DESIGN CALCULATIONS
FOR
MAGAZINE TYPE-A

Prepared For

Nothern Division
Naval Facilities Engineering Command
Philadelphia, PA.

Prepared By

AMMANN & WHITNEY
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A

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CKD. BY______ DATE______ SUBJECT______

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DERIVATIONS - EXT.

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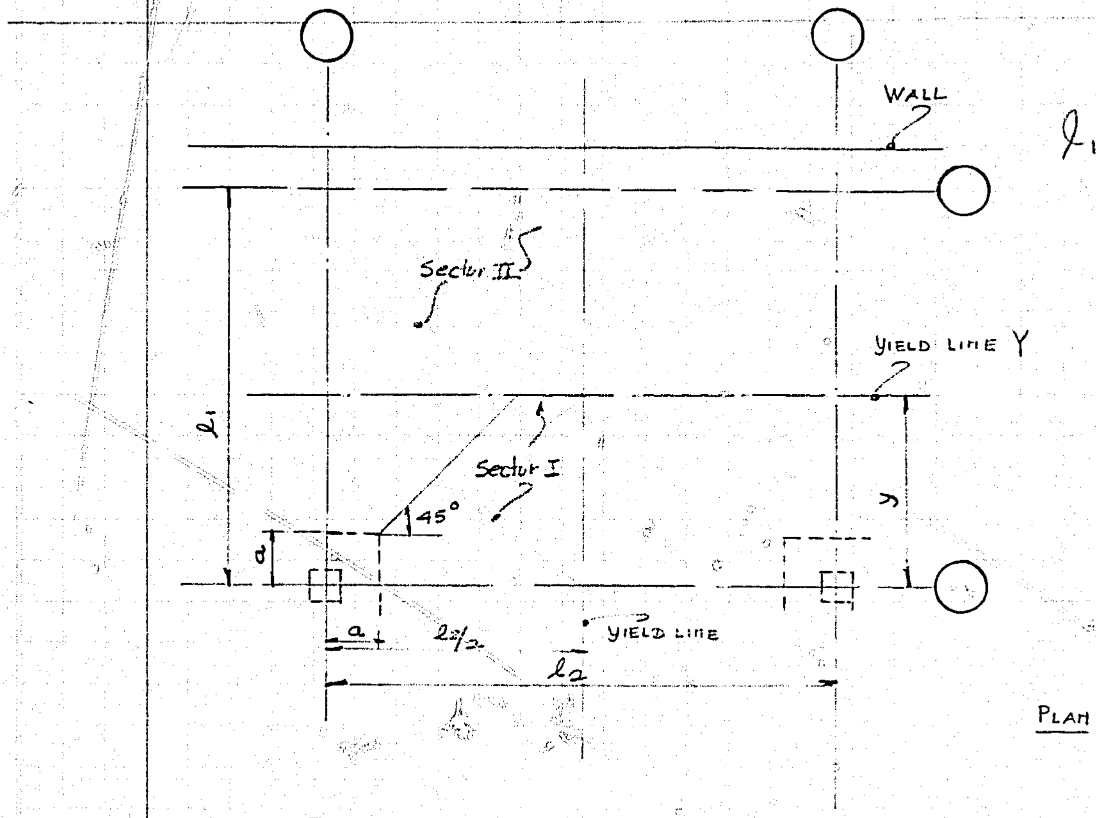
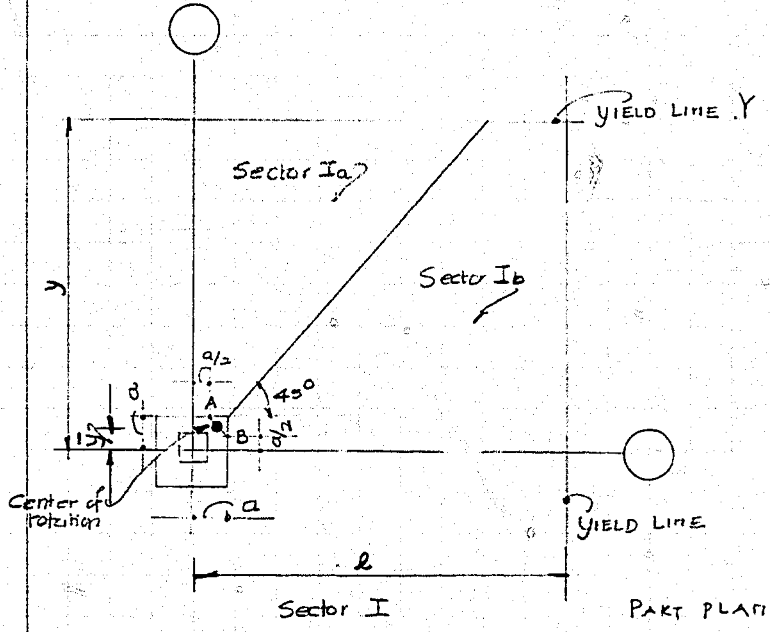
BY JPS DATE 1.4.78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 1 OF 343

CKD. BY ____ DATE ____ SUBJECT Exterior Panel

Locate the yield line marked Y



$l_1 < l_2$



$y < l$

$l = l_2/2$

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BY JPS **DATE** 11/18/77 **PROJECT** BOX MAGAZINE TYPE A **SHEET NO.** 2 **OF** 343

CKD. BY ______ **DATE** ______ **SUBJECT** Exterior Panel

General equations

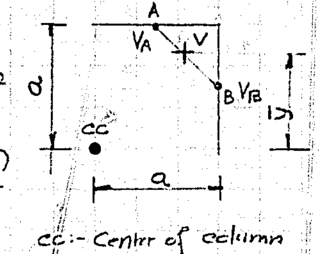
$\bar{y}$

$$V_A = \tfrac{1}{2}(y-a)(y+a) = .5y^2 - .5a^2$$

$$V = \ell y - a^2$$

$$V_B = V - V_A = \ell y - a^2 - .5y^2 + .5a^2 = \ell y - .5a^2 - .5y^2$$

$$V \text{ acts @ } \frac{(.5y^2 - .5a^2).707a}{\ell y - a^2} = \frac{(.5)(y^2-a^2)(.707a)}{\ell y - a^2}$$



cc:- Center of column

$$\bar{y} = \frac{a}{2} + \frac{(.5)(y^2-a^2)(.707a)(.707)}{\ell y - a^2}$$

$$= a/2 + \frac{.25a(y^2-a^2)}{\ell y - a^2} = .50a + .25a\left(\frac{y^2-a^2}{\ell y - a^2}\right) = \frac{.5a(\ell y - a^2) + .25a(y^2-a^2)}{\ell y - a^2}$$

ΣM_c

$$(y-a)(a) \qquad (.5)(y+a-2\bar{y}) \qquad .5a(y^2-a^2) - a(y-a)\bar{y}$$

$$(\ell-a)(y) \qquad (.5)(y-2\bar{y}) \qquad .5(\ell-a)y^2 - (\ell-a)y\bar{y}$$

$$\Sigma M_c = (.5a)(y^2-a^2) + .5(\ell-a)y^2 - \bar{y}(ay - a^2 + \ell y - ay)$$

$$= .5a(y^2-a^2) + .5(\ell-a)y^2 - \left[(.5a)(\ell y - a^2) + .25a(y^2-a^2)\right]$$

$$= .5ay^2 - .5a^3 + .5\ell y^2 - .5ay^2 - .5a\ell y + .5a^3 - .25ay^2 + .25a^3$$

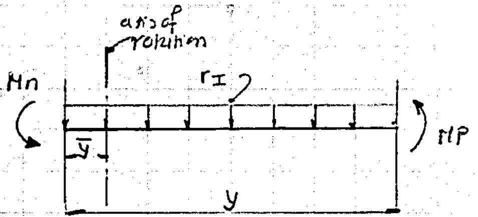
$$= .5\ell y^2 - .5a\ell y - .25ay^2 + .25a^3$$

Substitution $\ell = .5\ell_2$

$$= .25\ell_2 y^2 - .25a\ell_2 y - .25ay^2 + .25a^3$$

Section I

r_I



ΣM about axis of rotation $= 0$

$$M_n + M_p = (.25\ell_2 y^2 - .25a\ell_2 y - .25ay^2 + .25a^3)r_I$$

$$r_I = \frac{M_n + M_p}{.25\ell_2 y^2 - .25a\ell_2 y - .25ay^2 + .25a^3}$$

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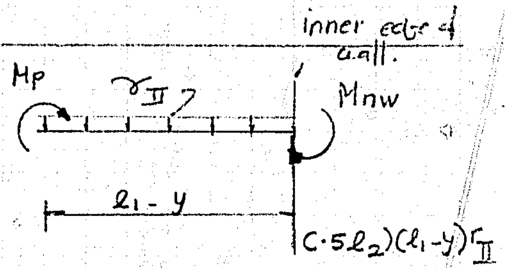
CKD. BY ____ DATE ____ SUBJECT Exterior Panel

Sector II

r_{II}

Mnw: negative moment @ wall.



moment about inner edge of wall

$$(.5\ell_2)(\ell_1-y)\left(\frac{\ell_1-y}{2}\right)r_{II} = Mp + Mnw$$

$$\therefore r_{II} = \frac{Mp + Mnw}{.25\ell_2(\ell_1-y)^2}$$

$\underline{r_I = r_{II}}$

$$\therefore \frac{Mn + Mp}{.25\ell_2 y^2 - .25a\ell_2 y - .25ay^2 + .25a^3} = \frac{Mp + Mnw}{.25\ell_2(\ell_1-y)^2} \quad \ldots\ldots \text{ general eq}^n.$$

Mn: -ve Moment Capacity @ column line. Ⓐ (lb/ft)

Mp: +ve Moment capacity @ yield line marked A (lb/ft)

Mnw. -ve Moment capacity @ external wall (lb/ft)

ℓ_1 : Span of panel (ft)

ℓ_2 : width of panel (ft)

a : half width of column capital (ft)

y : distance of yield line Y from column line Ⓐ (ft)

r : Unit resistance of slab (psf)

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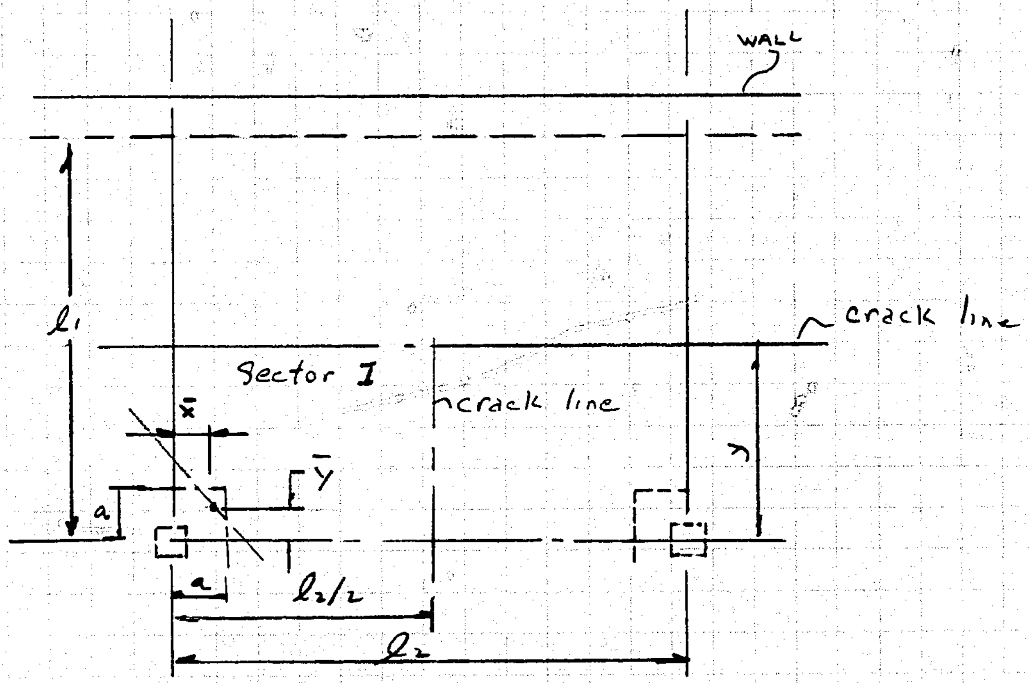
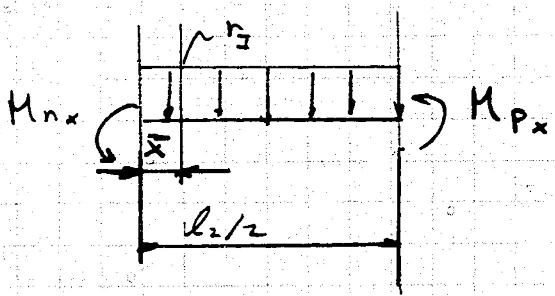


Compute R_I for x-axis bending

$$\bar{x} = \frac{a(ly - a^2) - .25a(y^2 - a^2)}{ly - a^2} \quad \text{where } l = l_2/2$$

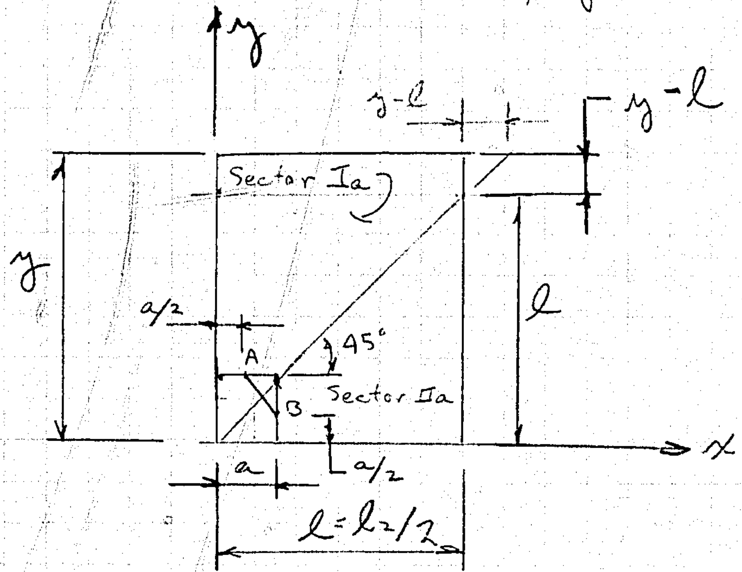
$$\sum M = 0$$

$$r_I(l_2/2 - \bar{x}) = M_{p_x} + M_{n_x}$$



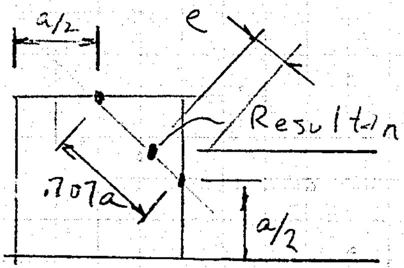
$$r_I = \frac{M_{p_x} + M_{n_x}}{(l_2/2 - \bar{x})}$$

$$l_1 > l_2 \; ; \; y > l$$



$$V_A = r\left(\left(\frac{2y - l}{2}\right)l - a^2/2\right) = \frac{2yl - l^2 - a^2}{2}$$

$$V_B = r\left(\frac{l^2 - a^2}{2}\right)$$



Resultant = $V_A + V_B = r(ly - a^2)$

$$e = \frac{(2yl - l^2 - a^2)(.707a)}{2(ly - a^2)}$$

$$\bar{y} = \frac{(2yl - l^2 - a^2)}{2(ly - a^2)}(.707a))(.707) + a/2$$

$$\bar{y} = \frac{(2yl - l^2 - a^2)a/2 + a/2(2(ly - a^2))}{2(ly - a^2)}$$

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CKD. BY DATE SUBJECT EXTERIOR PANEL

$$\bar{y} = \frac{\left(ayl - al^2/2 - a^3/2 + aly - a^3\right)}{2(ly - a^2)}$$

$$= \frac{\left(ayl - \frac{al^2}{4} - \frac{3a^3}{4}\right)}{(ly - a^2)}$$

Elastic Distribution

R vs. X

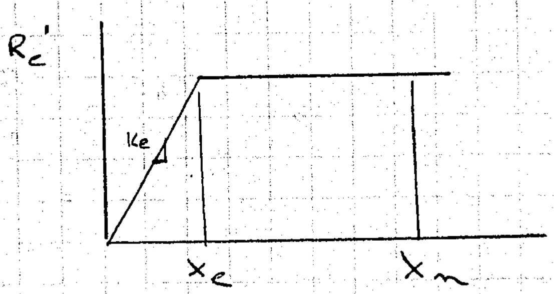
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 7 OF 343

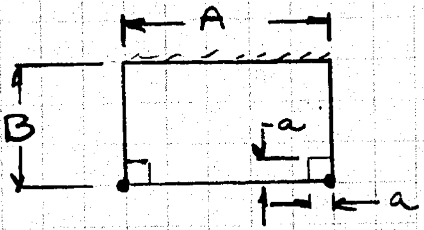
CKD. BY DATE SUBJECT Roof-Exterior Panel

Equations for Resistance vs. Deflection

$A/B = 1.28$

Elastic Distribution of Reinforcement





1. $K_e = \dfrac{25.97\,(AB-2a^2)\,EI}{(1-\mu^2)\,A^4}$ (see sh 3 & 4)

2. $x_e = \dfrac{.0385\,R_m\,A^4(1-\mu^2)}{E\,I}$

3. $m_e = .61\,m_c$

4. m_p = see attached sheets for EMF calcs

5. $m_T = \dfrac{150\,(AB-2a^2)\,t_c}{(1728)(32.2)(12)} + \dfrac{120\,(AB-2a^2)\,t_e}{(1728)(32.2)(12)} = \dfrac{(AB-2a^2)(t+.8t_e)}{4451}$

6. $T_{N_1} = 2\pi\sqrt{m_e/K_e}$ For $0 < x_m < 2x_e$

7. $T_{n_2} = 2\pi\sqrt{(m_e+m_p)/K_e}$ For $2x_e < x_m < 5x_e$

8. $T_{n_3} = 2\pi\sqrt{m_p/K_e}$ For $x_m > 5x_e$

BOX MAGAZINE TYPE A

AMMANN & WHITNEY - CONSULTING ENGINEERS - NEW YORK, NEW YORK, U.S.A. 343

B.W. DATE 5/24/57 PROJECT ~~[illegible] MANUAL~~ SHEET NO. ~~5~~ 8 OF ~~4~~

BY KLC DATE [illegible] SUBJECT FLAT SLAB - EXTERIOR PANEL SQUARE

ELASTIC DISTR. OF REINF EQS.

$$I = \frac{12t^3}{12} = t^3 = IN^4/FT$$

UNITS

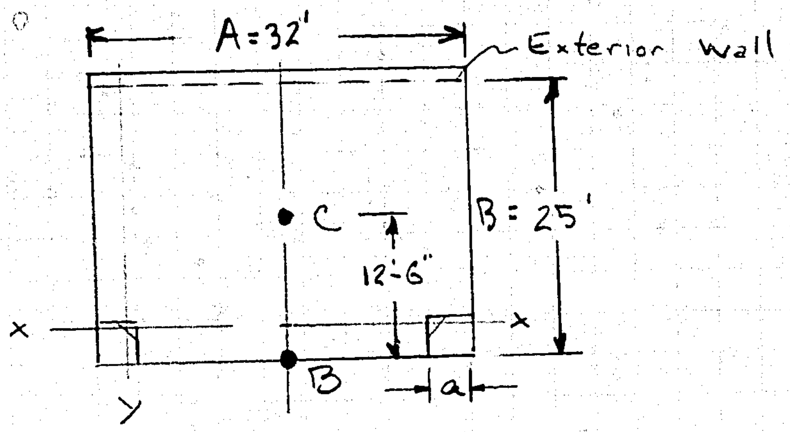
K_e	LB/IN
m_{e_0}, M_f, M_c	LB-SEC^2/IN
T_{N_1}, T_{N_2} T_{N_3}	SEC
E_c	PSI
I	IN^4/FT
t	IN
A, B	IN
a	IN
f_m	PSI

BY WS DATE 1/4/77 PROJECT BOX MAGAZINE TYPE A SHEET NO. 9 OF 343

CKD. BY DATE SUBJECT Roof - Exterior Panel

Elastic Distribution of Reinf-

Derivations



Deflection @ Pt C

1. Assume a plate fixed at wall & simply supported at the three interior edges

Ref: "Tables for the Analysis of Plates, Slabs & Diaphragms" Table 1.18 page 65
To adjust deflections for any value of μ; the deflections tabulated are multiplied by $\frac{1-\mu^2}{.91}$

$\gamma = \frac{A}{B}$ A = 32'   B = 25'   (note caps used in place of a & b in above Ref to avoid confusion)

$\gamma = 1.28$; by interpolation

1. $\delta_c = \frac{.0153 R_m A^4}{E t^3}\left(\frac{1-\mu^2}{.91}\right) = \frac{.0168 R_m A^4 (1-\mu^2)}{E t^3}$;

Let $I_q = 12t^3/12 = in^4/in$ width

$\delta_c = \frac{.0168 R_m A^4 (1-\mu^2)}{EI}$

Elastic Distribution of Reinforcement

2. Deflection @ Pt B (Ref: Above Ref Table 1.121 page 381; Note book is wrong)

$\gamma = B/A = .78$ Interchange to use tables

$A' = B;\ B' = A \quad B'/A' = 1.25$

$$\delta_B = \frac{.0395\, R_m B'^4}{Et^3}\left(\frac{1-\mu^2}{.91}\right)$$

$$= \frac{.0395\, R_m (.A)^4}{Et^3}, \left(\frac{1-\mu^2}{.91}\right) = \frac{.0434\, R_m A^4 (1-\mu^2)}{Et^3}$$

3. Total Deflection @ C

$$X_c = X_e = \delta_c + 1/2\, \delta_B$$

$$= \frac{.0385\, R_m A^4}{EI}(1-\mu^2)$$

4. $R_e' = R_m(AB - 2a^2)$

$$K_e = R_e'/X_e = \frac{25.97(AB-2a^2)EI}{(1-\mu^4)A^4}$$

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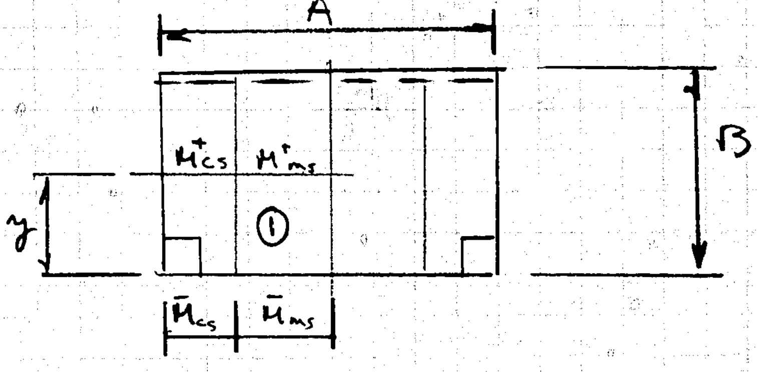
CKD. BY ____ DATE ____ SUBJECT Exterior Panel

Equations for Resistance vs Deflection

Equal Pos & Neg Reinf.; based on elastic Distribution of accross strip



For Sector 1 $\Sigma M_n + \Sigma M_p = \frac{R}{4}(Ay^2 - aAy - ay^2 + a^3)$

@ ultimate $R = R_m$ $\Sigma M_n + \Sigma M_p = 2\Sigma M_u$

First yield @ point of max. neg moment; moments in slab distributed elastically

$$M_n = \left(.75 - \frac{.1}{1+1/\alpha_{ec}}\right)M_o = f_1 M_o$$

$$M_p = \left(.63 - \frac{.28}{1+1/\alpha_{ec}}\right)M_o = f_2 M_o$$

$\Sigma M_n + \Sigma M_p = (f_1 + f_2)M_o$ $M_o = \frac{1/4\, R e f_1}{f_1+f_2}(Ay^2 - aAy - ay^2 + a^3)$

$M_n = .25 Re\left(\frac{f_1}{f_1+f_2}\right)(Ay^2 - aAy - ay^2 + a^3)$ @ 1st yield

M_n @ first yield = $\frac{1}{2}\Sigma(M_n + M_p)$ @ ultimate

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CKD. BY ______ DATE ______ SUBJECT Exterior Panel

$$\therefore \ \cancel{.25} R_e \left(\frac{f_1}{f_1+f_2}\right) \cancel{\left(Ay^2 - aAy - ay^2 + a^3\right)} =$$

$$\frac{1}{2} \frac{R_m}{\cancel{4}} \cancel{\left(Ay^2 - aAy - ay^2 + a^3\right)}$$

$$\underline{R_e = \frac{1}{2}\left(\frac{f_1+f_2}{f_1}\right) R_m} \qquad \frac{f_1}{f_1+f_2} = f$$

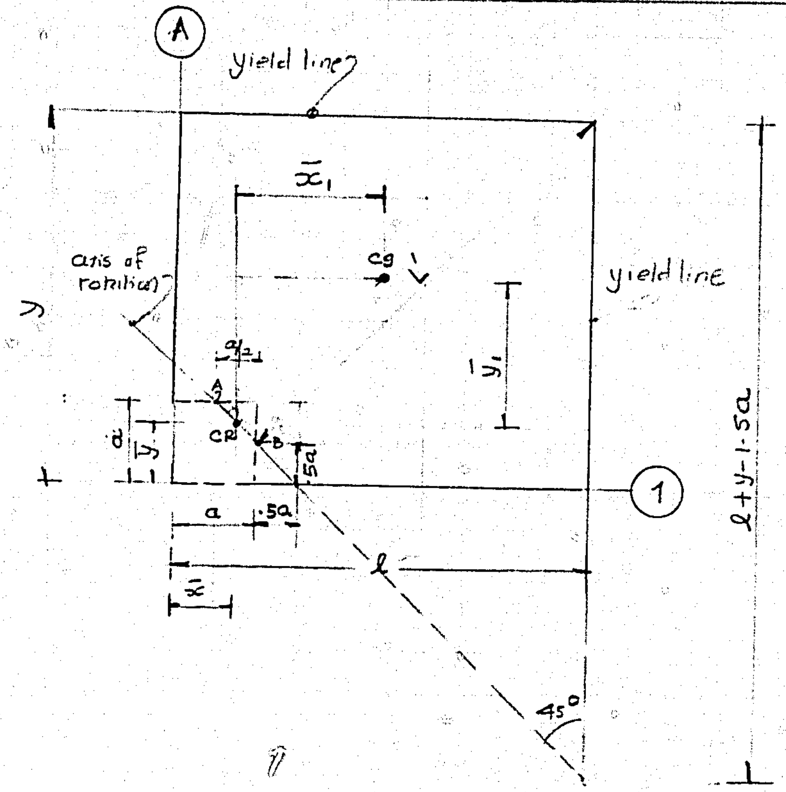
$$\therefore R_e = \frac{1}{2} \frac{R_m}{f}$$

Effective Mass Factor - Plastic Range

BY JPS DATE 1.6.78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 13 OF 343

CKD. BY____ DATE____ SUBJECT EXTERIOR PANEL – EFFECTIVE MASS FACTOR

CALCULATION OF EFFECTIVE MASS FACTOR IN PLASTIC RANGE



$$\bar{y} = .5a + \frac{.25a(y^2-a^2)}{\ell y - a^2} = \frac{(.5a)(\ell y - a^2) + (.25a)(y^2-a^2)}{\ell y - a^2}$$

$$\bar{x} = a - \frac{.25a(y^2-a^2)}{\ell y - a^2} = \frac{a(\ell y - a^2) - .25a(y^2-a^2)}{\ell y - a^2}$$

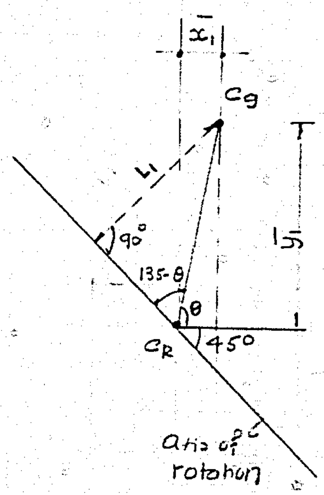
$$\bar{y}_1 = \frac{.5\ell y^2 - .5a\ell y - .25ay^2 + .25a^3}{\ell y - a^2}$$

$$\bar{x}_1 = \frac{.5y\ell^2 - a\ell y + .25ay^2 + .25a^3}{\ell y - a^2}$$

$$L' = (.707)(\ell + y - 1.5a)$$

$$\theta = \tan^{-1} \bar{y}_1 / \bar{x}_1$$

$$L_1 = \left(\sqrt{\bar{x}_1^2 + \bar{y}_1^2}\right) \sin(135 - \theta)$$



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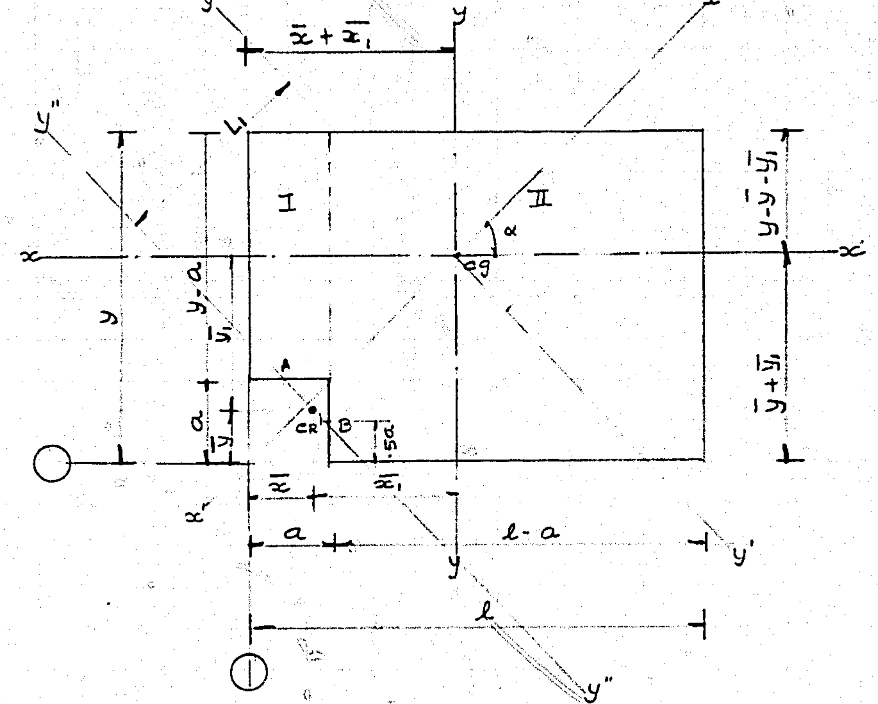
CKD. BY ____ DATE ____ SUBJECT EXTERIOR PANEL

$$A = \ell y - a^2$$

$$AL'L_1 = (\ell y - a^2)(.707)(\ell + y - 1.5a)\left(\sqrt{\bar{x}_1^2 + \bar{y}_1^2}\,\sin\left(135 - \tan^{-1}\frac{\bar{y}_1}{\bar{x}_1}\right)\right)$$



Part	Area$_A$	y from top	Ay	Ay^2	Icg	Ay^2 + Icg
I	$a(y-a)$	$(y-a)/2$	$.5a(y-a)^2$	$.25(a)(y-a)^3$	$\frac{1}{12}a(y-a)^3$	$.333a(y-a)^3$
II	$y(\ell-a)$	$y/2$	$.5y^2(\ell-a)$	$.25y^3(\ell-a)$	$\frac{1}{12}(\ell-a)y^3$	$.333(\ell-a)y^3$
Sum	$\ell y - a^2$					$.333a(y-a)^3 + .333(\ell-a)y^3$

$$I_{xx} = .333a(y-a)^3 + .333(\ell-a)y^3 - (\ell y - a^2)(y - \bar{y} - \bar{y}_1)^2$$

$$I_{yy} = .333(y-a)a^3 + \left[.083y(\ell-a)^3 + y(\ell-a)\left(\frac{\ell+a}{2}\right)^2\right] - (\ell y - a^2)(\bar{x} + \bar{x}_1)^2$$

$$I_{xy} = a(y-a)(\bar{x} + \bar{x}_1 - a/2)\left(\bar{y}_1 + \bar{y}_1 - \left(\frac{y+a}{2}\right)\right) + (y)(\ell-a)\left(\bar{x} + \bar{x}_1 - \frac{\ell+a}{2}\right)(\bar{y} + \bar{y}_1 - y/2)$$

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CKD. BY_____ DATE_____ SUBJECT EXTERIOR PANEL

$$I_{y'y'} = I_{yy}\cos^2\alpha + I_{xx}\sin^2\alpha + 2I_{xy}\cos\alpha\sin\alpha$$

$\alpha = 45^\circ$

$\sin\alpha = \cos\alpha = .707 \quad \therefore \sin^2\alpha = \cos^2\alpha = .50$

$$I_{y'y'} = (.50)(I_{xx} + I_{yy} + 2I_{xy})$$

$$I_{y''y''} = I_{y'y'} + (\ell y - a^2)(L_1)^2$$

$$(EMF)_1 = I_{y''y''} / ALL_1$$

$$(EMF)_2 \cdot 2/3$$

$$EMF = 1/2\left((EMF)_1 + (EMF)_2\right)$$

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CKD. BY ______ DATE ______ SUBJECT EXTERIOR PANEL

	Area 'A'	dist. from col. line 'A'	Moment
rect.	$(y-a)(a)$	$a/2$	$.5a^2(y-a)$
rect	$y(l-a)$	$a+\frac{l-a}{2}=\frac{l+a}{2}$	$.5y(l^2-a^2)$
Sum	$ly-a^2$		$.5a^2y-.5a^3+.5yl^2-.5ya^2$

$$\bar{x}_1+\bar{x}=\frac{.5yl^2-.5a^3}{ly-a^2}$$

$$\therefore \bar{x}_1=\frac{.5yl^2-.5a^3}{ly-a^2}-\frac{a(ly-a^2)-.25a(y^2-a^2)}{ly-a^2}$$

$$=\frac{.5yl^2-.5a^3-aly+a^3+.25ay^2-.25a^3}{ly-a^2}$$

$$=\frac{.5yl^2-aly+.25ay^2+.25a^3}{ly-a^2}$$

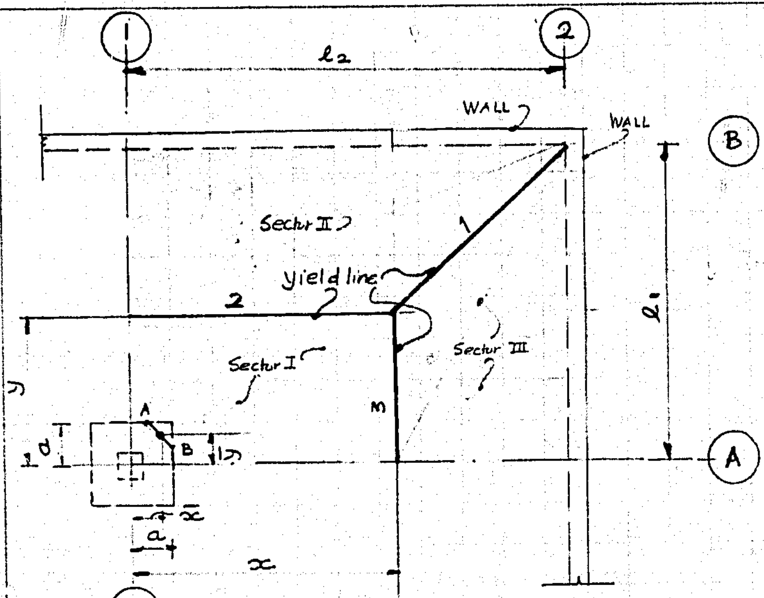
Derivations-Corner

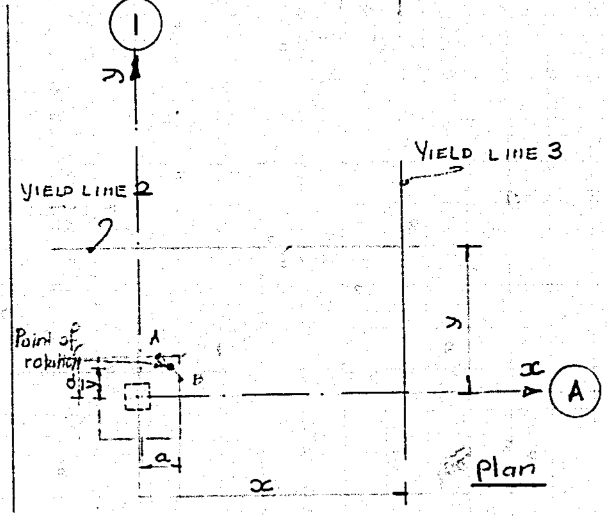
DERIVATIONS- CORNER

BY JPS DATE 1.5.'78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 17 OF 343

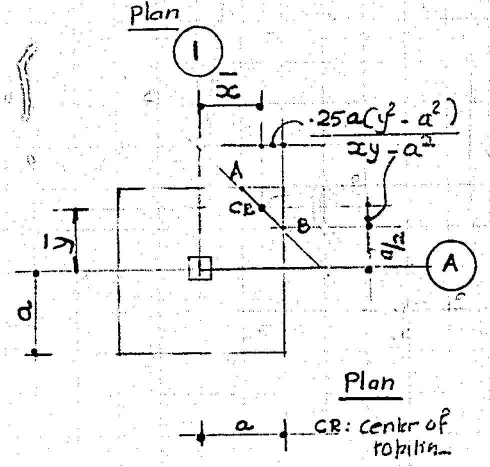
CKD. BY ______ DATE ______ SUBJECT CORNER PANEL

CORNER - PANEL Rectangular general eqn^s for locating yield lines 2 and 3.

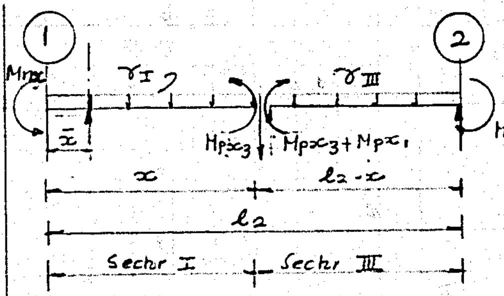


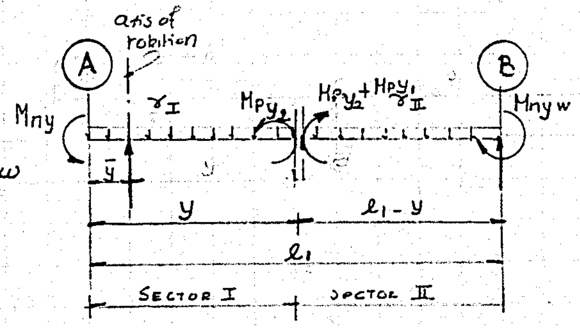


Plan



equilibrium method





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CKD. BY ______ DATE ______ SUBJECT Corner Panel

$$V_A = \tfrac{1}{2}(y+a)(y-a) = {\cdot}5y^2 - {\cdot}5a^2$$

$$V = xy - a^2$$

$$V_B = V - V_A = xy - a^2 - {\cdot}5y^2 + {\cdot}5a^2$$

$$V \text{ acts @ } \left(\frac{{\cdot}5y^2 - {\cdot}5a^2}{xy-a^2}\right)({\cdot}707)(a) = \frac{({\cdot}5)(y^2-a^2)({\cdot}707a)}{xy-a^2} \text{ from A along AB}$$

$$\bar{y} = {\cdot}5a + \frac{({\cdot}5)(y^2-a^2)({\cdot}707a)({\cdot}707)}{xy-a^2} = {\cdot}5a + \frac{{\cdot}25a(y^2-a^2)}{xy-a^2}$$

$$= \frac{{\cdot}5a(xy-a^2) + {\cdot}25a(y^2-a^2)}{xy-a^2}$$

Area 'A'	dist of c.g. from C.P.(y)	Ay
$(y-a)(a)$	$({\cdot}5)(y+a-2\bar{y})$	${\cdot}5a(y^2-a^2) - a(y-a)\bar{y}$
$(x-a)(y)$	$({\cdot}5)(y-2\bar{y})$	${\cdot}5(x-a)y^2 - (x-a)y\bar{y}$

$$H_c = \Sigma Ay = {\cdot}5a(y^2-a^2) - a(y-a)\bar{y} + ({\cdot}5)(x-a)y^2 - (x-a)y\bar{y}$$

$$= {\cdot}5a(y^2-a^2) - \bar{y}(ay - a^2 + xy - ay) + ({\cdot}5)(x-a)y^2$$

$$= {\cdot}5a(y^2-a^2) - \bar{y}(xy-a^2) + ({\cdot}5)(x-a)y^2$$

$$= {\cdot}5a(y^2-a^2) - {\cdot}5a(xy-a^2) - {\cdot}25a(y^2-a^2) + {\cdot}5(x-a)y^2$$

$$\begin{aligned}
= \;& {\cdot}5ay^2 - {\cdot}5a^3 \\
& \quad + {\cdot}5a^3 - {\cdot}5axy \\
& - {\cdot}25ay^2 + {\cdot}25a^3 \\
& - {\cdot}5ay^2 \qquad\qquad + {\cdot}5xy^2 \\
\hline
& - {\cdot}25ay^2 + {\cdot}25a^3 - {\cdot}5axy + {\cdot}5xy^2
\end{aligned}$$

$$= {\cdot}5xy^2 - {\cdot}5axy - {\cdot}25ay^2 + {\cdot}25a^3$$

Sector I y $\quad M_{ny} + M_{py_2} = R_I\left((y)(x-a)(y/2 - \bar{y}) + (y-a)(a)(y/2 + a/2 - \bar{y} \right)$

Sector I x $\quad M_{nx} + M_{px3} = R_I\left(x(y-a)(\frac{x}{2} - \bar{x}) + (x-a)(a)(\frac{x-a}{2} + a - \bar{x} \right)$

Sector II y

$$M_{nyw} + M_{py2} + M_{py3} = R_I\left(x(\ell_1 - y)(\frac{\ell_1 - y}{2}) + \frac{1}{2}(\ell_2 - x)(\ell_1 - y)(\frac{\ell_1 - y}{3})\right)$$

$$= R_I\left(\frac{x(\ell_1 - y)^2}{2} + \frac{(\ell_2 - x)(\ell_1 - y)^2}{6} \right)$$

Sector III x

$$M_{nxw} + M_{px3} + M_{px1} = R_I\left(y(\ell_2 - x)(\frac{\ell_2 - x}{2}) + \frac{1}{2}(\ell_2 - x)(\ell_1 - y)(\frac{\ell_2 - x}{3})\right)$$

$$= R_I\left(\frac{y(\ell_2 - x)^2}{2} + \frac{(\ell_1 - y)(\ell_2 - x)^2}{6} \right)$$

general equations

Sector I y & Sector II y

$$\frac{M_{ny} + M_{py2}}{\{ y(x-a)(.5y - \bar{y}) + (y-a)(a)(.5y + .5a - \bar{y}) \}} = \frac{M_{nyw} + M_{py2} + M_{py1}}{\{ .5(x)(\ell_1 - y)^2 + .167(\ell_2 - x)(\ell_1 - y)^2 \}}$$

..... eqn. 1.

Sector I x & Sector III x

$$\frac{M_{nx} + M_{px3}}{\{ x(y-a)(.5x - \bar{x}) + (x-a)(a)(.5x + .5a - \bar{x}) \}} = \frac{M_{nxw} + M_{px3} + M_{px1}}{\{ .5(y)(\ell_2 - x)^2 + .167(\ell_1 - y)(\ell_2 - x)^2 \}}$$

..... eqn. 2.

eqn. 1

$$\therefore \frac{M_{ny} + M_{py2}}{.5xy^2 - .5axy - .25ay^2 + .25a^3} = \frac{M_{nyw} + M_{py2} + M_{py1}}{(\ell_1 - y)^2(.167\ell_2 + .333x)}$$

$$\frac{M_{ny} + M_{py2}}{(.5x - .25a)y^2 - .5axy + .25a^3} = \frac{M_{nyw} + M_{py2} + M_{py1}}{.167(\ell_1 - y)^2(\ell_2 + 2x)}$$ .... Eqn. 1.

BY JPS DATE 1.5.78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 20 OF 343

CKD. BY DATE SUBJECT CORNER PANEL

$$\bar{x} = a - \frac{.25a(y^2 - a^2)}{xy - a^2} = \frac{a(xy - a^2) - .25a(y^2 - a^2)}{xy - a^2}$$

$$(x)(y-a)(.5x - \bar{x}) + (x-a)(a)(.5(x-a) + a - \bar{x})$$

$$(xy - ax)(.5x - \bar{x}) + (ax - a^2)(.5x + .5a - \bar{x})$$

$$\begin{array}{llll} .5x^2y & -.5ax^2 & & \\ & -xy\bar{x} & +ax\bar{x} & \\ & .5ax^2 & -ax\bar{x} & +.5a^2x \\ & & & -.5a^2x - .5a^3 + a^2\bar{x} \\ \hline .5x^2y & -xy\bar{x} & & -.5a^3 + a^2\bar{x} \end{array}$$

$$= .5x^2y - \bar{x}(xy - a^2) - .5a^3$$

$$= .5x^2y - \{a(xy - a^2) - .25a(y^2 - a^2)\} - .5a^3$$

$$= .5x^2y - axy + a^3 + .25ay^2 - .25a^3 - .5a^3$$

$$= .5x^2y - axy + .25ay^2 + .25a^3$$

eqn. 2.

$$\frac{Hnx + Mpx3}{.5yx^2 - axy + (.25ay^2 + .25a^3)} = \frac{Hnxw + Hpx3 + Mpx1}{.167(l_2 - x)^2(l_1 + 2y)} \quad \text{ean.2}$$

Summary

$$\frac{Mny + Mpy2}{(.5x - .25a)y^2 - .5axy + .25a^3} = \frac{Hnyw + Hpy2 + Hpy1}{.167(l_1 - y)^2(l_2 + 2x)} \quad \ldots\ eq^n.\ 1$$

$$\frac{Mnx + Hpx3}{.5yx^2 - axy + (.25ay^2 + .25a^3)} = \frac{Hnxw + Hpx3 + Mpx1}{.167(l_2 - x)^2(l_1 + 2y)} \quad \ldots\ eq^n.\ 2.$$

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CKD. BY ______ DATE ______ SUBJECT CORNER PANEL

M_{ny} = Total ultimate negative moment capacity in y direction for a length of 'x' along column line Ⓐ

M_{py1} = Total ultimate positive moment capacity in y direction for a length of $\sqrt{(l_2-x)^2+(l_1-y)^2}$ along yield line 1.

M_{py2} = Total ultimate positive moment capacity in y direction for a length of 'x' along yield line 2.

M_{nyw} = Total ultimate negative moment capacity in y direction for a length of l_2 along wall @ line Ⓑ

M_{nx} = Total ultimate negative moment capacity in x direction for a length of 'y' along column line ①

M_{px1} = Total ultimate positive moment capacity in x direction for a length of $\sqrt{(l_2-x)^2+(l_1-y)^2}$ along yield line 1.

M_{px3} = Total ultimate positive moment capacity in x direction for a length of 'y' along yield line 3.

M_{nxw} = Total ultimate negative moment capacity in x direction for a length of l_1 along wall @ line ②

l_1 : Smaller side of rectangular panel.

l_2 : longer side of rectangular panel.

a : half width of column capital.

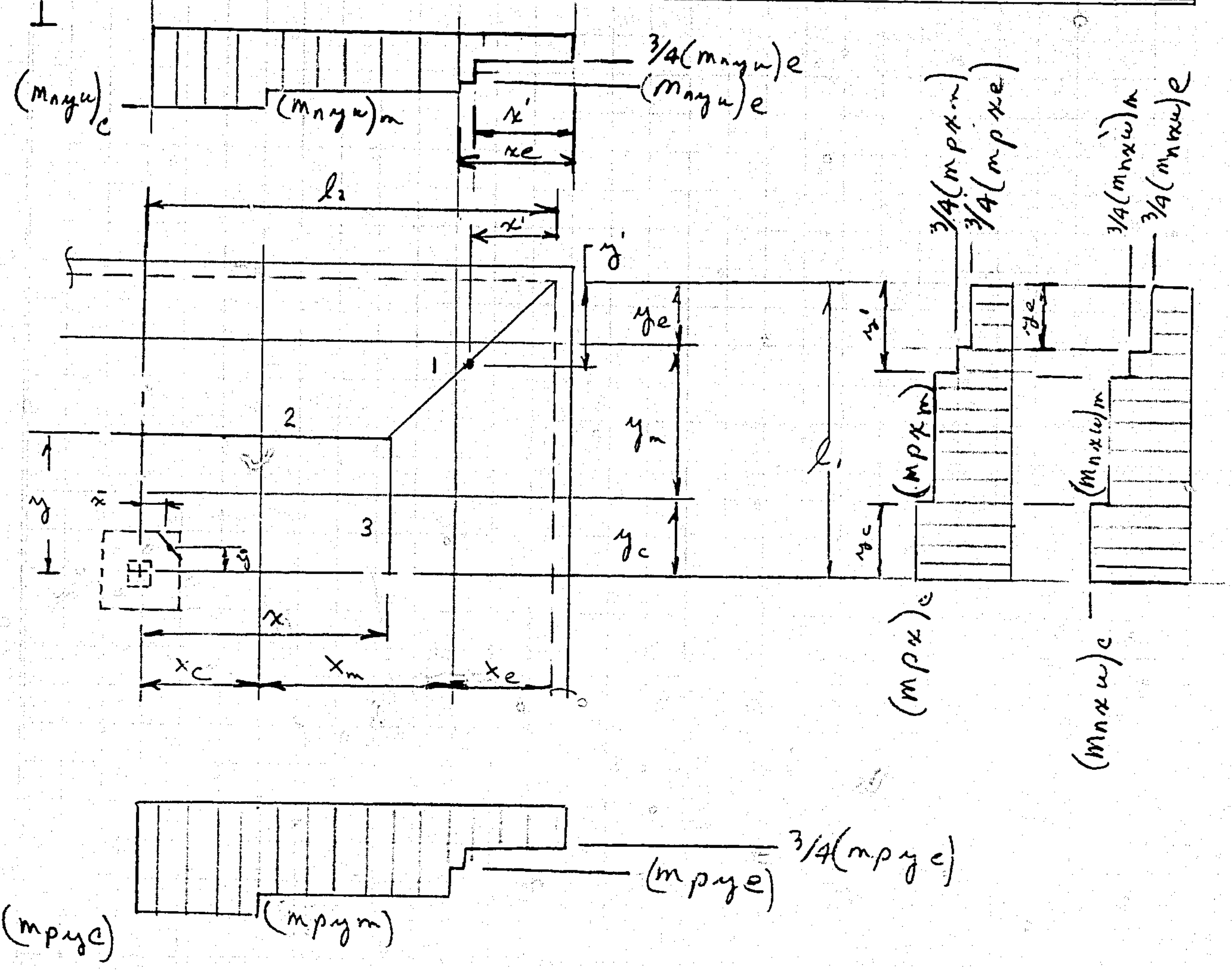
x : location of yield line 3 from column 1-A along column line Ⓐ

y : location of yield line 1 from column 1-A along column line ①

BY W S DATE 1/78 PROJECT Box MAGAZINE TYPE A SHEET NO. 22 OF 343

CKD. BY ____ DATE ____ SUBJECT CORNER PANEL - Corner Effects

I



$$x' = \frac{l_2 - x}{2} \qquad y' = \frac{l_1 - y}{2}$$

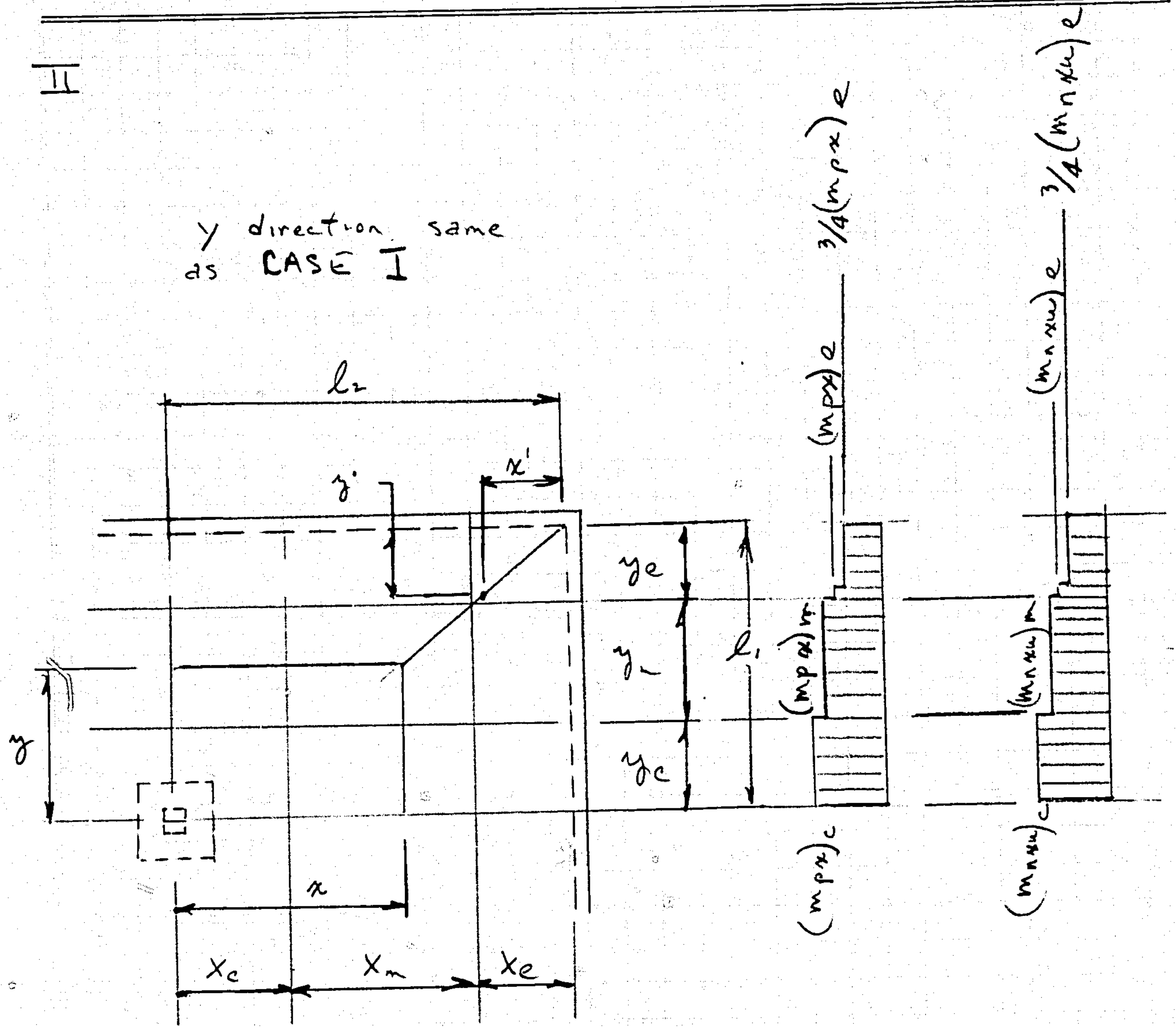
Assuming Crack line intersection always occurs in mid strip

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 23 OF 343

CKD. BY ______ DATE ______ SUBJECT CORNER PANEL - Corner Effects

II

y direction same as CASE I



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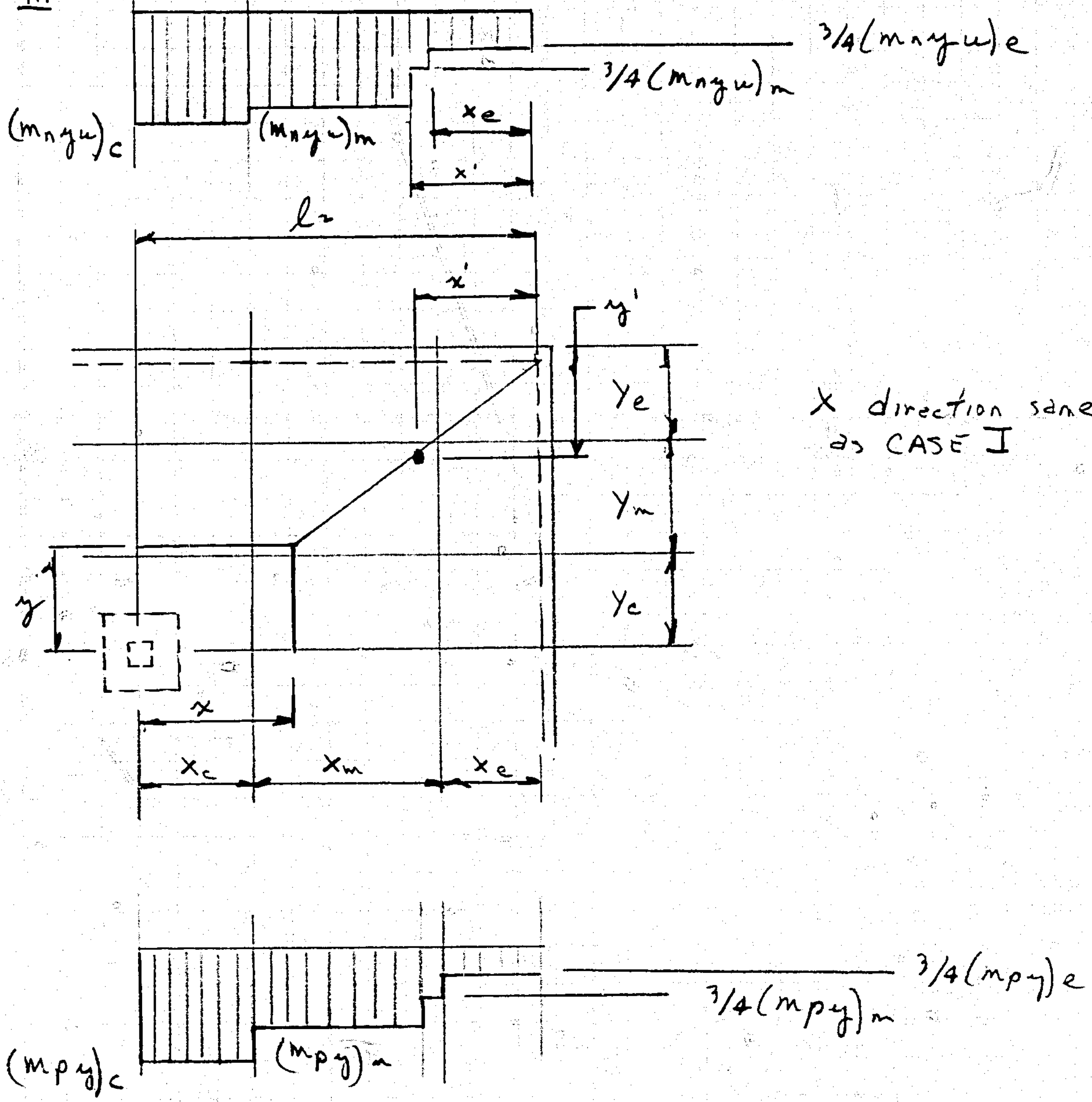
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 24 OF 343

CKD. BY ______ DATE ______ SUBJECT CORNER PANEL - Corner Effects

III



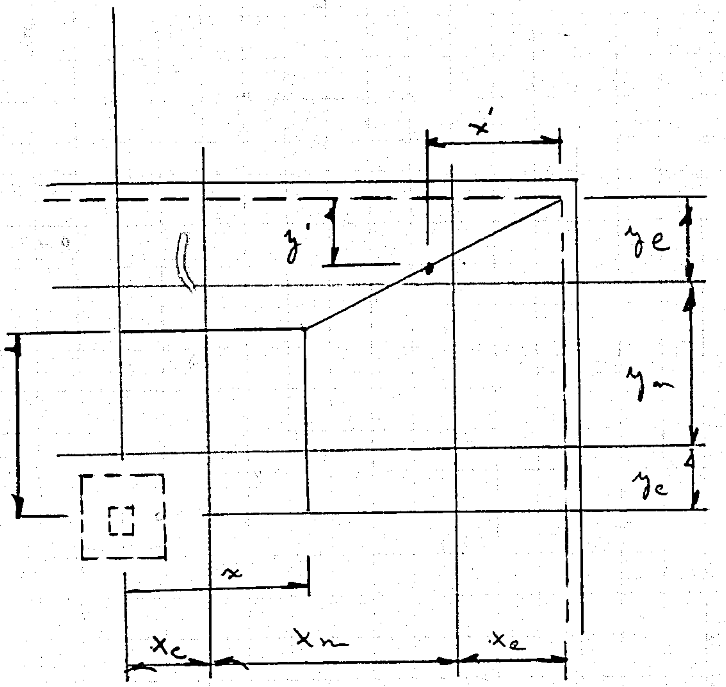
X direction same as CASE I

BY WS DATE 1/78 PROJECT Box MAGAZINE TYPE A SHEET NO. 25 OF 343

CKD. BY ____ DATE ____ SUBJECT CORNER PANEL - Corner Effects

IV

x direction same as CASE III



y direction same as case II

BY JPS DATE 1.9.78 PROJECT Box MAGAZINE TYPE A SHEET NO. 26 OF 343

CKD. BY ______ DATE ______ SUBJECT Corner Panel - Corner Effects

Case	
I Eq. 1	$X' < X_e$ $\frac{x_c(mnye + mpye - mnym - mpym) + x(mnym + mpym)}{(.5x - .25a)y^2 - .5axy + .25a^3} =$ $\frac{x_c(mpye + mnywe) + xm(mpym + mnywm) + (x_e - x/8 -)(mpye + mnywe)}{.167(l_1 - y)^2(l_2 + 2x)}$
Eq. 2	$Y' > Y_e$ $\frac{y_c(mnxc + mpxc - mnxm - mpxm) + y(mnxm + mpxm)}{.5yx^2 - axy + (.25ay^2 + .25a^3)} =$ $\frac{y_c(mpxc + mnxwc) + (l_1 - y_c - y/8 - \frac{3}{4}y_e)(mpxm + mnxwm) + .75y_e(mpxe + mnxwe)}{.167(l_2 - x)^2(l_1 + 2y)}$
II Eq. 1	as case I, Eq. 1 $X' < X_e$
Eq. 2.	$Y' < Y_e$ $\frac{y_c(mnxc + mpxc - mnxm - mpxm) + y(mnxm + mpxm)}{.5yx^2 - axy + (.25ay^2 + .25a^3)} =$ $\frac{y_c(mpxc + mnxwe) + y_m(mpxm + mnxwm) + (y_e - y/8)(mpxe + mnxwe)}{.167(l_2 - x)^2(l_1 + 2y)}$

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CKD. BY ____ DATE ____ SUBJECT Corner Panel - Corner Effects

Case III $x' > x_e$

Eq. 1.

$$\frac{x_c(mnye + mpye - mnym - mpym) + x(mnym + mpym)}{(.5x - .25a)y^2 - .5axy + .25a^3} =$$

$$\frac{x_c(mpye + mnywe) + (l_2 - x_c - x/8 - 3/4\, x_e)(mpym + mnywm) + .75x_c(mpye + mnywe)}{.167(l_1 - y)^2(l_2 + 2x)}$$

Eq. 2 Same as Case I Eq. 2. $y' > y_e$

Case IV $x' > x_e$

Eq. 1. Same as Case III Eq. 1.

Eq. 2 $y' < y_e$ Same as Case II Eq. 2

Elastic Distribution of Reinforcement

R vs. x

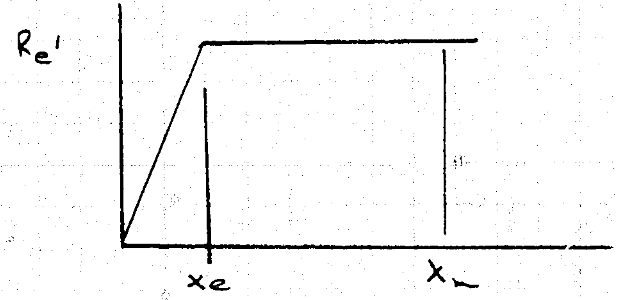
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 28 OF 343

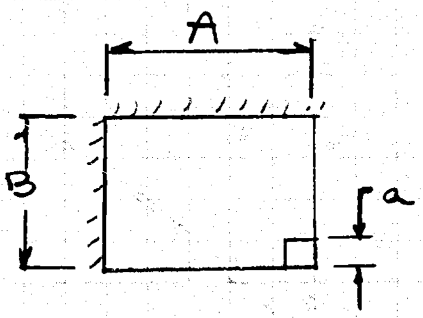
CKD. BY ______ DATE ______ SUBJECT Roof- Corner Panel

Equations for Resistance Vs. Deflection

$A/B = 1.28$

Elastic Distribution of Reinforcement





1. $K_e = \frac{26.81(AB-a^2)EI}{(1-\mu^2)A^4}$

2. $X_e = \frac{.0373 R_m A^4 (1-\mu^2)}{EI}$

3. $m_e = .61\, m_c$

4. m_p: see attached sheets for EMF calcs

5. $m_c = \frac{150(AB-a^2)t}{4451} + \frac{120(AB-a^2)t_e}{4451}$

6. $T_{N_1} = 2\pi\sqrt{m_e/K_e}$ For $0 < X_m < 2x_e$

7. $T_{n_2} = 2\pi\sqrt{(m_e+m_p)/K_e}$ For $2X_e < X_m < 5X_e$

8. $T_{n_3} = 2\pi\sqrt{m_p/K_e}$ For $X_m > 5X_e$

BOX MAGAZINE TYPE A

AMMANN & WHITNEY - CONSULTING ENGINEERS - NEW YORK, NEW YORK, U.S.A. 343

BY S.W. DATE 5/24/57 PROJECT ~~RANJ MANUAL~~ SHEET NO. 29 OF [illegible]

CKD. BY [illegible] DATE [illegible]57 SUBJECT FLAT SLAB - EXTERIOR PANEL SQUARE

ELASTIC DISTR. OF REINF EQS.

$$I = \frac{12t^3}{12} = t^3 = IN^4/FT$$

UNITS

K_e	LB/IN
m_e, m_p, m_c	LB-SEC²/IN
T_{N_1} T_{N_2} T_{N_3}	SEC
E_c	PSI
I	IN⁴/FT
t	IN
L	IN
a	IN
R_m	PSI

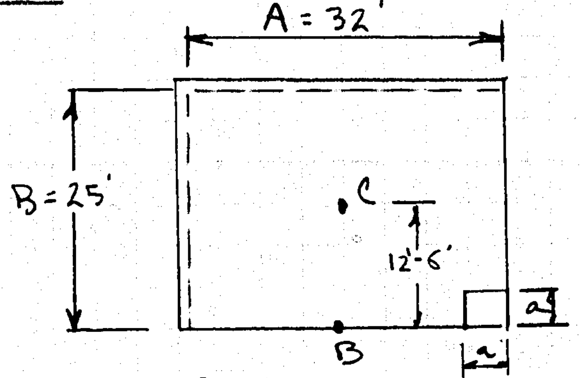
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 30 OF 343

CKD. BY ____ DATE ____ SUBJECT Roof Corner Panel

Equations for Resistance vs. Deflection

Elastic Distribution of Reinforcement

Derivations



Deflection @ Pt C

1. Assume a plate fixed along 2 adjacent edges and simply supported along 2 adjacent edges

Ref: 'Tables for the Analysis of Plates, Slabs & Diaphragms' Table 1.4 page 52; δ adjusted by $1-\mu^2/.91$

$$\gamma = \frac{A}{B} = 1.28$$

1. $$\delta_c = \frac{.0142 R_m A^4}{Et^3}\left(\frac{1-\mu^2}{(.91)}\right) = \frac{.0156 R_m A^4(1-\mu^2)}{Et^3}$$

Let $I_G = 12t^3/12 = in^4/in$ width

$$\delta_c = \frac{.0156 R_m A^4(1-\mu^2)}{EI}$$

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CKD. BY ______ DATE ______ SUBJECT Corner Panel

Elastic Distribution of Reinforcement

2. Deflection @ Pt B (Ref Exterior Panel - Elastic Distribution)

$$\delta_B = .0434 R_m A^4 (1-\mu^2)/Et^3$$

3. Total Deflection @ C

$$x_c = x_e - \delta_c + 1/2\, \delta_B$$

$$= \frac{.0373 R_m A^4 (1-\mu^2)}{EI}$$

4. $R_e' = R_m (AB - a^2)$

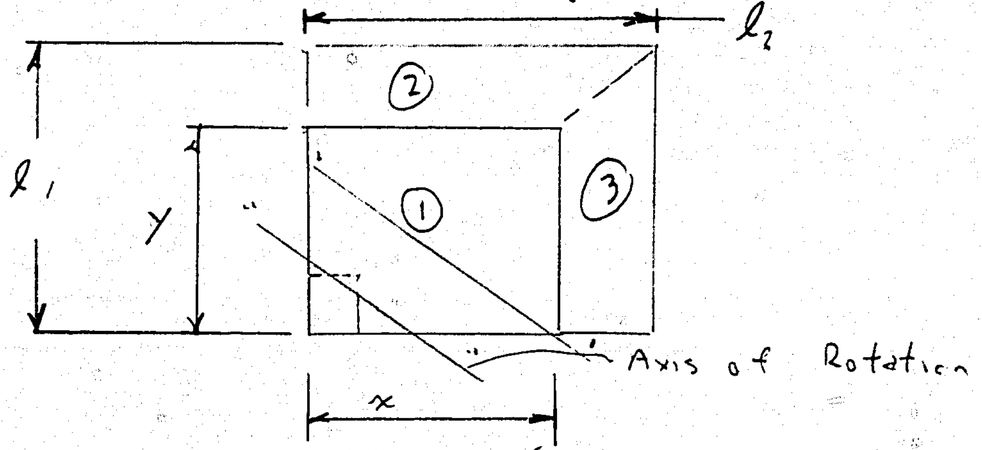
$$K_e = R_e'/x_e = \frac{26.81 (AB - a^2) EI}{(1-\mu^4) A^4}$$

Effective Mass Factors in Plastic Range

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 32 OF 343

CKD. BY_____ DATE_____ SUBJECT Corner Panel

Calculation of EMF



Ref: Derivation for (EMF), for Exterior panel replace "l" in above referenced derivations with "x"

Sector 1

1. $$\bar{y} = \frac{.5a(xy-a^2) + .25a(y^2-a^2)}{xy-a^2}$$

2. $$\bar{x} = \frac{a(xy-a^2) - .25a(y^2-a^2)}{xy-a^2}$$

3. $$\bar{y}_1 = \frac{.5xy^2 - .5axy - .25ay^2 + .25a^3}{xy-a^2}$$

4. $$\bar{x}_1 = \frac{.5yx^2 - axy + .25ay^2 + .25a^3}{xy-a^2}$$

5. $L' = .707(x + y - 1.5a)$

6. $\theta = \tan^{-1}(\bar{y}_1/\bar{x}_1)$

7. $L_1 = \sqrt{\bar{x}_1^2 + \bar{y}_1^2}\,\sin(135-\theta)$

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CKD. BY DATE SUBJECT Corner Panel

Calculation of EMF

8. $I_{xx} = \frac{a}{3}(y-a)^3 + \frac{y^3}{3}(x-a) - (xy-a^2)(y-\bar{y}-\bar{y}_1)^2$

9. $I_{yy} = \frac{a^3}{3}(y-a) + \frac{y}{12}(x-a)^3 + y(x-a)\left(\frac{x+a}{2}\right)^2 -$
$(xy-a^2)(\bar{x}+\bar{x}_1)^2$

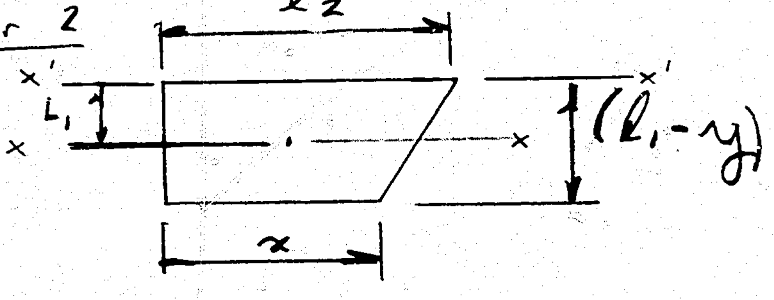
10. $I_{xy} = a(y-a)(\bar{x}+\bar{x}_1-a/2)\left(\bar{y}+\bar{y}_1 - \left(\frac{y+a}{2}\right)\right) +$
$(y)(x-a)(\bar{x}+\bar{x}-\frac{1}{2}(X/2+a)(\bar{y}+\bar{y}_1-y/2))$

11. $I_{y'y'} = .5(I_{xx}+I_{yy}+2I_{xy})$

12. $I_{y''y''} = I_{y'y'} + (xy-a^2)(L_1^2)$

13. $(EMF)_1 = I_{y''y''}/AL'L_1$

Sector 2



Sector 2 EMF

$$L' = l_1 - y$$

$$L_1 = l_1 - y - (l_1 - y)\frac{(2l_2 + x)}{3(l_2 + x)}$$

$$L_1 = \frac{3(l_2+x)(l_1-y)-(l_1-y)(2l_2+x)}{3(l_2+x)} = \frac{(l_1-y)(3l_2+3x-2l_2-x)}{3(l_2+x)}$$

$$L_1 = \frac{(l_1-y)(l_2+2x)}{3(l_2+x)}$$

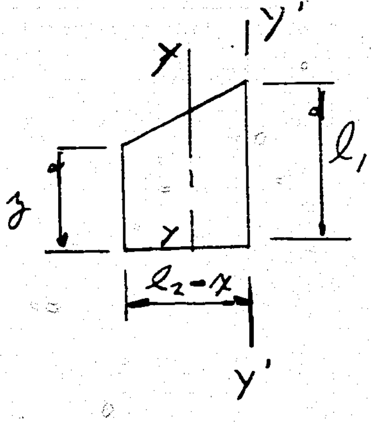
$$I_{xx} = \frac{(l_1-y)^3(l_2^2+4xl_2+x^2)}{36(l_2+x)}$$

$$I_{x'x'} = I_{xx} + AL_1^2$$

$$A = \frac{l_2+x}{2}(l_1-y)$$

$$(EMF)_2 = I_{x'x'}/AL'L_1$$

Sector 3 EMF



$$L' = l_2 - x$$

$$L_1 = \frac{(l_2-x)(l_1+2y)}{3(l_1+y)}$$

$$I_{yy} = \frac{(l_2-x)^3(l_1^2+4yl_1+y^2)}{36(l_1+y)}$$

$$A = \tfrac{1}{2}(l_1+y)(l_2-x)$$

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CKD. BY DATE SUBJECT Corner Panel

Sector 3

$$I_{y'y'} = I_{yy} + A L_1^2$$

$$(EMF)_3 = I_{y'y'}/A L' L_1$$

$$EMF = \frac{1}{3}\left(EMF_1 + EMF_2 + EMF_3\right)$$

ROOF DESIGN

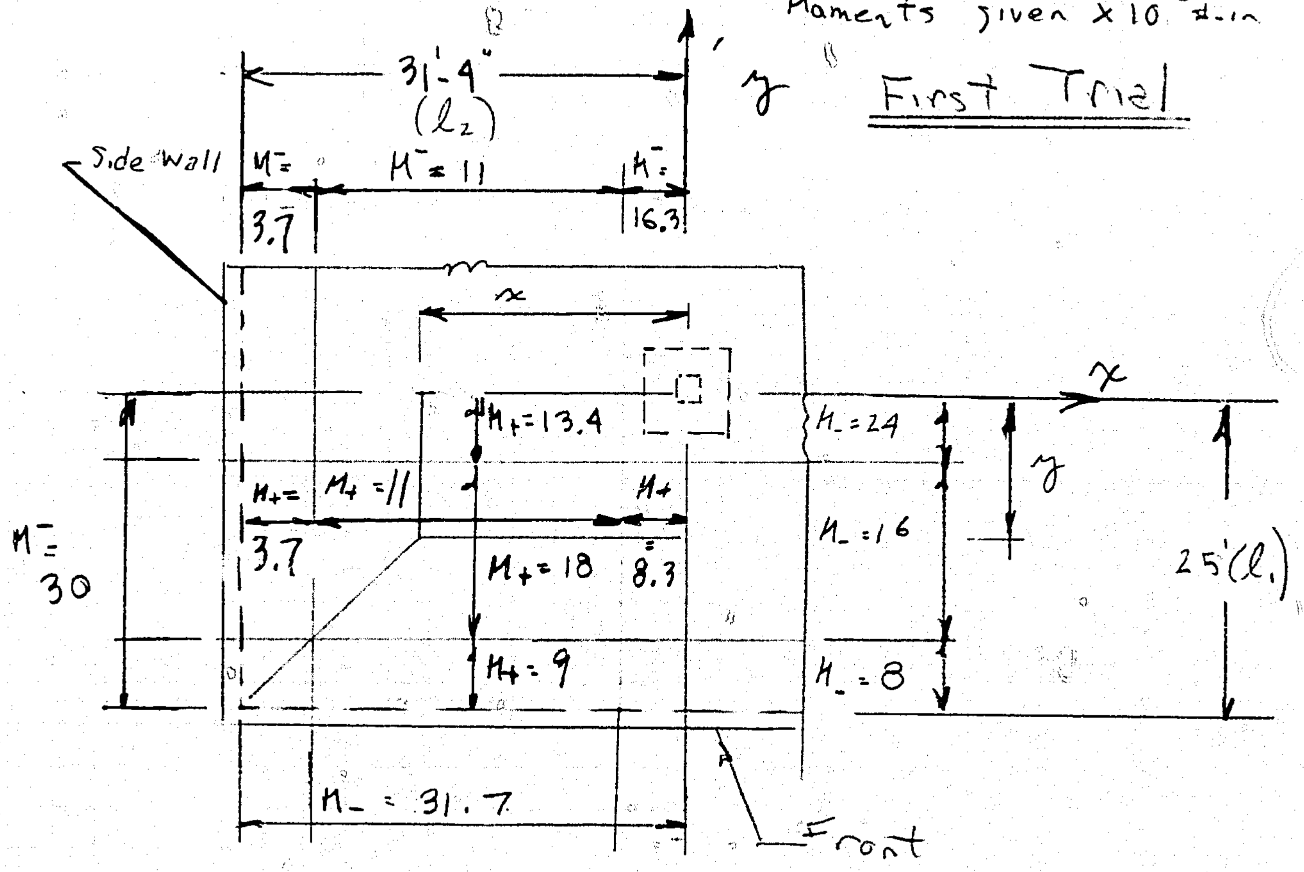
Roof Design

BY WS DATE 1/78 PROJECT Box MAGAZINE TYPE A SHEET NO. 62 OF 343

CKD. BY ______ DATE / SUBJECT Corner Panel Design

Moments given $\times 10^{-6}$ #-in

First Trial



For side wall assume $\alpha_{ec} = 1$

$M_+ = .49 M_o$
$M_{NW} = .33 M_o$
$M_n = .7 M_o$ ∴

$M_+ = (24+8)\left(\frac{.49}{.7}\right) = 22.4 \quad (M_+)_{cs} = .6(22.4) = 13.44$

$(M_+)_{ms} = .4(22.4) = 9$ (½ mid-strip

$(M_+)_e = 9$

$M_{NW} = \frac{.33}{.7}(24+8) = 15$ (100,000 #-in/in - use 75,000)

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From Computer Program

Trial #1

$R_y \sim 2600$ psf $y = 13.88'$

$R_x = 3000$ psf $X = 18.8'$

Trial #2

Reduce side wall neg moment by 10%

$M_{xw} = .9(75000) = 87500$ #-in/in

& use min steel in corner

$\rho = \underline{.0025}$ $M_{nxwe}/d^2 = 110$ $M_{nxwe} = 110(19.5)^2 = 41827$ #-in/in

$\varphi = \underline{.0018}$ $M_{nywe}/d^2 = 70$ $M_{nywe} = 70(19.5)^2 = 26617$ #-in/in

Results

$R_y = 2688$ psf $Y = 14'$

$R_x = 2925$ psf $X = 18'$

USE AVG OF R_x & R_y = $\frac{2688 + 2925}{2} = 2807$ psf

$= \underline{19.5 \text{ psi}}$

$$K_e = \frac{26.81 (AB - a^2) EI}{(1 - \nu^2) A^4}$$

$E = 3.83 \times 10^6$ psi $A = 31'\text{-}4''$ $B = 25'$ $a = 3.25'$

$I \sim .6 I_g$ & increased by 7.5% for drop panel

$I \cong 6146 \text{ in}^4$ increased by 7.5% for drop panel

$= 6606$

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CKD. BY______ DATE______ SUBJECT CORNER PANEL DESIGN

$$K_E = \frac{26.81\left(\overbrace{(376)(300)-(39)^2}^{111279}\right)\times 3.8\times 10^6 \times 6606}{(376)^4}$$

$$= 3.77 \times 10^6 \ \#/in$$

$$x_e = \frac{19.5(111279)}{3.77\times 10^6} = \underline{.576 in}$$

$$m_T = \frac{(111279)}{4451}\left(22+.67(24)\right) + \frac{4563\times 8}{4451} = 959 \ \#\text{-sec}^2/in$$

$$EMF \sim 1/2(.57+.61) = .59$$

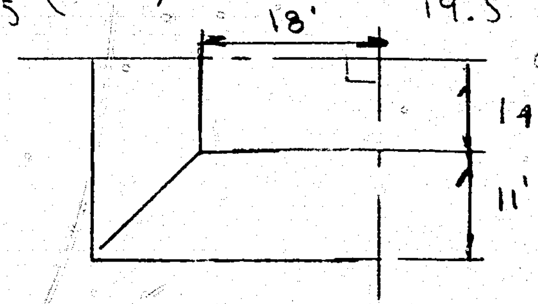
$$T_n = 2\pi\sqrt{\frac{.59(959)}{3.77\times 10^6}} = .077 sec = 77 ms$$

$$B/r = \frac{150}{19.5\cdot 3.1} = 9.1$$

$$t_d/T = \frac{12.4}{77} = .161$$

$$\left.\right\} \mu = 10.5$$

$$X_m = \frac{\overbrace{3.1}^{.092}}{19.5}(.576) + 10.5\left(.576 - \frac{3.1}{19.5}(.576)\right) = 5.17$$



$$\Theta = \tan^{-1}\left(\frac{5.17}{11\times 12}\right) = \underline{2.24^\circ} \text{ ok}$$

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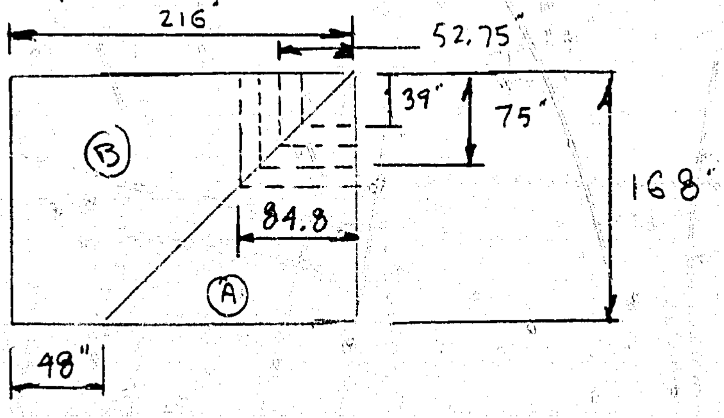
CKD. BY ____ DATE ____ SUBJECT Corner Panel Design

Check Punching Shear



Check Punching Shear in slab for sector B

$$A_B = 168\left(\frac{\overset{22175}{216+48}}{2}\right) - \frac{(84.8)^2}{2} = 18580 \text{ in}^2$$

$$v_B = \frac{18580(19.5)}{.85(84.8)(19.5)} = 257 \text{ psi} < 4\sqrt{f'_c} \text{ OK}$$

Check Punching Shear in drop panel for Sector B

$$A_{B'} = 22176 - (52.75)^2/2 = 20784 \text{ in}^2$$

$$v_{B'} = \frac{20784(19.5)}{.85(52.75)(27.5)} = \underline{328 \text{ psi NG}}$$

Try Moving X crack closer to column

Decrease $(M_n)_y$ by 10% } within tolerances of code
Increase $(M_p)_y$ by 10% }

Results NG - Crack Line doesn't shift by significant amount

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 66 OF 343
CKD. BY ______ DATE ________ SUBJECT CORNER PANEL DESIGN

Check Beam Shear accross short dimension

$$V_d = (216 - (75+19.5))(168)(19.5) = 398034^{\#}$$
$$V_s = (216(168) - (39)^2)19.5 = 678,000^{\#}$$

$$v = \frac{398034}{(.85)(168)(19.5)} = 142 \text{ psi}$$

$$M_u = 24\times10^6 + \frac{16\times10^6}{150}(75) + 678000(99.5-31)$$
$$\frac{19.5(168)}{2}(99.5)^2$$

$$= 46.6\times10^6 - 43.1\times10^6 = 3.5\times10^6 \text{ \#-in}$$

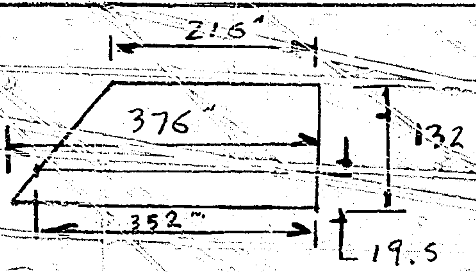
$$v_c = 1.9\sqrt{f'_c} + \frac{2500\rho_u V_u d}{M_u}$$

$$\rho_u = \frac{(.0115+.0065)}{2} \qquad (\rho\text{'s from page 17})$$
$$= .009$$

$$v_c = 1.9(63.2) + \frac{2500(.009)\overbrace{(398034)}(19.5)}{3.5\times10^6}$$

$$= 142.6 \text{ psi} > 142 \text{ psi ok}$$

Check @ Front Wall



$$V_s = 19.5\left(\frac{216+376}{2}\right)(132)$$
$$= 761904^{\#}$$
$$V_d = \frac{19.5(216+352)(112.5)}{2} =$$

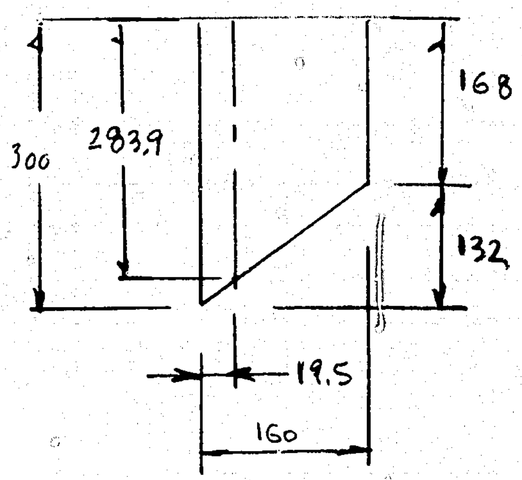
BY W.S. DATE 1/18 PROJECT BOX MAGAZINE TYPE A SHEET NO. 67 OF 343

CKD. BY ____ DATE ____ SUBJECT CORNER PANEL - DESIGN

$V_d = 623025^{\#}$ $\quad \ell \sim (216 + 68 + 2/3(68)) = 329$ in

$v = \dfrac{623025}{(.85)(329)(19.5)} = 114.2$ psi $< 2\sqrt{f_c'} = 126.5$ psi

Check Shear @ Side wall



$V_d = \dfrac{(168+283.9)}{2}(140.5)(19.5)$

$= 619046^{\#}$

$\ell_e = 168 + 66 + 2/3 (49.9) =$

$v_d = \dfrac{619046}{.85(267.3)19.5} = 139$ psi OK

$2\sqrt{f_c'} = 127$ psi OK

Shear @ Supt $= 19.5\left(\dfrac{168+300}{2}\right)(160) = \underline{730{,}080^{\#}}$

