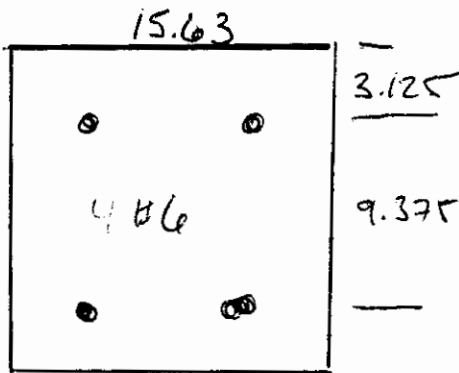


#2

$$f'_m = 1500 \text{ psi}$$

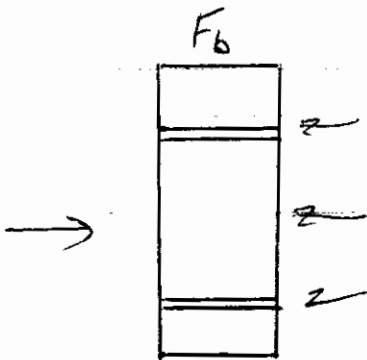
$$E'_m = 900(1500) = 1.35(10)^6 \text{ psi}$$

$$A_s = A'_s = \cancel{2} \text{ in}^2 \cdot 0.88 \text{ in}^2$$



$$n = 21.5$$

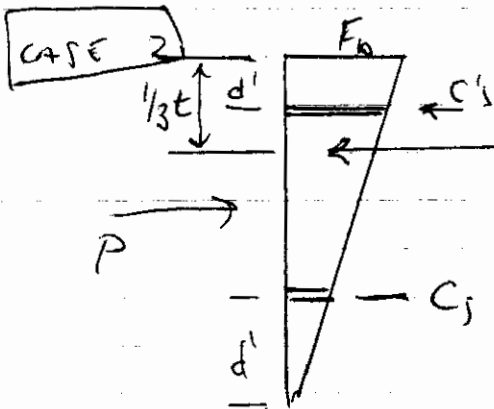
PURE COMPRESSION



$$P = n F_b A_s + n F_b A'_s + F_b b t$$

$$= 21.5(500)(0.88) + 21.5(500)(0.88) + 500(15.63)^2$$

$$= 141,068 \text{ lb}$$



$$C_m = \frac{1}{2} F_b b t = \frac{1}{2}(500)(15.63)^2 = 61074 \text{ lb}$$

$$C'_s = n F_b \left( \frac{t - d'}{t} \right) A'_s = 21.5(500) \left( \frac{15.63 - 3.125}{15.63} \right) (0.88)$$

$$= 7568 \text{ lb}$$

$$C_s = n F_b \left( \frac{d'}{t} \right) A_s = 21.5(500) \left( \frac{3.125}{15.625} \right) \cdot 0.88$$

$$= 1892 \text{ lb}$$

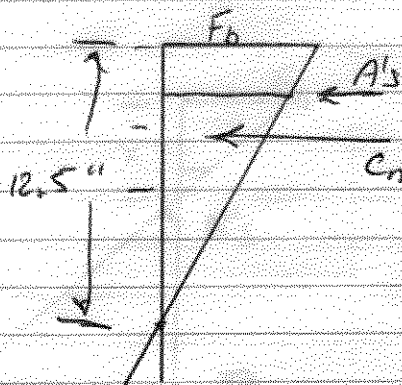
$$P = 70534 \text{ lb}$$

$$M = 7568 \left( \frac{15.625 - 3.125}{2} \right) + 1892 \left( \frac{15.625 - 3.125}{2} \right)$$

