Fermilab

Particle Physics Division 12-01-01

Mechanical Department Engineering Note

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Project: NuMi

Project Internal Reference:

Title: Target Hall Platform Extension Air Cooling System

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Key Words: NuMi, Target Hall and Concrete Shield Blocks

Abstract/Summary:

This Engineering Note includes the calculations for a steel plate floor extension to an existing floor created from vertically stacked concrete shield blocks. Since this new floor extends over an existing stairway, head height clearance is taken into consideration. This new floor plate will be supported by 5, C5 X 6.7 steel channels running perpendicular to the beam line. One end of these 5 channels is supported by a steel angle that is bolted to the existing shield blocks with expansion anchors. The other ends are supported by a new W12 X 19 steel beam. One end of the steel beam is supported by 4 X 4 steel tube column, while the other end is supported by steel bracket that is bolted to the shield block with expansion anchors. For safety reasons, a

railing will be added at the free end of this new floor deck. This new floor section is designed for a 250 pound per square foot live load.

The design analysis was performed according to both AISC "Allowable Stress Design" code and ASCE "Minimum Design Loads for Buildings and Other Structures". The results show that all members will safely support the floor extension within the allowable stress limits.

Applicable Codes:

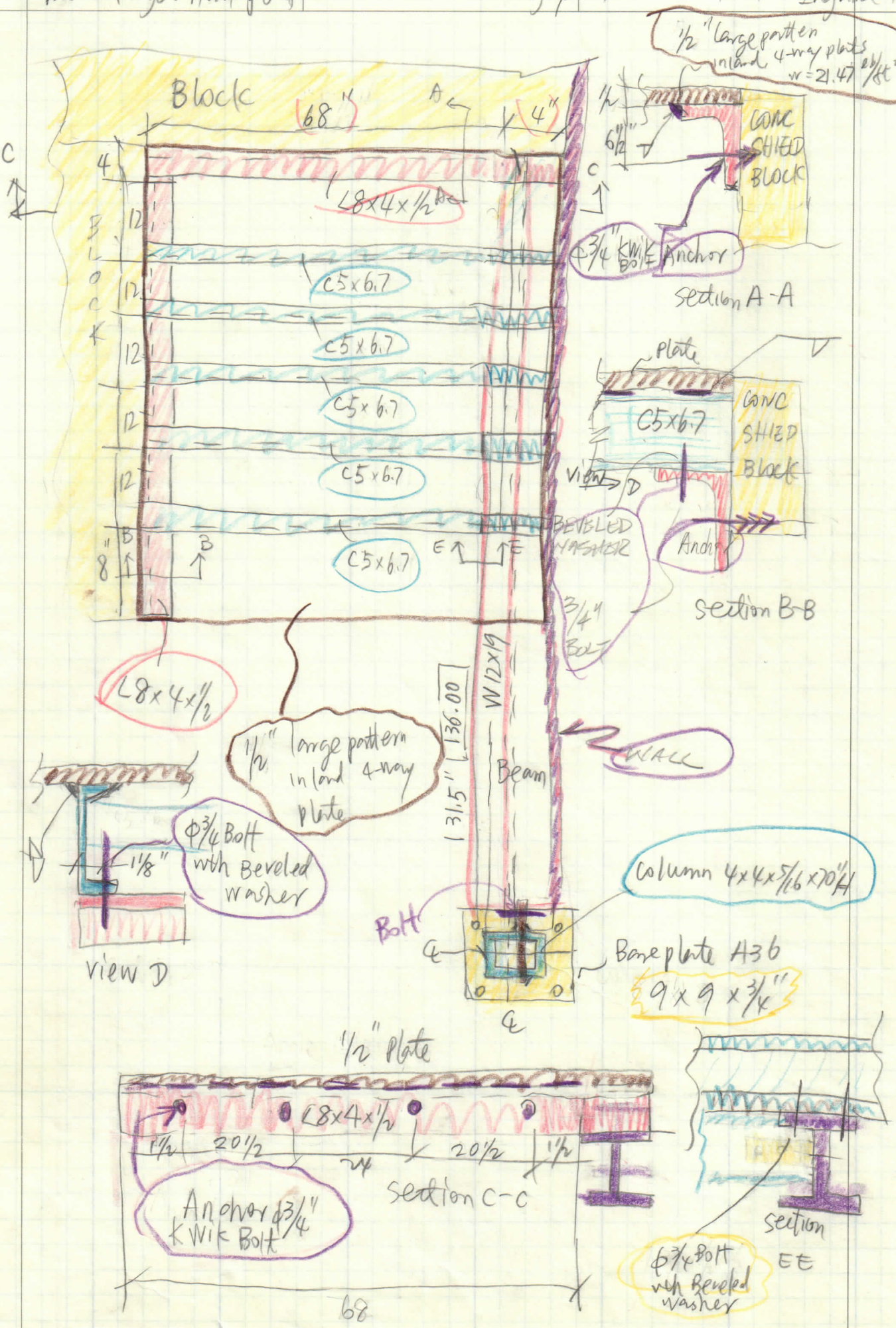
1. AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition

2. ASCE Minimum Design Loads for Buildings and Other Structures.

3. ANSI/AWS D1.1-98, Structural Welding Code – Steel

4. Hilti North America Product Technical Guide

Numi Target Hall platform extension air cooling system 6-4-04 Bob Woods Ingrid Fang



According to ANSI / ASCE 7-88, ASCE STANDARD, Minimum Design loads for Buildings and other Structures, table 2 Minimum Uniformly Distributed live loads.

$L_o = 250\ lb/ft^2$ — heavy

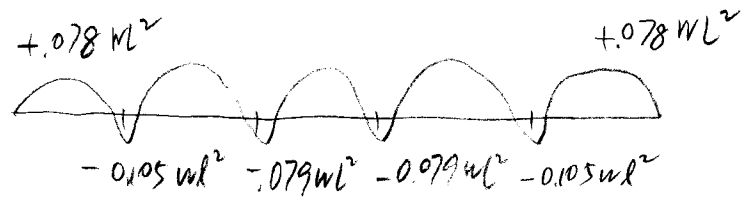
Thus, For 5/10" large partle in inland 4-way plates ASTM A-786,

Total load $= L_o + L_d$

$= 250 + 21.47 = 272\ lb/ft^2$

1. Check bending stress at 5 equal span area

According to AISC, ASD, STEEL CONSTRUCTION, page 2-312, know, the moment diagram is



$M_{max} = 0.105\,wl^2$

$= 0.105 \times 272 / 144 \times 12^2$

$= 28.56\ lb\text{-}in$

$S = \frac{ab}{6} = \frac{1 \times 0.5^2}{6} = 0.04\ in^3$

$f_b = \frac{M}{S} = \frac{28.56}{0.04} = 714\ psi$

Find the allowable

$$\frac{b}{t} = \frac{12}{0.5} = 24$$

$$190/\sqrt{F_y} = 190/\sqrt{30} = 34.7 \qquad F_y = 30\,ksi \text{ for ASTM A-786}$$

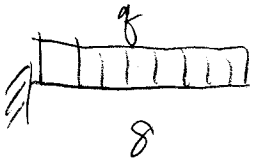
$$\frac{b}{t} < 190/\sqrt{F_y} \quad \rightarrow \text{ compact section}$$

$$F_b = 0.75\,F_y$$
$$= 0.75 \times 30$$
$$= 22.5\,ksi$$

Thus, $SF = \frac{22.5\,ksi}{0.7\,ksi} = 32$ <u>OK</u>

2. Check bending stress in the cantilevered end.

$$\boxed{w = 272\ lb/ft^2}\ 8 \qquad q = 272/12 = 22.7\ lb/in$$



$$M_{max} = \frac{wl^2}{2} = \frac{22.7 \times 8^2}{2} = 726\ lb\text{-}in$$

$$S = \frac{ab^2}{6} = \frac{1 \times 0.5^2}{6} = 0.04\ in^3$$

$$f_b = \frac{726}{0.04} = 18.160\ ksi$$

Find allowable

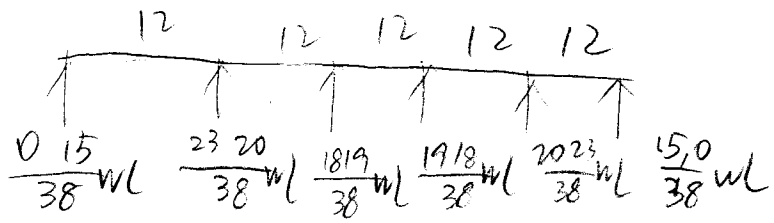
$$\frac{b}{t} = \frac{8}{0.5} = 16 < 190/\sqrt{F_y} = 34.7$$

compact section

$$F_b = 0.75 F_y$$
$$= 0.75 \times 30 = 22.5 \text{ ksi}$$

Thus, $SF = \frac{22.5}{18.660} = 1.2$ <u>OK</u>

3. Find the reaction force at the equal span area.

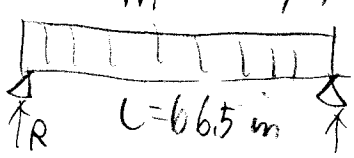


$$R_{max} = \frac{23}{38} wL$$
$$= \frac{23}{38} \times 272/144 \times 12 = 13.7 \text{ lb/in}$$