$(168+66)V_s + \dfrac{2}{3}V_s(66) = 278\,V_s = 730{,}090$

$V = \underline{2626\ ^{\#}/\text{in}}$

BY WS DATE 1/18 PROJECT Box Magazine Type A SHEET NO. 68 OF 343

CKD. BY DATE SUBJECT Corner Panel Design

Increase Depth of Drop Panel

Try 34"

$$A_B' = 22176 - \left(\frac{\overset{56}{\overbrace{39+17}}}{2}\right)^2 = 20608 \text{ in}^2$$

$$v_B' = \frac{20608(19.5)}{.85(58)(31.5)} = \underline{268 \text{ psi} \quad \text{OK}}$$

Revise col strip neg steel on basis of T=34"

x-direction $\quad d \sim 31.5$

$$\left(M_-/d^2\right) = \frac{24.1 \times 10^6}{(31.5)^2 \times 75} = 323 \qquad p \sim .0075$$

$$A_s = .0075(31.5 \times 12) = \underline{2.8 \text{ in}^2/\text{ft}}$$

Y-direction

$$M_-/d^2 = \frac{16.3 \times 10^6}{75 \times (30.5)^2} = 233 \qquad p \sim .0055$$

$$A_s = .0055(30.5 \times 12) = \underline{2.0 \text{ in}^2/\text{ft}}$$

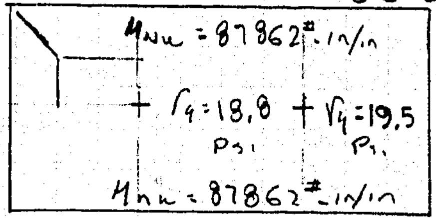
Final Design of Roof

Final Balance of Roof - Using Actual Wall Capacities

Rear Wall

$T_c = 30''$
$M_{NV} = 80006^{\#}\text{-in/in}$
$r_u = 50.4\ \text{psi}$
$x = 86.8''$

Side Wall
same as other side



Rear Wall

$T_c = 18''$
$M_{NV} = 32043^{\#}\text{-in/in}$
$r_u = 21\ \text{psi}$
$x = 95.7\ \text{in}$
} Side Wall

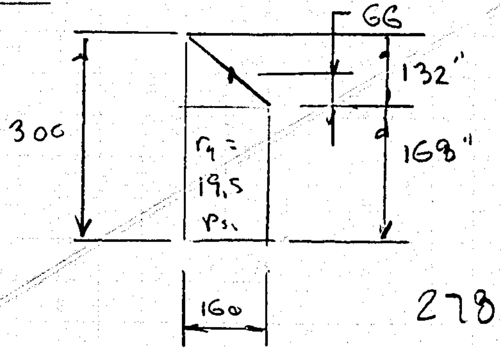
Front Wall

Front Wall

$M_{NV} = 80006^{\#}\text{-in/in}$
$V_v = 4096^{\#}/\text{in}$
$r_u = 44.9\ \text{psi}$
$T_c = 30''$
} already checked on page 21 of Front wall

Check Balance @ Side Wall

Roof



$$r_u\left(\frac{168+300}{2}\right)(160) =$$

$$V_{sw}(168+66) + \frac{2}{3}V_s(66)$$

$$278 V_{sw} = 730086^{\#}$$

$$V_s = 2626^{\#}/\text{in}$$

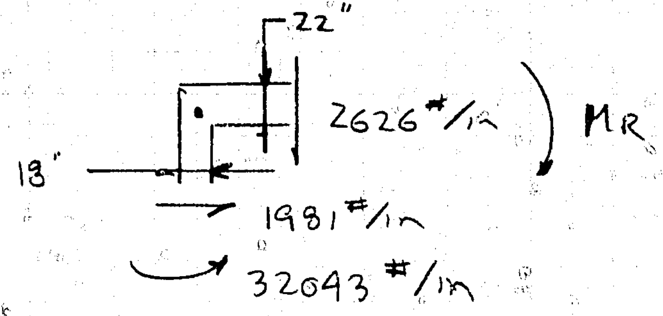
Side Wall

$$V_{sv} = \frac{3 r_u H(1-x/L)}{2(3-x/L)} = \frac{3(21)(182)(1-95.7/598)}{2(3-95.7/598)}$$

$$= \frac{9631}{4.86} = 1981^{\#}/\text{in}$$

BY WS DATE 1/17 PROJECT Box Magazine Type A SHEET NO. 10 OF 343

CKD. BY ______ DATE ______ SUBJECT Roof Design

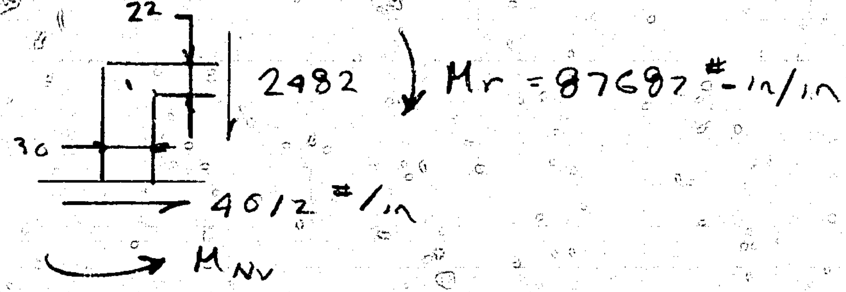


$M_R = 32043 + 1981(11) - 2626(9) = \underline{\underline{30200 \text{\#-in/in}}}$

Check Balance @ Rear Wall - Exterior span

$$(V_{sv})_{u/in} = \frac{3(50.4)(168)(3 - 86.8/1136)}{2(3 - 86.8/1136)}$$

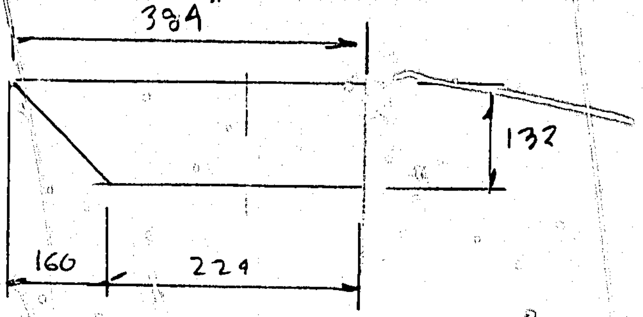
$$= \frac{23461}{5.85} = 4012 \text{\#/in}$$



$M_{Nv} = 87682 + 2482(15) - 4012(11)$

$= 80790 \text{\#-in/in}$ Joint Balanced

Check Balance @ Rear Wall - Corner Span



$$V = 19.5\left(\frac{384+224}{2}\right)(132) = 782500^{\#}$$

$$V_{SRW}(224+80) + \tfrac{2}{3} V_{SRW}(80) = 357.3\, V_{SRW}$$

$$V_{SRW} = \frac{782500}{357.3} = 2189^{\#}/in$$

$$M_{RW} = 87682 + 2189(15) - 4012(11) = 76383\ ^{\#}\text{-}in/in$$

Wall Designed For 80,000#-in/in say OK

BY KS DATE 1/75 PROJECT [illegible] NASPRUIL TYPE A SHEET NO. 72 OF 3A[illegible]

CKD. BY ______ DATE ________ SUBJECT ROOF DESIGN

Corner Panel

Moment Changes - Reduce Neg Moments @ Col by 10%
Increase Pos Moments by 10%

$(M_{nx})_{cs} = 288000^{\#}\text{-in/in}$; $(M_{nx})_{ms} : 96000^{\#}\text{-in/in}$

$(M_{px})_{cs} : 196532^{\#}\text{-in/in}$; $(M_{px})_{ms} = 132000^{\#}\text{-in/in}$; $M_{nn} : 30200^{\#}\text{-in/in}$

Recompute v_y, x & y w/ program (see attached output)

By interpolation of output:

$v_y : 18.5\,\text{psi}$ $x = 13.9'$
$y = 18.35'$

Recheck Deflection

$$K_e = \frac{26.81(AB - a^2)\,E\,I}{(1-\mu^2)\,A^4}$$

A = 31'-4"
B = 25'
a = 38.4"
$\mu \sim .15$ $I = 6606\,\text{in}^4$

$$K_e = \frac{26.81\left((376)(300) - (38.4)^2\right)(3.83\times10^6)(6606)}{(1-(.15)^2)\,(376)^4}$$

$$= 3.87\times10^6\ \#/\text{in}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 73 OF 343

CKD. BY ____ DATE ____ SUBJECT ROOF DESIGN

$$x_E = \frac{18.5(111356)}{3.86\times10^6} = \underline{.533 \text{ in}}$$

$$m_T = 959(\text{page } 27) + \frac{4\times4563}{4451}(34''\text{ drop panel})$$

$$= 963.1 \ \#\text{-sec}^2\text{-in}$$

$$EMF = \tfrac{1}{2}(.58 + .61) = .595$$

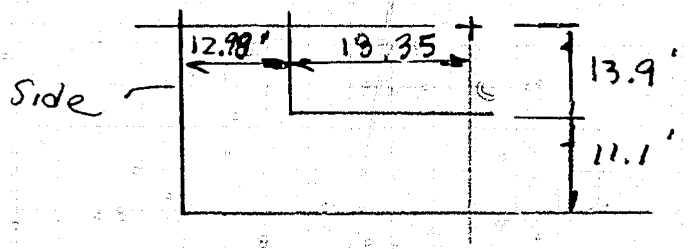
$$T_n = 2\pi\sqrt{\frac{.595(963.1)}{3.86\times10^6}} = .077 \text{ sec} = 77 \text{ ms}$$

$$\left.\begin{array}{l} B/r = \dfrac{150}{18.5-3.1} = 9.74 \\ \\ t_d/T = \dfrac{12.4}{77} = .161 \end{array}\right\} \mu = 12.3$$

$$x_{DL} = \frac{3.1}{18.5}(.533) = .089 \text{ in}$$

$$x_e' = .533 - .089 = .444$$

$$X_m = .089 + 12.3(.444) = 5.55 \text{ in}$$



$$\theta = \tan^{-1}\left(\frac{5.55}{11.1\times12}\right) = \underline{2.38^\circ \text{ OK}}$$

BLANK FRAME

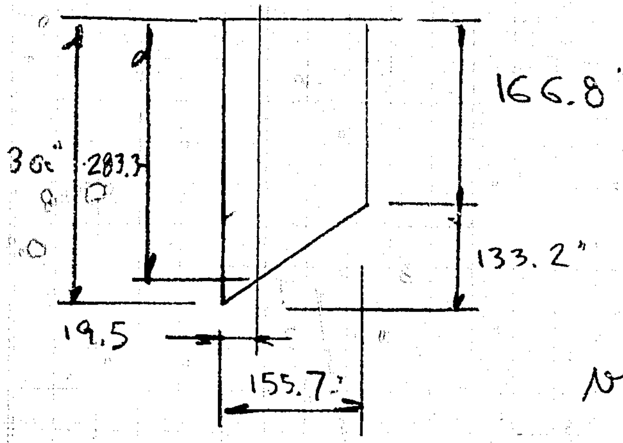
FOR

PROPER PAGINATION

BY NS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 74 OF 343

CKD. BY DATE SUBJECT ROOF DESIGN

Recheck Shear @ side wall



$$V = \frac{18.5(166.8 + 283.3)}{2}(136.3)$$

$$= 566684^{\#}$$

$$l_e = 166.8 + 66.6 + 2/3(49.9)$$

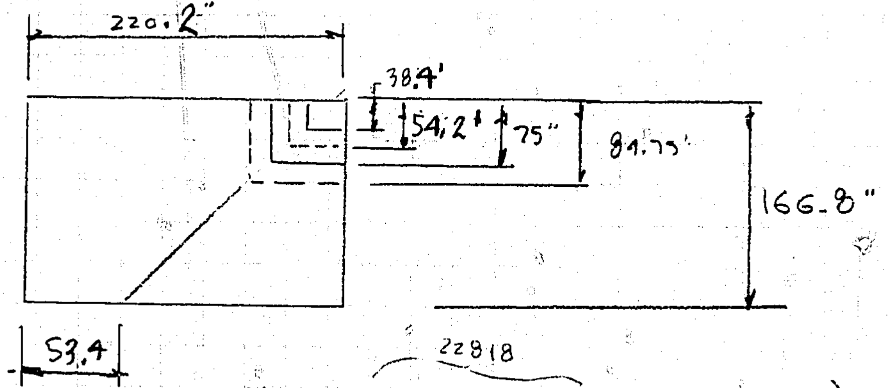
$$= 266.6$$

$$\nu_c = \frac{566684}{.85(266.6)(19.5)} : 127.6 \text{ psi}$$

say OK

$$\nu_c = 127 \text{ psi}$$

Check Shear Around Drop Panel



Slab $$\nu_c = \frac{18.5\left(\overbrace{1/2(220.2 + 53.4)(166.8)}^{22818} - (84.75)^2/2\right)}{.85(84.75)(19.5)} \doteq 253 \text{ psi}$$ say ok

Drop Panel $$\nu_c = \frac{18.5(22818 - (54.2)^2/2)}{.85(54.2)(31.5)} : 272 \text{ psi}$$ say NG

$$\nu_c = 4\sqrt{f_c'} = 253 \text{ psi}$$

CORNER PANEL ON FRONT SIDE   SHEET 110   115 of 343

ELASTIC DISTRIBUTION

```
               MNYC    0.21733E 06
               MNYM    0.48681E 05
               MNYWC   0.84306E 05
               MNYWM   0.84306E 05
               MNYWE   0.84306E 05
               MPYC    0.11066E 06
               MPYM    0.48681E 05
               MPYE    0.48681E 05
               MNXC    0.32000E 06
               MNXM    0.10666E 06
               MNXWC   0.75200E 05
               MNXWM   0.75200E 05
               MNXWE   0.75200E 05
               MPXC    0.17866E 06
               MPXM    0.12000E 06
               MPXE    0.12000E 06
          MOMENTS IN LBS-FT


               L1      0.25000E 02
               L2      0.31330E 02
               A       0.32500E 01
          DIMENSIONS IN FEET

                 X          Y        R1Y        R2Y        R1X        R3X         XB         YB        EMF1 EMF2 EMF3 EMF
               (FT)       (FT)      (PSF)      (PSF)      (PSF)      (PSF)       (FT)       (FT)

              6.250      6.250    57848.1     1732.7    87948.1     1295.7      2.437      2.437      0.39 0.57 0.58 0.51
              6.250      6.875    42655.2     1854.3    78298.3     1250.2      2.329      2.545      0.41 0.57 0.58 0.52
              6.250      7.500    32806.0     1989.1    70210.4     1207.5      2.227      2.647      0.42 0.57 0.59 0.53
              6.250      8.125    26040.3     2139.2    63388.7     1167.4      2.129      2.745      0.44 0.57 0.59 0.53
              6.250      8.750    21185.1     2306.9    57594.1     1129.6      2.034      2.840      0.45 0.57 0.60 0.54
              6.250      9.375    17579.2     2495.1    52635.8     1094.0      1.941      2.933      0.46 0.57 0.60 0.54
              6.250     10.000    14826.0     2707.4    48362.3     1060.4      1.850      3.024      0.48 0.57 0.61 0.55
              6.250     10.625    12675.2     2947.9    44653.3     1028.6      1.761      3.113      0.48 0.57 0.61 0.55
              6.250     11.250    10962.5     3222.0    41412.8      998.4      1.672      3.202      0.49 0.57 0.61 0.56
              6.250     11.875     9576.0     3536.2    38563.9      969.9      1.584      3.290      0.50 0.57 0.62 0.56
              6.250     12.500     8437.6     3898.6    36044.6      942.7      1.497      3.377      0.51 0.57 0.62 0.56
              6.250     13.125     7491.4     4319.8    33804.7      916.9      1.411      3.463      0.52 0.57 0.62 0.57
              6.250     13.750     6696.2     4813.2    31802.9      892.3      1.325      3.549      0.52 0.57 0.63 0.57
              6.250     14.375     6021.5     5396.1    30005.5      868.8      1.240      3.634      0.53 0.57 0.63 0.57
              6.250     15.000     5444.1     6091.7    28384.4      846.4      1.155      3.719      0.53 0.57 0.63 0.58
              7.191      6.250    48383.7     1655.5    55793.4     1398.8      2.576      2.298      0.39 0.57 0.58 0.51
              7.191      6.875    35818.7     1771.6    50848.0     1349.6      2.482      2.392      0.40 0.57 0.58 0.52
              7.191      7.500    27636.6     1900.4    46617.6     1303.5      2.394      2.480      0.42 0.57 0.59 0.53
              7.191      8.125    21995.1     2043.8    42969.7     1260.2      2.308      2.566      0.43 0.57 0.59 0.53
              7.191      8.750    17933.7     2204.1    39800.1     1219.5      2.225      2.649      0.44 0.57 0.60 0.54
              7.191      9.375    14909.3     2383.9    37026.6     1181.0      2.144      2.730      0.45 0.57 0.60 0.54
              7.191     10.000    12594.6     2586.7    34583.9     1144.7      2.065      2.809      0.46 0.57 0.61 0.55
              7.191     10.625    10782.7     2816.5    32419.4     1110.4      1.987      2.887      0.47 0.57 0.61 0.55
              7.191     11.250     9337.2     3078.4    30490.6     1077.9      1.910      2.964      0.48 0.57 0.61 0.56
              7.191     11.875     8165.2     3378.6    28763.0     1047.0      1.833      3.041      0.49 0.57 0.62 0.56
              7.191     12.500     7201.5     3724.9    27208.2     1017.7      1.757      3.117      0.50 0.57 0.62 0.56
              7.191     13.125     6399.5     4127.3    25802.6      989.8      1.682      3.192      0.50 0.57 0.62 0.57
              7.191     13.750     5724.7     4598.7    24526.7      963.2      1.607      3.267      0.51 0.57 0.63 0.57
              7.191     14.375     5151.6     5155.6    23364.0      937.9      1.533      3.341      0.52 0.57 0.63 0.57
              8.133      6.250    42066.3     1584.4    38089.8     1514.7      2.674      2.200      0.39 0.58 0.58 0.52
              8.133      6.875    31225.0     1695.5    35172.1     1461.4      2.592      2.282      0.40 0.58 0.58 0.52
              8.133      7.500    24144.4     1818.8    32664.1     1411.5      2.513      2.361      0.41 0.58 0.59 0.53
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 8.133     8.125   19250.1   1956.0   30485.6   1364.6   2.438   2.436   0.43 0.58 0.59 0.53
 8.133     8.750   15719.3   2109.4   28576.3   1320.5   2.365   2.509   0.44 0.58 0.60 0.54
 8.133     9.375   13085.1   2281.5   26889.4   1278.8   2.293   2.581   0.45 0.58 0.60 0.54
 8.133    10.000   11065.8   2475.6   25388.5   1239.5   2.223   2.651   0.46 0.58 0.61 0.55
 8.133    10.625    9483.0   2695.6   24044.7   1202.4   2.153   2.721   0.47 0.58 0.61 0.55
 8.133    11.250    8218.7   2946.2   22834.5   1167.1   2.085   2.789   0.47 0.58 0.61 0.56
 8.133    11.875    7192.5   3233.5   21739.3   1133.7   2.017   2.857   0.48 0.58 0.62 0.56
 8.133    12.500    6347.9   3564.9   20743.4   1102.0   1.950   2.924   0.49 0.58 0.62 0.56
 8.133    13.125    5644.3   3950.0   19834.0   1071.8   1.884   2.990   0.49 0.58 0.62 0.57
 8.133    13.750    5051.9   4401.1   19000.3   1043.0   1.817   3.057   0.50 0.58 0.63 0.57
 8.133    14.375    4548.4   4934.1   18233.4   1015.6   1.751   3.123   0.51 0.58 0.63 0.57
 9.074     6.250   37550.0   1518.7   27501.3   1645.5   2.748   2.126   0.39 0.59 0.58 0.52
 9.074     6.875   27925.9   1625.2   25597.0   1587.7   2.674   2.200   0.40 0.59 0.58 0.52
 9.074     7.500   21627.0   1743.4   23961.5   1533.4   2.604   2.270   0.41 0.59 0.59 0.53
 9.074     8.125   17265.3   1874.9   22539.8   1482.5   2.536   2.338   0.42 0.59 0.59 0.53
 9.074     8.750   14113.9   2021.9   21291.0   1434.5   2.471   2.403   0.43 0.59 0.60 0.54
 9.074     9.375   11759.7   2186.9   20184.2   1389.3   2.406   2.468   0.44 0.59 0.60 0.54
 9.074    10.000    9953.0   2373.0   19195.6   1346.6   2.343   2.531   0.45 0.59 0.61 0.55
 9.074    10.625    8535.3   2583.8   18306.5   1306.2   2.281   2.593   0.46 0.59 0.61 0.55
 9.074    11.250    7402.0   2824.0   17502.1   1268.0   2.220   2.654   0.47 0.59 0.61 0.56
 9.074    11.875    6481.3   3099.4   16770.3   1231.7   2.159   2.715   0.47 0.59 0.62 0.56
 9.074    12.500    5723.0   3417.1   16101.3   1197.2   2.099   2.775   0.48 0.59 0.62 0.56
 9.074    13.125    5091.0   3786.3   15487.1   1164.4   2.039   2.835   0.49 0.59 0.62 0.56
 9.074    13.750    4558.5   4218.6   14920.9   1133.1   1.980   2.894   0.49 0.59 0.63 0.57
 9.074    14.375    4105.6   4729.6   14397.2   1103.3   1.921   2.953   0.50 0.59 0.63 0.57
10.015     6.250   34160.7   1457.8   20726.4   1794.1   2.805   2.069   0.40 0.59 0.58 0.52
10.015     6.875   25441.8   1560.1   19390.0   1731.0   2.738   2.136   0.40 0.59 0.58 0.53
10.015     7.500   19726.3   1673.5   18245.5   1671.9   2.674   2.200   0.41 0.59 0.59 0.53
10.015     8.125   15763.4   1799.8   17252.3   1616.4   2.613   2.261   0.42 0.59 0.59 0.54
10.015     8.750   12896.7   1940.9   16380.5   1564.1   2.554   2.320   0.43 0.59 0.60 0.54
10.015     9.375   10753.1   2099.3   15607.8   1514.8   2.496   2.378   0.44 0.59 0.60 0.54
10.015    10.000    9106.6   2277.8   14917.1   1468.2   2.438   2.436   0.45 0.59 0.61 0.55
10.015    10.625    7813.7   2480.2   14295.1   1424.2   2.382   2.492   0.45 0.59 0.61 0.55
10.015    11.250    6779.4   2710.8   13731.5   1382.5   2.327   2.547   0.46 0.59 0.61 0.56
10.015    11.875    5938.6   2975.2   13217.7   1342.9   2.272   2.602   0.47 0.59 0.62 0.56
10.015    12.500    5245.8   3280.1   12747.0   1305.3   2.217   2.657   0.47 0.59 0.62 0.56
10.015    13.125    4668.0   3634.5   12313.8   1269.5   2.163   2.711   0.48 0.59 0.62 0.56
10.015    13.750    4181.0   4049.5   11913.3   1235.5   2.109   2.765   0.49 0.59 0.63 0.57
10.015    14.375    3766.7   4540.0   11541.8   1203.0   2.055   2.819   0.49 0.59 0.63 0.57
10.957     6.250   31523.3   1401.2   16152.2   1963.8   2.850   2.024   0.40 0.60 0.58 0.52
10.957     6.875   23503.9   1499.5   15163.2   1894.7   2.789   2.085   0.41 0.60 0.58 0.53
10.957     7.500   18240.5   1608.6   14318.9   1830.0   2.731   2.143   0.41 0.60 0.59 0.53
10.957     8.125   14587.1   1729.9   13588.0   1769.2   2.675   2.199   0.42 0.60 0.59 0.54
10.957     8.750   11942.1   1865.6   12947.6   1712.0   2.621   2.253   0.43 0.60 0.60 0.54
10.957     9.375    9962.7   2017.8   12380.8   1658.0   2.568   2.306   0.44 0.60 0.60 0.55
10.957    10.000    8441.3   2189.4   11874.5   1607.1   2.516   2.358   0.44 0.60 0.61 0.55
10.957    10.625    7245.9   2384.0   11418.8   1558.9   2.464   2.410   0.45 0.60 0.61 0.55
10.957    11.250    6289.0   2605.6   11005.8   1513.2   2.413   2.461   0.46 0.60 0.61 0.56
10.957    11.875    5510.9   2859.7   10629.3   1469.9   2.363   2.511   0.46 0.60 0.62 0.56
10.957    12.500    4869.5   3152.8   10284.2   1428.7   2.313   2.561   0.47 0.60 0.62 0.56
10.957    13.125    4334.3   3493.4    9966.2   1389.6   2.264   2.610   0.48 0.60 0.62 0.57
10.957    13.750    3883.0   3892.4    9672.1   1352.3   2.214   2.660   0.48 0.60 0.63 0.57
11.898     6.250   29412.7   1348.5   12927.9   2158.7   2.887   1.987   0.40 0.60 0.58 0.53
11.898     6.875   21949.8   1443.1   12166.1   2082.8   2.831   2.043   0.41 0.60 0.58 0.53
11.898     7.500   17046.9   1548.1   11517.7   2011.7   2.778   2.096   0.42 0.60 0.59 0.54
11.898     8.125   13641.0   1664.8   10957.9   1944.8   2.726   2.148   0.42 0.60 0.59 0.54
11.898     8.750   11173.4   1795.4   10468.4   1881.9   2.676   2.198   0.43 0.60 0.60 0.54
11.898     9.375    9325.5   1941.9   10035.9   1822.6   2.627   2.247   0.44 0.60 0.60 0.55
11.898    10.000    7904.5   2107.1    9650.1   1766.6   2.579   2.295   0.44 0.60 0.61 0.55
11.898    10.625    6787.4   2294.3    9303.3   1713.6   2.532   2.342   0.45 0.60 0.61 0.55
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11.898	11.250	5892.9	2507.6	8989.3	1663.4	2.485	2.389	0.46	0.60	0.61	0.56
11.898	11.875	5165.2	2752.1	8703.2	1615.8	2.439	2.435	0.46	0.60	0.62	0.56
11.898	12.500	4565.0	3034.2	8441.1	1570.5	2.393	2.481	0.47	0.60	0.62	0.56
11.898	13.125	4064.2	3362.0	8199.7	1527.5	2.347	2.527	0.47	0.60	0.62	0.57
11.898	13.750	3641.8	3746.0	7976.3	1486.5	2.302	2.572	0.48	0.60	0.63	0.57
12.840	6.250	27685.2	1183.3	10574.1	2384.1	2.917	1.957	0.41	0.61	0.58	0.53
12.840	6.875	20675.8	1266.3	9968.8	2300.3	2.866	2.008	0.41	0.61	0.58	0.53
12.840	7.500	16067.2	1358.4	9455.1	2221.8	2.817	2.057	0.42	0.61	0.59	0.54
12.840	8.125	12863.5	1460.9	9012.5	2147.9	2.769	2.105	0.42	0.61	0.59	0.54
12.840	8.750	10541.0	1575.4	8626.4	2078.5	2.723	2.151	0.43	0.61	0.60	0.54
12.840	9.375	8801.0	1704.0	8285.8	2013.0	2.677	2.197	0.44	0.61	0.60	0.55
12.840	10.000	7462.3	1849.0	7982.6	1951.1	2.633	2.241	0.44	0.61	0.61	0.55
12.840	10.625	6409.5	2013.2	7710.4	1892.6	2.589	2.285	0.45	0.61	0.61	0.55
12.840	11.250	5566.1	2200.4	7464.3	1837.1	2.546	2.328	0.45	0.61	0.61	0.56
12.840	11.875	4879.8	2415.0	7240.2	1784.5	2.503	2.371	0.46	0.61	0.62	0.56
12.840	12.500	4313.7	2662.5	7035.1	1734.6	2.460	2.414	0.46	0.61	0.62	0.56
12.840	13.125	3841.1	2950.2	6846.4	1687.0	2.418	2.456	0.47	0.61	0.62	0.57
12.840	13.750	3442.4	3287.1	6671.9	1641.8	2.376	2.498	0.47	0.61	0.63	0.57
12.840	14.375	3103.0	3685.2	6509.9	1598.6	2.334	2.540	0.48	0.61	0.63	0.57
13.781	6.250	26245.3	1140.9	8805.4	2646.8	2.943	1.931	0.41	0.61	0.58	0.53
13.781	6.875	19612.5	1221.0	8312.6	2553.8	2.895	1.979	0.42	0.61	0.58	0.54
13.781	7.500	15248.6	1309.8	7895.2	2466.6	2.849	2.025	0.42	0.61	0.59	0.54
13.781	8.125	12213.3	1408.6	7536.5	2384.6	2.805	2.069	0.43	0.61	0.59	0.54
13.781	8.750	10011.8	1519.0	7224.1	2307.5	2.762	2.112	0.43	0.61	0.60	0.55
13.781	9.375	8361.7	1643.0	6949.0	2234.8	2.720	2.154	0.44	0.61	0.60	0.55
13.781	10.000	7091.7	1782.8	6704.5	2166.1	2.678	2.196	0.44	0.61	0.61	0.55
13.781	10.625	6092.6	1941.2	6485.4	2101.1	2.638	2.236	0.45	0.61	0.61	0.56
13.781	11.250	5292.0	2121.6	6287.5	2039.6	2.597	2.277	0.45	0.61	0.61	0.56
13.781	11.875	4640.4	2328.5	6107.6	1981.2	2.557	2.317	0.46	0.61	0.62	0.56
13.781	12.500	4102.7	2567.2	5943.0	1925.7	2.518	2.356	0.46	0.61	0.62	0.56
13.781	13.125	3653.8	2844.5	5791.8	1872.9	2.478	2.396	0.47	0.61	0.62	0.57
13.781	13.750	3275.0	3169.4	5652.2	1822.7	2.439	2.435	0.47	0.61	0.63	0.57
13.781	14.375	2952.4	3553.2	5522.6	1774.8	2.400	2.474	0.48	0.61	0.63	0.57
14.723	6.250	25026.7	1101.2	7443.8	2955.5	2.965	1.909	0.41	0.62	0.58	0.54
14.723	6.875	18711.6	1178.5	7034.4	2851.6	2.921	1.953	0.42	0.62	0.58	0.54
14.723	7.500	14554.3	1264.1	6688.5	2754.2	2.878	1.996	0.42	0.62	0.59	0.54
14.723	8.125	11661.4	1359.5	6391.7	2662.7	2.836	2.038	0.43	0.62	0.59	0.54
14.723	8.750	9562.2	1466.1	6133.6	2576.6	2.796	2.078	0.43	0.62	0.60	0.55
14.723	9.375	7988.3	1585.8	5906.8	2495.3	2.757	2.117	0.44	0.62	0.60	0.55
14.723	10.000	6776.6	1720.7	5705.5	2418.7	2.718	2.156	0.44	0.62	0.61	0.55
14.723	10.625	5823.1	1873.5	5525.3	2346.1	2.680	2.194	0.45	0.62	0.61	0.56
14.723	11.250	5058.8	2047.7	5362.8	2277.4	2.642	2.232	0.45	0.62	0.61	0.56
14.723	11.875	4436.6	2247.4	5215.3	2212.2	2.604	2.270	0.46	0.62	0.62	0.56
14.723	12.500	3923.1	2477.8	5080.6	2150.2	2.567	2.307	0.46	0.62	0.62	0.57
14.723	13.125	3494.2	2745.5	4956.9	2091.3	2.530	2.344	0.47	0.62	0.62	0.57
14.723	13.750	3132.4	3059.0	4842.7	2035.2	2.494	2.380	0.47	0.62	0.63	0.57
14.723	14.375	2824.1	3429.5	4736.9	1981.7	2.457	2.417	0.47	0.62	0.63	0.57
15.664	6.250	23982.0	1063.8	6373.8	3321.4	2.984	1.890	0.42	0.62	0.58	0.54
15.664	6.875	17938.5	1138.5	6028.2	3204.7	2.942	1.932	0.42	0.62	0.58	0.54
15.664	7.500	13958.1	1221.3	5736.7	3095.2	2.902	1.972	0.42	0.62	0.59	0.54
15.664	8.125	11187.1	1313.4	5486.9	2992.4	2.863	2.011	0.43	0.62	0.59	0.55
15.664	8.750	9175.7	1416.4	5270.1	2895.6	2.826	2.048	0.43	0.62	0.60	0.55
15.664	9.375	7667.2	1532.0	5079.8	2804.3	2.789	2.085	0.44	0.62	0.60	0.55
15.664	10.000	6505.4	1662.3	4911.1	2718.1	2.752	2.122	0.44	0.62	0.61	0.56
15.664	10.625	5591.0	1810.0	4760.4	2636.6	2.716	2.158	0.45	0.62	0.61	0.56
15.664	11.250	4857.9	1978.3	4624.6	2559.4	2.681	2.193	0.45	0.62	0.61	0.56
15.664	11.875	4261.0	2171.2	4501.4	2486.1	2.645	2.229	0.46	0.62	0.62	0.56
15.664	12.500	3768.3	2393.7	4389.1	2416.5	2.611	2.263	0.46	0.62	0.62	0.57
15.664	13.125	3356.7	2652.3	4286.1	2350.3	2.576	2.298	0.46	0.62	0.62	0.57
15.664	13.750	3009.4	2955.2	4191.1	2287.2	2.541	2.333	0.47	0.62	0.63	0.57

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15.664	14.375	2713.5	3313.1	4103.2	2227.1	2.507	2.367	0.47	0.62	0.63	0.57
16.606	6.250	23076.5	1028.7	5518.1	3759.8	3.001	1.873	0.42	0.62	0.58	0.54
16.606	6.875	17267.8	1100.8	5222.4	3627.6	2.962	1.912	0.42	0.62	0.58	0.54
16.606	7.500	13440.5	1180.9	4973.2	3503.7	2.924	1.950	0.43	0.62	0.59	0.55
16.606	8.125	10775.1	1270.0	4760.0	3387.3	2.887	1.987	0.43	0.62	0.59	0.55
16.606	8.750	8839.8	1369.5	4575.2	3277.7	2.852	2.022	0.43	0.62	0.60	0.55
16.606	9.375	7387.9	1481.3	4413.2	3174.4	2.817	2.057	0.44	0.62	0.60	0.55
16.606	10.000	6269.6	1607.3	4269.8	3076.9	2.782	2.092	0.44	0.62	0.61	0.56
16.606	10.625	5389.1	1750.1	4141.7	2984.6	2.748	2.126	0.45	0.62	0.61	0.56
16.606	11.250	4683.1	1912.9	4026.6	2897.2	2.715	2.159	0.45	0.62	0.61	0.56
16.606	11.875	4108.2	2099.4	3922.2	2814.2	2.682	2.192	0.45	0.62	0.62	0.56
16.606	12.500	3633.5	2314.6	3827.2	2735.4	2.649	2.225	0.46	0.62	0.62	0.57
16.606	13.125	3237.0	2564.6	3740.1	2660.5	2.616	2.258	0.46	0.62	0.62	0.57
16.606	13.750	2902.3	2857.5	3659.9	2589.1	2.584	2.290	0.47	0.62	0.63	0.57
16.606	14.375	2617.1	3203.6	3585.7	2521.0	2.551	2.323	0.47	0.62	0.63	0.57
17.547	6.250	22284.0	995.5	4823.3	4291.0	3.016	1.858	0.42	0.63	0.58	0.54
17.547	6.875	16680.4	1065.3	4567.2	4140.2	2.979	1.895	0.43	0.63	0.58	0.54
17.547	7.500	12986.9	1142.8	4351.7	3998.8	2.943	1.931	0.43	0.63	0.59	0.55
17.547	8.125	10413.9	1229.0	4167.5	3865.9	2.908	1.966	0.43	0.63	0.59	0.55
17.547	8.750	8545.2	1325.4	4008.0	3740.9	2.874	2.000	0.44	0.63	0.60	0.55
17.547	9.375	7142.9	1433.5	3868.4	3623.0	2.841	2.033	0.44	0.63	0.60	0.56
17.547	10.000	6062.6	1555.5	3745.0	3511.6	2.809	2.065	0.44	0.63	0.61	0.56
17.547	10.625	5211.9	1693.7	3634.9	3406.3	2.777	2.097	0.45	0.63	0.61	0.56
17.547	11.250	4529.6	1851.2	3535.9	3306.5	2.745	2.129	0.45	0.63	0.61	0.56
17.547	11.875	3973.9	2031.7	3446.4	3211.9	2.714	2.160	0.45	0.63	0.62	0.57
17.547	12.500	3515.1	2239.9	3364.9	3121.9	2.683	2.191	0.46	0.63	0.62	0.57
17.547	13.125	3131.7	2481.9	3290.3	3036.4	2.652	2.222	0.46	0.63	0.62	0.57
17.547	13.750	2808.1	2765.3	3221.7	2954.9	2.621	2.253	0.47	0.63	0.63	0.57
17.547	14.375	2532.4	3100.2	3158.3	2877.2	2.590	2.284	0.47	0.63	0.63	0.57
18.489	6.250	21584.7	964.1	4251.5	4943.4	3.029	1.845	0.43	0.63	0.58	0.54
18.489	6.875	16161.7	1031.8	4027.5	4769.6	2.994	1.880	0.43	0.63	0.58	0.55
18.489	7.500	12586.2	1106.8	3839.2	4606.7	2.960	1.914	0.43	0.63	0.59	0.55
18.489	8.125	10094.7	1190.3	3678.5	4453.6	2.927	1.947	0.43	0.63	0.59	0.55
18.489	8.750	8284.7	1283.6	3539.4	4309.6	2.895	1.979	0.44	0.63	0.60	0.55
18.489	9.375	6926.2	1388.4	3417.8	4173.8	2.864	2.010	0.44	0.63	0.60	0.56
18.489	10.000	5879.4	1506.5	3310.4	4045.5	2.833	2.041	0.44	0.63	0.61	0.56
18.489	10.625	5055.0	1640.3	3214.7	3924.1	2.802	2.072	0.45	0.63	0.61	0.56
18.489	11.250	4393.8	1792.9	3128.7	3809.2	2.772	2.102	0.45	0.63	0.61	0.56
18.489	11.875	3855.1	1967.7	3051.0	3700.1	2.742	2.132	0.45	0.63	0.62	0.57
18.489	12.500	3410.2	2169.4	2980.4	3596.5	2.713	2.161	0.46	0.63	0.62	0.57
18.489	13.125	3038.6	2403.7	2915.8	3498.0	2.683	2.191	0.46	0.63	0.62	0.57
18.489	13.750	2724.8	2678.2	2856.4	3404.1	2.654	2.220	0.46	0.63	0.63	0.57
18.489	14.375	2457.4	3002.6	2801.6	3314.6	2.625	2.249	0.47	0.63	0.63	0.58

BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET NO. 79 OF 343

CKD. BY ______ DATE ______ SUBJECT Roof Design

Front Corner Design

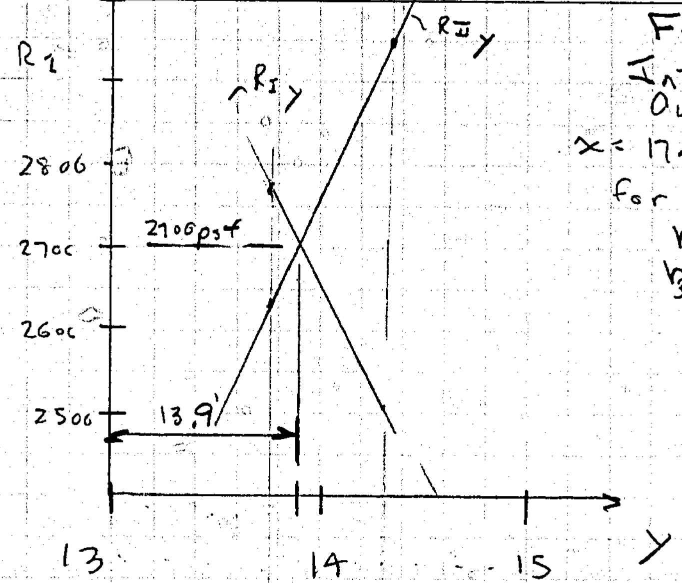
Interpolation of Program Output

$x = 17.55$

for $y = 13.9$

$r_{1x} = 3124$

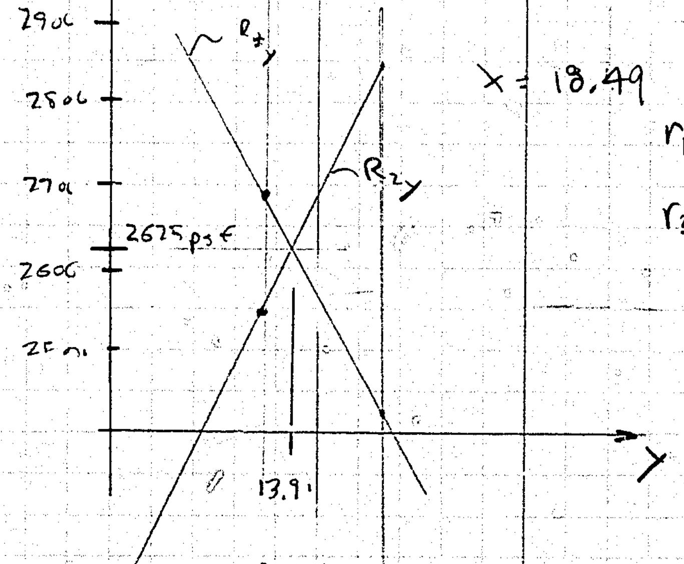
$r_{3x} = 2498$



$x = 18.49$ for $y = 13.9$

$r_{1x} = 2776$

$r_{3x} = 2878$



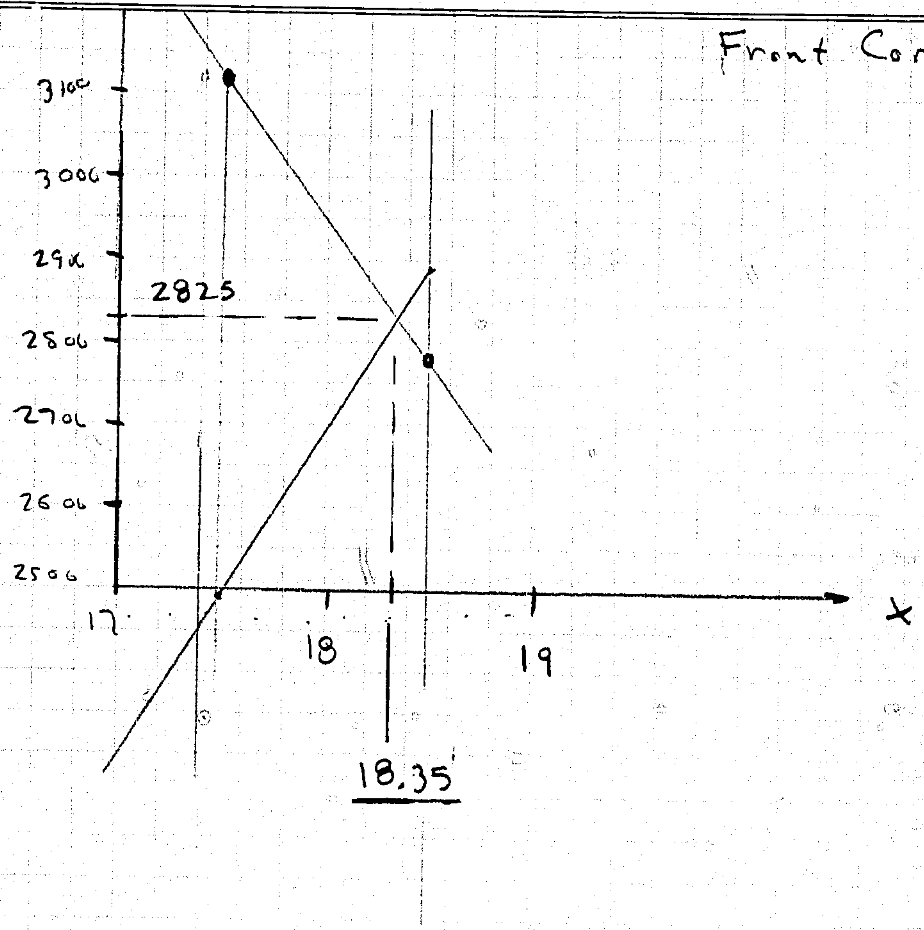
$r_{avg} = 2663$ psf

AMMANN & WHITNEY - CONSULTING ENGINEERS - NEW YORK, N. Y.

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 80 OF 343

CKD. BY ___ DATE ___ SUBJECT ROOF DESIGN

Front Corner-Design



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R_u corner panel - final design

Front side

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     MNYC    0.21733E 06
     MNYM    0.48681E 05
     MNYWC   0.87863E 05
     MNYWM   0.87863E 05
     MNYWE   0.26617E 05
     MPYC    0.11066E 06
     MPYM    0.48681E 05
     MPYE    0.48681E 05
     MNXC    0.28800E 06
     MNXM    0.95999E 05
     MNXWC   0.30200E 05
     MNXWM   0.30200E 05
     MNXWE   0.30200E 05
     MPXC    0.19653E 06
     MPXM    0.13200E 06
     MPXE    0.13200E 06

 MOMENTS IN LBS-FT

     L1      0.25000E 02
     L2      0.31330E 02
     A       0.31700E 01
 DIMENSIONS IN FEET

      X          Y        R1Y        R2Y        R1X        R3X        XB         YR          EMF1 EMF2 EMF3 EMF
    (FT)       (FT)      (PSF)      (PSF)      (PSF)      (PSF)      (FT)       (FT)

     6.250      6.250    55162.2     1644.6    81487.8     1101.8     2.377      2.377       0.39 0.57 0.58 0.51
     6.250      6.875    40913.6     1760.0    72912.4     1063.1     2.274      2.480       0.41 0.57 0.58 0.52
     6.250      7.500    31601.5     1887.9    65698.3     1026.9     2.175      2.579       0.43 0.57 0.59 0.53
     6.250      8.125    25166.6     2030.4    59587.3      992.8     2.081      2.673       0.44 0.57 0.59 0.53
     6.250      8.750    20527.4     2189.6    54372.9      960.8     1.989      2.765       0.45 0.57 0.60 0.54
     6.250      9.375    17069.4     2368.2    49890.7      930.6     1.899      2.855       0.47 0.57 0.60 0.54
     6.250     10.000    14421.2     2569.7    46010.3      902.0     1.810      2.944       0.48 0.57 0.61 0.55
     6.250     10.625    12347.3     2798.0    42627.8      875.0     1.723      3.031       0.49 0.57 0.61 0.55
     6.250     11.250    10692.3     3058.2    39660.3      849.5     1.637      3.117       0.50 0.57 0.61 0.56
     6.250     11.875     9350.1     3356.4    37041.3      825.2     1.552      3.202       0.50 0.57 0.62 0.56
     6.250     12.500     8246.5     3700.4    34716.6      802.1     1.468      3.286       0.51 0.57 0.62 0.56
     6.250     13.125     7327.8     4100.2    32642.4      780.2     1.384      3.370       0.52 0.57 0.62 0.57
     6.250     13.750     6554.9     4568.4    30782.6      759.3     1.300      3.454       0.52 0.57 0.63 0.57
     6.250     14.375     5898.4     5121.7    29107.3      739.4     1.217      3.537       0.53 0.57 0.63 0.57
     6.250     15.000     5335.9     5781.9    27591.9      720.4     1.134      3.620       0.53 0.57 0.63 0.58
     7.191      6.250    46331.2     1573.5    52161.4     1189.4     2.511      2.243       0.39 0.57 0.58 0.51
     7.191      6.875    34489.3     1683.9    47702.1     1147.7     2.421      2.333       0.41 0.57 0.58 0.52
     7.191      7.500    26718.1     1806.4    43882.1     1108.5     2.335      2.419       0.42 0.57 0.59 0.53
     7.191      8.125    21329.3     1942.7    40581.3     1071.8     2.253      2.501       0.43 0.57 0.59 0.53
     7.191      8.750    17433.0     2095.0    37706.4     1037.2     2.173      2.581       0.45 0.57 0.60 0.54
     7.191      9.375    14521.5     2265.9    35184.1     1004.6     2.094      2.660       0.46 0.57 0.60 0.54
     7.191     10.000    12286.9     2458.7    32956.5      973.8     2.017      2.737       0.47 0.57 0.61 0.55
     7.191     10.625    10533.7     2677.1    30977.1      944.6     1.941      2.813       0.48 0.57 0.61 0.55
     7.191     11.250     9132.2     2926.0    29208.4      917.0     1.866      2.888       0.48 0.57 0.61 0.56
     7.191     11.875     7994.0     3211.4    27619.8      890.8     1.792      2.962       0.49 0.57 0.62 0.56
     7.191     12.500     7056.7     3540.5    26186.1      865.9     1.718      3.036       0.50 0.57 0.62 0.56
     7.191     13.125     6275.7     3923.0    24886.6      842.3     1.645      3.109       0.51 0.57 0.62 0.57
     7.191     13.750     5617.8     4371.0    23704.0      819.7     1.572      3.182       0.51 0.57 0.63 0.57
     7.191     14.375     5058.5     4900.4    22623.6      798.2     1.500      3.254       0.52 0.57 0.63 0.57
     7.191     15.000     4578.9     5532.1    21633.3      777.7     1.428      3.326       0.52 0.57 0.63 0.58
     8.133      6.250    40395.2     1508.1    35842.0     1287.9     2.606      2.148       0.39 0.58 0.58 0.52
     8.133      6.875    30144.5     1613.9    33185.3     1242.7     2.526      2.228       0.40 0.58 0.58 0.52
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8.133	7.500	23399.0	1731.3	30900.3	1200.4	2.451	2.303	0.42	0.58	0.59	0.53
8.133	8.125	18710.6	1861.9	28913.6	1160.6	2.378	2.376	0.43	0.58	0.59	0.53
8.133	8.750	15314.0	2007.9	27169.9	1123.1	2.307	2.447	0.44	0.58	0.60	0.54
8.133	9.375	12771.6	2171.7	25626.9	1087.8	2.238	2.516	0.45	0.58	0.60	0.54
8.133	10.000	10817.4	2356.4	24251.6	1054.4	2.169	2.585	0.46	0.58	0.61	0.55
8.133	10.625	9282.2	2565.8	23018.0	1022.9	2.102	2.652	0.47	0.58	0.61	0.55
8.133	11.250	8053.6	2804.4	21905.0	993.0	2.036	2.718	0.48	0.58	0.61	0.56
8.133	11.875	7054.7	3077.8	20895.6	964.6	1.970	2.784	0.48	0.58	0.62	0.56
8.133	12.500	6231.5	3393.3	19976.1	937.7	1.905	2.849	0.49	0.58	0.62	0.56
8.133	13.125	5544.9	3759.9	19134.7	912.0	1.840	2.914	0.50	0.58	0.62	0.57
8.133	13.750	4966.1	4189.3	18362.0	887.6	1.776	2.978	0.50	0.58	0.63	0.57
8.133	14.375	4473.8	4696.6	17649.7	864.4	1.712	3.042	0.51	0.58	0.63	0.57
9.074	6.250	36131.1	1447.7	26002.0	1399.2	2.677	2.077	0.39	0.59	0.58	0.52
9.074	6.875	27010.2	1549.2	24256.5	1350.1	2.606	2.148	0.41	0.59	0.58	0.52
9.074	7.500	20996.4	1661.9	22757.1	1304.1	2.538	2.216	0.42	0.59	0.59	0.53
9.074	8.125	16809.6	1787.2	21452.9	1260.8	2.473	2.281	0.43	0.59	0.59	0.53
9.074	8.750	13772.0	1927.4	20306.3	1220.1	2.409	2.345	0.44	0.59	0.60	0.54
9.074	9.375	11495.5	2084.6	19289.2	1181.8	2.347	2.407	0.44	0.59	0.60	0.54
9.074	10.000	9743.9	2262.0	18379.5	1145.5	2.286	2.468	0.45	0.59	0.61	0.55
9.074	10.625	8366.5	2463.0	17560.4	1111.2	2.226	2.528	0.46	0.59	0.61	0.55
9.074	11.250	7263.3	2692.0	16818.3	1078.8	2.166	2.588	0.47	0.59	0.61	0.56
9.074	11.875	6365.7	2954.5	16142.2	1048.0	2.107	2.647	0.48	0.59	0.62	0.56
9.074	12.500	5625.5	3257.3	15523.2	1018.7	2.049	2.705	0.43	0.59	0.62	0.56
9.074	13.125	5007.7	3609.2	14954.1	990.8	1.991	2.763	0.49	0.59	0.62	0.57
9.074	13.750	4486.7	4021.4	14428.7	964.3	1.933	2.821	0.49	0.59	0.63	0.57
9.074	14.375	4043.2	4508.4	13942.0	939.0	1.875	2.879	0.50	0.59	0.63	0.57
10.015	6.250	32919.7	1391.6	19667.0	1525.5	2.732	2.022	0.40	0.59	0.58	0.52
10.015	6.875	24642.4	1489.3	18436.5	1472.0	2.668	2.086	0.41	0.59	0.58	0.53
10.015	7.500	19176.7	1597.5	17382.5	1421.8	2.607	2.147	0.42	0.59	0.59	0.53
10.015	8.125	15366.7	1718.1	16467.4	1374.7	2.548	2.206	0.42	0.59	0.59	0.54
10.015	8.750	12599.6	1852.8	15663.8	1330.3	2.490	2.264	0.43	0.59	0.60	0.54
10.015	9.375	10523.9	2004.0	14951.0	1288.5	2.434	2.320	0.44	0.59	0.60	0.54
10.015	10.000	8925.4	2174.5	14313.3	1249.0	2.378	2.376	0.45	0.59	0.61	0.55
10.015	10.625	7667.5	2367.7	13738.6	1211.6	2.324	2.430	0.46	0.59	0.61	0.55
10.015	11.250	6659.4	2587.8	13217.2	1176.2	2.270	2.484	0.46	0.59	0.61	0.56
10.015	11.875	5838.8	2840.1	12741.4	1142.6	2.216	2.538	0.47	0.59	0.62	0.56
10.015	12.500	5161.6	3131.2	12305.0	1110.7	2.163	2.591	0.48	0.59	0.62	0.56
10.015	13.125	4596.2	3469.5	11902.9	1080.3	2.111	2.643	0.48	0.59	0.62	0.57
10.015	13.750	4119.2	3865.7	11530.8	1051.4	2.058	2.696	0.49	0.59	0.63	0.57
10.015	14.375	3713.0	4333.9	11185.2	1023.8	2.006	2.748	0.49	0.59	0.63	0.57
10.957	6.250	30414.0	1339.6	15369.5	1669.8	2.776	1.978	0.40	0.60	0.58	0.53
10.957	6.875	22790.5	1433.6	14455.8	1611.2	2.718	2.036	0.41	0.60	0.58	0.53
10.957	7.500	17750.7	1537.8	13675.7	1556.3	2.662	2.092	0.42	0.60	0.59	0.53
10.957	8.125	14234.2	1653.8	13000.2	1504.7	2.608	2.146	0.42	0.60	0.59	0.54
10.957	8.750	11678.1	1783.5	12408.1	1456.1	2.555	2.199	0.43	0.60	0.60	0.54
10.957	9.375	9759.2	1929.0	11883.6	1410.3	2.504	2.250	0.44	0.60	0.60	0.55
10.957	10.000	8280.6	2093.1	11415.0	1367.1	2.453	2.301	0.45	0.60	0.61	0.55
10.957	10.625	7116.4	2279.1	10992.8	1326.2	2.403	2.351	0.45	0.60	0.61	0.55
10.957	11.250	6182.9	2491.0	10609.9	1287.4	2.354	2.400	0.46	0.60	0.61	0.56
10.957	11.875	5422.7	2733.9	10260.5	1250.6	2.305	2.449	0.47	0.60	0.62	0.56
10.957	12.500	4795.1	3014.1	9940.0	1215.7	2.257	2.497	0.47	0.60	0.62	0.56
10.957	13.125	4270.9	3339.7	9644.5	1182.5	2.208	2.546	0.48	0.60	0.62	0.57
10.957	13.750	3828.6	3721.1	9370.8	1150.8	2.161	2.593	0.48	0.60	0.63	0.57
10.957	14.375	3451.7	4171.8	9116.4	1120.7	2.113	2.641	0.49	0.60	0.63	0.57
11.898	6.250	28404.4	1291.1	12328.8	1835.6	2.812	1.942	0.41	0.60	0.58	0.53
11.898	6.875	21302.5	1381.7	11623.2	1771.1	2.758	1.996	0.41	0.60	0.58	0.53
11.898	7.500	16603.2	1482.1	11022.7	1710.8	2.707	2.047	0.42	0.60	0.59	0.54
11.898	8.125	13321.7	1593.9	10503.9	1654.0	2.658	2.096	0.43	0.60	0.59	0.54
11.898	8.750	10934.7	1718.9	10050.3	1600.6	2.609	2.145	0.43	0.60	0.60	0.54
11.898	9.375	9141.8	1859.2	9649.2	1550.3	2.562	2.192	0.44	0.60	0.60	0.55

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11.898	10.000	7759.6	2017.3	9291.4	1502.8	2.515	2.239	0.45	0.60	0.61	0.55
11.898	10.625	6670.8	2196.6	8969.5	1457.8	2.469	2.285	0.45	0.60	0.61	0.55
11.898	11.250	5797.4	2400.8	8677.6	1415.2	2.424	2.330	0.46	0.60	0.61	0.56
11.898	11.875	5085.8	2634.9	8411.9	1374.8	2.379	2.375	0.46	0.60	0.62	0.56
11.898	12.500	4498.2	2905.0	8168.1	1336.4	2.334	2.420	0.47	0.60	0.62	0.56
11.898	13.125	4007.3	3218.8	7943.4	1299.9	2.290	2.464	0.47	0.60	0.62	0.57
11.898	13.750	3592.9	3586.4	7735.3	1265.1	2.246	2.508	0.48	0.60	0.63	0.57
11.898	14.375	3239.8	4020.8	7541.9	1231.9	2.202	2.552	0.48	0.60	0.63	0.57
12.840	6.250	26756.9	1129.0	10102.4	2027.3	2.842	1.912	0.41	0.61	0.58	0.53
12.840	6.875	20080.7	1208.2	9540.6	1956.1	2.792	1.962	0.41	0.61	0.58	0.53
12.840	7.500	15659.8	1296.1	9063.8	1889.4	2.745	2.009	0.42	0.61	0.59	0.54
12.840	8.125	12570.6	1393.9	8653.0	1826.8	2.699	2.055	0.43	0.61	0.59	0.54
12.840	8.750	10322.4	1503.2	8294.5	1767.3	2.654	2.100	0.43	0.61	0.60	0.55
12.840	9.375	8632.9	1625.8	7978.2	1712.2	2.610	2.144	0.44	0.61	0.60	0.55
12.840	10.000	7329.8	1764.1	7696.4	1659.7	2.567	2.187	0.44	0.61	0.61	0.55
12.840	10.625	6303.0	1920.9	7443.3	1610.1	2.525	2.229	0.45	0.61	0.61	0.56
12.840	11.250	5479.0	2099.5	7214.3	1563.0	2.483	2.271	0.46	0.61	0.61	0.56
12.840	11.875	4807.5	2304.2	7005.8	1518.4	2.441	2.313	0.46	0.61	0.62	0.56
12.840	12.500	4252.9	2540.4	6814.8	1475.9	2.399	2.355	0.47	0.61	0.62	0.56
12.840	13.125	3789.4	2814.8	6638.9	1435.6	2.358	2.396	0.47	0.61	0.62	0.57
12.840	13.750	3398.0	3136.3	6476.2	1397.2	2.317	2.437	0.48	0.61	0.63	0.57
12.840	14.375	3064.5	3516.1	6325.0	1360.6	2.277	2.477	0.48	0.61	0.63	0.57
13.781	6.250	25381.7	1088.3	8425.1	2250.6	2.867	1.887	0.41	0.61	0.58	0.53
13.781	6.875	19059.6	1164.6	7967.0	2171.7	2.821	1.933	0.42	0.61	0.58	0.54
13.781	7.500	14870.5	1249.3	7579.1	2097.6	2.777	1.977	0.42	0.61	0.59	0.54
13.781	8.125	11941.8	1343.6	7245.6	2028.1	2.734	2.020	0.43	0.61	0.59	0.54
13.781	8.750	9809.3	1448.9	6955.1	1962.6	2.693	2.061	0.43	0.61	0.60	0.55
13.781	9.375	8206.2	1567.1	6699.2	1900.9	2.652	2.102	0.44	0.61	0.60	0.55
13.781	10.000	6969.3	1700.5	6471.7	1842.6	2.612	2.142	0.44	0.61	0.61	0.55
13.781	10.625	5994.2	1851.5	6267.7	1787.5	2.572	2.182	0.45	0.61	0.61	0.56
13.781	11.250	5211.6	2023.7	6083.4	1735.2	2.533	2.221	0.45	0.61	0.61	0.56
13.781	11.875	4573.7	2221.0	5915.7	1685.7	2.494	2.260	0.46	0.61	0.62	0.56
13.781	12.500	4046.7	2448.7	5762.3	1638.6	2.455	2.299	0.46	0.61	0.62	0.56
13.781	13.125	3606.1	2713.2	5621.3	1593.8	2.417	2.337	0.47	0.61	0.62	0.57
13.781	13.750	3234.1	3023.1	5490.9	1551.1	2.379	2.375	0.47	0.61	0.63	0.57
13.781	14.375	2917.0	3389.2	5369.9	1510.5	2.341	2.413	0.48	0.61	0.63	0.57
14.723	6.250	24216.4	1050.0	7131.2	2513.1	2.889	1.865	0.42	0.62	0.58	0.54
14.723	6.875	18193.4	1123.7	6750.3	2424.9	2.846	1.908	0.42	0.62	0.58	0.54
14.723	7.500	14200.3	1205.4	6428.3	2342.2	2.805	1.949	0.42	0.62	0.59	0.54
14.723	8.125	11407.5	1296.4	6152.0	2264.6	2.765	1.989	0.43	0.62	0.59	0.55
14.723	8.750	9373.1	1398.0	5911.8	2191.5	2.726	2.028	0.43	0.62	0.60	0.55
14.723	9.375	7843.2	1512.1	5700.6	2122.5	2.687	2.067	0.44	0.62	0.60	0.55
14.723	10.000	6662.4	1640.7	5513.0	2057.5	2.650	2.104	0.44	0.62	0.61	0.55
14.723	10.625	5731.4	1786.5	5345.1	1995.9	2.613	2.141	0.45	0.62	0.61	0.56
14.723	11.250	4983.9	1952.6	5193.6	1937.6	2.576	2.178	0.45	0.62	0.61	0.56
14.723	11.875	4374.5	2143.0	5056.0	1882.2	2.540	2.214	0.46	0.62	0.62	0.56
14.723	12.500	3871.0	2362.7	4930.2	1829.7	2.504	2.250	0.46	0.62	0.62	0.57
14.723	13.125	3450.0	2617.9	4814.7	1779.6	2.468	2.286	0.47	0.62	0.62	0.57
14.723	13.750	3094.4	2916.9	4708.1	1732.0	2.432	2.322	0.47	0.62	0.63	0.57
14.723	14.375	2791.3	3270.1	4609.2	1686.6	2.397	2.357	0.48	0.62	0.63	0.57
15.664	6.250	23216.4	1014.1	6112.7	2824.2	2.908	1.846	0.42	0.62	0.58	0.54
15.664	6.875	17449.4	1085.3	5790.8	2725.1	2.867	1.887	0.42	0.62	0.58	0.54
15.664	7.500	13624.3	1164.2	5519.2	2632.2	2.829	1.925	0.43	0.62	0.59	0.54
15.664	8.125	10947.9	1252.0	5286.4	2544.9	2.791	1.963	0.43	0.62	0.59	0.55
15.664	8.750	8997.7	1350.2	5084.3	2462.3	2.755	1.999	0.43	0.62	0.60	0.55
15.664	9.375	7530.7	1460.3	4906.9	2385.4	2.719	2.035	0.44	0.62	0.60	0.55
15.664	10.000	6398.1	1584.6	4749.6	2312.2	2.683	2.071	0.44	0.62	0.61	0.56
15.664	10.625	5504.9	1725.4	4609.0	2243.0	2.648	2.106	0.45	0.62	0.61	0.56
15.664	11.250	4787.7	1885.8	4432.3	2177.5	2.614	2.140	0.45	0.62	0.61	0.56
15.664	11.875	4202.8	2069.7	4367.4	2115.3	2.580	2.174	0.46	0.62	0.62	0.56

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15.664	12.500	3719.4	2281.8	4262.5	2056.2	2.546	2.208	0.46	0.62	0.62	0.57
15.664	13.125	3315.3	2528.3	4166.2	2000.0	2.512	2.242	0.47	0.62	0.62	0.57
15.664	13.750	2973.8	2817.1	4077.4	1946.5	2.479	2.275	0.47	0.62	0.63	0.57
15.664	14.375	2682.8	3158.2	3995.2	1895.4	2.445	2.309	0.47	0.62	0.63	0.57
16.606	6.250	22348.9	980.3	5297.0	3197.0	2.924	1.830	0.42	0.62	0.58	0.54
16.606	6.875	16803.5	1049.0	5021.2	3084.8	2.886	1.868	0.43	0.62	0.58	0.54
16.606	7.500	13123.9	1125.3	4788.8	2979.6	2.850	1.904	0.43	0.62	0.59	0.55
16.606	8.125	10548.4	1210.2	4590.0	2880.8	2.814	1.940	0.43	0.62	0.59	0.55
16.606	8.750	8671.3	1305.1	4417.6	2787.9	2.780	1.974	0.44	0.62	0.60	0.55
16.606	9.375	7258.8	1411.6	4266.4	2700.2	2.746	2.008	0.44	0.62	0.60	0.55
16.606	10.000	6168.1	1531.7	4132.6	2617.4	2.713	2.041	0.44	0.62	0.61	0.56
16.606	10.625	5307.8	1667.8	4013.1	2539.1	2.680	2.074	0.45	0.62	0.61	0.56
16.606	11.250	4616.8	1822.9	3905.5	2464.9	2.647	2.107	0.45	0.62	0.61	0.56
16.606	11.875	4053.2	2000.6	3808.1	2394.5	2.615	2.139	0.46	0.62	0.62	0.57
16.606	12.500	3587.4	2205.7	3719.2	2327.6	2.583	2.171	0.46	0.62	0.62	0.57
16.606	13.125	3197.9	2444.0	3637.8	2264.0	2.551	2.203	0.46	0.62	0.62	0.57
16.606	13.750	2868.8	2723.1	3562.8	2203.4	2.520	2.234	0.47	0.62	0.63	0.57
16.606	14.375	2588.2	3052.9	3493.4	2145.6	2.488	2.266	0.47	0.62	0.63	0.57
17.547	6.250	21589.1	948.4	4633.7	3648.7	2.939	1.815	0.43	0.63	0.58	0.54
17.547	6.875	16237.3	1014.9	4394.7	3520.7	2.903	1.851	0.43	0.63	0.58	0.55
17.547	7.500	12685.1	1088.7	4193.6	3400.6	2.868	1.886	0.43	0.63	0.59	0.55
17.547	8.125	10198.0	1170.8	4021.7	3287.9	2.835	1.919	0.43	0.63	0.59	0.55
17.547	8.750	8384.8	1262.6	3872.8	3181.8	2.802	1.952	0.44	0.63	0.60	0.55
17.547	9.375	7020.0	1365.6	3742.5	3081.7	2.770	1.984	0.44	0.63	0.60	0.56
17.547	10.000	5966.1	1481.8	3627.2	2987.2	2.739	2.015	0.44	0.63	0.61	0.56
17.547	10.625	5134.6	1613.5	3524.3	2897.8	2.707	2.047	0.45	0.63	0.61	0.56
17.547	11.250	4466.6	1763.5	3431.9	2813.1	2.677	2.077	0.45	0.63	0.61	0.56
17.547	11.875	3921.8	1935.5	3348.2	2732.8	2.646	2.108	0.46	0.63	0.62	0.57
17.547	12.500	3471.4	2133.9	3272.0	2656.5	2.616	2.138	0.46	0.63	0.62	0.57
17.547	13.125	3094.7	2364.4	3202.2	2583.9	2.586	2.168	0.46	0.63	0.62	0.57
17.547	13.750	2776.4	2634.4	3138.0	2514.7	2.556	2.198	0.47	0.63	0.63	0.57
17.547	14.375	2505.0	2953.5	3078.7	2448.8	2.526	2.228	0.47	0.63	0.63	0.57
18.489	6.250	20918.2	918.2	4087.2	4203.4	2.952	1.802	0.43	0.63	0.58	0.55
18.489	6.875	15737.1	982.6	3878.1	4055.9	2.918	1.836	0.43	0.63	0.58	0.55
18.489	7.500	12297.2	1054.1	3702.3	3917.6	2.885	1.869	0.43	0.63	0.59	0.55
18.489	8.125	9888.0	1133.6	3552.1	3787.7	2.853	1.901	0.44	0.63	0.59	0.55
18.489	8.750	8131.3	1222.5	3422.3	3665.5	2.822	1.932	0.44	0.63	0.60	0.55
18.489	9.375	6808.8	1322.2	3308.6	3550.2	2.792	1.962	0.44	0.63	0.60	0.56
18.489	10.000	5787.3	1434.7	3208.2	3441.3	2.762	1.992	0.45	0.63	0.61	0.56
18.489	10.625	4981.2	1562.2	3118.8	3338.4	2.732	2.022	0.45	0.63	0.61	0.56
18.489	11.250	4333.7	1707.4	3038.4	3240.8	2.703	2.051	0.45	0.63	0.61	0.56
18.489	11.875	3805.4	1873.9	2965.8	3148.2	2.674	2.080	0.46	0.63	0.62	0.57
18.489	12.500	3368.6	2066.0	2899.7	3060.3	2.645	2.109	0.46	0.63	0.62	0.57
18.489	13.125	3003.3	2289.2	2839.2	2976.7	2.617	2.137	0.46	0.63	0.62	0.57
18.489	13.750	2694.6	2550.6	2783.6	2897.0	2.589	2.165	0.47	0.63	0.63	0.57
18.489	14.375	2431.3	2859.5	2732.3	2821.1	2.560	2.194	0.47	0.63	0.63	0.58

BY WS DATE 1/18 PROJECT BOX MAGAZINE TYPE A SHEET NO. 85 OF 343

CKD. BY ______ DATE ____ SUBJECT ROOF DESIGN

Consider Actual Geometry $r = 43 + \frac{31.5}{2} = 58.75 \text{ in}$

$$A = 22818 - \pi(58.75)^2/8 = 21463 \text{ in}^2$$

$$v_c = \frac{18.5(21463)}{(.85)\left(\frac{\pi(58.75)}{4}\right)(31.5)} = 321 \text{ psi} > 253 \text{ psi NG}$$

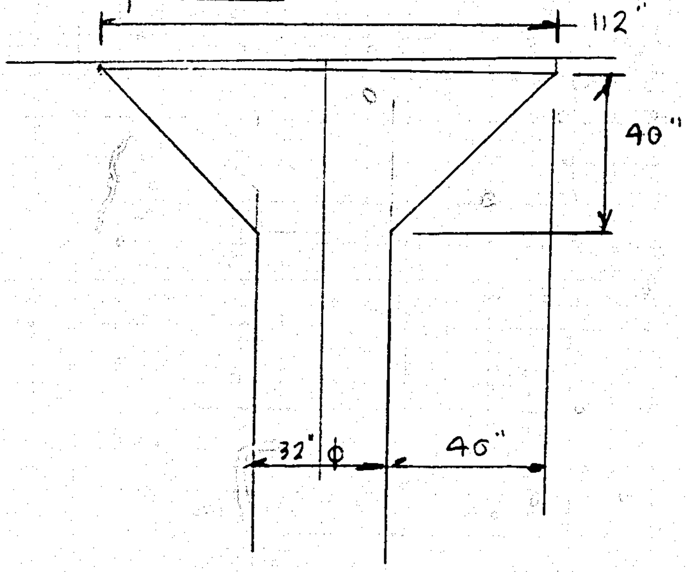
Increase radius of Column Capital to 56"

$$r = 56 + \frac{31.5}{2} = 71.25$$

$$A = 22818 - \pi\left(\frac{71.75}{8}\right)^2 = 20796 \text{ in}^2$$

$$v_c = \frac{18.5(20796)}{.85\left(\frac{\pi}{8}\right)(71.25)(31.5)} = 255 \text{ psi OK}$$

Final Configuration



BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 86 OF 343

CKD. BY ____ DATE ____ SUBJECT ROOF DESIGN

Compute r_4 for 112" φ Column Capital

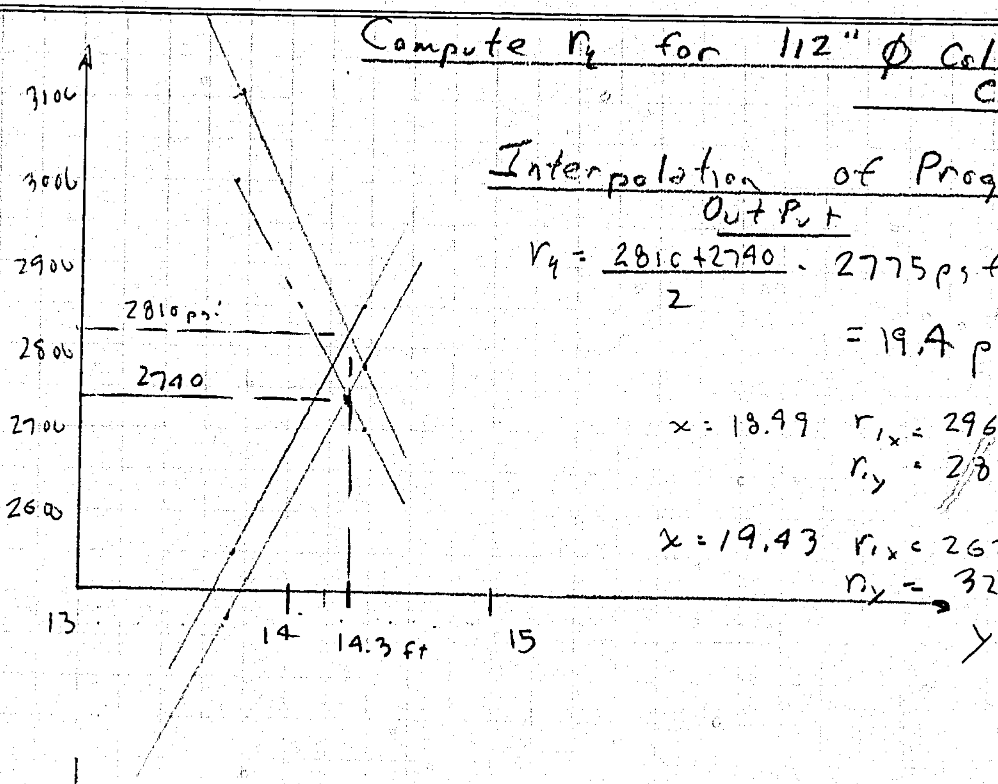
Interpolation of Program Output

$r_4 = \frac{2810+2740}{2} = 2775$ psf

$= 19.4$ psi

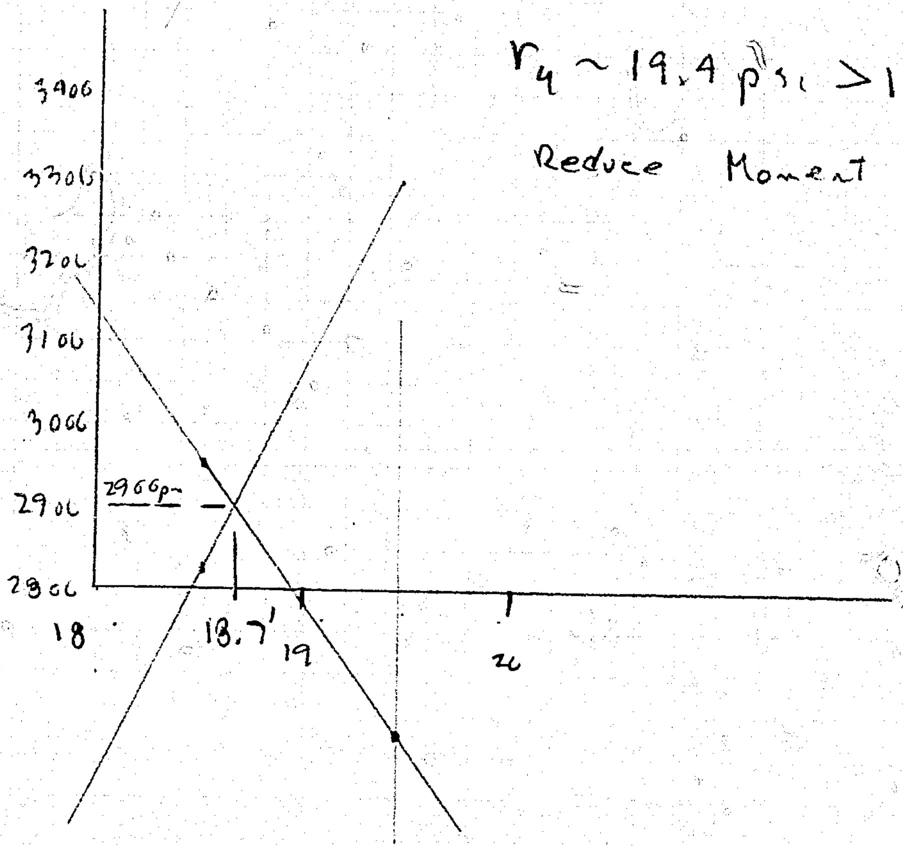
$x = 18.99$ $r_{1x} = 2960$
$r_y = 2830$

$x = 19.43$ $r_{1x} = 2620$
$r_y = 3295$



$r_4 \sim 19.4$ psi > 18.5 psi

Reduce Moment Capacity



Corner Panel w/ 112" φ Column Capital

```
          MNYC    0.21733E 06
          MNYM    0.48681E 05
          MNYWC   0.87863E 05
          MNYWM   0.87863E 05
          MNYWE   0.26617E 05
          MPYC    0.11066E 06
          MPYM    0.48681E 05
          MPYE    0.48681E 05
          MNXC    0.25800E 06
          MNXM    0.95999E 05
          MNXWC   0.30200E 05
          MNXWM   0.30200E 05
          MNXWE   0.30200E 05
          MPXC    0.19653E 06
          MPXM    0.13200E 06
          MPXE    0.13200E 06
     MOMENTS IN LBS-FT


          L1      0.25000E 02
          L2      0.31330E 02
          A       0.41400E 01
     DIMENSIONS IN FEET

          X          Y          R1Y         R2Y         R1X         R3X         XB         YB              EMF1 EMF2 EMF3 EMF
        (FT)       (FT)       (PSF)       (PSF)       (PSF)       (PSF)       (FT)       (FT)

        6.250      6.250   110686.4      1644.6   153386.5      1101.8      3.104      3.105           0.34 0.57 0.58 0.49
        6.250      6.875    74330.8      1760.0   129450.4      1063.1      2.932      3.277           0.36 0.57 0.58 0.50
        6.250      7.500    53565.5      1887.9   110141.5      1026.9      2.778      3.431           0.39 0.57 0.59 0.51
        6.250      8.125    40517.7      2030.4    94671.9       992.8      2.636      3.573           0.41 0.57 0.59 0.52
        6.250      8.750    31757.2      2189.6    82240.4       960.8      2.502      3.707           0.42 0.57 0.60 0.53
        6.250      9.375    25579.5      2368.2    72172.7       930.6      2.373      3.836           0.44 0.57 0.60 0.54
        6.250     10.000    21054.8      2569.7    63939.4       902.0      2.249      3.960           0.45 0.57 0.61 0.54
        6.250     10.625    17638.9      2798.0    57135.8       875.0      2.128      4.081           0.47 0.57 0.61 0.55
        6.250     11.250    14995.3      3058.2    51455.4       849.5      2.010      4.199           0.48 0.57 0.61 0.55
        6.250     11.875    12906.8      3356.4    46665.7       825.2      1.893      4.316           0.49 0.57 0.62 0.56
        6.250     12.500    11227.7      3700.4    42589.5       802.1      1.779      4.430           0.50 0.57 0.62 0.56
        6.250     13.125     9857.1      4100.2    39090.3       780.2      1.665      4.544           0.50 0.57 0.62 0.56
        6.250     13.750     8723.7      4568.4    36062.5       759.3      1.553      4.656           0.51 0.57 0.63 0.57
        6.250     14.375     7775.6      5121.7    33423.1       739.4      1.442      4.767           0.52 0.57 0.63 0.57
        6.250     15.000     6974.4      5781.9    31106.8       720.4      1.331      4.878           0.52 0.57 0.63 0.57
        6.250     15.625     6291.3      6578.5    29061.3       702.3      1.222      4.987           0.53 0.57 0.63 0.58
        7.191      6.250    86606.0      1573.5    84280.5      1189.4      3.324      2.885           0.34 0.57 0.58 0.50
        7.191      6.875    58786.9      1683.9    75050.7      1147.7      3.174      3.035           0.36 0.57 0.58 0.51
        7.191      7.500    42719.0      1806.4    67072.9      1108.5      3.039      3.170           0.38 0.57 0.59 0.51
        7.191      8.125    32529.7      1942.7    60229.4      1071.8      2.914      3.295           0.40 0.57 0.59 0.52
        7.191      8.750    25636.0      2095.0    54369.3      1037.2      2.796      3.413           0.41 0.57 0.60 0.53
        7.191      9.375    20743.4      2265.9    49343.0      1004.6      2.683      3.526           0.43 0.57 0.60 0.53
        7.191     10.000    17140.0      2458.7    45016.3       973.8      2.574      3.635           0.44 0.57 0.61 0.54
        7.191     10.625    14406.8      2677.1    41274.4       944.6      2.467      3.742           0.45 0.57 0.61 0.54
        7.191     11.250    12282.8      2926.0    38021.4       917.0      2.363      3.846           0.46 0.57 0.61 0.55
        7.191     11.875    10598.6      3211.4    35178.2       890.8      2.261      3.948           0.47 0.57 0.62 0.55
        7.191     12.500     9240.1      3540.5    32679.9       865.9      2.161      4.048           0.48 0.57 0.62 0.56
        7.191     13.125     8128.2      3923.0    30472.9       842.3      2.061      4.148           0.49 0.57 0.62 0.56
        7.191     13.750     7206.2      4371.0    28513.5       819.7      1.963      4.246           0.50 0.57 0.63 0.56
        7.191     14.375     6433.2      4900.4    26765.5       798.2      1.865      4.344           0.50 0.57 0.63 0.57
        7.191     15.000     5778.7      5532.1    25199.0       777.7      1.768      4.441           0.51 0.57 0.63 0.57
        7.191     15.625     5219.4      6294.3    23739.0       758.1      1.672      4.537           0.52 0.57 0.63 0.57
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8.133	6.250	72190.0	1508.1	52189.4	1287.9	3.466	2.743	0.35	0.58	0.58	0.50
8.133	6.875	49319.8	1613.9	47695.3	1242.7	3.335	2.874	0.36	0.58	0.58	0.51
8.133	7.500	36023.4	1731.3	43733.2	1200.4	3.217	2.992	0.38	0.58	0.59	0.51
8.133	8.125	27545.0	1861.9	40246.0	1160.6	3.106	3.103	0.39	0.58	0.59	0.52
8.133	8.750	21782.2	2007.9	37174.7	1123.1	3.001	3.208	0.41	0.58	0.60	0.53
8.133	9.375	17675.8	2171.7	34464.1	1087.8	2.901	3.308	0.42	0.58	0.60	0.53
8.133	10.000	14641.2	2356.4	32064.6	1054.4	2.803	3.406	0.43	0.58	0.61	0.54
8.133	10.625	12332.5	2565.8	29933.1	1022.9	2.709	3.500	0.44	0.58	0.61	0.54
8.133	11.250	10533.7	2804.4	28032.6	993.0	2.616	3.593	0.45	0.58	0.61	0.55
8.133	11.875	9104.1	3077.8	26331.6	964.6	2.526	3.683	0.46	0.58	0.62	0.55
8.133	12.500	7948.6	3393.3	24803.3	937.7	2.436	3.773	0.47	0.58	0.62	0.56
8.133	13.125	7001.0	3759.9	23425.0	912.0	2.348	3.861	0.48	0.58	0.62	0.56
8.133	13.750	6214.0	4189.3	22177.5	887.6	2.260	3.949	0.49	0.58	0.63	0.56
8.133	14.375	5553.2	4696.6	21044.4	864.4	2.174	4.035	0.49	0.58	0.63	0.57
8.133	15.000	4992.9	5302.1	20011.8	842.1	2.088	4.121	0.50	0.58	0.63	0.57
9.074	6.250	62592.7	1447.7	35202.6	1399.2	3.566	2.643	0.36	0.59	0.58	0.51
9.074	6.875	42948.8	1549.2	32625.1	1350.1	3.450	2.759	0.37	0.59	0.58	0.51
9.074	7.500	31478.6	1661.9	30349.4	1304.1	3.345	2.864	0.38	0.59	0.59	0.52
9.074	8.125	24137.9	1787.2	28332.7	1260.8	3.246	2.963	0.39	0.59	0.59	0.52
9.074	8.750	19132.8	1927.4	26538.4	1220.1	3.152	3.057	0.40	0.59	0.60	0.53
9.074	9.375	15556.7	2084.6	24935.3	1181.8	3.062	3.147	0.41	0.59	0.60	0.53
9.074	10.000	12907.8	2262.0	23497.2	1145.5	2.974	3.235	0.42	0.59	0.61	0.54
9.074	10.625	10888.4	2463.0	22201.9	1111.2	2.889	3.320	0.44	0.59	0.61	0.54
9.074	11.250	9312.2	2692.0	21030.7	1078.8	2.806	3.403	0.44	0.59	0.61	0.55
9.074	11.875	8057.5	2954.5	19967.8	1048.0	2.725	3.484	0.45	0.59	0.62	0.55
9.074	12.500	7041.9	3257.3	18999.8	1018.7	2.644	3.565	0.46	0.59	0.62	0.56
9.074	13.125	6208.0	3609.2	18115.3	990.8	2.565	3.644	0.47	0.59	0.62	0.56
9.074	13.750	5514.6	4021.4	17304.4	964.3	2.486	3.723	0.48	0.59	0.63	0.56
9.074	14.375	4931.8	4508.4	16558.8	939.0	2.408	3.801	0.48	0.59	0.63	0.57
9.074	15.000	4437.1	5089.5	15871.4	914.9	2.331	3.878	0.49	0.59	0.63	0.57
10.015	6.250	55744.0	1391.6	25250.4	1525.5	3.640	2.569	0.36	0.59	0.58	0.51
10.015	6.875	38368.4	1489.3	23596.7	1472.0	3.537	2.672	0.37	0.59	0.58	0.52
10.015	7.500	28191.7	1597.5	22143.5	1421.8	3.441	2.768	0.38	0.59	0.59	0.52
10.015	8.125	21661.8	1718.1	20356.7	1374.7	3.352	2.857	0.39	0.59	0.59	0.52
10.015	8.750	17199.5	1852.8	19709.7	1330.3	3.267	2.942	0.40	0.59	0.60	0.53
10.015	9.375	14005.0	2004.0	18680.9	1288.5	3.186	3.023	0.41	0.59	0.60	0.53
10.015	10.000	11634.8	2174.5	17753.1	1249.0	3.106	3.103	0.42	0.59	0.61	0.54
10.015	10.625	9825.2	2367.7	16912.3	1211.5	3.029	3.180	0.43	0.59	0.61	0.54
10.015	11.250	8410.8	2587.8	16146.9	1176.2	2.954	3.255	0.44	0.59	0.61	0.55
10.015	11.875	7283.7	2840.1	15447.1	1142.6	2.880	3.329	0.45	0.59	0.62	0.55
10.015	12.500	6370.4	3131.2	14805.1	1110.7	2.807	3.402	0.46	0.59	0.62	0.56
10.015	13.125	5619.7	3469.5	14213.9	1080.3	2.735	3.474	0.46	0.59	0.62	0.56
10.015	13.750	4995.1	3865.7	13667.7	1051.4	2.664	3.545	0.47	0.59	0.63	0.56
10.015	14.375	4469.6	4333.9	13161.7	1023.8	2.593	3.616	0.48	0.59	0.63	0.57
10.015	15.000	4023.2	4892.6	12691.6	997.5	2.523	3.686	0.48	0.59	0.63	0.57
10.957	6.250	50611.0	1339.6	18957.5	1669.8	3.698	2.511	0.37	0.60	0.58	0.52
10.957	6.875	34916.8	1433.6	17809.7	1611.2	3.604	2.605	0.38	0.60	0.58	0.52
10.957	7.500	25703.9	1537.8	16807.4	1556.3	3.517	2.692	0.38	0.60	0.59	0.52
10.957	8.125	19780.9	1653.8	15923.3	1504.7	3.436	2.773	0.39	0.60	0.59	0.53
10.957	8.750	15726.5	1783.5	15136.4	1456.1	3.358	2.851	0.40	0.60	0.60	0.53
10.957	9.375	12819.3	1929.0	14430.8	1410.3	3.284	2.925	0.41	0.60	0.60	0.54
10.957	10.000	10660.3	2093.1	13793.8	1367.1	3.212	2.997	0.42	0.60	0.61	0.54
10.957	10.625	9009.7	2279.1	13215.4	1326.2	3.141	3.068	0.43	0.60	0.61	0.54
10.957	11.250	7718.4	2491.0	12687.4	1287.4	3.072	3.137	0.44	0.60	0.61	0.55
10.957	11.875	6688.3	2733.9	12203.1	1250.6	3.005	3.204	0.44	0.60	0.62	0.55
10.957	12.500	5853.0	3014.1	11757.2	1215.7	2.938	3.271	0.45	0.60	0.62	0.56
10.957	13.125	5166.0	3339.7	11345.0	1182.5	2.872	3.337	0.46	0.60	0.62	0.56
10.957	13.750	4593.9	3721.1	10962.5	1150.8	2.807	3.402	0.46	0.60	0.63	0.56
10.957	14.375	4112.3	4171.8	10606.7	1120.7	2.742	3.467	0.47	0.60	0.63	0.57
11.898	6.250	46620.8	1291.1	14739.2	1835.6	3.743	2.466	0.38	0.60	0.58	0.52

