MOUR GROUP
ENGINEERING + DESIGN

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

Structural Calculations
for
CBISC-06 Series

CBISCPRL** 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

STRUCTURALY CALCULATED VIBRATION ISOLATION ROOF CURB FOR YORK UNITS

ZX08-14; XX08-12; XYA7, ZYA7
ZY07-12; XY07-09; ZL08-14

PROVENT P/N	A	B	EST. WEIGHT
CBISCPRL18**	8"	18"	380 Lbs.
CBISCPRL21**	11"	21"	405 Lbs.
CBISCPRL24**	14"	24"	425 Lbs.

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

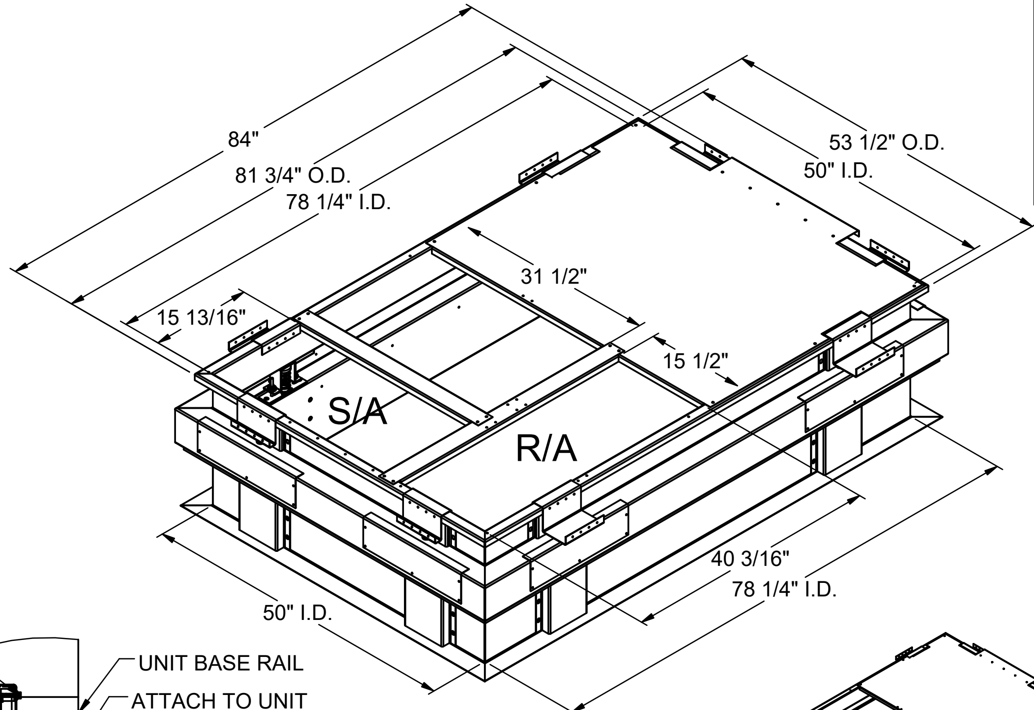
Meets seismic requirements for the following codes:
CBC 2019
IBC 2018

