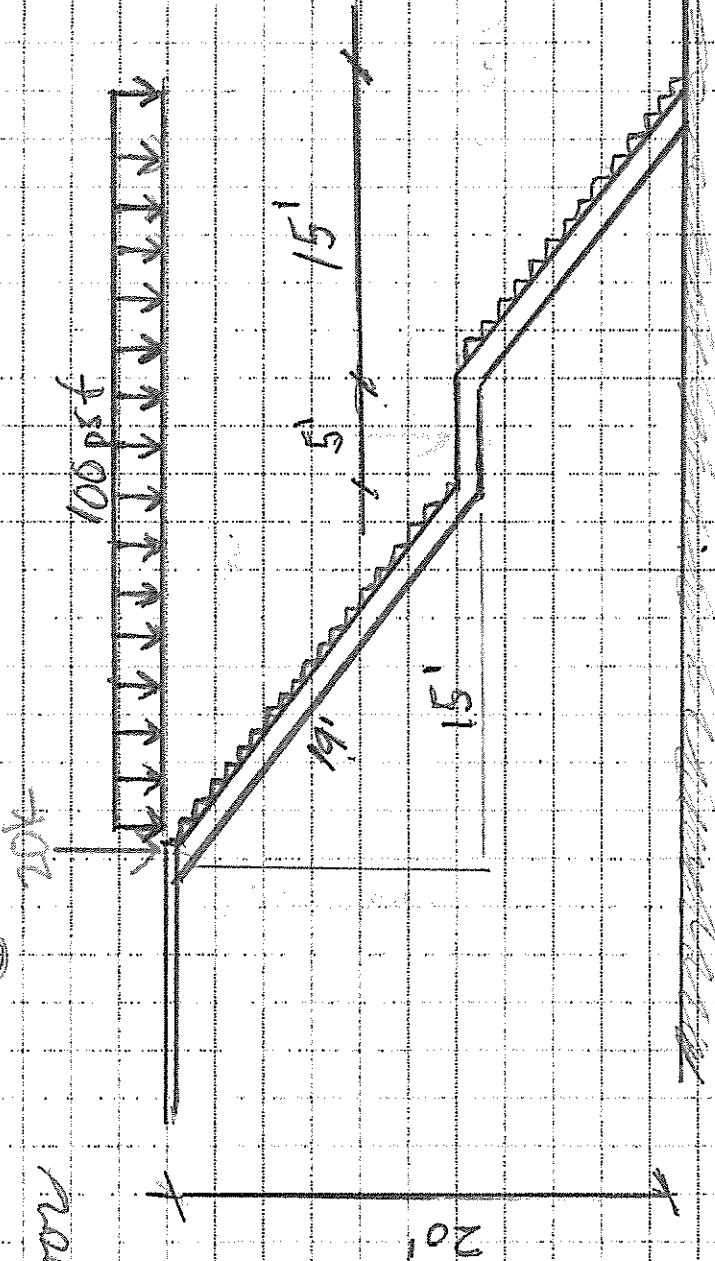




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JOB SUNY Buffalo Stairs
SHEET NO. 1 OF
CALCULATED BY PS DATE
CHECKED BY DATE
SCALE

longest stair stringer occurs between 2nd and 3rd floor



$$\text{width of stair} = 5.67' \quad \text{area of stair} = (15+15+5)(5.67) = 198.5 \text{ ft}^2$$

$$100 \text{ psf}(198.5) = 20 \text{ k}$$

$$M_{\text{max}} = 35(20 \text{ k}) = 700 \text{ k ft} \quad \text{use } W24 \times 370$$

(worst case scenario)

$$M_n / \Omega = 700 \text{ k ft} \quad \text{at } 26.25 \text{ ft}$$

(assuming partial fixity)



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JOB SUNY Buffalo Stairs

SHEET NO. 2 OF _____

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Design of tread posts

$$1 \text{ tread} = 100 \text{ psf} (1) (5.26) = 526 \text{ lb}$$

$$\text{HSS } 6 \times 4 \times \frac{1}{4} \text{ capacity} = 118 \text{ k } \underline{\text{ok}}$$

check weld - post to stringer

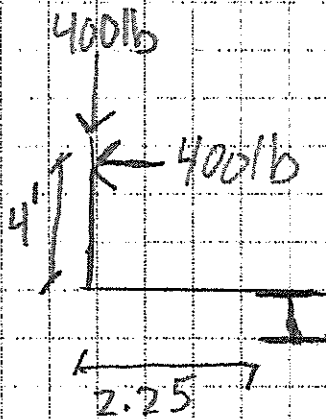
$$.928 \text{ DR} = \frac{R_n}{\phi} = .928 (4) (12) = 44 \text{ k } \underline{\text{ok}}$$

