2

Structural Calculations

For:

Oregon Trail Building Fire Escape

333 SW 5th Ave

Portland, OR 97204

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER 12219 OREGON JULY 15, 1983 WADE W. YOUNIE

EXPIRES: 06-30-20 14

12-198481-FA

Prepared For:

Hennebery Eddy Architecture

921 SW Washigton, Suite 250

Portland, oR 97205

8-Oct-12

Job Number: 12031-0071

400 SW 6th Avenue, Suite 605 Portland, OR 97204 Phone: (503) 242.2448 Fax: (503) 242.2449

Seattle Spokane Portland San Diego Austin

Design Criteria:

Codes		2010 OSSC	
		ASCE 7-05	
		Fire Marshall Office (FMO) Policy CE B-8 (See Attached)	
Gravity Loads			
	Landings		
		Dead Load =	10 psf
		Live Load =	100 psf
		Concentrated LL =	300 lbs
		Railings	50 plf
		Concentrated Railing =	200 lbs
	Firemans Ladder		
		Horiz Force =	200 lbs
		Horiz Line Load =	50 plf
		Rung =	500 lbs
		Vert Load =	133 plf
Material Properties			
		(E) Concrete Strength =	3000 psi
		(E) Steel Yield Strength =	36 ksi

Table of Contents:

Narrative:

There are two fire escapes on the Oregon Trail Building (OTB). They are original to the building with various modifications over the years. There are five landings each with the bottom landing (2nd Floor) hung from the 3rd floor landing by (4) 3/4" diameter rods. This appears to have been a modification to the original structure. There is significant rust thoughout the stucture. The rusted sections will be reviewed by DCI Engineers once the entire structure has been remediatated. At that point, specific locations requireing repair will be done. Then the various tests required by the FMO will be performed with special inspection, and observation of DCI Engineers. A final report will be provided by DCI engineers to go along with the special inpsections report outlining the pull, shear, and pushover tests and whether the structure is adequate to carry the loads as prescribed by the FMO's policy.

15-108481-EV

Project No.	Sheet No.
12031-0071	1
	Date 8/27/12
	By RWF

DCI ENGINEERS

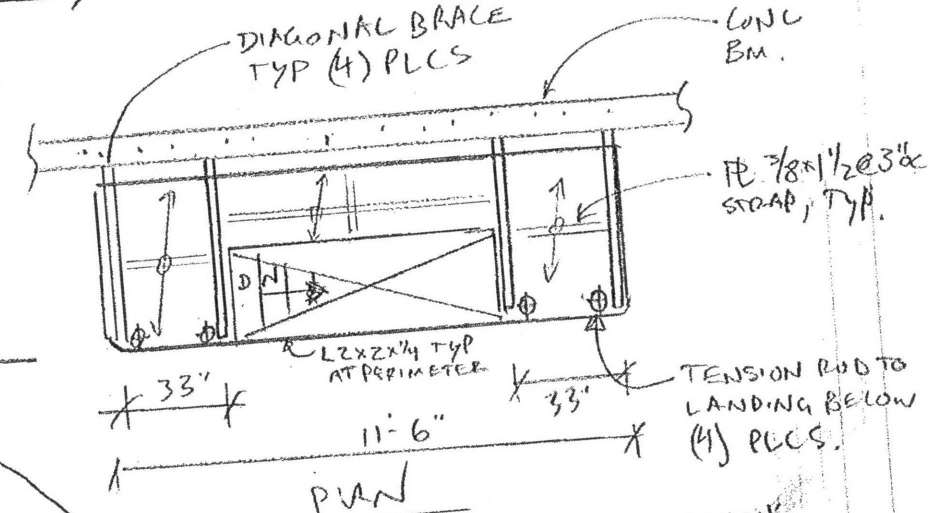
Project: OREGON TRAIL BLDG FIRE ESCAPES

Subject: FIRE ESCAPE ANALYSIS (BOTTOM TWO LANDINGS)

PROJECT INFO

DL = 10 PSF

LL = 100 PSF



WORST CASE DIAG BRACE AT INTERIOR

BRACE 1 1/4" □

$I_x = 0.20345\ in^4$

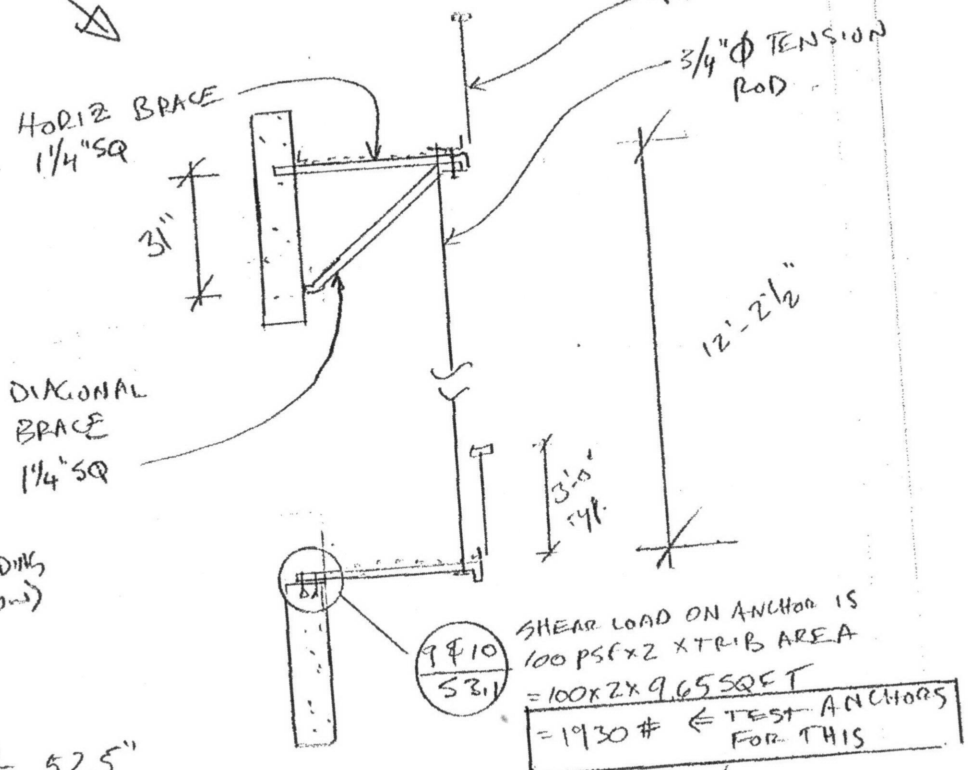
$S_x = 0.3255\ in^3$

$A = 1.56\ in^2$

$E = 29 \times 10^6$

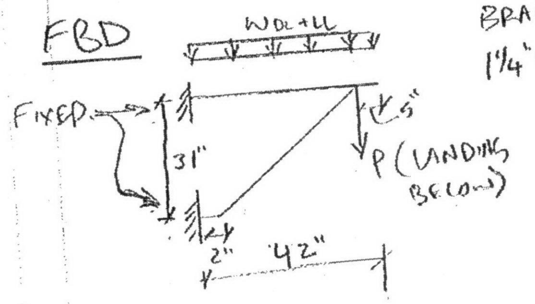
$F_y = 36^{ksi}$ (ASSUMED)

$r = 0.361$



SHEAR LOAD ON ANCHOR IS 100 PSF x 2 x TRIB AREA = 100x2x9.65 SQFT = 1930# ← TEST ANCHORS FOR THIS

FBD



$TRIB = \frac{33''}{2} + \frac{11'\text{-}6'' - 2(33'')}{2} = 52.5''$

LRFD

1.2DL + 1.6LL ← APPLIED IN RISA 2D MODEL

$w = (10\,PSF_{DL} + 100_{LL})\frac{52.5}{12} = 43.8\,plf_{DL} + 438\,plf_{LL}$ } APPLIED LOADS

$P = w(42''/2) = 76.7\#_{DL} + 767\#_{LL}$

SEE RISA 2D ANALYSIS pgs: 8-11

DCI ENGINEERS

Project	Project No.	Sheet No.
OREGON TRAIL BUILDING FIRE ESCAPES	12031-0071	2
Subject	**Date**	**By**
FIRE ESCAPE ANALYSIS	8/27/12	RMF