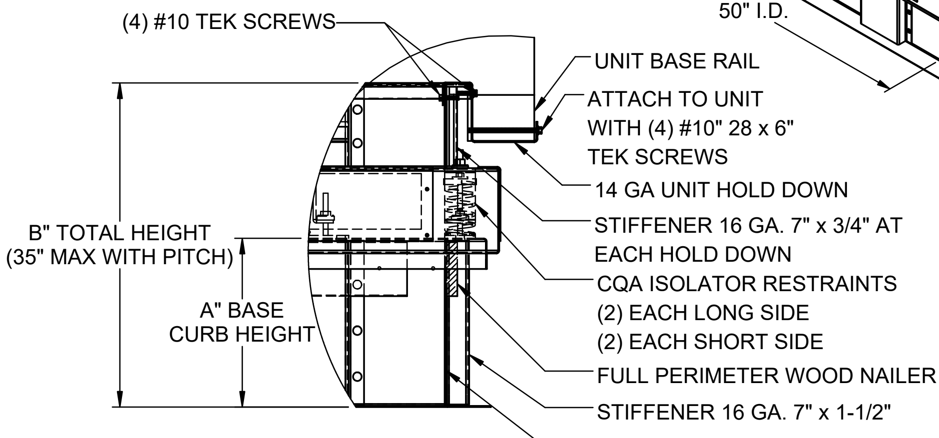
FEATURES

- Roof 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).