post to tread

$$\frac{R_n}{\phi} = .928 (4) (8) = 30 \text{ k } \underline{\text{ok}}$$

use HSS $6 \times 4 \times \frac{1}{4}$

Design of mid-landing



$$24/240 = .23'' \text{ max}$$

$$\delta = \frac{FL^3}{3EI} = \frac{(.4)(27)^3}{(3)(29,000)(I)}$$

$$20010 I = 7873$$

$$I = .4 \text{ in}^4 \text{ min}$$



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JOB

SUNY Buffalo Stairs

SHEET NO.

3

OF

CALCULATED BY

PS

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DATE

SCALE

Deflection Check

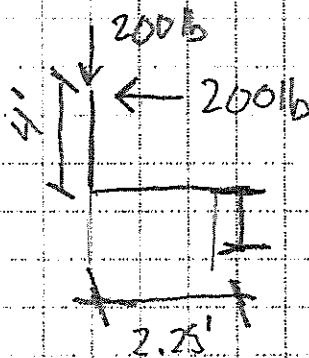
$$\delta = \frac{FL^3}{48EI}$$

$$L/200 = 44\text{ft}/200 = .22\text{ft} = 2.64\text{in}$$

$$2.64 = \frac{(20)(528)^3}{48(29000)(13400)}$$

$$2.64 < .16 \quad \text{ok}$$

Torsion Check



deflection of tread from rail (cantilever)

$$2L/240 = 2(2.25)/240 = .0188\text{ft} = .23\text{in}$$

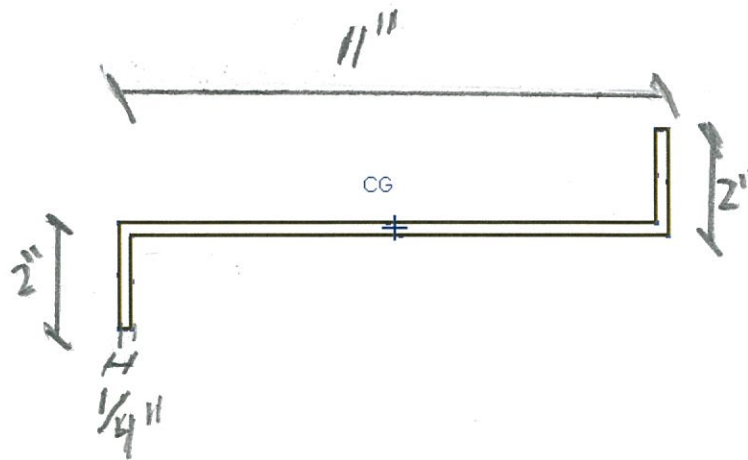
$$\delta = \frac{FL^3}{3EI} = \frac{(2)(2.7)^3}{3(29,000)(I)} = .23\text{in max}$$

solve for I

$$200/I = 3937$$

$$I = .2\text{in}^4 (\text{min})$$

see shape builder attachment for shape of tread



$$I_y = 1.347 \text{ in}^4 > 1.5 \text{ in}^4 \quad \text{ok}$$

Overall Dimensions

Width	11.000 in
Height	4.000 in
Perimeter	30.000 in

Geometric Properties

Iy	54.819 in ⁴
Ix	1.347 in ⁴
J	0.076 in ⁴
ry	3.856 in
rx	0.604 in
A	3.687 in ²
Sy Right	9.967 in ³
Sy Left	9.967 in ³
Sx Bottom	0.674 in ³
Sx Top	0.674 in ³
Centroid Y	1.363 in
Centroid X	-1.642 in

Material Properties

E	29000.000 Ksi
---	---------------

Plastic Properties

Zy	12.602 in ³
Zx	1.168 in ³
PNA-Y	1.363 in
PNA-X	-1.642 in

Polar Properties

Ip	56.166 in ⁴
rp	3.903 in

Principal Properties

I2	0.817 in ⁴
I1	55.350 in ⁴
Ixy	5.354 in ⁴
Theta	95.662 deg



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JOB SUNY Buffalo Stairs
SHEET NO. 5 OF _____
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$$I = \frac{1}{12} b h^3 \quad b = 68 \quad I = \frac{1}{12} (68) h^3$$
$$h = \sqrt[3]{.07} \quad .5^3 = .125 \quad \underline{ok} \quad \text{use } \frac{1}{2}'' \text{ thickness}$$

Design of Connections to floors

assume 20k axial shear in each direction

$$4 \times A325 = 33k \text{ max } \underline{ok}$$

Weld of plate to stringer

$$\text{Max shear} = 20k \quad 3'' \text{ weld every } 1''$$

$$43(3'') = 129'' \text{ weld} \times 2 \text{ (both sides)}$$
$$= 258'' \quad \frac{1}{4} \text{ weld}$$

$$M_c = \text{max tension / compression}$$

$$I = \frac{700(14)(12)}{13400} = 8.77k$$

$$.928 DI = .928(4)(3)(2)$$
$$= 22.27k \quad \underline{ok}$$



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JOB

SUNY Buffalo Stair

SHEET NO.

