

Span = 11'

Try 6" slab w/4t&b @ 12"

$$As := .2 \quad Asp := .2 \quad d := 4 \quad b := 12 \quad dp := 2$$

$$fc := 2500 \quad D := 6 \quad Ig := b \cdot \frac{D^3}{12} \quad Ig = 216 \quad wd := \frac{D}{12 \cdot 150} + 10 \quad wl := 40$$

$$Span := 11 \quad wc := 150 \quad Ec := 33 \cdot (wc^3 \cdot fc)^{.5} \quad Ec = 3031243.56 \quad Es := 29000000$$

$$n := \frac{Es}{Ec} \quad n = 9.57$$

$$B := \frac{b}{n \cdot As} \quad r := (n - 1) \cdot \frac{Asp}{n \cdot As}$$

$$Ma := (wd + wl) \cdot \frac{Span^2}{8} \quad Ma = 756.3$$

$$fr := 7.5 \cdot fc^{.5} \quad fr = 375 \quad Mcr := fr \cdot \frac{Ig}{\frac{D}{2}} \quad Mcr = 27000$$

$$kd := \frac{\left[\left[2 \cdot d \cdot B \cdot \left(1 + r \cdot \frac{dp}{d} \right) + (1 + r)^2 \right]^5 - (1 + r) \right]}{B}$$

$$kd = 1.09$$

$$Icr := b \cdot \frac{kd^3}{3} + n \cdot As \cdot (d - kd)^2 + (n - 1) \cdot Asp \cdot (kd - dp)^2 \quad Icr = 22.8$$

$$Ie := \frac{Mcr^3}{Ma^3} \cdot Ig + \left[1 - \left(\frac{Mcr}{Ma} \right)^3 \right] \cdot Icr \quad Ie = 8790473.05 \quad Ie := \text{if}[(Ie > Ig), Ig, Ie]$$

$$Ie = 216$$

$$K := 1$$

$$ai := \frac{K \cdot \frac{5}{48} \cdot Ma \cdot Span^2 \cdot 144}{Ec \cdot Ie} \quad ai = 0.0021 \quad rp := \frac{Asp}{D \cdot b}$$

$$lam := \frac{2}{1 + 50 \cdot rp} \quad acpsh := lam \cdot ai \quad acpsh = 0.0037 \quad \text{OK}$$

$$Mu := (wd \cdot 1.4 + wl \cdot 1.6) \cdot \frac{Span^2}{8} \quad Mu = 1179.82 \quad a := \frac{As \cdot 60000}{.85 \cdot b \cdot fc} \quad a = 0.47$$

$$PhiMc := .9 \cdot 60000 \cdot As \cdot \left(d - \frac{a}{2} \right) \cdot \frac{1}{12} \quad PhiMc = 3388.24$$

Grade Beam

Try 18"dx18"w w/3-#4&2-#5b

$$A_s := .62 \quad A_{sp} := .6 \quad d := 15 \quad b := 18 \quad dp := 2$$

$$f_c := 2500 \quad D := 18 \quad I_g := b \cdot \frac{D^3}{12} \quad I_g = 8748 \quad Spac := 10$$

$$wd := \frac{D}{12 \cdot 150} + 10 \quad wl := 40$$

$$wd := \frac{D \cdot b}{144} \cdot 150 + \frac{(Spac \cdot 12 - D)}{12} \cdot 150 + \frac{(Spac \cdot 12 - D)}{12} \cdot 10 \quad wl := Spac \cdot 40$$

$$Span := 8 \quad R := (wd + wl) \cdot Span \quad R = 16780 \quad \text{Use: 1-4"dia pipe pile}$$

$$wd = 1697.5 \quad wl = 400$$

$$w_c := 150 \quad E_c := 33 \cdot (w_c^3 \cdot f_c)^{.5} \quad E_c = 3031243.56 \quad E_s := 29000000$$

$$n := \frac{E_s}{E_c} \quad n = 9.57$$

$$B := \frac{b}{n \cdot A_s} \quad r := (n - 1) \cdot \frac{A_{sp}}{n \cdot A_s}$$

$$M_a := (wd + wl) \cdot \frac{Span^2}{8} \quad M_a = 16780$$

$$f_r := 7.5 \cdot f_c^{.5} \quad f_r = 375 \quad M_{cr} := f_r \cdot \frac{I_g}{\frac{D}{2}} \quad M_{cr} = 364500$$

$$kd := \frac{\left[2 \cdot d \cdot B \cdot \left(1 + r \cdot \frac{dp}{d} \right) + (1 + r)^2 \right]^{.5} - (1 + r)}{B}$$

$$kd = 2.76$$

$$I_{cr} := b \cdot \frac{kd^3}{3} + n \cdot A_s \cdot (d - kd)^2 + (n - 1) \cdot A_{sp} \cdot (kd - dp)^2 \quad I_{cr} = 1017.77$$

$$I_e := \frac{M_{cr}^3}{M_a^3} \cdot I_g + \left[1 - \left(\frac{M_{cr}}{M_a} \right)^3 \right] \cdot I_{cr} \quad I_e = 79234592.97 \quad I_e := \text{if}[(I_e > I_g), I_g, I_e]$$

$$I_e = 8748$$

$$K := 1$$

$$a_i := \frac{K \cdot \frac{5}{48} \cdot M_a \cdot \text{Span}^2 \cdot 144}{E_c \cdot I_e} \quad a_i = 0.0006 \quad r_p := \frac{A_{sp}}{D \cdot b}$$

$$\lambda_m := \frac{2}{1 + 50 \cdot r_p} \quad a_{cpsh} := \lambda_m \cdot a_i \quad a_{cpsh} = 0.0011 \quad \text{OK}$$

$$M_u := (w_d \cdot 1.4 + w_l \cdot 1.6) \frac{\text{Span}^2}{8} \quad M_u = 24132 \quad a := \frac{A_s \cdot 60000}{.85 \cdot b \cdot f_c} \quad a = 0.97$$

$$\Phi M_c := .9 \cdot 60000 \cdot A_s \cdot \left(d - \frac{a}{2} \right) \cdot \frac{1}{12} \quad \Phi M_c = 40493.29 \quad \text{OK}$$

Use: 2-#5b