 Compression = 2.6 %
 $D_0 = 0.09228$ $D_{50} = 0.09981$ $D_{100} = 0.10733$
 C_v at 13.9 min. = 0.03 ft.²/day $C_\alpha = 0.001$

Pressure: 8.00 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11155	15	8.00	0.12305
2	0.10	0.11525	16	10.00	0.12400
3	0.20	0.11565	17	14.00	0.12560
4	0.30	0.11605	18	20.00	0.12750
5	0.40	0.11630	19	31.00	0.13005
6	0.80	0.11720	20	41.00	0.13165
7	1.00	0.11750	21	65.00	0.13395
8	1.25	0.11790	22	140.00	0.13655
9	2.00	0.11885	23	180.00	0.13710
10	3.00	0.11980	24	300.00	0.13800
11	4.00	0.12065	25	360.00	0.13830
12	5.00	0.12135	26	533.00	0.13890
13	6.00	0.12195	27	1440.00	0.14020
14	7.00	0.12250			



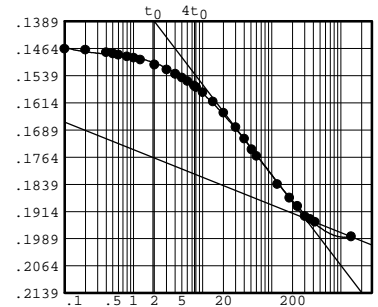
Void Ratio = 0.989 Compression = 5.4 %
 $D_0 = 0.10860$ $D_{50} = 0.12075$ $D_{100} = 0.13289$
 C_v at 10.4 min. = 0.04 ft.²/day $C_\alpha = 0.003$

Pressure: 16.00 tsf

TEST READINGS

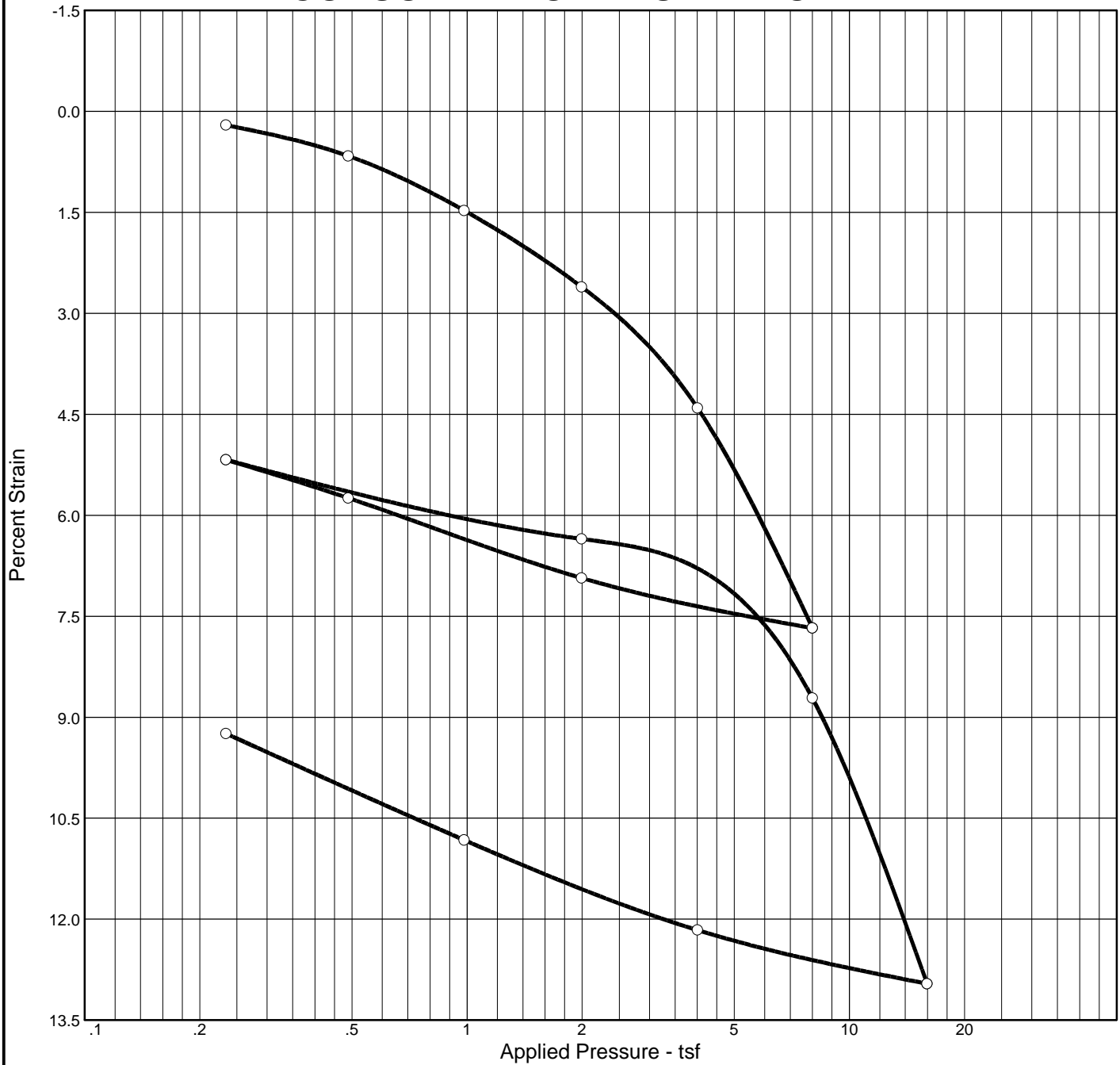
Load No. 10

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14685	16	8.00	0.16200
2	0.10	0.15140	17	10.00	0.16345
3	0.20	0.15170	18	14.00	0.16600
4	0.40	0.15240	19	20.00	0.16910
5	0.50	0.15270	20	30.00	0.17310
6	0.60	0.15305	21	40.00	0.17625
7	0.80	0.15355	22	51.00	0.17920
8	1.00	0.15390	23	60.00	0.18105
9	1.25	0.15445	24	120.00	0.18880
10	2.00	0.15580	25	180.00	0.19255
11	3.00	0.15715	26	235.00	0.19485
12	4.00	0.15835	27	300.00	0.19760
13	5.00	0.15940	28	360.00	0.19845
14	6.00	0.16035	29	420.00	0.19925
15	7.50	0.16160	30	1409.00	0.20325



Void Ratio = 0.860 Compression = 11.5 %
 $D_0 = 0.14355$ $D_{50} = 0.16835$ $D_{100} = 0.19316$
 C_v at 29.4 min. = 0.01 ft.²/day $C_\alpha = 0.008$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.9 %	39.5 %	82.3	52	31	2.76		3.55	0.30	0.04			1.092

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 3</p> <p>Location: Boring11-107MU, #2, 30-32', ND RRCS, MN, Brenna Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right; font-weight: bold;">Figure</p>
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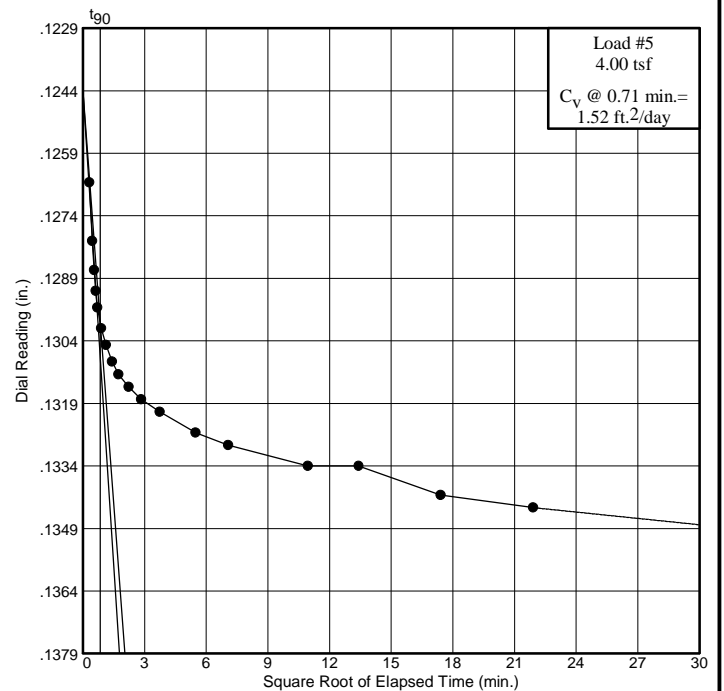
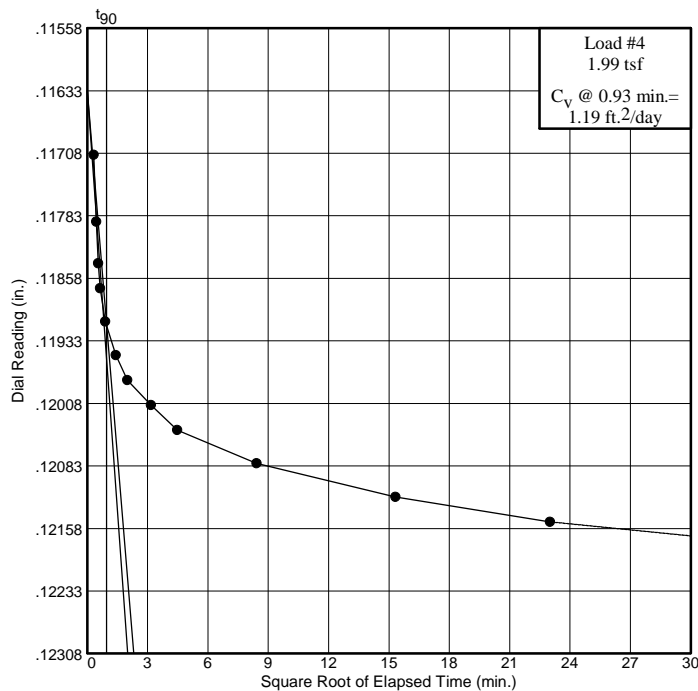
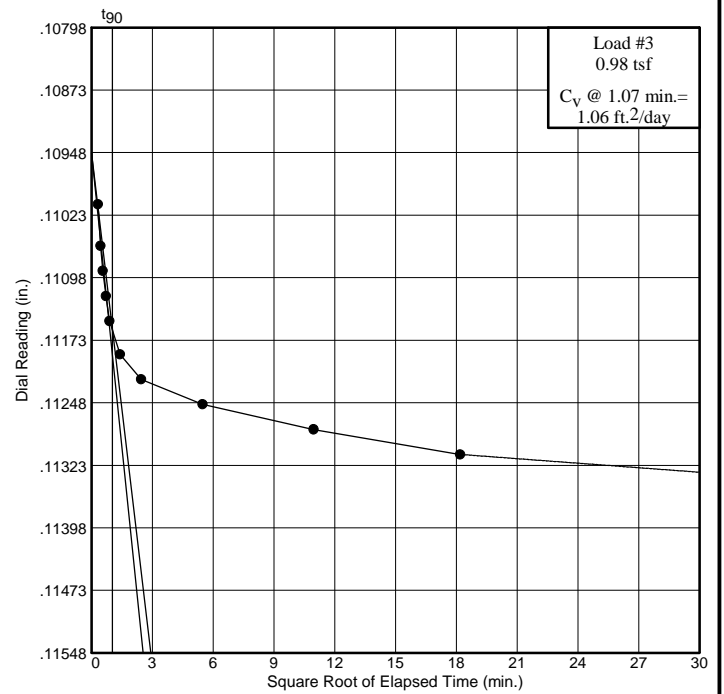
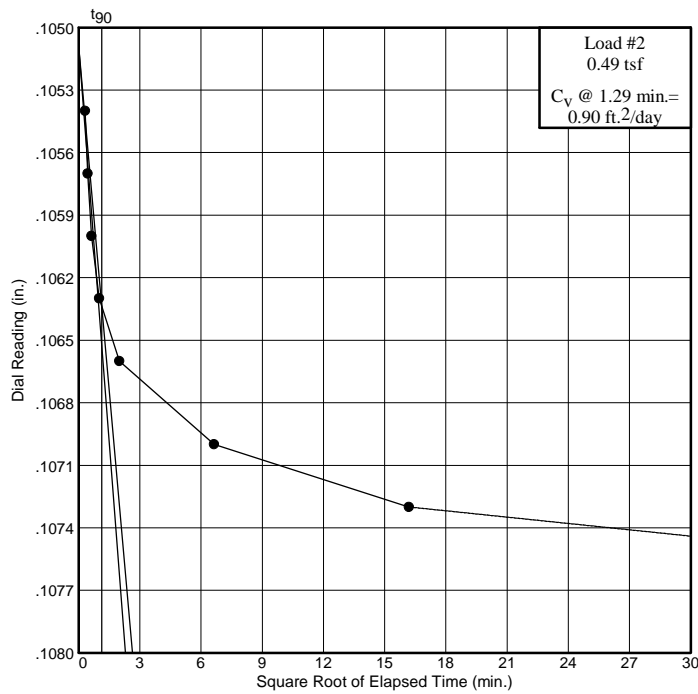
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-107MU, #2, 30-32', ND RRCS, MN, Brenna Formation



BRAUNSM
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Figure

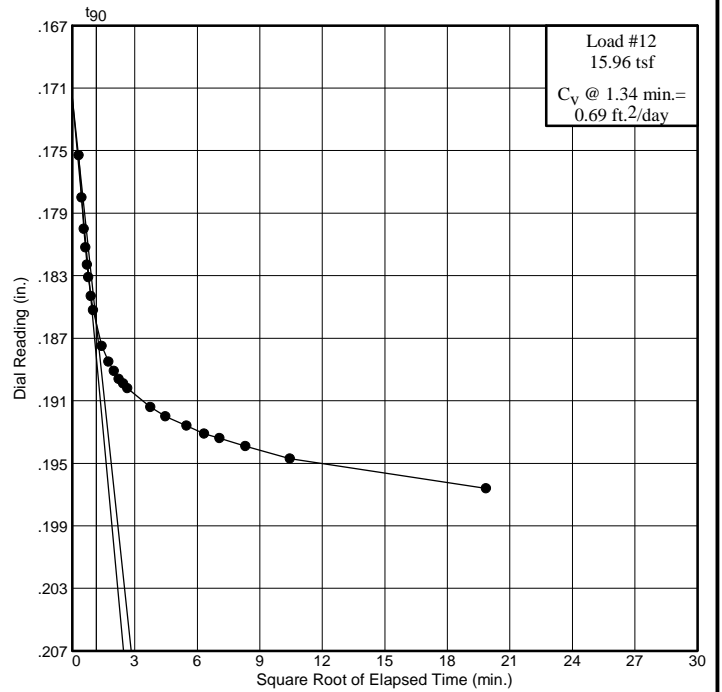
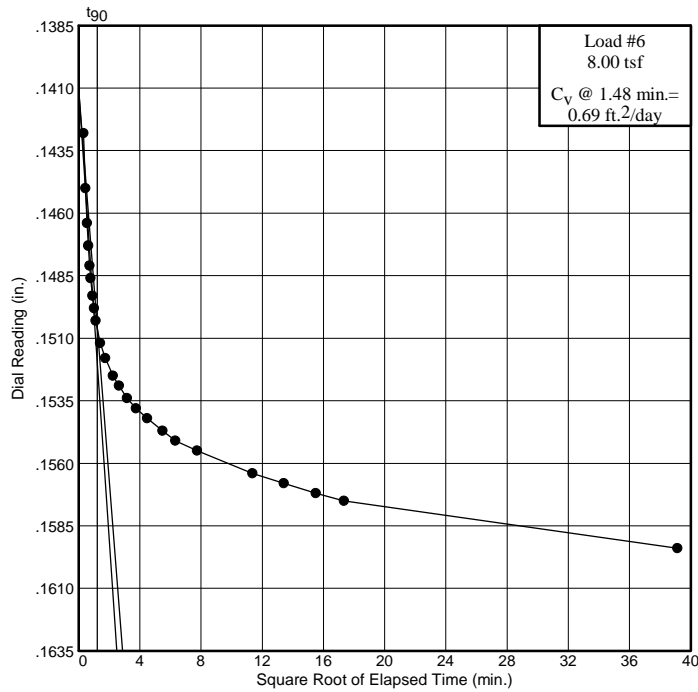
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-107MU, #2, 30-32', ND RRCS, MN, Brenna Formation



BRAUNSM
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Figure

CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: Boring11-107MU, #2
Elev. or Depth: 30-32' **Sample Length(in./cm.):**
Location: Boring11-107MU, #2, 30-32', ND RRCS, MN, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 52 **Plasticity Index:** 31
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 142.34 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 110.82 g.		Dry w+t =
Tare Wt. = 31.09 g.	Spec. Gravity = 2.76	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 109.12 g.	Defl. Table = Machine4-2009	
Moisture = 39.5 %	Ht. Solids = 0.3537 in.	Moisture = %
Wet Den. = 114.9 pcf	Dry Wt. = 78.20 g.*	Dry Wt. = n/a
Dry Den. = 82.3 pcf	Void Ratio = 1.092	Void Ratio = 0.899
	Saturation = 99.9 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10260				1.092	
0.23	0.10460	0.00050			1.088	0.2 Compr.
0.49	0.10830	0.00080	0.90		1.079	0.7 Compr.
0.98	0.11450	0.00100	1.06		1.062	1.5 Compr.
1.99	0.12340	0.00150	1.19		1.038	2.6 Compr.
4.00	0.13720	0.00200	1.52		1.000	4.4 Compr.
8.00	0.16210	0.00270	0.69		0.932	7.7 Compr.
1.99	0.15540	0.00150			0.947	6.9 Compr.
0.49	0.14590	0.00080			0.972	5.7 Compr.
0.23	0.14140	0.00050			0.984	5.2 Compr.
1.99	0.15110	0.00150			0.960	6.4 Compr.
8.00	0.16980	0.00270			0.910	8.7 Compr.
15.96	0.20210	0.00360	0.69		0.821	13.0 Compr.
4.00	0.19460	0.00200			0.838	12.2 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression / Swell
0.98	0.18370	0.00100			0.866	10.8 Compr.
0.23	0.17150	0.00050			0.899	9.2 Compr.

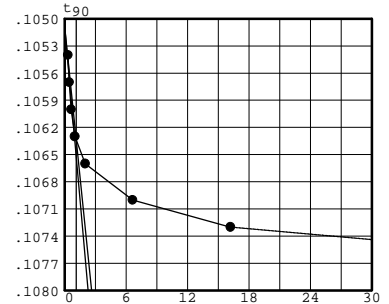
$C_c = 0.30$ $P_c = 3.55$ tsf $C_r = 0.04$

Pressure: 0.49 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.10460
2	0.10	0.10620
3	0.20	0.10650
4	0.40	0.10680
5	1.00	0.10710
6	4.00	0.10740
7	44.00	0.10780
8	262.00	0.10810
9	1295.00	0.10830



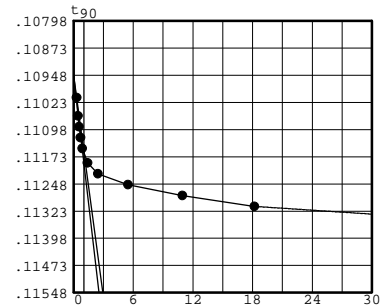
Void Ratio = 1.079 Compression = 0.7 %
 $D_0 = 0.10509$ $D_{90} = 0.10634$ $D_{100} = 0.10648$
 C_v at 1.3 min. = 0.90 ft.²/day

Pressure: 0.98 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10830	11	331.00	0.11410
2	0.10	0.11110	12	1628.00	0.11450
3	0.20	0.11160			
4	0.30	0.11190			
5	0.50	0.11220			
6	0.80	0.11250			
7	2.00	0.11290			
8	6.00	0.11320			
9	30.00	0.11350			
10	120.00	0.11380			



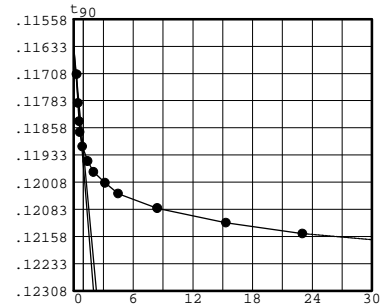
Void Ratio = 1.062 Compression = 1.5 %
 $D_0 = 0.10949$ $D_{90} = 0.11161$ $D_{100} = 0.11184$
 C_v at 1.1 min. = 1.06 ft.²/day

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11450	11	71.00	0.12230
2	0.10	0.11860	12	235.00	0.12270
3	0.20	0.11940	13	529.30	0.12300
4	0.30	0.11990	14	1568.00	0.12340
5	0.40	0.12020			
6	0.80	0.12060			
7	2.00	0.12100			
8	4.00	0.12130			
9	10.00	0.12160			
10	20.00	0.12190			



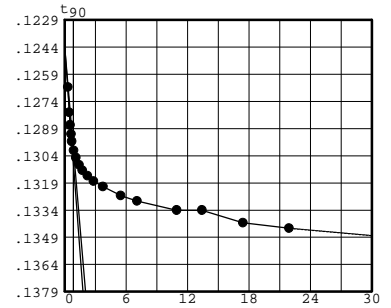
Void Ratio = 1.038 Compression = 2.6 %
 D₀ = 0.11633 D₉₀ = 0.11916 D₁₀₀ = 0.11947
 C_v at 0.9 min. = 1.19 ft.²/day

Pressure: 4.00 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12340	11	5.00	0.13350
2	0.10	0.12860	12	8.00	0.13380
3	0.20	0.13000	13	14.00	0.13410
4	0.30	0.13070	14	30.00	0.13460
5	0.40	0.13120	15	50.00	0.13490
6	0.50	0.13160	16	120.00	0.13540
7	0.80	0.13210	17	180.00	0.13540
8	1.25	0.13250	18	303.00	0.13610
9	2.00	0.13290	19	480.00	0.13640
10	3.00	0.13320	20	1420.00	0.13720



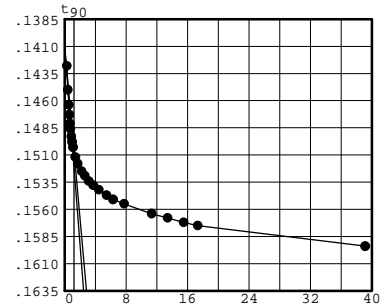
Void Ratio = 1.000 Compression = 4.4 %
 D₀ = 0.12440 D₉₀ = 0.12997 D₁₀₀ = 0.13058
 C_v at 0.7 min. = 1.52 ft.²/day

Pressure: 8.00 tsf

TEST READINGS

Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13720	14	7.00	0.15560
2	0.10	0.14550	15	10.00	0.15610
3	0.20	0.14770	16	14.00	0.15650
4	0.30	0.14910	17	20.00	0.15690
5	0.40	0.15000	18	30.00	0.15740
6	0.50	0.15080	19	40.00	0.15780
7	0.60	0.15130	20	60.00	0.15820
8	0.80	0.15200	21	129.00	0.15910
9	1.00	0.15250	22	180.00	0.15950
10	1.25	0.15300	23	240.00	0.15990
11	2.00	0.15390	24	301.00	0.16020
12	3.00	0.15450	25	1532.00	0.16210
13	5.00	0.15520			



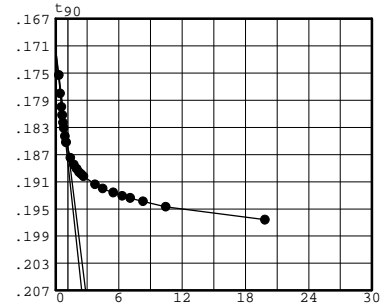
Void Ratio = 0.932 Compression = 7.7 %
 $D_0 = 0.14106$ $D_{90} = 0.15060$ $D_{100} = 0.15166$
 C_v at 1.5 min. = 0.69 ft.²/day

Pressure: 15.96 tsf

TEST READINGS

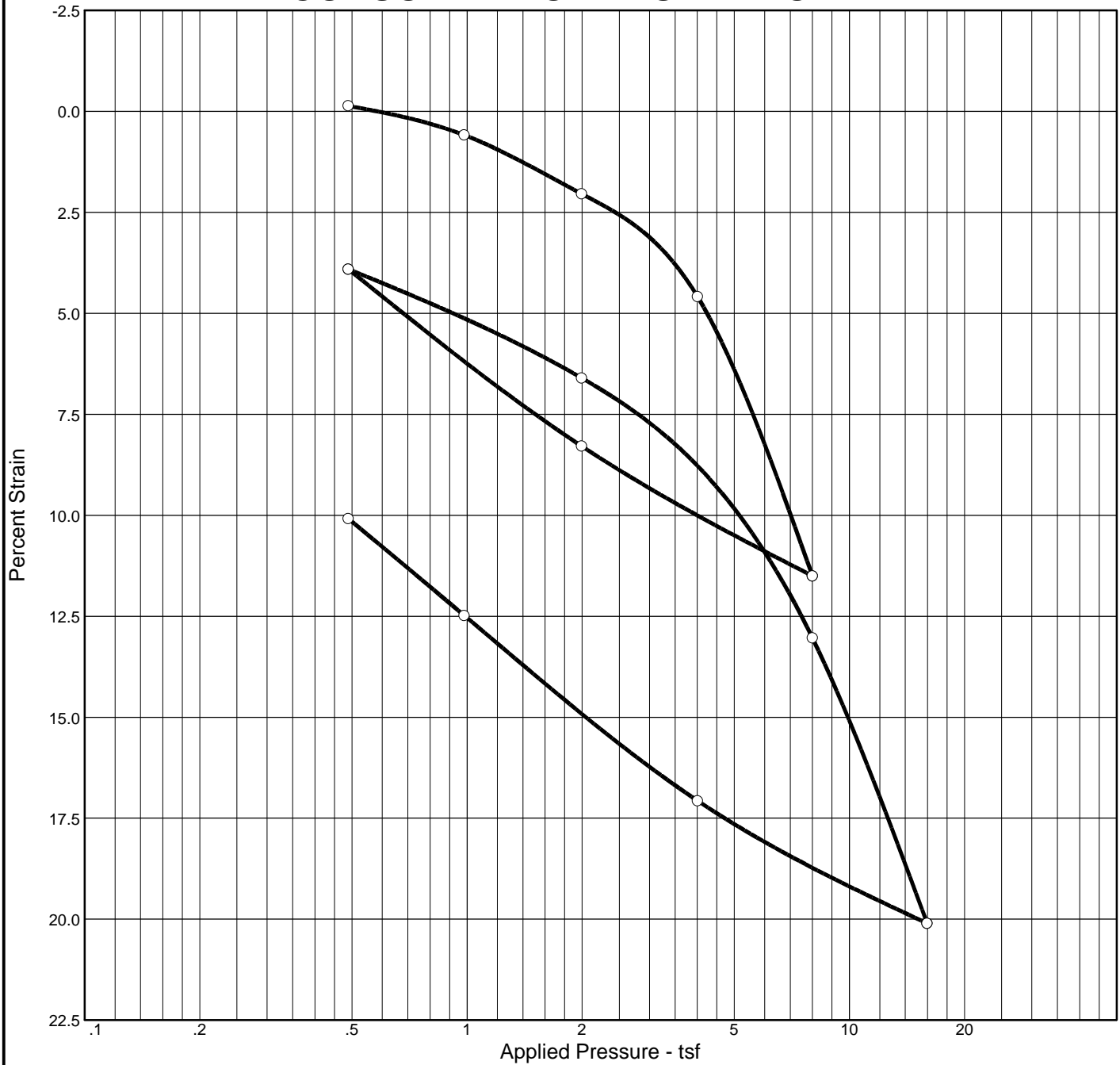
Load No. 12

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16980	14	6.00	0.19350
2	0.10	0.17890	15	7.00	0.19380
3	0.20	0.18160	16	14.00	0.19500
4	0.30	0.18360	17	20.00	0.19560
5	0.40	0.18480	18	30.00	0.19620
6	0.50	0.18590	19	40.00	0.19670
7	0.60	0.18670	20	50.00	0.19700
8	0.80	0.18790	21	69.00	0.19750
9	1.00	0.18880	22	109.00	0.19830
10	2.00	0.19110	23	394.00	0.20020
11	3.00	0.19210	24	451.00	0.20050
12	4.00	0.19270	25	1298.00	0.20210
13	5.00	0.19320			



Void Ratio = 0.821 Compression = 13.0 %
 $D_0 = 0.17163$ $D_{90} = 0.18607$ $D_{100} = 0.18768$
 C_v at 1.3 min. = 0.69 ft.²/day

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
103.1 %	50.3 %	73.0	95	67	2.718		4.26	0.67	0.16			1.326

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 11-110MU, #2, 35-37', Sheyenne River, Brenna Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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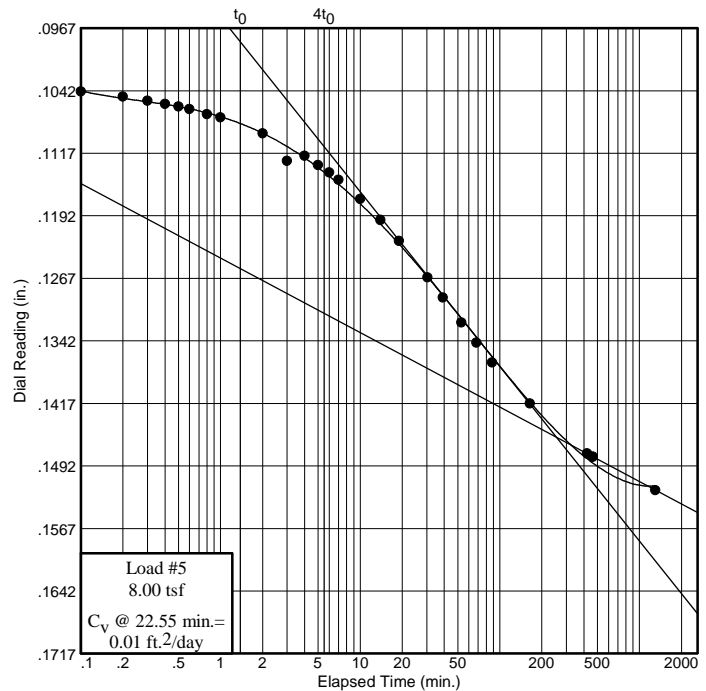
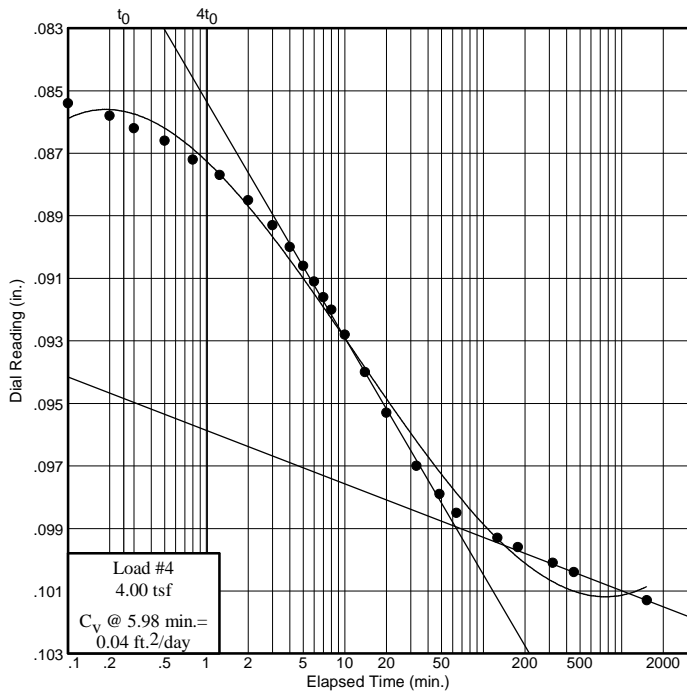
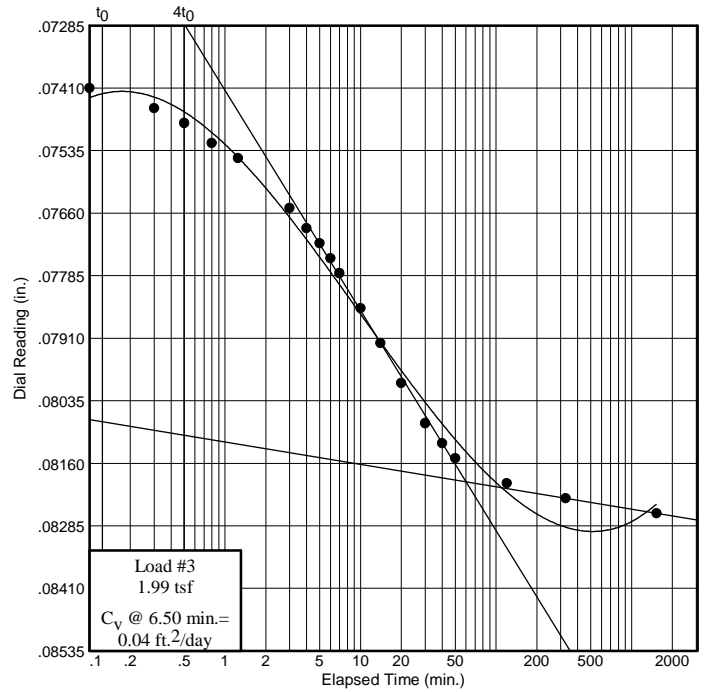
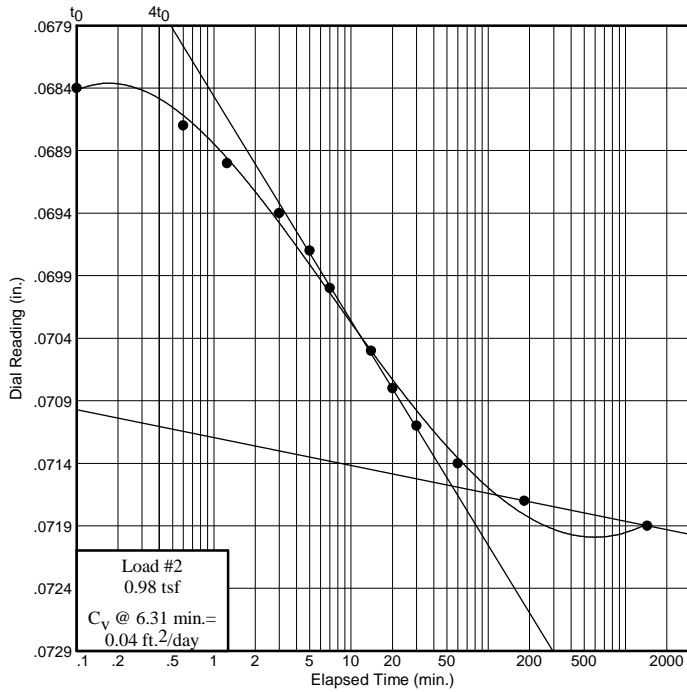
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #2, 35-37', Sheyenne River, Brenna Formation



BRAUNSM
INTERTEC

Figure

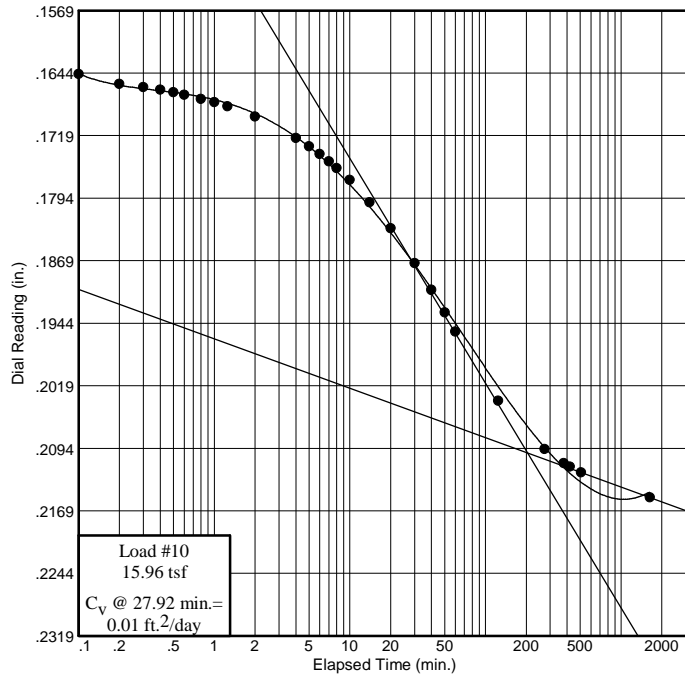
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #2, 35-37', Sheyenne River, Brenna Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #2
Elev. or Depth: 35-37' **Sample Length(in./cm.):**
Location: Boring11-110MU, #2, 35-37', Sheyenne River, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 95 **Plasticity Index:** 67
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 148.41 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 108.87 g.		Dry w+t =
Tare Wt. = 30.21 g.	Spec. Gravity = 2.718	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 103.38 g.	Defl. Table = Machine4-2009	
Moisture = 50.3 %	Ht. Solids = 0.3159 in.	Moisture = %
Wet Den. = 109.6 pcf	Dry Wt. = 68.80 g.*	Dry Wt. = n/a
Dry Den. = 73.0 pcf	Void Ratio = 1.326	Void Ratio = 1.091
	Saturation = 103.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.06760				1.326	
0.49	0.06740	0.00080			1.329	0.1 Swell
0.98	0.07290	0.00100	0.04	0.000	1.312	0.6 Compr.
1.99	0.08410	0.00150	0.04	0.001	1.278	2.0 Compr.
4.00	0.10330	0.00200	0.04	0.002	1.219	4.6 Compr.
8.00	0.15480	0.00270	0.01	0.013	1.058	11.5 Compr.
1.99	0.13000	0.00150			1.133	8.3 Compr.
0.49	0.09710	0.00080			1.235	3.9 Compr.
1.99	0.11760	0.00150			1.172	6.6 Compr.
8.00	0.16610	0.00270			1.022	13.0 Compr.
15.96	0.21890	0.00360	0.01	0.009	0.858	20.1 Compr.
4.00	0.19500	0.00200			0.929	17.1 Compr.
0.98	0.16030	0.00100			1.035	12.5 Compr.
0.49	0.14250	0.00080			1.091	10.1 Compr.

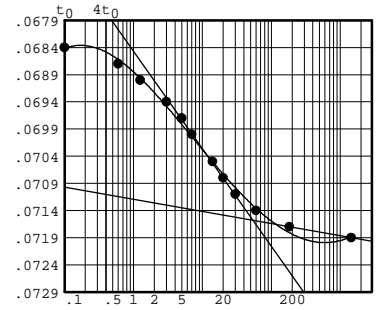
$C_c = 0.67$ $P_c = 4.26$ tsf $C_r = 0.16$

Pressure: 0.98 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06740	11	60.00	0.07240
2	0.10	0.06940	12	183.00	0.07270
3	0.60	0.06970	13	1442.00	0.07290
4	1.25	0.07000			
5	3.00	0.07040			
6	5.00	0.07070			
7	7.00	0.07100			
8	14.00	0.07150			
9	20.00	0.07180			
10	30.00	0.07210			



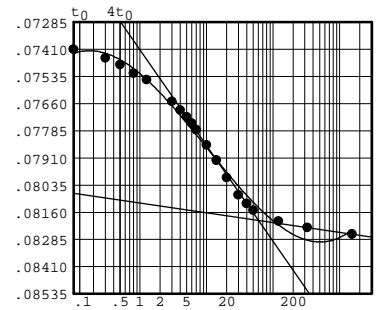
Void Ratio = 1.312 Compression = 0.6 %
 $D_0 = 0.06836$ $D_{50} = 0.06997$ $D_{100} = 0.07158$
 C_v at 6.3 min. = 0.04 ft.²/day $C_\alpha = 0.000$

Pressure: 1.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07290	11	7.00	0.07930
2	0.10	0.07560	12	10.00	0.08000
3	0.30	0.07600	13	14.00	0.08070
4	0.50	0.07630	14	20.00	0.08150
5	0.80	0.07670	15	30.00	0.08230
6	1.25	0.07700	16	40.00	0.08270
7	3.00	0.07800	17	50.00	0.08300
8	4.00	0.07840	18	120.00	0.08350
9	5.00	0.07870	19	327.00	0.08380
10	6.00	0.07900	20	1531.00	0.08410



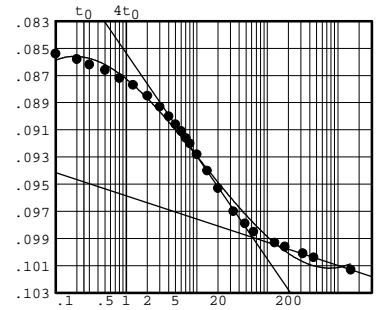
Void Ratio = 1.278 Compression = 2.0 %
 $D_0 = 0.07385$ $D_{50} = 0.07791$ $D_{100} = 0.08197$
 C_v at 6.5 min. = 0.04 ft.²/day $C_\alpha = 0.001$

Pressure: 4.00 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08410	14	8.00	0.09400
2	0.10	0.08740	15	10.00	0.09480
3	0.20	0.08780	16	14.00	0.09600
4	0.30	0.08820	17	20.00	0.09730
5	0.50	0.08860	18	33.00	0.09900
6	0.80	0.08920	19	48.30	0.09990
7	1.25	0.08970	20	64.00	0.10050
8	2.00	0.09050	21	127.00	0.10130
9	3.00	0.09130	22	178.00	0.10160
10	4.00	0.09200	23	318.00	0.10210
11	5.00	0.09260	24	453.00	0.10240
12	6.00	0.09310	25	1524.00	0.10330
13	7.00	0.09360			



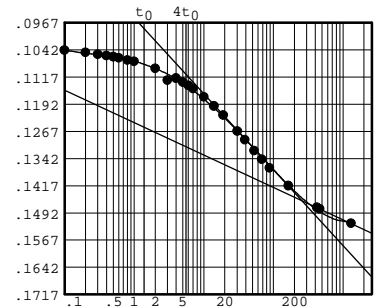
Void Ratio = 1.219 Compression = 4.6 %
 $D_0 = 0.08404$ $D_{50} = 0.09149$ $D_{100} = 0.09893$
 C_v at 6.0 min. = 0.04 ft.²/day $C_\alpha = 0.002$

Pressure: 8.00 tsf

TEST READINGS

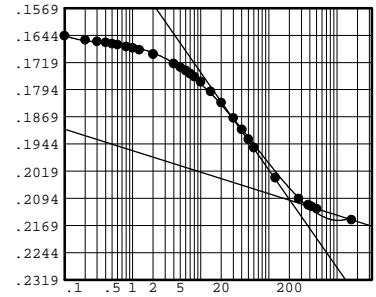
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10330	15	7.00	0.11760
2	0.10	0.10700	16	10.00	0.11990
3	0.20	0.10760	17	14.00	0.12240
4	0.30	0.10810	18	19.00	0.12490
5	0.40	0.10850	19	30.30	0.12930
6	0.50	0.10880	20	39.00	0.13170
7	0.60	0.10910	21	53.00	0.13470
8	0.80	0.10970	22	68.00	0.13710
9	1.00	0.11010	23	88.00	0.13950
10	2.00	0.11200	24	164.00	0.14440
11	3.00	0.11530	25	422.00	0.15040
12	4.00	0.11470	26	463.50	0.15080
13	5.00	0.11580	27	1300.00	0.15480
14	6.00	0.11670			



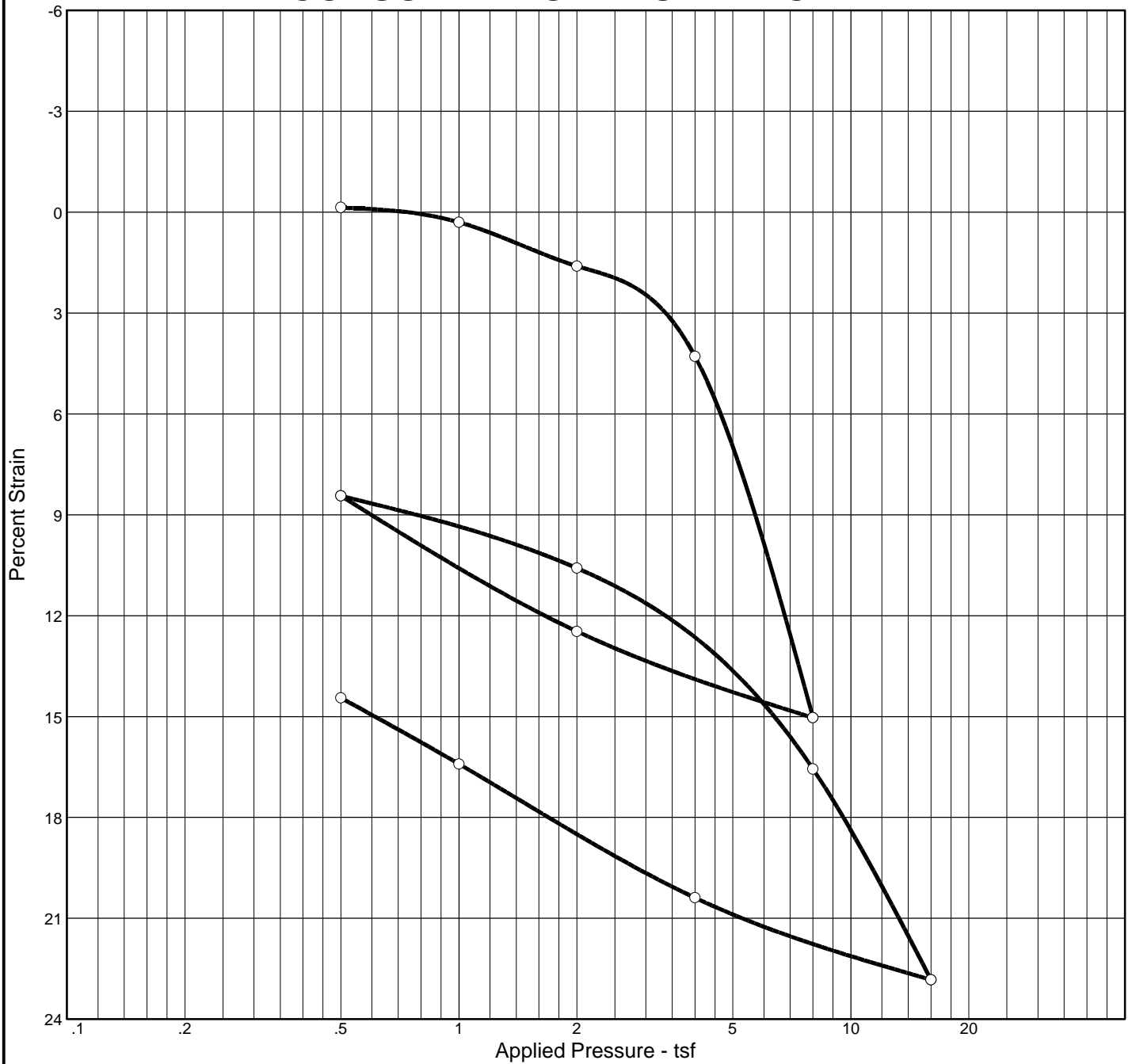
Void Ratio = 1.058 Compression = 11.5 %
 $D_0 = 0.10225$ $D_{50} = 0.12401$ $D_{100} = 0.14577$
 C_v at 22.6 min. = 0.01 ft.²/day $C_\alpha = 0.013$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16610	16	8.00	0.17940
2	0.10	0.16810	17	10.00	0.18080
3	0.20	0.16930	18	14.00	0.18350
4	0.30	0.16970	19	20.00	0.18660
5	0.40	0.17000	20	30.00	0.19080
6	0.50	0.17030	21	40.00	0.19400
7	0.60	0.17060	22	50.00	0.19670
8	0.80	0.17110	23	60.00	0.19900
9	1.00	0.17150	24	124.00	0.20730
10	1.25	0.17200	25	273.00	0.21310
11	2.00	0.17320	26	379.00	0.21480
12	4.00	0.17580	27	420.00	0.21520
13	5.00	0.17680	28	508.00	0.21590
14	6.00	0.17770	29	1631.00	0.21890
15	7.00	0.17860			



Void Ratio = 0.858 Compression = 20.1 %
 $D_0 = 0.16340$ $D_{50} = 0.18668$ $D_{100} = 0.20997$
 C_v at 27.9 min. = 0.01 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
100.0 %	53.1 %	69.4	86	64	2.710		4.03	0.94	0.15			1.439

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 11-110MU, #3, 48-50', Sheyenne River, Brenna Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right; font-weight: bold;">Figure</p>
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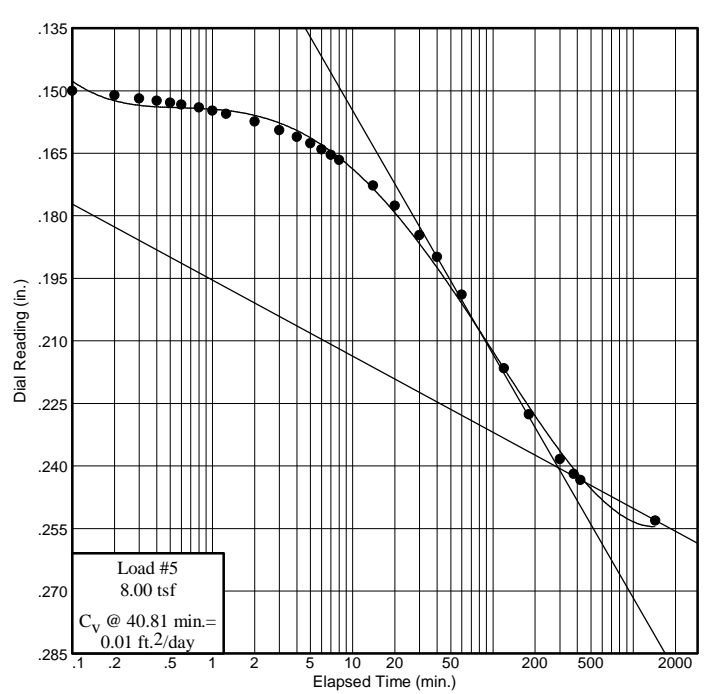
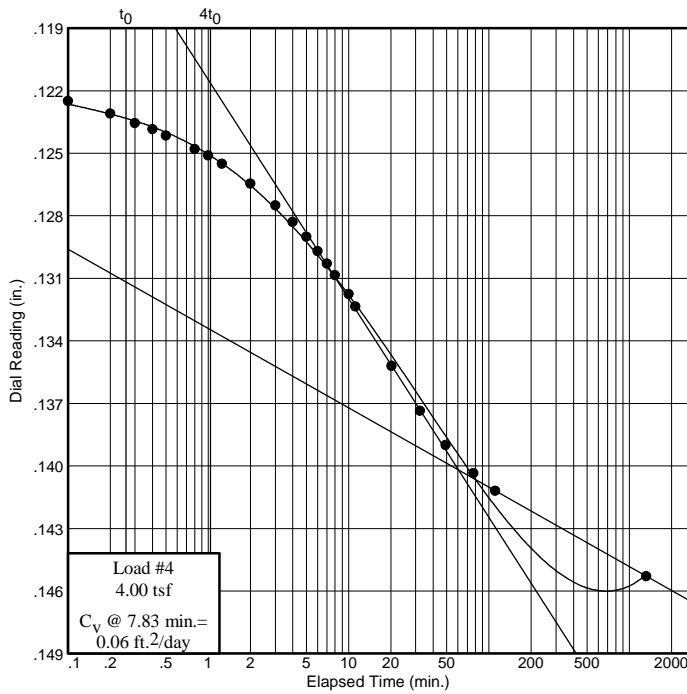
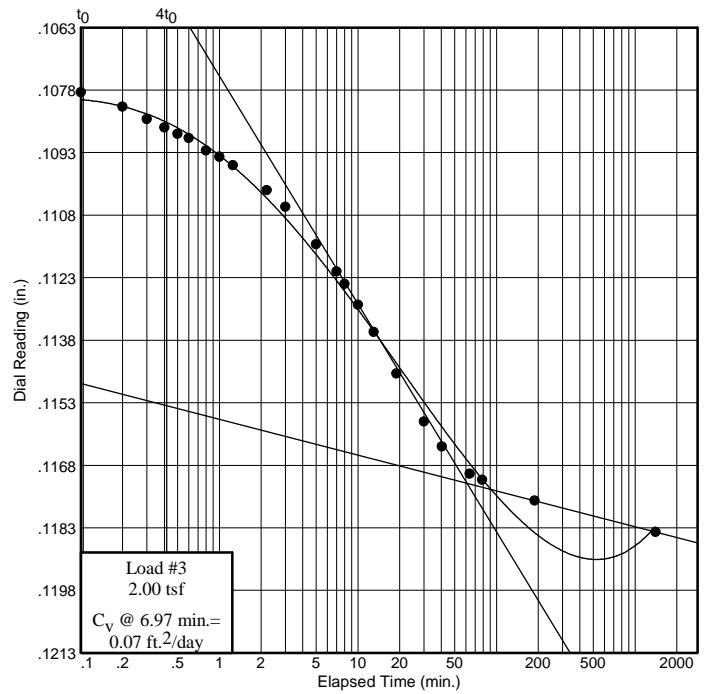
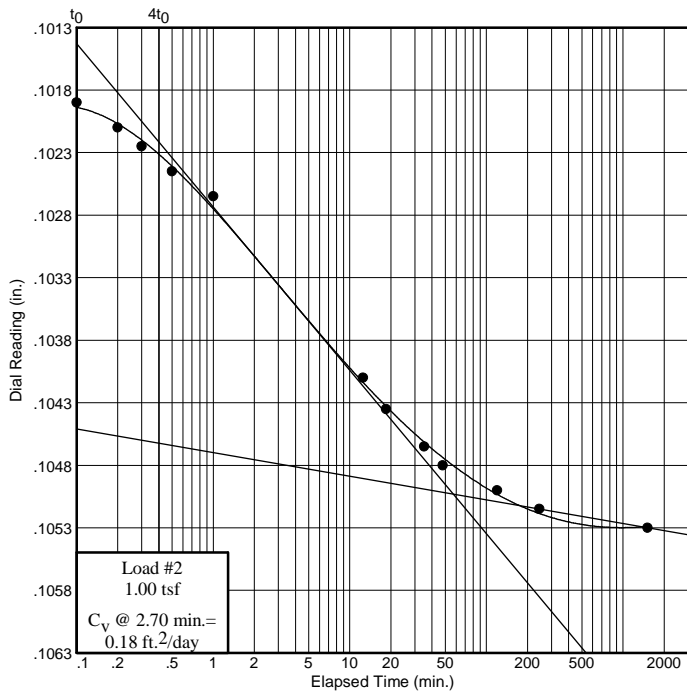
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #3, 48-50', Sheyenne River, Brenna Formation



BRAUNSM
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Figure

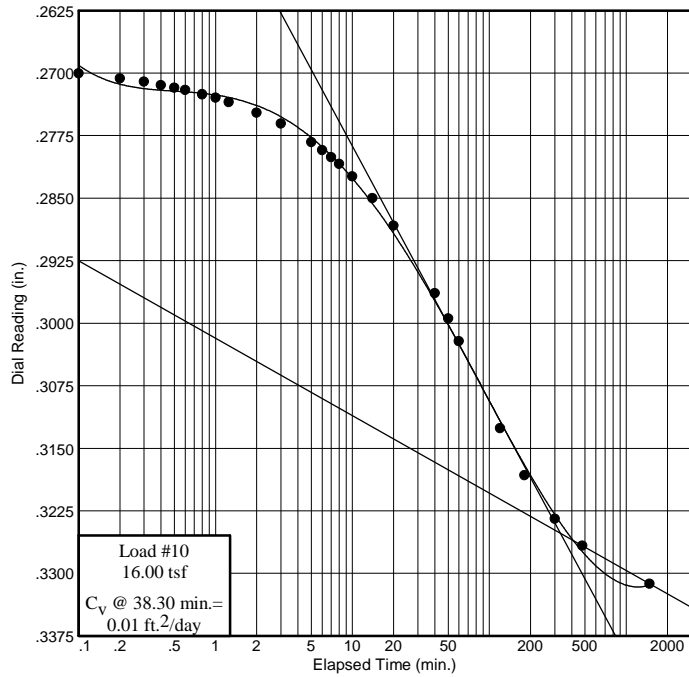
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #3, 48-50', Sheyenne River, Brenna Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #3
Elev. or Depth: 48-50' **Sample Length(in./cm.):**
Location: Boring11-110MU, #3, 48-50', Sheyenne River, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 86 **Plasticity Index:** 64
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 132.86 g.	Consolidometer # = 2	Wet w+t =
Dry w+t = 97.60 g.		Dry w+t =
Tare Wt. = 31.18 g.	Spec. Gravity = 2.710	Tare Wt. =
Height = 1.00 in.	Height = 1.00 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 136.92 g.	Defl. Table = Machine2-Air-2011	
Moisture = 53.1 %	Ht. Solids = 0.4113 in.	Moisture = %
Wet Den. = 106.2 pcf	Dry Wt. = 89.44 g.*	Dry Wt. = n/a
Dry Den. = 69.4 pcf	Void Ratio = 1.439	Void Ratio = 1.086
	Saturation = 100.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10230				1.439	
0.50	0.10185	0.00095			1.442	0.1 Swell
1.00	0.10685	0.00155	0.18	0.000	1.431	0.3 Compr.
2.00	0.12065	0.00225	0.07	0.001	1.400	1.6 Compr.
4.00	0.14825	0.00295	0.06	0.004	1.334	4.3 Compr.
8.00	0.25690	0.00380	0.01	0.019	1.072	15.0 Compr.
2.00	0.22960	0.00225			1.135	12.5 Compr.
0.50	0.18790	0.00095			1.233	8.4 Compr.
2.00	0.21075	0.00225			1.181	10.6 Compr.
8.00	0.27220	0.00380			1.035	16.6 Compr.
16.00	0.33620	0.00495	0.01	0.011	0.882	22.8 Compr.
4.00	0.30975	0.00295			0.942	20.4 Compr.
1.00	0.26845	0.00155			1.039	16.4 Compr.
0.50	0.24815	0.00095			1.086	14.4 Compr.

