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ENGINEERING + DESIGN

6593 Riverdale St.
San Diego, CA 92120
619-727-4800

Structural Calculations
for
CBISC-02 Series

CBISCLXL** SERIES

Prepared for:

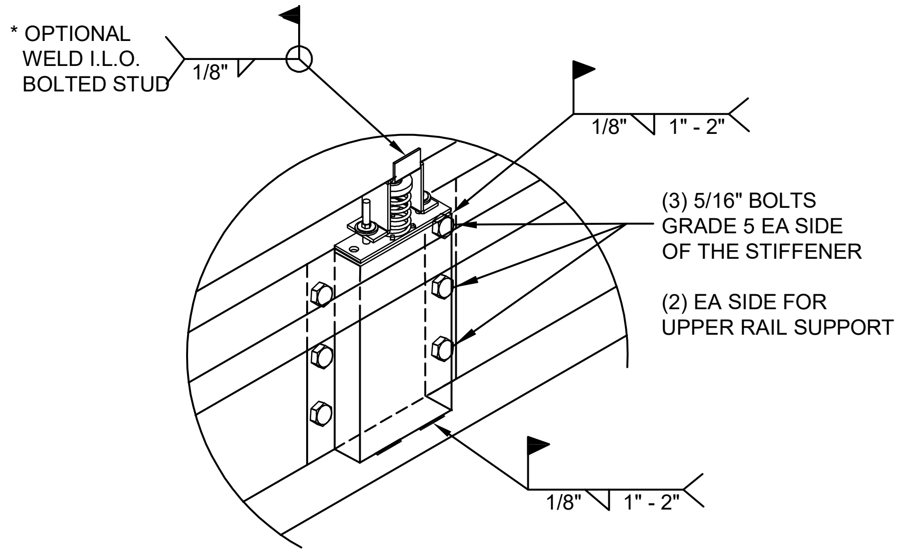
PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

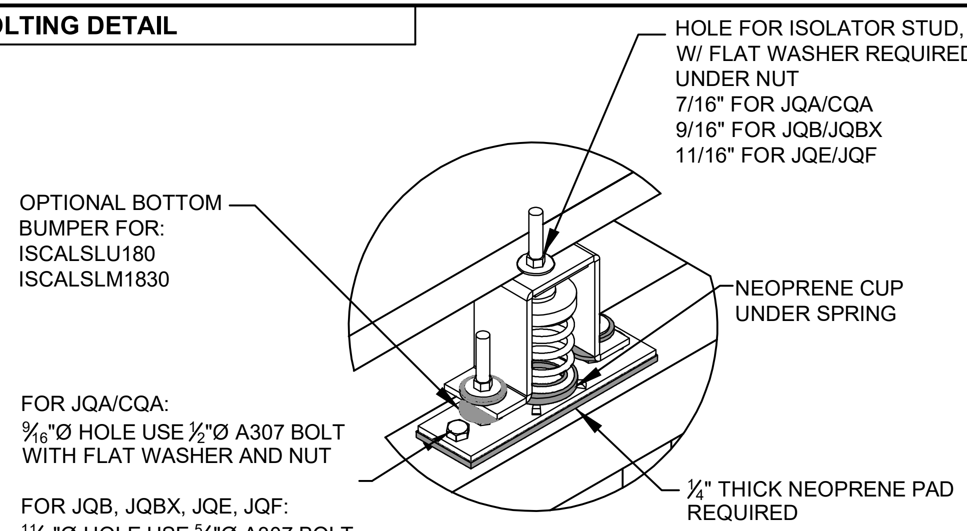
Date: August 23, 2023

Project Number: PV2312

WELDMENT AND BOLTING DETAIL



BASE CURB SUPPORT



FOR BOLT ON ISOLATORS

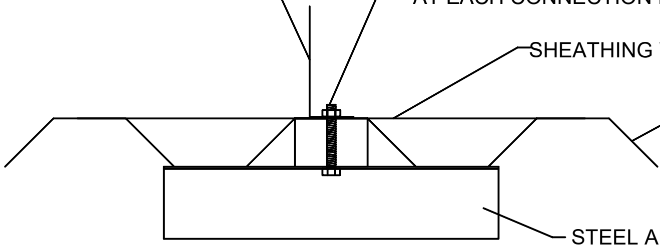
Note: * - INDICATES WELD REQUIRED I.L.O.
BOLTED STUD FOR THE FOLLOWING CURBS:
- -LXL (CBISC-02)
- -PRD3715 (CBISC-04)
- -SAV1518 (CBISC-12)
- -SAV2025 (CBISC-13)
- -SAV28 (CBISC-14)

ProVent
3847 WABASH DRIVE
MIRA LOMA, CA 91725
PHONE (951) 685-1101
FAX (619) 872-9799

SUBMITTED TO:______
COMPANY:______
JOB NAME:______
EQUIPMENT:______
NOTES:______

FORM NO:		
CB-61		
DATE:	REV:	DRAWN BY:
08/14/23	2	FMM

STEEL ATTACHMENT



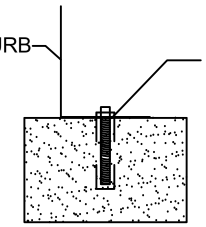
CURB	NO. OF ANCHORAGE BOLTS REQUIRED	
	LONG SIDE	SHORT SIDE
LXS	3 @ 19.25" O.C.	2 @ 23" O.C.
LXL	3 @ 19.25" O.C.	2 @ 33" O.C.
SUN3672	4 @ 21" O.C.	2 @ 27.25" O.C.
PRD3715	6 @ 14.28" O.C.	3 @ 20.75" O.C.
PRS	4 @ 20.46" O.C.	2 @ 31.13" O.C.
PRL	5 @ 17.44" O.C.	2 @ 41.5" O.C.
SAV1518	6 @ 22.43" O.C	3 @ 35.56" O.C.
SAV2025	7 @ 21.02" O.C	3 @ 35.56" O.C.
SAV28	7 @ 23.75" O.C	3 @ 35.56" O.C.

ASSUMES:
CONC SLAB
f'c= 4000PSI MINIMUM
6" MIN THICKNESS
NORMAL WEIGHT CONCRETE
MIN. 9-1/8" EDGE DISTANCE.