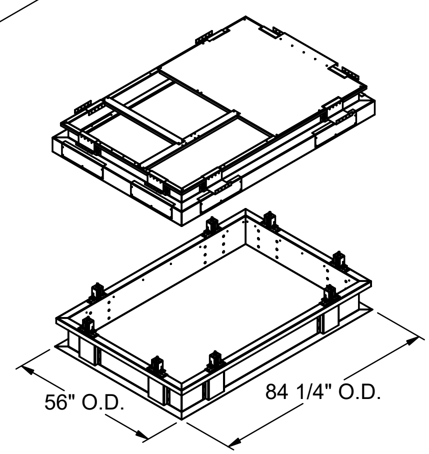
NOTES

- 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

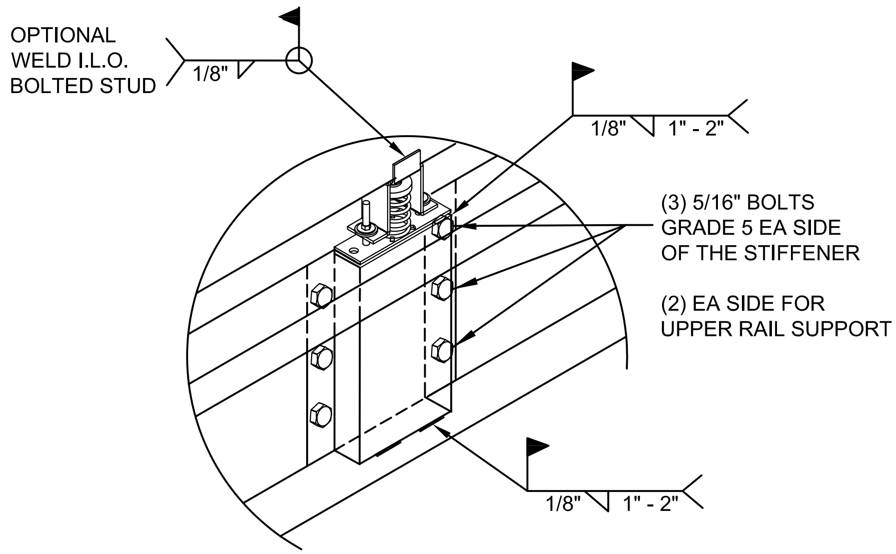
3847 WABASH DRIVE
MIRA LOMA, CA 91752

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

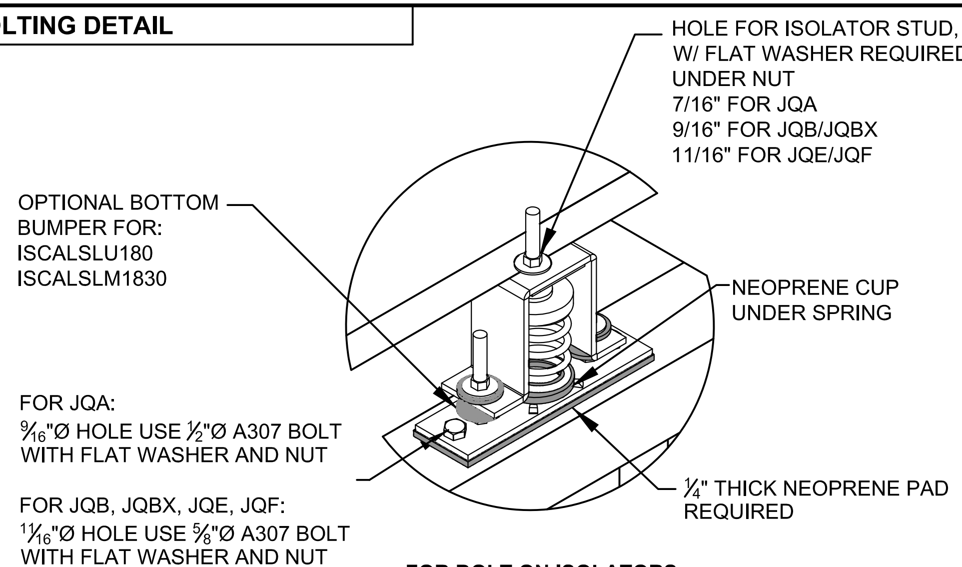
SUBMITED TO: ____________
COMPANY: ____________
JOB NAME: ____________
EQUIPMENT: ____________
NOTES: ____________

FORM NO:	PART NUMBER:	
CBISC-06	-	
DATE:	REV:	DRAWN BY:
6/30/2022	4	FMM

WELDMENT AND BOLTING DETAIL



BASE CURB SUPPORT



FOR BOLT ON ISOLATORS

ProVent

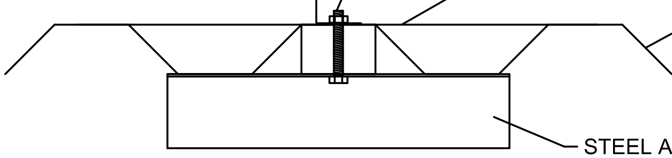
3847 WABASH DRIVE
MIRA LOMA, CA 91725

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

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

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

STEEL ATTACHMENT



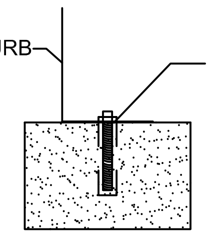
	NO. OF ANCHORAGE BOLTS REQUIRED	
CURB	LONG SIDE	SHORT SIDE
LXS	3 @ 19.25" O.C.	2 @ 23" O.C.
LXL	3 @ 19.25" O.C.	2 @ 33" O.C.
SUN3672	4 @ 21" O.C.	2 @ 27.25" O.C.
PRD3715	6 @ 14.28" O.C.	3 @ 20.75" O.C.
PRS	4 @ 20.46" O.C.	2 @ 31.13" O.C.
PRL	3 @ 36.13" O.C.	2 @ 44" O.C.
SLU180	4 @ 35.08" O.C.	3 @ 37"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

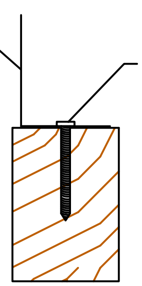
CONCRETE ATTACHMENT



	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.

ProVent
3847 WABASH DRIVE
MIRA LOMA, CA 91752

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

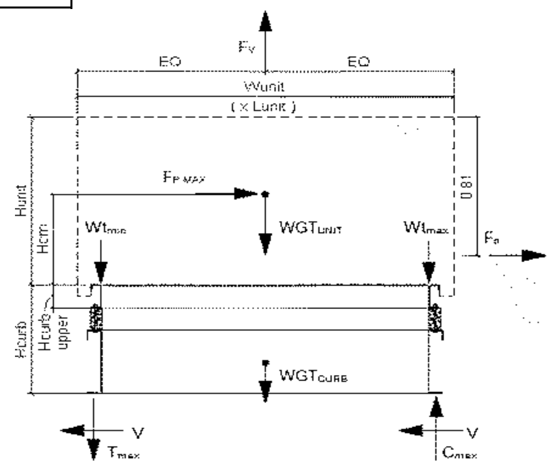
SUBMITTED TO: ____
COMPANY: ____
JOB NAME: ____
EQUIPMENT: ____
NOTES: ____

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

MOUR GROUP
ENGINEERING + DESIGN

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

Client:	ProVent	PV2203	Upper curb rail
Project:	CBISC-06	Iso Curb	CBISCPRL
Unit:	ZX 08-14; XX 08-12; ZY 07-12; XY 07-09		



