Fermilab

Particle Physics Division 12-01-01

Mechanical Department Engineering Note

Number: MD-Eng-56 Date: October 4, 2004

Project: PPD

Project Internal Reference:

Title: Lab B Platform Modifications

Author(s): Russell Alber and Ingrid Fang

Reviewer(s): Bob Woods

Key Words: Bubble Chamber, Lab B and Platform

Abstract/Summary:

The Lab B platform was originally used as a loading elevator to ease the Bubble Chamber operation in the basement. The platform was supported by a hydraulic cylinder which was mounted 13 ft below lab B floor surface in the basement. In order to regain the maximum basement floor usage, the platform support will be modified.

This engineering note documents the three major design changes in the project. They are:

1. Existing platform modifications and load rating calculations.

The existing mechanical and electrical devices will be removed from the platform. The existing beam skirt and the two channels on the bottom of the platform will also be removed. This modified platform will rest on the new support beams which are perpendicular to the channel C8x18.75.

2. New platform support design to free the basement floor space.

   Three W10x49 beams will be used to support the platform. Each beam will be connected to the concrete beams through Hilti anchors and high strength bolts.

3. The west side of the concrete beam will be reinforced to carry the additional load from the platform.

   Two 6x6x3/16 square tubes will be used as columns to shorten the existing beam span. Two ¾" base plates will be welded to each end of the tube. The top plate will be connected to the concrete beam and the bottom plate will be connected to the concrete floor through Hilti anchors.

The design analysis was performed according to both AISC "Allowable Stress Design" code and ACI "Building Code Requirements for Structural Concrete and Commentary". The results show that all steel members and concrete members will safely support the modified platform within the allowable stress limits. The modified platform is rated for 250 psf.

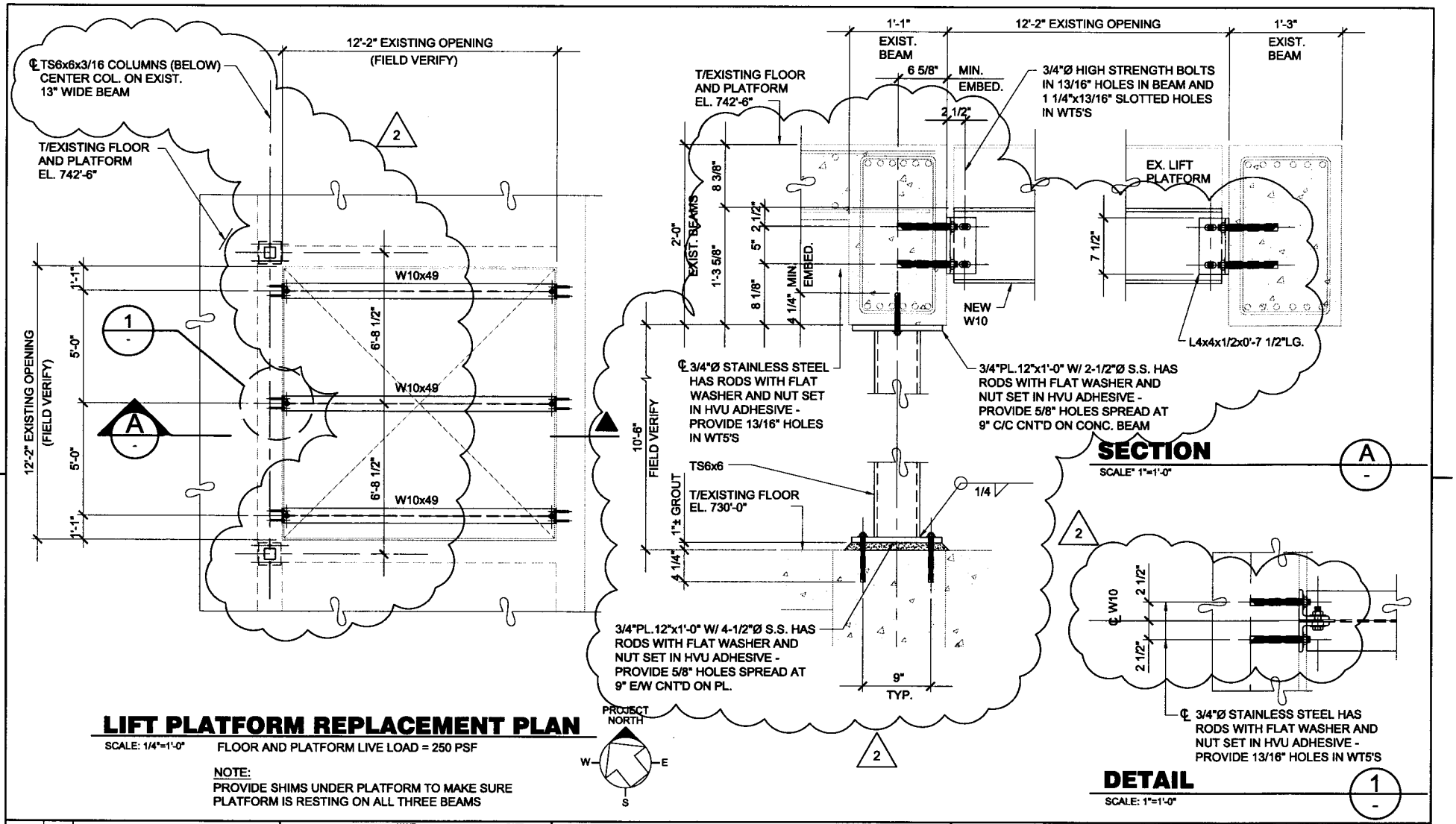
Applicable Codes:

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

2. ACI "Building Code Requirements for Structural Concrete and Commentary".

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

4. Hilti North America Product Technical Guide



LIFT PLATFORM REPLACEMENT PLAN

SCALE: 1/4"=1'-0"

FLOOR AND PLATFORM LIVE LOAD = 250 PSF

NOTE:
PROVIDE SHIMS UNDER PLATFORM TO MAKE SURE PLATFORM IS RESTING ON ALL THREE BEAMS

SECTION A

SCALE" 1"=1'-0"

DETAIL 1

SCALE: 1"=1'-0"

REV.	DATE	DESCRIPTIONS
2	09/28/04	General revision
1	09/22/04	Revised beam size

REVISIONS

	NAME	DATE
DESIGNED	R. ALBER	
DRAWN	R. ALBER	
CHECKED	T. LACKOWSKI	
APPROVED	D. NEVIN/E. CRUMPLEY	
SUBMITTED	H. JOSTLEIN	

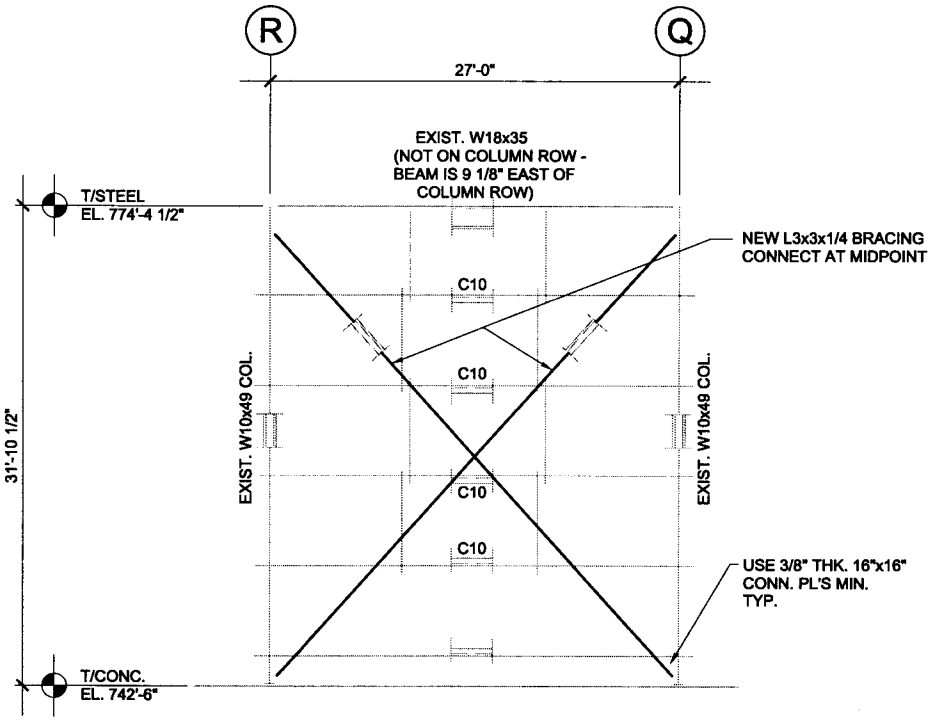
SCALE:
1/4"=1'-0" 4 0 4 8 SCALE FEET
1"=1'-0" 1 0 1 2 SCALE FEET

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

BUBBLE CHAMBER DEMOLITION
LIFT PLATFORM REPLACEMENT PLAN

DRAWING NO. 8-2-158 SS-2 REV. 2

PAGE NINE 23



ELEVATION - COLUMN ROW 1

SCALE: 1/8"=1'-0" LOOKING WEST

NOTES:

1. THE SUBCONTRACTOR SHALL VERIFY ALL DIMENSIONS AND EXISTING CONDITIONS BEFORE STARTING WORK. IF CONDITIONS VARY FROM THOSE INDICATED ON THE DRAWINGS, THE FERMILAB CONSTRUCTION COORDINATOR SHALL BE NOTIFIED AND NO WORK SHALL BE DONE IN THIS AREA WITHOUT HIS APPROVAL.

