VLMK CONSULTING ENGINEERS
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STRUCTURAL CALCULATIONS

for

I SAT - TI

14325 NE Airport Way, Suite 101
Portland, OR 97230

for

Powin Corporation

6975 Southwest Sandburg Rd, Suite 326
Tigard, OR 97223

REGISTERED PROFESSIONAL ENGINEER
17352
OREGON
JULY 19, 1994
HAVLIN G. KEMP
EXP. 6-30-13

12-204022-CO

Prepared By: Stephen Stenberg

VLMK Job Number: 20120585

Date: November 05, 2012

1 - 12/05/12 : STRONGBACK ADDITION

I SAT - TI

14325 NE Airport Way, Suite 101
Portland, OR

VLMK JOB NO. 20120585

STRUCTURAL CALCULATIONS FOR BUILDING PERMIT

TABLE OF CONTENTS

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DESCRIPTION OF STRUCTURAL SYSTEM

The 'I SAT – TI' project includes the installation of (2) windows in existing concrete tilt panel walls at the Powin Center on 14325 NE Airport Way Suite 101, Portland, OR. This package includes structural calculations verifying the structural integrity of the existing tilt panels to resist the additional wind and seismic forces.

*****LIMITATIONS*****

VLMK Consulting Engineers was retained in a limited capacity for this project. The design is based upon information provided by the client, who is solely responsible for the accuracy of the information. No responsibility and/or liability is assumed by, nor is any to be assigned to, VLMK Consulting Engineers for items beyond that shown in this Structural Calculation Package.

DESIGN CRITERIA

CODES:

2010 Oregon Structural Specialty Code (Based on the 2009 International Building Code)

DESIGN LOADS:

Live Loads:

Roof Snow Load

Flat Roof Snow Load, P_f	25.0	psf
Snow Exposure Factor, C_e	1.0	
Snow Load Importance Factor, I_s	1.0	
Thermal Factor, C_t	1.0	

Dead Loads:

Roof (Commercial Buildings)

Assumed Total Dead Load	15.0	psf

Wall Weights

6" Concrete tilt panel	75.0	psf

Wind:

Basic Wind Speed (3-second gust)	95 mph
Wind Importance Factor, I_w	$I_w = 1.0$
Occupancy Category	II
Wind Exposure	B

Seismic:

Seismic Importance Factor	1.0
Occupancy Category	II
Mapped Spectral Response Accelerations	$S_s = 91.6\%$
	$S_1 = 531.6\%$
Site Class	D
Spectral Response Coefficients	$S_{ds} = 69.2\%$
	$S_{d1} = 37.2\%$
Seismic Design Category	D

MATERIALS

Structural Steel:

Plates, Shapes	ASTM A36	$F_y = 36$ ksi
Structural Tubes	ASTM A500 Gr.B	$F_y = 46$ ksi

Drilled Anchors:

Concrete Drilled Anchors	Simpson Strong-Bolt Wedge Anchor	ICC ESR-1771
	Hilti Kwik-Bolt TZ Anchor	ICC ESR-1917

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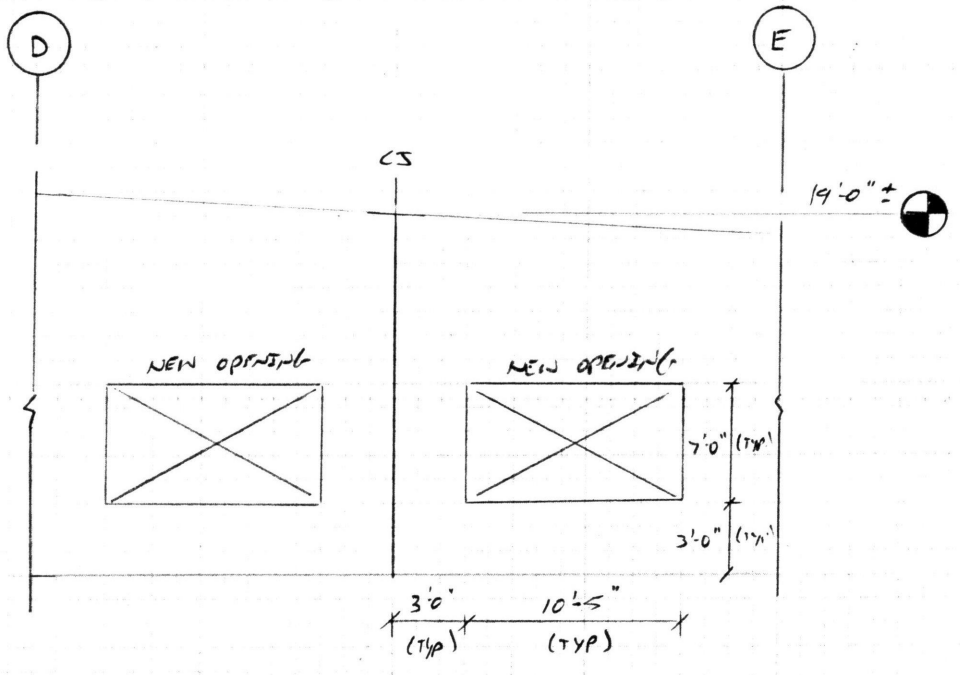
Job: ISAT - TI
Client: PONIN CORP.
Job No. 20120585 By SMS
Date 11/12 Sheet No. C-1

NEW PANEL OPENING DESIGN



LOADS

TRIB.

