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

Structural Calculations
for
CBISC-12 Series

CBISCSAV1518** SERIES

Prepared for:

PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

Date: July 13, 2022

Project Number: PV2203

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

VIBRATION ISOLATION ROOF CURBS SUNCHOICE UNITS

AV 15-18

PROVENT P/N	A	B	EST. WEIGHT
CBISCSAV151818**	8"	18"	556 Lbs
CBISCSAV151821**	11"	21"	606 Lbs
CBISCSAV151824**	14"	24"	656 Lbs

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

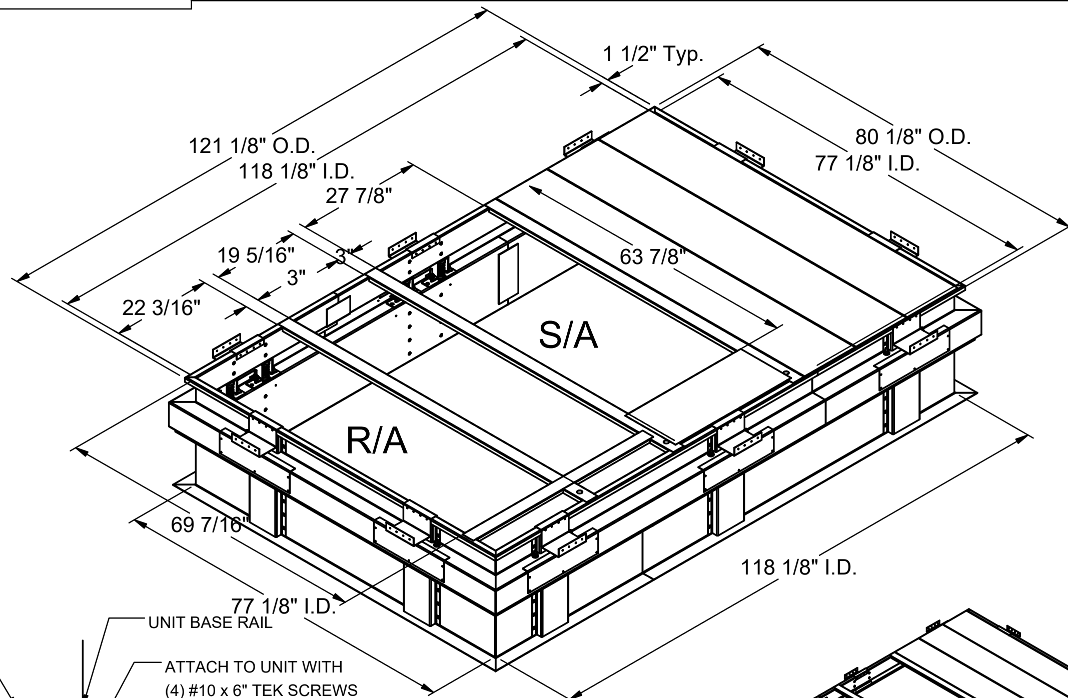
Meets seismic requirements for the following codes:
CBC 2019
IBC 2018

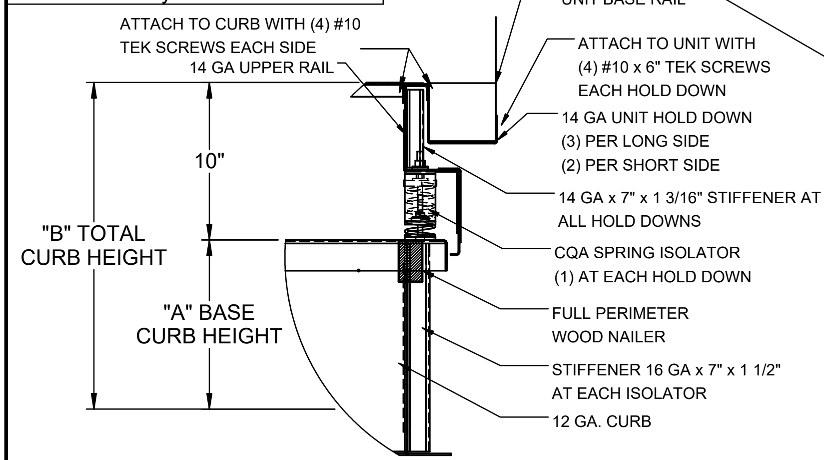
FEATURES

- Roof curb base 12 ga.
- Roof curb upper rail 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).