6

OF

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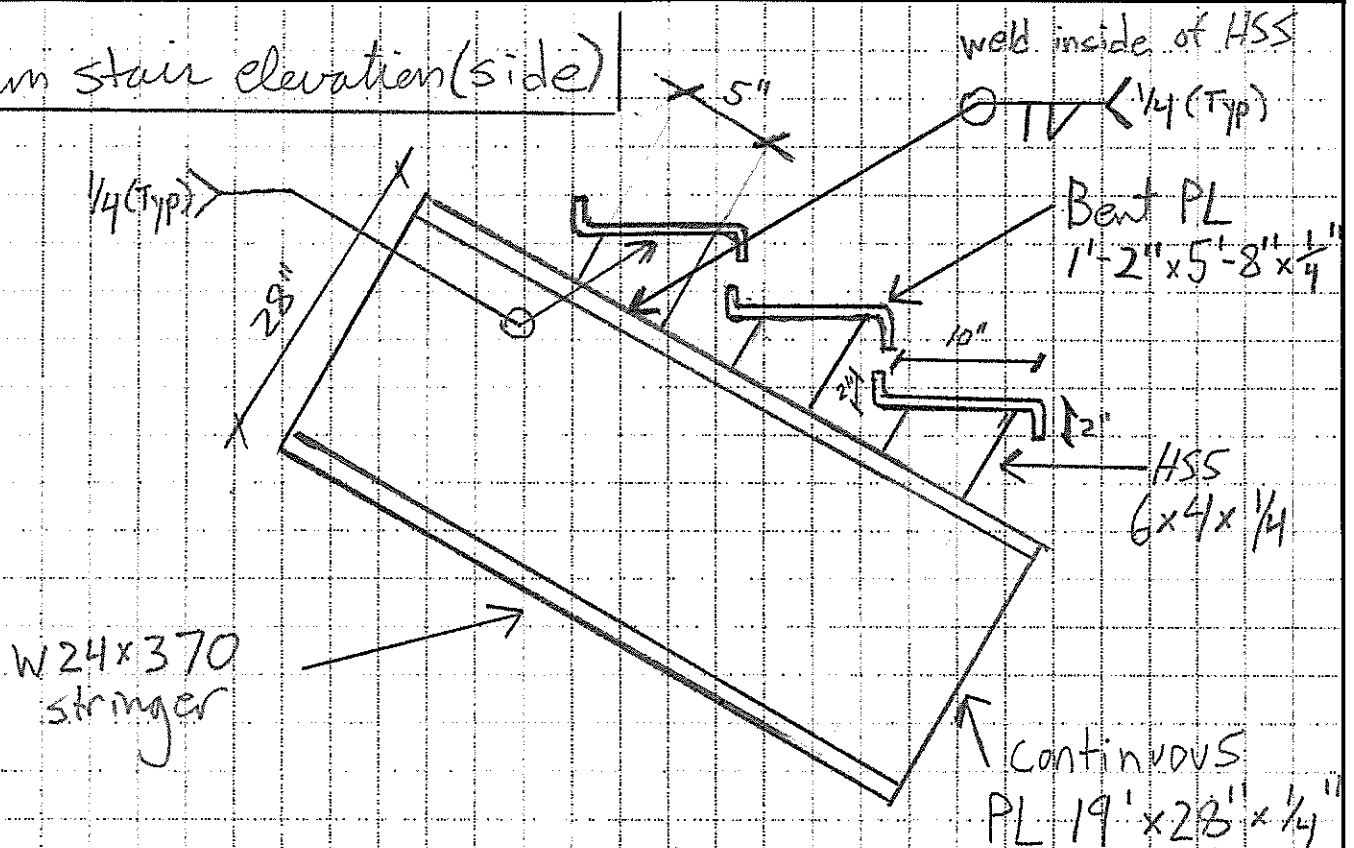
DATE