$w_{DEAD} = (15\ psf)(5') = \underline{0.075\ klf}$ [ROOF DEAD]

$w_{SNOW} = (25\ psf)(5') = \underline{0.125\ klf}$ [SNOW]

OUT-OF-PLANE INFO

WIND: V = 95 mph, Exp. B

I = 1.0, ZONE 4

SEISMIC: $S_{DS} = 0.69$, I = 1.0

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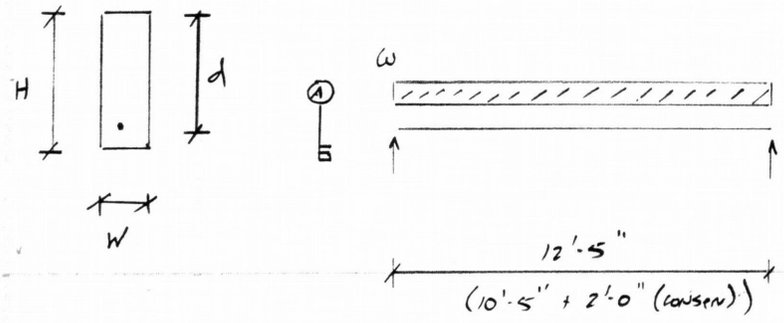
Job ISAT - TI
Client POWER CORP.
Job No. 20120585 By SMS
Date 12/12 Sheet No. C-2

△1 - 12/05/12
"THIS WHOLE SHEET IS REVISED

NEW PANEL OPENING DESIGN (CONT.)

* SEE PREVIOUS SHEET FOR ILLUSTRATION

OVERHEAD WINDOW CHECK



LOADS

$\omega_{D_{ROOF}} = 1.2(15\ psf)(5') = \underline{90\ plf}$

$\omega_{D_{WALL}} = 1.2(150\ lb/ft^3)(6''/12)(9'\ (TALL)) = \underline{1{,}015\ plf}$

$\omega_{LL} = 1.6(25\ psf)(5') = \underline{200\ plf}$

NOTES

* TYPICAL REINFORCING : #5 BARS @ 1'-6" O.C. [SEE REF. 1 AND 2]

CALCS

$$M_{max} = \frac{\omega l^2}{8} = \frac{(90 + 1{,}015 + 200)\ plf\ (12.42')^2}{8} = \underline{25.16\ k\text{-}ft}$$

$H = \underline{9'\text{-}0''}$, $d = (9'\text{-}0'' - 1'\text{-}5'') = \underline{7'\text{-}7''}$, $W = \underline{0'\text{-}6''}$

$$\phi M_n = \frac{(0.9)\,A_s F_y\,(d - a/2)}{12}$$

$A_s = 0.31\ in^2$, $F_y = 60\ ksi$

$$a = \frac{(0.31\ in^2)(60\ ksi)}{0.85(4\ ksi)(6'')}$$

$a = 0.91$

$\phi M_n = 125\ k\text{-}ft > 25.16\ k\text{-}ft$

∴ WINDOW IS OK AND NO ADDITIONAL HEADER IS REQ'D

* SEE OUT-OF-PLANE LOADS →

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Job: ISAT - TI
Client: POWIN CORP.
Job No. 20120585 By SMS
Date 12/12 Sheet No. C-3

1 - 12/05/12
(THIS WHOLE SHEET IS REVISED)

NEW PANEL OPENING DESIGN (CONT.)

OVERHEAD WINDOW CHECK (CONT.)

OUT-OF PLANE LOADING

$w_W = 1.6\,(14.4\,psf) = \underline{23.0\ psf}$ [SEE ATTACHED C-]

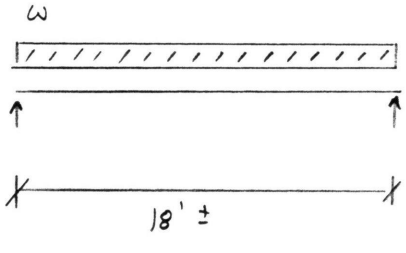
* CONTROLS → $w_E = \dfrac{0.4\,S_{DS}\,I\,W}{1.0} = \dfrac{0.4\,(0.692)(1.0)(1.2 \times 75\,psf)}{1.0} = \underline{25.0\ psf}$

$M_{max} = \dfrac{wL^2}{8} = \dfrac{(25.0)(12.41')^2}{8} = 0.48\ k\text{-}ft/ft$

$\phi M_n = (0.9)(0.21\,in^2/ft)(60\,ksi)(3'')(1''/12'') = 2.85\ k\text{-}ft/ft > 0.48$

∴ NO HEADER IS REQ'D

STRONGBACK DESIGN



LOADS

$w_{WIND} = (23.0\,psf)(8')$ (TRIB (CONSERV)) $= \underline{184\ plf}$

$M_{max} = \dfrac{wL^2}{8} = \dfrac{(184\,plf)(12')^2}{8} = \underline{2.45\ k\text{-}ft}$

$\Delta_{ALLOW} = L/240 = \underline{1.44''}$

$S_{x\text{-}REQ'D} = \dfrac{(2.45\,k\text{-}ft)(12''/1')}{(46\,ksi)(0.9)} = \underline{2.16\ in^3}$

USE HSS 4x4x1/2
($S_x = 5.97\,in^3$, $I_x = 11.9\,in^4$)

$I_{x\text{-}REQ'D} = \dfrac{5 \cdot (18' \cdot 184\,plf)(18' \cdot 12)^3}{384\,(29{,}000\,ksi)(1.44)} = \underline{10.40\ in^4}$

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Job: I SAT - TI
Job No.: 20120585
Date: 11/12
Sheet No.: C - 4

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Wind Loads - Main Wind-Force Resisting Systems

Based on the 2009 International Building Code and ASCE 7-05, 6.4 (Method 1 - Simplified Procedure)

	B	Exposure Category [Section 6.5.6.3]
K_{zt} =	1.00	Topographic Factor [Figure 6-4]
I =	1.00	Importance Factor [Table 6-1]
Roof Slope =	0 to 5	Degrees
V =	95 mph	Basic Wind Speed 3-Second Gust [Figure 6-1]

Per ASCE 7-05, 6.4.2.1 and Figure 6-2

Horizontal Loads

Height (ft)	Adjustment λ	End Zones (psf)		Interior Zones (psf)	
		Wall (A)	Roof (B)	Wall (C)	Roof (D)
15	1.00	14.4	-7.5	9.5	-4.5
20	1.00	14.4	-7.5	9.5	-4.5
25	1.00	14.4	-7.5	9.5	-4.5
30	1.00	14.4	-7.5	9.5	-4.5
35	1.05	15.1	-7.8	10.0	-4.7
40	1.09	15.6	-8.1	10.4	-4.9
45	1.12	16.1	-8.3	10.6	-5.0
50	1.16	16.6	-8.6	11.0	-5.2
55	1.19	17.1	-8.9	11.3	-5.3
60	1.22	17.5	-9.1	11.6	-5.4