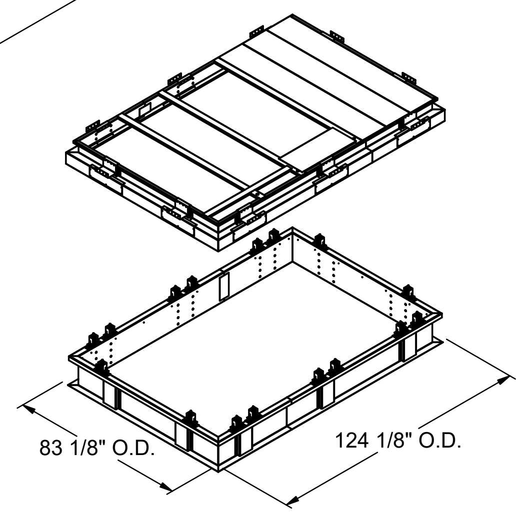
NOTES

- 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

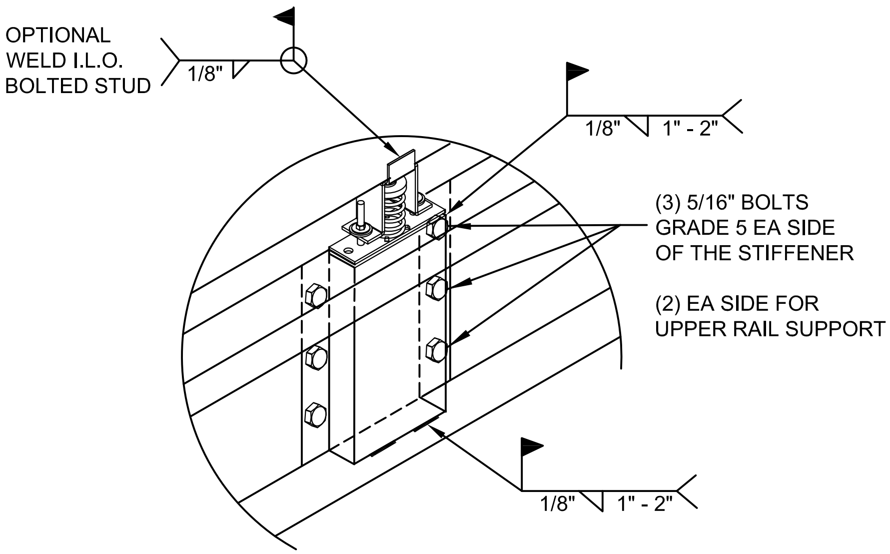
**3847 WABASH DRIVE
MIRA LOMA, CA 91752**

**PHONE (951) 685-1101
FAX (619) 872-9799**

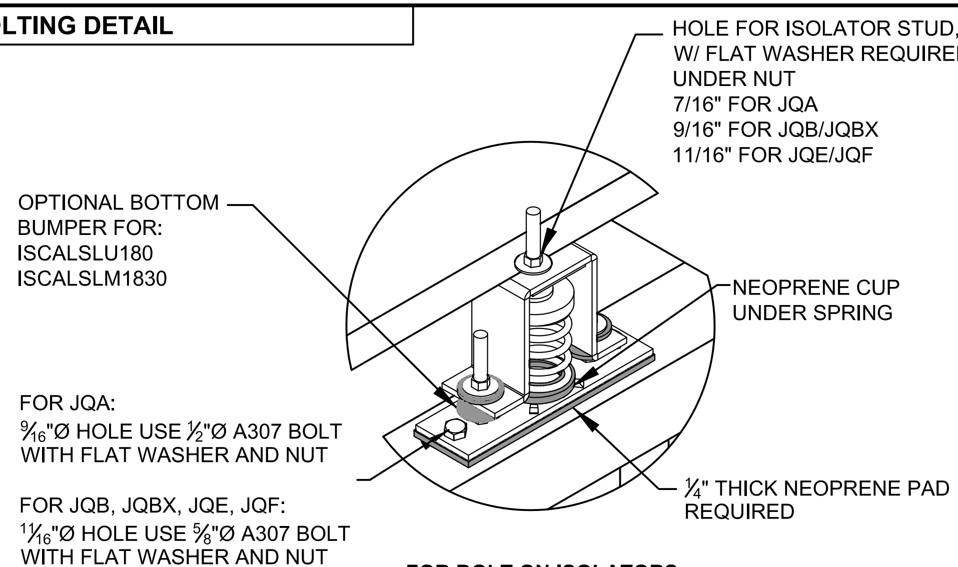
SUBMITED TO: ____________
COMPANY: ____________
JOB NAME: ____________
EQUIPMENT: ____________
NOTES: ____________