4. Check Bending stress of channel C5x6.7

$W_2 = 6.7$ lb/ft
$W_1 = 13.7$ lb/in

For channel C5x6.7 $W = 6.7$ lb/ft



$L_u = 3.70$ ft
$= 44$ in

$$M_{max} = \frac{wl^2}{8} \quad \text{where } W = 6.7/12 + 13.7 = 14.25 \text{ lb/in} \quad L_u < L$$

$$= \frac{14.25 \times 66.5^2}{8} = 7882 \text{ lb-in}$$

$$F_b = \frac{12 \times 10^3 C_b}{ld/A_f} \le 0.60 F_y$$

$S = 3.00 \text{ in}^3$

where $C_b = 1$
$l = 66.5$ in
$d/A_f = 8.93$

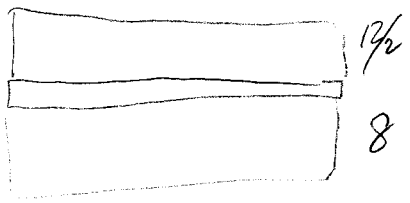
$$f_b = \frac{7882}{3} = 2.6 \text{ ksi}$$

$$F_b = \frac{12\times10^3 \times 1}{66.5\times 8.93} = 20 \text{ ksi} < 0.60\times 36 = 21.6 \text{ ksi}$$

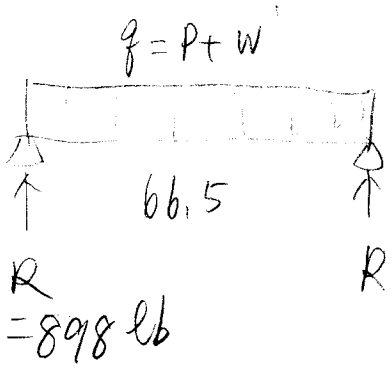
(governs)

thus, $SF = \frac{20}{2.6} = 7.7$ OK

5. check Bending stress on the channel near the cantilevered end



$$P = W\left(8+\frac{12}{2}\right)$$
$$= W(8+6)$$
$$= 14W$$
$$= 14\times 272/144$$
$$= 26.44 \text{ lb/in}$$



$$q = P + W'$$
$$= 26.44 + 6.2/12$$
$$= 27.0 \text{ lb/in}$$

$$M_{max} = \frac{wL^2}{8} = \frac{27.0\times 66.5^2}{8} = 14.926 \text{ kip-in}$$

$$S = 3.0 \text{ in}^3$$

$$f_b = \frac{14.926}{3} = 5.0 \text{ ksi}$$

$F_b = 20$ ksi (from previous study)

thus, $SF = \frac{20}{5.0} = 4.0$ OK

6. check the Bending Stress on angle L8×4×1/2

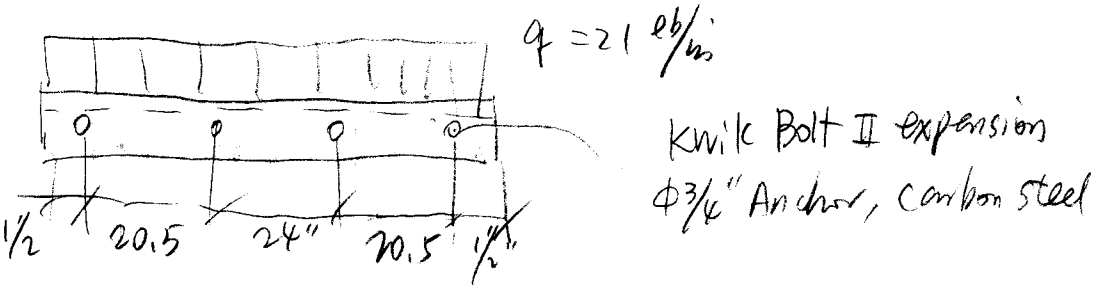
load $= (\frac{12}{2}) + 4 = 10$ in

$w = 272\ lb/ft^2 \times 10 = 272/144 \times 10 = 18.9\ lb/in$

$q = w + w'$

$= 18.9 + 19.6/12$

$= 21\ lb/in$



From Hilti catalog, knowing

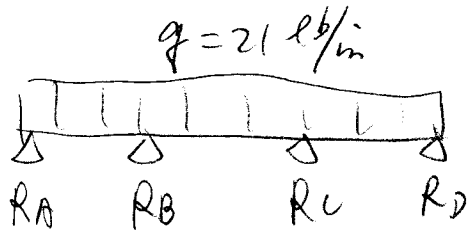
for 4000 psi, edge distance $c = 7$ in

Tension $2670 \times 1.0 \times 0.72 = 1923$ lb

Shear $4140 \times 1.0 \times 0.72 = 2981$ lb

space $s = 6$ in @ $f_R = 1.0$

Thus,



Assume 3 equal span of 24"

$M_{max} = 0.1 w l^2$

$= 0.1 \times 21 \times 24^2 = 1209.6$ lb-in

$S = 7.49\ in^3$

$$f_b = \frac{M}{S} = \frac{1209}{7.49} = 161 \text{ psi}$$

$$R_A = 0.4\,wl = 0.4 \times 21 \times 24 = 201.6 \text{ lbs}$$

$$R_B = R_C = 1.10\,wl = 1.10 \times 21 \times 24 = 554.4 \text{ lbs}$$

$$R_D = R_A = 201.6 \text{ lbs}$$

Since $R_B, R_A, R_D, R_C \leq$ shear $= 2981$ lbs (Anchor)

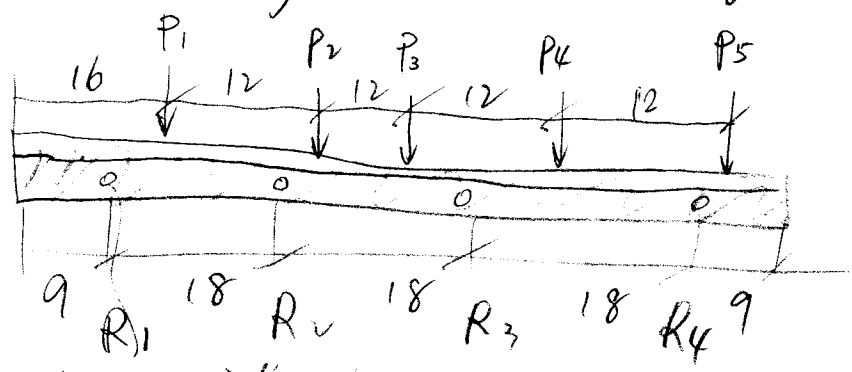
$$SF = \frac{2981}{554} = 5.4 \quad \underline{\underline{OK}}$$

$$F_b = 0.60\,F_y$$

$$= 0.60 \times 36 = 21.6 \text{ ksi}$$

$$SF = \frac{21.6}{0.161} = 134 \quad \underline{\underline{OK}}$$

7. Check the Bending stress on lower Angle $L8 \times 4 \times 1/2$



KWIK Φ 3/4" Anchor

$$P_1 = P_2 = P_3 = P_4 = 474 \text{ lbs}$$

$$P_5 = 898 \text{ lbs}$$

PRINT REACTION SOLUTIONS PER NODE

***** POST1 TOTAL REACTION SOLUTION LISTING *****

LOAD STEP= 1 SUBSTEP= 1
TIME= 1.0000 LOAD CASE= 0

THE FOLLOWING X,Y,Z SOLUTIONS ARE IN GLOBAL COORDINATES

NODE	FX	FY	MZ
10	0.0000	620.40	
28		622.67	
46		664.24	
64		1007.7	

TOTAL VALUES

VALUE	0.0000	2915.0	0.0000

PRINT ELEMENT TABLE ITEMS PER ELEMENT

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MOMZ
1	0.50932E-10
2	0.32742E-10
3	0.36380E-11
4	0.14552E-10
5	-289.00
6	-578.00
7	-867.00
8	-1156.0
9	-1445.0
10	-1734.0
11	-1402.6
12	-1071.2
13	-739.80
14	-408.40
15	-76.995
16	254.41
17	585.81
18	474.21
19	362.61
20	251.01
21	139.41
22	27.812
23	-83.787
24	-195.39
25	-306.98
26	-418.58
27	-530.18
28	-641.78
29	-130.71
30	-62.641
31	5.4289
32	73.499
33	141.57
34	209.64
35	277.71
36	345.78
37	413.85
38	481.92
39	549.99
40	618.06
41	686.13