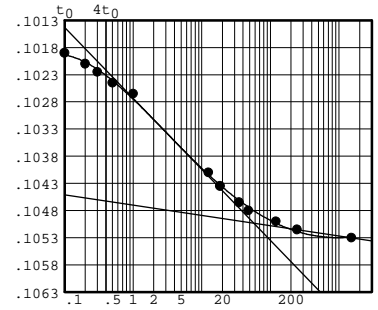
$C_c = 0.94$ $P_c = 4.03$ tsf $C_r = 0.15$

Pressure: 1.00 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10185	11	120.00	0.10655
2	0.10	0.10345	12	244.00	0.10670
3	0.20	0.10365	13	1515.00	0.10685
4	0.30	0.10380			
5	0.50	0.10400			
6	1.00	0.10420			
7	12.50	0.10565			
8	18.50	0.10590			
9	35.00	0.10620			
10	48.00	0.10635			



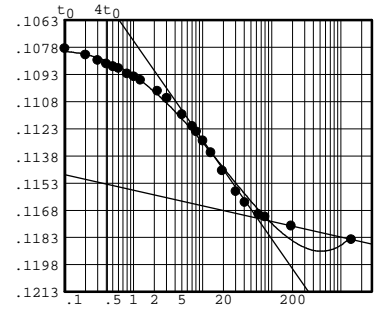
Void Ratio = 1.431 Compression = 0.3 %
 $D_0 = 0.10156$ $D_{50} = 0.10330$ $D_{100} = 0.10503$
 C_v at 2.7 min. = 0.18 ft.²/day $C_\alpha = 0.000$

Pressure: 2.00 tsf

TEST READINGS

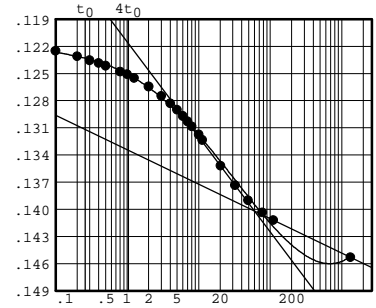
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10685	13	5.00	0.11375
2	0.10	0.11010	14	7.00	0.11440
3	0.20	0.11045	15	8.00	0.11470
4	0.30	0.11075	16	10.00	0.11520
5	0.40	0.11095	17	13.00	0.11585
6	0.50	0.11110	18	19.00	0.11685
7	0.60	0.11120	19	30.00	0.11800
8	0.80	0.11150	20	40.30	0.11860
9	1.00	0.11165	21	64.00	0.11925
10	1.25	0.11185	22	79.00	0.11940
11	2.20	0.11245	23	188.50	0.11990
12	3.00	0.11285	24	1409.00	0.12065



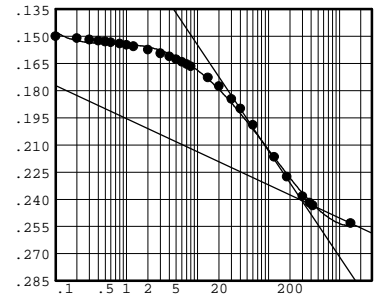
Void Ratio = 1.400 Compression = 1.6 %
 $D_0 = 0.10750$ $D_{50} = 0.11236$ $D_{100} = 0.11723$
 C_v at 7.0 min. = 0.07 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12065	13	5.00	0.13195
2	0.10	0.12545	14	6.00	0.13265
3	0.20	0.12605	15	7.00	0.13325
4	0.30	0.12650	16	8.00	0.13380
5	0.40	0.12680	17	10.00	0.13470
6	0.50	0.12710	18	11.20	0.13530
7	0.80	0.12775	19	20.20	0.13815
8	1.00	0.12805	20	32.30	0.14030
9	1.25	0.12845	21	49.20	0.14195
10	2.00	0.12940	22	77.50	0.14330
11	3.00	0.13045	23	111.00	0.14415
12	4.00	0.13125	24	1324.00	0.14825



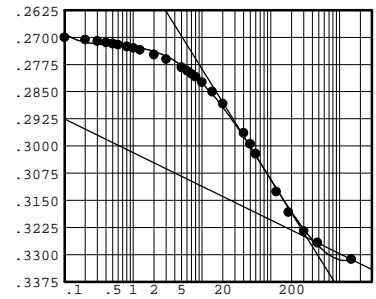
Void Ratio = 1.334 Compression = 4.3 %
 $D_0 = 0.12152$ $D_{50} = 0.13086$ $D_{100} = 0.14020$
 C_v at 7.8 min. = 0.06 ft.²/day $C_\alpha = 0.004$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14825	15	6.00	0.16785
2	0.10	0.15380	16	7.00	0.16915
3	0.20	0.15490	17	8.00	0.17040
4	0.30	0.15565	18	14.00	0.17655
5	0.40	0.15620	19	20.00	0.18140
6	0.50	0.15670	20	30.00	0.18845
7	0.60	0.15715	21	40.00	0.19365
8	0.80	0.15785	22	60.00	0.20275
9	1.00	0.15855	23	120.00	0.22040
10	1.25	0.15936	24	181.00	0.23140
11	2.00	0.16120	25	300.00	0.24215
12	3.00	0.16325	26	377.00	0.24570
13	4.00	0.16490	27	420.00	0.24715
14	5.00	0.16645	28	1436.00	0.25690



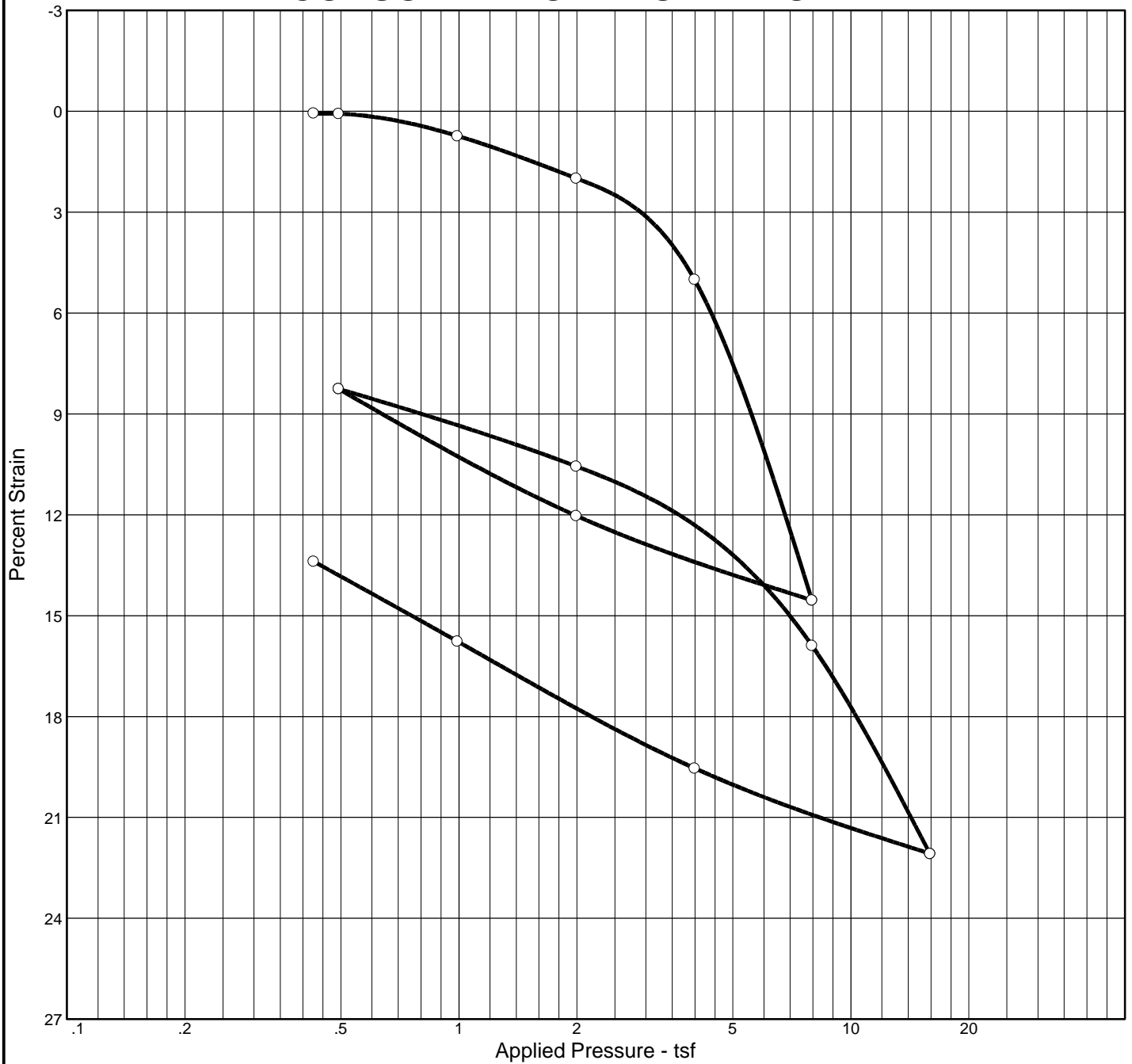
Void Ratio = 1.072 Compression = 15.0 %
 $D_0 = 0.14530$ $D_{50} = 0.19290$ $D_{100} = 0.24049$
 C_v at 40.8 min. = 0.01 ft.²/day $C_\alpha = 0.019$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.27220	15	7.00	0.28505
2	0.10	0.27500	16	8.00	0.28585
3	0.20	0.27560	17	10.00	0.28735
4	0.30	0.27600	18	14.00	0.28995
5	0.40	0.27640	19	20.00	0.29325
6	0.50	0.27670	20	40.00	0.30135
7	0.60	0.27700	21	50.00	0.30440
8	0.80	0.27750	22	60.00	0.30710
9	1.00	0.27790	23	120.00	0.31755
10	1.25	0.27845	24	180.00	0.32320
11	2.00	0.27970	25	300.00	0.32840
12	3.00	0.28100	26	478.00	0.33165
13	5.00	0.28325	27	1477.00	0.33620
14	6.00	0.28420			



Void Ratio = 0.882 Compression = 22.8 %
 $D_0 = 0.26840$ $D_{50} = 0.29682$ $D_{100} = 0.32523$
 C_v at 38.3 min. = 0.01 ft.²/day $C_\alpha = 0.011$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
97.0 %	43.5 %	76.3	72	53	2.70		3.97	0.72	0.13			1.210

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 2</p> <p>Location: Boring11-118MU, #2, 33-35', Wild Rice, Brenna Formation</p> <div style="text-align: center; margin-top: 10px;"> </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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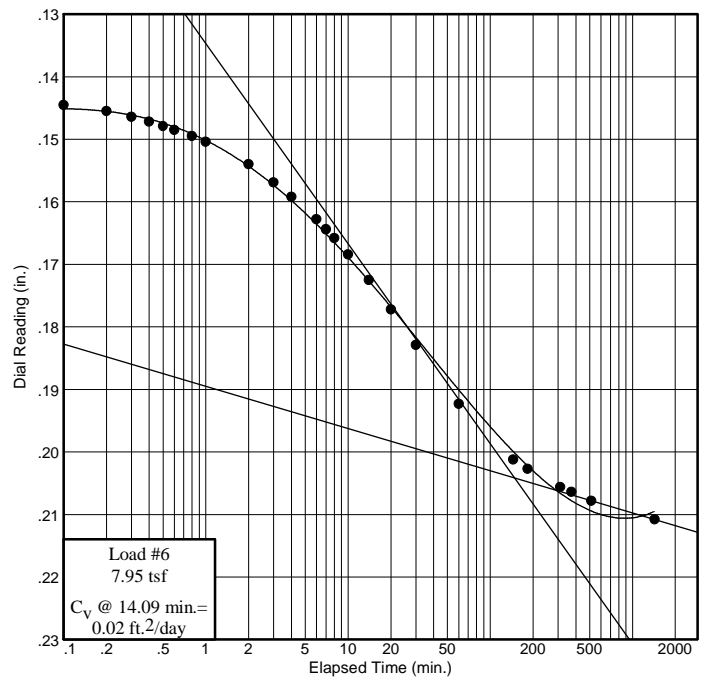
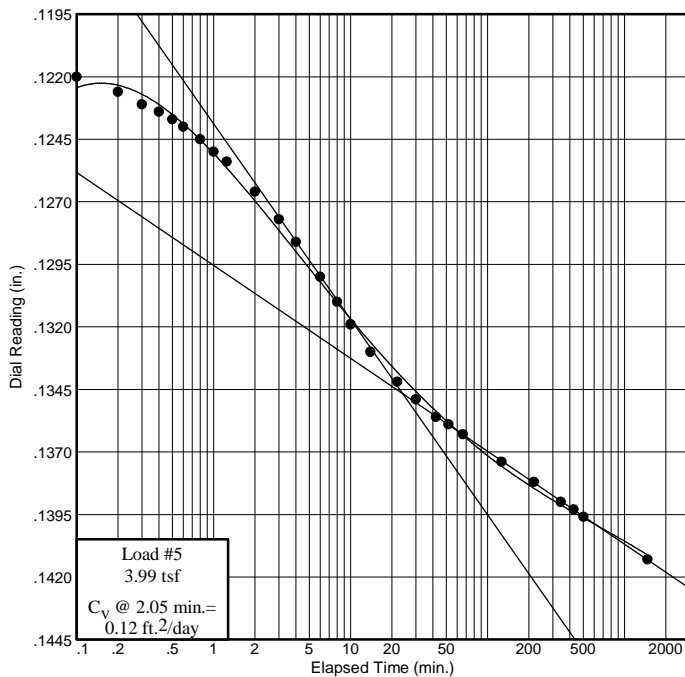
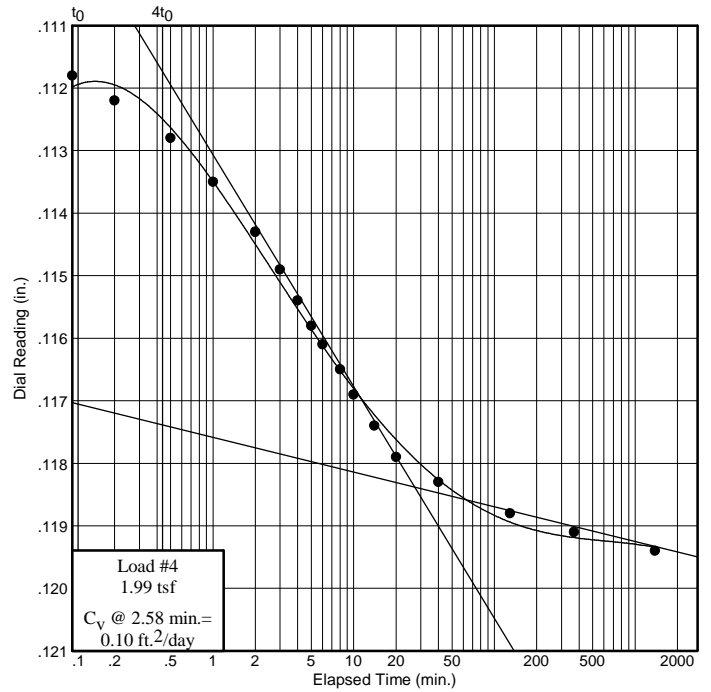
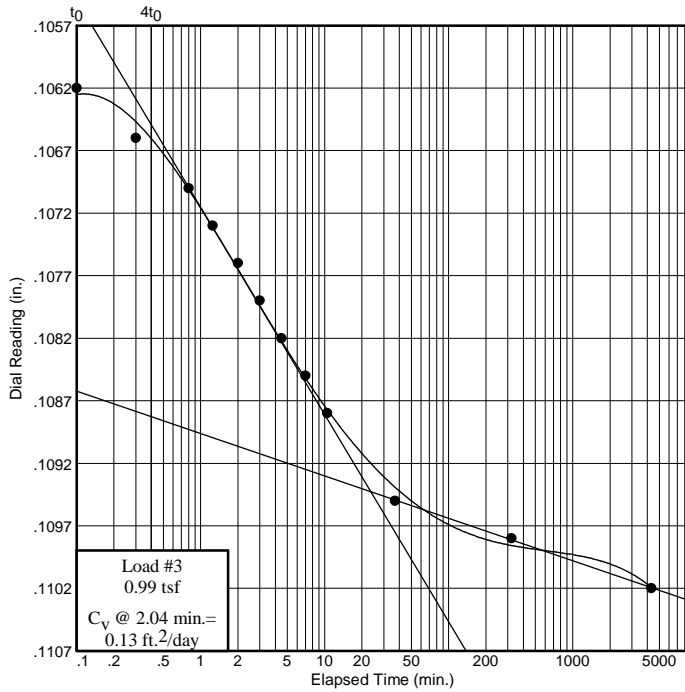
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #2, 33-35', Wild Rice, Brenna Formation



BRAUNSM
INTERTEC

Figure

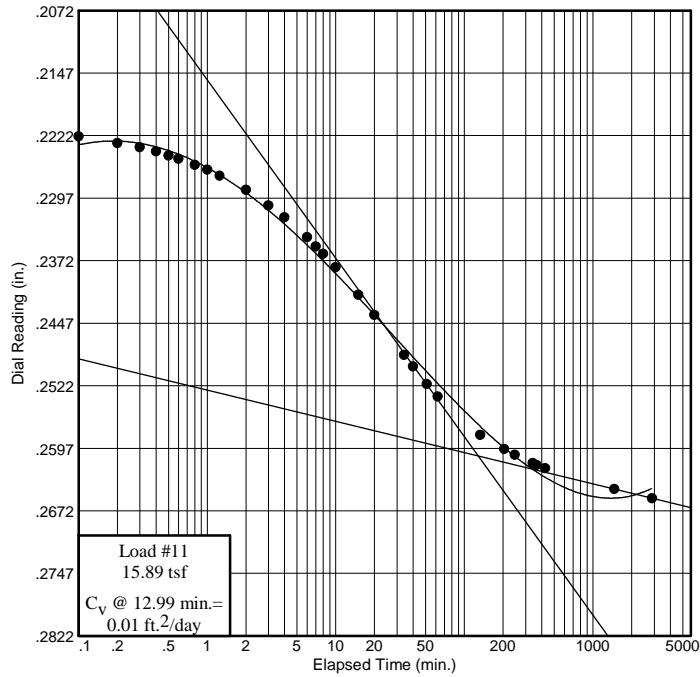
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #2, 33-35', Wild Rice, Brenna Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-118MU, #2
Elev. or Depth: 33-35' **Sample Length(in./cm.):**
Location: Boring11-118MU, #2, 33-35', Wild Rice, Brenna Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 72 **Plasticity Index:** 53
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 158.20 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 119.30 g.		Dry w+t =
Tare Wt. = 29.87 g.	Spec. Gravity = 2.70	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 102.56 g.	Defl. Table = Machine3-2009	
Moisture = 43.5 %	Ht. Solids = 0.3296 in.	Moisture = %
Wet Den. = 109.4 pcf	Dry Wt. = 71.47 g.*	Dry Wt. = n/a
Dry Den. = 76.3 pcf	Void Ratio = 1.210	Void Ratio = 0.914
	Saturation = 97.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10490				1.210	
0.43	0.10530	0.00000			1.209	0.1 Compr.
0.49	0.10590	0.00050			1.209	0.1 Compr.
0.99	0.11090	0.00070	0.13	0.000	1.194	0.7 Compr.
1.99	0.12040	0.00100	0.10	0.001	1.166	2.0 Compr.
3.99	0.14280	0.00150	0.12	0.005	1.100	5.0 Compr.
7.95	0.21280	0.00200	0.02	0.010	0.889	14.5 Compr.
1.99	0.19350	0.00100			0.944	12.0 Compr.
0.49	0.16550	0.00050			1.028	8.2 Compr.
1.99	0.18280	0.00100			0.977	10.6 Compr.
7.95	0.22260	0.00200			0.859	15.9 Compr.
15.89	0.26860	0.00290	0.01	0.006	0.722	22.1 Compr.
3.99	0.24870	0.00150			0.778	19.5 Compr.
0.99	0.22040	0.00070			0.862	15.8 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression /Swell
0.43	0.20240	0.00000			0.914	13.4 Compr.

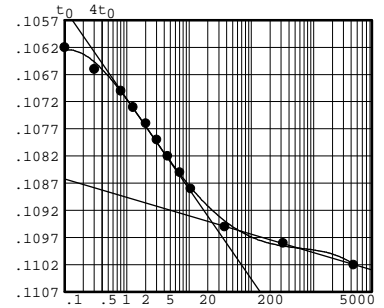
$C_c = 0.72$ $P_c = 3.97$ tsf $C_r = 0.13$

Pressure: 0.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10590	11	37.00	0.11020
2	0.10	0.10690	12	321.00	0.11050
3	0.30	0.10730	13	4312.00	0.11090
4	0.80	0.10770			
5	1.25	0.10800			
6	2.00	0.10830			
7	3.00	0.10860			
8	4.50	0.10890			
9	7.00	0.10920			
10	10.50	0.10950			



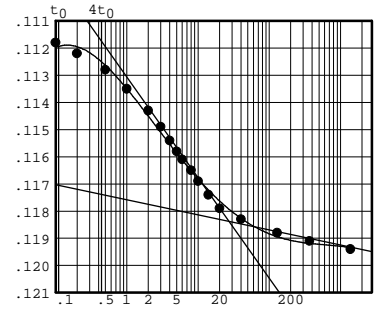
Void Ratio = 1.194 Compression = 0.7 %
 $D_0 = 0.10590$ $D_{50} = 0.10766$ $D_{100} = 0.10943$
 C_v at 2.0 min. = 0.13 ft.²/day $C_\alpha = 0.000$

Pressure: 1.99 tsf

TEST READINGS

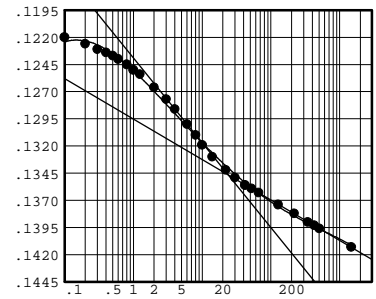
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11090	11	8.00	0.11750
2	0.10	0.11280	12	10.00	0.11790
3	0.20	0.11320	13	14.00	0.11840
4	0.50	0.11380	14	20.00	0.11890
5	1.00	0.11450	15	40.00	0.11930
6	2.00	0.11530	16	129.00	0.11980
7	3.00	0.11590	17	368.00	0.12010
8	4.00	0.11640	18	1386.00	0.12040
9	5.00	0.11680			
10	6.00	0.11710			



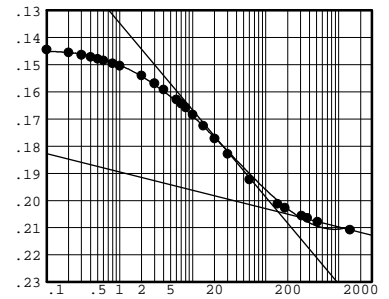
Void Ratio = 1.166 Compression = 2.0 %
 $D_0 = 0.11139$ $D_{50} = 0.11488$ $D_{100} = 0.11838$
 C_v at 2.6 min. = 0.10 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12040	15	8.00	0.13250
2	0.10	0.12350	16	10.00	0.13340
3	0.20	0.12410	17	14.00	0.13450
4	0.30	0.12460	18	22.00	0.13570
5	0.40	0.12490	19	30.00	0.13640
6	0.50	0.12520	20	42.00	0.13710
7	0.60	0.12550	21	52.00	0.13740
8	0.80	0.12600	22	66.00	0.13780
9	1.00	0.12650	23	127.00	0.13890
10	1.25	0.12690	24	218.00	0.13970
11	2.00	0.12810	25	343.00	0.14050
12	3.00	0.12920	26	425.00	0.14080
13	4.00	0.13010	27	504.00	0.14110
14	6.00	0.13150	28	1472.00	0.14280



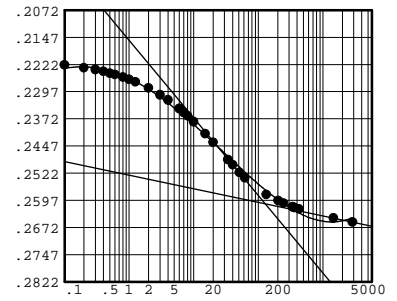
Void Ratio = 1.100 Compression = 5.0 %
 $D_0 = 0.11940$ $D_{50} = 0.12704$ $D_{100} = 0.13468$
 C_v at 2.1 min. = 0.12 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.14280	14	7.00	0.16640
2	0.10	0.14650	15	8.00	0.16780
3	0.20	0.14750	16	10.00	0.17040
4	0.30	0.14840	17	14.00	0.17450
5	0.40	0.14920	18	20.00	0.17920
6	0.50	0.14990	19	30.00	0.18490
7	0.60	0.15050	20	60.00	0.19430
8	0.80	0.15150	21	145.00	0.20320
9	1.00	0.15240	22	183.00	0.20470
10	2.00	0.15600	23	311.00	0.20760
11	3.00	0.15890	24	373.00	0.20840
12	4.00	0.16120	25	514.30	0.20980
13	6.00	0.16480	26	1431.00	0.21280



Void Ratio = 0.889 Compression = 14.5 %
 $D_0 = 0.14130$ $D_{50} = 0.17273$ $D_{100} = 0.20416$
 C_v at 14.1 min. = 0.02 ft.²/day $C_\alpha = 0.010$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.22260	17	10.00	0.24090
2	0.10	0.22520	18	15.00	0.24420
3	0.20	0.22600	19	20.00	0.24660
4	0.30	0.22650	20	34.00	0.25140
5	0.40	0.22700	21	40.00	0.25280
6	0.50	0.22750	22	51.00	0.25490
7	0.60	0.22790	23	62.00	0.25640
8	0.80	0.22860	24	133.00	0.26100
9	1.00	0.22920	25	204.00	0.26270
10	1.25	0.22990	26	247.00	0.26340
11	2.00	0.23160	27	341.00	0.26440
12	3.00	0.23350	28	364.00	0.26460
13	4.00	0.23490	29	427.00	0.26500
14	6.00	0.23730	30	1466.00	0.26750
15	7.00	0.23840	31	2880.00	0.26860
16	8.00	0.23930			



Void Ratio = 0.722 Compression = 22.1 %
 $D_0 = 0.22060$ $D_{50} = 0.24062$ $D_{100} = 0.26064$
 C_v at 13.0 min. = 0.01 ft.²/day $C_\alpha = 0.006$

Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

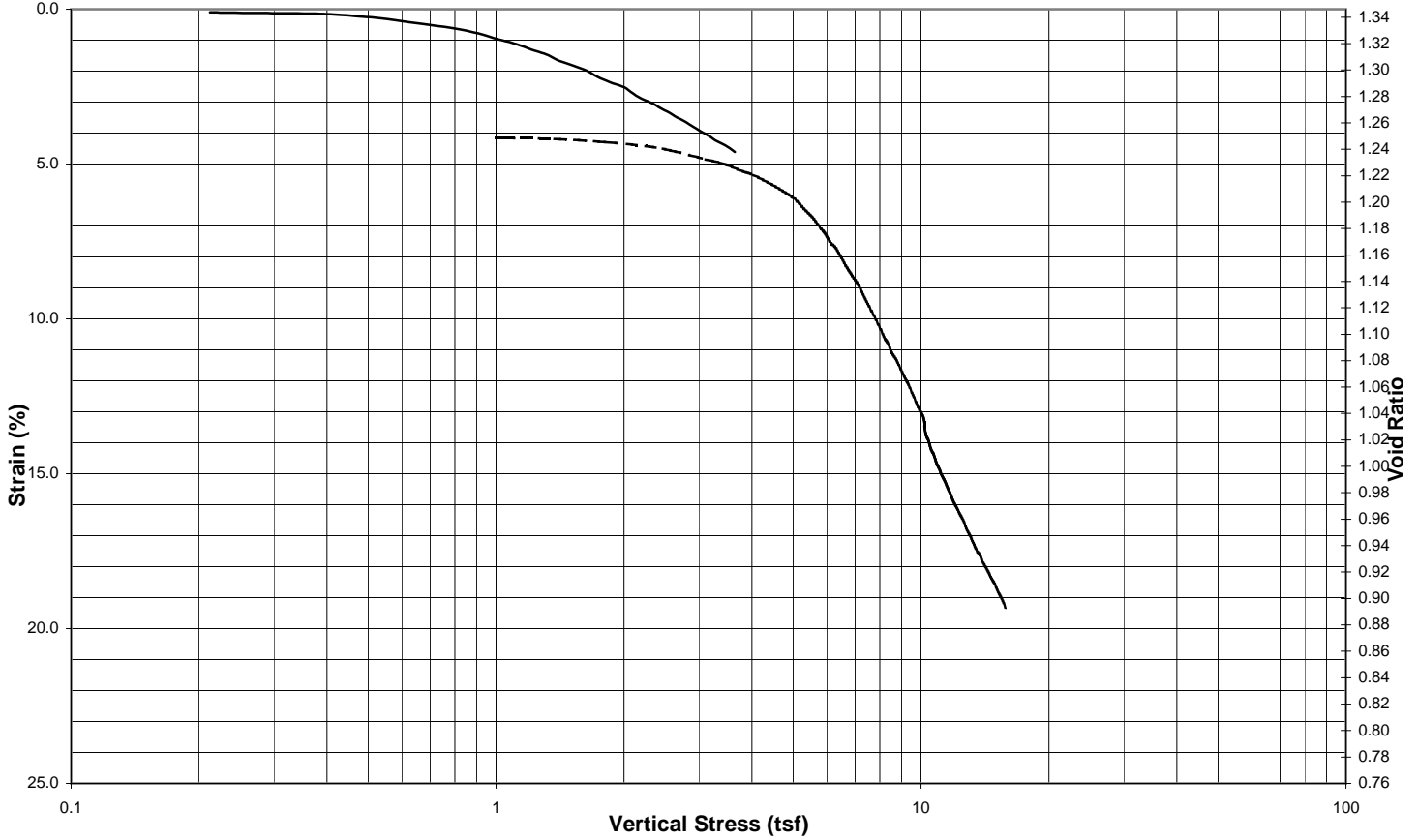
Specimen Information

Boring: FAR 10-78MU Sample: 3 Depth: 55-57 Type: 5T

Soil Type: Fat Clay w/a few pockets of silt (CH) Argusville

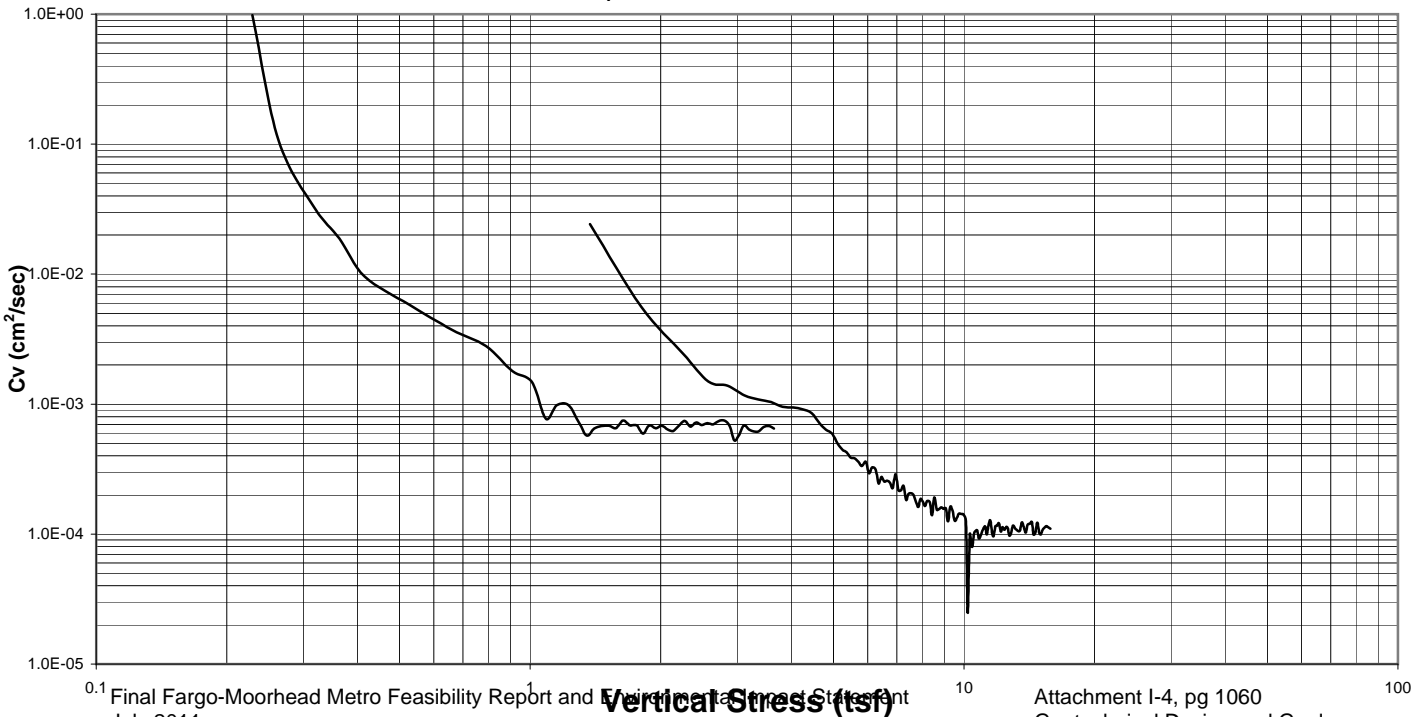
Initial Conditions: Dry Density (pcf): 73.8 Moisture Content (%): 47.5% e_o 1.344

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	Cc	Cr
	5.3 tsf	0.82	0.05

C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

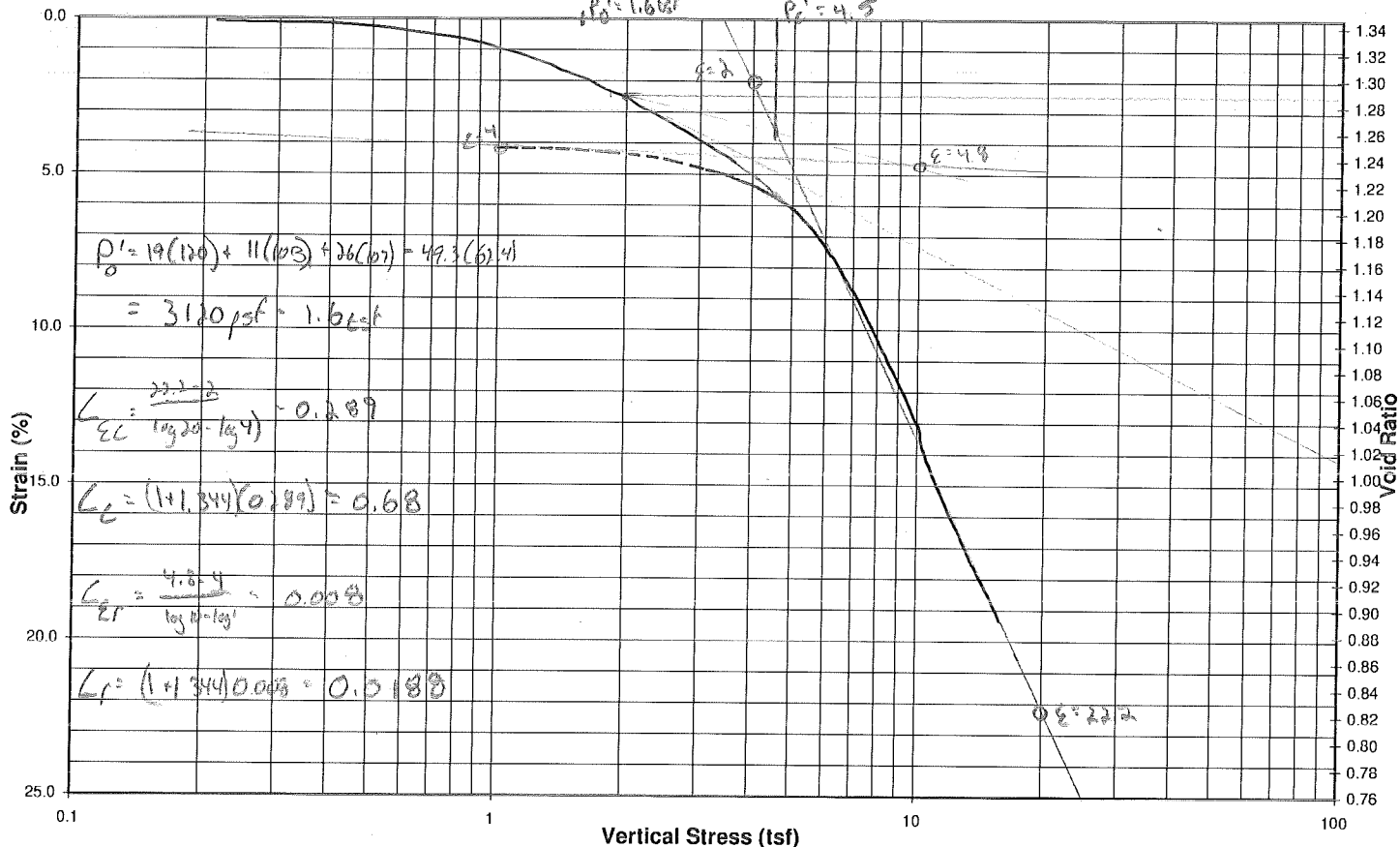
Specimen Information

Boring: FAR 10-78MU Sample: 3 Depth: 55-57 Type: 5T
 Soil Type: Fat Clay w/a few pockets of silt (CH) Argusville

Initial Conditions: Dry Density (pcf): 73.8 Moisture Content (%): 47.5% e_0 1.344

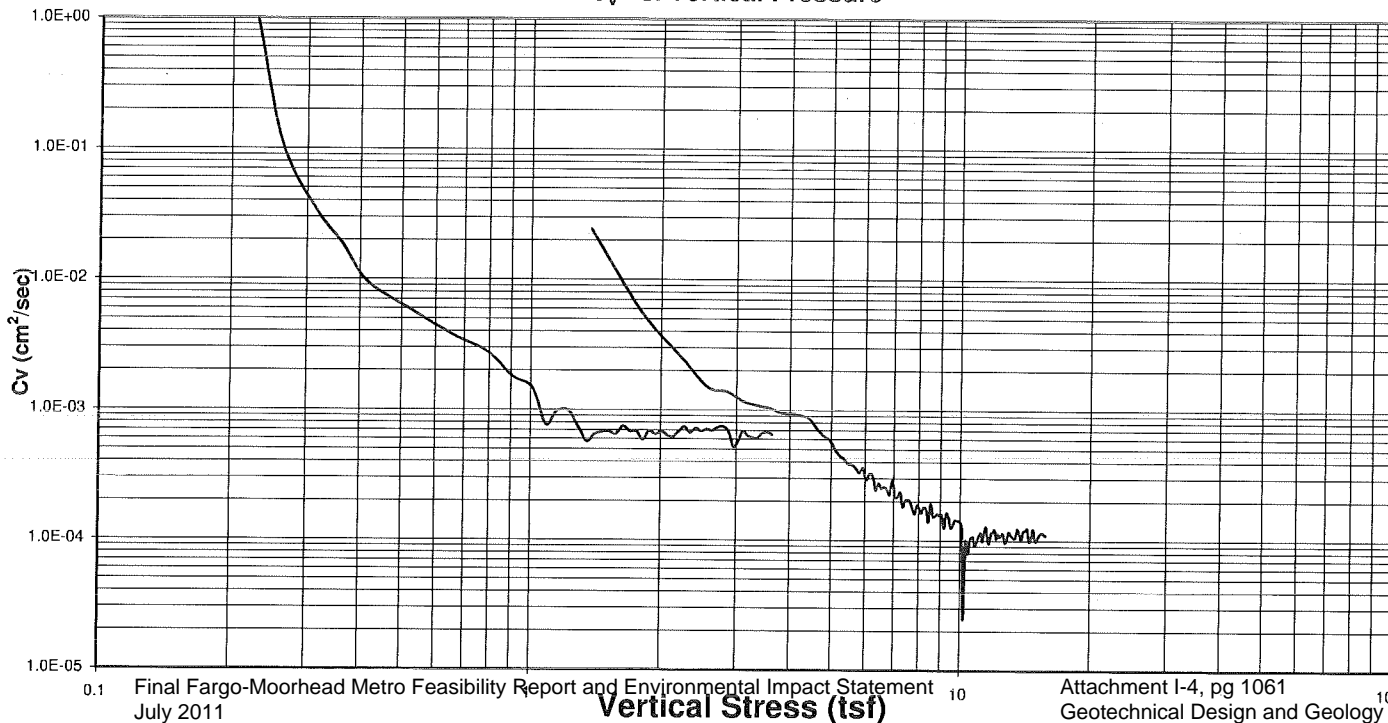
Axial Strain vs. Vertical Pressure

GWT = 6.7' BGS



Calculated Consolidation Coefficients	Pc	5.3 tsf	Cc	0.82	Cr	0.05
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C_v vs. Vertical Pressure



Constant Rate of Strain Data Table

Project: IOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL
 Boring: 10-78MU Sample 3 Depth: 55-57

Date: 10/27/10
 Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.11%	0.229	0.003	0.011	0.227	9.85E-01	3.43E-06	1.342
0.97%	1.010	0.298	0.295	0.800	1.47E-03	2.34E-08	1.321
1.82%	1.520	0.387	0.255	1.249	6.84E-04	9.69E-09	1.301
2.53%	2.010	0.444	0.221	1.701	6.81E-04	1.36E-08	1.285
3.35%	2.564	0.486	0.189	2.228	7.16E-04	9.96E-09	1.265
3.94%	3.026	0.571	0.189	2.632	5.71E-04	6.63E-09	1.252
4.96%	3.922	0.718	0.183	3.427	5.30E-04	8.43E-09	1.228
4.19%	1.373	0.134	0.097	1.282	2.43E-02	3.84E-08	1.246
4.71%	2.852	0.832	0.292	2.266	1.39E-03	7.84E-09	1.234
5.51%	4.251	0.985	0.232	3.565	9.10E-04	7.78E-09	1.215
6.37%	5.241	1.159	0.221	4.437	4.46E-04	5.97E-09	1.195
7.42%	6.041	1.367	0.226	5.092	2.93E-04	6.48E-09	1.170
8.83%	7.061	1.700	0.241	5.876	2.17E-04	3.77E-09	1.137
10.34%	8.034	2.096	0.261	6.567	1.79E-04	2.10E-09	1.102
11.80%	9.081	2.572	0.283	7.274	1.58E-04	2.54E-09	1.067
13.13%	10.095	3.009	0.298	7.973	1.25E-04	1.52E-09	1.036
14.78%	10.979	3.022	0.275	8.859	1.02E-04	8.91E-10	0.998
16.11%	12.156	3.353	0.276	9.803	1.04E-04	1.16E-09	0.966
17.05%	13.097	3.590	0.274	10.579	1.11E-04	1.17E-09	0.944
17.76%	13.880	3.822	0.275	11.199	1.02E-04	1.30E-09	0.928
18.46%	14.749	4.075	0.276	11.889	1.22E-04	7.43E-10	0.911
19.33%	15.815	4.344	0.275	12.767	1.10E-04	9.65E-10	0.891

Constant Rate of Strain Consolidation Test

Date: 10/8/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

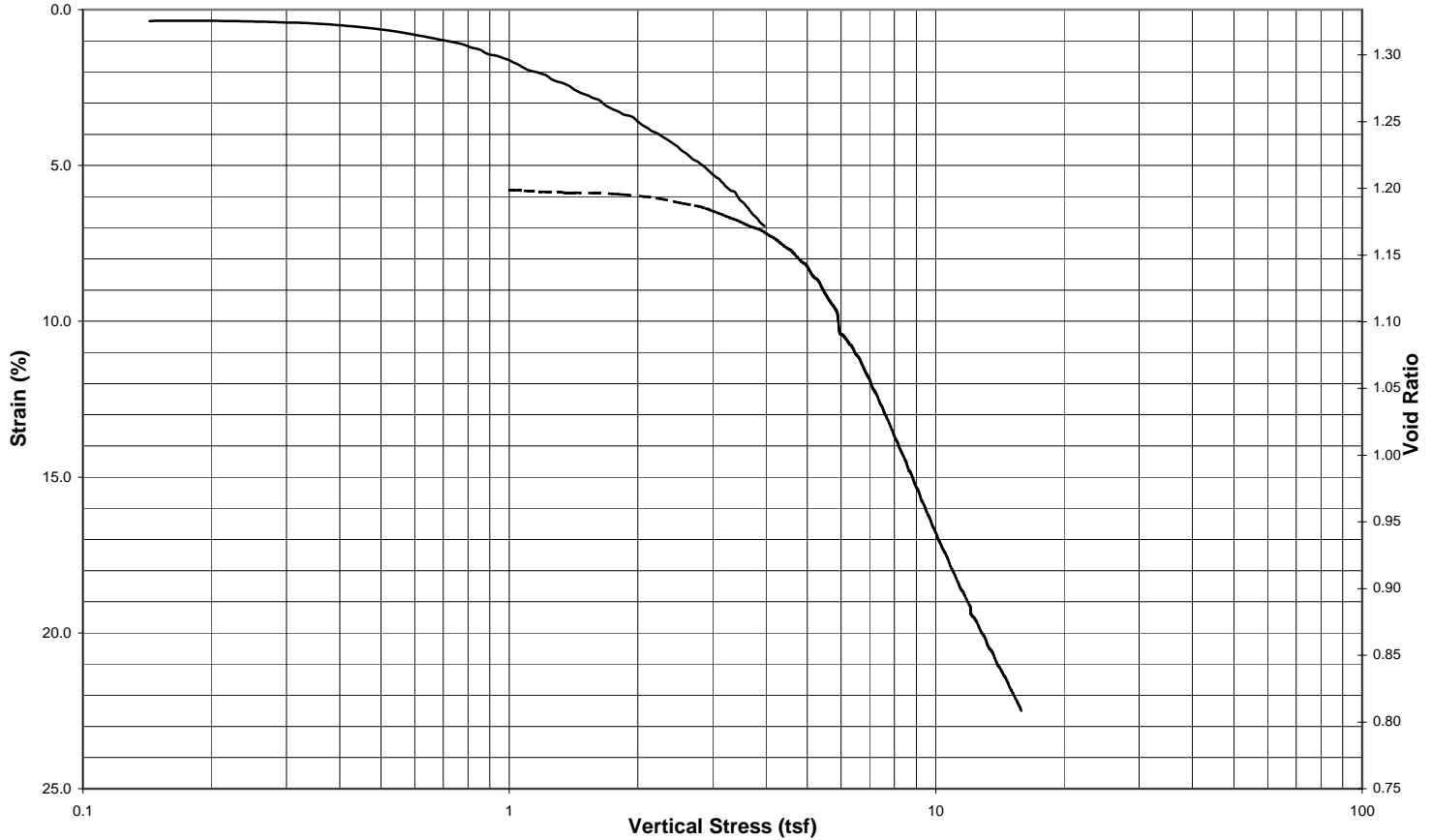
Specimen Information

Boring: FAR 10-79MU Sample: 2 Depth: 40-42 (Top) Type: 5T

Soil Type: Fat Clay (CH) Argusville

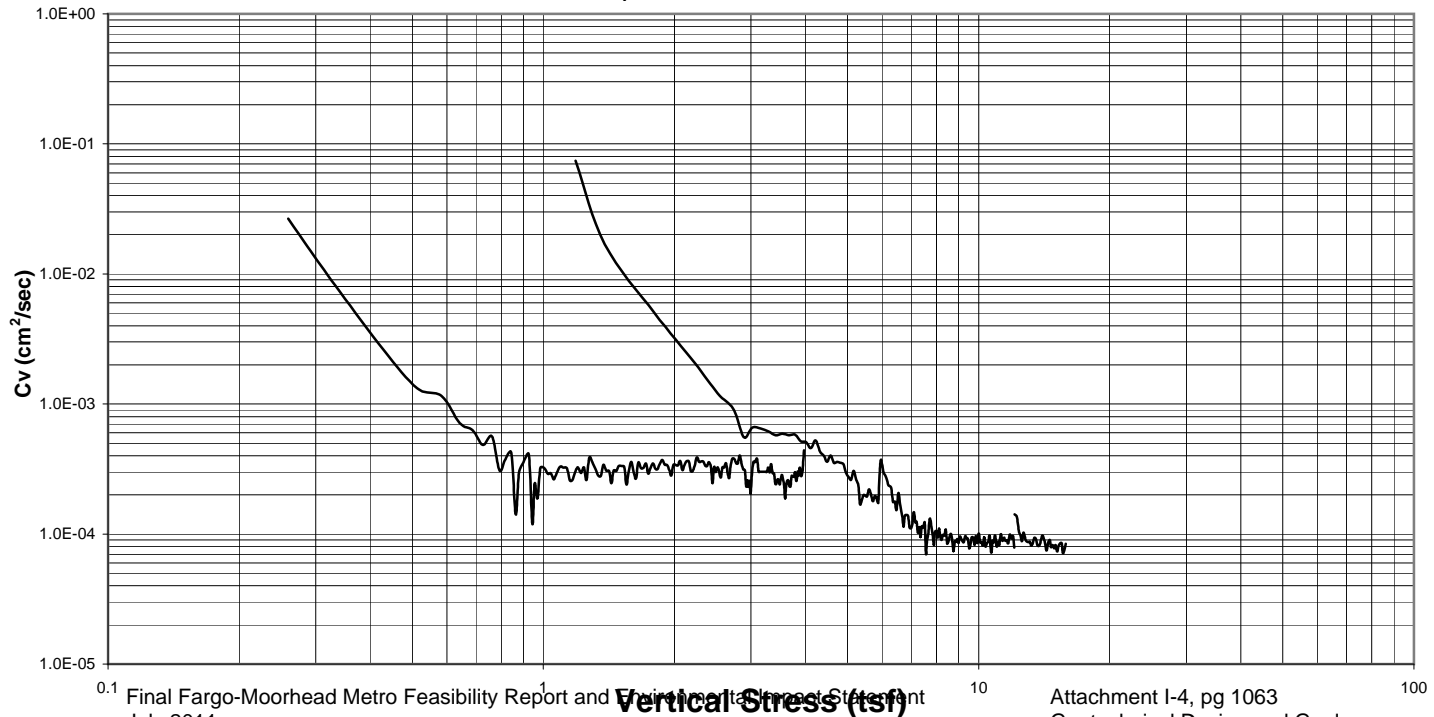
Initial Conditions: Dry Density (pcf): 72.7 Moisture Content (%): 49.3% e_o 1.336

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	3.9 tsf	Cc	0.69	Cr	0.051
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/8/10

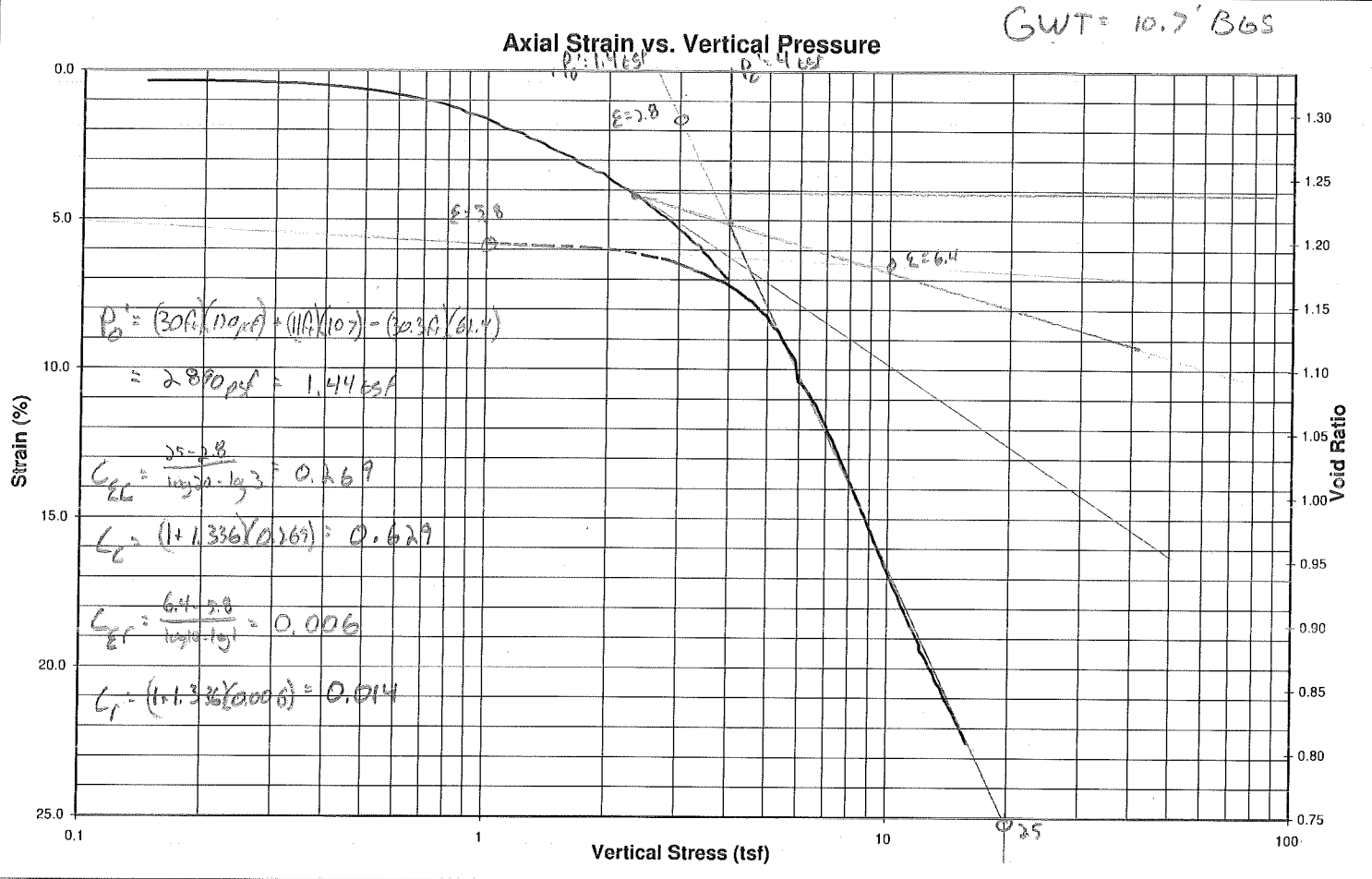
Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

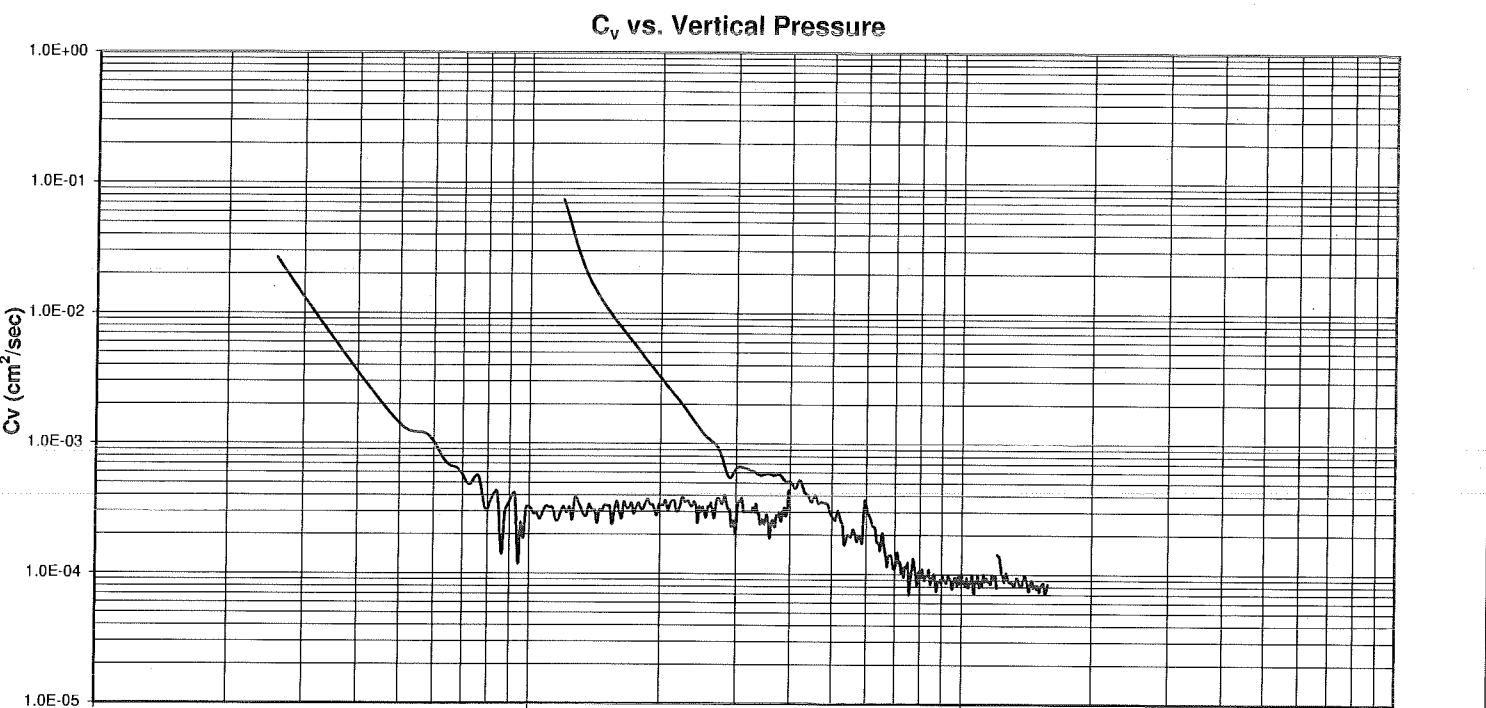
Specimen Information

Boring: FAR 10-79MU Sample: 2 Depth: 40-42 (Top) Type: 5T
 Soil Type: Fat Clay (CH) Argusville

Initial Conditions: Dry Density (pcf): 72.7 Moisture Content (%): 49.3% e_o 1.336



Calculated Consolidation Coefficients	Pc	3.9 tsf	Cc	0.69	Cr	0.051
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Constant Rate of Strain Data Table

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING Date: 10/8/10
 Boring: 10-79MU Sample 2 Depth: 40-42 (Top) Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.39%	0.259	0.042	0.160	0.231	2.66E-02	1.26E-07	1.327
1.53%	0.955	0.282	0.295	0.756	2.45E-04	4.39E-09	1.300
3.62%	2.014	0.320	0.159	1.794	3.38E-04	7.51E-09	1.251
5.32%	3.014	0.348	0.115	2.778	2.82E-04	4.49E-09	1.212
6.94%	3.968	0.376	0.095	3.714	4.41E-04	5.51E-09	1.174
5.84%	1.185	0.047	0.040	1.154	7.42E-02	9.21E-08	1.199
6.29%	2.732	0.848	0.310	2.132	9.16E-04	4.51E-09	1.189
7.08%	3.904	0.876	0.224	3.296	5.16E-04	4.87E-09	1.170
8.13%	4.886	0.932	0.191	4.243	3.45E-04	4.08E-09	1.146
9.29%	5.602	1.100	0.196	4.842	2.20E-04	4.72E-09	1.119
10.64%	6.212	1.252	0.202	5.346	2.36E-04	4.11E-09	1.087
11.96%	7.033	1.596	0.227	5.924	1.18E-04	3.13E-09	1.057
13.18%	7.719	1.858	0.241	6.424	1.31E-04	2.39E-09	1.028
14.66%	8.577	2.169	0.253	7.062	9.56E-05	2.83E-09	0.994
15.74%	9.247	2.394	0.259	7.572	8.67E-05	1.26E-09	0.968
16.69%	9.930	2.598	0.262	8.113	8.53E-05	1.24E-09	0.946
17.76%	10.753	2.844	0.264	8.762	8.88E-05	1.29E-09	0.921
18.57%	11.428	3.034	0.265	9.303	9.36E-05	8.61E-10	0.902
19.76%	12.584	3.326	0.264	10.255	8.82E-05	1.13E-09	0.874
20.70%	13.647	3.686	0.270	11.063	8.21E-05	1.02E-09	0.852
21.53%	14.680	4.012	0.273	11.866	7.93E-05	1.11E-09	0.833
22.50%	15.867	4.340	0.274	12.822	8.40E-05	1.10E-09	0.810

Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

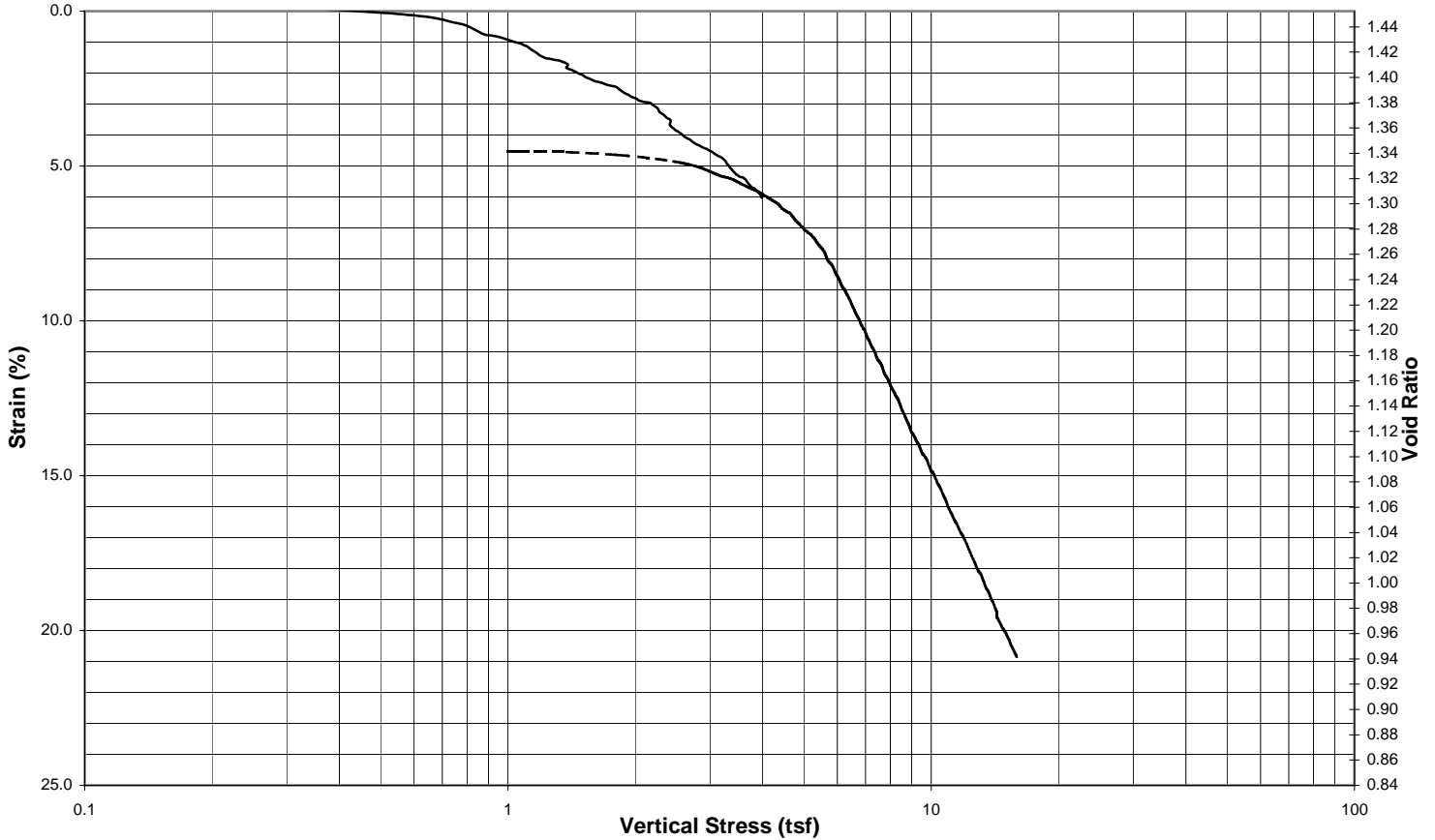
Specimen Information

Boring: FAR 10-80MU Sample: 3 Depth: 55-57 Type: 5T

Soil Type: Fat Clay w/a few pockets of silt (CH) Argusville

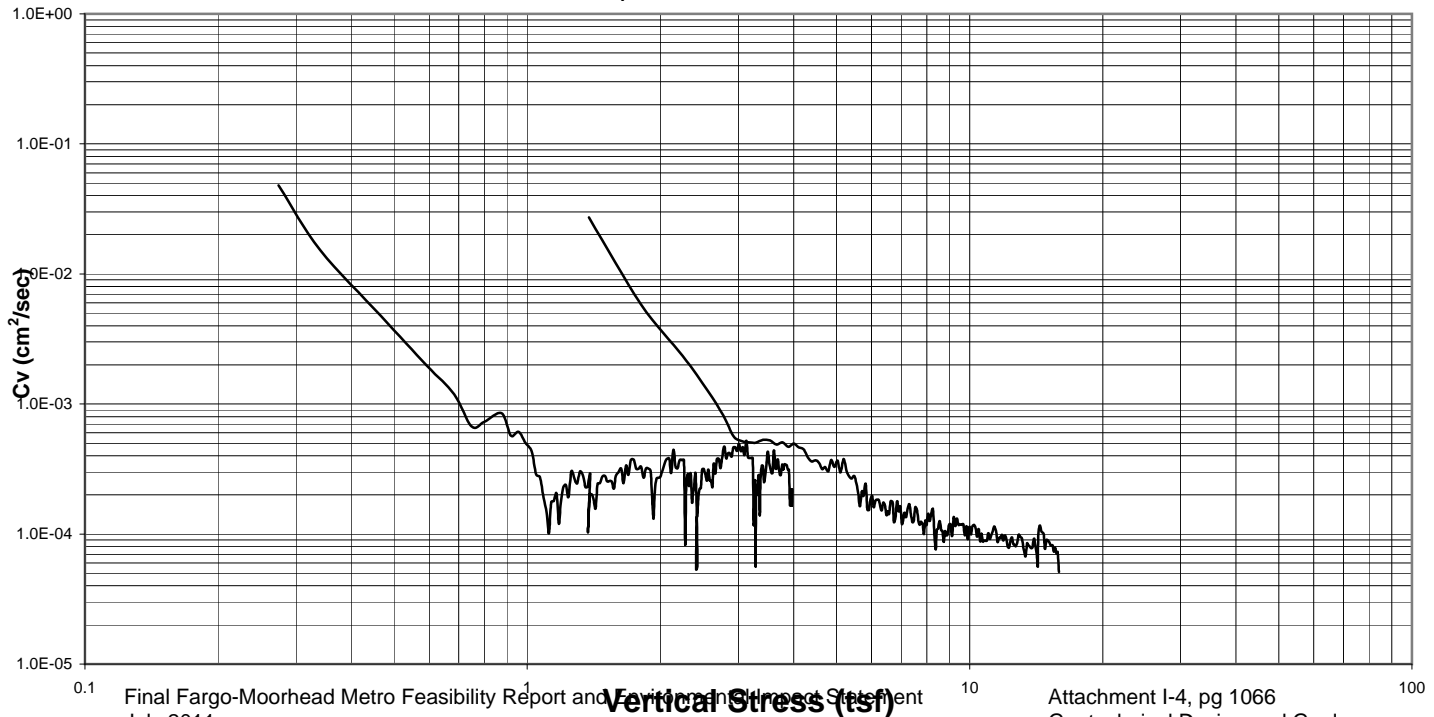
Initial Conditions: Dry Density (pcf): 70.8 Moisture Content (%): 51.8% e_o 1.450