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11.898	6.875	32222.4	1381.7	13696.2	1771.1	3.657	2.552	0.38	0.60	0.58	0.52
11.898	7.500	23755.4	1482.1	13164.5	1710.8	3.578	2.631	0.39	0.60	0.59	0.53
11.898	8.125	18303.7	1593.9	12521.9	1654.0	3.504	2.705	0.39	0.60	0.59	0.53
11.898	8.750	14566.9	1718.9	11951.8	1600.6	3.432	2.777	0.40	0.60	0.60	0.53
11.898	9.375	11884.9	1859.2	11441.6	1550.3	3.364	2.845	0.41	0.60	0.60	0.54
11.898	10.000	9890.4	2017.3	10981.4	1502.8	3.297	2.912	0.42	0.60	0.61	0.54
11.898	10.625	8364.4	2196.6	10563.6	1457.8	3.233	2.976	0.43	0.60	0.61	0.55
11.898	11.250	7169.7	2400.8	10182.2	1415.2	3.169	3.040	0.43	0.60	0.61	0.55
11.898	11.875	6216.0	2634.9	9832.0	1374.8	3.107	3.102	0.44	0.60	0.62	0.55
11.898	12.500	5442.2	2905.0	9509.2	1336.4	3.045	3.164	0.45	0.60	0.62	0.56
11.898	13.125	4805.3	3218.8	9210.2	1299.9	2.985	3.224	0.45	0.60	0.62	0.56
11.898	13.750	4274.8	3586.4	8932.4	1265.1	2.925	3.284	0.46	0.60	0.63	0.56
11.898	14.375	3827.9	4020.8	8673.2	1231.9	2.865	3.344	0.47	0.60	0.63	0.57
12.840	6.250	43430.0	1129.0	11779.5	2027.3	3.780	2.429	0.38	0.61	0.58	0.52
12.840	6.875	30060.8	1208.2	11133.6	1956.1	3.701	2.508	0.39	0.61	0.58	0.53
12.840	7.500	22188.0	1296.1	10576.1	1889.4	3.628	2.581	0.39	0.61	0.59	0.53
12.840	8.125	17112.8	1393.9	10088.6	1826.8	3.559	2.650	0.40	0.61	0.59	0.53
12.840	8.750	13630.4	1503.2	9657.5	1767.8	3.494	2.715	0.40	0.61	0.60	0.54
12.840	9.375	11128.6	1625.8	9272.7	1712.2	3.430	2.779	0.41	0.61	0.60	0.54
12.840	10.000	9266.6	1764.1	8926.3	1659.7	3.369	2.840	0.42	0.61	0.61	0.54
12.840	10.625	7841.1	1920.9	8612.3	1610.1	3.309	2.900	0.42	0.61	0.61	0.55
12.840	11.250	6724.3	2099.5	8325.8	1563.0	3.250	2.959	0.43	0.61	0.61	0.55
12.840	11.875	5832.3	2304.2	8063.0	1518.4	3.192	3.017	0.44	0.61	0.62	0.55
12.840	12.500	5108.1	2540.4	7820.7	1475.9	3.135	3.074	0.44	0.61	0.62	0.56
12.840	13.125	4511.8	2814.8	7596.2	1435.6	3.079	3.130	0.45	0.61	0.62	0.56
12.840	13.750	4014.9	3136.3	7387.5	1397.2	3.023	3.186	0.46	0.61	0.63	0.56
12.840	14.375	3595.2	3516.1	7192.7	1360.6	2.968	3.241	0.46	0.61	0.63	0.57
12.840	15.000	3240.1	3969.4	7010.3	1325.6	2.913	3.296	0.47	0.61	0.63	0.57
13.781	6.250	40820.2	1088.3	9625.5	2250.6	3.811	2.398	0.39	0.61	0.58	0.53
13.781	6.875	28288.1	1164.6	9114.4	2171.7	3.738	2.471	0.39	0.61	0.58	0.53
13.781	7.500	20899.9	1249.3	8675.2	2097.6	3.670	2.539	0.40	0.61	0.59	0.53
13.781	8.125	16132.3	1343.6	8292.7	2028.1	3.606	2.603	0.40	0.61	0.59	0.53
13.781	8.750	12858.1	1448.9	7955.6	1962.6	3.545	2.664	0.41	0.61	0.60	0.54
13.781	9.375	10504.2	1567.1	7655.5	1900.9	3.486	2.723	0.41	0.61	0.60	0.54
13.781	10.000	8751.1	1700.5	7386.0	1842.6	3.429	2.780	0.42	0.61	0.61	0.54
13.781	10.625	7408.1	1851.5	7142.1	1787.5	3.373	2.836	0.42	0.61	0.61	0.55
13.781	11.250	6355.4	2023.7	6919.9	1735.2	3.318	2.891	0.43	0.61	0.61	0.55
13.781	11.875	5514.2	2221.0	6716.3	1685.7	3.264	2.945	0.44	0.61	0.62	0.55
13.781	12.500	4831.0	2448.7	6528.7	1638.6	3.211	2.998	0.44	0.61	0.62	0.56
13.781	13.125	4268.3	2713.2	6355.1	1593.8	3.159	3.050	0.45	0.61	0.62	0.56
13.781	13.750	3799.1	3023.1	6193.7	1551.1	3.107	3.102	0.45	0.61	0.63	0.56
13.781	14.375	3403.7	3389.2	6043.1	1510.5	3.056	3.153	0.46	0.61	0.63	0.57
13.781	15.000	3067.3	3826.1	5902.1	1471.7	3.005	3.204	0.46	0.61	0.63	0.57
14.723	6.250	38646.0	1050.0	8010.4	2513.1	3.836	2.373	0.39	0.62	0.58	0.53
14.723	6.875	26308.0	1123.7	7595.4	2424.9	3.769	2.440	0.40	0.62	0.58	0.53
14.723	7.500	19822.4	1205.4	7240.3	2342.2	3.706	2.503	0.40	0.62	0.59	0.53
14.723	8.125	15310.9	1296.4	6932.0	2264.6	3.646	2.563	0.40	0.62	0.59	0.54
14.723	8.750	12210.5	1398.0	6661.2	2191.5	3.589	2.620	0.41	0.62	0.60	0.54
14.723	9.375	9980.0	1512.1	6420.7	2122.5	3.534	2.675	0.41	0.62	0.60	0.54
14.723	10.000	8317.9	1640.7	6205.2	2057.5	3.480	2.729	0.42	0.62	0.61	0.55
14.723	10.625	7044.0	1786.5	6010.6	1995.9	3.428	2.781	0.42	0.62	0.61	0.55
14.723	11.250	6045.0	1952.6	5833.7	1937.6	3.377	2.832	0.43	0.62	0.61	0.55
14.723	11.875	5246.4	2143.0	5671.8	1882.2	3.327	2.882	0.44	0.62	0.62	0.56
14.723	12.500	4597.6	2362.7	5522.8	1829.7	3.277	2.932	0.44	0.62	0.62	0.56
14.723	13.125	4063.0	2617.9	5385.0	1779.6	3.228	2.981	0.45	0.62	0.62	0.56
14.723	13.750	3617.1	2916.9	5257.0	1732.0	3.179	3.030	0.45	0.62	0.63	0.56
14.723	14.375	3241.2	3270.1	5137.7	1686.6	3.131	3.078	0.46	0.62	0.63	0.57
15.664	6.250	36806.7	1014.1	6768.9	2824.2	3.859	2.350	0.40	0.62	0.58	0.53
15.664	6.875	25553.6	1085.3	6425.0	2725.1	3.795	2.414	0.40	0.62	0.58	0.53
15.664	7.500	18907.9	1164.2	6131.7	2632.2	3.736	2.473	0.40	0.62	0.59	0.54

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15.664	8.125	14612.9	1252.0	5877.8	2544.9	3.680	2.529	0.41	0.62	0.59	0.54
15.664	8.750	11659.5	1350.2	5655.4	2462.8	3.627	2.582	0.41	0.62	0.60	0.54
15.664	9.375	9533.6	1460.3	5458.3	2385.4	3.575	2.634	0.42	0.62	0.60	0.55
15.664	10.000	7948.7	1584.6	5282.2	2312.2	3.525	2.684	0.42	0.62	0.61	0.55
15.664	10.625	6733.5	1725.4	5123.4	2243.0	3.476	2.733	0.43	0.62	0.61	0.55
15.664	11.250	5780.1	1885.8	4979.3	2177.5	3.428	2.781	0.43	0.62	0.61	0.55
15.664	11.875	5017.7	2069.7	4847.6	2115.3	3.380	2.829	0.44	0.62	0.62	0.56
15.664	12.500	4398.1	2281.8	4726.6	2056.2	3.334	2.875	0.44	0.62	0.62	0.56
15.664	13.125	3387.5	2528.3	4614.9	2000.0	3.288	2.921	0.45	0.62	0.62	0.56
15.664	13.750	3461.5	2817.1	4511.3	1946.5	3.242	2.967	0.45	0.62	0.63	0.56
15.664	14.375	3102.3	3158.2	4414.7	1895.4	3.197	3.012	0.46	0.62	0.63	0.57
16.606	6.250	35230.5	980.3	5794.3	3197.0	3.878	2.331	0.40	0.62	0.58	0.53
16.606	6.875	24477.0	1049.0	5504.5	3084.8	3.818	2.391	0.40	0.62	0.58	0.54
16.606	7.500	18122.0	1125.3	5258.0	2979.6	3.763	2.446	0.41	0.62	0.59	0.54
16.606	8.125	14012.4	1210.2	5045.2	2880.8	3.710	2.499	0.41	0.62	0.59	0.54
16.606	8.750	11185.0	1305.1	4859.2	2787.9	3.660	2.549	0.41	0.62	0.60	0.54
16.606	9.375	9148.9	1411.6	4694.7	2700.2	3.611	2.598	0.42	0.62	0.60	0.55
16.606	10.000	7630.3	1531.7	4548.0	2617.4	3.564	2.645	0.42	0.62	0.61	0.55
16.606	10.625	6465.5	1667.8	4416.1	2539.1	3.517	2.692	0.43	0.62	0.61	0.55
16.606	11.250	5551.4	1822.9	4296.5	2464.9	3.472	2.737	0.43	0.62	0.61	0.56
16.606	11.875	4820.2	2000.6	4187.4	2394.5	3.427	2.782	0.44	0.62	0.62	0.56
16.606	12.500	4225.8	2205.7	4087.3	2327.6	3.383	2.826	0.44	0.62	0.62	0.56
16.606	13.125	3735.8	2444.0	3995.0	2264.0	3.340	2.869	0.44	0.62	0.62	0.56
16.606	13.750	3327.0	2723.1	3909.4	2203.4	3.297	2.912	0.45	0.62	0.63	0.57
16.606	14.375	2982.2	3052.9	3829.8	2145.6	3.254	2.955	0.45	0.62	0.63	0.57
17.547	6.250	33864.6	948.4	5015.5	3648.7	3.394	2.315	0.41	0.63	0.53	0.54
17.547	6.875	23542.8	1014.9	4767.8	3520.7	3.838	2.371	0.41	0.63	0.58	0.54
17.547	7.500	17439.3	1088.7	4557.6	3400.6	3.786	2.423	0.41	0.63	0.59	0.54
17.547	8.125	13490.3	1170.8	4376.6	3287.9	3.736	2.473	0.41	0.63	0.59	0.54
17.547	8.750	10772.1	1262.6	4218.6	3181.8	3.689	2.520	0.42	0.63	0.60	0.55
17.547	9.375	8814.0	1365.6	4079.3	3081.7	3.643	2.566	0.42	0.63	0.60	0.55
17.547	10.000	7352.9	1481.8	3955.2	2987.2	3.598	2.611	0.42	0.63	0.61	0.55
17.547	10.625	6232.0	1613.5	3843.7	2897.8	3.554	2.655	0.43	0.63	0.61	0.55
17.547	11.250	5352.0	1763.5	3742.9	2813.1	3.511	2.698	0.43	0.63	0.61	0.56
17.547	11.875	4648.0	1935.5	3651.1	2732.8	3.469	2.740	0.44	0.63	0.62	0.56
17.547	12.500	4075.5	2133.9	3566.9	2656.5	3.427	2.782	0.44	0.63	0.62	0.56
17.547	13.125	3603.5	2364.4	3489.4	2583.9	3.386	2.823	0.44	0.63	0.62	0.56
17.547	13.750	3209.5	2634.4	3417.7	2514.7	3.346	2.863	0.45	0.63	0.63	0.57
17.547	14.375	2877.3	2953.5	3351.0	2448.8	3.305	2.904	0.45	0.63	0.63	0.57
18.489	6.250	32669.7	918.2	4383.5	4203.4	3.909	2.300	0.41	0.63	0.58	0.54
18.489	6.875	22724.5	982.6	4169.2	4055.9	3.856	2.353	0.41	0.63	0.53	0.54
18.489	7.500	16840.7	1054.1	3987.8	3917.6	3.806	2.403	0.41	0.63	0.59	0.54
18.489	8.125	13032.2	1133.6	3831.8	3787.7	3.759	2.450	0.41	0.63	0.59	0.55
18.489	8.750	10409.6	1222.5	3695.9	3665.5	3.714	2.495	0.42	0.63	0.60	0.55
18.489	9.375	8519.7	1322.2	3576.3	3550.2	3.671	2.538	0.42	0.63	0.60	0.55
18.489	10.000	7109.1	1434.7	3469.9	3441.3	3.628	2.581	0.42	0.63	0.61	0.55
18.489	10.625	6026.6	1562.2	3374.6	3338.4	3.587	2.622	0.43	0.63	0.61	0.56
18.489	11.250	5176.6	1707.4	3288.4	3240.3	3.546	2.663	0.43	0.63	0.61	0.56
18.489	11.875	4496.3	1873.9	3210.0	3148.2	3.506	2.703	0.44	0.63	0.62	0.56
18.489	12.500	3943.1	2066.0	3138.3	3060.3	3.467	2.742	0.44	0.63	0.62	0.56
18.489	13.125	3486.9	2289.2	3072.3	2976.7	3.428	2.781	0.44	0.63	0.62	0.57
18.489	13.750	3106.1	2550.6	3011.3	2897.0	3.389	2.820	0.45	0.63	0.63	0.57
18.489	14.375	2784.8	2859.5	2954.7	2821.1	3.351	2.858	0.45	0.63	0.63	0.57
19.430	6.250	31615.5	889.7	3863.6	4894.9	3.922	2.287	0.42	0.63	0.58	0.54
19.430	6.875	22001.9	952.1	3676.4	47[illegible]3.1	3.872	2.337	0.41	0.63	0.58	0.54
19.430	7.500	16311.7	1021.3	3518.1	4562.1	3.825	2.384	0.42	0.63	0.59	0.55
19.430	8.125	12627.0	1098.3	3382.2	4410.9	3.780	2.429	0.42	0.63	0.59	0.55
19.430	8.750	10088.8	1184.5	3264.1	4268.5	3.737	2.472	0.42	0.63	0.60	0.55
19.430	9.375	8259.1	1281.1	3160.2	4134.3	3.696	2.513	0.42	0.63	0.60	0.55
19.430	10.000	6893.1	1390.1	3068.0	4007.5	3.655	2.554	0.43	0.63	0.61	0.55

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19.430   10.625   5844.5   1513.6   2985.4   3887.6   3.616   2.593   0.43 0.63 0.61 0.56
19.430   11.250   5021.0   1654.4   2910.9   3773.9   3.577   2.632   0.43 0.63 0.61 0.56
19.430   11.875   4361.9   1815.7   2843.2   3666.2   3.539   2.670   0.44 0.63 0.62 0.56
19.430   12.500   3825.7   2001.8   2781.4   3563.8   3.502   2.707   0.44 0.63 0.62 0.56
19.430   13.125   3383.4   2218.0   2724.6   3466.4   3.465   2.744   0.44 0.63 0.62 0.57
19.430   13.750   3014.2   2471.3   2672.1   3373.6   3.428   2.781   0.45 0.63 0.63 0.57
19.430   14.375   2702.7   2770.7   2623.4   3285.2   3.391   2.818   0.45 0.63 0.63 0.57
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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 92 OF 343
CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

Reduce Interior Neg + Pos Moments by

$(1 - 18.5/19.4)100 = 5\%$ thereby maintaining $v_u \sim 18.5$ psi

Final Design Moments

x-direction Corner Panel

$(M_-)_{cs} = \frac{.95(21.6\times10^6)}{75} = 259200$ #-in/in

$(M_-)_{cs}/d^2 = \frac{259200}{(31.5)^2} = 261$ $\rho \sim .0063$

$A_s = .0063(31.5)(12)$

$= 2.4$ in²/ft

$(M_-)_{ms} = \frac{.95(14.4\times10^6)}{150} = 91200$ #/in/in

$(M_-)_{ms}/d^2 = \frac{91200}{(19.5)^2} = 239.8$ $\rho \sim .0055$

$A_s = .0055(12)(19.5) = 1.3$ in²/ft

$(M_+)_{cs} = \frac{.95(13.4\times10^6)}{75} = 169733$ #-in/in

$(M_+)_{cs}/d^2 = \frac{169733}{(20.8)^2} = 392$ $\rho \sim .0095$

$A_s = .0095(20.8)(12) = 2.4$ in²/ft

$(M_+)_{ms} = \frac{.95(18\times10^6)}{150} = 114000$ #-in/in

$(M_+)_{ms}/d^2 = \frac{114000}{(20.8)^2} = 263.5$ $\rho \sim .006$ $A_s = 1.5$ in²/ft

Interior Bay

$\frac{(M_+)_{cs}}{d^2} = \frac{.95(10.1 \times 10^6)}{75 \times (20.8)^2} = 296$ $\rho = .007$

$A_s = .007(20.8)(12) - 1.79 \text{ in}^2/\text{ft}$

$\frac{(M_+)_{ms}}{d^2} = \frac{.95(6.7 \times 10^6)}{75 \times (20.8)^2} \doteq 196$ $\rho \sim .0045$

$A_s = .0045(20.8)(12) =$

$\underline{1.12 \text{ in}^2/\text{ft}}$

Y - Direction

Corner Panel

$(M_-)_{cs} = 206460 \text{ \#-in/in}$ $(M_-/d)^2 = \frac{206460}{(30.5)^2} = 222$ $\rho = .0055$

$A_s = .0055(12)(30.5)$

$= \underline{2 \text{ in}^2/\text{ft}}$

$(M_-)_{ms} = 46240 \text{ \#-in/in}$ $(M_-)/d^2 = \frac{46240}{(19.5)^2} = 121.6$

$\rho = .0027$

$A_s = .0027(12)(19.5) - .63 \text{ in}^2/\text{ft}$

$(M_+)_{cs} = 105000 \text{ \#-in/in}$ $\frac{(M_+)_{cs}}{d^2} = \frac{105000}{(20.8)^2} = 243$ $\rho = .0055$

$A_s = .0055(20.8)(12)$

$= \underline{1.37 \text{ in}^2/\text{ft}}$

$(M_+)_{ms} = 46246 \text{ \#-in/in}$ $(M_+)/d^2 = \frac{46246}{(20.8)^2} = \underline{106.9}$

$A_s = .0025 \times 12 \times 20.8 = .62 \text{ in}^2$ $\rho \sim .0025$

Corner Panel w/112" ⌀ Column Capital
& Moment capacities reduced by 5 %

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        MNYC     0.20646E 06
        MNYM     0.46246E 05
        MNYWC    0.87863E 05
        MNYWM    0.87863E 05
        MNYWE    0.26617E 05
        MPYC     0.10513E 06
        MPYM     0.46246E 05
        MPYE     0.46246E 05
        MNXC     0.24510E 06
        MNXM     0.91999E 05
        MNXWC    0.30200E 05
        MNXWM    0.30200E 05
        MNXWE    0.30200E 05
        MPXC     0.18670E 06
        MPXM     0.12450E 06
        MPXE     0.12450E 06

MOMENTS IN LBS-FT


        L1       0.25000E 02
        L2       0.31330E 02
        A        0.41400E 01
DIMENSIONS IN FEET

      X          Y         R1Y         R2Y        R1X        R3X        XB         YB       EMF1 EMF2 EMF3 EMF
    (FT)       (FT)       (PSF)       (PSF)      (PSF)      (PSF)      (FT)       (FT)

    6.250      6.250    105151.7     1608.1   145715.0    1051.9     3.104      3.105      0.34 0.57 0.58 0.49
    6.250      6.875     70614.0     1720.9   122973.4    1015.0     2.932      3.277      0.36 0.57 0.58 0.50
    6.250      7.500     50887.1     1846.0   104628.6     980.4     2.778      3.431      0.39 0.57 0.59 0.51
    6.250      8.125     38491.7     1985.3    89931.7     947.9     2.636      3.573      0.41 0.57 0.59 0.52
    6.250      8.750     30169.2     2141.0    78121.4     917.3     2.502      3.707      0.42 0.57 0.60 0.53
    6.250      9.375     24300.5     2315.7    68556.9     888.4     2.373      3.836      0.44 0.57 0.60 0.54
    6.250     10.000     20002.0     2512.7    60735.3     861.2     2.249      3.960      0.45 0.57 0.61 0.54
    6.250     10.625     16756.9     2735.9    54271.9     835.4     2.128      4.081      0.47 0.57 0.61 0.55
    6.250     11.250     14245.5     2990.3    48875.7     811.0     2.010      4.199      0.48 0.57 0.61 0.55
    6.250     11.875     12261.5     3281.9    44325.6     787.8     1.893      4.316      0.49 0.57 0.62 0.56
    6.250     12.500     10666.2     3618.3    40453.4     765.8     1.779      4.430      0.50 0.57 0.62 0.56
    6.250     13.125      9364.2     4009.2    37129.3     744.9     1.665      4.544      0.50 0.57 0.62 0.56
    6.250     13.750      8287.5     4467.0    34253.1     725.0     1.553      4.656      0.51 0.57 0.63 0.57
    6.250     14.375      7386.8     5008.0    31745.9     706.0     1.442      4.767      0.52 0.57 0.63 0.57
    6.250     15.000      6625.7     5653.6    29545.6     687.8     1.331      4.878      0.52 0.57 0.63 0.57
    6.250     15.625      5976.7     6432.5    27602.5     670.5     1.222      4.987      0.53 0.57 0.63 0.58
    7.191      6.250     82275.4     1538.6    80065.3    1135.5     3.324      2.885      0.34 0.57 0.58 0.50
    7.191      6.875     55847.3     1646.6    71295.6    1095.7     3.174      3.035      0.36 0.57 0.58 0.51
    7.191      7.500     40582.9     1766.3    63715.7    1058.3     3.039      3.170      0.38 0.57 0.59 0.51
    7.191      8.125     30903.1     1899.6    57213.8    1023.2     2.914      3.295      0.40 0.57 0.59 0.52
    7.191      8.750     24354.1     2048.5    51646.2     990.2     2.796      3.413      0.41 0.57 0.60 0.53
    7.191      9.375     19706.1     2215.7    46870.9     959.1     2.683      3.526      0.43 0.57 0.60 0.53
    7.191     10.000     16283.0     2404.2    42760.4     929.7     2.574      3.635      0.44 0.57 0.61 0.54
    7.191     10.625     13686.4     2617.8    39205.5     901.9     2.467      3.742      0.45 0.57 0.61 0.54
    7.191     11.250     11668.6     2861.2    36115.2     875.5     2.363      3.846      0.46 0.57 0.61 0.55
    7.191     11.875     10068.6     3140.1    33414.2     850.5     2.261      3.948      0.47 0.57 0.62 0.55
    7.191     12.500      8778.1     3462.0    31040.8     826.7     2.161      4.048      0.48 0.57 0.62 0.56
    7.191     13.125      7721.7     3836.0    28944.2     804.1     2.061      4.148      0.49 0.57 0.62 0.56
    7.191     13.750      6845.9     4274.1    27082.9     782.6     1.963      4.246      0.50 0.57 0.63 0.56
    7.191     14.375      6111.6     4791.7    25422.4     762.1     1.865      4.344      0.50 0.57 0.63 0.57
    7.191     15.000      5489.7     5409.4    23934.3     742.5     1.768      4.441      0.51 0.57 0.63 0.57
    7.191     15.625      4958.4     6154.7    22594.9     723.8     1.672      4.537      0.52 0.57 0.63 0.57
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8.133	6.250	68580.2	1474.7	49579.2	1229.6	3.466	2.743	0.35	0.58	0.58	0.50
8.133	6.875	46853.6	1578.2	45308.9	1185.4	3.335	2.874	0.36	0.58	0.58	0.51
8.133	7.500	34222.0	1692.9	41544.2	1146.0	3.217	2.992	0.38	0.58	0.59	0.51
8.133	8.125	26167.7	1820.6	38230.9	1108.0	3.106	3.103	0.39	0.58	0.59	0.52
8.133	8.750	20693.0	1963.4	35312.8	1072.2	3.001	3.208	0.41	0.58	0.60	0.53
8.133	9.375	16791.9	2123.6	32737.5	1038.5	2.901	3.308	0.42	0.58	0.60	0.53
8.133	10.000	13909.1	2304.2	30457.8	1006.7	2.803	3.406	0.43	0.58	0.61	0.54
8.133	10.625	11715.8	2509.0	28432.7	976.5	2.709	3.500	0.44	0.58	0.61	0.54
8.133	11.250	10007.0	2742.2	26627.2	948.0	2.616	3.593	0.45	0.58	0.61	0.55
8.133	11.875	8648.8	3009.6	25011.2	920.9	2.526	3.683	0.46	0.58	0.62	0.55
8.133	12.500	7551.1	3318.1	23559.2	895.2	2.436	3.773	0.47	0.58	0.62	0.56
8.133	13.125	6650.9	3676.6	22249.9	870.8	2.348	3.861	0.48	0.58	0.62	0.56
8.133	13.750	5903.3	4096.5	21064.8	847.5	2.260	3.949	0.49	0.58	0.63	0.56
8.133	14.375	5275.5	4592.6	19988.4	825.2	2.174	4.035	0.49	0.58	0.63	0.57
8.133	15.000	4743.2	5184.6	19007.4	804.0	2.088	4.121	0.50	0.58	0.63	0.57
9.074	6.250	59462.7	1415.6	33441.9	1335.8	3.566	2.643	0.36	0.59	0.58	0.51
9.074	6.875	40801.1	1514.9	30992.7	1288.9	3.450	2.759	0.37	0.59	0.58	0.51
9.074	7.500	29904.5	1625.1	28830.3	1245.0	3.345	2.864	0.38	0.59	0.59	0.52
9.074	8.125	22930.9	1747.7	26914.1	1203.7	3.246	2.963	0.39	0.59	0.59	0.52
9.074	8.750	18176.0	1884.7	25209.2	1164.9	3.152	3.057	0.40	0.59	0.60	0.53
9.074	9.375	14778.8	2038.5	23686.0	1123.2	3.062	3.147	0.41	0.59	0.60	0.53
9.074	10.000	12262.3	2211.9	22319.7	1093.6	2.974	3.235	0.42	0.59	0.61	0.54
9.074	10.625	10343.9	2408.5	21089.0	1060.9	2.889	3.320	0.44	0.59	0.61	0.54
9.074	11.250	8846.5	2632.4	19976.3	1029.9	2.806	3.403	0.44	0.59	0.61	0.55
9.074	11.875	7654.6	2889.1	18966.5	1000.5	2.725	3.484	0.45	0.59	0.62	0.55
9.074	12.500	6689.8	3185.2	18046.9	972.6	2.644	3.565	0.46	0.59	0.62	0.56
9.074	13.125	5897.5	3529.3	17206.5	946.0	2.565	3.644	0.47	0.59	0.62	0.56
9.074	13.750	5238.9	3932.3	16436.2	920.7	2.486	3.723	0.48	0.59	0.63	0.56
9.074	14.375	4685.2	4408.6	15727.9	896.5	2.408	3.801	0.48	0.59	0.63	0.57
9.074	15.000	4215.2	4976.9	15074.8	873.5	2.331	3.878	0.49	0.59	0.63	0.57
10.015	6.250	52956.4	1360.9	23987.6	1456.4	3.640	2.569	0.36	0.59	0.58	0.51
10.015	6.875	36449.7	1456.3	22416.0	1405.3	3.537	2.672	0.37	0.59	0.58	0.52
10.015	7.500	26781.9	1562.2	21035.1	1357.4	3.441	2.768	0.38	0.59	0.59	0.52
10.015	8.125	20578.6	1680.1	19812.4	1312.4	3.352	2.857	0.39	0.59	0.59	0.52
10.015	8.750	16339.4	1811.8	18722.5	1270.1	3.267	2.942	0.40	0.59	0.60	0.53
10.015	9.375	13304.7	1959.7	17745.0	1230.1	3.186	3.023	0.41	0.59	0.60	0.53
10.015	10.000	11053.0	2126.4	16863.5	1192.4	3.106	3.103	0.42	0.59	0.61	0.54
10.015	10.625	9333.9	2315.3	16064.6	1156.7	3.029	3.180	0.43	0.59	0.61	0.54
10.015	11.250	7990.3	2530.6	15337.3	1122.9	2.954	3.255	0.44	0.59	0.61	0.55
10.015	11.875	6919.5	2777.3	14672.5	1090.9	2.880	3.329	0.45	0.59	0.62	0.55
10.015	12.500	6051.8	3062.0	14062.5	1060.4	2.807	3.402	0.46	0.59	0.62	0.56
10.015	13.125	5338.7	3392.8	13500.8	1031.4	2.735	3.474	0.46	0.59	0.62	0.56
10.015	13.750	4745.3	3780.3	12982.0	1003.8	2.664	3.545	0.47	0.59	0.63	0.56
10.015	14.375	4246.1	4238.1	12501.3	977.5	2.593	3.616	0.48	0.59	0.63	0.57
10.015	15.000	3822.1	4784.4	12054.7	952.4	2.523	3.686	0.48	0.59	0.63	0.57
10.957	6.250	48080.1	1310.0	18009.3	1594.2	3.698	2.511	0.37	0.60	0.58	0.52
10.957	6.875	33170.7	1401.9	16918.6	1538.2	3.604	2.605	0.38	0.60	0.58	0.52
10.957	7.500	24418.5	1503.8	15966.2	1485.8	3.517	2.692	0.38	0.60	0.59	0.52
10.957	8.125	18791.8	1617.3	15126.0	1436.5	3.436	2.773	0.39	0.60	0.59	0.53
10.957	8.750	14940.1	1744.1	14378.3	1390.2	3.358	2.851	0.40	0.60	0.60	0.53
10.957	9.375	12178.7	1886.4	13707.8	1346.5	3.284	2.925	0.41	0.60	0.60	0.54
10.957	10.000	10127.2	2046.9	13102.6	1305.2	3.212	2.997	0.42	0.60	0.61	0.54
10.957	10.625	8559.2	2228.7	12553.0	1266.1	3.141	3.068	0.43	0.60	0.61	0.54
10.957	11.250	7332.4	2436.0	12051.3	1229.1	3.072	3.137	0.44	0.60	0.61	0.55
10.957	11.875	6353.8	2673.5	11591.2	1194.0	3.005	3.204	0.44	0.60	0.62	0.55
10.957	12.500	5560.3	2947.5	11167.5	1160.7	2.938	3.271	0.45	0.60	0.62	0.56
10.957	13.125	4907.6	3266.0	10775.8	1129.0	2.872	3.337	0.46	0.60	0.62	0.56
10.957	13.750	4364.2	3638.9	10412.5	1098.7	2.807	3.402	0.46	0.60	0.63	0.56
10.957	14.375	3906.7	4079.7	10074.4	1069.9	2.742	3.467	0.47	0.60	0.63	0.57
11.898	6.250	44289.5	1262.6	14002.0	1752.4	3.743	2.466	0.38	0.60	0.58	0.52

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11.898	6.875	30611.1	1351.2	13200.9	1690.9	3.657	2.552	0.38	0.60	0.58	0.52
11.898	7.500	22567.5	1449.4	12505.6	1633.3	3.578	2.631	0.39	0.60	0.59	0.53
11.898	8.125	17388.4	1558.8	11895.0	1579.1	3.504	2.705	0.39	0.60	0.59	0.53
11.898	8.750	13838.5	1681.0	11353.2	1528.2	3.432	2.777	0.40	0.60	0.60	0.53
11.898	9.375	11290.6	1818.1	10868.4	1480.1	3.364	2.845	0.41	0.60	0.60	0.54
11.898	10.000	9395.8	1972.8	10431.1	1434.7	3.297	2.912	0.42	0.60	0.61	0.54
11.898	10.625	7946.2	2148.1	10034.1	1391.8	3.233	2.976	0.43	0.60	0.61	0.55
11.898	11.250	6811.2	2347.8	9671.7	1351.1	3.169	3.040	0.43	0.60	0.61	0.55
11.898	11.875	5905.2	2576.8	9339.0	1312.5	3.107	3.102	0.44	0.60	0.62	0.55
11.898	12.500	5170.0	2840.9	9032.2	1275.9	3.045	3.164	0.45	0.60	0.62	0.56
11.898	13.125	4565.0	3147.8	8748.2	1241.0	2.985	3.224	0.45	0.60	0.62	0.56
11.898	13.750	4061.0	3507.3	8484.2	1207.3	2.925	3.284	0.46	0.60	0.63	0.56
11.898	14.375	3636.5	3932.0	8233.0	1176.1	2.865	3.344	0.47	0.60	0.63	0.57
12.840	6.250	41258.2	1107.4	11190.4	1935.4	3.780	2.429	0.38	0.61	0.58	0.52
12.840	6.875	28557.5	1185.1	10576.5	1867.5	3.701	2.508	0.39	0.61	0.58	0.53
12.840	7.500	21078.5	1271.2	10046.7	1803.8	3.628	2.581	0.39	0.61	0.59	0.53
12.840	8.125	16257.0	1367.1	9583.4	1744.0	3.559	2.650	0.40	0.61	0.59	0.53
12.840	8.750	12948.8	1474.3	9173.8	1687.8	3.494	2.715	0.40	0.61	0.60	0.54
12.840	9.375	10572.1	1594.6	8808.1	1634.7	3.430	2.779	0.41	0.61	0.60	0.54
12.840	10.000	8803.2	1730.3	8479.0	1584.6	3.369	2.840	0.42	0.61	0.61	0.54
12.840	10.625	7449.0	1884.0	8160.6	1537.1	3.309	2.900	0.42	0.61	0.61	0.55
12.840	11.250	6388.0	2059.2	7908.4	1492.2	3.250	2.959	0.43	0.61	0.61	0.55
12.840	11.875	5540.6	2260.0	7658.7	1449.6	3.192	3.017	0.44	0.61	0.62	0.55
12.840	12.500	4852.6	2491.6	7423.4	1409.1	3.135	3.074	0.44	0.61	0.62	0.56
12.840	13.125	4286.2	2760.8	7215.1	1370.6	3.079	3.130	0.45	0.61	0.62	0.56
12.840	13.750	3814.1	3076.1	7016.8	1333.9	3.023	3.186	0.46	0.61	0.63	0.56
12.840	14.375	3416.3	3448.6	6831.8	1299.0	2.968	3.241	0.46	0.61	0.63	0.57
13.781	6.250	38778.9	1067.4	9144.1	2148.7	3.811	2.398	0.39	0.61	0.58	0.53
13.781	6.875	26873.5	1142.3	8658.3	2073.3	3.738	2.471	0.39	0.61	0.58	0.53
13.781	7.500	19854.7	1225.3	8241.0	2002.6	3.670	2.539	0.40	0.61	0.59	0.53
13.781	8.125	15325.5	1317.8	7877.5	1936.2	3.606	2.603	0.40	0.61	0.59	0.53
13.781	8.750	12215.1	1421.1	7557.1	1873.7	3.545	2.664	0.41	0.61	0.60	0.54
13.781	9.375	9979.0	1537.0	7271.9	1814.8	3.486	2.723	0.41	0.61	0.60	0.54
13.781	10.000	8313.5	1667.8	7015.8	1759.2	3.429	2.780	0.42	0.61	0.61	0.54
13.781	10.625	7037.7	1816.0	6784.1	1706.5	3.373	2.836	0.42	0.61	0.61	0.55
13.781	11.250	6037.6	1984.8	6573.0	1656.7	3.318	2.891	0.43	0.61	0.61	0.55
13.781	11.875	5238.5	2178.4	6379.5	1609.3	3.264	2.945	0.44	0.61	0.62	0.55
13.781	12.500	4589.4	2401.7	6201.3	1564.4	3.211	2.998	0.44	0.61	0.62	0.56
13.781	13.125	4054.8	2661.1	6036.3	1521.6	3.159	3.050	0.45	0.61	0.62	0.56
13.781	13.750	3609.1	2965.0	5883.0	1480.9	3.107	3.102	0.45	0.61	0.63	0.56
13.781	14.375	3233.5	3324.1	5739.9	1442.1	3.056	3.153	0.46	0.61	0.63	0.57
14.723	6.250	36713.4	1029.9	7609.8	2399.2	3.836	2.373	0.39	0.62	0.58	0.53
14.723	6.875	25467.4	1102.1	7215.4	2315.0	3.769	2.440	0.40	0.62	0.58	0.53
14.723	7.500	18831.2	1182.3	6877.9	2236.1	3.706	2.503	0.40	0.62	0.59	0.53
14.723	8.125	14545.3	1271.5	6584.9	2162.0	3.646	2.563	0.40	0.62	0.59	0.54
14.723	8.750	11599.9	1371.2	6327.6	2092.2	3.589	2.620	0.41	0.62	0.60	0.54
14.723	9.375	9480.9	1483.0	6099.0	2026.4	3.534	2.675	0.41	0.62	0.60	0.54
14.723	10.000	7901.9	1609.2	5894.3	1964.3	3.480	2.729	0.42	0.62	0.61	0.55
14.723	10.625	6691.7	1752.2	5709.4	1905.5	3.428	2.781	0.42	0.62	0.61	0.55
14.723	11.250	5742.7	1915.1	5541.2	1849.8	3.377	2.832	0.43	0.62	0.61	0.55
14.723	11.875	4984.0	2101.8	5387.3	1797.0	3.327	2.882	0.44	0.62	0.62	0.56
14.723	12.500	4367.6	2317.3	5245.8	1746.8	3.277	2.932	0.44	0.62	0.62	0.56
14.723	13.125	3859.8	2567.6	5114.8	1699.1	3.228	2.981	0.45	0.62	0.62	0.56
14.723	13.750	3436.2	2860.9	4993.3	1653.6	3.179	3.030	0.45	0.62	0.63	0.56
14.723	14.375	3079.2	3207.3	4879.9	1610.3	3.131	3.078	0.46	0.62	0.63	0.57
15.664	6.250	34966.1	994.6	6430.3	2695.3	3.859	2.350	0.40	0.62	0.58	0.53
15.664	6.875	24275.7	1064.4	6103.5	2601.7	3.795	2.414	0.40	0.62	0.58	0.53
15.664	7.500	17962.4	1141.8	5824.8	2513.0	3.736	2.473	0.40	0.62	0.59	0.54
15.664	8.125	13882.2	1227.9	5583.5	2429.7	3.680	2.529	0.41	0.62	0.59	0.54
15.664	8.750	11076.4	1324.2	5372.1	2351.3	3.627	2.582	0.41	0.62	0.60	0.54

15.664	9.375	9056.8	1432.3	5184.9	2277.3	3.575	2.634	0.42	0.62	0.60	0.55
15.664	10.000	7551.2	1554.1	5017.5	2207.5	3.525	2.684	0.42	0.62	0.61	0.55
15.664	10.625	6396.7	1692.2	4866.6	2141.5	3.476	2.733	0.43	0.62	0.61	0.55
15.664	11.250	5491.0	1849.6	4729.7	2078.9	3.428	2.781	0.43	0.62	0.61	0.55
15.664	11.875	4766.8	2029.9	4604.5	2019.5	3.380	2.829	0.44	0.62	0.62	0.56
15.664	12.500	4178.2	2238.0	4489.6	1963.1	3.334	2.875	0.44	0.62	0.62	0.56
15.664	13.125	3693.1	2479.8	4383.4	1909.5	3.288	2.921	0.45	0.62	0.62	0.56
15.664	13.750	3288.4	2762.9	4284.9	1858.4	3.242	2.967	0.45	0.62	0.63	0.56
15.664	14.375	2947.2	3097.6	4193.1	1809.7	3.197	3.012	0.46	0.62	0.63	0.57
16.606	6.250	33468.6	961.4	5504.5	3052.2	3.878	2.331	0.40	0.62	0.58	0.53
16.606	6.875	23252.9	1028.9	5229.1	2945.1	3.818	2.391	0.40	0.62	0.58	0.54
16.606	7.500	17215.7	1103.7	4994.8	2844.7	3.763	2.446	0.41	0.62	0.59	0.54
16.606	8.125	13311.7	1187.0	4792.6	2750.4	3.710	2.499	0.41	0.62	0.59	0.54
16.606	8.750	10625.6	1280.0	4615.8	2661.6	3.660	2.549	0.41	0.62	0.60	0.54
16.606	9.375	8691.4	1384.5	4459.5	2577.9	3.611	2.598	0.42	0.62	0.60	0.55
16.606	10.000	7248.7	1502.3	4320.1	2498.9	3.564	2.645	0.42	0.62	0.61	0.55
16.606	10.625	6142.2	1635.7	4194.7	2424.1	3.517	2.692	0.43	0.62	0.61	0.55
16.606	11.250	5273.8	1787.8	4081.1	2353.3	3.472	2.737	0.43	0.62	0.61	0.56
16.606	11.875	4579.2	1962.2	3977.4	2286.0	3.427	2.782	0.44	0.62	0.62	0.56
16.606	12.500	4014.5	2163.3	3882.3	2222.2	3.383	2.826	0.44	0.62	0.62	0.56
16.606	13.125	3549.0	2397.0	3794.6	2161.5	3.340	2.869	0.44	0.62	0.62	0.56
16.606	13.750	3160.6	2670.7	3713.3	2103.6	3.297	2.912	0.45	0.62	0.63	0.57
16.606	14.375	2833.1	2994.2	3637.6	2048.5	3.254	2.955	0.45	0.62	0.63	0.57
17.547	6.250	32171.1	930.1	4764.7	3483.4	3.894	2.315	0.41	0.63	0.58	0.54
17.547	6.875	22365.4	995.4	4529.3	3361.2	3.838	2.371	0.41	0.63	0.58	0.54
17.547	7.500	16567.2	1067.8	4329.5	3246.6	3.786	2.423	0.41	0.63	0.59	0.54
17.547	8.125	12815.7	1148.3	4157.4	3139.0	3.736	2.473	0.41	0.63	0.59	0.54
17.547	8.750	10233.4	1238.3	4007.3	3037.7	3.689	2.520	0.42	0.63	0.60	0.55
17.547	9.375	8373.2	1339.4	3874.9	2942.1	3.643	2.566	0.42	0.63	0.60	0.55
17.547	10.000	6985.2	1453.3	3757.0	2851.9	3.598	2.611	0.42	0.63	0.61	0.55
17.547	10.625	5920.3	1582.5	3651.1	2766.6	3.554	2.655	0.43	0.63	0.61	0.55
17.547	11.250	5084.3	1729.6	3555.2	2685.8	3.511	2.698	0.43	0.63	0.61	0.56
17.547	11.875	4415.5	1898.3	3468.0	2609.1	3.469	2.740	0.44	0.63	0.62	0.56
17.547	12.500	3871.7	2092.8	3388.0	2536.2	3.427	2.782	0.44	0.63	0.62	0.56
17.547	13.125	3423.2	2318.9	3314.4	2466.9	3.386	2.823	0.44	0.63	0.62	0.56
17.547	13.750	3049.0	2583.8	3246.2	2400.9	3.346	2.863	0.45	0.63	0.63	0.57
17.547	14.375	2733.4	2896.7	3182.8	2337.9	3.305	2.904	0.45	0.63	0.63	0.57
18.489	6.250	31035.9	900.5	4164.2	4013.0	3.909	2.300	0.41	0.63	0.58	0.54
18.489	6.875	21588.1	963.7	3960.6	3872.2	3.856	2.353	0.41	0.63	0.58	0.54
18.489	7.500	15993.5	1033.8	3783.2	3740.2	3.806	2.403	0.41	0.63	0.59	0.54
18.489	8.125	12380.5	1111.8	3639.9	3616.2	3.759	2.450	0.41	0.63	0.59	0.55
18.489	8.750	9889.1	1199.0	3510.8	3499.5	3.714	2.495	0.42	0.63	0.60	0.55
18.489	9.375	8093.6	1296.8	3397.1	3389.4	3.671	2.538	0.42	0.63	0.60	0.55
18.489	10.000	6753.6	1407.1	3296.1	3285.5	3.628	2.581	0.42	0.63	0.61	0.55
18.489	10.625	5725.2	1532.1	3205.4	3187.2	3.587	2.622	0.43	0.63	0.61	0.56
18.489	11.250	4917.7	1674.6	3123.5	3094.1	3.546	2.663	0.43	0.63	0.61	0.56
18.489	11.875	4271.5	1837.9	3049.0	3005.7	3.506	2.703	0.44	0.63	0.62	0.56
18.489	12.500	3745.9	2026.3	2930.9	2921.8	3.467	2.742	0.44	0.63	0.62	0.56
18.489	13.125	3312.5	2245.2	2918.2	2841.9	3.428	2.781	0.44	0.63	0.62	0.57
18.489	13.750	2950.7	2501.6	2860.2	2765.9	3.389	2.820	0.45	0.63	0.63	0.57
18.489	14.375	2645.5	2804.6	2806.4	2693.4	3.351	2.858	0.45	0.63	0.63	0.57
19.430	6.250	30034.4	872.5	3670.3	4673.2	3.922	2.287	0.42	0.63	0.58	0.54
19.430	6.875	20901.6	933.8	3492.4	4509.2	3.872	2.337	0.41	0.63	0.58	0.54
19.430	7.500	15495.9	1001.7	3342.0	4355.5	3.825	2.384	0.42	0.63	0.59	0.55
19.430	8.125	11995.5	1077.2	3212.9	4211.1	3.780	2.429	0.42	0.63	0.59	0.55
19.430	8.750	9584.3	1161.7	3100.6	4075.2	3.737	2.472	0.42	0.63	0.60	0.55
19.430	9.375	7846.1	1256.5	3001.9	3947.0	3.696	2.513	0.42	0.63	0.60	0.55
19.430	10.000	6548.4	1363.4	2914.3	3826.0	3.655	2.554	0.43	0.63	0.61	0.55
19.430	10.625	5552.3	1484.5	2835.8	3711.5	3.616	2.593	0.43	0.63	0.61	0.56
19.430	11.250	4769.9	1622.5	2765.0	3603.1	3.577	2.632	0.43	0.63	0.61	0.56

19.430	11.375	4143.7	1730.8	2700.7	3500.2	3.539	2.670	0.44	0.63	0.62	0.56
19.430	12.500	3634.4	1963.3	2641.9	3402.4	3.502	2.707	0.44	0.63	0.62	0.56
19.430	13.125	3214.2	2175.4	2587.9	3307.4	3.465	2.744	0.44	0.63	0.62	0.57
19.430	13.750	2863.5	2423.8	2538.0	3221.9	3.428	2.781	0.45	0.63	0.63	0.57
19.430	14.375	2567.6	2717.4	2491.8	3136.5	3.391	2.818	0.45	0.63	0.63	0.57

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343

BLANK FRAME

FOR

PROPER PAGINATION

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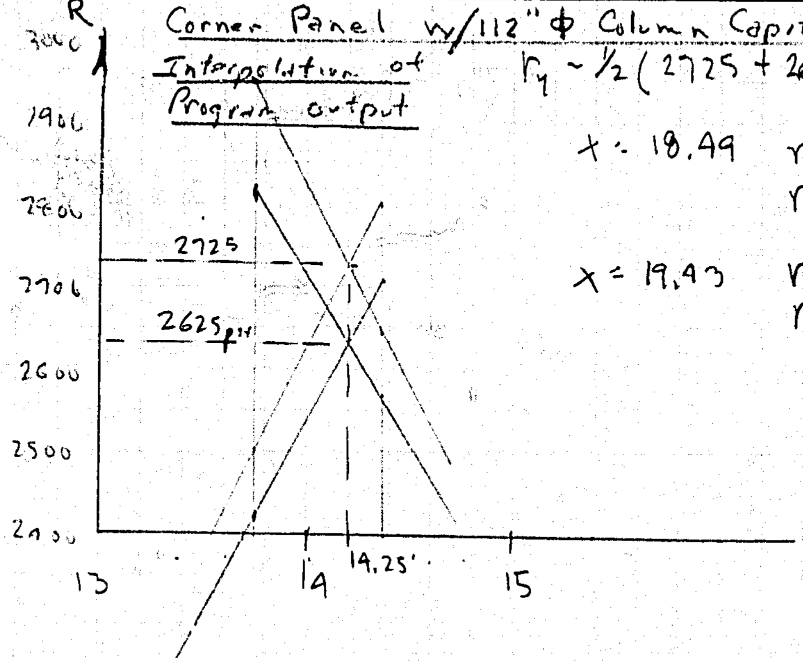
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 99 OF 343

CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

Corner Panel w/112" Φ Column Capital & Reduced Capacities

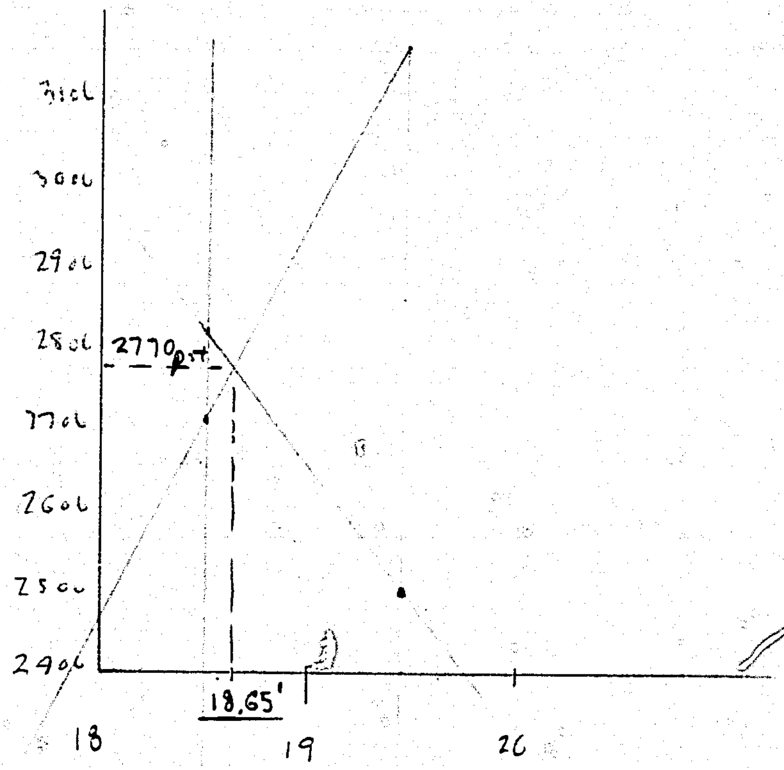
Interpolation of Program output

$r_y \sim 1/2 (2725 + 2625) = 2675\,psf \sim 18.6\,psi$ OK



$x = 18.49$ $r_{1x} = 2816\,psf$
$r_{1y} = 2707\,psf$

$x = 19.43$ $r_{1x} = 2506\,psf$
$r_{1y} = 3152\,psf$



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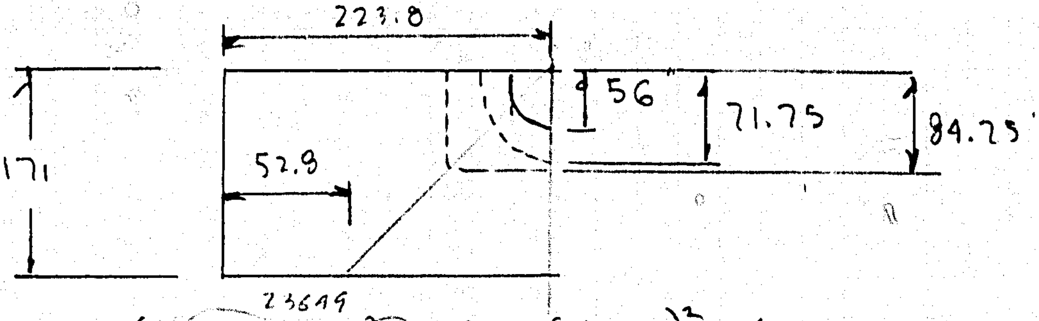
Interior Panel w/ 112" ¢ Column Capital / Reduced Moments

```
MN    0.17412E 07
MP    0.11071E 07
MNW   0.13920E 07
L1    0.25000E 02
L2    0.32000E 02
A     0.41400E 01
D     0.16250E 01
DR    0.62500E 01
TDR   0.26250E 01

MOMENTS IN LBS-FT AND LENGTHS IN FT

   Y        RI        RII        XBAR       YBAR        EMF         VA         VB        SHA        SHB        SHAP       SHBP
  (FT)     (PSF)     (PSF)       (FT)       (FT)                   (LBS)      (LBS)      (PSI)      (PSI)      (PSI)      (PSI)

 14.50    2838.57   2838.49      3.20       3.00        0.60 ~~274459.25 335857.50    291.05      35.45     322.32     131.64~~
```

BY WS DATE 1/75 PROJECT Box Magazine Type A SHEET NO. 101 OF 343

CKD. BY ____ DATE ____ SUBJECT Roof Design

Final Check of Drop Panel in Corner



$$A = \overset{23649}{\left(\frac{223.8+52.8}{2}\right)}(171) - (71.75)^2 \pi/8 = 21627 \text{ in}^2$$

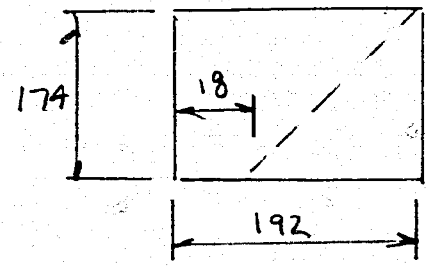
$$N_c = \frac{18.6(21627)}{(.85)(31.5)\left(\frac{\pi(71.75)}{4}\right)} = \underline{266 \text{ psi say OK}}$$

Check Slab

$$N_c = \frac{\left(23649-(84.75)^2/2\right)(18.6)}{.85(84.75)(19.5)} = \underline{265 \text{ psi say ok}}$$

Final Check of Drop Panel-Ext Panel

$r_4 = 19.7$ psi $y = 14.5$ ft $= 174$ in



$$A = 174\left(\frac{192+18}{2}\right) - \frac{\pi(71.75)^2}{8} = 16248 \text{ in}^2$$

$$N_c = \frac{19.7(16248)}{.85(31.5)\left(\frac{\pi(71.75)}{4}\right)} = \underline{212 \text{ psi OK}}$$

Slab ok by inspection

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 102 OF 343

CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

Check Deflections - Final

Corner Panel

$r_q = 18.6$ psi   Column Cap - 112" ∅ = 99" Equiv Sq.

$$K_e = \frac{26.81(AB - a^2)EI}{(1-\mu^2)A^4}$$

$A = 31'-4"$

$B = 25'$

$a = 4.14' (49.6")$

$\mu \sim .15$

$I = 6606 \text{ in}^4$

$$K_e = \frac{26.81\left(\overbrace{(376)(300) - (49.6)^2}^{110339}\right)(3.83\times10^6)(6606)}{(1-(.15)^2)(376)^4}$$

$$= \underline{3.83\times10^6 \text{ \#/in}}$$

$$x_e = \frac{18.6(110339)}{3.83\times10^6} = .535 \text{ in}$$

$T_n = 77$ ms (page 41)

$$\left.\begin{aligned} B/r &= \frac{150}{18.6-3.1} = 9.67 \\ t_d/T &= 12.4/77 = .161 \end{aligned}\right\} \mu = 12.2$$

$$x_{DL} = \frac{3.1}{18.6}(.535) = .089 \text{ in} \qquad x_e' = .535 - .089 = \underline{.446 \text{ in}}$$

$$x_m = .089 + 12.2(.446) = 5.53 \text{ in}$$

$$\theta = \tan^{-1}\left(\frac{5.53}{10.75\times12}\right) = \underline{2.4° \text{ say OK}}$$

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BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET NO. 103 OF 3A3

CKD. BY ____ DATE ____ SUBJECT Roof Design

Exterior Panel

$r_1 = 19.7 \text{ psi}$

$$K_E = \frac{25.97\left(AB - 2a^2\right) EI}{\left(1-\mu^2\right) A^4}$$

$A = 32'$
$B = 25'$
$a = 4.14'$

$$K_E = \frac{25.97\left(\overbrace{(384)(300) - 2(49.7)^2}^{110259}\right)\left(3.83\times 10^6 \times 6600\right)}{\left(1-(.15)^2\right)\left(384\right)^4}$$

$$= 3.41 \times 10^6 \text{ \#/in}$$

$X_E = 19.7(110259)/3.41\times10^6 = .637 \text{ in}$

$X_{DL} = \frac{3.1}{19.7}(.637) = .1 \text{ in}$

$T_n \sim 83 \text{ ms}$ (page 10)

$$\left.\begin{array}{l} B/r = \dfrac{150}{(19.7-3.1)} = 9.04 \\ t_d/T \sim .199 \text{ (page 10)} \end{array}\right\} \mu = 9.3$$

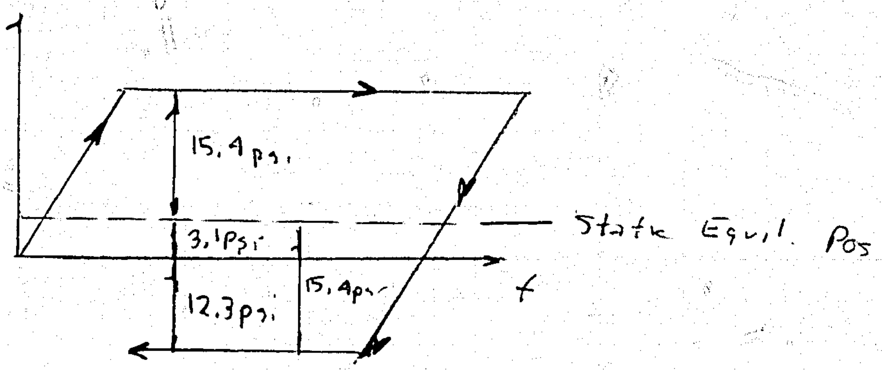
$X_m = .1 + 9.3(.637 - .1) = 5.09 \text{ in}$ $y = 14.5'$

$\theta = \tan^{-1}\left(\frac{5.09}{10.5\times12}\right) = \underline{2.3° \text{ say OK}}$

Roof Rebound Design

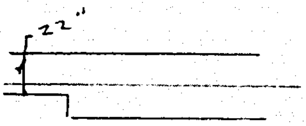
Wgt. of slab & cover = 3.1 psi

Corner Panel $r_u = 18.5$ psi   100% Rebound



12.3/18.5 = .66

Moments Reqd
X-direction   Corner Panel



$(M_-)_{cs}$ .66(259 k-in) = 172.2 k-in

$d \sim 22 - .75 - 1.375/2 = 20.6$ in

$M/d^2 = 406$ $\rho \sim .0695$ $(A_s^-)_{cs} = .0695(20.6)(12) = 2.3$ in²/ft

$(M_-)_{ms} = .66(91.2) = 60.1$ k-in $d \sim 22 - .75 - .5 = 20.75$

$M/d^2 = 139.6$ $\rho = .0033$ $(A_s^-) = .0033(20.75)(12) = .82$ in²/ft

$(M_+)_{cs} = 169.7 \times .66 = 112$ k-in

$d \sim 22 - 2 - .68 = 19.32$

$M/d^2 = (112/(19.32)^2) \times 10^3 = 300$ $\rho = .007$

$(A_s^+)_{cs} = .007(19.3)(12) = 1.62$ in²/ft

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BY WS DATE 1/78 PROJECT FOX MAGAZINE TYPE A SHEET NO. 105 OF 343
CKD. BY ____ DATE ____ SUBJECT ROOF DESIGN

$(M_+)_{ms} = 114 \times .66 = 75.2$ k-in $d \sim 19.3$

$\frac{M}{d^2} = \frac{75200}{(19.3)^2} = 202$ $\rho \sim .0046$

$(A_s^+)_{ms} = (.0046)(19.3)(12) = \underline{1.07 \text{ in}^2/\text{ft}}$

<u>Interior Panel</u>

$(M_+)_{cs} = .66(128) = \underline{84.4 \text{ k-in}}$

$d \sim 19.3$ in

$M/d^2 = 84.5/(19.3)^2 = 227$ $\rho = .0655$

$(A_s^+)_{cs} = .0655(19.3)(12) = \underline{1.3 \text{ in}^2/\text{ft}}$

$(M_+)_{ms} = .66(84.4) = 56$ k-in

$M/(d)^2 = 56/(19.3)^2 = 150$ $\rho = .0635$

$(A_s^+)_{ms} = .0035(19.3)(12) = \underline{.81 \text{ in}^2/\text{ft}}$

<u>Y-Direction</u>

Corner Panel $(M_-)_{cs} = .66(206.5) = 136.3$ k-in/in

$d \sim 20.6 - 1.375 = 19.2$

$M/d^2 = 136300/(19.2)^2 = 368$ $\rho = .0093$

$(A_s^-)_{cs} = .0093(19.2)(12) = \underline{2.1 \text{ in}^2/\text{ft}}$

$(M_-)_{ms} = .66(46) = 30.4$ $d \sim 19.75$

$M/d^2 = 30400/(19.75)^2 = 78$ $\rho = .0018$ $(A_s^-)_{ms} = .0018(19.75)(12)$
$= \underline{.43 \text{ in}^2/\text{ft}}$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 106 OF 343

CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

$(M_+)_{cs} = .66(105) = 69.3$ k-in/in

$d = 22 - 2 - 1.5 = 18.5$

$M/d^2 = 69300/(18.5)^2 = 202 \quad \rho \sim .0047$

$(A_s^+)_{cs} = .0047(18.5)(12) = \underline{1.04\ in^2/ft}$

$(M_+)_{ms} = .75(46.2) = \underline{34.9\ k\text{-}in} \quad \rho = .0018$

$(A_s^+)_{ms} = .0018(18.5)(12)$

$= \underline{.4\ in^2/ft}$

$(M)_{end} = (87)(.66) = 57.4$ k-in/in

$M/d^2 = \frac{57400}{(19.75)^2} = 147 \quad \rho \sim .0033$

$A_s = .0033(12)(19.75)$

$= \underline{.78\ in^2/ft}$

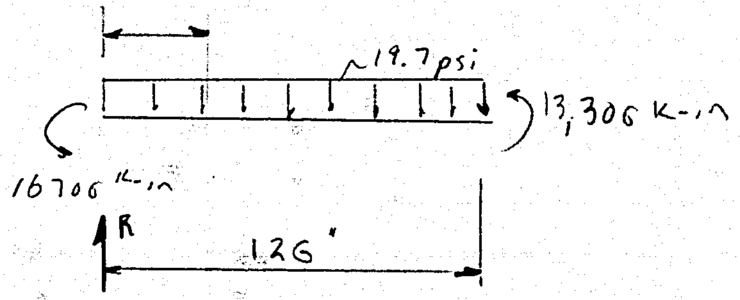
BY IVS DATE 1/72 PROJECT Box Magazine Type A SHEET NO. 107 OF 343

CKD. BY ____ DATE ____ SUBJECT Roof Design

Details

Inflection Points

Exterior Span



$$R = 19.7 \times 126 \times 192 = 477.^{k}$$

$$M = 477x - 16700 - \frac{.0197(192)x^2}{2} =$$

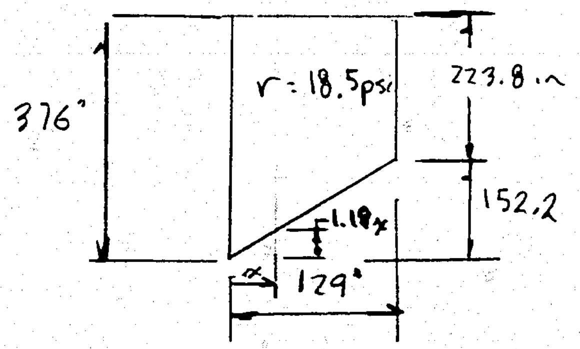
For M=0

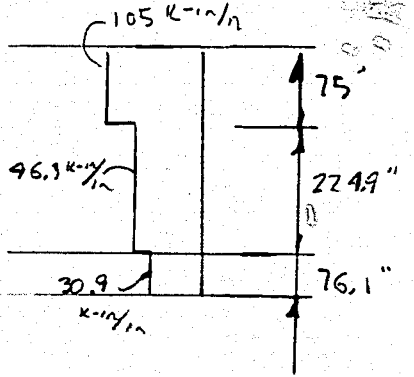
$$1.89x^2 - 477x + 16700 = 0$$

$$x = \frac{477 \pm \sqrt{(477)^2 - 4(16700)(1.89)}}{2(1.89)} = \frac{477 \pm 318.2}{3.78}$$

$$x = 42" = \underline{3'\text{-}6"}$$

Corner Span





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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 108 OF 343

CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

Corner Panel

$$M_p = 105(75) + 46.3(224.9) + 30.9(76.1) = \underline{20639 \text{ k-in}}$$

$$M_n = 87.9(75 + 224.9) + \frac{2}{3}(26.6)(76.1) = \underline{27710}$$

$$R = \frac{18.5}{10^3}\left(\frac{376 + 223.8}{2}\right)(129) = 715.7^k$$

$$M = 715.7x - 27710 - (376 - 1.18x)\left(\frac{18.5}{10^3}\right)\left(\frac{x^2}{2}\right) - \frac{18.5}{10^3}(x)\left(\frac{1.18x}{\cancel{2}}\right)\left(\frac{2 \times 1.18x}{3}\right)$$

$$= 715.7x - 27710 - 3.49x^2 + .0109x^3 - .0086x^3$$

$$= 715.7x + .0023x^3 - 27710 - 3.49x^2$$

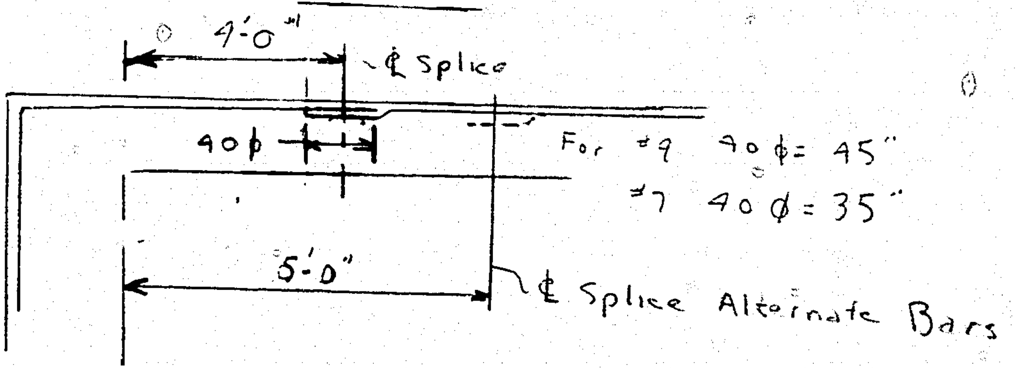
Try $x = 54"$

$$M = 38647 + 362 - 27710 - 10147 = 1152$$

$x \sim 51"$ $M = -44$

Inflection Point Corner = 4'-3"
Center = 3'-6"

Use 4'-0"

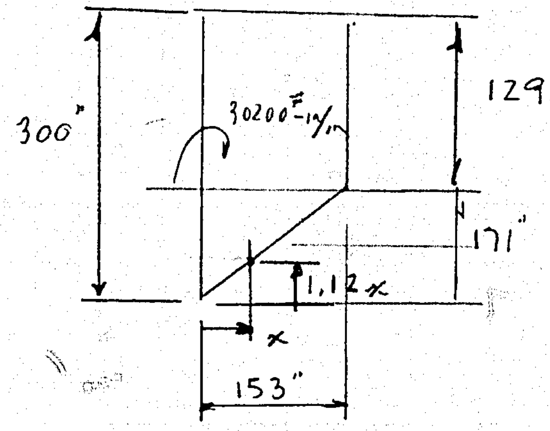


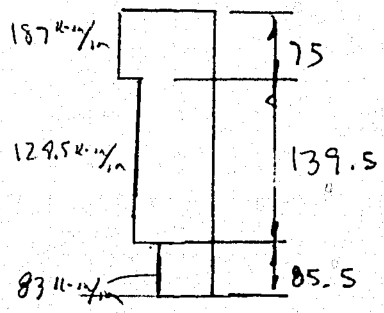
For #9 40ϕ = 45"
#7 40ϕ = 35"

BY WS DATE 1/72 PROJECT Box Magazine Type A SHEET NO. 109 OF 313

CKD. BY ____ DATE ____ SUBJECT Roof Design

Inflection Pt Corner Panel - Long Direction





$$M_n = 30200(.300) = 9060 \text{ k-in}$$

$$M_p = 187(75) + 129.5(139.5) + 83(85.5) = 38489 \text{ k-in}$$

$$R = 18.5\left(\frac{300+129}{2}\right)\left(\frac{153}{10^3}\right) = \underline{607.1^k}$$

$$M = 607.1x - 9060 - (300 - 1.12x)\left(\frac{x^2}{2}\right)\left(\frac{18.5}{10^3}\right) -$$

$$\frac{18.5}{10^3}\left(\frac{1.12x}{2}\right)(x)\left(\frac{2 \times 1.12x}{3}\right)$$

$$= 607.1x - 9060 - 2.78x^2 + .0104x^3 - .0077x^3$$

$$M = 607.1x + .0027x^3 - 9060 - 2.78x^2$$

$$x = 16.1 \quad M = 9774 + 11.3 - 9060 - 721 = 4.3$$

Inflection Point @ 16" From __Wall__

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 110 OF 343
CKD. BY ______ DATE ______ SUBJECT ROOF DESIGN

Check Stress in Bars For Rebound

Interior Panel - Short Direction

$M = 477x - 1.89x^2 - 16700 \qquad x = 48$

$x = 48 \qquad M = 477(48) - 1.89(48)^2 - 16700 = +1841 \text{ k-in}$

$x = 72 \qquad M = 477(72) - 1.89(72)^2 - 16700 = 7846 \text{ k-in}$

In Rebound $\bar{M} = \frac{2}{3}M = 5230 \text{ k-in}$

$(M_+)_{cs} = \frac{.6 \times 5230 \times 10^3}{13.25 \times 12} = 19739 \text{ \#-in/in} \qquad f_s = \underline{12.5 \text{ ksi}}$

$(M_+)_{ms} = \frac{.4}{.6}(19739) = 13159 \text{ -in/in} \qquad f_s = \underline{16.6 \text{ ksi}}$

Long Direction

$M = 607.1x + .0627x^3 - 9060 - 2.79x^2$

$x = 60'' \qquad M = 17941 \text{ k-in}$

$(M_+)_{cs} = .6(17941) = 10764 \text{ k-in} \qquad M = 69000 \text{ \#-in/in}$

$(M_+)_{ms} = .4(17941) = 7176 \text{ k-in} \qquad M = 31308 \text{ \#-in/in}$

#7 @ 12 $\quad \rho = \frac{.6}{12 \times 19.4} = .0026$

$M/d^2 = 110 \qquad M = 110(19.4)^2 = 41.4 \text{ k-in}$

Rebound $M = \frac{2}{3}M_+ = 2 \times 69/3 = 46 \text{ k}$ Say OK

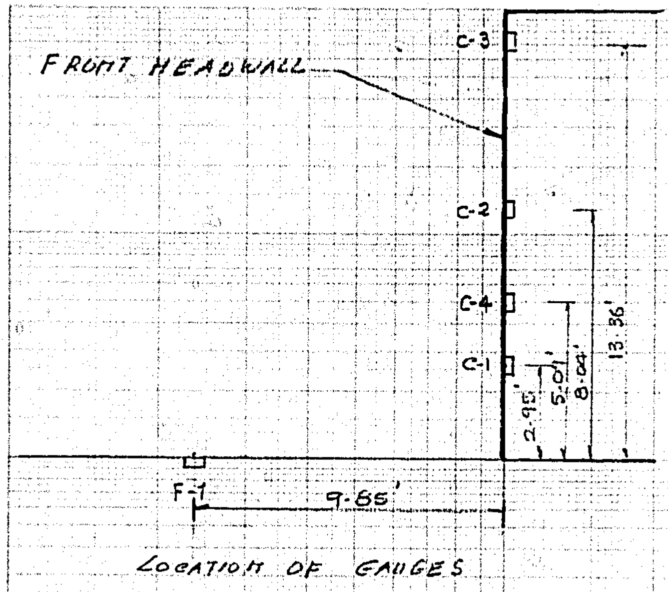
FRONT WALL

Front Wall

BLANK FRAME

FOR

PROPER PAGINATION



LOCATION OF GAUGES

BALLASTIC RESEARCH LABORATORY

BRL MODEL IGLOO TESTS

HEADWALL LOADING ON ACCEPTOR. TO THE REAR OF A DONOR.

