Structural Analysis Report of Anchorage Design for Propane Exchange Cage - Aluminum

Conducted at:
Various Locations
San Jose, CA

Prepared for:

21739 State Hwy 64
Canton, TX 75103

11/21/13

Expires 6/30/2015

November 21, 2013

Prepared by:

ABN ENGINEERING
1317 E Thunderhill Place
Phoenix, AZ 85048
Phone: 480-213-8524

Abn Engineering
1317 E. Thunderhill Place
Phoenix, AZ 85048
Phone# (480) 213-8524

November 15, 2013

Description of the project:

Structural calculations for the seismic check and anchorage design of new propane exchange cage - Aluminum

Design Codes:

2010 California Building Code and ASCE 7-05

References:

1. Drawings of propane exchange cage, CEC #20-18 ALUM

Design Criteria:

Occupancy Category III; Soil site class D and Seismic Design Category E

Proposed Loading:
(N) (18) Propane Tank, 40 lbs each
(N) Aluminum Propane Exchange Cage, 170 lbs

(N) Propane Exchange Case Structural Framing:
21GA & 14GA aluminum sheets for covering.
16GA steel sheets for shelf

Results:

As per provided structural calculations, the new aluminum propane exchange cage page stresses are calculated under vertical and lateral loads, and the stresses are under the allowable values, by inspection. Also, the proposed connections are adequate to support the proposed loads.

Conclusions:

Based on the results from the structural analysis, the new aluminum propane exchange case and connections are structurally adequate to support the proposed loads.

1. Lateral Loads Calculation

(2010 CBC & ASCE 7-05)

1.1 Earthquake Load

(by using Ground Motion Parameters Calculator Version 5.1.0)

Soil Site Class = D

Seismic Use Group = III

Seismic Parameters (Worst case in San Jose area) (from output of Seismic Design Parameters)

S_S = 2.277 g S_{MS} = 2.277 g S_{DS} = 2/3 S_{MS} = 1.518 g

S_1 = 1.285 g S_{M1} = 1.928 g S_{D1} = 2/3 S_{M1} = 1.285 g

Seismic Design Category = E

ρ = 1.0 (ASCE 7, 12.3.4.1)

Seismic Design Force : (for Nonstructural Components)

R = 2.5 a_p = 1.0 (ASCE 7, Table 13.5-1)

I_p = 1.25 z/h = 0.0

For Propane Cage: W_p = 890 lbs ***(18 x 40 lb Tank + 170 lbs of Cage)***

$F_p = [0.4\ a_p\ S_{DS}\ W_p / (R_p/I_p)] \times (1+2(z/h))$ (ASCE 7, 13.3-1)

$= 270.2$ lbs

$F_{p,MAX} = 1.6\ S_{DS}\ I_p\ W_p$ $= 2{,}702.0$ lbs

$F_{p,MIN} = 0.3\ S_{DS}\ I_p\ W_p$ $= 506.6$ lbs

Therefore F_p = 506.6 lbs

Seismic Load Effects E :

For Propane Cage: $E = \rho F_p \pm 0.2\ S_{DS}\ D$ (ASCE 7, 12.4)

= 506.6 lbs (Lateral) ± 0.304 D lbs (Vertical)

= 0.569 W (lbs) (Lateral) ± 0.304 W (lbs) (Vertical)

0.7E = 354.6 lbs (Lateral) ± 0.213 D lbs (Vertical)

= 0.398 W (lbs) (Lateral) ± 0.213 W (lbs) (Vertical)

Output of Ground Motion Parameters Calculator Version 5.1.0

Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 37.4
Longitude = -122.25
Spectral Response Accelerations Ss and S1
Ss and S1 = Mapped Spectral Acceleration Values
Site Class B - Fa = 1.0 ,Fv = 1.0
Data are based on a 0.01 deg grid spacing

Period (sec)	Sa (g)
0.2	2.277 (Ss, Site Class B)
1.0	1.285 (S1, Site Class B)

Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 37.4
Longitude = -122.25
Spectral Response Accelerations SMs and SM1
SMs = Fa x Ss and SM1 = Fv x S1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)
0.2	2.277 (SMs, Site Class D)
1.0	1.928 (SM1, Site Class D)

Conterminous 48 States
2005 ASCE 7 Standard
Latitude = 37.4
Longitude = -122.25
Design Spectral Response Accelerations SDs and SD1
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 1.0 ,Fv = 1.5

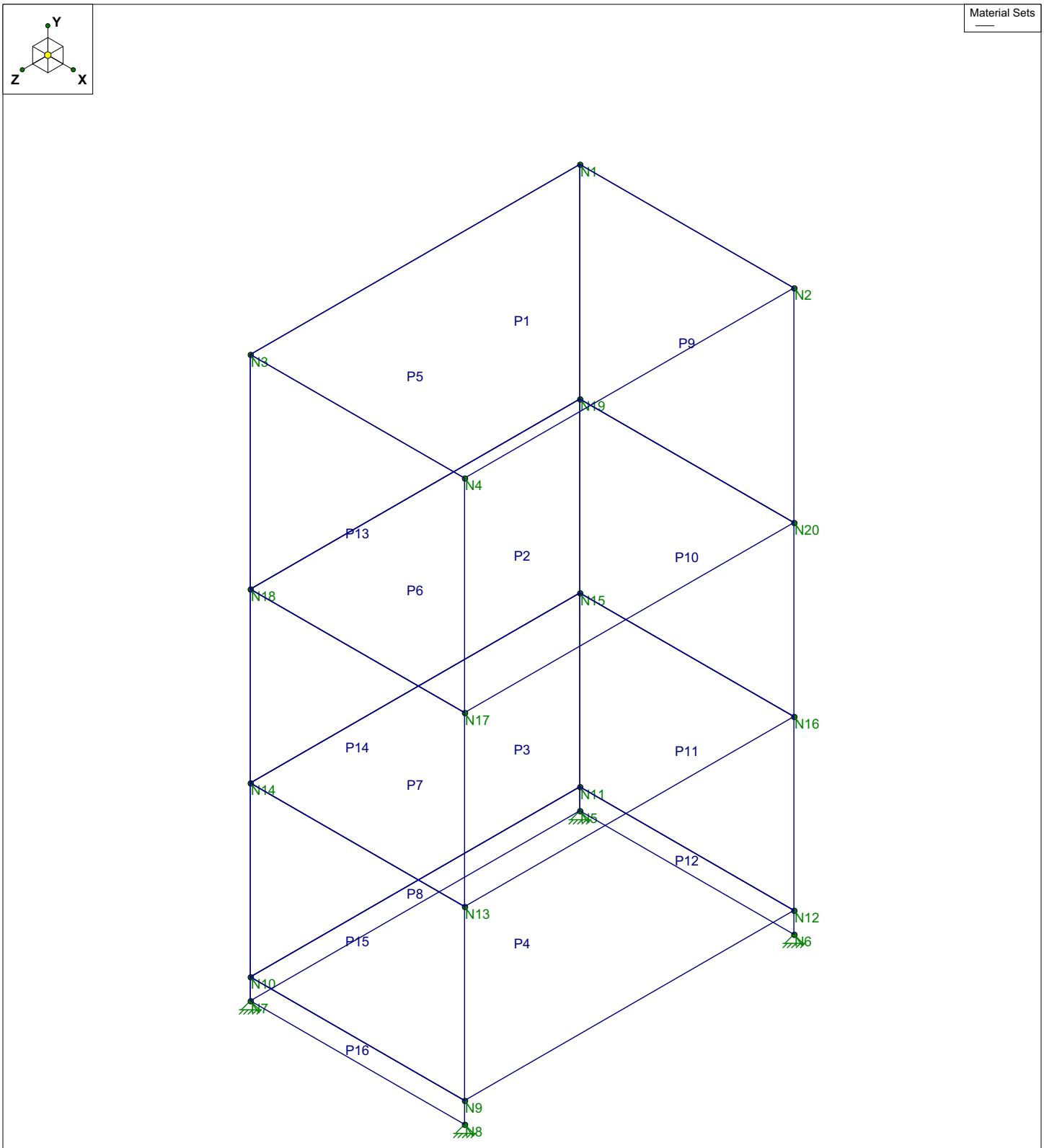
Period (sec)	Sa (g)
0.2	1.518 (SDs, Site Class D)
1.0	1.285 (SD1, Site Class D)