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc	4.4 tsf	Cc	0.73	Cr	0.09
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C_v vs. Vertical Pressure



Constant Rate of Strain Consolidation Test

Date: 10/27/10

Job: 7577

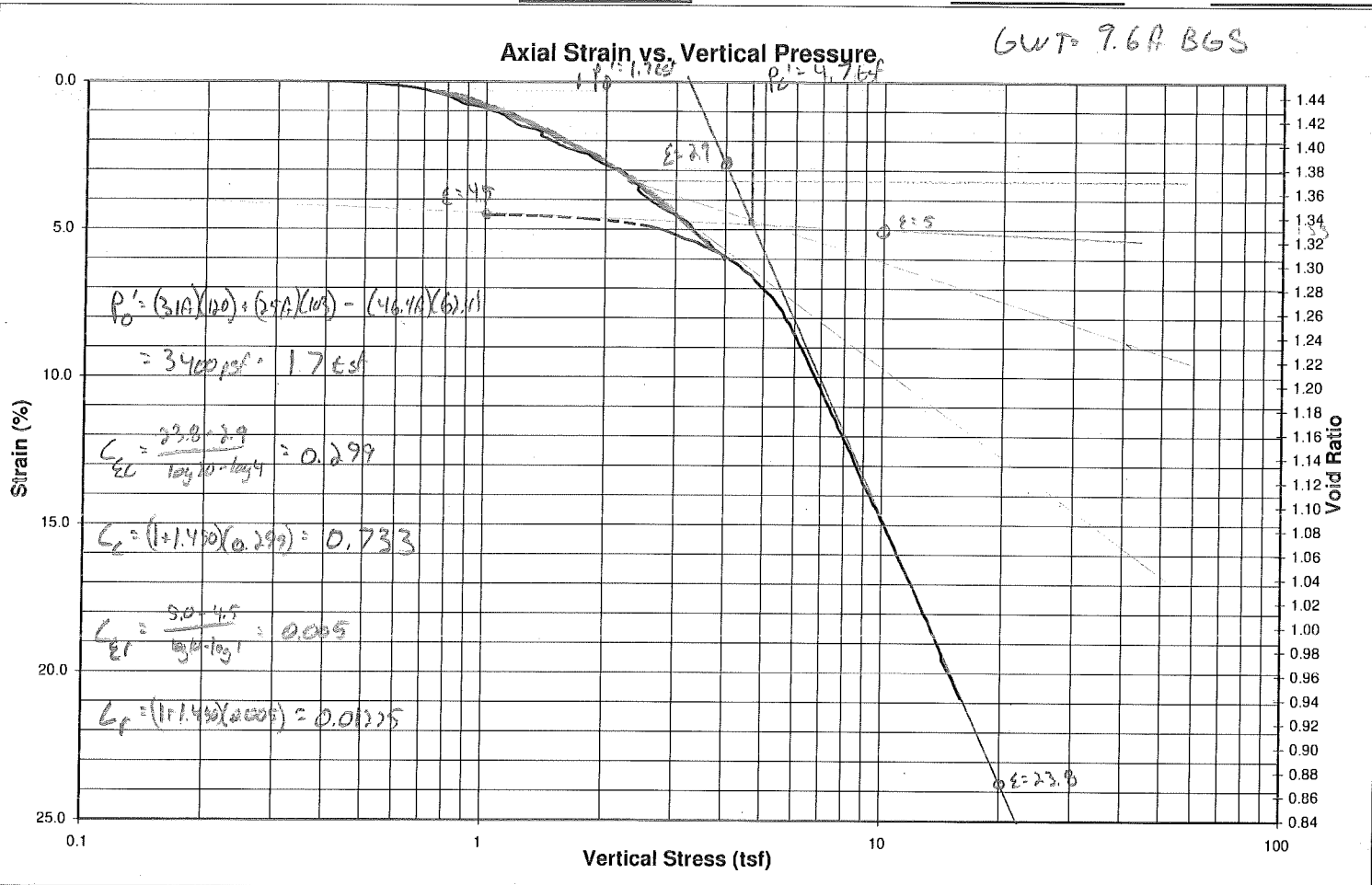
Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Specimen Information

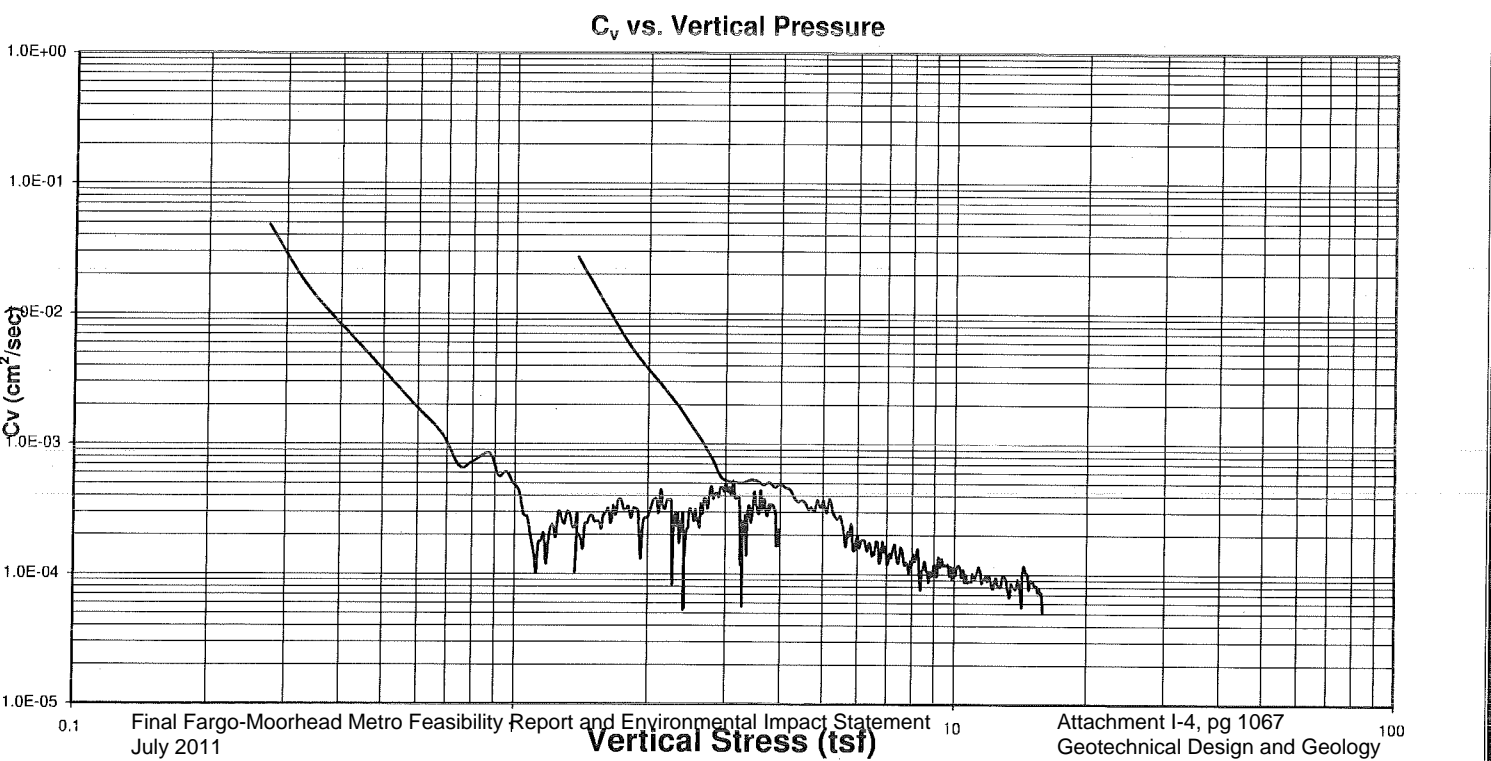
Boring: FAR 10-80MU Sample: 3 Depth: 55-57 Type: 5T

Soil Type: Fat Clay w/a few pockets of silt (CH) Argusville

Initial Conditions: Dry Density (pcf): 70.8 Moisture Content (%): 51.8% e_0 1.450



Calculated Consolidation Coefficients	Pc	4.4 tsf	Cc	0.73	Cr	0.09
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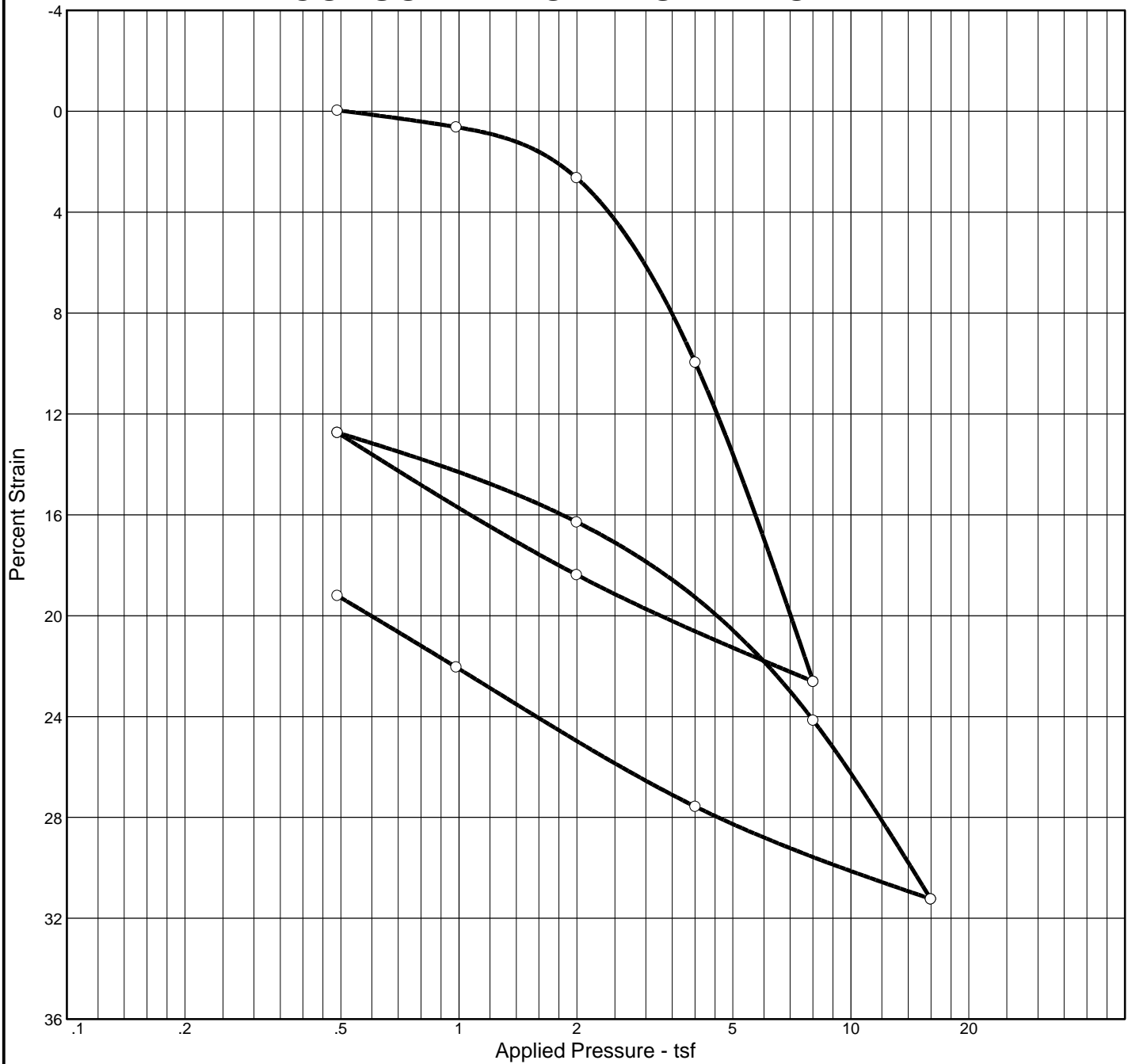


Constant Rate of Strain Data Table

Project: IOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL Date: 10/27/10
 Boring: 10-80MU Sample 3 Depth: 55-57 Job: 7577

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.02%	0.467	0.143	0.305	0.366	4.76E-03	4.11E-08	1.449
0.74%	0.875	0.259	0.296	0.693	8.48E-04	1.21E-08	1.431
1.54%	1.257	0.321	0.256	1.032	3.03E-04	2.82E-09	1.412
2.42%	1.765	0.316	0.179	1.547	3.18E-04	9.56E-10	1.390
3.40%	2.356	0.315	0.134	2.141	1.75E-04	5.24E-09	1.366
5.40%	3.612	0.308	0.085	3.404	4.41E-04	5.72E-09	1.317
6.03%	3.975	0.325	0.082	3.756	2.21E-04	3.63E-09	1.302
4.55%	1.378	0.119	0.086	1.298	2.72E-02	3.63E-08	1.338
5.22%	3.053	0.936	0.306	2.392	5.19E-04	4.85E-09	1.322
5.92%	4.001	0.957	0.239	3.335	4.97E-04	4.91E-09	1.305
7.06%	5.030	0.983	0.195	4.351	3.68E-04	4.11E-09	1.277
8.59%	6.019	1.172	0.195	5.210	1.97E-04	2.80E-09	1.239
10.44%	7.024	1.458	0.208	6.015	1.19E-04	3.96E-09	1.194
12.16%	8.056	1.809	0.224	6.800	1.44E-04	2.63E-09	1.152
13.66%	9.058	2.200	0.243	7.524	1.19E-04	1.23E-09	1.115
14.96%	10.148	2.566	0.253	8.355	1.14E-04	1.48E-09	1.083
15.98%	10.942	2.824	0.258	8.967	8.91E-05	1.37E-09	1.058
16.98%	11.924	3.111	0.261	9.748	8.90E-05	1.02E-09	1.034
17.99%	12.816	3.380	0.264	10.449	8.71E-05	1.08E-09	1.009
18.89%	13.774	3.683	0.267	11.194	7.79E-05	1.04E-09	0.987
20.11%	15.045	4.037	0.268	12.217	8.91E-05	9.07E-10	0.957
20.85%	15.924	4.336	0.272	12.883	5.11E-05	3.32E-10	0.939

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
93.2 %	56.0 %	64.4	90	63	2.709		2.68	1.03	0.22			1.627

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2850		

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 10-105MU, #4, 45-47', Maple River, Argusville Formation</p> <p style="text-align: center;">BRAUNSM INTERTEC</p>	<p>Remarks:</p> <p>Load #3 C_v = 0.057 ft²/day Load #4 C_v = 0.0065 ft²/day Load #5 C_v = 0.0034 ft²/day Load #10 C_v = 0.0030 ft²/day</p>
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Figure

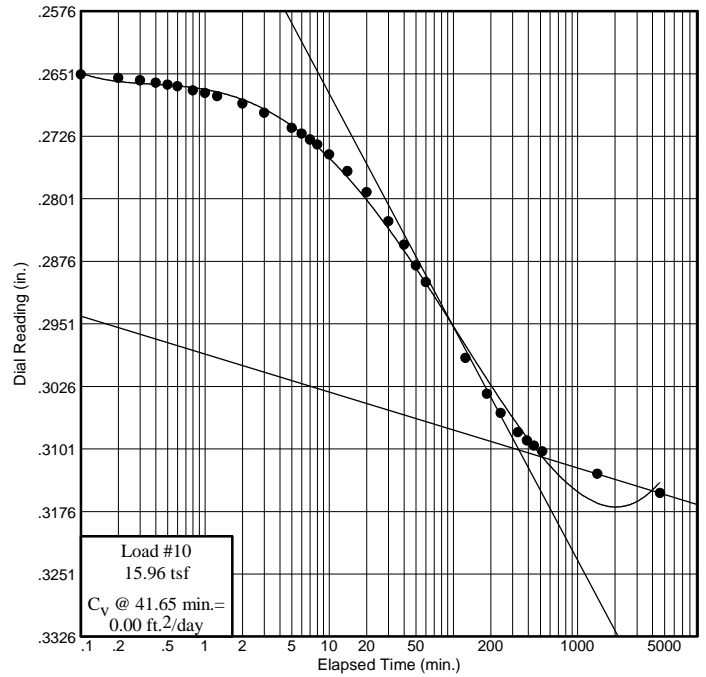
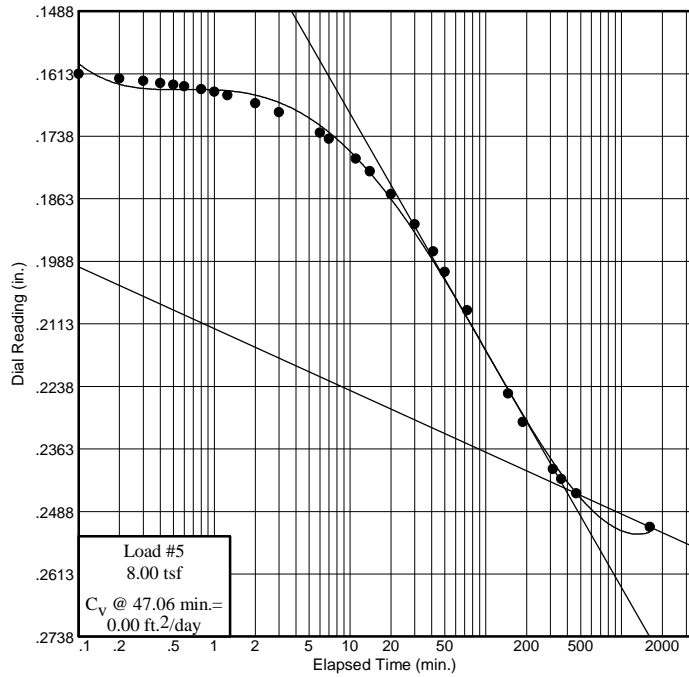
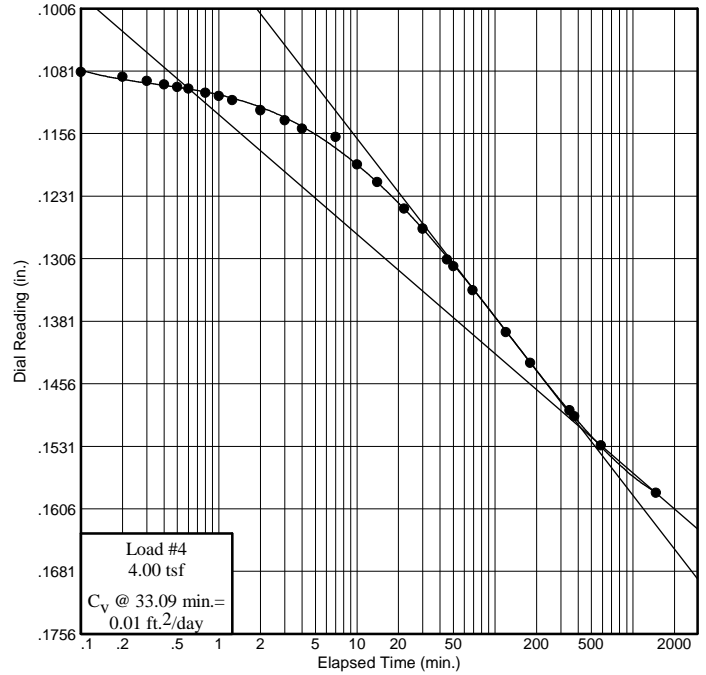
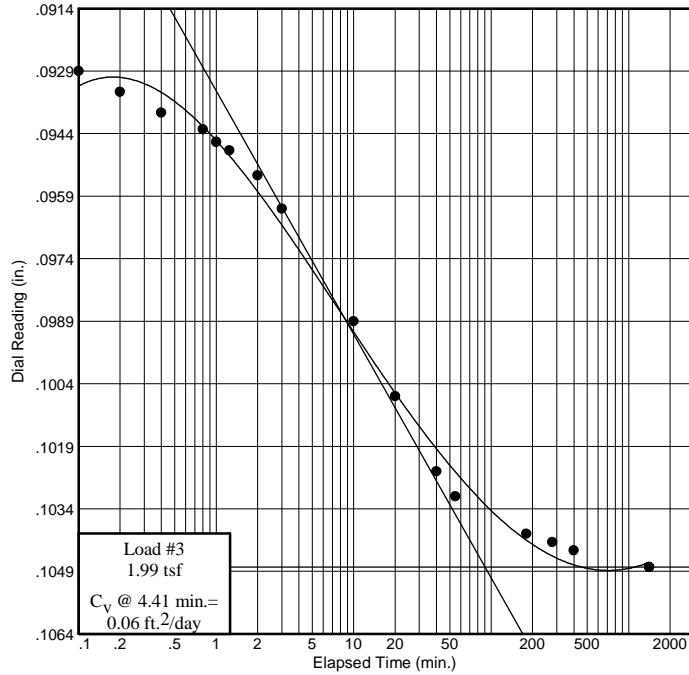
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring 10-105MU, #4, 45-47', Maple River, Argusville Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring 10-105MU, #4
Elev. or Depth: 45-47' **Sample Length(in./cm.):**
Location: Boring 10-105MU, #4, 45-47', Maple River, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2850
Liquid Limit: 90 **Plasticity Index:** 63
USCS: **AASHTO:** **Figure No.:**

Testing Remarks: Load #3 Cv = 0.057 ft²/day
 Load #4 Cv = 0.0065 ft²/day
 Load #5 Cv = 0.0034 ft²/day
 Load #10 Cv = 0.0030 ft²/day

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 158.11 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 112.29 g.		Dry w+t =
Tare Wt. = 30.44 g.	Spec. Gravity = 2.709	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 94.92 g.	Defl. Table = Machine4-2009	
Moisture = 56.0 %	Ht. Solids = 0.2804 in.	Moisture = %
Wet Den. = 100.4 pcf	Dry Wt. = 60.85 g.*	Dry Wt. = n/a
Dry Den. = 64.4 pcf	Void Ratio = 1.627	Void Ratio = 1.122
	Saturation = 93.2 %	

* Initial dry weight used in calculations

End-of-Load Summary

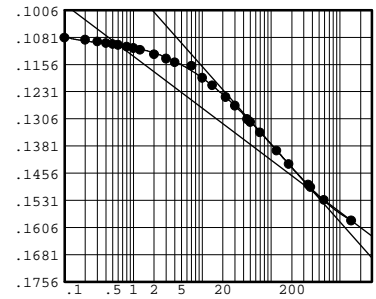
Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08540				1.627	
0.49	0.08590	0.00080			1.628	0.0 Swell
0.98	0.09100	0.00100			1.610	0.6 Compr.
1.99	0.10630	0.00150	0.06	0.000	1.558	2.6 Compr.
4.00	0.16070	0.00200	0.01	0.020	1.365	10.0 Compr.
8.00	0.25460	0.00270	0.00	0.019	1.033	22.6 Compr.
1.99	0.22220	0.00150			1.144	18.4 Compr.
0.49	0.18000	0.00080			1.292	12.7 Compr.
1.99	0.20680	0.00150			1.199	16.3 Compr.
8.00	0.26590	0.00270			0.993	24.1 Compr.
15.96	0.31900	0.00360	0.00	0.008	0.806	31.2 Compr.

Pressure: 4.00 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10630	15	10.00	0.12130
2	0.10	0.11020	16	14.00	0.12340
3	0.20	0.11080	17	22.00	0.12660
4	0.30	0.11130	18	30.00	0.12900
5	0.40	0.11170	19	45.00	0.13270
6	0.50	0.11200	20	50.00	0.13350
7	0.60	0.11220	21	69.00	0.13640
8	0.80	0.11270	22	120.00	0.14140
9	1.00	0.11310	23	180.00	0.14510
10	1.25	0.11360	24	347.00	0.15080
11	2.00	0.11480	25	375.00	0.15150
12	3.00	0.11600	26	586.00	0.15500
13	4.00	0.11700	27	1464.00	0.16070
14	7.00	0.11800			



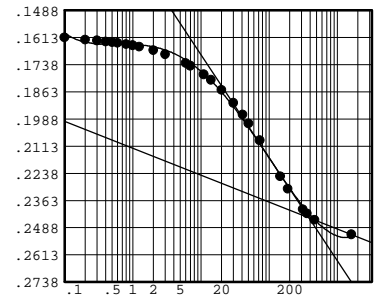
Void Ratio = 1.365 Compression = 10.0 %
 $D_0 = 0.10480$ $D_{50} = 0.12785$ $D_{100} = 0.15089$
 C_v at 33.1 min. = 0.01 ft.²/day $C_\alpha = 0.020$

Pressure: 8.00 tsf

TEST READINGS

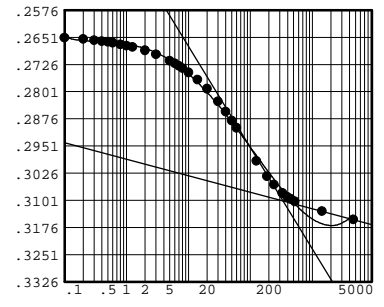
Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16070	15	11.00	0.18100
2	0.10	0.16400	16	14.00	0.18350
3	0.20	0.16500	17	20.00	0.18810
4	0.30	0.16540	18	30.00	0.19410
5	0.40	0.16590	19	41.00	0.19950
6	0.50	0.16620	20	50.00	0.20360
7	0.60	0.16650	21	73.00	0.21130
8	0.80	0.16710	22	146.00	0.22790
9	1.00	0.16760	23	188.00	0.23360
10	1.25	0.16830	24	313.00	0.24300
11	2.00	0.16990	25	360.00	0.24500
12	3.00	0.17170	26	464.00	0.24790
13	6.00	0.17580	27	1618.00	0.25460
14	7.00	0.17700			



Void Ratio = 1.033 Compression = 22.6 %
 $D_0 = 0.15870$ $D_{50} = 0.20143$ $D_{100} = 0.24415$
 C_v at 47.1 min. = 0.00 ft.²/day $C_\alpha = 0.019$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.26590	17	10.00	0.27840
2	0.10	0.26880	18	14.00	0.28040
3	0.20	0.26920	19	20.00	0.28290
4	0.30	0.26950	20	30.00	0.28640
5	0.40	0.26980	21	40.00	0.28920
6	0.50	0.27000	22	50.00	0.29170
7	0.60	0.27020	23	60.00	0.29370
8	0.80	0.27070	24	125.00	0.30280
9	1.00	0.27100	25	186.00	0.30710
10	1.25	0.27140	26	240.00	0.30940
11	2.00	0.27230	27	330.00	0.31170
12	3.00	0.27340	28	391.00	0.31270
13	5.00	0.27520	29	446.00	0.31330
14	6.00	0.27590	30	521.00	0.31400
15	7.00	0.27660	31	1437.00	0.31670
16	8.00	0.27720	32	4602.00	0.31900



Void Ratio = 0.806 Compression = 31.2 %
 $D_0 = 0.26320$ $D_{50} = 0.28672$ $D_{100} = 0.31023$
 C_v at 41.7 min. = 0.00 ft.²/day $C_\alpha = 0.008$

Constant Rate of Strain Consolidation Test

Date: 5/11/11

Job: 7922

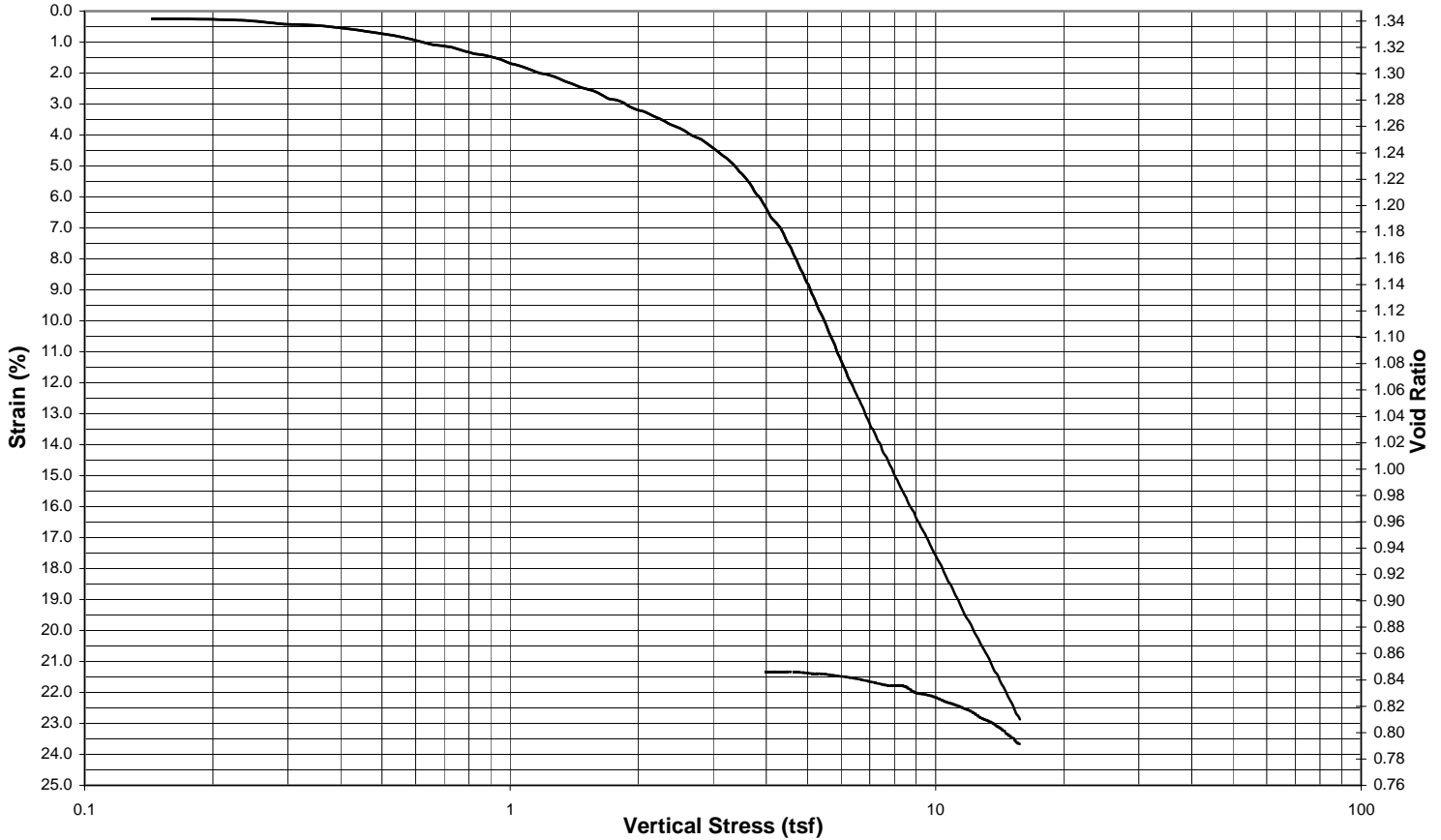
Project: Fargo Moorhead Metro Feasibility Project

Specimen Information

Boring: 10-105MU Sample: 5 Depth: 55-57 Type: 5T
 Soil Type: Fat Clay (CH)

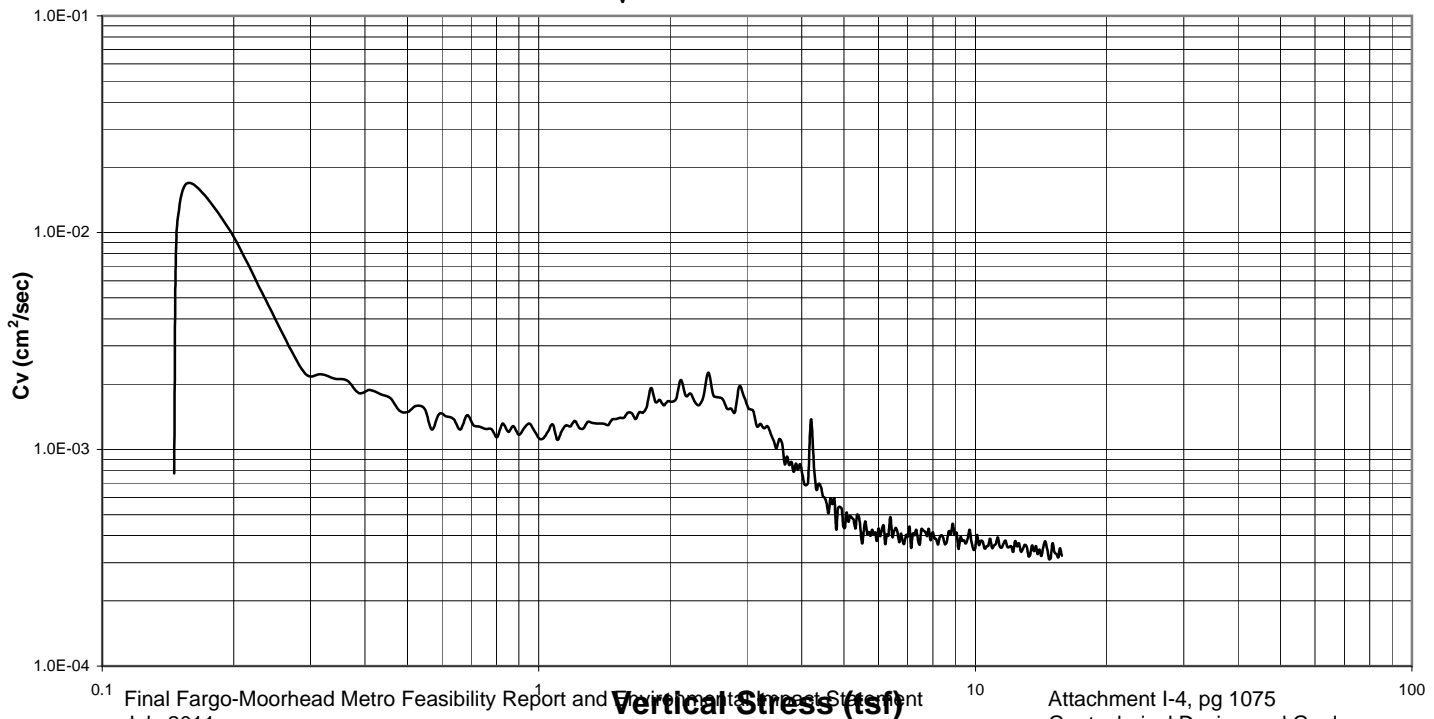
Initial Conditions: Dry Density (pcf): 73.1 Moisture Content (%): 48.0% e_o 1.350

Axial Strain vs. Vertical Pressure



Calculated Consolidation Coefficients	Pc 3.8 tsf	Cc 0.65	Cr 0.09
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C_v vs. Vertical Pressure

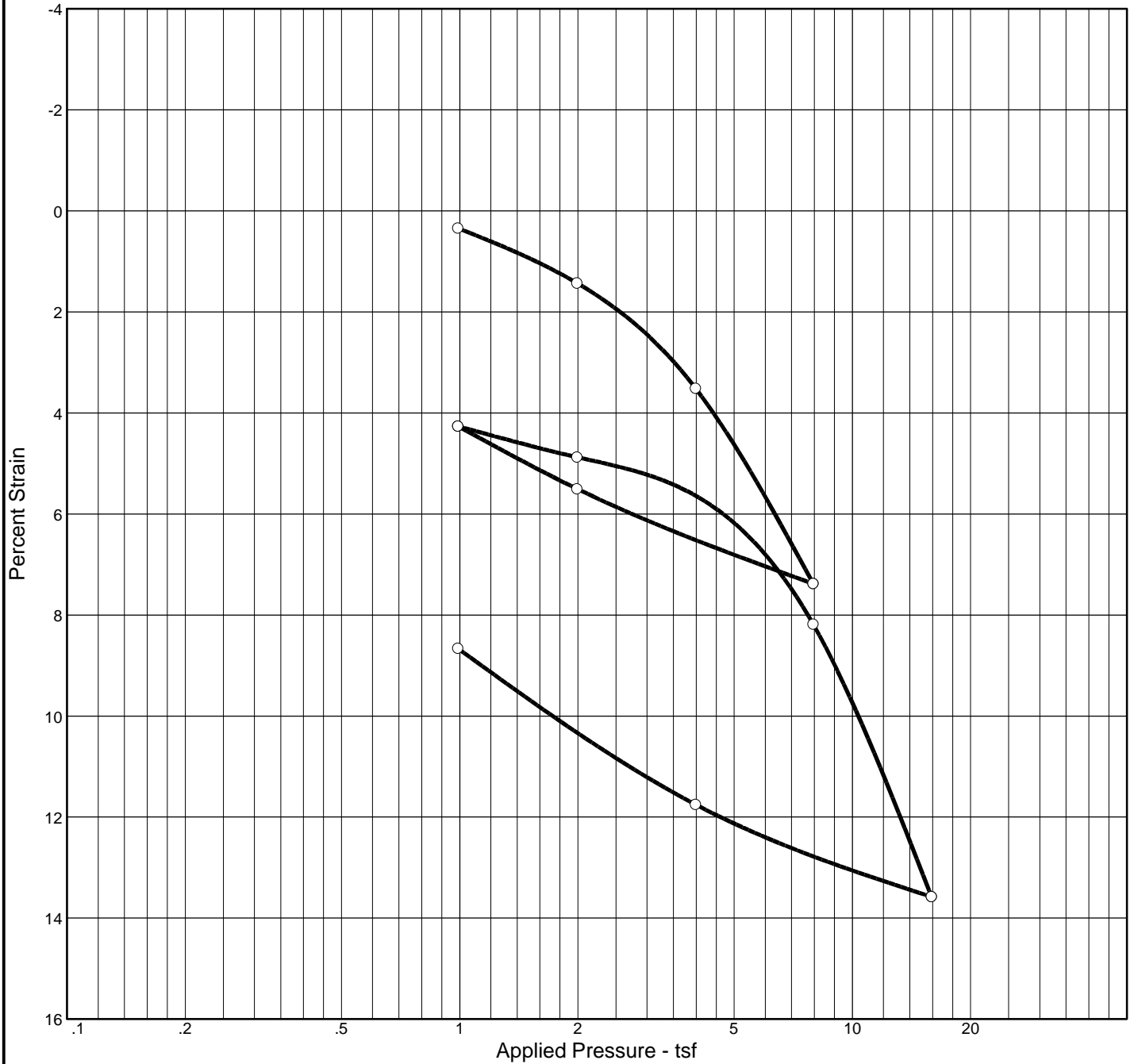


Constant Rate of Strain Data Table

Project: Fargo Moorhead Metro Feasibility Project Date: 5/11/11
 Boring: 10-105MU Sample 5 Depth: 55-57 Job: 7922

Axial Strain	Vert. Stress (tsf)	Excess Pressure (tsf)	Pressure Ratio	Eff. Stress (tsf)	Cv (cm ² /sec)	K (cm/sec)	Void Ratio
0.25%	0.159	0.009	0.057	0.153	1.70E-02	5.29E-08	1.344
0.43%	0.317	0.044	0.137	0.288	2.22E-03	1.32E-08	1.340
1.29%	0.780	0.078	0.101	0.727	1.24E-03	2.56E-08	1.320
1.69%	1.002	0.087	0.086	0.944	1.12E-03	1.22E-08	1.310
2.50%	1.504	0.093	0.062	1.441	1.38E-03	1.57E-08	1.291
3.24%	2.064	0.107	0.052	1.992	1.72E-03	1.54E-08	1.274
3.87%	2.576	0.145	0.056	2.479	1.74E-03	3.00E-08	1.259
4.46%	3.026	0.176	0.058	2.908	1.54E-03	2.43E-08	1.245
5.25%	3.504	0.190	0.054	3.376	1.01E-03	2.05E-08	1.227
6.41%	4.015	0.214	0.053	3.870	7.65E-04	2.31E-08	1.199
8.83%	5.025	0.339	0.067	4.797	4.34E-04	1.27E-08	1.142
11.41%	6.051	0.433	0.072	5.759	3.98E-04	8.92E-09	1.082
13.45%	7.062	0.519	0.073	6.712	4.38E-04	3.90E-09	1.034
15.06%	8.059	0.611	0.076	7.647	3.88E-04	4.92E-09	0.996
16.45%	9.064	0.685	0.076	8.601	4.12E-04	1.47E-09	0.963
17.48%	9.904	0.767	0.077	9.386	3.44E-04	3.37E-09	0.939
18.61%	10.928	0.842	0.077	10.359	3.51E-04	4.29E-09	0.913
19.79%	12.088	0.940	0.078	11.453	3.57E-04	3.41E-09	0.885
20.71%	13.103	1.012	0.077	12.420	3.56E-04	2.95E-09	0.863
21.47%	14.029	1.070	0.076	13.306	3.45E-04	3.58E-09	0.845
22.30%	15.031	1.133	0.075	14.266	3.68E-04	3.17E-09	0.826
22.87%	15.787	1.178	0.075	14.991	3.24E-04	2.70E-09	0.813

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
98.1 %	35.1 %	85.8	63	44	2.705		4.53	0.37	0.08			0.969

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

Project No. BL-10-10065 Client: USACE W912ES-11-P-0024 Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 3 Location: Boring11-107MU, #4, 50-52', ND RRCS, MN, Argusville Formation	Remarks: <div style="text-align: right;">Figure</div>

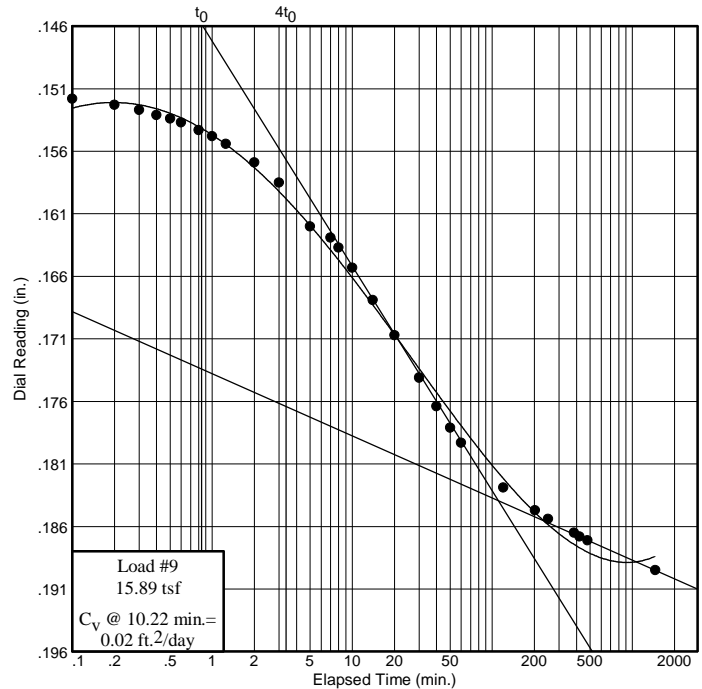
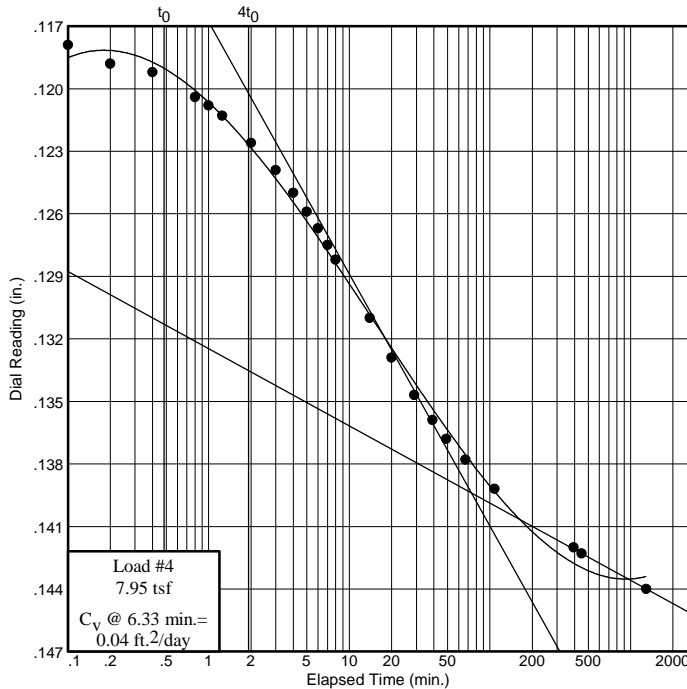
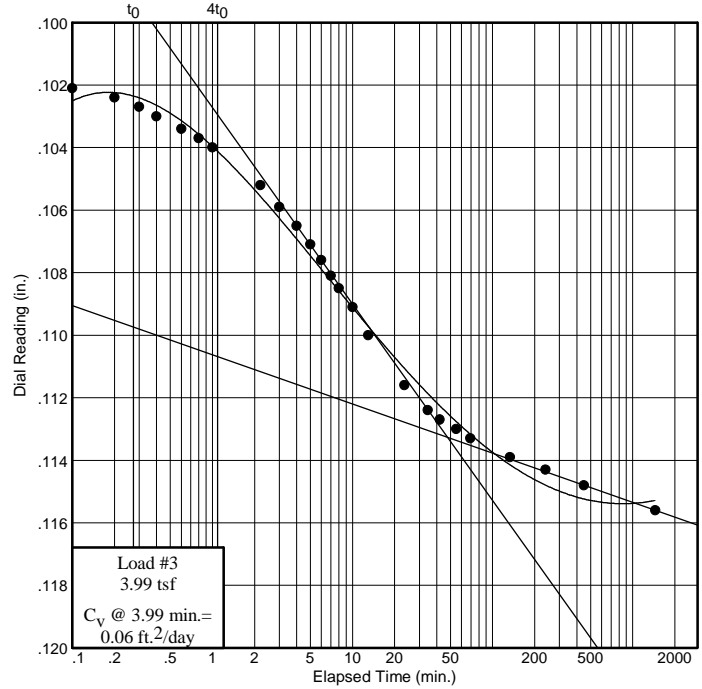
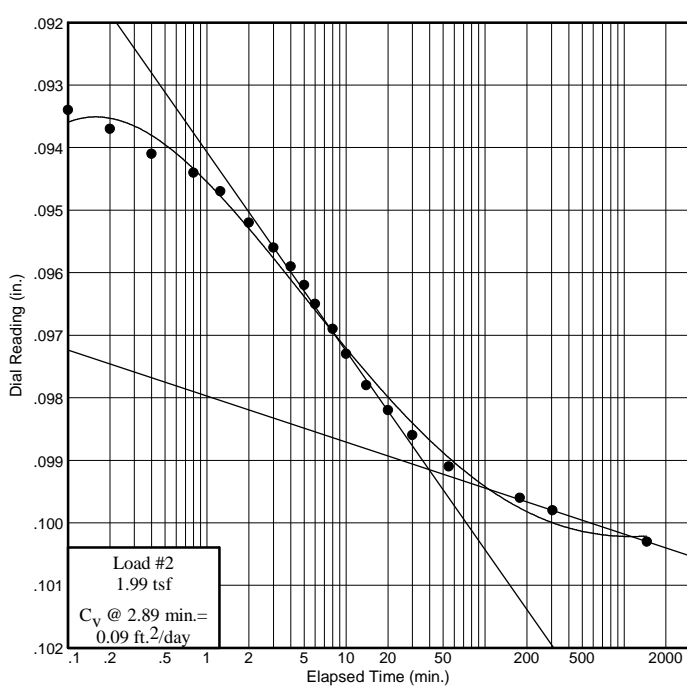
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-107MU, #4, 50-52', ND RRCS, MN, Argusville Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: Boring11-107MU, #4
Elev. or Depth: 50-52' **Sample Length(in./cm.):**
Location: Boring11-107MU, #4, 50-52', ND RRCS, MN, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 63 **Plasticity Index:** 44
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 74.80 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 63.16 g.		Dry w+t =
Tare Wt. = 30.01 g.	Spec. Gravity = 2.705	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 109.49 g.	Defl. Table = Machine3-2009	
Moisture = 35.1 %	Ht. Solids = 0.3730 in.	Moisture = %
Wet Den. = 115.9 pcf	Dry Wt. = 81.04 g.*	Dry Wt. = n/a
Dry Den. = 85.8 pcf	Void Ratio = 0.969	Void Ratio = 0.798
	Saturation = 98.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression /Swell
start	0.08980				0.969	
0.99	0.09300	0.00070			0.962	0.3 Compr.
1.99	0.10130	0.00100	0.09	0.001	0.940	1.4 Compr.
3.99	0.11710	0.00150	0.06	0.002	0.899	3.5 Compr.
7.95	0.14600	0.00200	0.04	0.005	0.823	7.4 Compr.
1.99	0.13120	0.00100			0.860	5.5 Compr.
0.99	0.12180	0.00070			0.885	4.3 Compr.
1.99	0.12660	0.00100			0.873	4.9 Compr.
7.95	0.15190	0.00200			0.807	8.2 Compr.
15.89	0.19240	0.00290	0.02	0.007	0.701	13.6 Compr.
3.99	0.17760	0.00150			0.737	11.8 Compr.
0.99	0.15410	0.00070			0.798	8.7 Compr.

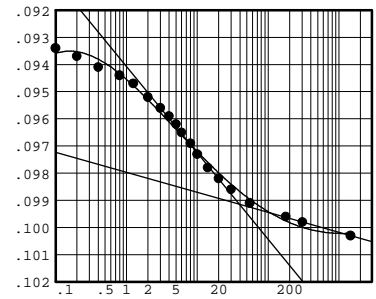
$C_c = 0.37$ $P_c = 4.53$ tsf $C_r = 0.08$

Pressure: 1.99 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09300	11	6.00	0.09750
2	0.10	0.09440	12	8.00	0.09790
3	0.20	0.09470	13	10.00	0.09830
4	0.40	0.09510	14	14.00	0.09880
5	0.80	0.09540	15	20.00	0.09920
6	1.25	0.09570	16	30.00	0.09960
7	2.00	0.09620	17	55.00	0.10010
8	3.00	0.09660	18	178.00	0.10060
9	4.00	0.09690	19	305.00	0.10080
10	5.00	0.09720	20	1457.00	0.10130



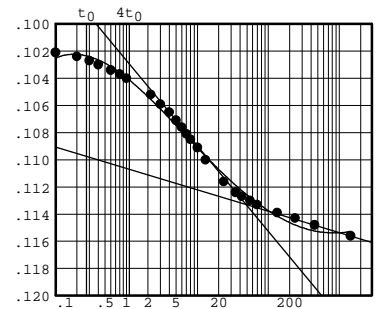
Void Ratio = 0.940 Compression = 1.4 %
 $D_0 = 0.09230$ $D_{50} = 0.09572$ $D_{100} = 0.09915$
 C_v at 2.9 min. = 0.09 ft.²/day $C_\alpha = 0.001$

Pressure: 3.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10130	14	7.00	0.10960
2	0.10	0.10360	15	8.00	0.11000
3	0.20	0.10390	16	10.00	0.11060
4	0.30	0.10420	17	13.00	0.111150
5	0.40	0.10450	18	23.50	0.11310
6	0.60	0.10490	19	34.50	0.11390
7	0.80	0.10520	20	42.00	0.11420
8	1.00	0.10550	21	55.00	0.11450
9	2.20	0.10670	22	69.30	0.11480
10	3.00	0.10740	23	133.50	0.11540
11	4.00	0.10800	24	238.30	0.11580
12	5.00	0.10860	25	449.00	0.11630
13	6.00	0.10910	26	1448.00	0.11710



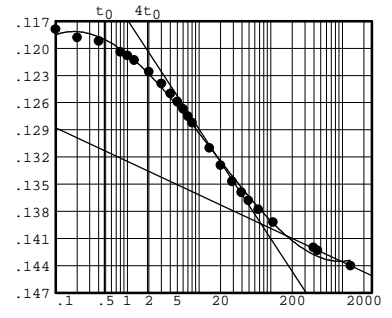
Void Ratio = 0.899 Compression = 3.5 %
 $D_0 = 0.10058$ $D_{50} = 0.10692$ $D_{100} = 0.11327$
 C_v at 4.0 min. = 0.06 ft.²/day $C_\alpha = 0.002$

Pressure: 7.95 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11710	13	7.00	0.12950
2	0.10	0.11990	14	8.00	0.13020
3	0.20	0.12080	15	14.00	0.13300
4	0.40	0.12120	16	20.00	0.13490
5	0.80	0.12240	17	29.00	0.13670
6	1.00	0.12280	18	39.00	0.13790
7	1.25	0.12330	19	49.00	0.13880
8	2.00	0.12460	20	67.00	0.13980
9	3.00	0.12590	21	108.00	0.14120
10	4.00	0.12700	22	393.00	0.14400
11	5.00	0.12790	23	450.00	0.14430
12	6.00	0.12870	24	1295.00	0.14600



Void Ratio = 0.823 Compression = 7.4 %
 $D_0 = 0.11534$ $D_{50} = 0.12737$ $D_{100} = 0.13940$
 C_v at 6.3 min. = 0.04 ft.²/day $C_\alpha = 0.005$

Pressure: 1.99 tsf

TEST READINGS

Load No. 7

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12180	11	20.00	0.12550
2	0.10	0.12230	12	40.00	0.12600
3	0.40	0.12260	13	125.00	0.12630
4	1.00	0.12290	14	1459.00	0.12660
5	2.00	0.12330			
6	3.00	0.12360			
7	5.00	0.12400			
8	8.00	0.12450			
9	10.00	0.12480			
10	14.00	0.12520			

Void Ratio = 0.873 Compression = 4.9 %

Pressure: 7.95 tsf

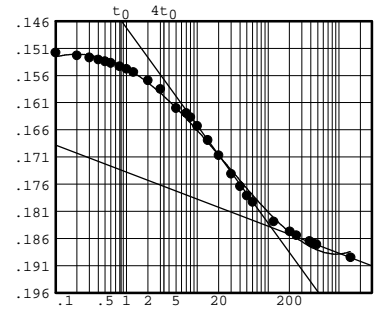
TEST READINGS

Load No. 8

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12660	11	2.00	0.13490
2	0.10	0.12980	12	2880.00	0.15190
3	0.20	0.13030			
4	0.30	0.13080			
5	0.40	0.13120			
6	0.50	0.13160			
7	0.60	0.13190			
8	0.80	0.13240			
9	1.00	0.13290			
10	1.25	0.13350			

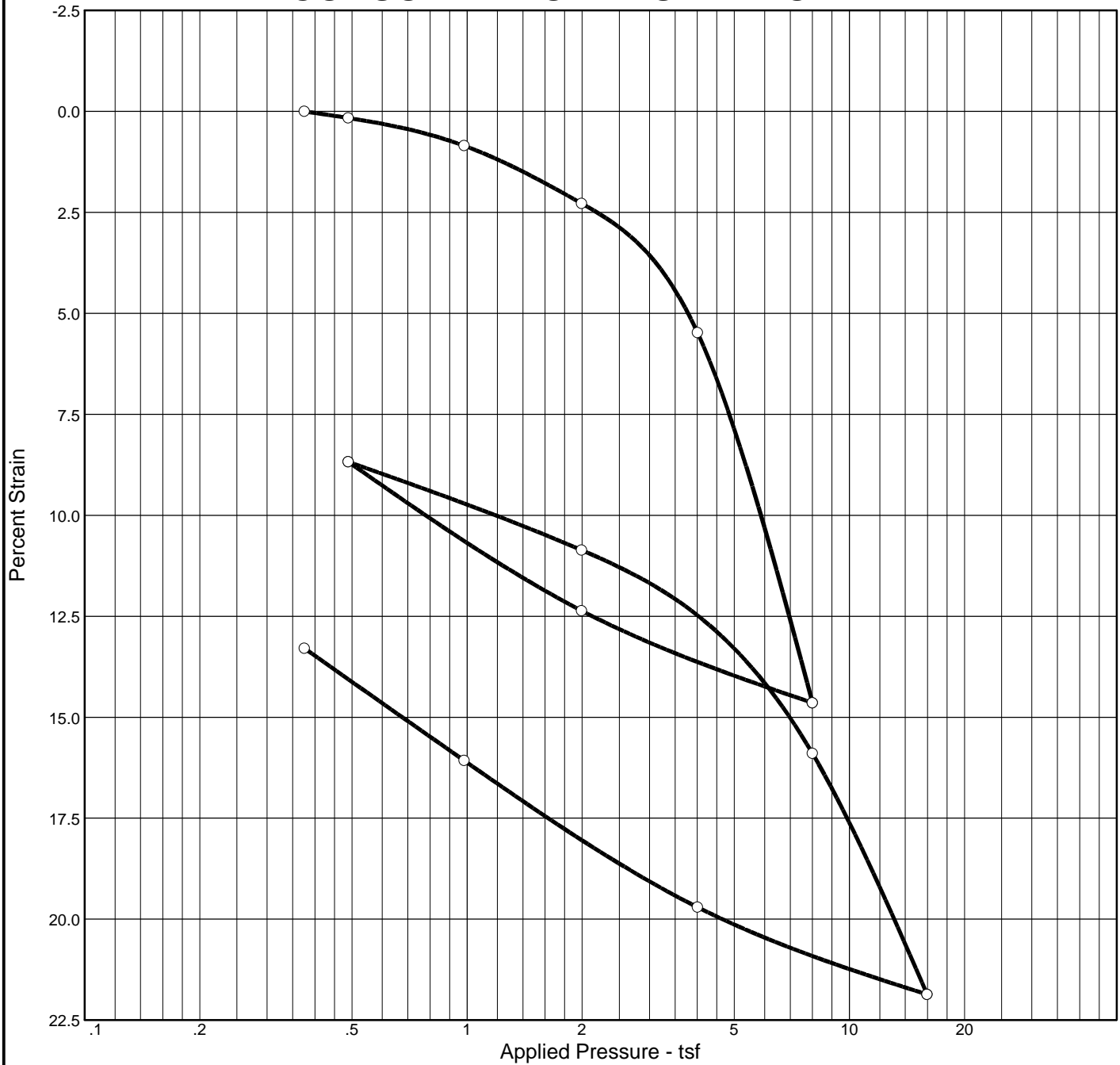
Void Ratio = 0.807 Compression = 8.2 %

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.15190	16	10.00	0.16820
2	0.10	0.15470	17	14.00	0.17080
3	0.20	0.15520	18	20.00	0.17360
4	0.30	0.15560	19	30.00	0.17700
5	0.40	0.15600	20	40.00	0.17930
6	0.50	0.15630	21	50.00	0.18100
7	0.60	0.15660	22	60.00	0.18220
8	0.80	0.15720	23	120.00	0.18580
9	1.00	0.15770	24	202.00	0.18760
10	1.25	0.15830	25	250.00	0.18830
11	2.00	0.15980	26	383.00	0.18940
12	3.00	0.16140	27	420.00	0.18970
13	5.00	0.16490	28	480.00	0.19000
14	7.00	0.16580	29	1460.00	0.19240
15	8.00	0.16660			



Void Ratio = 0.701 Compression = 13.6 %
 $D_0 = 0.14857$ $D_{50} = 0.16625$ $D_{100} = 0.18393$
 C_v at 10.2 min. = 0.02 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.1 %	49.2 %	71.9	85	64	2.693		4.15	0.72	0.13			1.338