Meets seismic requirements for the following codes:
CBC 2022
IBC 2021

ROOF ANCHORAGE DETAIL
CBISC Series
LXS
LXL
SUN3672
PRD3715
PRS
PRL
SAV1518
SAV2025
SAV28

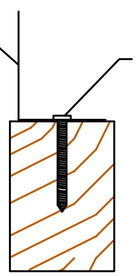
CONCRETE ATTACHMENT



CURB	NO. OF ANCHORAGE BOLTS REQUIRED	
	LONG SIDE	SHORT SIDE
LXS	4 @ 12.83" O.C.	2 @ 23.0" O.C.
LXL	4 @ 12.83" O.C.	3 @ 16.50" O.C.
SUN3672	4 @ 21.0" O.C.	2 @ 27.25" O.C.
PRD3715	9 @ 8.92" O.C.	6 @ 8.30" O.C.
PRS	5 @ 15.34" O.C.	3 @ 15.56" O.C.
PRL	7 @ 11.63" O.C.	4 @ 13.83" O.C.
SAV1518	8 @ 16.02" O.C.	6 @ 14.23" O.C.
SAV2025	9 @ 15.77" O.C.	6 @ 14.23" O.C.
SAV28	10 @ 15.83" O.C.	6 @ 14.23" O.C.

*** SIX INCHES FROM EACH CORNER EVENLY SPACED.**
**** CENTERED.**

WOOD ATTACHMENT



CURB	NO. OF ANCHORAGE SCREWS REQUIRED	
	LONG SIDE	SHORT SIDE
LXS	8 @ 6.07" O.C.	5 @ 6.75" O.C.
LXL	7 @ 7.08" O.C.	7 @ 6.17" O.C.
SUN3672	9 @ 8.38" O.C.	5 @ 7.81" O.C.
PRD3715	15 @ 5.38" O.C.	10 @ 5.06" O.C.
PRS	10 @ 7.26" O.C.	6 @ 7.03" O.C.
PRL	12 @ 6.70" O.C.	8 @ 6.50" O.C.
SAV1518	15 @ 8.29" O.C.	10 @ 8.35" O.C.
SAV2025	18 @ 7.65" O.C.	10 @ 8.35" O.C.
SAV28	20 @ 7.71" O.C.	10 @ 8.35" O.C.

FOUR INCHES FROM EACH CORNER EVENLY SPACED

ProVent

3847 WABASH DRIVE
MIRA LOMA, CA 91752

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SUBMITTED TO: ____________
COMPANY: ____________
JOB NAME: ____________
EQUIPMENT: ____________
NOTES: ____________

FORM NO:		
CB-62		
DATE:	**REV:**	**DRAWN BY:**
6/28/2023	4	FMM

For wood, concrete and steel attachment see Roof Anchorage Detail, Form No. CB-62.

Welded Isolation springs housingare standard. For bolted spring housing, neoprene pads and spring cups see Weldment and Bolting Detail, Form No. CB-61

STRUCTURALLY CALCULATED VIBRATION ISOLATION ROOF CURB FOR LX SERIES LARGE CHASSIS UNITS

P***B CABINET

PROVENT P/N	A	B	EST. WEIGHT
CBISCLXL18**	8"	18"	205 Lbs.
CBISCLXL21**	11"	21"	224 Lbs.
CBISCLXL24**	14"	24"	239 Lbs.

**Note: Spring configuration must be added to part number at time of order

Weight of upper portion supported by spring isolators= 130 Lbs.

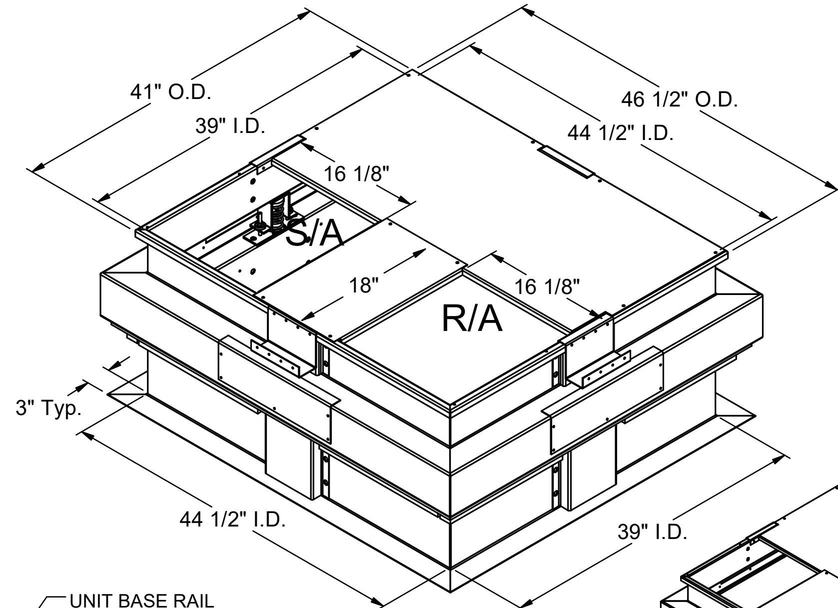
Meets seismic requirements for the following codes:
CBC 2022
IBC 2021

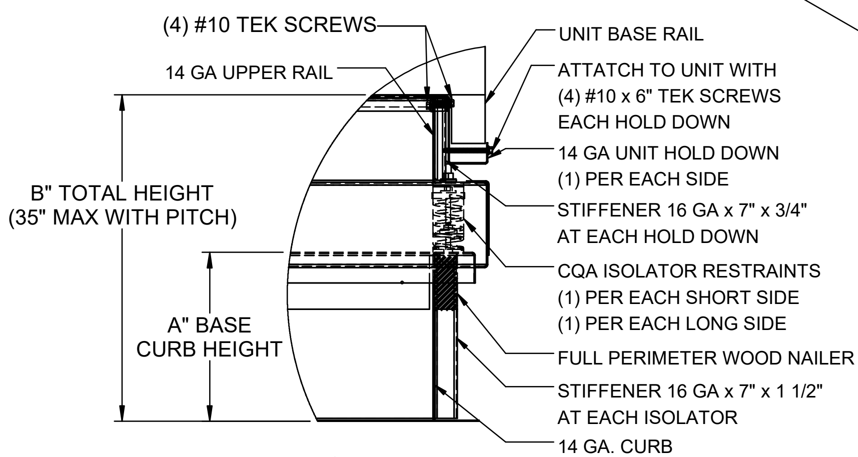
FEATURES

- Roof curbs sides and ends are 14 ga.
- Fully welded construction.
- Gasketing package provided.
- Heat treated wood nailer provided.
- insulated deck pans provided.
- Pitched curbs and taller curbs are available.
- CalDyn OSHPd pre-approved seismic restraints. (OPM-0401-13), (CQA).