CHECKED BY

DATE

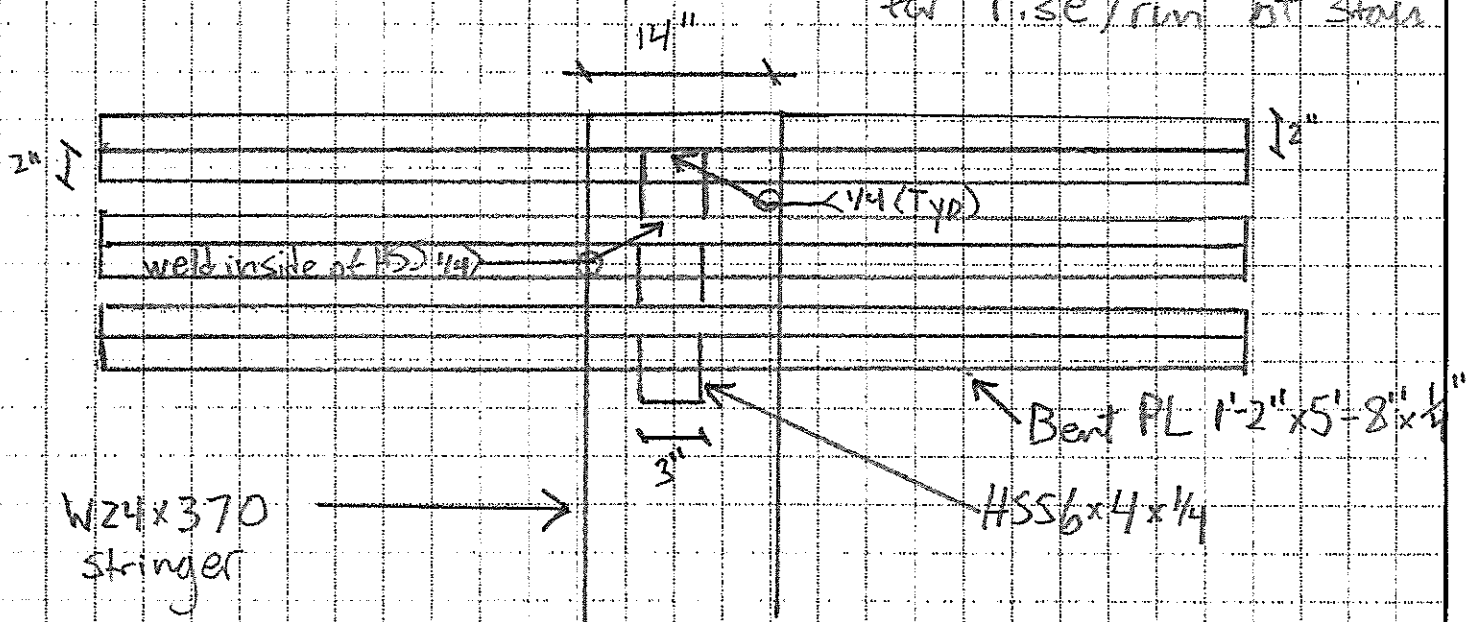
SCALE

atrium stair elevation (side)



atrium stair elevation (front)