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MOMZ
42	311.20
43	-63.729
44	-438.66
45	-813.59
46	-1188.5
47	-899.21
48	-609.91
49	-320.60
50	-31.292
51	258.01
52	547.32
53	836.63
54	682.93

55	529.24
56	375.55
57	221.85
58	68.161
59	-85.533
60	-239.23
61	-392.92
62	-546.61
63	-700.31
64	-854.00
65	0.18190E-11
66	0.18190E-11
67	0.90949E-12
68	-0.22737E-11
69	-0.22737E-11
70	-0.22737E-11
71	-0.22737E-11
72	-0.22737E-11

MINIMUM VALUES
ELEM 10
VALUE -1734.0

MAXIMUM VALUES
ELEM 53
VALUE 836.63

From Ansys, knowing:

$R_1 = 620.40$ lb $\qquad M_{max} = 1734$ lb-in

$R_2 = 622.67$ lb

$R_3 = 664.24$ lb

$R_4 = 1007.7$ lb.

Since

$\max R = 1007.7 < \text{Shear} = 2981$ lb. (Anchor)

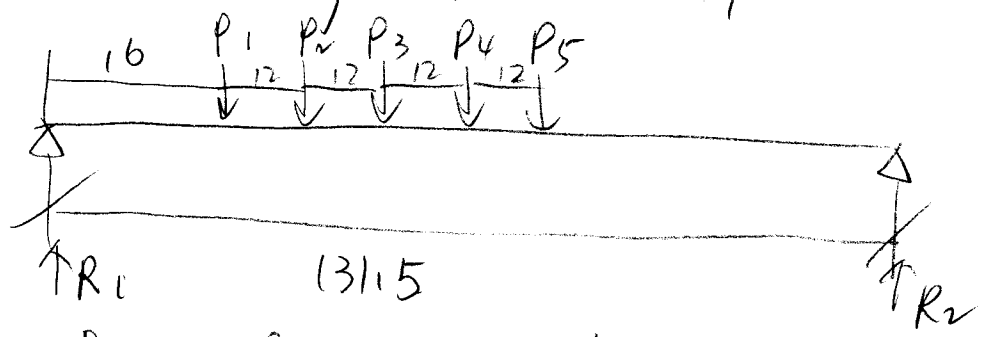
$$SF = \frac{2981}{1007.7} = 3.0 \qquad \underline{\underline{OK}}$$

$$f_b = \frac{M}{S} = \frac{1734}{7.49} = 232 \text{ psi}$$

$F_b = 21.6$ ksi (from previous study)

$$SF = \frac{21.6}{0.232} = 93 \qquad \underline{\underline{OK}}$$

8. Check the Bending stress on W12x19



$P_1 = P_2 = P_3 = P_4 = 474$ lbs

$P_5 = 898$ lbs

From Ansys, knowing:

$R_1' = 1867$ lbs $\qquad R_2' = 927$ lbs

$M_{max} = 62942$ lbs-in

PRINT REACTION SOLUTIONS PER NODE

***** POST1 TOTAL REACTION CALCULATION LISTING **

LOAD STEP= 1 SUBSTEP= 1
TIME= 1.0000 LOAD CASE= 0

THE FOLLOWING X,Y,Z SOLUTIONS ARE IN GLOBAL COORDINATES

NODE	FX	FY	MZ
1	0.0000	1866.7	
133		927.27	

TOTAL VALUES

VALUE	0.0000	2794.0	0.0000

PRINT ELEMENT TABLE ITEMS PER ELEMENT

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MMAX
1	0.93132E-09
2	1866.7
3	3733.5
4	5600.2
5	7466.9
6	9333.7
7	11200.
8	13067.
9	14934.
10	16801.
11	18667.
12	20534.
13	22401.
14	24267.
15	26134.
16	28001.
17	29868.
18	31260.
19	32653.
20	34046.
21	35439.
22	36831.
23	38224.
24	39617.
25	41010.
26	42402.
27	43795.
28	45188.
29	46580.
30	47499.
31	48418.
32	49337.
33	50255.
34	51174.
35	52093.
36	53012.
37	53930.
38	54849.
39	55768.
40	56686.
41	57605.

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MMAX
42	58050.
43	58495.
44	58939.
45	59384.
46	59829.
47	60274.
48	60718.
49	61163.
50	61608.
51	62053.
52	62497.
53	62942.
54	62913.

55	62883.
56	62854.
57	62825.
58	62796.
59	62766.
60	62737.
61	62708.
62	62679.
63	62649.
64	62620.
65	62591.
66	61655.
67	60720.
68	59785.
69	58850.
70	57914.
71	56979.
72	56044.
73	55109.
74	54173.
75	53238.
76	52303.
77	51368.
78	50432.
79	49497.
80	48562.
81	47627.
82	46691.

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MMAX
83	45756.
84	44821.
85	43885.
86	42950.
87	42015.
88	41080.
89	40144.
90	39209.
91	38274.
92	37339.
93	36403.
94	35468.
95	34533.
96	33598.
97	32662.
98	31727.
99	30792.
100	29856.
101	28921.
102	27986.
103	27051.
104	26115.
105	25180.
106	24245.
107	23310.
108	22374.
109	21439.
110	20504.
111	19569.
112	18633.
113	17698.
114	16763.
115	15828.

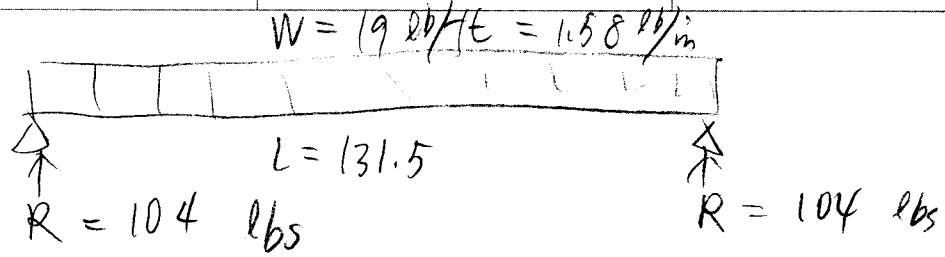
116	14892.
117	13957.
118	13022.
119	12086.
120	11151.
121	10216.
122	9280.7
123	8345.4

***** POST1 ELEMENT TABLE LISTING *****

STAT ELEM	CURRENT MMAX
124	7510.9
125	6676.3
126	5841.8
127	5007.3
128	4172.7
129	3338.2
130	2503.6
131	1669.1
132	834.54

MINIMUM VALUES
ELEM 1
VALUE 0.93132E-09

MAXIMUM VALUES
ELEM 53
VALUE 62942.



$$m_{max} = \frac{wL^2}{8} = \frac{1.58 \times 131.5^2}{8} = 3415.3 \text{ lb-in}$$

Thus,

$$R_1 = R_1' + R = 1867 + 104 = 1971 \text{ lbs}$$

$$R_2 = R_2' + R = 927 + 104 = 1031 \text{ lbs}$$

$$M_{max} = M_{max} + m_{max}$$
$$= 62942 + 3415.3$$
$$= 66357.3 \text{ lb in}$$

$$f_b = \frac{M}{S} = \frac{66357.3}{21.3} = 3.1 \text{ ksi}$$

For W12x19, $L_c = 4.10$ ft

$L_u = 5.3$ ft

$L_b = 122.25/12 = 12.22$ ft.