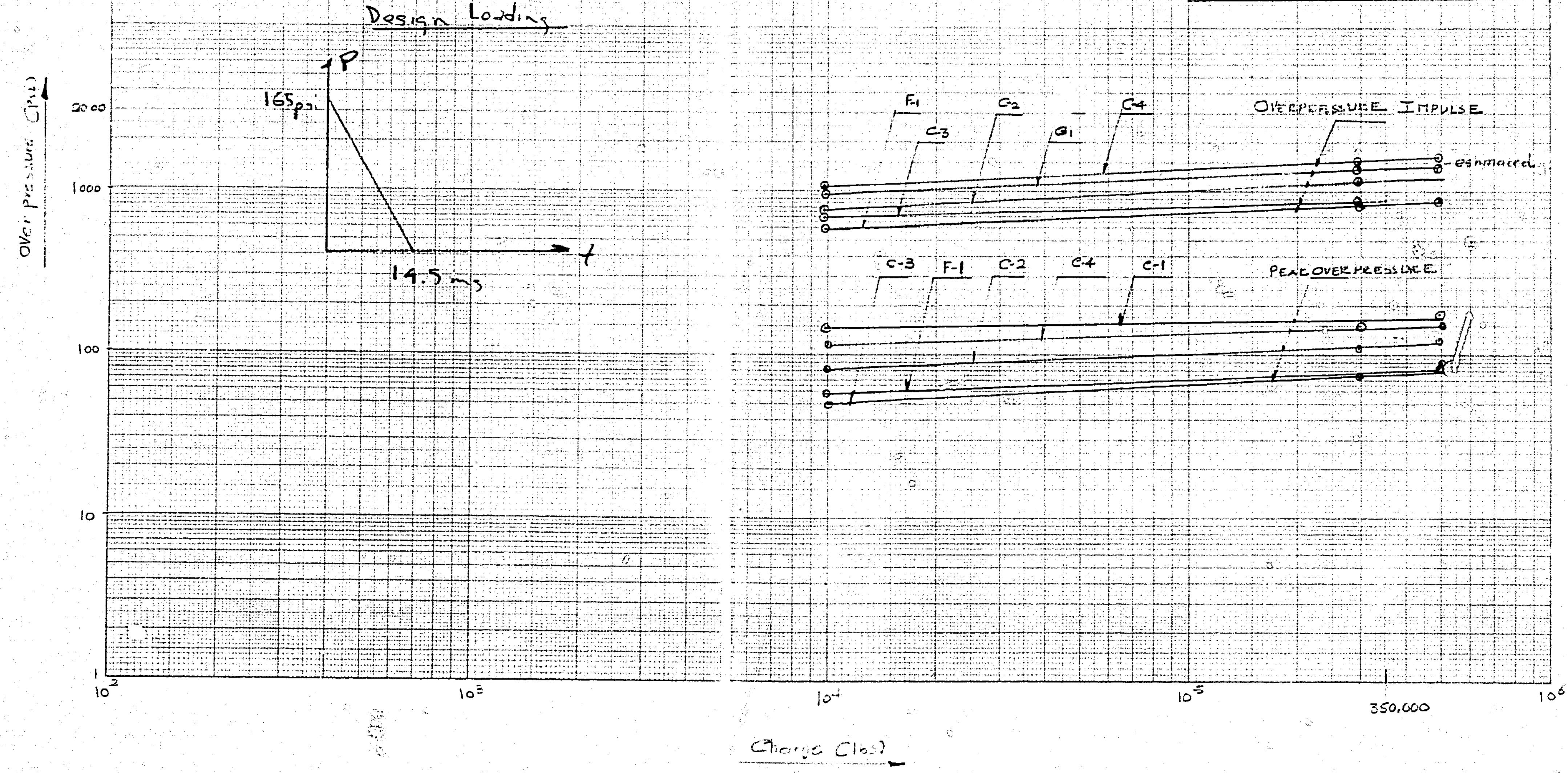
TABLE III. US RESULTS

CHARGE V/S PEAK OVERPRESSURE

CHARGE V/S OVERPRESSURE IMPULSE

Charge : 350,000 lbs

item	F_1	C_1	C_2	C_3	C_4
Peak overpressure (psi)	80	165	115	75	145
overpressure impulse (psi-ms)	825	1200	1075	875	1300
time (msec)	20.62	14.54	18.70	23.33	17.93



Summary $T_c = 30''$

$M_{vp} = \underline{120,000^{\#}\text{-in/in}}$ $d_v \sim 26.75\text{ in}$

$M_v/d^2 = 167.7$ $\rho \sim .004$ $(A_s)_v = .004(12)(26.75)$

$= \underline{1.28\text{ in}^2/\text{FT}}$

$M_H = 60500^{\#}\text{-in/in}$ $d_H \sim 26''$

$M_H/d_H^2 = 89.9$ $\rho \sim .0021$

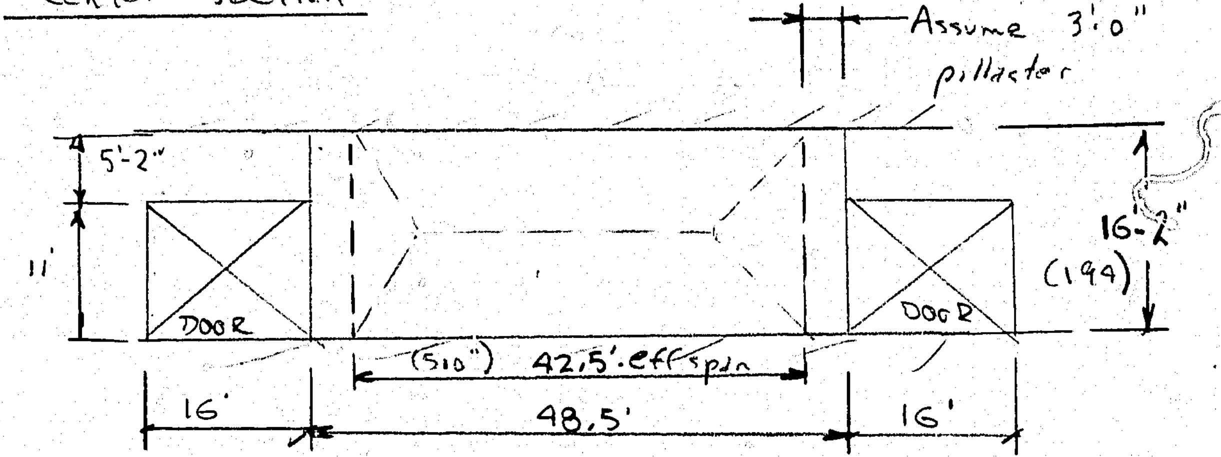
$(A_s)_H = .0021(12)(26)$

$= \underline{.66\text{ in}^2/\text{ft}}$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 113 OF 343
CKD. BY_____ DATE_____ SUBJECT FRONT WALL

Front Wall Design - First Trial

Center Section



Try 26" Wall d ~ 23.5 in

Use min Steel in horiz direction $\rho = .0018$

$M/d^2 = 80 \quad M = 44000$ #-in/in

Design for $v_u = 40$ psi

$$v_u = \frac{5(M_{HN}+M_{HP})}{x^2} \qquad x = \sqrt{\frac{5(M_{HN}+M_{HP})}{v_u}}$$

$$x = \sqrt{\frac{10(44000)}{40}} = 104.9'' = .21\,L$$

$$L/H \left(\frac{\Sigma M_V}{\Sigma M_N}\right)^{1/2} = 3.3 \text{ for } x = .21L$$

$$\left(\frac{\Sigma M_V}{\Sigma M_N}\right)^{1/2} = 3.3\left(\frac{194}{510}\right) = 1.25 \qquad M_V = 1.57\,M_H$$

$M_V = 69080$ #-in/in $\rho \sim .0028$

BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET No. 114 OF 343

CKD. BY ______ DATE ______ SUBJECT Front Wall

Check Shear @ d From Support

$$v_{d_w} = \frac{3v_u(.5 - d_c/H)(1 - x/L - 2d_c x/HL)}{d_c/H(3 - x/L - 8dx/HL)}$$

$x/L = .21$ $d/H = 23.5/194 = .12$

$$v_{d_w} = \frac{3(40)(.5 - .12)(1 - .21 - 2(.21)(.12))}{.12(3 - .21 - 8(.21)(.12))} = \frac{33.7}{.31} = 109 psi$$

$$v_c = .85(2\sqrt{f_c'}) = .85(2)\sqrt{4000} = \underline{107.5 psi \sim 109 psi}$$

OK

$$v_{d_H} = \frac{3v_u(1 - d/x)^2}{d/x(5 - 4d/x)}$$

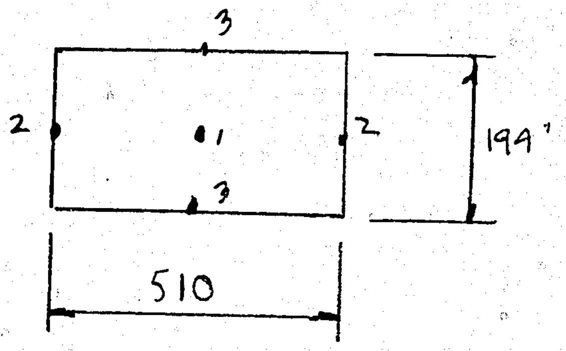
$d/x = 23.5/104.9 = .224$

$$= \frac{3(40)(1 - .224)^2}{.224(5 - 4(.224))} = \frac{72.3}{.92} = \underline{78.6 psi < 107.5 psi}$$

OK

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 115 OF 343
CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Check Deflections



$H/L = \underline{.38}$

$M = \beta r H^2$

$H^2 = 37636$

$x = \gamma r H^4 / D$

$$D = \frac{E_c I_a}{(1-\mu^2)} \qquad I_g = (26)^3/12 = 1464 \text{ in}^4$$

$$\rho_{AVG} = \frac{.0028(510) + .0018(194)}{510 + 194} = .0025$$

$n = E_s/E_c = 29/3.83 = 7.6$

$F = .014 \quad I_c = .014(23.5)^3 = 181.7 \text{ in}^4$

$I_a = \frac{1}{2}(1464 + 181.7) = \underline{822.9 \text{ in}^4}$

$$D = \frac{3.83 \times 10^6 \times 822.9}{(1-(.15)^2)} = \underline{3224 \times 10^6}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 116 OF 3A3

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$M_V = 69080$ #-in/in
$M_H = 44000$ #-in/in

First Yield

$H/L = .38$

$\beta_3 = .083$ $\qquad r_3 = 69080/.083(37636) = 22.1$ psi

$\beta_2 = .057$ $\qquad r_2 = 44000/.057 = \underline{\underline{20.5 \text{ psi}}}$

$\beta_{1V} = .0415$ $\qquad r_{1V} = 69080/.0415 = 44.2$ psi

$\beta_{1H} = .015$ $\qquad r_{1H} = 44000/.015 = 78$ psi

$Y_1 = .00257$

$$x_1 = \frac{(.00257)(20.5)(194)^4}{3224 \times 10^6} = \underline{.023 \text{ in}}$$

First Yield

$r_e = 20.5$ psi
$x_e = .023$ in

$M_3 = 64078$ #-in/in
$M_{1V} = 32639$ #-in/in
$M_{1H} = 11564$ #-in/in

Second Yield

$\beta_3 = .084$ $\qquad r_{ep}' = (69080 - 64078)/.084(37636) = \underline{1.6p}$

$Y = .0026$ $\qquad r_{ep} = \underline{\underline{22.1 \text{ psi}}}$

$$x_{ep} = \frac{(.0026)(1.58)(194)^4}{3224 \times 10^6} + .023 = \underline{.0248 \text{ in}}$$

Final Yield $\qquad \Delta r = 17.9$ psi

$Y = .0116$ $\qquad x_p = \frac{.0116(17.9)(194)^4}{3224 \times 10^6} + .0248 = \underline{.116 \text{ in}}$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 117 OF 343

CKD. BY DATE SUBJECT FRONT WALL

$$X_E = x_e\left(\frac{r_{ep}}{r_u}\right) + x_{ep}\left(1-\frac{r_e}{r_u}\right) + x_p\left(1-\frac{r_{ep}}{r_u}\right)$$

$r_e = 20.5$ psi $\qquad x_e = .023$ in

$r_{ep} = 22.1$ psi $\qquad x_{ep} = .0248$ in

$r_u = 40$ psi $\qquad x_p = .116$ in

$$X_E = .023\left(\frac{22.1}{40}\right) + .0248\left(1-\frac{20.5}{40}\right) + .116\left(1-\frac{22.1}{40}\right)$$

$$= .013 + .0121 + .052$$

$$= \underline{.0771\text{ in}}$$

$K_E = 40/.0771 = 518.8$ psi/in

$$W_{gt} = \frac{.7(\text{KLM}) \times 26 \times 150}{1728} = 1.58\ \#/\text{in}^2$$

$$T_n = 2\pi\sqrt{\frac{1.58\times10^6}{386.4\times518.8}} = 17.6\text{ ms}$$

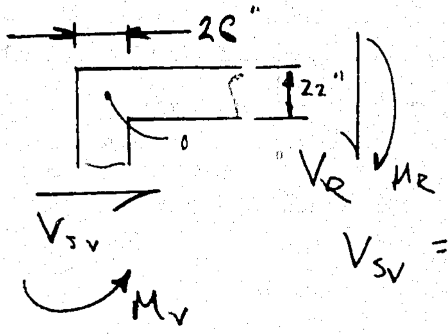
$$\left.\begin{aligned} t_d/T &= \frac{14.5}{17.6} = .82 \\ B/r_u &= \frac{165}{40} = 4.13 \end{aligned}\right\}\ \mu = 44$$

$x_m = 44(.0771) = 3.39$ in $\qquad \theta = \tan^{-1}\left(\frac{3.39}{97}\right) = \underline{\underline{2^\circ}}$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 118 OF 343

CKD. BY DATE SUBJECT FRONT WALL

Balance Joint @ Roof



$$V_{sv} = \frac{3 r_u (1 - x/L) H}{2(3 - x/L)}$$

$$V_{sv} = \frac{3(40)(1-.21)(194)}{2(3-.21)} = \frac{18391}{5.58}$$

$V_{sv} = 3295$ #/in $M_v = 69080$ #-in/in

$M@o = 69080 + 3295(11) = 105325$ #-in/in

$V_R = 2482$ #/in (page 13 of roof design)

$M_R = 105325 - 2482(13) = \underline{73059}$ #-in/in

Roof Design Assumes $M_{nu} = 84549$ #-in/in (page 22 of Roof Design)

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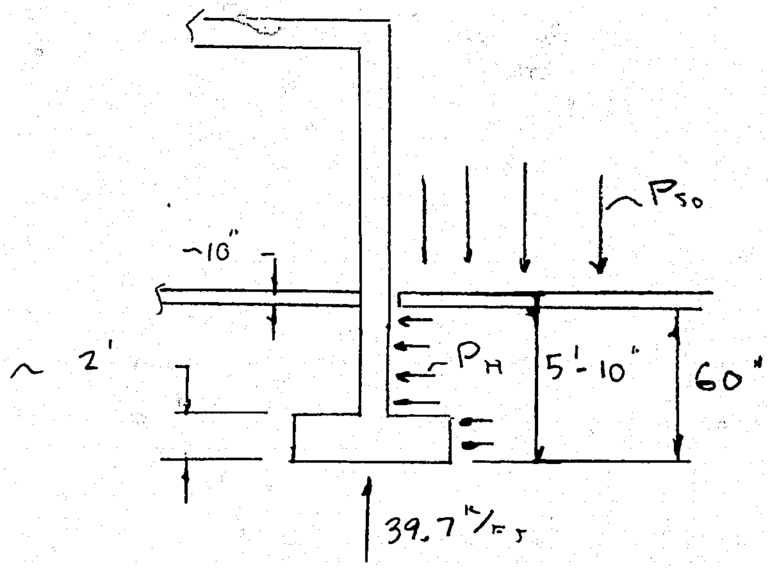
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 119 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Check Development of Moment @ Floor

FINAL DESIGN



P_r = 165 psi t_d = 14.5 ms

For P_r = 165 psi P_{so} = 40 psi i_s ~ 12.5 psi-ms

i_s = 12.5$(350000)^{1/3}$ = 881 psi-ms

t_{of} = 2(881)/40 = 44 ms   use t_o = 14.5 ms

Lateral Pressure Coefficient = .5

∴ P_h = .5(40) = 20 psi

Assume coefficient of friction of .3

Horizontal Reaction that can be developed @ Footing

= .3(39.7) = 11.9 K/FT = 1 K/in

For DLF of Horiz Reaction @ Footing = 2(20)(60)(.375) = 900# < 1000#

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 120 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Lower Wall Behaves as S.F Beam with span of 60 - 24 = 36"

$k_E = 185 EI/\ell^3$

$I = 822.9 \text{ in}^4$

$K_E = 185 \times 3.83 \times 10^6 \times 822.9/(36)^3 = 12.5 \times 10^6$ #/in

$M_E = \dfrac{.78(26 \times 150)}{1728} = 1.76$ #-sec²/in

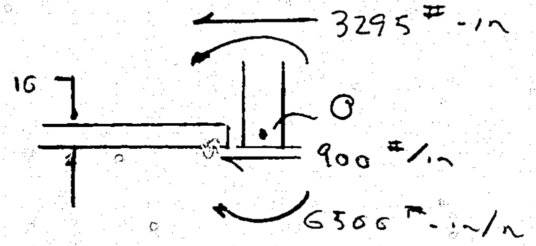
$T_n = 2\pi \sqrt{\dfrac{1.76 \times 10^6}{386.4 \times 12.5 \times 10^6}} = .12$ ms

$t_o / T_n = 14.5/.12 = 120$ DLF = 2

Moment @ Floor = $2 \times 20 \times (36)^2/8 = 6500$ #-in/in

Reaction = $.625 \times 20 \times 36 \times 2 = 900$ #/in

Balance Joint



$M@o = 6500 + 900(5) = 11000$ #-in/in

Moment that can be developed at base of wall = $11000 - 3295(5) = -5475$ #/in

Member is simply supported @ base

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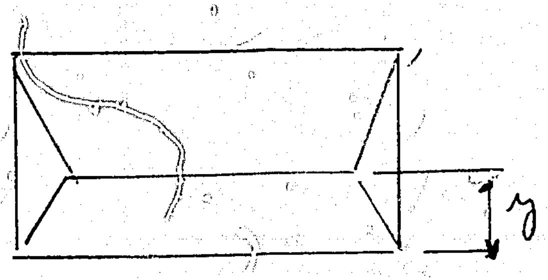
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 121 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Check as Simply supported @ Base

$M_{VP} = M_{VN} = 69080$ #-in/in

$M_H = 44000$ # · in/in



$$y = \frac{H}{M_{VN}}\left(\pm\sqrt{M_{VP}^2 + M_{VP}M_{VN}} - M_{VP}\right)$$

$M_{VP} = M_{VN}$ $y = .414H = .414(194) = \underline{80.3 \text{ in}}$

Try $x \sim .245 L = 125''$

$$\frac{11.7\, M_{VP}(3L - x)}{H^2(3L - 4x)} = \frac{5(M_{HN} + M_{HP})}{x^2}$$

$$\frac{11.7(69080)(3(510) - 125)}{(194)^2(3(510) - 4(125))} = 29.3 \text{ psi}$$ 29.[illegible]

$$\frac{5(2)(44000)}{(125)^2} = 28.2 \text{ psi}$$ $r \sim 29.0$ psi

$$x = \sqrt{\frac{440006}{29}} = 123.2 \text{ in} \doteq .242 L$$

BY NS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 122 OF 343

CKD. BY____ DATE____ SUBJECT FRONT WALL

$$N_{vu} = \frac{3r_u(.585 - d/H)(1 - x/L - 1.71dx/HL)}{d/H(3 - x/L - 6.84dx/HL)}$$

$$x/L = .242$$
$$d/H = .12$$

$$N_{vu} = \frac{3(29)(.585 - .12)(1 - .242 - 1.71(.12)(.242))}{.12\ (3 - .242 - 6.84(.242)(.12))}$$

$$= \frac{28.7}{.307} = 93.4 \text{ psi}$$

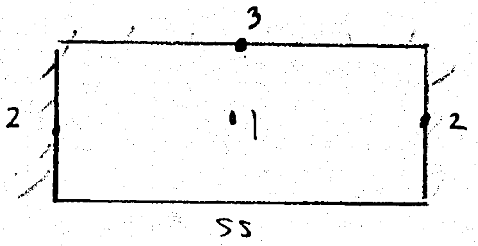
$$d/x = 23.5/123.2 = .191$$

$$N_{vH} = \frac{3r_u(1 - d/x)^2}{d/x(5 - 4d/x)} = \frac{3(29)(1 - .19)^2}{.19(5 - 4(.19))} = \frac{57}{.81} = 70.6 \text{ ps.}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 123 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Check Deflections



$H/L = .38$

$M_V = 69090$ #-in/in

$M_H = 44000$ #-in/in

$H^2 = 37636$

First Yield

$M_3 = .117\, r H^2$ $\quad r_3 = 69090/.117(37636) = \underline{15.7\text{ psi}}$

$M_2 = .07\, r H^2$ $\quad r_2 = 44000/.07(37636) = 16.7\text{ psi}$

$M_{1V} = .062\, r H^2$ $\quad r_{1V} = 69090/.062(37636) = 29.6\text{ p..}$

$M_{1H} = \sim$

$$w = \frac{.0599 a^4}{E h^3 \sim E(12 I)}$$

$$x_e = \frac{.059(15.7)(37636)^2}{3.83 \times 10^6 \times 822.9(12)} = \underline{.034\text{ in}} \qquad r_e = 15.7\text{ psi}$$

Neglect Second Yield

Third Yield. $\gamma = .0116$

$$x_p = \frac{(13.3)(.0116)(194)^4}{3224 \times 10^6} + .034 = \underline{.102\text{ in}}$$

$$x_E = .034 + .102\left(1 - \frac{15.7}{29}\right) = \underline{.081\text{ in}}$$

$K_E = 29/.081 = 359$ psi/in

Wgt ~ 1.58

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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 124 OF 3[illegible]

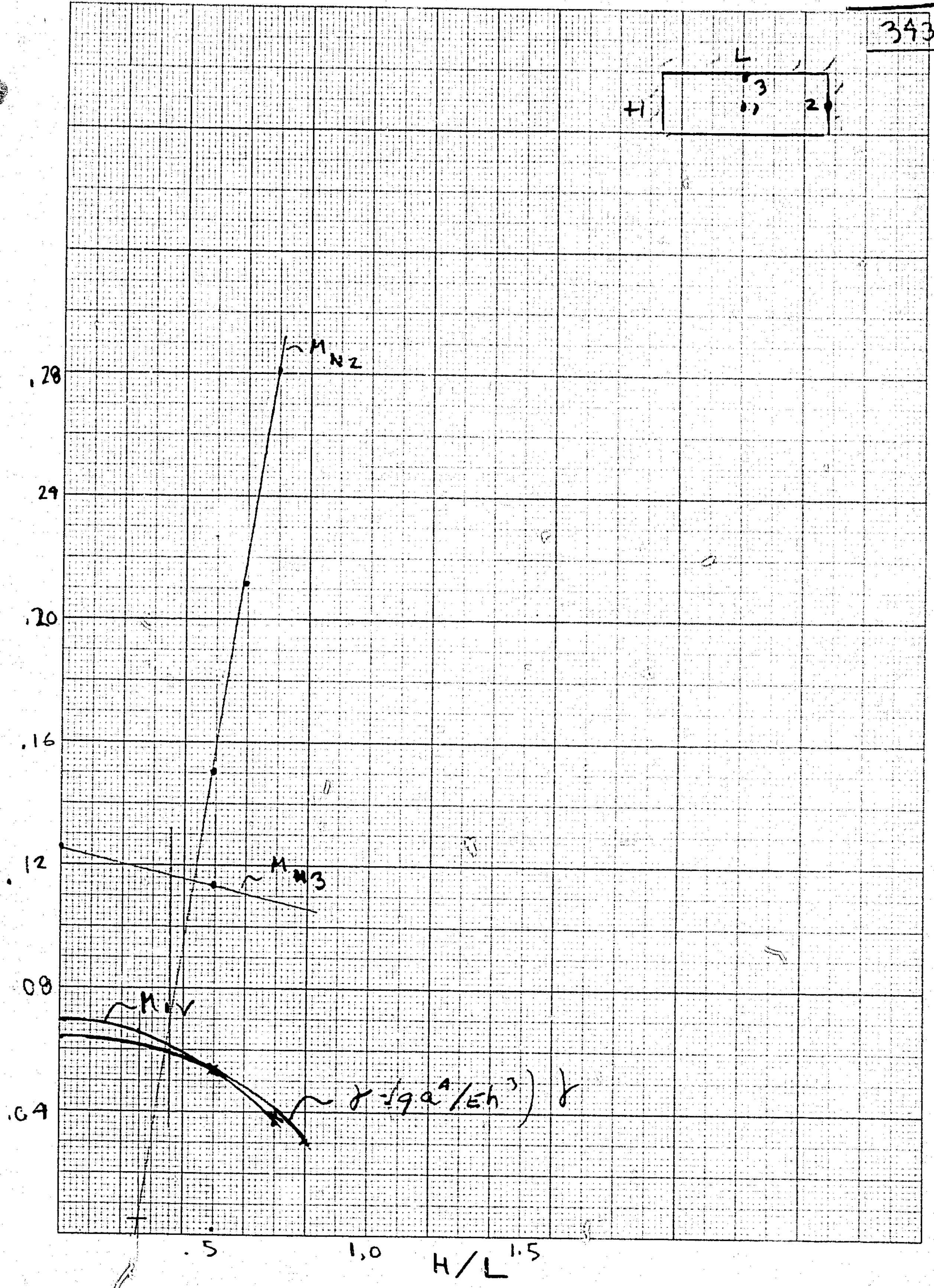
CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$$T_n = 2\pi \sqrt{\frac{1.58 \times 10^6}{386.4 \times 359}} = 21.2 \text{ ms}$$

$$\left.\begin{aligned} t_d/T &= 14.5/21.2 = .68 \\ B/r_n &= 165/29 = 5.7 \end{aligned}\right\} \mu = 60$$

$$x_m = 60(.081) = 4.86 \text{ in}$$

$$\theta = \tan^{-1}\left(\frac{4.86}{80.3}\right) = \underline{3.5^\circ \text{ NG}}$$


L
3
H
1
2
M_{N2}
.28
24
.20
.16
.12
M_{N3}
.08
M_V
.04
γ = (qa⁴/Eh³) γ
.5
1.0
1.5
H/L

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 126 OF 342

CKD. BY DATE SUBJECT FRONT WALL

Try 28" wall

Use Min steel in Horiz direction $\rho = .0018$

$\frac{M_H}{d^2} = .80$ for $\rho = .0018$

$M_H = 52019 \# \cdot in/in$

Try $r = 36$ psi

$$x = \left(\frac{5(2)(52019)}{36}\right)^{1/2} = \underline{120.2 \text{ in}}$$

$$M_{VP} = \frac{36(194)^2(3(510) - 4(126.2))}{11.7(3(510) - 126.2)} = \underline{86183 \# \cdot in/in}$$

$d/H = 25.5/194 = .131 \quad x/L = .236$

$$N_{VN} = \frac{3(36)(.585 - .131)(1 - .236 - 1.71(.236)(.131))}{.131(3 - .236 - 6.84(.236)(.131))}$$

$$= \frac{34.9}{.334} = \underline{104.4 \text{ psi}} \quad \underline{\text{OK}}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 127 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Check Deflections

First Yield

$$r_3 = 86183/.117(37636) = \underline{\underline{19.6\ \text{psi}}}$$

$$r_2 = 52019/.67(37636) = 19.75\ \text{psi}$$

$$I_g = \frac{(28)^3}{12} = 1829\ \text{in}'$$

$$I_c: \quad \rho_{Avg} = \frac{.0018(194) + .003(510)}{704} = .0027$$

$$n = 7.6$$

$$F = .0155 \quad I_c = .0155(25.5)^3 = 257\ \text{in}^4$$

$$I_a = \frac{1829 + 257}{2} = \underline{1043\ \text{in}^4}$$

$$x_e = \frac{.059\,(19.6)(37636)^2}{(3.93\times10^6)(1043)(12)} = \underline{.034}$$

Final Yield

$$y = .0116$$

$$x_p = \frac{16.4\,(.0116)(194)^4}{3724\times10^6\left(\frac{1043}{822.9}\right)} + .034 = \underline{.099\ \text{in}}$$

$$x_E = .034 + .099\left(1 - \frac{19.6}{36}\right) = \underline{.0791\ \text{in}}$$

$$K_E = 36/.0791 = 455.1\ \text{psi/in}$$

$$W_{gt} = .705\times28\times150/1728 = 1.71\ \#/\text{in}^2$$

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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 128 OF 347

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$$T_n = 2\pi\sqrt{\frac{1.71\times10^6}{386.4\times455.1}} = 19.6\,ms$$

$$\left.\begin{aligned} t_d/T &= \frac{14.5}{19.6} = .74 \\ B/r_u &= \frac{165}{36} = 4.6 \end{aligned}\right\}\ \mu = 44$$

$$X_m = 44(.099) = 4.36''$$

$$\theta = \tan^{-1}\left(\frac{4.36}{80.3}\right) = \underline{\underline{3.1^\circ \text{ NG}}} \qquad \underline{\underline{28'' \text{ WALL NG}}}$$

Increase M_{VP} to $1.5\,M_{VN} = 1.5(86183) = 129274$ #-in/in

$$y = .436H = 84.6\text{ in}$$

$$\frac{10.5\,M_{VP}(3L-x)}{H^2(3L-4x)} = \frac{5(M_{HN}+M_{HP})}{x^2}$$

$$x = .21L = 107.1\text{ in}$$

$$\frac{10.5(129274)(3(510)-107.1)}{(194)^2(3(510)-4(107.1))} = \underline{46.6\,psi}$$

$$\frac{5(2)(52019)}{(107.1)^2} = \underline{45.4\,psi}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 129 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Try 30" wall $d \sim 27.5$

$\rho = .0018$

$\frac{M_H}{d^2} \approx 80$ $M_H = 80(27.5)^2 = 60500$ #-in/in

$M_{VN} = 80000$ #-in/in

Try $M_{VP} = 120{,}000$ #-in/in

$.2L < x < .255L$ $x \sim .23L = 117.3$ in

$$r_u = \frac{5(2)(60500)}{(117.3)^2} = 44 \text{ psi}$$

$$r_u = \frac{10.5(120000)(3(510) - 117.3)}{(194)^2(3(510) - 4(117.3))} = 44.6 \text{ psi}$$

$r_u = 44.4$ psi $x = 116.7$ in $= .23L$ $d/H = .142$

$$v_{NEW} = \frac{3(44.4)(.564 - .142)(1 - .23 - 1.77(.23)(.142))}{.142(3 - .23 - 7.1(.23)(.142))}$$

$$= \frac{40}{.36} = \underline{110 \text{ psi} \sim OK}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 130 OF 34?

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

$$\rho_{AVG} = \frac{.0018(194) + \frac{120000}{60500}(.0018)(510)}{704}$$

$= .0031 \quad F = .0175$

$I_g = (30)^3/12 = 2250 \text{ in}^4$

$I_c = .0175(27.5)^2 = 364 \text{ in}^4$

$I_a = \underline{1307 \text{ in}^4}$

$D = 3229 \times 10^6 \left(\frac{1307}{822.9}\right) = 5121 \times 10^6$

$M_{VN} = 80000$ #-in/in

$M_H = 60500$ #-in/in

$M_{VP} = 120,000$ #-in/in

$V_4 = 44.9$ psi

<u>First Yield</u>

$r_3 = 80000/.117(37636) = 18.2$ psi

$r_2 = 60500/.07(37636) = 23$ psi

$r_e = 18.2$ psi

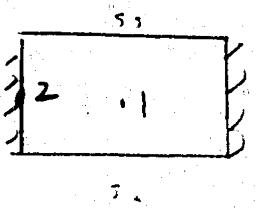
$$X_e = \frac{(.059)(18.2)(37636)^2}{3.83 \times 10^6 \times 1307 \times 12} = \underline{.025 \text{ in}}$$

$M_2 = \frac{18.2}{23}(60500) = 47874$ #-in/in

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 131 OF 343

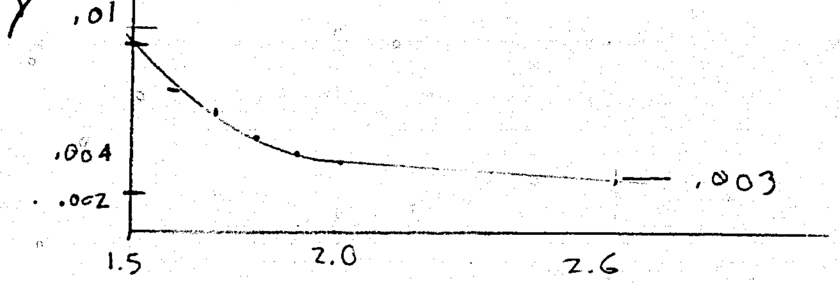
CKD. BY_____ DATE_____ SUBJECT FRONT WALL

Second Yield



$M_2 \sim .119\, r\, H^2$

$w_1 = ,101\ r\, H^4/12EI^3$



$r_2 = (60506 - 47874)/.119(37636) = \underline{2,82\ psi}$

$x_{ep} = \frac{,101(2,82)(194)^4}{12 \times 3,83 \times 10^6 \times 1307} + ,025 = \underline{,0317\ in}$

$r_{ep} = 21,02$ psi

$x_{ep} = \underline{,0317\ in}$

Final Yield $\Delta r = 23.9$ psi $Y = .0116$

$X_p = .0317 + \frac{23.9(.0116)(194)^4}{5121 \times 10^6} = \underline{,107\ in}$

BY WS **DATE** 1/78 **PROJECT** BOX MAGAZINE TYPE A **SHEET NO.** 132 **OF** 343

CKD. BY ______ **DATE** ______ **SUBJECT** FRONT WALL

$r_e = 18.2$ psi $x_e = .025$ in

$r_{ep} = 21$ psi $x_{ep} = .0317$ in

$r_u = 44.9$ psi $x_p = .107$ in

$$X_E = .025\left(\frac{21}{44.9}\right) + .0317\left(1 - \frac{19.2}{44.9}\right) + .107\left(1 - \frac{21}{44.9}\right)$$

$$= .011 + .0188 + .057 = \underline{.087 \text{ in}}$$

$$K_E = 44.9/.087 = 517.5 \text{ psi/in}$$

$$W_g t = \frac{.705(30)(150)}{1728} = 1.83 \text{ psi/in}^2$$

$$T_n = 2\pi\sqrt{\frac{1.83 \times 10^6}{386.4 \times 517.5}} = 19 \text{ ms}$$

$$\left.\begin{aligned} t_d/T &= \frac{14.5}{19} = .76 \\ B/r_u &= \frac{165}{44.9} = 3.67 \end{aligned}\right\} \mu = 29.5$$

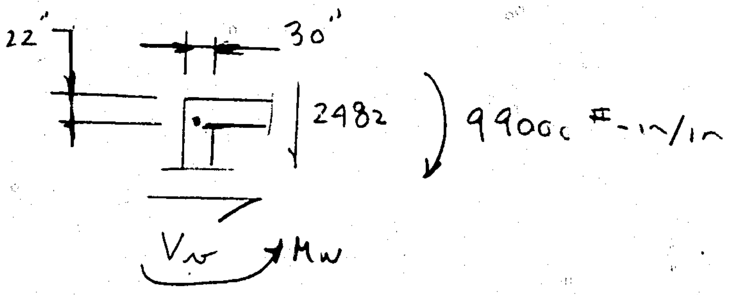
$$x_m = 29.5(.087) = \underline{2.6 \text{ in}}$$

$$\theta = \tan^{-1}\left(\frac{2.9}{.436(194)}\right) = \underline{1.96^\circ} \quad \text{OK}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 133 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Balance Roof Joint



$$V_w = \frac{3 r_u (.564 H)(1 - x/L)}{3 - x/L}$$

$$= \frac{3(44.9)(.564 \times 194)(1 - .23)}{3 - .23} = 4096\ ^{\#}/in$$

$$M_w = 99000 + 2482(15) - 4096(11)$$

$$= 91174\ ^{\#}\text{-in/in}$$

Designed for 80,000 #-in/in

$$\frac{M_{vp}}{M_{vn}} = \frac{120000}{91174} = 1.316$$

$$y = H\left(\sqrt{(1.316)^2 + 1.316} - 1.316\right) = .430 H = 83.4 \text{ in}$$

$$\frac{2 M_{vp}(3L - x)}{.43 H^2 (3L - 4H)} = \frac{10.82 M_{vp}(3L - x)}{H^2(3L - 4x)}$$

$$x \sim .23L = 117.3 \text{ in}$$

$$r_u = \frac{10.82(120000)(3(510) - 117.3)}{(194)^2(3(510) - 4(117.3))} = \underline{45.9 \text{ psi}}$$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 134 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$$\frac{5(2)(60500)}{(117.3)^2} = 44 \text{ psi}$$

$$r_u \sim 45.5 \text{ psi}$$

$$x = \sqrt{\frac{605000}{45.5}} = \underline{115.3 \text{ in}} = .226L$$

$$N_{nu} = \frac{3 r_u (.57 - d/H)(1 - x/L - 1.75 dx/HL)}{d_c/H(3 - x/L - 7dx/HL)}$$

$$= \frac{3(45.5)(.57 - .142)(1 - .226 - 1.75(.226)(.142))}{.142(3 - .226 - 7(.226)(.142))}$$

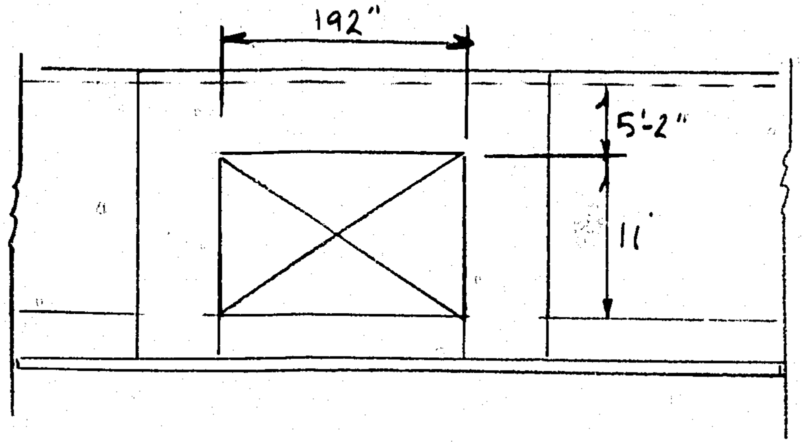
$$= \frac{41.9}{.362} = 115.7 \text{ psi} \sim$$

Set Roof Moment Lower

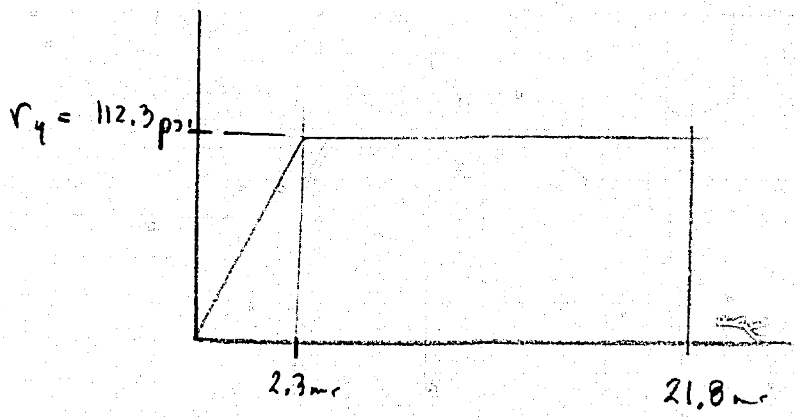
$$M_{nu} = 80000 + 4096(11) - 2482(15)$$

$$= \underline{87826^{\#}\text{-in/in}}$$

Door Support Beam - Upper



Door Response - Assuming Immoveable Supports

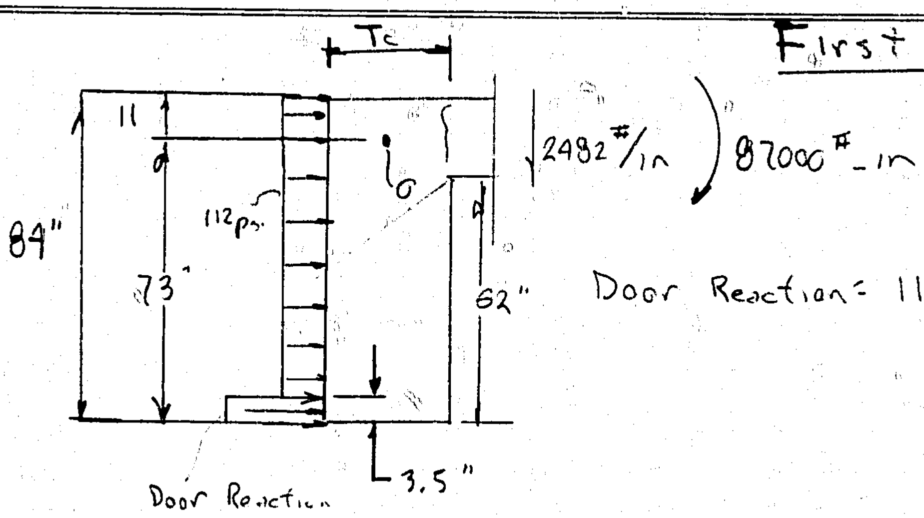


Assume effective pressure loading on wall ~ 112.3psi

BY W S DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 136 OF 343

CKD. BY DATE / SUBJECT FRONT WALL

First Trial



Door Reaction = 112.3(66) = 7412#/in

ΣM_o 7412(73 − 3.5/2) + 112(84 − 3.5)($\frac{84-3.5}{2}$ − 11) − 2482($\frac{T_c}{2}$) − 87000

= 528105 + 263718 − 1241 T_c − 87000

= 704823 #-in/in − 1241 T_c

Span of Beam = 192"

Design Torque = (96 − d)(704823 − 1214 T_c)

= 67.7 × 10^6 + 1214 d T_c − 704823 d − 116544 T_c

Design Shear Horiz

$(V_u)_H$ = 7412 + 112.3(.85(62) − 3.5) = 12937#/in

Design Shear Vert'l

$(V_u)_v$ = 2482(96 − .15(192)) = 166790#

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 137 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Try $T_c = 48''$ $d \sim 43''$

$$\nu_{tu} = \frac{3T}{\phi \Sigma x^2 y} \qquad x = 48 \quad y = 84$$

$$T_u = 67.7 \times 10^6 + 1214(43)(48) - 704823(43) - 116544(48)$$

$$= 34.3 \times 10^6 \text{ \#-in}$$

$$\nu_{tu} = \frac{3 \times 34.3 \times 10^6}{.85(48)^2(84)} = \underline{625.5 \text{ psi}}$$ @ d from support

$$(\nu_u)_h = \frac{12937}{.85(43)} = \underline{354 \text{ psi}}$$ @ .15ℓ below floor

$$(\nu_u)_v = \frac{166790}{.85(79)(43)} = \underline{58 \text{ psi}}$$; @ .15ℓ from pillaster

$$\nu_v = \frac{2482(96-43)}{.85(79)(43)} = \underline{45.6 \text{ psi}}$$ @ d from pillaster

Try $\underline{T_c = 46''}$ $\underline{d \sim 41''}$

$$T_u = 67.7 \times 10^6 + 1214(41)(46) - 704823(41) - 116544(46)$$

$$= 35.7 \times 10^6 \text{ \#-in}$$

$\nu_{tu} = 3 \times 35.7 \times 10^6 / .85(46)^2(84) = \underline{709 \text{ psi}}$ @ d from pillaster

$(\nu_A)_h = 12937/.85(41) = \underline{371.2 \text{ psi}}$ @ .15ℓ below floor

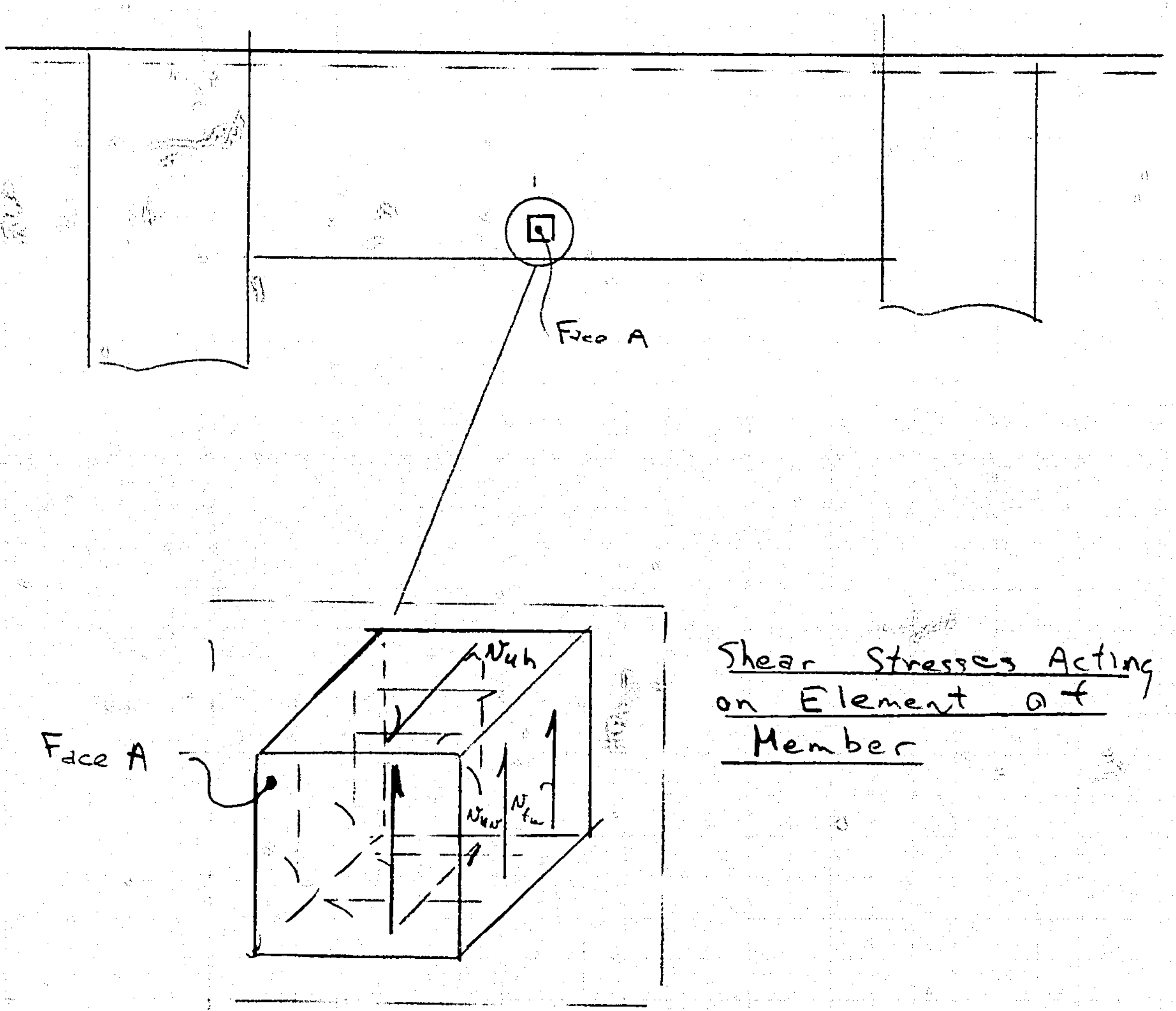
$(\nu_u)_v = 166790/(.85(79)(41)) = \underline{60.6 \text{ psi}}$ @ .15ℓ, from pillaster

$= \underline{49.6 \text{ psi}}$ @ d from pillaster

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 138 OF 347

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Use 48" Member



Shear Stresses Acting on Element of Member

Design for Torsion Combined w/ Vert Shear

$$v_{tc} = \frac{2.4\sqrt{4000}}{\sqrt{1+\left(\frac{1.2\,(45.6)}{625.5}\right)^2}} = \frac{151.8}{1.004} = \underline{151.3\ psi}$$

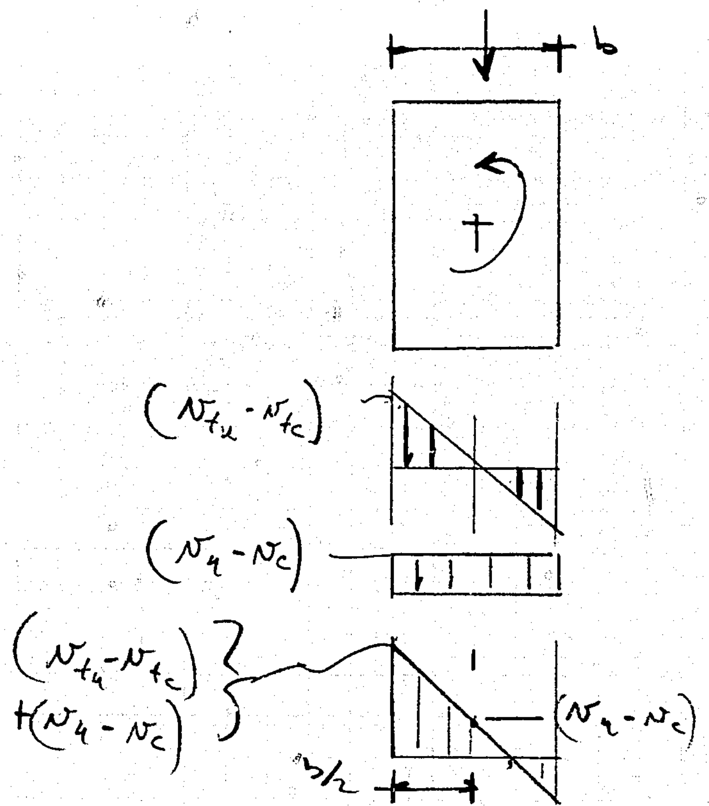
$$v_c = \frac{2\sqrt{4000}}{\sqrt{1+\left(\frac{625.5}{1.2(45.6)}\right)^2}} = \underline{11\ psi}$$

$$\nu_{t_u} = \frac{12\sqrt{f_c'}}{\sqrt{1+\left(\frac{1.2\,\nu_u}{\nu_{t_u}}\right)^2}} = \frac{12(63.2)}{\sqrt{1+\left(\frac{1.2(45.6)}{625.5}\right)^2}} = 755.5 \text{ psi}$$

$$> 625.5 \text{ psi}$$

OK

Determine Shear Reinforcement Reqd @ distance d



$$A = \frac{\nu_{t_u} - \nu_{t_c} + 2(\nu_u - \nu_c)b}{4}$$

$$A = \frac{\left((\nu_{t_u} - \nu_{t_c}) + 2(\nu_u - \nu_c)\right) b\, s}{4 f_y}$$

$$A = \frac{((625.5-151)+2(45.6-11))(48)(5)}{4(40000)} = .1635$$

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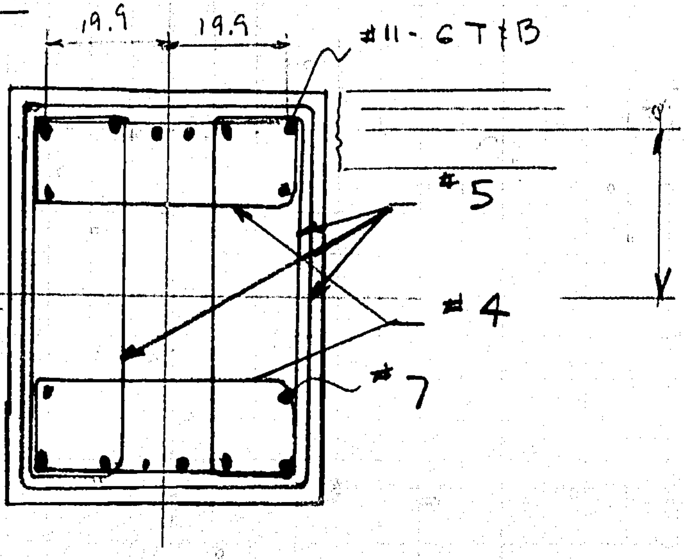
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 140 OF 3A2

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Section Detail



$A = 3A_b$

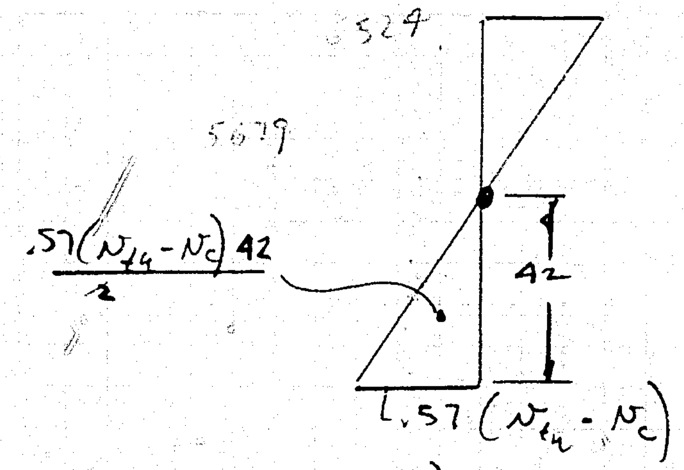
$A_b = .0545$

Try #5 bar $A_b = .31 in^2$

$S = \frac{.31}{.054} = 5.7"$

Use $5\frac{1}{2}"$

Check Shear Short Face



From ACI Proceedings
1938 - ANDERSON
for $\frac{H}{B} = \frac{84}{48} - 1.71$

$(N)_{\text{short face}} = .57(N)_{\text{long face}}$

$$A = \frac{12(N_{t4} - N_c)S}{40000} = \frac{12(625.5 - 151)(5.5)}{40000} = .78 in^2$$

Available $= .31 in^2$ Need $\frac{.78 - .31}{2} = \frac{.47}{2} in^2 = .24 in^2$

Use #4

Spacing

$$T = (96-x)(704823 - 1214T_c) = (96-x)(704823-1214(48))$$

$$= \underline{62.1\times10^6 - 646500x}$$

$$\nu_t = \frac{3T}{.85\Sigma x^2 y} = \frac{3(62.1\times10^6 - 646500x)}{.85(48)^2(84)}$$

$$= \underline{1132-11.8x}$$

$$\nu_v = \frac{2482(96-x)}{.85(43)(79)} = \underline{82.5-.86x}$$

$$A_v = .91 = \frac{((\nu_{tu}-\nu_{tc}) + 2(\nu_u-\nu_c))bs_v}{4f_y} \qquad \nu_{tc} = 151p$$

$$A_h = \frac{12(\nu_t-\nu_c)s_h}{40000} = .78 \qquad \nu_c = 11psi$$

x	ν_{tu}	ν_u	s_v	s_h
d(43)	625.5	45.6	5.5	5.4
55	483	35.2	8	7.8~8
67	341	24.9	13.9	13.7
79	199.8	14.6	54	53.2
91	59.2	4.29	~	

Max spacing =

$$\frac{x_1+y_1}{4} = \frac{49.5+80.5}{4}$$

$$= 31.25$$

$$\nu_t - \nu_c = \frac{.78(40000)}{12\times31.25}$$

$$= 83.2 psi$$

$N_t = 83.2 + 151 - 234.2 = 1132 - 11.8\%$

$x = \underline{76\text{" from support}}$

Design For Flexural Steel

$I \sim .6 \times 48 \times (84)^3/12 = \underline{1.42 \times 10^6 \text{ in}^4}$

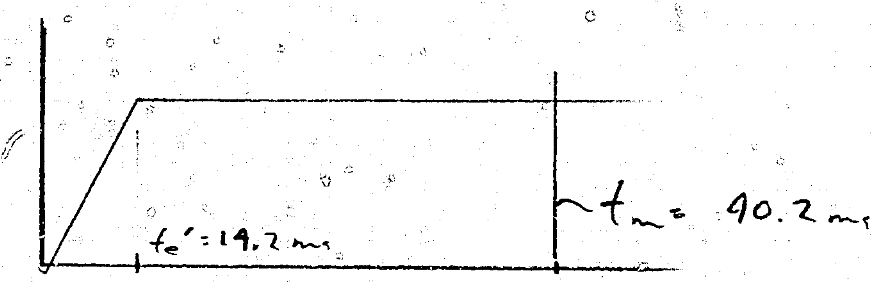
$Wgt = \dfrac{48 \times 84 \times 192 \times 150}{1728} = \underline{67200\#}$ $\quad K_{Lm} \sim .73$

$K_E = \dfrac{384EI}{5L^3}$ $\quad E = 3.8 \times 10^6 \text{ psi}$

$K_E = \dfrac{384 \times 3.8 \times 10^6 \times 1.42 \times 10^6}{5(192)^3} = 58.6 \times 10^6 \#/\text{in}$

$T_n = 2\pi\sqrt{\dfrac{.73 \times 67200 \times 10^6}{386.4 \times 58.6 \times \cancel{10^6}}} = \underline{9.25 \text{ ms}}$

Roof Response for 165 psi on front wall



$P = 33 \text{ psi}$ $\quad i = 510 \text{ psi-ms}$ $\quad t_d = \dfrac{2 \times 510}{33} = \underline{30.9 \text{ ms}}$

$(T_n)_{roof} = 77 \text{ ms}$ $\quad r_u = 18.5 \text{ psi}$

$t_d/T = 30.9/77 = .4$ $\quad DLF = 1.1$ $\quad t_e = .9(30.9) = 27.81$

$t_m = 1.3\, t_d = \underline{40.2 \text{ ms}}$ $\quad t_o = \dfrac{18.5}{1.1(33)}(27.81) = 14.2 \text{ ms}$

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CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Rise time of Loading on Beam = $t_e' = 14.2$ ms

$\frac{t_e'}{T_n} = \frac{14.2}{9.25} = 1.54$ DLF on Beam = 1.2

Beam Load = 1.2(2482) = $\underline{2978 \ \#/in}$

$M_{\ell} = \frac{w\ell^2}{8} = \frac{2978 \times (192)^2}{8} = \underline{13.7 \times 10^6 \ \#\text{-}in}$

$\rho_{min} = \frac{200}{f_y} = \frac{200}{44000} = \underline{.0045}$

$M_u = .9 \rho f_y b d^2 \left(1 - .59 \rho \frac{f_y}{f_c'}\right)$ $d \sim 79$

$= .9 \times .0045 \times 44000 \times 48 \times (79)^2 \left(1 - .59 \times .0045 \times \frac{44000}{5000}\right)$

$= 52.2 \times 10^6 \ \#\text{-}in >> \underline{13.7 \times 10^6 \ \#\text{-}in}$

Use $\rho = .0025$

$M_u = .9 \times .0025 \times 44000 \times 48 \times (79)^2 \left(1 - .59 \times .0025 \times \frac{44000}{5000}\right)$

$= 29.3 \times 10^6 \ \#\text{-}in >> 13.7 \times 10^6$

$A_s = .0025 \times 48 \times 79 = \underline{9.5 \ in^2}$ use 6 #11 Top & Btm

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 144 OF 343
CKD. BY DATE SUBJECT FRONT WALL

For Deep Beam Shear $A_{wh} = .0025 b s_2$

$= .0025 \times 48 \times 18 = 2.16 \text{ in}^2 / 4 \text{ bars}$

$A_b = .59 \text{ in}^2$ use #7

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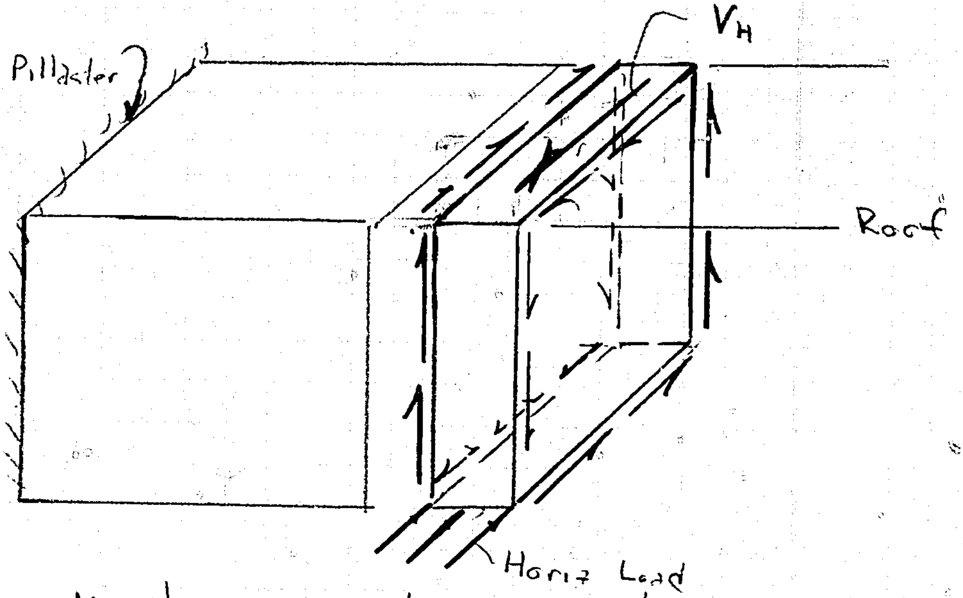
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 145 OF 343
CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Design for v_h

$$l/d = 62/48 = 1.29$$

$$v_c = \left(3.5 - \frac{2.5 M_u}{V_u d}\right) \times \left(1.9\sqrt{f_c'} + 2500 \rho_w \frac{V_u d}{M_u}\right)$$

Horizontal Loading on slice of wall



Member is subjected to pure shear; Moment continuously reacted by torsional shear stresses; hence $v_c \sim 6\sqrt{f_c'} = 6\sqrt{4000} = 379$ psi

$v_h = 354$ psi $< v_c$ OK no reinforcement reqd

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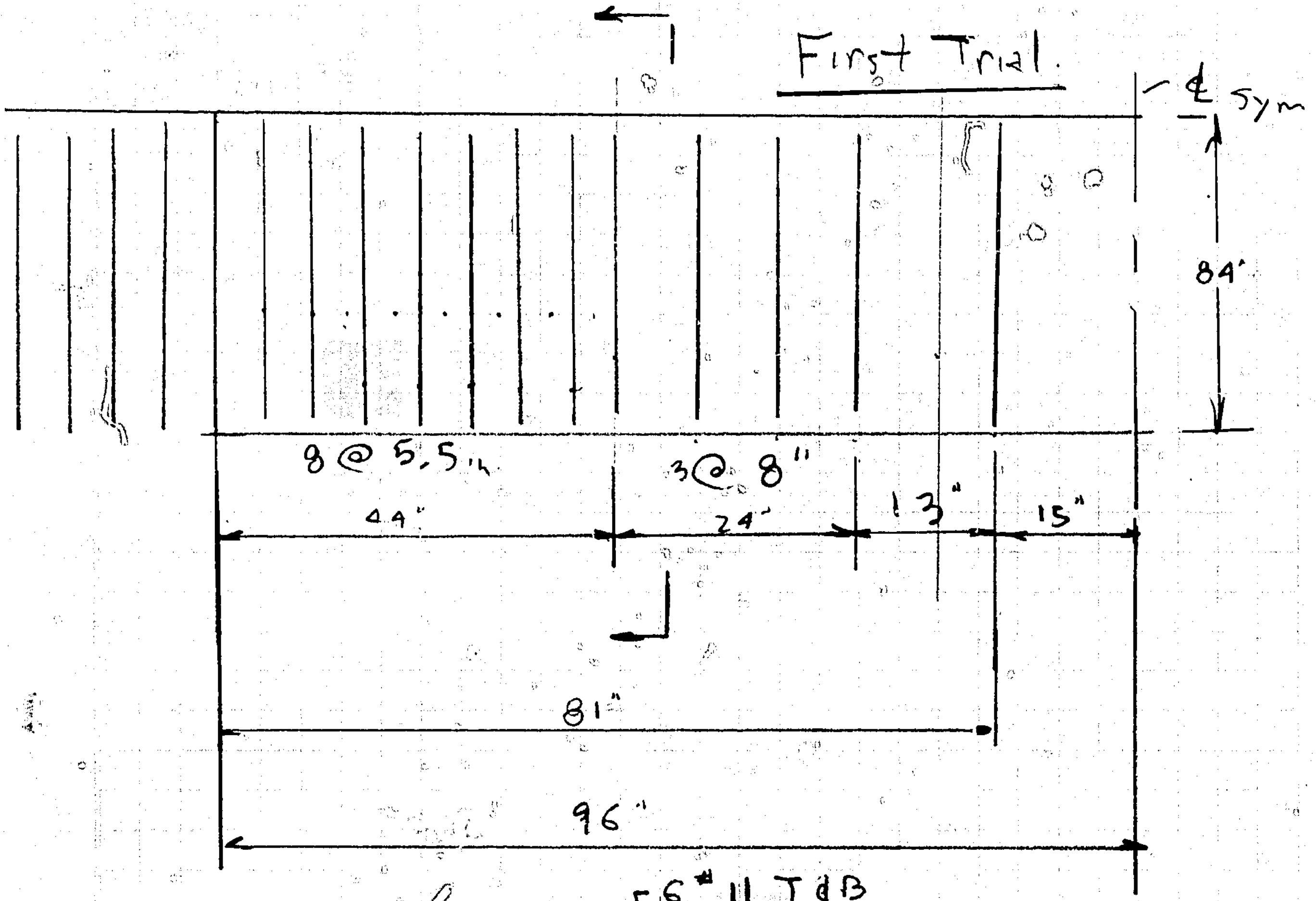
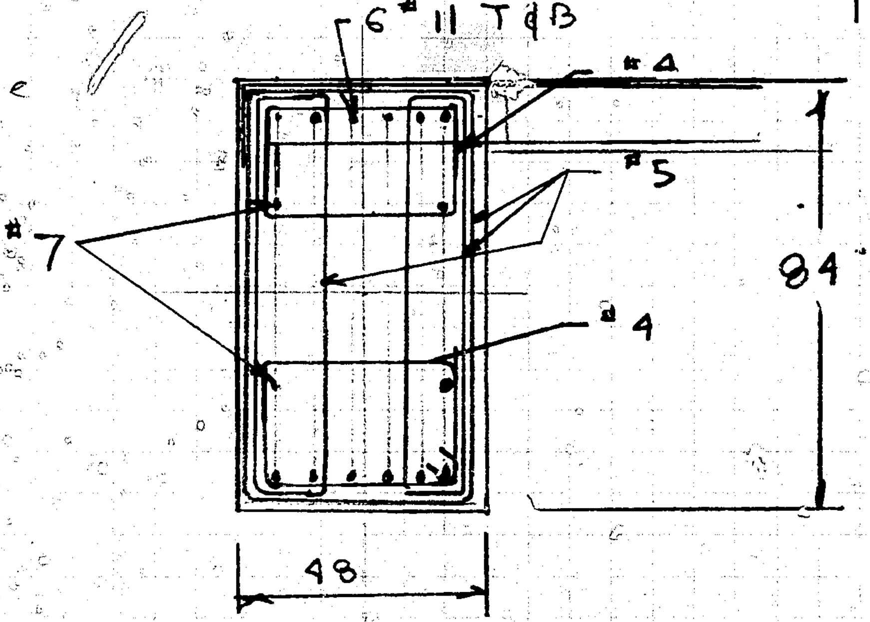
BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET No. 146 OF 342

CKD. BY____ DATE____ SUBJECT Tie Spacing

First Trial.



Ravise for 56" Member

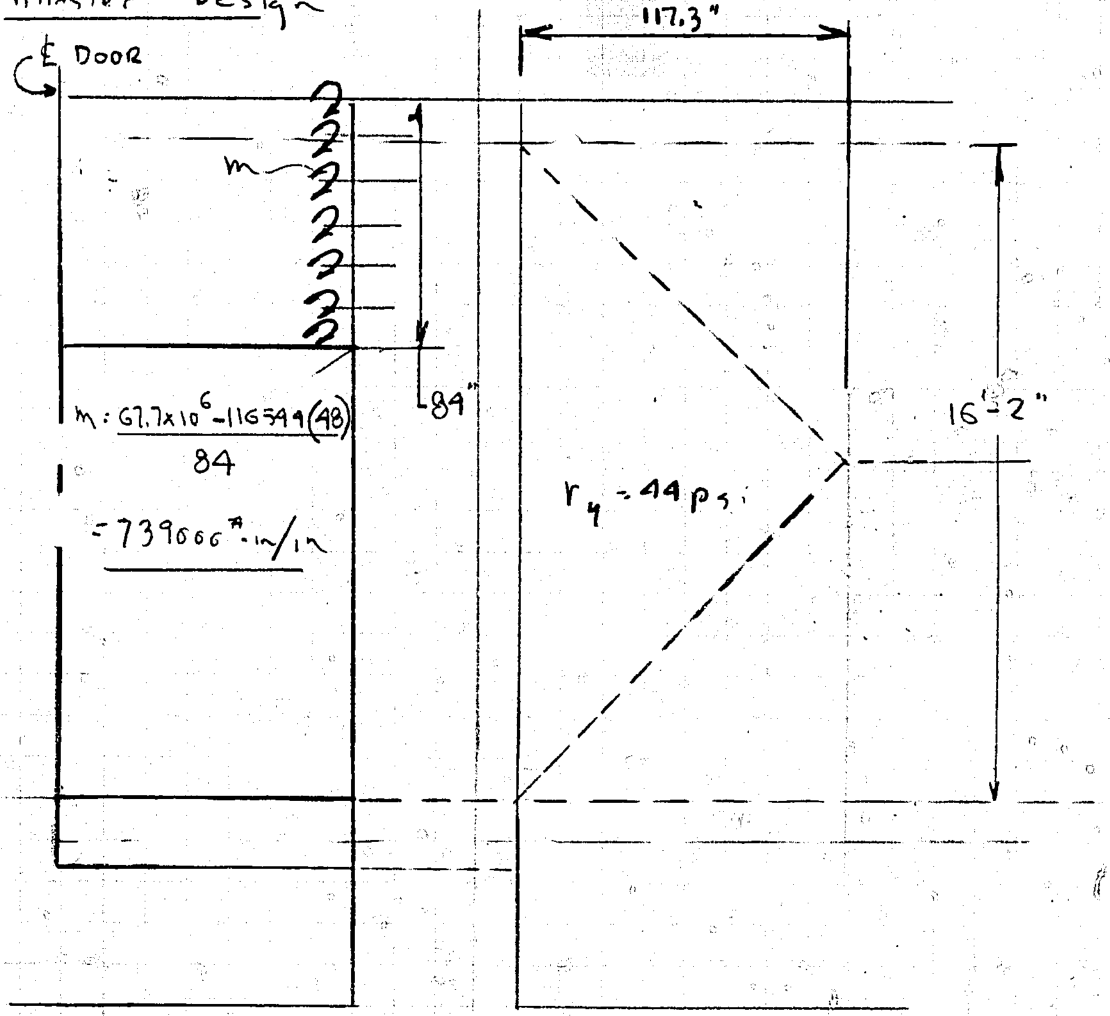


$(194)^2(3(510) - 4(117.3))$

BY NS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 147 OF 343

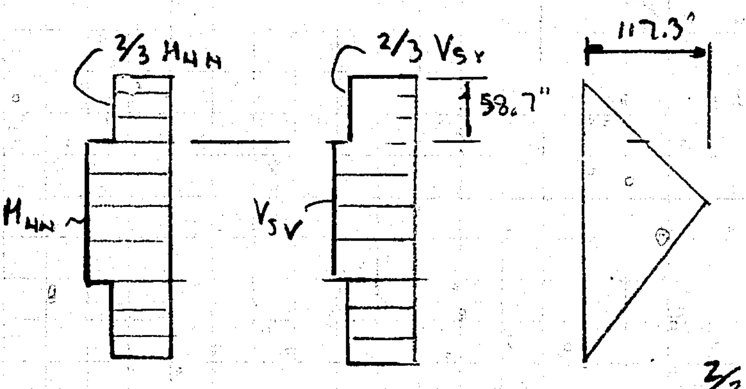
CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Pillaster Design



$$m = \frac{67.7\times10^6 - 116549(48)}{84}$$

$= \underline{739066\ \#\text{-in/in}}$



$$V_{sv} = \frac{3 r_u x}{5}$$

$$= \frac{3(44)(117.3)}{5}$$

$V_{sv} = \underline{3097\ \#/\text{in}}$

$2/3\ V_{sv} = \underline{2064\ \#/\text{in}}$

$M_{HH} = \underline{60500\ \#\text{-in/in}}$

$2/3\ M_{HH} = \underline{40333\ \#\text{-in/in}}$

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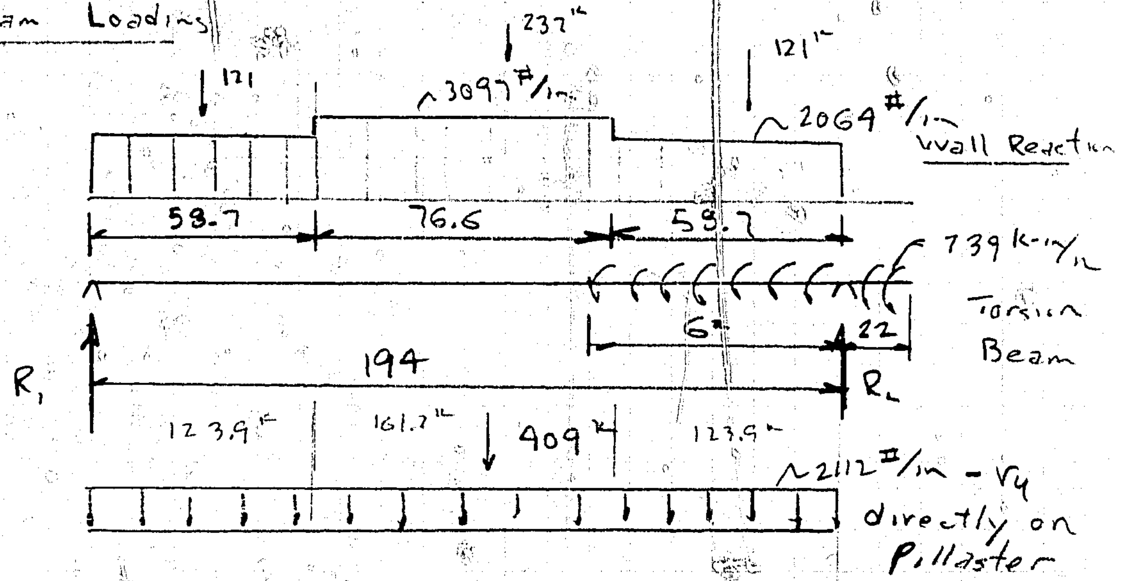
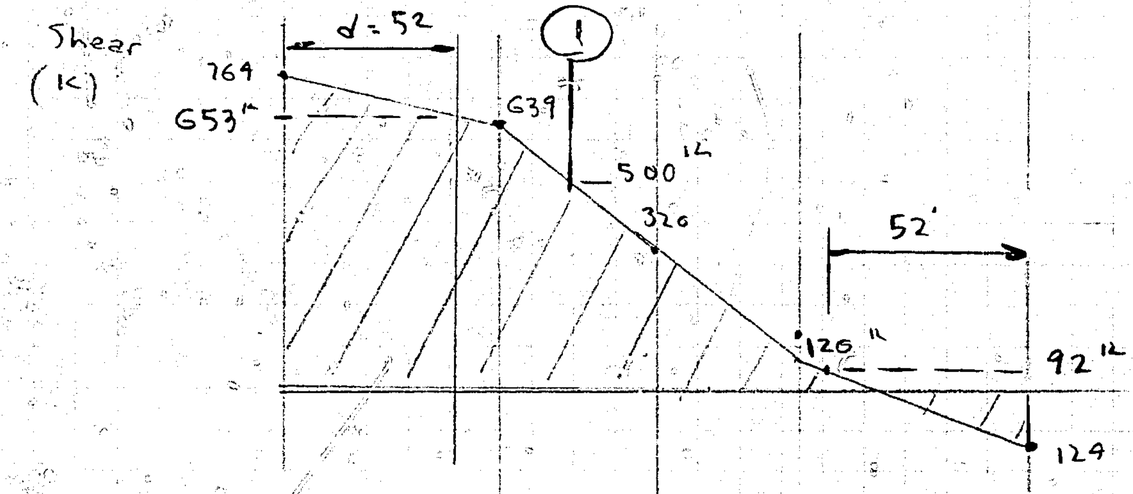
BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE 1 SHEET NO. 148 OF 343
CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Beam Loading



$$R_1 = \overset{444}{\frac{121+237+121+409}{2}} + \frac{739(84)}{194} = \underline{764\text{ k}}$$

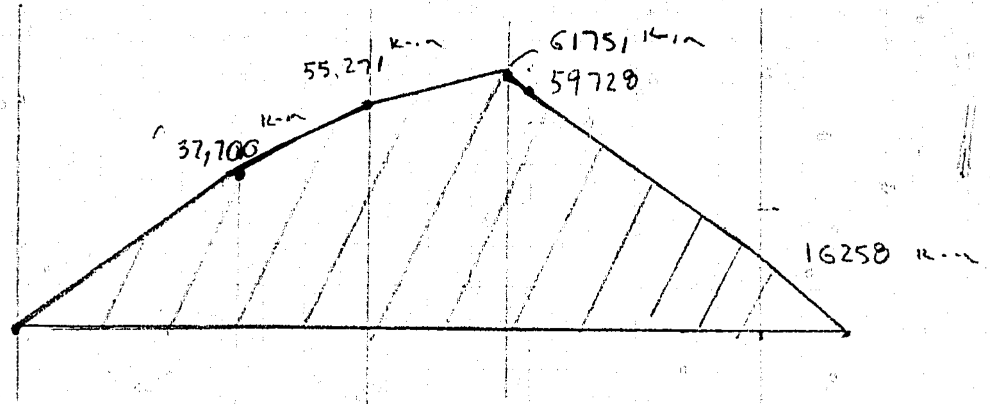
$$R_2 = 888 - 764 = \underline{124^k}$$



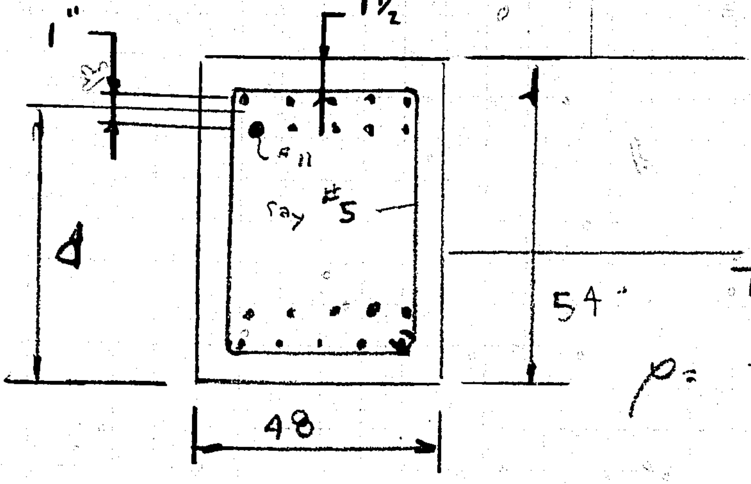
BY WS. DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 149 OF 343

CKD. BY ______ DATE ________ SUBJECT FRONT WALL

Moment



Try 54" Deep Pillaster



d ~ 54 - 1.5 - .625 - 1.375 - .5

= 50"

Try 14 #11 A_s = 21.94 in²

$$\rho = \frac{21.94}{50 \times 48} = .0091$$

$$M_u = \varphi f_{dy} b d^2 \left(1 - .59 \gamma \frac{f_{dy}}{f'_{dc}} \right)$$

$f_{dy} = 44$ ksi
$f'_{dc} = 5$ ksi

$$= .0091 (44)(48)(50)^2 \left(1 - .59(.0091)\left(\frac{44}{5}\right)\right)$$

= 45,700 k-in Try 18 #11 or 22-#10

A_s = 28.08 in² ρ = 28.08/50×48 = .0117

18 #11

$$M_u = .0117(44)(48)(50)^2\left(1 - .59(.0117)\left(\frac{44}{5}\right)\right) = \underline{58023 \text{ k-in}}$$

say OK

22-#10 d = 50.375 ρ = 22(1.27)/50.4×48 = .0116

$$M_u = .0116(44)(48)(50.4)^2(1 - .59(.0116)(44/5)) = 58483 \text{ k-in}/\text{say OK}$$

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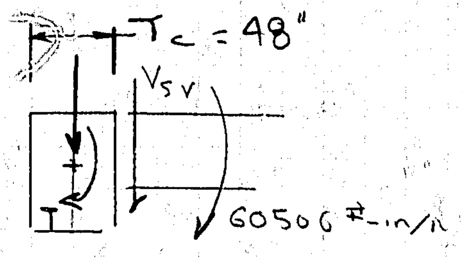
BY WS DATE 1/72 PROJECT BOX MAGAZINE TYPE A SHEET NO. 150 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

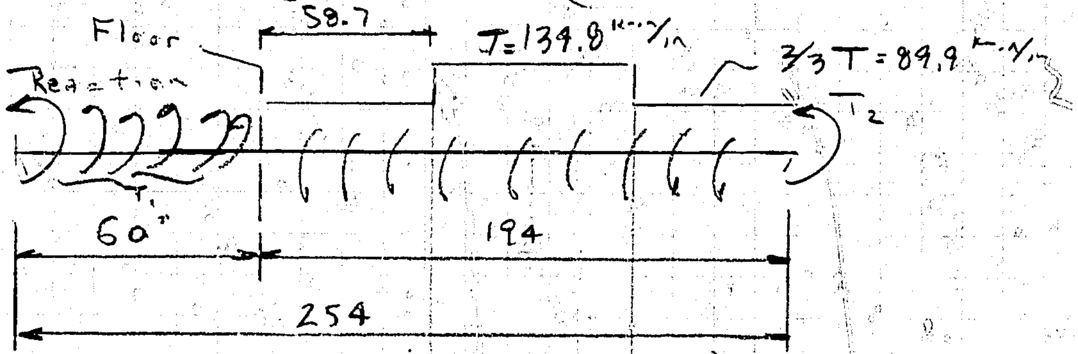
Check Shear & Torsion



$$T = 60506 + V_{sv} T_c/2 = 60506 + \frac{48}{2} V_{sv} =$$

$$= 60506 + 24 V_{sv} ;$$

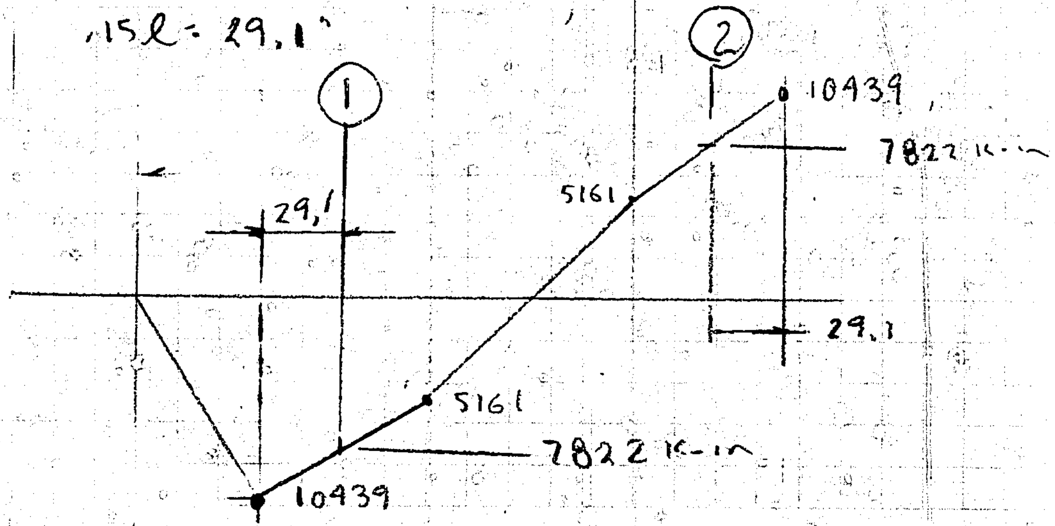
Torsion Reacted @ Footing & @ Roof



$$T_1 = T_2 = 58.7(89.9) + 134.8(76.6/2)) \cong 10439 \text{ k-in}$$

Critical Sections @ .15ℓ from support

.15ℓ = 29.1"



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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 151 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

$v_{tu} = \frac{3T}{.85\Sigma x^2 y}$ $x = 48$ $y = 54$ $.85\Sigma x^2 y \cdot \underline{109670 \text{ in}^3}$

@ d - Abv footing   T = 7811 k-in   V = 0

$v_{tu} = \frac{3 \times 7811. \times 10^3}{109670} = 213.7$ psi

$v_u = 0$ $v_{tc} = 12\sqrt{f_c'} = 12\sqrt{4000} = 756$ psi > 213.7 psi

ok

@ d Abv Floor   T = 3614 k-in   V = 653k

$v_{tu} = \frac{3 \times 3614}{109670} \times 10^3 = 99.9$ psi $> 1.5\sqrt{f_c'}$

$v_u = \frac{653 \times 10^3}{.85 \times 48 \times 52}$ 308 psi

$$v_{tc} = \frac{2.4\sqrt{f_c'}}{\sqrt{1 + \left(\frac{1.2 v_u}{v_{tu}}\right)^2}} = \frac{2.4(63.2)}{\sqrt{1 + \left(\frac{1.2(308)}{99.9}\right)^2}} = 39.2 \text{ psi}$$

$v_{tu} = \frac{12(63.2)}{3.87} = 196$ psi > 99.9 psi ok

@ d below Roof   T = 7853 k-in   V = 120k

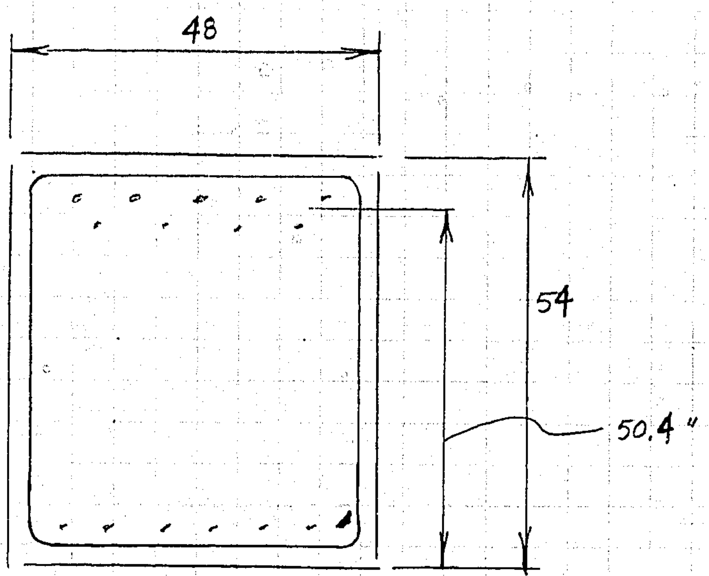
$v_{tu} = \frac{3 \times 7853 \times 10^3}{109670} = 214.9$ psi $v_{tu} \sim 759$ psi

$v_{tc} = 151$ psi

$v_u = \frac{120 \times 10^3}{.85 \times 48 \times 52} = 56.6$ psi

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 152 OF 343

CKD. BY_____ DATE_____ SUBJECT FRONT WALL



@ 1 $v_u = \frac{500 \times 10^3}{.85 \times 50.4 \times 48} = 243.2$ psi

$v_{tu} = \frac{3 \times 7822 \times 10^3}{.85 \times 54 \times (48)^2} = 222$ psi

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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 153 OF 343

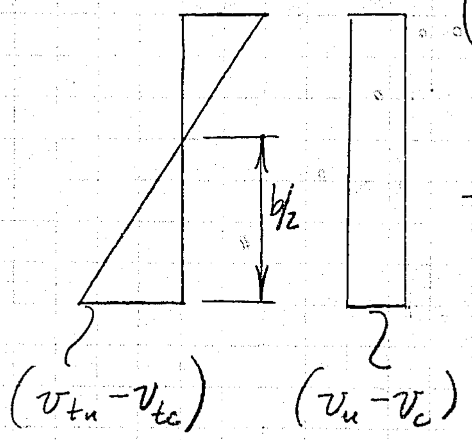
CKD. BY DATE SUBJECT FRONT WALL

$$v_{tc} = \frac{2.4\sqrt{4066}}{\sqrt{1+\frac{1.2\times243.2}{222}}} = \frac{151.8}{1.52} = 91.2 \text{ psi}$$

$$v_c = \frac{2\sqrt{4066}}{\sqrt{1+\left(\frac{222}{1.2\times243.2}\right)^2}} = \frac{126.5}{1.26} = 100.7 \text{ psi}$$

Long Side

$$\left(\frac{(v_{tu}-v_{tc})\frac{b}{2}}{2} + \frac{(v_u-v_c)b}{2}\right)S = A_t f_y$$



$$\frac{((v_{tu}-v_{tc})+2(v_u-v_c))bS}{4f_y} = A_t$$

$$A_t = \left(\frac{(222-91.2)+2(243.2-106.7)}{4\times40000}\right)(48)S$$

$$= .125\ S$$

For #5 bar $A = .31$, $S = .31/.125 = 2.48''$

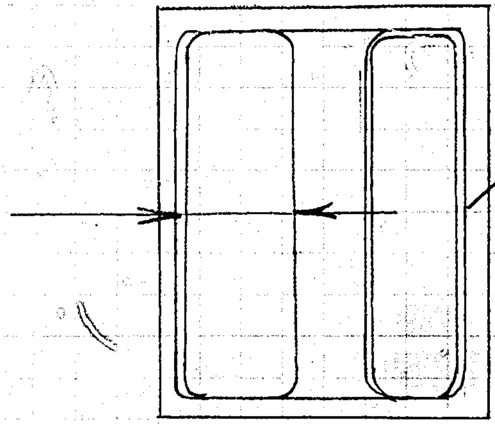
Short Side

$$h/b = 54/48 = 1.125$$

$$v_2 \sim v_1$$

$$A_t = \frac{(222 - 91.2)(27)\,S}{2 \times 400\,00}$$

$$= \frac{(222 - 91.2)(27)(2.5)}{80,000} = \underline{.110 \text{ in}^2}$$



$A = 3 \times .315 = .93$

$S = \frac{.93}{.125} = \underline{\underline{7.5''}}$

Use 7"

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 155 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Check @ Top

$$v_{tu} = \frac{3 \times 7822 \times 10^3}{105754} = 222 \text{ psi}$$

$$v_{tc} = 222 - 150 = 72 \text{ psi}$$

$$A_t = \frac{(92)(48)(12)}{160000} = .26 \text{ in}^2$$

Check Spacing From Bt_u

x	T	V	v_{tu}	v_u	S
29.1					
41.1	6753	453	192 psi	220 psi	9.1 in
48	6162	411	175	195	11.3
53.1	5799	362	165	176	15.3

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 156 OF 312

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Redesign of Door Support Beam - Upper for $5\overset{8}{4}''$ Section

From pag. → - Design Torque TD:

$$T_D = 67{,}700 + 1.21 dT_c - 704.8d - 116.5T_c$$

$T_c = 54''$

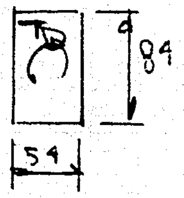
$$T_D = 61409 + 65.3d - 704.8d =$$

$$= \underline{61409 - 639.5d}$$

Here use $d = .15\ell$

$$T_D = 61409 - 639.5(.15 \times 192) \cdot \quad 42991 \text{ k-in}$$

$$v_{tu} = \frac{3T}{\phi \Sigma x^2 y} = \left(\frac{3 \times 42991}{.85 \times (54)^2 (84)}\right) \times 10^3$$



v_{tu} $\underline{619.5 \text{ psi}}$

Vert'l Load on Beam = $\underline{166.8^k + \text{Direct Load} + \text{Wgt}}$

Direct Load: use 18.5 psi; Wgt: 150(7)(4.5)/12 = 394 #/in

Direct Load = 18.5(54) = 999 #/in

Wgt = $\underline{399 \text{ \#/in}}$

Σ = 1393 #/in

$$V_u = 166.8 + 1.39(.35(192)) = 260.2^{k}$$

$$v_u = 260.2/.85(54)(79) = .072^{ksi}$$

$\underline{72^{psi}}$

$$v_{tc} = \frac{2.4\sqrt{f_c'}}{\sqrt{1 + \left(\frac{1.2 v_u}{v_{tu}}\right)^2}} = \frac{2.4\sqrt{4000}}{\sqrt{1 + \left(\frac{1.2(72)}{619.5}\right)^2}} = \underline{150 \text{ psi}} < 619.5 \text{ psi}$$

Reinf reqd

$$v_{tu} = \frac{12\sqrt{f_c'}}{\sqrt{1 + \left(\frac{1.2(v_u)}{v_{tu}}\right)^2}} = \quad \underline{751 \text{ psi} > 619.5 \text{ psi}}$$

$$v_c = \frac{2\sqrt{f_c'}}{\sqrt{1+\left(\frac{v_{tu}}{1.2 v_u}\right)^2}} = \frac{2\sqrt{4000}}{\sqrt{1+\left(\frac{619.5}{1.2(71)}\right)^2}} = \underline{\underline{17.2 psi}}$$

From page 27:

$$\text{Shear Reinf Area} = \frac{\left(\left(v_{tu} - v_{tc}\right) + 2\left(v_u - v_c\right)\right) b s}{4 f_y}$$

@ .15 ℓ

$$A = \frac{\left(\left(619.5-150\right) + 2\left(72-17.2\right)\right) 54}{4(40000)} = \underline{\underline{.195 S}}$$

Section Detail

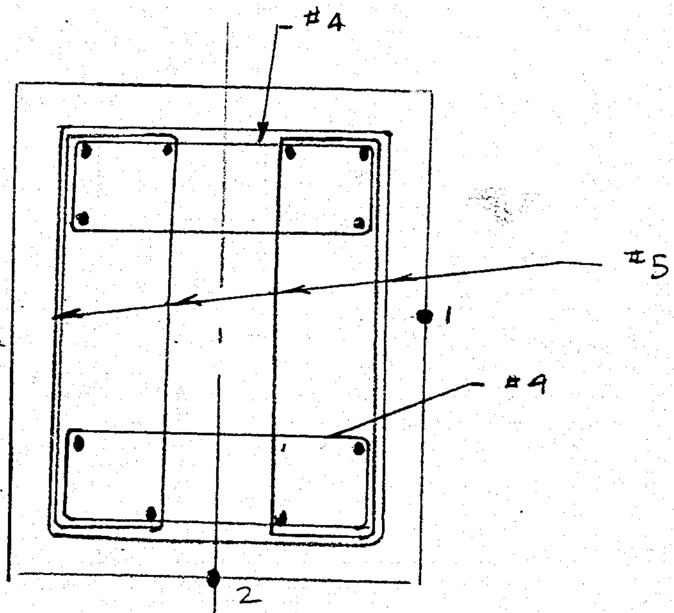
$A = 3A_b$

$A_b = .065 S$

Try #5 bar - A = .31 in²

$$S = \frac{.31}{.065} = \underline{\underline{4 8}}$$

use 5"



Check Shear on Short Face

From page 28 $A = \dfrac{12\left(v_{tu} - v_c\right) S}{40000}$ for $v_2/v_1 = .57$

BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET No. 158 OF 343

CKD. BY ____ DATE ____ SUBJECT Front Wall

For $h/b = 84/54 \cdot 1.55 \quad v_2/v_1 = .62$

$$A = \frac{.62}{.57}\left(\frac{12)(v_{tu} - v_c) S}{40000}\right) = \frac{13.1\,(v_{tu} - v_c) S}{40000}$$

$$A = \frac{13.1(619.5 - 150)(5)}{40000} = .77 \text{ in}^2$$

Available $.31 \text{ in}^2$ Need $.46 \text{ in}^2$ use #4

Spacing of Ties

$T_D = 61409 - 639.5x$

$$v_{tu} = \frac{3 T_D}{\phi \Sigma x^2 y} = 10^3\left(\frac{3(61409 - 639.5x)}{.85(54)^2(84)}\right) = \underline{894.8 - 9.2x}$$

$v_u = 102.6 - \underline{1.06}x$

$$A_v = \frac{\left[(v_{tu} - 150) + 2(v_u - 17)\right] 5.45}{160000} \qquad A_v = \underline{.99} \text{ in}^2$$

$$A_h = \frac{13.1(v_{tu} - 151)5}{40000} \qquad A_h = \underline{.71} \text{ in}^2$$

x	v_{tu}	v_u	s_w	s_h
29.9(.15l)	619.8	72	4.76	4.6"
40.8	509.4	59	6.2	6"
50"	422	50	8.2	8"
52.8	399	46.6	8.94	8.74"
64.8	288.6	33.9	15.9	15.7"
72"			32.4	30.4"
76.8	178.4	21.2	81	79"
88.8	68	8.5	—	—

Use 4.5" instead of 5'

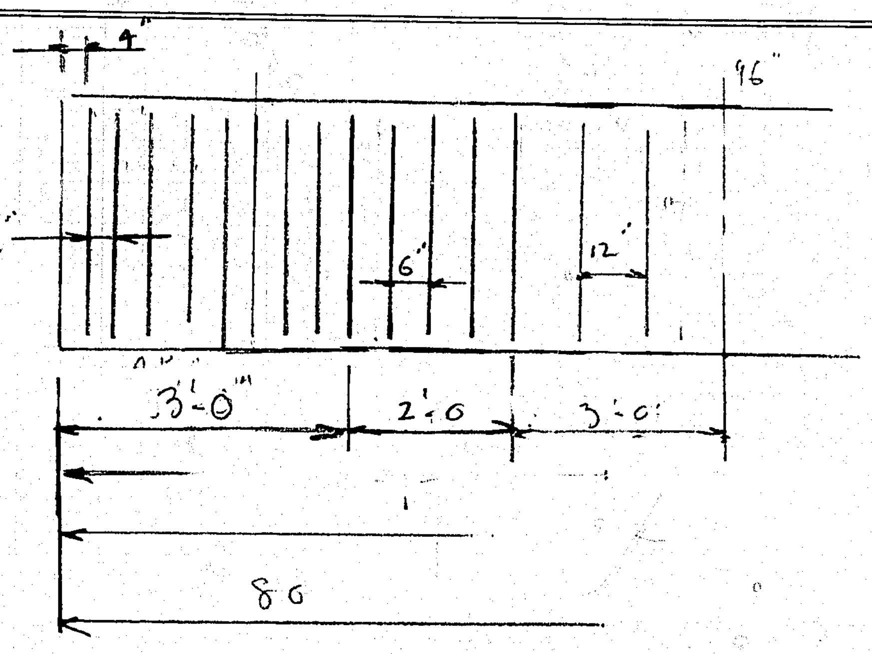
$$\text{Max } S = \frac{x_1 + y_1}{4} = \frac{50.4 + 80.4}{4}$$