Load Calculation for RISA Analysis

Dead Loads:

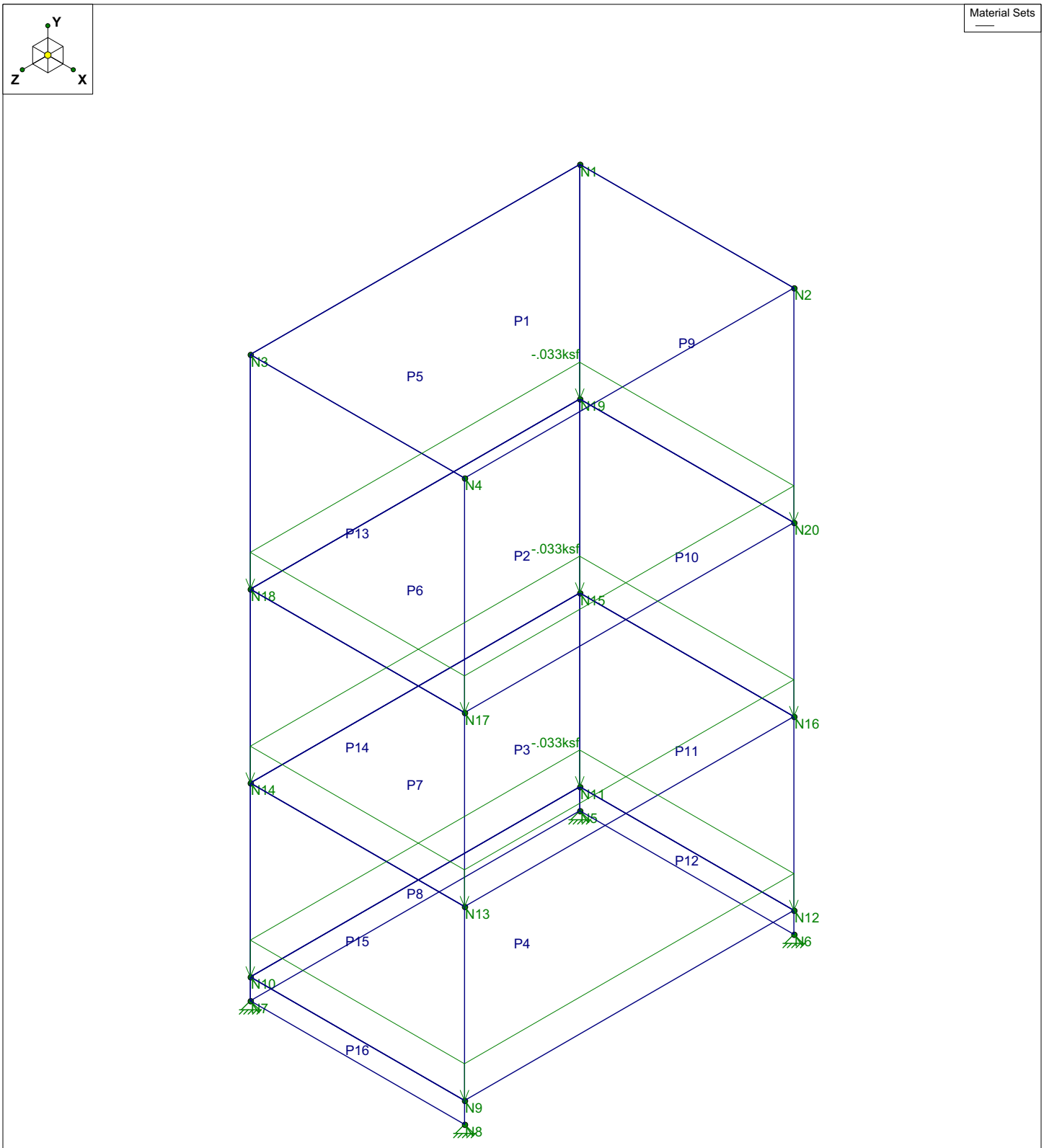
Propane Tank = **40** lbs / each

(6) Propane Tank per Shelf = **240** lbs Area = **7.2** ft^2
= **33** psf / shelf



