RC BEAM DESIGN (ACI318-2014)

In accordance with ACI318

Tedds calculation version 3.3.06

Concrete details

Compressive strength of concrete — f'_c = **5000** psi

Density of reinforced concrete — w_c = **150** lb / ft^3

Concrete type — Normal weight

Modulus of elasticity of concrete (cl.19.2.2.1) — $E = (w_c / 1 \text{ lb/ft}^3)^{1.5} * 33 \text{ psi} * (f'_c / 1 \text{ psi})^{0.5}$ = **4286826** psi

Strength reduction factor for shear — ϕ_s = **0.75**

Reinforcement details

Yield strength of reinforcement — f_y = **60000** psi

Compression-controlled strain limit (cl.21.2.2.1) — ε_{ty} = **0.00200**

Nominal cover to reinforcement

Cover to top reinforcement — c_{nom_t} = **1.5** in

Cover to bottom reinforcement — c_{nom_b} = **1.5** in

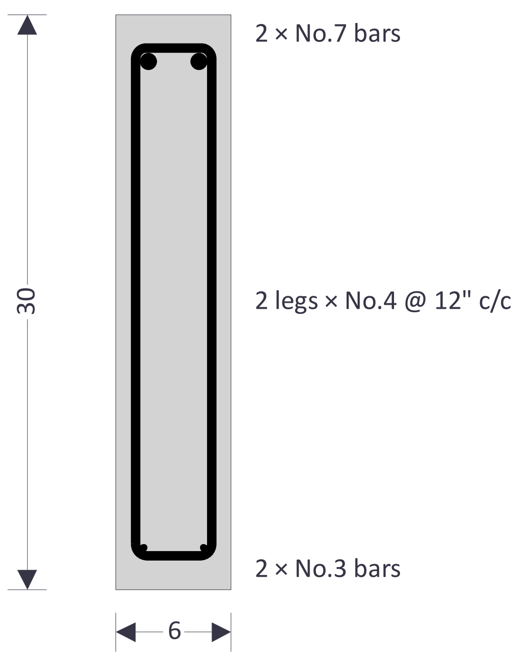
Cover to side reinforcement — c_{nom_s} = **0.75** in

Section 1 - Half Max M3 (Positive) and Half Max V2

Rectangular section details

Section width — b = **6** in

Section depth — h = **30** in



Negative moment. Rectangular section in flexure (Section 9.5.2)

Factored bending moment at section — $M_u = M_{neg\_s1}$ = **80.000** kip_ft

Effective depth to tension reinforcement — d = **27.563** in

Tension reinforcement provided — 2 * No.7 bars

Area of tension reinforcement provided $A_{s,prov}$ = **1.203** in^2

Minimum area of reinforcement (cl.9.6.1.2) $A_{s,min}$ = max(3 psi * √(f'$_c$ / 1 psi), 200 psi) * b * d / f$_y$ = **0.585** in^2

PASS - Area of reinforcement provided is greater than minimum area of reinforcement required

Stress block depth factor (cl.22.2.2.4.3) β_1 = min(max(0.85 - 0.05 * (f'$_c$ - 4 ksi) / 1 ksi, 0.65), 0.85) = **0.80**

Depth of equivalent rectangular stress block a = $A_{s,prov}$ * f$_y$ / (0.85 * f'$_c$ * b) = **2.83** in

Depth to neutral axis c = a / β_1 = **3.537** in

Net tensile strain in extreme tension fibers ε_t = 0.003 * (d$_o$ - c) / max(c, 0.001 in) = **0.02038**

Net tensile strain in tension controlled zone

Strength reduction factor (cl.21.2.1) ϕ_f = min(max(0.65 + 0.25 * (ε_t - ε_{ty}) / (0.005 - ε_{ty}), 0.65), 0.9) = **0.90**

Nominal moment strength M_n = $A_{s,prov}$ * f$_y$ * (d - a / 2) = **157.231** kip_ft

Design moment strength ϕM_n = M_n * ϕ_f = **141.508** kip_ft

PASS - Required moment strength is less than design moment strength

Flexural cracking

Max. center to center spacing of tension reinf. $s_{t,max}$ = s_{top} + $\phi_{s1\_t\_L1}$ = **2.625** in

Service load stress in reinforcement (cl.24.3.2) f$_s$ = 2/3 * f$_y$ = **40000** psi

Clear cover of reinforcement c_c = c_{nom_t} + ϕ_v = **2.000** in

Maximum allowable top bar spacing (Table 24.3.2) s_{max} = min(15in * 40000psi / f$_s$ - 2.5 * c$_c$, 12in * 40000psi / f$_s$) = **10.000** in

PASS - Maximum allowable tension reinforcement spacing exceeds actual spacing

Spacing limits for reinforcement

Top bar clear spacing s_{top} = (b - (2 * (c_{nom_s} + ϕ_{s1_v}) + $\phi_{s1\_t\_L1}$ * $N_{s1\_t\_L1}$)) / ($N_{s1\_t\_L1}$ - 1) = **1.750** in

Min. allowable top bar clear spacing (cl.25.2.1) $s_{top,min}$ = **1.000** in

Bottom bar clear spacing s_{bot} = (b - (2 * (c_{nom_s} + ϕ_{s1_v}) + $\phi_{s1\_b\_L1}$ * $N_{s1\_b\_L1}$)) / ($N_{s1\_b\_L1}$ - 1) = **2.750** in

Min. allowable bottom bar clear spacing (cl.25.2.1) $s_{bot,min}$ = **1.000** in

PASS - Actual bar spacing exceeds minimum allowable

Rectangular section in shear

Design shear force V_u = **14.000** kips

Concrete weight modification factor λ = **1.00**

Concrete shear strength (eqn. 22.5.5.1) ϕV_c = ϕ_s * λ * 2 psi * √(min(f'$_c$, 10000psi) / 1 psi) * b * d = **17.541** kips

Reinforcement shear strength (eqn. 22.5.1.1) ϕV_s = max(V_u - ϕV_c, 0 kips) = **0.000** kips

Maximum reinforcement shear strength $\phi V_{s,max}$ = ϕ_s * 8 psi * √(min(f'$_c$, 10000psi) / 1 psi) * b * d = **70.163** kips

Area of design shear reinf. required (eqn. 22.5.10.5.3) $A_{sv,des}$ = ϕV_s / (ϕ_s * min(f$_y$, 60000 psi) * d) = **0.000** in^2/ft

Minimum area of shear reinforcement (Table 9.6.3.3) $A_{sv,min}$ = max(50 psi, 0.75 psi * √(f'$_c$ / 1 psi)) * b / min(f$_y$, 60000 psi) = **0.064** in^2/ft

ϕV_c >= V_u >= ϕV_c/2 - minimum reinforcement required

Area of shear reinforcement required $A_{sv,req}$ = $A_{sv,min}$ = **0.064** in^2/ft

Shear reinforcement provided 2 legs * No.4 @ 12" c/c

Area of shear reinforcement provided $A_{sv,prov}$ = **0.393** in^2/ft

PASS - Area of shear reinforcement provided exceeds area of shear reinforcement required

Maximum longitudinal spacing (Table 9.7.6.2.2) $s_{vl,max}$ = min(d / 2, 24 in) = **13.781** in

PASS - longitudinal spacing of stirrups is less than the maximum allowable