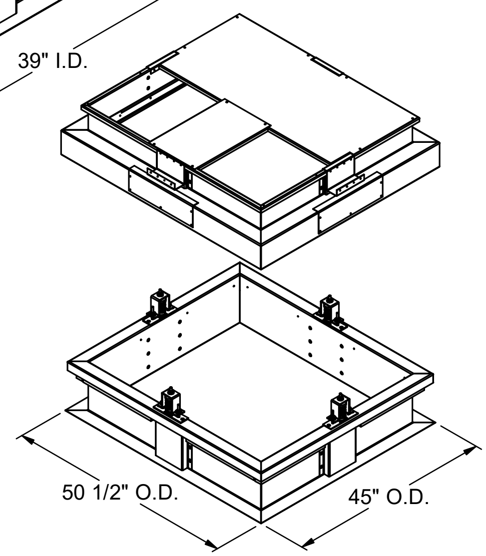
NOTES

- Attach ductwork to roof curb. Flanges of duct rest on top of the curb, Support ductwork below the curb.
- Thru the curb utillities are available. Contact you York distributor or Provent directly.





PROFILE DETAIL



ProVent

3847 WABASH DRIVE
MIRA LOMA, CA 91752

PHONE (951) 685-1101
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SUBMITED TO:
COMPANY:
JOB NAME:
EQUIPMENT:
NOTES:

FORM NO: CBISC-02

PART NUMBER: -

DATE: 8/14/2023

REV: 5

DRAWN BY: FMM

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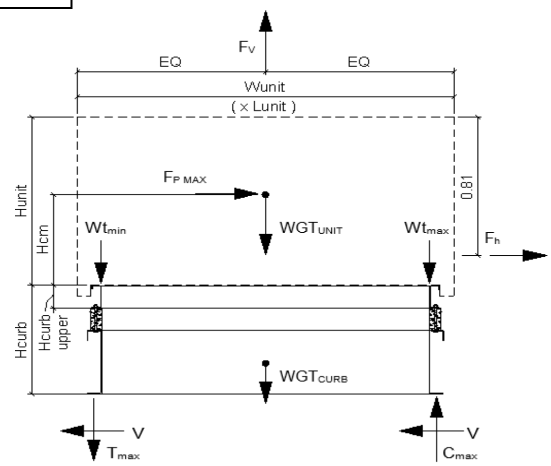
ENGINEERING + DESIGN

6593 Riverdale St.
San Diego, CA 92120
(619)727-4800

Client:	ProVent	PV2312	Upper curb rail
Project:	CBISC-02	Iso Curb	CBISCLXL
Unit:	ALL P***B CABINET		



Upper Curb Information

Hcurb upper = 5.5 in (Height of upper curb rail)
Lcurb = 46.5 in (Length of upper curb)
wcurb = 41 in (Width of upper curb)
WGTupper = 130 lbs (Weight of upper curb)
# Clips long side = 1 # Clips short side = 1

Unit Information

WGTunit = 656 lbs (Weight of Unit)
Wtmax = 197 lbs (Maximum corner weight)
Wtmin = 139 lbs (Minimum corner weight)
Hunit = 55 in (Height of unit above curb)
Hcm = 27.5 in (Height to center of mass)
Lunit = 51.25 in (Length of unit)
Wunit = 45.75 in (Width of unit)

Seismic Loading - 2021 IBC/2022CBC

Ss = 2.85 (Worst case for majority of California)
Fa = 1.20 (Default Site Class D - Table 11.4-1 ASCE 7-16)
Ip = 1.50 (Importance Factor Category III Building)
Sms = 3.420 (Fa*Ss) ap = 2.5
Sds = 2.280 (2/3*Sms) Rp = 2
Fpmax = 5.130 Wp (0.4*ap*Sds*Ip)*Wp*3/Rp <=1.6*Sds*Ip*Wp
FpmaxASD = 2356 lbs (0.7*Fpmax) FpmaxASD = 2823 lbs
(unit only) (unit + upper rail)

Wind Loading - 2021 IBC/2022 CBC

Kz = 1.13 (For 60 ft roof height, Exposure C - Table 26.10-1 ACSE 7-16)
Kzt = 1.00 (Max. assumed topographic factor)
Kd = 0.85 (Directionality factor Table 26.6-1 ASCE 7-16)
Ke = 1.00 (Ground Elevation Factor Table 26.9-1 ASCE 7-16)
V = 110 (Wind velocity, mph for Occupancy Cat III-IV bldgs Exp. Cat C, Fig 26.5-1D - ASCE7-16)
$GCr_{(horiz)}$ = 1.9 (Refer Sect 29.4.1 ASCE 7-16)
$GCr_{(vert)}$ = 1.5 (Refer Sect 29.4.1 ASCE 7-16)
qz 29.8 psf = $0.00256*Kz*Kzt*Kd*Ke*V^2$ (Eq. 26.10-1 ASCE 7-16)
$F_{h\ ASD\ trans}$ = 730 lbs = 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ = 652 lbs = 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ = 436 lbs = 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Upper Curb Loading

Transverse:

$Compression_{SEISMIC}$ = 2099 lbs =[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ = 1502 lbs =[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb)]/wcurb
$Compression_{WIND}$ = 508 lbs =[$F_{h\ ASD\ trans}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ = 541 lbs =[$F_{h\ ASD\ trans}$*Hcm-2*0.6*Wtmin*wcurb+$F_{vertASD}$*wcurb/2]/wcurb
---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ = 1912 lbs =[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ = 1315 lbs =[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb)]/Lcurb
$Compression_{WIND}$ = 404 lbs =[$F_{h\ ASD\ long}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ = 436 lbs =[$F_{h\ ASD\ long}$*Hcm-2*0.6*Wtmin*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb
---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	2099	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1502	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	1912	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1315	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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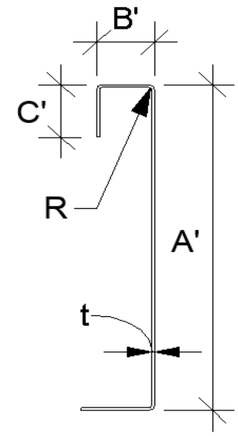
Curb Design

Fy = 50 ksi   Fu = 65 ksi
E = 29500 ksi   t = 0.0713 | 14 Gauge

Calculate Section Properties of Curb

A'=	5.500	in	a =	5.144 in	= A'-(2r+t)
B'=	1.000	in	a'=	5.429 in	= A'-t
C'=	0.000	in (0 if no lips)	b =	0.822 in	= B'-[r+t/2+α(r+t/2)]
α =	0.000	(0 - no Lip; 1 w/ lip)	b'=	0.964 in	= B'-(t/2+αt/2)
R =	0.1069	(Inside bend radius)	c =	0.000 in	= α[C'-(r+t/2)]
t =	0.0713	in	c'=	0.000 in	= α(C'-t/2)
r'=	0.143	in = R+t/2	u =	0.224 in	= πr/2
x =	0.129	in (Distance between centroid and web centerline)			
Ix =	1.899	in^4	rx =	1.92 in	
Iy =	0.034	in^4	ry =	0.257 in	
A =	0.52	in^2	rmin =	0.257 in	