2. THE SUBCONTRACTORS SHALL COORDINATE WORK AND COOPERATE WITH SUBCONTRACTORS ON ADJACENT AND CONCURRENT WORK.

3. SCALE FOR THE DRAWINGS IS FOR GENERAL INFORMATION ONLY, LOCATIONS AND DIMENSIONS SHALL BE TAKEN AS SHOWN AND NOT SCALED.

4. ALL STEEL SHALL BE NEW STEEL AND SHALL CONFORM TO ASTM SPECIFICATION INDICATED (LATEST REVISION) UNLESS OTHERWISE NOTED AND SHALL BE FABRICATED AND ERECTED IN ACCORDANCE WITH CURRENT A.I.S.C. STANDARDS AND APPLICABLE CODES:

WIDE FLANGE	A572 GRADE 50 OR A36
PLATE, ANGLE, CHANNELS	A36
TUBE STEEL	A500, GRADE C

5. ALL STRUCTURAL STEEL SHALL BE DETAILED, FABRICATED AND ERECTED IN ACCORDANCE WITH "THE CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES" AND THE "SPECIFICATIONS FOR DESIGN FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS" (A.I.S.C. LATEST EDITION).

6. ALL STRUCTURAL STEEL SHALL BE OF SIZE SHOWN ON DRAWINGS AND SHALL BE STRAIGHT AND FREE OF TWIST. SUBSTITUTIONS WILL NOT BE PERMITTED WITHOUT APPROVAL OF THE FERMI LAB.

7. THERE SHALL BE NO FIELD CUTTING OF STRUCTURAL STEEL MEMBERS FOR THE WORK OR OTHER TRADES WITHOUT THE PRIOR WRITTEN APPROVAL OF THE FERMI LAB.

8. BOLTED CONNECTIONS SHALL BE BEARING TYPE CONNECTIONS WITH THREADS INCLUDED IN SHEAR PLANE (A325-N) UTILIZING 3/4" DIAMETER HIGH STRENGTH BOLTS WITH WASHERS UNDER NUTS CONFORMING TO ASTM DESIGNATION A325 (LATEST REVISION) TIGHTENED TO SPECIFIED TENSION UNLESS OTHERWISE SHOWN OR NOTED.

9. WELDED CONNECTIONS SHALL BE AS SHOWN ON DETAILS. ALL WELDING SHALL BE EITHER MANUAL ARC WELDING OR SUBMERGED ARC WELDING, BOTH TO PROVIDE PROPERTIES OF THE BASE MATERIAL. TECHNIQUES OF WELDING AND PREHEAT ARE TO FOLLOW PUBLISHED RECOMMENDATIONS OF BASE MATERIAL MANUFACTURER. ALL WELDING SHALL BE PERFORMED BY CERTIFIED WELDERS AND IN ACCORDANCE WITH THE PUBLISHED RECOMMENDATIONS OF THE AMERICAN WELDING SOCIETY AS NOTED IN THE A.I.S.C. SPECIFICATIONS UNLESS OTHERWISE SHOWN. MINIMUM TENSILE STRENGTH OF ELECTRODES SHALL BE 70 KSI.

10. SHOP CONNECTIONS SHALL BE WELDED OR BOLTED. WELDS SHALL BE DESIGNED TO BE FULLY EQUIVALENT IN STRENGTH TO BOLTED CONNECTIONS.

11. ALL STRUCTURAL STEEL TO HAVE ONE PRIMER COAT OF I.C.I. DEVGUARD 4160 AND (2) TWO COATS OF I.C.I. DEVGUARD 4308. PREPARE SURFACE FOR EXTERIOR EXPOSURE AND APPLY PER MANUFACTURER'S RECOMMENDATIONS. SUPPLY DRAW DOWN SAMPLE OF PAINT COLORS.

REV.	DATE	DESCRIPTIONS
		REVISIONS

	NAME	DATE
DESIGNED	R. ALBER	
DRAWN	R. ALBER	
CHECKED	T. LACKOWSKI	
APPROVED	D. NEVIN/E. CRUMPLEY	
SUBMITTED	H. JOSTLEIN	

SCALE: 1/8"=1'-0"

8 0 8 16
SCALE FEET

FERMI NATIONAL ACCELERATOR LABORATORY

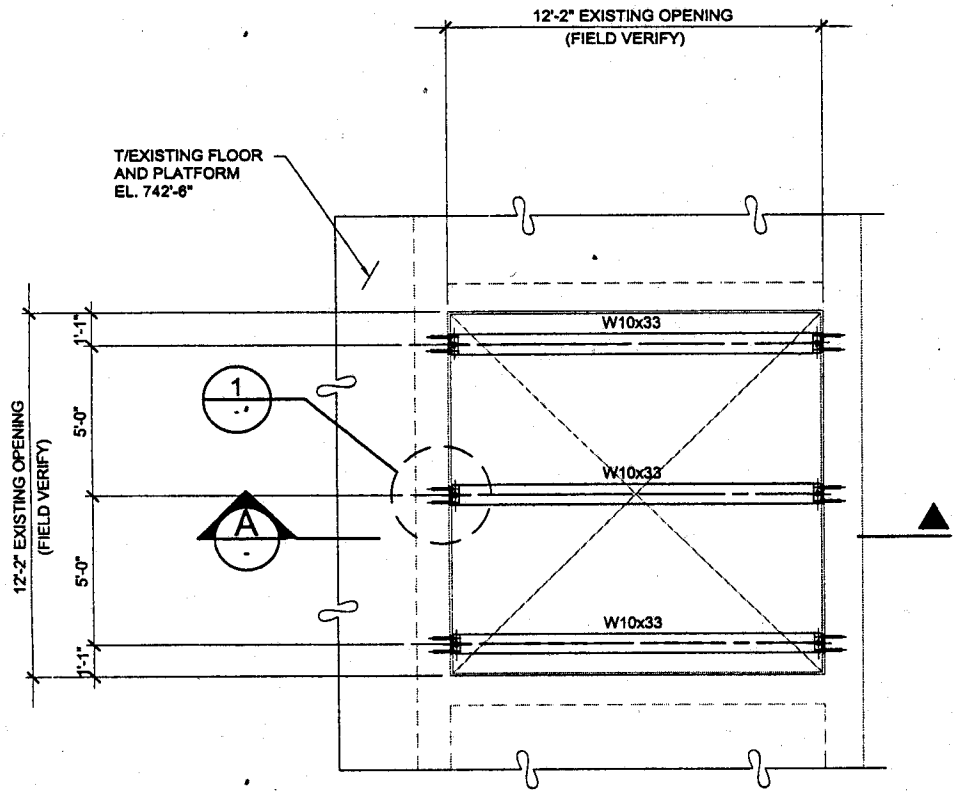
UNITED STATES DEPARTMENT OF ENERGY

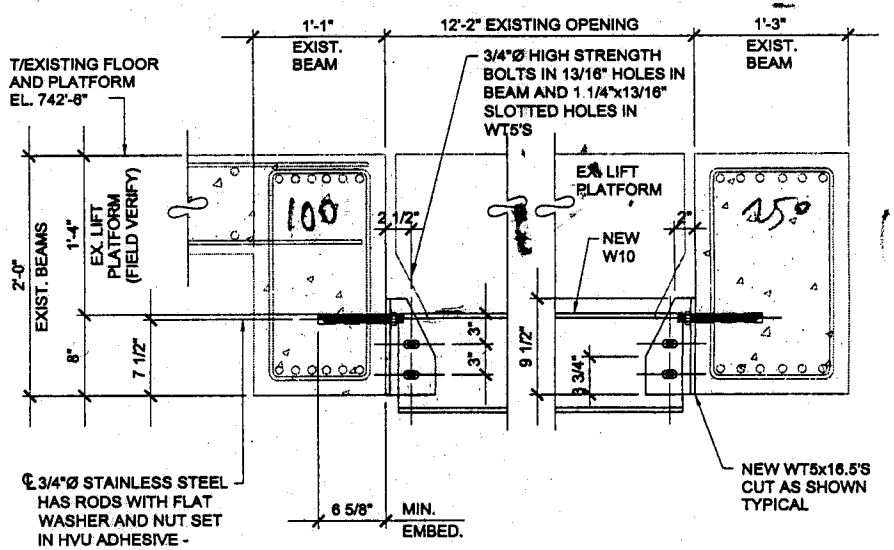
BUBBLE CHAMBER DEMOLITION

ELEVATION - COLUMN ROW 1

DRAWING NO. **8-2-158** **SS-1** REV.