FORM NO:	PART NUMBER:	
CBISC-12	-	
DATE:	**REV:**	**DRAWN BY:**
4/20/2022	2	FMM

WELDMENT AND BOLTING DETAIL



BASE CURB SUPPORT



FOR BOLT ON ISOLATORS

ProVent

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SUBMITTED TO:________________
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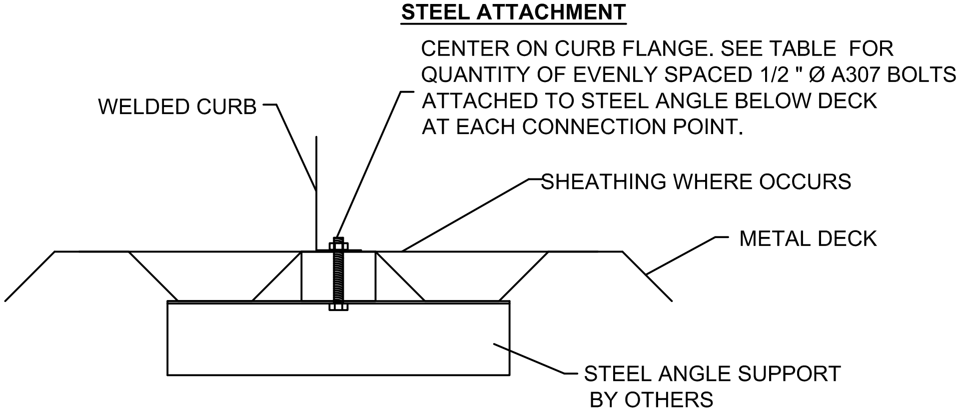
FORM NO:		
CB-61		
DATE:	REV:	DRAWN BY:
02/08/18	1	ALL

STEEL ATTACHMENT



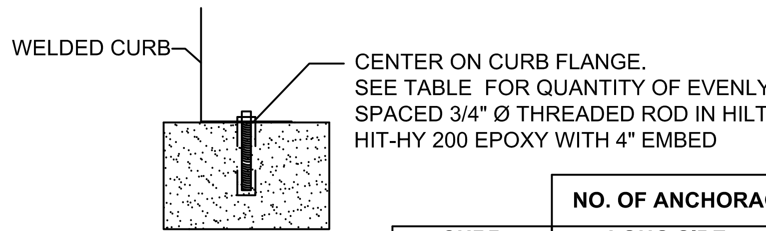
	NO. OF ANCHORAGE BOLTS REQUIRED	
CURB	**LONG SIDE**	**SHORT SIDE**
LXS	3 @ 19.25" O.C.	2 @ 23" O.C.
LXL	3 @ 19.25" O.C.	2 @ 33" O.C.
SUN3672	4 @ 21" O.C.	2 @ 27.25" O.C.
PRD3715	6 @ 14.28" O.C.	3 @ 20.75" O.C.
PRS	4 @ 20.46" O.C.	2 @ 31.13" O.C.
PRL	3 @ 36.13" O.C.	2 @ 44" O.C.
SLU180	4 @ 35.08" O.C.	3 @ 37" O.C.
SLM1830	5 @ 29.06" O.C	4 @ 24.67" O.C.
SAV1518	4 @ 37.38" O.C	3 @ 35.56" O.C.
SAV2025	4 @ 42.04" O.C	3 @ 35.56" O.C.
SAV28	5 @ 35.63" O.C	3 @ 35.56" O.C.

ASSUMES:
CONC SLAB
f'c= 4000PSI MINIMUM
6" MIN THICKNESS
NORMAL WEIGHT CONCRETE
OR SAND LIGHT WEIGHT

Meets seismic requirements for the following codes:
CBC 2019
IBC 2018

ROOF ANCHORAGE DETAIL
CBISC Series
LXS
LXL
SUN3672
PRD3715
PRS
PRL
SLU180
SLM1830
SAV1518
SAV2025
SAV28

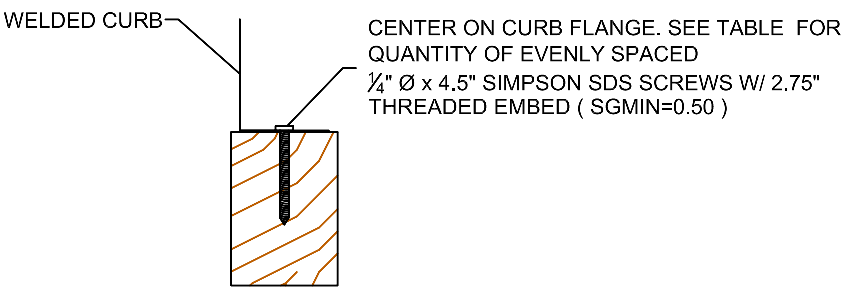
CONCRETE ATTACHMENT



	NO. OF ANCHORAGE BOLTS REQUIRED	
CURB	**LONG SIDE**	**SHORT SIDE**
LXS	7 @ 6.42" O.C.	4 @ 7.67" O.C.
LXL	7 @ 6.42" O.C.	5 @ 8.25" O.C.
SUN3672	9 @ 7.88" O.C.	4 @ 9.08" O.C.
PRD3715	14 @ 5.49" O.C.	9 @ 5.19" O.C.
PRS	10 @ 6.82" O.C.	5 @ 7.78" O.C.
PRL	11 @ 7.23" O.C.	6 @ 8.8" O.C.
SLU180	12 @ 9.57" O.C.	8 @ 10.57" O.C.
SLM1830	18 @ 6.84" O.C.	11 @7.4" O.C.
SAV1518	12 @ 10.19" O.C.	6 @ 14.23" O.C.
SAV2025	14 @ 14.97" O.C.	6 @ 14.23" O.C.
SAV28	14 @ 10.96" O.C.	6 @ 14.23" O.C.

