MOUR GROUP
ENGINEERING + DESIGN

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

Structural Calculations
for
CBISC-14 Series

CBISCSAV28** 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 28

PROVENT P/N	A	B	EST. WEIGHT
CBISCSAV2818**	8"	18"	653 Lbs
CBISCSAV2821**	11"	21"	698 Lbs
CBISCSAV2824**	14"	24"	748 Lbs

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

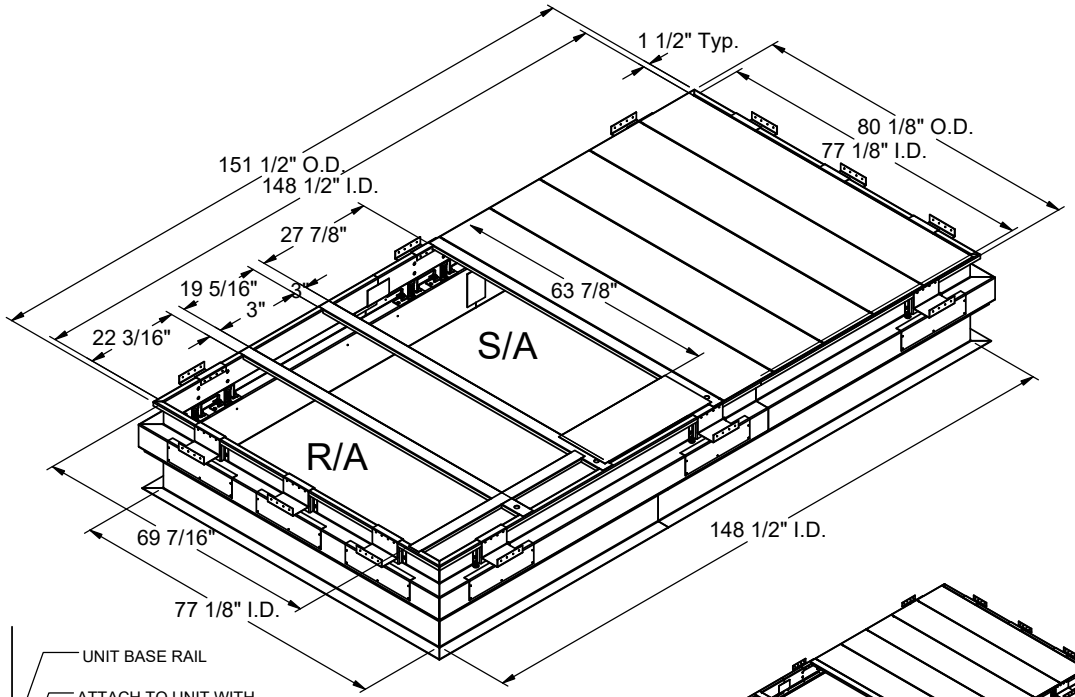
Meets seismic requirements for the following codes:
CBC 2019
IBC 2018

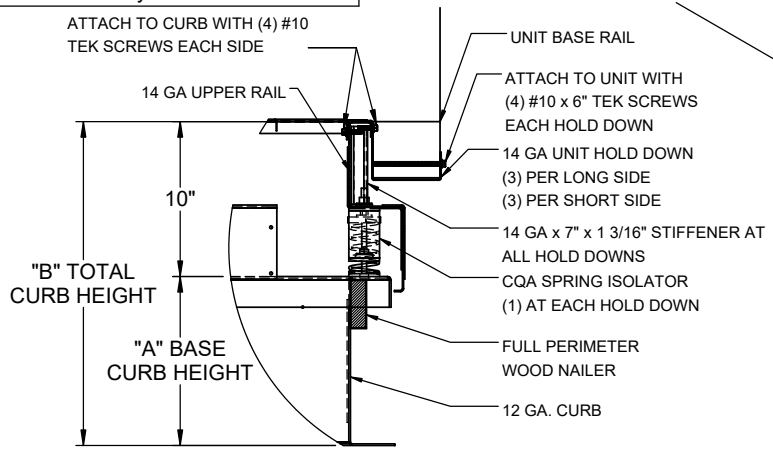
FEATURES

- 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).