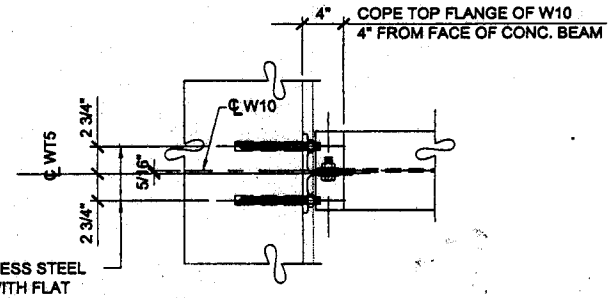
22 JUN 2004





SECTION A

SCALE: 1"=1'-0"



DETAIL 1

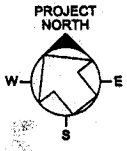
SCALE: 1"=1'-0"

LIFT PLATFORM REPLACEMENT PLAN

SCALE: 1/4"=1'-0"

FLOOR AND PLATFORM LIVE LOAD = 250 PSF

NOTE:
PROVIDE SHIMS UNDER PLATFORM TO MAKE SURE PLATFORM IS RESTING ON ALL THREE BEAMS



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SCALE:
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UNITED STATES DEPARTMENT OF ENERGY

BUBBLE CHAMBER DEMOLITION
LIFT PLATFORM REPLACEMENT PLAN

DRAWING NO. 8-2-158 SS-2 REV.

23 JUN 2004

5 ton → 325 psf = w.

Lab B Platform modification | Ingrid Fang | Oct 4, 20

1. CHECK THE EXISTING PLATFORM FOR 250PSF LIVE LOAD

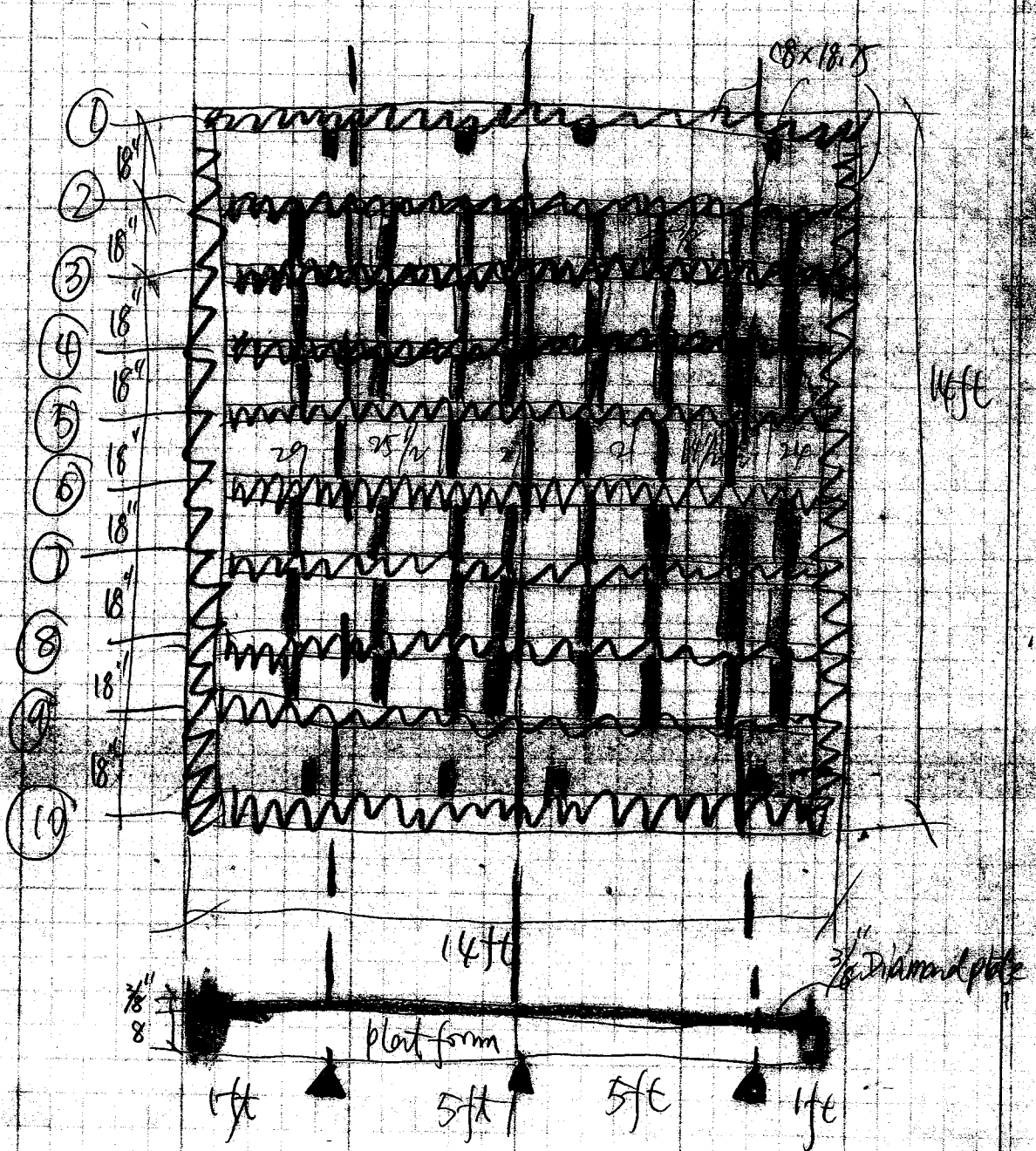
Knowing: DL - platform = 6000 lbs

LL - platform = 250 psf

Design load = DL + LL

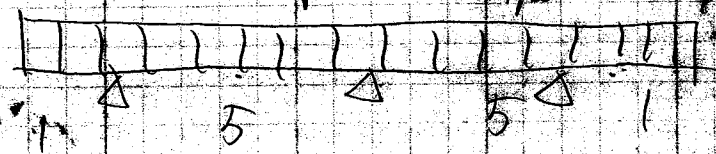
$= (6000/14 \times 14) + 250 = 280$ psf

Using 325 psf for calculation



a. check the C8×18.75

$W = 325 \times 18''/12 = 488$ lb/ft



From Ansys, Mmax

$M_{max} = 1245$ lb-ft $V_{max} = 2576.3$ lbs

FIND: $f_b = \frac{M}{S}$ where $M = 1245$ lb-ft

$S = 11.0$ in^3, $L_u = 4.10$ ft

$= \frac{1245 \times 12}{11.0}$

$= 1.358$ ksi $< F_b$ OK

FIND F_b,

$L_c = \frac{76 b_f}{\sqrt{F_y}} = \frac{76 \times 2\frac{1}{2}}{\sqrt{36}} = 31.66$ in

$L_b = 5.0$ ft $> L_c > L_u$

$F_b = \frac{12 \times 10^3 C_b}{l\, d/A_f} = \frac{12 \times 10^3 \times 1}{144 \times 8.75} = 9.5$ ksi

$SF = \frac{9.5}{1.358} = 7$

FIND f_v:

$f_v = \frac{F}{A}$ where $F = V_{max} = 2576.3$ lbs

$A = 4.04$ in^2

$= \frac{2576.3}{4.04} = 0.638$ ksi $< F_v$ OK

1

ELEMENTS

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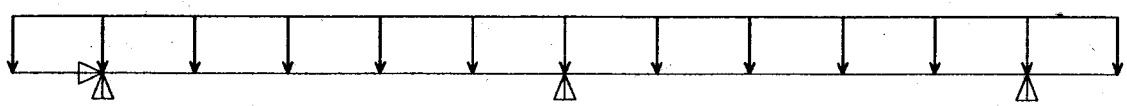


PRINT ELEMENT TABLE ITEMS PER ELEMENT

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

STAT EM	CURRENT MOMZ
1	-0.52580E-12
2	-216.50
3	443.82
4	671.15
5	465.48
6	-173.20
7	-1244.9
8	-173.20
9	465.47
10	671.15
11	443.82
12	-216.50

MINIMUM VALUES
ELEM 7
VALUE -1244.9

MAXIMUM VALUES
ELEM 10
VALUE 671.15

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
2	0.0000	1309.8	
7		2576.5	
12		1309.8	
TOTAL VALUES			
VALUE	0.0000	5196.0	0.0000

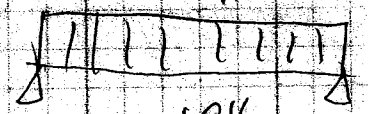
FIND Fv:

$$F_v = 0.4 F_y = 0.4 \times 36 = 14.4 \text{ ksi}$$

$$SF = \frac{14.4}{0.638} = 22.5$$

b. check 3/8" plate (top diaphragm plate)

$$W = 325 \times 1 \text{ ft} = 325 \text{ lb/ft}$$



18"