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

WOOD ATTACHMENT



FOUR INCHES FROM EACH CORNER EVENLY SPACED

	NO. OF ANCHORAGE SCREWS REQUIRED	
CURB	**LONG SIDE**	**SHORT SIDE**
LXS	7 @ 7.08" 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 @ 6.93" O.C.	8 @ 6.86" O.C.
SLU180	14 @ 8.4" O.C.	10 @ 8.67" O.C.
SLM1830	19 @ 6.68" O.C.	13 @ 6.5" O.C.
SAV1518	13 @ 9.68" O.C.	9 @ 9.39" O.C.
SAV2025	15 @ 9.29" O.C.	9 @ 9.39" O.C.
SAV28	16 @ 9.77" O.C.	9 @ 9.39" O.C.

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FORM NO:		
CB-62		
DATE:	**REV:**	**DRAWN BY:**
6/30/2022	2	FMM

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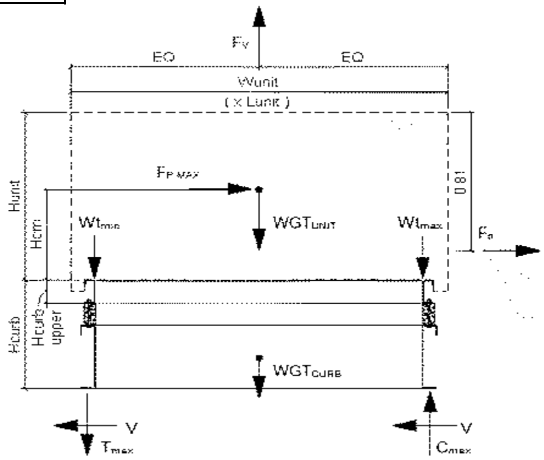
Client:	ProVent PV2203 Upper curb rail
Project:	CBISC-12 Iso Curb CBISCSAV1518
Unit:	Sunchoice 15-18



Upper Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	121.125	in	(Length of upper curb)
wcurb =	80.125	in	(Width of upper curb)
WGTupper =	103	lbs	(Weight of upper curb)
# Clips long side =	3		# Clips short side = 2

Unit Information

WGTunit =	2380	lbs	(Oper. Weight of Unit)
Wtmax =	666	lbs	(Maximum corner weight)
Wtmin =	506	lbs	(Minimum corner weight)
Hunit =	49.25	in	(Height of unit above curb)
Hcm =	24.625	in	(Height to center of mass)
Lunit =	129.75	in	(Length of unit)
Wunit =	88.75	in	(Width of unit)

Seismic Loading - 2018 IBC/2019 CBC

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 =	8547	lbs	(0.7*Fpmax)	FpmaxASD =	8916 lbs
	(unit only)				(unit + upper rail)

Wind Loading - 2018 IBC/2019 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)
$F_{h\ ASD\ trans}$ =	1673	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	1145	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	2141	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Upper Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	4385	lbs	$=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	2343	lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb]]/wcurb$
$Compression_{WIND}$ =	243	lbs	$=[F_{h\ ASD\ trans}*Hcm+2*0.6*Wtmax*wcurb-F_{vert\ ASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	978	lbs	$=[F_{h\ ASD\ trans}*Hcm-2*0.6*Wtmin*wcurb+F_{vertASD}*wcurb/2]/wcurb$

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	3496	lbs	$=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	1454	lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb]]/Lcurb$
$Compression_{WIND}$ =	-38	lbs	$=[F_{h\ ASD\ long}*Hcm+2*0.6*Wtmax*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	696	lbs	$=[F_{h\ ASD\ long}*Hcm-2*0.6*Wtmin*Lcurb+F_{vertASD}*Lcurb/2]/Lcurb$

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	4385	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2343	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	3496	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1454	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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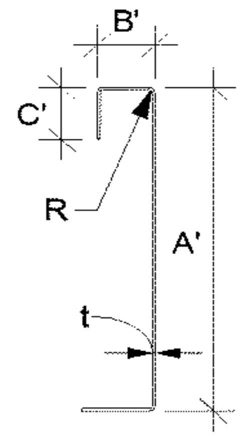
Curb Design

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'=	1.750	in	a'=	5.429	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 =	0.337	in (Distance between centroid and web centerline)			
Ix =	2.687	in^4	rx =	2.08	in
Iy =	0.169	in^4	ry =	0.521	in
A =	0.62	in^2	rmin =	0.521	in



Axial Compression

Pa =	4.273	k	(Max Axial Comp)
Pn/Ωc =	5.794	k	
Fe =	19.09	ksi	
λc =	1.62		
Fn =	16.74	ksi	
Ly =	80.38	in	Lateral unbraced length
k_yL_y/r_y =	123		(assume k=0.8)

Ω_c = 1.80

$$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c} \qquad If\ \lambda_c \le 1.5;\ F_n = \left(0.658^{\lambda_c^2}\right) F_y \qquad If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c^2} F_y$$

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

Compression Check = O.K.