ANALYSIS CONT'D

FROM RISA 2D

CHECK MOMENTS

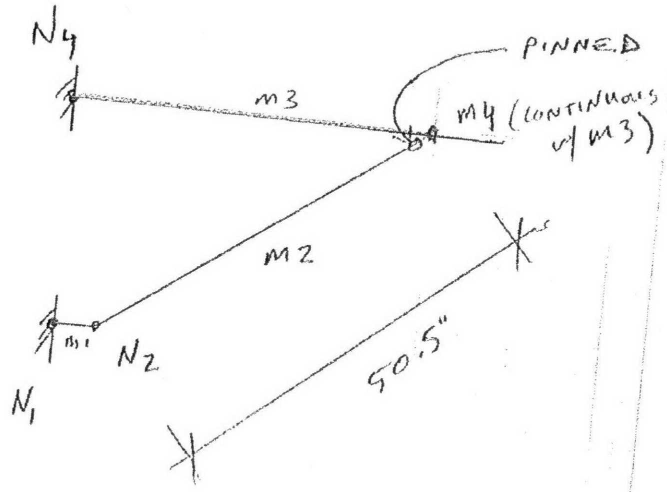
M_3 M_{MAX} IN $M_3 = 0.873^{K-FT}$

$= 10.476^{K-IN}$

$S_{X\,REQ'D} = \frac{M}{(0.9)(F_b)} = 0.323\,in^3$

$S_{X\,1.25Ø} = 0.3255\,in^3 > 0.323\,in^3$

OK



SEE 1/S3.1 & 5/S3.1 FOR 2X UNFACTORED LOADS FOR TENSION/SHEAR TESTS

M_{MAX} $M_1 = 0.396\,K\text{-}FT$

$= 4.75\,KIN$

$S_{X\,REQ'D} = \frac{M}{0.9 F_b} = 0.147\,in^3 > 0.3255\,in^3$ OK

OK

NO REINF NECESSARY

WORST CASE IS 3RD FLOOR LANDING. ALSO ANALYZED IN RISA 2D ARE THE 4TH, 5TH & 6TH FLOOR TYPICAL LANDINGS TO FIND SHEARS & TENSIONS FOR PULL TESTS

FOR TYPICAL LANDING 4TH, 5TH, 6TH SEE PG: 12
FOR 3RD FLOOR LANDING SEE PG: 13

CHECK Kl/r FOR M_2

$K = 1.0$ $l = 50.5"$ $r = 0.361$

$\frac{Kl}{r} = \frac{(50.5)(1.0)}{0.361} = 140 \geq 133.7 = 4.71\sqrt{\frac{E}{F_y}}$

USE: $F_{cr} = 0.877 F_e$ $F_e = \frac{\pi E}{\left(\frac{Kl}{r}\right)^2} = 4.64\,ksi$

$0.877(4.64\,ksi)$

$F_{cr} = 4.066$

$P_n = F_{cr} A_g = (4.066)(1.56\,in^2) = 6.34\,KIPS > 3.77\,KIPS$ APPLIED

OK NO REINF NEEDED.

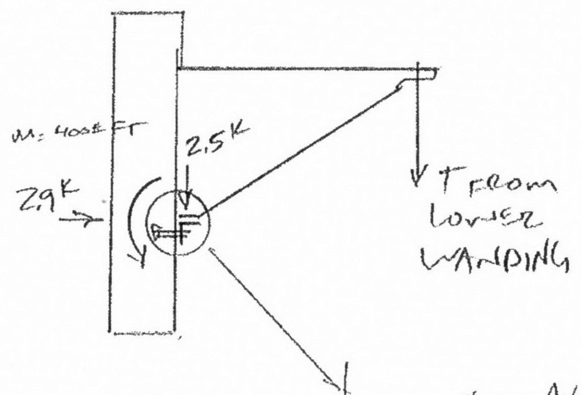
DCI ENGINEERS	Project No. 12031-0071	Sheet No. 3
Project OTB		Date 10/8/12
Subject 3RD FLOOR BOTTOM BRACE		By RMF

CHECK BOTTOM OF DIAGONAL BRACE

AT 3RD FLOOR LANDING BOTTOM BRACE BEARS ON BRICK VENEER.

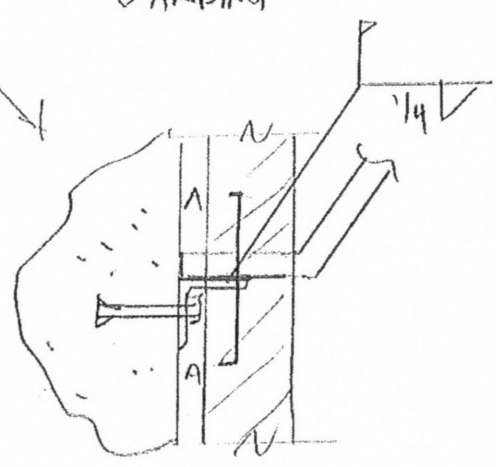
SOLUTION: PROVIDE ALTERNATE BEARING CONNECTION

USE RISA 2D MODEL
W/ LRFD
1.2DL + 1.6LL

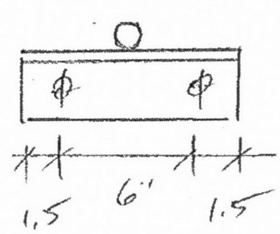


SEE PG: 14 FOR LOAD RESULTS

USE: (2) 5/8" ϕ x 4" EMBED KBTZ



SECTION



ELEV A-A

SEE HILTI DESIGN SOFTWARE pgs: 15-2

DCI ENGINEERS	Project No. 12031-0071	Sheet No. 4
Project: OREGON TRAIL BLDG FIRE ESCAPES		Date: 8/27/17
Subject: FIRE ESCAPE ANALYSIS		By: RMF

ANALYSIS CONT'D

CHECK TENSION RODS ON LOWER LANDING

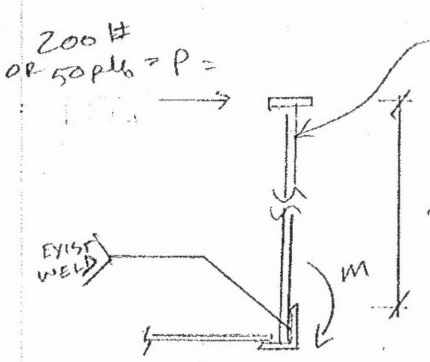
$3/4" \phi \Rightarrow A = 0.44 in^2$

$F_y = 36$ ksi

CAPACITY = $\phi F_y A_g = 0.9(36)(0.44) = 14$ KIPS

(LRFD) DESIGN LOAD = 1.32 KIPS ≤ 14 KIPS OK

CHECK RAIL POSTS



VERT STANCHION @ 40" O.C. L 1x1x1/4 ← SEVERELY DETERIORATED DUE TO RUST. TEST EA LEVEL W/ 400# LOAD

$P = (1.6 \times 200) =$

$M = 320 \times 34" = 10.88$ K·in

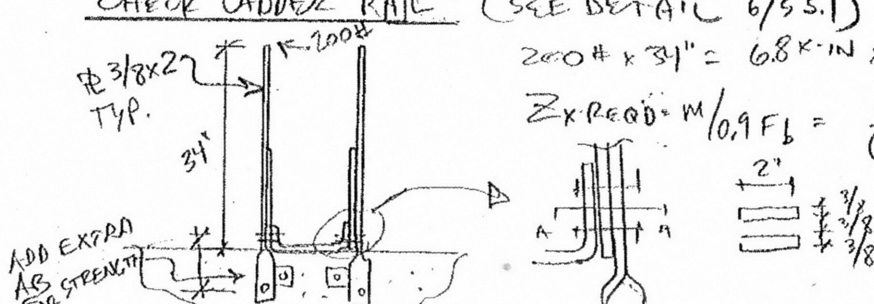
$S_{x\,REQ'D} = \dfrac{10.88}{(0.9)(36)} = 0.3358 in^3$

$S_{x_L} = 0.156 in^3 \not> 0.3358 in^3$

NG

GUARD RAIL HAS CONTINUOUS TOP PL AT PERIMETER & IS EITHER KICKED W/ DIAGONAL BRACE AT ENDS OR IS BOLTED TO CONC WALL. TEST HANDRAIL TO 2X UNFACTORED LOADS PER FMO POLICY 200×2 = 400#

CHECK LADDER RAIL AT TOP OF FIREMANS LADDER (SEE DETAIL 6/S3.1) (LRFD)



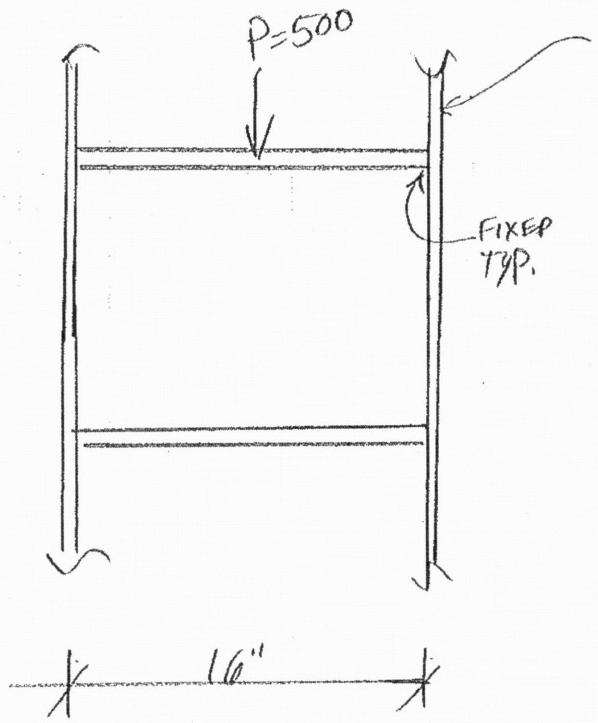
$200\# \times 34" = 6.8$ K·IN $\times 1.6 = 10.88$ K·IN