Bending:

$$M = \frac{wL^2}{8} = \frac{(325/12)}{8} \times 18^2 = 1097 \text{ lb-in}$$

$$S = \frac{ab^2}{6} = \frac{12 \times 0.375^2}{6} = 0.28 \text{ in}^3$$

$$f_b = \frac{M}{S} = \frac{1097}{0.28} = 3.9 \text{ ksi} < F_b \quad \underline{ok}$$

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

$$SF = \frac{F_b}{f_b} = \frac{27}{3.9} = 7$$

Shear:

$$f_v = \frac{F}{A} \quad \text{where } F = \frac{wL}{2} = \frac{325/12 \times 18}{2} = 244 \text{ lbs}$$

$$A = 12 \times 0.375 = 4.5 \text{ in}^2$$

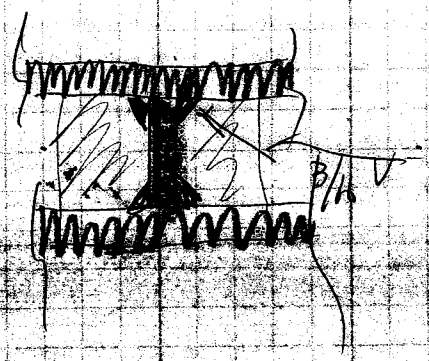
$$= \frac{244}{4.5}$$

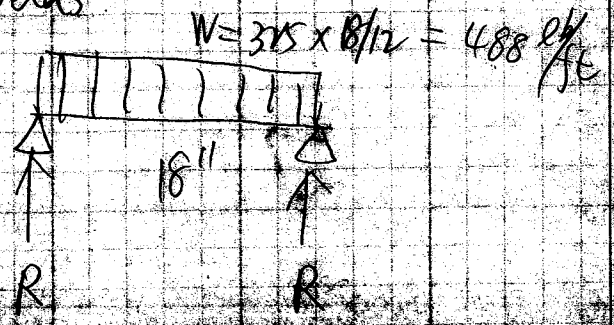
$$= 54 \text{ psi} < F_v \quad \underline{ok}$$

$$F_v = 0.4 F_y = 0.4 \times 36 = 14.4 \text{ ksi}$$

$$SF = \frac{14.4}{0.054} = 267$$

c. check the stiffner plate welds





$$R = \frac{wL}{2} = \frac{488/12 \times 18}{2} = 366 \text{ lbs}$$

for 3/16" fillet, allowable : $0.707 \times \frac{3}{16} \times 0.3 \times 70$

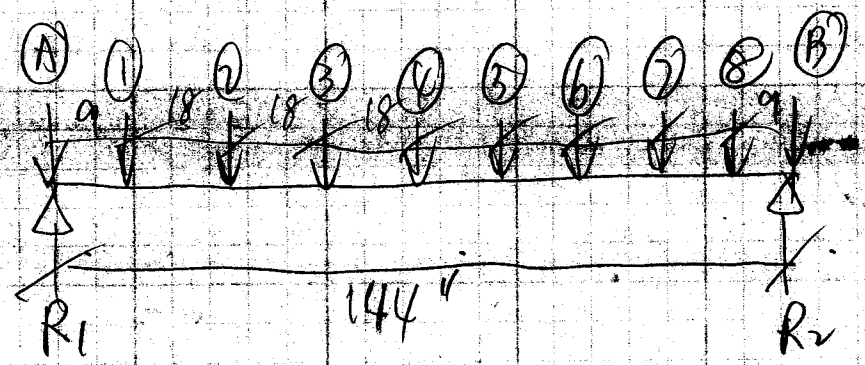
$= 2.78$ kip/in

$$SF = \frac{2.78}{0.366} = 7.5 \quad \underline{\text{ok}}$$

Thus, the modified platform will safely carry 250 psf live load.

2. New platform support design.

a. check the W10x49 Beam



$P_1 = P_2 = P_3 = P_4 = P_5 = P_6 = P_7 = P_8 = 2576$ lbs

$P_A = P_B = \frac{1}{2} P_1 = \frac{1}{2} \times 2576 = 1288$ lbs

channel

2½

.487

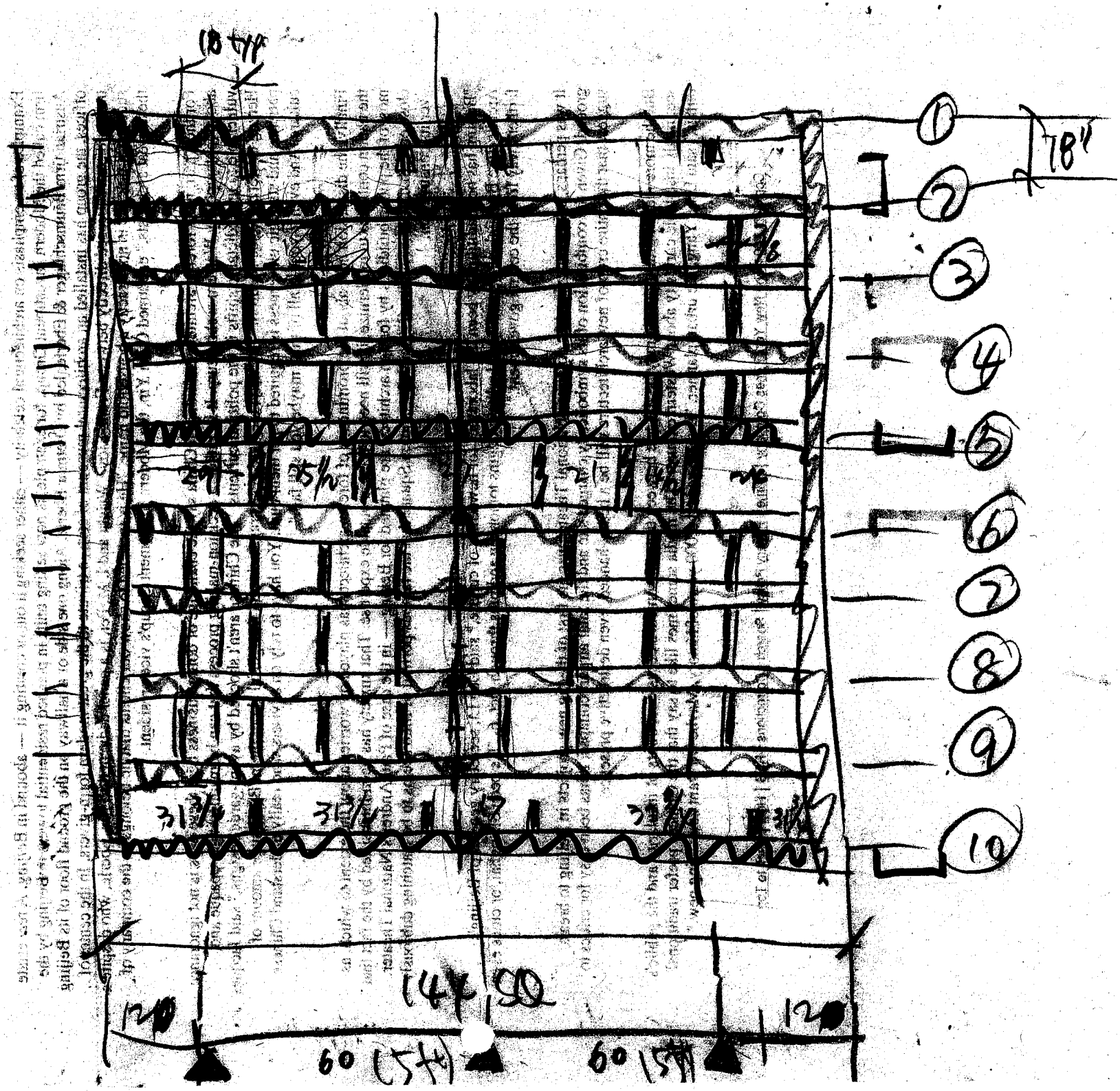
¼

C 8x18.75

top plate

= 3/8"