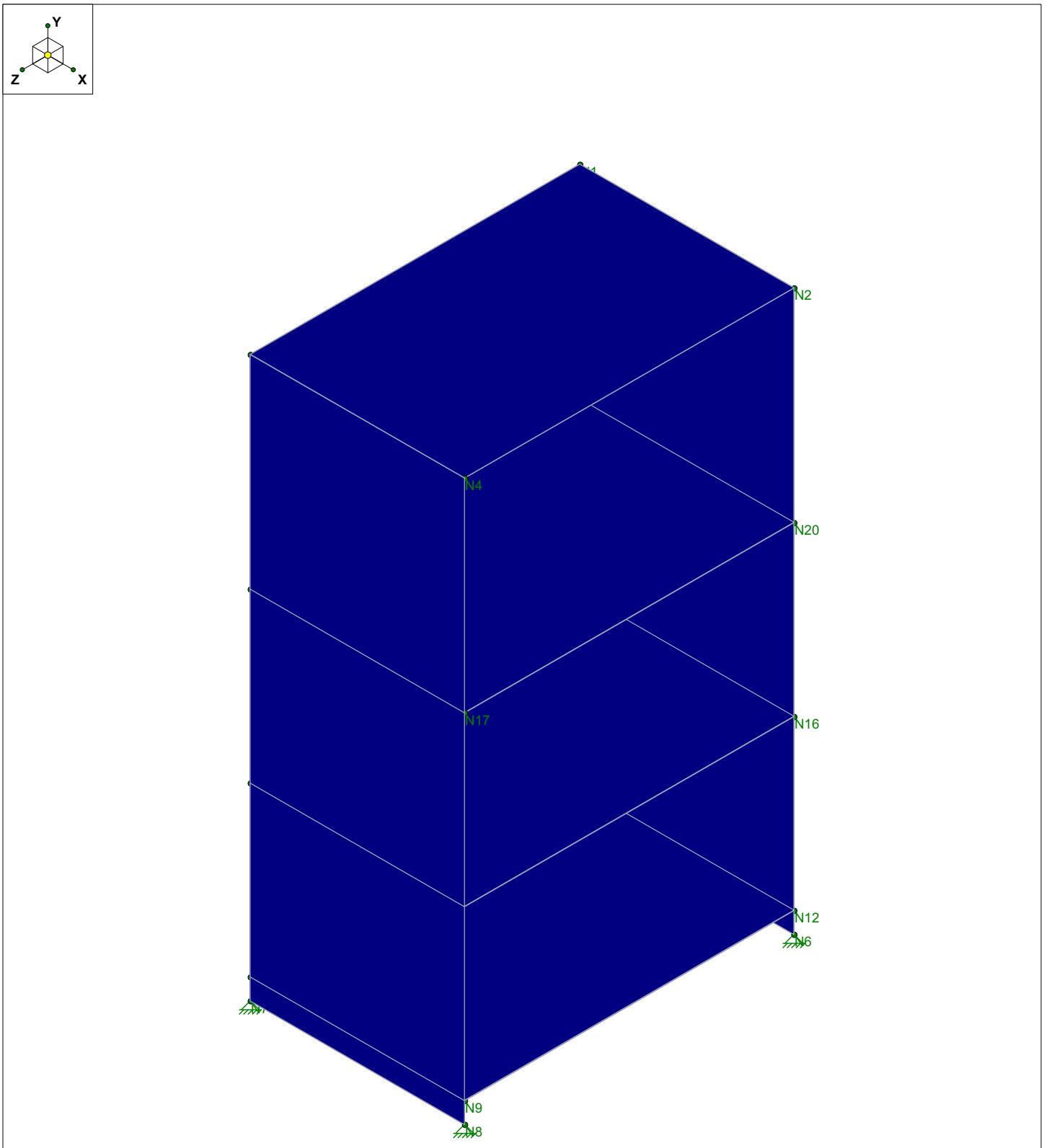
Solution: Envelope

		SK - 1
YJK	CEC-20#-18 ALUM	Nov 14, 2013 at 8:39 PM
	Plate and Node Numbers	CEC-20#-18 - ALUM.r3d



Loads: BLC 1, DL
Solution: Envelope

		SK - 2
YJK	CEC-20#-18 ALUM	Nov 14, 2013 at 8:40 PM
	Dead Load	CEC-20#-18 - ALUM.r3d



Solution: Envelope

		SK - 3
YJK	CEC-20#-18 ALUM	Nov 14, 2013 at 8:40 PM
	3D Model	CEC-20#-18 - ALUM.r3d

General Material Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]
1	gen_Conc3NW	3155	1372	.15	.6	.145
2	gen_Conc4NW	3644	1584	.15	.6	.145
3	gen_Conc3LW	2085	906	.15	.6	.11
4	gen_Conc4LW	2408	1047	.15	.6	.11
5	gen_Alum	10600	4077	.3	1.29	.173
6	gen_Steel	29000	11154	.3	.65	.49
7	RIGID	1e+6		.3	0	0

Joint Coordinates and Temperatures

	Label	X [ft]	Y [ft]	Z [ft]	Temp [F]	Detach From Diap...
1	N1	0	5.667	0	0	
2	N2	2.167	5.667	0	0	
3	N3	0	5.667	3.333	0	
4	N4	2.167	5.667	3.333	0	
5	N5	0	0	0	0	
6	N6	2.167	0	0	0	
7	N7	0	0	3.333	0	
8	N8	2.167	0	3.333	0	
9	N9	2.167	.21	3.333	0	
10	N10	0	.21	3.333	0	
11	N11	0	.21	0	0	
12	N12	2.167	.21	0	0	
13	N13	2.167	1.91	3.333	0	
14	N14	0	1.91	3.333	0	
15	N15	0	1.91	0	0	
16	N16	2.167	1.91	0	0	
17	N17	2.167	3.61	3.333	0	
18	N18	0	3.61	3.333	0	
19	N19	0	3.61	0	0	
20	N20	2.167	3.61	0	0	

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N5	Reaction	Reaction	Reaction				
2	N7	Reaction	Reaction	Reaction				
3	N8	Reaction	Reaction	Reaction				
4	N6	Reaction	Reaction	Reaction				

Plate Primary Data

	Label	A Joint	B Joint	C Joint	D Joint	Material	Thickness[in]
1	P1	N2	N1	N3	N4	gen_Alum	.032
2	P2	N20	N19	N18	N17	gen_Steel	.06
3	P3	N16	N15	N14	N13	gen_Steel	.06
4	P4	N12	N11	N10	N9	gen_Steel	.06
5	P5	N1	N19	N18	N3	gen_Alum	.015
6	P6	N19	N15	N14	N18	gen_Alum	.015
7	P7	N15	N11	N10	N14	gen_Alum	.015
8	P8	N11	N5	N7	N10	gen_Alum	.015
9	P9	N2	N1	N19	N20	gen_Alum	.032
10	P10	N20	N19	N15	N16	gen_Alum	.032
11	P11	N16	N15	N11	N12	gen_Alum	.032
12	P12	N12	N11	N5	N6	gen_Alum	.032

Plate Primary Data (Continued)

	Label	A Joint	B Joint	C Joint	D Joint	Material	Thickness[in]
13	P13	N4	N3	N18	N17	gen_Alum	.032
14	P14	N17	N18	N14	N13	gen_Alum	.032
15	P15	N13	N14	N10	N9	gen_Alum	.032
16	P16	N9	N10	N7	N8	gen_Alum	.032

Plate Surface Loads (BLC 1 : DL)

	Plate Label	Direction	Magnitude[ksf,F]
1	P4	Y	-.033
2	P3	Y	-.033
3	P2	Y	-.033

Plate Surface Loads (BLC 2 : EQX)

	Plate Label	Direction	Magnitude[ksf,F]
1	P4	X	.033
2	P3	X	.033
3	P2	X	.033

Plate Surface Loads (BLC 3 : EQZ)

	Plate Label	Direction	Magnitude[ksf,F]
1	P4	Z	.033
2	P3	Z	.033
3	P2	Z	.033

Basic Load Cases

	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distribu...	Area(M...	Surface...
1	DL	DL		-1						3
2	EQX	ELX	1							3
3	EQZ	ELZ			1					3

Load Combinations

	Description	Sol...	PD...	SR...	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor	BLC	Factor
1	DL	Yes			DL	1														
2	1.2DL+EQX	Yes			DL	1.2	ELX	.569	DL	.304										
3	1.2DL-EQX	Yes			DL	1.2	ELX	-.569	DL	.304										
4	1.2DL+EQZ	Yes	Y		DL	1.2	ELZ	.569	DL	.304										
5	1.2DL-EQZ	Yes	Y		DL	1.2	ELZ	-.569	DL	.304										
6	0.9DL+EQX	Yes	Y		DL	.9	ELX	.569	DL	-.304										
7	0.9DL-EQX	Yes	Y		DL	.9	ELX	-.569	DL	-.304										
8	0.9DL+EQZ	Yes	Y		DL	.9	ELZ	.569	DL	-.304										
9	0.9DL-EQZ	Yes	Y		DL	.9	ELZ	-.569	DL	-.304										