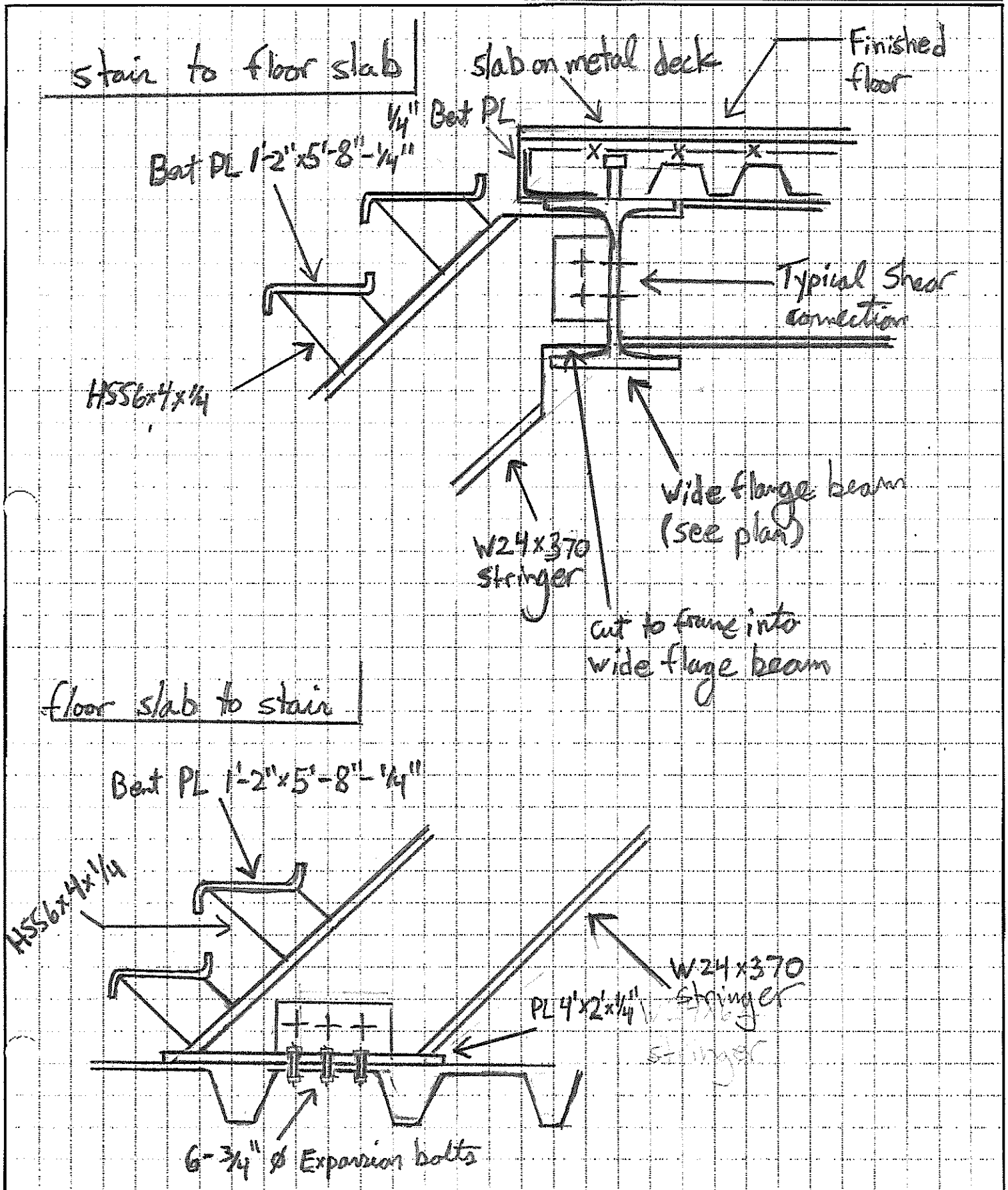
Note: (both sides)
see architectural drawing
for rise/run of stairs





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JOB SUNY Butcher Stairs
SHEET NO. 7 OF _____
CALCULATED BY PS DATE _____
CHECKED BY _____ DATE _____
SCALE _____