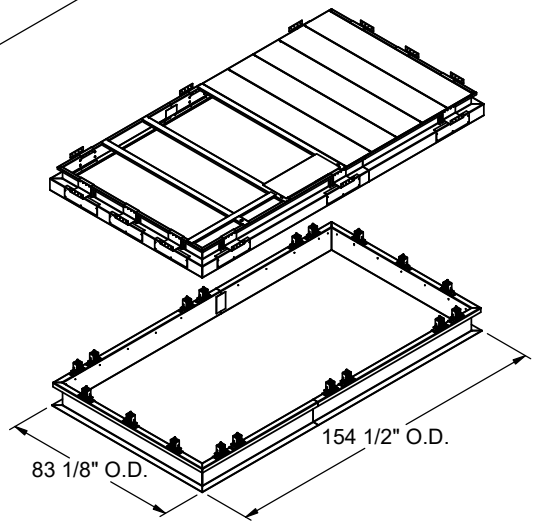
NOTES

- 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



REGISTERED PROFESSIONAL ENGINEER
GLENN A. MOURITZEN
SE 3578
Exp. 6/30/23
STRUCTURAL
STATE OF CALIFORNIA

ProVent

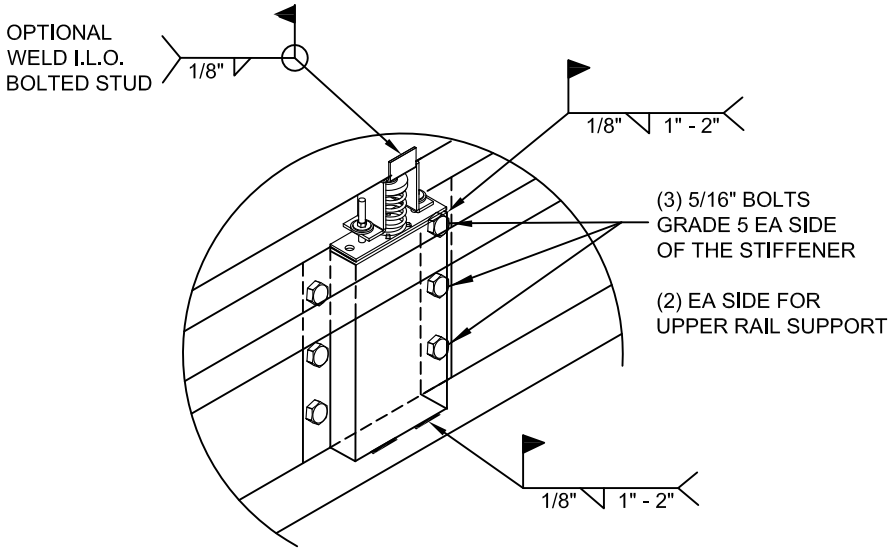
3847 WABASH DRIVE
MIRA LOMA, CA 91752

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

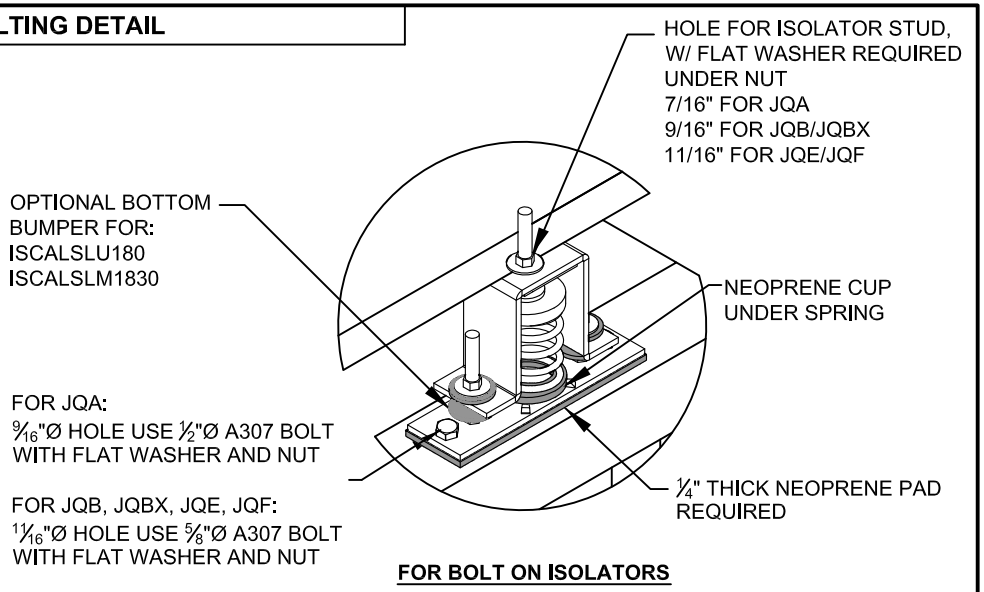
SUBMITED TO: _____
COMPANY: _____
JOB NAME: _____
EQUIPMENT: _____
NOTES: _____

FORM NO:	PART NUMBER:	
CBISC-14	CBISCSAV28 SERIES	
DATE: 4/20/2022	**REV:** 1	**DRAWN BY:** FMM

WELDMENT AND BOLTING DETAIL



BASE CURB SUPPORT



FOR BOLT ON ISOLATORS

ProVent
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SUBMITTED TO:
COMPANY:
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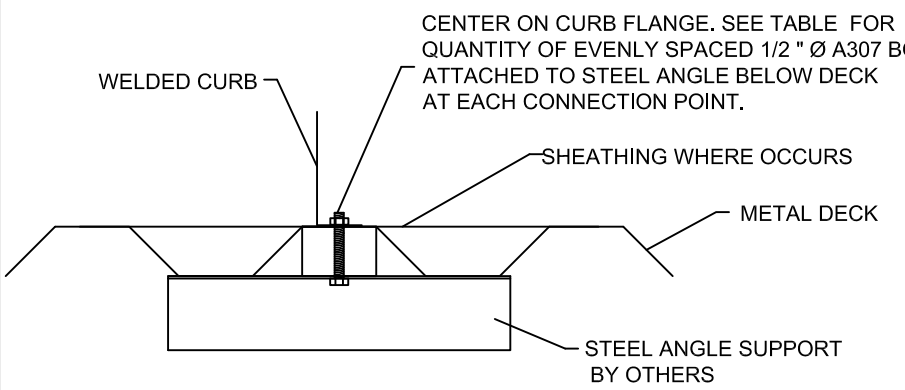
NOTES:

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

STEEL ATTACHMENT



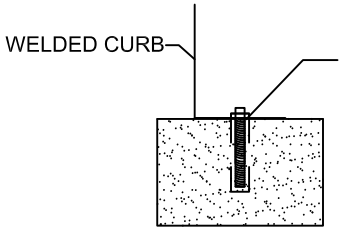
	NO. OF ANCHORAGE BOLTS REQUIRED	
CURB	LONG SIDE	SHORT SIDE
LXS	3 @ 19.25" O.C.	2 @ 23" O.C.
LXL	3 @ 19.25" O.C.	2 @ 33" O.C.
SUN3672	4 @ 21" O.C.	2 @ 27.25" O.C.
PRD3715	6 @ 14.28" O.C.	3 @ 20.75" O.C.
PRS	4 @ 20.46" O.C.	2 @ 31.13" O.C.
PRL	3 @ 36.13" O.C.	2 @ 44" O.C.
SLU180	4 @ 35.08" O.C.	3 @ 37" 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

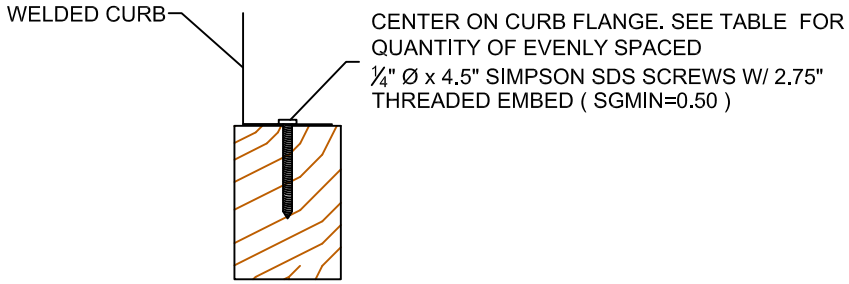
CONCRETE ATTACHMENT



	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



	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.