$Z_{x\,REQD} = M / 0.9 F_b = \dfrac{10.88 K\cdot IN}{(0.9)(36 ksi)} = 0.335 in^3 = Z_{REQ'D}$

$Z_x = 0.56 in^3 > 0.335 in^3$ OK

ANALYSIS CONT'D

CHECK FIREMAN LADDER RUNGS



(LRFD) LL

500# x 1.6 = 800#

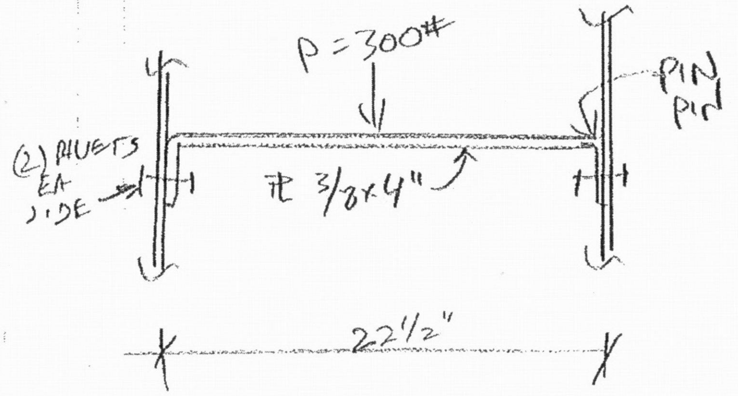
$M = \frac{Pl}{8} = \frac{800(16")}{8} = 1600$ #-IN

$Z_{X REQ'D} = \frac{M}{0.9F_b} = \frac{1600}{(0.9)(36^{KSI})} = 0.0494 in^3$

$Z_{3/4"\phi} = \frac{d^3}{6} = 0.0703 in^3 > 0.0494 in^3$

OK

CHECK STAIR TREAD



300# x 1.6 = 480

$M = \frac{Pl}{4} = 2700$ # IN

$Z_{X REQ'D} = \frac{M}{0.9F_b} = \frac{2.7^{KIN}}{0.9(36^{KSI})}$

$Z_{X REQ'D} = 0.0833 in^3$

$Z_{X PL} = \frac{bd^2}{4} = \frac{(4)(3/8)^2}{4} = 0.14 in^3$

$Z_{PL} = 0.14 in^3 > 0.0833 in^3 = Z_{X REQ'D}$

OK

EDCI ENGINEERS	Project No. 1203-0071	Sheet No. 6
Project: OTB FIRE ESCAPES		Date 10/8/12
Subject: ANALYSIS - FIREFIGHTERS LADDER		By RMF

CHECK VERT LOAD ON LADDER

VERT LOAD = 100#/FT /FT WIDE

16" = 16/12 = 1.33

$12' \times 100 \times \frac{16}{12} = 1600\#/(2)$ SIDES

$= 800\#$

LRFD

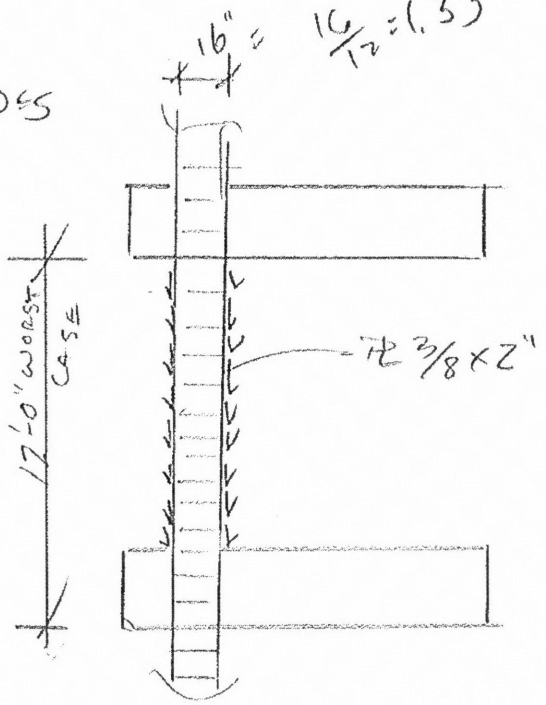
$1.6 \times 800 = 1280\# = P_{REQ'D}$

CAPACITY OF VERT LADDER =

$2" \times 3/8 \times 3600\ (0.9)$ φ

$P_{PL} = 24.3^k > 1.28^k = P_{REQ'D}$

OK



CHECK LADDER FOR HORIZ LOAD

FOR . 9' CONTINUOUS SPAN

USE: 3 SPAN

0.08 0.025 0.08 ← M DIAGRAM

-0.10 (-0.10) ← WORST CASE

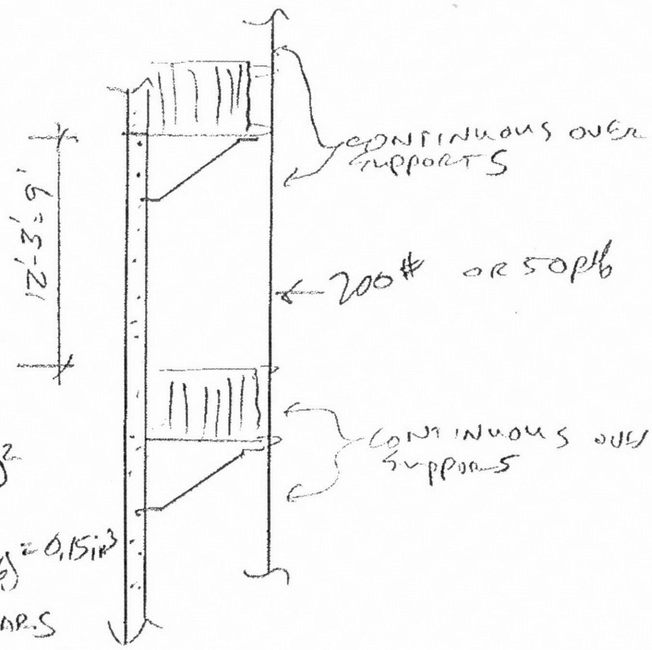
WORST CASE: $0.1 w l^2 = 0.8 (50/12)(9 \times 12)^2$
W/ 50 plb.

$M = 4.86^{k\text{-}in}$

$S_{X REQ'D} = \frac{M}{0.9 F_b} = \frac{4.86}{0.9(36)} = 0.15 in^3$

$S_X \text{ BAR} = \frac{bh^2}{6} = \frac{3/8\ (2")^2}{6} = 0.25 in^3 \times 2$ BARS

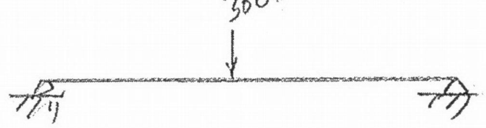
$= 0.5 in^3 > 0.15 in^3$ OK



DCI ENGINEERS	Project No. 12031-0071	Sheet No. 7
Project OTB FIRE ESCAPE		Date
Subject SLATS		By RME

CHECK SLATS.