$L_b > L_c, L_u$

$$F_b = \frac{12 \times 10^3 C_b}{l d / A_f} \leq 0.60 F_y$$

$C_b = 1$

$\frac{d}{A_f} = 8.67$

$l = 122.25$

$$F_b = \frac{12 \times 10^3 \times 1}{131.5 \times 8.67} = 10.5 \text{ ksi} \quad \text{(governs)}$$

$$F_b = 0.60 F_y$$
$$= 0.60 \times 36$$
$$= 21.6 \text{ ksi}$$

$$SF = \frac{F_b}{f_b} = \frac{10.5}{3.1} = 3.4$$

ok

9. Check the stresses on the column 4x4x5/16 x 65L

Compression:

$$f_a = \frac{F}{A} \quad \text{where} \quad F = R_2 + W = 1031 + 70 \times 14.83/12 = 1118 \text{ lbs}$$
$$A = 4.36 \text{ in}$$
$$= \frac{1118}{4.36}$$
$$= 256 \text{ psi}$$

Bending:

$$f_b = \frac{MC}{I} \quad \text{where} \quad M = F \times e$$
$$= 1118 \times 7 = 7826 \text{ lb-in}$$
$$= \frac{7826 \times 2}{9.58} \qquad C = 2 \text{ in}$$
$$I = 9.58 \text{ in}^4$$
$$= 1.6 \text{ ksi}$$

Allowable:

$$F_a = C_a F_y$$
$$= 0.339 \times 46$$
$$= 15.59 \text{ ksi}$$

$$Kl/r = 2 \times 65/1.48$$
$$= 87.8$$
$$C_c = 111.6$$
$$Kl/r < C_c$$

$F_b = 0.66 F_y$

$= 0.66 \times 46$

$= 30.36$ ksi

$\frac{b}{t} = \frac{4}{5/16} = 16$

$190/\sqrt{F_y} = 28$

$\frac{b}{t} < \frac{190}{\sqrt{F_y}}$ ∴ compact

Combined stresses:

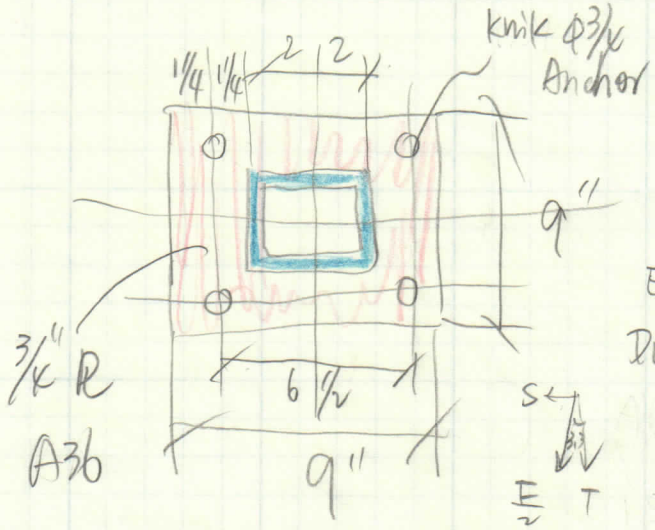
$$\frac{f_a}{F_a} = \frac{256}{15.59 \times 10^3} = 0.016 < 0.15$$

$$\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1$$

$$0.016 + \frac{1.6}{30.36} = 0.068 < 1$$

OK

10. Check Base plate 9x9x3/4



Due to eccentricity,

$M = 7826$ lb-in

$F = M/e = \frac{7826}{6.5} = 1204$ lbs

Each Anchor $= \frac{F}{2} = 602$ lbs.

Due to floor pitched at 3.3 degrees

$T = \frac{F}{2} \times \cos 3.3 = 601$ lbs

$S = \frac{F}{2} \times \sin 3.3 = 35$ lbs

$C = 5.375$

$S = 6\frac{1}{2} - f_A = 1$

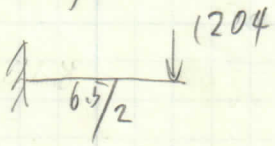
Allowable: $T = 1.0 \times 2670 = 2670$ lbs

$S = 0.51 \times 4140 = 2111.4$ lbs

$\frac{f_T}{F_t} + \frac{f_s}{F_s} \leq 1 \quad \frac{601}{2670} + \frac{35}{2111} = 0.24 < 1$

OK

Bending stress.



$M_{max} = Pl$

$= 1204 \times 3.25 = 3913$ lb-in

$$S = \frac{ab^2}{6} = \frac{9 \times 0.75^2}{6} = 0.84 \text{ in}^3$$

$$f_b = \frac{M}{S} = \frac{3913}{0.84} = 4.7 \text{ ksi}$$

$$F_b = 0.75 F_y = 0.75 \times 36 = 27 \text{ ksi}$$

$$\frac{b}{t} = \frac{9 - 2 \times 0.75}{0.75} = 10$$

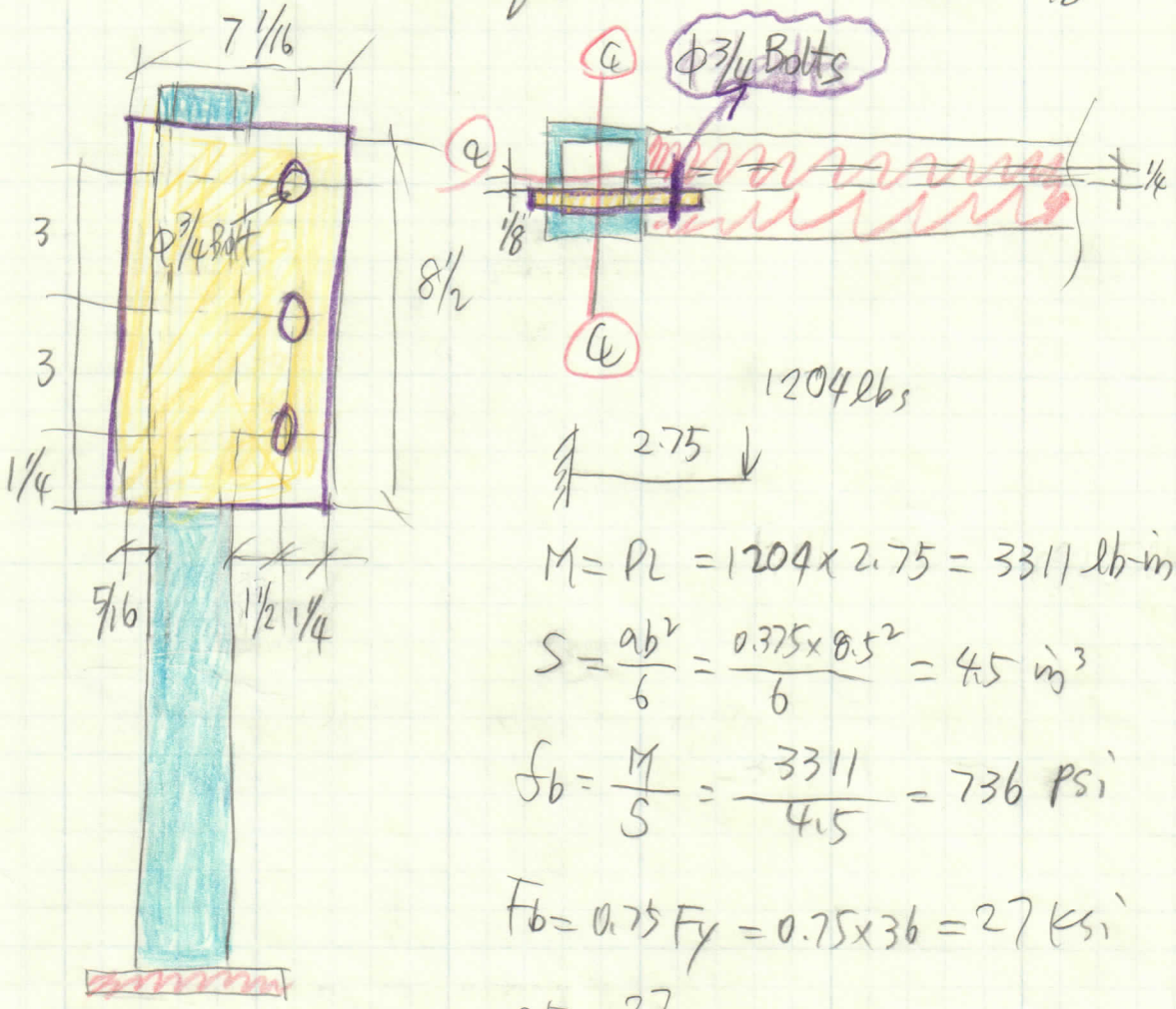
$$\frac{190}{\sqrt{F_y}} = \frac{190}{\sqrt{36}} = 31.6$$