FOUR INCHES FROM EACH CORNER EVENLY SPACED

ProVent

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6/30/2022	2	FMM

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San Diego, CA 92120
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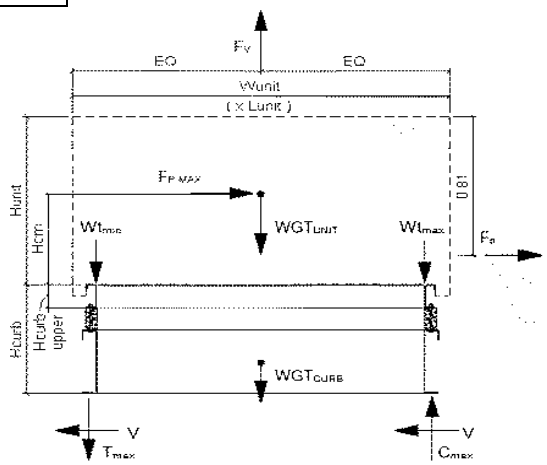
Client:	ProVent	PV2203	Upper curb rail
Project:	CBISC-14	Iso Curb	CBISCSAV28
Unit:	Sunchoice 28		

Upper Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	151.5	in	(Length of upper curb)
wcurb =	80.125	in	(Width of upper curb)
WGTupper =	112	lbs	(Weight of upper curb)
# Clips long side =	3	# Clips short side =	2

Unit Information

WGTunit =	2720	lbs	(Oper. Weight of Unit)
Wtmax =	762	lbs	(Maximum corner weight)
Wtmin =	578	lbs	(Minimum corner weight)
Hunit =	57.22	in	(Height of unit above curb)
Hcm =	28.61	in	(Height to center of mass)
Lunit =	160.0625	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 =	9768	lbs	(0.7*Fpmax)	FpmaxASD =	10170 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)
$F_{h\ ASD\ trans}$ =	2365	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	1311	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	2642	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Upper Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	5497	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	3163	lbs	=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb)]/wcurb
$Compression_{WIND}$ =	437	lbs	=[$F_{h\ ASD\ trans}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1472	lbs	=[$F_{h\ ASD\ trans}$*Hcm-2*0.6*Wtmin*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	3854	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1520	lbs	=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb)]/Lcurb
$Compression_{WIND}$ =	-159	lbs	=[$F_{h\ ASD\ long}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	875	lbs	=[$F_{h\ ASD\ long}$*Hcm-2*0.6*Wtmin*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	5497	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	3163	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	3854	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1520	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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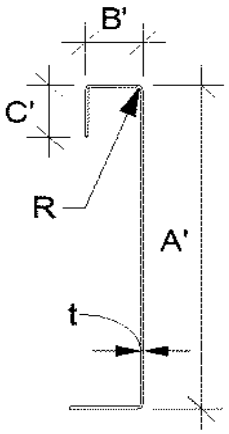
Curb Design

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'=	[1.500] in		a'=	5.429 in	= A'-t
C'=	[0.500] in	(0 if no lips)	b =	1.233 in	= B'-[r+t/2+α(r+t/2)]
α =	[0.500]	(0 - no Lip; 1 w/ lip)	b'=	1.447 in	= B'-(t/2+αt/2)
R =	0.1069	(Inside bend radius)	c =	0.161 in	= α[C'-(r+t/2)]
t =	0.0713 in		c'=	0.232 in	= α(C'-t/2)
r'=	0.143 in	= R+t/2	u =	0.224 in	= πr/2
x =	0.292 in	(Distance between centroid and web centerline)			
Ix =	2.515 in^4		rx =	2.04 in	
Iy =	0.133 in^4		ry =	0.470 in	
A =	0.60 in^2		rmin =	0.470 in	

Axial Compression

Pa = 4.884 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 4.957 k
Fe = 16.90 ksi
λc = 1.72
Fn = 14.82 ksi
Ly = 77.13 in Lateral unbraced length
k_yL_y/r_y = 131 (assume k=0.8)

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

Compression Check = O.K.