ANALYSIS OF SLATS IS AN ITERATIVE PROCESS TO FIND THE INCREASED STIFFNESS OF THE SLAT AS IT GOES INTO TENSION WHILE FAILING IN BENDING



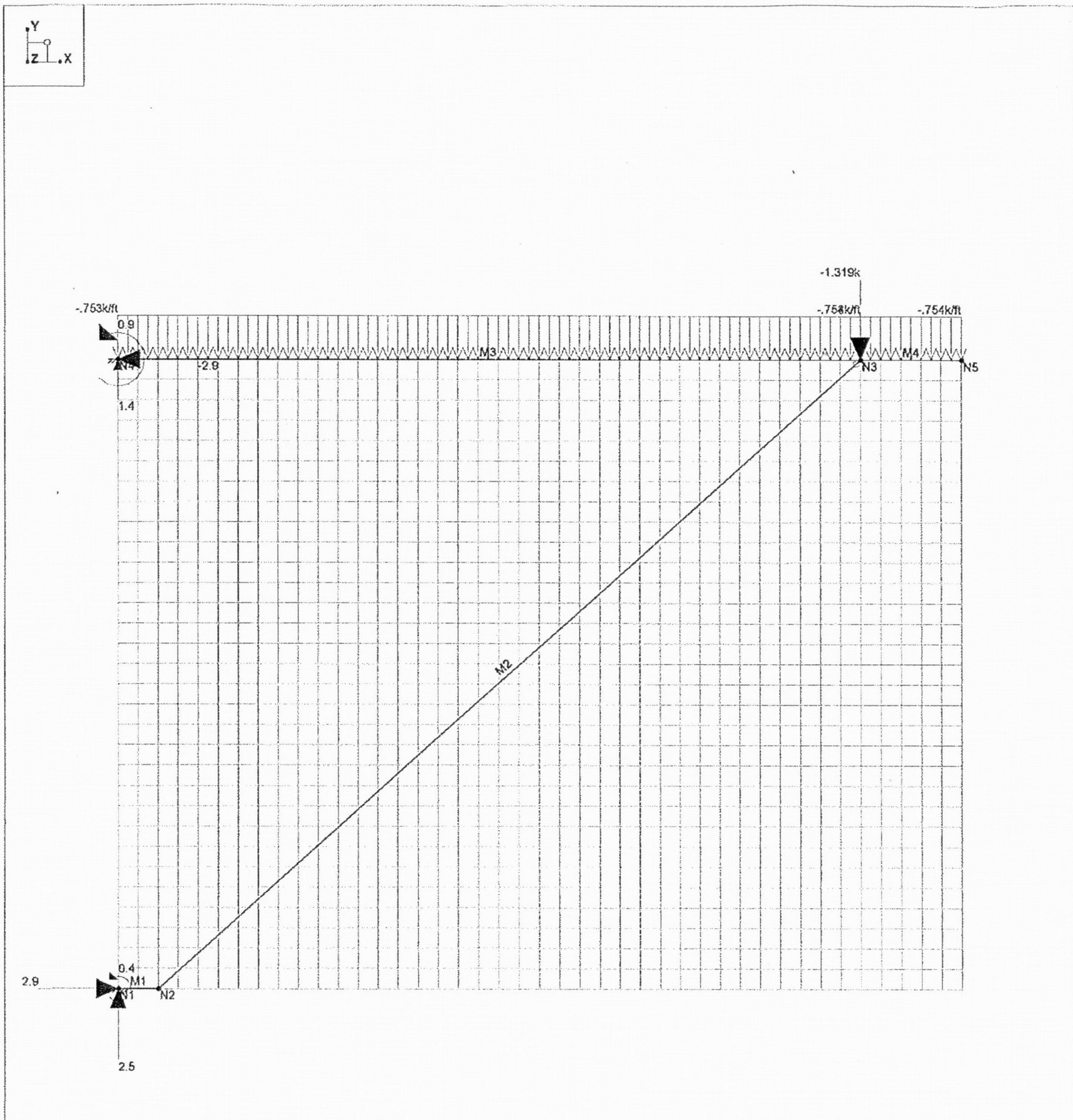
AS TENSION GOES UP DUE TO POINT LOAD AXIAL TENSION INCREASES, THUS STIFFENING THE MEMBER AS IT DEFLECTS THIS ITERATIVE PROCESS RELIES ON TOO MANY VARIABLES TO CALCULATE AT THIS TIME.

UNFACTORED LL ↓ ↓ REQ'D MULTIPLIER

PROVIDE 300 X 2

= 600# POINT LOAD ON (3) SLATS DURING TESTING OF FIRE ESCAPE. SEE 5/S3.1 FOR TEST. LOAD IN DOCUMENTS

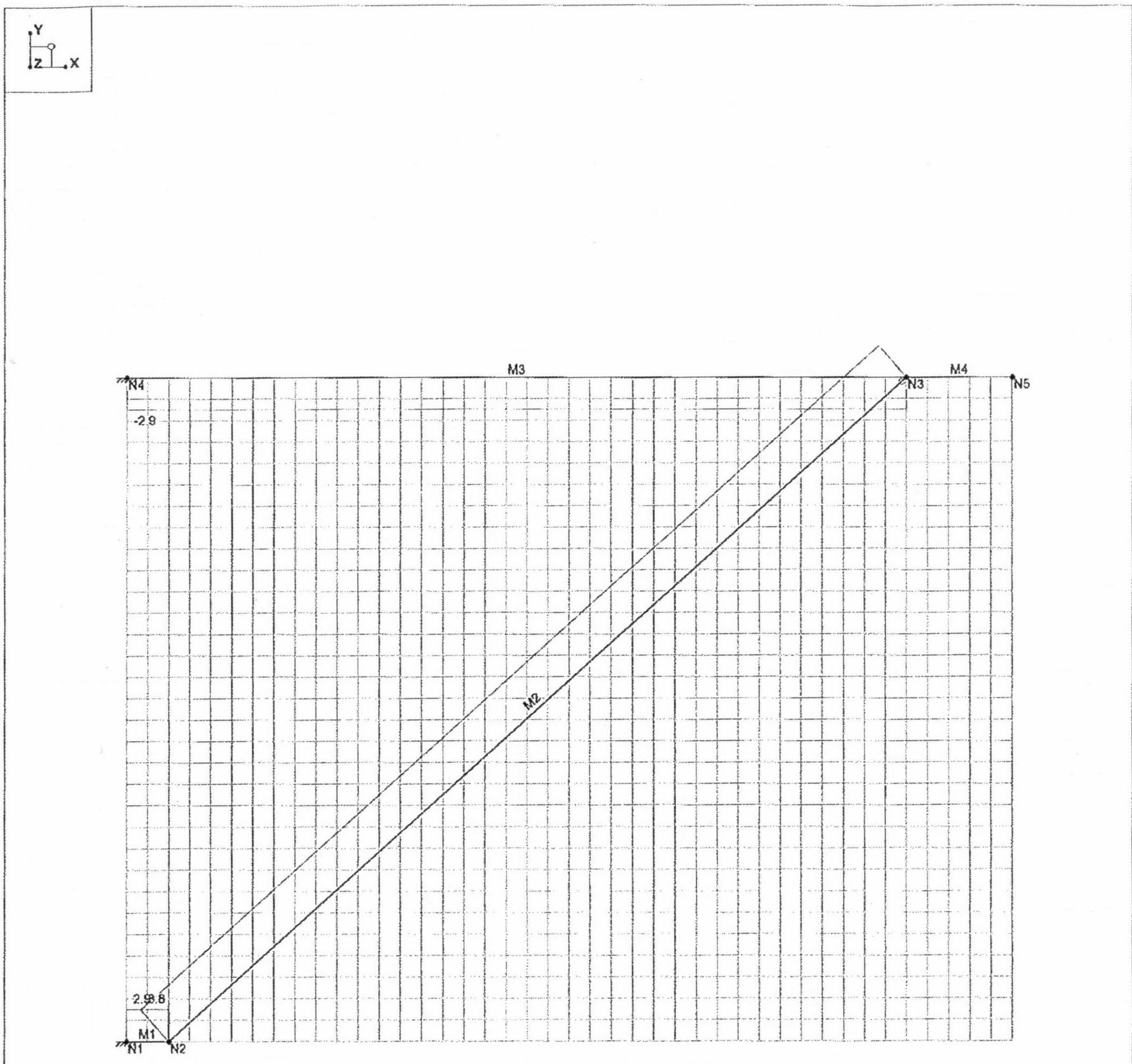
8



Loads: LC 1, LRFD 1.2DL + 1.6LL
Results for LC 1, LRFD 1.2DL + 1.6LL
Reaction units are k and k-ft