$$\frac{b}{t} < \frac{190}{\sqrt{F_y}} \quad \text{compact}$$

$$SF = \frac{27}{4.7} = 5.7$$

OK

11. Check the connecting plate A36 $8\frac{1}{2} \times 7\frac{1}{16} \times \frac{3}{8}$



$$M = PL = 1204 \times 2.75 = 3311 \text{ lb-in}$$

$$S = \frac{ab^2}{6} = \frac{0.375 \times 8.5^2}{6} = 4.5 \text{ in}^3$$

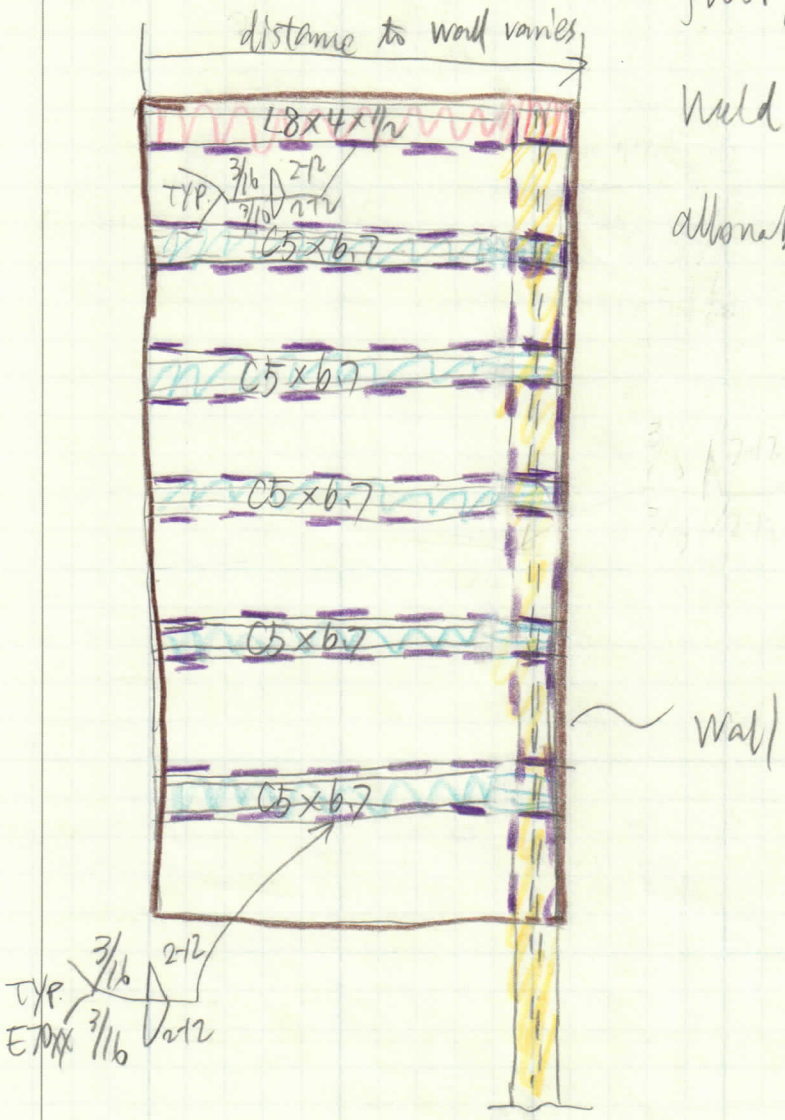
$$f_b = \frac{M}{S} = \frac{3311}{4.5} = 736 \text{ psi}$$

$$F_b = 0.75 F_y = 0.75 \times 36 = 27 \text{ ksi}$$

$$SF = \frac{27}{0.736} = 37.0$$

OK

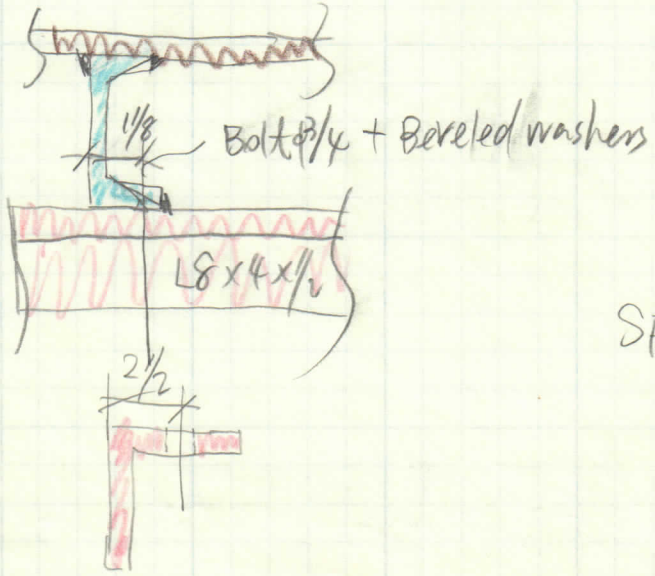
12. Connections between the floorplate & it's supports



Weld size: 3/16"

allowable: $0.3 \times 70 \times 0.707 \times 3/16$
$= 2.78$ kip/in

13. Connection between C5x6.7 and L8x4x1/2



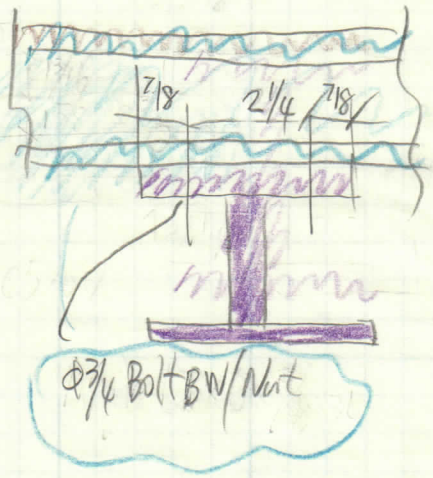
F = 898 lbs

Allowable Tension for Φ3/4 is 19.4 kips

$SF = \frac{19.4}{0.898} = 21.6$

OK

14. Connection between W12x19 and C5x6.7



$P = 898$ lbs

Shear Allowable:

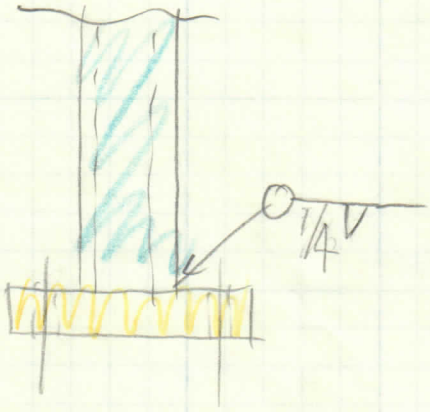
for 3/4 Bolt

$S = 9300$ lbs

$$SF = \frac{9300}{898} = 10.$$

OK

15. Connection between Column & Base plate



From previous study, knowing allowable load on weld is

2.78 kip/in

For Bending, $M = 7826$ lb·in

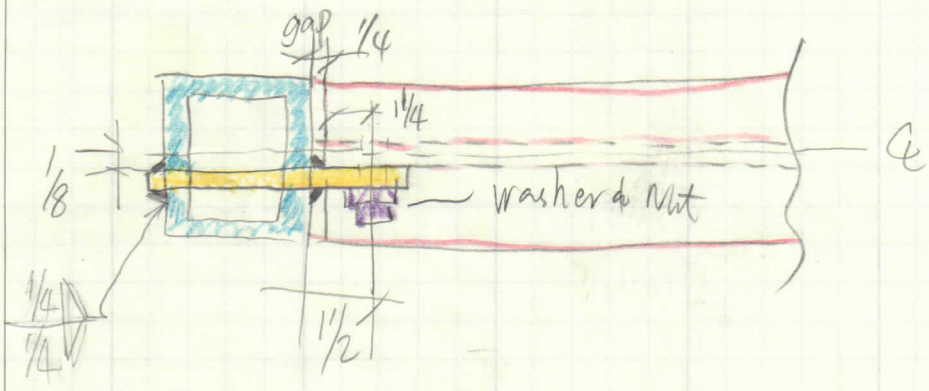
$$S_W = bd + \frac{d^2}{3} = 2\times 2 + \frac{2^2}{3} = 5.3 \text{ in}^2$$

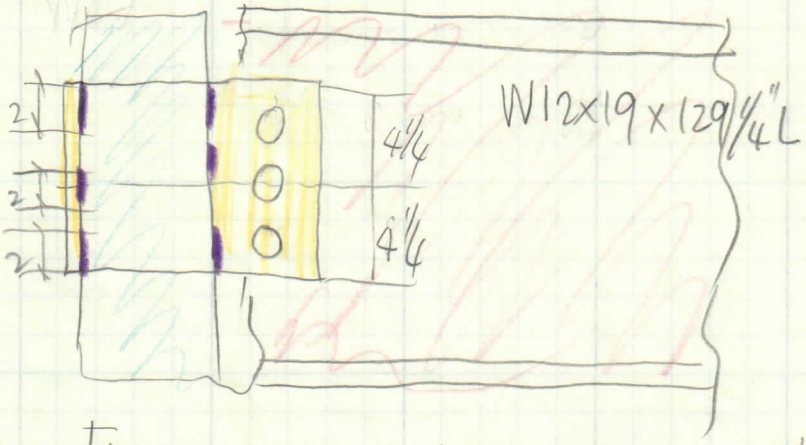
$$\sigma = \frac{M}{S_W} = \frac{7826}{5.3} = 1.5 \text{ kip/in}$$

$$SF = \frac{2.78}{1.5} = 1.9$$

OK

16. Connection between column & W12x19.





From previous study, know, for 3/16 fillet weld allowable load is 2.78 kip/in.