Axial Compression

Pa =	1.178 k	(Max Axial Comp)
Pn/Ωc =	4.964 k	
Fe =	19.75 ksi	
λc =	1.59	
Fn =	17.32 ksi	
Ly =	39.00 in	Lateral unbraced length
k_yL_y/r_y =	121	(assume k=0.8)

Ω_c = 1.80

$$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c}$$

$$If\ \lambda_c \le 1.5;\ \ F_n = \left(0.658^{\lambda_c^2}\right) F_y$$

$$If\ \lambda_c > 1.5;\ \ F_n = \frac{0.877}{\lambda_c^{\ 2}} F_y$$

$$\lambda_c = \sqrt{\frac{F_y}{F_e}}$$

$$F_e = \frac{\pi^2 E}{\left(kl/r\right)^2}$$

Compression Check = O.K.

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50	
t =	0.0713 in	h/t =	77.14 ≤ 260	C_R = 0.08	(See table C3.4.1-2, fastened to
N =	7.00	N/t =	98.18 ≤ 210	C_N = 0.12	support, two flange, end loading)
Ω_w =	1.75	N/h =	1.273 ≤ 2.0	C_h = 0.048	
P_n =	1.947 k	R/t =	1.50 ≤ 12.0		
P_n/Ω_w =	1.112 k				

$$P_n = Ct^2 F_y \sin(90)\left(1 - C_R\sqrt{\frac{R}{t}}\right)\left(1 + C_N\sqrt{\frac{N}{t}}\right)\left(1 - C_h\sqrt{\frac{h}{t}}\right)$$

Long side: Pu_{Trans} = 2.099 k   **web stiffener REQ'D**   # clips = 1
Short side: Pu_{Long} = 1.912 k   **web stiffener REQ'D**   # clips = 1

Check Web Stiffener   16Ga x 3/4in x 7in (C-channel)

$$P_n = 0.7\left(P_{wc} + A_e F_y\right) \ge P_{wc}$$

width of stiffener =	7.000 in	ts =	0.0566 | 16 Gauge	Pwc =	1.947 k
web of stiff. w =	6.717 in	Rs =	0.0849 in	Pn =	14.669 k
***Check w/ts ≤ 1.28√E/Fys		Ω_c =	1.70	Ae =	0.380 in^2
w/ts =	118.675				
1.28√(E/Fys) =	31.091	--> w/ts over limit	Use C3.7.2	Pn/Ω_c =	8.629 k **O.K.**

Corner Connections   **1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts**

Tcrnmax = 706 lbs   Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1050 lbs   Max(Tens/2 -OR- Comp/2 corner connections per side)

Bolt:	Tall =	2480 lbs	Vall =	1208 lbs
Threaded Insert:	Tall =	2860 lbs	Vall =	1096 lbs

# of Bolts required for Tension = 0.3
# of Bolts required for Shear = 1.0
# of Bolts Used = 2.0

Check Combined Stress in Bolts & Inserts: 0.621 **O.K.**

Check 1/8" welded connection   <--- USE WELD   Ω = 2.35

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.710 in

$$P_n/_{\Omega} = \frac{1}{\Omega} 0.75tLF_u \ge V_{req}$$

$$L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$$

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Connection Unit to Curb Clip — #10 SMS screw — Ω = 3.0

t1 =	0.0713 in (clip thickness)	t2/t1 = 1.0	Fu1 =	65 ksi
t2 =	0.0713 in (unit base rail thickness)		Fu2 =	65 ksi
d =	0.190 in (screw diameter)		dw =	0.375 in (nom. washer diameter)

For t2/t1 ≤ 1.0: Pns = 2266 #

Shear: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ 2.27 k

Tension: $P_{ns} = 2.7t_1dF_{u1}$ 2.38 k

$P_{ns} = 2.7t_2dF_{u2}$ 2.38 k

For t2/t1 ≥ 2.5: Pns = 2377 #

$P_{ns} = 2.7t_1dF_{u1}$ 2.38 k

$P_{ns} = 2.7t_2dF_{u2}$ 2.38 k

Pns/Ω = 755 #

Pss/Ω = 540 # <- Controls

Pnot = 0.748 k (screw pull-out strength)

Pnov = 2.607 k (screw pull-over strength)

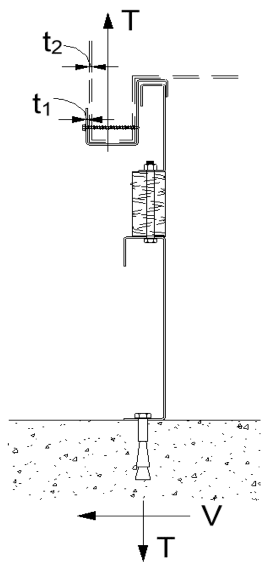
Pts/Ω = 249 # <- Controls

Pts/Ω = 820 # (full tensile screw capacity)

$P_{not} = 0.85t_cdF_{u2})$

$t_c = \min(t_1, t_2)$

$P_{nov} = 1.5t_1d_wF_{u1}$



	Shear (k)	# clips	V_{clip} (k)	V_{allow}(lb)	# screws	spacing
Long side:	1.178	1	1.18	540 #	4	2.00 in
Short side:	1.178	1	1.18	540 #	4	2.00 in

clip width (in) = 7.00 — clip height = 2.5 in

min spacing = 0.57 in — edge distance = 0.5 in (min. 1.5d)

Check Block shear rupture: O.K. — thinnest part = 0.0713 — AISI BSR applies

Fy = 50 ksi — Ω = 2.22 bolt/screw connection

Agv = 0.463 in² — Anv = 0.416 in² — Ant = 0.082 in²

Rn/Ω = 8.674 k — $R_n = 0.6F_yA_{gv} + F_uA_{nt} \le 0.6F_uA_{nv} + F_uA_{nt}$

BSR O.K. (AISI Sect. E5.3)

Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	2790	lbs
	$Tens_{MAX}$ =	2161	lbs
	$Shear_{MAX}$ =	2823	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2522	lbs
	$Tens_{MAX}$ =	1893	lbs
	$Shear_{MAX}$ =	2823	lbs