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 11-110MU, #4, 55-57', Sheyenne River, Argusville Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUN <small>SM</small> INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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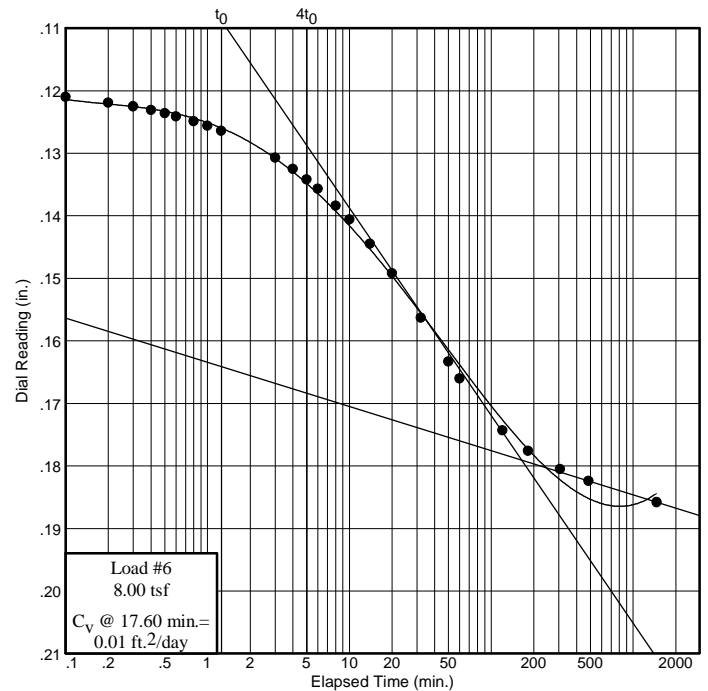
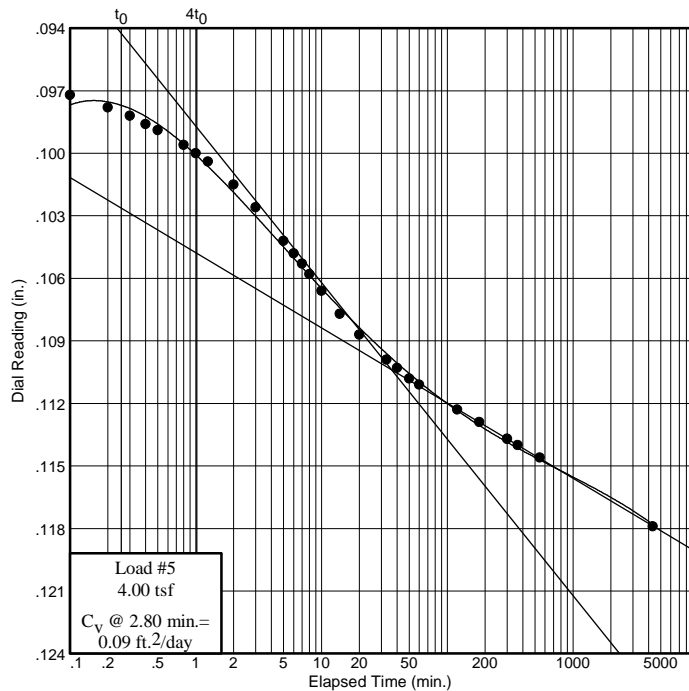
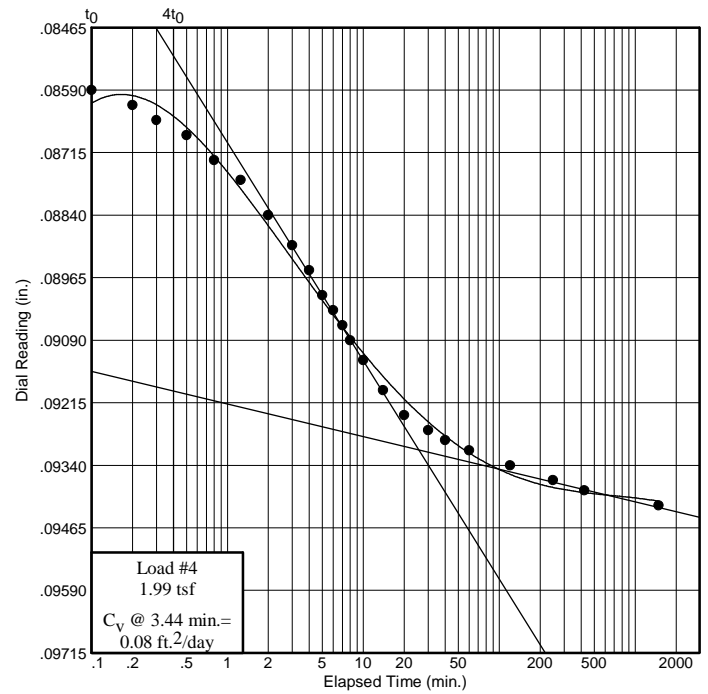
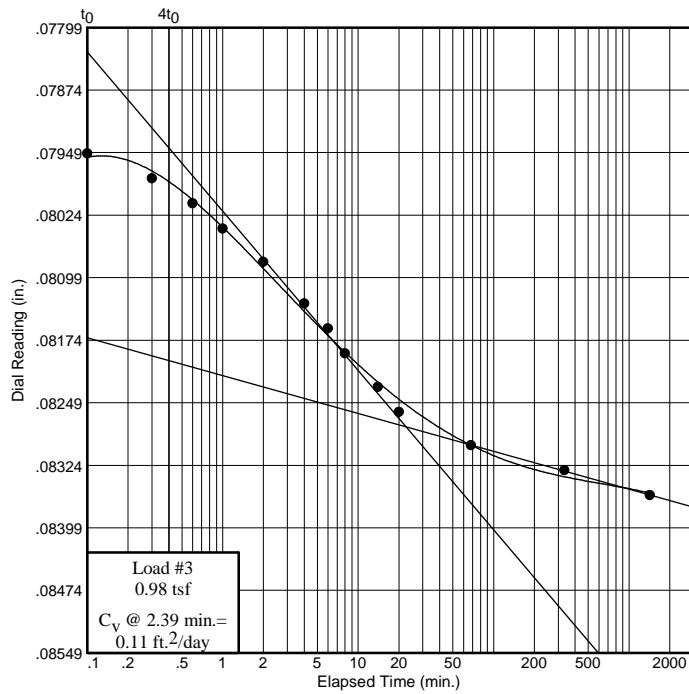
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #4, 55-57', Sheyenne River, Argusville Formation



BRAUNSM
INTERTEC

Figure

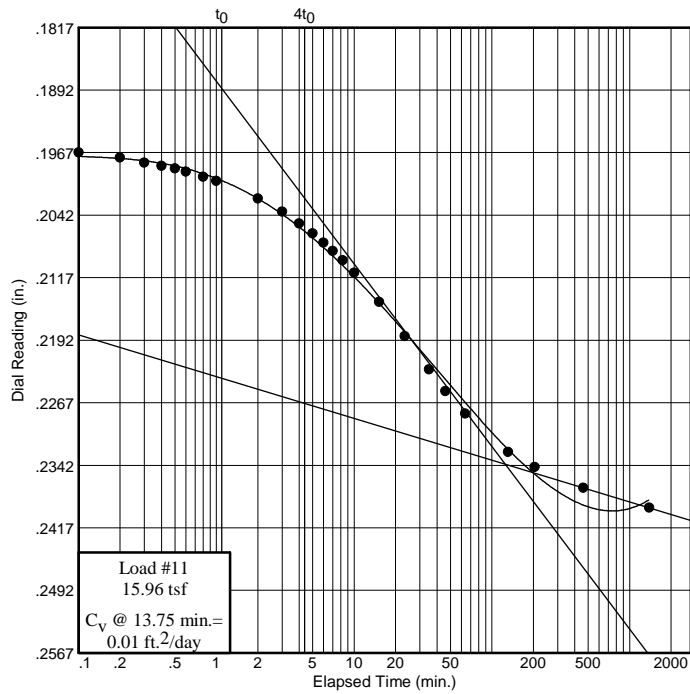
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #4, 55-57', Sheyenne River, Argusville Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #4
Elev. or Depth: 55-57' **Sample Length(in./cm.):**
Location: Boring11-110MU, #4, 55-57', Sheyenne River, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 85 **Plasticity Index:** 64
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

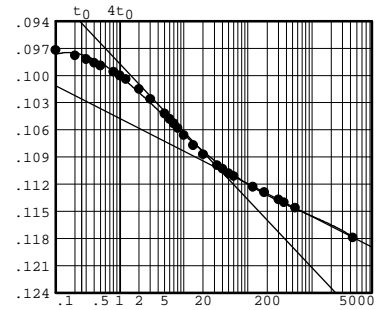
TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 150.83 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 111.11 g.		Dry w+t =
Tare Wt. = 30.46 g.	Spec. Gravity = 2.693	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 102.05 g.	Defl. Table = Machine4-2009	
Moisture = 49.2 %	Ht. Solids = 0.3169 in.	Moisture = %
Wet Den. = 107.3 pcf	Dry Wt. = 68.38 g.*	Dry Wt. = n/a
Dry Den. = 71.9 pcf	Void Ratio = 1.338	Void Ratio = 1.027
	Saturation = 99.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

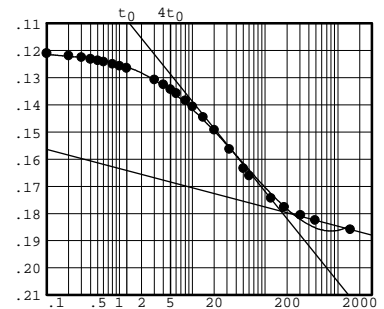
Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.07730				1.338	
0.38	0.07730	0.00000			1.338	0.0 Swell
0.49	0.07850	0.00080			1.334	0.2 Compr.
0.98	0.08460	0.00100	0.11	0.001	1.318	0.9 Compr.
1.99	0.09570	0.00150	0.08	0.001	1.285	2.3 Compr.
4.00	0.11990	0.00200	0.09	0.005	1.210	5.5 Compr.
8.00	0.18850	0.00270	0.01	0.010	0.996	14.6 Compr.
1.99	0.17040	0.00150			1.049	12.4 Compr.
0.49	0.14240	0.00080			1.135	8.7 Compr.
1.99	0.15930	0.00150			1.084	10.9 Compr.
8.00	0.19780	0.00270			0.967	15.9 Compr.
15.96	0.24290	0.00360	0.01	0.008	0.827	21.9 Compr.
4.00	0.22530	0.00200			0.878	19.7 Compr.
0.98	0.19740	0.00100			0.962	16.1 Compr.

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09570	15	8.00	0.10780
2	0.10	0.09920	16	10.00	0.10860
3	0.20	0.09980	17	14.00	0.10970
4	0.30	0.10020	18	20.00	0.11070
5	0.40	0.10060	19	33.00	0.11190
6	0.50	0.10090	20	40.00	0.11230
7	0.80	0.10160	21	50.00	0.11280
8	1.00	0.10200	22	60.00	0.11310
9	1.25	0.10240	23	120.00	0.11430
10	2.00	0.10350	24	180.00	0.11490
11	3.00	0.10460	25	300.00	0.11570
12	5.00	0.10620	26	364.00	0.11600
13	6.00	0.10680	27	544.00	0.11660
14	7.00	0.10730	28	4317.00	0.11990



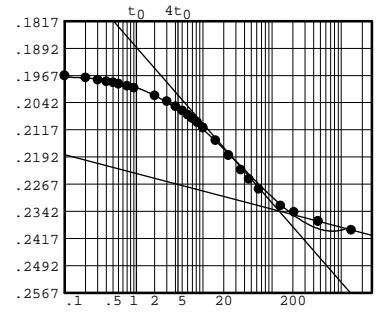
Void Ratio = 1.210 Compression = 5.5 %
 $D_0 = 0.09527$ $D_{50} = 0.10282$ $D_{100} = 0.11038$
 C_v at 2.8 min. = 0.09 ft.²/day $C_\alpha = 0.005$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11990	14	6.00	0.13840
2	0.10	0.12370	15	8.00	0.14110
3	0.20	0.12460	16	10.00	0.14330
4	0.30	0.12520	17	14.00	0.14720
5	0.40	0.12580	18	20.00	0.15190
6	0.50	0.12630	19	32.00	0.15900
7	0.60	0.12680	20	50.00	0.16600
8	0.80	0.12760	21	60.00	0.16870
9	1.00	0.12830	22	120.00	0.17700
10	1.25	0.12910	23	182.00	0.18030
11	3.00	0.13340	24	305.00	0.18320
12	4.00	0.13520	25	485.00	0.18510
13	5.00	0.13690	26	1468.00	0.18850



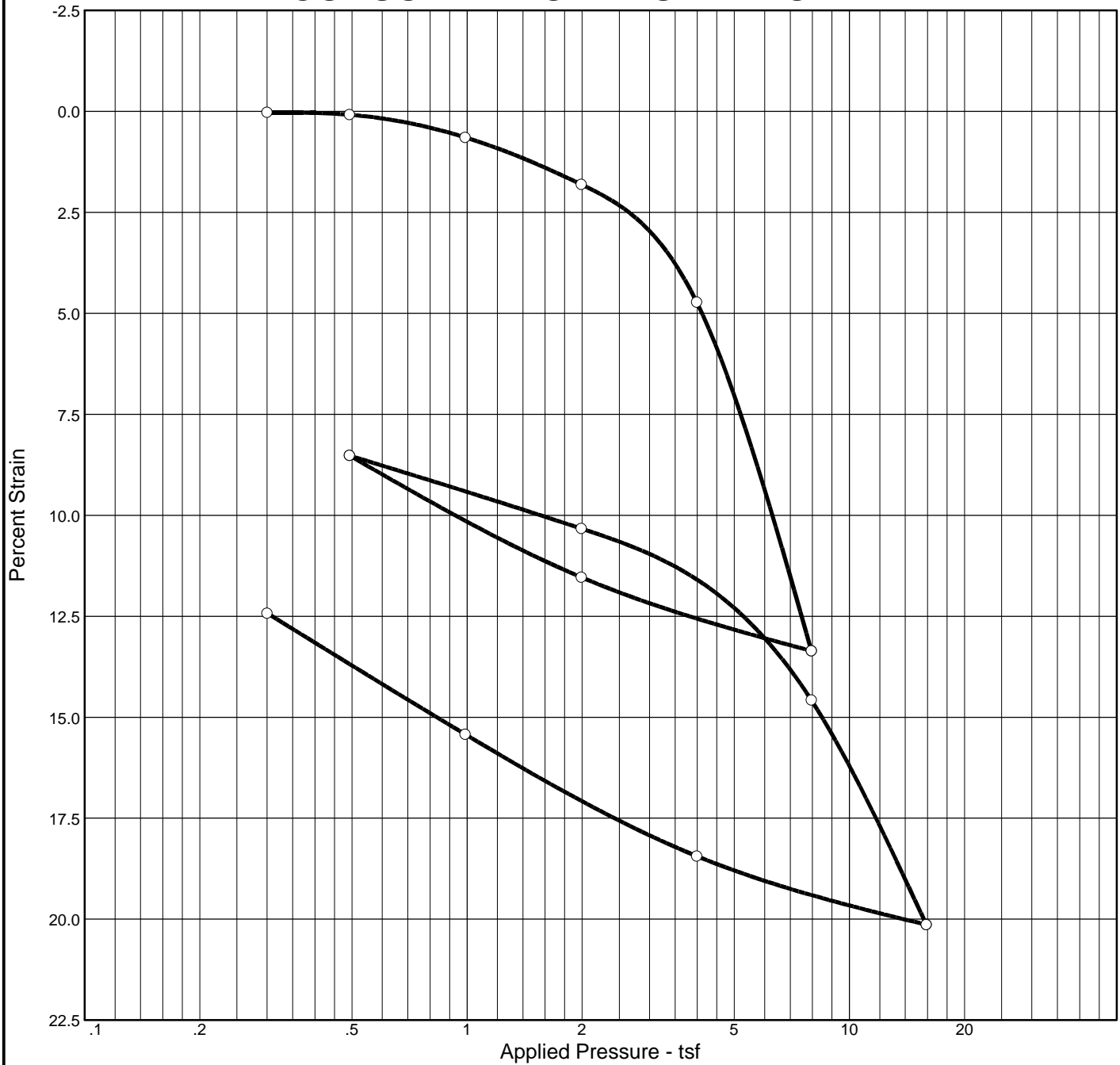
Void Ratio = 0.996 Compression = 14.6 %
 $D_0 = 0.11710$ $D_{50} = 0.14808$ $D_{100} = 0.17907$
 C_v at 17.6 min. = 0.01 ft.²/day $C_\alpha = 0.010$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.19780	14	6.00	0.21110
2	0.10	0.20030	15	7.00	0.21210
3	0.20	0.20090	16	8.25	0.21320
4	0.30	0.20150	17	10.00	0.21470
5	0.40	0.20190	18	15.20	0.21820
6	0.50	0.20220	19	23.30	0.22230
7	0.60	0.20260	20	35.00	0.22630
8	0.80	0.20320	21	46.00	0.22890
9	1.00	0.20370	22	64.00	0.23160
10	2.00	0.20580	23	131.50	0.23620
11	3.00	0.20740	24	205.00	0.23800
12	4.00	0.20880	25	460.00	0.24050
13	5.00	0.21000	26	1387.00	0.24290



Void Ratio = 0.827 Compression = 21.9 %
 $D_0 = 0.19395$ $D_{50} = 0.21401$ $D_{100} = 0.23407$
 C_v at 13.7 min. = 0.01 ft.²/day $C_\alpha = 0.008$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
100.0 %	45.5 %	75.4	70	48	2.679		4.29	0.83	0.10			1.218

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>Location: Boring 11-110MU, #5, 60-62', Sheyenne River, Argusville Formation</p> <div style="text-align: center; margin-top: 10px;"> </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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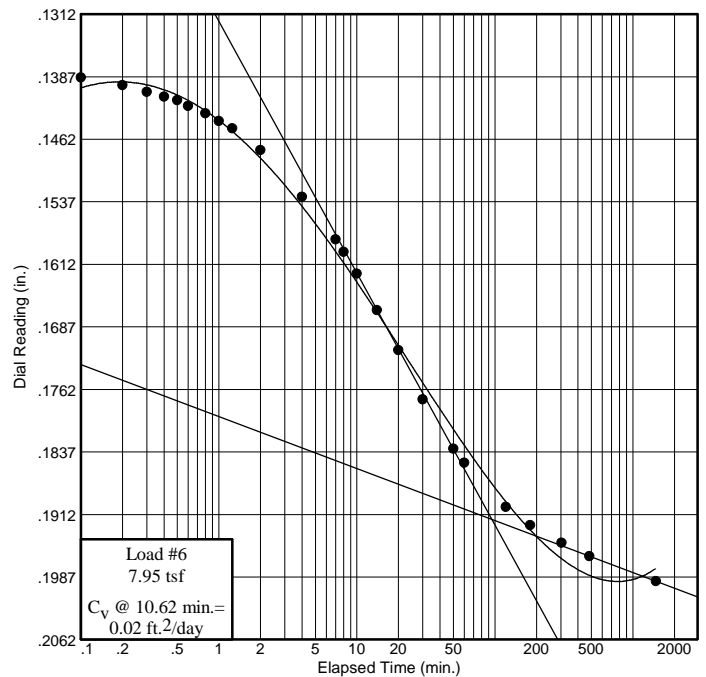
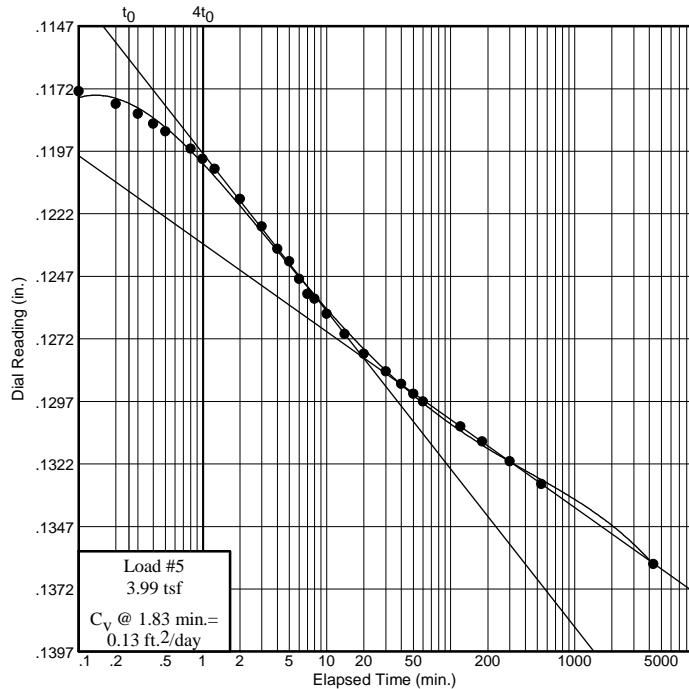
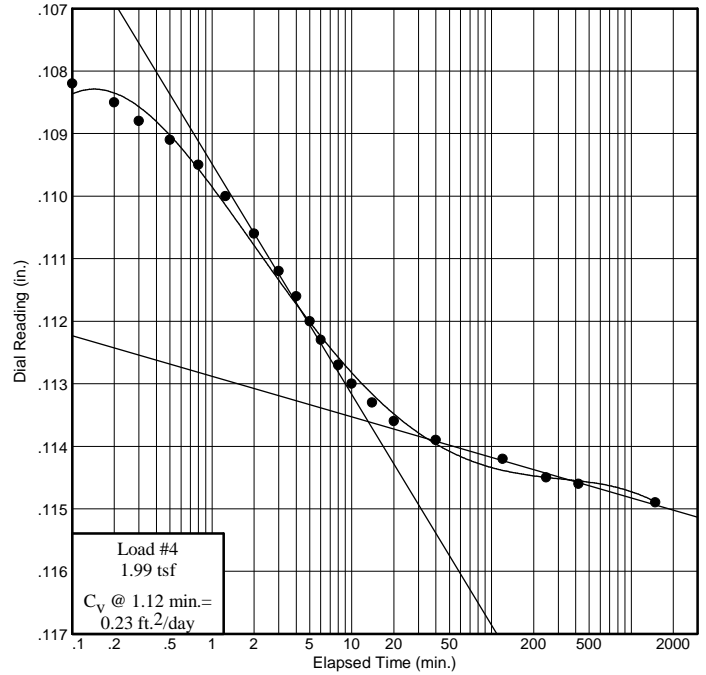
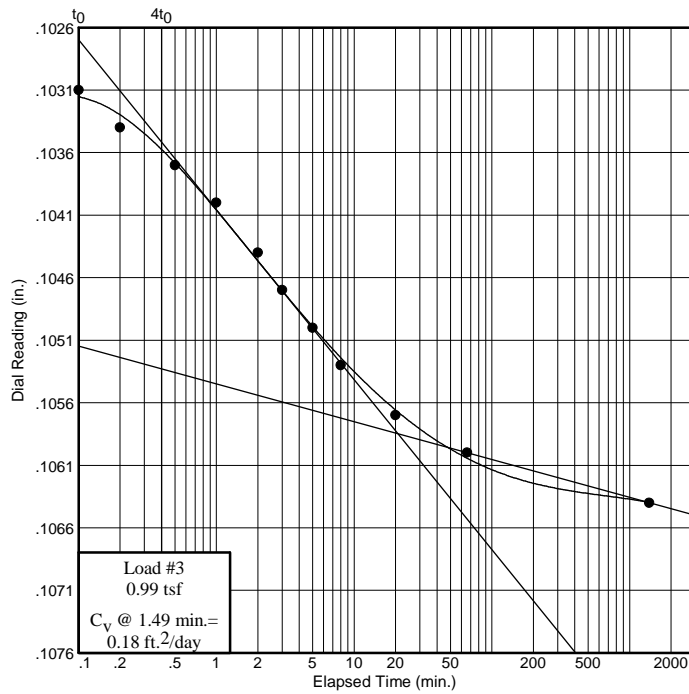
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #5, 60-62', Sheyenne River, Argusville Formation



BRAUNSM
INTERTEC

Figure

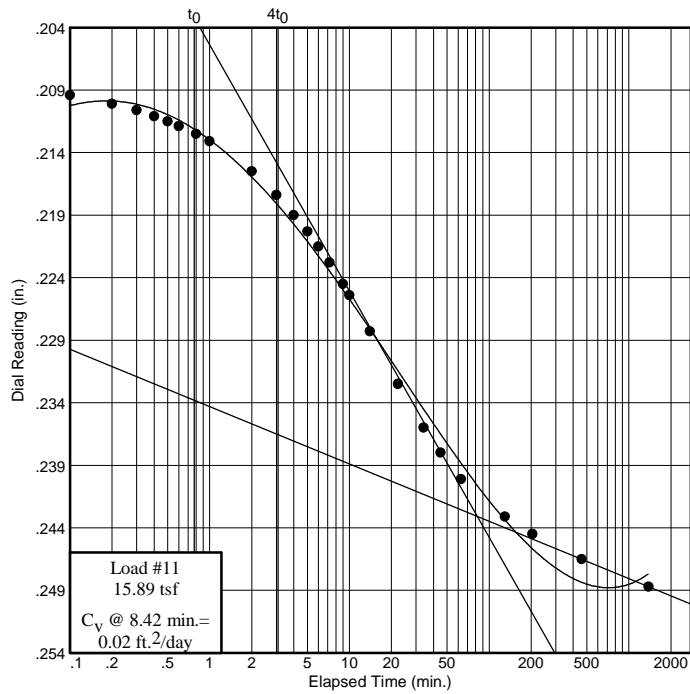
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #5, 60-62', Sheyenne River, Argusville Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #5
Elev. or Depth: 60-62' **Sample Length(in./cm.):**
Location: Boring11-110MU, #5, 60-62', Sheyenne River, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 70 **Plasticity Index:** 48
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 153.85 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 115.25 g.		Dry w+t =
Tare Wt. = 30.35 g.	Spec. Gravity = 2.679	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 103.03 g.	Defl. Table = Machine3-2009	
Moisture = 45.5 %	Ht. Solids = 0.3292 in.	Moisture = %
Wet Den. = 109.7 pcf	Dry Wt. = 70.83 g.*	Dry Wt. = n/a
Dry Den. = 75.4 pcf	Void Ratio = 1.218	Void Ratio = 0.942
	Saturation = 100.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.10170				1.218	
0.30	0.10190	0.00000			1.217	0.0 Compr.
0.49	0.10280	0.00050			1.216	0.1 Compr.
0.99	0.10710	0.00070	0.18	0.000	1.203	0.6 Compr.
1.99	0.11590	0.00100	0.23	0.001	1.177	1.8 Compr.
3.99	0.13770	0.00150	0.13	0.005	1.113	4.7 Compr.
7.95	0.20120	0.00200	0.02	0.009	0.921	13.4 Compr.
1.99	0.18690	0.00100			0.962	11.5 Compr.
0.49	0.16440	0.00050			1.029	8.5 Compr.
1.99	0.17810	0.00100			0.988	10.3 Compr.
7.95	0.21010	0.00200			0.894	14.6 Compr.
15.89	0.25160	0.00290	0.02	0.007	0.771	20.1 Compr.
3.99	0.23780	0.00150			0.809	18.4 Compr.
0.99	0.21500	0.00070			0.875	15.4 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression /Swell
0.30	0.19240	0.00000			0.942	12.4 Compr.

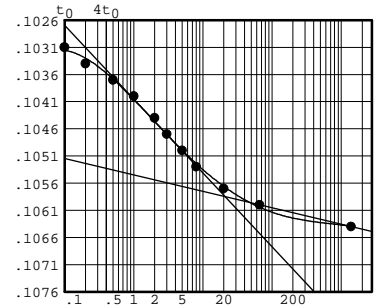
$C_c = 0.83$ $P_c = 4.29$ tsf $C_r = 0.10$

Pressure: 0.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10280	11	66.00	0.10670
2	0.10	0.10380	12	1387.00	0.10710
3	0.20	0.10410			
4	0.50	0.10440			
5	1.00	0.10470			
6	2.00	0.10510			
7	3.00	0.10540			
8	5.00	0.10570			
9	8.00	0.10600			
10	20.00	0.10640			



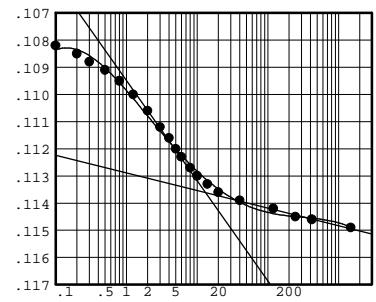
Void Ratio = 1.203 Compression = 0.6 %
 $D_0 = 0.10273$ $D_{50} = 0.10429$ $D_{100} = 0.10585$
 C_v at 1.5 min. = 0.18 ft.²/day $C_\alpha = 0.000$

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10710	12	6.00	0.11330
2	0.10	0.10920	13	8.00	0.11370
3	0.20	0.10950	14	10.00	0.11400
4	0.30	0.10980	15	14.00	0.11430
5	0.50	0.11010	16	20.00	0.11460
6	0.80	0.11050	17	40.00	0.11490
7	1.25	0.11100	18	120.00	0.11520
8	2.00	0.11160	19	246.00	0.11550
9	3.00	0.11220	20	420.00	0.11560
10	4.00	0.11260	21	1486.00	0.11590
11	5.00	0.11300			



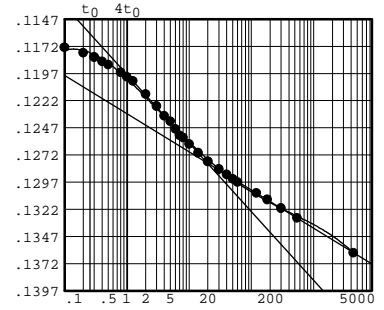
Void Ratio = 1.177 Compression = 1.8 %
 $D_0 = 0.10640$ $D_{50} = 0.11000$ $D_{100} = 0.11361$
 C_v at 1.1 min. = 0.23 ft.²/day $C_\alpha = 0.001$

Pressure: 3.99 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.11590	15	7.00	0.12690
2	0.10	0.11880	16	8.00	0.12710
3	0.20	0.11930	17	10.00	0.12770
4	0.30	0.11970	18	14.00	0.12850
5	0.40	0.12010	19	20.00	0.12930
6	0.50	0.12040	20	30.00	0.13000
7	0.80	0.12110	21	40.00	0.13050
8	1.00	0.12150	22	50.00	0.13090
9	1.25	0.12190	23	60.00	0.13120
10	2.00	0.12310	24	120.00	0.13220
11	3.00	0.12420	25	180.00	0.13280
12	4.00	0.12510	26	300.00	0.13360
13	5.00	0.12560	27	541.00	0.13450
14	6.00	0.12630	28	4315.00	0.13770



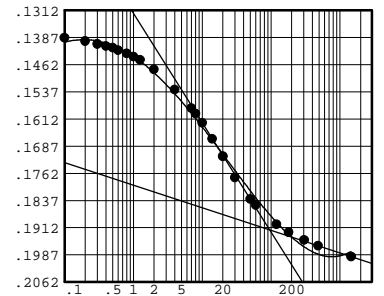
Void Ratio = 1.113 Compression = 4.7 %
 $D_0 = 0.11535$ $D_{50} = 0.12165$ $D_{100} = 0.12796$
 C_v at 1.8 min. = 0.13 ft.²/day $C_\alpha = 0.005$

Pressure: 7.95 tsf

TEST READINGS

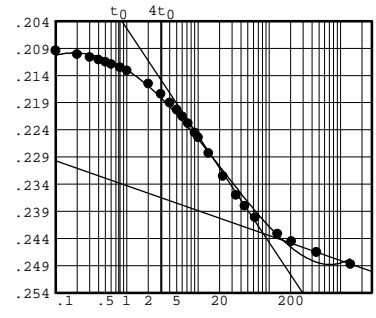
Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13770	14	8.00	0.16170
2	0.10	0.14080	15	10.00	0.16430
3	0.20	0.14170	16	14.00	0.16870
4	0.30	0.14250	17	20.00	0.17350
5	0.40	0.14310	18	30.00	0.17940
6	0.50	0.14350	19	50.00	0.18530
7	0.60	0.14420	20	60.00	0.18700
8	0.80	0.14510	21	120.00	0.19230
9	1.00	0.14600	22	180.00	0.19450
10	1.25	0.14690	23	304.00	0.19660
11	2.00	0.14950	24	484.00	0.19820
12	4.00	0.15510	25	1466.00	0.20120
13	7.00	0.16020			



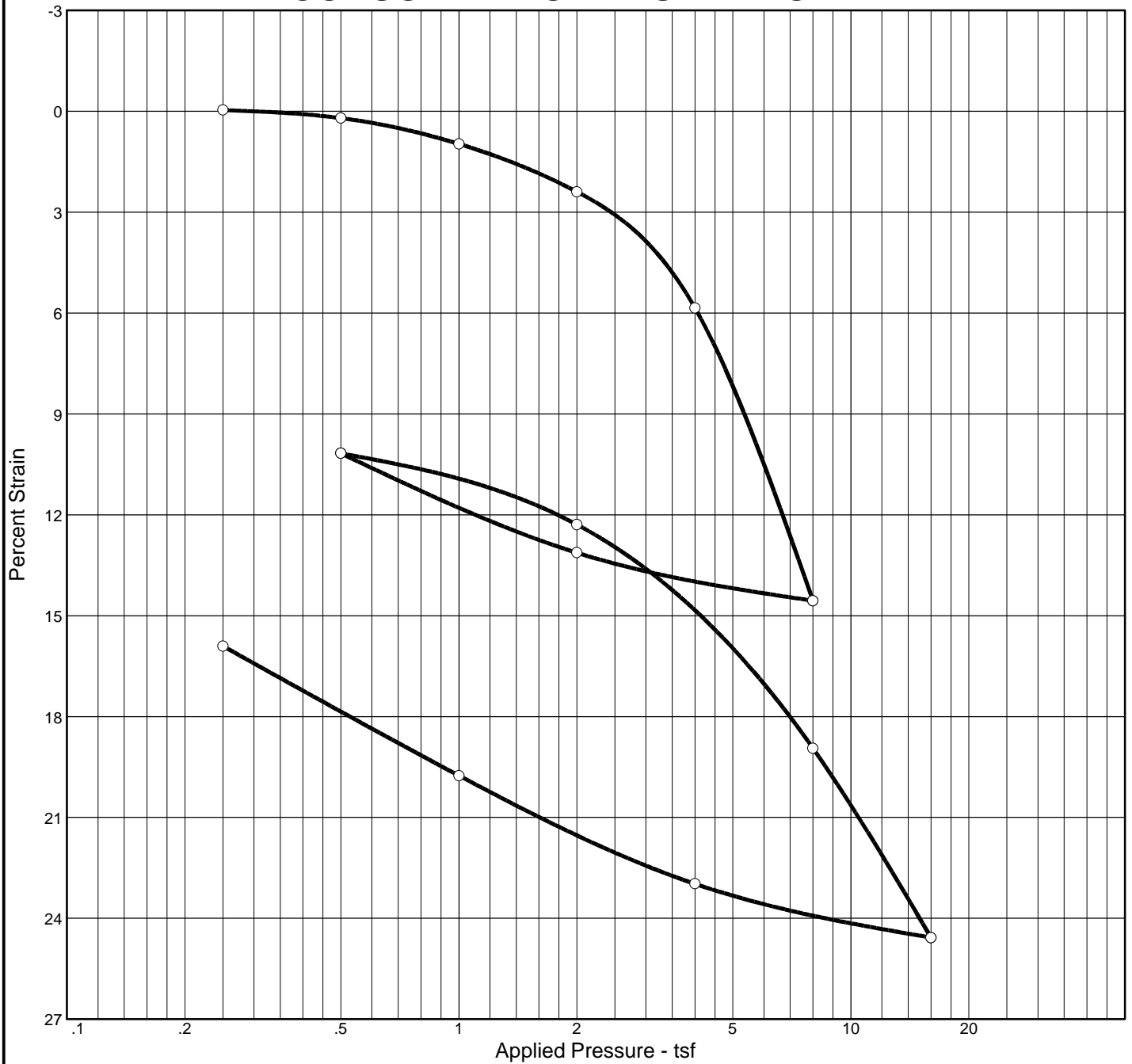
Void Ratio = 0.921 Compression = 13.4 %
 $D_0 = 0.13620$ $D_{50} = 0.16400$ $D_{100} = 0.19180$
 C_v at 10.6 min. = 0.02 ft.²/day $C_\alpha = 0.009$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.21010	14	6.00	0.22440
2	0.10	0.21230	15	7.20	0.22570
3	0.20	0.21300	16	9.00	0.22740
4	0.30	0.21350	17	10.00	0.22830
5	0.40	0.21400	18	14.00	0.23120
6	0.50	0.21440	19	22.30	0.23540
7	0.60	0.21480	20	34.00	0.23890
8	0.80	0.21540	21	45.00	0.24090
9	1.00	0.21600	22	63.00	0.24300
10	2.00	0.21840	23	130.00	0.24600
11	3.00	0.22030	24	204.10	0.24740
12	4.00	0.22190	25	459.00	0.24940
13	5.00	0.22320	26	1386.00	0.25160



Void Ratio = 0.771 Compression = 20.1 %
 $D_0 = 0.20600$ $D_{50} = 0.22454$ $D_{100} = 0.24308$
 C_v at 8.4 min. = 0.02 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.9 %	47.6 %	73.7	60	43	2.693		4.02	0.76	0.12			1.282

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 2</p> <p>Location: Boring11-118MU, #3, 45-47', Wild Rice, Argusville Formation</p> <div style="text-align: center; margin-top: 10px;"> </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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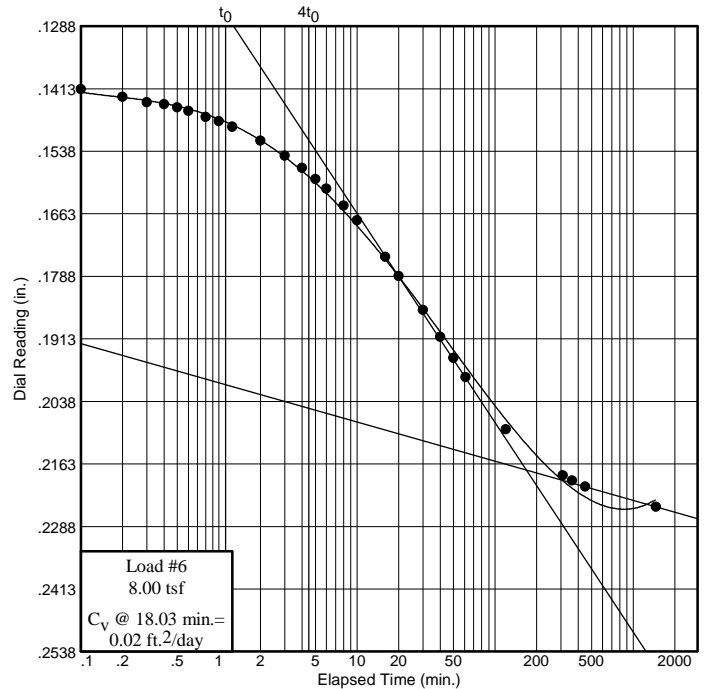
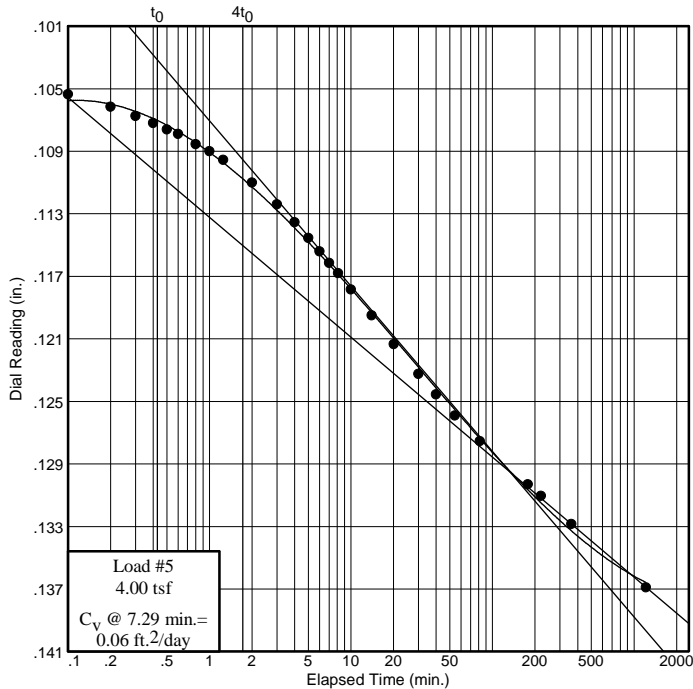
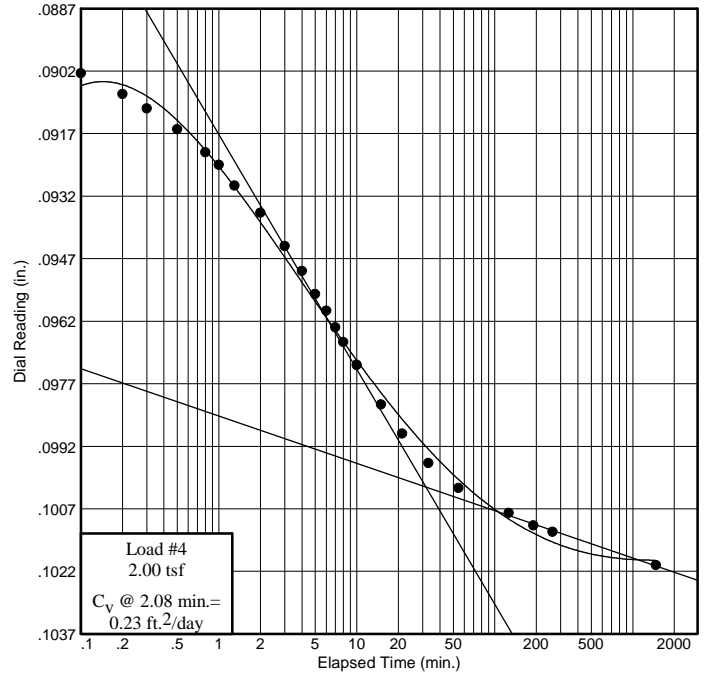
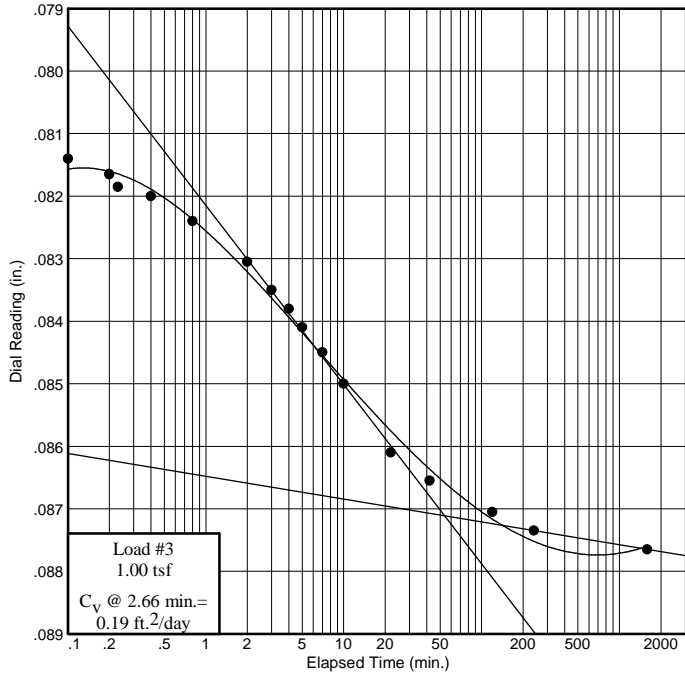
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #3, 45-47', Wild Rice, Argusville Formation



BRAUNSM
INTERTEC

Figure

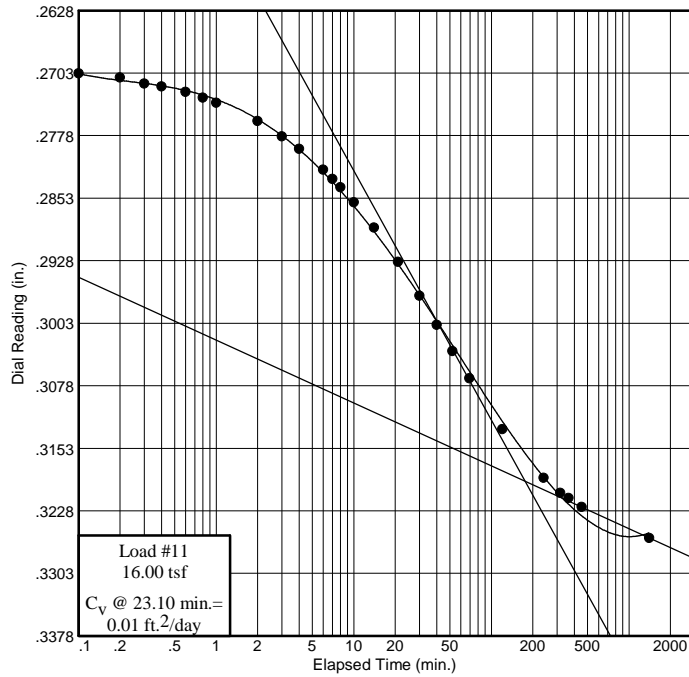
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #3, 45-47', Wild Rice, Argusville Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-118MU, #3
Elev. or Depth: 45-47' **Sample Length(in./cm.):**
Location: Boring11-118MU, #3, 45-47', Wild Rice, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 60 **Plasticity Index:** 43
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

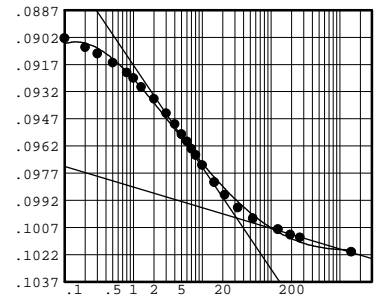
TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 158.48 g.	Consolidometer # = 2	Wet w+t =
Dry w+t = 117.09 g.		Dry w+t =
Tare Wt. = 30.09 g.	Spec. Gravity = 2.693	Tare Wt. =
Height = 1.01 in.	Height = 1.01 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 141.13 g.	Defl. Table = Machine2-Air-2011	
Moisture = 47.6 %	Ht. Solids = 0.4425 in.	Moisture = %
Wet Den. = 108.7 pcf	Dry Wt. = 95.63 g.*	Dry Wt. = n/a
Dry Den. = 73.7 pcf	Void Ratio = 1.282	Void Ratio = 0.919
	Saturation = 99.9 %	

* Initial dry weight used in calculations

End-of-Load Summary

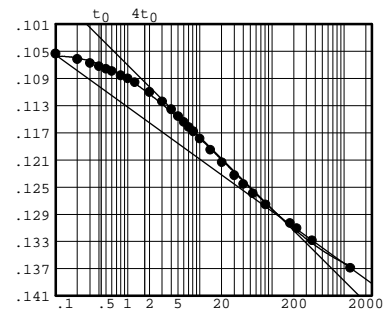
Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.07785				1.282	
0.25	0.07795	0.00050			1.283	0.0 Swell
0.50	0.08085	0.00095			1.278	0.2 Compr.
1.00	0.08920	0.00155	0.19	0.000	1.260	1.0 Compr.
2.00	0.10430	0.00225	0.23	0.001	1.228	2.4 Compr.
4.00	0.13985	0.00295	0.06	0.008	1.149	5.8 Compr.
8.00	0.22865	0.00380	0.02	0.008	0.950	14.6 Compr.
2.00	0.21270	0.00225			0.983	13.1 Compr.
0.50	0.18155	0.00095			1.050	10.2 Compr.
2.00	0.20425	0.00225			1.002	12.3 Compr.
8.00	0.27300	0.00380			0.850	18.9 Compr.
16.00	0.33100	0.00495	0.01	0.009	0.721	24.6 Compr.
4.00	0.31285	0.00295			0.758	23.0 Compr.
1.00	0.27895	0.00155			0.831	19.8 Compr.

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08920	13	6.00	0.09820
2	0.10	0.09250	14	7.00	0.09860
3	0.20	0.09300	15	8.00	0.09895
4	0.30	0.09335	16	10.00	0.09950
5	0.50	0.09385	17	15.00	0.10045
6	0.80	0.09440	18	21.30	0.10115
7	1.00	0.09470	19	33.00	0.10185
8	1.30	0.09520	20	54.50	0.10245
9	2.00	0.09585	21	126.50	0.10305
10	3.00	0.09665	22	190.50	0.10335
11	4.00	0.09725	23	262.50	0.10350
12	5.00	0.09780	24	1470.00	0.10430



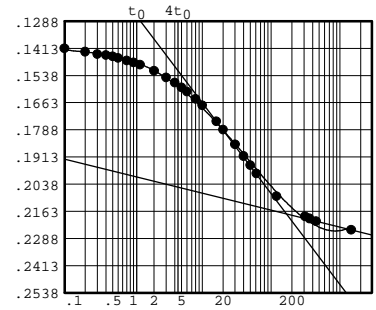
Void Ratio = 1.228 Compression = 2.4 %
 $D_0 = 0.08765$ $D_{50} = 0.09391$ $D_{100} = 0.10018$
 C_v at 2.1 min. = 0.23 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10430	15	6.00	0.11835
2	0.10	0.10830	16	7.00	0.11910
3	0.20	0.10910	17	8.10	0.11975
4	0.30	0.10970	18	10.00	0.12080
5	0.40	0.11015	19	14.00	0.12245
6	0.50	0.11055	20	20.10	0.12430
7	0.60	0.11085	21	30.00	0.12620
8	0.80	0.11150	22	40.00	0.12750
9	1.00	0.11195	23	54.30	0.12885
10	1.25	0.11250	24	81.30	0.13050
11	2.00	0.11395	25	178.00	0.13325
12	3.00	0.11535	26	220.00	0.13400
13	4.00	0.11650	27	361.00	0.13580
14	5.00	0.11750	28	1218.00	0.13985



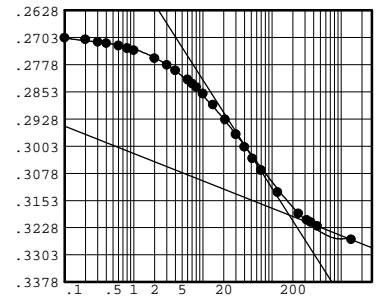
Void Ratio = 1.149 Compression = 5.8 %
 $D_0 = 0.10332$ $D_{50} = 0.11642$ $D_{100} = 0.12953$
 C_v at 7.3 min. = 0.06 ft.²/day $C_\alpha = 0.008$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13985	15	6.00	0.16505
2	0.10	0.14520	16	8.00	0.16845
3	0.20	0.14670	17	10.00	0.17140
4	0.30	0.14780	18	16.00	0.17870
5	0.40	0.14820	19	20.00	0.18255
6	0.50	0.14885	20	30.00	0.18935
7	0.60	0.14955	21	40.00	0.19470
8	0.80	0.15075	22	50.00	0.19890
9	1.00	0.15160	23	61.00	0.20275
10	1.25	0.15270	24	120.00	0.21320
11	2.00	0.15550	25	310.00	0.22240
12	3.00	0.15850	26	361.00	0.22340
13	4.00	0.16095	27	450.00	0.22465
14	5.00	0.16315	28	1460.00	0.22865



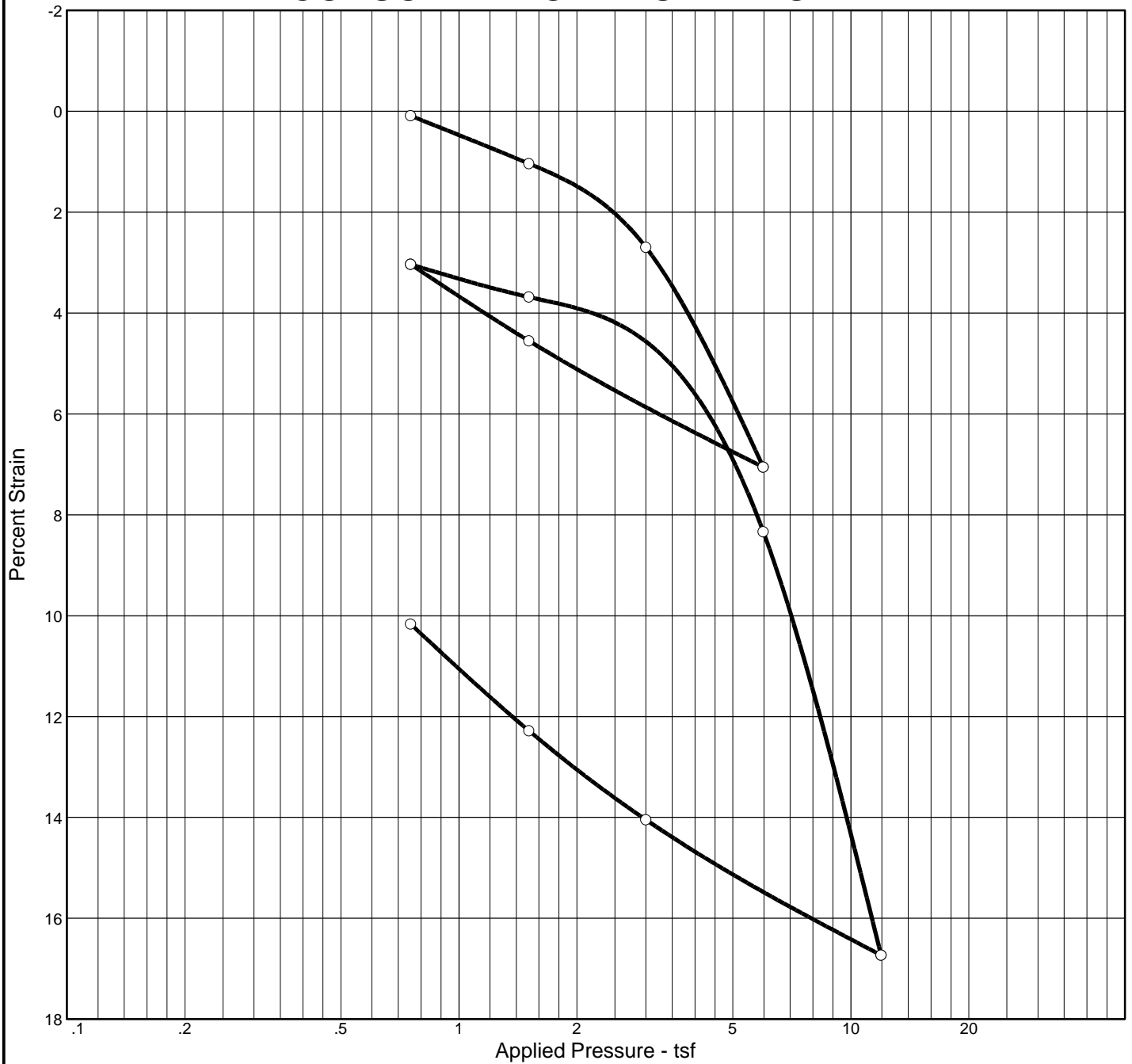
Void Ratio = 0.950 Compression = 14.6 %
 $D_0 = 0.13697$ $D_{50} = 0.17723$ $D_{100} = 0.21750$
 C_v at 18.0 min. = 0.02 ft.²/day $C_\alpha = 0.008$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.27300	15	10.00	0.29075
2	0.10	0.27530	16	14.00	0.29380
3	0.20	0.27580	17	21.00	0.29790
4	0.30	0.27650	18	30.00	0.30195
5	0.40	0.27685	19	40.00	0.30545
6	0.60	0.27750	20	52.00	0.30860
7	0.80	0.27820	21	69.00	0.31185
8	1.00	0.27880	22	120.00	0.31795
9	2.00	0.28100	23	240.00	0.32380
10	3.00	0.28285	24	317.00	0.32560
11	4.00	0.28435	25	363.00	0.32620
12	6.00	0.28685	26	453.00	0.32730
13	7.00	0.28795	27	1402.00	0.33100
14	8.00	0.28895			



Void Ratio = 0.721 Compression = 24.6 %
 $D_0 = 0.26920$ $D_{50} = 0.29423$ $D_{100} = 0.31926$
 C_v at 23.1 min. = 0.01 ft.²/day $C_\alpha = 0.009$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.6 %	45.7 %	75.1	77	55	2.687		4.41	0.74	0.12			1.233

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 2</p> <p>Location: Boring11-118MU, #4, 55-57', Wild Rice, Argusville Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUN <small>SM</small> INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right; font-weight: bold;">Figure</p>
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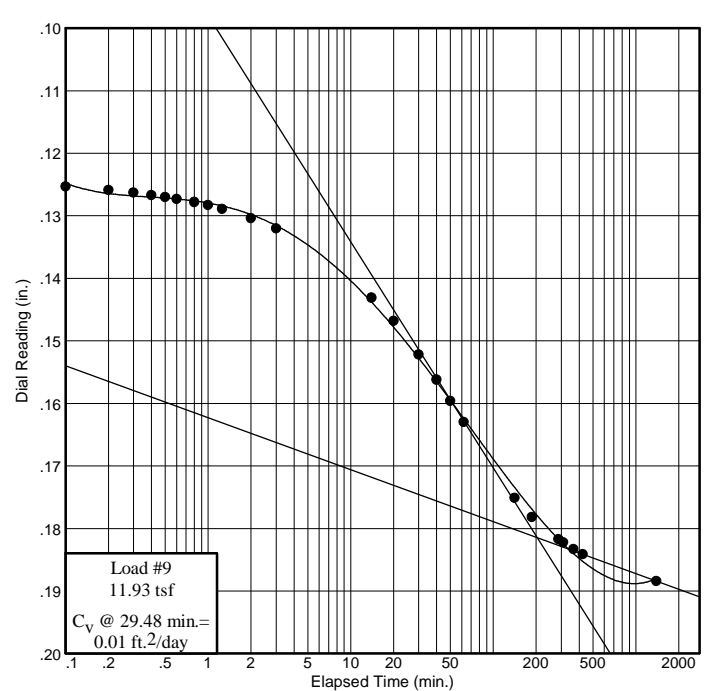
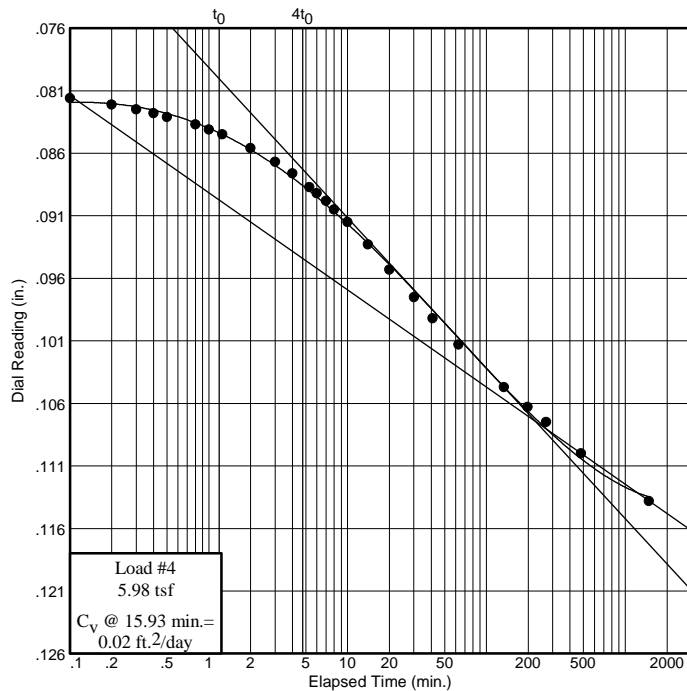
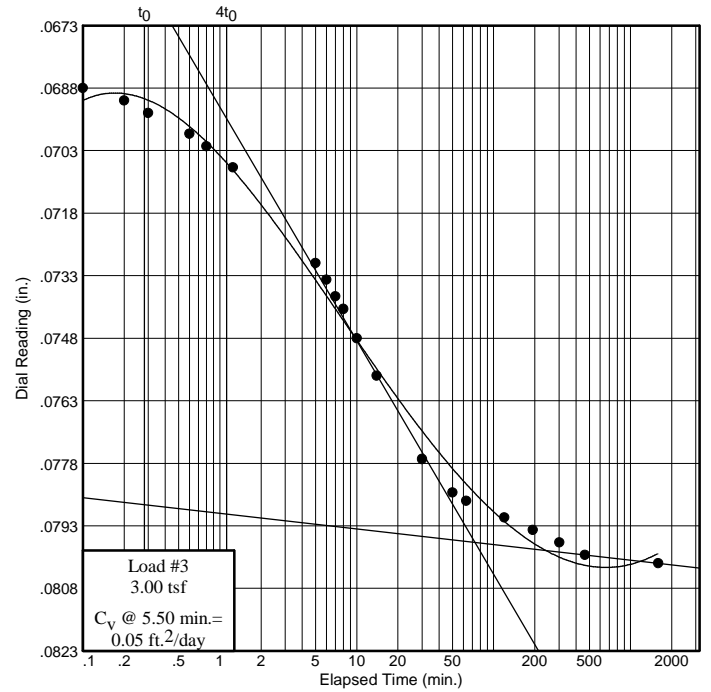
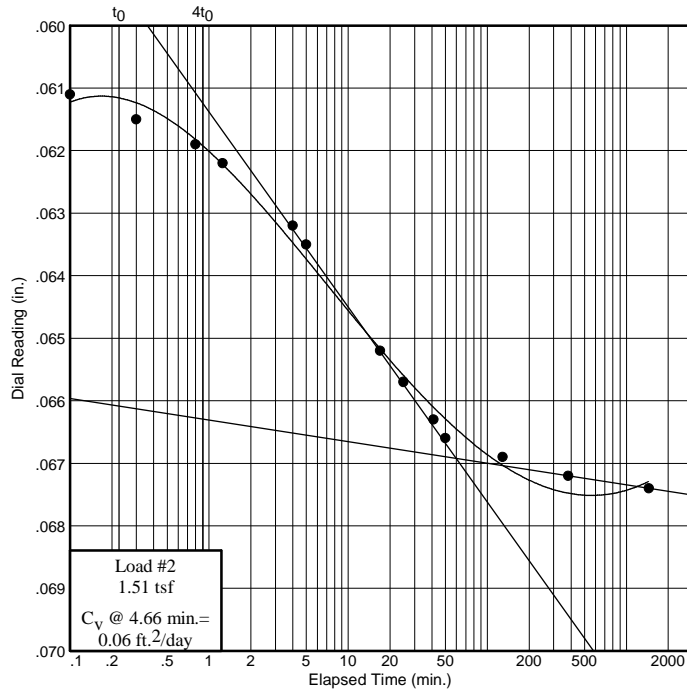
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #4, 55-57', Wild Rice, Argusville Formation



BRAUNSM
INTERTEC

Figure

CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: Boring11-118MU, #4
Elev. or Depth: 55-57' **Sample Length(in./cm.):**
Location: Boring11-118MU, #4, 55-57', Wild Rice, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 77 **Plasticity Index:** 55
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 139.43 g.	Consolidometer # = 5	Wet w+t =
Dry w+t = 105.15 g.		Dry w+t =
Tare Wt. = 30.11 g.	Spec. Gravity = 2.687	Tare Wt. =
Height = .77 in.	Height = .77 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 108.81 g.	Defl. Table = Machine5-2009	
Moisture = 45.7 %	Ht. Solids = 0.3453 in.	Moisture = %
Wet Den. = 109.4 pcf	Dry Wt. = 74.69 g.*	Dry Wt. = n/a
Dry Den. = 75.1 pcf	Void Ratio = 1.233	Void Ratio = 1.006
	Saturation = 99.6 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.05940				1.233	
0.75	0.06200	0.00190			1.231	0.1 Compr.
1.51	0.07040	0.00300	0.06	0.000	1.210	1.0 Compr.
3.00	0.08450	0.00430	0.05	0.000	1.173	2.7 Compr.
5.98	0.11980	0.00600	0.02	0.010	1.075	7.1 Compr.
1.51	0.09750	0.00300			1.131	4.6 Compr.
0.75	0.08470	0.00190			1.165	3.0 Compr.
1.51	0.09080	0.00300			1.151	3.7 Compr.
5.98	0.12970	0.00600			1.047	8.3 Compr.
11.93	0.19670	0.00830	0.01	0.012	0.859	16.7 Compr.
3.00	0.17200	0.00430			0.919	14.0 Compr.
1.51	0.15710	0.00300			0.959	12.3 Compr.
0.75	0.13970	0.00190			1.006	10.2 Compr.