Upper Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	81.75	in	(Length of upper curb)
wcurb =	53.5	in	(Width of upper curb)
WGTupper =	69	lbs	(Weight of upper curb)
# Clips long side =	2		# Clips short side = 2

Unit Information

WGTunit =	1318	lbs	(Weight of Unit)
Wtmax =	395	lbs	(Maximum corner weight)
Wtmin =	264	lbs	(Minimum corner weight)
Hunit =	48.56	in	(Height of unit above curb)
Hcm =	24.28	in	(Height to center of mass)
Lunit =	87.18	in	(Length of unit)
Wunit =	61.69	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 =	4733	lbs	(0.7*Fpmax)	FpmaxASD =	4981 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)
$F_{h\ ASD\ trans}$ =	1110	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	786	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	1000	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Upper Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	3191	lbs	$=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	2000	lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb]]/wcurb$
$Compression_{WIND}$ =	478	lbs	$=[F_{h\ ASD\ trans}*Hcm+2*0.6*Wtmax*wcurb-F_{vert\ ASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	688	lbs	$=[F_{h\ ASD\ trans}*Hcm-2*0.6*Wtmin*wcurb+F_{vertASD}*wcurb/2]/wcurb$

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	2449	lbs	$=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	1258	lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb]]/Lcurb$
$Compression_{WIND}$ =	208	lbs	$=[F_{h\ ASD\ long}*Hcm+2*0.6*Wtmax*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	417	lbs	$=[F_{h\ ASD\ long}*Hcm-2*0.6*Wtmin*Lcurb+F_{vertASD}*Lcurb/2]/Lcurb$

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	3191	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2000	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2449	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1258	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

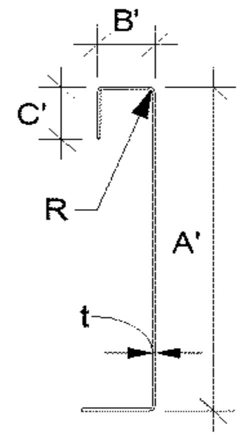
MOUR GROUP
ENGINEERING + DESIGN

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

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 = 2.366 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 11.320 k
Fe = 49.34 ksi
λc = 1.01
Fn = 32.72 ksi
Ly = 50.00 in   Lateral unbraced length
k_yL_y/r_y = 77   (assume k=0.8)
Compression Check = O.K.

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

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				
Long side: Pu_{Trans} =	1.596 k	web stiffener REQ'D	# clips = 2		
Short side: Pu_{Long} =	1.224 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)

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

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 = 1245 lbs   Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1596 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 = 0.5
# of Bolts required for Shear = 1.5
# of Bolts Used = 3.0
Check Combined Stress in Bolts & Inserts: 0.653 **O.K.**

Check 1/8" welded connection

<--- USE WELD   Ω = 2.35

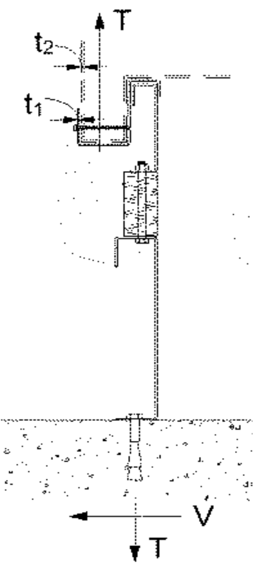
Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 1.079 in