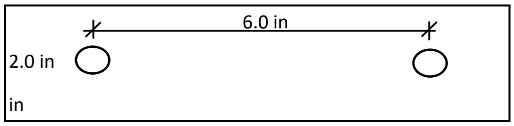
Loads at each Isolator Type: **CQA**

Transverse loading: (on long edge)	$Comp_{MAX}$ =	1395.1	lbs
	$Tens_{MAX}$ =	1080.7	lbs
# isolators: 2	$Shear_{MAX}$ =	470.4	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	2521.5	lbs
	$Tens_{MAX}$ =	1892.7	lbs
# isolators: 1	$Shear_{MAX}$ =	470.4	lbs

Max compression force on isolator: 2.522 k ≤ 3.176 k **O.K.**

Max uplift on isolator: 1.893 k ≤ 3.176 k **O.K.**

Max shear on isolator: 0.470 k ≤ 1.163 k **O.K.**



Forces on top bolt:

Tension = 1.893 k — d_b = 0.375

Shear = 0.470 k — ıpper rail, t = 0.0713 in

Shear on curb rail: $P_n = teF_u$ — Ω = 2.00 (Appendix A, Section E3.1 AISI)

Shear O.K. Pn/Ω = 4.635 k — e = 1.0 in

Net section rupture: $P_n = A_nF_t$ — Ω = 2.22 (Appendix A, Section E3.2 AISI)

Pn/Ω = 4.989 k — An = 0.116 in

N.S.R. O.K. — $F_t = (0.1 + 3d/s)F_u \le F_u =$ 43.063 ksi

Bolt Bearing Strength: $P_n = Cm_fdtF_u$ — Ω = 2.50 (Section E3.3.1 AISI)

Pn/Ω = 2.086 k — d/t = 5.26

Bearing O.K. — C = 3.00 — mf = 1.00

Shear and tension in bolt: (Appendix A, Section E3.4 AISI)

Tension: $P_{nt} = A_bF_{nt}$ — Fnt = 40.5 ksi — A_b = 0.1104 in²

Pnt/Ω = 1.988 k **Bolt tension O.K.** — Ωt = 2.25 (Table E3.4-1, AISI)

Shear: $P_{nv} = A_bF_{nv}$ — Fnv = 24.0 ksi — Ωv = 2.40 (Table E3.4-1, AISI)

Pnv/Ω = 1.104 k **Bolt shear O.K.**

Combined Shear and tension in bolt:

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}}f_v \le F_{nt}$ — ft = 17.14 ksi — fv = 4.26 ksi — O.K.

F'nt = 35.40 ksi — Fnv/Ω = 10.00 ksi

$P'_{nt} = A_bF'_{nt}$ — P'nt/Ω = 1.738 k **No Good - Use Welds**

Longitudinal weld loading: L = 1.5 — $P_n/\Omega = \frac{1}{\Omega}\left(1 - \frac{0.01L}{t_2}\right)Lt_2F_{u2} \ge V_{req}$ — Ω = 2.55

If L/t < 25: L/t = 21.04 — t = 0.0713 — Pn/Ω = 2.153 k

Transverse weld loading: t = 0.0713 — $P_n/\Omega = \frac{1}{\Omega}tLF_u \ge T_{req}$ — Ω = 2.35

L = 1 — Fu = 65 ksi — Pn/Ω = 1.972 k

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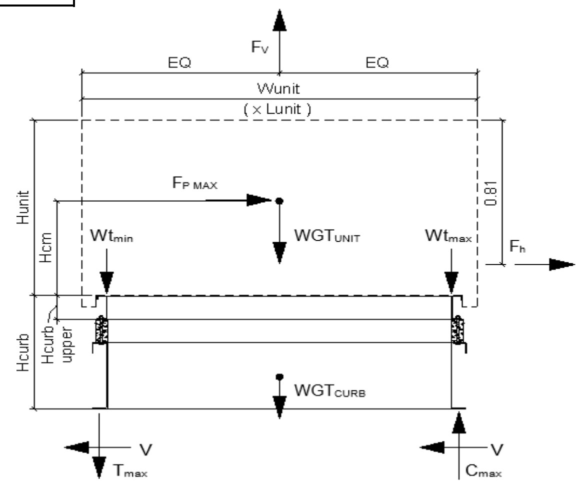
Client:	ProVent	PV2312		Base curb
Project:	CBISC-02	Iso Curb	CBISCLXL	
Unit:	ALL P***B CABINET			



Base Curb Information

Hbase curb =	25	in	(Height of base curb)
Lcurb =	50.5	in	(Length of base curb)
wcurb =	45	in	(Width of base curb)
WGTbase =	109	lbs	(Weight of base curb)

Springs long side = 2 # Springs short side = 1

Unit Information

WGTunit =	656	lbs	(Weight of Unit)
Wt'max =	229	lbs	(Wtmax+1/4*WGTupper)
Wt'min =	172	lbs	(Wtmin+1/4*WGTupper))
Hunit =	55	in	(Height of unit above curb)
H'cm =	37.5	in	(Hcm+10"(upper+spring))
Lunit =	51.25	in	(Length of unit)
Wunit =	45.75	in	(Width of unit)
$WGT_{unit+upper+base}$ =	895	lbs	(Total weight)

Seismic Loading - 2021 IBC/2022CBC

Ss =	2.85		(Worst case for majority of California)		
Fa =	1.20		(Default Site Class D - Table 11.4-1 ASCE 7-16)		
Ip =	1.50		(Importance Factor Category III Building)		
Sms =	3.420		(Fa*Ss)	ap =	2.5
Sds =	2.280		(2/3*Sms)	Rp =	2
Fpmax =	5.130	Wp	(0.4*ap*Sds*Ip)*Wp*3/Rp <=1.6*Sds*Ip*Wp		
FpmaxASD =	2823	lbs	(0.7*Fpmax)	FpmaxASD =	3214 lbs
	(unit + upper rail)				(unit + upper rail + base curb)