Envelope Joint Reactions

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	N5	max	.119	3	.498	3	.226	5	0	1	0	1	0	1
2		min	-.104	6	-.083	6	-.223	8	0	1	0	1	0	1
3	N7	max	.119	3	.498	3	.223	9	0	1	0	1	0	1
4		min	-.104	6	-.083	6	-.226	4	0	1	0	1	0	1
5	N8	max	.111	7	.495	2	0	5	0	1	0	1	0	1
6		min	-.126	2	-.084	7	0	8	0	1	0	1	0	1
7	N6	max	.111	7	.495	2	0	9	0	1	0	1	0	1
8		min	-.126	2	-.084	7	0	4	0	1	0	1	0	1

Envelope Joint Reactions (Continued)

	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
9	Totals:	max	.448	3	1.183	3	.448	5						
10		min	-.448	6	.469	6	-.448	4						

Envelope Joint Displacements

	Joint		X [in]	LC	Y [in]	LC	Z [in]	LC	X Rotation ...	LC	Y Rotation ...	LC	Z Rotation [...	LC
1	N1	max	.008	2	0	6	.003	8	2.359e-5	4	3.488e-5	9	7.038e-5	7
2		min	-.005	7	-.001	3	-.003	5	-2.317e-5	9	-3.489e-5	4	-1.314e-4	2
3	N2	max	.008	2	0	7	.004	4	2.208e-5	8	3.255e-5	9	7.121e-5	7
4		min	-.005	7	-.003	2	-.004	9	-2.316e-5	5	-3.261e-5	4	-1.317e-4	2
5	N3	max	.008	2	0	6	.003	4	2.317e-5	8	3.489e-5	5	7.038e-5	7
6		min	-.005	7	-.001	3	-.003	9	-2.359e-5	5	-3.488e-5	8	-1.314e-4	2
7	N4	max	.008	2	0	7	.004	8	2.316e-5	4	3.261e-5	5	7.121e-5	7
8		min	-.005	7	-.003	2	-.004	5	-2.208e-5	9	-3.255e-5	8	-1.317e-4	2
9	N5	max	0	6	0	6	0	8	3.609e-4	8	9.686e-7	2	9.277e-5	3
10		min	0	3	0	3	0	5	-3.651e-4	5	-4.573e-7	7	-7.909e-5	6
11	N6	max	0	2	0	7	0	4	6.314e-4	4	4.571e-7	7	0	1
12		min	0	7	0	2	0	9	-6.234e-4	9	-9.686e-7	2	0	1
13	N7	max	0	6	0	6	0	4	3.651e-4	4	4.573e-7	7	9.277e-5	3
14		min	0	3	0	3	0	9	-3.609e-4	9	-9.686e-7	2	-7.909e-5	6
15	N8	max	0	2	0	7	0	8	6.234e-4	8	9.686e-7	2	0	1
16		min	0	7	0	2	0	5	-6.314e-4	5	-4.571e-7	7	0	1
17	N9	max	0	2	0	7	0	8	4.569e-6	8	1.965e-5	5	2.923e-5	6
18		min	0	7	0	2	0	5	-6.671e-6	5	-1.882e-5	8	-3.827e-5	3
19	N10	max	0	6	0	6	0	4	8.926e-6	4	6.643e-6	5	5.599e-5	7
20		min	0	3	0	3	0	9	-7.85e-6	9	-5.98e-6	8	-6.152e-5	2
21	N11	max	0	6	0	6	0	8	7.85e-6	8	5.98e-6	9	5.599e-5	7
22		min	0	3	0	3	0	5	-8.926e-6	5	-6.643e-6	4	-6.152e-5	2
23	N12	max	0	2	0	7	0	4	6.671e-6	4	1.882e-5	9	2.923e-5	6
24		min	0	7	0	2	0	9	-4.569e-6	9	-1.965e-5	4	-3.827e-5	3
25	N13	max	.002	2	0	7	.002	8	1.984e-5	4	2.159e-5	5	1.644e-5	7
26		min	-.002	7	-.002	2	-.002	5	-1.811e-5	9	-2.055e-5	8	-5.785e-5	2
27	N14	max	.002	2	0	6	.001	4	2.788e-5	8	2.078e-5	5	1.033e-4	7
28		min	-.002	7	-.001	3	-.001	9	-2.869e-5	5	-1.981e-5	8	-1.472e-4	2
29	N15	max	.002	2	0	6	.001	8	2.869e-5	4	1.981e-5	9	1.033e-4	7
30		min	-.002	7	-.001	3	-.001	5	-2.788e-5	9	-2.078e-5	4	-1.472e-4	2
31	N16	max	.002	2	0	7	.002	4	1.811e-5	8	2.055e-5	9	1.644e-5	7
32		min	-.002	7	-.002	2	-.002	9	-1.984e-5	5	-2.159e-5	4	-5.785e-5	2
33	N17	max	.005	2	0	7	.003	8	2.074e-5	8	3.08e-5	5	6.904e-5	7
34		min	-.004	7	-.003	2	-.003	5	-2.138e-5	5	-3.044e-5	8	-1.291e-4	2
35	N18	max	.005	2	0	6	.002	4	2.693e-5	4	2.999e-5	5	7.173e-5	7
36		min	-.004	7	-.001	3	-.002	9	-2.672e-5	9	-2.965e-5	8	-1.326e-4	2
37	N19	max	.005	2	0	6	.002	8	2.672e-5	8	2.965e-5	9	7.173e-5	7
38		min	-.004	7	-.001	3	-.002	5	-2.693e-5	5	-2.999e-5	4	-1.326e-4	2
39	N20	max	.005	2	0	7	.003	4	2.138e-5	4	3.044e-5	9	6.904e-5	7
40		min	-.004	7	-.003	2	-.003	9	-2.074e-5	9	-3.08e-5	4	-1.291e-4	2

Envelope Plate/Shell Principal Stresses

	Plate		Surf...	Sigma1 [ksi]	LC	Sigma2 [ksi]	LC	Tau Max [ksi]	LC	Angle [rad]	LC	Von Mises [ksi]	LC
1	P1	max	T	.005	5	0	3	.005	5	2.349	4	.008	5
2		min		0	1	-.005	9	0	1	-.785	8	0	1
3		max	B	.005	5	0	3	.005	5	2.349	4	.008	5
4		min		0	1	-.005	9	0	1	-.785	8	0	1
5	P2	max	T	.017	5	.005	3	.008	4	.612	8	.016	4
6		min		.004	7	-.003	8	0	7	-.612	9	.004	7
7		max	B	.017	5	.005	3	.008	4	.612	8	.016	4

Allowable stress = 15 ksi > Max. stress = 1.3 ksi, (O.K.)