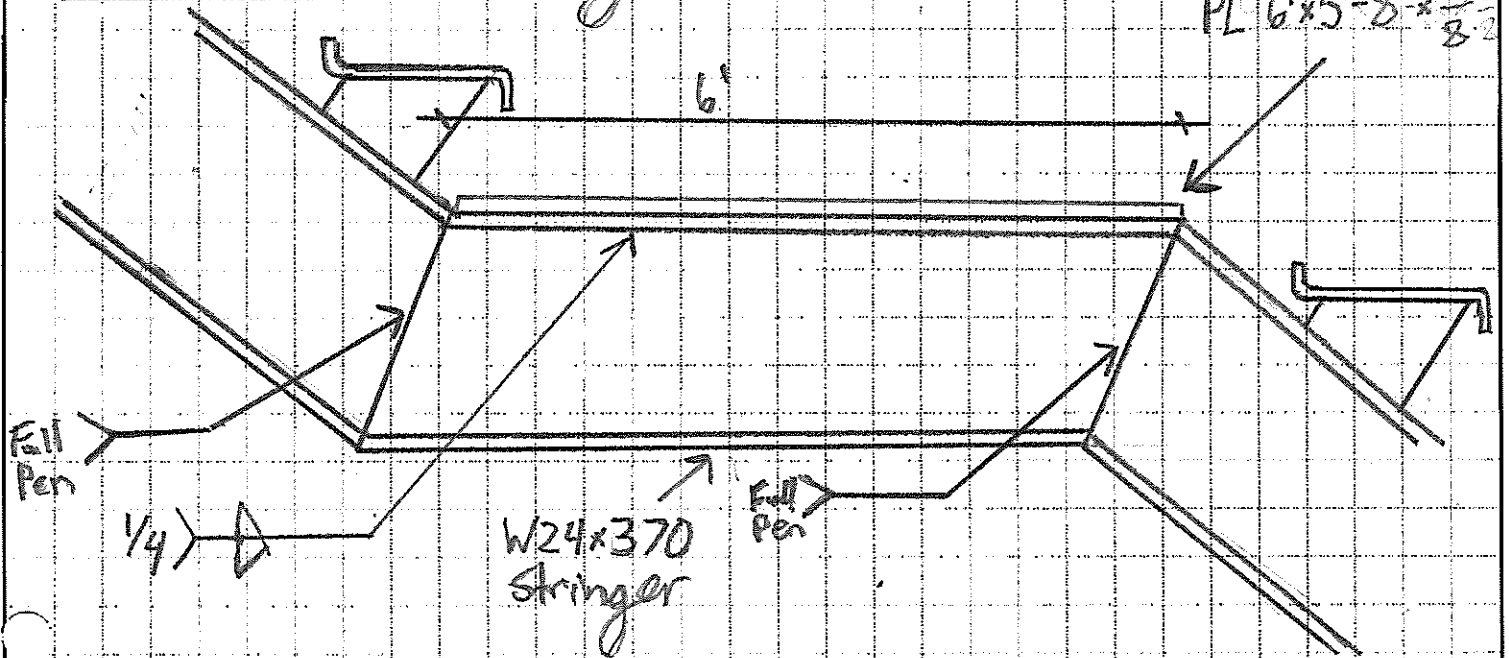




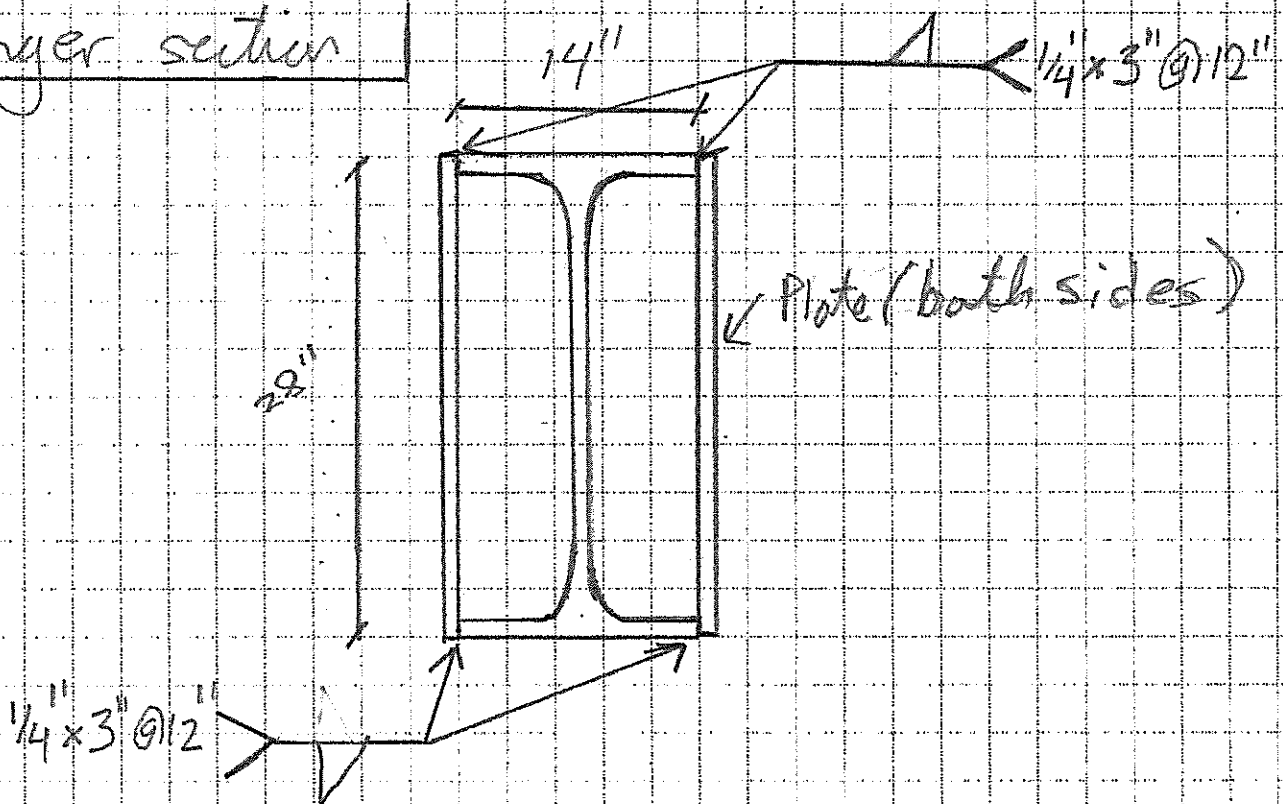
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JOB SUNY Buffalo Stairs
SHEET NO. 8 OF _____
CALCULATED BY PS DATE _____
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stair mid-landing elevation