Wind Loading - 2021 IBC/2022 CBC

Kz =	1.13		(For 60 ft roof height, Exposure C - Table 26.10-1 ACSE 7-16)
Kzt =	1.00		(Max. assumed topographic factor)
Kd =	0.85		(Directionality factor Table 26.6-1 ASCE 7-16)
Ke =	1.00		(Ground Elevation Factor Table 26.9-1 ASCE 7-16)
V =	110		(Wind velocity, mph for Occupancy Cat III-IV bldgs Exp. Cat C, Fig 26.5-1D - ASCE7-16)
$GCr_{(horiz)}$ =	1.9		(Refer Sect 29.4.1 ASCE 7-16)
$GCr_{(vert)}$ =	1.5		(Refer Sect 29.4.1 ASCE 7-16)
qz	29.8	psf	= 0.00256*Kz*Kzt*Kd*Ke*V^2 (Eq. 26.10-1 ASCE 7-16)
$F_{h\ ASD\ trans}$ =	1086	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hbase curb+10") (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	970	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hbase curb+10")
$F_{vert\ ASD}$ =	436	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Base Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	2957	lbs	=[FpmaxASD*H'cm+2*(1+0.14S_{DS})*Wt'max*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2256	lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*wcurb)]/wcurb
$Compression_{WIND}$ =	963	lbs	=[$F_{h\ ASD\ trans}$*H'cm+2*0.6*Wt'max*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	917	lbs	=[$F_{h\ ASD\ trans}$*H'cm-2*0.6*Wt'min*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	2701	lbs	=[FpmaxASD*H'cm+2*(1+0.14*S_{DS})*Wt'max*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1999	lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*Lcurb)]/Lcurb
$Compression_{WIND}$ =	777	lbs	=[$F_{h\ ASD\ long}$*H'cm+2*0.6*Wt'max*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	732	lbs	=[$F_{h\ ASD\ long}$*H'cm-2*0.6*Wt'min*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	2957	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2256	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2701	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1999	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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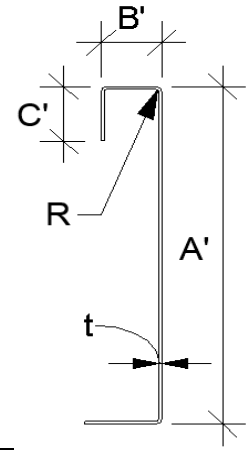
Curb Design

Fy = 50 ksi   Fu = 65 ksi
E = 29500 ksi   t = 0.0713 14 Gauge



Calculate Section Properties of Curb

A'=	25.000 in		a =	24.644 in	= A'-(2r+t)
B'=	1.750 in		a'=	24.929 in	= A'-t
C'=	0.000 in (0 if no lips)		b =	1.572 in	= B'-[r+t/2+α(r+t/2)]
α =	0.000 (0 - no Lip; 1 w/ lip)		b'=	1.714 in	= B'-(t/2+αt/2)
R =	0.1069 (Inside bend radius)		c =	0.000 in	= α[C'-(r+t/2)]
t =	0.0713 in		c'=	0.000 in	= α(C'-t/2)
r'=	0.143 in	= R+t/2	u =	0.224 in	= πr/2
x =	0.104 in (Distance between centroid and web centerline)				
Ix =	128.737 in		rx =	8.00 in	
Iy =	0.218 in		ry =	0.329 in	
A =	2.01 in^2		rmin =	0.329 in	

Axial Compression

Pu = 1.411 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 18.917 k
Fe = 19.29 ksi
λc = 1.61
Fn = 16.91 ksi
Ly = 50.50 in   Lateral unbraced length
k_yL_y/r_y = 123   (assume k=0.8)

$$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c} \quad If\ \lambda_c \le 1.5;\ F_n = \left(0.658^{\lambda_c^2}\right) F_y \quad If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c^2} F_y \quad \lambda_c = \sqrt{\frac{F_y}{F_e}} \quad F_e = \frac{\pi^2 E}{\left(kl/r\right)^2}$$

Compression Check = O.K.

Check Web Crippling

h =	25 in	-- Check limits:		C = 4.00
t =	0.0713 in	h/t =	350.63 ≤ 260	C_R = 0.14
N =	7.00	N/t =	98.18 ≤ 210	C_N = 0.35
Ω_w =	1.75	N/h =	0.28 ≤ 2.0	C_h = 0.02
P_n =	2.105 k	R/t =	1.50 ≤ 9.0	
P_n/Ω_w =	1.203 k			

(See table C3.4.1-2, fastened to support, one flange, end loading)

$$P_n = Ct^2F_y\sin(90)\left(1 - C_R\sqrt{\frac{R}{t}}\right)\left(1 + C_N\sqrt{\frac{N}{t}}\right)\left(1 - C_h\sqrt{\frac{h}{t}}\right)$$

Long side: Pu_{Trans} = 1.479 k **web stiffener REQ'D** # clips = 2
Short side: Pu_{Long} = 2.701 k **web stiffener REQ'D** # clips = 1

*****h/t > 260; use web stiffeners**

Check Web Stiffener   16Ga x 1.5in x 7in (C-channel)

width of stiffener = 7.000 in   ts = 0.0566 16 Gauge
web of stiff. w = 6.717 in   Rs = 0.0849 in
***Check w/ts ≤ 1.28√E/Fys Ω_c = 1.70

w/ts = 118.675
1.28√(E/Fys) = 31.091 --> w/ts over limit Use C3.7.2

$$P_n = 0.7\left(P_{wc} + A_eF_y\right) \ge P_{wc}$$

Pwc = 2.105 k   Ae = 0.380 in^2
Pn = 14.780 k
Pn/Ω_c = 8.694 k **O.K.**

Corner Connections   **1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts**

Tcrnmax = 803 lbs   Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1479 lbs   Max(Tens/2 -OR- Comp/2 corner connections per side)

Bolt:	Tall =	2480 lbs	Vall =	1208 lbs
Threaded Insert:	Tall =	2860 lbs	Vall =	1096 lbs

# of Bolts required for Tension = 0.3
# of Bolts required for Shear = 1.3
# of Bolts Used = 3.0
Check Combined Stress in Bolts & Inserts: 0.558 **O.K.**

Check 1/8" welded connection   <--- USE WELD   Ω = 2.35

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 1.000 in

$$P_n/_\Omega = \frac{1}{\Omega}0.75tLF_u \ge V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$$

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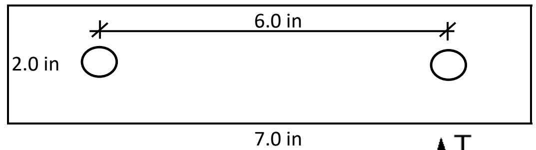
Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	2790	lbs
	$Tens_{MAX}$ =	2161	lbs
	$Shear_{MAX}$ =	2823	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2522	lbs
	$Tens_{MAX}$ =	1893	lbs
	$Shear_{MAX}$ =	2823	lbs

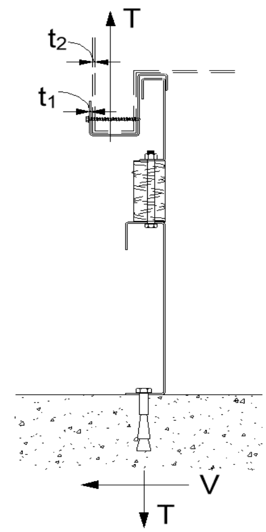
Loads at each Isolator Type: **CQA**

Transverse loading: (on long edge)	$Comp_{MAX}$ =	1395.1	lbs
	$Tens_{MAX}$ =	1080.7	lbs
# isolators: 2	$Shear_{MAX}$ =	470.4	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	2521.5	lbs
	$Tens_{MAX}$ =	1892.7	lbs
# isolators: 1	$Shear_{MAX}$ =	470.4	lbs

Max compression force on isolator: 2.522 k ≤ 3.176 k **O.K.**
Max uplift on isolator: 1.893 k ≤ 3.176 k **O.K.**
Max shear on isolator: 0.470 k ≤ 1.163 k **O.K.**



Forces on bottom bolts:
d_b = 0.5 in
base curb, t = 0.0713 in
Tension = 0.946 k / bolt
Shear = 0.235 k / bolt



Shear on base curb: $P_n = teF_u$ Ω = 2.00 (Appendix A, Section E3.1 AISI)
Pn/Ω = 4.635 k e = 1.0 in
Shear O.K.