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

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

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: $P_{ns} = 2.7t_1 dF_{u1}$ 2.38 k

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

For t2/t1 ≥ 2.5: Pns = 2377 #

$P_{ns} = 2.7t_1 dF_{u1}$ 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)
Pnov = 2.607 k (screw pull-over strength)
Pts/Ω = 249 # <- Controls
Pts/Ω = 820 # (full tensile screw capacity)

$P_{not} = 0.85t_c dF_{u2}$)
$t_c = \min(t_1, t_2)$)
$P_{nov} = 1.5t_1 d_w F_{u1}$

	Shear (k)	# clips	V_{clip} (k)	V_{allow}(lb)	# screws	spacing
Long side:	2.366	2	1.18	540 #	4	2.00 in
Short side:	2.366	2	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 in^2 — Anv = 0.416 in^2 — Ant = 0.082 in^2
Rn/Ω = 8.674 k — $R_n = 0.6F_y A_{gv} + F_u A_{nt} \le 0.6F_u A_{nv} + F_u A_{nt}$
BSR O.K. (AISI Sect. E5.3)

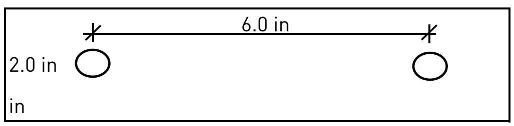
Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	3687	lbs
	$Tens_{MAX}$ =	2578	lbs
	$Shear_{MAX}$ =	4981	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2729	lbs
	$Tens_{MAX}$ =	1620	lbs
	$Shear_{MAX}$ =	4981	lbs

Loads at each Isolator Type: **CQA**

Transverse loading: (on long edge)	$Comp_{MAX}$ =	1843.7	lbs
	$Tens_{MAX}$ =	1288.9	lbs
# isolators: 2	$Shear_{MAX}$ =	622.6	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	1364.6	lbs
	$Tens_{MAX}$ =	809.8	lbs
# isolators: 2	$Shear_{MAX}$ =	622.6	lbs

Max compression force on isolator: 1.844 k ≤ 3.176 k O.K.
Max uplift on isolator: 1.289 k ≤ 3.176 k O.K.
Max shear on isolator: 0.623 k ≤ 1.163 k O.K.



Forces on top bolt:
Tension = 1.289 k — d_b = 0.375 in
Shear = 0.623 k — per rail, t = 0.0713 in — 7.0 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. — $F_t = (0.1 + 3d/s)F_u \le F_u =$ 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 in^2
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:

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

ft = 11.67 ksi — fv = 5.64 ksi O.K.
F'nt = 29.82 ksi — Fnv/Ω = 10.00 ksi

$P'_{nt} = A_b F'_{nt}$ — P'nt/Ω = 1.464 k **Combined O.K.**

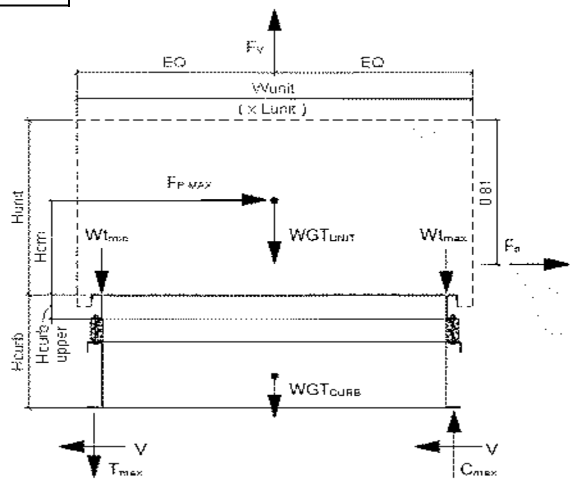
Longitudinal weld loading: L = 1.5 — $P_n/\Omega = \frac{1}{\Omega}\left(1 - \frac{0.01L}{t_2}\right) L t_2 F_{u2} \ge V_{req}$ — Ω = 2.55
If L/t < 25: L/t = 21.04 — t = 0.0713 — Pn/Ω = 2.153 k