Envelope Plate/Shell Principal Stresses (Continued)

	Plate		Surf...	Sigma1 [ksi]	LC	Sigma2 [ksi]	LC	Tau Max [ksi]	LC	Angle [rad]	LC	Von Mises [ksi]	LC
8		min		.004	7	-.003	8	0	7	-.612	9	.004	7
9	P3	max	T	.051	2	.019	3	.026	2	1.571	7	.052	2
10		min		.013	7	-.006	6	.003	7	-.523	9	.012	7
11		max	B	.051	2	.019	3	.026	2	1.571	7	.052	2
12		min		.013	7	-.006	6	.003	7	-.523	9	.012	7
13	P4	max	T	.099	5	.015	3	.079	5	1.571	7	.139	5
14		min		.011	7	-.071	9	.004	7	-.753	9	.01	7
15		max	B	.099	5	.015	3	.079	5	1.571	7	.139	5
16		min		.011	7	-.071	9	.004	7	-.753	9	.01	7
17	P5	max	T	.008	9	0	6	.009	5	2.316	8	.015	5
18		min		0	2	-.011	5	0	2	0	6	0	6
19		max	B	.008	9	0	6	.009	5	2.316	8	.015	5
20		min		0	2	-.011	5	0	2	0	6	0	6
21	P6	max	T	.038	6	.006	6	.071	3	2.225	9	.173	3
22		min		-.049	3	-.192	3	.008	2	0	6	.025	2
23		max	B	.038	6	.006	6	.071	3	2.225	9	.173	3
24		min		-.049	3	-.192	3	.008	2	0	6	.025	2
25	P7	max	T	.228	6	.06	6	.192	3	2.252	9	.475	3
26		min		-.147	3	-.531	3	.037	2	0	2	.088	2
27		max	B	.228	6	.06	6	.192	3	2.252	9	.475	3
28		min		-.147	3	-.531	3	.037	2	0	2	.088	2
29	P8	max	T	.67	9	.129	6	.752	5	2.328	9	1.317	4
30		min		-.251	3	-.945	4	.069	1	0	2	.175	1
31		max	B	.67	9	.129	6	.752	5	2.328	9	1.317	4
32		min		-.251	3	-.945	4	.069	1	0	2	.175	1
33	P9	max	T	.005	8	-.003	7	.006	5	.848	8	.011	5
34		min		0	1	-.009	5	.002	1	-.521	9	.003	1
35		max	B	.005	8	-.003	7	.006	5	.848	8	.011	5
36		min		0	1	-.009	5	.002	1	-.521	9	.003	1
37	P10	max	T	.061	7	-.036	8	.126	2	.687	7	.262	2
38		min		-.058	5	-.27	2	.012	8	-.572	6	.032	8
39		max	B	.061	7	-.036	8	.126	2	.687	7	.262	2
40		min		-.058	5	-.27	2	.012	8	-.572	6	.032	8
41	P11	max	T	.152	7	-.029	8	.26	2	2.301	8	.556	2
42		min		-.143	5	-.585	2	.028	8	-.533	6	.048	8
43		max	B	.152	7	-.029	8	.26	2	2.301	8	.556	2
44		min		-.143	5	-.585	2	.028	8	-.533	6	.048	8
45	P12	max	T	.245	7	-.173	8	.392	2	2.35	8	.855	2
46		min		-.197	5	-.912	2	.142	1	-.522	6	.301	8
47		max	B	.245	7	-.173	8	.392	2	2.35	8	.855	2
48		min		-.197	5	-.912	2	.142	1	-.522	6	.301	8
49	P13	max	T	.005	9	-.003	7	.006	4	.848	9	.011	4
50		min		0	1	-.009	4	.002	1	-.521	8	.003	1
51		max	B	.005	9	-.003	7	.006	4	.848	9	.011	4
52		min		0	1	-.009	4	.002	1	-.521	8	.003	1
53	P14	max	T	.061	7	-.036	9	.126	2	.687	7	.262	2
54		min		-.058	4	-.27	2	.012	9	-.572	6	.032	9
55		max	B	.061	7	-.036	9	.126	2	.687	7	.262	2
56		min		-.058	4	-.27	2	.012	9	-.572	6	.032	9
57	P15	max	T	.152	7	-.029	9	.26	2	2.301	9	.556	2
58		min		-.143	4	-.585	2	.028	9	-.533	6	.048	9
59		max	B	.152	7	-.029	9	.26	2	2.301	9	.556	2
60		min		-.143	4	-.585	2	.028	9	-.533	6	.048	9
61	P16	max	T	.245	7	-.173	9	.392	2	2.35	9	.855	2
62		min		-.197	4	-.912	2	.142	1	-.522	6	.301	9
63		max	B	.245	7	-.173	9	.392	2	2.35	9	.855	2
64		min		-.197	4	-.912	2	.142	1	-.522	6	.301	9

Envelope Plate Forces (per ft)

	Plate		Qx [k]	LC	Qy [k]	LC	Mx [k-ft]	LC	My [k-ft]	LC	Mxy [k-ft]	LC	Fx [k]	LC	Fy [k]	LC	Fxy [k]	LC
1	P1	max	0	1	.001	8	0	1	0	1	0	1	0	3	0	3	.002	5
2		min	0	1	-.001	5	0	1	0	1	0	1	0	1	0	1	-.002	8
3	P2	max	0	1	.015	8	0	1	0	1	0	1	.011	2	.004	3	.004	8
4		min	0	1	-.015	5	0	1	0	1	0	1	.003	7	0	6	-.004	9
5	P3	max	0	1	.039	8	0	1	0	1	0	1	.037	2	.013	3	.008	4
6		min	0	1	-.039	5	0	1	0	1	0	1	.005	7	-.004	6	-.008	9
7	P4	max	0	1	.025	8	0	1	0	1	0	1	.03	2	.011	3	.056	8
8		min	0	1	-.025	5	0	1	0	1	0	1	.003	7	-.004	6	-.056	5
9	P5	max	0	1	0	1	0	1	0	1	0	1	0	6	0	7	.002	5
10		min	0	1	0	1	0	1	0	1	0	1	0	3	0	2	-.002	4
11	P6	max	0	1	0	1	0	1	0	1	0	1	.007	6	.001	6	.011	8
12		min	0	1	0	1	0	1	0	1	0	1	-.035	3	-.009	3	-.011	9
13	P7	max	0	1	0	1	0	1	0	1	0	1	.041	6	.011	6	.026	4
14		min	0	1	0	1	0	1	0	1	0	1	-.096	3	-.026	3	-.026	5
15	P8	max	0	1	0	1	0	1	0	1	0	1	.079	6	.023	6	.134	8
16		min	0	1	0	1	0	1	0	1	0	1	-.154	3	-.045	3	-.134	5
17	P9	max	0	1	.002	5	0	1	0	1	0	1	0	5	0	8	.002	4
18		min	0	1	-.002	8	0	1	0	1	0	1	0	8	-.003	5	-.002	9
19	P10	max	0	1	.027	9	0	1	0	1	0	1	-.005	8	-.013	8	.035	3
20		min	0	1	-.027	4	0	1	0	1	0	1	-.022	5	-.095	5	-.035	6
21	P11	max	0	1	.049	5	0	1	0	1	0	1	-.002	8	0	8	.069	3
22		min	0	1	-.049	8	0	1	0	1	0	1	-.056	5	-.215	5	-.069	6
23	P12	max	0	1	0	1	0	1	0	1	0	1	0	8	.001	8	.103	7
24		min	0	1	0	1	0	1	0	1	0	1	-.094	5	-.325	5	-.103	2
25	P13	max	0	1	.002	9	0	1	0	1	0	1	0	4	0	9	.002	5
26		min	0	1	-.002	4	0	1	0	1	0	1	0	9	-.003	4	-.002	8
27	P14	max	0	1	.027	5	0	1	0	1	0	1	-.005	9	-.013	9	.035	3
28		min	0	1	-.027	8	0	1	0	1	0	1	-.022	4	-.095	4	-.035	6
29	P15	max	0	1	.049	9	0	1	0	1	0	1	-.002	9	0	9	.069	3
30		min	0	1	-.049	4	0	1	0	1	0	1	-.056	4	-.215	4	-.069	6
31	P16	max	0	1	0	1	0	1	0	1	0	1	0	9	.001	9	.103	7
32		min	0	1	0	1	0	1	0	1	0	1	-.094	4	-.325	4	-.103	2