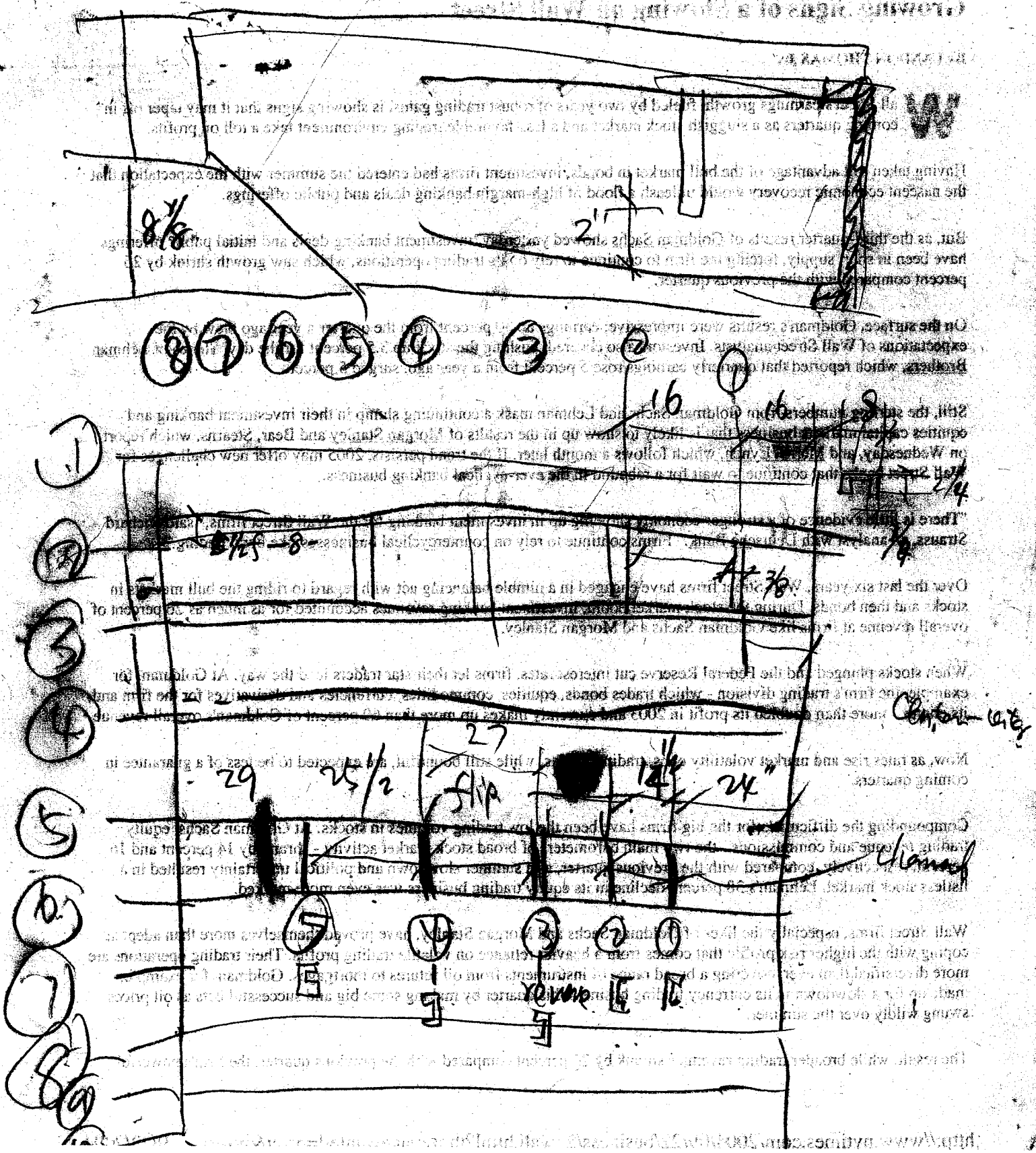
9/03/04

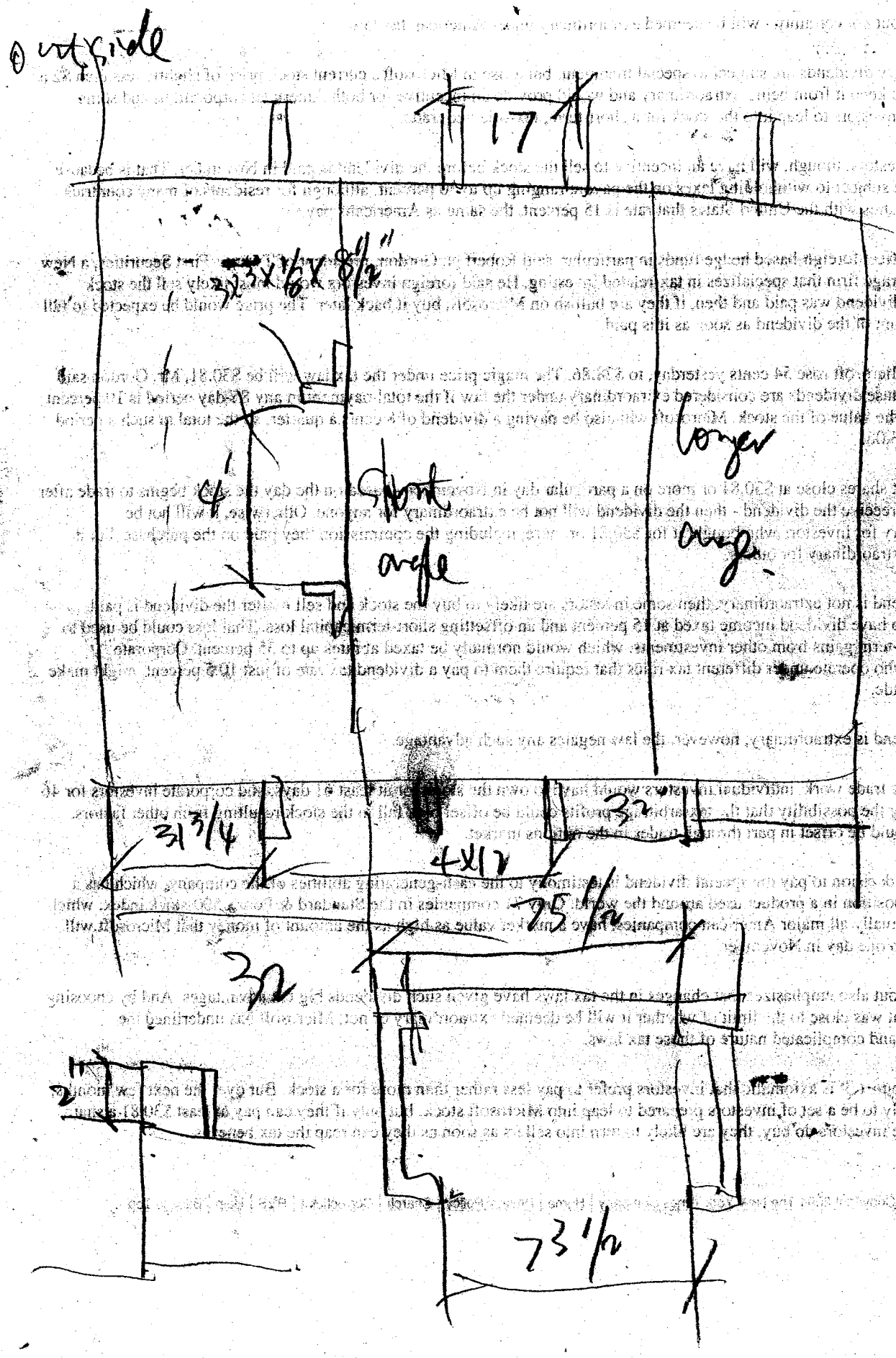


3" mold, 10" centr.

12' + 2" tap

top plate = 7/8 + 1/8 = 3/8




outside
17
3x3x1/6x8 1/2"
4'
short angle
longer angle
31 3/4
4x12
32
75 1/2
2"
73 1/2

1
ELEMENTS

U
F

ANSYS

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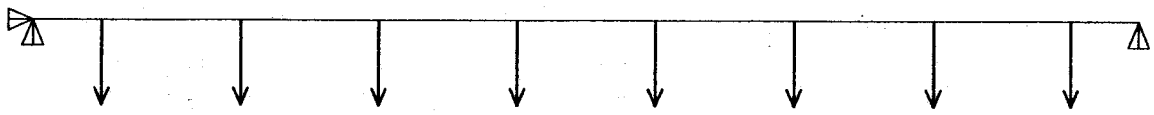
14:32:29



PRINT ELEMENT TABLE ITEMS PER ELEMENT

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

STAT	CURRENT MOM1
1	0.46566E-09
2	92736.
3	0.16229E+06
4	0.23184E+06
5	0.27821E+06
6	0.32458E+06
7	0.34776E+06
8	0.37094E+06
9	0.37094E+06
10	0.37094E+06
11	0.34776E+06
12	0.32458E+06
13	0.27821E+06
14	0.23184E+06
15	0.16229E+06
16	92736.