$$+ 61074 \left( \frac{15.625}{2} - \frac{15.625}{3} \right)$$

$$= 185653 \text{ in-lb}$$

CASE 3 STRAIN @ BOTTOM STEEL = 0



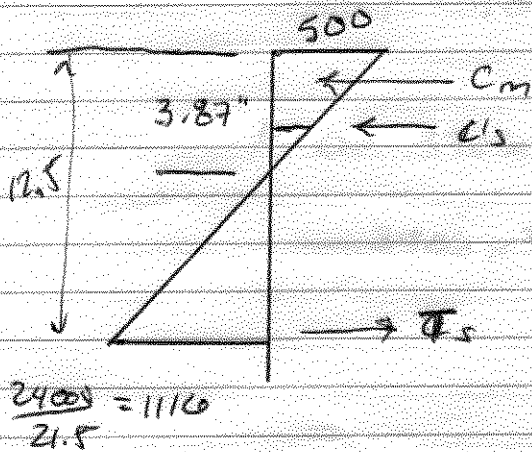
$$C_m = \frac{1}{2}(500)(15.625)(12.5) = 48828 \text{ lb}$$

$$Q_s = .88(21.5)(500) \left( \frac{12.5 - 3.125}{12.5} \right) = 7095 \text{ lb}$$

$$P = 55923 \text{ lb}$$

$$M = 48828 \left( \frac{15.625}{2} - \frac{12.5}{3} \right) + 7095(4.6875) = 211276 \text{ in-lb}$$

CASE 4 - BALANCED



$$C_m = \frac{1}{2}(500)(3.87)(15.62) = 15117 \text{ lb}$$

$$C_s = .88(21.5)(500) \left( \frac{3.87 - 3.125}{3.87} \right) = 1821 \text{ lb}$$

$$T_s = 24000(.88) = 21120 \text{ lb}$$

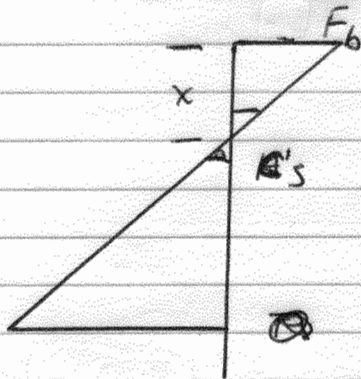
$$M = (1821 + 21120)(4.6875) + 15117 \left( \frac{15.625}{2} - \frac{3.87}{3} \right) = 206137 \text{ in-lb}$$

$$\frac{1116 + 500}{12.5} = \frac{500}{56}$$

$$x = 3.87''$$

$$P = 15117 + 1821 - 21120 = -4182$$

CASE 5 - PURE BENDING



$$f'_s = \left( \frac{x - d'}{x} \right) F_b$$

$$f_s = \left( \frac{d - x}{x} \right) F_b$$

$$C_m = \frac{1}{2} (500)(x)(15.625) = 3906x \text{ lb}$$

$$C'_s = .88(21.5)(500)(x - 3.125)/x = 9460 - \frac{29562.5}{x}$$

$$T = .88(21.5)(500) \left( \frac{12.5 - x}{x} \right) = \frac{118250}{x} - 9460$$

$$P = 0 = 3906x + 9460 - \frac{29562.5}{x} - \frac{118250}{x} + 9460$$

$$3906x^2 + 18920x - 147812.5 = 0$$

$$x = 4.189''$$

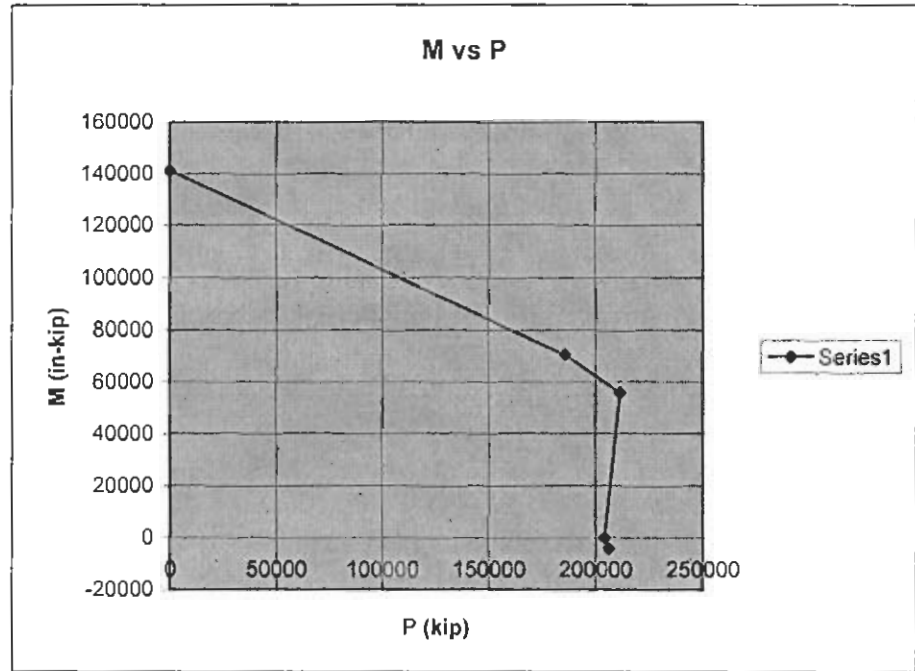
$$M = 3906(x) \left( \frac{15.625 - x}{2} - \frac{x}{3} \right) + \left( 9460 - \frac{29562.5}{x} \right) (4.6875)$$