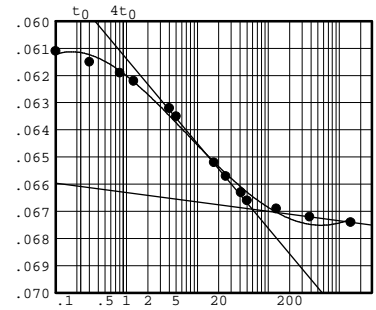
C_c = 0.74 P_c = 4.41 tsf C_r = 0.12

Pressure: 1.51 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06200	11	50.00	0.06960
2	0.10	0.06410	12	129.00	0.06990
3	0.30	0.06450	13	382.00	0.07020
4	0.80	0.06490	14	1449.00	0.07040
5	1.25	0.06520			
6	4.00	0.06620			
7	5.00	0.06650			
8	17.00	0.06820			
9	25.00	0.06870			
10	41.00	0.06930			



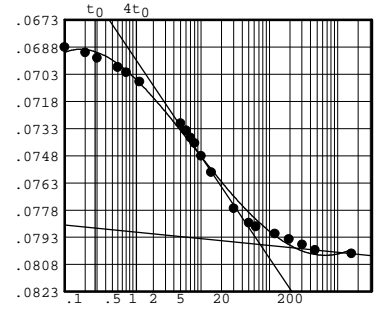
Void Ratio = 1.210 Compression = 1.0 %
 $D_0 = 0.06039$ $D_{50} = 0.06366$ $D_{100} = 0.06692$
 C_v at 4.7 min. = 0.06 ft.²/day $C_\alpha = 0.000$

Pressure: 3.00 tsf

TEST READINGS

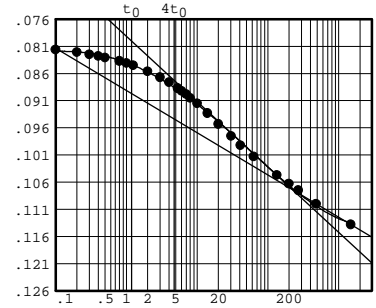
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.07040	12	10.00	0.07910
2	0.10	0.07310	13	14.00	0.08000
3	0.20	0.07340	14	30.00	0.08200
4	0.30	0.07370	15	50.00	0.08280
5	0.60	0.07420	16	63.00	0.08300
6	0.80	0.07450	17	120.00	0.08340
7	1.25	0.07500	18	193.00	0.08370
8	5.00	0.07730	19	302.00	0.08400
9	6.00	0.07770	20	466.00	0.08430
10	7.00	0.07810	21	1592.00	0.08450
11	8.00	0.07840			



Void Ratio = 1.173 Compression = 2.7 %
 $D_0 = 0.06751$ $D_{50} = 0.07360$ $D_{100} = 0.07970$
 C_v at 5.5 min. = 0.05 ft.²/day $C_\alpha = 0.000$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08450	15	7.00	0.09580
2	0.10	0.08760	16	8.00	0.09650
3	0.20	0.08810	17	10.00	0.09750
4	0.30	0.08850	18	14.00	0.09930
5	0.40	0.08880	19	20.00	0.10130
6	0.50	0.08910	20	30.10	0.10350
7	0.80	0.08970	21	41.00	0.10520
8	1.00	0.09010	22	63.00	0.10730
9	1.25	0.09050	23	134.00	0.11070
10	2.00	0.09160	24	198.00	0.11230
11	3.00	0.09270	25	270.00	0.11350
12	4.00	0.09360	26	480.00	0.11600
13	5.30	0.09470	27	1480.00	0.11980
14	6.00	0.09520			

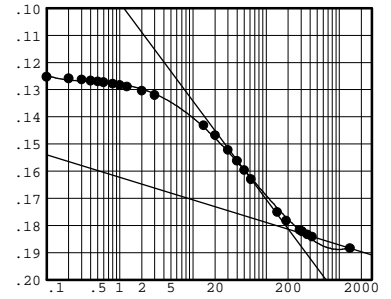


Void Ratio = 1.075 Compression = 7.1 %
 $D_0 = 0.08016$ $D_{50} = 0.09381$ $D_{100} = 0.10746$
 C_v at 15.9 min. = 0.02 ft.²/day $C_\alpha = 0.010$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09080	10	4.00	0.10290	19	50.00	0.12100
2	0.30	0.09550	11	6.00	0.10510	20	60.00	0.12190
3	0.40	0.09590	12	7.00	0.10600	21	124.00	0.12430
4	0.50	0.09630	13	8.00	0.10690	22	266.00	0.12620
5	0.80	0.09730	14	10.00	0.10860	23	345.00	0.12690
6	1.00	0.09780	15	14.00	0.11120	24	420.00	0.12730
7	1.25	0.09840	16	20.00	0.11430	25	1499.00	0.12970
8	2.00	0.09990	17	30.00	0.11770			
9	3.00	0.10150	18	40.00	0.11970			

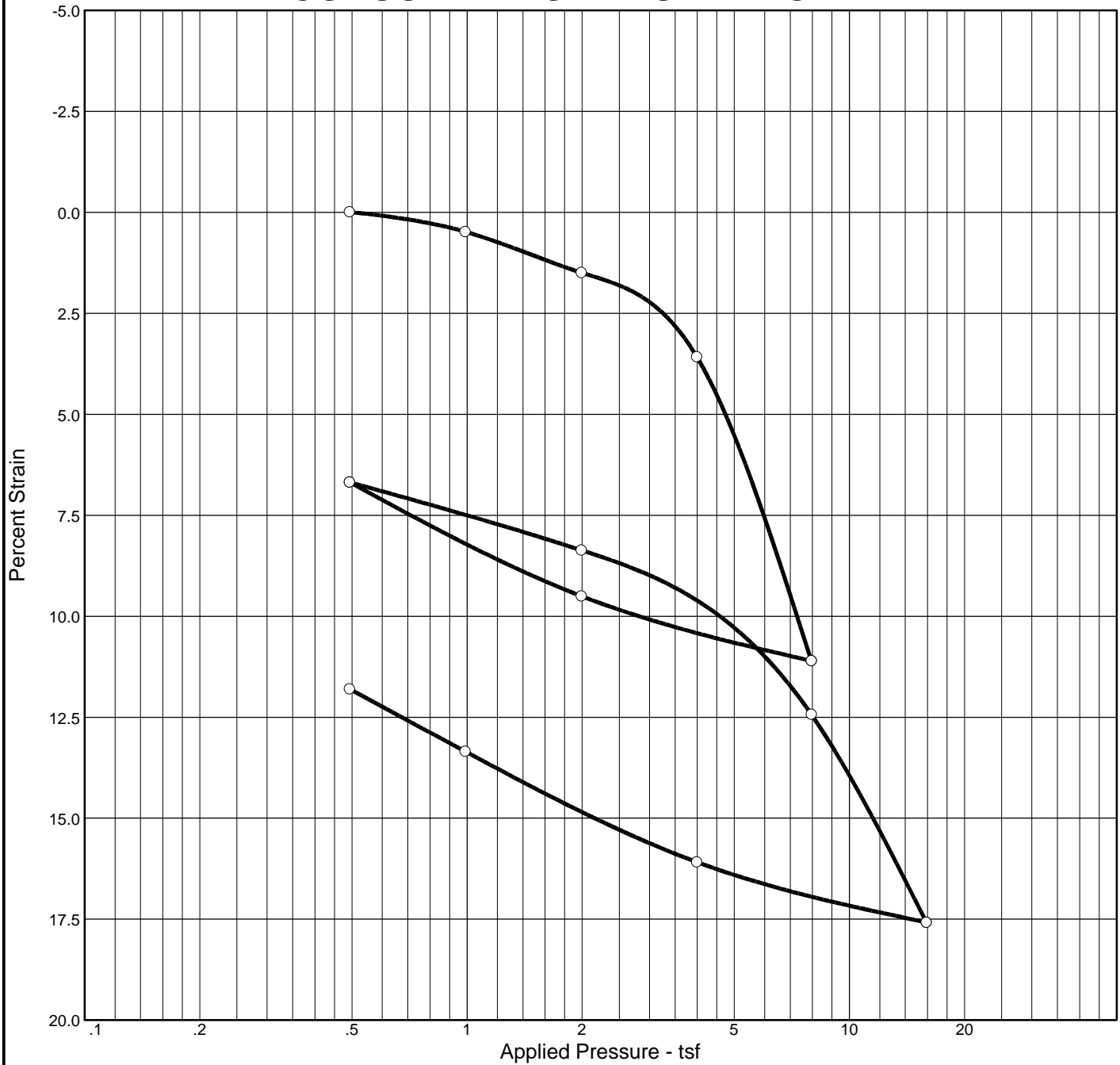
Void Ratio = 1.047 Compression = 8.3 %

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12970	14	20.00	0.15510
2	0.10	0.13360	15	30.00	0.16050
3	0.20	0.13420	16	40.00	0.16450
4	0.30	0.13460	17	50.00	0.16790
5	0.40	0.13500	18	62.00	0.17130
6	0.50	0.13530	19	141.00	0.18340
7	0.60	0.13560	20	187.00	0.18650
8	0.80	0.13610	21	286.00	0.19000
9	1.00	0.13660	22	309.00	0.19050
10	1.25	0.13720	23	365.00	0.19160
11	2.00	0.13870	24	424.00	0.19240
12	3.00	0.14030	25	1396.00	0.19670
13	14.00	0.15140			



Void Ratio = 0.859 Compression = 16.7 %
 $D_0 = 0.12370$ $D_{50} = 0.15257$ $D_{100} = 0.18144$
 C_v at 29.5 min. = 0.01 ft.²/day $C_\alpha = 0.012$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
100.1 %	39.6 %	81.5	61	41	2.695		4.52	0.59	0.09			1.066

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 2</p> <p>Location: Boring11-118MU, #5, 65-67', Wild Rice, Argusville Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUN <small>SM</small> INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right;">Figure</p>
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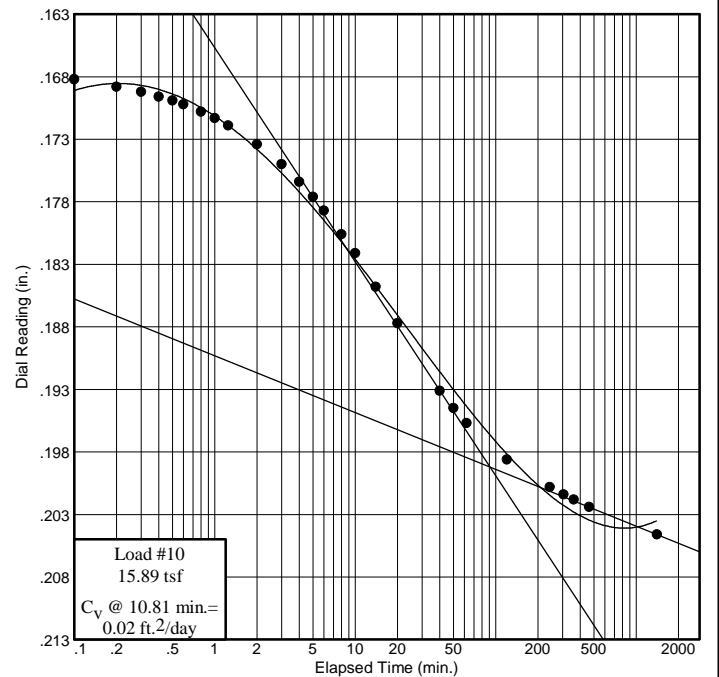
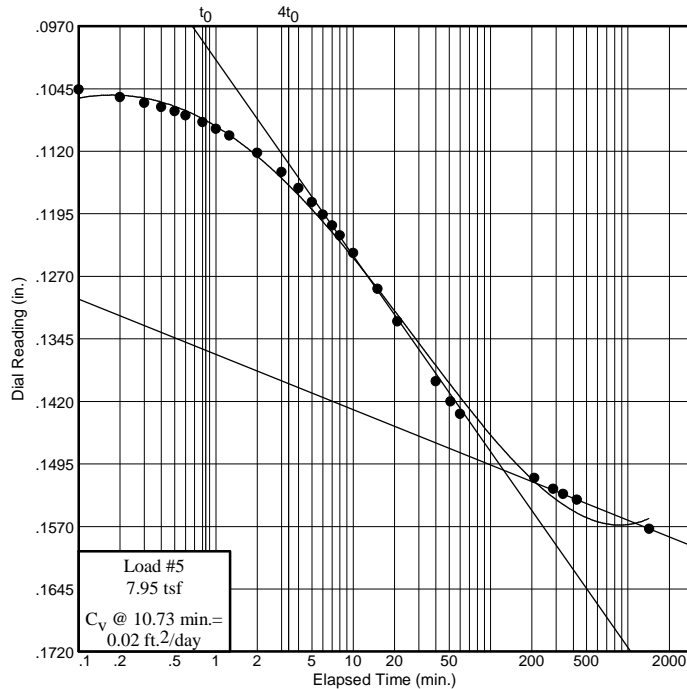
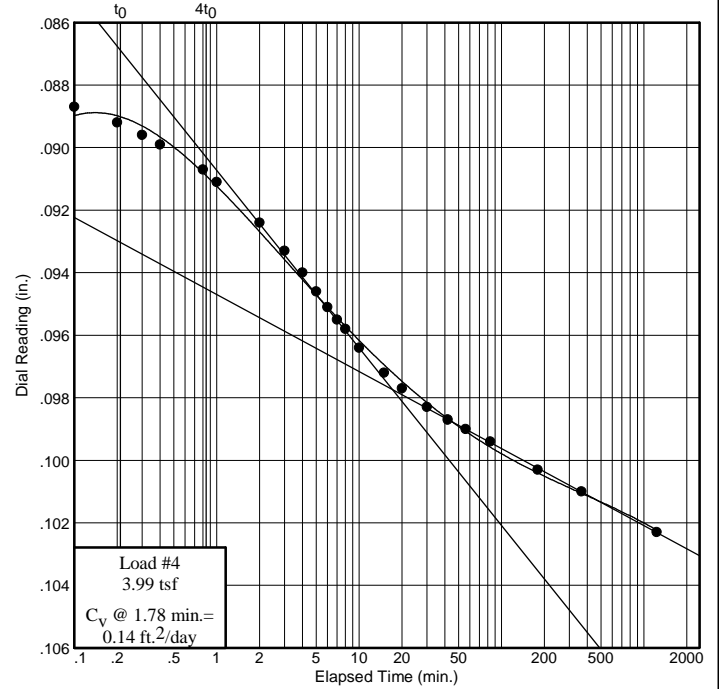
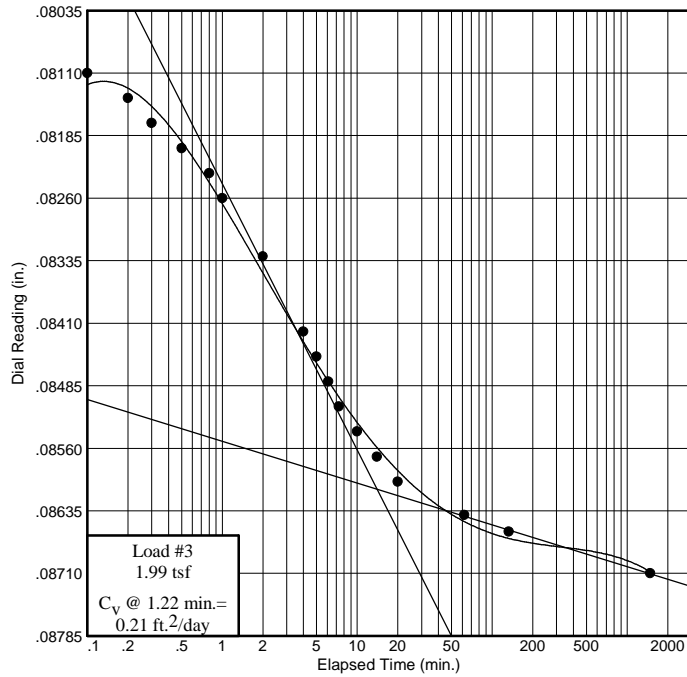
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 2

Location: Boring11-118MU, #5, 65-67', Wild Rice, Argusville Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 2
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-118MU, #5
Elev. or Depth: 65-67' **Sample Length(in./cm.):**
Location: Boring11-118MU, #5, 65-67', Wild Rice, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 61 **Plasticity Index:** 41
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 166.80 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 128.34 g.		Dry w+t =
Tare Wt. = 31.13 g.	Spec. Gravity = 2.695	Tare Wt. =
Height = .73 in.	Height = .73 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 106.83 g.	Defl. Table = Machine3-2009	
Moisture = 39.6 %	Ht. Solids = 0.3537 in.	Moisture = %
Wet Den. = 113.7 pcf	Dry Wt. = 76.55 g.*	Dry Wt. = n/a
Dry Den. = 81.5 pcf	Void Ratio = 1.066	Void Ratio = 0.822
	Saturation = 100.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.07620				1.066	
0.49	0.07660	0.00050			1.066	0.0 Swell
0.99	0.08040	0.00070			1.056	0.5 Compr.
1.99	0.08810	0.00100	0.21	0.001	1.035	1.5 Compr.
3.99	0.10380	0.00150	0.14	0.003	0.992	3.6 Compr.
7.95	0.15930	0.00200	0.02	0.009	0.836	11.1 Compr.
1.99	0.14660	0.00100			0.869	9.5 Compr.
0.49	0.12550	0.00050			0.928	6.7 Compr.
1.99	0.13830	0.00100			0.893	8.4 Compr.
7.95	0.16900	0.00200			0.809	12.4 Compr.
15.89	0.20750	0.00290	0.02	0.007	0.702	17.6 Compr.
3.99	0.19520	0.00150			0.733	16.1 Compr.
0.99	0.17440	0.00070			0.790	13.3 Compr.
0.49	0.16290	0.00050			0.822	11.8 Compr.

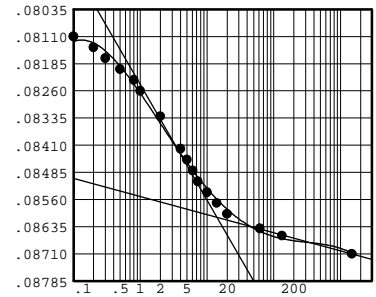
$C_c = 0.59$ $P_c = 4.52$ tsf $C_r = 0.09$

Pressure: 1.99 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08040	11	6.10	0.08580
2	0.10	0.08210	12	7.30	0.08610
3	0.20	0.08240	13	10.00	0.08640
4	0.30	0.08270	14	14.00	0.08670
5	0.50	0.08300	15	20.00	0.08700
6	0.80	0.08330	16	62.00	0.08740
7	1.00	0.08360	17	133.00	0.08760
8	2.00	0.08430	18	1479.00	0.08810
9	4.00	0.08520			
10	5.00	0.08550			



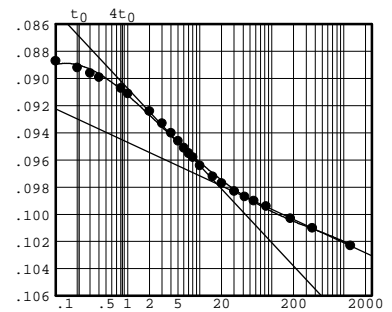
Void Ratio = 1.035 Compression = 1.5 %
 $D_0 = 0.07970$ $D_{50} = 0.08290$ $D_{100} = 0.08609$
 C_v at 1.2 min. = 0.21 ft.²/day $C_\alpha = 0.001$

Pressure: 3.99 tsf

TEST READINGS

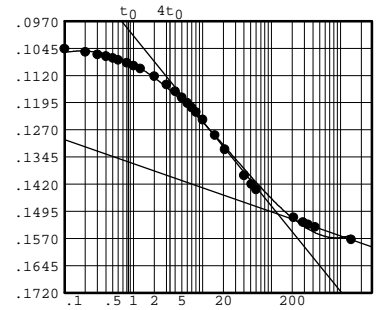
Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08810	13	7.00	0.09700
2	0.10	0.09020	14	8.00	0.09730
3	0.20	0.09070	15	10.00	0.09790
4	0.30	0.09110	16	15.00	0.09870
5	0.40	0.09140	17	20.00	0.09920
6	0.80	0.09220	18	30.00	0.09980
7	1.00	0.09260	19	42.00	0.10020
8	2.00	0.09390	20	56.00	0.10050
9	3.00	0.09480	21	83.30	0.10090
10	4.00	0.09550	22	180.00	0.10180
11	5.00	0.09610	23	364.00	0.10250
12	6.00	0.09660	24	1228.00	0.10380



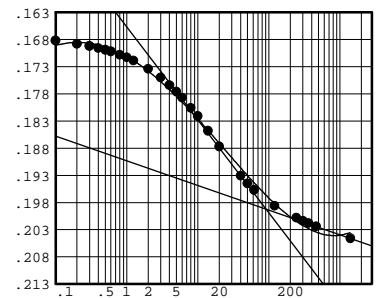
Void Ratio = 0.992 Compression = 3.6 %
 $D_0 = 0.08713$ $D_{50} = 0.09243$ $D_{100} = 0.09774$
 C_v at 1.8 min. = 0.14 ft.²/day $C_\alpha = 0.003$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10380	15	6.00	0.12160
2	0.10	0.10660	16	7.00	0.12290
3	0.20	0.10750	17	8.00	0.12410
4	0.30	0.10820	18	10.00	0.12620
5	0.40	0.10870	19	15.00	0.13050
6	0.50	0.10920	20	21.00	0.13440
7	0.60	0.10970	21	40.00	0.14160
8	0.80	0.11050	22	51.00	0.14400
9	1.00	0.11130	23	60.00	0.14550
10	1.25	0.11210	24	208.00	0.15320
11	2.00	0.11420	25	286.00	0.15450
12	3.00	0.11650	26	338.00	0.15510
13	4.00	0.11840	27	425.00	0.15580
14	5.00	0.12010	28	1432.00	0.15930



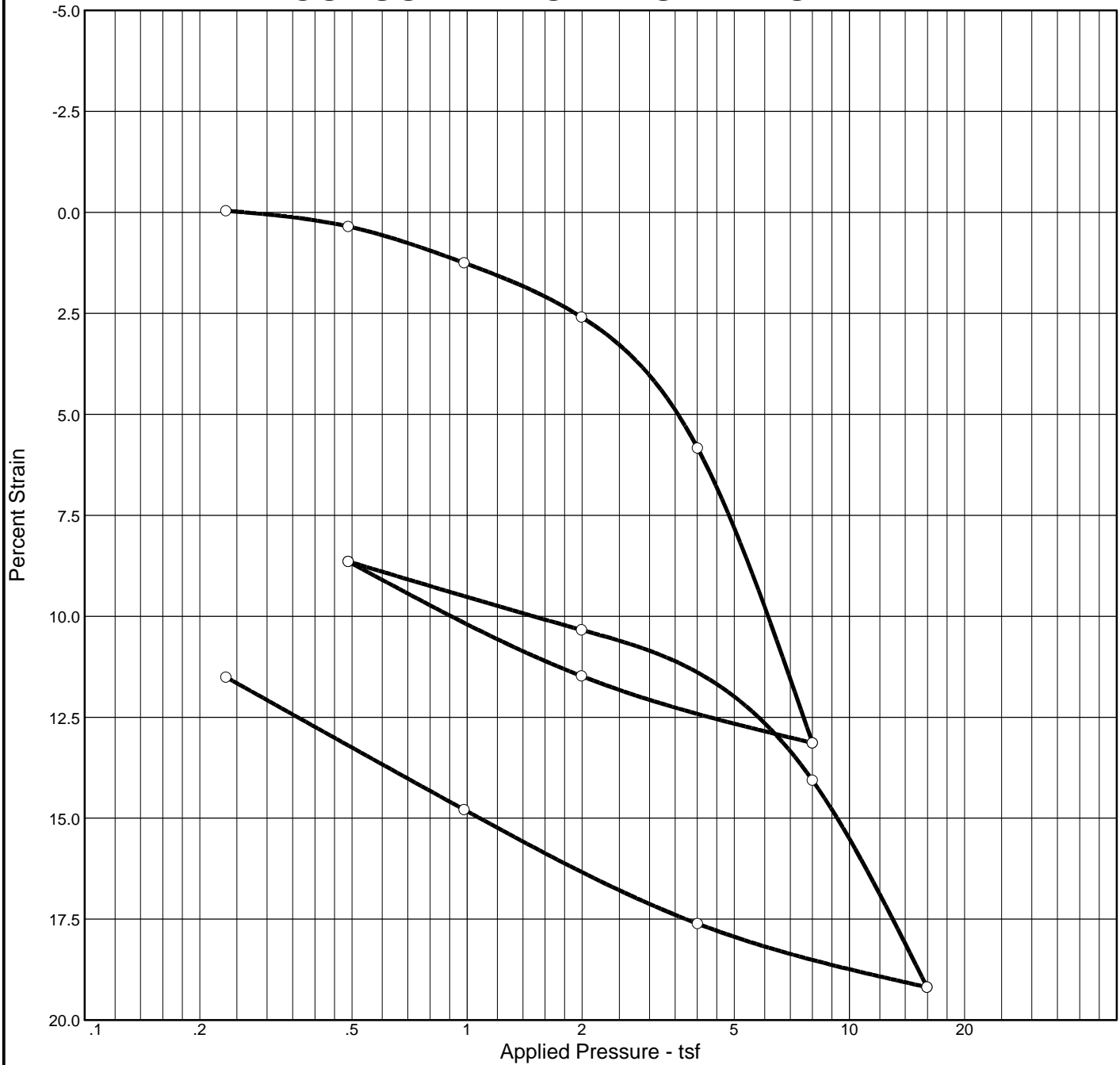
Void Ratio = 0.836 Compression = 11.1 %
 $D_0 = 0.10059$ $D_{50} = 0.12543$ $D_{100} = 0.15026$
 C_v at 10.7 min. = 0.02 ft.²/day $C_\alpha = 0.009$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.16900	15	6.00	0.18160
2	0.10	0.17110	16	8.00	0.18350
3	0.20	0.17170	17	10.00	0.18500
4	0.30	0.17210	18	14.00	0.18770
5	0.40	0.17250	19	20.00	0.19060
6	0.50	0.17280	20	40.00	0.19600
7	0.60	0.17310	21	50.00	0.19740
8	0.80	0.17370	22	62.00	0.19860
9	1.00	0.17420	23	120.00	0.20150
10	1.25	0.17480	24	243.00	0.20370
11	2.00	0.17630	25	304.00	0.20430
12	3.00	0.17790	26	360.00	0.20470
13	4.00	0.17930	27	462.00	0.20530
14	5.00	0.18050	28	1410.00	0.20750



Void Ratio = 0.702 Compression = 17.6 %
 $D_0 = 0.16700$ $D_{50} = 0.18310$ $D_{100} = 0.19920$
 C_v at 10.8 min. = 0.02 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
99.1 %	41.5 %	79.1	56	34	2.698		3.22	0.46	0.09			1.131

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 3</p> <p>Location: Boring11-119MU, #2, 40-42', Fargo Pile Load Test, Argusville Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUN INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right; font-weight: bold;">Figure</p>
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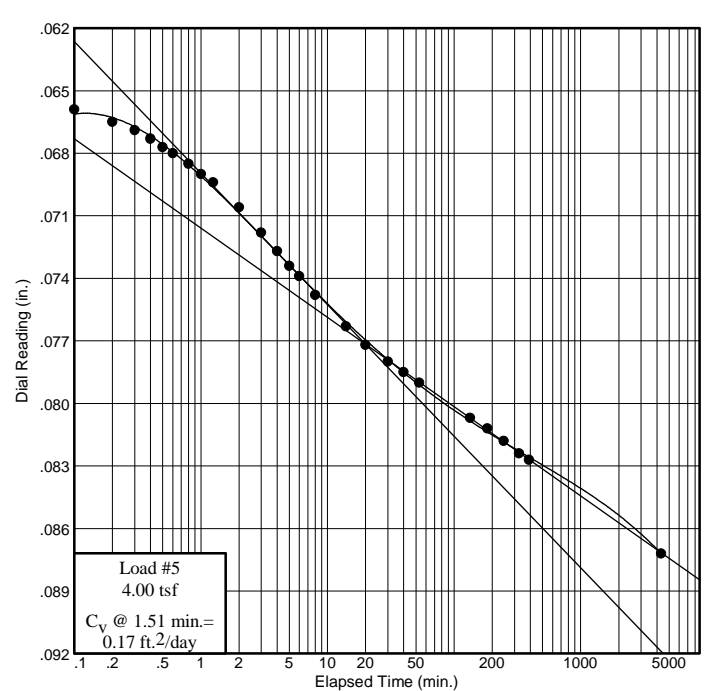
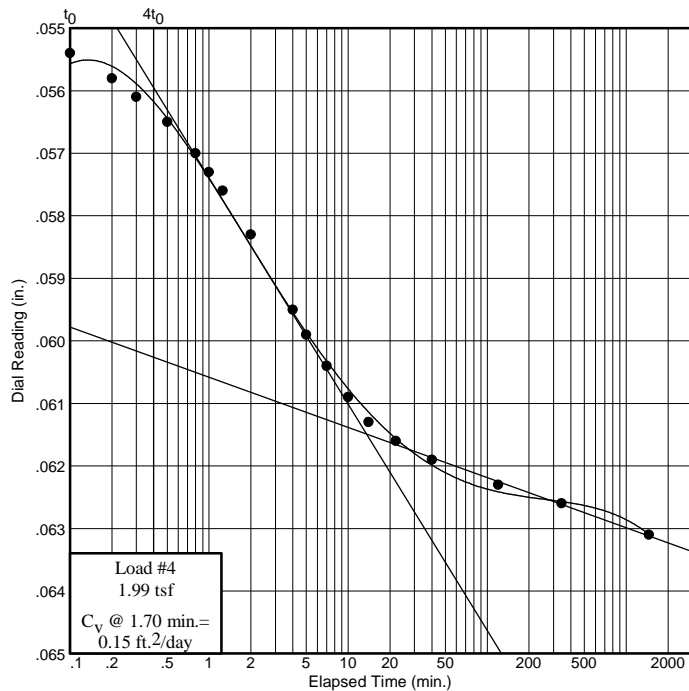
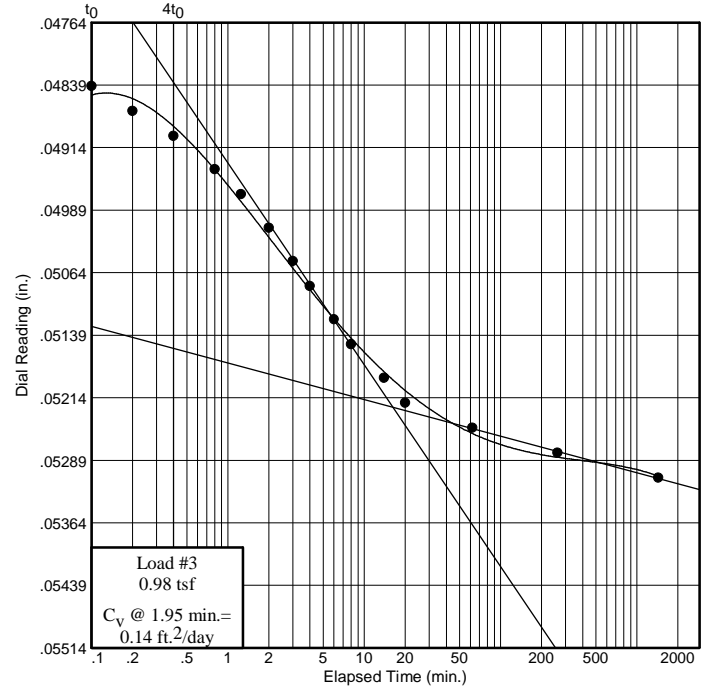
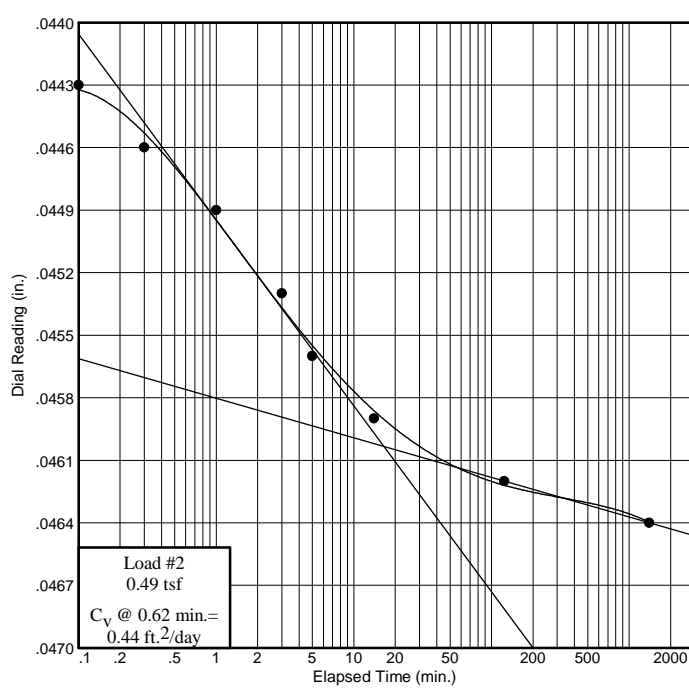
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-119MU, #2, 40-42', Fargo Pile Load Test, Argusville Formation



BRAUNSM
INTERTEC

Figure

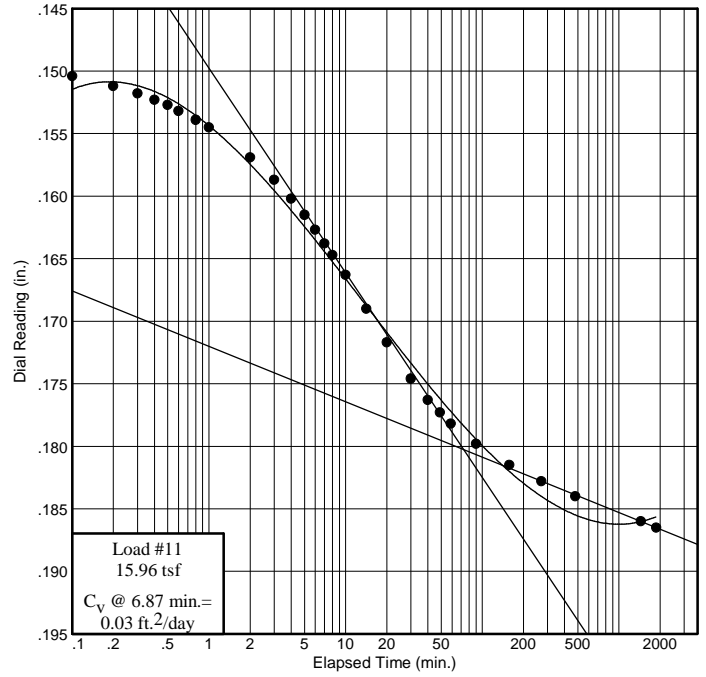
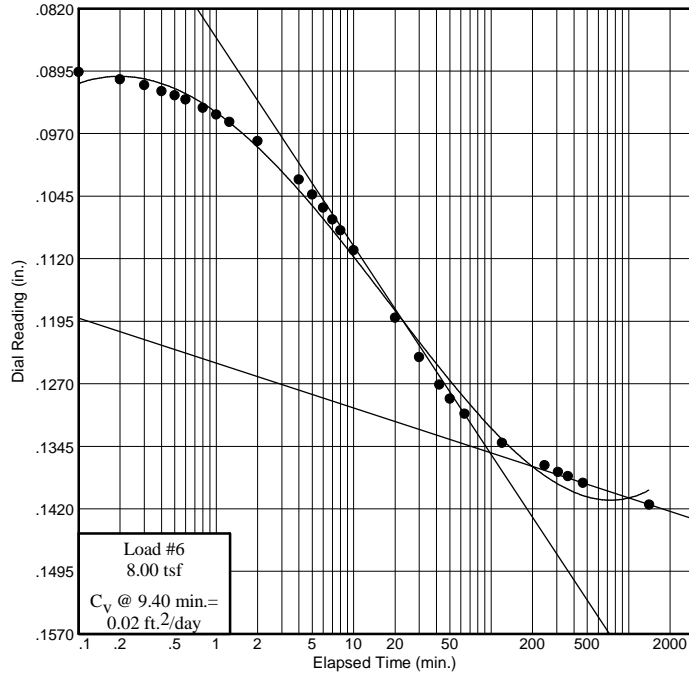
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-119MU, #2, 40-42', Fargo Pile Load Test, Argusville Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-119MU, #2
Elev. or Depth: 40-42' **Sample Length(in./cm.):**
Location: Boring11-119MU, #2, 40-42', Fargo Pile Load Test, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 56 **Plasticity Index:** 34
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 161.71 g.	Consolidometer # = 4	Wet w+t =
Dry w+t = 123.10 g.		Dry w+t =
Tare Wt. = 30.17 g.	Spec. Gravity = 2.698	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.49 in.	Diameter = 2.49 in.	
Weight = 106.82 g.	Defl. Table = Machine4-2009	
Moisture = 41.5 %	Ht. Solids = 0.3491 in.	Moisture = %
Wet Den. = 111.9 pcf	Dry Wt. = 75.47 g.*	Dry Wt. = n/a
Dry Den. = 79.1 pcf	Void Ratio = 1.131	Void Ratio = 0.885
	Saturation = 99.1 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.04380				1.131	
0.23	0.04400	0.00050			1.131	0.0 Swell
0.49	0.04720	0.00080	0.44	0.000	1.123	0.3 Compr.
0.98	0.05410	0.00100	0.14	0.001	1.104	1.3 Compr.
1.99	0.06460	0.00150	0.15	0.001	1.075	2.6 Compr.
4.00	0.08920	0.00200	0.17	0.006	1.006	5.8 Compr.
8.00	0.14420	0.00270	0.02	0.008	0.851	13.1 Compr.
1.99	0.13070	0.00150			0.886	11.5 Compr.
0.49	0.10890	0.00080			0.946	8.6 Compr.
1.99	0.12220	0.00150			0.910	10.3 Compr.
8.00	0.15110	0.00270			0.831	14.1 Compr.
15.96	0.19010	0.00360	0.03	0.007	0.722	19.2 Compr.
4.00	0.17680	0.00200			0.755	17.6 Compr.
0.98	0.15480	0.00100			0.816	14.8 Compr.

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft. ² /day)	C_α	Void Ratio	% Compression /Swell
0.23	0.12990	0.00050			0.885	11.5 Compr.

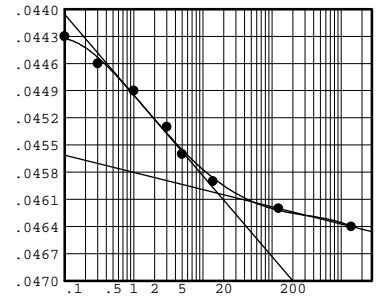
$C_c = 0.46$ $P_c = 3.22$ tsf $C_r = 0.09$

Pressure: 0.49 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading
1	0.00	0.04400
2	0.10	0.04510
3	0.30	0.04540
4	1.00	0.04570
5	3.00	0.04610
6	5.00	0.04640
7	14.00	0.04670
8	124.00	0.04700
9	1400.00	0.04720



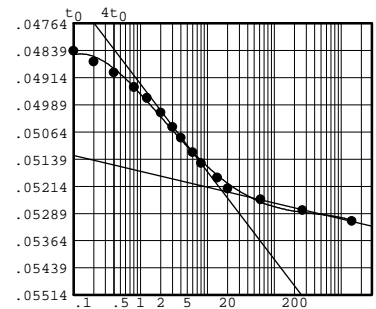
Void Ratio = 1.123 Compression = 0.3 %
 $D_0 = 0.04350$ $D_{50} = 0.04477$ $D_{100} = 0.04603$
 C_v at 0.6 min. = 0.44 ft.²/day $C_\alpha = 0.000$

Pressure: 0.98 tsf

TEST READINGS

Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.04720	11	8.00	0.05250
2	0.10	0.04940	12	14.00	0.05290
3	0.20	0.04970	13	20.00	0.05320
4	0.40	0.05000	14	62.00	0.05350
5	0.80	0.05040	15	262.00	0.05380
6	1.25	0.05070	16	1437.00	0.05410
7	2.00	0.05110			
8	3.00	0.05150			
9	4.00	0.05180			
10	6.00	0.05220			



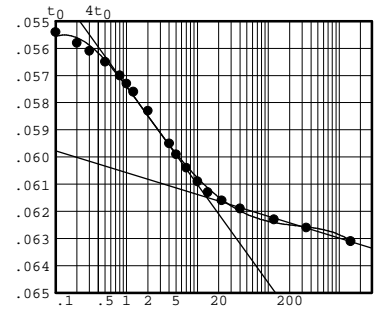
Void Ratio = 1.104 Compression = 1.3 %
 $D_0 = 0.04813$ $D_{50} = 0.05019$ $D_{100} = 0.05225$
 C_v at 1.9 min. = 0.14 ft.²/day $C_\alpha = 0.001$

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.05410	11	5.00	0.06140
2	0.10	0.05690	12	7.00	0.06190
3	0.20	0.05730	13	10.00	0.06240
4	0.30	0.05760	14	14.00	0.06280
5	0.50	0.05800	15	22.00	0.06310
6	0.80	0.05850	16	40.00	0.06340
7	1.00	0.05880	17	120.00	0.06380
8	1.25	0.05910	18	343.00	0.06410
9	2.00	0.05980	19	1452.00	0.06460
10	4.00	0.06100			



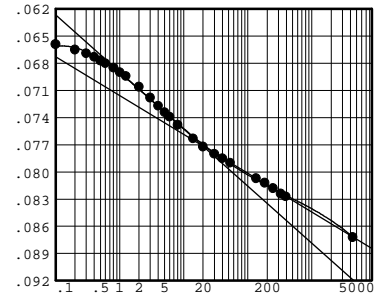
Void Ratio = 1.075 Compression = 2.6 %
 $D_0 = 0.05497$ $D_{50} = 0.05823$ $D_{100} = 0.06149$
 C_v at 1.7 min. = 0.15 ft.²/day $C_\alpha = 0.001$

Pressure: 4.00 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.06460	15	6.00	0.07590
2	0.10	0.06790	16	8.00	0.07680
3	0.20	0.06850	17	14.00	0.07830
4	0.30	0.06890	18	20.00	0.07920
5	0.40	0.06930	19	30.00	0.08000
6	0.50	0.06970	20	40.00	0.08050
7	0.60	0.07000	21	53.00	0.08100
8	0.80	0.07050	22	134.00	0.08270
9	1.00	0.07100	23	183.00	0.08320
10	1.25	0.07140	24	247.00	0.08380
11	2.00	0.07260	25	326.00	0.08440
12	3.00	0.07380	26	390.00	0.08470
13	4.00	0.07470	27	4333.00	0.08920
14	5.00	0.07540			



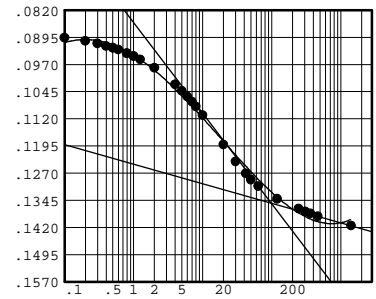
Void Ratio = 1.006 Compression = 5.8 %
 $D_0 = 0.06310$ $D_{50} = 0.07013$ $D_{100} = 0.07715$
 C_v at 1.5 min. = 0.17 ft.²/day $C_\alpha = 0.006$

Pressure: 8.00 tsf

TEST READINGS

Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08920	15	7.00	0.11000
2	0.10	0.09230	16	8.00	0.11130
3	0.20	0.09320	17	10.00	0.11370
4	0.30	0.09390	18	20.00	0.12180
5	0.40	0.09460	19	30.00	0.12650
6	0.50	0.09510	20	42.00	0.12980
7	0.60	0.09560	21	50.00	0.13150
8	0.80	0.09660	22	64.00	0.13330
9	1.00	0.09740	23	120.00	0.13680
10	1.25	0.09830	24	245.00	0.13950
11	2.00	0.10060	25	307.00	0.14030
12	4.00	0.10520	26	362.00	0.14080
13	5.00	0.10700	27	465.00	0.14160
14	6.00	0.10860	28	1411.00	0.14420



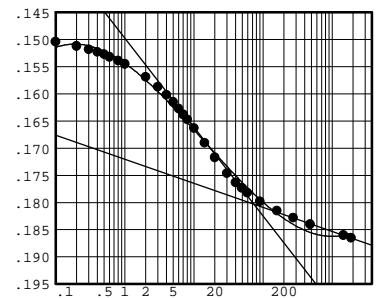
Void Ratio = 0.851 Compression = 13.1 %
 $D_0 = 0.08720$ $D_{50} = 0.11122$ $D_{100} = 0.13525$
 C_v at 9.4 min. = 0.02 ft.²/day $C_\alpha = 0.008$

Pressure: 15.96 tsf

TEST READINGS

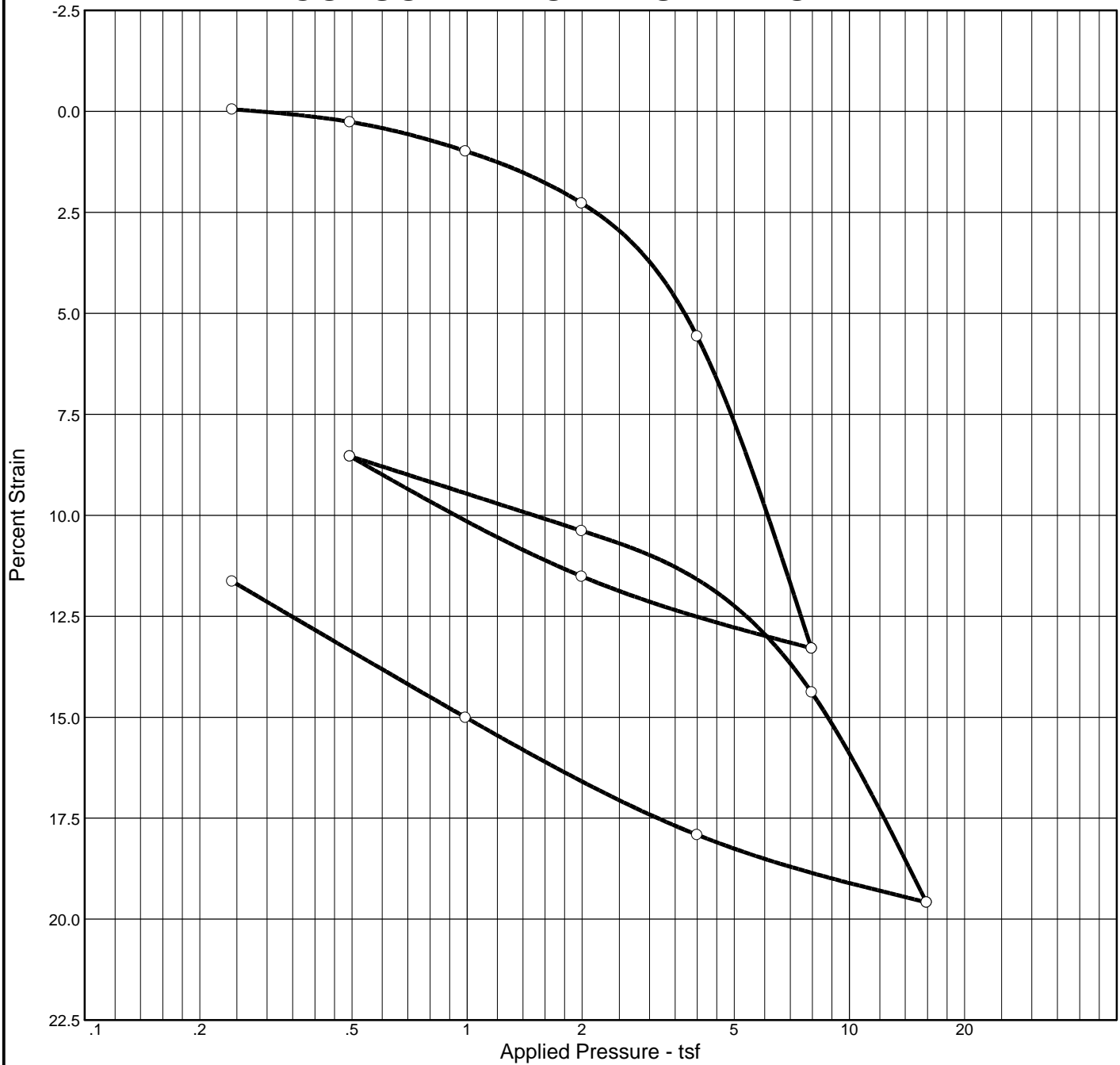
Load No. 11

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.15110	16	8.00	0.16830
2	0.10	0.15400	17	10.00	0.16990
3	0.20	0.15480	18	14.20	0.17260
4	0.30	0.15540	19	20.00	0.17530
5	0.40	0.15590	20	30.00	0.17820
6	0.50	0.15630	21	40.00	0.17990
7	0.60	0.15680	22	49.00	0.18090
8	0.80	0.15750	23	59.00	0.18180
9	1.00	0.15810	24	90.00	0.18340
10	2.00	0.16050	25	158.00	0.18510
11	3.00	0.16230	26	271.00	0.18640
12	4.00	0.16380	27	479.00	0.18760
13	5.00	0.16510	28	1445.00	0.18960
14	6.00	0.16630	29	1874.00	0.19010
15	7.00	0.16740			



Void Ratio = 0.722 Compression = 19.2 %
 $D_0 = 0.14840$ $D_{50} = 0.16433$ $D_{100} = 0.18026$
 C_v at 6.9 min. = 0.03 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
98.0 %	41.6 %	78.7	62	43	2.712		3.45	0.48	0.09			1.152

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

<p>Project No. BL-10-10065 Client: USACE W912ES-11-P-0024</p> <p>Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Request NO. 3</p> <p>Location: Boring11-119MU, #3, 50-52', Fargo Pile Load Test, Argusville Formation</p> <div style="text-align: center; font-weight: bold; font-size: 1.2em;"> BRAUNSM INTERTEC </div>	<p>Remarks:</p> <p style="text-align: right; font-weight: bold;">Figure</p>
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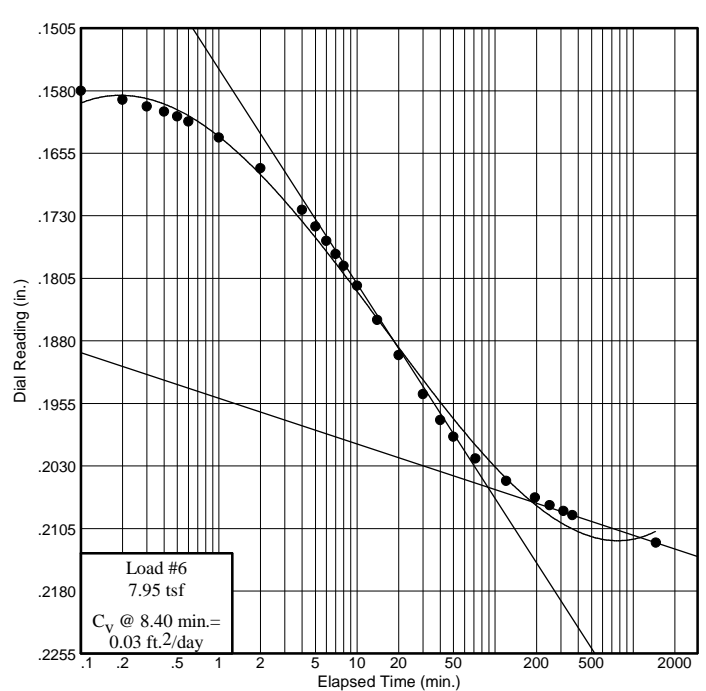
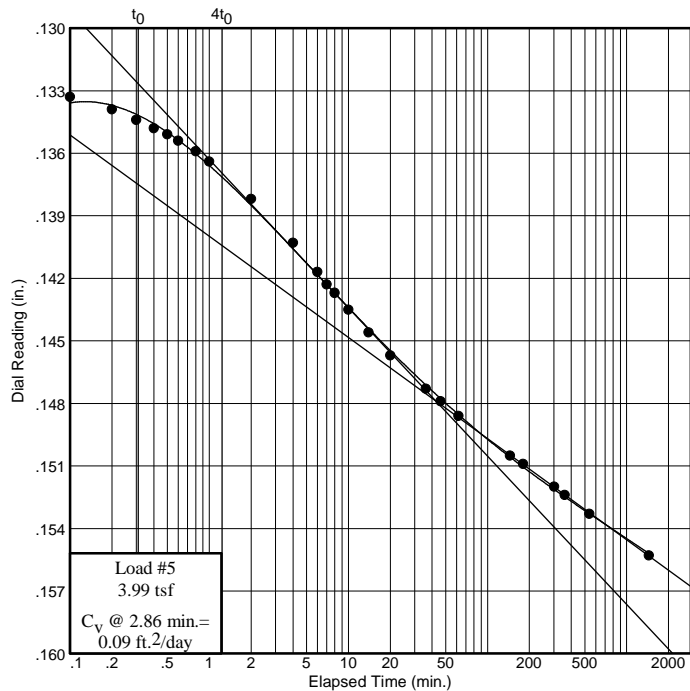
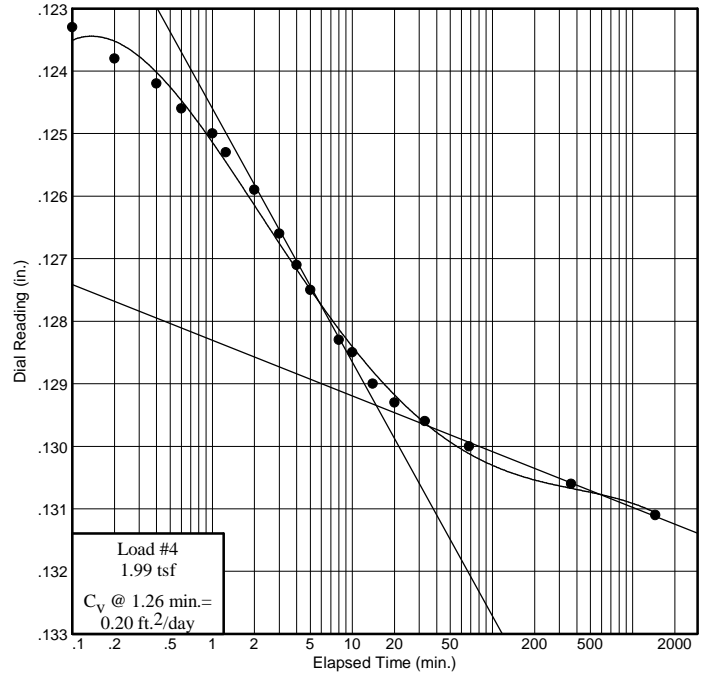
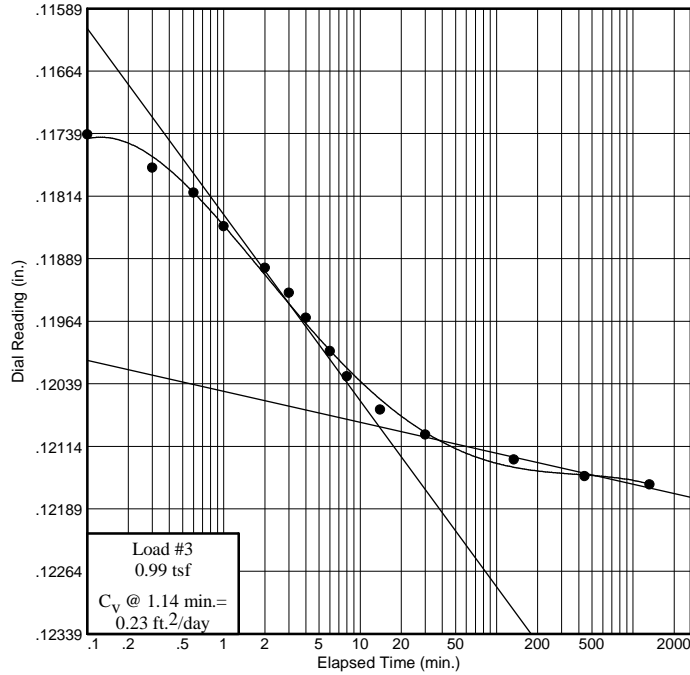
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-119MU, #3, 50-52', Fargo Pile Load Test, Argusville Formation



BRAUNSM
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Figure

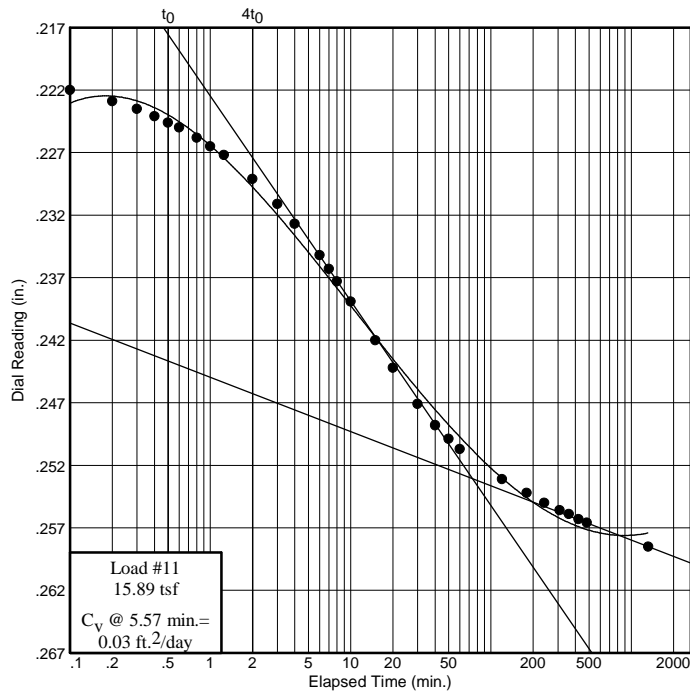
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing Request NO. 3

Location: Boring11-119MU, #3, 50-52', Fargo Pile Load Test, Argusville Formation



BRAUNSM
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Figure

SWELL/CONSOLIDATION TEST DATA

Client: USACE W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing Request NO. 3
Project Number: BL-10-10065

Sample Data

Source:

Sample No.: Boring11-119MU, #3
Elev. or Depth: 50-52' **Sample Length(in./cm.):**
Location: Boring11-119MU, #3, 50-52', Fargo Pile Load Test, Argusville Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 62 **Plasticity Index:** 43
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 161.98 g.	Consolidometer # = 3	Wet w+t =
Dry w+t = 123.44 g.		Dry w+t =
Tare Wt. = 30.81 g.	Spec. Gravity = 2.712	Tare Wt. =
Height = .74 in.	Height = .74 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 105.50 g.	Defl. Table = Machine3-2009	
Moisture = 41.6 %	Ht. Solids = 0.3421 in.	Moisture = %
Wet Den. = 111.4 pcf	Dry Wt. = 74.50 g.*	Dry Wt. = n/a
Dry Den. = 78.7 pcf	Void Ratio = 1.152	Void Ratio = 0.901
	Saturation = 98.0 %	

* Initial dry weight used in calculations

End-of-Load Summary

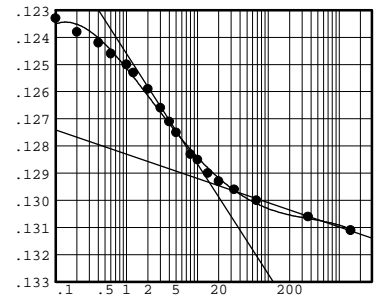
Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.11440				1.152	
0.24	0.11430	0.00030			1.153	0.1 Swell
0.49	0.11680	0.00050			1.146	0.3 Compr.
0.99	0.12230	0.00070	0.23	0.001	1.131	1.0 Compr.
1.99	0.13210	0.00100	0.20	0.001	1.103	2.3 Compr.
3.99	0.15680	0.00150	0.09	0.007	1.032	5.6 Compr.
7.95	0.21420	0.00200	0.03	0.008	0.866	13.3 Compr.
1.99	0.20010	0.00100			0.904	11.5 Compr.
0.49	0.17770	0.00050			0.968	8.5 Compr.
1.99	0.19180	0.00100			0.928	10.4 Compr.
7.95	0.22220	0.00200			0.842	14.4 Compr.
15.89	0.26140	0.00290	0.03	0.007	0.730	19.6 Compr.
3.99	0.24770	0.00150			0.766	17.9 Compr.
0.99	0.22550	0.00070			0.829	15.0 Compr.