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50	
t =	0.0713 in	h/t =	77.14 ≤ 200	C_R = 0.08	(See table C3.4.1-2, fastened to support, two flange, end loading)
N =	7.00	N/t =	98.18 ≤ 210	C_N = 0.12	
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				
Long side: Pu_{Trans} =	1.462 k	web stiffener REQ'D	# clips = 3		
Short side: Pu_{Long} =	1.748 k	web stiffener REQ'D	# clips = 2		

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

Check Web Stiffener

16Ga x 1-3/16in x 7in (C-channel)

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

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 =	2229 lbs	Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax =	2192 lbs	Max(Tens/2 -OR- Comp/2 corner connections per side)

Bolt:	Tall =	2480 lbs	Vall =	1208 lbs
Threaded Insert:	Tall =	2860 lbs	Vall =	1536 lbs

# of Bolts required for Tension = 0.9

# of Bolts required for Shear = 1.8

# of Bolts Used = 3.0

Check Combined Stress in Bolts & Inserts: 0.905 O.K.

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

Assume L/t > 25: 25*t = 1.783 in

Lreq'd = 1.482 in

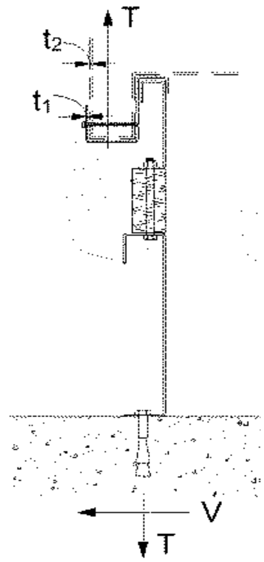
$$P_n/_{\Omega} = \frac{1}{\Omega}0.75tLF_u \geq V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$$

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

t1 = 0.1017 in (clip thickness) t2/t1 = 0.7 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: $P_{ns} = 2.7t_1dF_{u1}$ 3.39 k

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

For t2/t1 ≥ 2.5: Pns = 2377 #

$P_{ns} = 2.7t_1dF_{u1}$ 3.39 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 = 3.718 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:	4.273	3	1.42	540 #	4	2.00 in
Short side:	4.273	2	2.14	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 = 0.661 in^2 Anv = 0.593 in^2 Ant = 0.117 in^2

Rn/Ω = 12.372 k $R_n = 0.6F_yA_{gv} + F_uA_{nt} \leq 0.6F_uA_{nv} + F_uA_{nt}$

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

Curb Loads (copied from above)

Transverse:	$Comp_{MAX}$ =	4990	lbs
(on long edge)	$Tens_{MAX}$ =	3004	lbs
	$Shear_{MAX}$ =	8916	lbs
Longitudinal:	$Comp_{MAX}$ =	3855	lbs
(on short edge)	$Tens_{MAX}$ =	1869	lbs
	$Shear_{MAX}$ =	8916	lbs

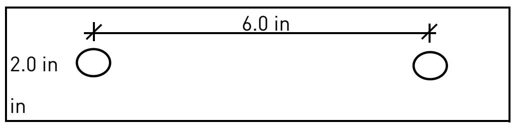
Loads at each Isolator Type: **CQA**

Transverse loading:	$Comp_{MAX}$ =	1663.4	lbs
(on long edge)	$Tens_{MAX}$ =	1001.3	lbs
# isolators: 3	$Shear_{MAX}$ =	891.6	lbs
Longitudinal loading:	$Comp_{MAX}$ =	1927.7	lbs
(on short edge)	$Tens_{MAX}$ =	934.5	lbs
# isolators: 2	$Shear_{MAX}$ =	891.6	lbs

Max compression force on isolator: 1.928 k ≤ 3.176 k O.K.

Max uplift on isolator: 1.001 k ≤ 3.176 k O.K.

Max shear on isolator: 0.892 k ≤ 1.163 k O.K.



7.0 in

Forces on top bolt:

Tension = 1.001 k d_b = 0.375 in

Shear = 0.892 k ›per 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. $F_t = (0.1 + 3d/s)F_u \leq F_u =$ 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 in^2

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:

$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}}f_v \leq F_{nt}$$

ft = 9.07 ksi fv = 8.07 ksi O.K.