Vertical Loads

Height (ft)	Adjustment λ	End Zones (psf)		Interior Zones (psf)		Windward Overhang (psf)	
		Windward Roof (E)	Leeward Roof (F)	Windward Roof (G)	Leeward Roof (H)	Windward Roof (E_{OH})	Windward Roof (G_{OH})
15	1.00	-17.3	-9.8	-12.0	-7.6	-24.2	-18.9
20	1.00	-17.3	-9.8	-12.0	-7.6	-24.2	-18.9
25	1.00	-17.3	-9.8	-12.0	-7.6	-24.2	-18.9
30	1.00	-17.3	-9.8	-12.0	-7.6	-24.2	-18.9
35	1.05	-18.1	-10.3	-12.6	-8.0	-25.4	-19.8
40	1.09	-18.8	-10.7	-13.1	-8.3	-26.3	-20.6
45	1.12	-19.3	-11.0	-13.4	-8.5	-27.0	-21.2
50	1.16	-20.0	-11.4	-13.9	-8.8	-28.0	-21.9
55	1.19	-20.5	-11.7	-14.3	-9.0	-28.7	-22.5
60	1.22	-21.0	-12.0	-14.6	-9.3	-29.5	-23.1

C-5

USGS Design Maps Summary Report

User-Specified Input

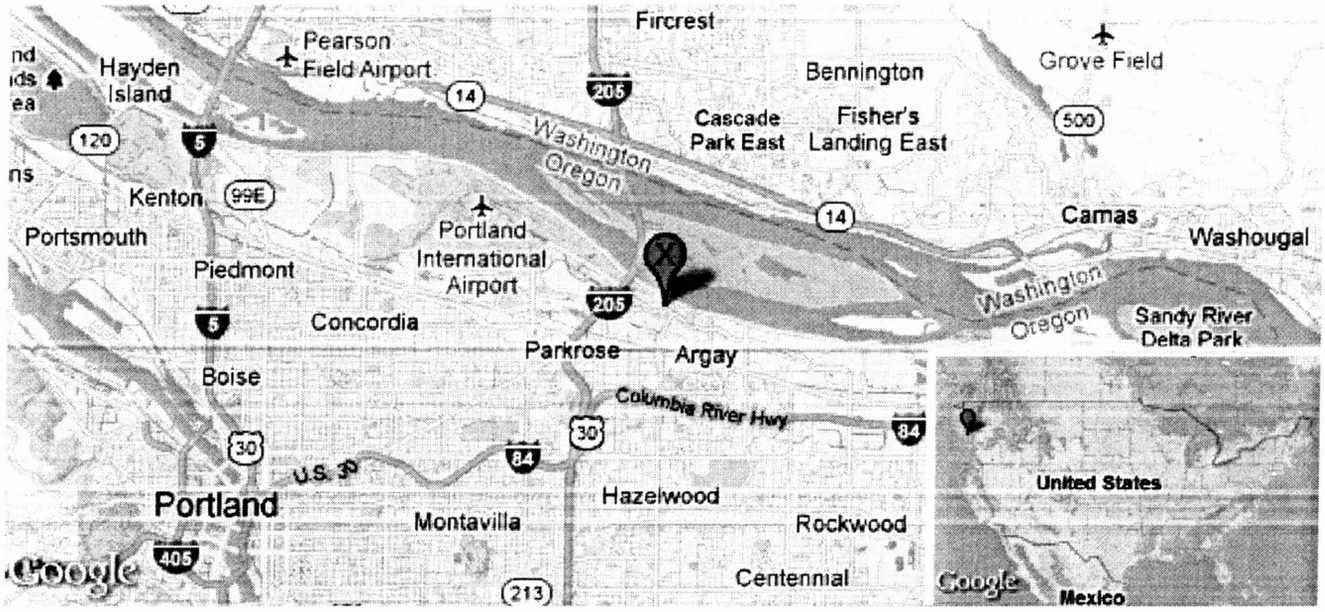
Report Title I SAT - TI
Mon November 5, 2012 22:28:33 UTC

Building Code Reference Document 2006/2009 International Building Code
(which makes use of 2002 USGS hazard data)

Site Coordinates 45.56704°N, 122.53594°W

Site Soil Classification Site Class D – "Stiff Soil"

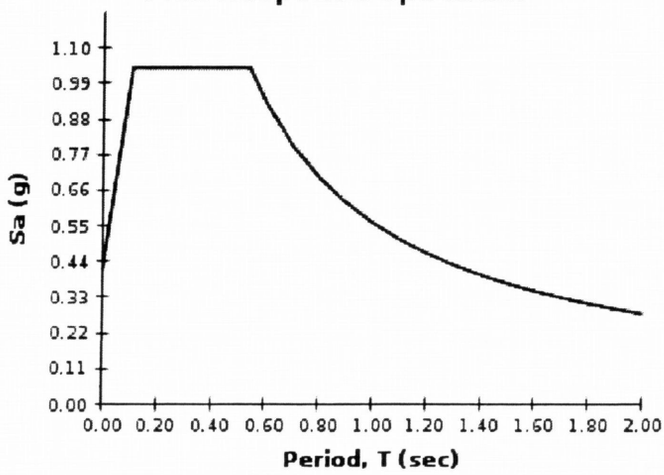
Occupancy Category Occupancy Category I



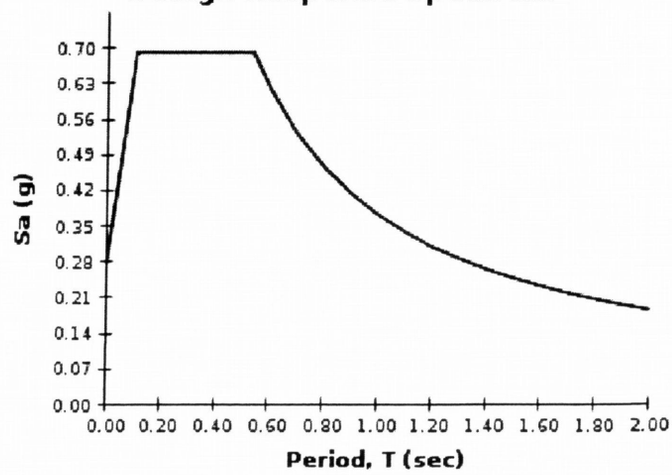
USGS-Provided Output

S_S =	0.916 g	S_{MS} =	1.039 g	S_{DS} =	0.692 g
S_1 =	0.316 g	S_{M1} =	0.559 g	S_{D1} =	0.372 g