Pressure: 1.99 tsf

TEST READINGS

Load No. 4

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.12230	11	5.00	0.12850
2	0.10	0.12430	12	8.00	0.12930
3	0.20	0.12480	13	10.00	0.12950
4	0.40	0.12520	14	14.00	0.13000
5	0.60	0.12560	15	20.00	0.13030
6	1.00	0.12600	16	33.00	0.13060
7	1.25	0.12630	17	68.00	0.13100
8	2.00	0.12690	18	364.00	0.13160
9	3.00	0.12760	19	1450.00	0.13210
10	4.00	0.12810			



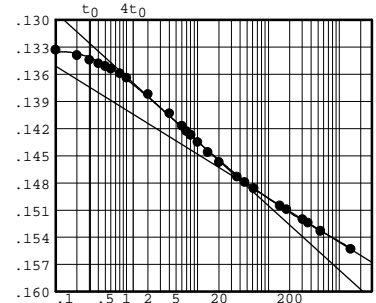
Void Ratio = 1.103 Compression = 2.3 %
 $D_0 = 0.12160$ $D_{50} = 0.12547$ $D_{100} = 0.12935$
 C_v at 1.3 min. = 0.20 ft.²/day $C_\alpha = 0.001$

Pressure: 3.99 tsf

TEST READINGS

Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13210	14	8.00	0.14420
2	0.10	0.13480	15	10.00	0.14500
3	0.20	0.13540	16	14.00	0.14610
4	0.30	0.13590	17	20.00	0.14720
5	0.40	0.13630	18	36.00	0.14880
6	0.50	0.13660	19	46.00	0.14940
7	0.60	0.13690	20	62.00	0.15010
8	0.80	0.13740	21	145.00	0.15200
9	1.00	0.13790	22	180.00	0.15240
10	2.00	0.13970	23	302.00	0.15350
11	4.00	0.14180	24	360.00	0.15390
12	6.00	0.14320	25	538.50	0.15480
13	7.00	0.14380	26	1442.00	0.15680



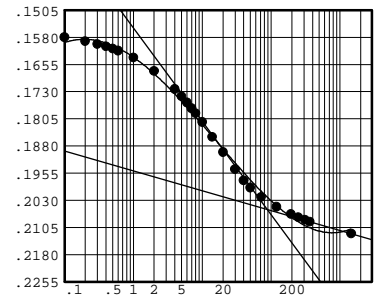
Void Ratio = 1.032 Compression = 5.6 %
 $D_0 = 0.13121$ $D_{50} = 0.13956$ $D_{100} = 0.14790$
 C_v at 2.9 min. = 0.09 ft.²/day $C_\alpha = 0.007$

Pressure: 7.95 tsf

TEST READINGS

Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.15680	15	10.00	0.18340
2	0.10	0.16000	16	14.00	0.18750
3	0.20	0.16110	17	20.00	0.19170
4	0.30	0.16190	18	30.00	0.19640
5	0.40	0.16250	19	40.00	0.19950
6	0.50	0.16310	20	50.00	0.20150
7	0.60	0.16370	21	72.00	0.20410
8	1.00	0.16560	22	120.00	0.20680
9	2.00	0.16930	23	194.00	0.20880
10	4.00	0.17430	24	249.00	0.20970
11	5.00	0.17630	25	312.00	0.21040
12	6.00	0.17800	26	364.00	0.21090
13	7.00	0.17960	27	1459.00	0.21420
14	8.00	0.18100			



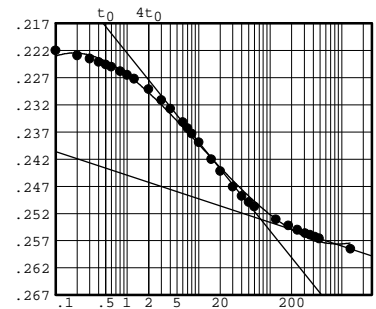
Void Ratio = 0.866 Compression = 13.3 %
 $D_0 = 0.15530$ $D_{50} = 0.18042$ $D_{100} = 0.20554$
 C_v at 8.4 min. = 0.03 ft.²/day $C_\alpha = 0.008$

Pressure: 15.89 tsf

TEST READINGS

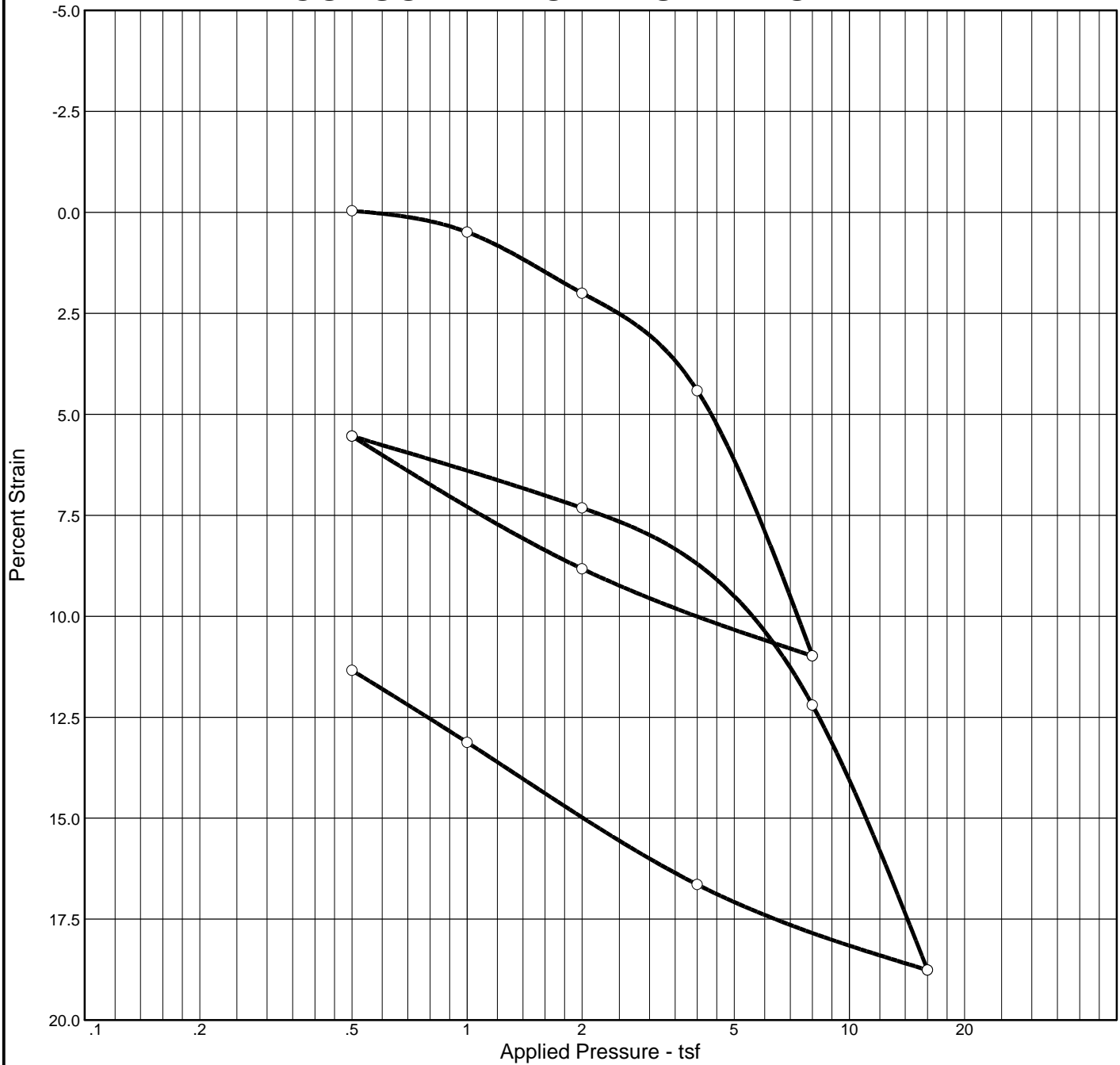
Load No. 11

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.22220	17	10.00	0.24180
2	0.10	0.22490	18	15.00	0.24490
3	0.20	0.22580	19	20.00	0.24710
4	0.30	0.22640	20	30.00	0.25000
5	0.40	0.22700	21	40.00	0.25170
6	0.50	0.22750	22	50.00	0.25280
7	0.60	0.22790	23	60.00	0.25360
8	0.80	0.22870	24	120.00	0.25600
9	1.00	0.22940	25	180.00	0.25710
10	1.25	0.23010	26	240.00	0.25790
11	2.00	0.23200	27	308.00	0.25850
12	3.00	0.23400	28	360.00	0.25880
13	4.00	0.23560	29	420.00	0.25920
14	6.00	0.23810	30	483.00	0.25950
15	7.00	0.23920	31	1325.00	0.26140
16	8.00	0.24020			



Void Ratio = 0.730 Compression = 19.6 %
 $D_0 = 0.21821$ $D_{50} = 0.23564$ $D_{100} = 0.25307$
 C_v at 5.6 min. = 0.03 ft.²/day $C_\alpha = 0.007$

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P _c (tsf)	C _c	C _r	Swell Press. (tsf)	Swell %	e ₀
Sat.	Moist.											
98.3 %	42.9 %	77.2	66	46	2.689		4.45	0.56	0.11			1.174

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY, brown (CH), Top of sample, ASTM D 2435	CH	

Project No. BL-10-10065 Client: W912ES-11-P-0024 Project: Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing Location: Boring 11-110MU, #6, 65-67', Sheyenne River, Till Formation	Remarks:

Figure

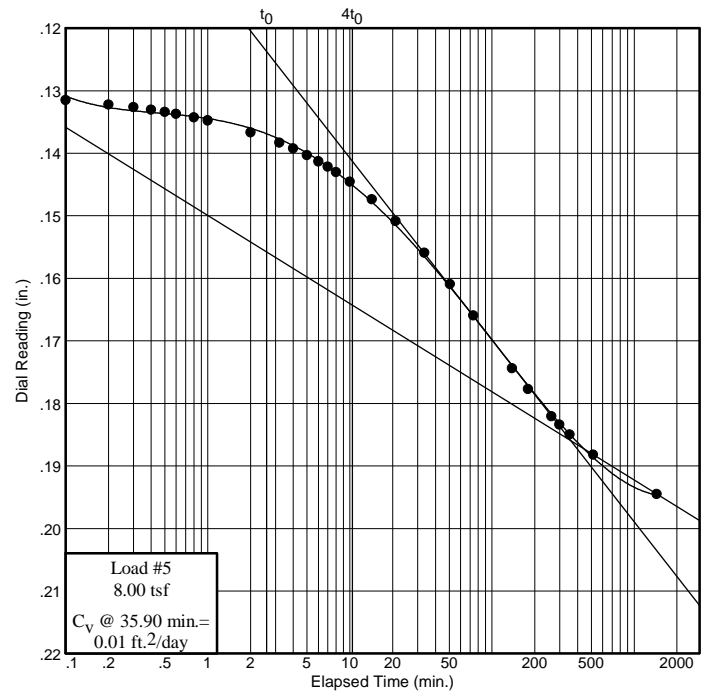
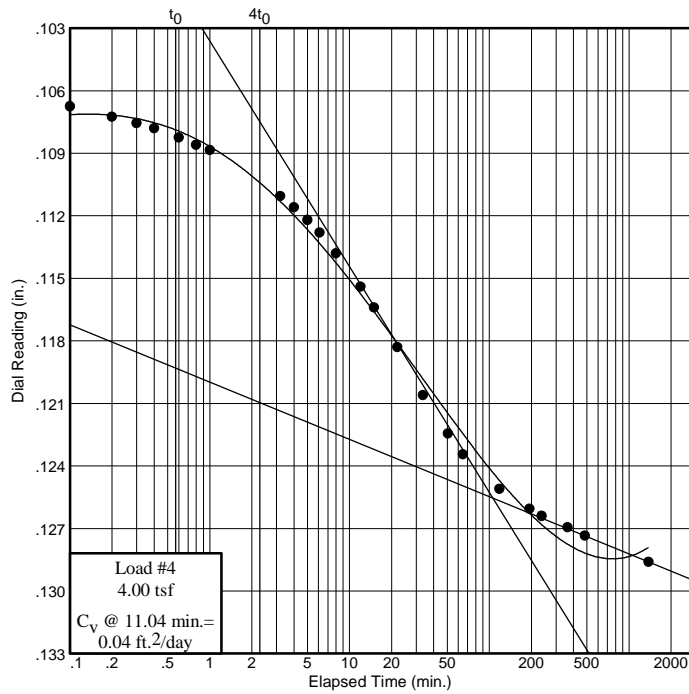
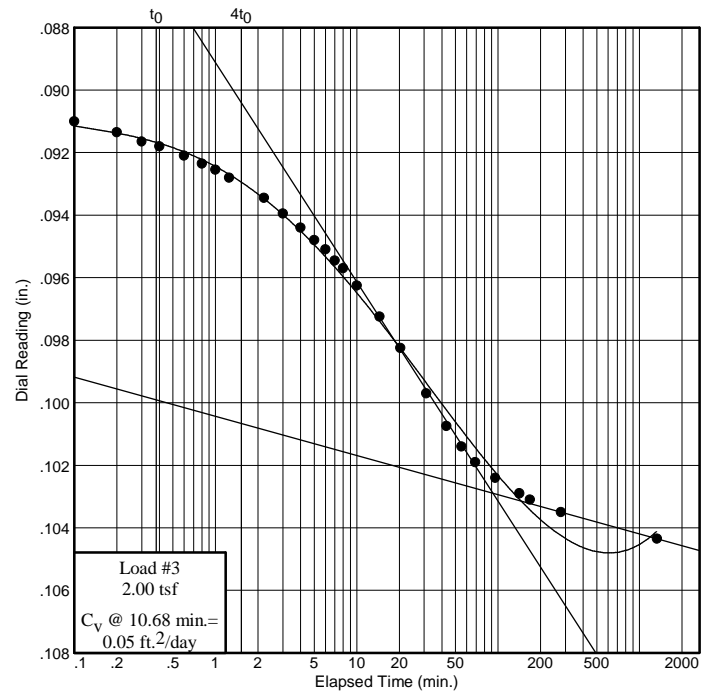
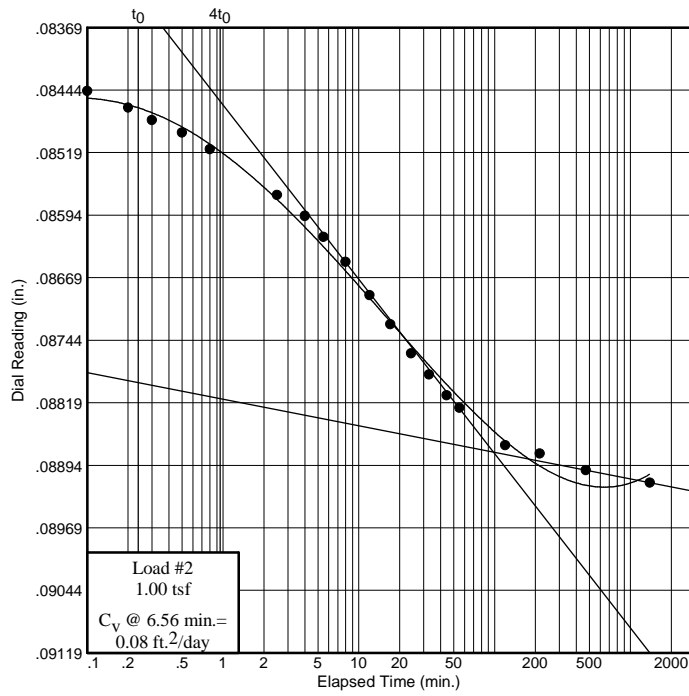
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #6, 65-67', Sheyenne River, Till Formation



BRAUNSM
INTERTEC

Figure

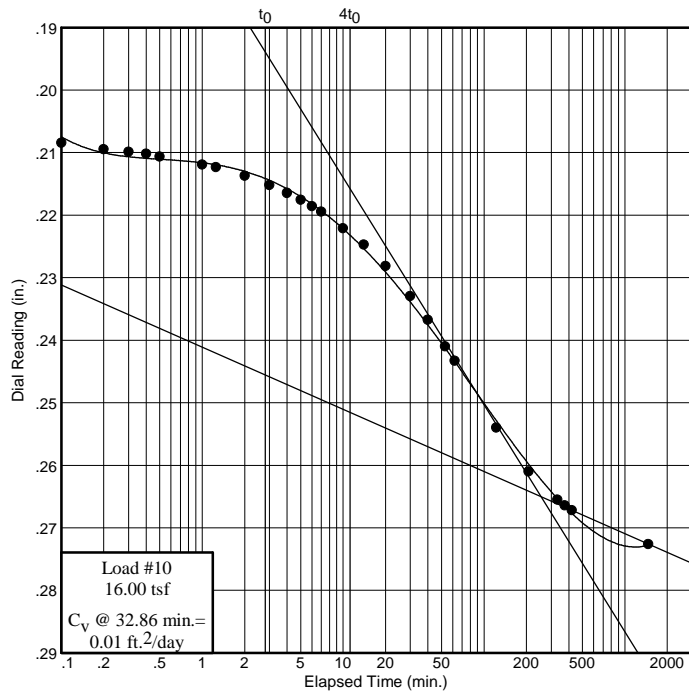
Dial Reading vs. Time

Project No.: BL-10-10065

Project: Fargo-Moorhead Metro Feasibility Study

Phase 4 Undisturbed Testing

Location: Boring11-110MU, #6, 65-67', Sheyenne River, Till Formation



BRAUNSM
INTERTEC

Figure

SWELL/CONSOLIDATION TEST DATA

Client: W912ES-11-P-0024
Project: Fargo-Moorhead Metro Feasibility Study
 Phase 4 Undisturbed Testing
Project Number: BL-10-10065

Sample Data

Source:
Sample No.: 11-110, #6
Elev. or Depth: 65-67' **Sample Length(in./cm.):**
Location: Boring11-110MU, #6, 65-67', Sheyenne River, Till Formation
Description: FAT CLAY, brown (CH), Top of sample, ASTM D 2435
Liquid Limit: 66 **Plasticity Index:** 46
USCS: CH **AASHTO:** **Figure No.:**
Testing Remarks:

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 167.36 g.	Consolidometer # = 2	Wet w+t =
Dry w+t = 126.14 g.		Dry w+t =
Tare Wt. = 30.12 g.	Spec. Gravity = 2.689	Tare Wt. =
Height = 1.00 in.	Height = 1.00 in.	
Diameter = 2.50 in.	Diameter = 2.50 in.	
Weight = 142.45 g.	Defl. Table = Machine2-Air-2011	
Moisture = 42.9 %	Ht. Solids = 0.4619 in.	Moisture = %
Wet Den. = 110.4 pcf	Dry Wt. = 99.67 g.*	Dry Wt. = n/a
Dry Den. = 77.2 pcf	Void Ratio = 1.174	Void Ratio = 0.927
	Saturation = 98.3 %	

* Initial dry weight used in calculations

End-of-Load Summary

Pressure (tsf)	Final Dial (in.)	Machine Defl. (in.)	C _v (ft. ² /day)	C _α	Void Ratio	% Compression /Swell
start	0.08425				1.174	
0.50	0.08480	0.00095			1.175	0.0 Swell
1.00	0.09070	0.00155	0.08	0.000	1.163	0.5 Compr.
2.00	0.10660	0.00225	0.05	0.001	1.130	2.0 Compr.
4.00	0.13155	0.00295	0.04	0.003	1.078	4.4 Compr.
8.00	0.19830	0.00380	0.01	0.015	0.935	11.0 Compr.
2.00	0.17510	0.00225			0.982	8.8 Compr.
0.50	0.14085	0.00095			1.053	5.5 Compr.
2.00	0.16000	0.00225			1.015	7.3 Compr.
8.00	0.21055	0.00380			0.909	12.2 Compr.
16.00	0.27755	0.00495	0.01	0.011	0.766	18.8 Compr.
4.00	0.25430	0.00295			0.812	16.6 Compr.
1.00	0.21755	0.00155			0.888	13.1 Compr.
0.50	0.19905	0.00095			0.927	11.3 Compr.

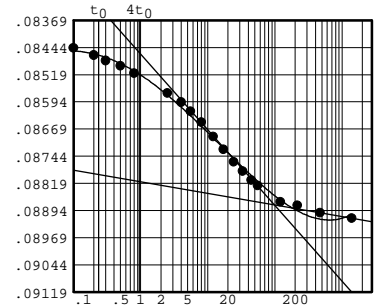
$C_c = 0.56$ $P_c = 4.45$ tsf $C_r = 0.11$

Pressure: 1.00 tsf

TEST READINGS

Load No. 2

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.08480	11	12.00	0.08845
2	0.10	0.08600	12	17.10	0.08880
3	0.20	0.08620	13	24.30	0.08915
4	0.30	0.08635	14	33.00	0.08940
5	0.50	0.08650	15	44.30	0.08965
6	0.80	0.08670	16	55.00	0.08980
7	2.50	0.08725	17	120.00	0.09025
8	4.00	0.08750	18	215.00	0.09035
9	5.50	0.08775	19	470.00	0.09055
10	8.00	0.08805	20	1390.00	0.09070



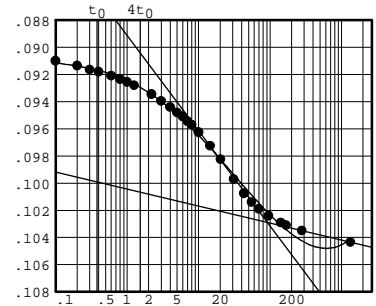
Void Ratio = 1.163 Compression = 0.5 %
 $D_0 = 0.08413$ $D_{50} = 0.08646$ $D_{100} = 0.08878$
 C_v at 6.6 min. = 0.08 ft.²/day $C_\alpha = 0.000$

Pressure: 2.00 tsf

TEST READINGS

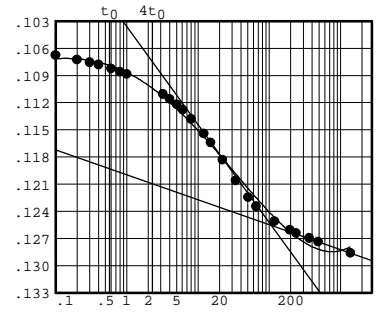
Load No. 3

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.09070	15	7.00	0.09770
2	0.10	0.09325	16	8.00	0.09795
3	0.20	0.09360	17	10.00	0.09850
4	0.30	0.09390	18	14.50	0.09950
5	0.40	0.09405	19	20.30	0.10050
6	0.60	0.09435	20	31.00	0.10195
7	0.80	0.09460	21	43.00	0.10300
8	1.00	0.09480	22	55.00	0.10365
9	1.25	0.09505	23	69.00	0.10415
10	2.20	0.09570	24	95.50	0.10465
11	3.00	0.09620	25	141.50	0.10515
12	4.00	0.09665	26	168.00	0.10535
13	5.00	0.09705	27	279.00	0.10575
14	6.00	0.09735	28	1331.00	0.10660



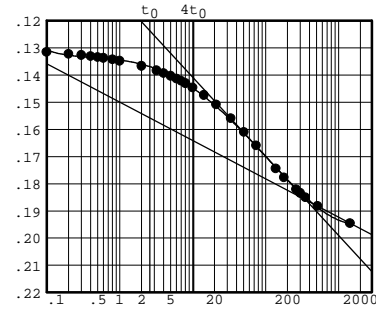
Void Ratio = 1.130 Compression = 2.0 %
 $D_0 = 0.09040$ $D_{50} = 0.09665$ $D_{100} = 0.10290$
 C_v at 10.7 min. = 0.05 ft.²/day $C_\alpha = 0.001$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.10660	14	12.00	0.11835
2	0.10	0.10970	15	15.00	0.11935
3	0.20	0.11020	16	22.00	0.12125
4	0.30	0.11050	17	33.50	0.12355
5	0.40	0.11075	18	50.50	0.12540
6	0.60	0.11120	19	65.00	0.12640
7	0.80	0.11155	20	118.00	0.12805
8	1.00	0.11180	21	194.00	0.12900
9	3.20	0.11400	22	237.00	0.12935
10	4.00	0.11455	23	363.00	0.12990
11	5.00	0.11515	24	484.00	0.13030
12	6.10	0.11575	25	1380.00	0.13155
13	8.00	0.11675			



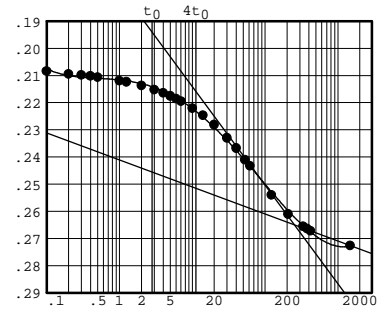
Void Ratio = 1.078 Compression = 4.4 %
 $D_0 = 0.10535$ $D_{50} = 0.11544$ $D_{100} = 0.12554$
 C_v at 11.0 min. = 0.04 ft.²/day $C_\alpha = 0.003$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.13155	16	8.00	0.14680
2	0.10	0.13530	17	10.00	0.14835
3	0.20	0.13600	18	14.30	0.15115
4	0.30	0.13645	19	21.00	0.15465
5	0.40	0.13685	20	33.50	0.15970
6	0.50	0.13720	21	50.50	0.16475
7	0.60	0.13750	22	74.00	0.16975
8	0.80	0.13805	23	138.20	0.17820
9	1.00	0.13855	24	179.30	0.18150
10	2.00	0.14045	25	261.50	0.18585
11	3.20	0.14210	26	298.00	0.18720
12	4.00	0.14305	27	352.30	0.18880
13	5.00	0.14410	28	515.00	0.19200
14	6.00	0.14510	29	1440.00	0.19830
15	7.00	0.14595			

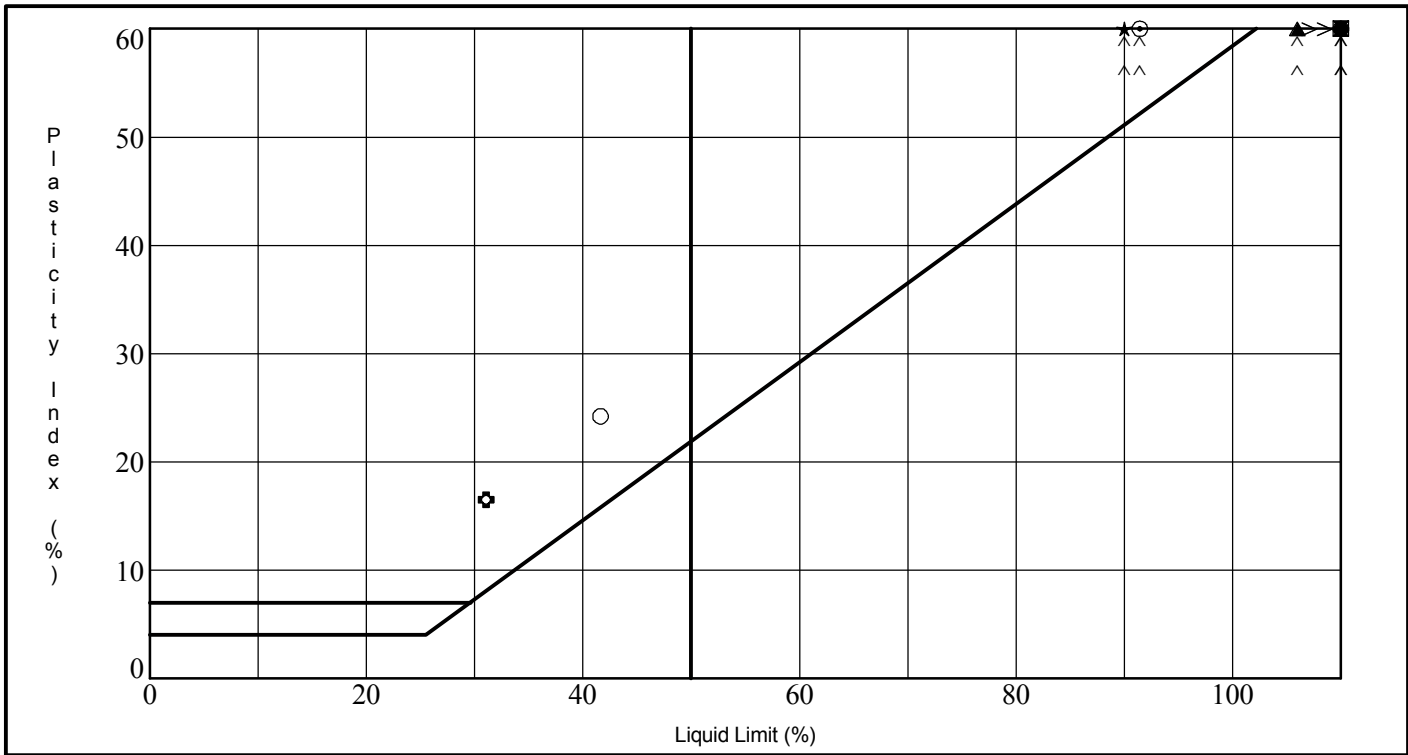


Void Ratio = 0.935 Compression = 11.0 %
 $D_0 = 0.12871$ $D_{50} = 0.15735$ $D_{100} = 0.18599$
 C_v at 35.9 min. = 0.01 ft.²/day $C_\alpha = 0.015$

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.00	0.21055	15	10.00	0.22705
2	0.10	0.21338	16	14.00	0.22965
3	0.20	0.21440	17	20.00	0.23310
4	0.30	0.21480	18	30.00	0.23790
5	0.40	0.21515	19	40.00	0.24170
6	0.50	0.21560	20	53.00	0.24595
7	1.00	0.21685	21	62.00	0.24825
8	1.25	0.21730	22	122.00	0.25895
9	2.00	0.21865	23	207.00	0.26595
10	3.00	0.22015	24	332.00	0.27045
11	4.00	0.22140	25	374.00	0.27135
12	5.00	0.22250	26	420.00	0.27215
13	6.00	0.22350	27	1466.00	0.27755
14	7.00	0.22440			



Void Ratio = 0.766 Compression = 18.8 %
 $D_0 = 0.20508$ $D_{50} = 0.23506$ $D_{100} = 0.26504$
 C_v at 32.9 min. = 0.01 ft.²/day $C_\alpha = 0.011$

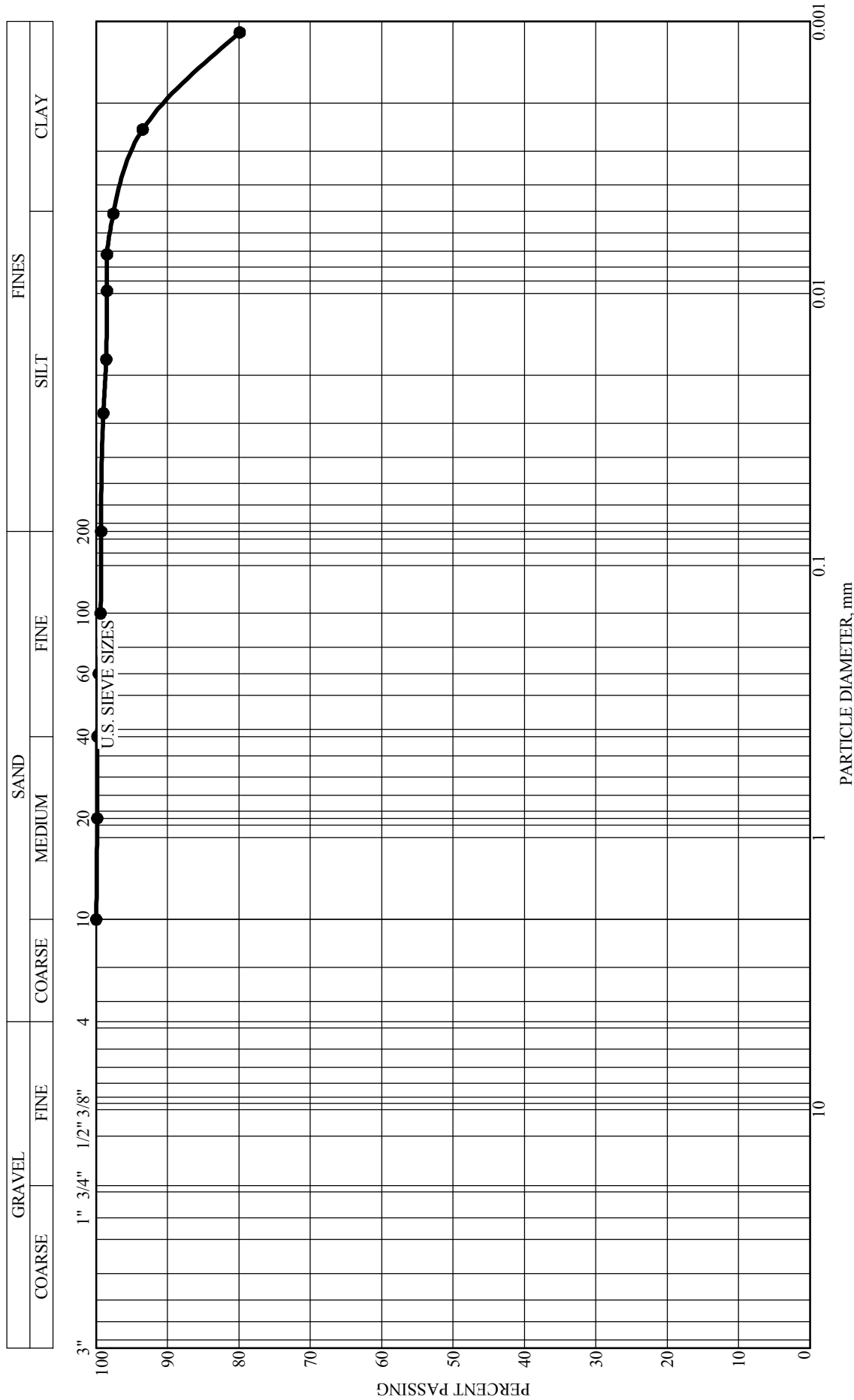



Specimen Identification	LL	PL	PI	Fines	Classification
● 10-105MU 15.0'-17.0'	113	32	81	100	FAT CLAY, brown (CH)
☒ 10-105MU 25.0'-27.0'	119	32	87	100	FAT CLAY, brown (CH)
▲ 10-105MU 35.0'-37.0'	106	29	77	100	FAT CLAY, brown (CH)
★ 10-105MU 45.0'-47.0'	90	27	63	94	FAT CLAY, brown (CH)
⊙ 10-105MU 55.0'-57.0'	91	25	66	92	FAT CLAY, brown (CH)
⊕ 10-105MU 67.0'-69.0'	31	15	16	59	SANDY LEAN CLAY, brown (CL)
○ 10-105MU 77.0'-79.0'	42	17	25	58	SANDY LEAN CLAY, brown (CL)

ATTERBERG LIMITS BL-10-10065.GPJ BRAUN.GDT 3/4/11 12:55

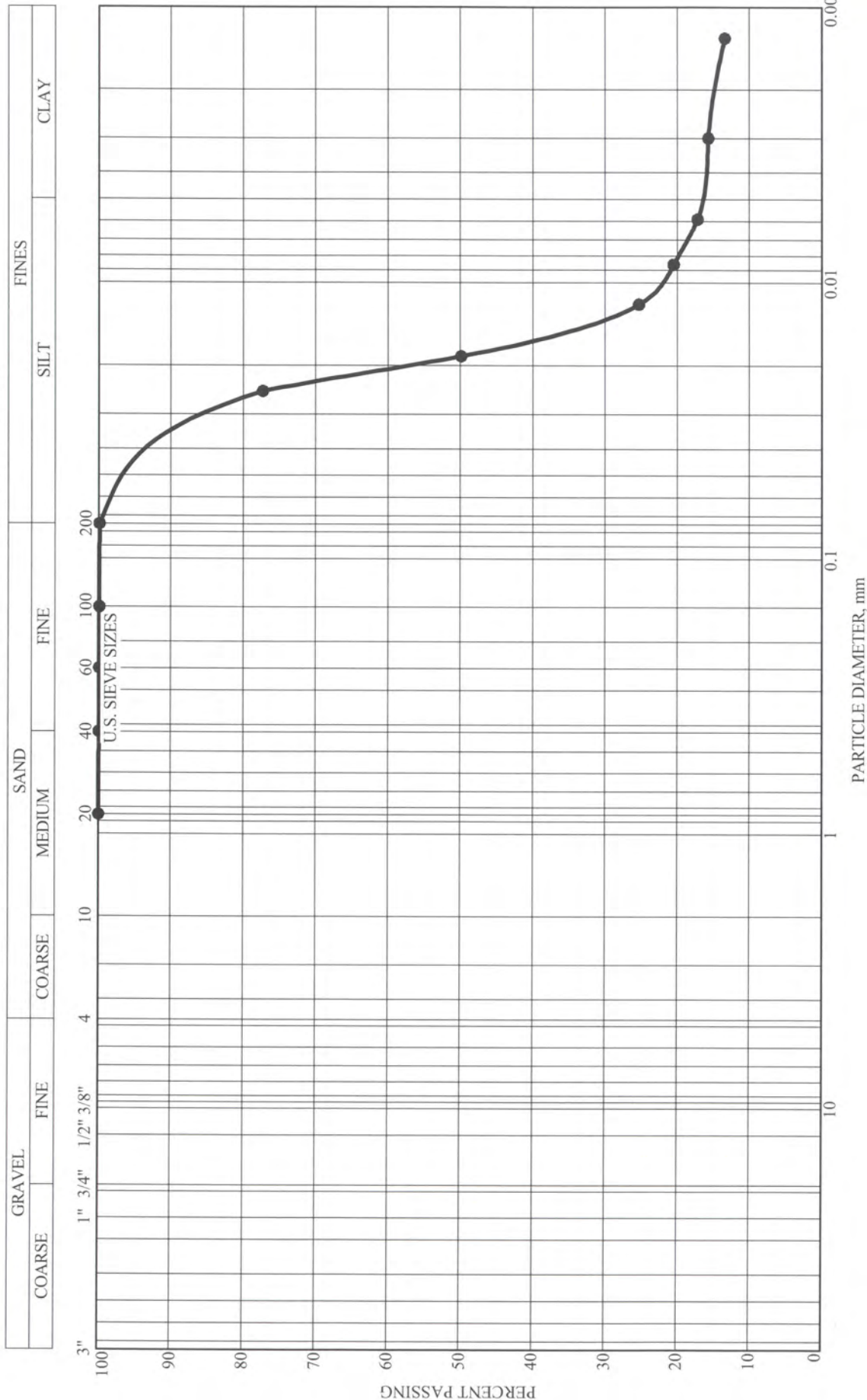
Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing	ATTERBERG LIMITS RESULTS

GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-09-03127 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Moorhead</p> <p>BORING: 09-14MU SAMPLE: 2 DEPTH: 15.0'-17.0'</p> <p style="text-align: right;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY(CH)</p> <p>GRAVEL: 0.0% SAND: 0.7% SILT: 1.8% CLAY: 97.5% D60= Cu= D30= Cc= D10=</p>
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GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-09-03127
Fargo-Moorhead Metro Feasibility Study
Fargo-Moorhead, ND
Fargo

BORING: 09-23MU DEPTH: 20.0'-22.0'

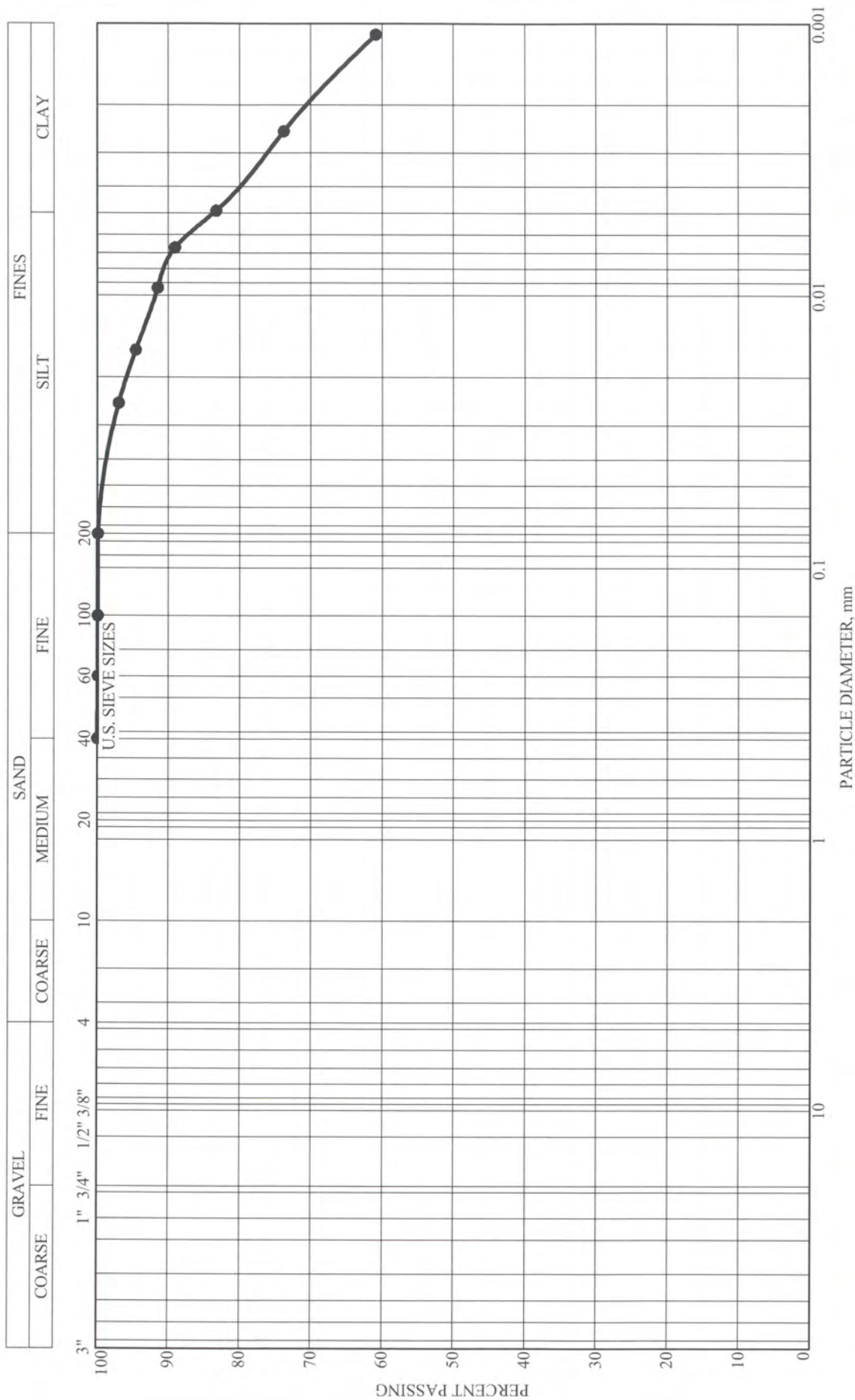
Braun Intertec Corporation




GRAVEL	0.0%
SAND	0.1%
SILT	83.1%
CLAY	16.8%
D60=0.021	Cu=
D30=0.013	Cc=
D10=	

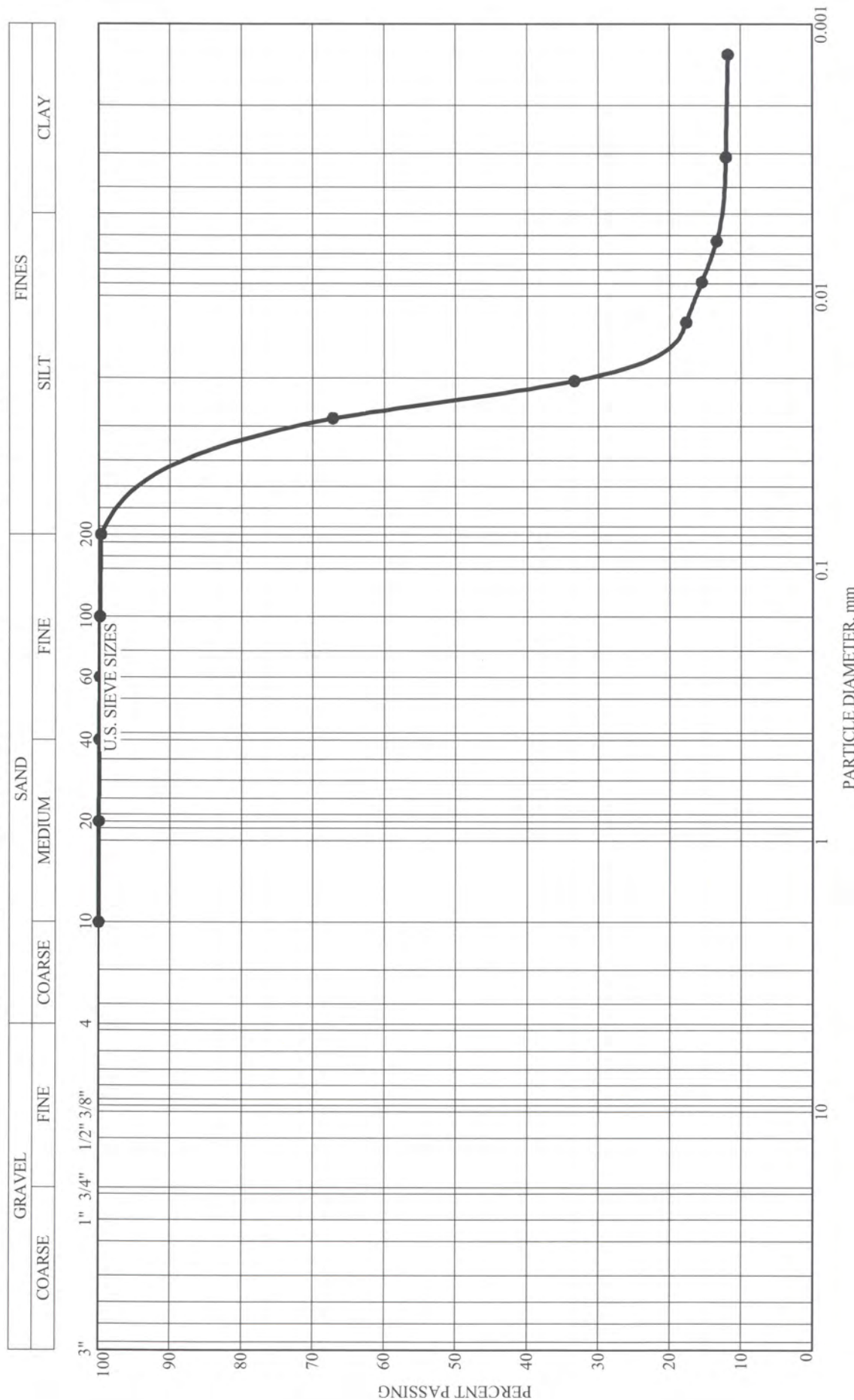
CLASSIFICATION:
SILT(ML)

GRAIN SIZE ACCUMULATION CURVE (ASTM)



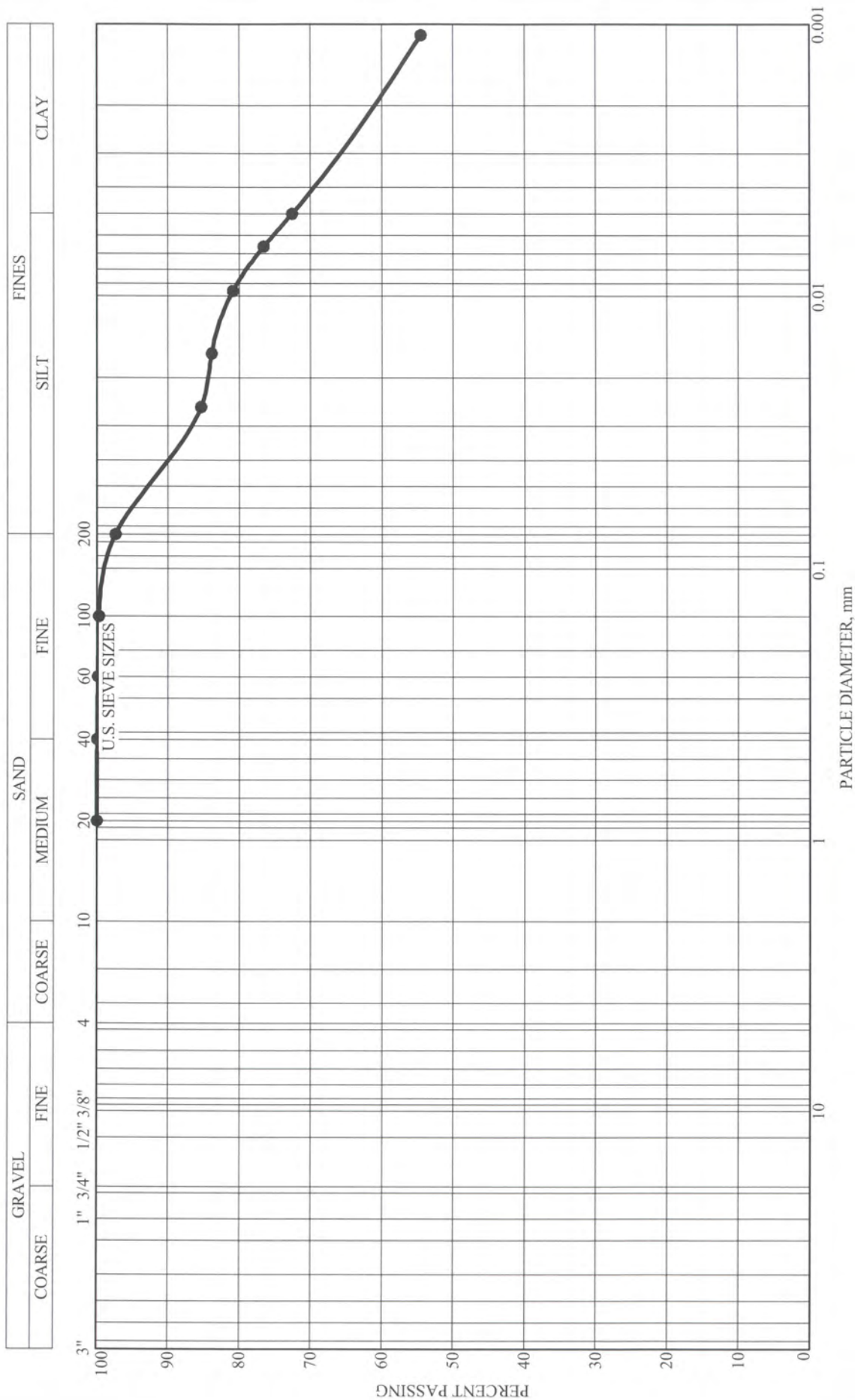
	<p>Braun Project BL-09-03127 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Fargo</p> <p>BORING: 09-23MU DEPTH: 28.0'-30.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY(CH)</p> <p>GRAVEL 0.0% SAND 0.1% SILT 16.2% CLAY 83.7%</p> <p>D₆₀= D₃₀= D₁₀=</p> <p>C_u= C_c=</p>
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GRAIN SIZE ACCUMULATION CURVE (ASTM)



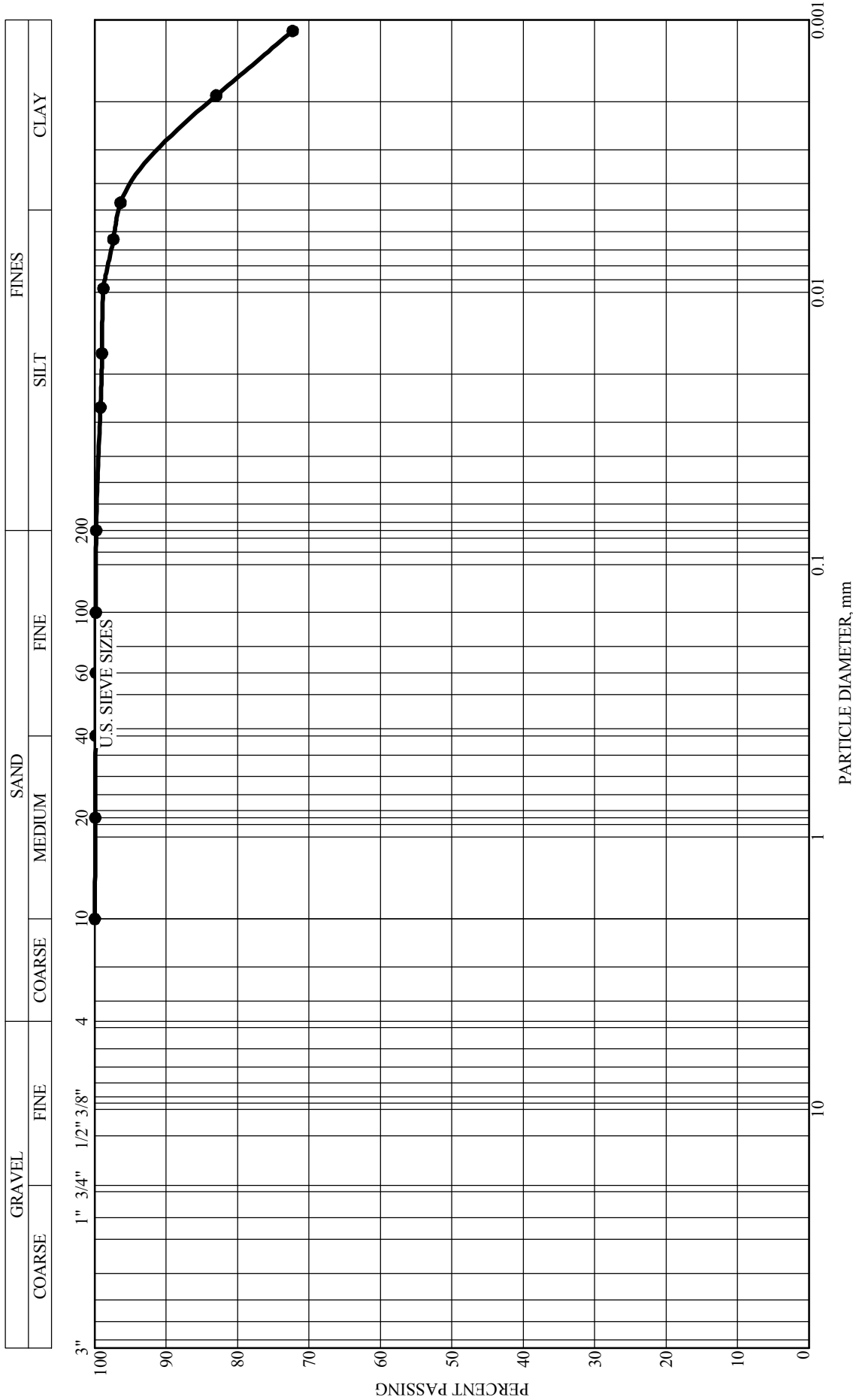
BRAUN SM INTERTEC	Braun Project BL-09-03127 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Moorhead	CLASSIFICATION: SILT(ML)
	BORING: 09-25MU DEPTH: 21.0'-23.0' Braun Intertec Corporation	
	GRAVEL 0.0% SAND 0.3% SILT 86.7% CLAY 13.0% D60=0.026 D30=0.018 D10=	Cu= Cc=


GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-09-03127 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Moorhead</p> <p>BORING: 09-25MU DEPTH: 25.0'-27.0'</p> <p style="font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY(CH)</p> <p>GRAVEL 0.0% SAND 2.6% SILT 24.8% CLAY 72.6%</p> <p>D60=0.002 D30= D10=</p> <p>Cu= Cc=</p>
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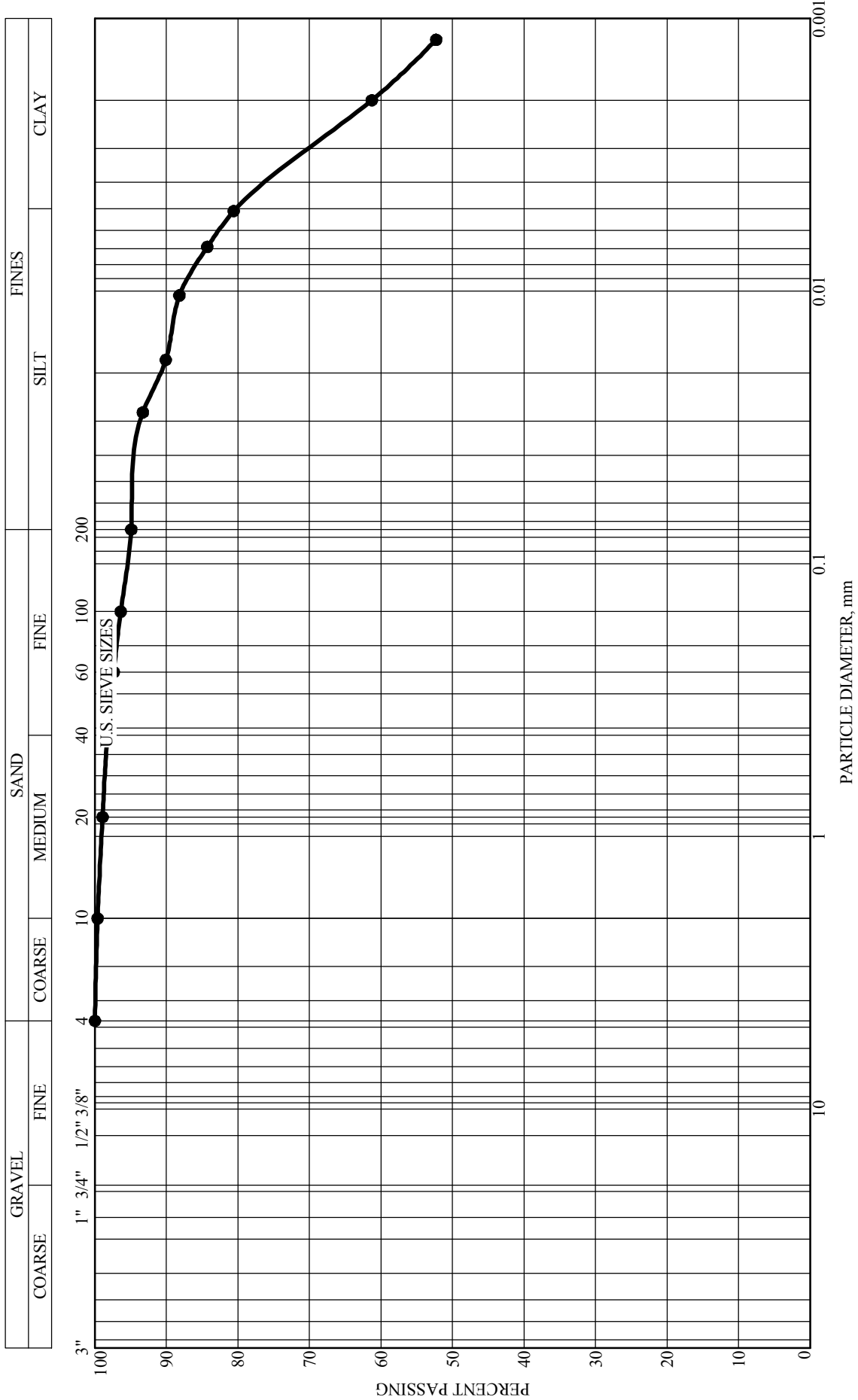
GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-09-03127 W912ES-09-P-0115 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Fargo BORING: 09-25MU SAMPLE: 4 DEPTH: 50.0'-52.0'</p>	<p>GRAVEL 0.0% SAND 0.2% SILT 3.2% CLAY 96.6% D60= D30= D10=</p>
		<p>CLASSIFICATION: FAT CLAY(CH) SE-F-13, Fargo, Brenna Formation</p>

Braun Intertec Corporation

GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-09-03127
W912ES-09-P-0115
Fargo-Moorhead Metro Feasibility Study
Fargo-Moorhead, ND
Fargo
 BORING: 09-25MU SAMPLE: 5 DEPTH: 66.0'-68.0'
 Braun Intertec Corporation