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50	(See table C3.4.1-2, fastened to support, two flange, end loading)
t =	0.0713 in	h/t =	77.14 ≤ 200	C_R = 0.08	
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				

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

Long side: Pu_{Trans} = 1.832 k **web stiffener REQ'D** # clips = 3
Short side: Pu_{Long} = 1.927 k **web stiffener REQ'D** # clips = 2

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 = 2542 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 2749 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 = 1.0
# of Bolts required for Shear = 2.3
# of Bolts Used = [4.0]

Check Combined Stress in Bolts & Inserts: 0.825 **O.K.**

Check 1/8" welded connection

<--- USE WELD Ω = 2.35

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 1.858 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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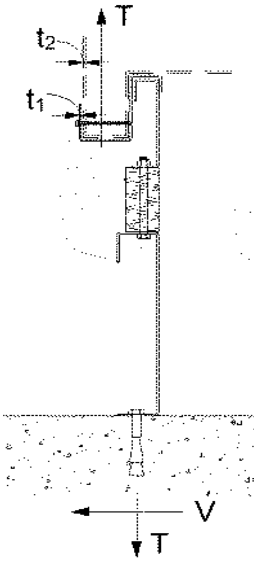
Connection Unit to Curb Clip | #10 SMS screw | Ω = 3.0

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 # | For t2/t1 ≥ 2.5: | Pns = 2377 #

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

Tension: $P_{ns} = 2.7t_1 dF_{u1}$ | 3.39 k | $P_{ns} = 2.7t_1 dF_{u1}$ | 3.39 k

$P_{ns} = 2.7t_2 dF_{u2}$ | 2.38 k | $P_{ns} = 2.7t_2 dF_{u2}$ | 2.38 k

Pns/Ω = 755 #

Pss/Ω = 540 # <- Controls

Pnot = 0.748 k (screw pull-out strength) $P_{not} = 0.85t_c dF_{u2})$

$t_c = \min(t_1, t_2)$

Pnov = 3.718 k (screw pull-over strength) $P_{nov} = 1.5t_1 d_w F_{u1}$

Pts/Ω = 249 # <- Controls

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

	Shear (k)	# clips	V_{clip} (k)	V_{allow} (lb)	# screws	spacing
Long side:	4.884	3	1.63	540 #	4	2.00 in
Short side:	4.884	2	2.44	540 #	5	1.50 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 in² | Anv = 0.574 in² | Ant = 0.117 in²

Rn/Ω = 12.372 k $R_n = 0.6F_y A_{gv} + F_u A_{nt} \leq 0.6F_u A_{nv} + F_u A_{nt}$

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

Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	6197	lbs
	$Tens_{MAX}$ =	3932	lbs
	$Shear_{MAX}$ =	10170	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	4158	lbs
	$Tens_{MAX}$ =	1892	lbs
	$Shear_{MAX}$ =	10170	lbs

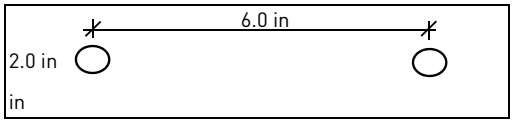
Loads at each Isolator Type: **CQA**

Transverse loading: (on long edge) # isolators: 3	$Comp_{MAX}$ =	2065.8	lbs
	$Tens_{MAX}$ =	1310.6	lbs
	$Shear_{MAX}$ =	1017.0	lbs
Longitudinal loading: (on short edge) # isolators: 2	$Comp_{MAX}$ =	2078.8	lbs
	$Tens_{MAX}$ =	946.0	lbs
	$Shear_{MAX}$ =	1017.0	lbs

Max compression force on isolator: 2.079 k ≤ 3.176 k **O.K.**

Max uplift on isolator: 1.311 k ≤ 3.176 k **O.K.**

Max shear on isolator: 1.017 k ≤ 1.163 k **O.K.**



Forces on top bolt:

Tension = 1.311 k | d_b = 0.375 in

Shear = 1.017 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: $P_n = A_n F_t$ | 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: $P_n = Cm_f dtF_u$ | 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: $P_{nt} = A_b F_{nt}$ | 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: $P_{nv} = A_b F_{nv}$ | 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 = 11.87 ksi | fv = 9.21 ksi | O.K.

