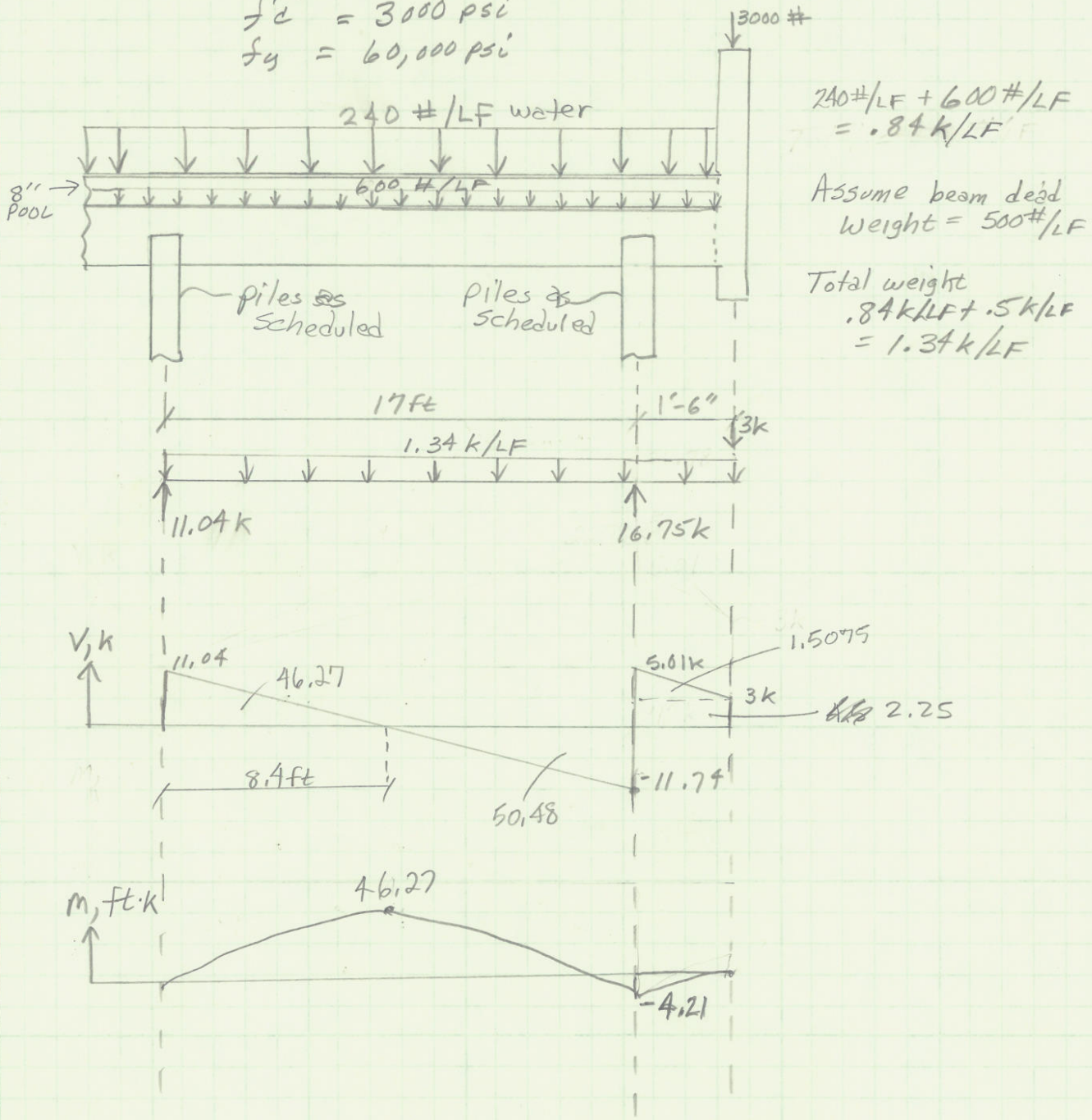
Swimming Pool Support

Required: Design a 'T' beam between piles to support itself, an 8 in thick concrete swimming pool, 3000 pd load for vertical side of pool & water in pool.