$= 32.7" \sim 32"$

Cutoff @ $x = 72"$

BY W.S DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 159 OF 343

CKD. BY_____ DATE_____ SUBJECT FRONT WALL



Flexural Steel

Try $\rho = .0025$ (per TM 5)

$M_u = \rho f_y b d^2 (1 - .59 \rho f_y / f_c')$

$= .0025 \times 44 \times 54 \times (79)^2 (1 - .59 \times .0025 \times 44/5)$

$= 36600$ k-in

Applied Moment: Roof Reaction = 2500#/in

+ Direct Load on Member

Max @ 156psi Roof Load

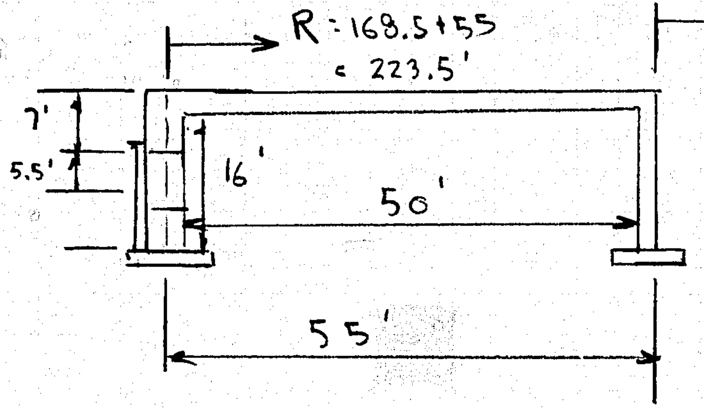
$T_n = 9.25$ psi $t_d = 12.4$ ms $t_d / T_n = 12.4/9.25 = 1.35$

DLF = 1.65 $t_m = .35 t_d = 4.34$ ms

Max Roof Resistance Developed @ 14.2 ms

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 160 OF 343
CKD. BY DATE SUBJECT FRONT WALL

Check Design for Donor to Rear of Acceptor



$R = 2W^{1/3} + 27.5'$

$= 2(70.5) + 27.5$

$= 168.5'$

Z @ Edge of Wall $= \frac{223.5}{70.5} = \underline{3.17}$

From Avg Curve given in Section on Rear Wall Design:

$P_{so} = 110$ psi

$\bar{i} = 14.5$ psi·ms/lb$^{1/3}$ $i = 1022$ psi-ms

$t_d = 2(1022)/110 = \underline{18.6 \text{ ms}}$

R to center of Door = 223.5+12.5 = 236'

$Z = 236/70.5 = 3.34$

From Above Referenced Curve

$P_{so} = 95$ psi

$\bar{i}_s = 14$ psi-ms/lb$^{1/3}$ $i_s = 987$ psi-ms

$t_d = 2 \times 987/95 = 20.8$ ms

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CKD. BY ______ DATE ______ SUBJECT FRONT WALL

From Door Design

r_u of Door = 112.3 psi

$T_n = 11.9$ ms

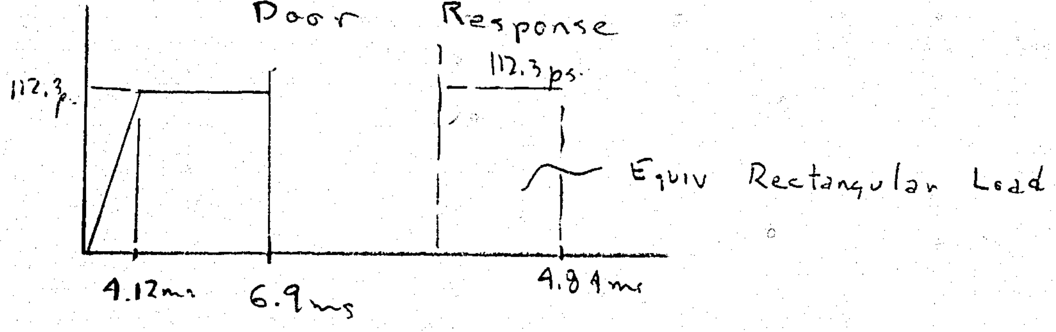
$\therefore B/r_u = 95/112.3 = .85$

$t_d/T = 20.8/11.9 = 1.75$

$\mu = 1.75$

$t_m = .33 t_d = .33(20.8) = 6.9$ ms

$t_e = \frac{112.3}{1.73(95)}(.29 \times 20.8) = 4.12$ ms



Beam Response to Direct Loading

$I_g = \frac{1}{12}(54)(84)^3 = 2.67 \times 10^6$ in^4

$\rho \sim .0025$ $n = 29/3.83 = 7.6$ $F = .135$

$I_c = .0135(54)(79)^3 = 359425$ in^4

$I_a = ½(2.67 \times 10^6 + .36 \times 10^6) = 1.51 \times 10^6$ in^4

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CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$$K = \frac{384EI}{L^3}$$

$$= \frac{384 \times 3.83 \times 10^6 \times 1.51 \times 10^6}{5(192)^3} = \underline{62.8 \times 10^6 \ \#/in}$$

Wgt : Conside wgt of Member + Wgt of Roof to crack line (~10'-6" of slab)

$$wgt = \frac{150}{1728}\left((54)(84) + (22)(126)\right)192 = \underline{121800\#}$$

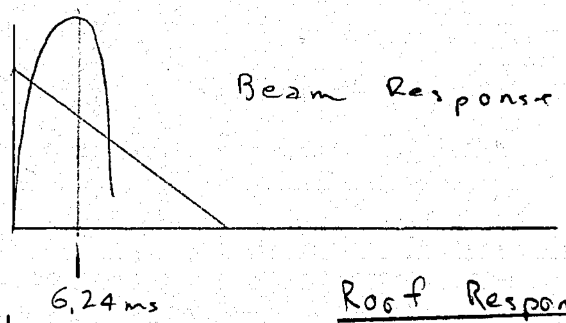
$$(K_{LM})_e = .79$$

$$T_n = 2\pi\sqrt{\frac{.79 \times 121800 \times \cancel{10^6}}{386.4 \times 62.8 \times \cancel{10^6}}} = \underline{12.5 \text{ ms}}$$

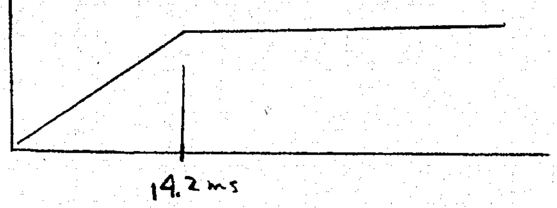
$$t_d = 18.6 \text{ ms}$$

$$t_d / T = 18.6/12.5 = 1.49 \qquad DLF = 1.68$$

$$t_m = .3\, t_d = .3(20.8) = 6.24 \text{ ms}$$



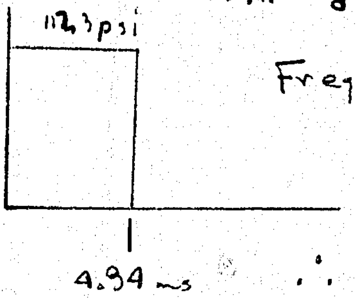
Roof Response



BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 163 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

1. The torsional Response of the Beam is a relatively low frequency response for a DLF = 1; For the equiv rectangular pulse shown on page 46 (& repeated below); Tn of beam in the torsional mode has to be 5.9 t_d or <u>28.4 ms</u>; for this



Frequency $t_m = 1.9\, t_d = 1.9(4.84) = 9.2\text{ms}$

∴ @ 6.24 ms the Effective Horiz. Load on the member is ~ $\frac{6.24}{9.2}(112.3)$

$= \underline{76.2\text{psi}}$

& The vert'l Load $= 1.68(110)(54) + \frac{6.24}{19.2}(2482)$

$= \underline{11070\,\#/\text{in}}$

$$\therefore T = \frac{76.2}{112.3}(42291) \cdot \quad 28700 \text{ k-in}$$

$$\nu_{tu} = \frac{3 \times 28700}{.85 \times (54)^2 \times 84}(10^3) = \underline{413.6 \text{ psi}}$$

$$V = 11070(96 - .15(192)) = \underline{743904^{\#}}$$

$$\nu_u = \frac{743904}{(.85)(54)(79)} = \underline{265.2 \text{ psi}}$$

$$\nu_{tc} = \frac{2.4\sqrt{4000}}{\left(1 + \left(\frac{1.2(205.2)}{913.6}\right)^2\right)^{1/2}} = \underline{130 \text{ psi}}$$

BY WS DATE 1/18 PROJECT BOX MAGAZINE TYPE A SHEET NO. 164 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

$$v_c = \frac{2\sqrt{4000}}{\sqrt{1+\left(\frac{413.6}{1.2(205.2)}\right)^2}} = \underline{64.7\,psi}$$

$$A_v = \frac{\left(\left(v_{tu} - v_{tc}\right) + 2\left(v_u - v_c\right)\right) b s}{4 f_y}$$

$$= \frac{\left(413.6 - 130\right) + 2\left(205.2 - 64.7\right)\right)(54)(4.5)}{4 \times 40000}$$

$$= .86 \, in^2 \text{ reqd} \quad \text{Available} = .93 \, in^2 \text{ ok}$$

$$A_h = \frac{13.1\left(v_{tu} - 130\right) s}{40000} = \frac{13.1(413.6-130)(4.5)}{40000}$$

$$= .42 \, in^2 \quad \text{Available} \quad .71 \, in^2 > \underline{.42 \text{ ok}}$$

@ 9.24 ms $v_{tu} = 619.8$ psi

$V \sim .5 V_m \quad v_u \sim .5(205.2) \cdot \underline{102.3\,psi}$

$$v_{tc} = \frac{2.4\sqrt{4000}}{\sqrt{\left(1+\left(\frac{1.2(102.3)}{619.8}\right)^2\right.}} = 149\,psi$$

$$v_u = \frac{2\sqrt{4000}}{5.15} = 24.6\,psi$$

$$A_v = \frac{\left(\left(619.8 - 149\right) + 2\left(102.3 - 24.6\right)\right) 4.5 \times 54}{4 \times 40000} = .95 \, in^2$$

Available - .93 in^2 say ok

$A_h = 13.1(619.8 - 149)(4.5)/40000 = .69\,in^2 < .71\,in^2$ ok

A

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BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 165 OF 343
CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Max Moment Developed on Member:

$M = wl^2/8 \qquad w = 11070^{\#}/in$

$M = (11090)(192)^2/8 = \underline{\underline{51000 \text{ k-in}}}$

$\rho = .0025$

$M_u = \rho b d^2 (1 - .59 \rho f_{dy}/f'_c) f_{dy}$

$= .0025 \times 54 \times (79)^2 (1 - .59 \times .0025 \times 44/5)(44) = 36590 \text{ k-in}$

< 51000

use $\rho = 51000/36600(.0025) = .0035$

$M_u = .0035 \times 54 \times (79)^2 (1 - .59 \times .0035 \times 44/5) 44 = \underline{50957 \text{ k-in}}$

Use $\rho = \underline{.0035}$ $\quad A_s = .0035(79)(54) = \underline{14.9 \text{ in}^2}$ btm

For top use $A_s = .0025(79)(54) = \underline{10.7 \text{ in}^2}$ top

Use 12 #10 or $\underline{10 \# 11}$

For Horiz steel use $.0025\, b S_2$

$\sim .0025 \times 54 \times 18 = 2.43 \text{ in}^2 \sim 4 \# 7$

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BY WS DATE 1/78 PROJECT Box Magazine Type A SHEET No. 166 OF 343

CKD. BY ______ DATE ______ SUBJECT FRONT WALL

Try Min Steel - .0025 for Bendng & let steel yield

M_u (page) = 36590 k-in for $\rho = .0025$

$r_u = 8M_u/l^2 = \frac{8 \times 36590}{(192)^2} = \underline{7.94^{k}/in}$

Applied Load = $110(54) + \frac{6.24}{14.2}(2482) = \underline{7030^{\#}/in}$

(see page 48 center)

$B/r_u = 7.03/7.94 = .89$

$t_d/T = 1.49$ (page 47) $\Big\}\ \mu = 1.9$

$x_m = 1.9\left(\frac{7.94 \times 192}{62.8 \times 10^3}\right) = .046$ in

$\theta = \tan^{-1}\left(\frac{.046}{96}\right) = .028^\circ << 2^\circ$ ok use $\rho = .0025$

$A_s = .0025(54)(79) = 10.6 in^2$ use $\underline{8 - \#10 \text{ Btm}}$

Rebound $\bar{r} = .55 r$ $\bar{M} = .55(36590) = \underline{20124 \text{ k-in}}$

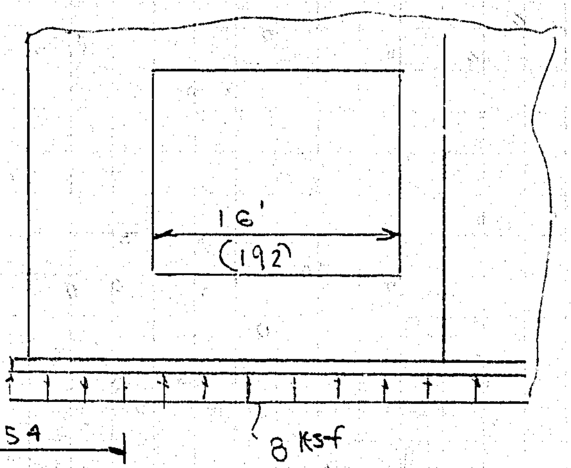
ues $\rho = .0018$ $A_s = .0018(54)(79) = 7.7 in^2$

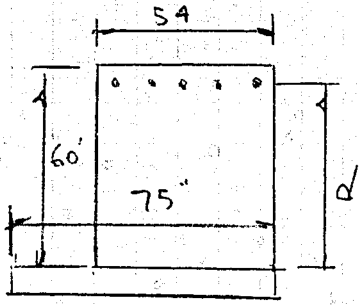
Use $\underline{6 - \#10 \text{ Top}}$

BY WS DATE 1/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 167 OF 343

CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Design of Lower Door Support Beam





Try $\rho = .0025$ for bending

$d \approx 60 - 1.5 - .875 - .625 = 57"$

$$M_u = 44(54)(57)^2\left(1 - .59 \times .0025 \times \frac{44}{5}\right)(.0025) = 19048 \text{ k-in}$$

$M = w\ell^2/8$ $\qquad w = \left(\frac{8000}{144}\right)(75) = 4166 \text{ \#/in}$

$M = (4.17)(192)^2/8 = 19215$ k-in say ok

Use $A_s = .0025(57)(54) = 7.7 \text{ in}^2$ use 5 - #11 Top

Btm A_s: $\rho = .0018$ $A_s = 5.5 \text{ in}^2$ use 3 - #11

Torsion $\quad T = 4166 \times \frac{75 - 54}{2} = 43743$ #-in/in

Design Torsion $= \frac{43743(.35(192))}{10^3} = 2939$ k-in

$$v_{tu} = \frac{3 \times 2939 \times 10^3}{.85(60)(54)^2} = 59 \text{ psi} < 1.5\sqrt{f'_c} = 94.9 \text{ psi}$$

Torsion Can be neglected

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CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Beam Shear

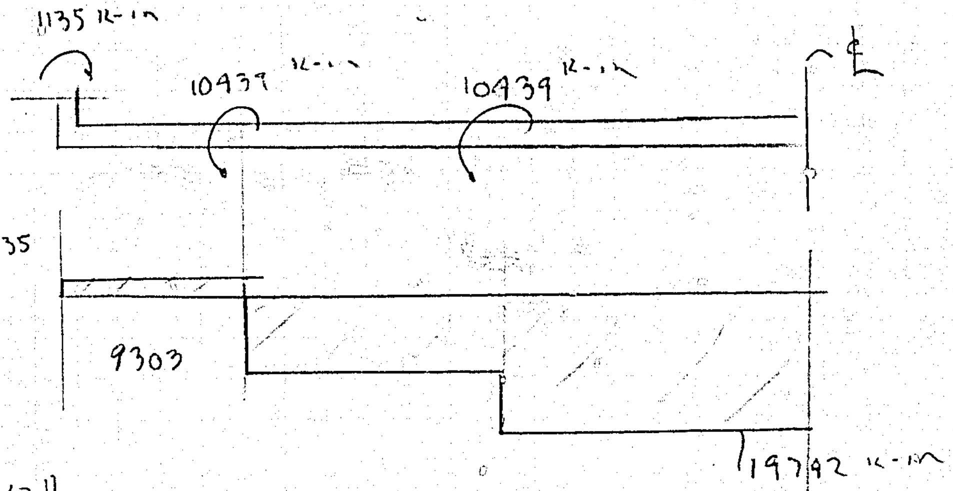
$$V @ .15\ell : 4166\left(\frac{.35(192)}{10^3}\right) : 280^k$$

$$v_u = \frac{280000}{.85(54)(57)} . \underline{107 \text{ psi}}$$

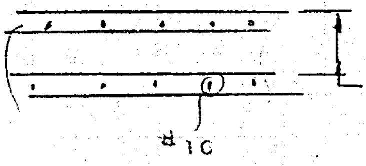
$$\text{Min Reinf Reqd} : \frac{50bS}{f_y} = \frac{50 \times 54 \times 12}{40000} = .81 \text{ in}^2$$

Use #6 stirrups @12"

Design of Lower Portion of Front Wall



30" wall



$d = 30 - 2 - 1.25 - .69 = 26.1$ in

Try #10 @ 6" $\rho = \frac{2(1.27)}{12(26.1)} = .0081$

$M_u = (60)(44)(26.1)^2(.0081)\overbrace{(1 - .59 \times .0081 \times 44/5)}^{.96}$

$= 14006$ k-in < 19742 k-in

Use #11 @ 5" $\rho = \frac{\left(\frac{12}{5}\right)(1.56)}{12(26.1)} = .0119$

$M_u = (60)(44)(26.1)^2(.0119)(.94) = 20007$ k-in

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CKD. BY ____ DATE ____ SUBJECT FRONT WALL

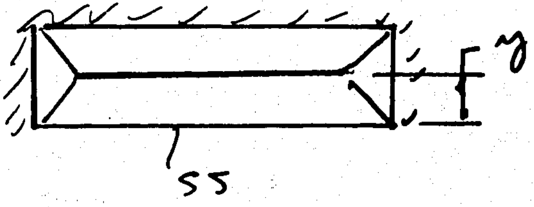
54" Wall $\quad d = 54 - 2 - 1.25 - .69 = 50"$

use #11 @ 10" $\quad \rho = \dfrac{\left(\frac{12}{10}\right)(1.56)}{12(50)} = .0031$

OK

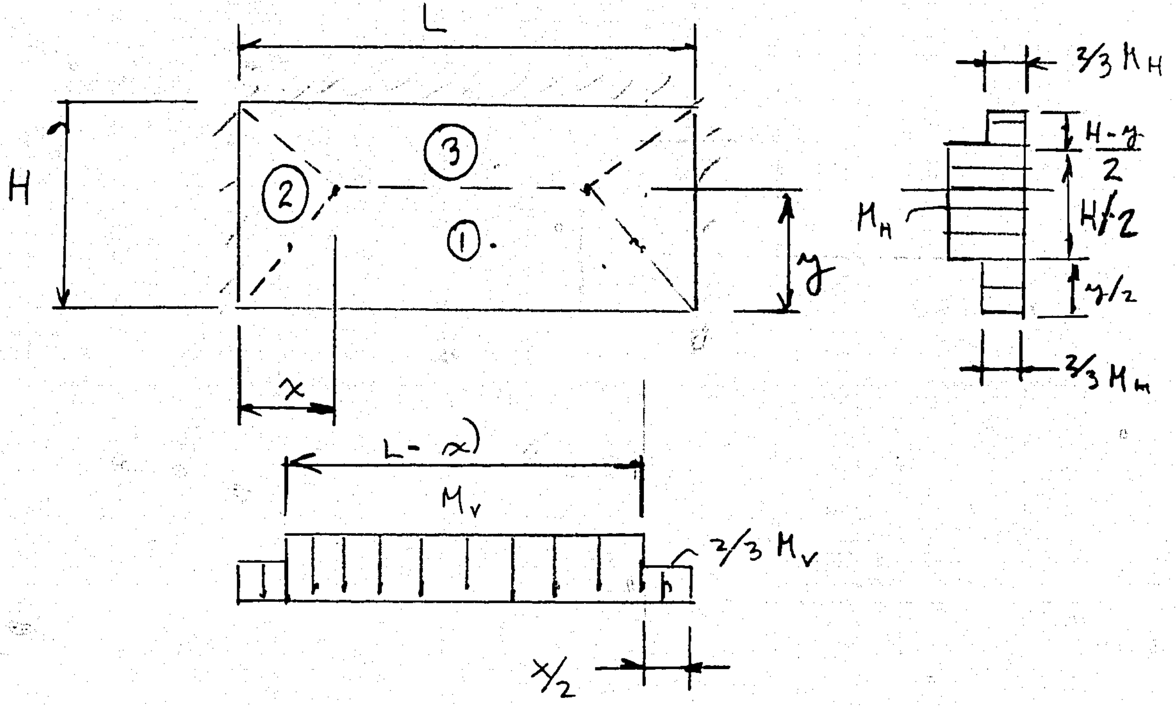
$M_u = 60(49)(50)^2(.0031)(1 - 5.2(.0031)) = \underline{20136 \text{ k-in}}$

Derivations



Equations for crack line location -

3 sides fixed
1 simply supported



Sector 1

$$\Sigma M_{vp} = M_{vp}\left(L - 2x + 2(x/2)\right) + \frac{2}{3} M_{vp}(\cancel{2})(x/\cancel{2})$$

$$= M_{vp}(L - x) + \frac{2}{3} M_{vp}\, x) = M_{vp}\left(L - x/3\right)$$

$$\Sigma M_{vN} : M_{vN}(L - x/3)$$

$$\Sigma M_{vp} + \Sigma M_{vN} = (M_{vN} + M_{vp})(L - x/3) = r\bar{y}$$

$$\Sigma A\bar{y} = y(L-2x)\, y/2 + \cancel{2}\left(\frac{x}{\cancel{2}}\right)(y)\left(\frac{y}{3}\right)$$

$$= y^2\left(\frac{L-2x}{2} + \frac{x}{3}\right) = \frac{y^2}{6}(3L - 6x + 2x)$$

$$= \frac{y^2}{6}(3L - 4x)$$

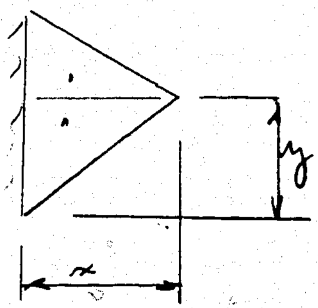
$$r = \frac{\left(\Sigma M_{vnt} + \Sigma M_{VP}\right) \tfrac{1}{3}\left(3L - x\right)}{\frac{y^2}{6}\left(3L - 4x\right)}$$

$$r_I = \frac{2\left(M_{VNt} + M_{VP}\right)\left(3L - x\right)}{y^2\left(3L - 4x\right)}$$

Sector 3 replace y by H - y

$$r_3 = \frac{2\left(M_{VNu} + M_{VP}\right)\left(3L - x\right)}{\left(H - y\right)^2\left(3L - 4x\right)}$$

Sector 2



$$\Sigma M = M_{HP}\left(\frac{H}{2}\right) + \frac{2}{3} M_{HP}\left(\frac{H}{2}\right)$$

$$+ M_{HN}\left(\frac{H}{2}\right) + \frac{2}{3} M_{HN}\left(\frac{H}{2}\right)$$

$$= \left(M_{HP} + M_{HN}\right)\left(\frac{5}{6} H\right)$$

$$A\bar{y} = \left(\frac{xy}{2}\right)\left(\frac{x}{3}\right) + \frac{x\left(H - y\right)}{2}\left(\frac{x}{3}\right)$$

$$= \frac{x^2}{6}\left(\cancel{y} + H - \cancel{y}\right) = \frac{Hx^2}{6}$$

$$r_2 = \frac{5\left(M_{HN} + M_{HP}\right)}{x^2}$$

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CKD. BY ____ DATE ____ SUBJECT FRONT WALL

For Solution

$$r_1 = r_2 = r_3$$

$r_1 = r_3$

$$\frac{\cancel{2}(M_{VP})\cancel{(3L-x)}}{y^2\cancel{(3L-4x)}} = \frac{\cancel{2}(M_{VN}+M_{VP})\cancel{(3L-x)}}{(H-y)^2\cancel{(3L-4x)}}$$

$$(H^2 - 2Hy \cancel{+ y^2})M_{VP} = y^2 M_{VN} + \cancel{y^2 M_{VP}}$$

$$\underline{M_{VN}y^2 + 2HyM_{VP} - H^2M_{VP} = 0}$$

$4H^2 + 16H^2$

$$y = \frac{-\cancel{2}HM_{VP} \pm \sqrt{(\cancel{2}HM_{VP})^2 + \cancel{4}H\,M_{VP}M_{VN}}}{\cancel{2}M_{VN}}$$

$$y = \frac{H}{M_{VN}}\left(\pm\sqrt{M_{VP}^2 + M_{VP}M_{VN}} - M_{VP}\right)$$

if $M_{VP} = M_{VN}$ $y = H\left(\pm\sqrt{2} - 1\right) = \underline{.414H}$

$\underline{r_1 = r_2}$

$$\frac{2(M_{VP})(3L-x)}{y^2(3L-4x)} = \frac{5(M_{HN}+M_{HP})}{x^2}$$

$$\frac{2(M_{VP})(3L-x)}{(.414H)^2(3L-4x)} = \frac{5(M_{HN}+M_{HP})}{x^2}$$

$r_1 = r_2$

$$\frac{11.7\,M_{VP}(3L-x)}{H^2\,(3L-4x)} = \frac{5\,(M_{HN}+M_{HP})}{x^2}$$

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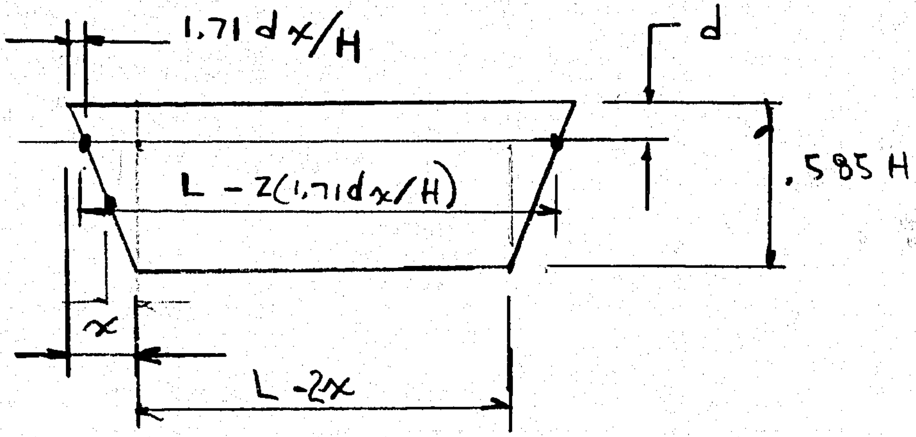
CKD. BY ____ DATE ____ SUBJECT FRONT WALL

Shear on Segment 3



$$r_u\left[(.585H-d)\left(\frac{L-2x + L-2(1.71dx/H)}{2}\right)\right]$$

$$r_u(.585H-d)\left(L-x-1.71dx/H\right)$$

$$V_v\left(L-2x+\cancel{2}(x/\cancel{2})\right) + \frac{2\times 2V_v}{3}\left(\frac{x}{2}-\frac{1.71dx}{H}\right)$$

$$V_v\left(L-2x+x\right) + \frac{4V_v}{3}\left(\frac{x}{2}-\frac{1.71dx}{H}\right)$$

$$V_v\left(L-x+\frac{2x}{3}-\frac{2.29dx}{H}\right)$$

$$=V_v\left(L-\frac{x}{3}-\frac{2.28dx}{H}\right| = r_u\left(.585H-d\right)\left(L-x-1.71dx/H\right)$$

$$V_v=\frac{r_u(.585H-d)(L-x-1.71dx/H)}{L-x/3-\frac{2.28dx}{H}}$$

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CKD. BY ____ DATE ____ SUBJECT FRONT WALL

$$V_v = \frac{3 r_u H(.585 - d/H)(1 - x/L - 1.71\, dx/HL)}{(3 - x/L - 6.84\, dx/HL)}$$

$$v_{uv} = \frac{3 r_u (.585 - d/H)(1 - x/L - 1.71\, dx/HL)}{d/H\,(3 - x/L - 6.84\, dx/HL)}$$

$$V_v = r_u (.585H)\left(\frac{L + L - 2x}{2}\right) = r_u (.585H)(L - x)$$

$$= V_v (L - x) + \frac{2}{3} V_v (\cancel{x}(x/\cancel{x}))$$

$$= V_v \left(L - x + \frac{2}{3} x\right) = V_v (L - x/3)$$

$$V_v = \frac{3 r_u (.585H)(1 - x/L)}{(3 - x/L)} 1$$

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CKD. BY ______ DATE ______ SUBJECT FRONT WALL

For $M_{vp} = 1.5 M_{vN}$

$$y = H\left(\pm\sqrt{(1.5)^2 + 1.5} - 1.5\right) = .436\,H$$

$$r_1 = r_2$$

$$\frac{10.5\,M_{vp}(3L - x)}{H^2(3L - 4x)} = \frac{5(M_{HN} + M_{HP})}{x^2}$$

$$.585\,H' = .564\,H \qquad H' = .964\,H$$

$$v_{un} = \frac{3\,r_u(.564H - d)\left(L - x - 1.77\,dx/H\right)}{d_c\left(3 - \frac{x}{L} - \overset{7.1}{\cancel{2.37}}\,dx/HL\right)}$$

$$v_{pu} = \frac{3\,r_u(.564 - d/H)\left(1 - x/L - 1.77\,dx/HL\right)}{d_c/H\left(3 - x/L - \overset{7.1}{\cancel{2.37}}\,dx/HL\right.}$$

$= 115$

SIDE WALLS

Side Walls

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 178 OF 343

CKD. BY____ DATE____ SUBJECT SIDE WALLS

Summary $T_c = 18''$

$M_v = 32043^{\#}\text{-in}/\text{in}$ $\quad d_v \sim 15.6$

$M_v/d_v^2 = 131.4$ $\quad \varphi \sim .0033$

$(A_s)_v = .0033(15.5)(12)$

$= \underline{.61 \text{ in}^2/\text{ft}}$

$M_H = 18919^{\#}\cdot\text{in}/\text{in}$ $\quad d_H \sim 14.9 \text{ in}$

$M_H/d_H^2 = 85$ $\quad \varphi \sim .0019$

$(A_s)_H = .0019(14.9)(12)$

$= .34 \text{ in}^2/\text{ft}$

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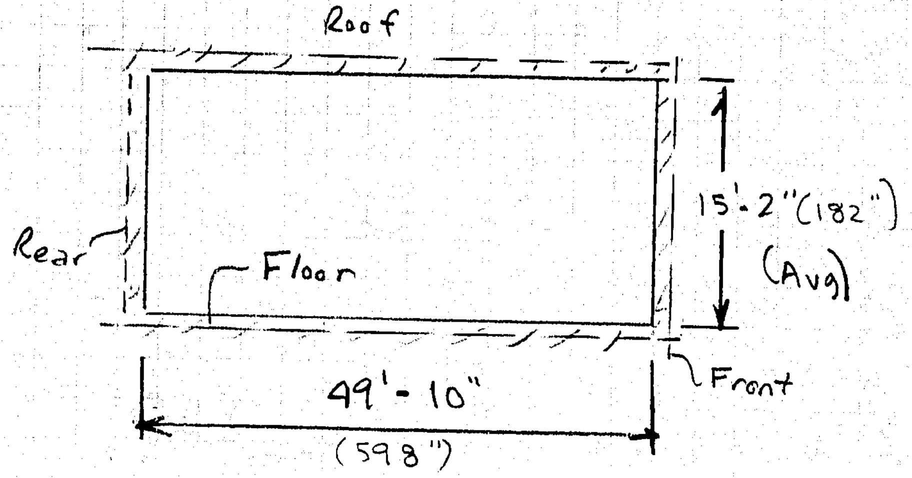
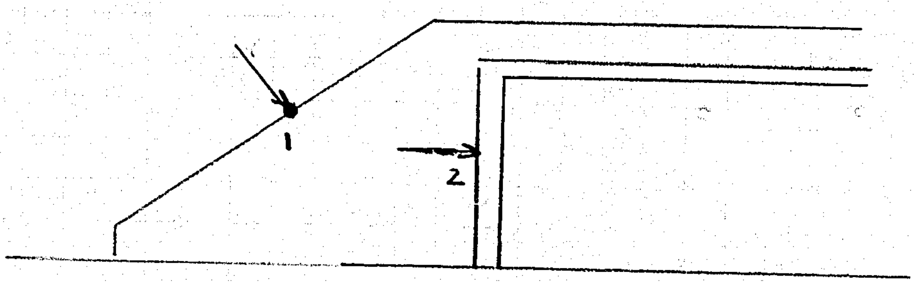
CKD. BY ______ DATE ______ SUBJECT Side Walls



Elevation

Loading



P-t @ 1 · From BLR test $P = (8.62)(14.5) = 125$ psi

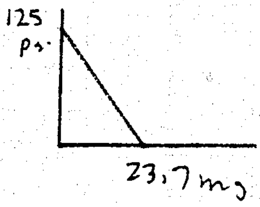
$I = (96.55)(14.5) = 1400$ psi-sec for charge of 293^K

For 350^K

$$I = 1400\left(\frac{350}{293}\right)^{1/3} = 1485 \text{ psi-sec}$$

$$t = \frac{2\times1485}{125} = \underline{23.7 \text{ ms}}$$

for pt 1



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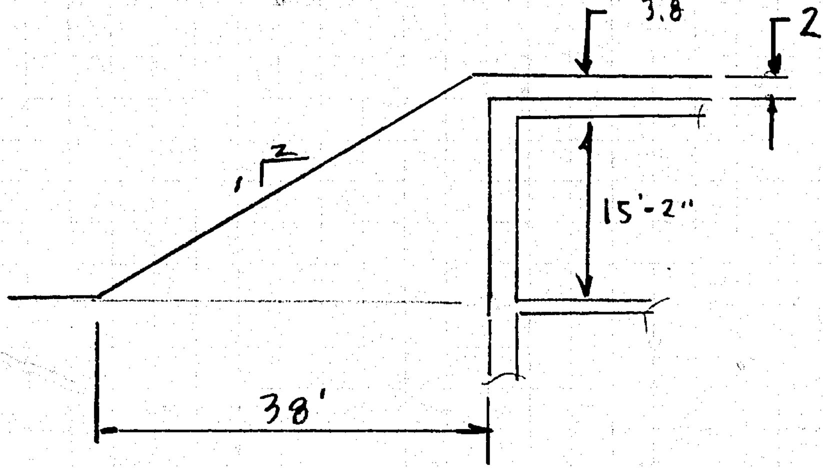
CKD. BY ____ DATE ____ SUBJECT SIDE WALLS

Determine Attenuation of pressure through soil to determine p-t @ Z

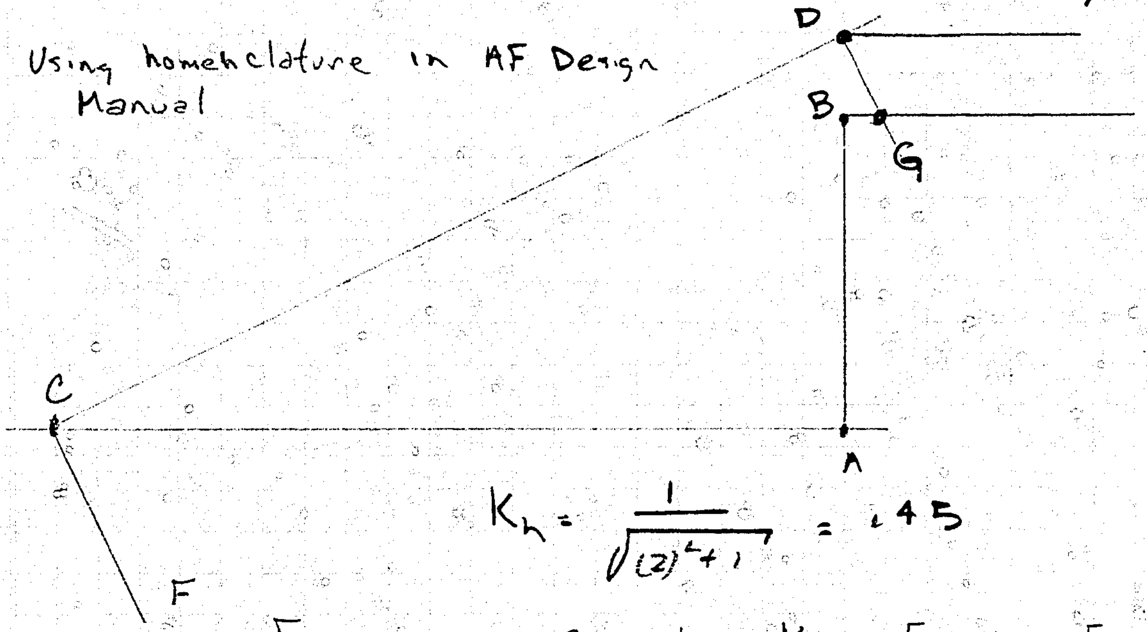


From AIR FORCE DESIGN MANUAL

Intensity Reduction Factor = $K_h = \frac{1}{\sqrt{S^2+1}}$; here S = 2

wher $K_h \geq K_o$ of Table 4-1 of that report

Using nomenclature in AF Design Manual



$$K_h = \frac{1}{\sqrt{(2)^2+1}} = .45$$

From scope of work $K_o = .5$; use .5

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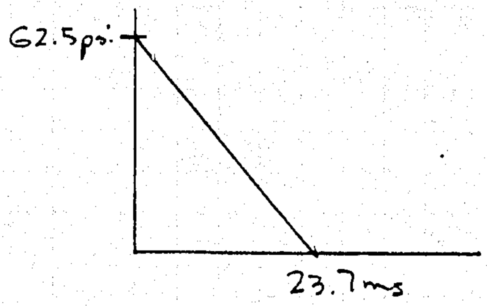
CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

Design Loading



FIRST TRIAL

Try 20" wall w/ $\varphi = .0025$

$d \sim 17.5$ $M/d^2 = 115$ $M = 35219$ #-in/in

$r_y = \frac{16M_p}{L} = \frac{16(35219)}{182} = 3096$ #/in or 17psi

$K_e = \frac{307EI}{\ell^3}$ for $n \sim 7.6$ $F \sim .013$

$I_c = .013(17.5)^3(12) = 836$ in⁴/ft

$I_g = (20)^3 = 8000$ in⁴/ft

$K_e = \frac{307 \times 3.87 \times 10^6 \times \frac{1}{2}(836+8000)}{(182)^3} = .86 \times 10^6$ #/in/ft

$m_e \sim .72 \frac{(20)(182)(12)(150)}{(1728)(386.9)} = 7.0$ #-sec²/in/ft

$T_n = 2\pi \sqrt{\frac{7.0}{.86 \times 10^6}} = .018$ sec $= 18$ ms

$$\left.\begin{array}{l} t_d/T = 23.7/18 = 1.32 \\ B/r_y = 62.5/17 = 3.7 \end{array}\right\} \mu = 80$$

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CKD. BY ____ DATE ____ SUBJECT SIDE WALLS

$$x_m = 80\left(\frac{17(182)(12)}{.86\times10^6}\right) = 3.45'' \quad \theta = \tan^{-1}\left(\frac{3.45}{91}\right) = \underline{2.17^\circ}$$

$$v_u @ d = \frac{17\times12\times(91-17.5)}{.85\times12\times17.5} = \frac{14999^{\#}}{178.5} = \underline{84\,psi}\ OK$$

Use Min steel in horiz direction

$$\frac{L}{H}\left(\frac{\Sigma M_V}{\Sigma M_N}\right)^{1/2} = \frac{598}{182}\left(\frac{.0025}{.0018}\right)^{1/2} = 3.9$$

$$x = .18L = .18(598) = 107.6''$$

$$r_u = \frac{10}{(107.6)^2}\left(35219\times\frac{.0018}{.0025}\right) = \underline{21.9\,psi}$$

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CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

Try 18" wall   w/. $\rho \sim .004$ FINAL DESIGN

$I_g = (18)^3 = 5832 \text{ in}^4$

$F = .021 \qquad I_c = .021(15.5)^3(12) = 938 \text{ in}^4$

$I_a = \frac{1}{2}(5832+938) = 3385 \text{ in}^4$

$k_e = \frac{307 \times 3.83 \times 10^6 \times 3385}{(182)^3} = .66 \times 10^6 \text{ \#/in/ft}$

$m_e = \frac{.72(18)(182)(12)(150)}{(1728)(386.4)} = 6.35 \text{ \#-sec}^2\text{/in/ft}$

$T_n = 2\pi \sqrt{\frac{6.35}{.66 \times 10^6}} = .0195 \text{ sec} = 19.5 \text{ ms}$

for $\rho = .004 \qquad M_u/d^2 = 175$

$M_u = 175(15.5)^2 = 42043 \text{ \#-in/in}$

$r_u = \frac{16(42043)}{(182)^2} = 20.3 \text{ psi}$

$t_d/T = 23.7/19.5 = 1.21$ } $\mu = 42.5$

$B/r_u = 62.5/20.3 = 3$ {

$x_m = \frac{42.5(20.3 \times 182 \times 12)}{.66 \times 10^6} = 2.85 \text{ in} \qquad \theta = \tan^{-1}\left(\frac{2.85}{91}\right)$

$= 1.8°$

$v_u @ d = \frac{20.3(\cancel{12})(91-15.5)}{.85 \times \cancel{12} \times 15.5} = 116 \text{ psi}$ ok

For min steel in other direction: $\frac{L}{H}\left(\frac{\Sigma M_V}{\Sigma M_H}\right)^{1/2} = \frac{598}{182}\left(\frac{.0040}{.0018}\right)^{1/2}$

$= 4.9$

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CKD. BY____ DATE____ SUBJECT SIDE WALLS

$x = .145\ell = .145(598) = 86.71$ in

$r_u = \frac{10}{(86.71)^2}\left(42043\left(\frac{.0018}{.004}\right)\right) = 25.2$ psi

Try 15" wall w/ $\rho = .008$

$I_g = (15)^3 = 3375$ in^4

$F = .038$ $I_c = .038(12.5)^3(12) = 890$ in^4

$I_a = 2132$ in^4

$K_e = \frac{2132}{3385}(.66\times10^6) = .42\times10^6$

$m_e = \frac{15}{18}(6.35) = 5.3$ #-sec^2/in

$T_n = 2\pi\sqrt{\frac{5.3}{.42\times10^6}} = .022$ sec

for $\rho = .008$ $M_u/d^2 = 330$

$M_u = 330(12.5)^2$

$= 51562$ #-in/in

$r_u = \frac{16\times51562}{(182)^2} = 24.9$ psi

$$\left.\begin{array}{l} t_d/T = 23.7/22 = 1.08 \\ B/r_u = 62.5/24.9 = 2.51 \end{array}\right\} \mu = 28$$

$X_m = 28\frac{(24.9\times12\times182)}{.42\times10^6} = 3.6''$ $\theta = \tan^{-1}\left(\frac{3.6}{91}\right) = 2.3^\circ$

$v@d = 24.9\times(91-12.5)/(.85\times12.5) = 184$ psi, NG

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CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

Design 18" wall for 2-way action

For r_u = 21 psi & ρ = .0018 in horiz direction

$$x = \left(\frac{10\left(42043\left(\frac{.0018}{.004}\right)\right)}{21}\right)^{1/2} = 94.9''$$

$$x/L = \frac{94.9}{598} = .16$$

$$\text{for } x = .16 \quad \frac{L}{H}\left(\frac{M_{VN}+M_{VP}}{M_{HN}+M_{HP}}\right)^{1/2} = 4.3$$

$$M_{VN}+M_{VP} = \left(\frac{4.3\times 182}{598}\right)^2 \left(\overbrace{2\times 42043\left(\frac{.0018}{.004}\right)}^{37839}\right)$$

$$= 64806 \text{ \#-in}$$

Check Shear $d/H = 15.5/182 = .085$
$x/L = .16$

$$(v_d)_v = \frac{3\times 21(.5-.085)(1-.16-2(.16)(.085))}{.085(3-.16-8(.16)(.085))}$$

$$= \frac{21.25}{.23} = 91.5 \text{ psi} \quad \text{ok}$$

All = $.85(2\sqrt{4000})$ = 107 psi > 91.5 psi ok

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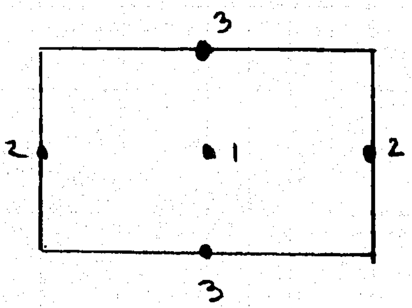
CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

Check Deflection for Plate Action



$H/L = 182/598 = ,3$

$M = \beta r H^2$

$x = \gamma r H^4/D$

$\rho_{AVG} = \frac{.003(598)+.0018(182)}{780} = ,0027$

$F = ,015 \quad I_c = .015(15.5)^3 = 55.9 \text{ in}^4$

$I_a = \frac{1}{2}(486+55.9) = 271 \text{ in}^4$

$D = \frac{E_c I_a}{(1-\mu^2)} = \frac{3.83 \times 10^6 (271)}{(1-(.15)^2)} = 1061 \times 10^6$

$M_V = 32043$ #-in/in

$M_H = 18919$ #-in/in

First Yield $\quad (H)^2 = 33123$

$\beta_3 = .083 \quad r_3 = 32043/,083(33123) = 11.7$ psi

$\beta_2 = .058 \quad r_2 = 18919/.058 \quad = 9.84$ psi

$\beta_{1V} = .042 \quad r_{1V} = 32043/,042 \quad = 23.0$ psi

$\beta_{1H} = .014 \quad r_{1H} = 18919/.014 \quad = 40.8$ psi

$\gamma = .00258$

$x_1 = \frac{9.84(33123)^2(.00258)}{1061 \times 10^6} = \underline{,026 \text{ in}}$

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CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

First Yield

$M_3 = \frac{9.84}{11.7}(32043) = 26949$ #-in/in

$M_{1V} = \frac{9.84}{23}(32043) = 13708$ #-in/in

$M_{1H} = \frac{9.84}{40.8}(18919) = 4562$ #-in/in

Second Yield

$\beta_3 = .084$ $r_3 = (32043-26940)/.084(33123) = 1.83$ psi

$\beta_{1V} = .042$ $r_{1V} = (32043-13708/.042(33123) = 13.2$ psi

$\beta_{1H} = .0135$ $r_{1H} = (18919-4562)/.0135(33123) = 32$ psi

$\gamma = .0026$

$$X_2' = \frac{1.83\,(33123)^2(.0026)}{1061 \times 10^6} = .005 \text{ in}$$

$r_2 = 11.7$ psi $X_2 = .031$ in ; $M_{1V} = 16249$ #-in/in
$M_{1H} = 5397$ #-in/in

Final Yield

$\beta_{1V} = .12$

$\beta_{1H} = .04$

$\gamma = .0125$

$X_3' = 9.3(33123)^2(.0125)/1061 \times 10^6 = \underline{.120 \text{ in}}$

$r_3 = 21$ psi $X_p = .151$ in

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 188 OF 343

CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

$r_e = 9.84$ psi $\qquad x_e = .026$ in

$r_{ep} = 11.7$ psi $\qquad x_{ep} = .031$ in

$r_u = 21$ psi $\qquad x_p = .151$ in

$$X_E = .026\left(\frac{11.7}{21}\right) + .031\left(1 - \frac{9.84}{21}\right) + .151\left(1 - \frac{11.7}{21}\right)$$

$$= .014 + .016 + .067 = .097 \text{ in}$$

$$K_E = 21/.097 = 216.8 \text{ psi/in}$$

$$W_q t = \frac{.7 \times 18 \times 150}{1728} = 1.1 \ \#/\text{in}^2$$

$$T_n = 2\pi\sqrt{\frac{1.1}{386.4 \times 216.8}} = .023 \text{ sec} = 23 \text{ ms}$$

$$\left.\begin{aligned} t_d/T &= \frac{23.7}{23} = 1.03 \\ B/r_u &= \frac{62.5}{21} = 3 \end{aligned}\right\} \mu = 33$$

$$X_m = 33(.097) = 3.2''$$

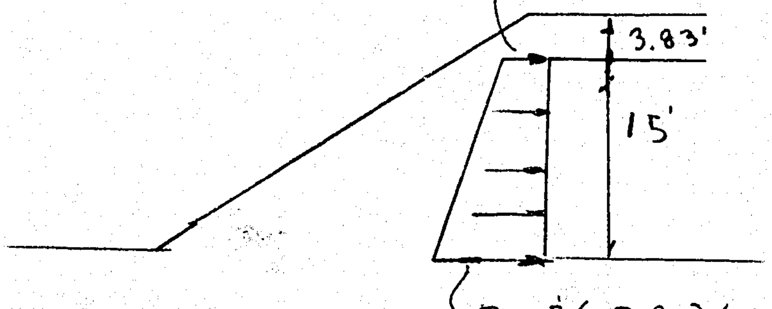
$$\theta = \tan^{-1}\left(\frac{3.2}{97}\right) = \underline{2.0^\circ \sim 2^\circ \text{ ok}}$$

<u>Check Horiz Shear</u> $\qquad d_c/x = 15.5/94 = .165$

$$v_h = \frac{3(21)(1-.165)^2}{.165(5-4(.165))} = \frac{43.9}{.72} = \underline{81.3 \text{ psi OK}}$$

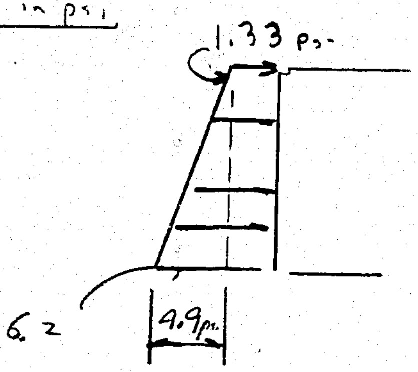
Check Hydrostatic Load on Wall

$P = .5(3.83)(.1) = .192$ k/SF



$P = .5(17.83)(.1) = \underline{.89}$ k/SF

Loading in psi



$M_{1.33} = \frac{1.33\,\ell^2}{12} = .11\ell^2$

$M_{4.9} = \frac{4.9(\ell^2)}{20} = \underline{.295\ell^2}$

$\Sigma = .355\ell^2$

$\frac{w_{eq}\cancel{\ell^2}}{12} = .355\cancel{\ell^2}$

$w_{eq} = \underline{\underline{4.3\text{ psi}}}$

Revise Response calcs for 18" Wall

$r_u = 21 - 4.3 = 16.7$ psi

$K_E = 216.8$ psi/in

$x_e = .097 - \frac{4.3}{21}(.097) = \underline{.077\text{ in}}$

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CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

$t_d / T = 1.03$

$B/r_u = \frac{62.5}{16.7} = 3.74$? ($\mu = 50$

$X_m = .02 + 50(.077) = 3.87$ in

$\theta = \tan^{-1}\left(\frac{3.87}{91}\right) = 2.4°$ OK

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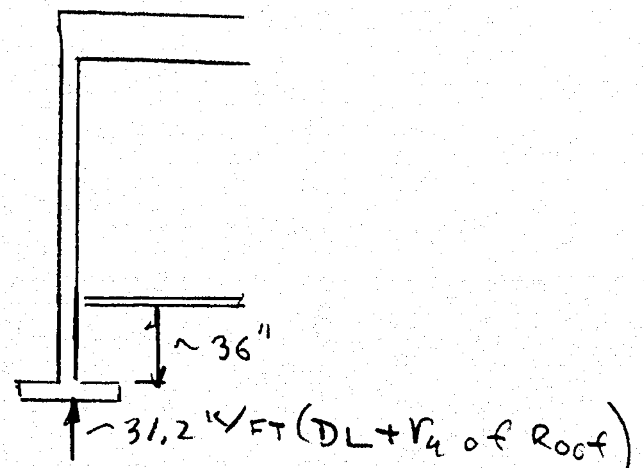
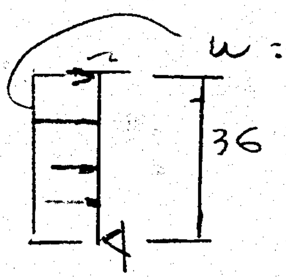
CKD. BY______ DATE________ SUBJECT SIDE WALLS

Check Development of Moment @ base of Wall



Analyze Lower portion as S-F beam w/DLF = 2



$w = 2(62.5) = 125$ psi

$M = wl^2/8 = 125(36)^2/8 = 20250$ #-in/in

Reaction = .625(125)(36) = 2813 #/in

Consider Friction

Assume $\mu = .3$

$f = .3(31,200/12) = 780$ #/in

Horiz Reaction on Footing = .375(125)(36) = 1688 #

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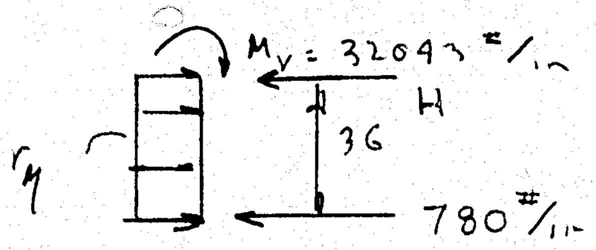
CKD. BY ____ DATE 10/19 SUBJECT SIDE WALLS



$$\frac{r_y \ell^2}{2} = 32043 + 780(36) = 60123 \text{ \#-in/in}$$

$$r_y = 92.8 \text{ psi}$$

$$H = 92.8(36) - 780 = 2561 \text{ \#/in}$$

$$K \sim \frac{8EI}{\ell^3} = \frac{8 \times 3.93 \times 10^6 \times 271}{(36)^3} = 177971 \text{ \#/in}$$

$$w_{gt} \sim \frac{18 \times 36 \times 150}{1728} + \left(\frac{48 \times 24 \times 150}{1728}\right) \sim \text{Footing}$$

$$= \underline{156^{\#}}$$

$$K_{LM} \sim .66$$

$$T_n = 2\pi \sqrt{\frac{.66(156 \times 10^6)}{386.4 \times 177971}} = 7.7 \text{ ms}$$

$$t_d/T = 23.7/7.7 = 3.1 \;?$$

$$B/r_y = 62.5/92 = .68 \quad \mu < 1.3$$

$$x_m = \left(\frac{92 \times 36}{177971}\right)1.3 = .024 \text{ in} \qquad \theta = \tan^{-1}\left(\frac{.024}{36}\right) = \underline{.04^\circ}$$

BY WS DATE 2/78 PROJECT FOX MAGAZINE TYPE A SHEET NO. 193 OF 343

CKD. BY ____ DATE ____ SUBJECT SIDE WALLS

Check Shear

$\ell_n/d = 36/15.5 = 2.3$

Critical Section @ .15ℓ from slab = 5.4" below slab

$V_u = \overset{3312}{92(36)} - 780 - 92(5.4) = \underline{2035}$ #/in

$M_u = 32043 + \frac{92(5.4)^2}{2} - 2532(5.4)$

$= 19711$ #/in

$v_c = \left(3.5 - \frac{2.5 M_u}{V_u d}\right)\left(1.9\sqrt{f'_c} + 2500\rho_w \frac{V_u d}{M_u}\right)$

$1.9\sqrt{f'_c} + 2500\rho_w \frac{V_u d}{M_u} = 126 + \frac{2500(.003)(2053 \times 15.5)}{19711}$

$= 132$

$\left(3.5 - \frac{2.5 M_u}{V_u d}\right) = 3.5 - \frac{2.5 \times 19711}{2053 \times 15.5} = 3.5 - 1.55 = 1.95$

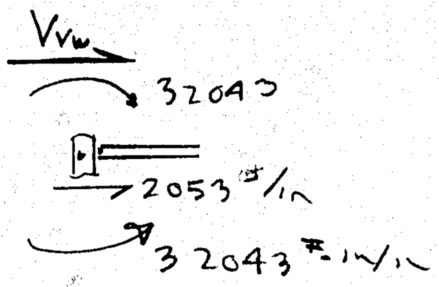
$v_c = 1.95(132) = 257.4$ psi

$v_u = \frac{2053}{.85(15.5)} = \underline{155.8 \text{ psi} < 257.4 \text{ psi OK}}$

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 194 OF 343

CKD. BY ______ DATE ______ SUBJECT SIDE WALLS

Balance Joint @ Floor



$$V_{V_w} = \frac{3 \times .27 \times 182 (1 - .16)}{2(3 - .16)} . 1695\#/in$$

Unbalance = (2053 - 1695) 5 = 1790 #-in/in - negligible

Conclusion - The lower portion of the wall (below fdn) will develop the full negative moment capacity of wall above floor

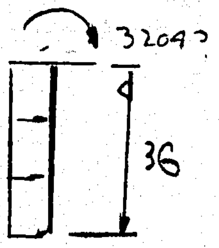
Hence - Design of Side wall as fixed @ base is valid

BY WS DATE 4/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 195 OF 343

CKD. BY DATE SUBJECT SIDE WALLS

Check Capacity without Friction Resistance

(ie Roof not fully developed)



$r_u \ell^2/2 = 32043$

$r_u = 49.4$ psi

Applied Load = 62.5 psi > 49.4 psi

Full Moment will be developed

Check Shear: $V = 49.4(.85 \times 36) = 1511$ #/in

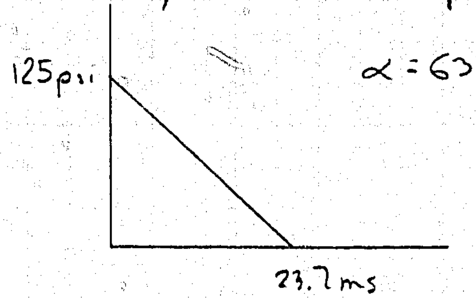
$v_c = \dfrac{1511}{.85(15.5)} = 114.7$ psi OK

M_{nv} of wall will be developed irregardless of whether roof response ~~at~~ attains $\underline{r_u}$

BY NS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 196 OF 343

CKD. BY ____ DATE ____ SUBJECT SIDE WALLS

Roof Loading for 125 psi on side mound



$\alpha = 63.4°$ $C_{r\alpha} = 2.3$

$P_{so} = 54$ psi

$3.8 < Z < 4.4$ use avg 4.1 $W^{1/3} = 70.5$

$Z_{avg} = 3.55$ $R = 4.1\,(70.5) = 289'$

R to ℄ of end span ~ $289 + 5 + 16 = 310$

$Z_{AVG} \sim 310/70.5 = 4.4$ $P_{so} \sim \frac{1}{2}(54+42) = 48$ psi

$i_s/w^{1/3} \sim 12.4$

$t_{of} = 2 \times 12.4 \times 70.5/48 = \underline{36.4\text{ ms}}$

<u>From Roof Design - Corner Panel</u>

$r = 19.5 - 3.1 = 16.4$ psi $T_n = 74$ ms

$$\left.\begin{aligned} B/r &= 48/16.4 = 2.92 \\ t_d/T &= 36.4/74 = .49 \end{aligned}\right\} \mu = 9$$

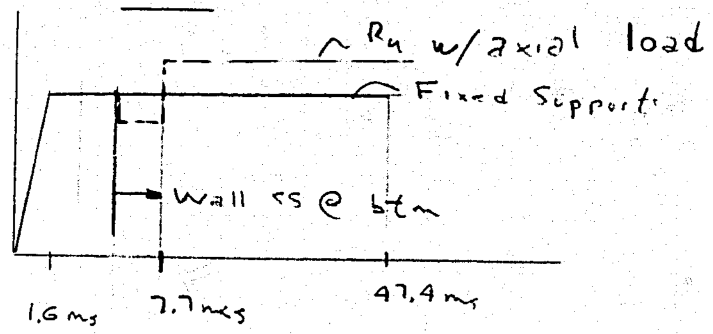
$t_m = 3T = 109.2$ ms

$t_e \sim \frac{16.4}{1.14(48)}\left(.7(36.4)\right) = \underline{7.6\text{ ms}}$

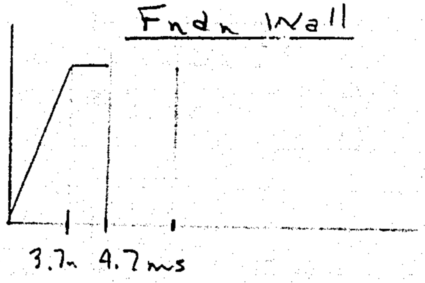
BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 197 OF 343
CKD. BY_____ DATE_____ SUBJECT SIDE WALLS

Check Phasing of Responses

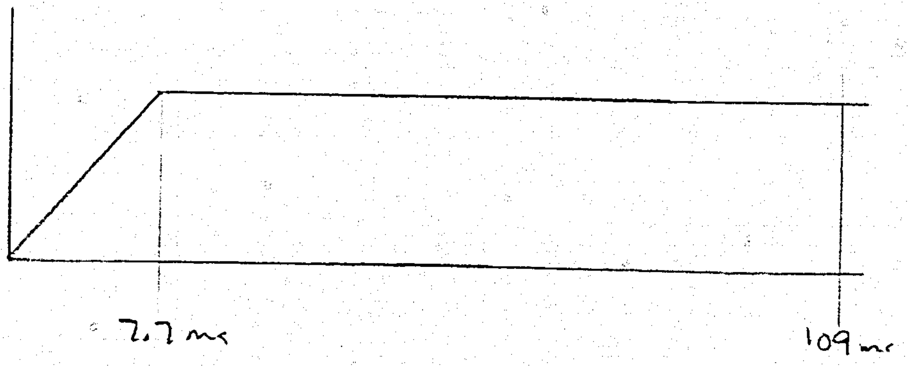
Wall



Fndn Wall



Roof Corner Panel



BACK WALL

Back wall

BY WS DATE 2/78 PROJECT Box Magazine Type A SHEET No. 198 OF 343

CKD. BY DATE SUBJECT Back Wall

Summary

$T_c = 30"$

$M_v = 120,000^{\#}\text{-in/in}$

$(A_s)_v = \underline{1.28\ \text{in}^2/\text{ft}}$

$M_H = 60500^{\#}\text{-in/in}$

$(A_s)_H = \underline{.66\ \text{in}^2/\text{ft}}$

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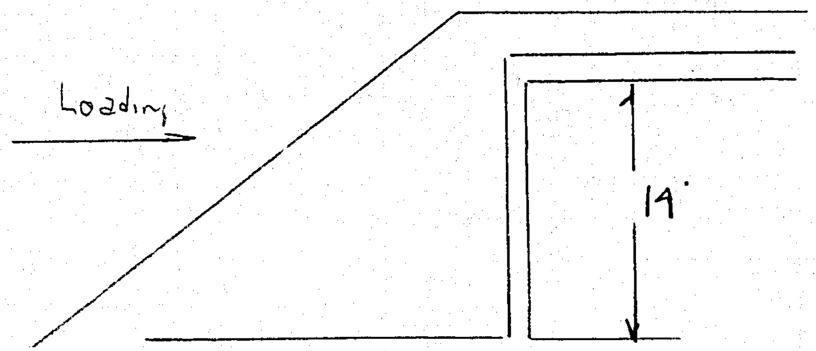
BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE -A SHEET NO. 199 OF 34

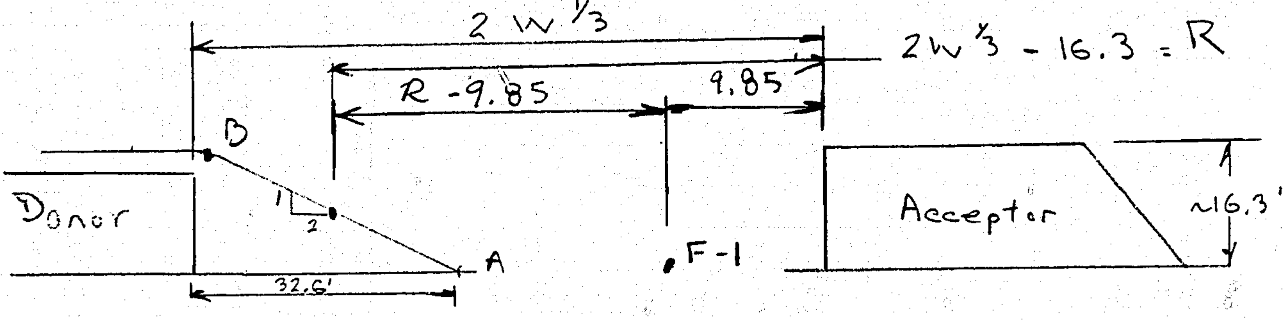
CKD. BY ______ DATE ________ SUBJECT BACK WALL

Back Wall Loading



Loading Computation

Data from BRL Report



@F-1 P_{so} = 80 psi
i_s = 825 psi-ms } for 350,000# Charge

From Table III BRL Repord

Chg. Wgt	P_{so}	Z	P_{si-ms}	R	R-9.85
98306	58	1.65	592	76'	66.2'
293904	73	1.75	816	116.7'	106.7'
486313	82	1.79	867	141'	131.2'

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 200 OF 343
CKD. BY ______ DATE ______ SUBJECT BACK WALL

Comparision of F-1 Readings for Loading on Acceptor to Rear of Donor with those on Roof For Loading on Acceptor to Front of Donor

Charge Wgt (#)	Gage	R (ft)	P_{so} (psi)	i_{so} (psi-ms)	Z (ft/$W^{1/3}$)	$W^{1/3}$
98306	UK-3	154	113	655	3.33	46.2
	UK-4	196	75	531	4.24	↓
	F-1	76	58	592		
293904	UK-3	198	170	840	3.0	66.5
	UK-4	240	89	1035	3.6	↓
	F-1	117	82	816		
486316	UK-3	206	191	900	2.5	78.6
	UK-4	262	149	1300	3.33	↓
	F-1	191	82	867		

Conclusion: Earth Mound absorbs significant amount of energy, ∴ to estimate loading on rear wall will extrapolate readings for gage: UK-3 & UK-4

Plot P_{ro} vs Z using gage. UK4
& i_{so} vs Z using gage UK4 as readings for UK-3 contain some effects of vortices

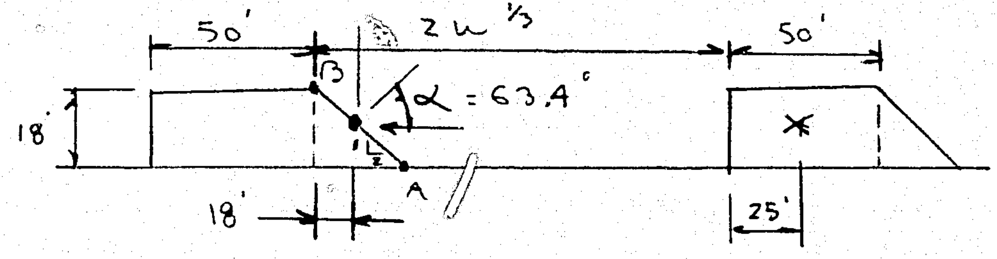
BY WS DATE 2/78 PROJECT Box Magazine Type A SHEET NO. 201 OF 2?1

CKD. BY ______ DATE ______ SUBJECT Back Wall

WGT	GAGE	R	Z	P_{so}	i_s
17640	UK-3	88.6	3.4	43.9	
(26.03)	UK-4	139	5.3	11.0	200
141120	UK-3	141	2.7	124	586
(52.1)	UK-4	191	3.7	73	1009
476280	UK-3	~~193.6~~			
(78.1)	UK-4	243.9	3.1	193	1099

For Load ℄ mid-hgt. of mound for W = 350,000#

$W^{1/3} = 70.5'$



$2(70.5) + 25 - 18 = 148'$

$Z = 148/70.5 = \underline{2.1}$

For $Z = 2.1$ $P_{so} = 270$ psi $i_s/W^{1/3} = 21$ psi-ms

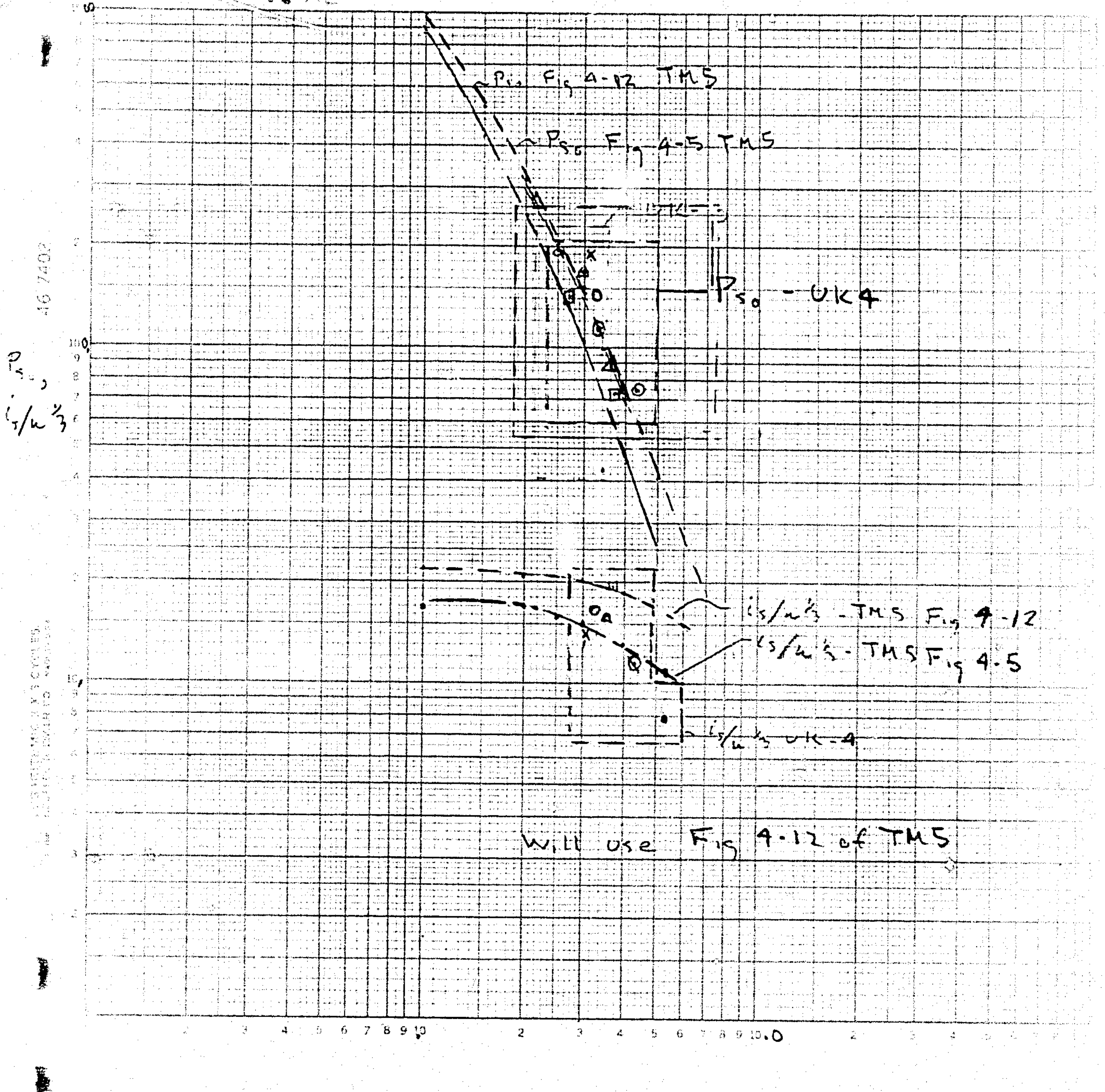
$C_{ra} = 2.3$ $P_r = 621$ psi $i_r/W^{1/3} = 210$ psi-ms

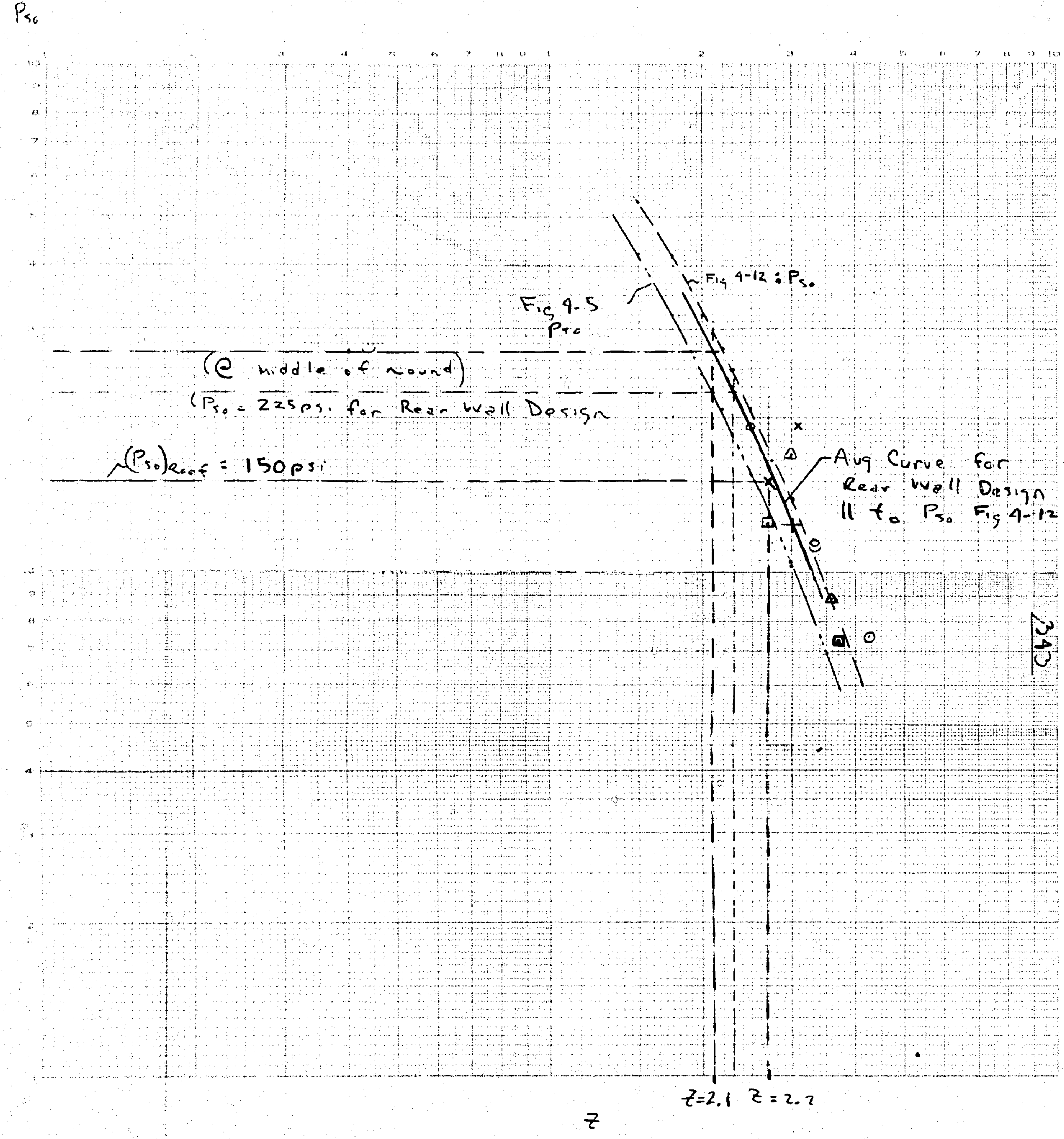
$t_c = 3S/U$ $U \sim 5$ ft/ms

$t_c = 3 \times 18/5000 = .0108$ sec

GAGE [illegible] SYMBOL	[illegible]
•	17690 #
⊙	[illegible] #
▣	141120 #
△	293909 #
×	475280 #
○	486316 #

GAGE UK-4 Symbol	Chg Wt
•	17690 #
⊙	33906 #
▣	141120 #
△	293909 #
×	454290 #
○	486316 #

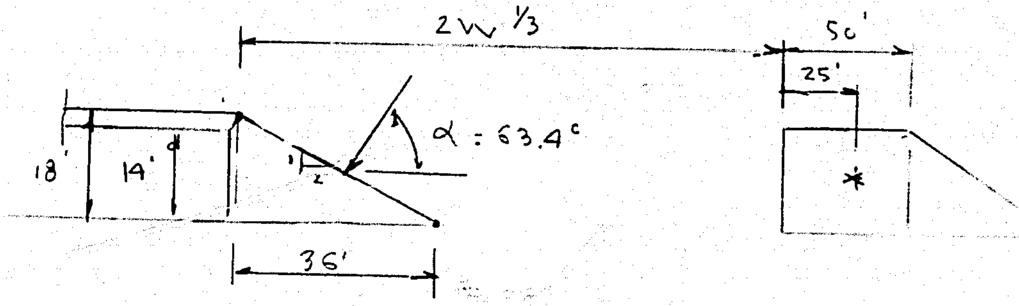



P_so
Fig 4-12 : P_so
Fig 4-5 P_so
(@ middle of round)
(P_so = 225 psi for Rear Wall Design
(P_so)_Roof = 150 psi
Avg Curve for Rear Wall Design ll to P_so Fig 4-12
Z=2.1
Z = 2.7
Z

Recorded P_{so} for UK-4 Avg out to P_{so} curve in Fig 4-12 of TM-5; P_{so} for UK-3 Avg out to curve ‖ to P_{so} of Fig 4-12 but with smaller values of P_{so} (see Fig) P_{so} of 150 psi for roof is Avg of P_{so} for Fig 4-5 & 4-12:

∴ for P_{so} use avg curve through data for UK-4
- for i_s use $i_s/w^{1/3}$ from Fig 4-5 (data averages out to this curve)

P_{so} - Plot curve
$i_s/w^{1/3}$ - Read off Fig 4-5



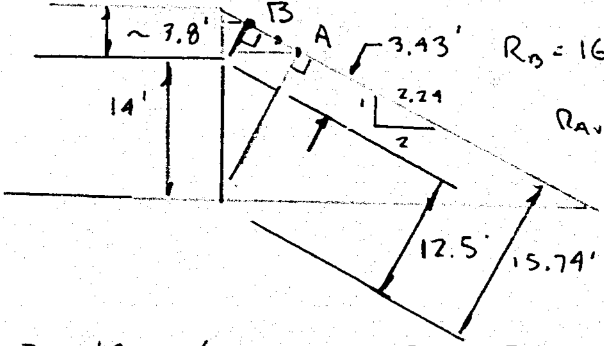
$W = 350{,}000$ lbs $W^{1/3} = 70.5$ lb $^{1/3}$

R to Wall = 2(70.5)+25 = 166'

$R_A = 166 - 15.74(1/2.24) = 158.9'$

$R_B = 166 - 3.43(1/2.24) = 164.5'$

$R_{AVG} = \underline{161.7'}$



$Z = 161.7/70.5 = \underline{2.3}$ P_{so} (Avg curve) = 225 psi

$i_s/w^{1/3}$ (Fig 4-5) = 17 psi-ms

BY [illegible] DATE [illegible] PROJECT Box Magazine Type A SHEET NO. 205 OF [illegible]

CKD. BY ______ DATE ______ SUBJECT BACK WALL

$\alpha : 63.9^\circ \quad C_{R\alpha} = 2.3 \quad P_r = 2.3(225) \cdot \underline{517.5\ psi}$

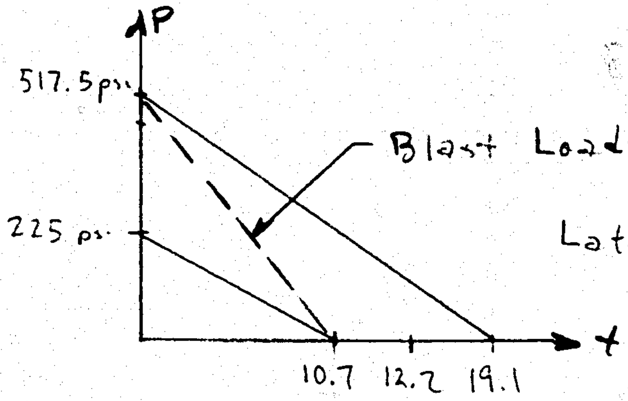
$i_R / W^{1/3} \text{ (Fig 4-5)} : 70\ psi \cdot ms \quad i_R : 4935\ psi \cdot ms$

$$t_{of} = 2\frac{(17)(70.5)}{225} : \underline{10.7\ ms}$$

$$t_r = \frac{2(4935)}{517.5} = \underline{19.1\ ms}$$

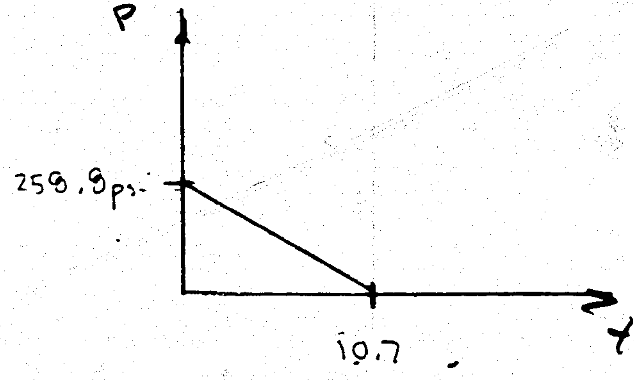
$t_c = 3S/U \qquad U \sim 3.3\ ft/ms$

$t_c = 3(14)/3.3 : \underline{12.7\ ms}$



Blast Loading on mound

Lateral Pressure Coefficient = .5

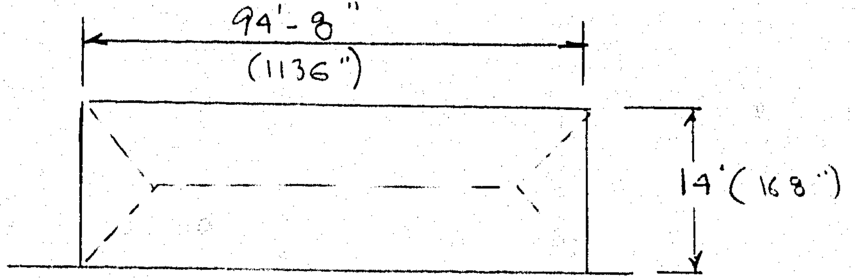


BY NS DATE 2/18 PROJECT BOX MAGAZINE TYPE A SHEET NO. 206 OF 343

CKD. BY ______ DATE ________ SUBJECT BACK WALL

Back Wall Design

FIRST TRIAL



From Side Wall Design $M_{HN} = 17021$ #-in/in (page 11)

Try Front Wall: $T_c = 26"$ $M_{VN} = M_{VP} = \underline{69080}$ #-in/in

$M_{HP} = 44066$ #-in/in

$$\frac{L}{H}\left(\frac{M_{VN}+M_{VP}}{M_{HN}+M_{HP}}\right)^{1/2} = \frac{1136}{168}\left(\frac{138160}{44066+17021}\right)^{1/2} = 10$$

$$X = .08L = .08(1136) = 90.88 \text{ in}$$

$$r_u = \frac{5(44066+17021)}{(90.88)^2} = \underline{36.9 \text{ psi}}$$

Check Deflections as one way member

$$K = \frac{307EI_a}{L^3}$$ $I_a \sim 823 \text{ in}^4$ (page 3 - front wall design)

$$K = \frac{307 \times 3.83 \times 10^6 \times 823}{(168)^3} = .204 \times 10^6 \text{ \#/in/in}$$

$$W_{st} = \frac{.7 \times 26 \times 150 \times 168}{1728} = 265 \text{ \#/in}$$

$$T_n = 2\pi\sqrt{\frac{265 \times 10^6}{386.4 \times 204000}} = 11.5 \text{ ms}$$

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 207 OF 34

CKD. BY _____ DATE _____ SUBJECT BACK WALL

$t_d/T = \frac{9.6}{11.5} = .83$

$P/q = \frac{287.5}{36.9} = 7.8$

$\Big\} \mu = 155$

$x_m = 155 \times \frac{36.9 \times 168}{207000} = 4.7''$

$\theta = \tan^{-1}\left(\frac{47}{91}\right) = 3°$ NG

$d_c/H = 23.5/168 = .139 \qquad x/L \sim .08$

$v_{uw} = \frac{3(36.9)(.5-.139)(1-.08-2(.08)(.139))}{.139(3-.08-8(.08)(.139))} = \frac{35.9}{.394} = 91.2$ psi

$v_c \sim 107.5$ psi Increase Resistance by $\frac{107.5}{91.2} = 1.18$

$\underline{r_u = 43.5} = \frac{5(M_{HN}+M_{HP})}{(90.88)^2}$

$M_{HN}+M_{HP} = 71854$ #-in/in $M_{HN} = 17021$ #-in/in

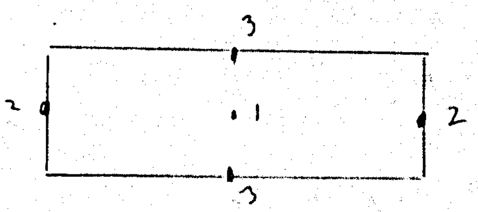
$\therefore M_{HP} = \underline{54834}$ #-in/in

$L/H \left(\frac{\Sigma M_V}{\Sigma M_H}\right)^{1/2} = 10$ for $x = .08L$

$\Sigma M_V = (10(168)/1136)^2 (\Sigma M_H) = 157149$ #-in/in

$M_{VN} = M_{VP} = \underline{78574}$ #-in/in

Compute Actual Plate Deflections



$H/L = 168/1136 = \underline{.147}$

$M_{HN} = 17021\ \#\text{-in/in}$

$M_{HP} = 54834\ \#\text{-in/in}$

$M_{VN} = M_{VP} = 78574\ \#\text{-in/in}$

$\rho_H \sim \frac{54834}{44000}(.0018) = .0022$

$\rho_V = \frac{78574}{44000}(.0018) = .0032$

$\rho_{AVG} = \frac{.0032(1136) + .0072(168)}{1136 + 168}$

$= \underline{\underline{.0031}}$

For $\rho = .0031$ $F \sim .017$

$I_a = \frac{1}{2}\left(\frac{(26)^3}{12} + .017(23.5)^3\right) = \underline{842\ \text{in}^4}$

$D = \frac{3.83 \times 10^6 \times 842}{(1-(.15)^2)} = 3300 \times 10^6$

First Yield

$M = \beta r H^2$ $X = \gamma r H^4/D$

$H^2 = 28224$

$\beta_3 = .083$ $r_3 = 78574/.083(28224) = \underline{33.5\ \text{psi}}$

$\beta_2 = .057$ $r_2 = 17021/.057(28224) = \underline{10.6\ \text{psi}}$

$\gamma = .00127$

$X_e = \frac{.00127(10.6)(28224)^2}{3300 \times 10^6} = \underline{.003\ \text{in}}$

$r_e = 10.6\ \text{psi}$ $M_3 = 24862\ \#\text{-in/in}$

$X_e = .003\ \text{in}$

Second Yield

$\beta_3 = .0835$ $\qquad r_3 = (78574 - 24862)/.0835(28224)$

$\gamma = .0026$ $\qquad = 22.8\text{ psi}$

$$x_{ep}' = \frac{.0026(22.8)(28224)^2}{3300 \times 10^6} = .0143\text{ in}$$

$x_{ep} = .0173\text{ in}$ $\qquad r_{ep} = 33.4\text{ psi}$

Final Yield

$\gamma = .013$ $\qquad \Delta r = 10.1\text{ psi}$

$$X_p = \frac{.013(10.1)(28224)^2}{3300 \times 10^6} + .0173 = .049\text{ in}$$

$r_e = 10.6\text{ psi}$ $\qquad x_e = .003\text{ in}$

$r_{ep} = 33.4\text{ psi}$ $\qquad x_{ep} = .0173\text{ in}$

$r_y = 43.5\text{ psi}$ $\qquad x_p = .032\text{ in}$

$$X_E = .003\left(\frac{33.4}{43.5}\right) + .0173\left(1 - \frac{10.6}{43.5}\right) + .049\left(1 - \frac{33.4}{43.5}\right)$$

$= .027$

$K_E = 43.5/.027 = 1625\text{ psi/in}$

r(earth pressure) = 4.3 psi

$$X_e' = .027 - \underbrace{\frac{4.3}{43.5}(.027)}_{.003} = .024$$

BY HS DATE 2/78 PROJECT FOX MAGAZINE TYPE A SHEET NO. 210 OF 243
CKD. BY ____ DATE ____ SUBJECT BACK WALL

$(K_{LM})_e = .77 \quad (K_{LM})_p = .0645 \quad K_{LM} = \frac{1}{2}(.77 + .645) = .708$

$w_q t = .708(26)(150)/1728 = 1.6$

$T_n = 2\pi\sqrt{\frac{1.60 \times 10^5}{386.4 \times 1625}} = 10.0\,ms$

$t_d/T = \frac{10.7}{10} = 1.07$

$B/r_u = \frac{258.8}{43.5 - 4.3} = 6.6 \quad \Big\} \ \mu = 190$

$X_m = .003 + 190(.024) = 4.56$

$\theta = \tan^{-1}\left(\frac{4.56}{84}\right) = \underline{3.1^\circ}$ NG

$v_{uv} = \frac{43.5}{36.9}(91.2) = \underline{107.5\,psi = v_c}$

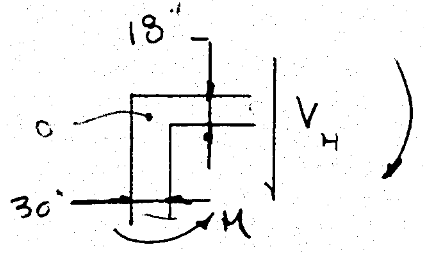
$V_{SH} = \frac{3 r_u \alpha}{5} = \frac{3(43.5)(90.98)}{5} = 23$[illegible]#/in

BY NS DATE 2/72 PROJECT BOX MAGAZINE TYPE A SHEET NO. 211 OF 343

CKD. BY ______ DATE ______ SUBJECT BACK WALL

Increase Thickness to 30"   FINAL DESI

Balance Joint @ Side Wall



$v_u = 21\,psi$

M_H 18919 #-in/in

$$V_H = \frac{3 v_u x}{5} = \frac{3(21)(94.9)}{5} = 1195\ \#/in$$

$$M_{@0} = 18919 + 1195(15) = 36855\ \#\text{-}in/in$$

$$M_{Ru} = 36855\ \#\text{-}in/in - 2372(9) = \underline{15507\ \#\text{-}in/in}$$

Try $\rho_H = .0018$

$M_u/d^2 = 80$ $d \sim 27.5$

$$M_{HP} = 80(27.5)^2 = \underline{60500\ \#\text{-}in/in}$$

$(M_{VN})_u = 80{,}000\ \#\text{-}in/in$ ~ use min steel

$\rho = .0025$ $\frac{M_v}{d^2} = 110$ $M_v = 110(27.5)^2 = 83187\ \#\text{-}in/in$

$$\frac{L}{H}\left(\frac{\Sigma M_v}{\Sigma M_H}\right)^{1/2} = \frac{1136}{168}\left(\frac{2(83187)}{60500+15507}\right) = 10$$

$x = 90.88\ in$

$$v_u = \frac{5(60500+15507)}{(90.88)^2} = 46\ psi\ \ NG$$

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 212 OF 343

CKD. BY ____ DATE ____ SUBJECT BACK WALL

Increase M_{VP} & $(M_{VN})_{Lower}$ use 120,000 #-in/in

$$\frac{(M_{VN_L}+M_{VP})}{y^2} = \frac{(M_{VN_U}+M_{VP})}{(H-y^2)}$$

$$(M_{VN_L}+M_{VP})H^2 - 2Hy(M_{VN_L}+M_{VP}) + y^2(M_{VN_L}+\cancel{M_{VP}}) =$$

$$y^2(M_{VN_U}+\cancel{M_{VP}})$$

$$y^2(M_{VN_L}-M_{VN_U}) - 2Hy(M_{VN_L}+M_{VP}) + H^2(M_{VN_L}+M_{VP}) = 0$$

$$y = \frac{\cancel{2}H(M_{VN_L}+M_{VP}) \pm \sqrt{\cancel{4}H^2(M_{VN_L}+M_{VP})^2 - \cancel{4}H^2(M_{VN_L}+M_{VP})(M_{VN_L}-M_{VN_U}}}{\cancel{2}(M_{VN_L}-M_{VN_U})}$$

$$y = H\left(\frac{M_{VN_L}+M_{VP}}{M_{VN_L}-M_{VN_U}} \pm \sqrt{\frac{(M_{VN_L}+M_{VP})^2}{(M_{VN_L}-M_{VN_U})^2} - \left(\frac{M_{VN_L}+M_{VP}}{M_{VN_L}-M_{VN_U}}\right)}\right)$$

$M_{VN_L}+M_{VP} = 240,000$ #-in/n

$M_{VN_L}-M_{VN_U} = 120,000 - 80,000 = 40,000$ #-in/in

$$y = H\left(\overset{6}{\frac{\cancel{240000}}{\cancel{40000}}} \pm \sqrt{(6)^2 - 6}\right)$$

$y = \underline{.522\,H} = \underline{87.7 \text{ in}}$

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BY WS DATE 2/78 PROJECT BQ MAGAZINE TYPE A SHEET NO. 213 OF 242

CKD. BY DATE SUBJECT BACK WALL

Try $x \sim$

$$\frac{2\,(M_{VN_L}+M_{VP})\,(3L-x)}{y^2\,(3L-4x)} = \frac{5\,(M_{HN}+M_{HP})}{x^2}$$

$y = .522\,H$

$$\frac{7.34\,(M_{VN_L}+M_{VP})\,(3-x/L)}{H^2\,(3-4x/L)} = \frac{5\,(M_{HN}+M_{HP})}{x^2}$$

Try $x = .08L = 90.88$

$$\frac{7.34\,(240000)\,(3-.08)}{(194)^2\,(3-4(.08))} = 51\text{psi}$$

$$5\frac{(60500+15507)}{(90.88)^2} = 46\text{psi}$$

$r \sim 50.4\text{psi}$ $x = 86.8\text{in} = .076\,L$

Check Deflections

$\rho_H = .0018$

$\rho_V = .0036$ } $\rho_{AVG} \sim \frac{.0018(168) + .0036(1136)}{1304}$

$= .0033$

$F \sim .018$

$I_a = \frac{1}{2}\left(\frac{(30)^3}{12} + .018(27.5)^3\right) = \underline{1312 \text{ in}^4}$

$D = \frac{1312}{842}\left(3300 \times 10^6\right) = \underline{5142 \times 10^6}$

$(M_{VN})_U = 80000$ #-in/in

$M_{VP} = 120000$ #-in/in

$(M_{VN})_L = 120000$ #-in/in

$(M_{HN}) = 15505$ #-in

$M_{HP} = 60500$ #-in/in

First Yield

$\beta_2 = .057$ $r_e = 15505/.057(28224) = \underline{9.64 \text{ psi}}$

$\gamma = .00127$

$x_e = \frac{.00127(9.6)(28224)^2}{5142 \times 10^6} = \underline{.0019 \text{ in}}$

$\beta_3 = .083$ $(M_3) = .083(9.64)(28224) = 22582$ #-in/in

Second Yield

$\beta_3 = .0835$

$y = .0026$

$(r_3)_u = \left(\frac{80000-22582}{.0835(28224)}\right) = 24.4 \, psi$

$(r_3)_L = \frac{(120000-22582)}{(.0835)(28224)} = 41.4 \, psi$

$(M_3)_L = \frac{24.4}{41.4}\left(120000-22582\right) + 22582$

$= 80000 \, \#\text{-in/in}$

$x_{ep} = \frac{.0026(24.4)(28224)^2}{5142 \times 10^6} + .0019 = \underline{.0117 \, in}$

$r_{ep} = \underline{39.04 \, psi}$

Third Yield

$y = .0054$

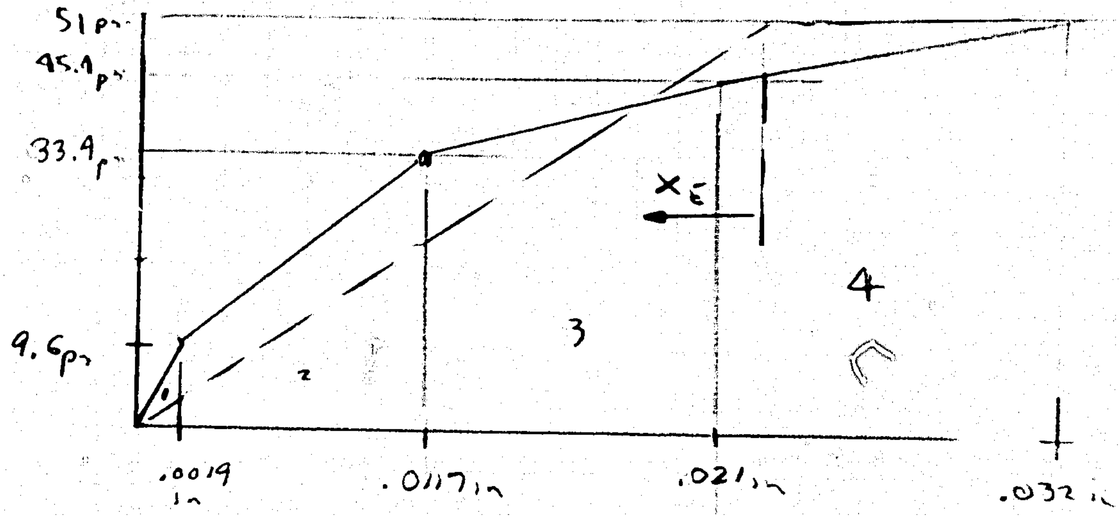
$\beta = .125 \qquad (r_3)_L = 40000/.125(28224) = \underline{11.4 \, psi}$

$(X_{ep})_1 = .0117 + \frac{.0054(11.4)(28224)^2}{5142 \times 10^6} = \underline{.021 \, in}$

$(r_{ep})_1 = \underline{45.44 \, psi}$

Final Yield $\quad \Delta r = 5.56 \, psi \quad \underline{y = .013}$

$x_p = .021 + \frac{5.56(.013)(28224)^2}{5142 \times 10^6} = \underline{.032 \, in}$



AREA ① $(9.6)(.0019)/2 = .009$

② $\left(\frac{9.6+33.4}{2}\right)(.0117-.0019) = .21$

③ $\left(\frac{45.4+33.4}{2}\right)(.021-.0117) = .36$

④ $\left(\frac{51+45.4}{2}\right)(.032-.021) = .53$

Σ 1.109

$$\frac{r_4 x_E}{2} + r_4(.032 - x_E) =$$

$$\frac{51 x_E}{2} + 51(.032 - x_E) = 1.63 - 25.5 x_E = 1.109$$

$$x_E = \frac{1.63 - 1.109}{25.5} = \underline{\underline{.02 \text{ in}}}$$

$K_E = 51/.02 = 2550$ psi/in $r_{s,1}$ 4.3 psi

$X_{DL} = \frac{4.3}{51}(.02) = .0017$ $x'_e = .02 - .0017 = .0183$

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BY WS DATE 2/75 PROJECT Box Magazine TYPE A SHEET NO. 217 OF 34?