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

MOUR GROUP
ENGINEERING + DESIGN

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

Client:	ProVent PV2203 Base curb
Project:	CBISC-06 Iso Curb CBISCPRL
Unit:	ZX 08-14; XX 08-12; ZY 07-12; XY 07-09



Base Curb Information

Hbase curb =	25	in	(Height of base curb)
Lcurb =	84.25	in	(Length of base curb)
wcurb =	56	in	(Width of base curb)
WGTbase =	356	lbs	(Weight of base curb)

Springs long side = 2 # Springs short side = 2

Unit Information

WGTunit =	1318	lbs	(Weight of Unit)
Wt'max =	413	lbs	(Wtmax+1/4*WGTupper)
Wt'min =	281	lbs	(Wtmin+1/4*WGTupper))
Hunit =	48.56	in	(Height of unit above curb)
H'cm =	34.28	in	(Hcm+10"(upper+spring))
Lunit =	87.18	in	(Length of unit)
Wunit =	61.69	in	(Width of unit)
$WGT_{unit+upper+base}$ =	1743	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 =	4981	lbs	(0.7*Fpmax) FpmaxASD = 6259 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)
$F_{h\ ASD\ trans}$ =	1716	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hbase curb+10") (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	1214	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hbase curb+10")
$F_{vert\ ASD}$ =	1000	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Base Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	4138	lbs	=[FpmaxASD*H'cm+2*(1+0.14S_{DS})*Wt'max*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2891	lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*wcurb]]/wcurb
$Compression_{WIND}$ =	1045	lbs	=[$F_{h\ ASD\ trans}$*H'cm+2*0.6*Wt'max*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1213	lbs	=[$F_{h\ ASD\ trans}$*H'cm-2*0.6*Wt'min*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	3115	lbs	=[FpmaxASD*H'cm+2*(1+0.14*S_{DS})*Wt'max*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1869	lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*Lcurb]]/Lcurb
$Compression_{WIND}$ =	489	lbs	=[$F_{h\ ASD\ long}$*H'cm+2*0.6*Wt'max*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	657	lbs	=[$F_{h\ ASD\ long}$*H'cm-2*0.6*Wt'min*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

---> Negative values indicate opposite load.

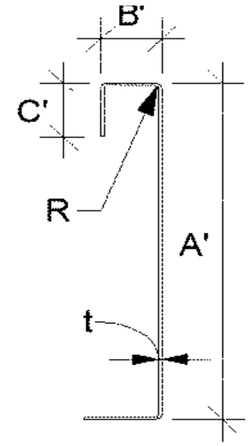
Governing Reactions:

Transverse:	$Comp_{MAX}$ =	4138	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2891	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	3115	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1869	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

MOUR GROUP
ENGINEERING + DESIGN

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



Curb Design

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

Calculate Section Properties of Curb

A'=	25.000 in		a =	24.492 in	= A'-(2r+t)
B'=	1.750 in		a'=	24.898 in	= A'-t
C'=	0.000 in	(0 if no lips)	b =	1.496 in	= B'-[r+t/2+α(r+t/2)]
α =	0.000	(0 - no Lip; 1 w/ lip)	b'=	1.699 in	= B'-(t/2+αt/2)
R =	0.1525	(Inside bend radius)	c =	0.000 in	= α[C'-(r+t/2)]
t =	0.1017 in		c'=	0.000 in	= α(C'-t/2)
r'=	0.203 in	= R+t/2	u =	0.319 in	= πr/2
x =	0.103 in	(Distance between centroid and web centerline)			
Ix =	181.709 in		rx =	7.97 in	
Iy =	0.302 in		ry =	0.325 in	
A =	2.86 in^2		rmin =	0.325 in	

Axial Compression

Pu =	2.490 k	(Max Axial Comp)
Pn/Ωc =	9.442 k	
Fe =	6.78 ksi	
λc =	2.72	
Fn =	5.94 ksi	
Ly =	84.25 in	Lateral unbraced length
k_yL_y/r_y =	207	(assume k=0.8)

Ω_c = 1.80

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

Compression Check = O.K.