F'nt = 19.95 ksi Fnv/Ω = 10.00 ksi

$P'_{nt} = A_bF'_{nt}$ P'nt/Ω = 0.979 k No Good - Use Welds

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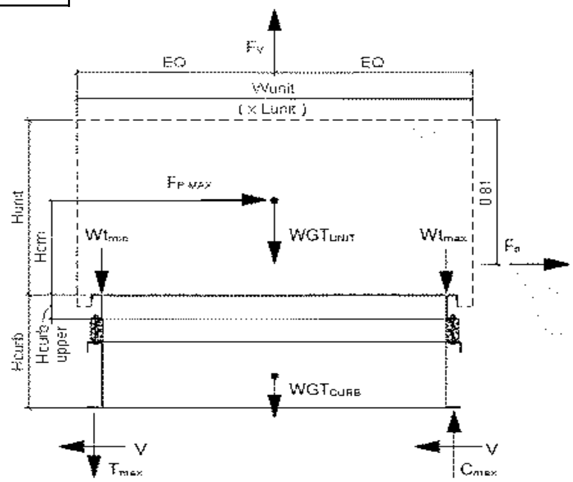
Client:	ProVent	PV2203	Base curb
Project:	CBISC-12	Iso Curb	CBISCSAV1518
Unit:	Sunchoice 15-18		



Base Curb Information

Hbase curb = 14 in (Height of base curb)
Lcurb = 124.125 in (Length of base curb)
wcurb = 83.125 in (Width of base curb)
WGTbase = 553 lbs (Weight of base curb)
# Springs long side = 3 # Springs short side = 2

Unit Information

WGTunit = 2380 lbs (Oper. Weight of Unit + 5%)
Wt'max = 692 lbs (Wtmax+1/4*WGTupper)
Wt'min = 532 lbs (Wtmin+1/4*WGTupper))
Hunit = 49.25 in (Height of unit above curb)
H'cm = 34.625 in (Hcm+10"(upper+spring))
Lunit = 129.75 in (Length of unit)
Wunit = 88.75 in (Width of unit)
$WGT_{unit+upper+base}$ = 3036 lbs (Total weight)

Seismic Loading - 2018 IBC/2019 CBC

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 = 8916 lbs (0.7*Fpmax) FpmaxASD = 10902 lbs
(unit + upper rail) (unit + upper rail + base curb)

Wind Loading - 2018 IBC/2019 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)
$F_{h\ ASD\ trans}$ = 2239 lbs = 0.6*qz*GCr*Lunit*(Hunit+Hbase curb+10") (Eq. 29.4-2)
$F_{h\ ASD\ long}$ = 1531 lbs = 0.6*qz*GCr*Wunit*(Hunit+Hbase curb+10")
$F_{vert\ ASD}$ = 2141 lbs = 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Base Curb Loading

Transverse:

$Compression_{SEISMIC}$ = 5540 lbs =[FpmaxASD*H'cm+2*(1+0.14S_{DS})*Wt'max*wcurb]/wcurb
$Tension_{SEISMIC}$ = 3416 lbs =[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*wcurb]]/wcurb
$Compression_{WIND}$ = 692 lbs =[$F_{h\ ASD\ trans}$*H'cm+2*0.6*Wt'max*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ = 1365 lbs =[$F_{h\ ASD\ trans}$*H'cm-2*0.6*Wt'min*wcurb+$F_{vertASD}$*wcurb/2]/wcurb
---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ = 4313 lbs =[FpmaxASD*H'cm+2*(1+0.14*S_{DS})*Wt'max*Lcurb]/Lcurb
$Tension_{SEISMIC}$ = 2189 lbs =[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*Lcurb]]/Lcurb
$Compression_{WIND}$ = 187 lbs =[$F_{h\ ASD\ long}$*H'cm+2*0.6*Wt'max*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ = 860 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:	$Comp_{MAX}$ =	5540	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	3416	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	4313	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	2189	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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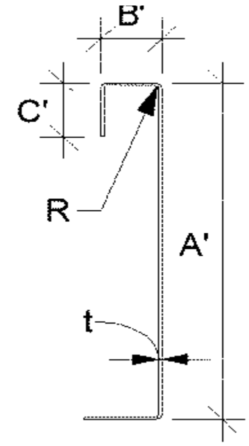

Curb Design

Fy =	50	ksi	Fu =	65	ksi
E =	29500	ksi	t =	0.1017	12 Gauge

Calculate Section Properties of Curb

A'=	14.000	in	a =	13.492	in	= A'-(2r+t)
B'=	1.750	in	a'=	13.898	in	= A'-t
C'=	1.000	in (0 if no lips)	b =	1.242	in	= B'-[r+t/2+α(r+t/2)]
α =	1.000	(0 - no Lip; 1 w/ lip)	b'=	1.648	in	= B'-(t/2+αt/2)
R =	0.1525	(Inside bend radius)	c =	0.746	in	= α[C'-(r+t/2)]
t =	0.1017	in	c'=	0.949	in	= α(C'-t/2)
r'=	0.203	in = R+t/2	u =	0.319	in	= πr/2
x =	0.297	in (Distance between centroid and web centerline)				
Ix =	45.336	in	rx =	4.88	in	
Iy =	0.610	in	ry =	0.566	in	
A =	1.91	in^2	rmin =	0.566	in	

Axial Compression

Pu =	4.458	k	(Max Axial Comp)	Ω_c = 1.80
Pn/Ωc =	9.779	k		
Fe =	10.53	ksi		
λc =	2.18			
Fn =	9.23	ksi		
Ly =	117.63	in	Lateral unbraced length	
k_yL_y/r_y =	166		(assume k=0.8)	

$$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c} \qquad If\ \lambda_c \le 1.5;\ F_n = \left(0.658^{\lambda_c^2}\right)F_y \qquad If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c^2}F_y$$

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

Compression Check = O.K.