Envelope Plate/Shell Corner Forces

	Plate	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
1	P1	N2	max	.002	4	.004	5	.003	5	.004	8	0	9	0	2
2			min	-.002	9	-.002	8	-.003	8	-.004	5	0	4	0	7
3		N1	max	.002	8	.002	5	.002	8	0	4	0	9	0	2
4			min	-.002	5	0	8	-.003	5	0	9	0	4	0	7
5		N3	max	.002	9	.002	4	.003	4	0	8	0	5	0	2
6			min	-.002	4	0	9	-.002	9	0	5	0	8	0	7
7		N4	max	.002	5	.004	4	.003	9	.004	4	0	5	0	2
8			min	-.002	8	-.002	9	-.003	4	-.004	9	0	8	0	7
9	P2	N20	max	.051	3	.116	5	.029	9	.032	4	0	9	0	2
10			min	-.028	6	.019	8	-.029	4	-.032	9	0	4	0	7
11		N19	max	.032	7	.109	5	.042	9	.022	4	0	9	0	2
12			min	-.055	2	.025	8	-.048	4	-.022	9	0	4	0	7
13		N18	max	.032	7	.109	4	.048	5	.022	8	0	5	0	2
14			min	-.055	2	.025	9	-.042	8	-.022	5	0	8	0	7
15		N17	max	.051	3	.116	4	.029	5	.032	8	0	5	0	2
16			min	-.028	6	.019	9	-.029	8	-.032	5	0	8	0	7
17	P3	N16	max	.076	3	.142	5	.023	5	.077	8	0	9	0	2
18			min	-.005	6	-.008	8	-.023	8	-.077	5	0	4	0	7
19		N15	max	.028	7	.134	5	.044	9	.063	4	0	9	0	3
20			min	-.098	2	0	8	-.064	4	-.063	9	0	4	0	6

Envelope Plate/Shell Corner Forces (Continued)

	Plate	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
21		N14	max	.028	7	.134	4	.064	5	.063	8	0	5	0	3
22			min	-.098	2	0	9	-.044	8	-.063	5	0	8	0	6
23		N13	max	.076	3	.142	4	.023	9	.077	4	0	5	0	2
24			min	-.005	6	-.008	9	-.023	4	-.077	9	0	8	0	7
25	P4	N12	max	.113	5	.125	5	.057	8	.048	4	0	9	0	3
26			min	-.058	8	.009	8	-.057	5	-.048	9	0	4	0	6
27		N11	max	.033	9	.122	5	.126	9	.042	8	0	9	0	3
28			min	-.087	4	.013	8	-.14	4	-.042	5	0	4	0	6
29		N10	max	.033	8	.122	4	.14	5	.042	4	0	5	0	3
30			min	-.087	5	.013	9	-.126	8	-.042	9	0	8	0	6
31		N9	max	.113	4	.125	4	.057	4	.048	8	0	5	0	3
32			min	-.058	9	.009	9	-.057	9	-.048	5	0	8	0	6
33	P5	N1	max	0	3	0	6	.003	5	0	4	0	8	0	5
34			min	0	6	-.001	3	-.003	8	0	9	0	5	0	8
35		N19	max	0	7	.005	4	.002	8	0	8	0	9	0	5
36			min	0	2	-.002	9	-.002	5	0	5	0	4	0	8
37		N18	max	0	7	.005	5	.002	4	0	4	0	5	0	4
38			min	0	2	-.002	8	-.002	9	0	9	0	8	0	9
39		N3	max	0	3	0	6	.003	9	0	8	0	4	0	4
40			min	0	6	-.001	3	-.003	4	0	5	0	9	0	9
41	P6	N19	max	0	3	.012	6	.022	4	0	8	0	9	0	4
42			min	0	6	-.057	3	-.016	9	0	5	0	4	0	9
43		N15	max	0	7	.058	3	.022	5	0	4	0	8	0	4
44			min	0	2	-.011	6	-.016	8	0	9	0	5	0	9
45		N14	max	0	7	.058	3	.016	9	0	8	0	4	0	5
46			min	0	2	-.011	6	-.022	4	0	5	0	9	0	8
47		N18	max	0	3	.012	6	.016	8	0	4	0	5	0	5
48			min	0	6	-.057	3	-.022	5	0	9	0	8	0	8
49	P7	N15	max	0	3	.069	6	.053	4	0	4	0	9	0	2
50			min	0	6	-.159	3	-.04	9	0	9	0	4	0	7
51		N11	max	0	7	.16	3	.053	5	0	8	0	9	0	2
52			min	0	2	-.068	6	-.04	8	0	5	0	4	0	7
53		N10	max	0	7	.16	3	.04	9	0	4	0	5	0	2
54			min	0	2	-.068	6	-.053	4	0	9	0	8	0	7
55		N14	max	0	3	.069	6	.04	8	0	8	0	5	0	2
56			min	0	6	-.159	3	-.053	5	0	5	0	8	0	7
57	P8	N11	max	0	8	.132	6	.224	4	0	8	0	8	0	6
58			min	0	5	-.257	3	-.223	9	0	5	0	5	0	3
59		N5	max	0	3	.257	3	.226	5	0	8	0	8	0	6
60			min	0	6	-.132	6	-.223	8	0	5	0	5	0	3
61		N7	max	0	3	.257	3	.223	9	0	4	0	4	0	6
62			min	0	6	-.132	6	-.226	4	0	9	0	9	0	3
63		N10	max	0	9	.132	6	.223	8	0	4	0	4	0	6
64			min	0	4	-.257	3	-.224	5	0	9	0	9	0	3
65	P9	N2	max	.002	9	.002	8	.003	8	.004	5	0	4	0	7
66			min	-.002	4	-.004	5	-.003	5	-.004	8	0	9	0	2
67		N1	max	.002	5	0	7	0	4	0	9	0	4	0	7
68			min	-.002	8	-.001	2	0	9	0	4	0	9	0	2
69		N19	max	.002	8	.006	4	0	9	0	9	0	4	0	7
70			min	-.003	5	-.003	9	0	4	0	4	0	9	0	2
71		N20	max	.003	4	.009	5	.004	5	.004	5	0	4	0	7
72			min	-.001	9	-.005	8	-.004	8	-.004	8	0	9	0	2
73	P10	N20	max	.028	6	-.014	8	.033	4	.029	9	0	4	0	7
74			min	-.053	3	-.125	5	-.033	9	-.029	4	0	9	0	2
75		N19	max	.058	2	-.004	7	.024	8	.021	9	0	4	0	7
76			min	-.033	7	-.09	2	-.024	5	-.021	4	0	9	0	2
77		N15	max	.052	3	.106	3	.025	9	.021	9	0	4	0	7

Envelope Plate/Shell Corner Forces (Continued)