Net section rupture: $P_n = A_nF_t$ Ω = 2.22 (Appendix A, Section E3.2 AISI)
Pn/Ω = 5.909 k An = 0.107 in
N.S.R. O.K. $F_t = (0.1 + 3d/s)F_u \le F_u =$ 55.250 ksi

Bolt Bearing Strength: $P_n = Cm_f dtF_u$ Ω = 2.50 (Section E3.3.1 AISI)
Pn/Ω = 2.781 k d/t = 7.01
Bearing O.K. C = 3.00 mf = 1.00

Shear and tension in bolt: (Appendix A, Section E3.4 AISI)
Tension $P_{nt} = A_bF_{nt}$ Fnt = 45.0 ksi A_b = 0.1963 in^2
Pnt/Ω = 3.927 k **Bolt tension O.K.** Ωt = 2.25
Shear $P_{nv} = A_bF_{nv}$ Fnv = 27.0 ksi Ωv = 2.40
Pnv/Ω = 2.209 k **Bolt shear O.K.** ***(Table E3.4-1, AISI)***

Combined Shear and tension in bolt:
$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \le F_{nt}$$
ft = 9.64 ksi fv = 1.20 ksi O.K.
F'nt = 45.00 ksi Fnv/Ω = 11.25 ksi
$P'_{nt} = A_bF'_{nt}$ P'nt/Ω = 3.927 k **Combined Not Applicable -> F'nt = Fnt**

Connection of Curb to Supporting Structure

Roof Loading SEISMIC: $(0.6\text{-}0.14S_{DS})D + 0.7E$ WIND: 0.6D + W

Transverse: $Uplift_{MAX}$ = 4338 lbs | $Shear_{MAX}$ = 1607 lbs

$Compression_{SEISMIC}$ =	5054 lbs	$=[FpmaxASD*(H'cm+Hbase\ curb)+(1+0.14S_{DS})*WGT_{unit+upper+base}*wcurb/2]/wcurb$
$Tension_{SEISMIC}$ =	4338 lbs	$=[FpmaxASD*(H'cm+Hbase\ curb)-(0.6-0.14S_{DS})*WGT_{unit+upper+base}*wcurb/2]/wcurb$
$Compression_{WIND}$ =	1559 lbs	$=[F_{h\ ASD\ trans}*(H'cm+Hbase\ curb)+0.6*WGT_{unit+upper+base}*wcurb/2-F_{vert\ ASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	1458 lbs	$=[F_{h\ ASD\ trans}*(H'cm+Hbase\ curb)-0.6*WGT_{unit+upper+base}*wcurb/2+F_{vertASD}*wcurb/2]/wcurb$

Longitudinal: $Uplift_{MAX}$ = 3852 lbs | $Shear_{MAX}$ = 1607 lbs

$Compression_{SEISMIC}$ =	4568 lbs	$=[FpmaxASD*(H'cm+Hbase\ curb)+(1+0.14S_{DS})*WGT_{unit+upper+base}*Lcurb/2]/Lcurb$
$Tension_{SEISMIC}$ =	3852 lbs	$=[FpmaxASD*(H'cm+Hbase\ curb)-(0.6-0.14S_{DS})*WGT_{unit+upper+base}*Lcurb/2]/Lcurb$
$Compression_{WIND}$ =	1251 lbs	$=[F_{h\ ASD\ long}*(H'cm+Hbase\ curb)+0.6*WGT_{unit+upper+base}*Lcurb/2-F_{vert\ ASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	1150 lbs	$=[F_{h\ ASD\ long}*(H'cm+Hbase\ curb)-0.6*WGT_{unit+upper+base}*Lcurb/2+F_{vertASD}*Lcurb/2]/Lcurb$

Wood Attachment: **1/4"ϕ x 4.5" Simpson SDS screws** **w/ 2.75" threaded emb** (SGmin = 0.43)

Transverse:

$Tall_{metal}$ =	997 lbs	$Vall_{metal}$ =	1097 lbs
$Tall_{wood}$ =	760 lbs	$Vall_{wood}$ =	672 lbs

# of Screws Req'd for Uplift = 5.71 COMBINED LOADING: 0.986 O.K.
# of Screws Req'd for Shear = 2.39 Req'd Min Spacing = 7.08 in o.c.
Total # of screws required = 7

Use 7 - 1/4"ϕ x 4.5" Simpson SDS screws @ 7.1 in o.c. along long side of curb w/ 2.75" threaded embed

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Longitudinal:

# of Screws Req'd for Uplift = 5.07 COMBINED LOADING: 0.895 O.K.
# of Screws Req'd for Shear = 2.39 Screw Spacing = 6.17 in o.c.
Total # of screws required = 7

Use 7 - 1/4"ϕ x 4.5" Simpson SDS screws @ 6.2 in o.c. along short side of curb w/ 2.75" threaded embed

Steel Deck Attachment: 1/2" ϕ A307 Bolts to steel angle below deck

$T_{all,bolt}$ = 3927 lbs $V_{all,bolt}$ = 2209 lbs

Transverse: $T_{all,metal}$ = 2086 lbs $V_{all,metal}$ = 2192 lbs

# of Bolts Req'd for Uplift = 2.08 COMBINED LOADING: 0.840 O.K.
# of Bolts Req'd for Shear = 0.73 Bolt Spacing = 19.25 in o.c.
Total # of bolts required = 3

Use 3 - 1/2" ϕ A307 Bolts to steel angle below deck @ 19.3 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 1.85 COMBINED LOADING: 0.762 O.K.
# of Bolts Req'd for Shear = 0.73 Bolt Spacing = 33.00 in o.c.
Total # of bolts required = 2