MINIMUM VALUES
ELEM 1
VALUE 0.46566E-09

MAXIMUM VALUES
ELEM 8
VALUE 0.37094E+06

From Ansys, knowing

$M_{max_x} = 370940$ lb-in

$\therefore R_1 = R_2 = \text{Reaction} + P_A$

$= 10304 + 1288$

$= 11592$ lbs

For W10x49 $S_x = 54.6$ in^3

$L_c = 10.6$ ft

$L_u = 26.0$ ft

$f_b = \frac{M}{S} = \frac{370940}{54.6} = 6.793$ ksi $< F_b = 21.6$ ksi

OK

F_b: $L_b = 144 = 12' > L_c$

$F_b = \frac{12 \times 10^3 C_b}{l_d / A_f} \leq 0.6 F_y = 0.6 \times 36$

$= 21.6$ ksi (governs)

$= \frac{12 \times 10^3 \times 1}{144 \times 1.78}$

$= 46.8$ ksi

$f_v = \frac{F}{A}$ where $F = 11592$ lbs

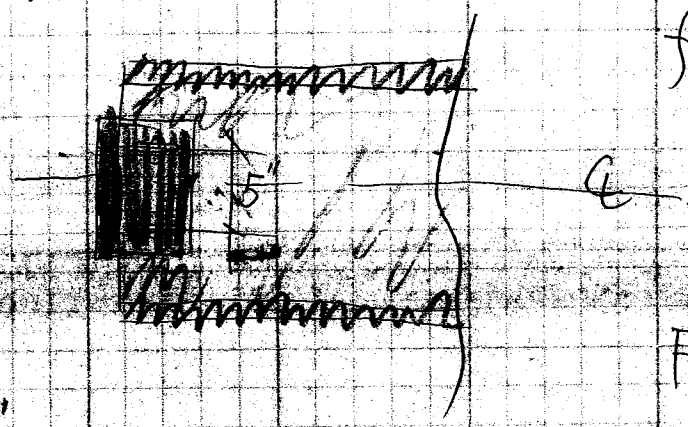
$A = 14.4$ in^2

$= \frac{11592}{14.4}$

$= 805$ psi $< F_v$ OK

$F_v = 0.4 F_y = 0.4 \times 36 = 14.4$ ksi

b. check the Angle $L4\times4\times\frac{1}{2}$ on the connection:



$f_v = \frac{F}{A}$ where $F = 11592/2$

$= 5796$ lbs

$= \frac{5796}{3.75}$ $A = 3.75\ in^2$

$= 1.5$ ksi < 14.4 ksi ok

$F_v = 0.4F_y$

$= 0.4\times36$

$= 14.4$ ksi

c. check the $\phi\frac{3}{4}$" Bolt:

Allowable shear on $\frac{3}{4}$" Bolt = 18.6 kips (Double shear)

Actual shear force at Bolt = 11.590 kips $<$ 18.6 kips

ok

d. check the Hilti Anchor HVA adhesive system

$\phi\frac{3}{4}$" STAINLESS STEEL HAS ROD WITH FLAT WASHER AND NUT SET IN HVU ADHESIVE

known: $f_c = 4000$ psi

allowable shear $\phi\frac{3}{4}$" = 11.5 kips

at $6\frac{5}{8}$" min. Embedment

reduction factor:

$S = 5 \rightarrow f_A = 0.78$

$C = 8\frac{1}{8} \rightarrow f_{RV}(1\ edge) = 0.78$

$11.5\times0.78\times0.78 = 7.0$ kips

4 Anchors for each connections.

$4 \times 7.0 = 28$ kips/connection

Actual load $= 11.590$ kips < 28 kips. OK

Thus the design as shown is adequate to take the load.

3. CHECK THE EXISTING CONCRETE SUPPORT BEAM FOR ADDITIONAL LOAD FROM THE PLATFORM

See Russell Alber's calculation for Beam strength calculation.

It concludes that the west side of the concrete beam will not safely take the additional load from the platform. Thus, two $6 \times 6 \times 3/16''$ square tubes will be used as columns to shorten the beam span.

a. check the column stress:

From Russell's Calculation, knowing $R = 65$ kips

For $6 \times 6 \times 3/16''$ when Effective length

$$\frac{kl}{r} = \frac{(1) \times (10.5)}{2.36} = 4.4 \text{ ft}$$

Allowable concentric load $= 107$ kips.

Since, $R = 65$ kip < 107 kips

the column will safely take the load.

b. check the Base plate thickness

$t_p = 2m\sqrt{\frac{f_p}{f_y}}$ where $m = (12 - 0.95 \times 6)/2 = 3.15$ in

$N = m + 3.15$ in

$= 2 \times 3.6 \times \sqrt{\frac{0.45}{36}}$

$= 0.7$ in

$A = B \times N$

$= 12 \times 12 = 144$ in^2

$f_p = \frac{P}{A} = \frac{65}{144} = 0.45$ ksi

use $3/4$" A36 plate

c. check the Hilti Anchor connections

$\phi 1/2$" STAINLESS STEEL HAS ROD WITH FLAT WASHER AND NUT SET IN HVU ADHESIVE.

known: $f_c = 4000$ psi

allowable shear $\phi 1/2$" $= 4785$ lbs $= 4.785$ kips at $4 1/4$" min. Embedment

no reduction factors are applied

Actual shear $= 10\% V$

$= 10\% \times 65$ kips $= 6.5$ kips

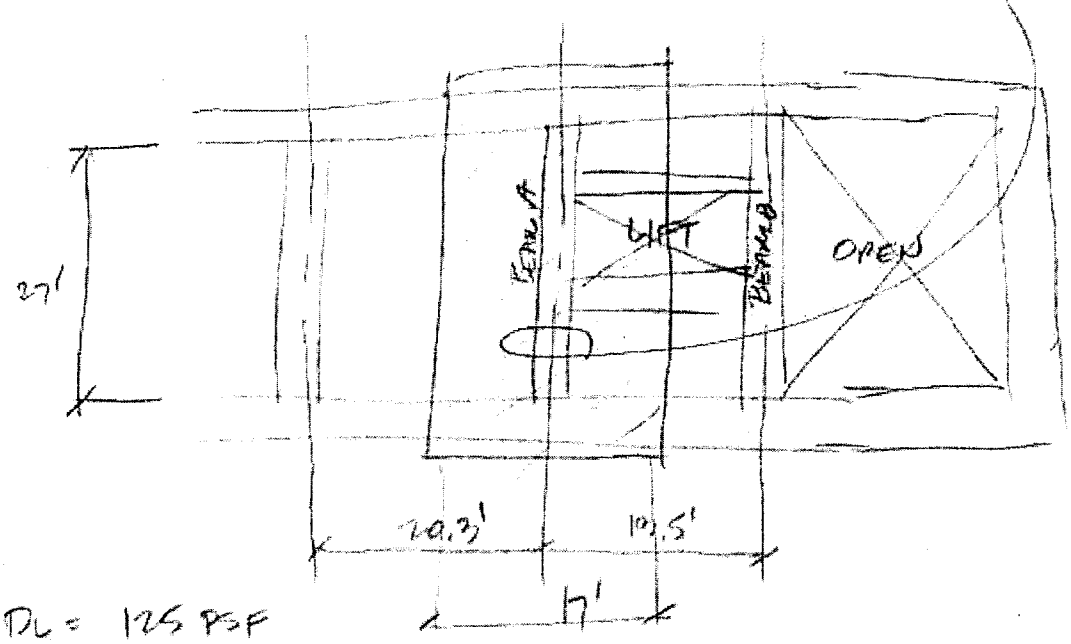
each Rod $= \frac{1}{4} \times 6.5 = 1.625$ kips < 4.785 kips

OK

FERMILAB ENGINEERING NOTE	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	Assembly	8-2-158		1/9

SUBJECT	NAME	DATE	REVISION DATE
LAB 'B' PLATFORM	R. ALBER	9/28/04	

• CHECK EXIST. CONC. BEAM FOR FULL 125 PSF LOAD
BEAMS ON BOTH SIDES OF LIFT ARE SIMILARLY
REINFORCED, USE WORST CASE - WEST BEAM.



DL = 125 PSF
LL = 250 PSF
FACTORED LOAD (ACI 318-02)

$1.2(125) + 1.6(250) = 550$ PSF

$w = 17'(0.550) = 9.35$ K/FT

USE ACI MOMENT COEFFICIENTS (8.3.3)

$M_u^- = \frac{wL^2}{16} = \frac{9.35(27)^2}{16} = 426$ K-FT

$M_u^+ = \frac{wL^2}{14} = \frac{9.35(27)^2}{14} = 487$ K-FT ←

$M_n = \frac{M_u}{\phi} = \frac{487}{0.9} = 541$ K-FT

$R_n = \frac{M_n}{bd^2} = \frac{541(12)(1000)}{13(23)^2} = 944 > 911$ FROM PCA NOTES TABLE 6-1

∴ BEAM NO GOOD w/o COMPRESSION REINF.

SUBJECT: LAB B PLATFORM

NAME: R. ALABA

DATE: 9/28/04 | REVISION DATE:

FIND NOMINAL STRENGTH MOMENT RESISTED BY CONCRETE SECTION, W/O COMP. REINF.

$\rho_t = 0.01806$ FROM TABLE 6-1

$\omega = 0.01806\left(\frac{60}{4}\right) = 0.27$

$\frac{M_{nT}}{f'_c b d^2} = 0.2270$ FROM TABLE 7-1

$M_{nT} = 0.2270\,(4)(13)(23)^2 = 6244$ IN-K $= 520$ K-FT

$M_{REQ'D}$ TO BE RESISTED BY COMP. REINF.