Check Web Crippling

h =	25 in	-- Check limits:		C = 4.00
t =	0.1017 in	h/t =	245.82 ≤ 200	C_R = 0.14
N =	7.00	N/t =	68.83 ≤ 210	C_N = 0.35
Ω_w =	1.75	N/h =	0.28 ≤ 2.0	C_h = 0.02
P_n =	4.106 k	R/t =	1.50 ≤ 9.0	
P_n/Ω_w =	2.346 k			
Long side: Pu_{Trans} =	2.069 k	O.K.	# clips = 2	
Short side: Pu_{Long} =	1.558 k	O.K.	# clips = 2	

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

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

*****h/t > 200; 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

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

Pwc =	4.106 k	Ae =	0.380 in^2
Pn =	16.181 k		
Pn/Ω_c =	9.518 k	O.K.	

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

Tcrnmax = 1565 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 2069 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 = 0.6
# of Bolts required for Shear = 1.7
# of Bolts Used = 3.0
Check Combined Stress in Bolts & Inserts: 0.781 O.K.

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

Assume L/t > 25: 25*t = 2.543 in
Lreq'd = 0.981 in

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

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

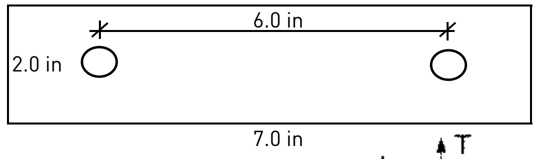
Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	3687	lbs
	$Tens_{MAX}$ =	2578	lbs
	$Shear_{MAX}$ =	4981	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	2729	lbs
	$Tens_{MAX}$ =	1620	lbs
	$Shear_{MAX}$ =	4981	lbs

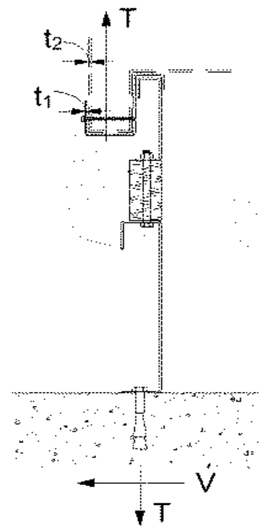
Loads at each Isolator Type: **CQA**

Transverse loading:	$Comp_{MAX}$ =	1843.7	lbs
(on long edge)	$Tens_{MAX}$ =	1288.9	lbs
# isolators: 2	$Shear_{MAX}$ =	622.6	lbs
Longitudinal loading:	$Comp_{MAX}$ =	1364.6	lbs
(on short edge)	$Tens_{MAX}$ =	809.8	lbs
# isolators: 2	$Shear_{MAX}$ =	622.6	lbs

Max compression force on isolator: 1.844 k ≤ 3.176 k O.K.
Max uplift on isolator: 1.289 k ≤ 3.176 k O.K.
Max shear on isolator: 0.623 k ≤ 1.163 k O.K.



Forces on bottom bolts:
d_b = 0.5 in
base curb, t = 0.1017 in
Tension = 0.644 k / bolt
Shear = 0.311 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 = 6.56 ksi fv = 1.59 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: $(0.6\text{-}0.14S_{DS})D + 0.7E$ WIND: 0.6D + W

Transverse: $Uplift_{MAX}$ = 6381 lbs | $Shear_{MAX}$ = 3130 lbs

$Compression_{SEISMIC}$ =	7775 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Tension_{SEISMIC}$ =	6381 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb
$Compression_{WIND}$ =	1839 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*wcurb/2-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1793 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)-0.6*$WGT_{unit+upper+base}$*wcurb/2+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 4159 lbs | $Shear_{MAX}$ = 3130 lbs