F'nt = 15.36 ksi | Fnv/Ω = 10.00 ksi

$P'_{nt} = A_b F'_{nt}$ | P'nt/Ω = 0.754 k **No Good - Use Welds**

Longitudinal weld loading: | L = 1.5 | $P_n/\Omega = \frac{1}{\Omega}\left(1 - \frac{0.01L}{t_2}\right) Lt_2 F_{u2} \geq V_{req}$ | Ω = 2.55

If L/t < 25: L/t = 14.75 | t = 0.1017 | Pn/Ω = 3.315 k

Transverse weld loading: | t = 0.1017 | $P_n/\Omega = \frac{1}{\Omega} tLF_u \geq T_{req}$ | Ω = 2.35

L = 1 | Fu = 65 ksi | Pn/Ω = 2.813 k

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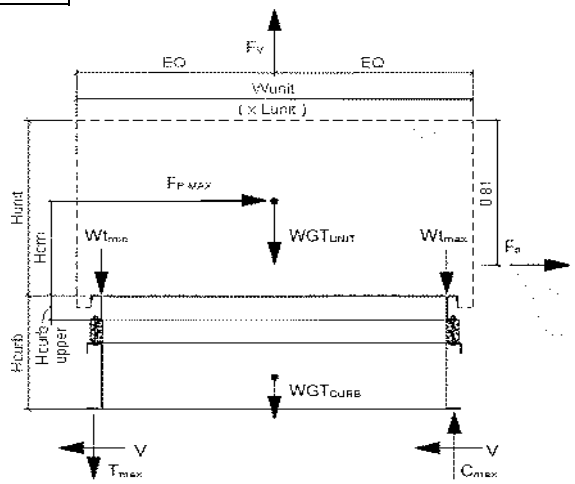
Client:	ProVent	PV2203	Base curb
Project:	CBISC-14	Iso Curb	CBISCSAV28
Unit:	Sunchoice 28		

Base Curb Information

Hbase curb =	14	in	(Height of base curb)
Lcurb =	154.5	in	(Length of base curb)
wcurb =	83.125	in	(Width of base curb)
WGTbase =	636	lbs	(Weight of base curb)
# Springs long side =	3	# Springs short side =	2



Unit Information

WGTunit =	2720	lbs	(Oper. Weight of Unit + 5%)
Wt'max =	790	lbs	(Wtmax+1/4*WGTupper)
Wt'min =	606	lbs	(Wtmin+1/4*WGTupper))
Hunit =	57.22	in	(Height of unit above curb)
H'cm =	38.61	in	(Hcm+10"(upper+spring))
Lunit =	160.0625	in	(Length of unit)
Wunit =	88.75	in	(Width of unit)
$WGT_{unit+upper+base}$ =	3468	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 =	10170	lbs	(0.7*Fpmax) FpmaxASD = 12454 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)
$F_{h\ ASD\ trans}$ =	3062	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hbase curb+10") (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	1698	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hbase curb+10")
$F_{vert\ ASD}$ =	2642	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Base Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	6807	lbs	$=[FpmaxASD*H'cm+2*(1+0.14S_{DS})*Wt'max*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	4383	lbs	$=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*wcurb)]/wcurb$
$Compression_{WIND}$ =	1049	lbs	$=[F_{h\ ASD\ trans}*H'cm+2*0.6*Wt'max*wcurb-F_{vert\ ASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	2016	lbs	$=[F_{h\ ASD\ trans}*H'cm-2*0.6*Wt'min*wcurb+F_{vertASD}*wcurb/2]/wcurb$