$$+ \left( \frac{118250}{x} - 9460 \right) (4.6875)$$

$$M = 104989 + 11266 + 87969 =$$

$$= 204225 \text{ in-lb}$$

P	M
141068	0 M=0
70534	185653
55923	211276
0	204225 P=0
-4182	206137 Balance



#3 16" x 16" (NOMINAL COLUMN)

w/  $P_D = 4960 \text{ lb}$ ,  $P_S = 9920 \text{ lb}$   $f'_m = 1500 \text{ psi}$

$M_w = 23 \text{ ft-k}$  ,  $n = 16.1$  ,  $e = 5.3125"$

LOAD CASES

D + W

$P = 4960 \text{ lb}$

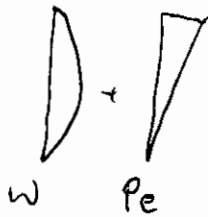
$M_w = 23 \text{ ft-k} = 276000 \text{ in-lb}$

$289175 \text{ in-lb}$

$M_{TOT} = 276000 + \frac{4960(5.3125)}{2} = \del{317500} \text{ in-lb}$

ASSUMING 3.125" COVER TO BAR CENTER

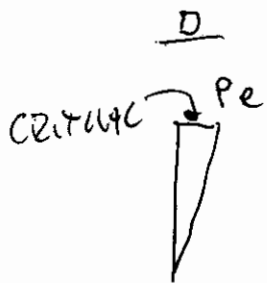
$g = 9.38 / 15.625 = 0.6$



$\frac{P}{F_c b t} = \frac{4960}{1.33(500)(15.63)^2} = .031$

$\frac{M}{F_c b t^2} = \frac{289175}{1.33(500)(15.63)^2} = 0.114$

$nP = 0.18$



$P = 4960$

$P_e = 4960(5.3125) = 26350 \text{ in-lb}$

$\frac{P}{F_c b t} = \frac{4960}{500(15.63)^2} = .0406$

$\frac{P_e}{F_c b t^2} = \frac{.0406(5.3125)}{15.63} = .0138$

$nP = \text{SMALL}$

D+L+W

$$P = 4960 + 9920 = 14880 \text{ lb}$$

$$M = \frac{276000 + 14880(5.3125)}{2} = 315525 \text{ in-lb}$$

$$\frac{P}{F_b b t} = \frac{14880}{1.33(500)(15.62)^2} = .092$$

$$\frac{M}{F_b b t^2} = \frac{315525}{1.33(500)(15.62)^2} = .024$$

$$n\rho = 0.23$$

D+L  $n\rho$  ALSO VERY SMALL

$$n\rho = .23 \text{ CONTROLLED} \quad \rho = \frac{.23}{16.1} = .0143$$

$$A_s = .0143(15.62)^2 = 3.5 \text{ in}^2 \quad 4 \#4 = 4 \text{ in}^2$$

CHECK LIMITS

$$r = \sqrt{\frac{(15.62)^4 / 12}{15.62^2}} = 4.51''$$

$$\frac{h}{r} = ? \quad \frac{24'(12'')}{4.51} = 63.9 \quad \left[ 1 - \left( \frac{63.9}{140} \right)^2 \right] = .792$$

