

WALL / SLAB REINFORCEMENT DESIGN TEMPLATE

REF. 1. ACI 318 Building Code and Commentary
2. ACI 350 Code Requirements for Environmental Structures

Password: obgmbi
Please Fill in the gray boxes.

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| Client Name: | U.S. ARMY CORPS OF ENGINEERS | Design By: | MBI |
| Project Name: | FARGO – MOORHEAD , FEASIBILITY STUDY, PHASE 4 | Review By: | |
| Work Description: | Sheyenne Aquaduct Structure - Low flow Channel Walls | Date: | 2/14/2011 |
| | | Job #: | 34091004 |

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|---------------------------------|----------------------|----------------------------|----|----------------|--------------|-------|-----|-----------------------|------|
| Cross Section Properties | | Material Properties | | Factors | | | | | |
| Height | h (in) | 15 | in | Concrete | f'_c (ksi) | 4 | ksi | ϕ Flex | 0.9 |
| Width | b (in) | 12 | in | Steel | E (ksi) | | ksi | ϕ Shear | 0.75 |
| Section as | | Wall Section | | | f_y (ksi) | 60 | ksi | Governing Code | |
| Section Modulus | S (in ³) | 450 in ³ | | | E (ksi) | 29000 | ksi | ACI 350- 01 | |
| Design Forces | | | | | | | | | |
| Shear | Vu (kips) | 35 | | n | | 9 | | | |
| Moment | Mu (k-ft/ft) | 86.316 | | | | | | | |

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|--------------------------------------|---------|-------------------------------|---|-----------------------|-------------------|-------------------------|
| Flexural Reinforcement Design | | Minimum Required Steel | | | | |
| Cover | 3 | in | $3fc'^{1/2}/fy =$ | 0.00316 | $200/fy =$ | 0.00333 |
| Length Bet. Mov. Jt. | 50 | ft | $\rho_{min Flex} =$ | 0.0033333 | $A_s min Flex =$ | 0.468 in ² |
| Bar index | # 5 | | $\rho_{min T\&S} =$ | 0.005 | $A_s min T\&S =$ | 0.450 in ² |
| d (Tension Reinf.) | 11.6875 | in | $\rho_{Balance} =$ | 0.0285068 | $A_s max =$ | 3.99808 in ² |
| Design Mom. (Fact.) | 86.316 | kip-ft / ft | Rn | 0.702 | Constant | 0.413 |
| | | | | | OK | |
| a | 2.733 | in | $A_s Required =$ | 1.858 in ² | $\rho Required =$ | 0.01325 |
| k | 0.234 | | $A_s Provide =$ | 1.858 in ² | | |
| j | 0.88 | | $A_s Selected =$ | # 9 | $A_s Selected =$ | 2.000 in ² |
| Moment Calculated | 86.32 | kip-ft | Spacing @ | 6 | in | < Amax |
| Difference Δ | 0.000 | | Spacing is OK per ACI 318 | | | |
| a' | 2.941 | | Tension controlled ϕ 0.9 | | | |
| β_1 | 0.85 | | Same as f assumed initially, OK. | | | |
| c | 3.460 | | | | | |
| ϵ_t | 0.0071 | > | 0.005 | | | |
| ϕM_n | 91.95 | kip-ft / ft | > Design Moment, Section OK | | | |

| | | | | | |
|---------------------------------|--------|---------------------------------|------------------|-------|-----------------|
| Cracking moment Capacity | | Flexural Moment Capacity | | | |
| $f_r =$ | 474.34 | psi | $A_s Selected =$ | 2.000 | in ² |
| $M_r Cracking =$ | 17.79 | k-ft | $M_u Flex =$ | 91.95 | k-ft |

| | | |
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| Shear Reinforcement Design | | |
| Vc | 17.74 | kip |
| ϕ Shear | 0.75 | |
| ϕVc | 13.31 | kip |
| Vs | 33.36 | kip |
| | | Vu = 35.00 kip |

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| Minimum Shear Reinforcement | | 11.4.6 — Minimum shear reinforcement | |
| 11.4.6.1 — A minimum area of shear reinforcement, $A_{v,min}$, shall be provided in all reinforced concrete flexural members (prestressed and nonprestressed) where V_u exceeds $0.5\phi V_c$, except in members satisfying one or more of (a) through (f): | | Is any of the requirements (a thru f) satisfied? YES | |
| (a) Footings and solid slabs; | | $Av Min / s =$ | 0.0095 |
| (b) Hollow-core units with total untopped depth not greater than 12.5 in. and hollow-core units where V_u is not greater than $0.5\phi V_{cw}$; | | OR | $50bw/ft =$ |
| (c) Concrete joist construction defined by 8.13; | | | 0.010 |
| (d) Beams with h not greater than 10 in.; | | Shear Reinforcement Required | |
| (e) Beam integral with slabs with h not greater than 24 in. and not greater than the larger of 2.5 times thickness of flange, and 0.5 times width of web; | | Spacing Requirement | |
| (f) Beams constructed of steel fiber-reinforced, normalweight concrete with f'_c not exceeding 6000 psi, h not greater than 24 in., and V_u not greater than $\phi 2\sqrt{f'_c} b_w d$. | | $s = d/2$ | 5.84375 in |
| | | $4fc'^{0.5}bw*d$ | 35.48 kip |
| | | $smax =$ | 6.00 in |
| | | OR | $Vs =$ |
| | | $Av Min =$ | 0.06 in ² |
| | | $Av/s = Vs/ft*d$ | 0.0476 |
| | | $Av Required =$ | 0.29 in ² |
| | | $Av Provide =$ | 0.29 in ² |
| | | Stirrup Size | # 3 |
| | | # Legs | 2 |
| | | $A_s Selected =$ | 0.220 in ² |
| | | > Av Provide, OK | |

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| Calculation of Moment Capacity with Min. Reinforcement | |
| Analyze as a | 8 |
| 1 | $\rho_{min Flex}$ 0.00333 Flexural Members |
| 2 | $\rho_{min Wall Ver}$ 0.0015 Wall Vertical (ACI 318 Section 14.3.2) |
| 3 | $\rho_{min Wall Hor}$ 0.0025 Wall Horizontal (ACI 318 Section 14.3.2) |
| 4 | $\rho_{min Slab T\&S}$ 0.0018 Temp. & Shrink for Slabs (ACI 318 Section 7.12.2.1) |
| 5 | $\rho_{min Wall Ver}$ 0.003 Wall Vertical (ACI 350 Section 14.3.2) |
| 6 | $\rho_{min Wall Hor}$ 0.005 Wall Horizontal (ACI 350 Section 14.3.3) |
| 7 | $\rho_{min Slab T\&S}$ 0.0018 Temp. & Shrink (ACI 318 Section 7.12.2.1) |
| 8 | Select Reinforcement Below |
| $A_s Selected$ | # 9 @ 12 in $A_s Selected$ 1 in ² |
| Than ρ_{min} | 0.00000 |
| $A_s = \rho_{min} * bd$ or bh | 1.0000 in ² One Face Only $A_s =$ 0.5 in ² |
| $T = A_s * fy$ | 60.000 kip $T = A_s * fy$ 30.000 kip |
| $a = T / (0.85 b fc')$ | 1.471 in $a = T / (0.85 b fc')$ 0.735 |
| $M = T * (d-a/2)$ | 54.761 kip-ft $M = T * (d-a/2)$ 28.300 kip-ft |
| $M_u = \phi * M$ | 49.285 kip-ft $M_u = \phi * M$ 25.470 kip-ft |