CKD. BY ______ DATE ______ SUBJECT BACK WALL

$$u_1 t = .708(30)(150)/1728 = 1.84$$

$$T_n = 2\pi \sqrt{\frac{1.84 \times 10^6}{386.4 \times 2550}} = 8.6 \text{ ms}$$

$$\left.\begin{array}{l} t_d/T = \frac{10.7}{8.6} = 1.25 \\ B/r_1 = \frac{258.8}{51-4.3} = 5.54 \end{array}\right\} \mu = 155$$

$$X_m = .0617 + 155(.0183) = \underline{\underline{2.83 \text{ in}}}$$

$$\theta = \tan^{-1}\left(\frac{2.83}{\underline{\underline{.48(168)}}}\right) = \underline{\underline{2^\circ}}$$

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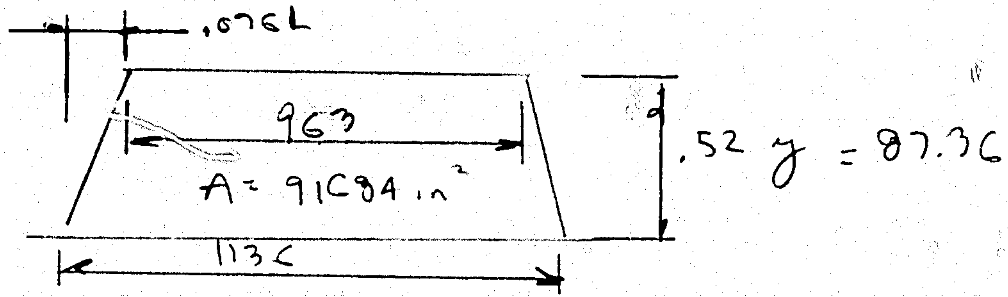
BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 218 OF 343

CKD. BY _____ DATE _____ SUBJECT BACK WALL

Check Shear Lower Section



$$N_{uv} = \frac{3v_u(.52 - d/H)(1 - x/L - 1.92dx/HL)}{d/H(3 - x/L - 7.7dx/HL)}$$

$$d/H = 27.5/168 = .164 \qquad x/L = .076$$

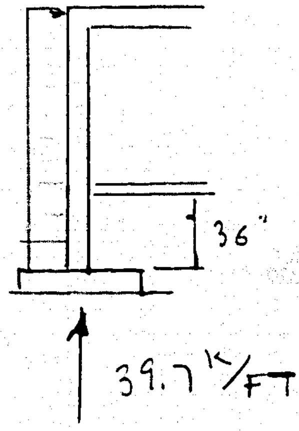
$$N_{vu} = \frac{3(51)(.52 - .164)(1 - .076 - 1.92(.076)(.164))}{.164(3 - .076 - 7.7(.164)(.076))}$$

$$= \frac{49}{.46} = 105.6 p \quad \underline{\underline{OK}}$$

$$V_v = \frac{3 \times 51(.52 \times 194)(1 - .076)}{3 - .076} = 4877 \#/L$$

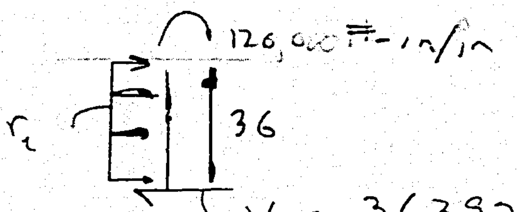
Check Development of Moment @ Lower Support

Consider Friction Support of Footing



$\mu \sim .3$

$39.7^{k}/FT$ (r_4 Roof + DL)



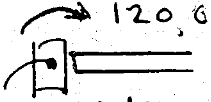
$V_H = .3\left(\frac{39700}{12}\right) . \underline{992^{\#}}$

$\frac{r_4 l^2}{2} = 120000 + 992(36)$

$r_4 = \underline{240 psi}$ $\quad V_H = 240(36) - 992 = \underline{7650}^{\#}/in$

$V@ .15 L = 240(30.8) = 7399^{\#}/in$

Check Balance @ Floor



$V = 4877^{\#}/in$

$\Sigma M_c = 120000 + 4877(5) = 144385^{\#}/in$

$\Sigma M_c = \frac{(r_4)}{2} l^2 + 5(r_4 l - 992) - 992(36)$

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BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 220 OF 343

CKD. BY ____ DATE ____ SUBJECT BACK WALL

$$v_u = \frac{185000}{828} = \underline{223\,psi}$$

$$V @ .15\,l = .85(36)(223) = 6824\ \#/in$$

$$M_u = \frac{223(30.6)^2}{2} - 992(30.6) = 74049\ \#\text{-}in/in$$

$$\frac{V_u d}{M_u} = \frac{(6824)(27.5)}{74048} = \underline{\underline{2.53}}$$

$$\frac{M_u}{V_u d} = .39 \qquad \rho = .0036$$

$$3.5 - 2.5\frac{M_u}{V_u d} = 3.5 - 2.5(.39) = 2.53 \sim 2.5$$

$$1.9\sqrt{f_c'} + 2500\,\rho_u \frac{V_u d}{M_u} = 120.2 + 2500(.0036)(2.53)$$

$$= 143\,psi$$

$$v_c = 2.5(143) = 357\,psi \qquad 6\sqrt{f_c'} = 379\,psi$$

$$v_u = \frac{6824}{.85(27.5)} = 292\,psi < 357\,psi \quad \underline{\underline{OK}}$$

Moment @ Lower Support of wall can be developed without any problems

BY WS DATE 2/78 PROJECT Box Magnum Type A SHEET NO. 221 OF 343

CKD. BY ______ DATE ______ SUBJECT BACK WALL

Check without Friction

$$M_u = 144395 = \frac{v_u l^2}{2} + 5 v_u l = 828$$

$$v_u = \underline{\underline{174 \text{ psi}}}$$

$$V @ .15 l = 174(30.6) = 5324 \ \#/\text{in}$$

$$v_c = \frac{5324}{.85(27.5)} = 227 \text{ psi}$$

$$M_u = \frac{174(30.6)^2}{2} = 81963$$

$$\frac{V_u d}{M_u} = \frac{5324 \times 27.5}{81963} = 1.8$$

$$3.5 - \frac{2.5 M_u}{V_u d} = 3.5 - 2.5(1/1.8) = 2.1$$

$$2500 \frac{\rho_w V_u d}{M_u} = 2500(.0036)(1.8) = 16.2$$

$$v_c = (2.1)(120.2 + 16.2) = 286 \text{psi} \underline{> 277 \text{psi}_{\text{OK}}}$$

Check Deflections

$$K = \frac{8EI}{l^3} = \frac{8 \times 3.83 \times 10^6 \times 1312}{(36)^3} = .86 \times 10^6 \ \#/\text{in}$$

$$W_{st} = .66\left(\frac{30 \times 36 \times 150}{1728}\right) + \frac{24 \times 60 \times 150}{1728} = 186\#$$

BY WS DATE 2/77 PROJECT Box Magazine Type 4 SHEET NO. 222 OF 343

CKD. BY ____ DATE ____ SUBJECT BACK WALL

$$T_n = 2\pi\sqrt{\frac{196 \times 10^6}{386.4 \times .86 \times 10^6}} = 4.7 \text{ ms}$$

$$t_d / T_n = \frac{10.7}{4.7} = 2.3$$

$$B/r_i = \frac{258.4}{174} = 1.48$$

$\mu = 15.5$

$$X_m = \frac{15.5(174 \times 36)}{.86 \times 10^6} = .113 \text{ in}$$

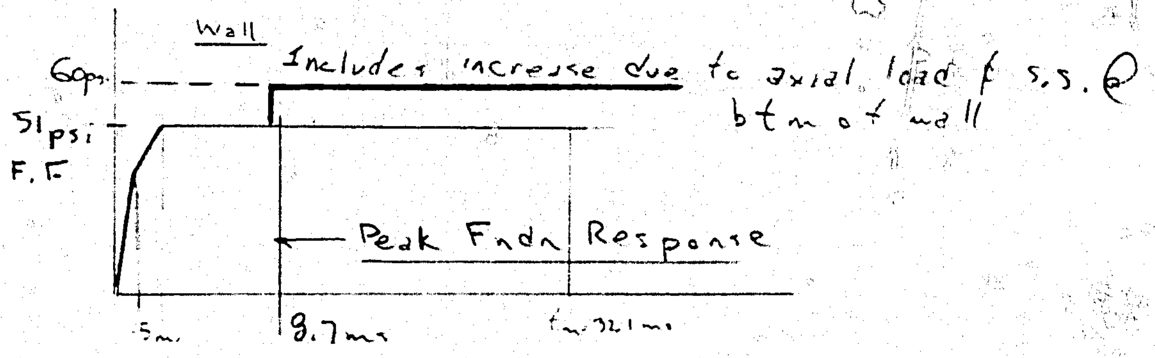
$$\theta = \tan^{-1}\left(\frac{.113}{36}\right) = .18^\circ$$ O ←

BY NS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 223 OF 34

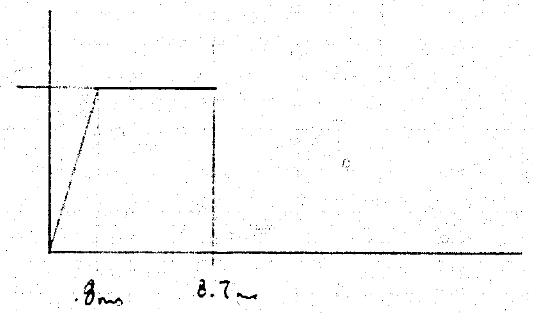
CKD. BY ____ DATE ____ SUBJECT BACK WALL

Check Phasing of Responses

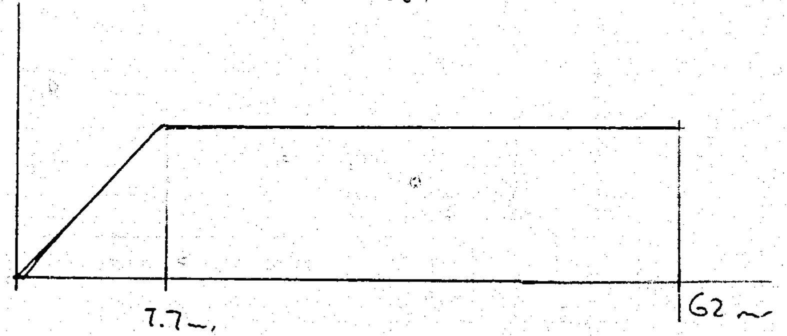
Rear Wall



Fndn Wall

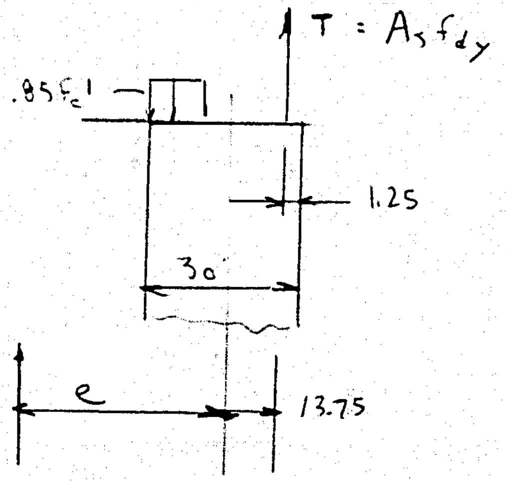


Roof



Compute Increase Wall Capacity For Axial Load

$f_c' = 5^k$



$A_s = .0037(28.8)$
$= .106 \text{ in}^2/\text{in}$
$f_y = 40^{ksi}$

$P_y = 2482^{\#}/\text{in}$

$$2482(e + 13.75) = (a) \times 1 \times .85 \times 5000(28.75 - a/2)$$

$$2482e + 34127 = 122187a - 2125a^2$$

$$2482 = a \times .85 \times 5000 - .106(40000)$$

$$a = \frac{2482 + 4240}{4250} = 1.58 \text{ in}$$

$$2482e = 122187(1.58) - 2125(1.58) - 34127 = 155571^{\#}\text{-in/in}$$

$$e = \underline{62.6"}$$

$$\text{if } e = 0 \quad \text{then } M_p = \underline{155571^{\#}\text{-in/in}}$$

$$\text{if } M_{vn} \sim 80000^{\#}\text{-in/in} \quad M_{vp}/M_{vn} = 1.94$$

<u>For SS</u> @ base of wall

$$y = H\left(\pm\sqrt{(1.94)^2 + 1.94} - 1.94\right) = .452H = 75.9"$$

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BY WS DATE 2/72 PROJECT Box Magazine Type A SHEET NO. 225 OF 243
CKD. BY ______ DATE ______ SUBJECT BACK WALL

Try $x = .08L = 90.99$ in

$$\frac{2(158000)(3(1136)-90.99)}{(75.9)^2(3(1136)-4(90.99))} = \underline{60\,psi}$$

$$= \frac{5(15505+60500)}{(90.99)^2} = 46\,psi$$

Try $x = 79.6$

$$v = \frac{2(158000)(3(1136)-79.6)}{(75.9)^2(3(1136)-4(79.6))} = \underline{59.1\,psi} > \underline{51\,psi}$$

Check Increase in Shear Capacity Due to axial load

$$v_c = 1.9\sqrt{f_c'} + 2500\,\rho_w \frac{V_u d}{M_u}$$

$$M_m = M_u - \frac{N_u(4h-d)}{8}$$

$h = 30"$
$d = 28.75$
$N_u = 2482\#$-in

$$\frac{N_u(4h-d)}{8} = \frac{2482(4(30)-27.5)}{8} = 28698\,\#\text{-in/in}$$

$$M_u \sim 158000 - 60(90.99-29.8)^2/2 = 42382\,\#\text{-in/in}$$

$$M_m = 42382 - 28698 = 13684\text{-in/in}$$

$$V_u \sim 60(90.99-27.5)$$
$$3802\,\#/\text{in}$$

$$\frac{V_u d}{M_m} = \frac{3802 \times 27.5}{13684} = 7.6$$

BY VS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 226 OF 343

CKD. BY ______ DATE ______ SUBJECT BACK WALL

$\rho = .0037$

$v_c = 1.9(63.2) + 2500(.0037)(7.6) = \underline{190.4\text{ psi}}$

$v_u = \dfrac{3802}{.85(27.5)} = \underline{163\text{ psi} < 190.4\text{ psi} \quad \text{OK}}$

BY WS DATE 2/78 PROJECT Box Magazine Type 1 SHEET NO. 227 OF 3[illegible]

CKD. BY ______ DATE ______ SUBJECT BACK WALL

Check Response with btm. simply supported

K to first yield ~ $185EI/\ell^3$; K first yield to final yield = $384EI/5\ell^3$

$M_{VN} = 80000^{\#}$-in/in

$M_{VP} = 158000^{\#}$-in/in

$M_{VN} = r_e \ell^2/8$ $\qquad r_e = 8(80000)/(168)^2 = 22.7$ psi

$$M_p = \frac{9}{128}(22.7)(168)^2 = 45048^{\#}\text{-in/in}$$

$$r_{ep} = \frac{8(158000 - 45048)}{(168)^2} = \underline{32 \text{ psi}}$$

$r_p = 32 + 22.7 = 54.7$ psi

From page 36 r_p for two way action = 60 psi

Say $r_e = 22.7$ psi $\quad r_{ep} = 60 - 22.7 = 37.3$ psi

$$x_e = \frac{(22.7)(168)^4}{185 \times 3.83 \times 10^6 \times 1312} = \underline{.019 \text{ in}}$$

$$x_p = \frac{5(168)^4(37.3)}{384 \times 3.83 \times 10^6 \times 1312} + .019 = \underline{.096 \text{ in}}$$

$$x_E = .019 + .096\left(1 - \frac{22.7}{60.0}\right) = .079 \text{ in} \qquad K_E = 60/.079 = 762.6 \text{ psi/in}$$

$w_g T = 1.84$ psi (page 18)

$$T_n = 2\pi\sqrt{\frac{1.84 \times 10^6}{386.4 \times 762.2}} = \underline{15.7\ ms}$$

$$\left.\begin{array}{l} t_d/T = \dfrac{10.7}{15.7} = .682 \\ \\ B/r_y = \dfrac{259.8}{60-4.3} = 4.64 \end{array}\right\} \mu = 37.5$$

$$x_{DL} = \frac{4.3}{60}\left(\frac{60}{762.6}\right) = .0056\ in$$

$$x_m = .0056 + (.079 - .0056)37.5 = \underline{2.76\ in}$$

$$\theta = \tan^{-1}\left(\frac{2.76}{75.9"}\right) = \underline{2.09^\circ\ ok}$$

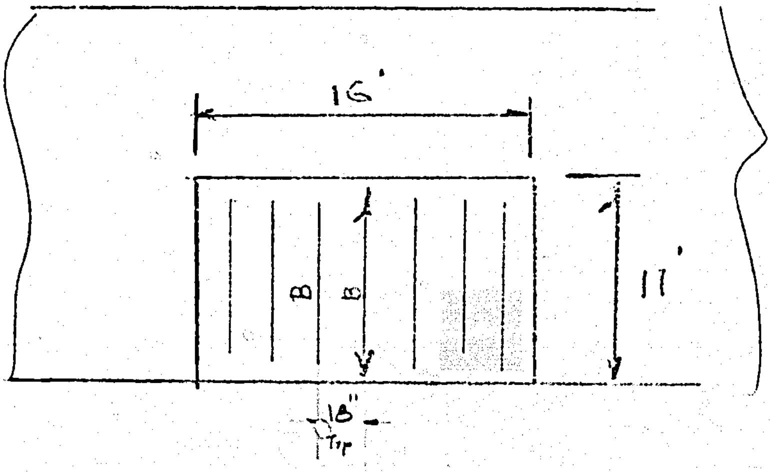
Decrease in stiffness due to SS condition @ base offset by higher r_y due to increase in moment capacity produced by axial compressive load

DOOR

Door

BY JPS DATE 1/25/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 229 OF 3A3
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

DOOR



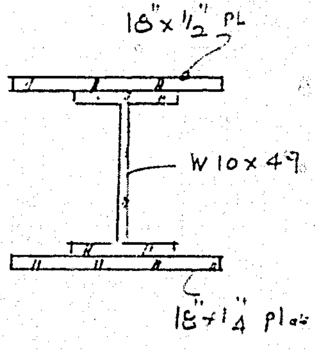
B. BEAM ELEVATION

Beam

Span: 11'-0" Simple beam. Vertically
Spacing: 16" ; End Bay < 16"
Steel : A36

Check b/t ratio

$b/t = \frac{8}{.5} = 16 \approx 15.8$ OKAY



SECTION

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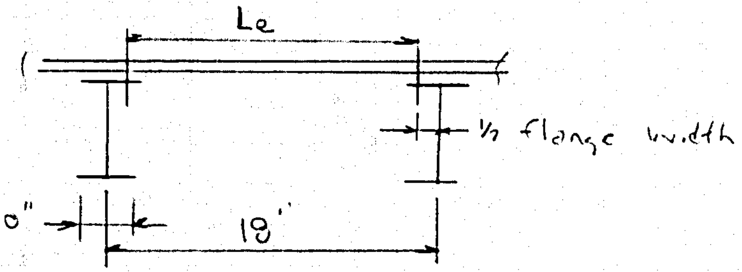
BY WS DATE 3/12 PROJECT BOX MAGAZINE TYPE A SHEET NO. 230 OF [illegible]

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Plating Design

1/2" PL w/Beams 18" OC



$L_e = 18 - 2\left(\frac{5}{2}\right) = 13"$

$F_y = 36^{ksi}$ DIF = 1.1 $F_{dy} = 1.1(36) = 39.6$ ksi

$r_u = \frac{16 M_p}{L}$ (interior span)

$M_p = \frac{f_{dy} t^2}{5} = \frac{39.6}{2}\left(\frac{(.5)^2}{6} + \frac{(.5)^2}{4}\right) = \underline{2.06 \text{ k-in/in}}$

$r_u = \frac{16(2.06)}{13} = 2.53^k = \underline{195 \text{ psi}}$

$K_E = \frac{307 EI}{L^3} = \frac{307 \times 29 \times 10^6 \times (.5)^3/12}{(13)^3} = \underline{42212 \text{ \#/in/in}}$

$X_E = \frac{195 \times 13}{42212} = \underline{.06 \text{ in}}$

$T_n = .28 L^2 \sqrt{\frac{W}{gEI}}$

L = 13/12 = 1.083'

W = 22.1 #/ft /12 = 1.84 #/ft/in

g = 32.2 ft/sec²

$E = 29 \times 10^6 \times 144 = 4176 \times 10^6$ psf

$I = \frac{(.5)^3}{248832} = .50 \times 10^{-6}$ ft⁴/in

$T_n = .28(1.083)^2 \sqrt{\frac{1.84}{32.2 \times 4176 \times 10^6 \times .50 \times 10^{-6}}}$

$T_n = .328(1.5 \times 10^{-3}) = 1.71 \times 10^{-3}$ sec = $\underline{1.71 \text{ ms}}$

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BY IVS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET No. 231 OF 343

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Loading $\quad B = 165$ psi $\quad t_d = 14.5$ ms

$$\left.\begin{array}{l} t_d/T = \frac{14.5}{1.71} = 8.5 \\ B/r_u = \frac{165}{195} = .85 \end{array}\right\} \mu = 2.75$$

$$X_m = 2.75(.06) = .165''$$

$$\theta = \tan^{-1}\left(\frac{.165}{\frac{13}{2}}\right) = 1.45^\circ < 2^\circ \text{ OK}$$

Check End Bay as simple-Fixed Member

$$r_u = 12 M_p/L = \frac{12}{16}(195) = 146.3 \text{ psi}$$

$$K_E = 160\frac{EI}{L^3} \qquad K_E = \frac{160}{307}(42212) = 22006 \text{ \#/in/in}$$

$$X_E = 146.3 \times 13/22006 = \underline{.086 \text{ in}}$$

$$T_n = .042 L^2\sqrt{\frac{w}{gEI}} \qquad T_n = \frac{.042}{.028}(1.71) = \underline{2.57 \text{ ms}}$$

$$\left.\begin{array}{l} t_d/T = \frac{14.5}{2.57} = 5.64 \\ B/r_u = \frac{165}{146.3} = 1.13 \end{array}\right\} \mu = 11.5$$

BY WS DATE 3/72 PROJECT Box Magazine Type A SHEET NO. 232 OF 343

CKD. BY ______ DATE ______ SUBJECT Blast Door

Try 16" End Bay $L_e \sim 11"$

$R_u = \frac{12 M_p}{L} = \frac{12(2.06)}{11} = 2.25^k \sim 204 \text{ psi}$

$K_E = \frac{160 \times 29 \times 10^3 \times (.5)^3/12}{(11)^3} = 36313 \text{ \#/in/in}$

$X_E = \frac{204 \times 11}{36313} = \underline{.062 \text{ in}}$

$T_n = 2.57\left(\frac{11}{13}\right)^2 = 1.84 \text{ ms}$

$$\left.\begin{aligned} t_d/T &= 14.5/1.84 = 7.88 \\ B/r_u &= 165/204 = .81 \end{aligned}\right\} \mu = 2.4$$

$X_m = 2.4 \times .062 = .149 \text{ in}$ $\theta = \tan^{-1}\left(\frac{.149}{5.5}\right) = 1.55° \text{ ok}$

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BY JP DATE 11/25/76 PROJECT BOX MAGAZINE TYPE A SHEET NO. 233 OF 343
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

STIFFENER DESIGN

section properties

Part	A	y	Ay	Ay²	Icg	Ay²+Icg
PL 18"×1/2"	9	.25	2.25	.56	-	.56
W10×49	14.40	5.50	79.20	435.60	273.00	708.60
PL 18"×1/4"	4.50	10.62	47.79	507.53	-	507.53
sum	27.90		129.24	943.69	273.00	1216.69

$\bar{y} = \frac{129.24}{27.90} = 4.63''$ ddt $A\bar{y}^2 = 598.09$

$I = 618.60 \text{ in}^4$

$S_{min} = \frac{618.60}{10.75-4.63} = 101.08 \text{ in}^3$

$\frac{S+Z}{2} = (1.1)(101.08) = 111.18 \text{ in}^3$

$M_p = (36000)(1.1)(111.18) = 4403000$ lbin

$r_u bL = \frac{8M_p}{L} = \frac{(8)(4403000)}{132} = 266850$ lbs

$r_u = \frac{266850}{(18)(132)} = 112.31$ psi

$K_E = \frac{384EI}{5L^3} = \frac{(384)(29)(10)^6(618.60)}{(5)(11)^3(144)} = 7.19\times10^6$ lbs/ft.

$X_E = \frac{r_u bL}{K_E} = .45$ in.

$T_n = .64L^2\sqrt{\frac{W}{gEI}}$

$= (.64)(11)^2\sqrt{\frac{(94.90)(144)}{(32.2)(29)(10^6)(618.60)}}\ 10^3 = 11.91$ ms msec

Where
$L = 11'-0''$
$W = 30.60+49.00+15.30 = 94.90$ lbs/ft.
$g = 32.2 \text{ ft/sec}^2$
$E = 29\times10^6$ psi
$I = 618.60 \text{ in}^4$

BY JM DATE 1/25/76 PROJECT Box Magazine Type A SHEET NO. 234 OF 342

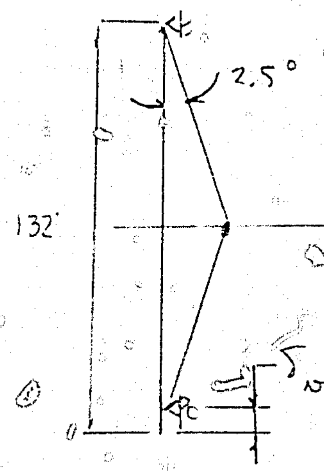
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

$$\frac{B}{r_u} = \frac{165}{112.31} = 1.47 , \qquad T/T_N = \frac{14.54}{11.91} = 1.22$$

$$\mu = 6.40$$

$$X_M = \mu Y_E = (6.4)(0.45) = 2.88 \text{ in}$$

$$\theta = \sin^{-1}\frac{X_M}{66} = \sin^{-1}\frac{2.88}{66} = 2.50^\circ$$



$$\delta_v = 2(66 - 66\cos 2.5) = \underline{.125 \text{ in}}$$

BY ____ DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 235 OF 343
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Door/Bearing Stresses on Concrete

Top & Btm f_q = 112.3 psi (5.5' width)

Sides - 195 psi - 9" width

$f_b^0 = .85\phi f'_c \quad \phi = .7$

$f_b = .85(.7)(4000) = 2380$ psi

Side Bearing Width Reqd: $\frac{195\times 9}{2380}$ = .74 in

Top & Btm Bearing Width: $\frac{112.3(66)}{2380}$ = 3.11 in use 3½"

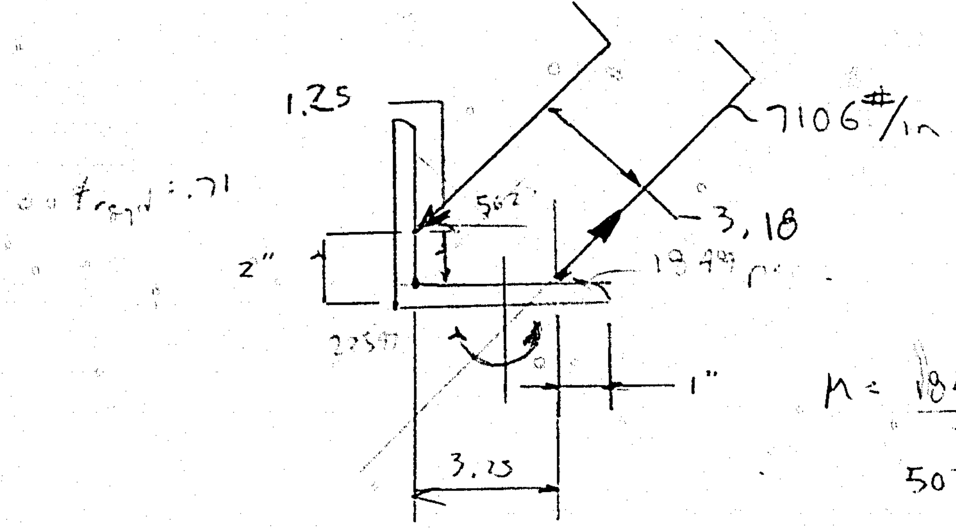
$\frac{112.3\times(66+3.5)}{3.5}$ = 2230 psi < 2380 psi OK

Use 3½" All Around

BY N DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 236 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Design of Door Bearing Support



$M = \frac{1849(x)^2}{2} - 5023(x-1)$

Space @ 11" OC

$\frac{dM}{dx} = 1949x - 5023 = 0$

P = 11×7106 = 78166#

x = 2.71

Weld Load = 78166/8 = 9770#/in

M = 1835 #-in/in

Use 3/8 weld - Dynamic Capacity = .375×21×1.87×.707

= 10.4 K/in OK

Anchorage: imbed straps 12" w/2" Hook

Surface Area of Shear prism = $2\times\left(\frac{2+12}{2}\right)(12) +$

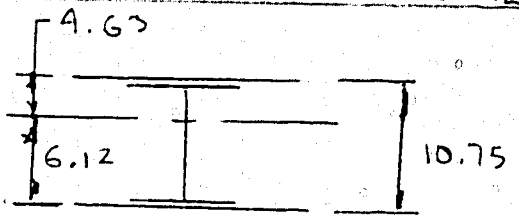
$2\left(\frac{4+12}{2}\right)(12) = 360\,in^2$

$v_c = 4\sqrt{f_c'}$ ultimate

Capacity = $(4\sqrt{4000})(360) = 91073\# > 78166\#$ OK

BY NS DATE 5/78 PROJECT Box MAGAZINE TYPE A SHEET NO. 237 OF 343
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Check Welds of Ext PL to W10x49



$I = 618.6 \text{ in}^4$

$r_u = 112.3 \text{ psi}$

$q = \frac{VQ}{I}$ $\quad V = 112.3(66)(18) = \underline{133412}$ #

$q = \frac{133142 \times 18 \times .5 \times (4.63 - .25)}{618.6} = 8501$ #/in

$= 4250$ #/in /weld

For 1/4 fillet weld continuous $\quad q = .25 \times .707 \times 21 \times 1.87 = 6.94$ k/in

> 4.25 k/in

Use 1/4" Continuous

$\tau_{max} = \frac{VQ}{It}$ $\quad Q = 18(.5)(4.63 - .25) + 10(.562)(4.63 - .5 - .281)$

$+ \frac{(4.63 - .5 - .562)(.34)}{2}$

$Q = 39.4 + 21.6 + 2.16 = 63.2 \text{ in}^3$

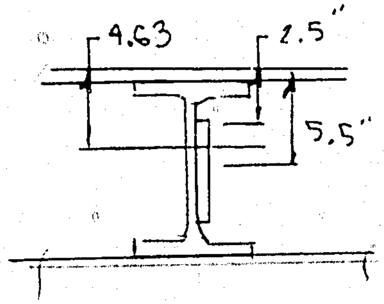
$\tau = \frac{133412 \times 63.2}{618.6 \times .34} = 40088$ psi Need web Doublers

$F_v = .55 F_y = .55(39600) = 21780$ psi need twice thickness

Weld 3/8" × 7" pl onto web

BY WS DATE 5/18 PROJECT BOX MAGAZINE TYPE A SHEET NO. 238 OF 343

CKD. BY______ DATE______ SUBJECT BLAST DOOR



$$A = 27,9 + 7 \times .375 = 30,5\ in^2$$

$$\bar{y}' = \frac{(7 \times ,375)(5.5 - 4,63)}{30,5} = ,075\ in$$

$$\bar{y} = 4,63 + ,075 = \underline{4,71\ in}$$

$$I = 618.6 + 30.5(,075)^2 + \frac{,375}{12}(7)^3 = \underline{629,5\ in^4}$$

$$Q\ @\ \text{controid} = 63,2 + (18(,5) + 10(,562) + 1,21)(,075) + (4,71 - 2,5)^2(,375)/2 = 65,3\ in^3$$

$$\tau = \frac{133412 \times 65.3}{629.5(,34 + ,375)} = \underline{19355\ psi \quad OK}$$

Check τ @ end of PL

$$Q = 18(,5)(4,71 - ,25) + 10(,562)(3,93) + \frac{(2.5 - ,5 - ,562)^2}{2}(,34)$$

$$= 40,1 + 22 + ,35 = 62,45\ in^3$$

Use square weld to develop plate & use 7 3/4" Long PL

Length of Doubler reqd

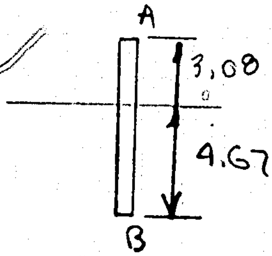
$$V = \frac{629.5(21780)(.34)}{65.3} = 71387^{\#}$$

$$w = 112.3(18) = 2021^{\#}$$

$$x = \frac{133912 - 71387}{2021} = 30.7\text{ in}$$

$$\tau = \frac{71387 \times 65.3}{629.5(.34+.375)} = 10356\text{ psi}$$

$$V \sim 10356(7.75 \times .375) = 30097^{\#}$$



$$M\ @\ 30.7\text{ in} = 133912(30.7) - \frac{2021(30.7)^2}{2} = 3.14 \times 10^6\ \#\text{-in}$$

$$\sigma_A = \frac{3.14 \times 10^6 \times 3.08}{629.5} = 15363\text{ psi}$$

$$\sigma_B = 23293\text{ psi}$$

$$I_{\text{℄}} = \frac{1}{12}(7.75)^3(.375) + 7.75(.375)(.8)^2 = 16.4\text{ in}^4$$

$$M = 15363 \times 16.4/3.08 = 81802\ \#\text{-in}$$

or

$$23293 \times 16.4/4.67 = 81806\ \#\text{-in}$$

Development Length $= \frac{81802}{30097} = 2.71''$ use 6"

Wgt Added = 9.88(3.33)(2) = 66#/Member = 658#/Door

BY WE DATE 3/ PROJECT Box Magazine Type A SHEET NO. 240 OF 343

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Check welding of 1/4 PL

$$Q = (18 \times .25)(10.75 - 4.71 - .125) = 26.6\ in^3$$

$$q = \frac{133412 \times 26.6}{629.5} = \underline{5641\ ^{\#}/in}$$

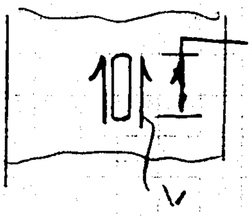
Slot Weld $t_{max} = 9/16$

$l_{max} = 2.5$

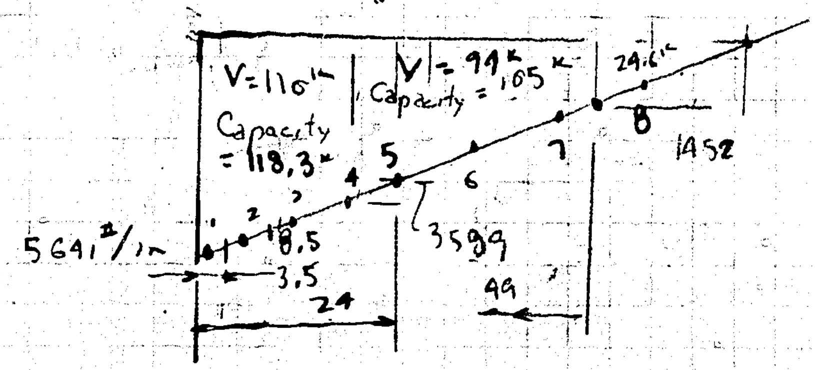
Capacity $= (.5625 \times 2.5)(21 \times 1.87) = \underline{55.2\ K}$

Min Spacing = 5 in

Spacing Capacity of PL @ weld : $F_{av} = 21^{ksi}$



$V = 2.5 \times .25 \times 2 \times 21 = \underline{26.3}^{k}$



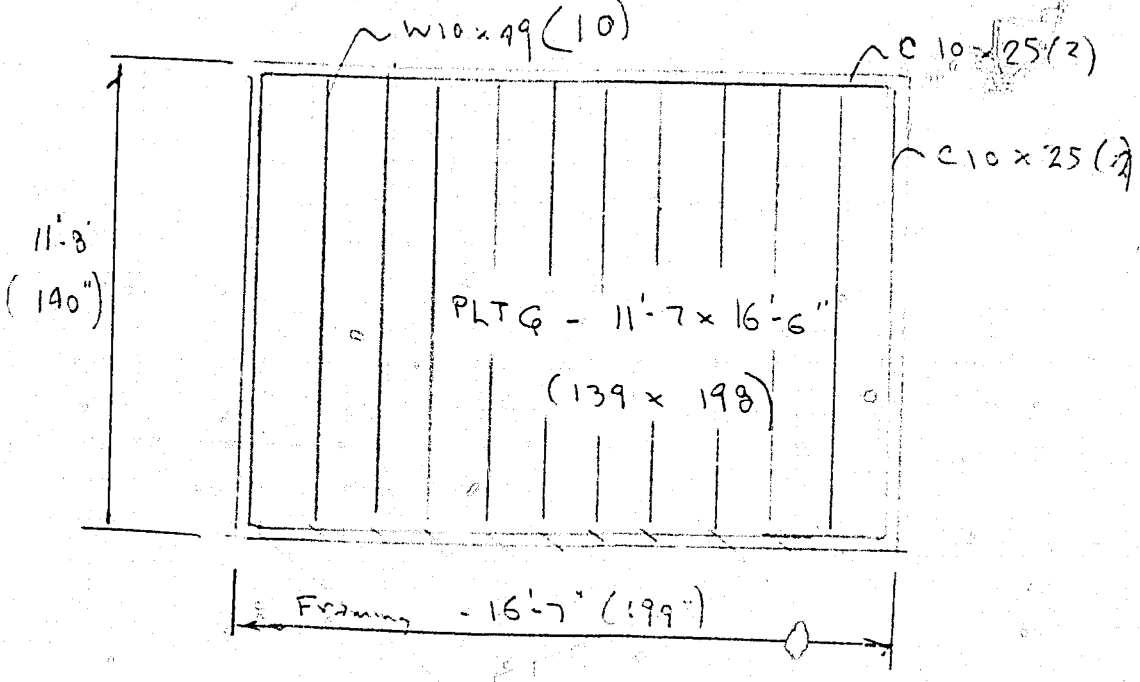
Check PL @ Weld 2 $V = \frac{5641}{2}\left(\frac{62.5}{66} + \frac{57.5}{66}\right)(5) = 25640^{\#}$

Capacity = 26300# ok

Check PL @ Weld 5 $V = \frac{5641}{2}\left(\frac{49.5}{66} + \frac{37}{66}\right)(7.5) = 26121^{\#} < 26300^{\#}$

Trolly Beam Design

Wgt of Door



Wgt

W10×49×11.67'(10) = (10)(49)(11.67) 5718#

C10×25 × 11.67'(2) = (2)(25)(11.67) 583 #

C10×25 × 16.58 (2) = (2)(25)(16.58) 829 #

1/2" PL × 139 × 198 = (236.5)(16.5) = 3902#

1/4 PL × 139 × 198 = (118)(16.5) = 1947#

Σ 12979#

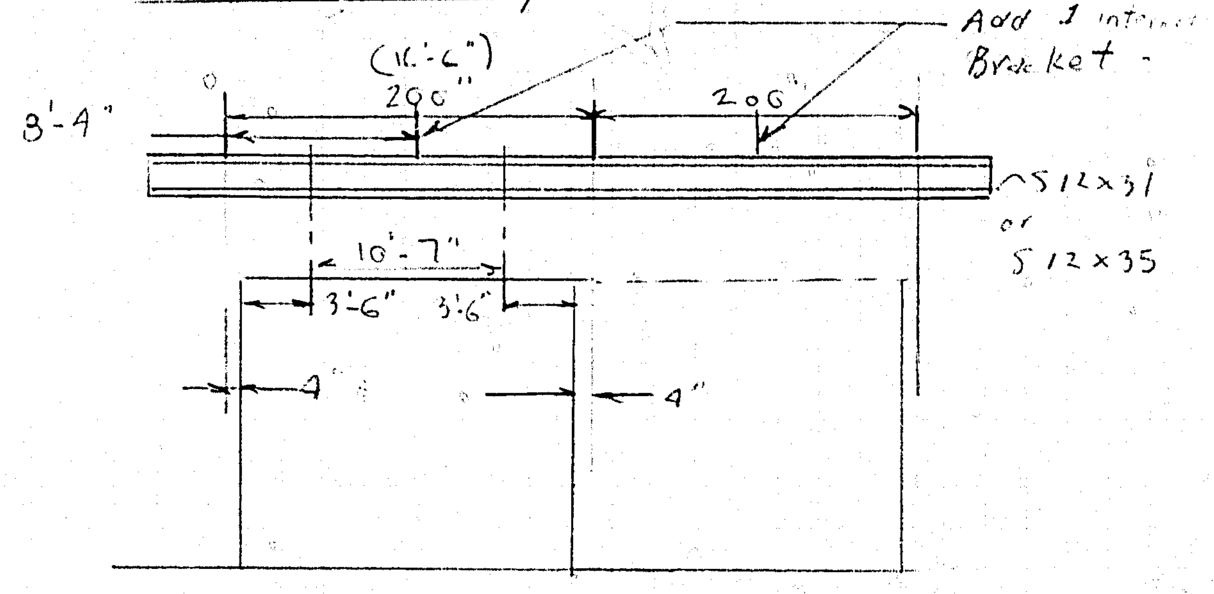
Web Reinforcement 658#

13637#

BY IVS DATE 3/78 PROJECT Box MAGAZINE Type A SHEET NO. 242 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Design of Trolly Beam



Try S12 x 31 $S = 36.4 in^3$ $I = 218 in^4$

Check for Stress: S.F Beam $M = 3/16 PL$

$P = 1/2 Wgt = 1/2(13637) = 6819\#$ Impact Factor = 1.25

$f_b = .66F_y = .66(36) = 24^{ksi}$

$M = 36.4 \times 24 = 873.6$ k-in

$$L = \frac{16 \times 873.6}{3 \times 1.25 \times 6.8} = 548 in$$

Deflection ~ .05" $= .009317 Pl^3/EI$

$$L^3 = \frac{.05 \times 29 \times 10^6 \times 218}{.009317 \times 1.25(6819)} = 3980317$$

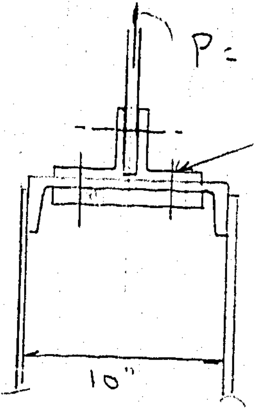
$L = 158 in$

BY WS DATE 3/78 PROJECT Box MAGAZINE TYPE A SHEET NO. 243 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

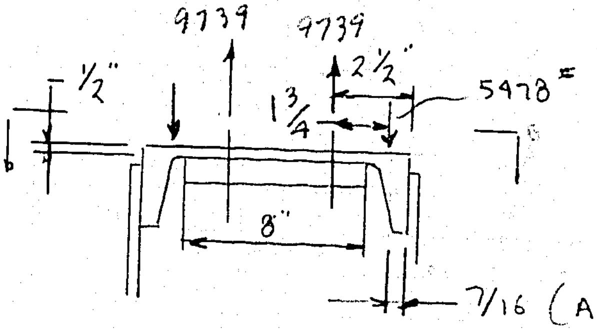
Design of Head Section

$P = 1.25(6819) = \underline{8523\#}$

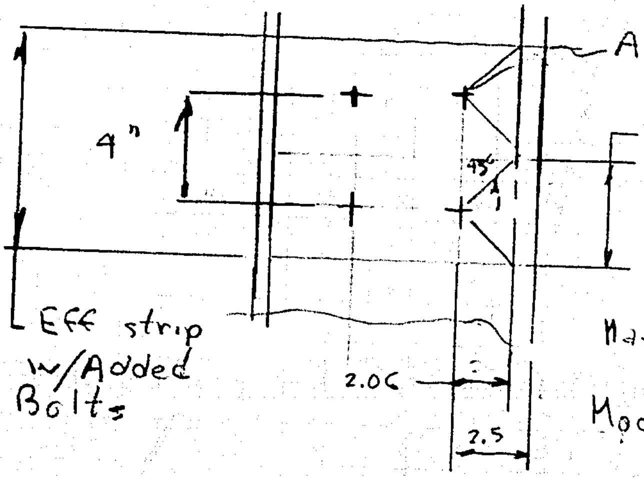


Use 3/4" Φ A325 Bolts

Capacity/Bolt = $\underline{17.6^K}$



7/16 (AVG Thickness of Flg)



Add 2 bolts

Effective Strip = 2(2.06) = 4.125

Eff strip w/Added Bolts

Max Moment = 4261(2.06) + 5975(1.75)
= 18358 #-in

Modulus of Web = $\frac{(4.125-.75)(.5)^2}{6} = .141 \text{ in}^3$

$F_b = .75F_y = .75(36000) = 27000$ psi

Capacity = 27000(.141) = 3807#-in < 18358 NG

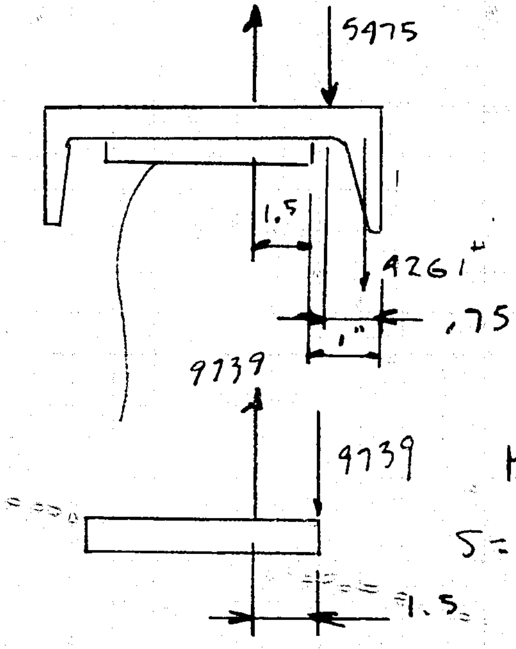
$S_{Reqd} = \frac{18358}{27000} = .68 \text{ in}^3$

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 244 OF 343

CKD. BY ______ DATE ______ SUBJECT Blast Door

Add 2 bolts - to make Effective width = 4 + 2(2.06) = 8.12

$t_{reqd} = \left(\frac{6(.68)}{8.12-1.5}\right)^{1/2} = .785"$ use 3/4" PL - 8" wide by 8 1/2" Long



$M = 9739(1.5) = 14609$ #-in

$S = \frac{(8.5-1.5)(.75)^2}{6} = .656 \text{ in}^3$

$f_b = 14609/.656 = 22261$ psi OK

M in [$= 4261(1) + 5975(.25) = 5629$ #-in

$S = \frac{(8.5-1.5)(.5)^2}{6} = .29 \text{ in}^3$

$f_b = 5629/.26 = 19306$ psi OK

Shear $= \left(\frac{4261+5975}{8.5(.5)}\right) = 2290$ psi OK

Capacity of weld of PL to [$= .707(.1875)(21000)(8.5)$
$= 23662\# > 4261\#$ OK

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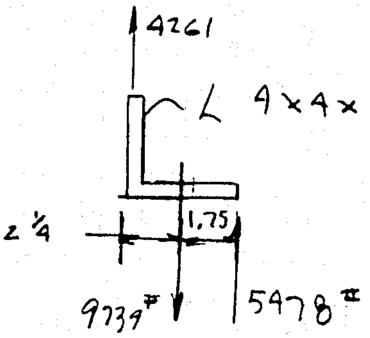
BY WS DATE 3/78 PROJECT BOY MAGAZINE TYPE A SHEET No. 245 OF 343
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Attachment L



Bending Moment in L = 4261(2.25) = 9587 #-in

$S_{Reqd} = \frac{9587}{27000} = .355 \text{ in}^3$

$t_{reqd} = \sqrt{\frac{6(.355)}{8.5}} = .5"$ use 4x4x½ L

Pin φ Reqd: $F_v = .4 F_y = 14400$ psi

$A_{Reqd} = 4261/14400 = .295 \text{ in}^2$

$d = \sqrt{\frac{4 \times .295}{\pi}} = .613$ in use 1" φ Pin

Bearing stress on L = $\frac{4261}{(\pi)(.5)}$ = 2712 psi

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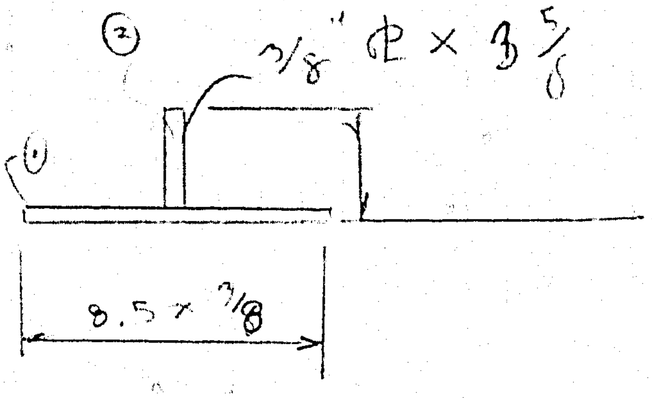
BY WS DATE 3/75 PROJECT BOX MAGAZINE TYPE A SHEET NO. 246 OF 343

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR



	A	$\bar{y}$	$A\bar{y}$	$A\bar{y}^2$	I_c
1	1.36	2.18	3	6.5	1.5
2	3.2	.19	.61	⌒	-
	4.56	.79	3.61	6.5	1.5

$I = 8 - 4.56(.79)^2$

$= 5.15 \text{ in}^4$

$S_{min} = \frac{5.15}{3.21} = 1.6 \text{ in}^3$

$f_b = 9597/1.6 = 6000 \text{psi}$

use 4×4×3/8 L

$\sqrt{(32.2)(29)(10^6)(618.60)}$ = 11.97 ms E = 29×10 psi

I = 618.60 in⁴

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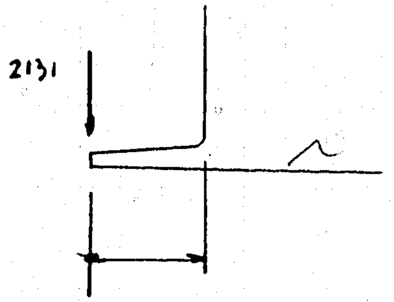
BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 247 OF 343

CKD. BY____ DATE____ SUBJECT Blast Door

Check Local Bending Stresses in Track Flange - Lower

4 - Rollers/Trolly - 8522#/Trolly

2131#/Roller



S12 × 31 $t_f = .544$ in

$M = .51P = .51(2131) = 1086$ #·in

$S = (.544)^2/6 = .049$ in²

$f_b = 1086/.049 = 22018$ psi $F_b = .75F_y = 27000$ psi

OK

Check Compability of Details w/ 22' Door

Increase in stresses = 22/16 = 1.375

1. PL Stress (Page 4) 22261(1.375) = 30608 psi NG

   Use 9" wide PL $F_b = \left(\frac{8-1.5}{9-1.5}\right)(30608) = 26527$ psi ok

2. Bolt Tension T = 9739(1.375) = 13391# < 17000# OK

3. [Web bending stresses = 19300(1.375) = 26537 psi OK

4. ∠ bending S reqd = 1.375(.355) = .488 in³

   $t = \sqrt{6(.488)/9} = .57$ in use 4×4×5/8∠

5. Pin ϕ $\sqrt{\left(\frac{4 \times .295}{\pi}\right)1.375} = .718$ 1" ϕ ok

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 248 OF 343
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

6. Bending of Lower Track Flange

$f_b = 1.375(22018) \cdot 30275$ psi NG conservative

Use Procedure given in BHP Monorail Beam Design Manual

Transverse stress $= 2.4P/t^2$

$$f = \frac{2.4 \times 2131 \times 1.375}{(.544)^2} = \underline{23763 \text{ psi} < 27000 \text{ psi}} \text{ OK}$$

Long'l Stress

$$F_b = \frac{2.75P}{t^2} + f_b = \frac{2.75(2131)(1.375)}{(.544)^2} + f_b \leq F_y/1.1$$

$$= 27288 \text{ psi} + f_b \quad ; \quad M = 3/16 P\ell \quad \ell \sim 100''$$

$$f_b \text{ : } M = \frac{3[1.375(4 \times 2131)](100)}{16} = 219759 \text{ \#-in}$$

$S = 36.4 \text{ in}^3 \quad f_b = 219759/36.4 = 6037$ psi

$F_b = 27288 + 6037 = 33325$ psi

$F_y/1.1 = 32727$ psi according to above manual this stress level is tolerable as the local Long'l stress $\left(2.75P/t^2\right)$ is a peak occuring on a extremely small area on the lower surface of the flange directly beneath the roller; also f_b is < 6037 since the trolly wheels are ~12" apart

Avg Local stress $= .25P/t^2 = \frac{.25(1.375)(2131)}{(.544)^2} = 2475$ psi

$f_b = 6037 + 2475 = 8512$ psi < 24000 psi ok

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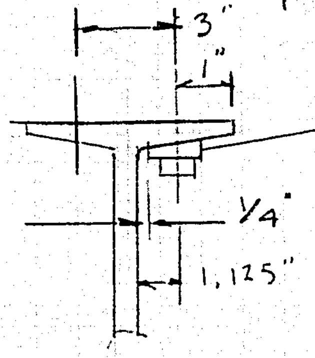
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Check Upper Connection

Use 4 - 3/4" φ bolts spaced 4" apart



Heavier crane rail reqd for 1) wrench clearance 2) to take out lateral load of .2 × wgt

Lateral Load = .2 × 13637 = 2727# for 16' Door

= 3750# for 22' Door

= 1875#/troller

Max Design Torque

$$= \frac{1875 \times 6}{2} = 5625\text{\#-in} \quad J = .9\,\text{in}^4$$

$\tau = Th/J = 5625(.544)/.9 = \underline{3400\,psi}$ @ center of flange

Fillet radius ~ 1.1875 - .544 = .643

Stress concentration ~ 1.4 (Approx)

$\tau_{max} = 1.4(3400) = \underline{4760\,psi}$ @ fillet

Long'l stress = $\underline{8512\,psi}$ (compression)

Transverse stress = 23763 psi @ fillet

$$\tau_{max} = \sqrt{\left(\frac{23.7+8.5}{2}\right)^2 + (4.76)^2} = \underline{16.8 > .4F_y = 14400\,ps \cdot NG}$$

$$\sigma_{max} = \frac{23.7-8.5}{2} + 16.8 = \underline{24.4^{psi}\ \text{OK}}$$

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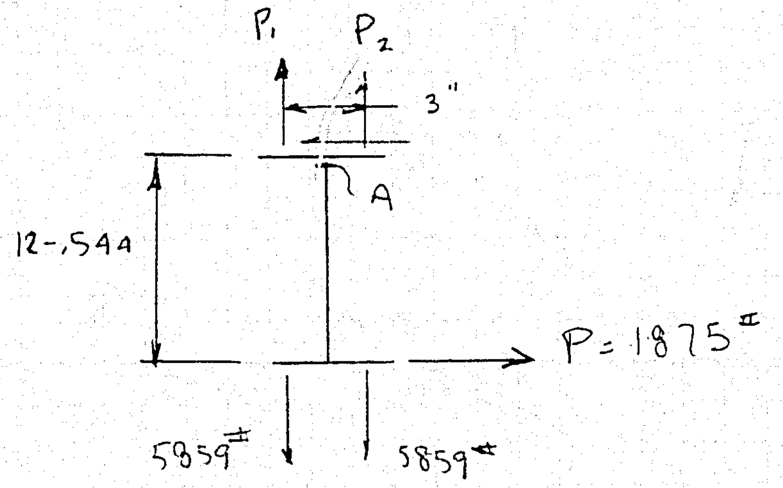
Check Transfer of lateral load to support

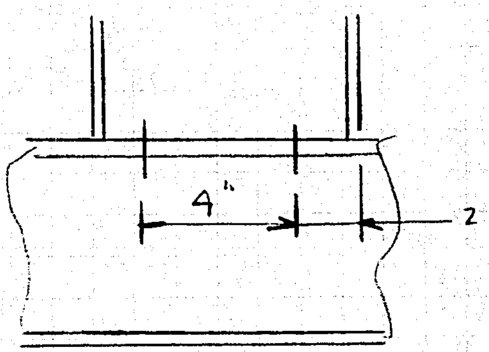


$P_1 = 5859 + 1875(11.6)/3 = 13019^{\#}$

$P_2 = 5859 - 1875(11.6)/3 = -1391^{\#}$

Check Bending in Web t_w =

width of Resisting Section



width = 4 + 2 1/4 + 2 1/4 = 8 1/2

$M = 1875 \times (11.6 - 1.1875(k)) = 19523$ #-in

$t_w = .375 \quad S = 8.5(.375)^2/6 = \underline{.2 \text{ in}^3}$

$f_b = 19523/.2 = 97615$ psi NG

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CKD. BY ______ DATE ______ SUBJECT Blast Door

Try S12×50#

$t_f = .659$ in $t_w = .687$

$M = 1875(12 - .659 - 1.9375) = 18569$ #-in

$f_b = \dfrac{18659}{8.5(.687)^2/6} = 27906$ psi say OK ~ .75 F_y

Check Flange Bending for Bolt Loads

Max Bolt Load = 1/2 (13019) - 6509#

M ~ .31P (Load near fixed edge)

= .31(6509) · 2018 #-in/in

$f_b = \dfrac{6(2018)}{(.659)^2} = 27880$ psi ~ .75 F_y

Conside Lower flange as beaming lateral load between supports

$M = 3/16\,Pl = \frac{3}{16}(1875)(100) \cdot 35156$ #-in

$S = \dfrac{.659}{6}(5.5)^2 = 3.3$ in³ $f_b = \dfrac{35156}{3.3} = 10653$ psi OK

Margin for primary long'l stress & localized long'l stress = 14000 psi more than reqd

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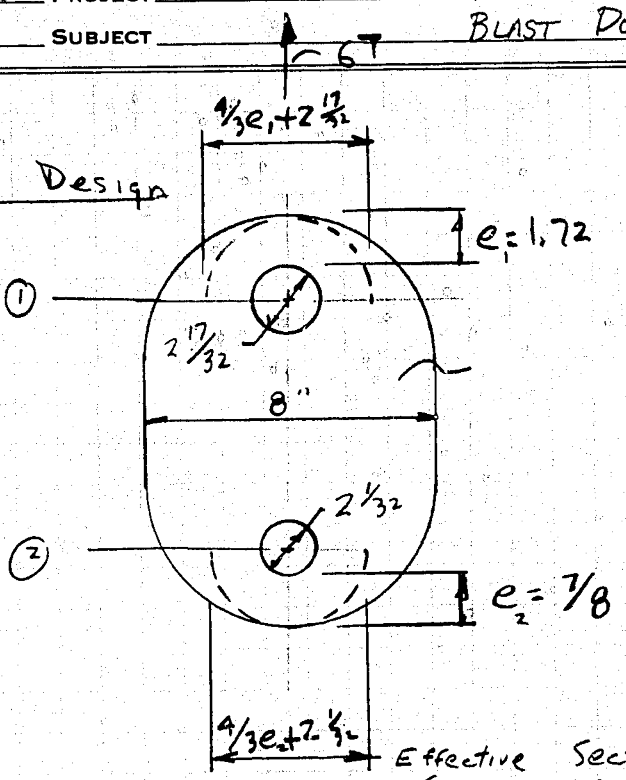
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Pin Plate Design



Effective Section in Tension (per AISC)

$b_1 = \frac{4}{3}(.875) = 1.17"$

$b_2 = 4/3(1.72) = 2.29"$

For 6 TON Trolley $P = 12^k$

$f_T = \frac{12}{1.17t} = \frac{10.26}{t}$ $\quad F_T = .45F_y = 16.2^{ksi}$

$t = \frac{10.26}{16.2} = .633"$ - used 1" PL OK

Check L $\quad e_L = 2 - \frac{2.63}{2}\ .984$

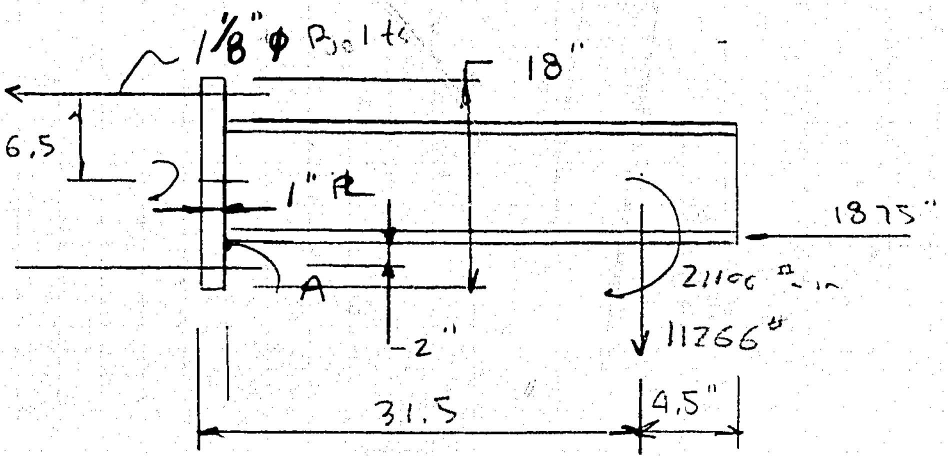
$b = \frac{4}{3} \times .984 = 1.31$

$f_T = \frac{12}{(2 \times 1.31)(.75)} = 6.1^{ksi} < 16.2^{ksi}$ OK

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 253 OF 343

CKD. BY ____ DATE ____ SUBJECT Blast Door

Hanger Design using W 8x67



$M = 11266(31.5) + 21100 + 1875 \times 4 = \underline{383479\ \#\text{-in}}$

$\Sigma F_v = 0 \quad T + 1875 - f_b(18)\left(\frac{kd}{2}\right) = 0 \quad f_b = .375 f_c'$

$= 1500\ p$

$T + 1875 - (1500)(9\,kd)$

$T + 1875 - 13500\,kd = 0$

$6.5T + f_b(18)\left(\frac{kd}{2}\right)\left[9 - \frac{kd}{3}\right) - 383479 = 0$

$6.5T + 13500\left[9kd - \frac{kd^2}{3}\right] - 383479 = 0$

$kd = 1.98'' \quad T = 24855\# \sim 12427\#/\text{Bolt}$

Use 1⅛" φ Bolts

Check PL Size Bending @ Bolt $M = .31P = .31(12427)$
$= 3852\ \#/in/in$

$t^2 = \frac{3852 \times 6}{27000} = .856 \quad t = .925$ use 1"

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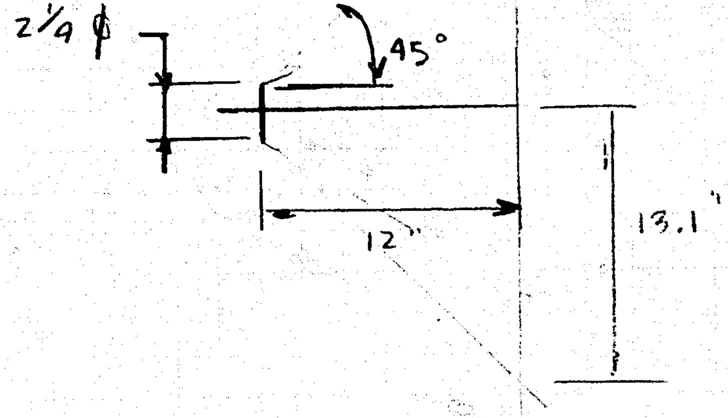
CKD. BY DATE SUBJECT BLAST DOOR

At Pt A

$$M = \frac{(1500)(1.98)}{2}\left(9 - \frac{1.98}{3}\right) = 4960 \text{ \#-in/in} < 3952 \text{ \#-in/in}$$

Check $f_b = 4960 \times 6 = 29760$ psi say ok

Check Imbedment length $(f_c)_{conc} = 4\sqrt{f_c'} = 252$ psi



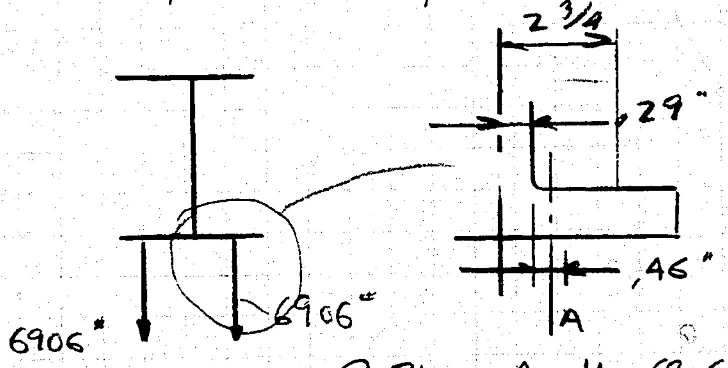
$A = \pi(12)(2.25 + 26.2)$

$= 1072 \text{ in}^2$

Capacity $= .707(253)(1072)$

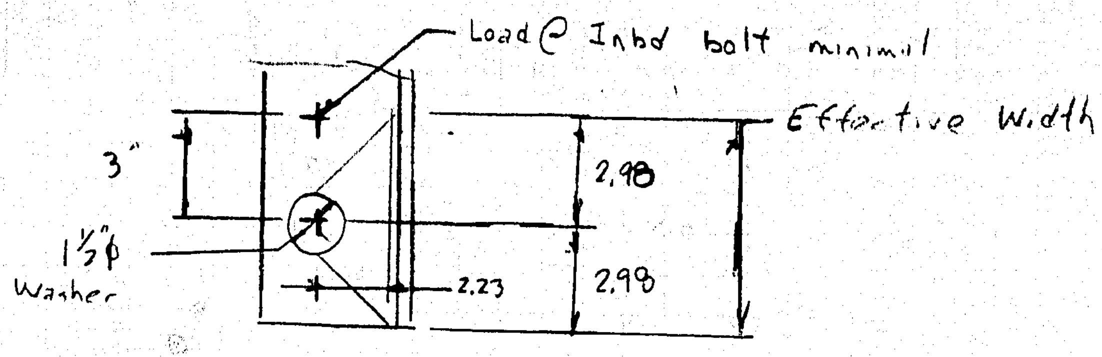
$= \underline{191749 \text{\#}}$ ok

Check Flange Bending for W 8 x 67



@ Plane A $M = 6906\left(\overbrace{2.75 - .29 - \frac{.46}{2}}^{2.23}\right)$

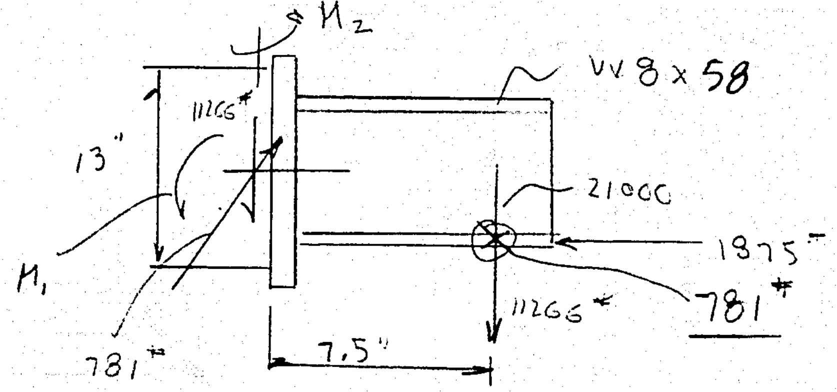
$= 15406 \text{ \#-in}$



$$t^2 = \frac{15400 \times 6}{5.96 \times 27000} = .574 \qquad t = .757 \text{ in}$$

t_f for W 8 × 58 = .808 in   use W 8 × 58

Check Anchorage for Short Supports



$M_1 = 11266(7.5) + 21000 + 1875 \times 4.5 = 113932$ #-in

$M_2 = 781 \times 7.5 = 5857$ #-in

For M_1 $\Sigma F = T + 1875 - 13500\,kd$

$6.5T + 13500\left[9kd - \frac{(kd)^2}{3}\right] - 113932 = 0$

$kd = .61"$ $T = 6360\# / 3180\#/\text{Bolt}$

A

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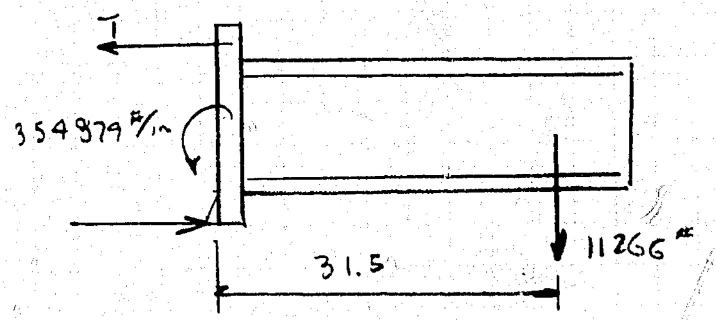
Check Sites Reqd w/o Lateral Load



① $\Sigma F_H = 0 \quad T - f_b (18)\frac{(kd)}{2} = \quad T - 13500\,kd = 0$

②
$\Sigma M = 0 \quad 6.5T + 13500\left[9kd - \frac{kd^2}{3}\right] - 354879\,\# = 0$

kd	T eq ①	T eq ②
1	13500	36596
.9	12150	38334
1.2	16200	33163
1.4	18900	29874
1.7	22950	24820
1.75	23625	24005

kd ~ 1.76 T = 23760 / 11880 # / Bolt

use 1" ϕ Bolts $F_v = 10^{ksi}$

$f_v = \frac{11266}{4 \times .7854} = 3586\text{ psi} \quad F_T = 28 - 1.6 F_v$

$F_T = 28 - 1.6(3.586) = 22^{ksi}$ use 20^{ksi}

$f_T = 11880 / .6057 = \underline{19613\text{ psi}}$ ok

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CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Check PL Size

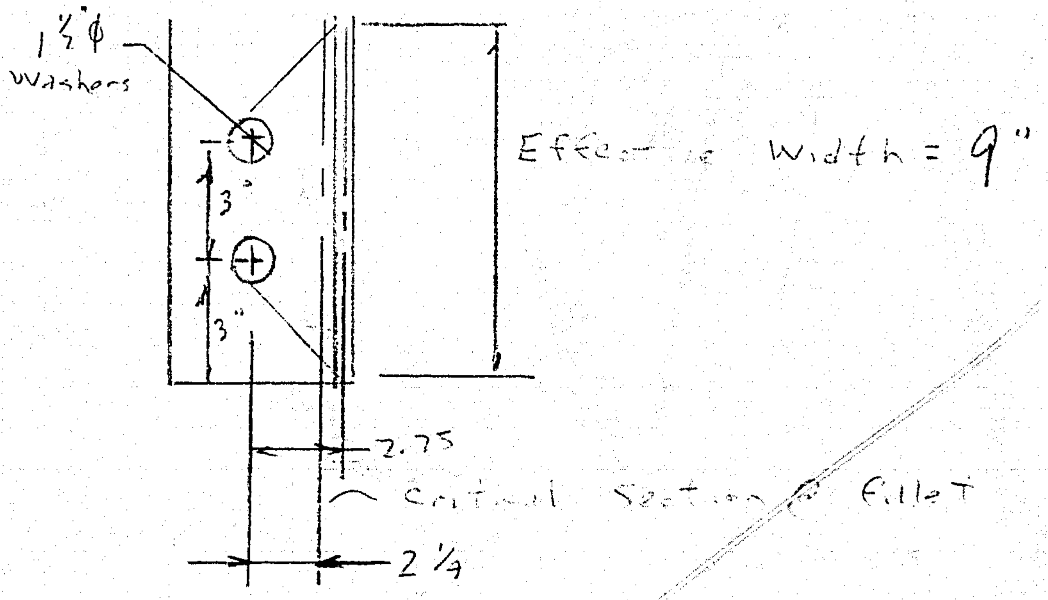
$$M = \frac{1500(1.76)}{2}\left(4 - \frac{1.76}{3}\right) = 4505 \text{ \#-in/in}$$

$$t^2 = \frac{6 \times 4505}{27000} = 1 \qquad t = 1''$$

Check Bending @ Bolt $M \sim .31P$

$M = .31(11880) = 3682$ #-in/in $<$ 4505 #-in/in ok

Check Hanger Size for Flange Bending



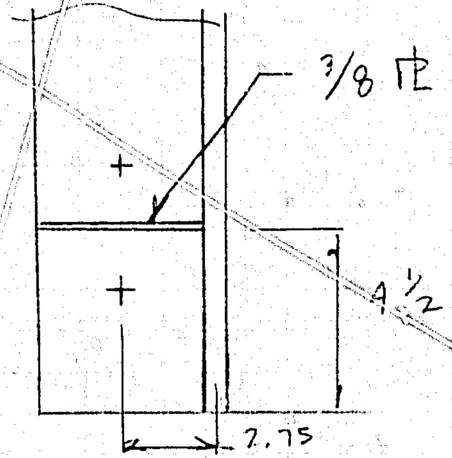
$$t = \sqrt{\frac{\left(\frac{11266}{2}\right)(2.25) \times 6}{9 \times 27000}} = .55 \text{ in}$$

Use W8×40

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 258 OF 3[illegible]

CKD. BY DATE SUBJECT BLAST DOOR

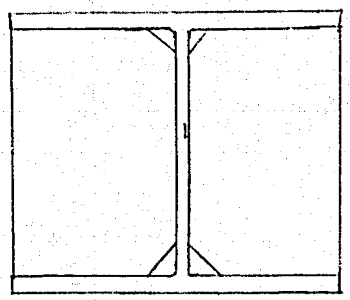
Use Gusset to Stiffen flange



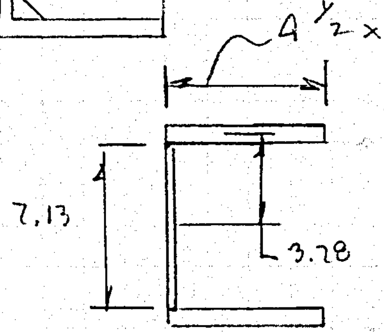
Try W8x31 $t_f = .433$

$S = 27.4$

$I = 97.8 \text{ in}^4$



Section



$$I = 2 \times .433 \times 4.5 \times (3.78)^2 + \frac{1}{12}(.325)(7.13)^3$$

$$= 55.7 + 11.3 = 67 \text{ in}^4$$

$$S = \frac{67}{4.03} = 16.6 \text{ in}^3$$

$M = 6906 \times 2.75 = 18992$ #-in

$f_b = 18992/16.25 = 1133$ psi ok

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CKD. BY DATE SUBJECT BLAST DOOR

Long'l Bending

M: 383479#-in

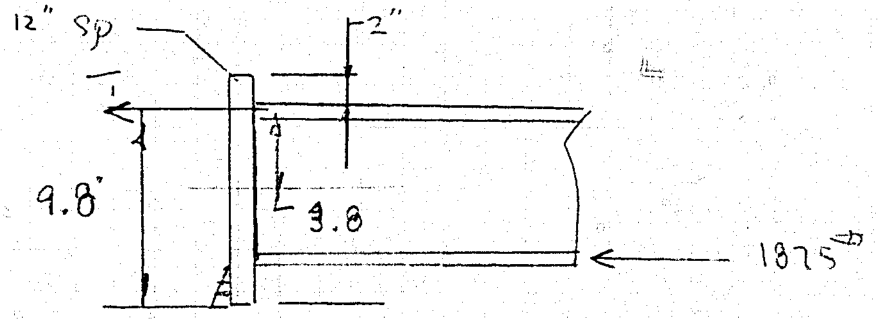
$$f_b = \frac{383479}{24.3} = 15781 \text{ psi OK}$$