MCE Response Spectrum



Design Response Spectrum



Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

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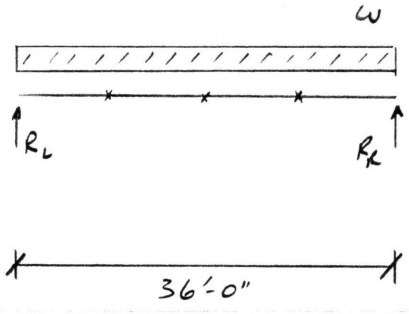
Job ISAT - TI
Client Power Corp.
Job No. 20120595 By SMS
Date 11/12 Sheet No. C-6

FRAMING DESIGN

NEW CEILING SUPPORT FRAMING



TRIB = 24"

LOADS

w_D = 0.5 psf (INSULATION)

1.8 psf (METAL SUSPENSION CEILING SYSTEM)

1.83 psf (SELF-WT OF JOIST)

1.5 psf (MISC)

5.63 psf

CALCS

$$M_{max} = \frac{wL^2}{8} = \frac{(5.63\ psf)(24''/12)(36')^2}{8} = 21.9\ k\text{-}in$$

$$M_u = \frac{M_n}{\Omega(1.67)} \Rightarrow M_n = 21.9\ k\text{-}in\ (1.67) = \underline{36.5\ k\text{-}in}$$

$$R_L = R_R = \frac{wL}{2} = \frac{(5.63\ psf)(24''/12)(36')}{2} = \underline{202\#}$$

* BRACE AT 1/4 POINTS, ∴ UNBRACED LENGTH = $\frac{(36')(12''/1')}{4} = \underline{108''}$

RESULTS

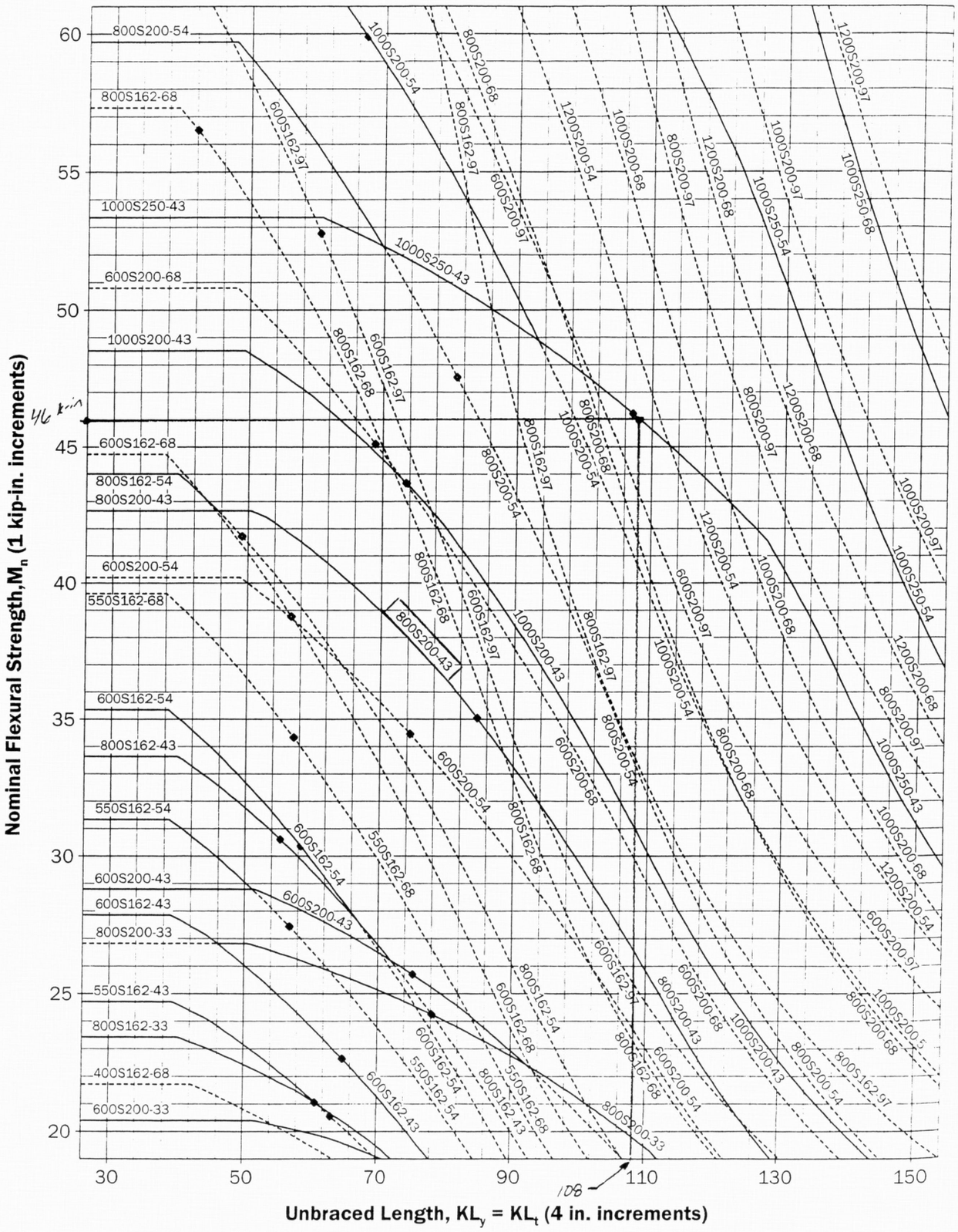
USE 1000S250-43 AT 24" O.C. AND BRACE AT 1/4 POINTS WITH 1½" WIDE STRAP OF EQUAL OR GREATER THICKNESS AS THE TRACK.