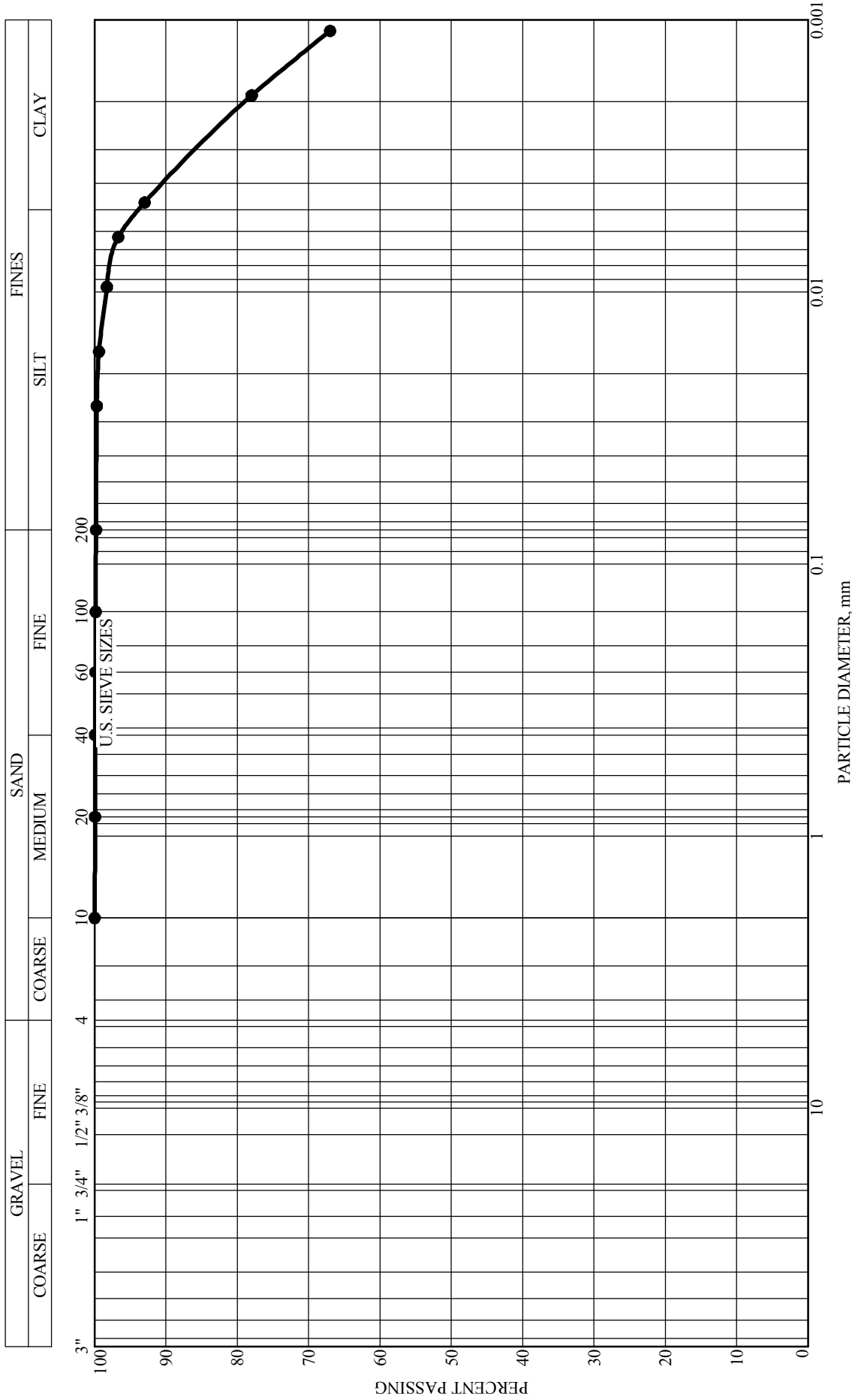
CLASSIFICATION:
FAT CLAY(CH)
 SE-F-13, Fargo, Argusville Formation


GRAVEL 0.0%
 SAND 5.1%
 SILT 14.7%
 CLAY 80.2%
 D60=0.002
 D30=
 D10=

Cu=
 Cc=

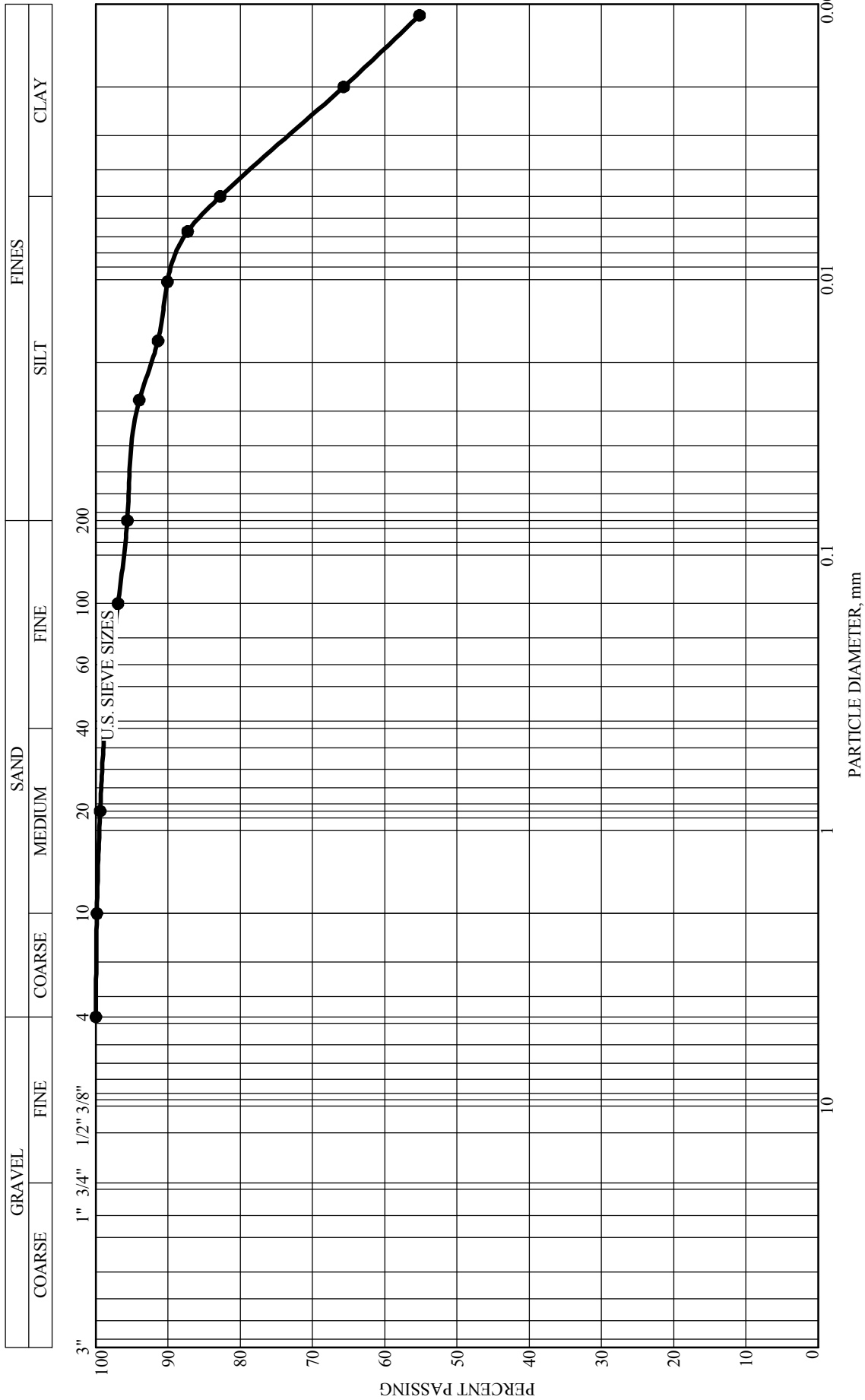


GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-09-03127 W912ES-09-P-0115 Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, ND Fargo</p>	<p>CLASSIFICATION: FAT CLAY(CH) SE-F-15, Fargo, Brenna Formation</p>
<p>BORING: 09-26MU-F SAMPLE: 3 DEPTH: 28.0'-30.0' Braun Intertec Corporation</p>	<p>GRAVEL 0.0% SAND 0.2% SILT 6.0% CLAY 93.8% D60= D30= D10=</p>	<p>GRAVEL SAND SILT CLAY D60= D30= D10=</p>

GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-09-03127
W912ES-09-P-0115
Fargo-Moorhead Metro Feasibility Study
Fargo-Moorhead, ND
Fargo

BORING: 09-27MU SAMPLE: 4 DEPTH: 64.0'-66.0'

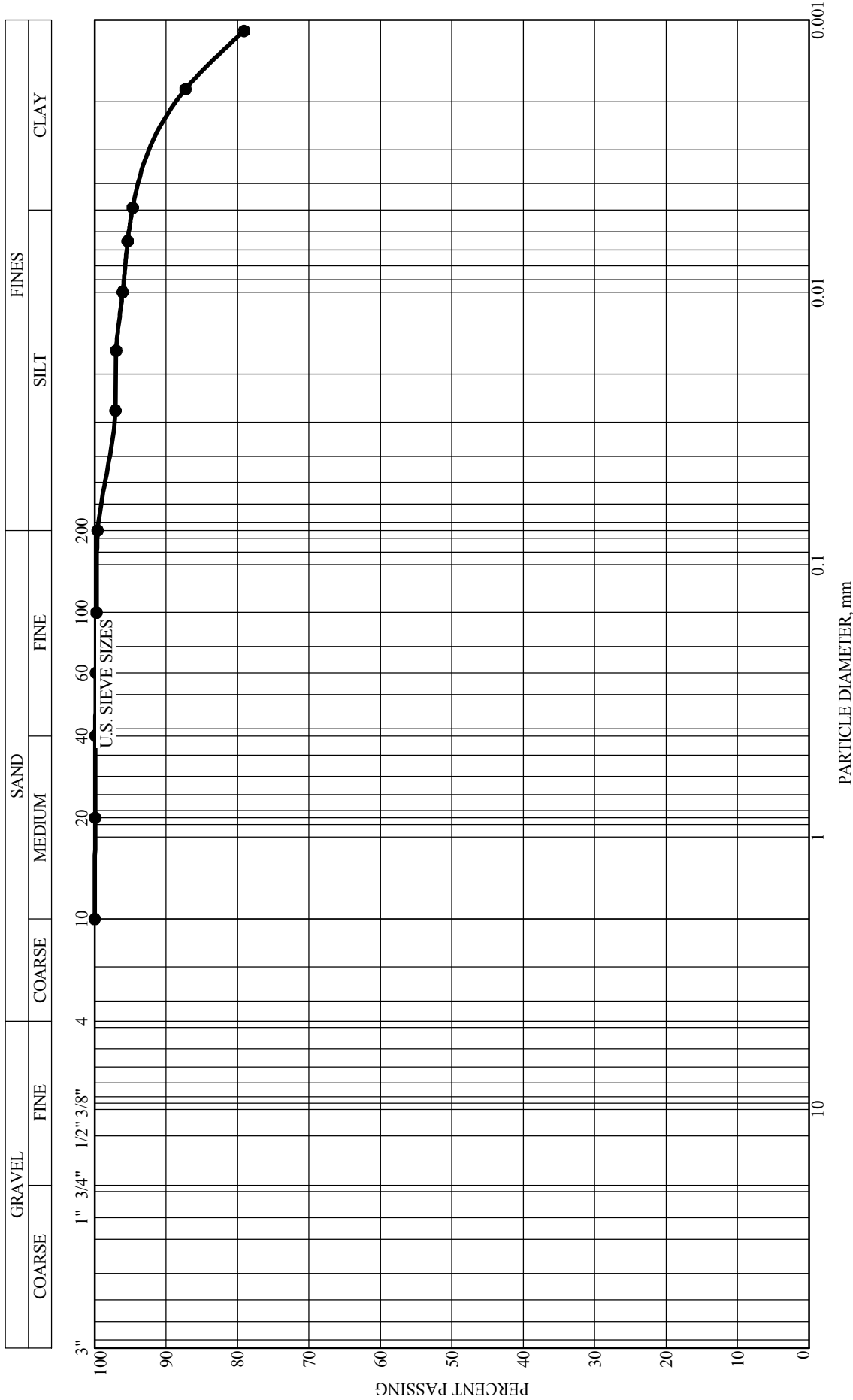
Braun Intertec Corporation

CLASSIFICATION:
FAT CLAY(CH)
 SE-F-19, Fargo, Argusville Formation

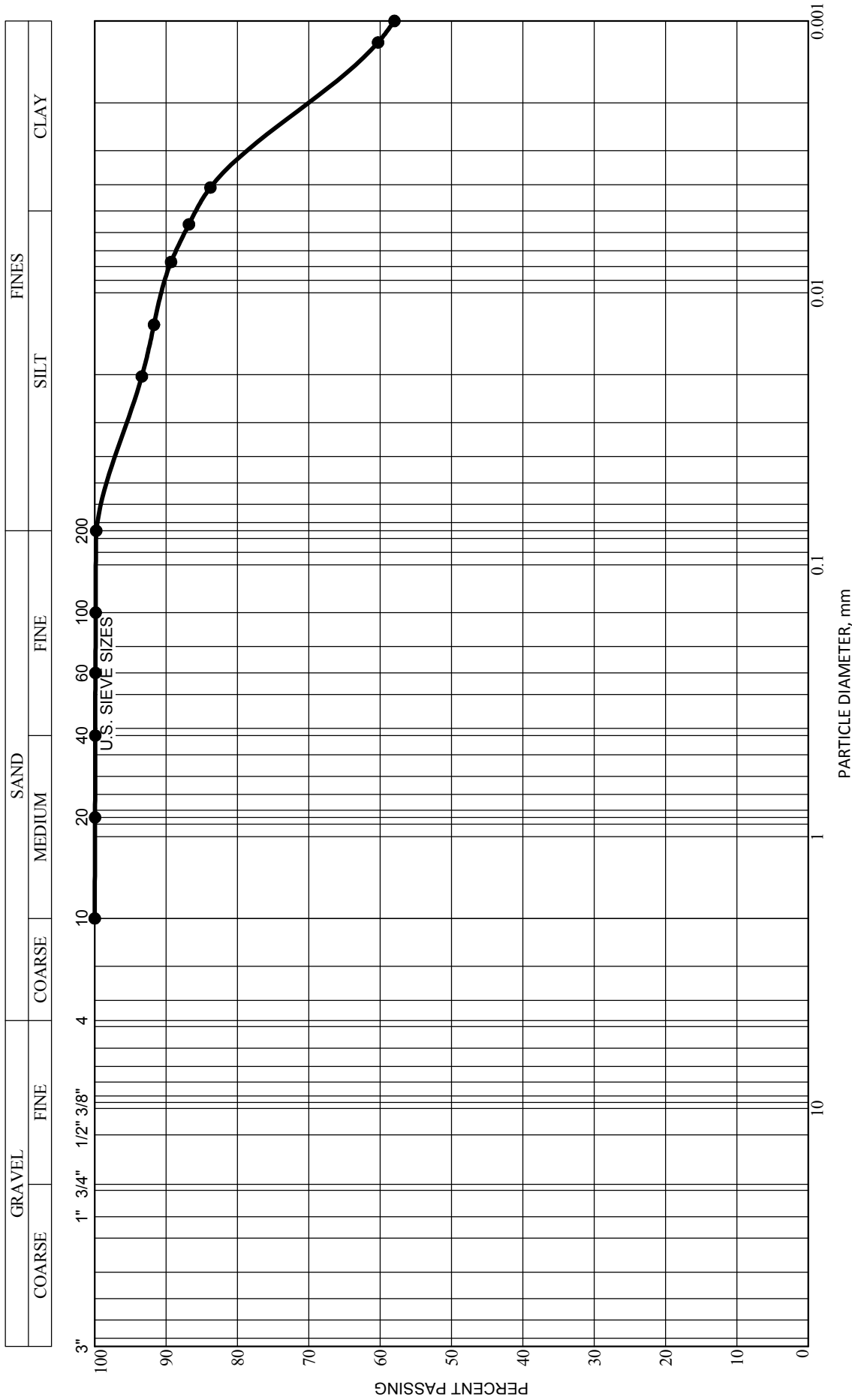
GRAVEL 0.0%
SAND 4.4%
SILT 12.8%
CLAY 82.8%
 D₆₀=0.001
 D₃₀=
 D₁₀=



GRAIN SIZE ACCUMULATION CURVE (ASTM)



GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-09-03127A
Fargo-Moorhead Metro Feasibility Study
Fargo-Moorhead, MN
Fargo
 BORING: 09-59MU SAMPLE: 2 DEPTH: 20.0'-22.0'
 Braun Intertec Corporation

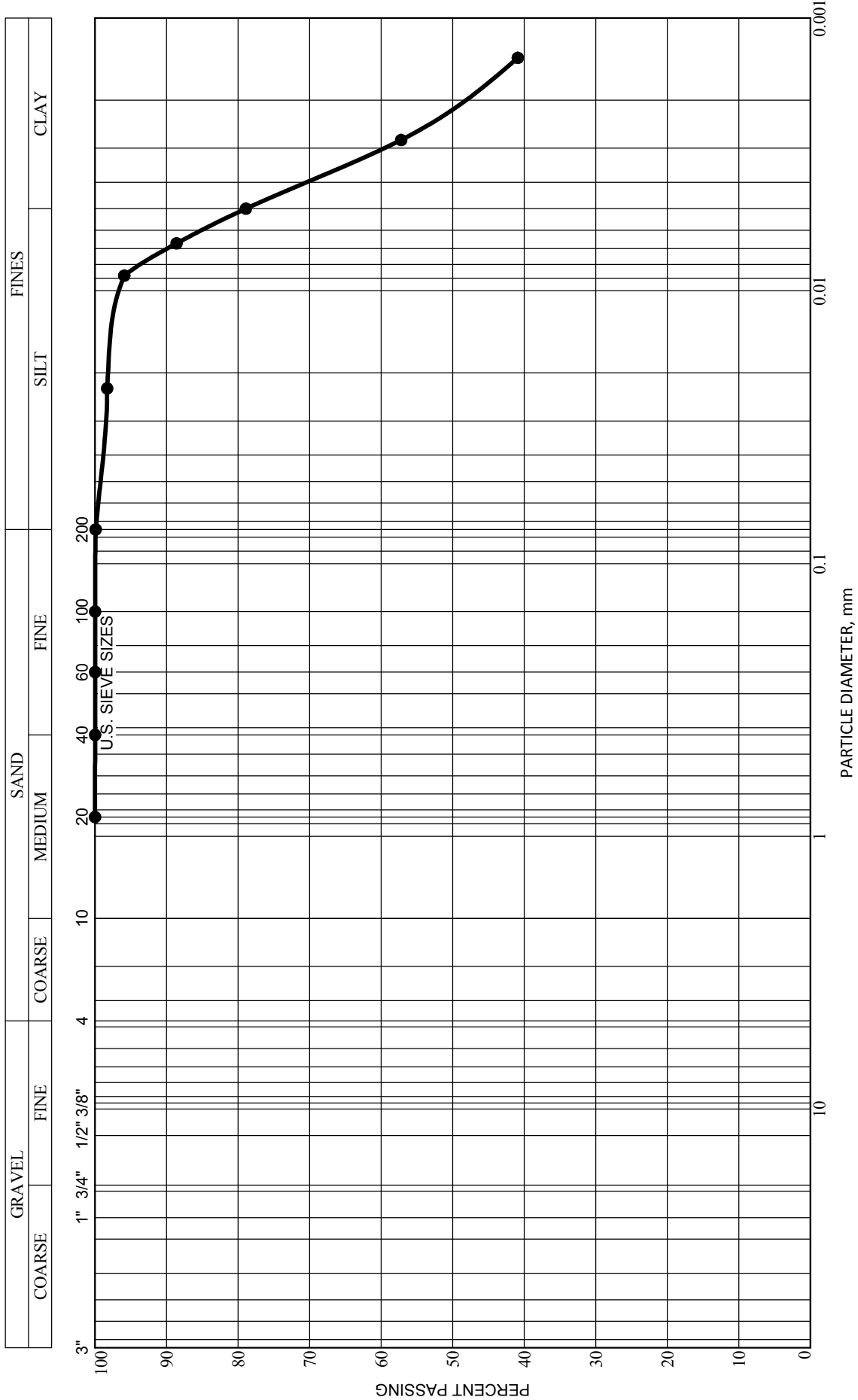
CLASSIFICATION:
FAT CLAY(CH)

GRAVEL 0.0%
 SAND 0.2%
 SILT 14.1%
 CLAY 85.7%
 D60=0.001
 D30=
 D10=

Cu=
 Cc=

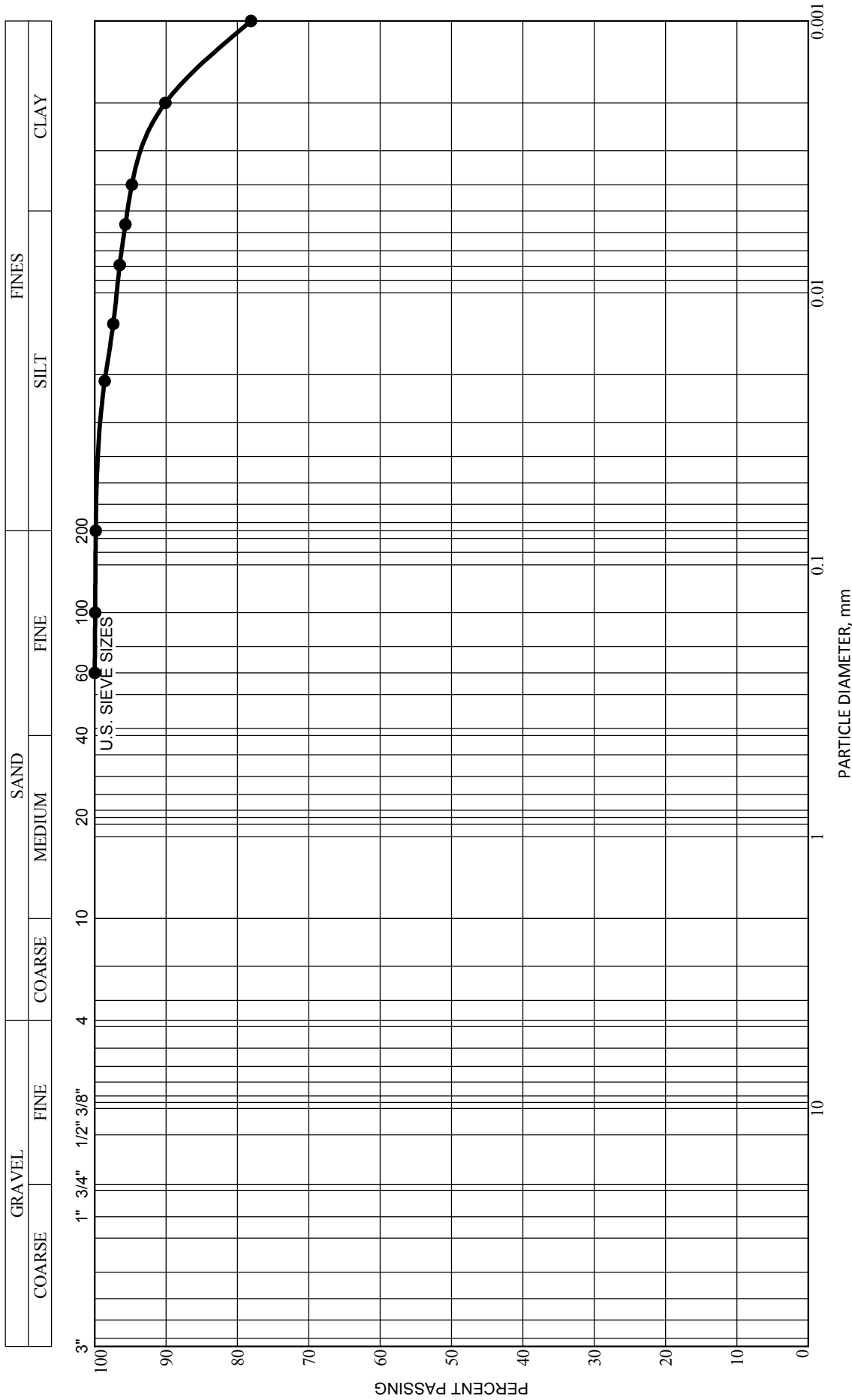



GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUN SM INTERTEC	Braun Project BL-09-03127A Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, MN Fargo BORING: 09-59MU SAMPLE: 3 DEPTH: 35.0'-37.0' Braun Intertec Corporation	CLASSIFICATION: FAT CLAY(CH) GRAVEL: 0.0% SAND: 0.1% SILT: 21.0% CLAY: 78.9% D60=0.003 D30= D10= Cu= Cc=
---	---	---

GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-09-03127A Fargo-Moorhead Metro Feasibility Study Fargo-Moorhead, MN</p> <p style="color: red;">Fargo</p> <p>BORING: 09-60MU SAMPLE: 3 DEPTH: 35.0'-37.0'</p> <p style="text-align: right;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY(CH)</p> <p>GRAVEL 0.0% SAND 0.1% SILT 4.5% CLAY 95.4% D60= Cu= D30= Cc= D10=</p>
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Grain Size Distribution ASTM D422

Job No. : **7577**

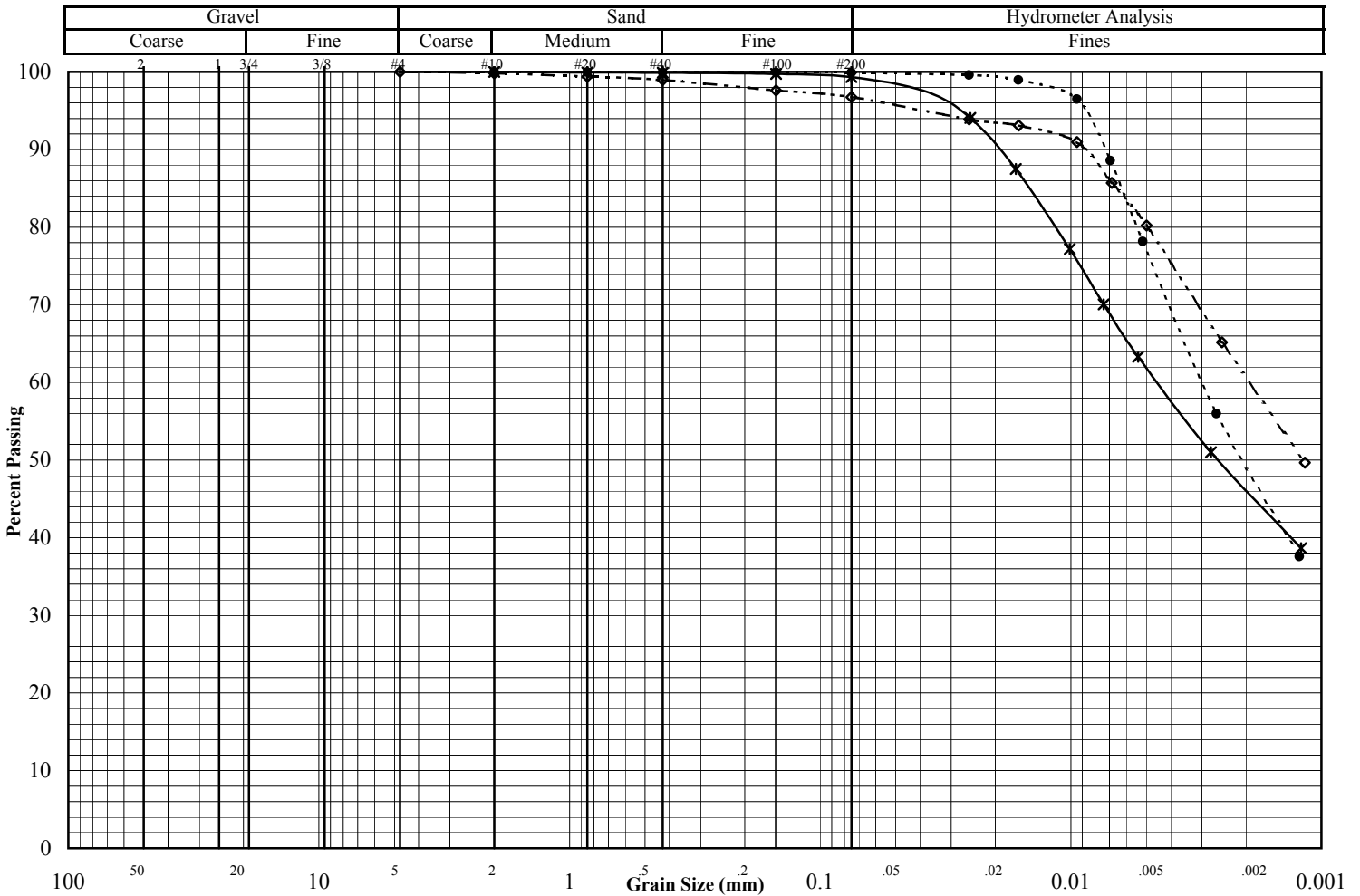
Project: FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING

Test Date: 8/19/10

Reported To: USACE -Geotech. & Geology Section

Report Date: 8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	10-78MU / ND Wild Rice	1	13-15	5T	Fat Clay w/a few laminations of silt (CH)
●	10-78MU / ND Wild Rice	2	25-27	5T	Fat Clay (CH)
◇	10-78MU / ND Wild Rice	3	55-57	5T	Fat Clay w/a few pockets of silt (CH)



	*	●	◇
Other Tests			
Liquid Limit	55.8	63.8	71.8
Plastic Limit	22.1	23.1	22.4
Plasticity Index	33.7	40.7	49.4
Water Content			
Dry Density (pcf)			
Specific Gravity	2.76	2.76	2.77
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			
(* = assumed)			

	*	●	◇
Percent Passing			
Mass (g)	232.2	116.9	159.4
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	100.0
#10	100.0	100.0	99.8
#20	99.9	100.0	99.4
#40	99.9	99.9	98.9
#100	99.7	99.9	97.6
#200	99.3	99.9	96.8

	*	●	◇
D ₆₀			
D ₃₀			
D ₁₀			
C _u			
C _c			

Remarks:

Fargo
10-78MU



Grain Size Distribution ASTM D422

Job No. : **7577**

Project:	FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING	Test Date:	8/19/10
Reported To:	USACE -Geotech. & Geology Section	Report Date:	8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	10-78MU / ND Wild Rice	1	13-15	5T	Fat Clay w/a few laminations of silt (CH)
Spec 2	10-78MU / ND Wild Rice	2	25-27	5T	Fat Clay (CH)
Spec 3	10-78MU / ND Wild Rice	3	55-57	5T	Fat Clay w/a few pockets of silt (CH)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	
3/8"		3/8"		3/8"	
#4	100.0	#4	100.0	#4	100.0
#10	100.0	#10	100.0	#10	99.8
#20	99.9	#20	100.0	#20	99.4
#40	99.9	#40	99.9	#40	98.9
#100	99.7	#100	99.9	#100	97.6
#200	99.3	#200	99.9	#200	96.8

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.025	94.1	0.025	99.6	0.025	93.9
0.017	87.5	0.016	99.0	0.016	93.1
0.010	77.2	0.009	96.5	0.009	91.0
0.007	70.0	0.007	88.6	0.007	85.7
0.005	63.3	0.005	78.2	0.005	80.2
0.003	51.0	0.003	56.0	0.002	65.2
0.001	38.6	0.001	37.6	0.001	49.7

Remarks

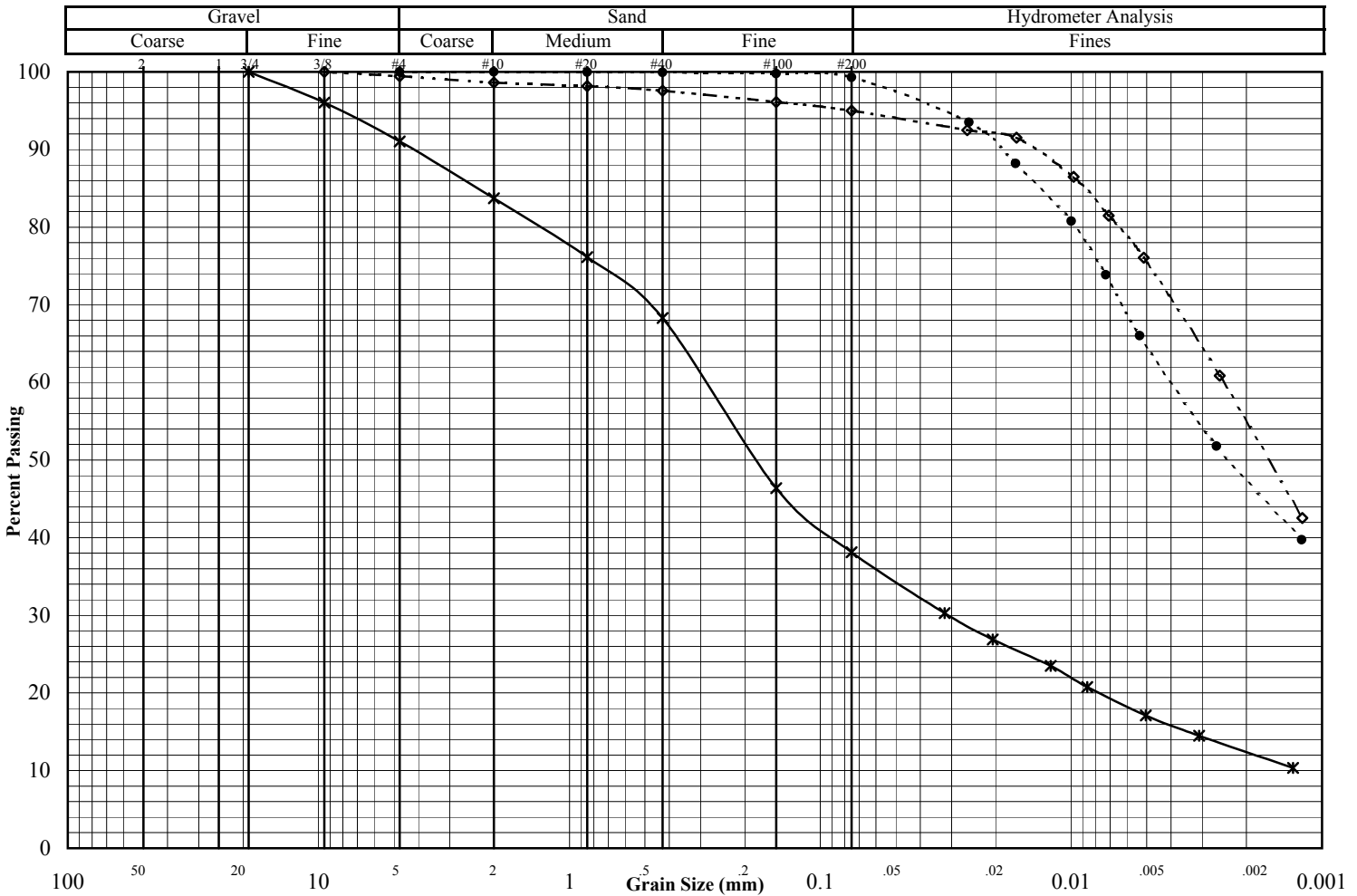
Specimen 1	Specimen 2	Specimen 3

Grain Size Distribution ASTM D422

Job No. : **7577**

Project:	FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING	Test Date:	8/19/10
Reported To:	USACE -Geotech. & Geology Section	Report Date:	8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	10-78MU / ND Wild Rice	4	70-71	3T	Clayey Sand w/a little gravel (CL)
●	10-79MU / ND RRCS	1	20-22	5T	Fat Clay w/a few laminations of silt, slightly blocky structured (CH)
◇	10-79MU / ND RRCS	2	40-42	5T	Fat Clay w/a few pockets of silt (CH)



	*	●	◇
Other Tests			
Liquid Limit	29.5	51.8	83.0
Plastic Limit	16.9	20.5	25.2
Plasticity Index	12.6	31.3	57.8
Water Content			
Dry Density (pcf)			
Specific Gravity	2.69	2.70	2.78
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			
(* = assumed)			

	*	●	◇
Percent Passing			
Mass (g)	284.9	196.3	166.4
2"			
1.5"			
1"			
3/4"	100.0		
3/8"	96.0		100.0
#4	91.1	100.0	99.5
#10	83.7	100.0	98.6
#20	76.1	100.0	98.2
#40	68.3	99.9	97.6
#100	46.4	99.8	96.1
#200	38.1	99.3	95.0

	*	●	◇
D ₆₀			
D ₃₀			
D ₁₀			
C _u			
C _c			

Remarks:

Fargo
10-78MU
10-79MU



Grain Size Distribution ASTM D422

Job No. : **7577**

Project:	FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING	Test Date:	8/19/10
Reported To:	USACE -Geotech. & Geology Section	Report Date:	8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	10-78MU / ND Wild Rice	4	70-71	3T	Clayey Sand w/a little gravel (CL)
Spec 2	10-79MU / ND RRCS	1	20-22	5T	Fat Clay w/a few laminations of silt, slightly blocky structured (CH)
Spec 3	10-79MU / ND RRCS	2	40-42	5T	Fat Clay w/a few pockets of silt (CH)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"	100.0	3/4"		3/4"	
3/8"	96.0	3/8"		3/8"	100.0
#4	91.1	#4	100.0	#4	99.5
#10	83.7	#10	100.0	#10	98.6
#20	76.1	#20	100.0	#20	98.2
#40	68.3	#40	99.9	#40	97.6
#100	46.4	#100	99.8	#100	96.1
#200	38.1	#200	99.3	#200	95.0

Hydrometer Data

Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.032	30.3	0.026	93.5	0.026	92.5
0.021	26.9	0.017	88.2	0.017	91.5
0.012	23.5	0.010	80.8	0.010	86.5
0.009	20.8	0.007	73.9	0.007	81.5
0.005	17.1	0.005	66.0	0.005	76.1
0.003	14.5	0.003	51.8	0.003	60.9
0.001	10.3	0.001	39.7	0.001	42.5

Remarks

Specimen 1	Specimen 2	Specimen 3

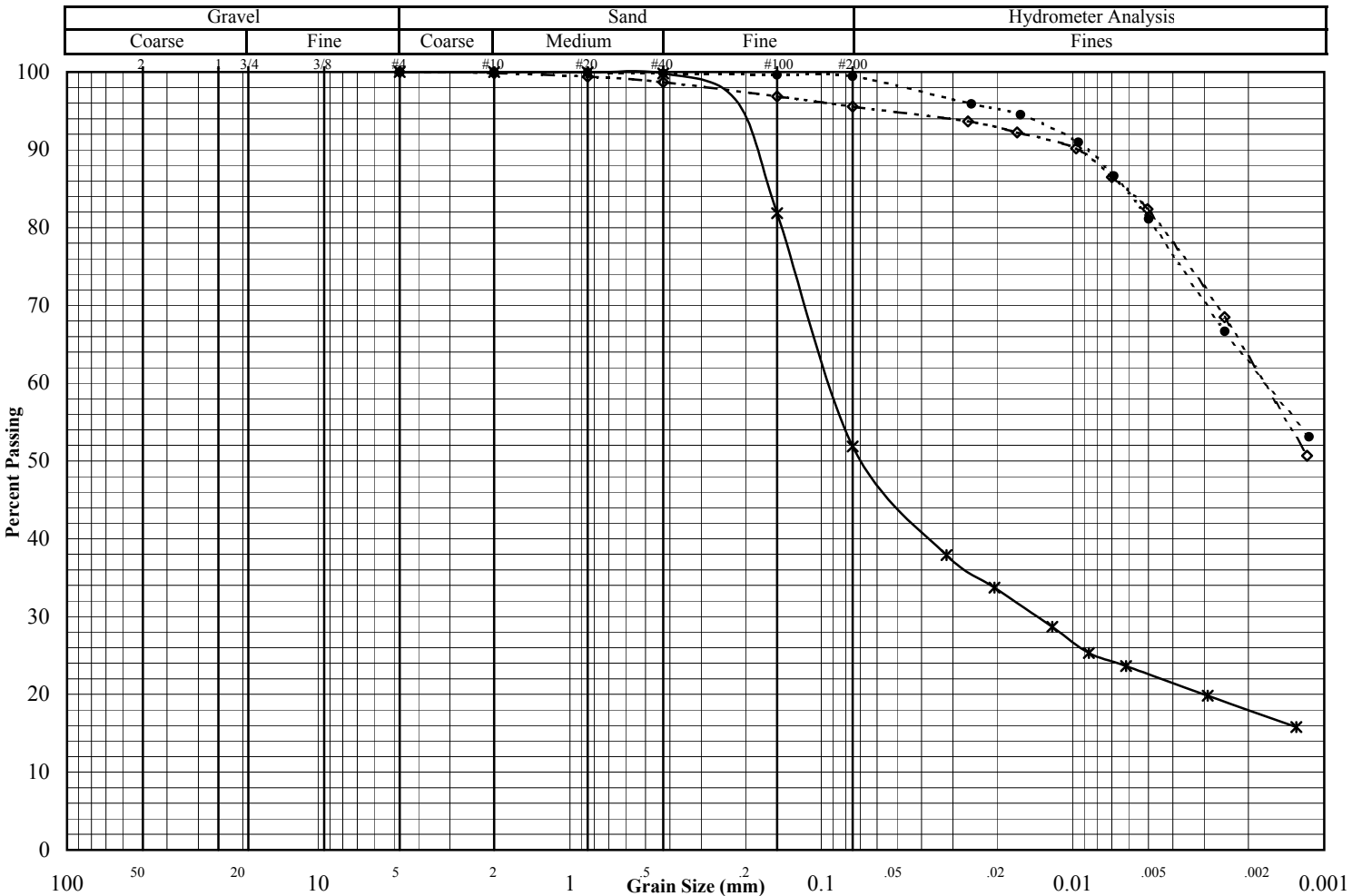


Grain Size Distribution ASTM D422

Job No. : **7577**

Project:	FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING	Test Date:	8/19/10
Reported To:	USACE -Geotech. & Geology Section	Report Date:	8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
*	10-80MU / ND Sheyenne	1	23-25	5T	Sandy Lean Clay w/a few pockets of silty sand (CL)
●	10-80MU / ND Sheyenne	2	35-37	5T	Fat Clay w/laminations of silt (CH)
◇	10-80MU / ND Sheyenne	3	55-57	5T	Fat Clay w/a few pockets of silt (CH)



	*	●	◇
Liquid Limit	28.2	90.7	78.1
Plastic Limit	17.1	29.1	26.8
Plasticity Index	11.1	61.6	51.3
Water Content			
Dry Density (pcf)			
Specific Gravity	2.67	2.78	2.78
Porosity			
Organic Content			
pH			
Shrinkage Limit			
Penetrometer			
Qu (psf)			
(* = assumed)			

	*	●	◇
Mass (g)	256.6	113.1	164.4
2"			
1.5"			
1"			
3/4"			
3/8"			
#4	100.0	100.0	100.0
#10	100.0	100.0	99.8
#20	100.0	99.9	99.4
#40	99.8	99.8	98.7
#100	81.8	99.6	96.9
#200	51.9	99.4	95.6

	*	●	◇
D ₆₀			
D ₃₀			
D ₁₀			
C _u			
C _c			

Remarks:

Fargo
10-80MU



Grain Size Distribution ASTM D422

Job No. : **7577**

Project:	FARGO-MOORHEAD METRO FEASIBILITY PROJECT - UNDISTURBED LABORATORY SOIL TESTING	Test Date:	8/19/10
Reported To:	USACE -Geotech. & Geology Section	Report Date:	8/20/10

	Location / Boring No.	Sample No.	Depth (ft)	Sample Type	Soil Classification
Spec 1	10-80MU / ND Sheyenne	1	23-25	5T	Sandy Lean Clay w/a few pockets of silty sand (CL)
Spec 2	10-80MU / ND Sheyenne	2	35-37	5T	Fat Clay w/laminations of silt (CH)
Spec 3	10-80MU / ND Sheyenne	3	55-57	5T	Fat Clay w/a few pockets of silt (CH)

Sieve Data

Specimen 1		Specimen 2		Specimen 3	
Sieve	% Passing	Sieve	% Passing	Sieve	% Passing
2"		2"		2"	
1.5"		1.5"		1.5"	
1"		1"		1"	
3/4"		3/4"		3/4"	
3/8"		3/8"		3/8"	
#4	100.0	#4	100.0	#4	100.0
#10	100.0	#10	100.0	#10	99.8
#20	100.0	#20	99.9	#20	99.4
#40	99.8	#40	99.8	#40	98.7
#100	81.8	#100	99.6	#100	96.9
#200	51.9	#200	99.4	#200	95.6

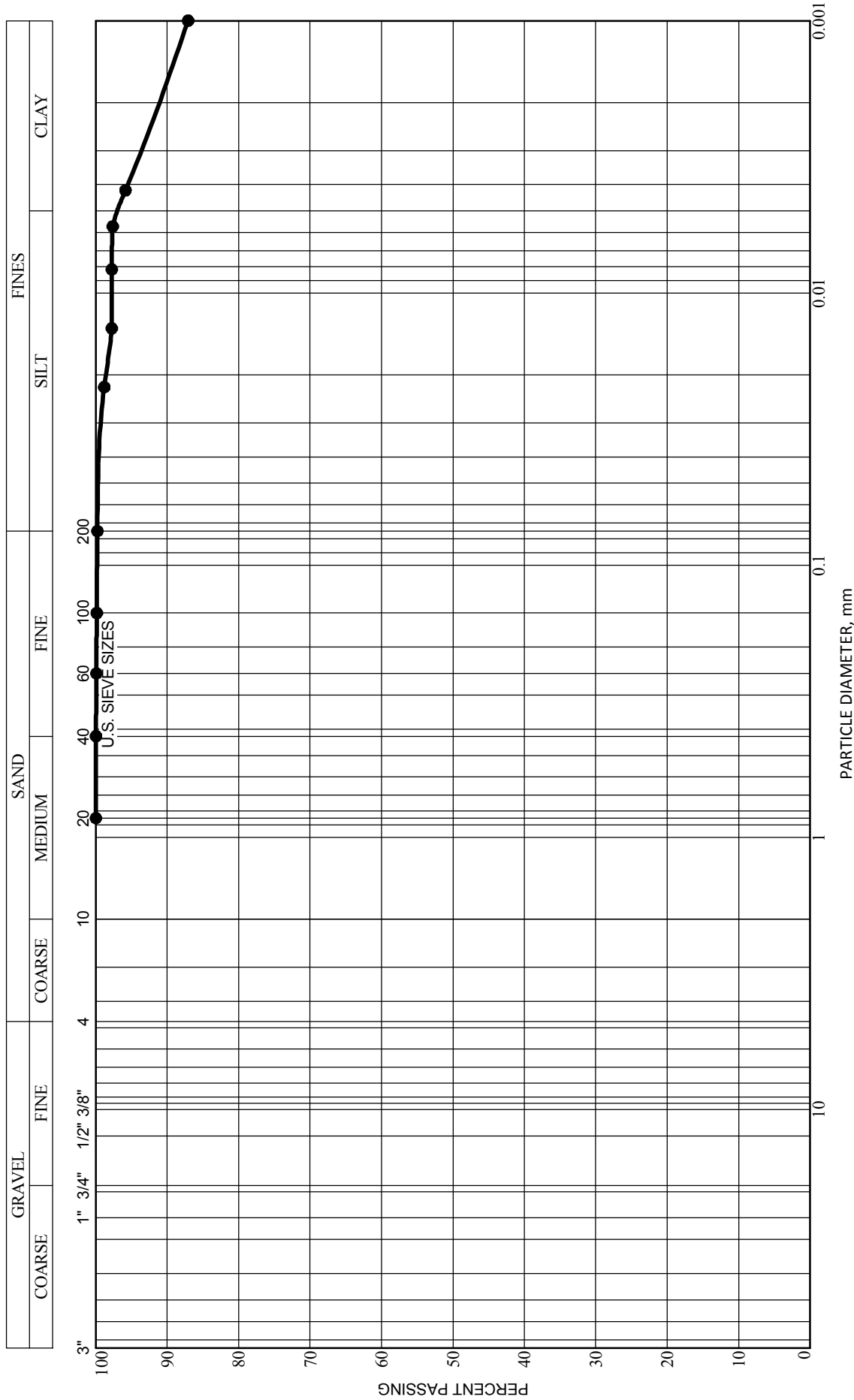
Hydrometer Data


Specimen 1		Specimen 2		Specimen 3	
Diameter (mm)	% Passing	Diameter	% Passing	Diameter	% Passing
0.032	37.9	0.025	95.9	0.026	93.7
0.020	33.7	0.016	94.5	0.017	92.2
0.012	28.7	0.009	91.0	0.010	90.2
0.009	25.3	0.007	86.6	0.007	86.5
0.006	23.7	0.005	81.1	0.005	82.4
0.003	19.8	0.002	66.6	0.002	68.5
0.001	15.8	0.001	53.1	0.001	50.7

Remarks

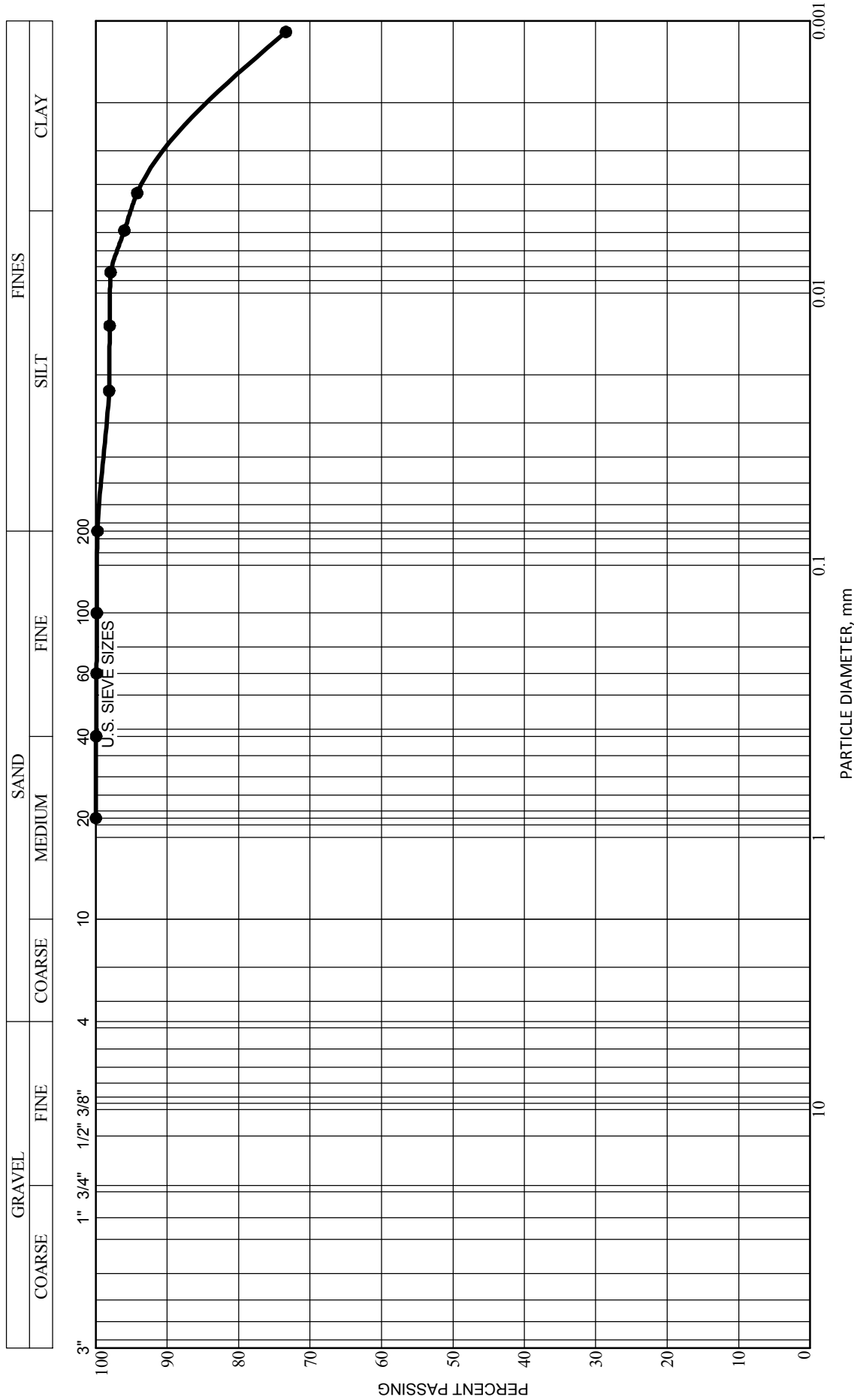
Specimen 1	Specimen 2	Specimen 3


GRAIN SIZE ACCUMULATION CURVE (ASTM)



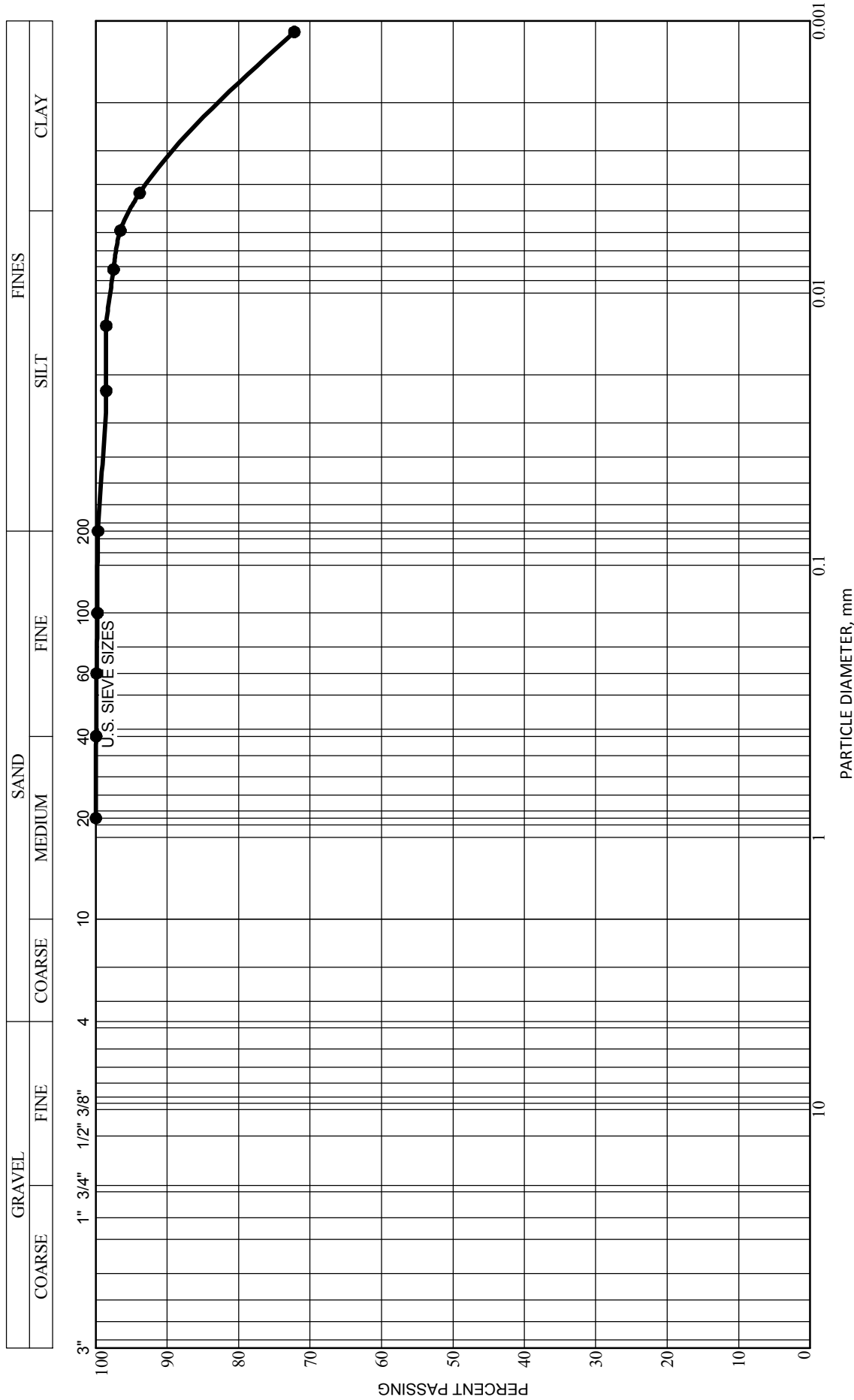
	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 10-105MU SAMPLE: 1 DEPTH: 15.0'-17.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Maple River, Dessicated Brenna Formation</p>
	<p>GRAVEL SAND FINE SILT FINES CLAY</p>	<p>0.0% 0.2% 2.9% 96.9% Cu= Cc=</p>
	<p>GRAVEL SAND SILT CLAY D60= D30= D10=</p>	


GRAIN SIZE ACCUMULATION CURVE (ASTM)



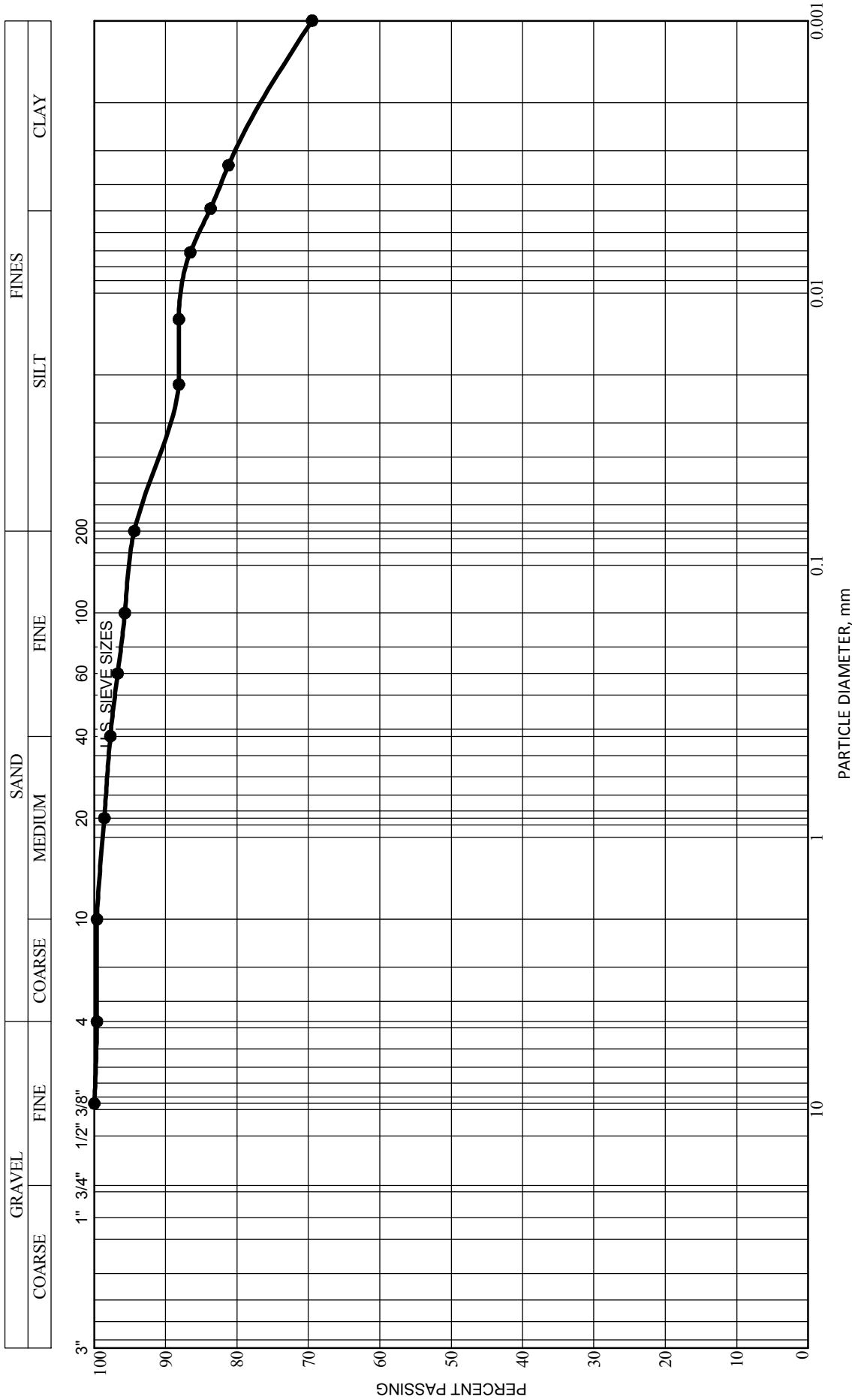
	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 10-105MU SAMPLE: 2 DEPTH: 25.0'-27.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Maple River, Brenna Formation</p>
	<p>GRAVEL SAND FINE SILT FINES CLAY</p>	<p>0.0% 0.2% 4.7% 95.1% Cu= Cc=</p>
	<p>GRAVEL SAND SILT CLAY D60= D30= D10=</p>	


GRAIN SIZE ACCUMULATION CURVE (ASTM)