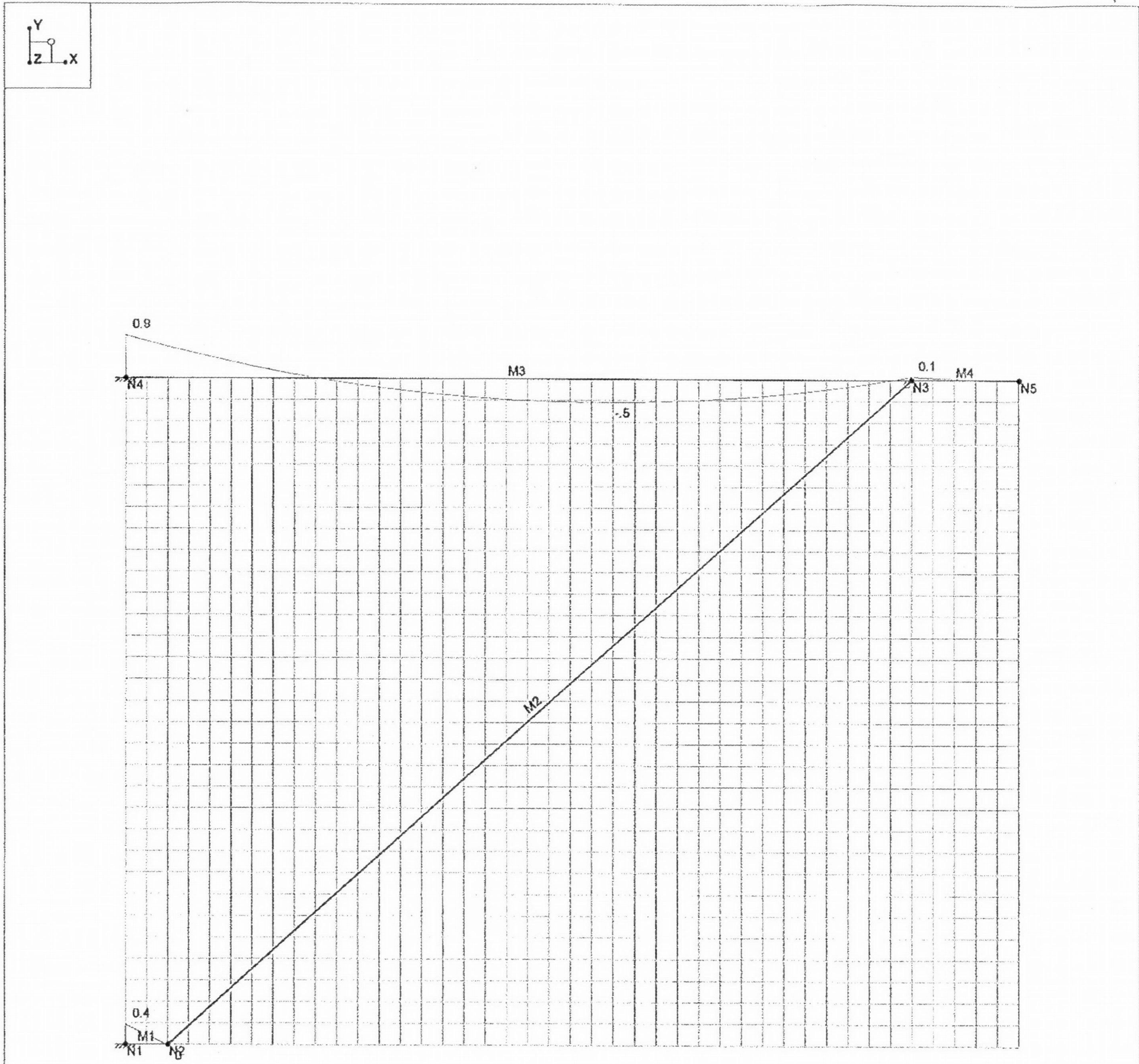
DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Aug 27, 2012 at 1:50 PM
12031-0071		untitled.r2d

9



Results for LC 1, LRFD 1.2DL + 1.6LL
Member Axial Forces (k)

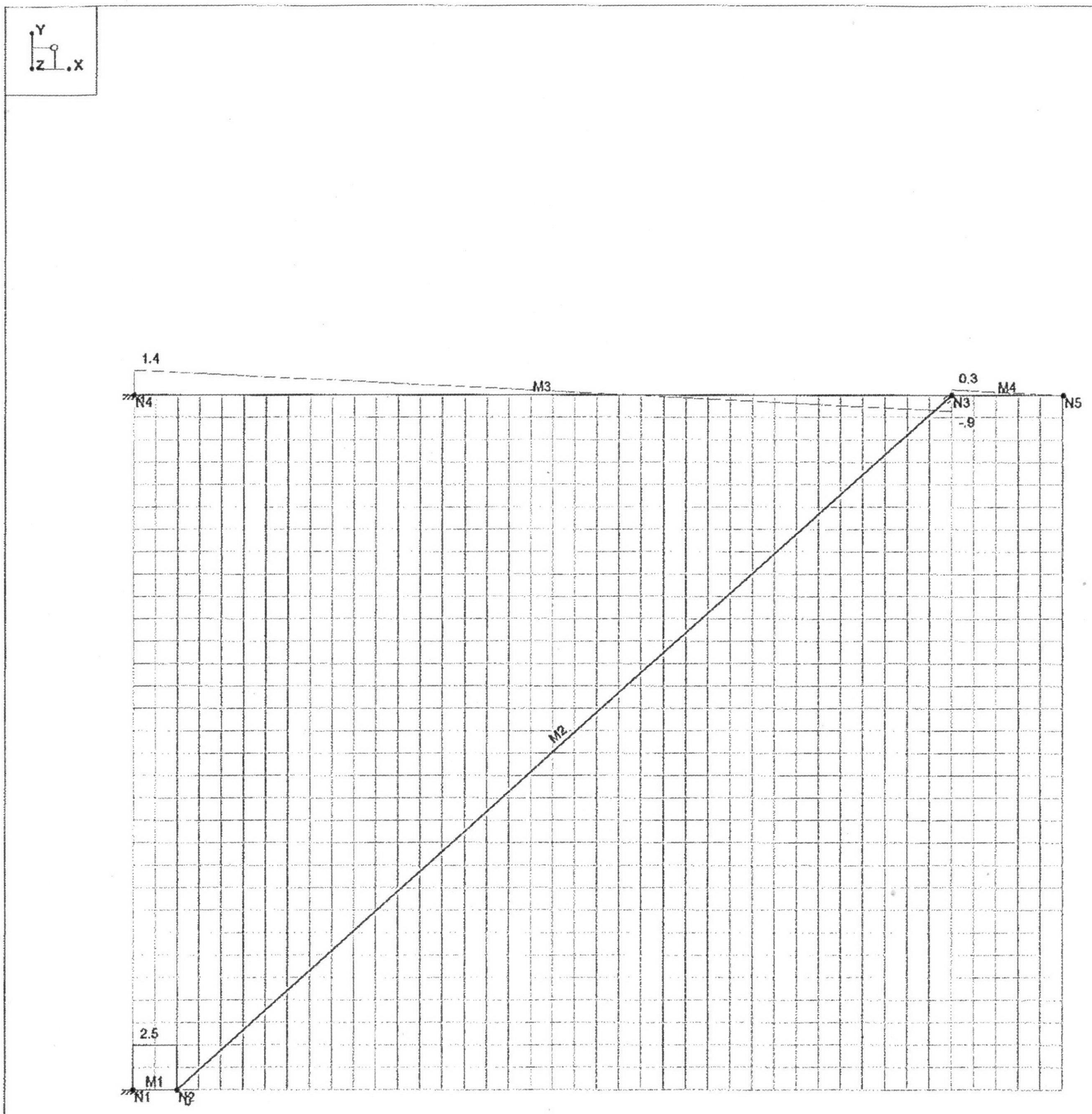
DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Aug 27, 2012 at 1:49 PM
12031-0071		untitled.r2d



Results for LC 1, LRFD 1.2DL + 1.6LL
Member Bending Moments (k-ft)

DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Aug 27, 2012 at 1:50 PM
12031-0071		untitled.r2d