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	4625	lbs	$=[FpmaxASD*H'cm+2*(1+0.14*S_{DS})*Wt'max*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	2201	lbs	$=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*Lcurb)]/Lcurb$
$Compression_{WIND}$ =	51	lbs	$=[F_{h\ ASD\ long}*H'cm+2*0.6*Wt'max*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	1018	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:	$Comp_{MAX}$ =	6807	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	4383	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	4625	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	2201	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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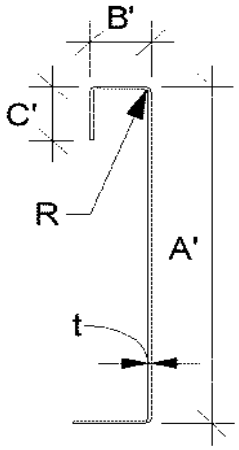
Curb Design

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 =	5.085 k	(Max Axial Comp)	Ω_c =	1.80
Pn/Ωc =	6.135 k			
Fe =	6.61 ksi	$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c}$	$If\ \lambda_c \le 1.5;\ F_n = \left(0.658^{\lambda_c^2}\right) F_y$	$\lambda_c = \sqrt{\frac{F_y}{F_e}}$
λc =	2.75		$If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c^2} F_y$	$F_e = \frac{\pi^2 E}{\left(kl/r\right)^2}$
Fn =	5.79 ksi			
Ly =	148.50 in	Lateral unbraced length		
k_yL_y/r_y =	210	(assume k=0.8)		

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} =	2.269 k	O.K.	# clips = 3		
Short side: Pu_{Long} =	2.312 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	

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

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 = 3113 lbs — Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)

Vcrnmax = 3403 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 = 1.3

# of Bolts required for Shear = 2.8

# of Bolts Used = 5.0

Check Combined Stress in Bolts & Inserts: 0.815 **O.K.**

Check 1/8" welded connection

<--- USE WELD Ω = 2.35

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

Lreq'd = 1.613 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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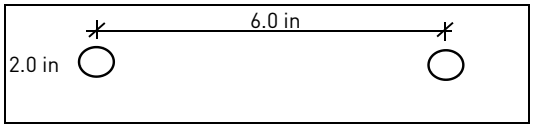
Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	6197	lbs
	$Tens_{MAX}$ =	3932	lbs
	$Shear_{MAX}$ =	10170	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	4158	lbs
	$Tens_{MAX}$ =	1892	lbs
	$Shear_{MAX}$ =	10170	lbs

Loads at each Isolator Type: **CQA**

Transverse loading: (on long edge) # isolators: 3	$Comp_{MAX}$ =	2065.8	lbs
	$Tens_{MAX}$ =	1310.6	lbs
	$Shear_{MAX}$ =	1017.0	lbs
Longitudinal loading: (on short edge) # isolators: 2	$Comp_{MAX}$ =	2078.8	lbs
	$Tens_{MAX}$ =	946.0	lbs
	$Shear_{MAX}$ =	1017.0	lbs

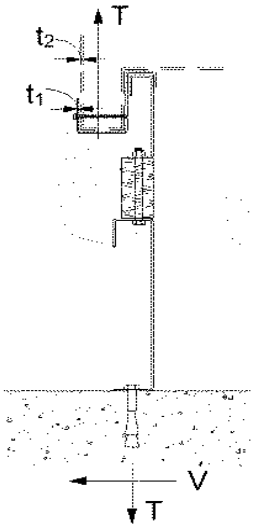
Max compression force on isolator: 2.079 k ⩽ 3.176 k **O.K.**
Max uplift on isolator: 1.311 k ⩽ 3.176 k **O.K.**
Max shear on isolator: 1.017 k ⩽ 1.163 k **O.K.**



Forces on bottom bolts:

d_b = 0.5 in
base curb, t = 0.1017 in
Tension = 0.655 k / bolt
Shear = 0.508 k / bolt

7.0 in



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. $F_t = (0.1 + 3d/s)F_u \leq F_u$ = 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:

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$ ft = 6.67 ksi fv = 2.59 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: $Uplift_{MAX}$ = 7395 lbs $Shear_{MAX}$ = 6227 lbs