Check δ

$$\Delta = \frac{13812(31.5)^3}{3\times 29.6\times 10^6\times 97.8} + \frac{21100(31.5)^2}{2\times 29\times 10^6\times 97.8}$$

$$= .051 + .004 = .055 \text{ in}$$

Anchorage Reqd



$$T + 1875 - f_b(12)(kd/2) = 0 \qquad f_b = .375 f_c' = 1500 \text{ psi}$$

$$T + 1875 - 9000\, kd = 0$$

$$3.8T + 12 f_b\left(\frac{kd}{2}\right)\left[6 - kd/3\right] = 383479\#\text{-in}$$

$$3.8T + 9000\, kd\left(6 - kd/3\right] = 383479\#$$

Kd = 5.43 in   T = 47000#

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BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 273

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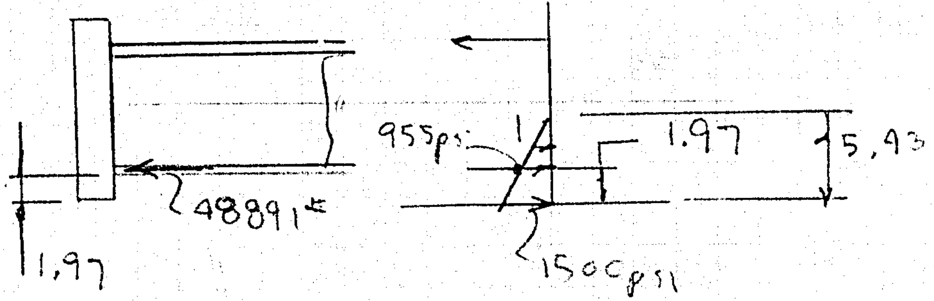
CKD. BY ____ DATE ____ SUBJECT Blast Door



$$M_{PL} = \frac{955}{2}(1.97)^2 + \frac{545}{3}(1.97)^2$$

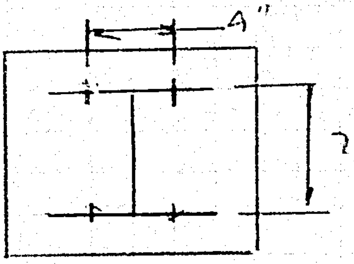
$$= 3242\# - in/in$$

$$t_{Reqd} = \sqrt{\frac{3242 \times 6}{.75 \times 36000}} = .848 \text{ use } 7/8'' PL$$

Stud Design

$$T = \frac{47000}{2} = 23500\#$$
$$V = \frac{11266}{4} = 2816\#$$

Assuming 4 - Studs



NG Loads too high for Nelson Studs; increase spacing to 9" horiz & 12" Vert

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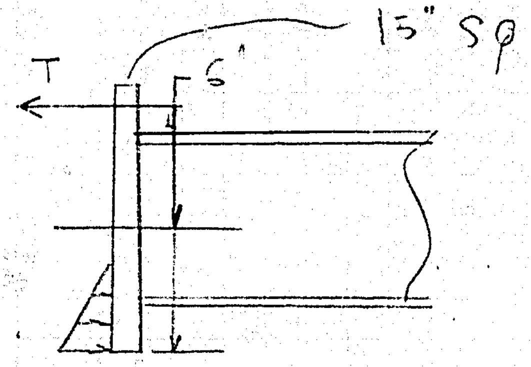
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR



$T + 1875 - 1500(15)\left(Kd/2\right)$

$T + 1875 - 11250\,Kd = 0$

$6T + 11250\,Kd\left(7.5 - Kd/3\right) = 383477$

$Kd = 2.79$ $T = \underline{29512^{\#}}$ / $14756^{\#}$/stud

$V = \underline{2816^{\#}}$ /stud

Try 7/8 × 6 3/16" φ Anchor $P_{uc} = 32.47^{K}$

Reqd Spacing = 4.657 in

$S_{uc} = 31.69^{K}$

Space @ $\underline{10"}$ - no tension Reduction
no shear Reduction

$$\left(P_u/P_{uc}\right)^{5/3} + \left(\frac{S_u}{S_{uc}}\right)^{5/3} \leq 1$$

Ult load factor = 2

$$\left(\frac{2 \times 14.8}{32.5}\right)^{5/3} + \left(\frac{2 \times 2.82}{31.7}\right)^{5/3} \leq 1$$

$.912 \leq 1$ ok

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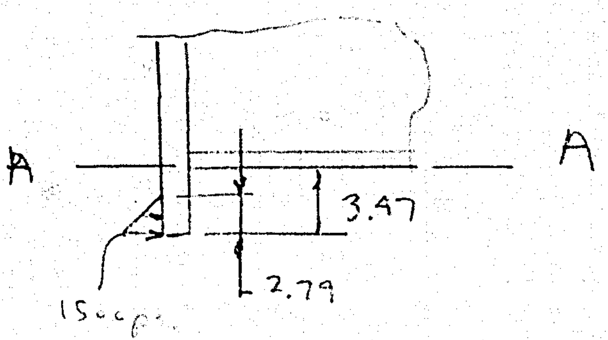
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Check PL Size



$$M@A = \frac{1500 \times 2.79}{2} + \left(.68 + 2 \times \frac{2.79}{3}\right) = 5315^{\#}\text{-in/in}$$

$$t_{reqd} = \sqrt{\frac{6 \times 5315}{27066}} = \underline{1.09\text{ in}}$$

Check tension side $M \sim .31P$

$M = .31 \times 14.8 = 4.6^{k\text{-in/in}} < 5.32^{k\text{-in/in}}$

Use 1⅛" PL 15x15

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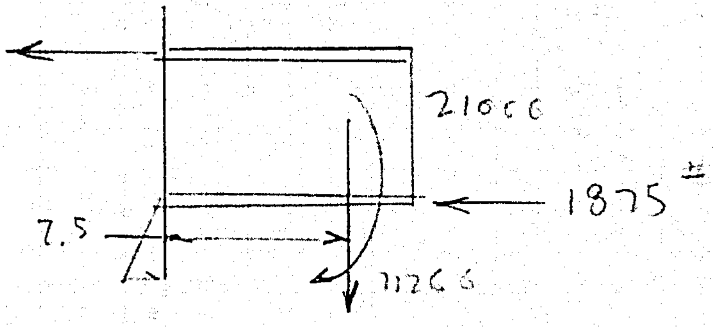
CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Check short member



$M = 11266(7.5) + 21000 + 1875(4.03) = 113051$ #-in

Try spacing behind flanges w/12" S, PL

$T + 1875 - 9000\,kd = 0$

$3.9T + 9000\,kd(6 - kd/3) = 113051$

$kd = 1.44$ $T = 11035\#/$ $5542\#/$

$V = 2316\#/\text{stud}$

Use 5/8 x 6 9/16 space @ 8" OC

$P_u = 16.56^k$ $S_{uc} = 16.19^k$

$$\left(P_u/P_{uc}\right)^{5/3} + \left(\frac{S_u}{S_{uc}}\right)^{5/3} \le 1$$ Load Factor = 2

$$\left(\frac{2\times5542}{16560}\right)^{5/3} + \left(\frac{2\times2316}{16190}\right)^{5/3} = .63 \le 1 \text{ ok}$$

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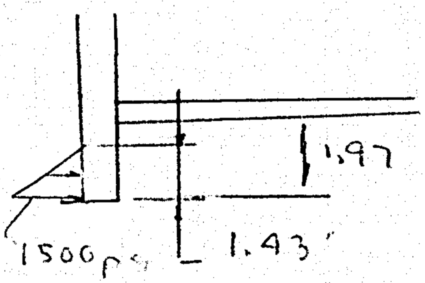
CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Plate Reqd



$$M = \left(\frac{1500 \times 1.43}{2}\right)(.95 + .54) = 1598 \text{ \#-in/in}$$

$$t = \sqrt{\frac{6 \times 1598}{27000}} = .595 \text{ use } 5/8" \text{ PL}$$

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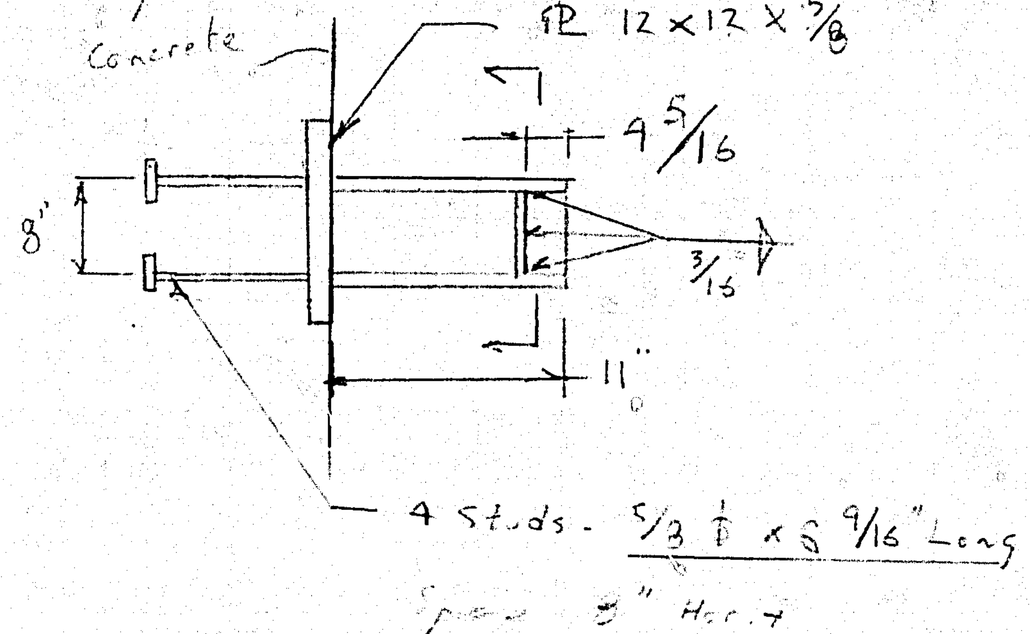
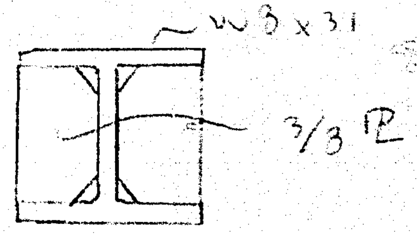
CKD. BY ______ DATE ______ SUBJECT Blast Door

Type I

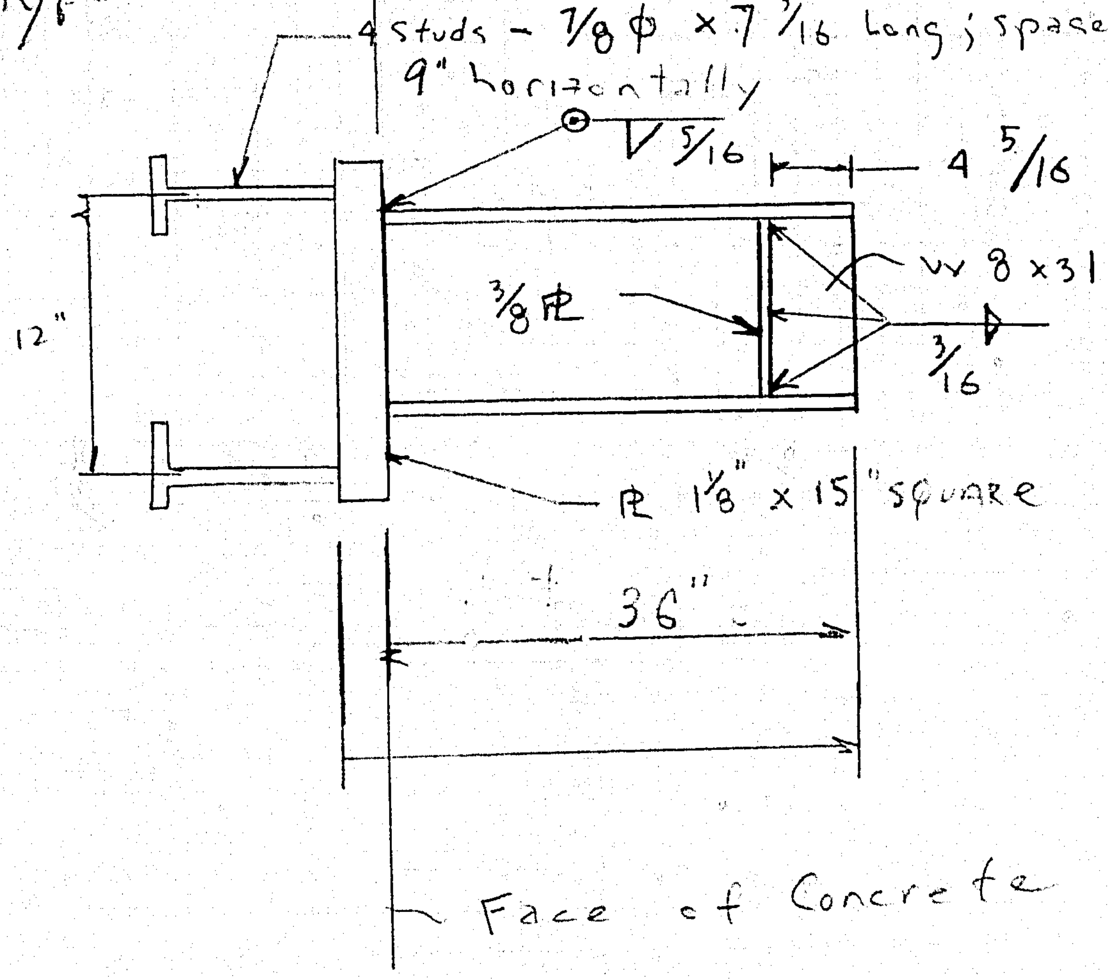




BY WS DATE 3/72 PROJECT BOX MAGAZINE TYPE A SHEET NO. 266 OF 342

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Type II



4

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BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 267 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Hanger ⅊

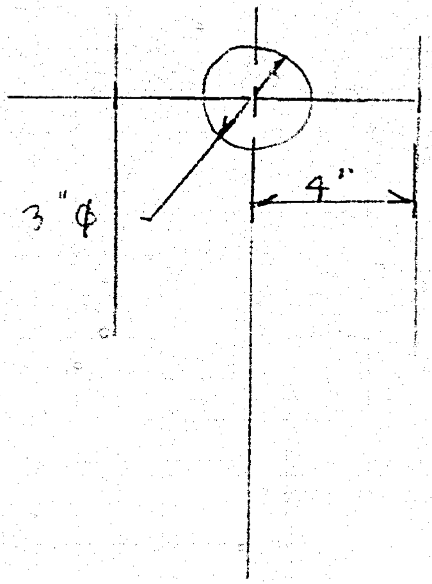
Wgt = 1.375(13637)(1.06 - increased overhang)

= 18750#

Trolley Design Load = $\frac{1.25(18750)}{2}$ = 11719#

F_t = .45 F_y = 16200 psi

Using 1" ⅊ W = $\frac{11719}{16200}$ = .723



BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 268 OF 312
CKD. BY DATE SUBJECT BLAST DOOR

Bumper Design

Wgt of Door - 18750#
Max Speed = 38 ft/min = 7.6 in/sec

Length of Support Beam = 24 + 1.5 + 5.375 (to Center of Door)
= 30.875

Use W12×65 to Hold Bumper $I = 533\ in^4$, $S = 88\ in^3$

$$K = 3EI/L^3 = \frac{3\times29\times10^6\times533}{(30.875)^3} = \underline{1.57\times10^6\ \#/in}$$

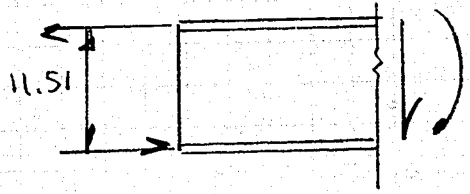
For 2 Bumpers $K = 3.15\times10^6\ \#/in$

$$X_{max} = V\sqrt{\frac{M}{K}} = 7.6\sqrt{\frac{18750/386.4}{3.15\times10^6}} = .0298\ in$$

$P_{max} = .0298(3.15\times10^6) = 93961^\# = 46980\ \#/Bumper$

$M_{max} = 46980(30.88) = 1.45\times10^6\ \#\text{-}in$; $\underline{V_{Max} = 46980^\#}$

$f_b = 1.45\times10^6/88 = 16454$ psi



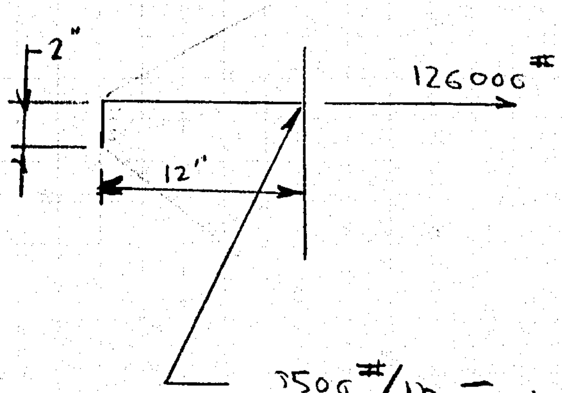
Anchor Strap Area Reqd

$$= \frac{1.45\times10^6}{11.51\times39600(f_{dy})} = 3.18\ in^2$$

Use 8×½ Anchor Strap $A = 4\ in^2$

$f_T = 1.45\times10^6/11.51(4) = 31494$ psi $\Big\}$ $\tau_{max} = 16806$ psi, ok
$f_s = 46980/8 = 5872$ psi $\Big\}$ $\sigma_{max} = \underline{32553}$ psi, ok

Anchorage Reqd



$v_c = 4\sqrt{f'_c} = 253$ psi

$A = (26+2)(12') + (30+6)(12)$

$= 768 \text{ in}^2$

$P_u = 768(253) = \underline{194304^{\#}}$

3500#/in – use 3/8" fillet weld

$P_u = .375(.707)(21)(1.87) = 10.4^{K}/in$

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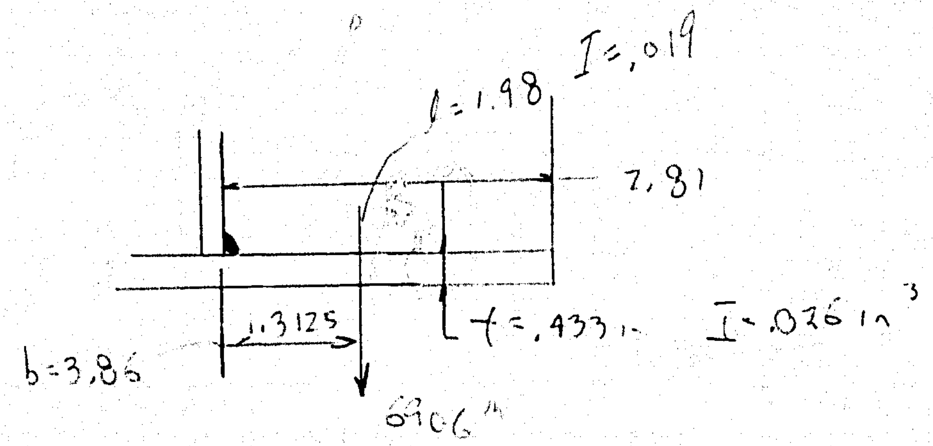
BY WS DATE 3/77 PROJECT Box Magazine Type A SHEET NO. 270 OF 341

CKD. BY ______ DATE ________ SUBJECT BLAST DOOR



$$K = \frac{3\times 29\times 10^6\times .026}{(1.3125)^3} = 1\times 10^6 \#/in$$

$$K = \frac{3\times 29\times 10^6\times .019}{(1.98)^3} = .22\times 10^6 \#/in$$

$$\Sigma\ 1.22\times 10^6 \#/in$$

$$P_1 = 1/1.22 \times 6906 = 5693 \#/in$$

$$P_2 = .22/1.22 \times 6906 = 1245 \#/in$$

$$f_{b_1} = \frac{5693\times 1.3125\times 6}{3.86\times(.433)^2} = 61993 psi \quad NG$$

$$f_{b_2} = \frac{1245(1.98)\times 6}{7.81\times(.433)^2} = 2807 psi$$

Need W 8 x 40 $t_f = .558$ $b = 4.04$

$$f_{b_1} = \frac{5693\times 1.3125\times 6}{4.04(.558)^2} = 36000 psi$$

Need W <u>8x48</u>

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BY NL DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 271 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Sprocket Hinge Design

Coeff of Friction: Static : .74

Rolling ~ K=,002

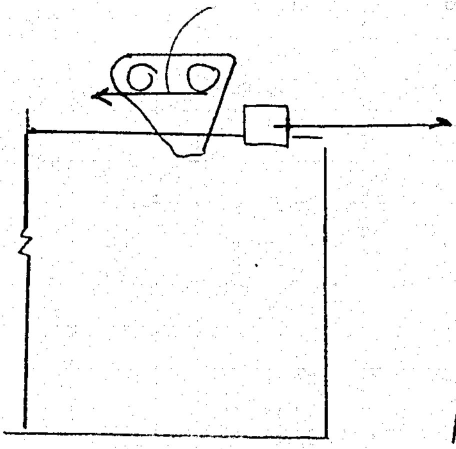
$$P = \frac{K}{r} L = \frac{.002}{r} L$$

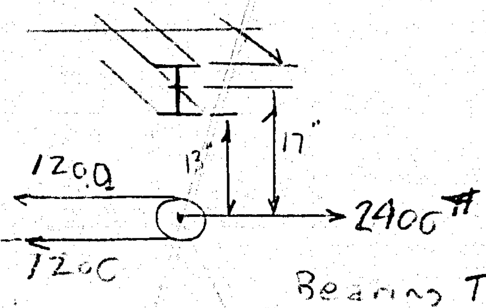
Wgt of Door: 18750#

Max Chain Load ~ 3% of Wgt = 563#

UH Chain Capacity = 6000# Load = 1200# use

SF = 5





Bearing Tk.

$$t = \frac{2400}{48600},$$

= .05" ok

M on [= 2400(13) = 31200#-in

$$S_{Reqd} = \frac{31200}{24000} = 1.33$$ ok C10×20 ok

Torque on Hanger = 2400 (17) = 40800 #-in

$J = 1.96\ in^4$

$$f_{s_{MAX}} = \frac{40800 \times .683}{1.96} = 14217\ psi$$

$F_s = .45\ F_y = 16200\ psi > 14217$ ok

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BY WS DATE 3/78 PROJECT Box MAGAZINE Type A SHEET NO. 272 OF 343

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Check Warping

$$H_{max} = \frac{Ta}{h} \tanh \frac{l}{2a} = \frac{Ta}{h} \text{ if } \frac{l}{2a} > 2.5$$

$$a = \frac{h}{2}\sqrt{\frac{EI_y}{JG}}$$

$$= \frac{8.5}{2}\sqrt{\frac{29 \times \cancel{10^6} \times 60.9}{1.96 \times 12 \times \cancel{10^6}}} = 36.8 \text{ in}$$

$$l = 31.5 + 8 \cdot 39.5''$$

$$\frac{l}{2a} = \frac{39.5}{73.6} = .54$$

$$H_{max} = \frac{(40800)(36.8)}{8.5} \tanh(.54) = \underline{86553 \text{ \#-in}}$$

$$f_{b_1} = \frac{86553 \times 2}{15} = \underline{11540 \text{ psi}}$$

29000 psi
3234 psi

$$f_{b_2} - \frac{2400(8.75)}{15} = \underline{1400 \text{ psi}}$$

f_{b_3} : Figure DL Alone As Max Chain Load Occurs on initial acceleration

$$H = \left(\frac{18750}{2}\right)(31.5) \cdot 295312 \text{ \#-in}$$

$$f_{b_3} = \frac{295312}{43.2} = \underline{6835 \text{ psi}}$$

$$\Sigma f_b = \underline{19775 \text{ psi} < 24000 \text{ psi}} \text{ ok}$$

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BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 273 OF 343

CKD. BY ___ DATE ___ SUBJECT BLAST DOOR

Check Locally @ Track Support

$f_s = 14217$ psi

$f_{b_1} = 1406$ psi

Local bending: Due to DL alone

$P = \frac{18750}{8} = \underline{2343^{\#}}$

$M = 2343\left(\frac{1}{1.22}\right)\left(1.3125\right) = 2520^{\#}\text{-in}$

$S = \frac{4.04(.683)^2}{6} = .314\ \text{in}^3$

$f_{b_L} = \frac{2520}{.314} = \underline{8022\ \text{psi}}$

$\Sigma f_b = 8022 + 1406 = \underline{9422\ \text{psi}}$

$f_s = \underline{14217\ \text{psi}} + \frac{2520}{4.04(.683)} = 15130\ \text{psi}$

$\tau_{max} = 15856\ \text{psi} < \underline{16200\ \text{psi}}$ OK

$\sigma_{max} = 20577\ \text{psi} < \underline{24000\ \text{psi}}$ ok

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BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 274 OF 343

CKD. BY ______ DATE ______ SUBJECT BLAST DOOR

Check Plate for 16.86^k Load

$M = .31(16.86) = 5.23^{k\text{-}in/in}$

or $M = \frac{16.86 \times 2}{5} = 6.74$ k-in/in use this value

$f_b = \frac{6.74 \times 6}{(1.125)^2} = 32 \text{ ksi} > 27 \text{ ksi}$

Use 1 1/4 PL

Check Weld of W to PL

$f_s \text{ max} = 19775 \text{ psi}$ $q = 19775 \times .693 = 13506 \text{ \#/in}$

$V_H = \frac{9617^{\#}}{8.5} = 1131 \text{ \#/in}$

$q_{res} = \frac{1}{2}\sqrt{13506^2 + (1131)^2} = 6776 \text{ \#/in}$

$t = \frac{6776}{.707 \times 21000} = .456''$ ~ 1/2" fillet req'd

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BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 275 OF 393

CKD. BY ____ DATE ____ SUBJECT BLAST DOOR

Load on Studs

Primary Bending $= \frac{295312}{2 \times 12} = \underline{12304^{\#}}$

Shear (Primary) $: \frac{18750}{2 \times 4} = \underline{2343^{\#}}$

Flange Moment $\frac{86553}{9} = \underline{9617^{\#}}$

Shear (Torsion) $= \frac{86553}{2 \times 8.5} = \underline{5091^{\#}}$ Horiz

Max Stud Load $= 12304 + 9617 = 21921^{\#}$ Tension

$= \sqrt{(2343)^2 + (5091)^2} = 5604^{\#}$ Shear

Add 2 studs & Increase Horiz spacing to $6\frac{1}{2}$"

Tension $\frac{295312}{3 \times 12} = 8203^{\#}$

Flange Moment $\frac{86553}{16} = 3655^{\#}$

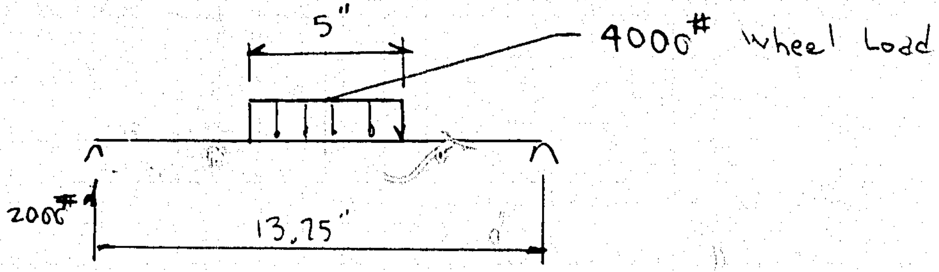
$\Sigma\ \underline{16858^{\#}}$

Shear (Primary) = $1171^{\#}$ Vert $\Big\}$ $\underline{3596^{\#}}$

(Horiz) $3394^{\#}$ Horiz

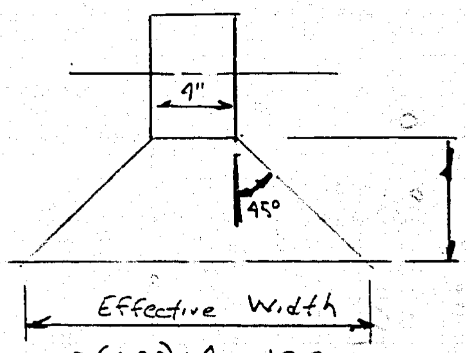
$\left(P_u / P_{uc}\right)^{5/3} + \left(S_u / S_{uc}\right)^{5/3} = \left(\frac{16.86}{16.27}\right)^{5/3} + \left(\frac{3.6}{15.9}\right)^{5/3} = 1,15$ say OK

Cover PL Design



$$M = 2000\left(\frac{13.75}{2}\right) - 2000\left(\frac{2.5}{2}\right) = \underline{11250^{\#}}\text{-in}$$

$$S = 12.75t^2/6 = 2.125t^2$$



$= 2(4.38)+4 = 12.75"$

MATL: C1020 Hot Rolled $F_y = 35^{ksi}$

$F_b = .75(35) = 26.25^{ksi}$

$$t^2 = \frac{11250}{2.125 \times 26250} = .201 \quad t = .45"$$

Use 1/2" PL $(21.5^{\#}/FT^2)$

Check Shear for 4000# Load on 4" width:

$$f_v = \frac{4000}{4 \times .5} = \underline{2000 psi \text{ OK}}$$

PL width = 16" = 1.33' WGT OF 1' = 1.33(21.5) = 28.6#

MAX 100# Sheets

Length = 100/28.6 = 3.49' = 3'-6"

Use 5 PLS - leave 1" CLEARANCE EACH SIDE:

$L = 16 \times 12 - 2/5 = 38" = 3'-2"$

WGT = 3.17×1.33×21.5 = 90.6#

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 277 OF 343

CKD. BY _____ DATE _____ SUBJECT BLAST DOOR

TRY 17" PL - 1.42'

$WGT = 1.42 \times 3.17 \times 21.5 = 97^{\#} < 100$ ok

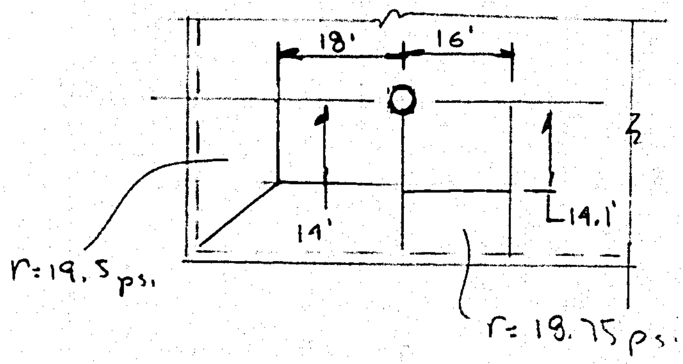
COLUMNS

Columns

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 278 OF 343

CKD. BY ______ DATE ______ SUBJECT Column Design - Prel

Tributary Area



Use Round Column

$$P = \frac{2\left[19.5((18)(14)) + 18.75(16)(14.1)\right]144}{10^3} = \underline{\underline{2630^k}}$$

$f_{c'} = 5000$ psi $e = .05h$ - spiral reinforcement

$f_{dy} = 44000$ psi

$\phi = .75$

Use ACI Publication SP-7

Try 36" ϕ Column $gD \sim 30"$ $g \sim .8$

$l_u \sim 14 - 3.25' = 10.8'$ $r \sim .25(36) = 9$

$\frac{kl_u}{r} = \frac{10.8 \times 12}{9} = 14.4$ assuming column braced against sidesway

$14.4 < 22$ According to ACI - slenderness effects can be neglected

$\frac{P_u}{f_c' D^2} = \frac{2630}{5 \times (36)^2} = .405$

From Chart 35 $P_t \sim$ negligible - reduce size of column

Columns

BY WS DATE 3/72 PROJECT Box Magazine Type A SHEET NO. 279 OF 3A

CKD. BY ______ DATE ______ SUBJECT Column Design

Try 32" Column $\qquad g \sim 28/32 = .875$ use .9 in Tables

$$\frac{P_u}{f_c' D^2} = \frac{2630}{(5)(32)^2} = .513$$

$\rho_t \sim .02 \qquad A_s = .02(\pi)(32)^2/4 = 16 \text{ in}^2$

Use 16 - #9 $\quad$ Spacing = $(\pi)(28)/16 = \underline{5.5"}$ OK

Spirals

$$\rho_s = .45\left(\frac{A_g}{A_c} - 1\right)\frac{f_c'}{f_y} = \frac{.45(5)}{44}\left(\left(\frac{32}{29}\right)^2 - 1\right) = .011$$

Try #4 spiral $\quad A_b = .2 \text{ in}^2 \quad d_b = .5 \text{ in}$

$$\rho_s = A_{sp}\cancel{\pi}(d_c - d_b) \big/ S_s \cancel{\pi} d_c^2/4$$

$$= 4\frac{A_{sp}(d_c - d_b)}{S_s d_c^2}$$

$d_c = 32 - 3 - 2(.5) - \frac{1.125}{2} = 27.4 \text{ in} \qquad g = \frac{27.4}{32} = .86$

orig assumptio ok

$$\rho_s = \frac{4(.2)(27.9 - .5)}{S_s(27.9)^2} = \frac{21.92}{778.4 S_s} = .011$$

$S_s = 2.55$ in

Try # 5 spiral $\quad d_c = 32 - 3 - 2(.625) - 1.125/2 = 27.2$

$$\rho_s = .011 = \frac{4(.31)(27.2 - .625)}{S_s(27.2)^2}$$

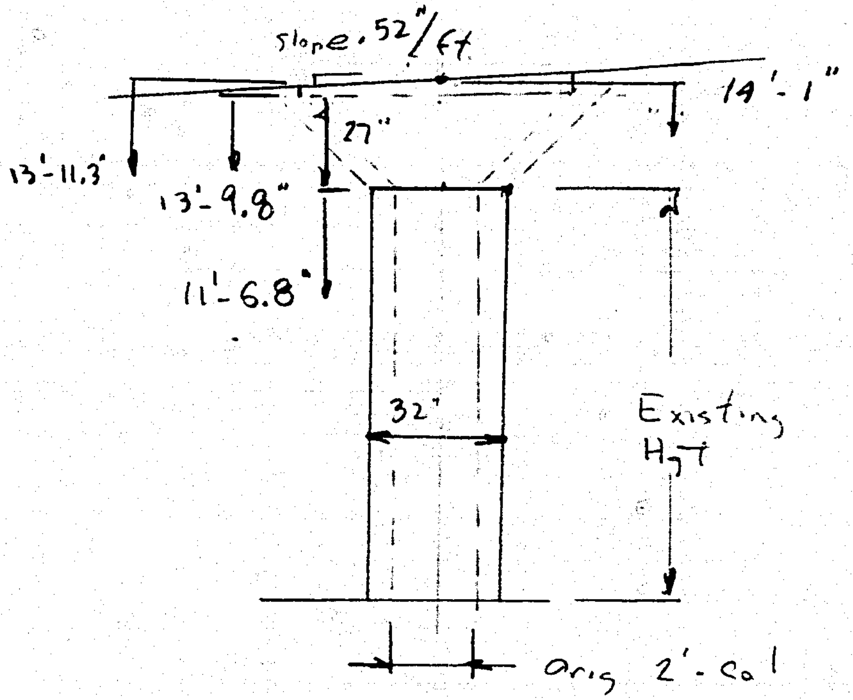
$S_s = 4$ in OK

Summary: Col ϕ - 32" Core ϕ = 29"

Long Reinf - 16 #9

Spirals - #5 @ 4"

Col. Cap



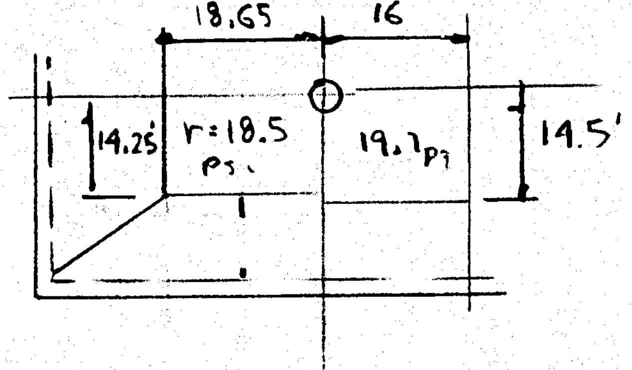
ϕ of new capital = 2(16 + 27) = 86"

Equiv Square Col cap = 76" ~ 6.4'

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 281 OF 343

CKD. BY______ DATE______ SUBJECT COLUMN DESIGN

Column Design - Final



$$P = 2\left(18.5\left(18.65 \times 14.25\right) + 19.7\left(16 \times 14.5\right)\right)\frac{144}{10^3}$$

$= \underline{2732^K}$ Prel Design Was for $\underline{2630^K}$

ok

Footing Design - Assume Avg Depth of Footing $\sim \underline{3'}$

Depth to underside of Footing = 5'-4

Try 19' Sq Wgt of Footing $= \frac{3 \times 19^2 \times 150}{10^3} = \underline{162.5^K}$

Wgt of Soil $\left(\frac{64-36}{12}\right)\frac{(19)^2(100)}{10^3} = \underline{84^K}$

Wgt of Slab $\frac{10}{12}\frac{(19)^2(150)}{10^3}$ $\underline{45^K}$

Total $= \underline{291.5^K}$

Column Load $= \underline{2732^K}$

Wgt of Column & Capital $\sim \underline{10^K}$

$$\frac{(\pi)(32)^2}{4 \times 144} \times \frac{(15+2.33)(150)}{10^3} + 2^K \text{Cap}$$

Total $= 3033.5^K$

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 282 OF 343

CKD. BY ______ DATE ______ SUBJECT Column Design

FOOTING DESIGN FOR 10^KSF ALLOWABLE BEARING PRESSURE

Total Design Load = 3034^K

$A_{REQD} = \frac{3034}{10} = 303.4\ Ft^2$ ~ use 17'-3"

Size Reqd

$$\begin{array}{lr} \text{Load} = & 3034^K \\ -\text{Ftg} & -163 \\ -\text{Soil Screening} & -84^K \\ -\text{Slab} & -45 \\ \hline & \underline{2742^K} \end{array}$$

Try 4'-Ftg $d \sim 48 - 3 - 1.25 = 43.75$

$A = \pi(43.75+32)(43.75) = 10441\ in^2$

$P_u = .85(10441)(4\sqrt{4000}) = 2238^K$

Try 4'-2" Ftg $d \sim \underline{45.75}$

$A = \pi(45.75+32)(45.75) = \underline{11175\ in^2}$

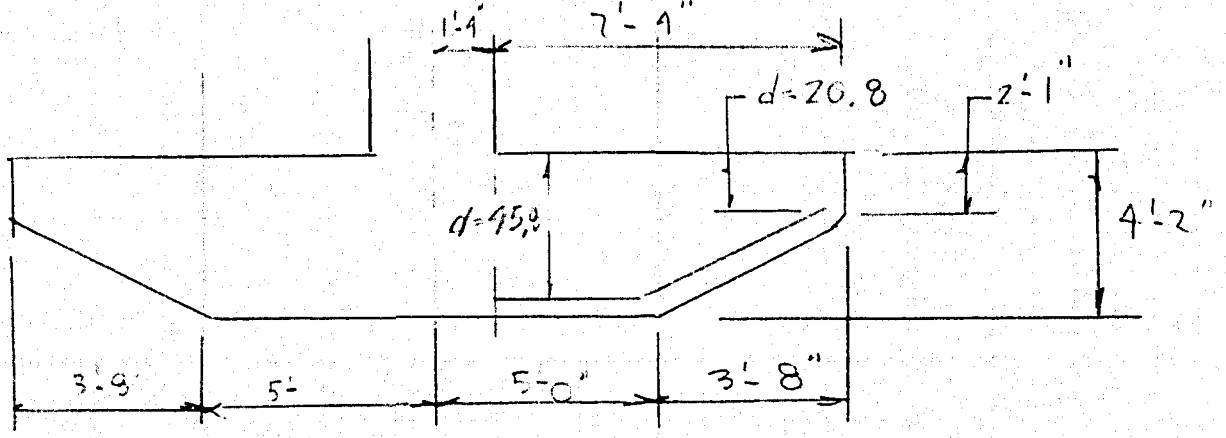
$P_u = .85(11175)(253) = \underline{2403^K}$

$P_u = 2742 - 10\left(\frac{45.75+32}{12}\right)^2\left(\frac{\pi}{4}\right) = \underline{2412^K \sim 2403^K\ OK}$

BY IV DATE 5/76 PROJECT Box Magazine Type A SHEET NO. 283 OF 343

CKD. BY ____ DATE ____ SUBJECT Column Design

Taper Ftg



$$d_{ave}^2 = \sqrt{\frac{(45.8)^2(10)+(20.8)^2(7.33)}{17.33}} = \underline{37.3 \text{ in}}$$

$$M_u = 10\frac{(7.33)^2}{2} = 268^{k-ft/ft} = 268 \text{ k-in/in}$$

$$M_u/d^2 = \frac{268000}{(37.3)^2} = 193$$

$\rho = .0045$ $A_s = .0045(37.3)(12) = 2 \text{ in}^2/\text{ft}$

Use #10@ 7" $A_s = \underline{2.17 \text{ in}^2 \text{ OK}}$

Check Shear @ d from support

$$V = \left(7.33 - \frac{37.3}{12}\right)(10) = 42.2^{k}/\text{ft} = 3.52^{k}/\text{in}$$

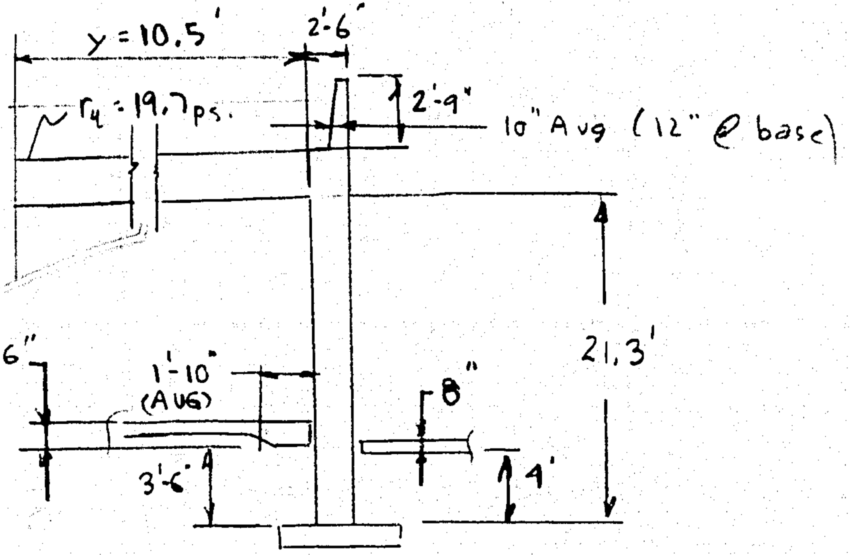
$$v_u = \frac{3520}{.85(37.3)} = \underline{111 \text{ psi OK}}$$

BY WS DATE 3/18 PROJECT Box Magazine Type A SHEET NO. 284 OF 343

CKD. BY ____ DATE ____ SUBJECT COLUMN DESIGN

Wall Ftgs Final Design

Front Wall - Center Bay



Ftg Design Dynamic Loads - Assume 5'-Ftg ~ 15' overhang

Dynamic Load:

P = 19.7(10.5+2.5)(12) = 3073 #/in = 36.9 K/FT

WGT OF WALL = 2.5(21.3)(.15) = 8 K/FT

Slab Inside Bldg: 1.5(.15)(1.25) = .28 K/FT

Soil Inside Bldg: 3.5(.1)(1.25) = .44 K/FT

Slab Outside Bldg = .67(.15)(1.25) = .13 K/FT

Soil Outside Bldg = 4(.1)(1.25) = .5 K/FT

Footing (Assume 14" Ftg) = 5(1.17)(.15) = .88 K/FT

47.13 K/FT

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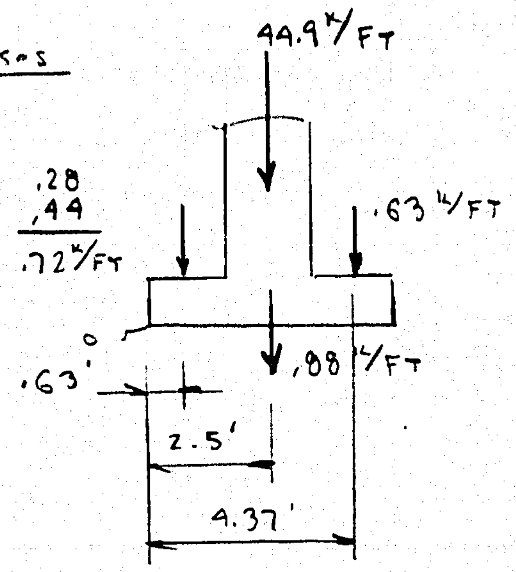
BY W/S DATE 1/77 PROJECT Box Magazine Type A SHEET NO. 285 OF 3A3

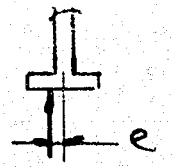
CKD. BY ______ DATE ______ SUBJECT Column Design

Bearing Stresses



$\Sigma F_v = 47.13 \ ^{k}/FT$

$\Sigma M_o = .72(.63) + (44.9 + .88)(2.5) + .63(4.37) = 117.7 \text{ k-FT}$



$$e = \frac{117.7}{47.13} - 2.5 = -\underline{.0027'}$$

$$f_b = \frac{47.13}{5} \pm \frac{(47.13)(.0027)(6)}{(5)^2}$$

$= 9.43 \pm .03$

$f_{b\,max} = 9.46 \text{ ksf} < 10 \text{ ksf ok}$

$f_{b\,min} = 9.4 \text{ ksf}$

BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 286 OF 343

CKD. BY ____ DATE ____ SUBJECT COLUMN DESIGN

Ftg Design Static Loads

Roof DL: $\frac{22(150)+24(100)}{1728} = 3.3$ psi

$P = 3.3(10.5+2.5)(12) = 514.8^{\#}/in = 6.2^{K}/FT$

$LL(100\,psf) = .100(10.5+1.5) = 1.2^{K}/FT$

WGT OF WALL $= 8^{K}/FT$

Slab + Soil Inside Bldg $= .78^{K}/FT$

Slab + Soil Outside Bldg $= .63^{K}/FT$

Ftg $= .88^{K}/FT$

$17.7^{K}/FT$

Bearing Stresses $\Sigma F_v = 17.7^{K}/FT$

$\Sigma M_o = .72(.63) + (6.2+1.2+8+.88)(2.5) + .63(4.37)$

$= 43.9$ K-FT

$e = \frac{43.9}{17.7} - 2.5 = .0198'$

$f_b = \frac{17.7}{5} \pm \frac{(17.7)(.0198)(6)}{25} = 3.54 \pm .084$

$f_{b\,max} = 3.62^{ksf} < 4^{ksi}$ } ok

$f_{b\,min} = 3.46^{ksf}$

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET No. 287 OF 343
CKD. BY ____ DATE ____ SUBJECT Column Design

Check Ftg Strength w #7@12"

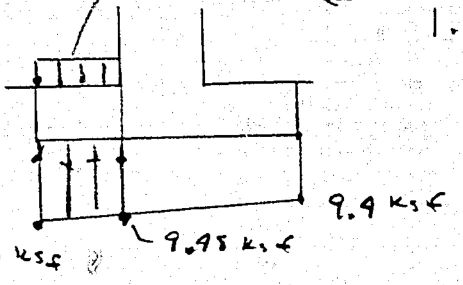
$d = 14 - 3 - .875/2 = 10.6"$

$V_u = .85 v_c d = .85(2\sqrt{4000})(10.6)/10^3) = 1.14^k/in$

$= \underline{13.7^k/FT}$

M_u (page 14) = 17.75 k-in/in

$w = \dfrac{(.88+.44+.28)}{1.25} = 1.28$ ksf



$V@.15\ell$ from wall $= (9.5-1.28)(.85)(1.25) = \underline{8.7^k/FT}$

$< \underline{13.7^k/FT}$ ok

$M_u = (9.5-1.28)(1.25)^2/2 = 6.42$ k-FT/FT $< \underline{17.75}$ ok

(/P4c) ( )4c) (16.29) (15.9) OK

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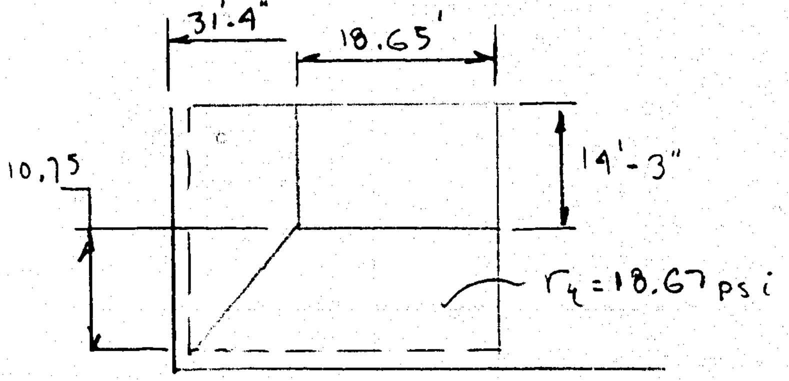
BY WS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 288 OF 343

CKD. BY____ DATE____ SUBJECT COLUMN DESIGN

Front Wall End Bay



$$P = \frac{18.67\,(31.33+18.65)(12)(10.75)(12)}{2 \times 10^3} = 722.2^K$$

$$V_{sv}\left[\left(18.65 + \frac{12.7}{2}\right) + \frac{\cancel{2}}{3}\left(\frac{12.7}{\cancel{2}}\right)\right] = 722.2^K$$

$V_{sv}(29.2) = 722.2^K$ $V_{sv} = 24.7\ ^K/FT$

Dynamic Loads

Slab V_{sv} = 24.7 K/FT

r_4 of Slab on top of wall (4'-6")

18.67(4.5)(12) = 1008#/in = 12.1 K/FT

Wgt of Wall = 4.5(21.3)(.15) = 14.4 K/FT

Slab + Soil Inside Bldg = .78 K/FT

Ftg (5.75(1.17)(.15) = 1.04 K/FT

53.02 K/FT

WGT = 3.17x1.33x21.5= 90.6#

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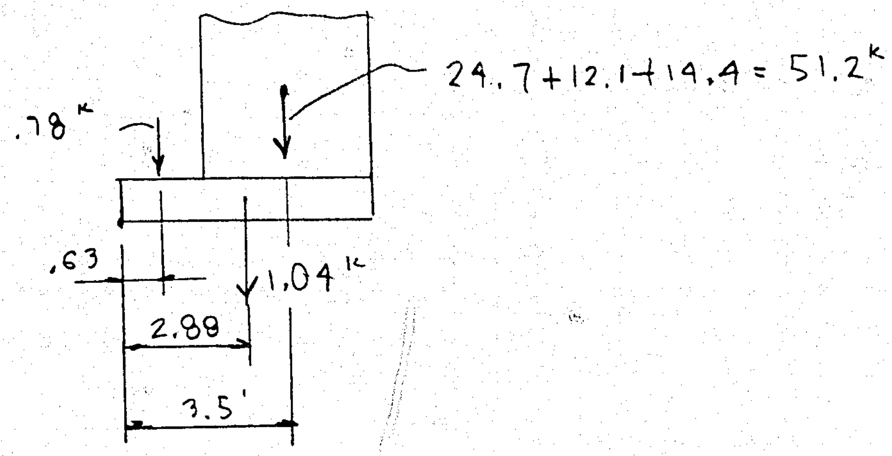
BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 289 OF 343

CKD. BY ______ DATE ______ SUBJECT Column Design

Bearing Stresses



$\Sigma F_v = 53.02 \,{}^{k}/_{FT}$

$\Sigma M_o = .78(.63) + 1.04(2.88) + 51.2(3.5) = 182.7 \text{ k-FT/FT}$

$e = 2.88 - \frac{182.7}{53.02} = \underline{.57'}$

$f_b = \frac{53.02}{5.75} \pm \frac{53.02(.57)(6)}{(5.75)^2} = 9.22 \pm 5.48$

$= 14.7^{ksf}$ MAX

$= 3.74^{ksf}$ Min

Extend Ftg out 0'-9" under dock (6.5' Ftg)

$\Sigma F_V = 53.02 + .32 + .75(1.17)(.15) = \underline{53.5 \,{}^{k}/_{FT}}$

$\Sigma M_o = 182.7 + .32(6.13) + .13(6.13) = 185.5 \text{ k-FT/FT}$

$e = \frac{185.5}{53.5} - 3.25 = .22$

BY WS DATE 3/72 PROJECT Box MAGAZINE TYPE A SHEET No. 290 OF 343

CKD. BY ______ DATE ______ SUBJECT COLUMN DESIGN

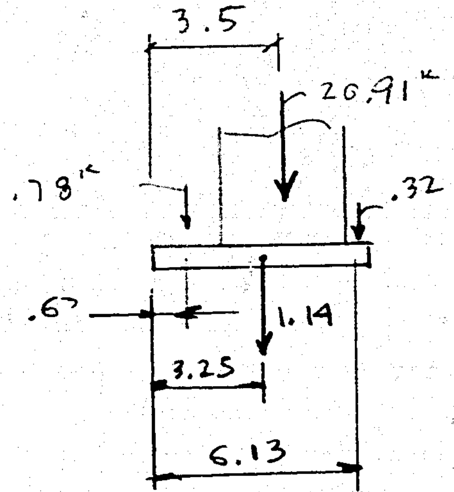
$$f_b = \frac{53.5}{6.5} \pm \frac{53.5(.22)(6)}{(6.5)^2} = 8.23 \pm 1.67$$

$$f_{b_{max}} = 9.9^{ksf}$$

$$f_{b_{min}} = 6.6^{ksf}$$

Static Loads

DL of Slab : $\frac{3.3}{18.65}(24.7)$	=	$4.37^{k}/FT$
DL on Top of Wall $\left(\frac{3.3}{18.65}\right)(12.1)$	=	$2.14^{k}/FT$
Wgt of Wall	=	14.4
Slab + Soil Inside Bldg	=	.78
Ftg (6.5)(1.17)(.15)	=	$1.14^{k}/FT$
Slab + Soil Outside Bldg	=	.32
		$23.15^{k}/FT$



$$\Sigma M_0 = .78(.63) + 20.91(3.50) + .32(6.13) + 1.14(3.25) = 79.34$$

$$e = 79.34/23.15 - 3.25 = .177'$$

BY WS DATE /78 PROJECT Box Magazine Type A SHEET NO. 291 OF 343

CKD. BY ____ DATE ____ SUBJECT Column Design

$$f_b = \frac{23.15}{6.5} \pm \frac{23.15(.177)(6)}{(6.5)^2} = 3.56 \pm .58^{\,ksf}$$

$$f_{b_{max}} = 4.14^{\,ksf} > 4 \quad NG$$

Extend out 3"

$$\Sigma F_v = 21.69 + \left(\frac{6.75}{6.5}\right)(1.14) + \frac{1}{.75}(.32) = \underline{23.3^{\,k/ft}}$$

$$\Sigma M_o = .78(.63) + 20.91(3.50) + 1.18(3.38) + .43(6.25)$$

$$= \underline{80.4 \text{ k-FT/FT}}$$

$$e = \frac{80.4}{23.3} - 3.375 = .076$$

$$f_b = \frac{23.3}{6.75} \pm \frac{23.3(.076)(6)}{(6.75)^2} = 3.45 \pm .233$$

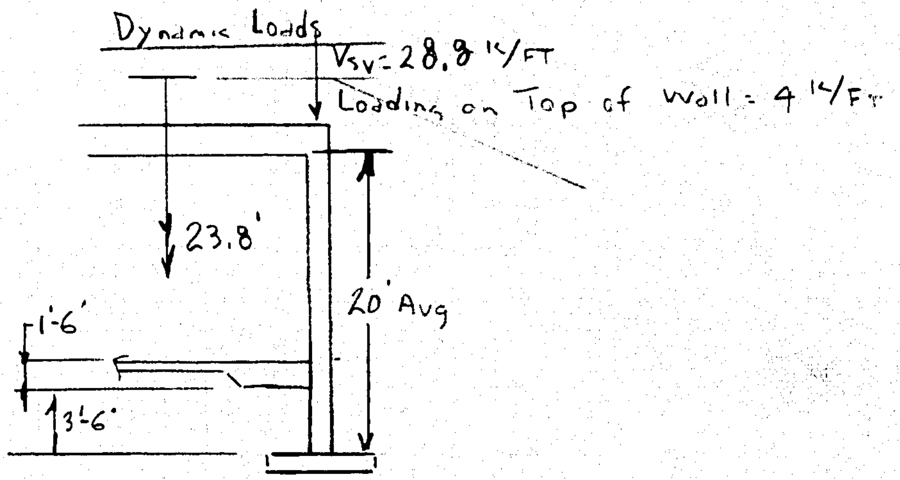
$$f_{b_{max}} = 3.68^{\,ksf} < 4^{\,ksf} \quad OK$$

<u>Ftg Strength</u> 14" w/ #7 @ 12" OK by inspection

BY W/S DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 292 OF 343

CKD. BY ____ DATE ____ SUBJECT COLUMN DESIGN

Side Wall -



Dynamic Loads Assume 4'-Ftg (1'-3" extension) x 14" Tk

Roof - = 28.8 k/FT

Loading on top of wall = 4 k/FT

Wgt of Wall (20x1.5x.15) = 4.5 k/FT

} 37.3 k/FT wall load

Soil Mound (23.8x1.25x.1) = 2.98 k/FT

Soil + Slab inside Bldg = .72 k/FT

Ftg (4x1.17x.15) = .7 k/FT

41.7 k/FT

Try 4'-6" Ftg Wall Load = 37.3

Soil Mound $(2.98 \times \frac{1.5}{1.25})$ = 3.6

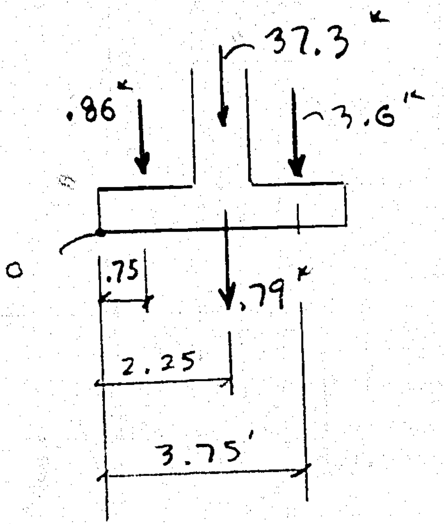
Soil + Slab inside bldg $(.72 \times \frac{1.5}{1.25})$ = .86

Ftg (.7x4.5/4) = .79 Σ = 42.55 k/FT

BY WS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 293 OF 343

CKD. BY ____ DATE ____ SUBJECT Column Design

Check Bearing Stresses



$\Sigma F_v = 42.55^k$

$\Sigma M_o = .86(.75) + (37.3 + .79)(2.25) + 3.6(3.75) = 99.8 \text{ K-FT}$

$$e = \frac{99.8}{42.55} - 2.25 = .097'$$

$$f_b = \frac{42.55}{4.5} \pm \frac{42.55(.097)(6)}{(4.5)^2} = 9.45 \pm 1.22 =$$

$f_{b\,max} = 10.7$ ksf

Try 5' Ftg (1.75' extension)

Wall Load	37.3 k/FT
Soil Mound $\left(2.98\left(\frac{1.75}{1.25}\right)\right)$ =	4.17 k/FT
Soil+Slab inside bldg $\left(.72 \times \frac{1.75}{1.25}\right)$ =	1.0 k/FT
Ftg $\left(\frac{5}{4} \times .7\right)$ =	.88 k/FT
	43.35 k/FT

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BY NS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 294 OF 343

CKD. BY ____ DATE ____ SUBJECT Column Design

$$\Sigma M_G = 1(.88) + (37.3 + .88)(2.5) + 4.17(4.12) = 113.5 \text{ K-FT}$$

$$e = \frac{113.5}{43.35} - 2.5 = .118'$$

$$f_b = \frac{43.35}{5} \pm \frac{43.55(.118)(6)}{25} = 8.71 \pm 1.23$$

$$f_{b_{max}} = 9.94^{ksf} < 10$$

$$f_{b_{min}} = 7.48^{ksf}$$

Check for Static Loads

Roof DL $\left(\frac{3.3}{18.65}\right)(28.8+4) = 5.8\ ^{K}/FT$

Roof LL (100psf - .69psi $\left(\frac{.69}{18.65}(28.8+4)\right) = 1.21\ ^{K}/FT$

Wgt of Wall 4.5 $^{K}/FT$

Wall Load 11.51

Soil Mound 4.17 $^{K}/FT$

Soil + Slab inside Bldg 1.0 $^{K}/FT$

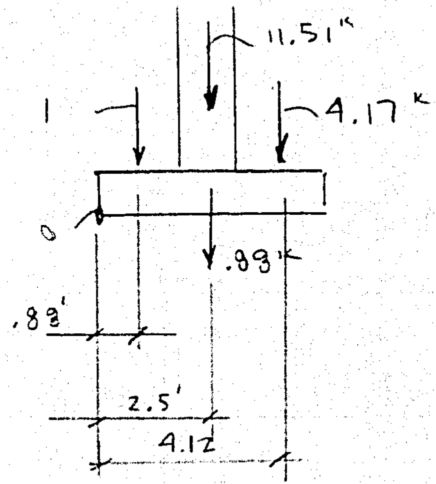
Ftg .88 $^{K}/FT$

17.56 $^{K}/FT$

BY NS DATE 3/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 295 OF 34

CKD. BY ______ DATE ______ SUBJECT COLUMN DESIGN

Check Bearing Stresses



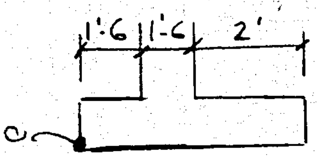
$$\Sigma M_o = 1.0(.88) + 2.5(11.51 + .88) + 4.17(4.12) = 49.04^{k\text{-}FT}$$

$$e = \frac{49.04}{17.56} - 2.5 = .29'$$

$$f_b = \frac{17.56}{5.0} \pm \frac{17.56(.29)(6)}{25} = 3.51 \pm 1.22$$

$$f_{b\,max} = 4.73\,Ksf > 4^{ksf} \text{ NG}$$

Move 3" to left



Wall Load 11.51k

Soil + Slab inside Bldg .86

Soil Mound$\left(\left(\frac{2}{1.75}\right)(4.17)\right)$ = 4.77

Ftg = .88

18.02k

BY NS DATE 2/18 PROJECT Box Magazine Type A SHEET NO. 296 OF 343

CKD. BY ______ DATE ______ SUBJECT Column Design

$$\Sigma M_o = 11.51(2.25) + .86(.75) + 4.77(4) + .88(2.5)$$

$$= 47.8 \text{ K-FT/FT}$$

$$e = \frac{47.8}{18.02} - 2.5 = .152$$

$$f_b = \frac{18.02}{5} \pm \frac{18(.15)(6)}{25} = 3.6 \pm .65$$

$$f_{b\,max} = 4.25 \text{ ksf}$$

$$f_{b\,min} = 2.95 \text{ ksf}$$

Move 4" to left (1'-5" overhang)

Wall load = 11.51^K

Soil + Slab inside bldg $\left(\frac{17}{18} \times .86\right) =$ $.81^K$

Soil Mound $\left(\frac{25}{24} \times 4.77\right) =$ 4.97^K

Ftg = .88

18.17^K

$$\Sigma M_c = 11.51(2.17) + .86(.71) + 4.97(3.96) + .88(2.5)$$

$$= 47.47 \text{ K-FT}$$

$$e = \frac{47.47}{18.17} - 2.5 = .11$$

$$f_b = \frac{18.17}{5} \pm \frac{18.17(.11)(6)}{25} = 3.63 \pm .48$$

$f_{b\,max} = 4.11$ ksf say ok

BY WS DATE [illegible] PROJECT BOX MAGAZINE TYPE A SHEET NO. 297 OF 3[illegible]

CKD. BY ____ DATE ____ SUBJECT COLUMN DESIGN

Check Dyn. Loading

$\Sigma M_o = 37.3(2.17) + .86(.71) + 4.97(3.96) + .88(2.5)$

$= 103.4 \text{ k-FT}$

$\Sigma F = 44.01^k$

$e = \frac{103.4}{44.01} - 2.5 = -.15$

$f_b = \frac{44.01}{5} \pm \frac{44.01(.15)(6)}{25} = 8.8 \pm 1.58$

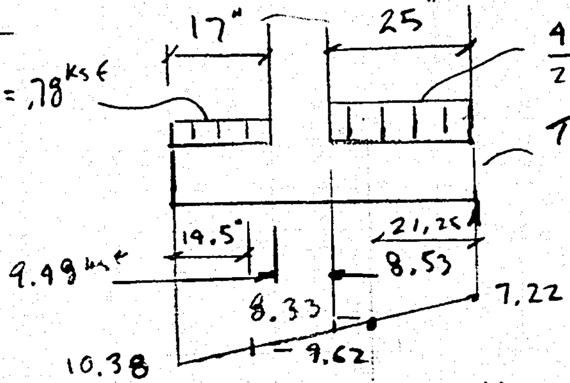
$f_{b_{max}} = 10.38^{ksf}$ say ok

$f_{b_{min}} = 7.22^{ksf}$

Check Ftg

$\frac{.86}{1.41} + .175 = .78^{ksf}$

$\frac{4.97}{2.08} + .175 = 2.56 \text{ ksf}$



T = 19" w/ #7@12"

$V_u = 13.76^k$

$M_u = 17.75^{k\text{-FT}/\text{FT}}$

RH. SIDE

$V_u = \left(\frac{8.33 + 7.22}{2} - 2.56\right)\left(\frac{21.25}{12}\right) = 9.23^k < 13.76^k$ ok

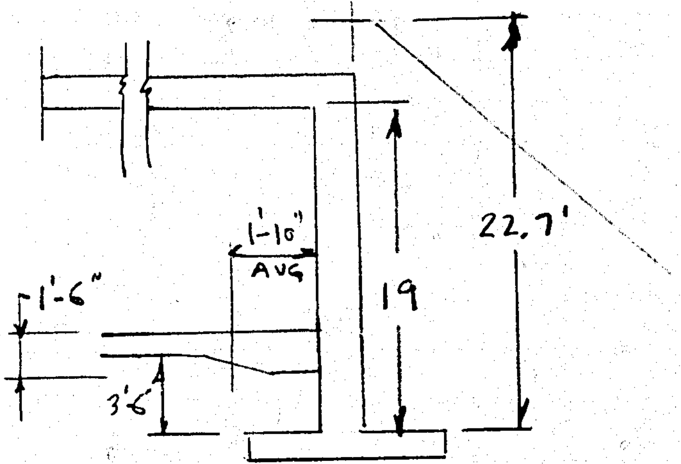
$M_u = \frac{(7.22 - 2.56)(2.08)^2}{2} + \frac{1.31(2.08)^2}{6} = 11.31 \text{ k-FT/FT} < 17.75$ ok

LH SIDE

$V_u = \left(\frac{10.38 + 9.62}{2} - .78\right)\left(\frac{14.5}{12}\right) = 11.1^k < 13.76^k$ ok

$M_u = (9.48 - .78)(1.42)^2/2 + .9(1.42)^2/3 = 9.39 \text{ k-FT} < 17.75$ ok

Rear Wall

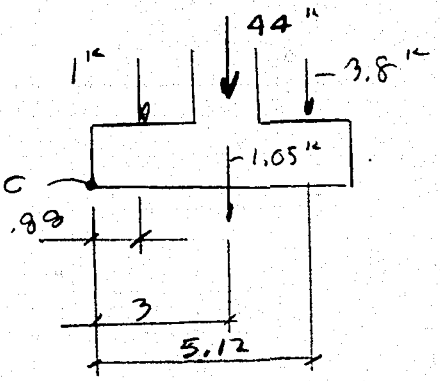


Assume 6' Ftg

w/ 21" overhang

Dynamic Load	- 36.9 k/FT	} 44 k/FT
Wgt of Wall $(2.5 \times 19 \times .15)$	- 7.1 k/FT	
Soil Mound $\left(\frac{22.7 + 21.8}{2}\right)(1.75)(.1)$	- 3.8 k/FT	
Soil + Slab Inside Bldg	- 1.0 k/FT	
Ftg $\left(\frac{14}{12} \times 6 \times .15\right)$	- 1.05 k/FT	
	49.9 k/FT	

Bearing Stresses



BY NS DATE 3/78 PROJECT Box Magazine Type A SHEET NO. 299 OF 34

CKD. BY ____ DATE ____ SUBJECT Column Design

$\Sigma M_o = 1(.88) + 45.05(3) + 3.8(5.12) = 155.5$ k-ft

$e = \frac{155.5}{49.9} - 3 = .115'$

$f_b = \frac{49.9}{6} \pm \frac{49.9(.115)(6)}{36} = 8.32 \pm .96$

$f_{b\,max} = 9.27$ ksf

$f_{b\,min} = 7.36$ ksf

Check Static Loads

Roof DL	$\left(\frac{3.3}{19.7}\right)(36.9) =$	6.18 k/ft	
Roof LL (100psf) (.69psi)	$\left(\frac{.69}{19.7}\right)(36.9) =$	1.29 k/ft	14.57 k
Wgt of Wall		7.1 k/ft	
Soil Mound		3.8 k/ft	
Soil + Slab inside bldg		1.0	
Ftg		1.05	
		19.42 k/ft	

$\Sigma M_o = 1(.88) + (14.57 + 1.05)(3) + 3.8(5.12) = 65.66$ k-ft/ft

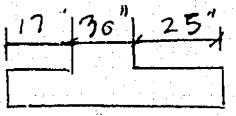
$e = \frac{65.66}{19.42} - 3 = .38'$

$$f_b = \frac{19.42}{6} \pm \frac{19.42(.38)(6)}{36} = 3.23 + 1.22$$

$f_{b\,max} = 4.45$ ksf

$f_{b\,min} = 3.23$ ksf

Move Wall 4" to left



Wall load = 14.57^k

Soil mound $\left(\frac{25}{21} \times 3.8\right) = 4.52^k$

Soil + Slab inside bldg $\left(\frac{17}{21} \times 1\right) = .81^k$

Ftg 1.05^k

20.95^k

$$\Sigma M_o = (.81)(.71) + 14.57(2.67) + 4.52(4.96) + 1.05(3)$$
$$= 65.05 \text{ k-ft}$$

$$e = \frac{65.05}{20.95} - 3 = .105$$

$$F_b = \frac{20.95}{6} \pm \frac{20.95(.105)(6)}{36} = 3.49 \pm .37$$

$f_{b\,max} = 3.85^{ksf} < 4^{ksf}$ OK

WING WALL

Recheck for Dyn Loads

$M = 65.05 + (45.05 - 14.57)(2.67) = 146.4$ k-FT

$F = 20.95 + (45.05 - 14.57) = 51.43^k$

$e = \frac{146.4}{51.43} - 3 = -.153$

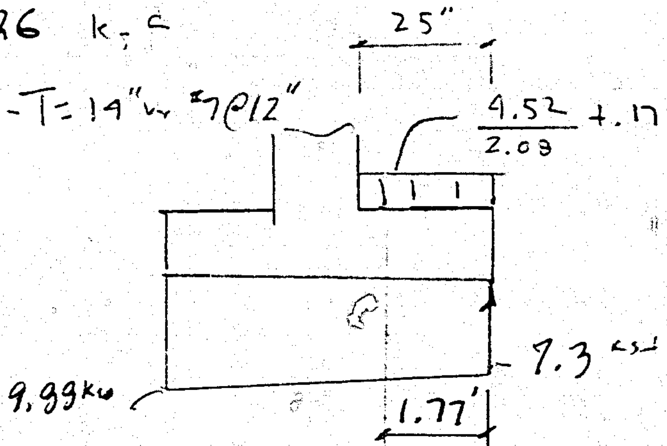
$f_b = \frac{51.43}{6} \pm \frac{51.43(.153)6}{36} = 8.57 \pm 1.31$

$f_{b_{max}} = 9.88$ ksf

$f_{b_{min}} = 7.26$ ksf

Check Ftg - T = 14" w/ #7@12"

$\frac{4.52}{2.08} + .175 = 2.35$ ksf



RH Side

$V_u = (7.3 - 2.35)(1.77) = 8.76^k < 13.7^k$ OK

$M_u = (7.3 - 2.35)(2.08)^2/2 = 10.7$ k-FT ≤ 17.75 OK

LH Side OK by inspection

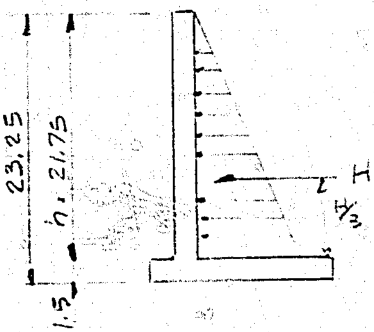
BY MWD DATE 2/15/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 303 OF 343

CKD. BY_____ DATE_____ SUBJECT DESIGN OF WING WALL - MAX HEIGHT SECT

MAXIMUM HEIGHT SECTION

NOTE: CONSIDER 15' WIDE STRIP - AVG HEIGHT = 27 - 3.75 = 23.25

DESIGN OF STEM



SOIL PRESSURE

SOIL DENSITY - $w = 100 \#/ft^3$

LATERAL EARTH PRESSURE COEFF
$K = 0.33$

$p_{MAX} = K w h = 0.33(100)(21.75)$
$= 718 \#/ft^2$

$$H = \frac{ph}{2} = \frac{718(21.75)}{2} = 7806 \#/ft$$

$$M = H\left(\frac{h}{3}\right) = 7806\left(\frac{21.75}{3}\right) = 56,590 \text{ ft}\#/ft$$

DESIGN $V = 1.7H = 1.7(7806) = 13,270 \#/ft$

DESIGN $M = 1.7M = 1.7(56,590) = 96,210 \text{ ft}\#/ft$

TRY $T = 20"$ w/ #7 @ 6 - $A_s = 1.20 \text{ in}^2/ft$

$$d = 20 - 2 - \frac{0.875}{2} = 17.5625"$$

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{1.20(40,000)}{0.85(4,000)(12)} = 1.176"$$

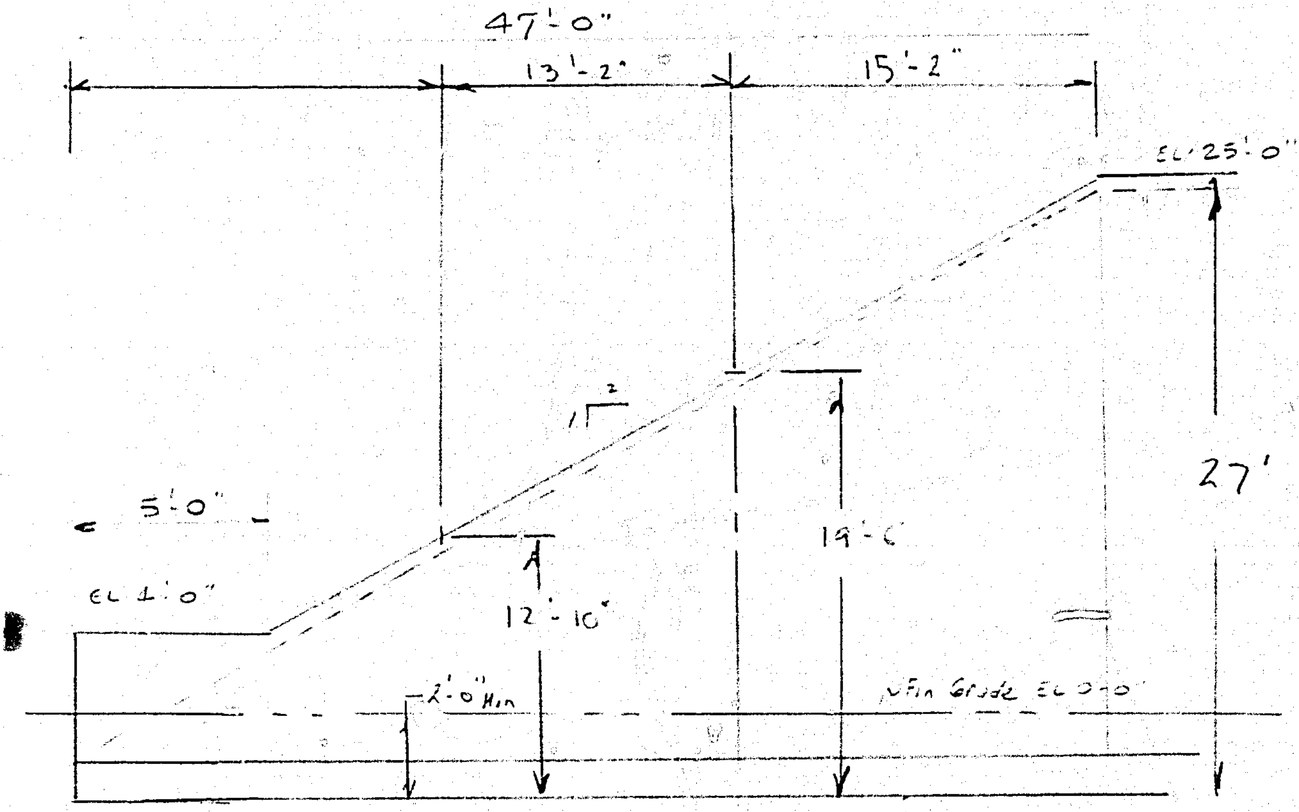
$$M_u = \phi A_s f_y \left(d - \frac{a}{2}\right) = 0.9 \frac{(1.20)}{12}(40,000)\left(17.5625 - \frac{1.176}{2}\right)$$

$= 61,110 \text{ ft}\#/ft$ (For $f_y = 60,000$ psi - $M_u = 91,700$ ft#/ft)

BY MWD DATE 2/3/76 PROJECT Box Magazine "Type A" SHEET NO. 302 OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL

DESIGN OF WING WALL



f_{ys} = 40,000 psi

f'_c = 4000 psi

All. Bearing Pressure = 4000 psf

BY MWD DATE 2/15/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 304 OF 343

CKD. BY______ DATE________ SUBJECT DESIGN OF WING WALL - MAX HEIGHT SECT.

TRY $T = 24''$ w/ #9 @ 6 - $A_s = 2.00 \text{ in}^2/\text{ft}$

$$d = 24 - 2 - \frac{1.128}{2} = 21.436''$$

$$a = \frac{2.00(40,000)}{0.85(4000)(12)} = 1.961''$$

$$M_u = \frac{0.9(2.00)}{12}(40,000)\left(21.436 - \frac{1.961}{2}\right) = 122,700 \text{ ft}^{\#}/\text{ft}$$

TRY $T = 24''$ w/ #8 @ 6 $A_s = 1.58 \text{ in}^2/\text{ft}$

$$d = 24 - 2 - 0.5 = 21.5''$$

$$a = \frac{1.58(40,000)}{0.85(4000)(12)} = 1.549''$$

$$M_u = \frac{0.9(1.58)}{12}(40,000)\left(21.5 - \frac{1.549}{2}\right) = 98,240 > \text{DESIGN } M = 96,210$$

CHECK SHEAR

$$v = \frac{V}{bd} = \frac{13,270}{12(21.5)} = 51.4 \text{ psi}$$

$$v_c = \phi 2 \sqrt{f'_c} = 0.85(2)\sqrt{4000} = 107.5 \text{ psi} > v$$

OK

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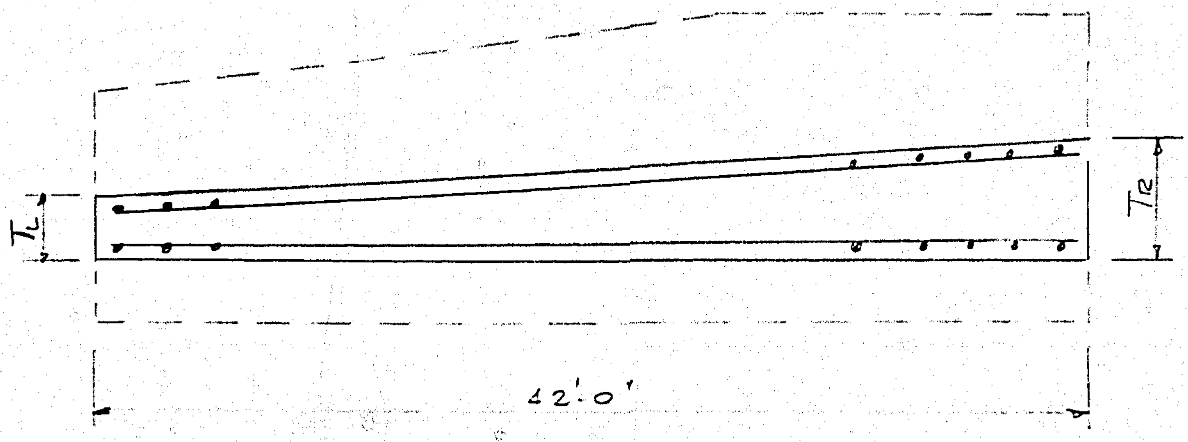
BY MWD DATE 2/16/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 305 OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL - MAX HEIGHT SECT.