	Plate	Joint		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
78			min	-.03	6	-.01	6	-.025	4	-.021	4	0	9	0	2
79		N16	max	.034	7	.162	2	.034	9	.029	9	0	4	0	7
80			min	-.056	2	-.022	7	-.034	4	-.029	4	0	9	0	2
81	P11	N16	max	.051	6	-.01	8	.057	8	.048	5	0	4	0	7
82			min	-.1	3	-.264	5	-.057	5	-.048	8	0	9	0	2
83		N15	max	.119	2	.013	8	.049	4	.042	9	0	4	0	7
84			min	-.071	7	-.2	5	-.049	9	-.042	4	0	9	0	2
85		N11	max	.101	3	.22	3	.05	9	.042	9	0	4	0	7
86			min	-.052	6	-.031	6	-.05	4	-.042	4	0	9	0	2
87		N12	max	.071	7	.377	2	.057	5	.048	5	0	4	0	6
88			min	-.12	2	-.101	7	-.057	8	-.048	8	0	9	0	3
89	P12	N12	max	.109	6	.063	7	0	4	0	9	0	9	0	6
90			min	-.115	3	-.473	2	0	9	0	4	0	4	0	3
91		N11	max	.117	2	.04	8	0	8	0	5	0	9	0	7
92			min	-.111	7	-.331	5	0	5	0	8	0	4	0	2
93		N5	max	.119	3	.345	5	0	5	0	5	0	5	0	3
94			min	-.104	6	-.054	8	0	8	0	8	0	8	0	6
95		N6	max	.111	7	.495	2	0	9	0	1	0	1	0	1
96			min	-.126	2	-.084	7	0	4	0	1	0	1	0	1
97	P13	N4	max	.002	8	.002	9	.003	4	.004	9	0	8	0	7
98			min	-.002	5	-.004	4	-.003	9	-.004	4	0	5	0	2
99		N3	max	.002	4	0	7	0	8	0	5	0	8	0	7
100			min	-.002	9	-.001	2	0	5	0	8	0	5	0	2
101		N18	max	.002	9	.006	5	0	5	0	5	0	8	0	7
102			min	-.003	4	-.003	8	0	8	0	8	0	5	0	2
103		N17	max	.003	5	.009	4	.004	9	.004	9	0	8	0	7
104			min	-.001	8	-.005	9	-.004	4	-.004	4	0	5	0	2
105	P14	N17	max	.028	6	-.014	9	.033	8	.029	5	0	8	0	7
106			min	-.053	3	-.125	4	-.033	5	-.029	8	0	5	0	2
107		N18	max	.058	2	-.004	7	.024	4	.021	5	0	8	0	7
108			min	-.033	7	-.09	2	-.024	9	-.021	8	0	5	0	2
109		N14	max	.052	3	.106	3	.025	5	.021	5	0	8	0	7
110			min	-.03	6	-.01	6	-.025	8	-.021	8	0	5	0	2
111		N13	max	.034	7	.162	2	.034	5	.029	5	0	8	0	7
112			min	-.056	2	-.022	7	-.034	8	-.029	8	0	5	0	2
113	P15	N13	max	.051	6	-.01	9	.057	4	.048	9	0	8	0	7
114			min	-.1	3	-.264	4	-.057	9	-.048	4	0	5	0	2
115		N14	max	.119	2	.013	9	.049	8	.042	5	0	8	0	7
116			min	-.071	7	-.2	4	-.049	5	-.042	8	0	5	0	2
117		N10	max	.101	3	.22	3	.05	5	.042	5	0	8	0	7
118			min	-.052	6	-.031	6	-.05	8	-.042	8	0	5	0	2
119		N9	max	.071	7	.377	2	.057	9	.048	9	0	8	0	6
120			min	-.12	2	-.101	7	-.057	4	-.048	4	0	5	0	3
121	P16	N9	max	.109	6	.063	7	0	8	0	5	0	5	0	6
122			min	-.115	3	-.473	2	0	5	0	8	0	8	0	3
123		N10	max	.117	2	.04	9	0	4	0	9	0	5	0	7
124			min	-.111	7	-.331	4	0	9	0	4	0	8	0	2
125		N7	max	.119	3	.345	4	0	9	0	9	0	9	0	3
126			min	-.104	6	-.054	9	0	4	0	4	0	4	0	6
127		N8	max	.111	7	.495	2	0	5	0	1	0	1	0	1
128			min	-.126	2	-.084	7	0	8	0	1	0	1	0	1

1.2 Anchor Bolt Design

(When EQ governs)

Anchor Bolts

Bolt Number = **1**

T (Tension on Bolt) = **83** lbs. (From RISA Results)

V (Shear on Bolt) = **226** lbs. (From RISA Results)

Try Min. (1) **1/2** **ϕ Hilti Kwik HUS Carbon Steel Screw Anchor System with Min. 2.25" Embedment** (ESR 3027)

f'_c = **2,500** psi

$\beta_N = N_u/\phi N_n$	$\beta_V = V_u/\phi V_n$	ζ	$\beta_{N,V}$ (%)	
0.107	**0.27**	**1.67**	**13.7**	**(See attached calculation)**

$\beta_{N,V} = \beta_N^{\zeta} + \beta_V^{\zeta} =$ **0.1369** < **1.0** (O.K.)

Use Min. (1) **1/2** **ϕ Hilti Kwik HUS Carbon Steel Screw Anchor System with Min. 2.25" Embedment** (ESR 3027)

See attached calculations for Strength Check

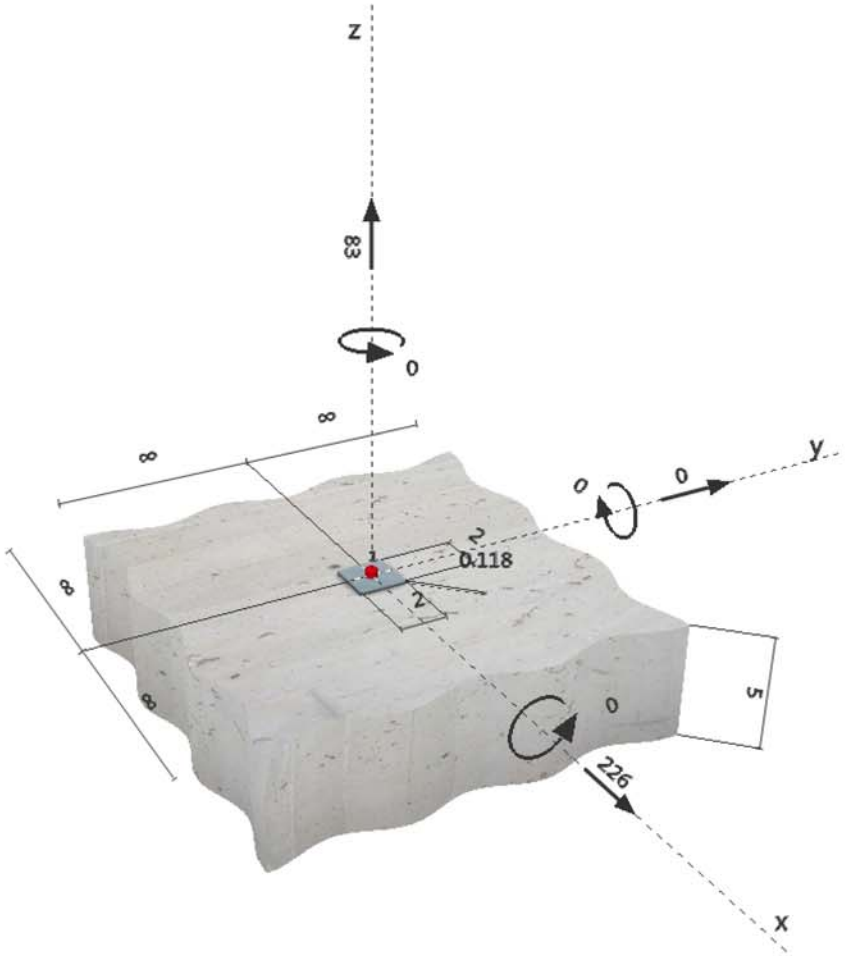
Company:		Page:	1
Specifier:		Project:	Propane Cage
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	11/14/2013
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**KWIK HUS-EZ (KH-EZ) 1/2 (2 1/4)**
Effective embedment depth:	h_{ef} = 1.520 in., h_{nom} = 2.250 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-3027
Issued I Valid:	8/1/2012 | 12/1/2013
Proof:	design method ACI 318 / AC193
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.118 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.118 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2500 psi; h = 5.000 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)	yes (D.3.3.5)