stringer section





JOB SWAY Butcher Shop

SHEET NO. 1 OF 1

CALCULATED BY PS DATE

CHECKED BY _____ DATE _____

SCALE _____

Lobby Stairs

$$A_{\text{stand}} = (5.67)(10) + (24)(5.67) + (24)(5.67) = 329 \text{ K}$$

$$329(100) = 33 \text{ K}$$

unbraced stringer length

$$8 + 24 + 4 = 33 \text{ ft} \text{ maximum}$$

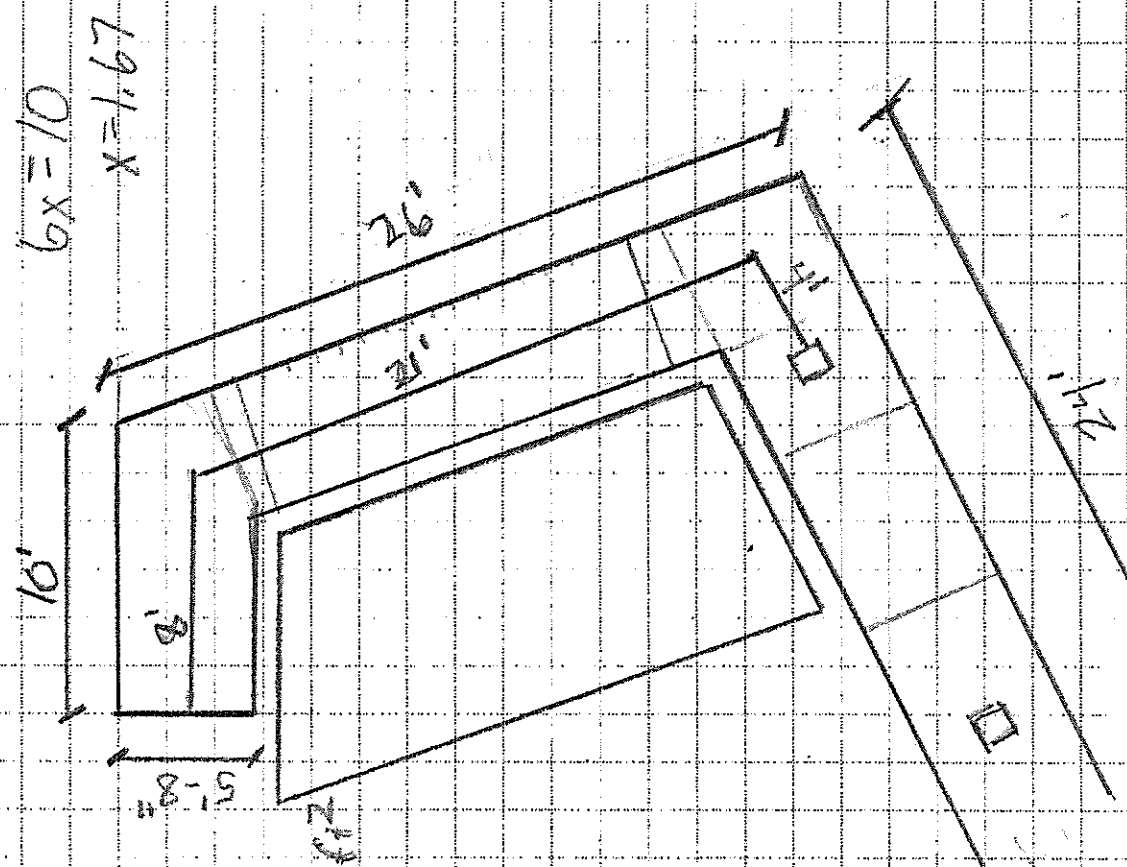
partial fixity $L = 250$

max point load on stringer $140 \text{ (} \pm 10 \text{)}$

751

$$A_{\max} = (25)(15) = 375 \text{ ft} \quad \checkmark$$

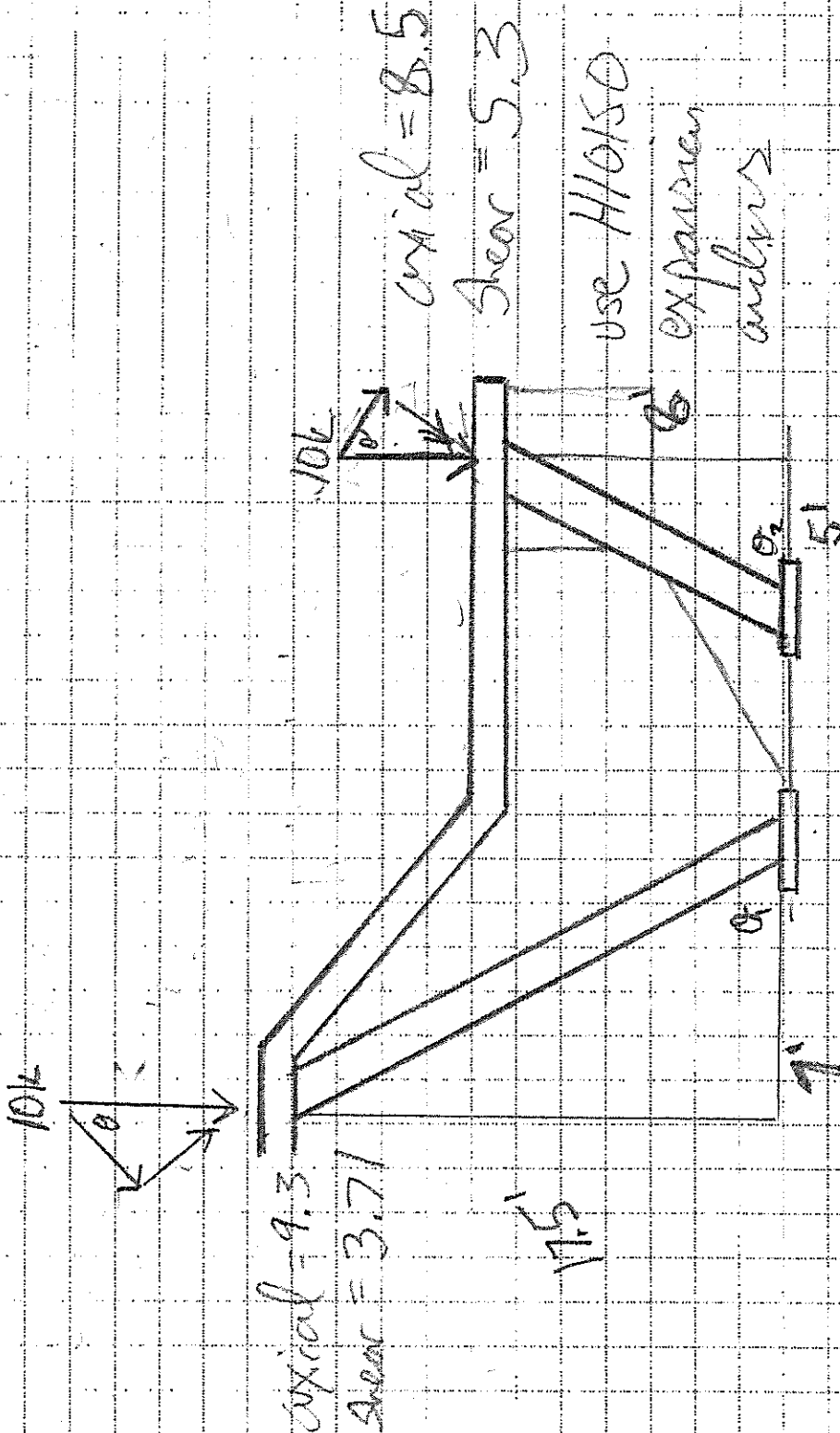
use 1/55 20x8x 5/8





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JOB SUNY Buffalo Station
SHEET NO. 2 OF
CALCULATED BY DS DATE
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SCALE



$$\begin{aligned} \tan \theta_1 &= \frac{17.5}{10} & \theta_1 &= 68.2^\circ & \tan \theta_2 &= \frac{8}{5} & \theta_2 &= 58^\circ \\ \cos 68.2^\circ &= \frac{10}{17.5} & X &= 3.71 & \cos 58^\circ &= \frac{5}{10} & X &= 5.3 \\ \sin 68.2^\circ &= \frac{17.5}{10} & Y &= 9.28 & \sin 58^\circ &= \frac{8}{10} & Y &= 8.5 \end{aligned}$$



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JOB SUNY Buffalo State
SHEET NO. 3 OF _____
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$$\frac{P_r}{P_c} = \frac{M_r}{M_c} \leq 1.0 \quad \text{Try } 455 \times 8 \times 1/2$$

$$\frac{9.3}{245} \quad \frac{70.49}{86} \leq 1.0 \quad .038 + .82 \leq 1 \quad \text{OK}$$

Full pen weld tube to tube

Use H10SD expansion anchor bolts

Base plate

use $1/6" \times 1/6" \times 1.5"$