$$P_n = \left[ .25(500) \left( \frac{15.62^2 - 4}{23790} \right) + .65(4)(24000) \right] \left( \right)$$

$$= 23790 + 49421$$

$$= 73210$$

$$16 > 14880 \text{ lb O.K.}$$

SHOULD BE 1500 HERE

23790  $\rightarrow$  14880 ALSO SO  $F_a$  CHECK WILL BE FINE

4 #4 TIES

$$48(30) = 24''$$

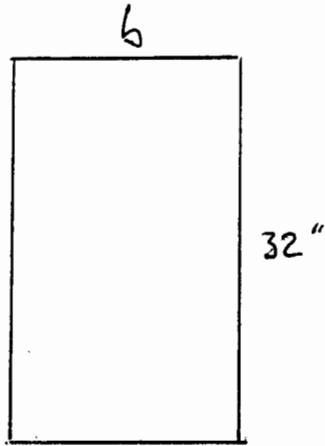
$$16(9/8) = 18''$$

$$\text{LEAST DIM} = 16''$$

(STEEL NOT NEEDED FOR PURE AXIAL)

USE #4 TIES @ 16''

#4 DETERMINE THE REINFORCEMENT & DIMENSION  $b$   
FOR THE CLAY BRICK COLUMN



$$f'_m = 2400 \text{ psi}$$

$$n = 12$$

$$w \text{ @ } 4" \text{ COVER}$$

$$g = 0.75$$

$$P_D = 181 \text{ K}$$

$$P_L = 143 \text{ K}$$

$$V_E = 31 \text{ K}$$

$$M_E = 137 \text{ ft-K}$$

$$P_E = 50 \text{ K}$$

TRY  $b = 16"$

D+L  $P = 181 + 143 = 324 \text{ K}$   $e = 3.2" \text{ (min)}$

D+L+E  $P = 374 \text{ K}$   
 $M = 137 \text{ ft-K} = 1644000 \text{ in-K}$

.9D+E  $P = .9(181) + 50 = 212.9$   
 $M = 137 \text{ ft-K} = 1644000 \text{ in-K}$

D+L

$$\frac{P}{F_b b t} = \frac{324000}{800(16)(32)} = 0.79$$

$$g = .6 \quad n\phi = .22$$

$$g = .8 \quad n\phi = .2$$

$$\frac{P_e}{F_b b t^2} = \frac{.79(3.2)}{32} = .079$$

$$g = .75 \quad n\phi = .205$$

D+L+E  $\frac{P}{F_b b t} = \frac{374000}{1.33(800)(32)(16)} = 0.69$

$$g = .6 \quad n\phi = .28$$

$$g = .8 \quad n\phi = .2$$

$$\frac{M}{F_b b t^2} = \frac{1644000}{1.33(800)(16)(32)^2} = .094$$

$$n\phi = 0.22$$

o 9D + E

$$\frac{P}{F_n b t} = \frac{212,900}{1.33(800)(32)(16)} = 0.39$$

$$\frac{M}{F_b b t^2} = \frac{1644000}{1.33(800)(16)(32)^2} = .094$$

$$g = .6 \quad n\phi = .08$$

$$= .6 \quad n\phi = .015$$

WONS CONTROL

$$n\phi_{max} = 0.22 \quad \phi = \frac{.22}{12} = .0183$$

$$A_s = .0183(16)(32) = 9.36 \text{ in}^2$$

$$8 \#10 = 10.16 \text{ in}^2$$

$$r = \sqrt{\frac{16(32)^3/12}{16(32)}} = 9.24''$$

$$\frac{h}{r} = \frac{120''}{9.24''} = 13$$

$$P_n = \left[ .25(24000)(16)(32) - 10.16 \right] + .65(10.16)(24000) \left[ 1 - \left( \frac{h}{400} \right)^2 \right]$$

$$= 298510 \text{ lb} + 157129 = 455640 \text{ lb}$$

$$324000 - 157129 = 166871 < 298510 \text{ lb}$$

$\therefore F_n$  ~~REQ. IS MET.~~  
REQ. IS MET.

TIES #4 @ 16"