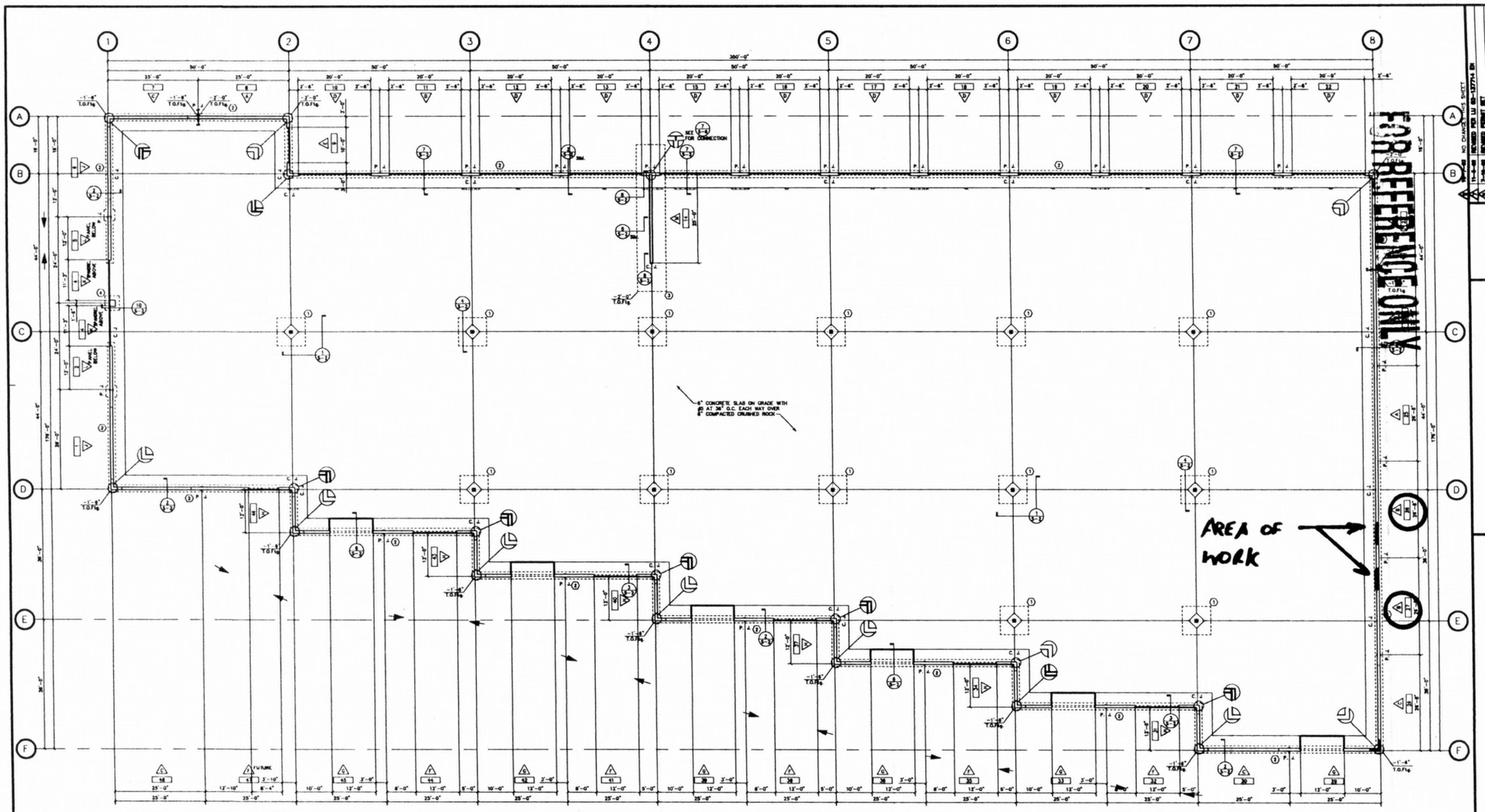
C-7

Chart II-2a

Nominal Flexural Strength
SSMA Studs
C-Sections with Lips (F_y = 33 ksi, C_b = 1)

Ω_b = 1.67 (ASD)
ϕ_{bY} = 0.95 (LRFD)
ϕ_{bLTB} = 0.90 (LRFD)





COLUMN AND FOOTING SCHEDULE

	COLUMN	FOOTING	REINFORCING	NOTES
1	T.S. 7 x 7 x 1/4"	7'-0" x 7'-0" x 20" DEEP	(8) #6 EACH WAY	SEE 4/S-2
2	TILT-UP PANELS	2'-0" WIDE x 1'-4" DEEP + CONT.	(3) #5 + CONT. TOP AND BOTTOM	SEE 2/S-2
3	TILT-UP PANEL	6'-0" WIDE x 40-0' LONG x 2'-0" DEEP	#7'S AT 6" O.C. LONGITUDINAL AT BOTTOM #4'S AT 8" O.C. TRANSVERSE AT BOTTOM #7'S AT 18" O.C. LONGITUDINAL AT TOP #4'S AT 18" O.C. TRANSVERSE AT TOP	CENTER FOOTING ON PANEL - SEE PANEL DETAILS
4	CONCRETE COLUMN	6'-6" x 6'-6" x 20"	(6) #6 EACH WAY	SEE 10/S-2
5	T.S. 5 x 5 x 1/4"	4'-0" x 4'-0" x 1'-8"	(4) #4 EACH WAY	SEE DETAIL 12/S-2

DESIGN SOIL PRESSURE 1500 psf PER ASSUMPTION

FOUNDATION PLAN

3/32"=1'-0"

CAUTION
3/32"=1'-0" SCALE

NOTES:

1.) $\frac{2'-0"}{T.O.F.Fig}$ INDICATES DEPTH OF TOP OF FOOTING BELOW FINISH FLOOR.

2.) (6) INDICATES COLUMN AND FOOTING BELOW FINISH FLOOR. SEE FOOTING SCHEDULE THIS SHEET.