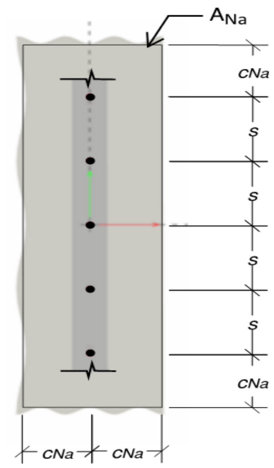
Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 33 in o.c. along short side of curb

For Concrete anchorage: SEISMIC $(0.6\text{-}0.14S_{DS})D + 0.7\Omega_o E$ Ωo = 2.5

Concrete Attachment: 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy w/ 4in embed

Epoxy: Hilti HIT-HY 200 V3 (ICC ESR 4868)

f'c = 4000 psi
h = 6 in (concrete thickness, t_min = h_ef + 2do) O.K.
h_ef = 4 in (effective embedment)
da = 0.625 in (anchor diameter) do = 0.75 in (hole diameter)
n = 5 (number of dummy anchors to check capacity with spacing effect)
s = 14 in (initial spacing estimate)
τk,cr / uncr = 1170 2220 psi (from ESR 4868, Table 14, Temp range B)
τk,cr / uncr = 1226 2327 psi If $f'_c > 2500$, $multiply\ by\ (f'_c/2500)^{0.1}$
c_{Na}= 9.0625 in (min. edge distance for full capacity); $c_{Na} = 10d_a\sqrt{\frac{\tau_{uncr}}{1100}}$



Tension:
Bond strength
***Bond strength will govern over concrete breakout

$N_{ag} = \frac{A_{Na}}{A_{Nao}}\varphi_{ec,Na}\varphi_{ed,Na}\varphi_{cp,Na}N_{ba}$ (ACI318-14, 17.4.5.1b)

$\varphi_{ec,Na}\varphi_{ed,Na}\varphi_{cp,Na} = 1.0$

A_{Na}= 1343.52 in^2
A_{Nao}= 328.52 in^2
N_{ba} = 9535 lbs $N_{ba} = \lambda_a\tau_{cr}\pi d_a h_{ef}\alpha_{n,seismic}$ $\alpha_{n,seismic} = 0.99$
N_{ag} = 38995 lbs (group) $\lambda_a = 1.0$
$øN_{ag}$ = 19010 lbs (group) CONTROLS λ_a =1.0 for normal weight conc; 0.6 for lightw

Breakout strength

$N_{cbg} = \frac{A_{Nc}}{A_{Nco}}\varphi_{ec,N}\varphi_{ed,N}\varphi_{cp,N}N_b$ $N_b = \lambda_a k_c\sqrt{f'_c}h_{ef}^{1.5}$

A_{Nc} = 816 in^2 N_b = 8601 lbs $ø_{conc}$ = 0.75
A_{Nco} = 144 in^2 kc = 17 $ø_{bond}$ = 0.65
N_{cbg} = 48741 lbs (group) $ø_{seis}$ = 0.75
$øN_{cbg}$ = 27417 lbs (group) $ø_{steel}$ = 0.65

Shear: Vsa,eq = 7865 (from ESR4868, Table 11) $\alpha_{v,seismic}$ = 0.6
Steel strength øVsa,eq = 3067

$T_{all,LRFD}$ = 3802 lbs (anchor) $V_{all,LRFD}$ = 3067 lbs $\propto = (1 + 0.2SDS)D + 2.5E$ =1.421
$T_{all,ASD} = T_{all,LRFD}/\alpha$ = 2225 lbs $V_{all,ASD} = V_{all,LRFD}/\alpha$ = 1795 lbs D =0.758 E 0.242 $\propto$ =1.709

Transverse: $Uplift_{MAX}$ = 5751 lbs $Shear_{MAX}$ = 4017 lbs

$Compression_{SEISMIC}$ = 6485 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*$WGT_{unit+curb}$*wcurb/2]/wcurb
$Tension_{SEISMIC}$ = 5751 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_{DS})*$WGT_{unit+curb}$*wcurb/2]/wcurb
$Shear_{SEISMIC}$ = 4017 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 2.58 spacing = 19.25 in o.c. Tapplied = 1437.9 lbs
Min Bolts Req'd Shear = 2.24 spacing = 19.25 in o.c. Vapplied = 573.9 lbs

Try using 4 bolts
spaced at 12.83 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 0.97 O.K.

Use 4 - 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 12.8 in o.c. max. along long side of curb w/ 4in embed

Longitudinal: $Uplift_{MAX}$ = 5111 lbs $Shear_{MAX}$ = 4017 lbs

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Compression$_{SEISMIC}$ = 5845 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*$WGT_{unit+curb}$*Lcurb/2]/Lcurb

Tension$_{SEISMIC}$ = 5111 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_{DS})*$WGT_{unit+curb}$*Lcurb/2]/Lcurb

Shear$_{SEISMIC}$ = 4017 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 2.30 spacing = 16.50 in o.c. Tapplied = 1703.7 lbs

Min Bolts Req'd Shear = 2.24 spacing = 16.50 in o.c. Vapplied = 573.9 lbs

Try using 3 bolts
spaced at 16.50 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.09 O.K.

Use 3 - 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 16.5 in o.c. max. along short side of curb w/ 4in embed

CURB DESIGN SUMMARY:	CBISC-02 CBISCLXL	**Unit:**	ALL P***B CABINET
UPPER CURB RAIL THICKNESS:	0.0713 in 14 Gauge		
UNIT CLIP THICKNESS:	0.0713 in 14 Gauge		
# OF CLIPS (LONG SIDE) -	1 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	16Ga x 3/4in x 7in (C-channel) stiffener at each clip		
# OF CLIPS (SHORT SIDE) -	1 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	16Ga x 3/4in x 7in (C-channel) stiffener at each clip		
VIBRATION ISOLATOR TYPE:	CQA	Top stud diameter: 3/8	(2) - CQA Isolators long side
Anchor bolt diameter:	1/2	Anchor hole diamter: 9/16	(1) - CQA Isolators short side
BASE CURB THICKNESS:	0.0713 in 14 Gauge		***Must weld top of CQA***
WEB STIFFENER:	16Ga x 1.5in x 7in (C-channel) stiffener at each clip on base curb		
CORNER CONNECTION:	Use minimum 3 - 1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts		

CURB ANCHORAGE	WOOD 1/4"ϕ x 4.5" Simpson SDS screws w/ 2.75" threaded embed (SGmin =	STEEL 1/2" ϕ A307 Bolts to steel angle below deck	CONCRETE 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy w/ 4in embed
LONG DIRECTION	7 @ 7.08 in o.c.	3 @ 19.25 in o.c.	4 @ 12.83 in o.c.
SHORT DIRECTION	7 @ 6.17 in o.c.	2 @ 33 in o.c.	3 @ 16.5 in o.c.