$M'_n = 541 - 520 = 21$ K-FT

DETERMINE THE COMP. STEEL STRESS f'_s

$c = 0.375 d_t = 0.375(23) = 8.625$ IN

$\frac{d'}{c} = \frac{2}{8.625} = 0.23 < 0.31$

∴ COMP. REINF. YIELDS @ NOMINAL STRENGTH ($f'_s = f_y$)

DETERMINE THE TOTAL REINF.

$A_s' = \frac{M'_n}{f_y(d-d')} = \frac{21(12)(1000)}{60{,}000(23-2)} = 0.2$ IN^2

$A_s = 0.2 + \rho bd$

$A_s = 0.2 + (0.01806(13)(23)) = 5.4$ IN^2

CHECK NOM. CAP.

WHEN COMP. REINF. YIELDS –

$a = \frac{(5.4-0.2)60}{0.85(4)(13)} = 7.33$ IN

$\phi M_n = 0.9\left[(5.4-0.2)(60)\left(23 - \frac{7.33}{2}\right) + 0.2(60)(23-2)\right]/12$

$\phi M_n = 488 \geq 487$: OK

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$A_s' = 0.2\ in^2$ MIN. ACTUAL 6-#4 = 6(0.2) = 1.2 in² > 0.2 ∴ OK

$A_s = 5.6\ in^2$ MIN ACTUAL 6-#7 = 6(0.6) = 3.6 in² < 5.6 ∴ NO GOOD

CHECK FOR $a = \frac{(3.6-1.2)(60)}{0.85(4)(13)} = 3.26''$

$$\phi M_n = 0.9\left[(3.6-1.2)(60)\left(23-\frac{3.26}{2}\right) + 1.2(60)(23-2)\right]/12$$

$\phi M_n = 344$ K-FT $= M_u$

$344 = \frac{w(27)^2}{14} \Rightarrow w = 6.6$ K/FT

$\frac{6.6}{17} = 388$ PSF

$388 = 1.2(125) + 1.6(LL)$

$LL_{AVAIL} = 150$ PSF NO GOOD

CHECK BEAM B

$w = (13.5/2 + 1)(0.550) = 4.26$ K/FT

$M_u^+ = \frac{4.26(27)^2}{14} = 222$ K-FT

$M_n = \frac{222}{0.9} = 250$ K-FT

$R_n = \frac{M_n}{bd^2} = \frac{250(12)(1000)}{15(23)^2} = 378 < 911$ ∴ OK FOR TENSILE ONLY

$\frac{M_n}{f'_c bd^2} = \frac{250(12)}{4(15)(23)^2} = 0.0945$

FROM TABLE 10-1

$w = 0.101$ ∴ $\rho = \frac{0.101(4)}{60} = 0.006733$

$A_{s\,REQ'D} = 0.006733(15)(23) = 2.3\ in^2 < 5.6\ in^2$ ∴

OK FOR 325 PSF LOAD.

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LAB 8 PLATFORM	R. ALDER	
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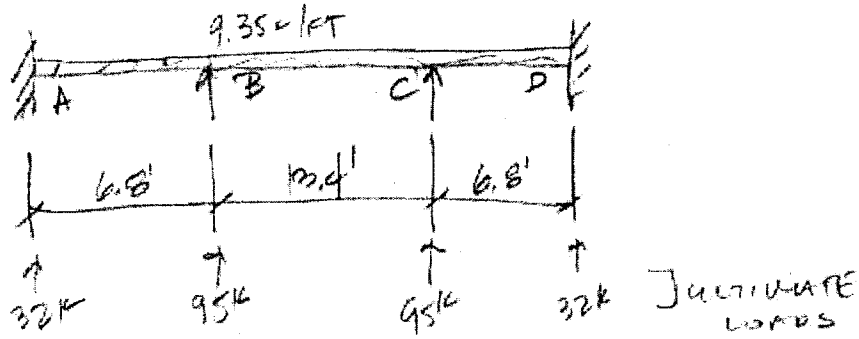
ADD TWO COLUMNS TO BEAM A SPREAD TO CLEAR EXIT DOOR



USE MOMENT DIST TO DETERMINE LOADS AT SUP'TS.

$K_{AB} = \frac{4EI}{L}$ SINCE E, I CONSTANT, USE 4EI = 13.4' MAX SPAN

$K_{AB} = \frac{13.4}{6.8} = 1.97$ $\quad DF_{AB} = 0$ (FIXED END)

$K_{BC} = 1.0$ $\quad DF_{BA} = \frac{1.97}{2.97} = 0.66$

$K_{CD} = 1.97$ $\quad DF_{BC} = \frac{1.00}{2.97} = 0.34$

$DF_{CB} = 0.34$

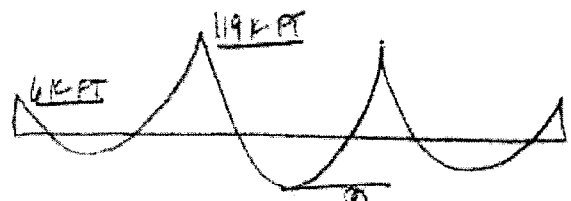
$DF_{CD} = 0.66$

$DF_{DC} = 0$ (FIXED END)

$FEM_{AB} = FEM_{CD} = \frac{wL^2}{12} = \frac{9.35(6.8)^2}{12} = 36$ K-FT

$FEM_{BC} = \frac{9.35(13.4)^2}{12} = 140$ K-FT

0	0.46	0.54	0.54	0.46	0
-36	+36	-140	+140	-36	+36
	+69	+35	-35	-69	
35		-18	+18		-35
	+12	+6	-6	-12	
6		-3	3		-6
	+2	+1	-1	-2	
1		0	0		-1
+6	+119	-119	119	-119	-6



$119 - \frac{93 \cdot (13.4)^2}{8} = -91$ K-FT

$M^-_{MAX} = 119$ K-FT

$M^+_{MAX} = 91$ K-FT

CHECK M^-_{MAX} FOR EXIST. BEAM
NEG REINF = 6-#4

$M_n = \frac{119}{0.9} = 132$ K-FT

$\frac{M_n}{f'_c b d^2} = \frac{132(12)}{4(13)(23)^2} = 0.058 \ldots \quad \omega = 0.060$

$\rho = \frac{0.060(4)}{60} = 0.004$

$A_{s\,req'd} = 0.004(13)(23) = 1.2 \leq 6(0.2) = 1.2 \text{ in}^2$

FERMILAB ENGINEERING NOTE	SECTION: FESS/ENG	PROJECT: 9-2-158	SERIAL-CATEGORY:	PAGE: 5A/9
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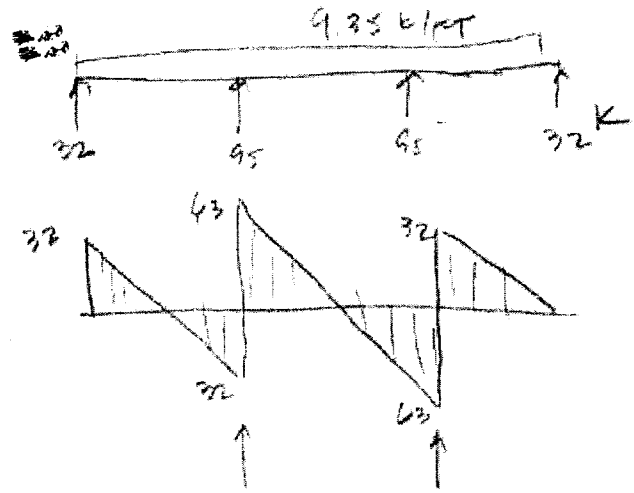
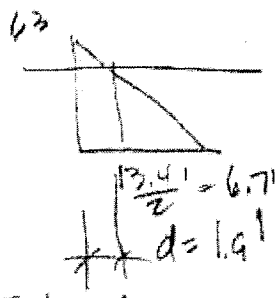
CHECK SHEAR -





$V_{ud} = \frac{(6.7-1.9)}{6.7}(63) = 45K.$

$V_{ud} = 45K$

$\phi V_c = \phi\, 2\sqrt{f'_c}\, b_w d$

$\phi V_c = 0.75(2)(\sqrt{4000})(13)(23)/(1000) = 28.4K < 45$

∴ SHEAR REINF. REQ'D.

$V_{ud} - \phi V_c = 45 - 28 = 17K < \phi 8\sqrt{f'_c}\, b_w d = 113K$ OK

$S_{REQ'D} = \frac{\phi A_v f_y d}{V_{ud} - \phi V_c} = \frac{0.75(0.22)(60)(23)}{17} = 13.4''$

$13.4'' > 10''$ .. OK. #3@10" AVAIL.

BEAM OK FOR SHEAR.