$Compression_{SEISMIC}$ = 10169 lbs =[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Tension_{SEISMIC}$ = 7395 lbs =[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Compression_{WIND}$ = 1658 lbs =[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*wcurb/2-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ = 2218 lbs =[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)-0.6*$WGT_{unit+upper+base}$*wcurb/2+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 3754 lbs $Shear_{MAX}$ = 6227 lbs

$Compression_{SEISMIC}$ = 6528 lbs =[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Tension_{SEISMIC}$ = 3754 lbs =[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Compression_{WIND}$ = 298 lbs =[$F_{h\ ASD\ long}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*Lcurb/2-$F_{vert\ ASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ = 859 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 embt** (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 = 9.73 COMBINED LOADING: 0.979 O.K.
# of Screws Req'd for Shear = 9.27 Req'd Min Spacing = 9.77 in o.c.
Total # of screws required = 16

Use 16 - 1/4"ϕ x 4.5" Simpson SDS screws @ 9.8 in o.c. along long side of curb w/ 2.75" threaded embed

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Longitudinal:

# of Screws Req'd for Uplift = 4.94 COMBINED LOADING: 0.919 O.K.

# of Screws Req'd for Shear = 9.27 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

$Tall_{bolt}$ = 3927 lbs $Vall_{bolt}$ = 2209 lbs

Transverse: $Tall_{metal}$ = 2975 lbs $Vall_{metal}$ = 3072 lbs

# of Bolts Req'd for Uplift = 2.49 COMBINED LOADING: 0.850 O.K.

# of Bolts Req'd for Shear = 2.82 Bolt Spacing = 35.63 in o.c.

Total # of bolts required = 5

Use 5 - 1/2" ϕ A307 Bolts to steel angle below deck @ 35.6 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 1.26 COMBINED LOADING: 0.605 O.K.

# of Bolts Req'd for Shear = 2.82 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 $(0.6\text{-}0.14S_{DS})D + 0.7\Omega_o E$ Ωo = 2.0

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

$Tall_{LRFD}$ = 1957 lbs $Vall_{LRFD}$ = 4540 lbs $\propto = (1 + 0.2SDS)D + 2.5E = 1.708$

$Tall_{ASD} = Tall_{LRFD}/\alpha$ = 1146 lbs $Vall_{ASD} = Vall_{LRFD}/\alpha$ = 2658 lbs $(D = 0.758, E = 0.242)$

Transverse: $Uplift_{MAX}$ = 15277 lbs $Shear_{MAX}$ = 12454 lbs

$Compression_{SEISMIC}$ = 18051 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Tension_{SEISMIC}$ = 15277 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Shear_{SEISMIC}$ = 12454 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 13.33 spacing = 10.96 in o.c. Tapplied = 1091.2 lbs

Min Bolts Req'd Shear = 4.69 spacing = 35.63 in o.c. Vapplied = 622.7 lbs

Try using 14 bolts spaced at 10.96 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.19

Use 14 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 11 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 7994 lbs $Shear_{MAX}$ = 12454 lbs

$Compression_{SEISMIC}$ = 10769 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Tension_{SEISMIC}$ = 7994 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Shear_{SEISMIC}$ = 12454 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 6.98 spacing = 11.85 in o.c. Tapplied = 999.3 lbs

Min Bolts Req'd Shear = 4.69 spacing = 17.78 in o.c. Vapplied = 622.7 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-14	CBISCSAV28	Unit:	Sunchoice 28
UPPER CURB RAIL THICKNESS:	0.0713 in	14 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 5 - #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 5 - 1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts			

CURB ANCHORAGE	WOOD	STEEL	CONCRETE
	1/4"ϕ x 4.5" Simpson SDS screws w/ 2.75" threaded embed (SGmin =	1/2" ϕ A307 Bolts to steel angle below deck	3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed
LONG DIRECTION	16 @ 9.77 in o.c.	5 @ 35.63 in o.c.	14 @ 10.96 in o.c.
SHORT DIRECTION	9 @ 9.39 in o.c.	3 @ 35.56 in o.c.	6 @ 14.23 in o.c.