3.) (A) INDICATES PANEL TYPE. SEE SHEET S-3 FOR PANEL ELEVATIONS.

4.) P.J. INDICATES PANEL JOINT, SEE DETAIL $\frac{2}{S-2}$ OR $\frac{3}{S-2}$

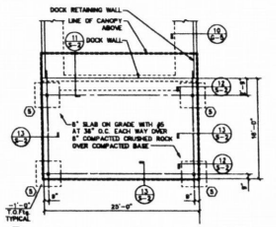
5.) C.J. INDICATES CONTROL JOINT SEE DETAIL $\frac{1}{S-2}$ CONCTRACTOR HAS THE OPTION TO ADJUST CONTROL JOINT LOCATION SUBJECT TO AN APPORVAL BY THE ENGINEER.

6.) INDICATES CONCRETE TILT-UP PANELS

7.) (8) INDICATES PANEL NUMBER FOR SHOP DRAWING COORDICATION

8.) S===S INDICATES FOOTING STEP, SEE DETAIL $\frac{3}{S-2}$

9.) INDICATES 2 x 6 STUD WALL WITH STUDS AT 16" O.C. - PLACE TWO STUDS AT EACH SIDE OF OPENING. NAIL DOUBLE STUDS TOGETHER WITH (3) 16d AT 12" O.C. - ATTACH P.T. 2x SILL PLATE TO SLAB WITH 1/2" DIA. ANCHOR BOLTS AT EACH END OF EACH WALL AND 48" O.C. BETWEEN END ANCHORS. EMBED 3 1/2".



FOUNDATION AT LOADING DOCK

S1-1.dwg 1/8" = 1'-0"

4 - 12/05/12
FINAL SHEET REVISED

R-1

VLMK PLOT DATES:
12/4/2001 16:17 CJM
12/19/2001 11:32 CJM
1/16/2002 14:41:13 CJM
3/5/2002 9:39:17 JD

Drawing Date

NO.	DATE	REVISIONS
1	1-4-02	REVISED PER LU 02-02714 GB
2	1-8-02	REVISED PER SHEET SET
3	2-6-02	REVISED PER SHEET SET
4	2-26-02	REVISED PER SHEET SET
5	3-5-02	REVISED PER SHEET SET
6	3-6-02	NO CHANGES THIS SHEET
7	3-8-02	NO CHANGES THIS SHEET
8	3-8-02	NO CHANGES THIS SHEET
9	3-8-02	NO CHANGES THIS SHEET

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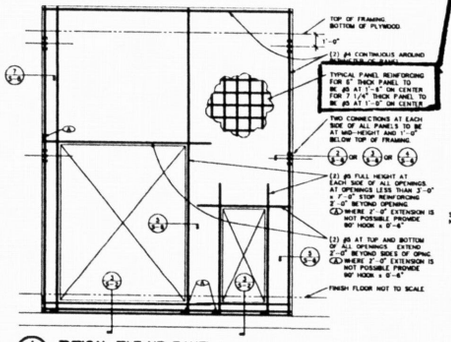
POWIN CENTER
14325 NE AIRPORT WAY
PORTLAND, OREGON

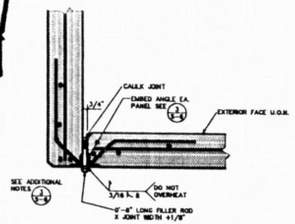
FOUNDATION PLAN

DATE	MARCH 4, 2002
SCALE	AS NOTED
PROJ. NO.	201018
DRAWN	CJM
CHECKED	HGK
SHEET NO.	S 1

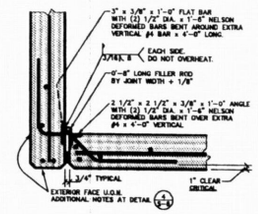
TYPICAL BARS ARE #5 AT 1'-6" O.C.