Check Web Crippling

h =	14	in	-- Check limits:		C = 4.00	(See table C3.4.1-2, fastened to support, one flange, end loading)
t =	0.1017	in	h/t =	137.66 ≤ 200	C_R = 0.14	
N =	7.00		N/t =	68.83 ≤ 210	C_N = 0.35	
Ω_w =	1.75		N/h =	0.5 ≤ 2.0	C_h = 0.02	
P_n =	4.578 k		R/t =	1.50 ≤ 9.0		
P_n/Ω_w =	2.616 k					
Long side: Pu_{Trans} =	1.847 k		O.K.	# clips = 3		
Short side: Pu_{Long} =	2.157 k		O.K.	# clips = 2		

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

Check Web Stiffener N/A

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		

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

Pwc =	4.578	k	Ae =	0.380 in^2
Pn =	16.511	k		
Pn/Ω_c =	9.712	k	Not Req'd	

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

Tcrnmax =	2726	lbs	Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax =	2770	lbs	Max(Tens/2 -OR- Comp/2 corner connections per side)

Bolt:	Tall =	2480 lbs	Vall =	1208 lbs
Threaded Insert:	Tall =	2860 lbs	Vall =	1536 lbs

# of Bolts required for Tension = 1.1

# of Bolts required for Shear = 2.3

# of Bolts Used = 4.0

Check Combined Stress in Bolts & Inserts: 0.848 O.K.

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

Assume L/t > 25: 25*t = 2.543 in

Lreq'd = 1.313 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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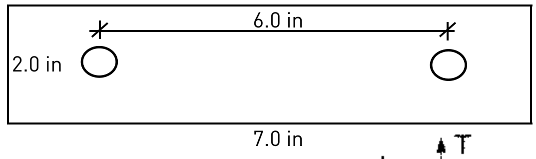
Curb Loads (copied from upper rail calcs)

Transverse:	$Comp_{MAX}$ =	4990	lbs
(on long edge)	$Tens_{MAX}$ =	3004	lbs
	$Shear_{MAX}$ =	8916	lbs
Longitudinal:	$Comp_{MAX}$ =	3855	lbs
(on short edge)	$Tens_{MAX}$ =	1869	lbs
	$Shear_{MAX}$ =	8916	lbs

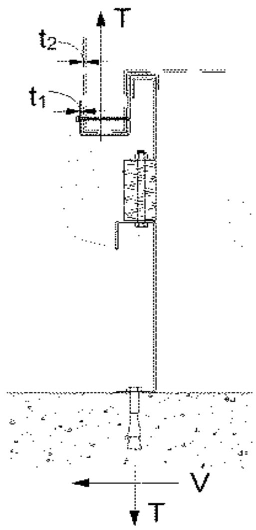
Loads at each Isolator Type: **CQA**

Transverse loading:	$Comp_{MAX}$ =	1663.4	lbs
(on long edge)	$Tens_{MAX}$ =	1001.3	lbs
# isolators: 3	$Shear_{MAX}$ =	891.6	lbs
Longitudinal loading:	$Comp_{MAX}$ =	1927.7	lbs
(on short edge)	$Tens_{MAX}$ =	934.5	lbs
# isolators: 2	$Shear_{MAX}$ =	891.6	lbs

Max compression force on isolator: 1.928 k ≤ 3.176 k O.K.
Max uplift on isolator: 1.001 k ≤ 3.176 k O.K.
Max shear on isolator: 0.892 k ≤ 1.163 k O.K.



Forces on bottom bolts:
d_b = 0.5 in
base curb, t = 0.1017 in
Tension = 0.501 k / bolt
Shear = 0.446 k / bolt



Shear on base curb: $P_n = teF_u$ Ω = 2.00 (Appendix A, Section E3.1 AISI)
Pn/Ω = 6.611 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 = 8.428 k An = 0.153 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 = 3.966 k d/t = 4.92
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 = 5.10 ksi fv = 2.27 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: $(0.6-0.14S_{DS})D + 0.7E$ WIND: 0.6D + W

Transverse: $Uplift_{MAX}$ = 5951 lbs | $Shear_{MAX}$ = 5451 lbs

$Compression_{SEISMIC}$ =	8380 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Tension_{SEISMIC}$ =	5951 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Compression_{WIND}$ =	1150 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*wcurb/2-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1469 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)-0.6*$WGT_{unit+upper+base}$*wcurb/2+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 3845 lbs | $Shear_{MAX}$ = 5451 lbs