Assumed: weight of water = 64.2 #/ft³
weight of concrete = 150 #/ft³
design beam as simply supported rectangle beam
f'_c = 3000 psi
f_y = 60,000 psi



240 #/LF + 600 #/LF
= .84 k/LF

Assume beam dead weight = 500 #/LF

Total weight
.84 k/LF + .5 k/LF
= 1.34 k/LF

a) Estimate beam size: (17ft) $h = \frac{\ell}{16} = \frac{17'}{16} = 1.06'$ or 12"

cateliver (18") $h = \frac{\ell}{8} = \frac{1.5}{8} = 0.1875'$

Use 12" for h with 3" cover ∴ d = 9"

$b = \frac{1}{2} h = \frac{1}{2} 12" = 6"$

beam wt $= \frac{6" \times 12"}{144} (150 \#/ft^3) = 75 \#/Lft$

b) $w_u = 1.2(1 + .075) = 1.29 K/LF$

$M_u = \frac{w_u L^2}{8} = 46.60 ft-k$

c) $R_n = \frac{M_u}{\phi b d^2} = \frac{(12"/ft)(46.6 ft-k)}{(0.9)(6")(9)^2} = \frac{559 in-k}{437.4} = 1.278$

$\rho = \frac{0.85 f'_c}{f_y}\left(1 - \sqrt{1 - \frac{2R_n}{0.85 f'_c}}\right)$

$= \frac{0.85(3k)}{60k}\left(1 - \sqrt{1 - \frac{2(1.278)}{(0.85)3000}}\right)$

$\rho = 0.0425\left(1 - \sqrt{1 - \left(\frac{2.556}{2550}\right)}\right) = 2.13 \times 10^{-5}$

$A_s = \rho b d = (2.13 \times 10^{-5})(6")(9") = 0.00115 in^2$

$A_{s,min} = \frac{3\sqrt{f'_c}}{f_y} b_w d = \frac{3\sqrt{3,000}}{60,000}(6")(9") = 0.14788 in^2$

∴ Use $0.14788 in^2$

Use 2 #3 bars = $0.22 in^2$

Check ρ $\frac{A_s}{bd} = \frac{0.22}{(6)(9)} = 0.004074 > \rho_{min}\ 0.0033$

$< \rho_{max}\ 0.0181$

d) Check if shear re-inforcement required

$$V_u = \frac{W_u \, l}{2} = \frac{(1.2)(1.34\,k/LF)}{2} = 0.804\,k$$

$$V_{u@d} = V_u - \frac{d}{12}(W_u) = .804k - \left(\frac{9}{12}\right)(1.34k) = 0.201k$$

$$\phi V_c = \phi 2\sqrt{f'_c}\, b_w d = (0.75)(2)\sqrt{3,000} = 82.2\#$$

$$\frac{\phi V_c}{2} = 41.1\#$$

$V_u > \frac{\phi V_c}{2}$ ∴ Stirrups required

$$V_{s,req} = \frac{V_{u@d} - \phi V_c}{\phi} = \frac{201\# - 82.2\#}{0.75} = 158.4$$

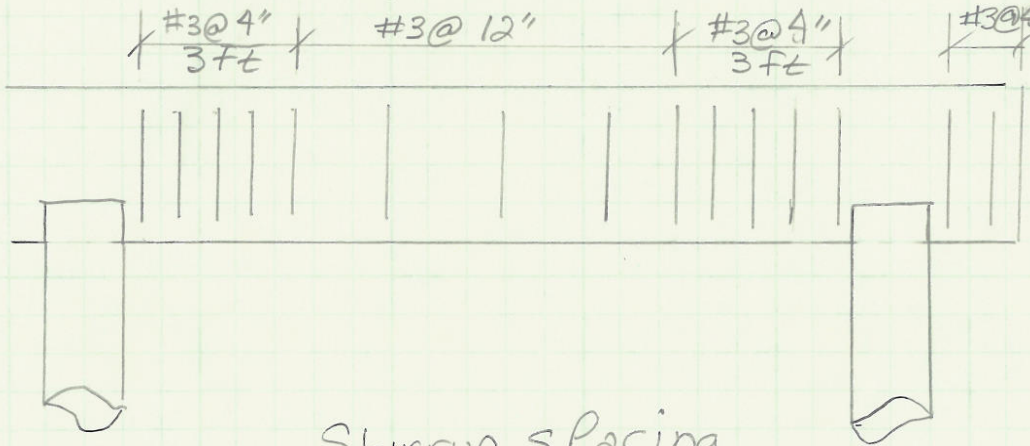
$$V_{s,max} = 4\sqrt{f'_c}\, b_w d = 4\sqrt{3000}\,(6)(9) = 11,830$$