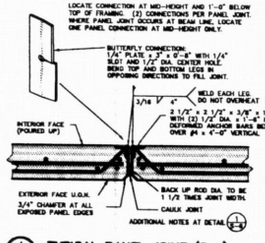
1 S-6 TYPICAL TILT UP PANEL



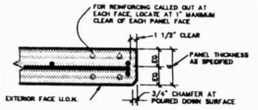
2 S-6 INSIDE CORNER PANEL CONNECTION



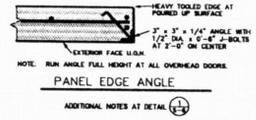
3 S-6 PANEL CORNER CONNECTION



4 S-6 TYPICAL PANEL JOINT (P.J.)



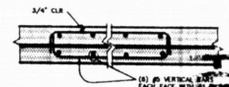
TYPICAL PANEL EDGE



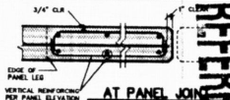
PANEL EDGE ANGLE

ADDITIONAL NOTES AT DETAIL

5 S-6 PANEL EDGE DETAILS



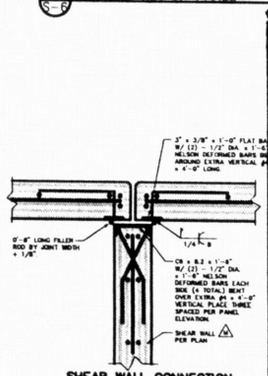
BETWEEN PANEL JOINTS



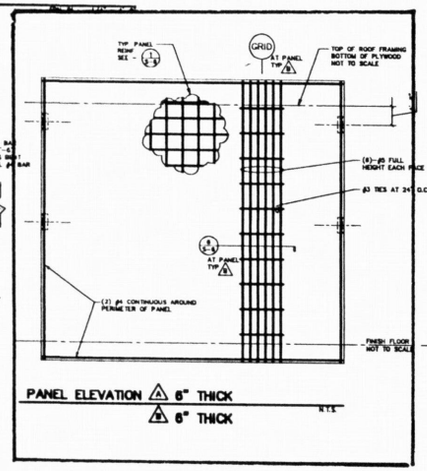
AT PANEL JOINT

6 S-6 EXTRA REINF. AT BEAM LINE

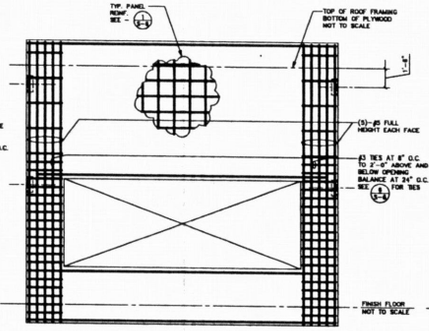
FOR REFERENCE ONLY



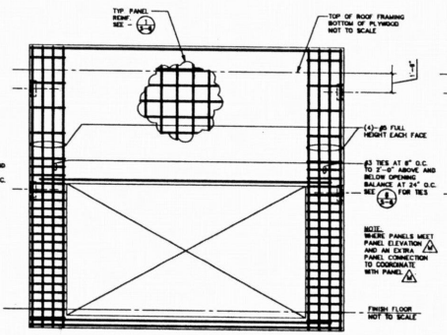
7 S-6 SHEAR WALL CONNECTION TO INTERSECTING PANELS



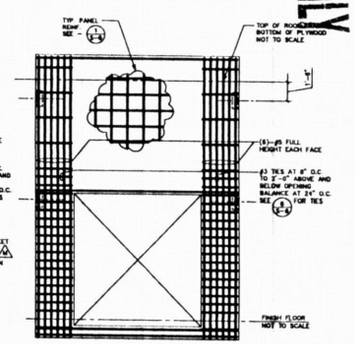
PANEL ELEVATION 5 6" THICK
6 6" THICK



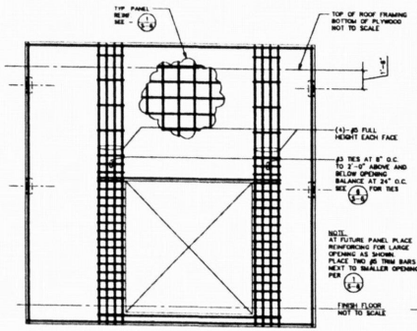
PANEL ELEVATION 6 6" THICK



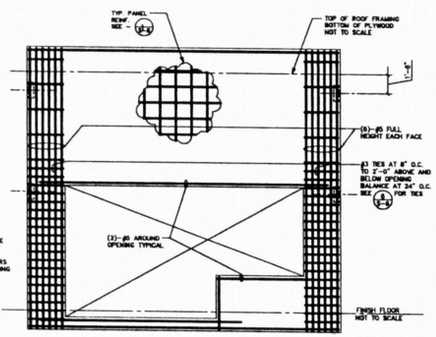
PANEL ELEVATION 4 6" THICK



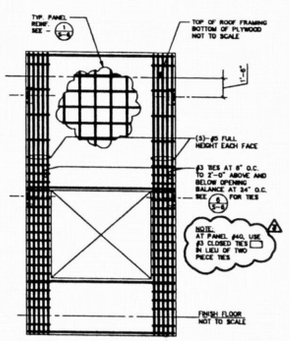
PANEL ELEVATION 1 6" THICK



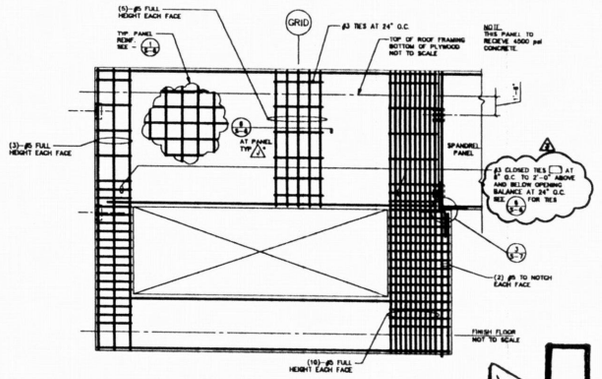
PANEL ELEVATION 7 6" THICK



PANEL ELEVATION 8 6" THICK



PANEL ELEVATION 4 6" THICK



PANEL ELEVATION 3 6 1/2" THICK
3 6 1/2" THICK

R-2

1 12/05/12

VLMK PLOT DATES:
11/21/2001 15:30:35 CJM
1/21/2002 7:44 CJM
2/5/2002 9:41:52 JS
3/21/2002 15:53:35 JRW

210183 S.dwg

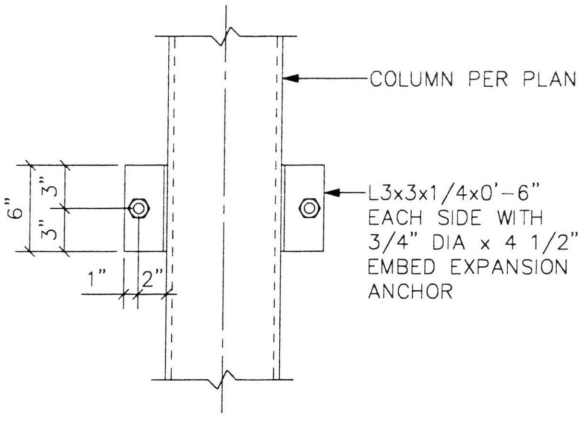
NO	DATE	REVISIONS
10-2-02	NO CHANGES THIS SHEET	
7-1-02	REVISED PER LU 02-127714 DS	
7-1-02	REVISED PERMIT SET	
5-3-02	REVISED PERMIT SET	
4-3-02	REVISED PERMIT SET	
3-21-02	REVISED PERMIT SET	
3-18-02	REVISED PERMIT SET	
3-15-02	NO CHANGES THIS SHEET	

VLMK CONSULTING ENGINEERS
3933 SW Kelly Avenue • Portland • Oregon 97239-4393
(503) 222-4453
(503) 248-9263
vlmk@vlmk.com
www.vlmk.com