$Compression_{SEISMIC}$ =	6273 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Tension_{SEISMIC}$ =	3845 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Compression_{WIND}$ =	440 lbs	=[$F_{h\ ASD\ long}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*Lcurb/2-$F_{vert\ ASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	760 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 screw: w/ 2.75" threaded emt** (SGmin = 0.43)

$Tall_{metal}$ = 1397 lbs $Vall_{metal}$ = 1230 lbs
Transverse: $Tall_{wood}$ = 760 lbs $Vall_{wood}$ = 672 lbs
# of Screws Req'd for Uplift = 7.83 COMBINED LOADING: 0.971 O.K.
# of Screws Req'd for Shear = 8.11 Req'd Min Spacing = 9.68 in o.c.
Total # of screws required = 13

Use 13 - 1/4"ϕ x 4.5" Simpson SDS screws @ 9.7 in o.c. along long side of curb w/ 2.75" threaded embed

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Longitudinal:

# of Screws Req'd for Uplift =	5.06	COMBINED LOADING:	0.931 O.K.
# of Screws Req'd for Shear =	8.11	Screw Spacing =	9.39 in o.c.
Total # of screws required =	9		

Use 9 - 1/4"ϕ x 4.5" Simpson SDS screws @ 9.4 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
$T_{all_{metal}}$ =	2975 lbs	$V_{all_{metal}}$ =	3072 lbs

Transverse:

# of Bolts Req'd for Uplift =	2.00	COMBINED LOADING:	0.853 O.K.
# of Bolts Req'd for Shear =	2.47	Bolt Spacing =	37.38 in o.c.
Total # of bolts required =	4		

Use 4 - 1/2" ϕ A307 Bolts to steel angle below deck @ 37.4 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift =	1.29	COMBINED LOADING:	0.676 O.K.
# of Bolts Req'd for Shear =	2.47	Bolt Spacing =	35.56 in o.c.
Total # of bolts required =	3		

Use 3 - 1/2" ϕ A307 Bolts to steel angle below deck @ 35.6 in o.c. along short side of curb

For Concrete anchorage: SEISMIC $(0.6-0.14S_{DS})D + 0.7\Omega_o E$ Ωo = 2.0

Concrete Attachment: 3/4" φ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed

$T_{all_{LRFD}}$ = 1957 lbs $V_{all_{LRFD}}$ = 4540 lbs $\alpha = (1 + 0.2SDS)D + 2.5E = 1.708$

$T_{all_{ASD}} = T_{all_{LRFD}}/\alpha$ = 1146 lbs $V_{all_{ASD}} = V_{all_{LRFD}}/\alpha$ = 2658 lbs $(D = 0.758, E = 0.242)$

Transverse: $Uplift_{MAX}$ = 12329 lbs $Shear_{MAX}$ = 10902 lbs

$Compression_{SEISMIC}$ = 14757 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Tension_{SEISMIC}$ = 12329 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Shear_{SEISMIC}$ = 10902 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift =	10.76	spacing =	11.21 in o.c.	Tapplied =	1027.4 lbs
Min Bolts Req'd Shear =	4.10	spacing =	28.03 in o.c.	Vapplied =	605.7 lbs

Try using 12 bolts spaced at 10.19 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.12

Use 12 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 10.2 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 8116 lbs $Shear_{MAX}$ = 10902 lbs

$Compression_{SEISMIC}$ = 10544 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Tension_{SEISMIC}$ = 8116 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Shear_{SEISMIC}$ = 10902 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift =	7.08	spacing =	10.16 in o.c.	Tapplied =	1014.4 lbs
Min Bolts Req'd Shear =	4.10	spacing =	17.78 in o.c.	Vapplied =	605.7 lbs

Try using 6 bolts spaced at 14.23 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.11

Use 6 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 14.2 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY:	CBISC-12	CBISCSAV1518	Unit: Sunchoice 15-18
UPPER CURB RAIL THICKNESS:	0.1017 in	12 Gauge	
UNIT CLIP THICKNESS:	0.1017 in	12 Gauge	
# OF CLIPS (LONG SIDE) -	3 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	16Ga x 1-3/16in x 7in (C-channel) stiffener at each clip		
# OF CLIPS (SHORT SIDE) -	2 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	16Ga x 1-3/16in x 7in (C-channel) stiffener at each clip		
VIBRATION ISOLATOR TYPE:	CQA	Top stud diameter: 3/8	(3) - CQA Isolators long side
Anchor bolt diameter:	1/2	Anchor hole diamter: 9/16	(2) - CQA Isolators short side
BASE CURB THICKNESS:	0.1017 in	12 Gauge	***Must weld top of CQA***
WEB STIFFENER:	NOT REQUIRED		
CORNER CONNECTION:	Use minimum 4 - 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 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed
LONG DIRECTION	13 @ 9.68 in o.c.	4 @ 37.38 in o.c.	12 @ 10.19 in o.c.
SHORT DIRECTION	9 @ 9.39 in o.c.	3 @ 35.56 in o.c.	6 @ 14.23 in o.c.