$V_{s,Req} < V_{s,max}$ ∴ ok

e) determine shear spacing

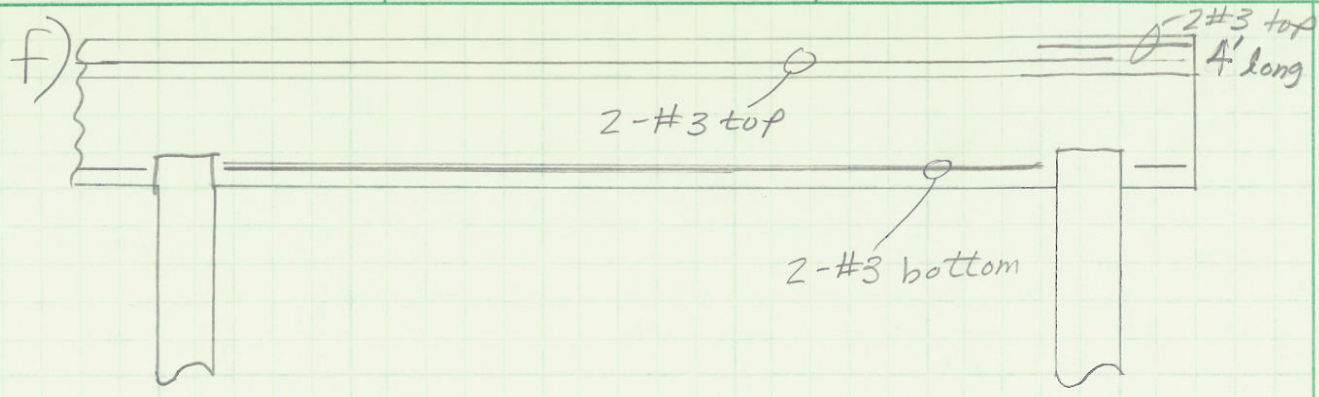
$$S_{max} = \min \begin{cases} d/2 = \frac{9}{2} = 4.5" \\ 24" = 24" \end{cases}$$

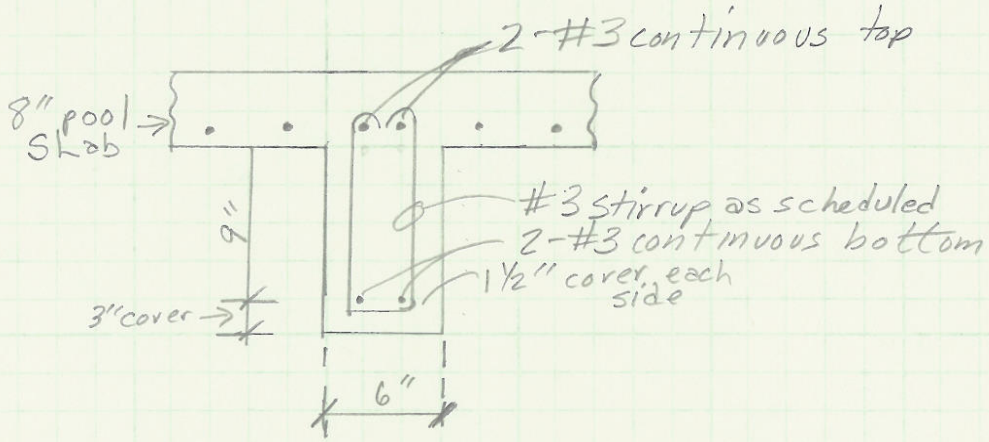
Use #3 stirrups @ 4" O.C. from piling to 3ft



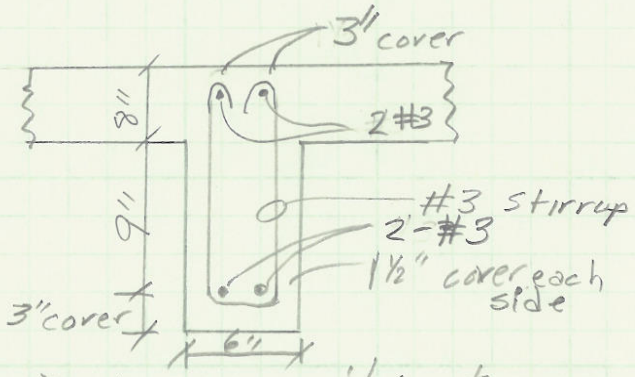
Stirrup spacing

f)





Between pilings



Between piling & END