Actual load = 1204 lb

Total weld length = (2+2+2) x 4 = 24 in

Actual load per in = 1204/24 = 50 lb/in.

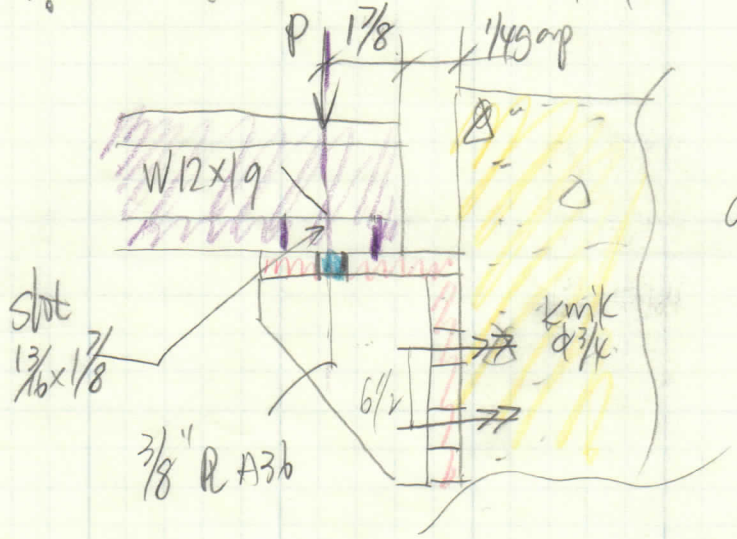
$$SF = \frac{2.78}{0.050} = 56$$ OK

For Bolt connection, ϕ 3/4" shear allowable is 9300 lbs.

Actual load is 1204 lbs

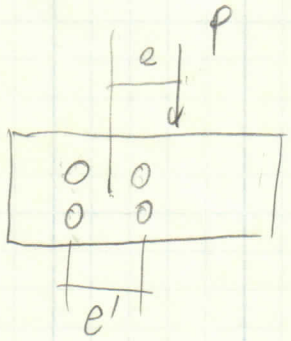
$$SF = \frac{9300}{1204/3} = 23$$ OK

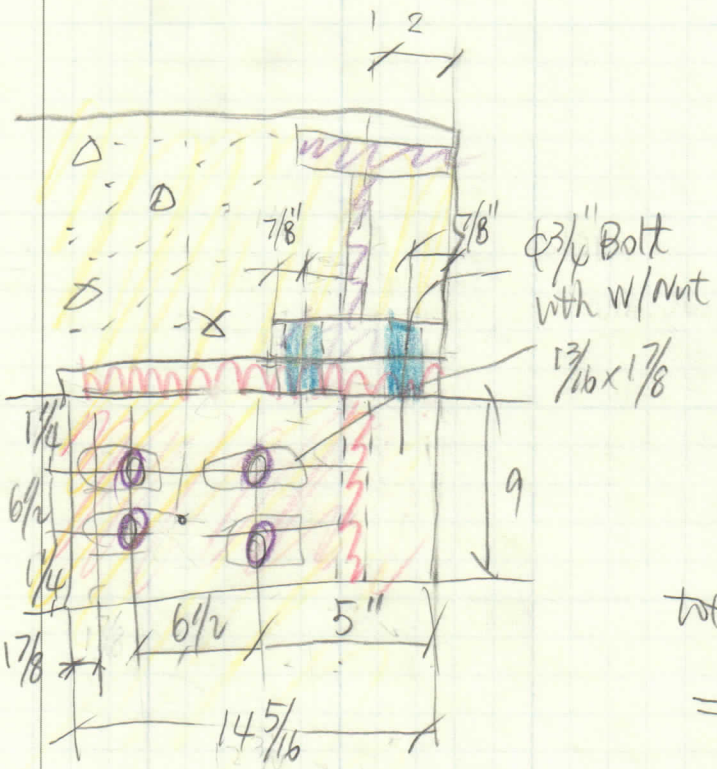
17. Connection between W12x19 & Concrete Block



$P = 1971$ lbs

a. check the kmk Bolts for shear.





$P \times e = F \times e'$

$1971 \times \left(\frac{6.5}{2} + 3\right) = F \times 6.5$

$F = 1895$ lb

each Bolt $= \frac{F}{2} = 948$ lbs.

total shear on the Bolt

$= \frac{P}{4} + 948$

$= \frac{1971}{4} + 948 = 1440$ lbs

Allowable:

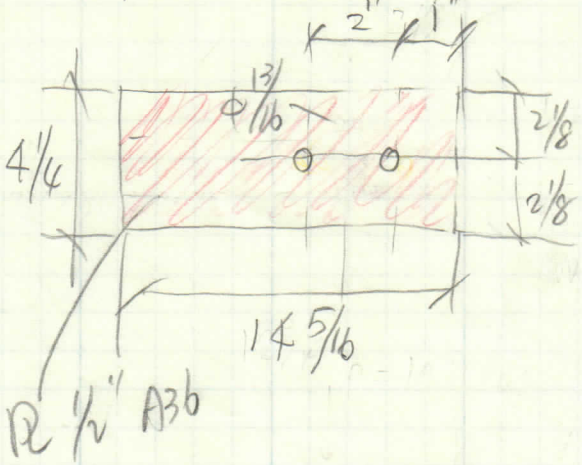
$4140 \times 0.51 \times 1.0 = 2111.4$ lbs

@ $c = 5''$ $s = 6\frac{1}{2}''$

$SF = \frac{2111.4}{1440} = 1.5$

OK

b. plate connected with W12x19



$M = PL$

$= 1971 \times 2.125$

$= 4189$ lb-in

$S = \frac{ab^2}{6}$

$= \frac{4 \times 0.5^2}{6} = 0.17 \text{ in}^3$

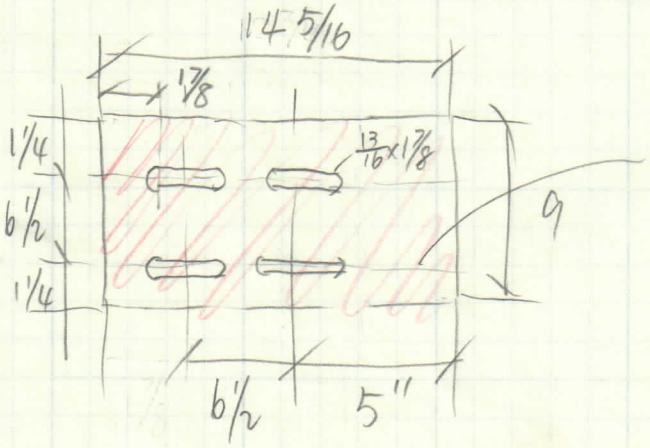
$f_b = \frac{M}{S} = \frac{4189}{0.17} = 25$ ksi $< F_b$ OK

$F_b = 0.75 F_y$

$= 0.75 \times 36$

$= 27$ ksi

c. plate connected with concrete Block



$M = 1971 \times 6.25$

$= 12318.75$ lb-in

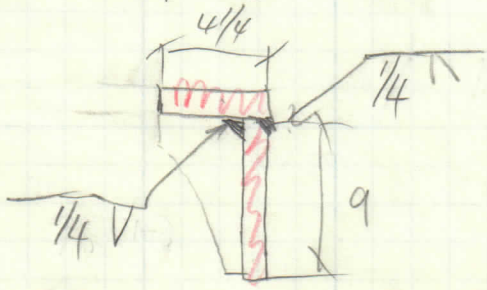
$S = \frac{ab^2}{6} = \frac{(9 - 2 \times 13/16) \times 0.625^2}{6}$

$= 0.48$

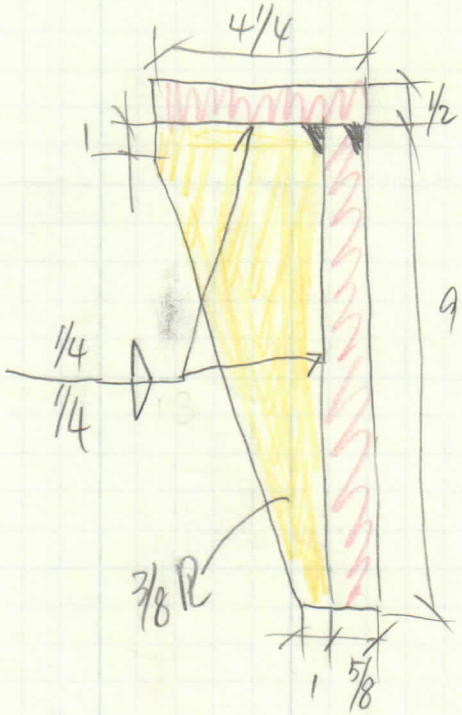
$f_b = \frac{M}{S} = \frac{12318.75}{0.48} = 25.6$ ksi