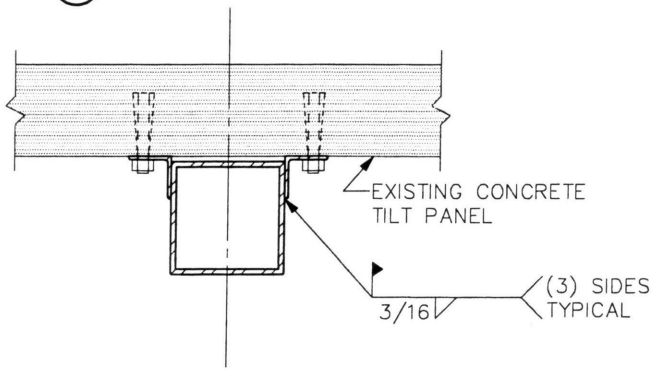
POWIN CENTER
14325 NE AIRPORT WAY
PORTLAND, OREGON

PANEL ELEVATIONS AND DETAILS

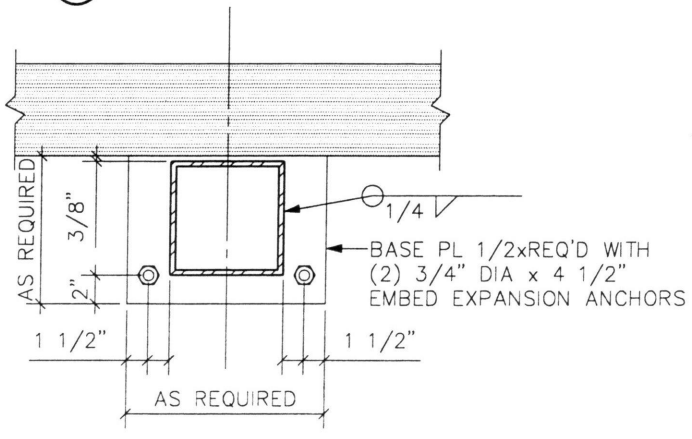
DATE	MARCH 4, 2002
SCALE	AS NOTED
PROJ. NO.	201018
DRAWN	CJM
CHECKED	HGK
SHEET NO.	S 6



A TUBE PLATE ELEVATION



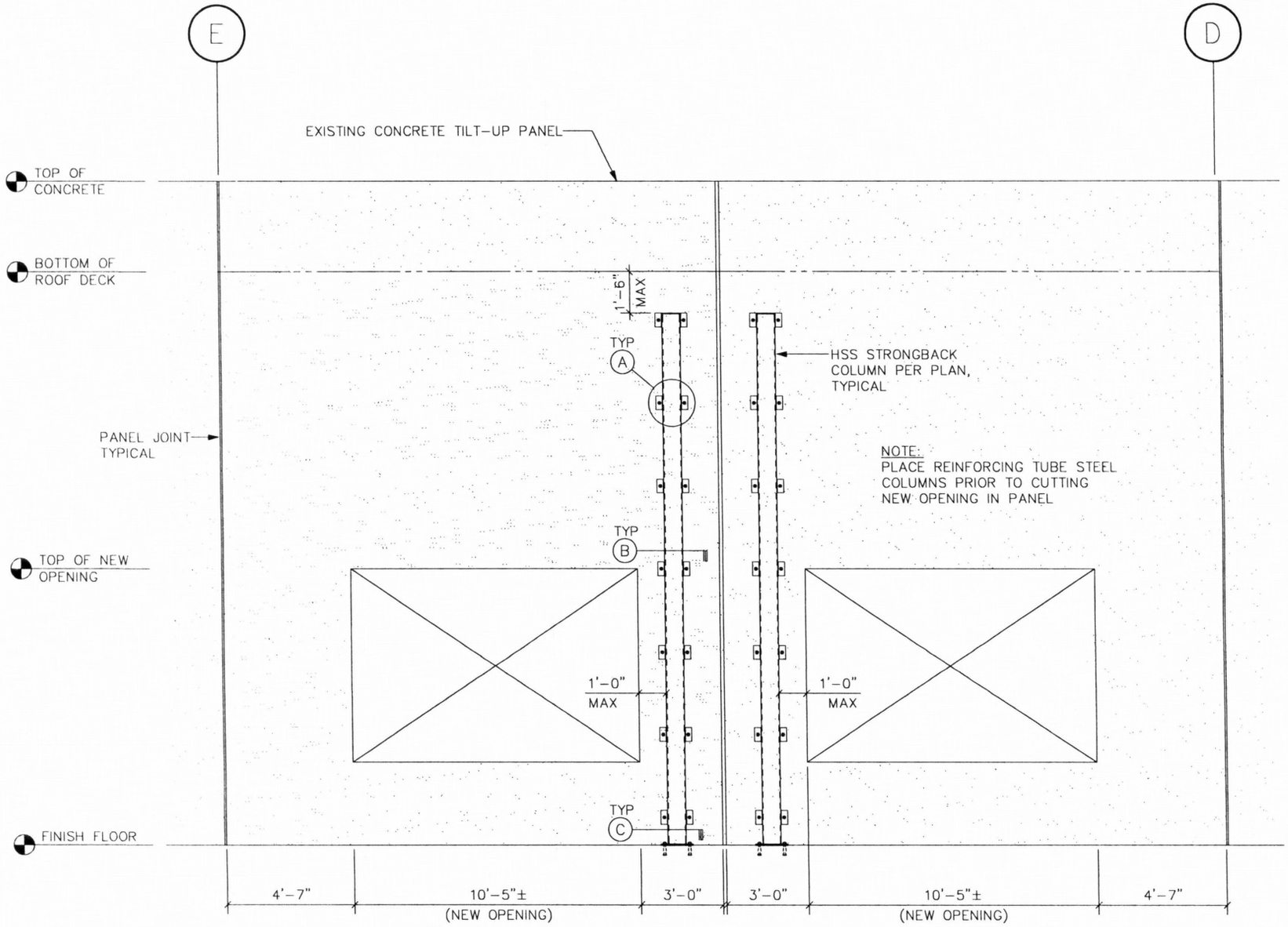
B TUBE PLATE SECTION



C BASE PLATE PLAN

3 / A3.0 — STRONG-BACK DETAILS

A - 12/05/12 A3-03.dwg 1" = 1'-0"



2 / A3.0 STRONG-BACK ELEVATION

Δ - 12/05/12 A3-02.dwg 1/4" = 1'-0"