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



Company:		Page:	2
Specifier:		Project:	Propane Cage
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	11/14/2013
E-Mail:			

2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	83	777	11 / -	OK
Shear	Pryout Strength	226	836	- / 28	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.107	0.270	5/3	14	OK

3 Warnings

- Please consider all details and hints/warnings given in the detailed report!

Fastening meets the design criteria!

4 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.
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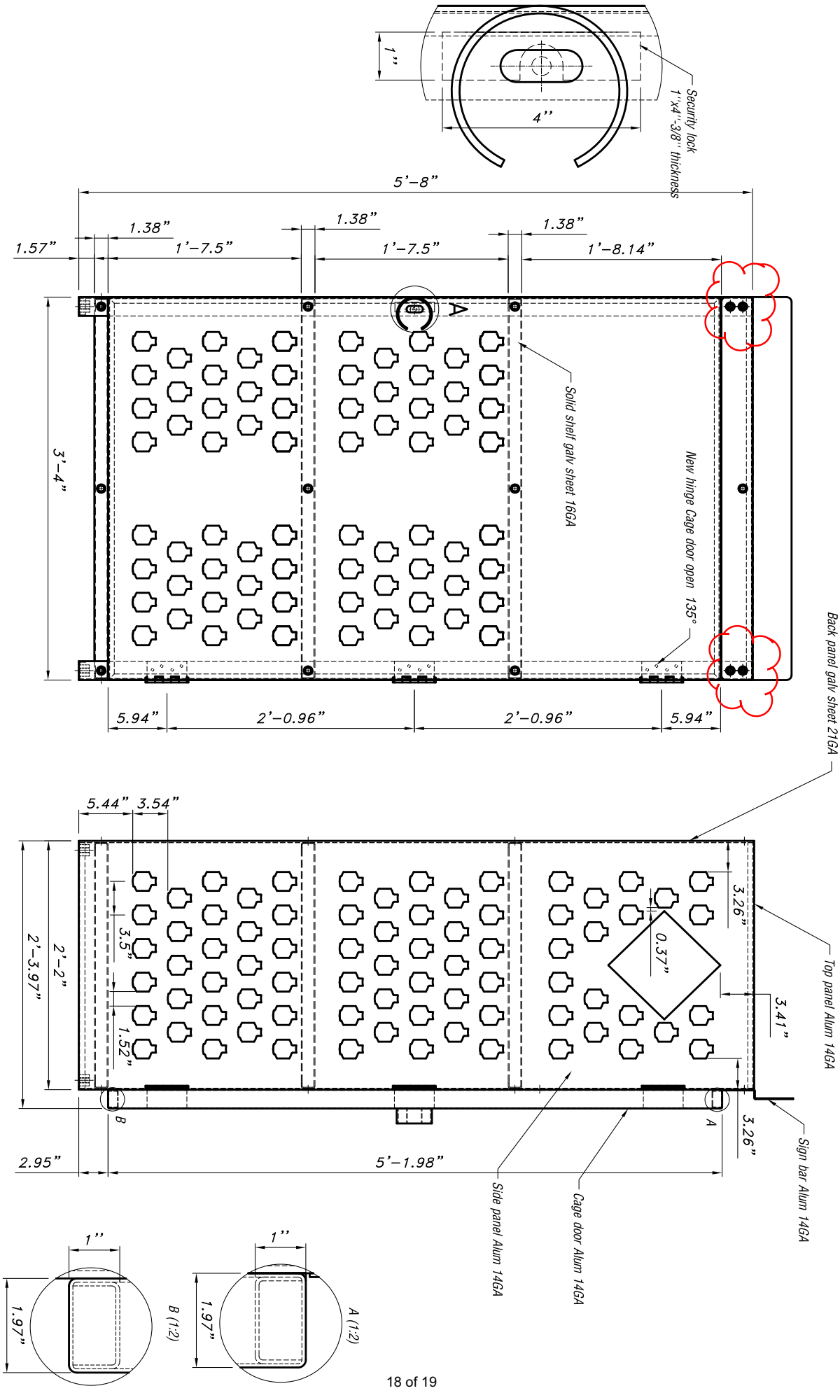
PO#5927
QTY: 50 PCS

CEC-20#-18 ALUM



SBI-Imports Product List - 5-15-2013

	Part Number	Description	Weight
Galv PC White	CEC-20#-18	Exchange Cylinder 18 Count for 20# - White Powder Coat	300
	CEC-20#12	Exchange Cylinder 12 Count for 20# - White Powder Coat	260
	CEC-20#-4	Exchange Cylinder 4 Count for 20# - White Powder Coat	110
	CEC-30#-8	Exchange Cylinder 12 Count for 30# - White Powder Coat	160
	CEC-30#-12	Exchange Cylinder 12 Count for 30# - White Powder Coat	340
	FCC-33#-18	Forklift Cylinder 18 Count for 33# - White Powder Coat	420
	FCC-33#-16	Forklift Cylinder 16 Count for 33# - White Powder Coat	340
	FCC-33#-12	Forklift Cylinder 12 Count for 33# - White Powder Coat	300
	FCC-33#-12HS	Forklift Cylinder 12 Count for 33# High Security - White PC	300
	FCC-33#-9	Forklift Cylinder 9 Count for 33# - White Powder Coat	190
	FCC-33#-8	Forklift Cylinder 8 Count for 33# - White Powder Coat	160
	FCC-33#-6	Forklift Cylinder 6 Count for 33# - White Powder Coat	160
	FCC-33#-4	Forklift Cylinder 4 Count for 33# - White Powder Coat	110
Aluminimum Cages	CEC-20#-18-ALM	Exchange Cylinder 18 Count for 20# - Aluminum	170
	CEC-20#12-ALM	Exchange Cylinder 12 Count for 20# - Aluminum	150

20# Propane bottles weigh approximately 37 lbs.
33# Propane bottles weigh approximately 53 lbs.

Weights can vary slightly +/- 2 or 3 pounds depending on manufacturer of bottles.