NOTE: CONSIDER A VARIABLE THICKNESS WALL



NOTE: TRY VARYING WALL THICKNESS FROM 24" TO 14"

TRY # 0 @ 6 AT HIGH END

① MAX HEIGHT - 5' FROM BLDG - $h = 27 - 1.5 - 0.5 - 2.5 = 22.5'$

FTG

GROUND [illegible] TOP WALL

TAKE SECT. 5' FROM END

$$d = 24 - \left(10 - \overset{1,19}{\frac{37(10)}{42}}\right) - 2 - \frac{1.128}{2} = 20{,}25''$$

$$a = \frac{2.00(40{,}000)}{0.85(4000)(12)} = 1.961$$

$$M_u = \frac{0.9(2.00)}{12}(40{,}000)\left(20{,}25 - \frac{1.961}{2}\right) = 115{,}600\ '\#/'$$

$$P_{MAX} = 0.33(100)(22.5) = 742\ \#/'^2$$

$$H = 742\left(\frac{22.5}{2}\right) = 8{,}350\ \#/' \quad - \text{DESIGN } V = 1.7H = 14{,}200\ \#/'$$

$$v = \frac{14{,}200}{12(21.436)} = 55.2\ psi \quad \underline{OK}$$

$$M = 8{,}350\left(\frac{22.5}{3}\right) = 62{,}630\ '\#/' \quad - \text{DESIGN } M = 1.7M = 106{,}500\ '\#/'$$

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BY MWD DATE 2/16/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 306 OF 343
CKD. BY ____ DATE ____ SUBJECT DESIGN OF WING WALL

② 15 FT FROM BLDG - $H = 27 - 7.5 = 19.5$

TRY #8 @ 6 $A_s = 1.58$ $h = 19.5 - 1.5 - 0.5 = 17.5'$

$$d = 24 - \left[10 - \overset{3.571}{\frac{(42-15)(10)}{42}}\right] - 2 - \frac{1.128}{2} - 0.125 = 17.74$$

$$a = \frac{1.58(40{,}000)}{0.85(4000)(12)} = 1.549''$$

$$M_u = \frac{0.9(1.58)(40{,}000)}{12}\left(17.74 - \frac{1.549}{2}\right) = 80{,}400 \text{ ft\#/ft}$$

$$P_{MAX} = 0.33(100)(17.5) = 578 \text{ \#/ft}^2$$

$$H = \frac{578}{2}(17.5) = 5050 \text{ \#/ft}$$ - DESIGN $V = 1.7H = 3{,}590$ #/ft

$$v = \frac{3{,}590}{12(17.74)} = 40.35 \text{ psi}$$

$$M = \frac{5050}{3}(17.5) = 29{,}500 \text{ ft\#/ft}$$ - DESIGN $M = 1.7M = 50{,}100$ ft#/ft

TRY #7 @ 6 $A_s = 1.20 \text{ in}^2/\text{ft}$

$d = 17.74$ $a = \frac{1.20(40{,}000)}{0.85(4000)(12)} = 1.176''$

$$M_u = \frac{0.9(1.20)(40{,}000)}{12}\left(17.74 - \frac{1.176}{2}\right) = 61{,}700 \text{ ft\#/ft}$$

USE #7 @ 6

③ 12 FT FROM BLDG $H = 27 - 6 = 21'$

$h = 21 - 1.5 - 0.5 = 19'$

FOR # 7 @ 6

$$d = 24 - \left[10 - \overset{7.137}{\frac{(42-12)}{42}(10)}\right] - 2 - 1.128 - 0.5 = 13.515''$$

$a = 1.176$

$$M_u = 0.9\frac{(1.20)}{12}(40{,}000)\left(13.515 - \frac{1.176}{2}\right) = 64{,}500 \text{ ft}^{\#}/\text{ft}$$

$$\text{DESIGN } M = \frac{1.7(0.33)(100)(19)^3}{2(3)} = 64{,}130 \text{ ft}^{\#}/\text{ft} \approx M_u$$

④ 25 FT FROM BLDG $H = 27 - 12.5 = 14.5'$

$h = 14.5 - 1.5 - 0.5 = 12.5'$

TRY # 6 @ 6 $A_s = 0.88$

$$d = 24 - \left[10 - \overset{5.952}{\frac{(42-25)}{42}(10)}\right] - 2 - 1.128 + 0.375 = 15.295''$$

$$a = \frac{0.88(40{,}000)}{0.85(4000)(12)} = 0.863$$

$$M_u = \frac{0.9(0.88)}{12}(40{,}000)\left(15.295 - \frac{0.863}{2}\right) = 39{,}200 \text{ ft}^{\#}/\text{ft}$$

$$P_{MAX} = 0.33(100)(12.5) = 412.5 \ {}^{\#}/\text{ft}^2$$

$$H = \frac{412.5}{2}(12.5) = 2578 \text{ — DESIGN } V = 1.7H = 4.380 \ {}^{\#}/\text{ft}$$

$$M = \frac{2578(12.5)}{3} = 10{,}740 \text{ — DESIGN } M = 1.7M = 18{,}260$$

④ 25 FT FROM BLDG (CONT'D)

TRY #5 @ 6 $A_s = 0.62 \text{ in}^2/\text{ft}$

$$d = 24 - \left[10 \cdot \frac{(\overset{5.952}{42-25})(10)}{42}\right] - 2 - 1.128 - \frac{0.625}{2} = 15.232''$$

$$a = \frac{0.62(40{,}000)}{0.85(4000)(12)} = 0.608$$

$$M_u = \frac{0.9(0.62)}{12}(40{,}000)\left(15.232 - \frac{0.608}{2}\right) = 27{,}760 \text{ ft}^{\#}/\text{ft}$$

⑤ 20 FT FROM BLDG $H = 27 - 10 = 17'$

$h = 17 - 1.5 - 0.5 = 15$

$$\text{DESIGN } M = \frac{1.7(0.33)(100)(15)^3}{2(3)} = 31{,}600 \text{ ft}^{\#}/\text{ft}$$

⑥ 30 FT FROM BLDG $H = 27 - 15 = 12'$

$h = 12 - 1.0 - 0.5 = 10.5'$

$$\text{DESIGN } M = \frac{1.7(0.33)(100)(10.5)^3}{2(3)} = 10{,}800 \text{ ft}^{\#}/\text{ft}$$

⑦ 42 FT FROM BLDG $H = 27 - 21 = 6$

$h = 6 - 1.0 - 0.5 = 4.5'$

$$\text{DESIGN } M = \frac{1.7(0.33)(100)(4.5)^3}{2(3)} = 852 \text{ ft}^{\#}/\text{ft}$$

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 309 OF 343

CKD. BY_____ DATE_____ SUBJECT DESIGN OF WING WALL

FOR #5 @ 12 - $A_s \cdot 0.31 \text{ in}^2/\text{ft}$

$d \cdot 14'' - 2 - \frac{0.625}{2} = 11.6875$

$a = \frac{0.31(40{,}000)}{0.85(4{,}000)(12)} = 0.304$

$M_u = 0.9 \frac{(0.31)}{12}(40{,}000)\left(11.6875 - \frac{0.304}{2}\right) = 10{,}730 \text{ lb}^{\#}/\text{ft}$

MIN HORIZONTAL STEEL

$\rho_T = 0.0025$ (FOR $f_y = 40{,}000$)

$A_s = 0.0025\, bT = 0.0025(12)(24) = 0.72$ (MAX)

For #5 @ 12 - $A_s = 0.31 \times 2 = 0.62 \text{ in}^2/\text{ft}$

$T = \frac{0.62}{0.0025(12)} = 20.7''$

USE #5 @ 12 HORIZ

BY NCS DATE 2/78 PROJECT Bx MAGAZINE TYPE A SHEET NO. 310 OF 343

CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

Bar Cutoff Lengths

@ 5' From Bldg

#9 @ 12"

$$a = \frac{1.00(40000)}{.85(4000)(12)} = .98$$

$$M_u = \frac{.9(1.0)(40000)}{12}\left(20.25 - \frac{.98}{2}\right) = 59280^{\#}\text{-ft/ft}$$

$$\text{Good For } \frac{59280}{1.7} = 34870^{\#}\text{-ft/ft}$$

$$H = .33(100)(x) \qquad M = 33x\left(\frac{x}{2}\right)\left(\frac{x}{3}\right) = 5.5x^3$$

$$5.5x^3 = 34870$$

$$x = \underline{18.5\,ft}$$

Tension Devel Length = $\frac{2}{3}(53) = 35.3 \sim 36''$

Cutoff Hgt from top of slab $= 22.5 - 18.5 + 3$
$= \underline{7'-0''}$

@ 15' From Bldg - $h_w = 17.5'$

#7 @ 12"

$$a = \frac{.60(40,000)}{.85(4000)(12)} = .58$$

$$M_u = \frac{.9(.58)(40000)}{12}\left(17.79 - \frac{.58}{2}\right) = 30363^{\#}\text{/ft/ft}$$

$$\text{Good for } \frac{30363}{1.7} = 17860^{\#}\text{-ft-f}$$

$$M = 5.5x^3 = 17860 \qquad x = 14.8'$$

Tension Devel Length = $\frac{2}{3}(32) = 21'' \sim 2'$

Cuttoff Hgt From Top of Slab = $17.5 - 14.8 + 2 = 4.7' \sim \underline{\underline{5'}}$

BY WS DATE 2/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 311 OF 343

CKD. BY ____ DATE ____ SUBJECT DESIGN OF WING WALL

25' From Bldg #5 @ 12"

$A_s = ,31 \text{ in}^2/\text{ft}$

$h = 12.5'$

$$a = \frac{.31(40\,000)}{.95(4000)(12)} = ,30$$

$$M_u = \frac{.9(,31)(40000)}{12}\left(15.23 - \frac{,30}{2}\right)\ 14024 \text{ \#-ft/ft}$$

Good For $\frac{14024}{1.7} = 8299 \text{ \#-ft/ft} = 5.5x^3$

$x = 11,44$ ft

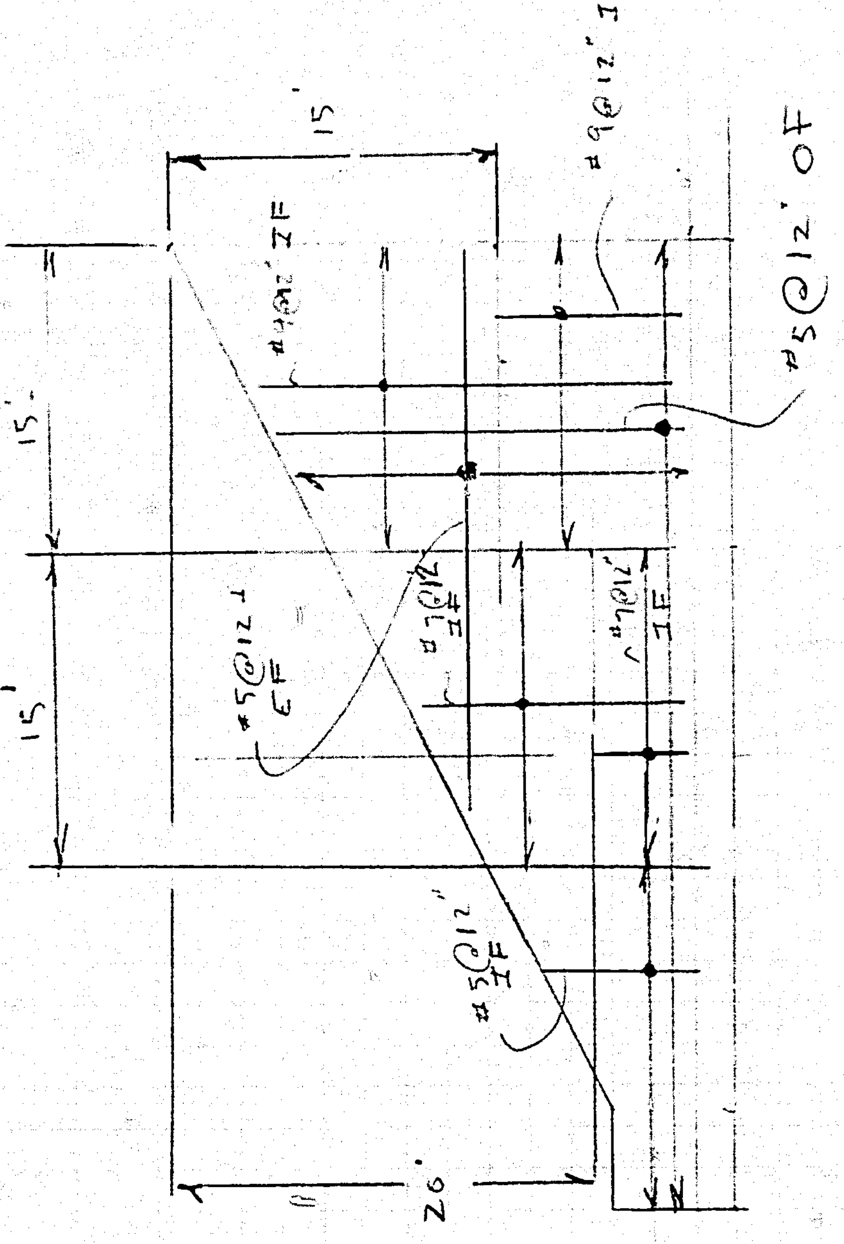
Tension Devel Length = 21" ~ 2'

Cutoff Length = 12.5 − 11,4 + 2 = 3.06'

@ 30' From Bldg #5 @ 12"

BY WS DATE 3/18 PROJECT Box Magazine Type A SHEET NO. 312 OF 343

CKD. BY ____ DATE ____ SUBJECT Design of Wing Wall



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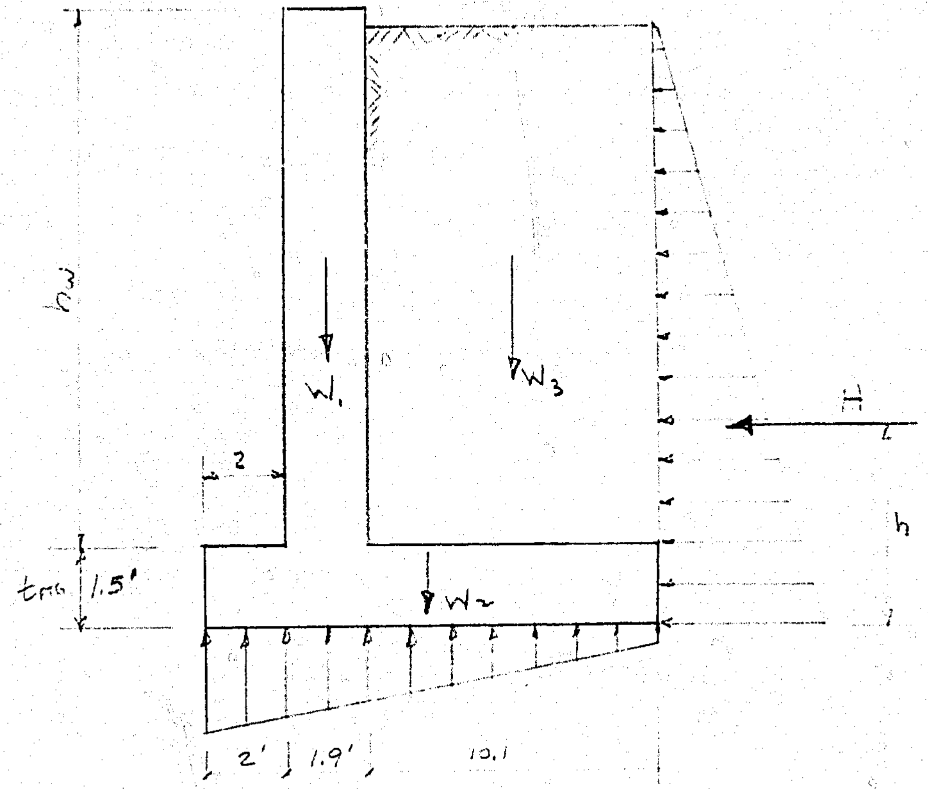
BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 313 OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = 22.8''$

$h_w = 27 - 2.5 - \underset{t_{FTG}}{1.5} = 23'$

$W_1 = 150\,(1)\left(\frac{22.8}{12}\right)(23) = 6{,}555$ #/ft

NOTE! ASSUME FTG WIDTH = 14'

$W_2 = 150(14)(1.5)(1) = 3{,}150$

$W_3 = 100(10.1)(22.5)(1) = 22{,}725$ #/ft

AMMANN & WHITNEY - CONSULTING ENGINEERS - NEW YORK, N. Y.

BY MWD DATE 2/17/73 PROJECT BOX MAGAZINE TYPE A SHEET No. 314 OF 343

CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(24.5)^2}{2} = 9904 \ \#/ft$$

$$M = \frac{9904(24.5)}{3} = 80,880 \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = 6,555\left[2 + \frac{1.9}{2}\right] + 3150\,[7] + 22,725\left[2 + 1.9 + \frac{10.1}{2}\right]$$

$$= 244,800 \ ft\#/ft$$

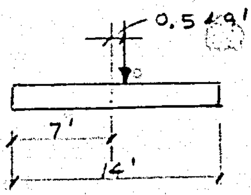
$$M_{APPLIED} = 80,880$$

$$F.S. = \frac{244,800}{80,880} = 3.03$$

SOIL PRESSURE

$$\Sigma W = 6,555 + 3150 + 22,725 = 32,430 \ \#/ft$$

$$\bar{x} = \frac{244,800}{32,430} = 7.549 \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(14)^2}{6} = 32.67 \ ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{32,430}{14} \pm \left[\frac{80,880 - 32,430(0.549)}{32.67}\right]$$

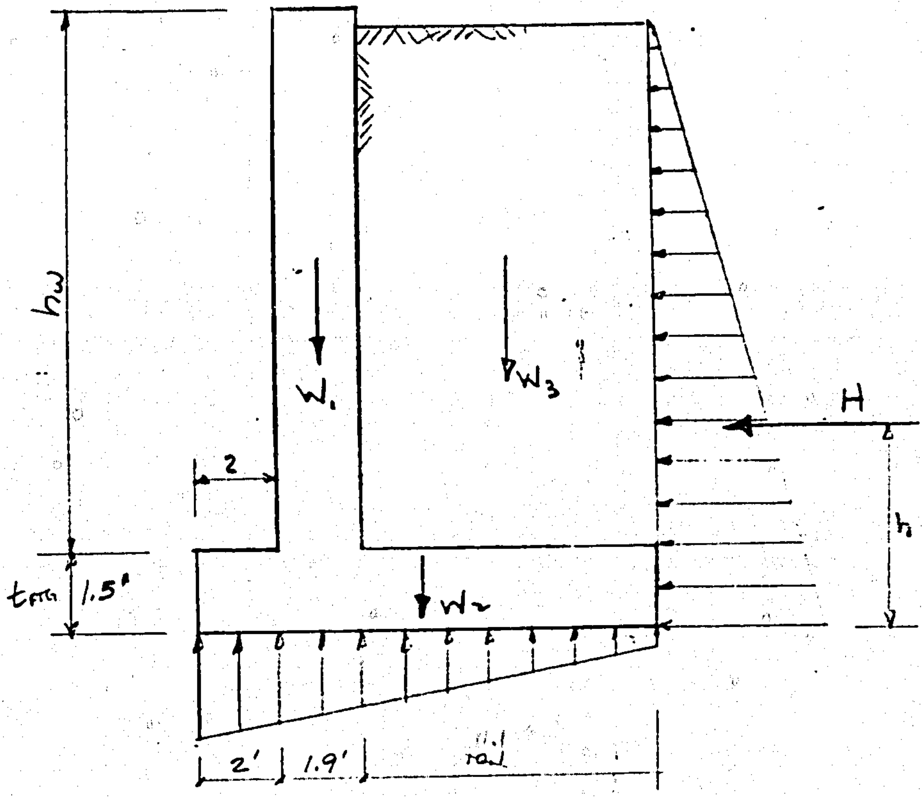
$$= 2316 \pm 1931$$

$$p_{MAX} = 4247 \ \#/ft^2 \ NG$$

$$p_{MIN} = 385 \ \#/ft^2$$

CKD. BY ____ DATE ____ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = 22.8''$

$h_w = 27 - 2.5 - \underset{t_{FTG}}{1.5} = 23'$

$W_1 = 150\,(1)(\frac{22.8}{12})(23) = 6,555$ #/ft

NOTE: ASSUME FTG WIDTH = ~~14~~ 15

$W_2 = 150\,(\overset{15}{\cancel{14}})(1.5)(1) = \overset{3375}{\cancel{3,150}}$

$W_3 = 100(\overset{11.1}{\cancel{10.1}})(22.5)(1) = \overset{24,975}{\cancel{22,725}}$ #/ft

BY MWD DATE 2/17/75 PROJECT BOX MAGAZINE TYPE A SHEET NO. 316 OF 343
CKD. BY ____ DATE ________ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(24.5)^2}{2} = 9904 \ \#/ft$$

$$M = \frac{9904(24.5)}{3} = 80{,}880 \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = 6{,}555\left[2+\frac{1.9}{2}\right] + \overset{3375}{\cancel{3150}}\left[\overset{7.5}{\cancel{7}}\right] + \overset{24{,}975}{\cancel{22{,}725}}\left[2+1.9+\frac{\overset{11.}{10.1}}{2}\right]$$

$$= \overset{280{,}660}{\cancel{244{,}800}} \ ft\#/ft$$

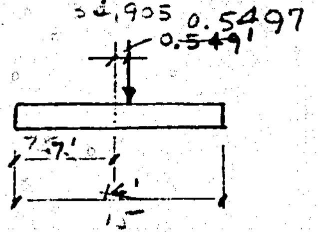
$$M_{APPLIED} = 80{,}880$$

$$F.S. = \frac{\overset{280{,}660}{\cancel{244{,}800}}}{80{,}880} = \overset{3.47}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = 6{,}555 + \overset{3375}{\cancel{3150}} + \overset{24{,}975}{\cancel{22{,}725}} = \overset{34{,}905}{\cancel{32{,}430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{280{,}660}{\cancel{244{,}800}}}{\underset{34{,}905}{\cancel{32{,}430}}} = \overset{8.0407}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{15}{\cancel{14}})^2}{6} = \overset{37.5}{\cancel{32.67}} \ ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{34{,}905}{\cancel{32{,}430}}}{\cancel{14}.5} \pm \left[\frac{80{,}880 - \overset{34{,}905}{\cancel{32{,}430}}(\overset{0.5497}{\cancel{0.549}})}{\underset{37.5}{\cancel{32.69}}}\right]$$

$$= \cancel{2316} \pm \cancel{1931}$$

$$2327 \pm 1645$$

$$p_{MAX} = \overset{3972}{\cancel{4247}} \ \#/ft^2$$

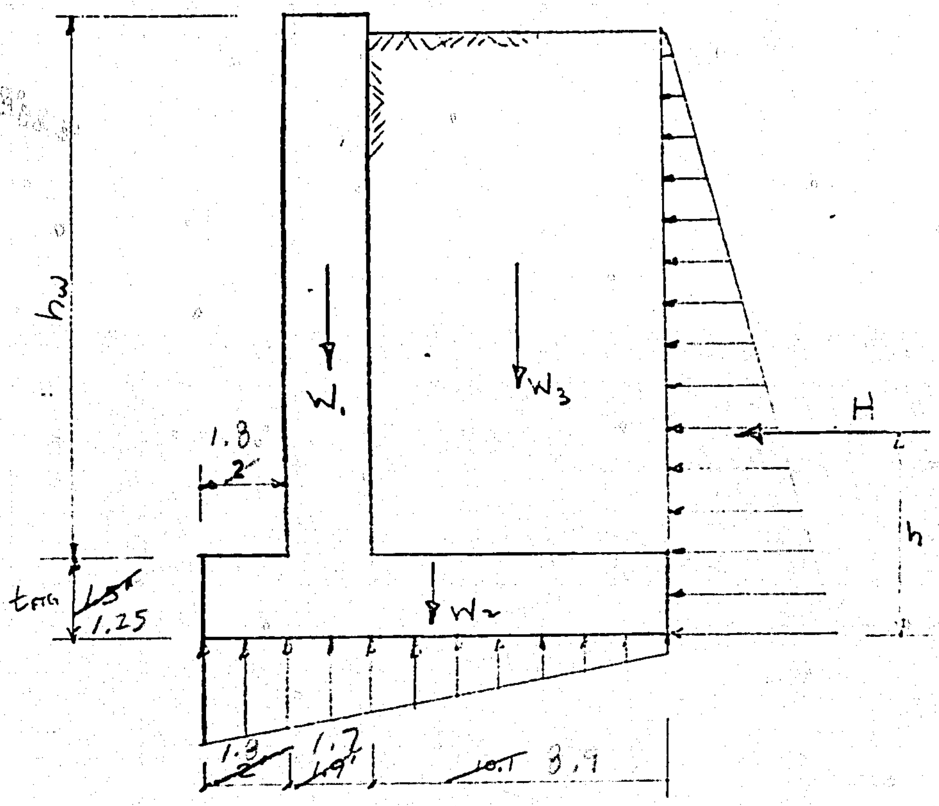
$$p_{MIN} = \underset{682}{\cancel{385}} \ \#/ft^2$$

BY MWD DATE 2/17/73 PROJECT ~~NAVY-MAGAZINE - TYPE II B~~ BOX MAGAZINE TYPE A SHEET NO. 317 OF 343

CKD. BY _____ DATE ________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

15' w/12.4' Footing



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = \overset{20.4}{\cancel{22.8}}''$

$$h_w = 27 - \overset{7,5}{\cancel{25}} - \underset{(t_{FTG}}{\overset{1,5}{\cancel{1.5}}} = \overset{18'}{23'}$$

$$W_1 = 150\,(1)\left(\frac{\overset{20.4}{\cancel{22.8}}}{12}\right)\left(\overset{18}{\cancel{23}}\right) = \overset{4590}{\cancel{6,555}}\ \#/ft$$

NOTE: ASSUME FTG WIDTH = $\overset{12.4}{\cancel{14'}}$

$$W_2 = 150\,(\overset{12.4}{\cancel{14}})(\overset{1.25}{\cancel{1.5}})(1) = \overset{2325}{\cancel{3,150}}$$

$$W_3 = 100\,(\overset{8.9}{\cancel{10.1}})(\overset{17.5}{\cancel{22.5}})(1) = \overset{15575}{\cancel{22,725}}\ \#/ft$$

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 318 OF 343

CKD. BY____ DATE____ SUBJECT____

$$H = 0.33(100)\left(\overset{19.5}{\cancel{24.5}}\right)^2 = \overset{6274}{\cancel{9904}}\ \#/ft$$

$$M = \frac{\overset{6274}{\cancel{9904}}\left(\overset{2-19.5}{\cancel{24.5}}\right)}{3} = \overset{40781}{\cancel{80,880}}\ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{4590}{\cancel{6,555}}\left[\overset{1.8}{\cancel{2}} + \frac{\overset{1.7}{\cancel{1.9}}}{2}\right] + \overset{2325}{\cancel{3150}}\left[\overset{6.2}{\cancel{7}}\right] + \overset{15575}{\cancel{22,725}}\left[\overset{1.9\ 1.7}{\cancel{2+1.9}} + \frac{\overset{9.8}{\cancel{10.1}}}{2}\right]$$

$$= \overset{150400}{\cancel{244,800}}\ ft\#/ft$$

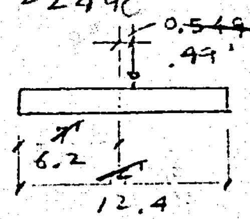
$$M_{APPLIED} = \cancel{80,880}\ 40782$$

$$F.S. = \frac{\overset{150400}{\cancel{244,800}}}{\underset{40782}{\cancel{80,880}}} = \overset{3.7}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \overset{4590}{\cancel{6,555}} + \overset{2325}{\cancel{3150}} + \overset{15575}{\cancel{22,725}} = \overset{22490}{\cancel{32,430}}\ \#/ft$$

$$\bar{x} = \frac{\overset{150400}{\cancel{244,830}}}{\underset{22490}{\cancel{32,430}}} = \overset{6.69}{\cancel{7.549}}\ ft$$



$$S = \frac{bd^2}{6} = \frac{1\left(\overset{12.4}{\cancel{14}}\right)^2}{6} = \overset{25.6}{\cancel{32.67}}\ ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{22490}{\cancel{32,430}}}{\cancel{14}\ 12.4} \pm \left[\frac{\overset{40782}{\cancel{80,880}} - \overset{22490}{\cancel{32,430}}(0.\overset{49}{\cancel{549}})}{\cancel{32.67}\ 25.6}\right]$$

$$= \cancel{2316} \pm \cancel{1931}$$

$$1813 \pm 1162$$

$$P_{MAX} = \overset{2975}{\cancel{1247}}\ \#/ft^2$$

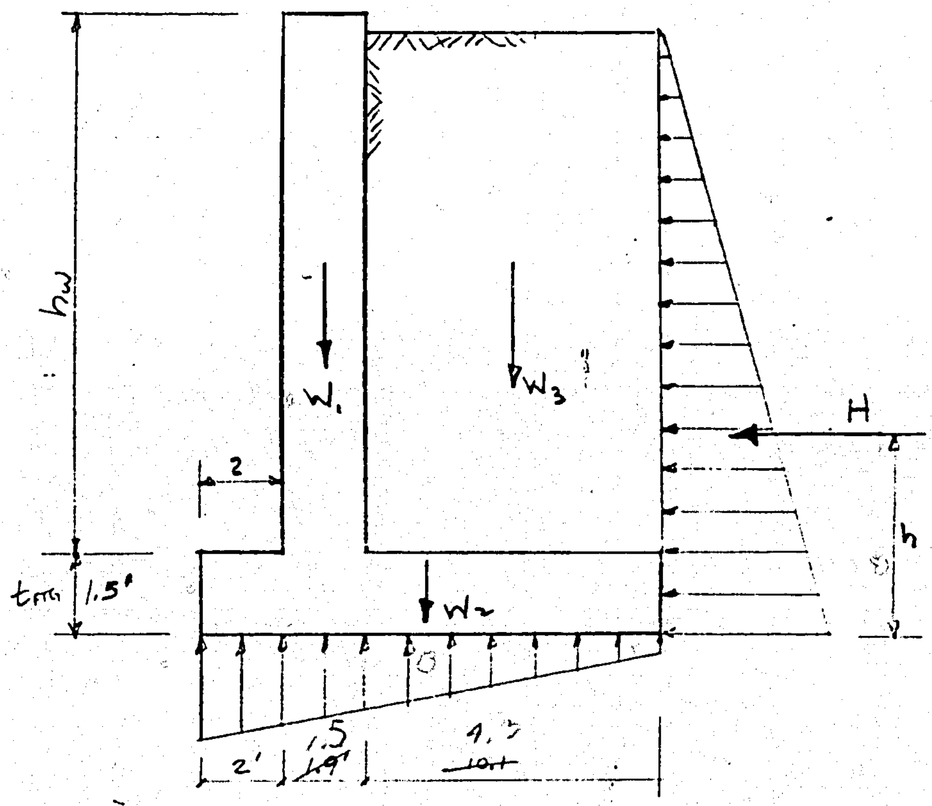
$$P_{MIN} = \underset{651}{\cancel{385}}\ \#/ft^2$$

BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE TYPE [illegible]~~ 30X MAGAZINE TYPE A SHEET NO. 319 OF 343

CKD. BY_____ DATE_____ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

25' w/ 8' FTG



FOR MAX HEIGHT (25' FROM BLDG) $t_{WALL} = \overset{16}{\cancel{22.5}}"$

$$h_w = 27 - \overset{12.5}{\cancel{2.5}} - \underset{t_{FTG}}{1.5} = \overset{13}{\cancel{23}}$$

$$W_1 = 150\,(1)\left(\frac{\overset{16}{\cancel{22.5}}}{12}\right)\left(\overset{13}{\cancel{23}}\right) = \overset{2915}{\cancel{6{,}555}}\ \#/ft$$

NOTE: ASSUME FTG WIDTH = ~~12~~ 8'

$$W_2 = 150\,(\overset{8}{\cancel{14}})(1.5)(1) = \overset{1800}{\cancel{3{,}150}}$$

$$W_3 = 100\,(\overset{4.3}{\cancel{10 ft}})(\overset{12.5}{\cancel{22.5}})(1) = \overset{5375}{\cancel{22{,}725}}\ \#/ft$$

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 330 OF 34[illegible]

CKD. BY ____ DATE ____ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)}{2}\left(\overset{14.5}{\cancel{24.5}}\right)^2 = \overset{3469}{\cancel{9904}}\ \#/ft$$

$$M = \frac{\overset{3469}{\cancel{9904}}\left(\overset{14.5}{\cancel{24.5}}\right)}{3} = \overset{16767}{\cancel{80,880}}\ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{2917}{\cancel{6,555}}\left[2+\frac{\overset{1.5}{\cancel{19}}}{2}\right] + \overset{1800}{\cancel{3150}}\left[\overset{4}{\cancel{7}}\right] + \overset{5375}{\cancel{22,725}}\left[2+\overset{1.5}{\cancel{19}}+\frac{\overset{4.3}{\cancel{10.1}}}{2}\right]$$

$$= \cancel{244,800}\ ft\#/ft \quad 45618$$

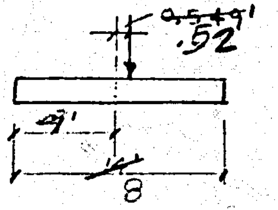
$$M_{APPLIED} = \cancel{80,880} \quad 16767$$

$$F.S. = \frac{\overset{45618}{\cancel{244,800}}}{\underset{16767}{\cancel{80,880}}} = \overset{2.7}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \overset{2925}{\cancel{6,555}} + \overset{1800}{\cancel{3150}} + \overset{5375}{\cancel{22,725}} = \overset{10100}{\cancel{32,430}}\ \#/ft$$

$$\bar{x} = \frac{\overset{45618}{\cancel{244,800}}}{\cancel{32,430}\ 10100} = \overset{4.52}{\cancel{7.549}}\ ft$$



$$S = \frac{bd^2}{6} = \frac{1\left(\overset{8}{\cancel{14}}\right)^2}{6} = \overset{10.67}{\cancel{32.67}}\ ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{10100}{\cancel{32,430}}}{\cancel{14}8} \pm \left[\frac{\overset{16767}{\cancel{80,880}} - \overset{10100}{\cancel{32,430}}\left(\overset{.52}{\cancel{0.549}}\right)}{\cancel{32.67}\ 10.67}\right]$$

$$= \underset{1263}{\cancel{2316}} \pm \underset{1079}{\cancel{1951}}$$

$$P_{MAX} = \overset{2342}{\cancel{4267}}\ \#/ft^2$$

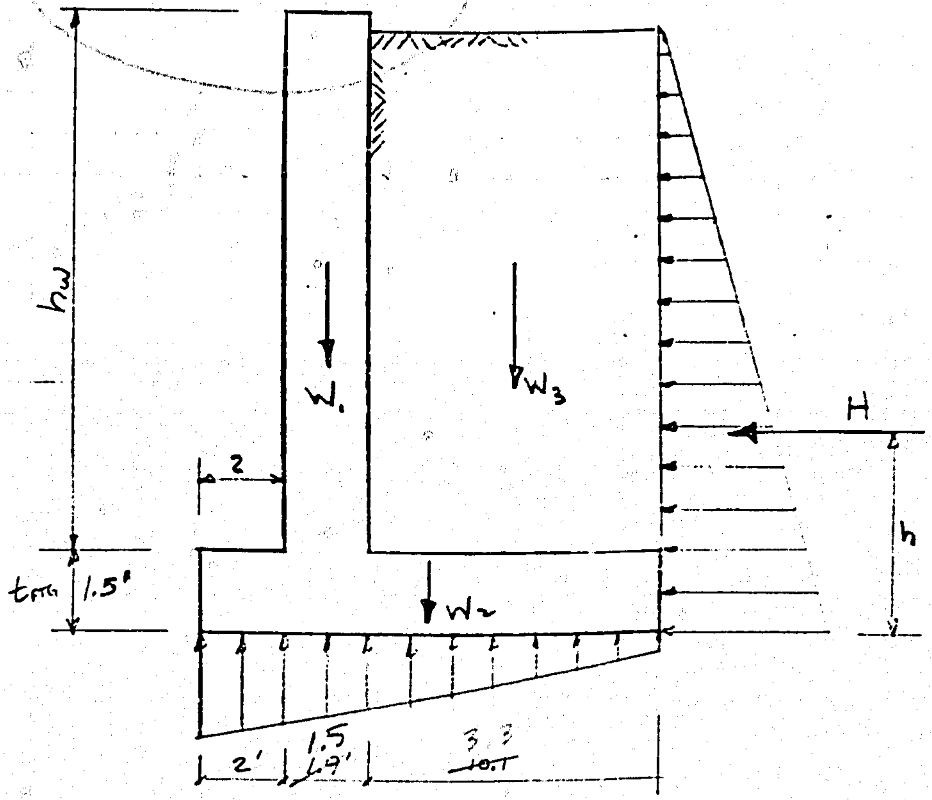
$$P_{MIN} = \underset{184}{\cancel{385}}\ \#/ft^2$$

BY MWD DATE 2/17/73 PROJECT ~~NAVY MAGAZINE TYPE B~~ BOX MAGAZINE TYPE A SHEET NO. ~~47~~ 321 OF 343

CKD. BY_____ DATE_____ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

25' W/7' FTG



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = \overset{18}{\cancel{22.8}}''$

$h_w = 27 - \overset{12.5}{\cancel{25}} - \underset{\llcorner t_{FTG}}{1.5} = \overset{13}{\cancel{23}}'$

$W_1 = 150\,(1)\left(\frac{\overset{18}{\cancel{22.8}}}{12}\right)\left(\overset{13}{\cancel{23}}\right) = \overset{2925}{\cancel{6,555}}$ #/ft

NOTE: ASSUME FTG WIDTH = $\overset{7}{\cancel{14}}'$

$W_2 = 150\,(\overset{7}{\cancel{14}})(1.5)(1) = \overset{1575}{\cancel{3,150}}$

$W_3 = 100\,(\overset{3.3}{\cancel{10.1}})(\overset{12.5}{\cancel{22.5}})(1) = \overset{4785}{\cancel{22,725}}$ #/ft

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BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. [illegible] OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(\overset{14.5}{\cancel{24.5}})^2}{2} = \overset{3469}{\cancel{9904}} \ \#/ft$$

$$M = \frac{9904(\overset{14.5}{\cancel{24.5}})}{3} = \overset{16767}{\cancel{80,880}} \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{2927}{\cancel{6,555}}\left[2 + \frac{\overset{1.5}{\cancel{1.9}}}{2}\right] + \overset{1575}{\cancel{3150}}\left[\overset{3.5}{\cancel{7}}\right] + \overset{4785}{\cancel{22,725}}\left[2 + \overset{1.5}{\cancel{1.9}} + \frac{\overset{3.3}{\cancel{10.1}}}{2}\right]$$

$$= \overset{38204}{\cancel{244,500}} \ ft\#/ft$$

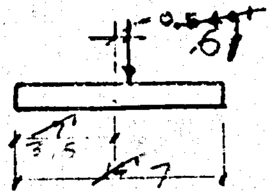
$$M_{APPLIED} = \cancel{80,880} \ \cancel{70,454} \ 16767$$

$$F.S. = \frac{\overset{38204}{\overset{\cancel{[illegible]}}{\cancel{244,500}}}}{\underset{16767}{\cancel{80,880}}} = \overset{2.27}{\overset{\cancel{2.35}}{\cancel{3.03}}}$$

SOIL PRESSURE

$$\Sigma W = \overset{2927}{\cancel{6,555}} + \overset{1575}{\cancel{3150}} + \overset{4785}{\cancel{22,725}} = \overset{9287}{\cancel{32,430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{38204}{\overset{\cancel{39454}}{\cancel{244,850}}}}{\cancel{32,430} \ 9287} = \overset{4.11}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{7}{\cancel{14}})^2}{6} = \overset{8.16}{\cancel{32.67}} \ ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{9287}{\cancel{32,430}}}{\underset{7}{\cancel{14}}} \pm \left[\frac{\overset{16767}{\cancel{80,880}} - \overset{9287}{\cancel{32,430}}(\overset{.61}{\cancel{0.549}})}{\underset{8.16}{\cancel{32.67}}}\right]$$

$$= \underset{1326}{\cancel{2316}} \pm \underset{1356}{\cancel{1931}}$$

$$P_{MAX} = \overset{2682}{\cancel{4247}} \ \#/ft^2$$

$$P_{MIN} = \underset{-30}{\cancel{385}} \ \#/ft^2$$

$$L = \frac{3}{2} \times 4.11 = 6.17$$

P_{max} : $2 \times 9287 / 6.17 = 3012$ psf

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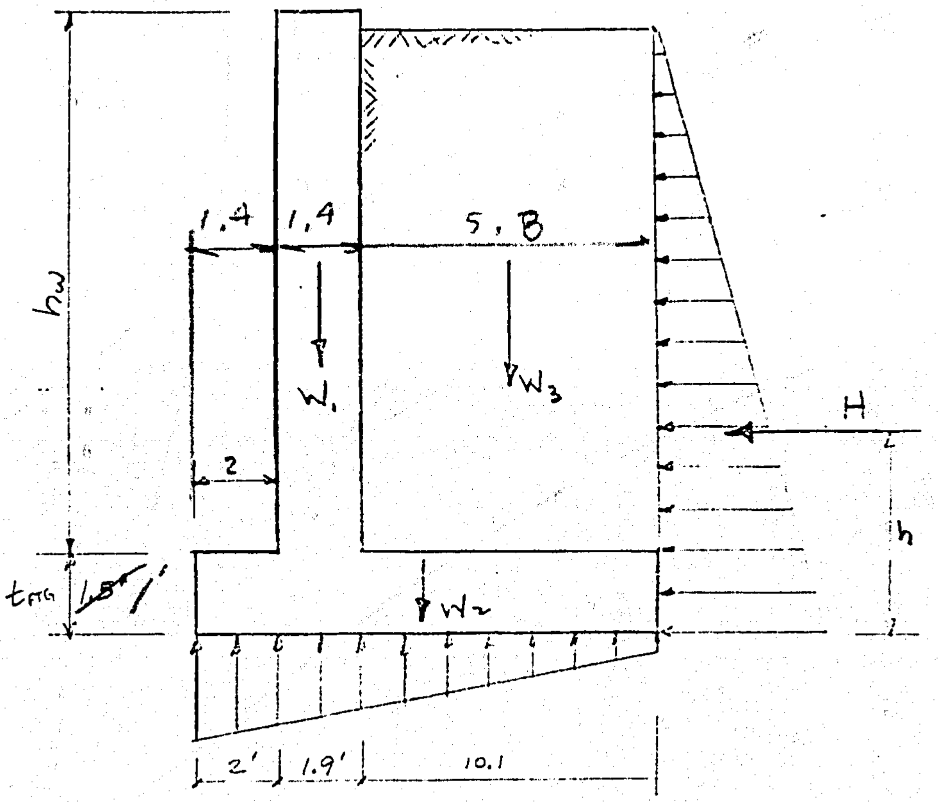
BY MWD DATE 2/17/73 PROJECT ~~NAVY MAGAZINE - TYPE S-B~~ BOX MAGAZINE TYPE A SHEET NO. 323 OF 343

CKD. BY _____ DATE ________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

30' w/ 8.6' FTG



FOR MAX HEIGHT (5' FROM BLDG) $t_{wall} = \overset{17}{\cancel{22.8}}''$

$$h_w = 27 - \overset{15}{\cancel{3.5}} - \underset{t_{FTG}}{1.5} = \overset{10.5}{\cancel{23}}'$$

$$W_1 = 150\,(1)\left(\frac{\overset{17}{\cancel{22.8}}}{12}\right)(\overset{10.5}{\cancel{23}}) = \overset{2231}{\cancel{6,555}}\ \#/ft$$

NOTE! ASSUME FTG WIDTH = $\overset{8.6}{\cancel{14}}$

$$W_2 = 150\,(\overset{8.6}{\cancel{14}})(\cancel{1.5})(1) = \overset{1290}{\cancel{3,150}}$$

$$W_3 = 100\,(\overset{5.8}{\cancel{10.1}})(\overset{10}{\cancel{22.5}})(1) = \overset{3800}{\cancel{22,725}}\ \#/ft$$

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BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 324 OF 343

CKD. BY_____ DATE_______ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(\overset{11.5}{\cancel{24.5}})^2}{2} = \overset{2182}{\cancel{9904}} \ \#/ft$$

$$M = \frac{\overset{2182}{\cancel{9904}}(\overset{11.5}{\cancel{24.5}})}{3} = \overset{8364}{\cancel{80,830}} \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{2231}{\cancel{6,555}}\left[\overset{1.4}{\cancel{2}} + \frac{\overset{1.4}{\cancel{1.9}}}{2}\right] + \overset{1296}{\cancel{3150}}\left[\overset{4.3}{\cancel{7}}\right] + \overset{5800}{\cancel{22,725}}\left[\overset{1.7}{\cancel{2}} + \overset{1.7}{\cancel{1.9}} + \frac{\overset{5.8}{10.1}}{2}\right]$$

$$= \overset{46772}{\cancel{244,300}} \ ft\#/ft$$

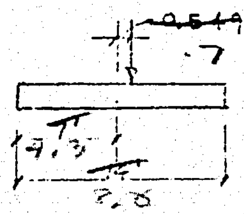
$$M_{APPLIED} = \cancel{80,850} \ 8364$$

$$F.S. = \frac{\overset{46772}{\cancel{244,800}}}{\underset{8364}{\cancel{80,800}}} = \overset{5.6}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \overset{2231}{\cancel{6,555}} + \overset{1296}{\cancel{3150}} + \overset{5800}{\cancel{22,725}} = \overset{9321}{\cancel{32,430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{46772}{\cancel{244,800}}}{\cancel{32,430} \ 9321} = \overset{5.0}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{8.6}{\cancel{14}})^2}{6} = \overset{12.3}{\cancel{32.67}} \ ft^3$$

$$p = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{9321}{\cancel{32,430}}}{\cancel{14} 8.6} \pm \left[\frac{\overset{8364}{\cancel{80,880}} - \overset{9321}{\cancel{32,430}}(\overset{.7}{\cancel{0.549}})}{\cancel{32.67} \ 12.3}\right]$$

$$= \underset{1083}{\cancel{2316}} \pm \underset{150}{\cancel{1931}}$$

$$p_{MAX} = \overset{1232}{\cancel{1249}} \ \#/ft^2$$

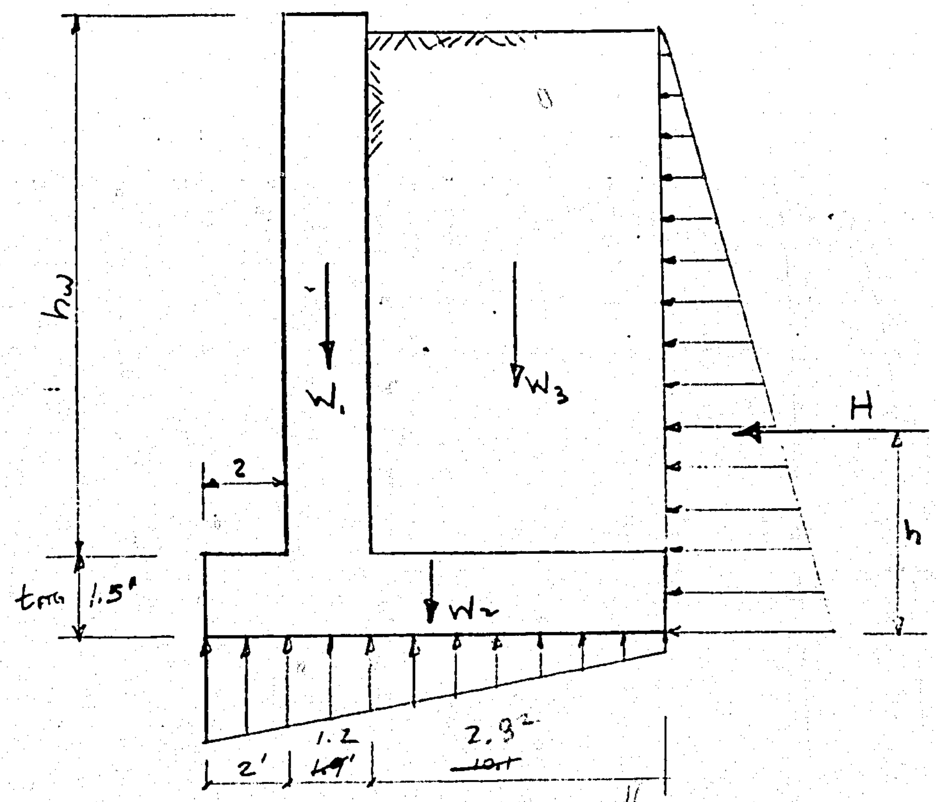
$$p_{MIN} = \underset{933}{\cancel{385}} \ \#/ft^2$$

BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE - TYPE II-B~~ BOX MAGAZINE TYPE A SHEET NO. 325 OF 343

CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

℄ 42' FROM BLDG



FOR MAX HEIGHT ($\overset{42}{\cancel{5}}'$ FROM BLDG) $t_{WALL} = \overset{14"}{\cancel{22.8}}"$

$$h_w = 27 - \overset{21}{\cancel{25}} - \underset{t_{FTG}}{1.5} = \overset{4.5}{\cancel{23}}'$$

$$W_1 = 150\,(1)\left(\frac{\overset{14}{\cancel{22.8}}}{12}\right)(\overset{9.5}{\cancel{23}}) = \overset{758}{\cancel{6,555}}\ \#/ft$$

NOTE! ASSUME FTG WIDTH = ~~14~~ 6'

$$W_2 = 150\,(\overset{6}{\cancel{14}})(1.5)(1) = \overset{1350\#}{\cancel{3,150}}$$

$$W_3 = 100\,(\overset{2.33}{\cancel{10ft}})(\overset{4}{\cancel{22.5}})(1) = \overset{1132}{\cancel{22,725}}\ \#/ft$$

$$H = \frac{0.33(100)(\overset{6}{\cancel{24.5}})^2}{2} = \overset{599}{\cancel{9904}} \ \#/ft$$

$$M = \frac{\overset{599}{\cancel{9904}}(\overset{6}{\cancel{24.5}})}{3} = \overset{1188}{\cancel{80,880}} \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{788}{\cancel{6,555}}\left[2+\frac{\overset{1.2}{\cancel{1.9}}}{2}\right] + \overset{1350}{\cancel{3150}}[\overset{3}{\cancel{7}}] + \overset{1132}{\cancel{22,725}}\left[2+\overset{1.2}{\cancel{1.9}}+\frac{\overset{1.8}{\cancel{10.1}}}{2}\right]$$

$$= \overset{11317}{\cancel{244,800}} \ ft\#/ft$$

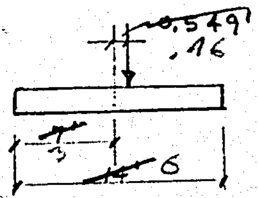
$$M_{APPLIED} = \cancel{80,880} \ 1188$$

$$F.S. = \frac{\overset{11317}{\cancel{244,800}}}{\underset{1188}{\cancel{80,880}}} = \overset{9.5}{\cancel{3.05}}$$

SOIL PRESSURE

$$\Sigma W = \overset{788}{\cancel{6,555}} + \overset{1350}{\cancel{3150}} + \overset{1132}{\cancel{22,725}} = \overset{3270}{\cancel{32,430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{11317}{\cancel{244,800}}}{\cancel{32,430} \ 3270} = \overset{3.46}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{6}{\cancel{14}})^2}{6} = \overset{6}{\cancel{32.67}} \ ft^3$$

$$p = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{3270}{\cancel{32,430}}}{\cancel{14} \ 6} \pm \left[\frac{\overset{1188}{\cancel{80,880}} - \overset{3270}{\cancel{32,430}}(0.\overset{.46}{\cancel{549}})}{\cancel{32.67} \ 6}\right]$$

$$= \underset{545}{\cancel{2316}} \pm \underset{52}{\cancel{1931}}$$

$$p_{MAX} = 4247 \ \#/ft^2$$
$$p_{MIN} = 385 \ \#/ft^2$$

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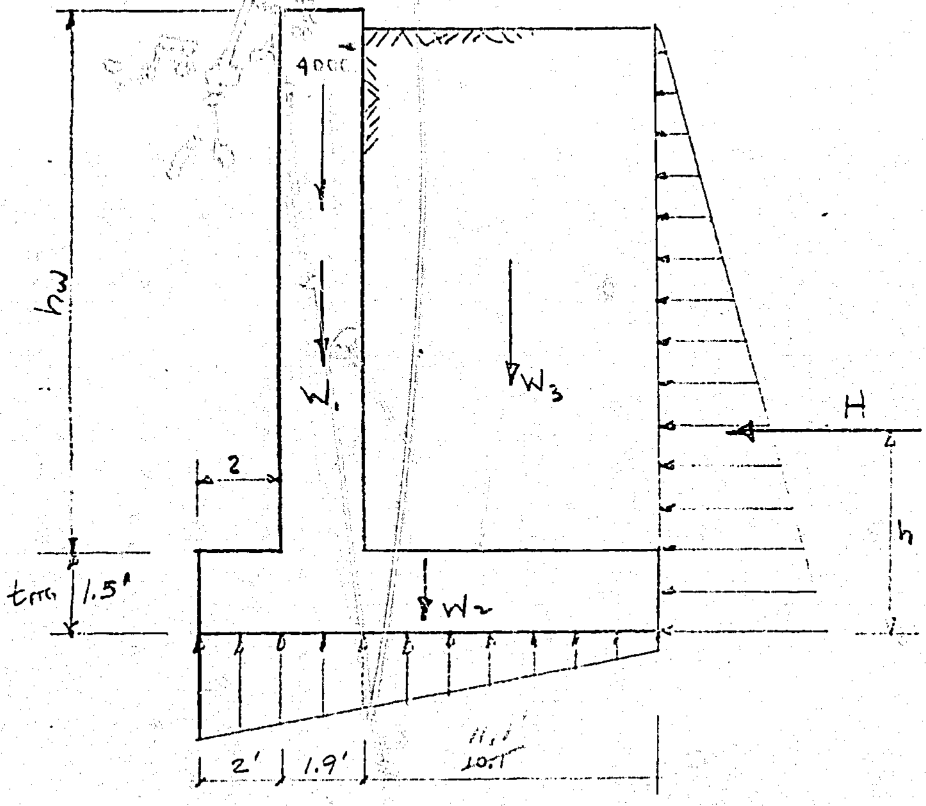
BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE TYPE II B~~ BOX MAGAZINE TYPE A SHEET NO. 327 OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

Loading Ramp Side

OVERTURNING ANALYSIS

@ 5'



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = 22.8''$

$h_w = 27 - 2.5 - \underset{t_{FTG}}{1.5} = 23'$

$W_1 = 150\,(1)\left(\frac{22.8}{12}\right)(23) = 6{,}555$ #/ft

NOTE: ASSUME FTG WIDTH = 14'

$W_2 = 150\,(\overset{15}{\cancel{14}})(1.5)(1) = \overset{3375}{\cancel{3{,}150}}$

$W_3 = 100\,(\overset{11.1}{\cancel{10.1}})(22.5)(1) = \overset{24975}{\cancel{22{,}725}}$ #/ft

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 328 OF 343
CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(24.5)^2}{2} = 9904 \ \#/ft$$

$$M = \frac{9901\,(24.5)}{3} = 80{,}880 \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{4000}{\overset{+}{6{,}555}}\left[2+\frac{1.9}{2}\right] + \overset{3375}{\cancel{3150}}\left[\overset{7.5}{\cancel{7}}\right] + \overset{24975}{\cancel{22{,}725}}\left[2+1.9+\overset{11.1}{\cancel{\frac{10.1}{2}}}\right]$$

$$= \overset{292460}{\cancel{244{,}800}} \ ft\#/ft$$

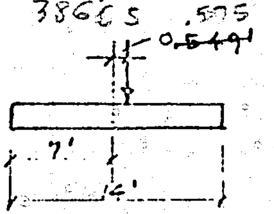
$$M_{APPLIED} = 80{,}880$$

$$F.S. = \frac{\overset{292460}{\cancel{244{,}800}}}{80{,}880} = \overset{3.61}{\cancel{3.05}}$$

SOIL PRESSURE

$$\Sigma W = \overset{4000}{\overset{+}{6{,}555}} + \overset{3375}{\cancel{3750}} + \overset{24975}{\cancel{22{,}725}} = \overset{38965}{\cancel{32{,}430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{292460}{\cancel{244{,}800}}}{\underset{38665}{\cancel{32{,}430}}} = \overset{7.575}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(14)^2}{6} = 32.67 \ ft^3$$

$$p = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{38905}{\cancel{32{,}430}}}{\cancel{14}15} \pm \left[\frac{80{,}880 - \overset{38965}{\cancel{32{,}430}}(0.\overset{575}{\cancel{549}})}{32.67}\right]$$

$$= \underset{2593}{\cancel{2316}} \pm \underset{1788}{\cancel{1931}}$$

$$P_{MAX} = \overset{4381}{\cancel{4247}} \ \#/ft^2$$

$$P_{MIN} = \underset{805}{\cancel{385}} \ \#/ft^2$$

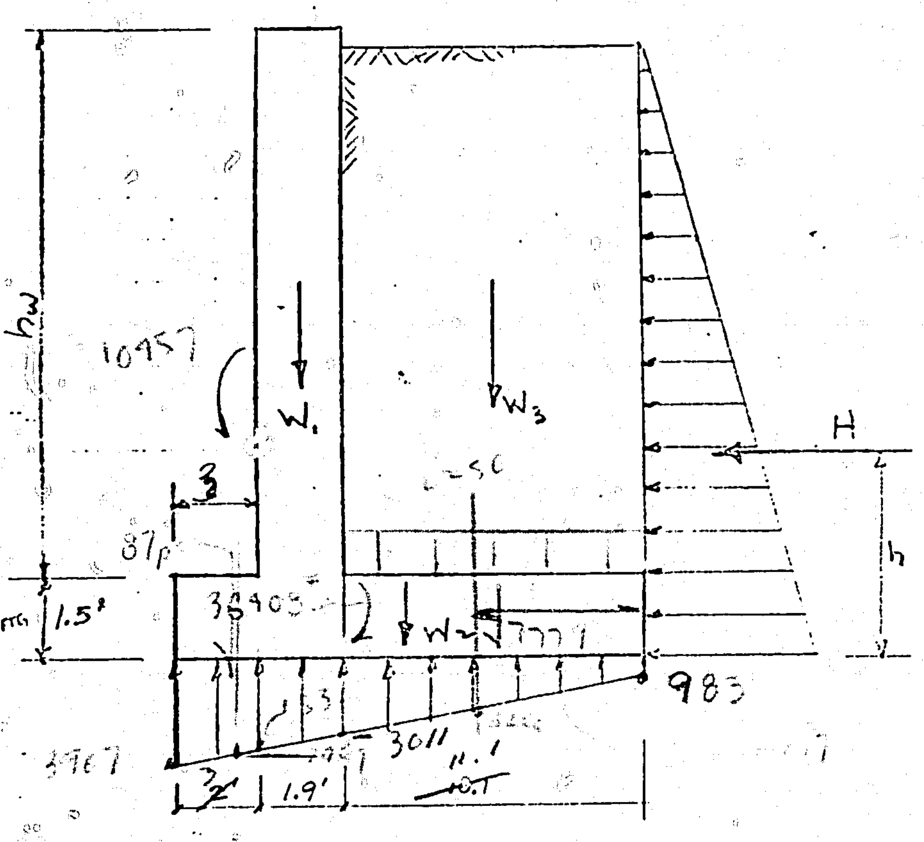
NG

BY. MUJD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE - TYPE II B~~ BOX MAGAZINE TYPE A SHEET NO. 329 OF 343

CKD. BY_____ DATE_______ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

@ 5' w/ 3' ~~RC~~ LIP



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = 22.8''$

$h_w = 27 - 2.5 - \underbrace{1.5}_{t_{FTG}} = 23'$

$W_1 = 150(1)(\frac{22.8}{12})(23) = 6,555$ #/ft +4000#

NOTE: ASSUME FTG WIDTH = ~~14~~ 16'

$W_2 = 150(\overset{16}{\cancel{14}})(1.5)(1) = \overset{3600}{\cancel{3,150}}$

$W_3 = 100(10.1)(22.5)(1) = \overset{24975}{\cancel{22,725}}$ #/ft

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE 1 SHEET NO. 330 OF 343

CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(24.5)^2}{2} = 9904 \;\#/ft$$

$$M = \frac{9904(24.5)}{3} = 80,880 \;ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{\overset{4000}{+}}{6,555}\left[\overset{3}{\cancel{2}} + \frac{1.9}{2}\right] + \overset{3600}{\cancel{3150}}\left[\overset{8}{\cancel{7}}\right] + \overset{29975}{\cancel{22,725}}\left[\overset{3}{\cancel{2}} + 1.9 + \frac{\overset{11.4}{\cancel{10.1}}}{2}\right]$$

$$= \overset{331481}{\cancel{244,800}} \;ft\#/ft$$

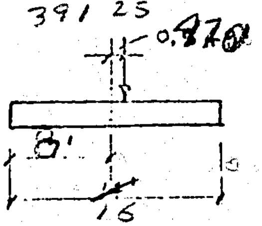
$$M_{APPLIED} = 80,880$$

$$F.S. = \frac{\overset{331481}{\cancel{244,800}}}{80,880} = \overset{4.1}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \overset{\overset{4000}{+}}{6,555} + \overset{3600}{\cancel{3150}} + \overset{29975}{\cancel{22,725}} = \overset{39125}{\cancel{32,430}} \;\#/ft$$

$$\bar{x} = \frac{\overset{331481}{\cancel{244,800}}}{\underset{39125}{\cancel{32,430}}} = \overset{8.472}{\cancel{7.549}} \;ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{16}{\cancel{14}})^2}{6} = \overset{42.66}{\cancel{32.67}} \;ft^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{39125}{\cancel{32,430}}}{\cancel{14}/16} \pm \left[\frac{80,880 - \overset{39125}{\cancel{32,430}}(0.\overset{47}{\cancel{549}})}{\cancel{32.67}\;42.66}\right]$$

$$= \underset{2495}{\cancel{2316}} \pm \underset{1962}{\cancel{1931}}$$

$$P_{MAX} = \overset{3967}{\cancel{1247}} \;\#/ft^2$$

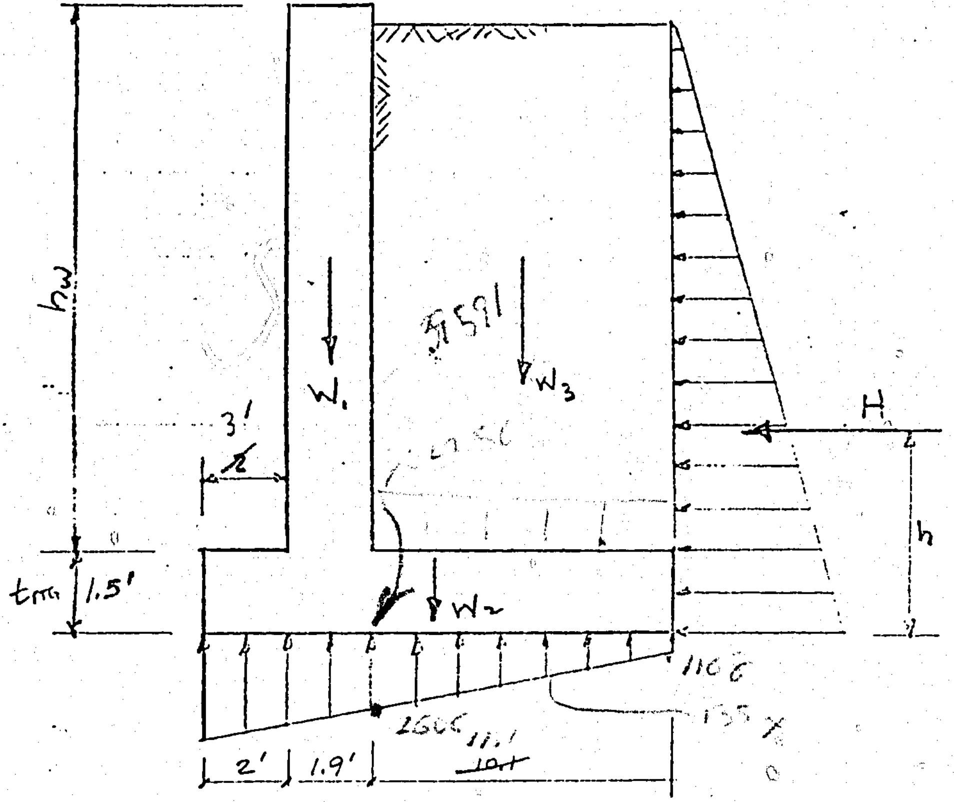
$$P_{MIN} = \underset{983}{\cancel{385}} \;\#/ft^2$$

BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE TYPE II B~~ BOX MAGAZINE TYPE A SHEET NO. 331 OF 343

CKD. BY_____ DATE________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

@ 5' w 3' lip (w/o RAMP LOAD



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = 22.8''$

$h_w = 27 - 2.5 - \underset{t_{FTG}}{1.5} = 23'$

$W_1 = 150\,(1)(\frac{22.8}{12})(23) = 6{,}555$ #/ft

NOTE: ASSUME FTG WIDTH = ~~14~~ 16'

$W_2 = 150\,(\overset{16'}{\cancel{14}})(1.5)(1) = \overset{3600}{\cancel{3{,}150}}$

$W_3 = 100(10.1)(22.5)(1) = \overset{24975}{\cancel{22{,}725}}$ #/ft

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BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 332 OF 2A3

CKD. BY______ DATE________ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(24.5)^2}{2} = 9904 \text{ \#/ft}$$

$$M = \frac{9904}{3}(24.5) = 80,880 \text{ ft \#/ft}$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = 6,555\left[\overset{3}{\cancel{2}} + \frac{1.9}{2}\right] + 3150\left[\overset{8}{\cancel{7}}\right] + 22,725\left[\overset{3}{\cancel{2}} + 1.9 + \frac{10.1}{2}\right]$$

$$= \overset{315680}{\cancel{244,800}} \text{ ft \#/ft}$$

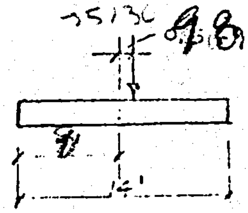
$$M_{APPLIED} = 80,880$$

$$F.S. = \frac{\overset{315680}{\cancel{244,800}}}{80,880} = \overset{3.91}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = 6,555 + \overset{3600}{\cancel{3150}} + \overset{24975}{\cancel{22,725}} = \overset{35130}{\cancel{32,430}} \text{ \#/ft}$$

$$\bar{x} = \frac{\overset{315680}{\cancel{244,800}}}{\underset{35130}{\cancel{32,430}}} = \overset{8.98}{\cancel{7.549}} \text{ ft}$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{16}{\cancel{14}})^2}{6} = \overset{42.66}{\cancel{32.67}} \text{ ft}^3$$

$$P = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{35130}{\cancel{32,430}}}{\cancel{14.16}} \pm \left[\frac{80,880 - \overset{35130}{\cancel{32,430}}(0,\overset{.98}{\cancel{549}})}{\cancel{32.67}\;41.66}\right]$$

$$= \underset{2195}{\cancel{2316}} \pm \underset{1087}{\cancel{1931}}$$

$$P_{MAX} = \overset{3282}{\cancel{1247}} \text{ \#/ft}^2$$

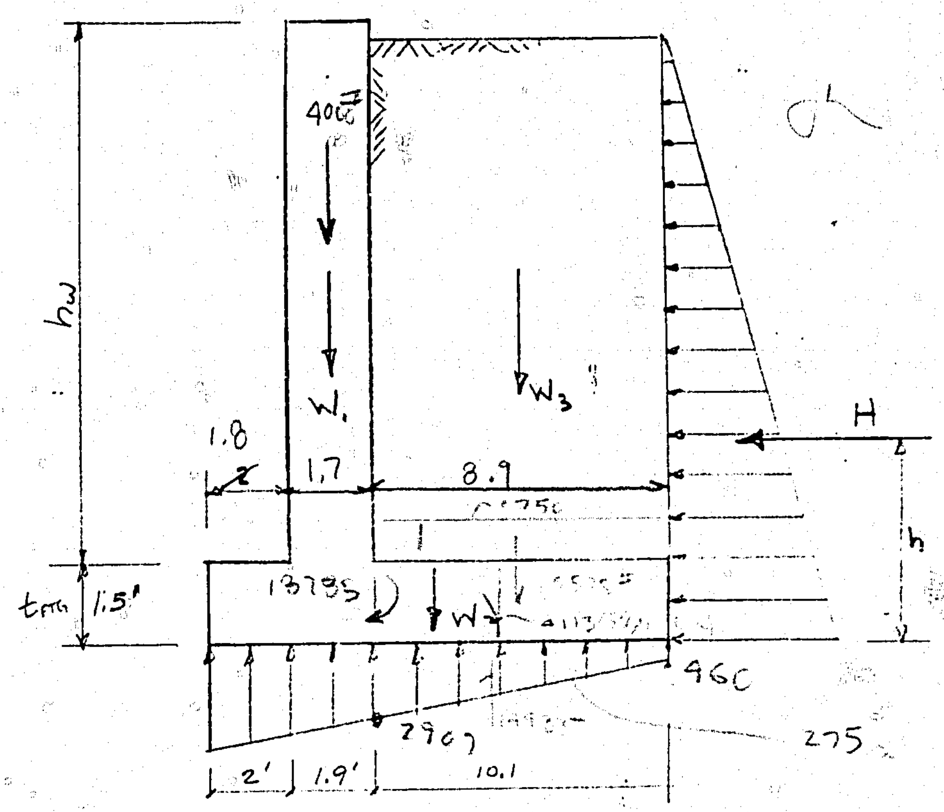
$$P_{MIN} = \underset{1108}{\cancel{385}} \text{ \#/ft}^2$$

BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE - TYPE II-B~~ BOX MAGAZINE TYPE A SHEET NO. 333 OF 343

CKD. BY______ DATE________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

15' w/ 12.4' Ftg / Ramp Load



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = \overset{20.4}{\cancel{22.5}}''$

$$h_w = 27 - \overset{7.5}{\cancel{25}} - \underset{t_{FTG}}{1.5} = \overset{18}{\cancel{25}}'$$

$$W_1 = 150\,(1)\left(\frac{\overset{20.4}{\cancel{22.5}}}{12}\right)(23) = \overset{4596}{\cancel{6,555}}\ \#/ft$$

NOTE: ASSUME FTG WIDTH = ~~14'~~ 12.4'

$$W_2 = 150\,(\overset{12.4}{\cancel{14}})(\overset{1.25}{\cancel{1.5}})(1) = \overset{2325}{\cancel{3,150}}$$

$$W_3 = 100\,(\overset{8.9}{\cancel{10.1}})(22.5)(1) = \overset{1556}{\cancel{22,725}}\ \#/ft$$

BY MWD DATE 2/17/78 PROJECT BOX MAGAZINE TYPE A SHEET NO. 334 OF 343

CKD. BY ______ DATE ________ SUBJECT DESIGN OF WING WALL

$$H = \frac{0.33(100)(\overset{19.5}{\cancel{24.5}})^2}{2} = \overset{6274}{\cancel{9904}} \ \#/ft$$

$$M = \frac{\overset{6274}{\cancel{9904}}(\overset{19.5}{\cancel{24.5}})}{3} \ \overset{40752}{\cancel{80,880}} \ ft\#/ft$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \underset{4596}{\overset{4000}{\cancel{6,555}}}\left[\overset{1.8}{\cancel{2}} + \frac{\overset{1.7}{\cancel{1.9}}}{2}\right] + \overset{2325}{\cancel{3150}}[\overset{6.2}{\cancel{7}}] + \overset{15560}{\cancel{32,725}}\left[\overset{1.8 \ \ 1.7 \ \ 8.9}{2 + 1.9 + \frac{10.1}{2}}\right]$$

$$= \underset{160889}{\cancel{244,800}} \ ft\#/ft$$

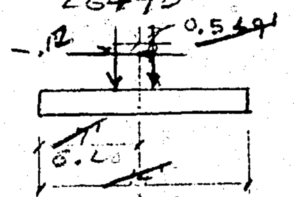
$$M_{APPLIED} = \underset{40782}{\cancel{80,880}}$$

$$F.S. = \frac{\overset{163764}{\cancel{244,800}}}{\underset{40782}{\cancel{80,880}}} = \overset{4.01}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \underset{4596}{\overset{4000 \ +}{\cancel{6,555}}} + \overset{2325}{\cancel{3150}} + \overset{15560}{\cancel{32,725}} = \overset{26475}{\cancel{32,430}} \ \#/ft$$

$$\bar{x} = \frac{\overset{160884}{\cancel{244,800}}}{\underset{26475}{\cancel{32,430}}} = \overset{6.07}{\cancel{7.549}} \ ft$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{12.4}{\cancel{14}})^2}{6} = \overset{25.6}{\cancel{32.67}} \ ft^3$$

$$p = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{26475}{\cancel{32,430}}}{\cancel{14} \ 12.4} \pm \left[\frac{\overset{40782}{\cancel{80,880}} + \overset{26475}{\cancel{32,430}}(\overset{.12}{\cancel{0.549}})}{\cancel{32.67} \ 25.6}\right]$$

$$= \underset{2135}{\cancel{2310}} \pm \underset{1717}{\cancel{1931}}$$

$$p_{MAX} = \overset{3852}{\cancel{4241}} \ \#/ft^2$$

$$p_{MIN} = \underset{418}{\cancel{385}} \ \#/ft^2$$

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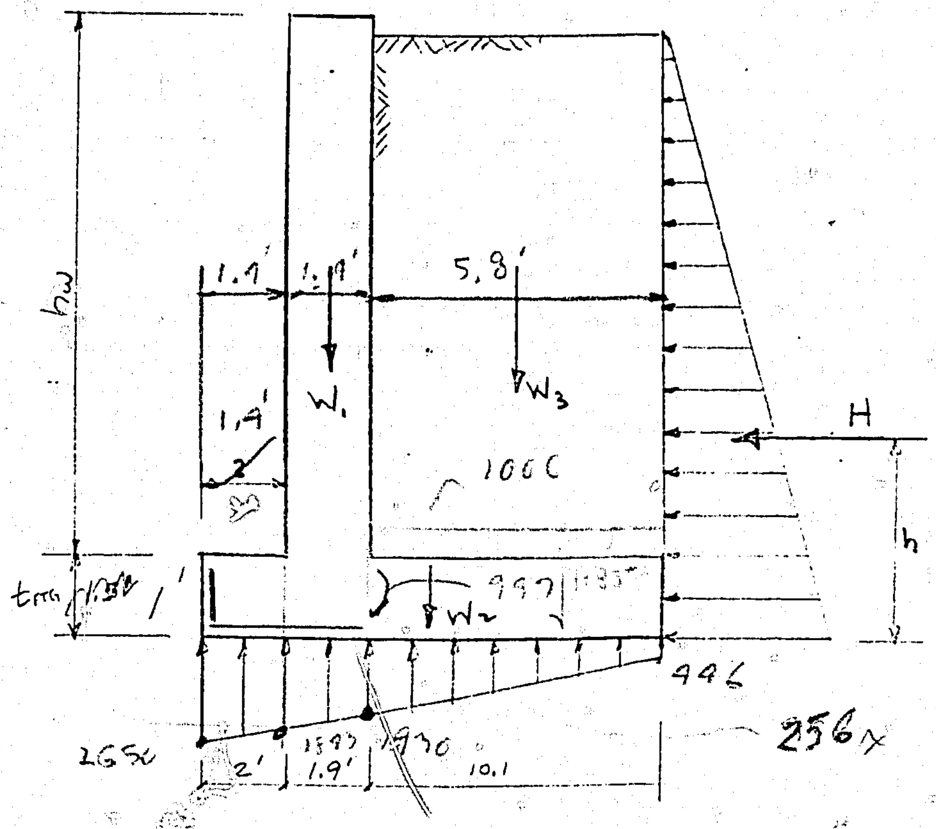
BY MWD DATE 2/17/78 PROJECT ~~NAVY MAGAZINE TYPE II B~~ BOX MAGAZINE TYPE A SHEET NO. 335 OF 343

CKD. BY______ DATE________ SUBJECT DESIGN OF WING WALL - OVERTURNING ANALYSIS

OVERTURNING ANALYSIS

30' w/8.6' + Ramp Load



FOR MAX HEIGHT (5' FROM BLDG) $t_{WALL} = \overset{17}{\cancel{22.8}}''$

$$h_w = 27 - \overset{15}{\cancel{25}} - \underset{t_{FTG}}{1.5} = \overset{10.5}{\cancel{23}}'$$

$$W_1 = 150\,(1)\left(\frac{\overset{17}{\cancel{22.8}}}{12}\right)(\overset{10.5}{\cancel{23}}) = \overset{2231}{\cancel{6,555}}\ \#/ft \quad + 4000$$

NOTE! ASSUME FTG WIDTH = $\overset{8.6}{\cancel{14}}'$

$$W_2 = 150\,(\overset{8.5}{\cancel{14}})(\overset{1}{\cancel{1.5}})(1) = \overset{1290}{\cancel{3,150}}$$

$$W_3 = 100\,(\overset{5.8}{\cancel{10.7}})(\overset{10}{\cancel{22.5}})(1) = \overset{5800}{\cancel{22,725}}\ \#/ft$$

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$$H = \frac{0.33(100)(\overset{11.5}{\cancel{24.5}})^2}{2} = \overset{518}{\cancel{9904}} \text{ \#/ft}$$

$$M = \frac{\overset{515}{\cancel{9904}}(\overset{11.5}{\cancel{24.5}})}{3} = \overset{8364}{\cancel{80,880}} \text{ ft\#/ft}$$

SAFETY FACTOR AGAINST OVERTURNING

$$M_{RESIST.} = \overset{4000}{\overset{2231}{\cancel{6,555}}}\left[\overset{1.4}{\cancel{2}}+\frac{\overset{1.4}{\cancel{1.9}}}{2}\right] + \overset{1290}{\cancel{3150}}\left[\overset{4.7}{\cancel{7}}\right] + \overset{5800}{\cancel{22,725}}\left[\overset{1.4}{\cancel{2}}+\overset{1.9}{\cancel{1.9}}+\frac{\overset{5.8}{\cancel{10.1}}}{2}\right]$$

$$= \overset{52208}{\cancel{244,800}} \text{ ft\#/ft}$$

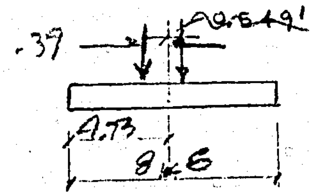
$$M_{APPLIED} = \cancel{80,880}\ 8364$$

$$F.S. = \frac{\overset{52208}{\cancel{244,800}}}{\underset{8364}{\cancel{80,880}}} = \overset{6.2}{\cancel{3.03}}$$

SOIL PRESSURE

$$\Sigma W = \overset{4000}{\overset{2231}{\cancel{6,555}}} + \overset{1290}{\cancel{3150}} + \overset{5800}{\cancel{22,725}} = \overset{13321}{\cancel{32,450}} \text{ \#/ft}$$

$$\bar{x} = \frac{\overset{52218}{\cancel{244,800}}}{\underset{13321}{\cancel{32,430}}} = \overset{3.91}{\cancel{7.549}} \text{ ft}$$



$$S = \frac{bd^2}{6} = \frac{1(\overset{8.6}{\cancel{14}})^2}{6} = \overset{12.3}{\cancel{32.67}} \text{ ft}^3$$

$$p = \frac{P}{A} \pm \frac{Mc}{I} = \frac{\overset{13321}{\cancel{32,430}}}{\cancel{14}\ 8.6} \pm \left[\frac{\overset{8364}{\cancel{80,880}} + \overset{13321}{\cancel{32,430}}(\overset{0.37}{\cancel{0.549}})}{\cancel{32.67}\ 12.3}\right]$$

$$= \underset{1598}{\cancel{2316}} \pm \underset{1162}{\cancel{1951}}$$

$$P_{MAX} = \overset{2650}{\cancel{4247}} \text{ \#/ft}^2$$

$$P_{MIN} = \underset{446}{\cancel{325}} \text{ \#/ft}^2$$

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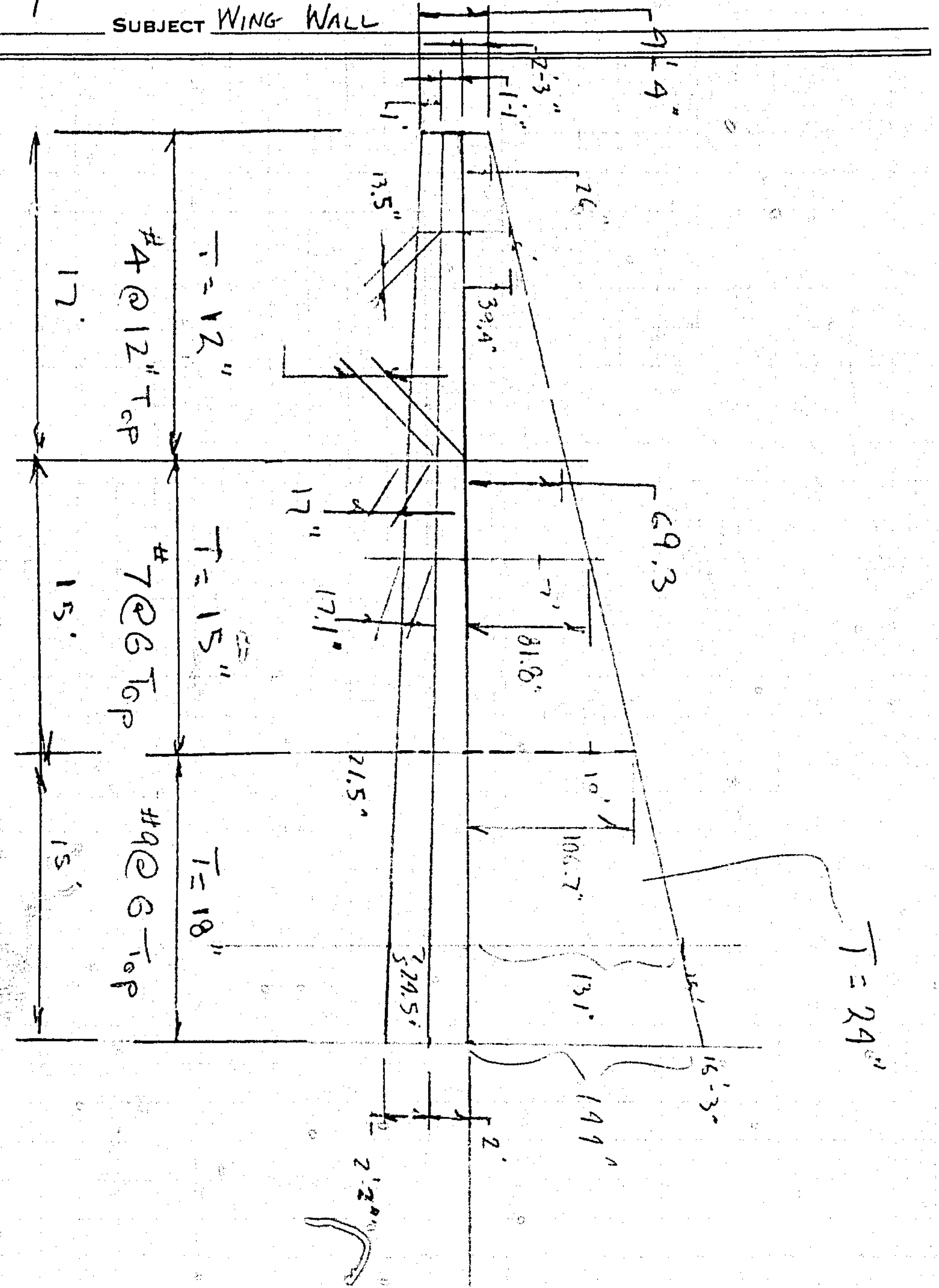
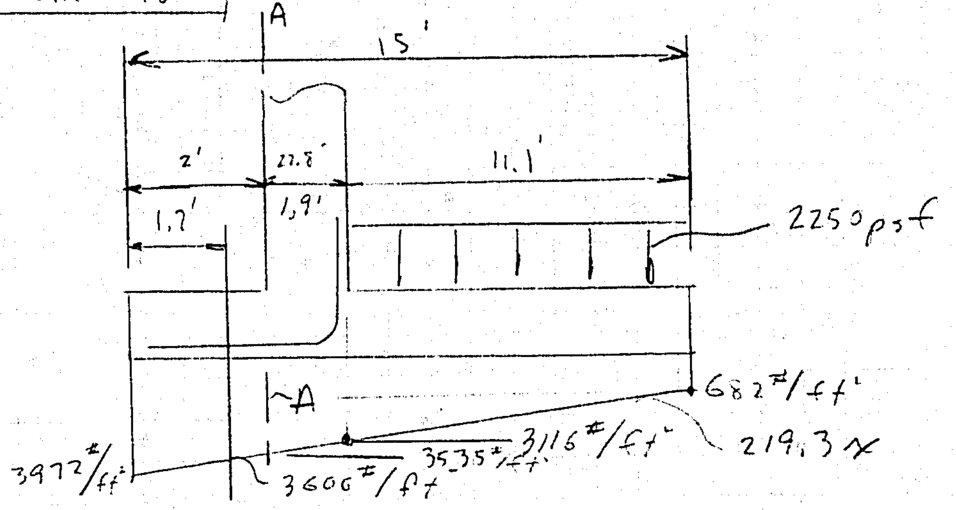


Footing Design

5' From Bldg



$V@.15l = \left(\frac{3972+3600}{2(.85)}\right)(1.7) \cdot \underline{7572\#/FT}$

$N_c = 2\sqrt{f_c'} = 126.\underline{5\ psi}$

$d = 1.7(7572)/12 \times 126.5 = \underline{8.4''}$

$T = 8.4 + 3 = 11.4''$

$\text{Moment @ A-A} = 3535(2)^2/2 + 437(2)^2/3 = 7652\#/ft/ft$

$V\ \text{RH Side} = (2250-682)x - \frac{219.3x^2}{2}$

$= 1568x - 109.7x^2$

$M = \frac{1568x^2}{2} - 109.7x^2(x/3)$

$= 784x^2 - 36.6x^3$

$@x = 11.1\ M = 96596 - 50055 = 46540\#/ft/ft$

$\text{Design Moment} = 1.7(46540) = 79118\#/ft/ft$

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CKD. BY______ DATE______ SUBJECT DESIGN OF WING WALL

For $T = 24$ $d = 24 - 2 - .5 = 21.5''$

$M_u : 79118$ $d = 21.5$ $M_u/d^2 = 171$

$\rho = .0045$ $A_s = 21.5 \times .0045 \times 12 = 1.16\ in^2/ft$

use #7@6 $A_s = 1.2\ in^2/ft$

$$a = \frac{1.2(40000)}{.85(4000)(12)} = 1.18\ in$$

$$M_u = \frac{.9(1.20)(40000)}{12}\left(21.5 - \frac{1.18}{2}\right) = 75276\ \#\text{-}ft/ft$$

say ok

For $T = 18$ $d = \underline{15.5}$ use #9@6"

$$a = \frac{2(40000)}{.85(4000)(12)} = \underline{1.96}$$

$$M_u = \frac{.9(2)(40000)}{12}\left(15.5 - 1.96/2\right) = 87120\ \#\text{-}ft/ft$$

> 79118 ok

V_{max} @ $x = 7.15' = 5603\ \#/ft$

$$v_u = \frac{1.7(5603)}{.85(12)(15.5)} = 60.2\ psi \text{ ok}$$

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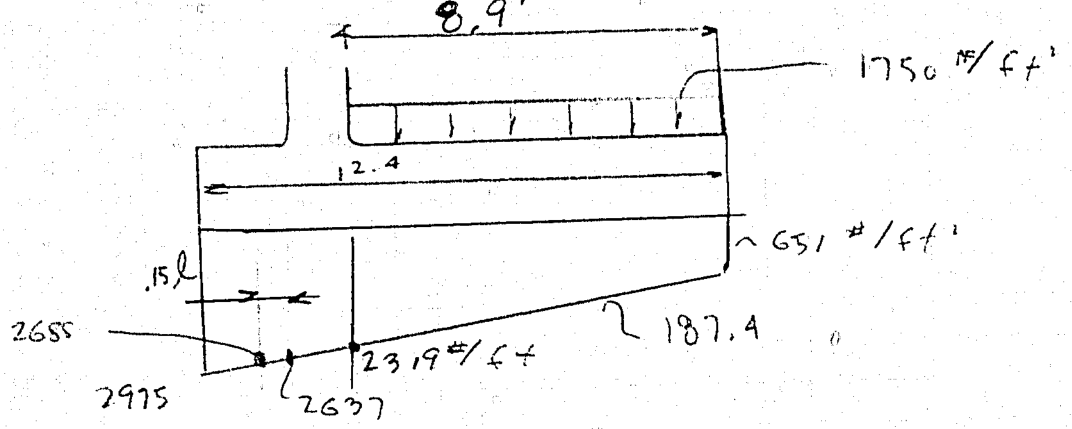
CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

Ftg design @ 15'



$$M_{max} = (1750-651)\left(\frac{8.9}{2}\right)^2 - (2319-651)(8.9)^2/6$$

$$= 43525 - 22020 = 21505 \text{ \#-f/ft}$$

Design Moment = $1.7(21505) = 36557$ #-ft/ft

Try # 7@ 6" $d = 15 - 2 - .44 = 12.6$ in

$$a = \frac{1.2(40000)}{.85(4000)(12)} = 1.18$$

$$M_u = .9\frac{(1.2)(40000)}{12}(12.6 - 1.18/2) = 43242 \text{ \#-ft/ft}$$

> 36557 Ok

$$V = (1750-651)x + \frac{187.4x^2}{2}$$

max @ $x = 5.86$ $V_{max} = 3217$ #-ft

$$v_u = \frac{1.7(3217)}{.85(12)(12.6)} = 42.6 \text{ psi ok}$$

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CKD. BY_____ DATE_____ SUBJECT DESIGN OF WING WALL

Check Lip

$$M = \frac{2637}{2}(1.8)^2 + (2975-2637)(1.8)^2/3$$

$= 4637$ #-ft-ft $\quad M_D = 7832$ #-ft/ft

$d = 15 - 3 - .44 = 11.6$ $\quad$ #7 @ 6" Btm (dowels)

$a = 1.18$

$$M_u = \frac{.9(1.2)(40000)}{12}\left(11.6 - \frac{1.18}{2}\right) = 39636\text{#-ft/ft}$$

$>> 7802$

$V @ .15\ell = 2975(1.53) + (2975-2688)(1.53)/2$

$= 4771$ #-ft/ft

$$v_u = \frac{1.7(4771)}{.85(12)(11.6)} = 69.5 \text{ psi} \quad \underline{\text{Ok}}$$

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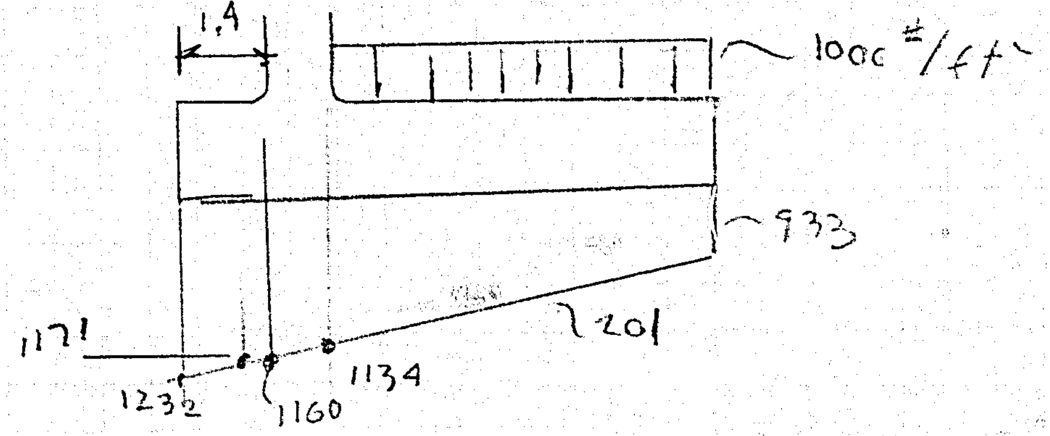
CKD. BY ______ DATE ______ SUBJECT DESIGN OF WING WALL

Ftg @ 30' T = 12" #5 @ 12"



$$M_{max} = (1000 - 933)\left(\frac{5.8}{2}\right)^2 - (1137 - 933)\left(\frac{5.8}{6}\right)^2$$

$$= 1126 - 1121 \sim 0$$

$$M = \frac{67x^2}{2} - \frac{200(x^2)}{6} = 33.5x^2 - 33.3x = 0$$

$$\text{Vs} = \rho_{min} = \frac{200}{40000} = .005$$

$d = 12 - 2 - .3 = 9.7$ $A_s = .005(12)(9.7) = \underline{.582\ in^2/ft}$

use #4 @ 12"

$$V = 67x - 201x^2/2 = 67x - 100.5x^2$$

V_{max} @ $x = .333$ $V = \underline{11\#}$

Check Overhang

$M = 1160(1.4)^2/2 + 71(1.4)^2/3 = 1183$ #-ft/ft

$M_u = 2011$ #-ft/ft

$$a = \frac{.31(40000)}{.55(4000)(12)} = .3 \quad M_u = \frac{.9(.31)(40000)(8.7 - .3/2)}{12}$$

$= 7952$ #-ft/ft $>> 2011$

$$V = 1171(.95(1.4)) + \frac{(1232-1171)}{2}(.85)(1.4) = 1430^{\#}/ft$$

$$d = 12 - 3 - .31 = 8.7$$

$$v_u = \frac{(1.7)(1430)}{.85(12)(8.7)} = \underline{\underline{27.4 \text{ psi OK}}}$$