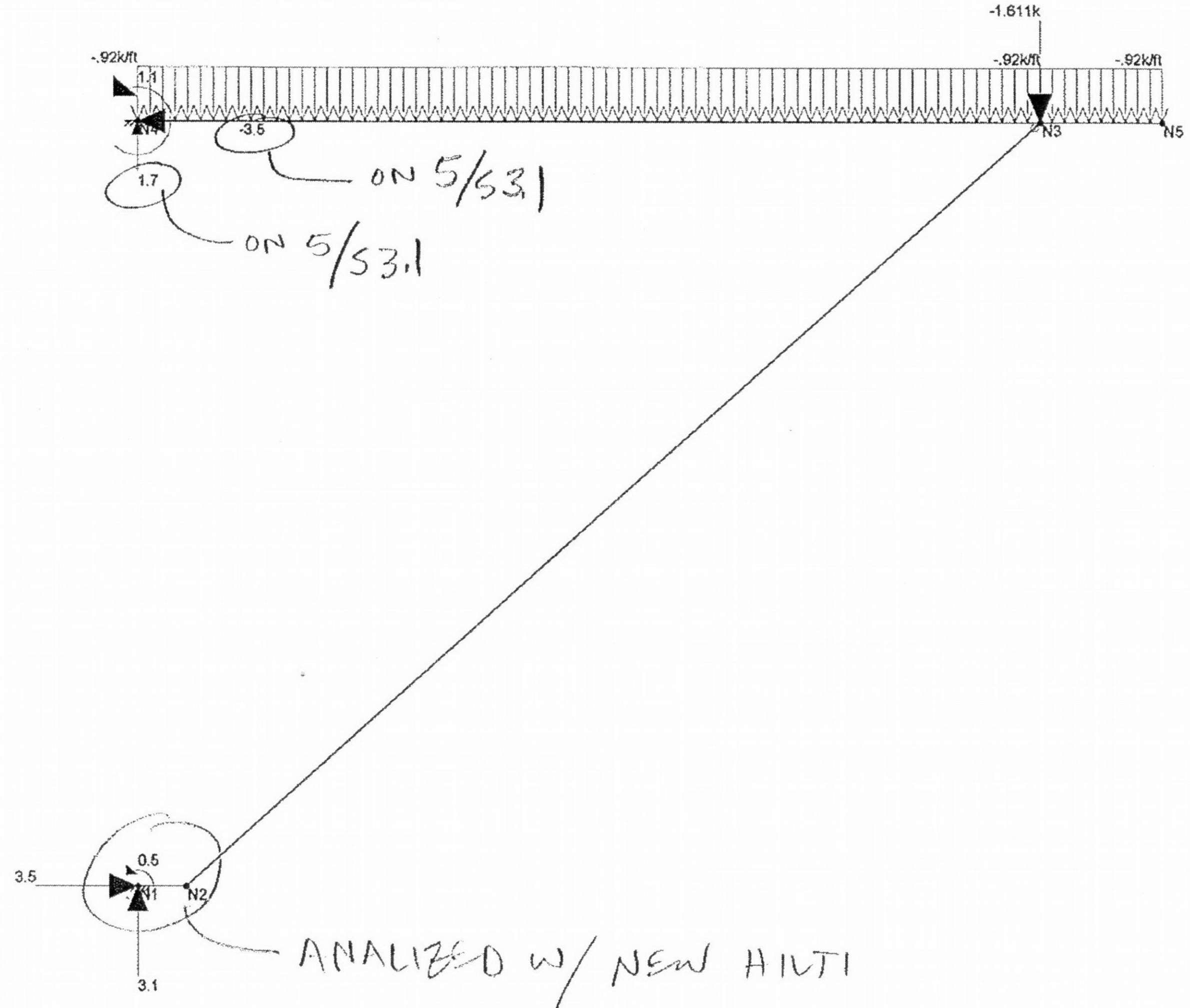
11



Results for LC 1, LRFD 1.2DL + 1.6LL
Member Shear Forces (k)

DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Aug 27, 2012 at 1:49 PM
12031-0071		untitled.r2d

3RD FLOOR LANDING
W/ 2 TIMES UNFACTORED LOADS.

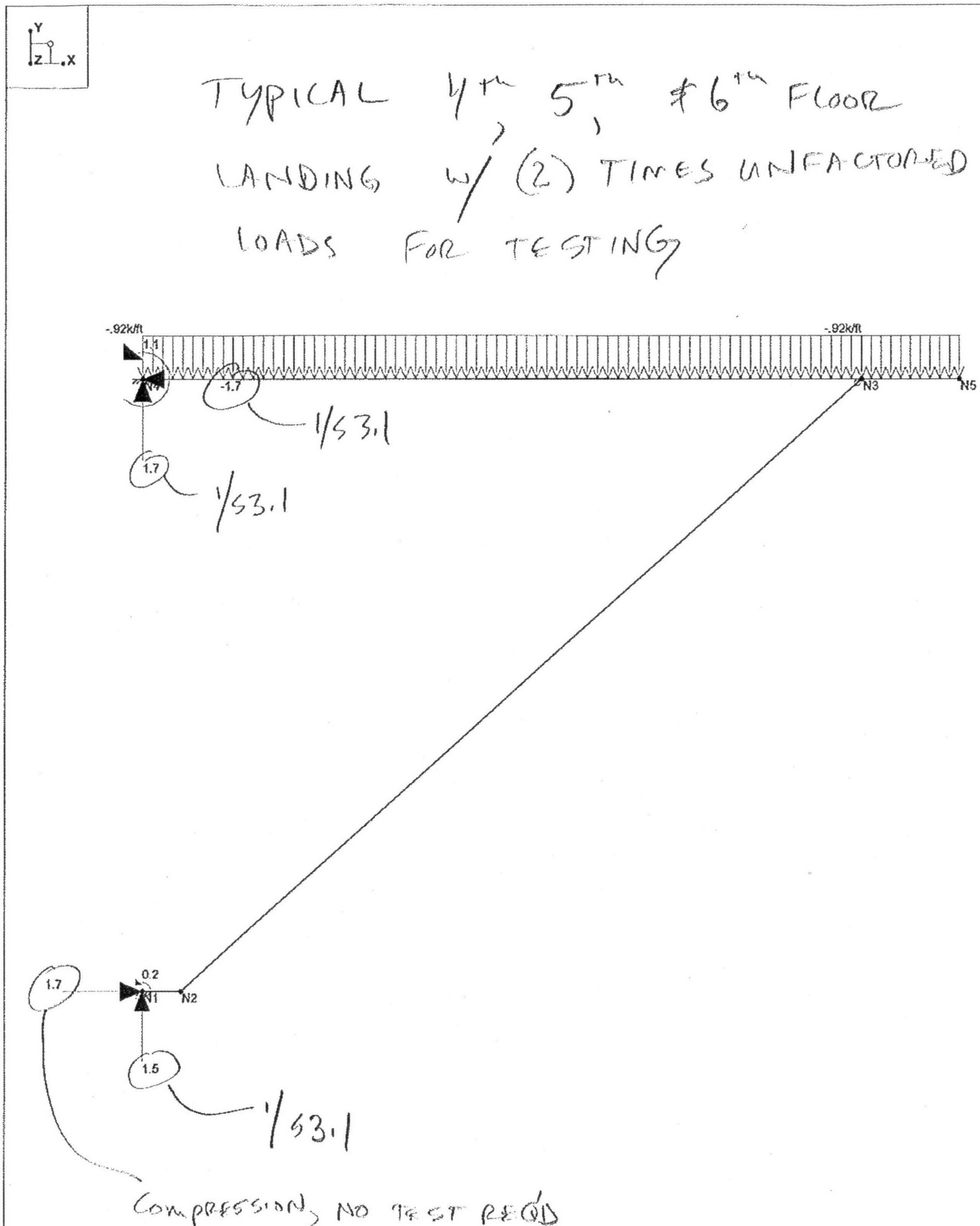


ANALIZED W/ NEW HILTI
CONNECTION DESIGN TESTING
NOT REQ'D

Loads: LC 4, 2 times Unfactored Loads for Testing 3rd Floor Landing
Results for LC 4, 2 times Unfactored Loads for Testing 3rd Floor Landing
Reaction units are k and k-ft

DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Oct 8, 2012 at 9:06 PM
12031-0071		12031-0071 Oregon Trail Bldg Fire...

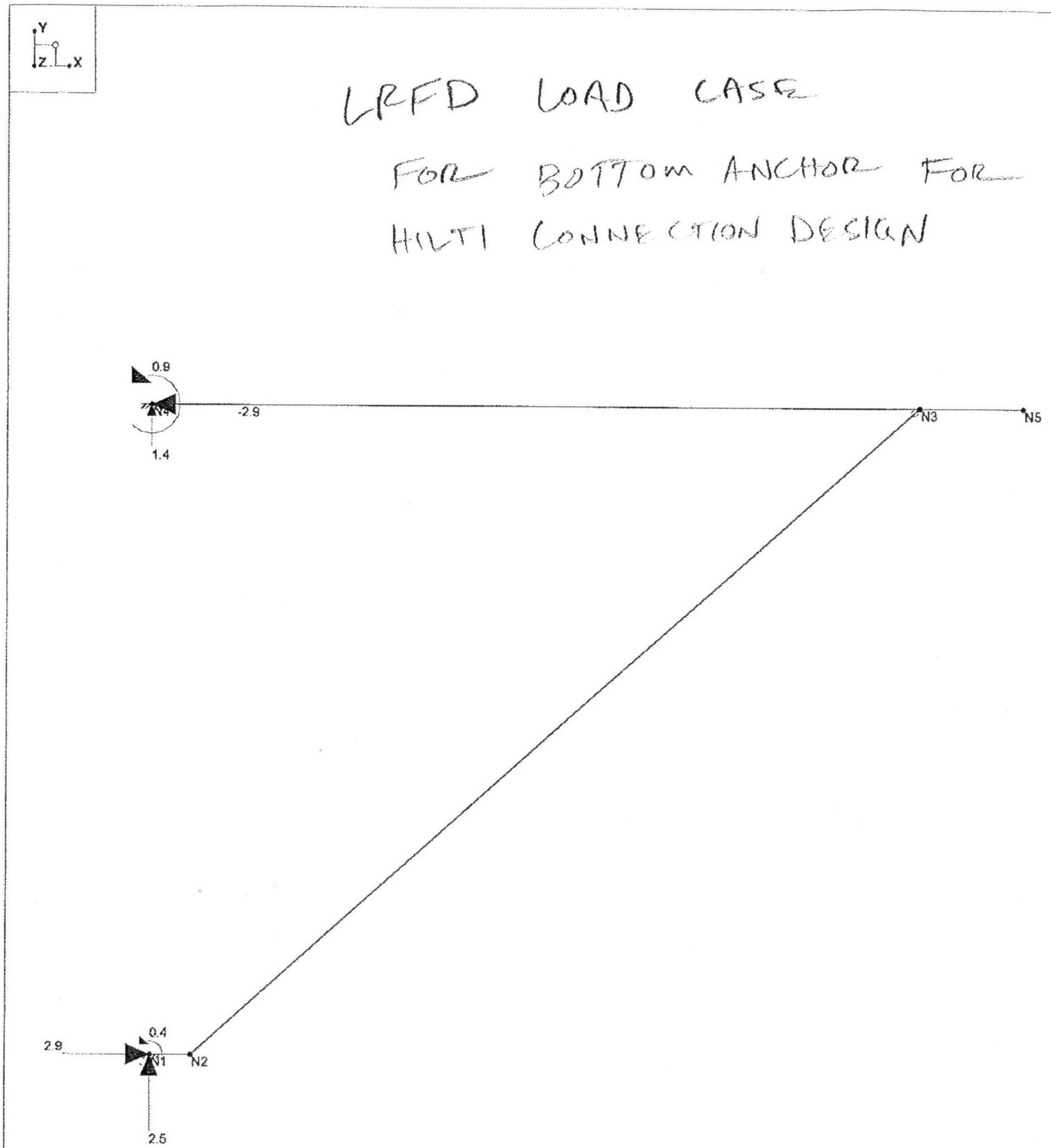
TYPICAL 4th, 5th, & 6th FLOOR LANDING w/ (2) TIMES UNFACTORED LOADS FOR TESTING