$SF = \frac{F_b}{f_b} = \frac{27}{25.6} = 1.05$ OK

d. welds between two plates



e. Gusset plate:



Bending:

$M = P \times L$

$= 1971 \times 2.125$

$= 4189$ lb-in

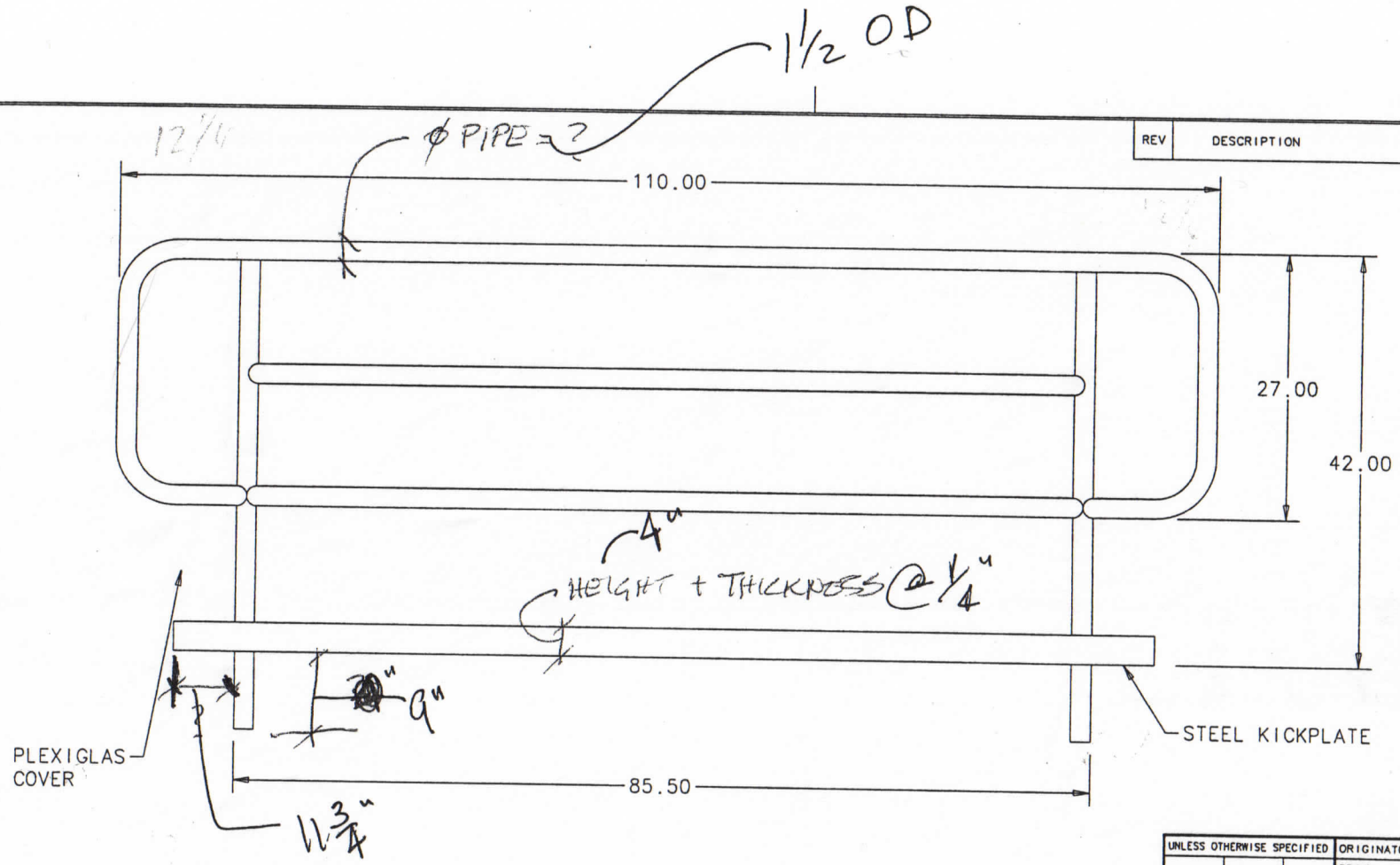
$S = \frac{ab^2}{6} = \frac{0.375 \times \left(\frac{1+9}{2}\right)^2}{6} = 1.56 \text{ in}^3$

$f_b = \frac{M}{S} = \frac{4189}{1.56} = 2.6$ ksi

$SF = \frac{F_b}{f_b} = \frac{27}{2.6} = 10.4$ OK

Welds:

fillet 1/4" skip weld.



REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE

UNLESS OTHERWISE SPECIFIED			ORIGINATOR		
			DRAWN		
±	±	±	CHECKED		
1. BREAK ALL SHARP EDGES MAX.			APPROVED		
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON			USED ON		
4. MAX. ALL MACH. SURFACES ✓			MATERIAL		
5. DRAWING UNITS:					

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SCALE	DRAWING NUMBER	SHEET	REV
	. — —	1 OF 1	

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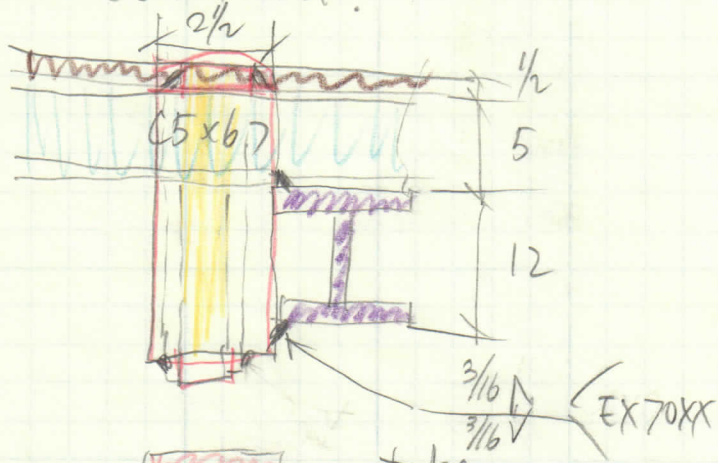
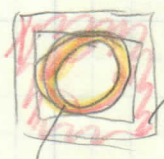
18. Removable hand rail.

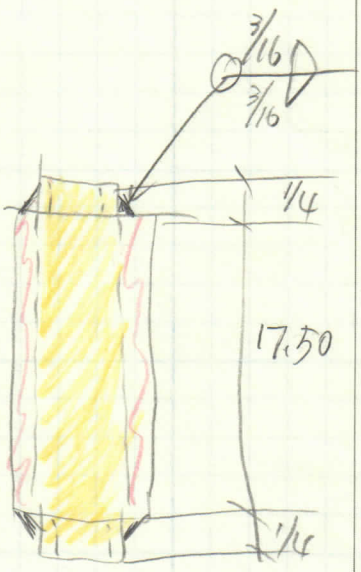
a. On the beam end:





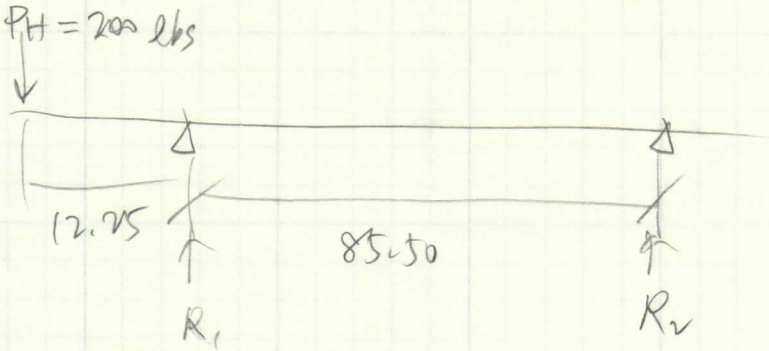
tube
2½×2½×¼ S=1.35

schedule 40 pipe
N.O. = Ø1½
O.D = 1.9
I.D = 1.610
wall = 0.145
W = 2.72 lb/ft
S = 0.326



Based on existing rail: W = 250 lbs

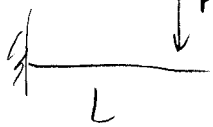
According to OSHA standard: Horizontal load = 200 lbs



$200 \times 12.25 = R_2 \times 85.50$ $\quad R_2 = 29$ lbs

$200(85.50 + 12.25) = R_1 \times 85.50$ $\quad R_1 = 229$ lbs

- Find Bending stress for the built up member.