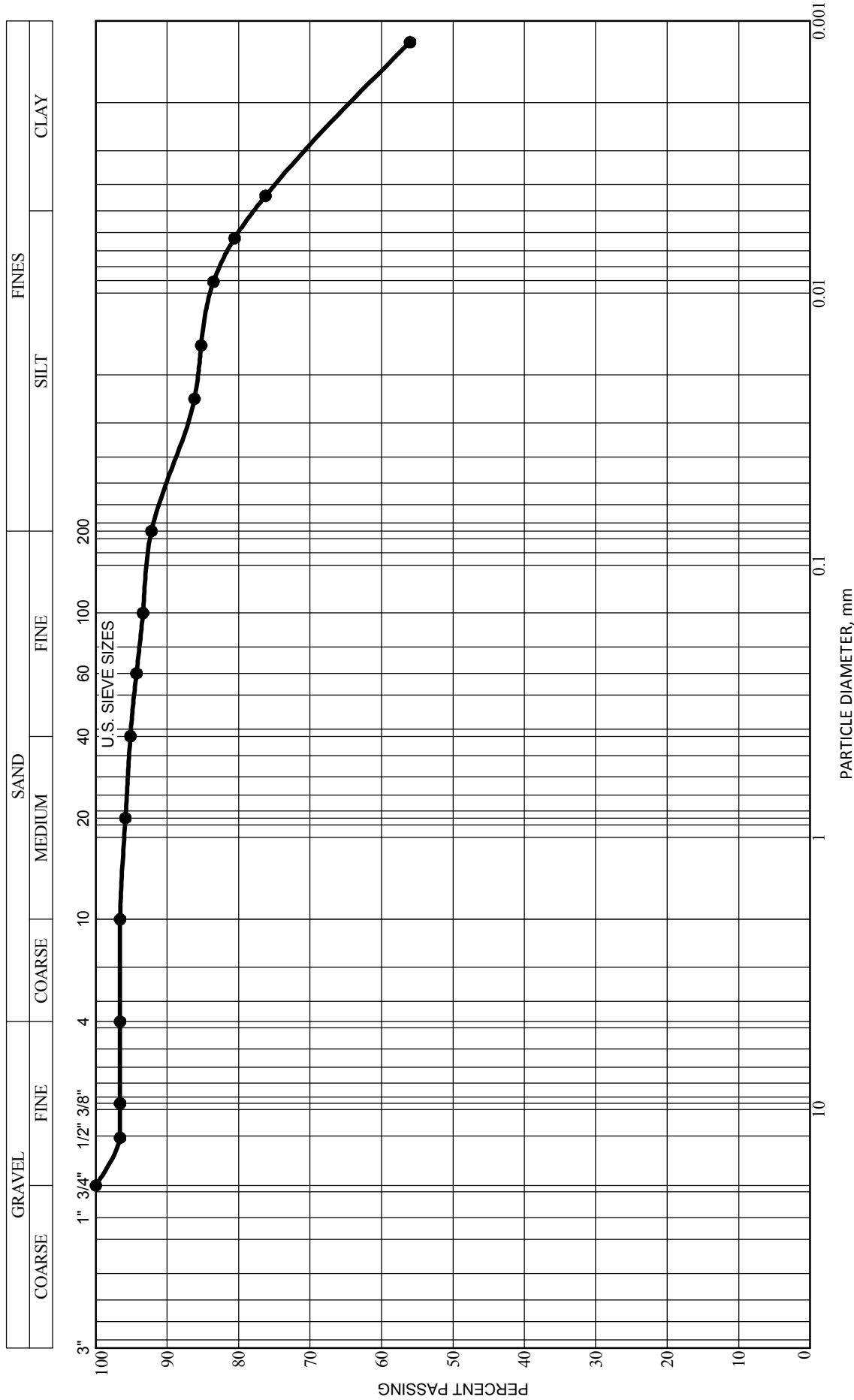
	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Maple River, Brenna Formation</p>
<p>BORING: 10-105MU SAMPLE: 3 DEPTH: 35.0'-37.0'</p> <p style="font-size: small;">Braun Intertec Corporation</p>	<p>GRAVEL 0.0%</p> <p>SAND 0.3%</p> <p>SILT 4.6%</p> <p>CLAY 95.2%</p> <p>D60= Cu=</p> <p>D30= Cc=</p> <p>D10=</p>	<p>GRAVEL</p> <p>SAND</p> <p>SILT</p> <p>CLAY</p> <p>D60=</p> <p>D30=</p> <p>D10=</p>


GRAIN SIZE ACCUMULATION CURVE (ASTM)



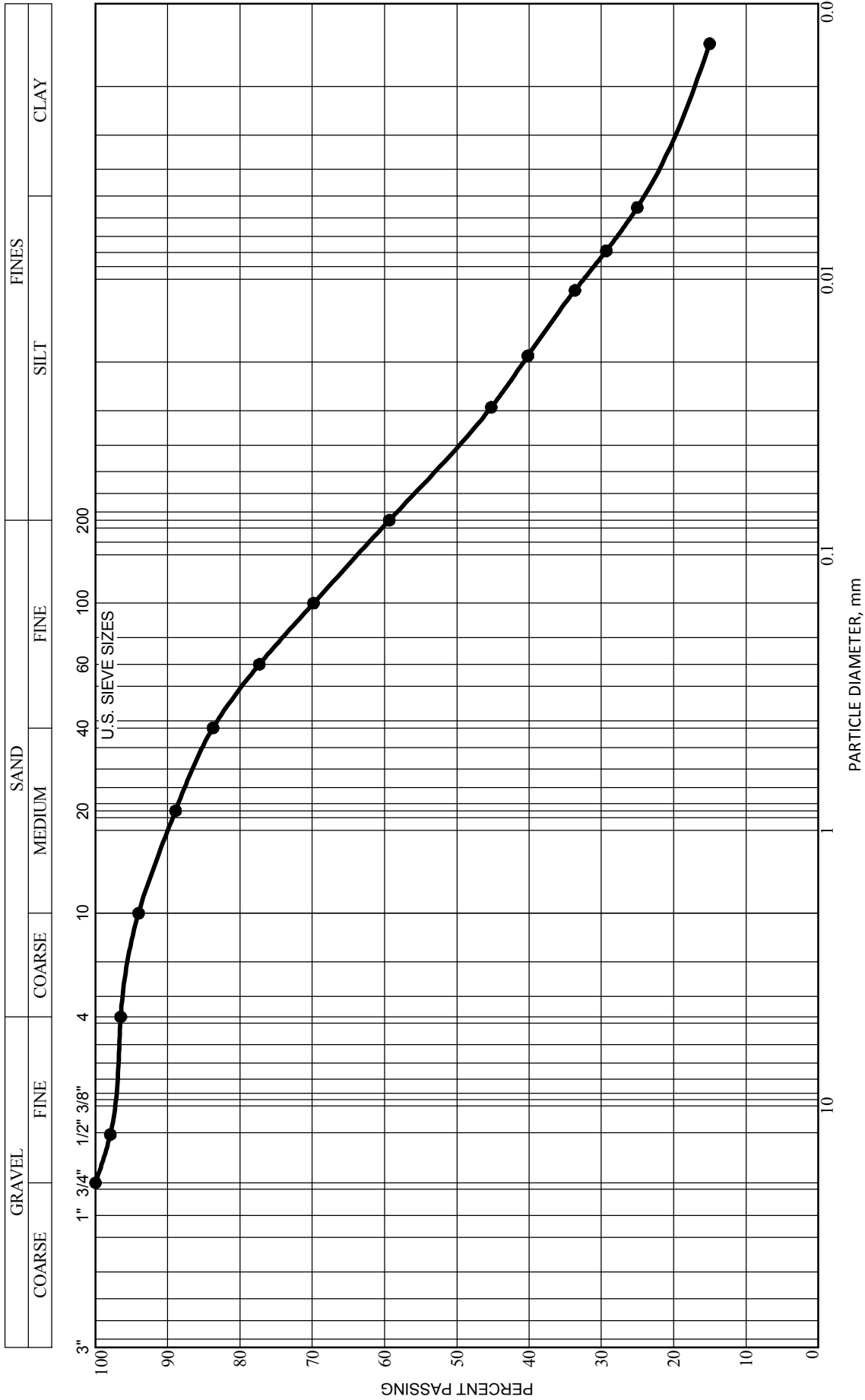
	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Maple River, Argusville Formation</p>
<p>BORING: 10-105MU SAMPLE: 4 DEPTH: 45.0'-47.0'</p>		<p>GRAVEL 0.4% SAND 5.2% SILT 10.5% CLAY 83.9% D60= D30= D10=</p>
<p>Braun Intertec Corporation</p>		

GRAIN SIZE ACCUMULATION CURVE (ASTM)

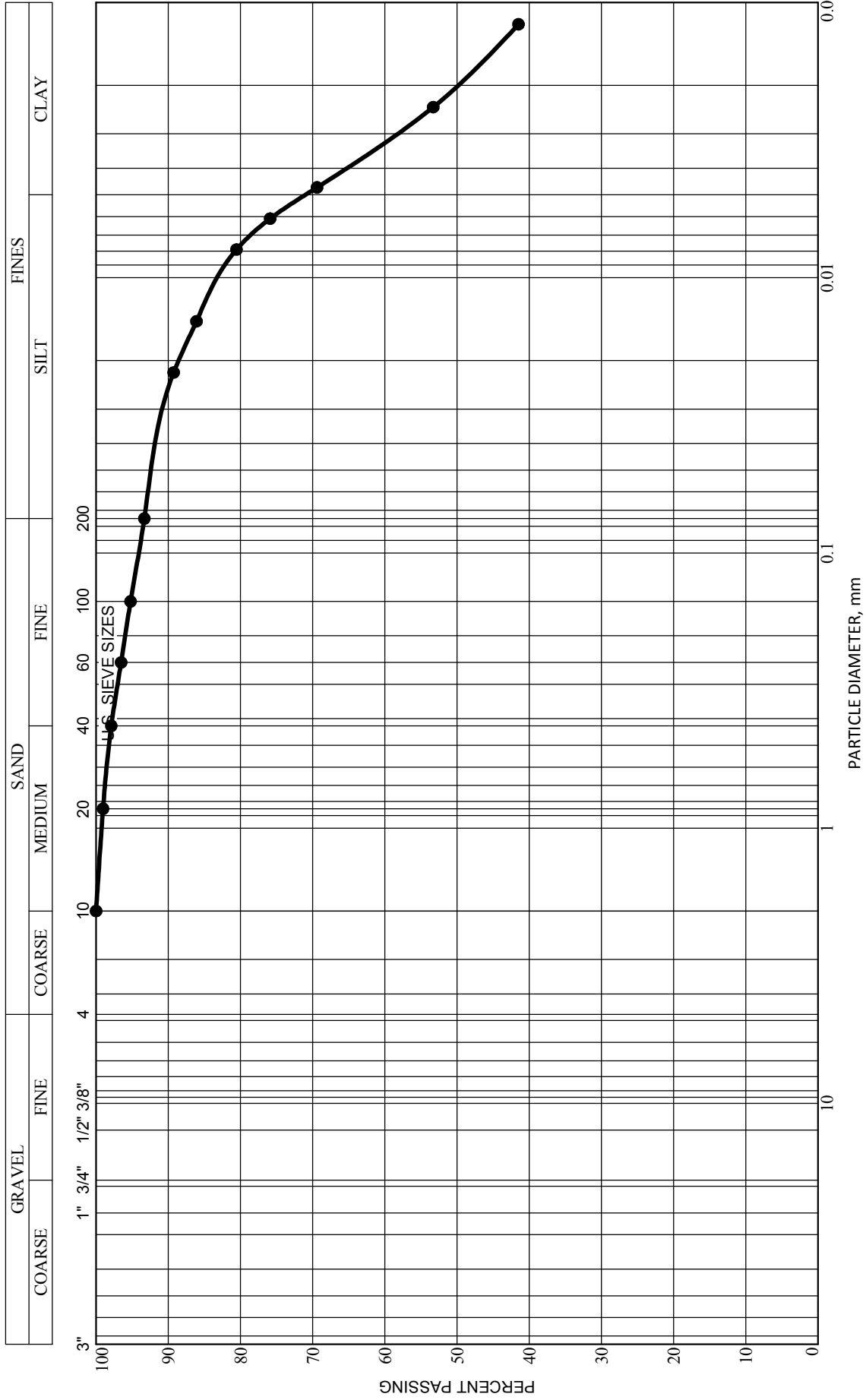



	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 10-105MU SAMPLE: 5 DEPTH: 55.0'-57.0' Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Maple River, Argusville Formation</p>
	<p>GRAVEL SAND FINE SILT FINES CLAY</p>	<p>3.4% 4.4% 14.4% 77.8% Cu= Cc=</p>
	<p>D60=0.002 D30= D10=</p>	

GRAIN SIZE ACCUMULATION CURVE (ASTM)

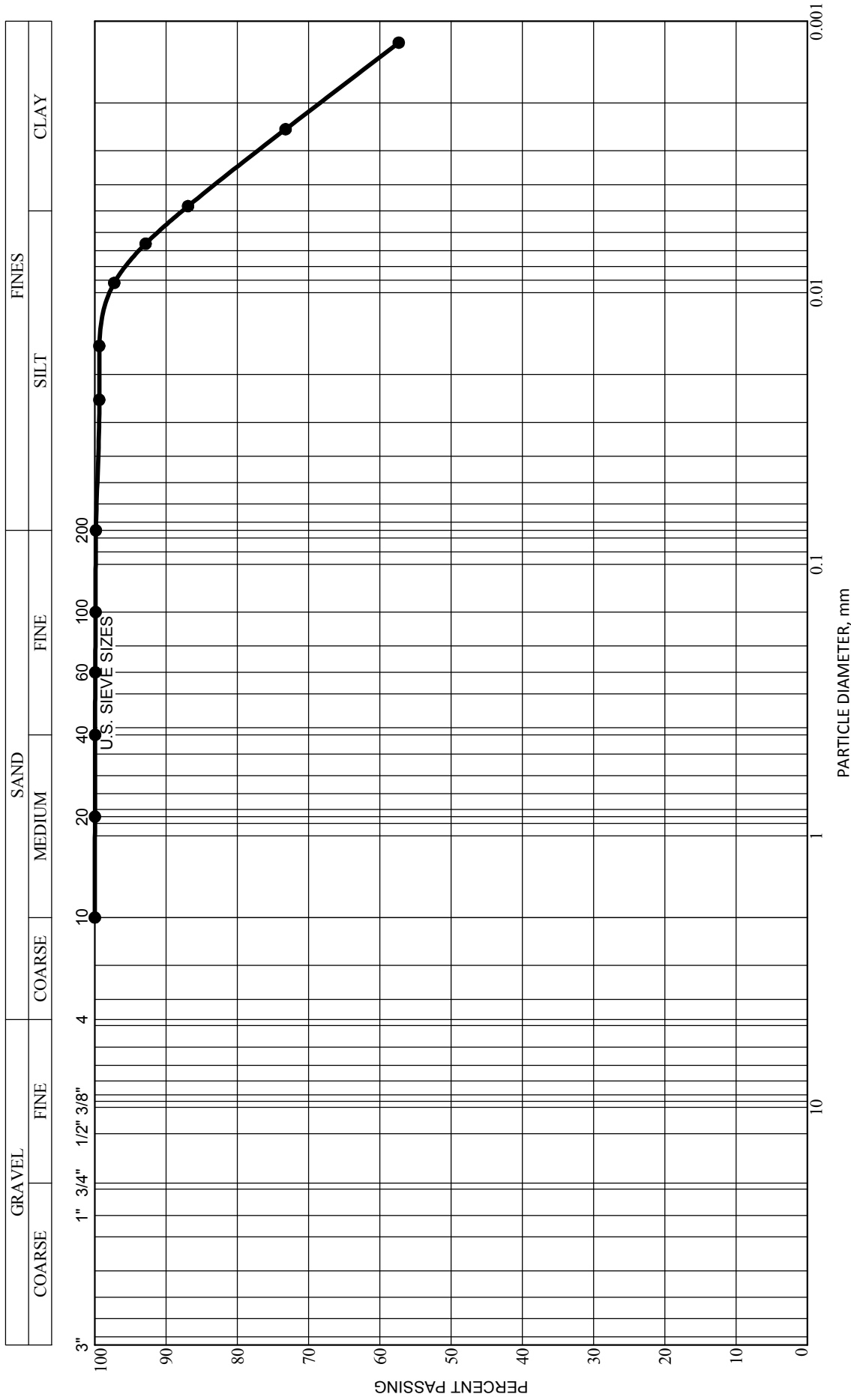


GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 11-107MU SAMPLE: 3 DEPTH: 40.0'-42.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) ND RRCS, MN, Argusville</p> <p>GRAVEL 0.0% SAND 6.7% SILT 22.4% CLAY 70.9% D60=0.003 D30= D10=</p> <p>Cu= Cc=</p>
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GRAIN SIZE ACCUMULATION CURVE (ASTM)



BRAUNSM
INTERTEC

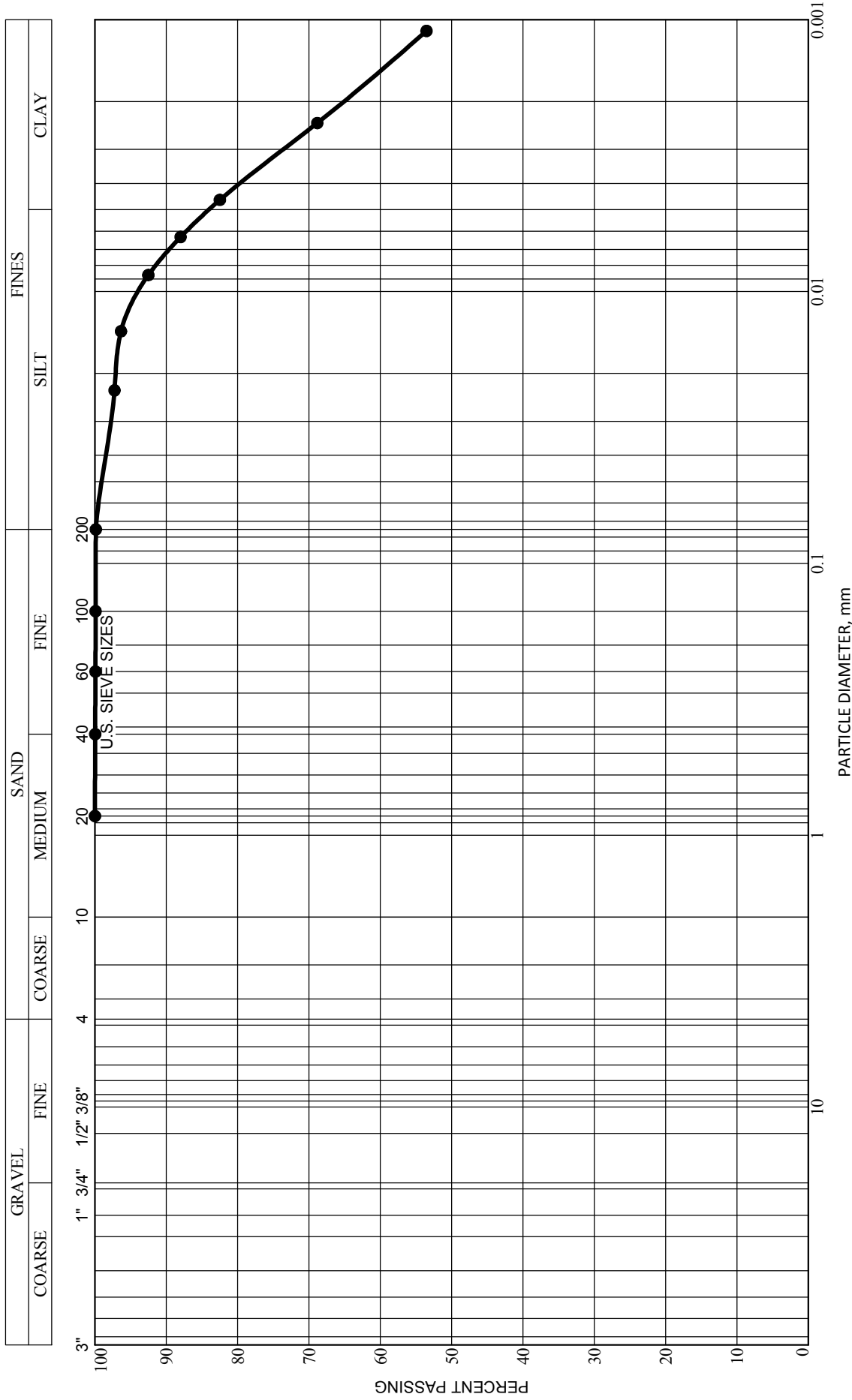
Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing


BORING: 11-110MU SAMPLE: 1 DEPTH: 25.0'-27.0'
Braun Intertec Corporation

CLASSIFICATION:
FAT CLAY, brown (CH)
Sheyenne River, OX Brenna Formation

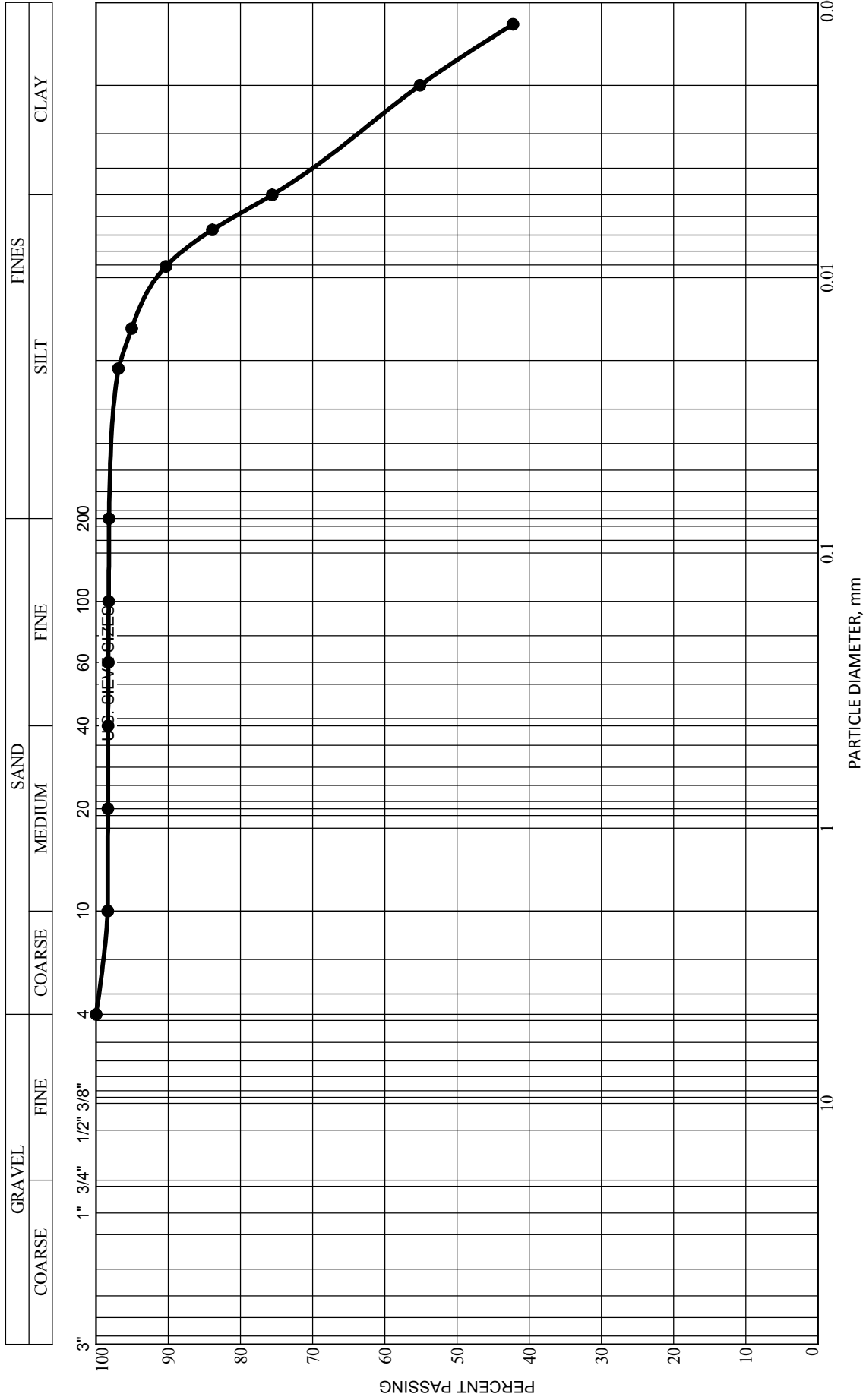
GRAVEL	0.0%
SAND	0.1%
SILT	12.2%
CLAY	87.7%
D60=0.001	Cu=
D30=	Cc=
D10=	

GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 11-110MU SAMPLE: 2 DEPTH: 35.0'-37.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Sheyenne River, Brenna Formation</p>																		
	<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <tr><td>GRAVEL</td><td>0.0%</td></tr> <tr><td>SAND</td><td>0.1%</td></tr> <tr><td>SILT</td><td>15.9%</td></tr> <tr><td>CLAY</td><td>83.9%</td></tr> <tr><td>D60=</td><td>0.002</td></tr> <tr><td>D30=</td><td></td></tr> <tr><td>D10=</td><td></td></tr> <tr><td>Cu=</td><td></td></tr> <tr><td>Cc=</td><td></td></tr> </table>	GRAVEL	0.0%	SAND	0.1%	SILT	15.9%	CLAY	83.9%	D60=	0.002	D30=		D10=		Cu=		Cc=		
GRAVEL	0.0%																			
SAND	0.1%																			
SILT	15.9%																			
CLAY	83.9%																			
D60=	0.002																			
D30=																				
D10=																				
Cu=																				
Cc=																				

GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

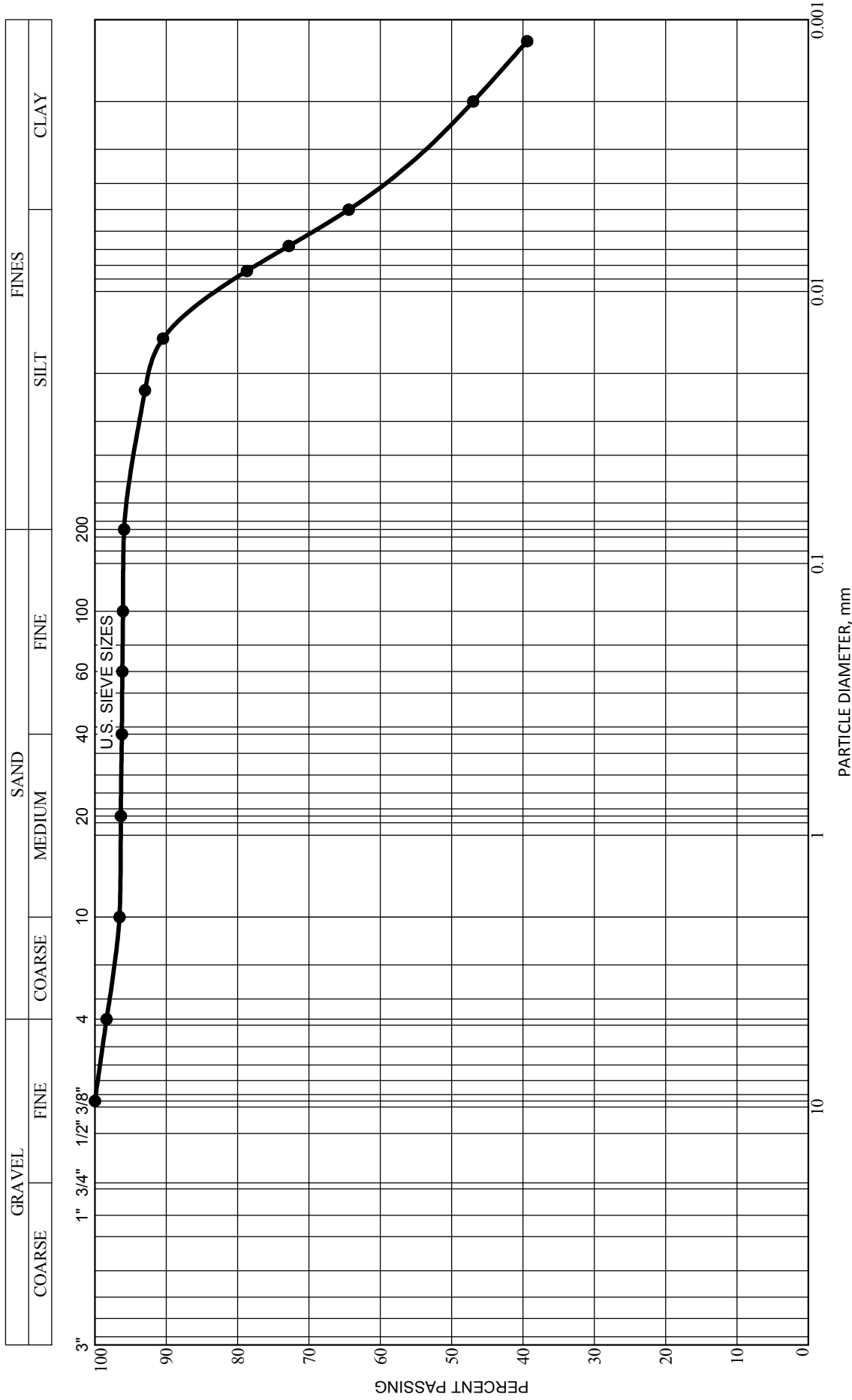
BORING: 11-118MU SAMPLE: 2 DEPTH: 33.0'-35.0'
 Braun Intertec Corporation

CLASSIFICATION:
 FAT CLAY, brown (CH)
 Wild Rice, Brenna Formation

GRAVEL 0.0%
 SAND 1.8%
 SILT 22.6%
 CLAY 75.6%
 D60=0.002
 D30=
 D10=



GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

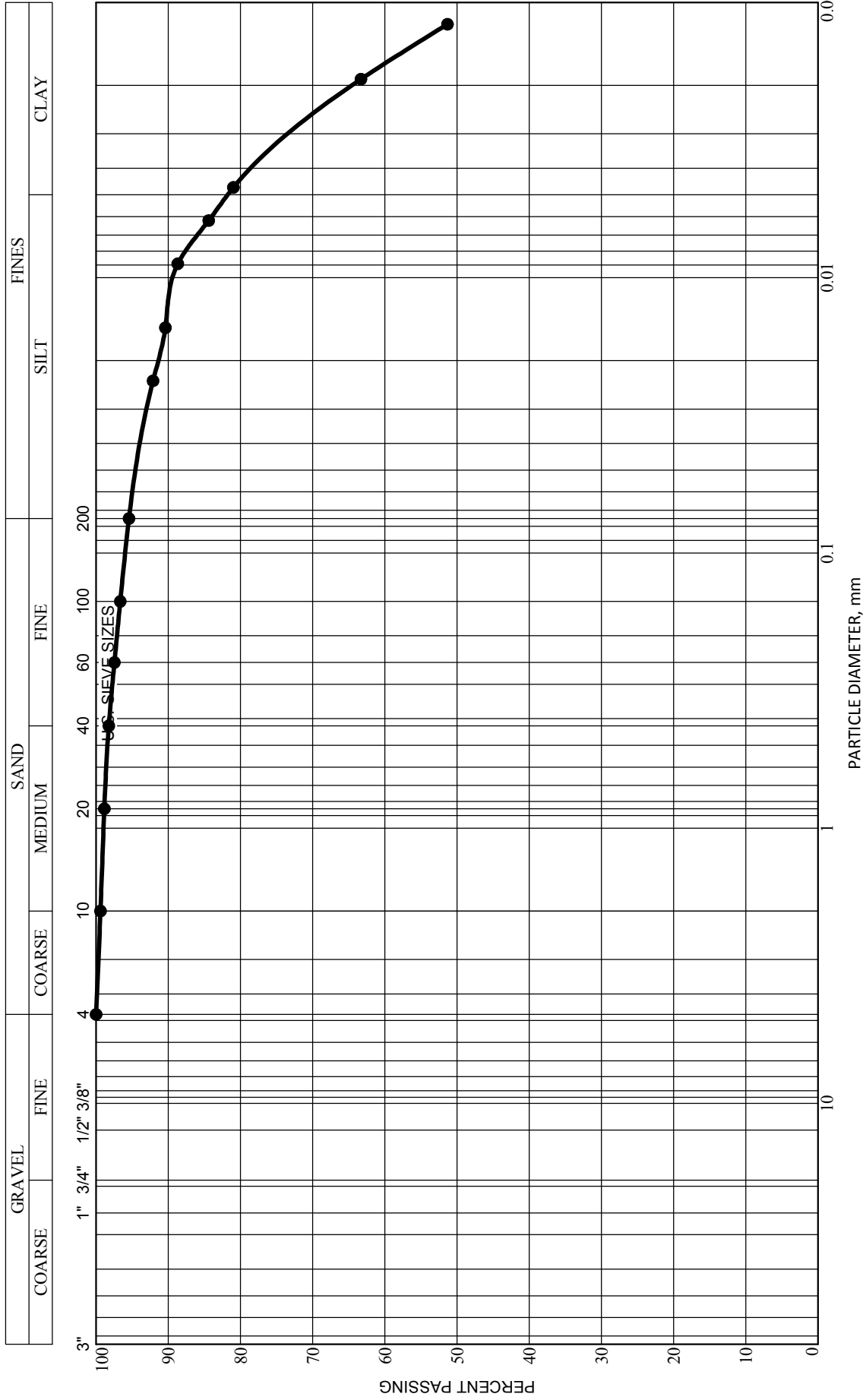
BORING: 11-118MU SAMPLE: 3 DEPTH: 45.0'-47.0'
 Braun Intertec Corporation


CLASSIFICATION:
 FAT CLAY, brown (CH)
 Wild Rice, Argusville Formation

GRAVEL 1.6%
 SAND 2.4%
 SILT 31.5%
 CLAY 64.4%
 D60=0.004
 D30=
 D10=

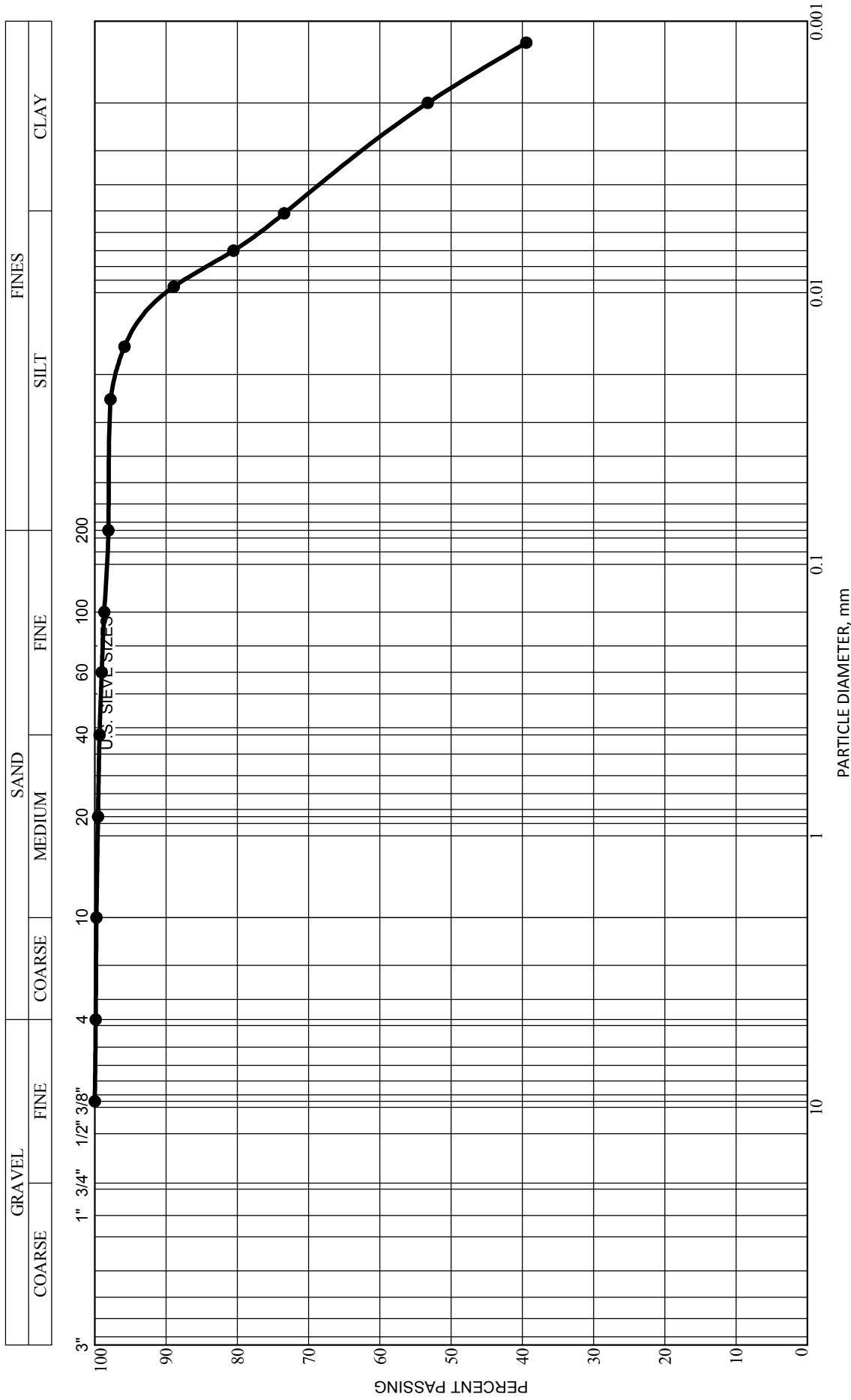



GRAIN SIZE ACCUMULATION CURVE (ASTM)



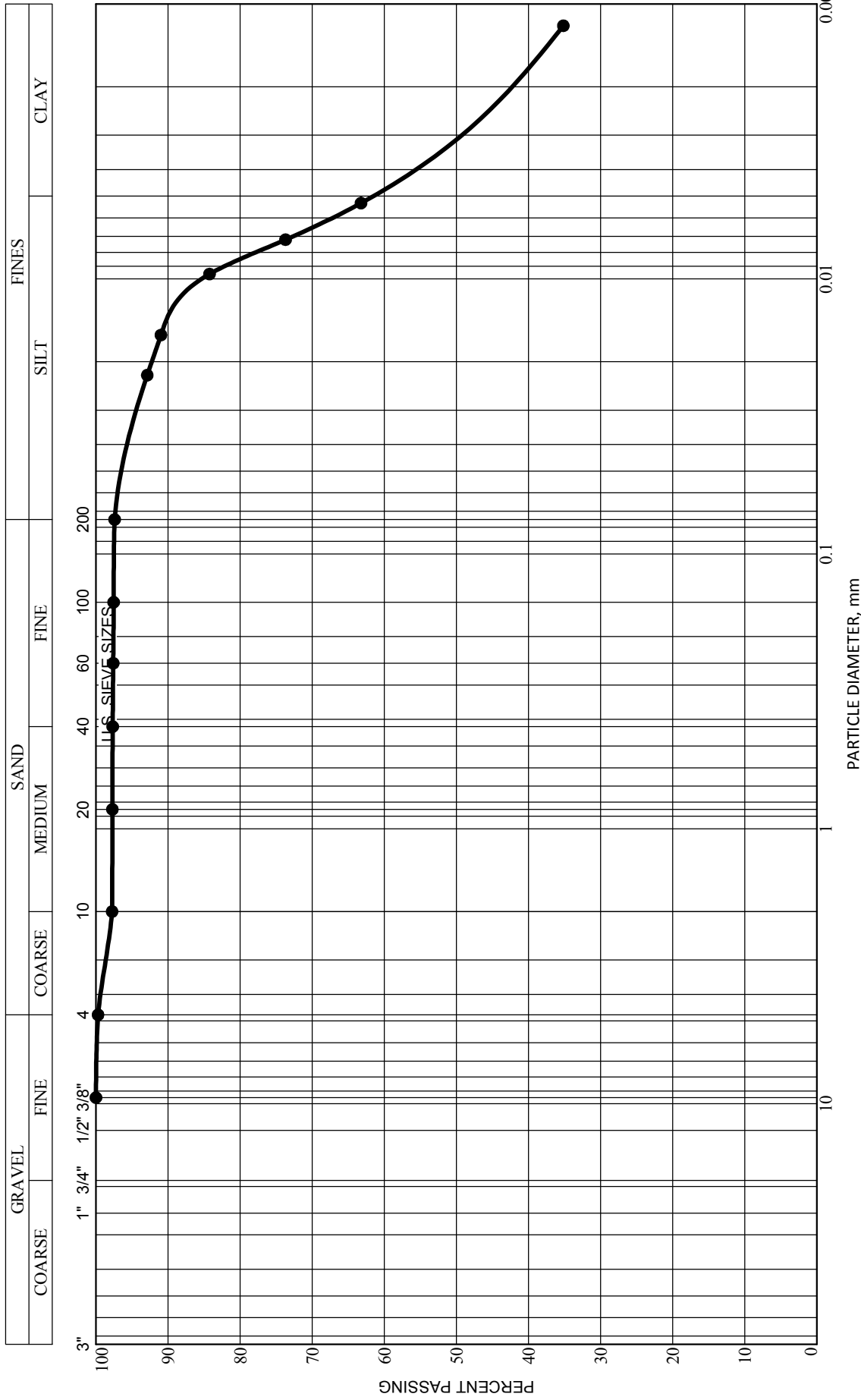
	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Wild Rice, Argusville Formation</p>																		
<p>BORING: 11-118MU SAMPLE: 4 DEPTH: 55.0'-57.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>		<table border="0" style="width: 100%;"> <tr> <td style="width: 33%;">GRAVEL</td> <td style="width: 33%;">0.0%</td> <td style="width: 33%;">D60=0.002</td> </tr> <tr> <td>SAND</td> <td>4.6%</td> <td>D30=</td> </tr> <tr> <td>SILT</td> <td>13.7%</td> <td>D10=</td> </tr> <tr> <td>CLAY</td> <td>81.7%</td> <td></td> </tr> <tr> <td></td> <td>Cu=</td> <td></td> </tr> <tr> <td></td> <td>Cc=</td> <td></td> </tr> </table>	GRAVEL	0.0%	D60=0.002	SAND	4.6%	D30=	SILT	13.7%	D10=	CLAY	81.7%			Cu=			Cc=	
GRAVEL	0.0%	D60=0.002																		
SAND	4.6%	D30=																		
SILT	13.7%	D10=																		
CLAY	81.7%																			
	Cu=																			
	Cc=																			

GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p> <p>BORING: 11-118MU SAMPLE: 5 DEPTH: 65.0'-67.0' Braun Intertec Corporation</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Wild Rice, Argusville Formation</p>
	<p>GRAVEL 0.1% SAND 1.8% SILT 25.1% CLAY 73.0%</p> <p>D60=0.003 Cu= D30= Cc= D10=</p>	

GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

BORING: 11-119MU SAMPLE: 1 DEPTH: 30.0'-32.0'
 Braun Intertec Corporation

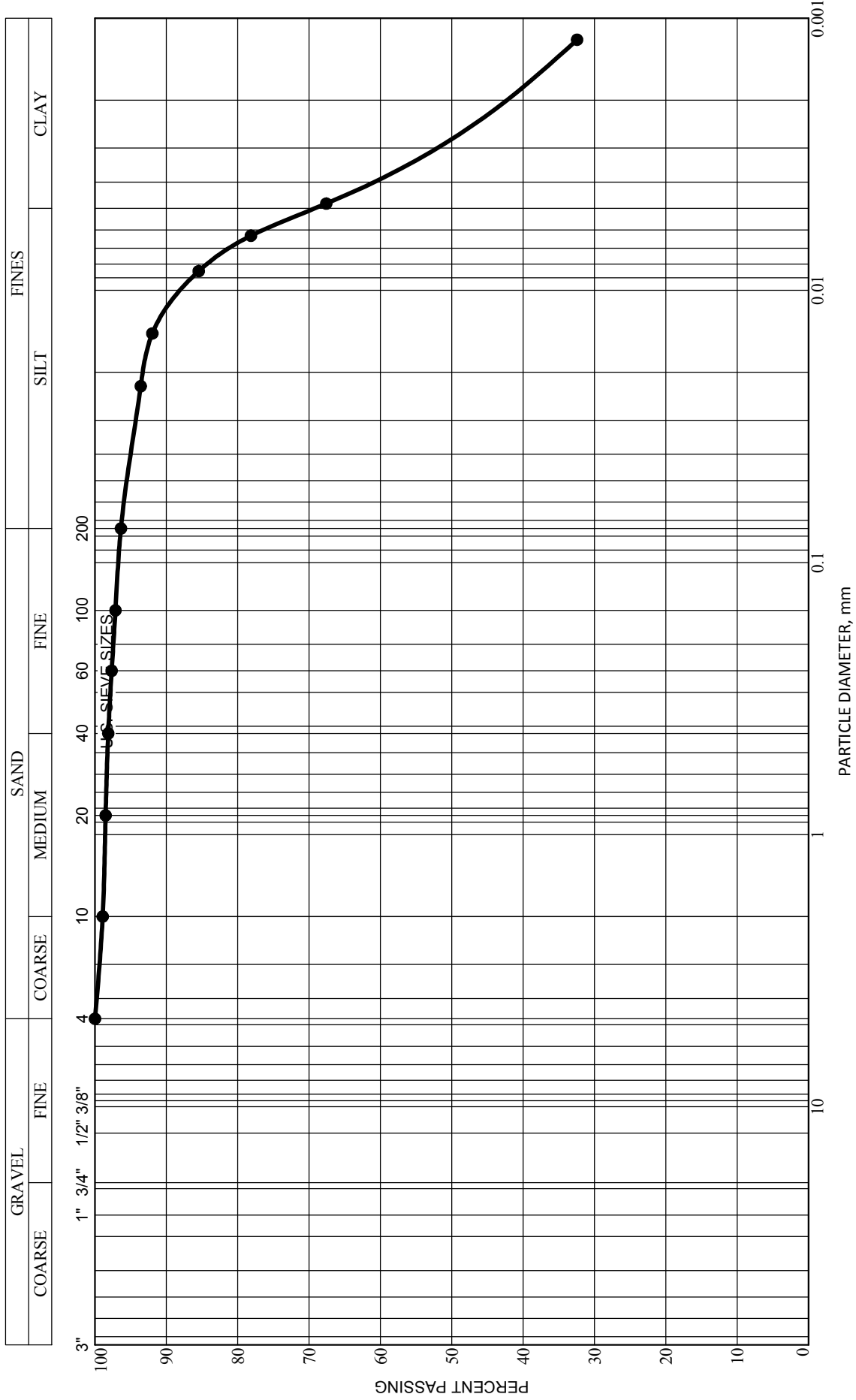
CLASSIFICATION:
 FAT CLAY, brown (CH)
 Fargo Pile Load Test, Brenna Formation


GRAVEL 0.3%
 SAND 2.3%
 SILT 35.3%
 CLAY 62.1%
 D60=0.004
 D30=
 D10=

Cu=
Cc=



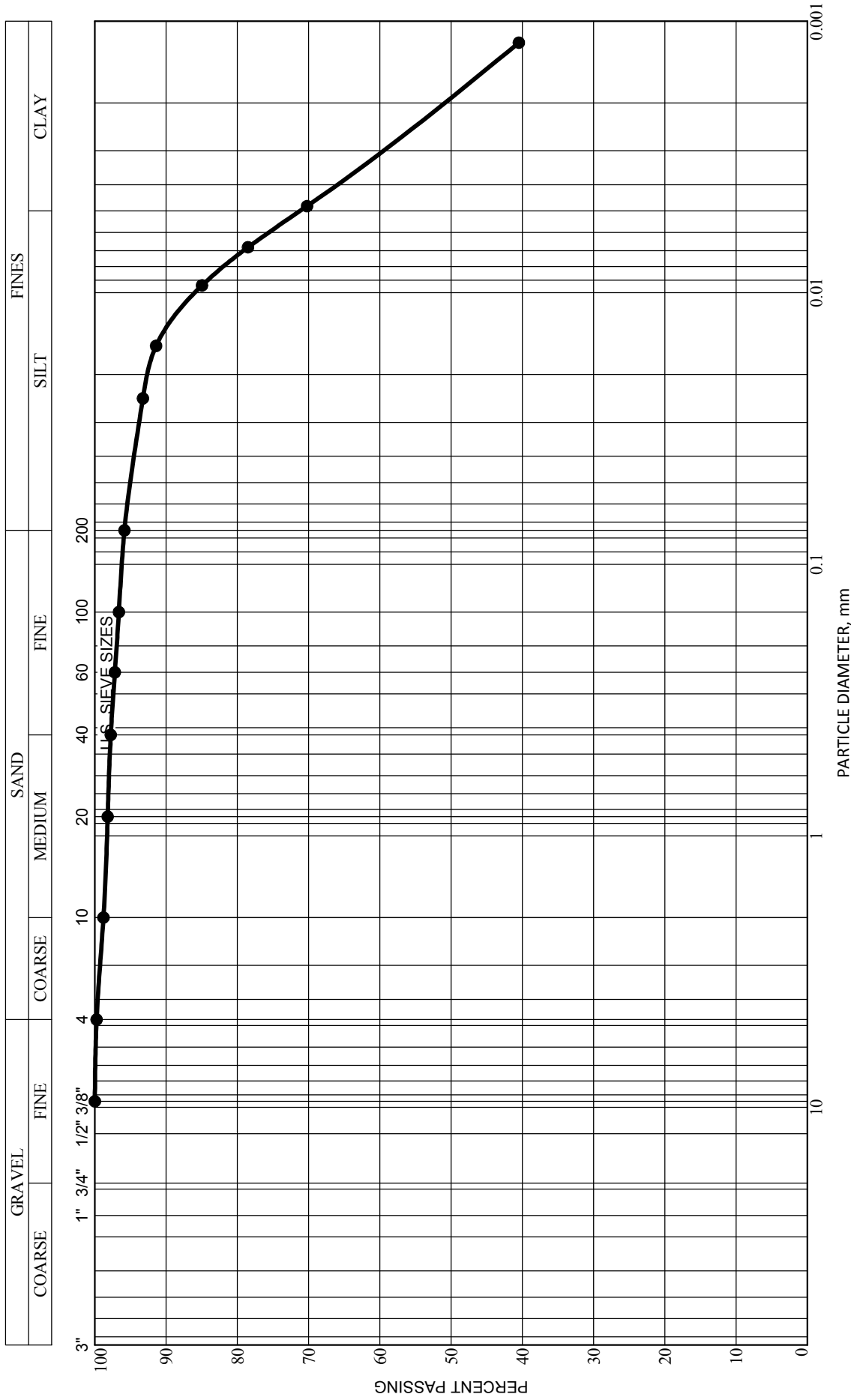
GRAIN SIZE ACCUMULATION CURVE (ASTM)




	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Fargo Pile Load Test, Argusville</p>
<p>BORING: 11-119MU SAMPLE: 2 DEPTH: 40.0'-42.0'</p>		<p>GRAVEL 0.0% SAND 3.6% SILT 27.2% CLAY 69.2% D60=0.004 D30= D10=</p>
<p>GRAVEL SAND FINE SILT FINES CLAY</p>		

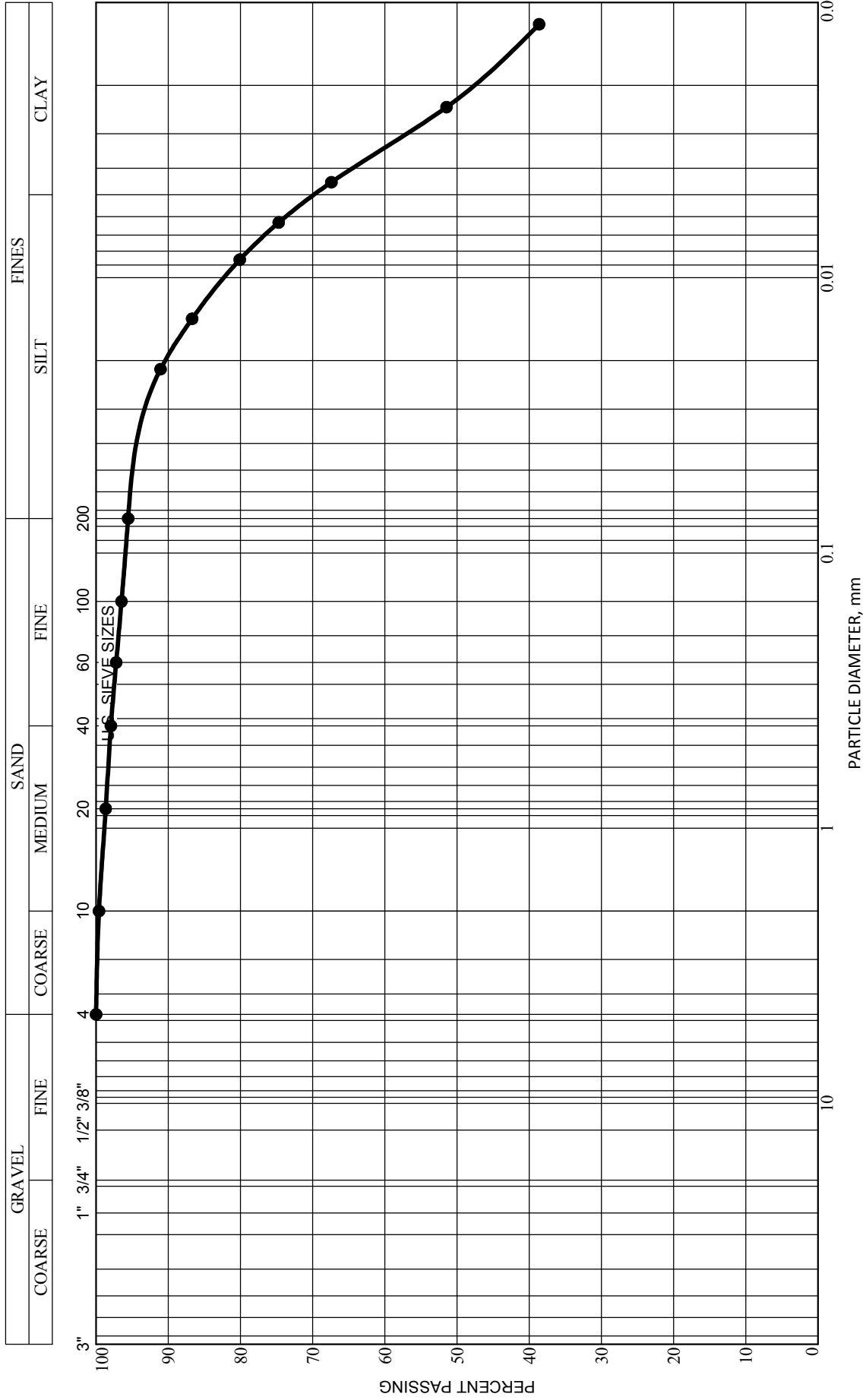
Braun Intertec Corporation

GRAIN SIZE ACCUMULATION CURVE (ASTM)



	<p>Braun Project BL-10-10065 W912ES-11-P-0024 Fargo-Moorhead Metro Feasibility Study Phase 4 Undisturbed Testing</p>	<p>CLASSIFICATION: FAT CLAY, brown (CH) Fargo Pile Load Test, Argusville</p>
<p>BORING: 11-119MU SAMPLE: 3 DEPTH: 50.0'-52.0'</p> <p style="text-align: right; font-size: small;">Braun Intertec Corporation</p>	<p>GRAVEL 0.3% SAND 3.9% SILT 24.7% CLAY 71.2% D60=0.003 D30= D10=</p>	<p>GRAVEL SAND SILT CLAY D60=0.003 D30= D10=</p>

GRAIN SIZE ACCUMULATION CURVE (ASTM)



Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

BORING: 11-119MU SAMPLE: 4 DEPTH: 61.0'-64.0'
 Braun Intertec Corporation

CLASSIFICATION:
 FAT CLAY, brown (CH)
 Fargo Pile Load Test, Till

GRAVEL 0.0%
 SAND 4.4%
 SILT 25.9%
 CLAY 69.7%
 D60=0.003
 D30=
 D10=



Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
09-25MU	66	81	20	61	94.9	CH				2.714	
09-26MU-F	8	67	17	50						2.738	
09-27MU	6	75	18	57						2.712	
09-27MU	64	89	20	69	95.6	CH				2.704	
09-34MU	16	114	24	90	99.6	CH				2.704	

Fargo Moorhead

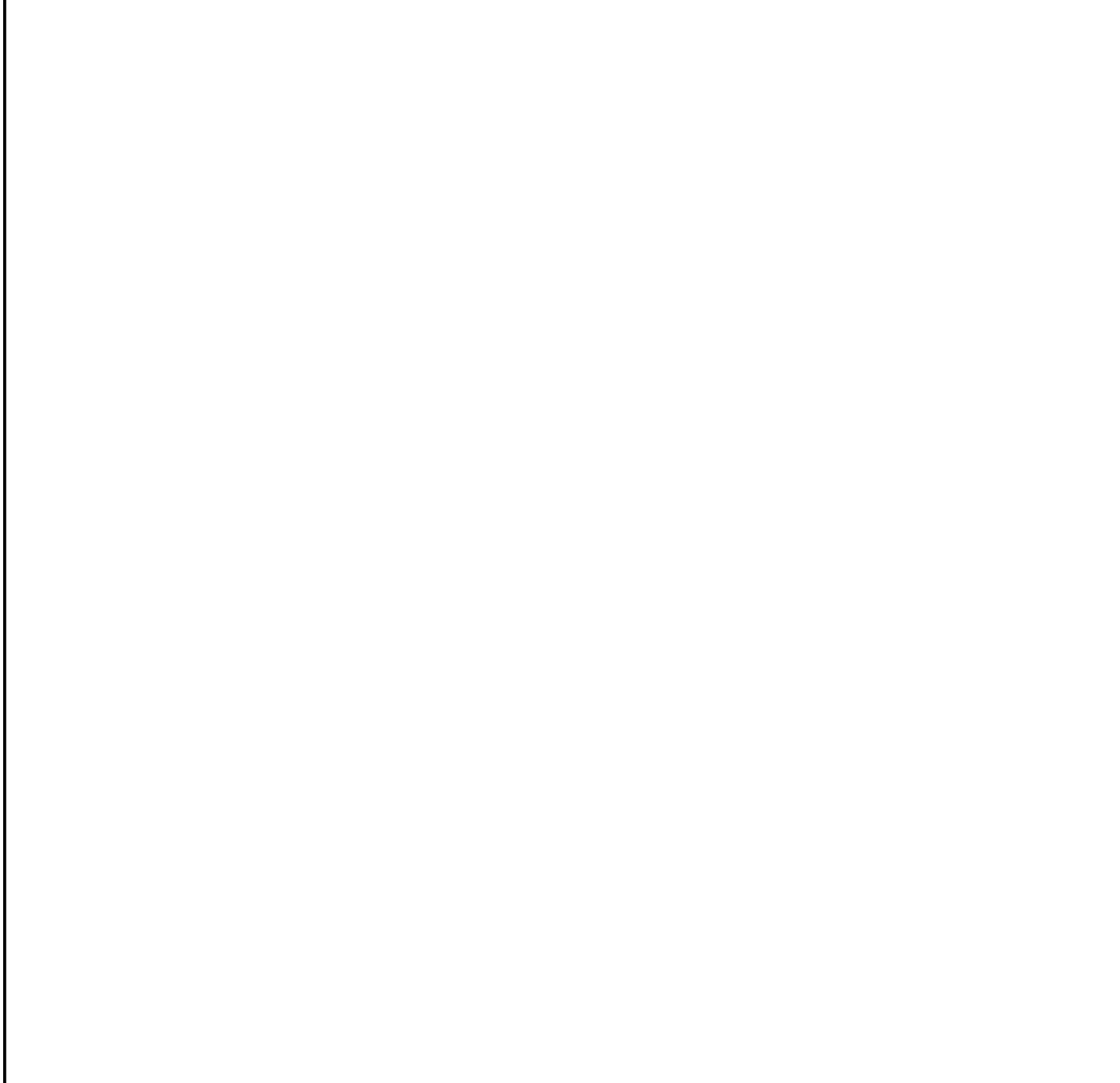
LAB SUMMARY GEO LAB BL-09-03127-3.GPJ BRAUN.GDT 11/16/09 16:50

Braun Project BL-09-03127
W912ES-09-P-0115
Fargo-Moorhead Metro Feasibility Study
Fargo-Moorhead, ND

LABORATORY RESULTS SUMMARY



Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
10-105MU	15	113	32	81	99.8	CH				2.777	
10-105MU	25	119	32	87	99.8	CH				2.72	
10-105MU	35	106	29	77	99.7	CH				2.764	
10-105MU	45	90	27	63	94.4	CH				2.709	
10-105MU	55	91	25	66	92.2	CH				2.698	
10-105MU	67	31	15	16	59.4	CL				2.676	
10-105MU	77	42	17	25	58.1	CL					



Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

LABORATORY RESULTS SUMMARY



LAB SUMMARY GEO LAB BL-10-10065.GPJ BRAUN.GDT 3/4/11 12:52

Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
11-107MU	20-22	71	19	52	99.7	CH				2.741	
11-107MU	30-32	52	21	31	99.3	CH				2.76	
11-107MU	40-42	60	18	42	93.3	CH				2.681	
11-107MU	50-52	63	19	44	98.3	CH				2.705	
11-119MU	30-32	56	19	37	97.4	CH				2.704	
11-119MU	40-42	56	22	34	96.4	CH				2.698	
11-119MU	50-52	62	19	43	95.8	CH				2.712	
11-119MU	61-64	66	19	47	95.6	CH				2.702	

LAB SUMMARY GEO LAB N:\GINT\PROJECTS\X-GEO\LAB\1-GINT FILES\MINNEAPOLIS\2010\BL-10-10065-DUMMY.GPJ BRAUN_V8_CURRENT.GDT 6/2/11 13:14

Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

LABORATORY RESULTS SUMMARY



Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
11-110MU	25-27	82	23	59	99.9	CH				2.744	
11-110MU	35-37	95	28	67	99.9	CH				2.718	
11-110MU	48-50	86	22	64	97.0	CH				2.71	
11-110MU	55-57	85	21	64	97.0	CH				2.693	
11-110MU	60-62	70	22	48	95.9	CH				2.679	
11-110MU	65-67	66	20	46	91.6	CH				2.689	

LAB SUMMARY GEO LAB N:\GINT\PROJECTS\X-GEO\LAB\1-GINT FILES\MINNEAPOLIS\2010\BL-10-10065-DUMMY.GPJ BRAUN_V8_CURRENT.GDT 4/26/11 08:01

Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

LABORATORY RESULTS SUMMARY



Borehole	Depth feet	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Organic Content (%)	Specific Gravity	Electrical Resistivity (ohm-cm)
11-118MU	201	91	24	67	99.7	CH				2.767	
11-118MU	332	72	19	53	98.2	CH				2.7	
11-118MU	453	60	17	43	95.9	CH				2.693	
11-118MU	554	77	22	55	95.4	CH				2.687	
11-118MU	655	61	20	41	98.1	CH				2.695	

LAB SUMMARY GEO LAB N:\GINT\PROJECTS\X-GEO\LAB\1-GINT FILES\MINNEAPOLIS\2010\BL-10-10065-DUMMY.GPJ BRAUN_V8_CURRENT.GDT 5/18/11 16:20

Braun Project BL-10-10065
W912ES-11-P-0024
Fargo-Moorhead Metro Feasibility Study
Phase 4 Undisturbed Testing

LABORATORY RESULTS SUMMARY