Loads: LC 5, 2 times Unfactored Loads for Testing Typ Landing
Results for LC 5, 2 times Unfactored Loads for Testing Typ Landing
Reaction units are k and k-ft

DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Oct 8, 2012 at 9:07 PM
12031-0071		12031-0071 Oregon Trail Bldg Fire...

LRFD LOAD CASE
FOR BOTTOM ANCHOR FOR
HILTI CONNECTION DESIGN



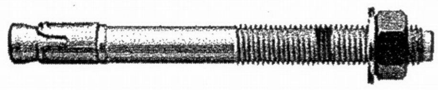
Results for LC 1, LRFD 1.2DL + 1.6LL
Reaction units are k and k-ft

DCI Engineers	Oregon Trail Bldg Fire Escape Brace	
Rollston Frangopoulos		Oct 4, 2012 at 6:22 PM
12031-0071		12031-0071 Oregon Trail Bldg Fire...

Company:		Page:	1
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

Specifier's comments: 3rd Flr Anchor at Diag Brace

1 Input data



Anchor type and diameter: **Kwik Bolt TZ - CS 5/8 (4)**

Effective embedment depth: h_{ef} = 4.000 in., h_{nom} = 4.438 in.

Material: Carbon Steel

Evaluation Service Report:: ESR 1917

Issued I Valid: 4/1/2012 | 5/1/2013

Proof: design method ACI 318 / AC193

Stand-off installation: e_b = 0.000 in. (no stand-off); t = 0.500 in.

Anchor plate: l_x x l_y x t = 3.000 in. x 9.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)

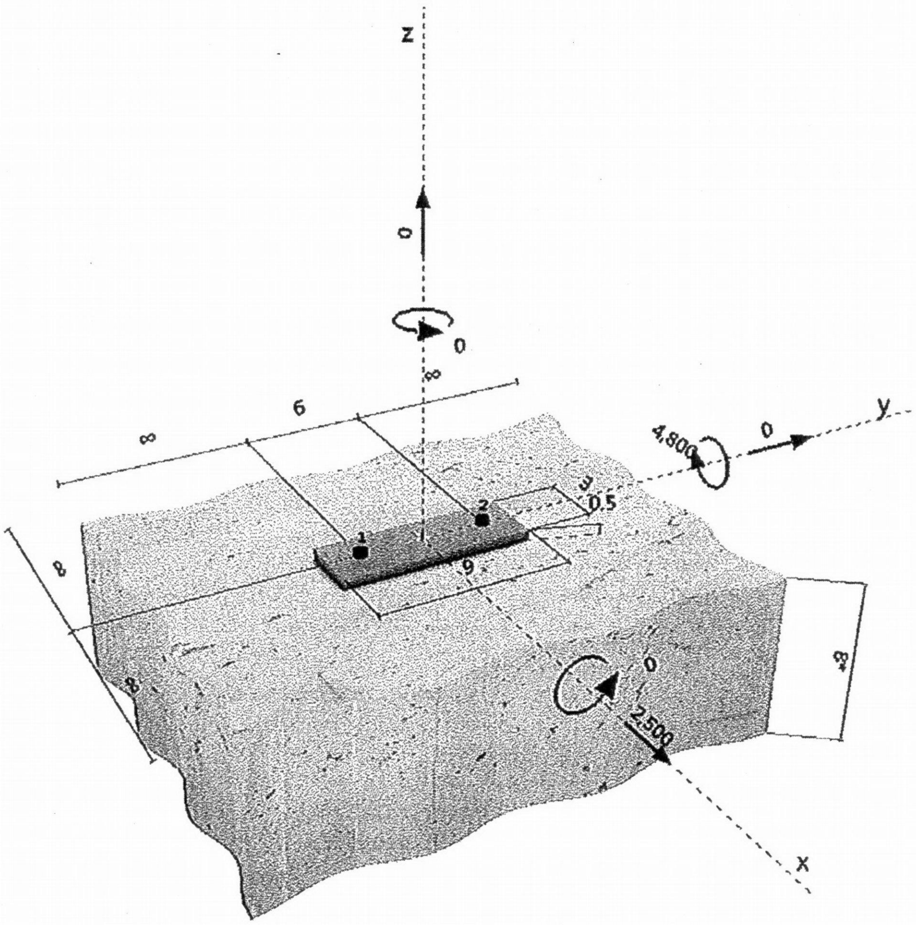
Profile: Round bars (AISC); (L x W x T) = 0.063 in. x 0.063 in. x 0.000 in.

Base material: cracked concrete, 2500, f_c' = 2500 psi; h = 8.000 in.

Reinforcement: tension: condition B, shear: condition B; no supplemental splitting reinforcement present
edge reinforcement: none or < No. 4 bar

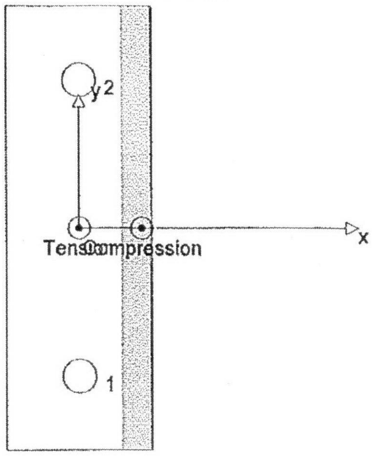
Seismic loads (cat. C, D, E, or F) no

Geometry [in.] & Loading [lb, in.lb]



Company:		Page:	2
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

2 Load case/Resulting anchor forces



Load case: Design loads

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1866	1250	1250	0
2	1866	1250	1250	0

max. concrete compressive strain: 0.30 [‰]
max. concrete compressive stress: 1292 [psi]
resulting tension force in (x/y)=(0.000/0.000): 3732 [lb]
resulting compression force in (x/y)=(1.286/0.000): 3732 [lb]

3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1866	12877	15	OK
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	3732	6630	57	OK

* anchor having the highest loading **anchor group (anchors in tension)

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR 1917
$\phi N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.16	106000

Calculations

N_{sa} [lb]
17170

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
17170	0.750	12877	1866

Company:		Page:	3
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

3.2 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b$ — ACI 318-08 Eq. (D-5)

$\phi\, N_{cbg} \geq N_{ua}$ — ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ — ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ — ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
4.000	0.000	0.000	∞	1.000

c_{ac} [in.]	k_c	λ	f_c' [psi]
6.750	17	1	2500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
216.00	144.00	1.000	1.000	1.000	1.000	6800

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
10200	0.650	6630	3732

Company:		Page:	4
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	1250	5259	24	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2500	14280	18	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading   **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value   refer to ICC-ES ESR 1917

$\phi V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.16	106000

Calculations

V_{sa} [lb]
8091

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
8091	0.650	5259	1250

4.2 Pryout Strength

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b\right]$ ACI 318-08 Eq. (D-31)

$\phi V_{cpg} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda \sqrt{f'_c}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	4.000	0.000	0.000	∞

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ	f'_c [psi]
1.000	6.750	17	1	2500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
216.00	144.00	1.000	1.000	1.000	1.000	6800

Results

V_{cpg} [lb]	$\phi_{concrete}$	ϕV_{cpg} [lb]	V_{ua} [lb]
20400	0.700	14280	2500

Company:		Page:	5
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.563	0.238	5/3	48	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

6 Warnings

- To avoid failure of the anchor plate the required thickness can be calculated in PROFIS Anchor. Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading!
- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to ACI 318, Part D.4.4(c).
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI318 or the relevant standard!