$P = R_1 + \frac{W}{2} = 229 + \frac{250}{2} = 354$ lbs

$L = 5 + \frac{1}{2} + 42$ (rail)

$= 47.5$ in

$M = PL$

$= 354 \times 47.5 = 16815$ lbs-in

$S = S_{tube} + S_{pipe}$

$= 1.35 + 0.326 = 1.676$ in^3

$f_b = \frac{M}{S} = \frac{16815}{1.676} = 10.032$ ksi

- Find the allowable stress.

for pipe: $\frac{D}{t} = \frac{1.5}{0.145} = 10.34$

$3300/F_y = \frac{3300}{35} = 94$

$\frac{D}{t} < \frac{3300}{F_y}$ compact.

$F_b = 0.66 F_y = 0.66 \times 35 = 23.1$ ksi (governs)

for square: $\frac{b}{t} = \frac{2.5}{0.25} = 10$

$\frac{190}{\sqrt{F_y}} = \frac{190}{\sqrt{46}} = 28$

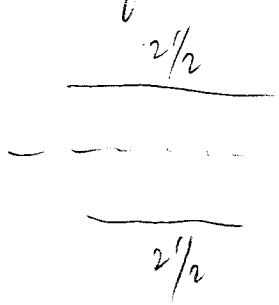
$\frac{b}{t} < \frac{190}{\sqrt{F_y}}$ compact

$F_b = 0.66 \times F_y = 0.66 \times 46 = 30.36$ ksi

- $SF = \frac{23.1}{10.0} = 2.3$

O|C

— Design the welds between the W12x19 and the built up member



$S_w = bd = 12 \times 2.5 = 30 \text{ in}^2$

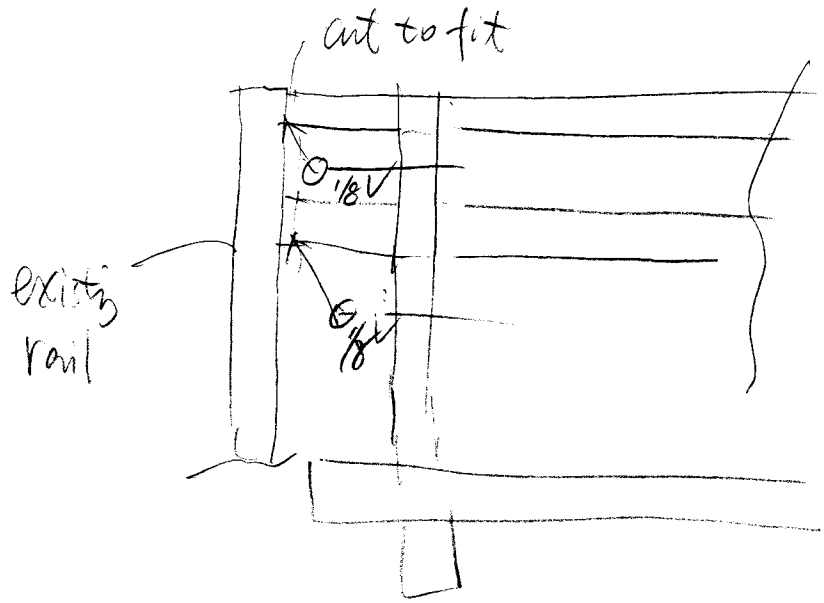
$\sigma = \frac{M}{S_w} = \frac{16815}{30} = 560.5 \text{ lb/in}$

allowable for 3/16 fillet weld:

$0.30 \times 70 \times 0.707 \times 3/16 = 2.78 \text{ kip/in}$

$SF = \frac{2780}{560.5} = 5$ OK

b. On the Block end:



2147

GENERAL NOTES:

1. ALL STEEL SHAPES AND PLATES SHALL BE ASTM A36.

2. STRUCTURAL TUBE COLUMN SHALL BE SQUARE STRUCTURAL TUBE CONFORMING TO ASTM A-500, GRADE B.

3. WELDING RODS SHALL BE E70XX.

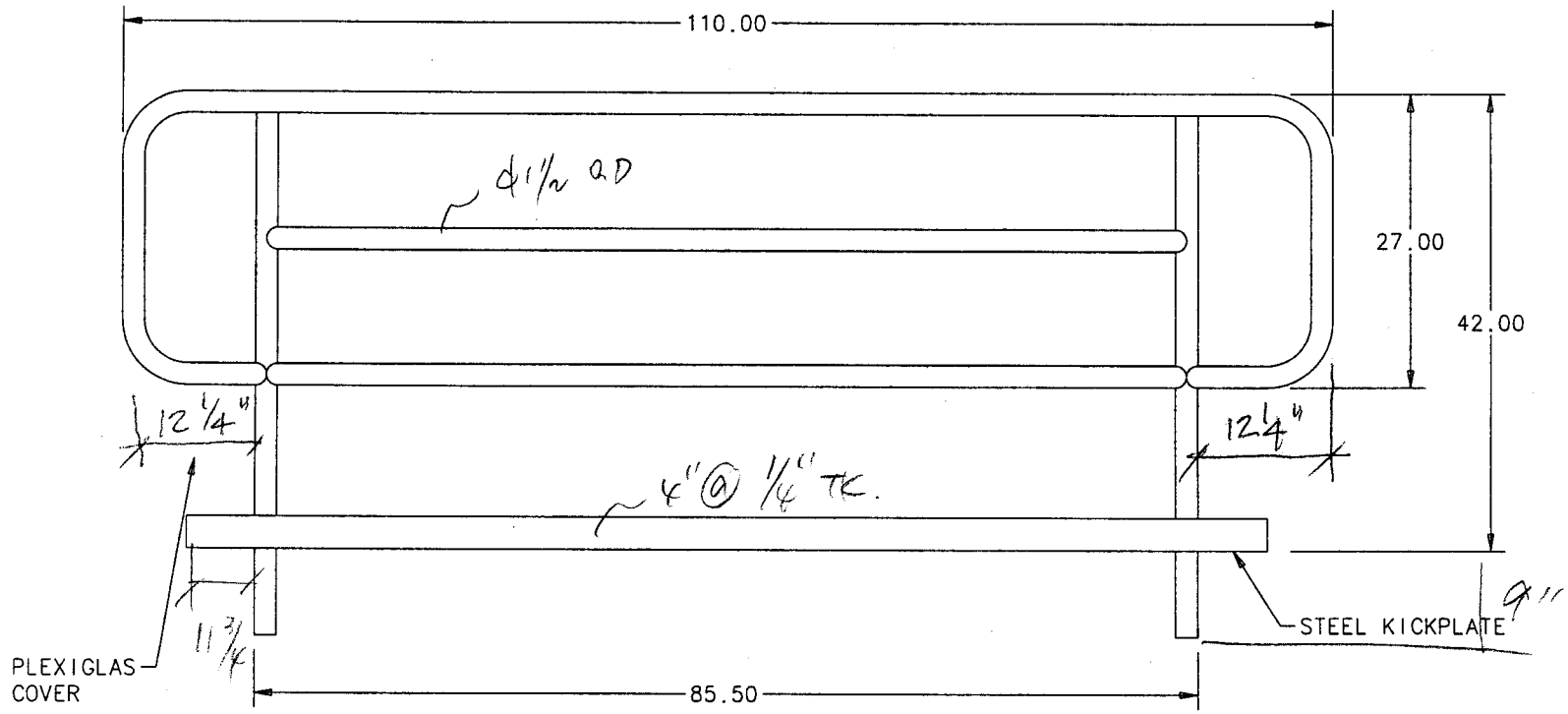
4. CONNECTION BOLTS SHALL BE GRADE 5. 3/4"Ø BOLTS SHALL BE TORQUED TO 225 FT. LBS

5. EXPANSION ANCHORS SHALL BE "HILTI" KWIK BOLT II WITH MINIMUM 3 1/4" EMBEDMENT. TORQUE TO 175 FT. LBS.

6. STEEL FLOOR PLATE SHALL BE "INLAND 4-WAY PLATE" CONFORMING TO ASTM A-786.

7. GROUT SHALL BE "UNISORB" EPOXY GROUT WITH A 7-DAY COMPRESSIVE STRENGTH OF 16,000 PSI OR BETTER.

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE



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			DRAWN		
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1. BREAK ALL SHARP EDGES MAX.			APPROVED		
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SCALE	DRAWING NUMBER	SHEET	REV
	. — —	1 OF 1	

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