FERMILAB
ENGINEERING NOTE

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FESS/ENG	9-2-1.8		6/9

SUBJECT: LAB 8 PLATFORM

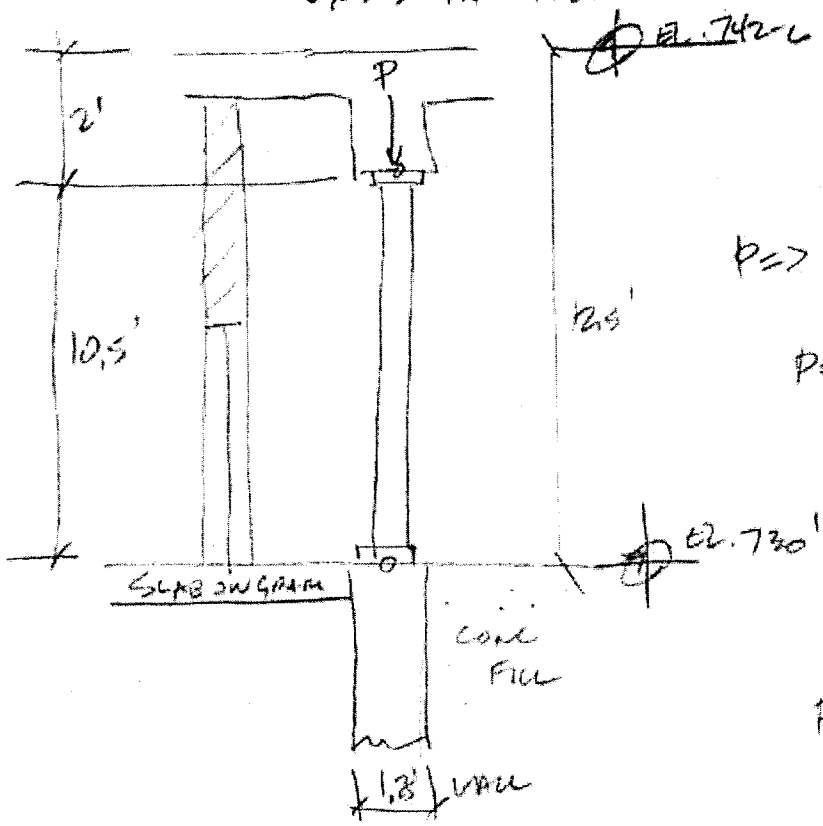
NAME: R. ALBER

DATE: 9/28/01

REVISION DATE:

CHECK M^T_{max} FOR EXIST. BEAM
FOR REINF: 6-#7
OK BY INSPECTION.

DESIGN COL'S - PER I FANG (9-27-01)
6x6x3/16 TUBE STEEL AVAILABLE.



$$P \Rightarrow (\overset{DL}{125} + \overset{LL}{250})(17')\left(\frac{13.4+6.8}{2}\right)$$

$$P = 65K$$

$$\frac{Kl}{r} = \frac{(1)(10.5)(12)}{2.36} = 53.4$$

$$C_c = \sqrt{\frac{2\pi^2(29{,}000)}{60}} = 97.7$$

$F_y = 46$ ksi (A500, GRADE C) ASSUMED. (TYPICAL)

$$F_a = \frac{\left[1 - \frac{(53.4)^2}{2(97.7)^2}\right]46}{\frac{5}{3} + \frac{3(53.4)}{8(97.7)} - \frac{(53.4)^3}{8(97.7)^3}} = \frac{39.1}{1.07 + 0.20 + 0.02} = 20.7 \text{ ksi}$$

$$f_a = \frac{65K}{4.27 \text{ in}^2} = 1.4 \text{ ksi} \ll 20.7 \text{ ksi}$$

$$\therefore I = \frac{1.4}{20.7} = 0.07 \text{ OR } 7\% \text{ STRESSED.}$$

FERMILAB ENGINEERING NOTE	SECTION: Kessler	PROJECT: 8-2-158	SERIAL CATEGORY	PAGE: 7/9
SUBJECT: IAB B- LIFT PLATFORM SUPPORT		NAME: R. ALBER		
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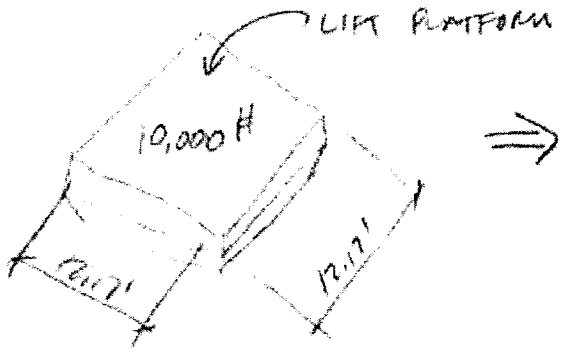
EXISTING LIFT D.L. ⇒ ASSUME 5 TONS (CONSERVATIVE)

DL =



⇒ 68 PSF

LL = 250 PSF EXIST. FLOOR LOADING
TL = 318 PSF, USE 325 PSF W/ BEAM WEIGHTS

3 BEAMS @ 5' SPC'G

$M = \frac{0.325(5)(12.17)^2}{8} = 30$ K-FT

USE W10x49 (IN STOCK)

TRY ~~W10x33~~ $\frac{l}{r_t} = \frac{12.17(12)}{2.14} = 68.2$

$F_b = \left[\frac{2}{3} - \frac{36(68.2)^2}{1530,000}\right]36 \leq 0.6(36)$

$F_b = 20.1$ KSI

$f_b = \frac{30(12)}{35} = 10.3 < 20.1$ ... OK USE ~~W10x33~~ W10x49 $b_f = 8"$

USE W10x49 $\frac{l}{r_t} = \frac{12.17(12)}{2.74} = 53.3$

$F_b = \left[\frac{2}{3} - \frac{36(53.3)^2}{1530000}\right]36 = 21.4$

~~USE ½ W10x33'S FOR CONN'S WT 5x16.5'S~~ USE L4x4x½ (IN STOCK)

$R = \frac{0.325(5)(12.17)}{2} = 10K$

USE 4 = ¾" ϕ HILTI SS HAS. RODS IN HVU ADHESIVE.
ALLOWABLE V = 11.5K / BOLT
REDUCE FOR EDGE DIST. + SPC'G PER DWG. SS-2
EDGE DIST ⊥ TO LOAD ~~7.5"~~ 8.1"
SPC'G ~~5.5"~~ 5"

FERMILAB ENGINEERING NOTE	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	Fess/Eng	8-2-158		8/9

SUBJECT	NAME	
LAB B - LIFT PLATFORM SUPPORT	R. ALBER	
	DATE	REVISION DATE
	6/22/04	

f_{RV} (⊥ to edge) = ~~0.72~~ 0.78 (E.D.)

f_K = ~~0.80~~ 0.78 (SPL'S)

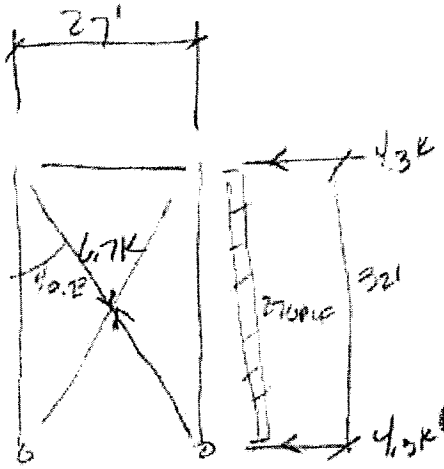
∴ ALLOWABLE = 11.5K (~~0.72~~ 0.78)(~~0.80~~ 0.78) = ~~6.6~~ 7.0 K/BOLT

4 ~~2~~ BOLTS PER CONN. (~~6.6~~ 7.0) = ~~13.2~~ 28 K/CONN > 10K REQ'D

∴ OK. USE 4 ~~2~~ - 3/4" HRS RODS

FERMILAB ENGINEERING NOTE	SECTION	PROJECT	SERIAL-CATEGORY	PAGE
	FESS/ENG	8-2-158		9/9

SUBJECT	NAME	
LAB B - BRACING ADDITION	R. ALBER	
	DATE 4/22/04	REVISION DATE



$W_L = 20$ PSF

CONT. AREA $= 27/2 = 13.5'$

$W_{WL} = 13.5(20) = 270$ PLF

$T = 6.7K$ (TENSION ONLY)

$L = \sqrt{32^2 + 27^2} = 41.8'$

CONNECT BRACE @ INTERSECTION

$L = 41.8/2 = 20.9'$

LIMIT $\frac{L}{r} < 200$ PER AISC

$r_{MIN} = \frac{20.9(12)}{200} = 0.836$

TRY L3x3x1/4 (SAME AS EXIST. BRACE) $r = 0.93'' > 0.836$ ∴ OK

$A = 1.44$ IN²

$\frac{P}{A} = \frac{6.7K}{1.44} = 4.7$ KSI $\ll 0.4(36) = 21.6$

∴ OK - USE L3x3x1/4's ATTACHED AT MIDPOINT