Fastening meets the design criteria!

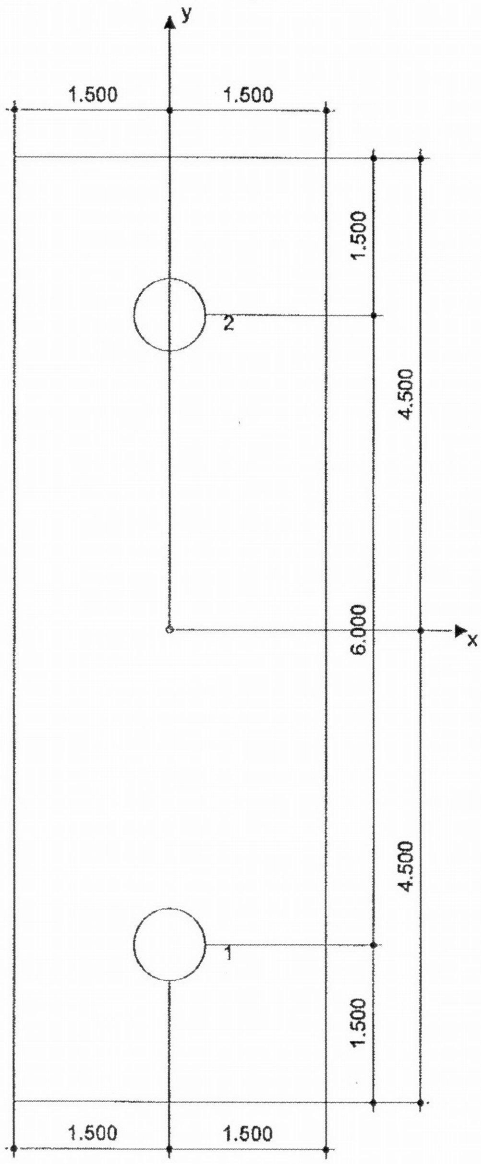
Company:		Page:	6
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: Round bars (AISC); 0.063 x 0.063 x 0.000 in.
Hole diameter in the fixture: d_f = 0.688 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated

Anchor type and diameter: Kwik Bolt TZ - CS, 5/8 (4)
Installation torque: 720.001 in.lb
Hole diameter in the base material: 0.625 in.
Hole depth in the base material: 4.438 in.
Minimum thickness of the base material: 8.000 in.

Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	-3.000	-	-	-	-
2	0.000	3.000	-	-	-	-

Company:		Page:	7
Specifier:		Project:	OTB Fire Escape
Address:		Sub-Project I Pos. No.:	12031-0071
Phone I Fax:	|	Date:	10/8/2012
E-Mail:			

8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

DRAFT

Attachment # 1
FMO Policy CE B-8
Fire Escape Issues
February 12, 2008

Fire Escape Performance Criteria

Fire escapes shall comply with the following standards:

1. Fire escape stairways and their landings shall support their dead load plus a live load of not less than 100 pounds per square foot or concentrated load of 300 pounds placed anywhere on the landing, balcony or stairway so as to produce the maximum stress.
2. All stairway and balcony railings shall support a horizontally applied force of not less than 50 pounds per lineal foot of railing applied at top of railing, or a concentrated load of 200 pounds placed anywhere on the railing so as to produce the maximum stress.
3. Firefighter's ladders shall be designed and connected to the building to withstand a minimum horizontal force of 200 pounds concentrated load or 50 pounds per lineal foot horizontal load so as to produce the maximum stress. Each rung shall support a concentrated load of 500 pounds placed anywhere on the rung so as to produce the maximum stress. Ladder assemblies shall have a minimum vertical load capacity of 100 pounds per lineal foot for each foot of width. New firefighter's ladders shall have a minimum width of 16 inches measured from inside rail to inside rail.
4. All loads noted above are unfactored loads.

DRAFT

Attachment # 2
FMO Policy CE B-8
Fire Escape Issues
February 12, 2008

Fire Escape Evaluation Using In-Situ Testing

Before a test is conducted the structural members and connections of the fire escape should be visually inspected. The entire fire escape shall be checked for rust damage and unauthorized modifications. Handrails must be physically checked for integrity. All welds, rivets, bolts, grates, hangers, framework, etc. must be inspected. Faulty welds, loose bolts, grates, rivets, and framework should be tightened, repaired, or replaced as necessary. The ladder must by evaluated for unauthorized modification. All safety chains shall be in good repair. Operate the counterbalanced stair or ladder release mechanism and make sure it operates easily. The stair or ladder must travel to the ground without hesitation. It must be stable and firm in its position after reaching the ground or sidewalk. This procedure must be conducted twice. Return the ladder to its normal position.

If visual inspection determines that structural repairs are required, that work must be completed before commencement of testing.

In-situ load testing shall be conducted as outlined below:

A test procedure shall be developed by a registered design professional. A stamped copy of the test procedure shall be submitted along with a fee to the Fire Marshal's Office for approval before any testing is carried out. The test protocol shall:

1. Simulate the applicable loading and deformation conditions as necessary to address the concerns regarding structural stability of the structure.
2. The test load shall be equal to two times the unfactored design loads (see Attachment #1). The test loads shall be left in place for one hour.
3. Test loads may be applied to the entire structure at one time. If however, each landing is to be tested separately, then members such as standpipes, ladders etc. connecting the landings must be disconnected so that load sharing does not occur.

Testing shall be supervised by a registered design professional.

The structure shall be considered to have successfully met the test requirements where the following criteria are satisfied. :

1. Within one hour after removal of the test load, the structure shall have recovered not less than 75 percent of the maximum deflection.
2. During and immediately after the test, the structure shall not show evidence of failure.

A complete final summary report prepared and stamped by a design professional shall be submitted to the Fire Bureau for review and approval

DRAFT

Attachment # 3
FMO Policy CE B-8
Fire Escape Issues
February 12, 2008

Fire Escape Evaluation Using Structural Analysis and Limited Testing

The fire escape shall first be visually inspected by a registered design professional. The entire fire escape shall be checked for rust, damage and unauthorized modifications. Handrails must be physically checked for integrity. All welds, rivets, bolts, grates, hangars, framework, etc. must be inspected. Faulty welds, loose bolts, grates, rivets, and framework should be tightened, repaired, or replaced as necessary. The ladder must be checked for unauthorized modification. All safety chains shall be in good repair. Operate the counterbalanced stair or ladder release mechanism and make sure it operates easily. The stair or ladder must travel to the ground without hesitation. It must be stable and firm in its position after reaching the ground or sidewalk. This procedure must be conducted twice. Return the ladder to its normal position.

A complete structural analysis of all the elements and connections shall be completed for each fire escape on the building. The analysis shall be done by a registered design professional. The analysis shall be based on the design criteria in Attachment #1. Fire escapes and parts thereof shall be analyzed in accordance with the provisions of Oregon Structural Specialty Code. The structural analysis shall be based on actual material properties and other as-built conditions.

In addition to the structural analysis, limited testing shall be conducted to determine the adequacy of the anchorage of the fire escape to the building structure or for any connection that cannot be analyzed due to connection being hidden from view. Unless agreed to by the Fire Marshal's Office upon recommendation from the design professional performing the analysis, testing of anchorage for the fire escape to concrete or reinforced or unreinforced masonry structure is required to determine the capacity of the anchors.

Testing is not required where all the anchors are being replaced and shown by analysis to meet requirements of the Oregon Structural Specialty Code. The new anchors shall be designed to resist all the loads imposed on the connection by the fire escape.

Testing Requirements:

1. Testing shall be conducted by a qualified testing agency under the supervision of the registered design professional.
2. The anchors shall be tested to two times the unfactored design loads. See Attachment #1 for minimum design loads.
3. The anchors shall be tested for all loads imposed on the anchor (Shear and tension). Test loads shall be left in place for one hour.
4. The registered design professional shall prepare and submit a plan for testing of the anchors. This testing plan shall be approved by the Fire Bureau before testing is carried out.
5. A minimum of 20% of the anchors shall be tested.
6. The anchors shall be considered to have successfully met the test requirements if 90% or more of the tested anchors pass the test and 100% of the anchors have a capacity of at-least 150% of the unfactored design loads. If this is not the case another 20% of the anchors shall be tested. The tests shall be repeated until the anchors are acceptable per acceptance criteria defined above.
7. All failed anchors shall be retrofitted and the new anchors shall carry the entire load imposed by the fire escape. There shall be no load sharing between existing and new anchors in a connection.

A complete evaluation report prepared and stamped by a design professional that includes but is not limited to drawings, calculations and test results shall be submitted to the Fire Marshal's Office along with the required fee for review and approval.