$Compression_{SEISMIC}$ =	5554 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Tension_{SEISMIC}$ =	4159 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb
$Compression_{WIND}$ =	877 lbs	=[$F_{h\ ASD\ long}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*Lcurb/2-$F_{vert\ ASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	831 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)

Transverse:
$Tall_{metal}$ = 1397 lbs $Vall_{metal}$ = 1230 lbs
$Tall_{wood}$ = 760 lbs $Vall_{wood}$ = 672 lbs
# of Screws Req'd for Uplift = 8.40 COMBINED LOADING: 0.933 O.K.
# of Screws Req'd for Shear = 4.66 Req'd Min Spacing = 6.93 in o.c.
Total # of screws required = 12

Use 12 - 1/4"ϕ x 4.5" Simpson SDS screws @ 6.9 in o.c. along long side of curb w/ 2.75" threaded embed

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

Longitudinal:

# of Screws Req'd for Uplift = 5.47 — COMBINED LOADING: 0.917 O.K.

# of Screws Req'd for Shear = 4.66 — Screw Spacing = 6.86 in o.c.

Total # of screws required = 8

Use 8 - 1/4"ϕ x 4.5" Simpson SDS screws @ 6.9 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 = 2.14 — COMBINED LOADING: 0.998 O.K.

# of Bolts Req'd for Shear = 1.42 — Bolt Spacing = 36.13 in o.c.

Total # of bolts required = 3

Use 3 - 1/2" ϕ A307 Bolts to steel angle below deck @ 36.1 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 1.40 — COMBINED LOADING: 0.749 O.K.

# of Bolts Req'd for Shear = 1.42 — Bolt Spacing = 44.00 in o.c.

Total # of bolts required = 2

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 44 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

$Tall_{LRFD}$ = 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: $Uplift_{MAX}$ = 13007 lbs — $Shear_{MAX}$ = 6259 lbs

$Compression_{SEISMIC}$ = 14401 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Tension_{SEISMIC}$ = 13007 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*wcurb/2]/wcurb

$Shear_{SEISMIC}$ = 6259 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 11.35 spacing = 6.57 in o.c. — Tapplied = 1182.4 lbs

Min Bolts Req'd Shear = 2.35 spacing = 36.13 in o.c. — Vapplied = 368.2 lbs

Try using 11 bolts spaced at 7.23 in o.c. — COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.17

Use 11 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 7.2 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 8563 lbs — $Shear_{MAX}$ = 6259 lbs

$Compression_{SEISMIC}$ = 9958 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Tension_{SEISMIC}$ = 8563 lbs =[Ωo*FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+curb+base}$*Lcurb/2]/Lcurb

$Shear_{SEISMIC}$ = 6259 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 7.47 spacing = 6.29 in o.c. — Tapplied = 1070.4 lbs

Min Bolts Req'd Shear = 2.35 spacing = 22.00 in o.c. — Vapplied = 368.2 lbs

Try using 6 bolts spaced at 8.80 in o.c. — COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.07

Use 6 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 8.8 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY:	CBISC-06 CBISCPRL		**Unit:** ZX 08-14; XX 08-12; ZY 07-12; XY 07-09
UPPER CURB RAIL THICKNESS:	0.1017 in 12 Gauge		
UNIT CLIP THICKNESS:	0.0713 in 14 Gauge		
# OF CLIPS (LONG 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		
# 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	(2) - 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		---Bolt or Weld O.K.---
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 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy w/ 4" embed
LONG DIRECTION	12 @ 6.93 in o.c.	3 @ 36.13 in o.c.	11 @ 7.23 in o.c.
SHORT DIRECTION	8 @ 6.86 in o.c.	2 @ 44 in o.c.	6 @ 8.8 in o.c.