MOUR GROUP
ENGINEERING + DESIGN

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

Structural Calculations

for

CBISC-05 Series

CBISCPRS** SERIES

REGISTERED PROFESSIONAL ENGINEER
GLENN A. MOURITZEN
SE 3578
Exp. 6/30/25
STRUCTURAL
STATE OF CALIFORNIA

Prepared for:

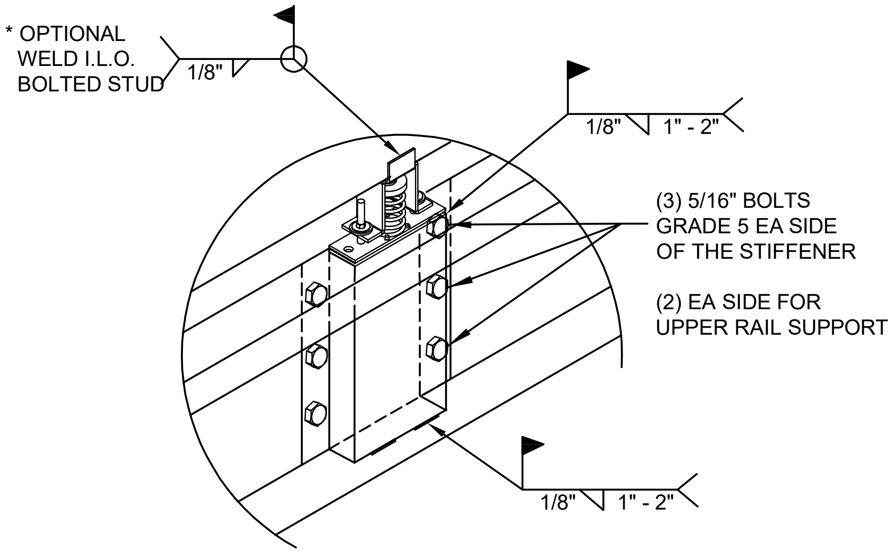
PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

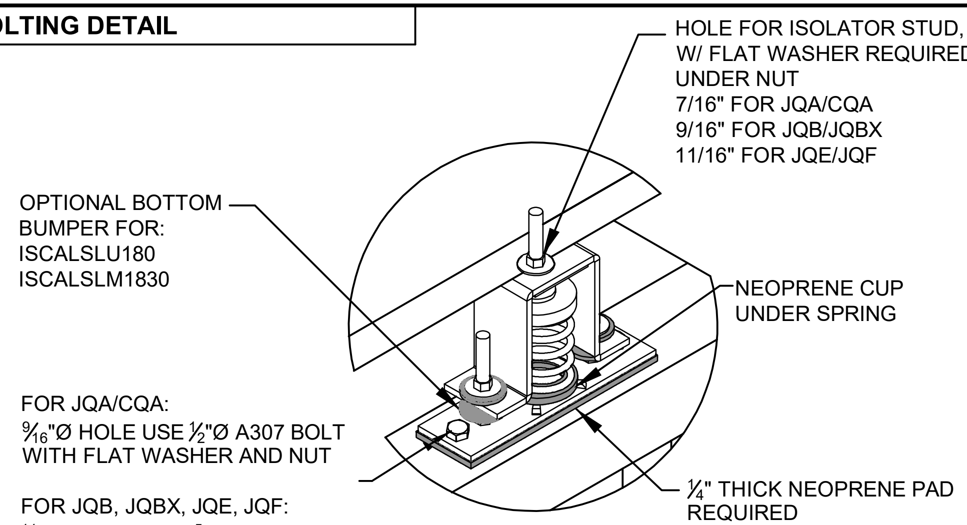
Date: August 23, 2023

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

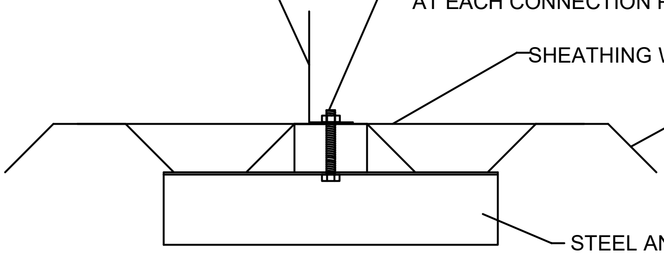
SUBMITTED TO:__________
COMPANY:__________
JOB NAME:__________
EQUIPMENT:__________
NOTES:__________

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

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

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

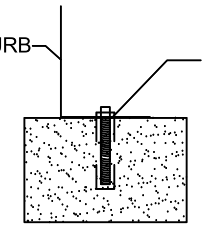
STEEL ATTACHMENT



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.

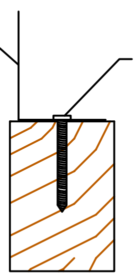
CONCRETE ATTACHMENT



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 DIRECT FIT (SUN CORE) SMALL CABINET UNITS

ZX 04-07; XX A7, ZX A7, ZY, ZQ, XY, XQ, ZL 04-06

PROVENT P/N	A	B	EST. WEIGHT
CBISCPRS18**	8"	18"	305 Lbs.
CBISCPRS21**	11"	21"	320 Lbs.
CBISCPRS24**	14"	24"	335 Lbs.

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

Weight of upper portion supported by spring isolators= 188 Lbs.

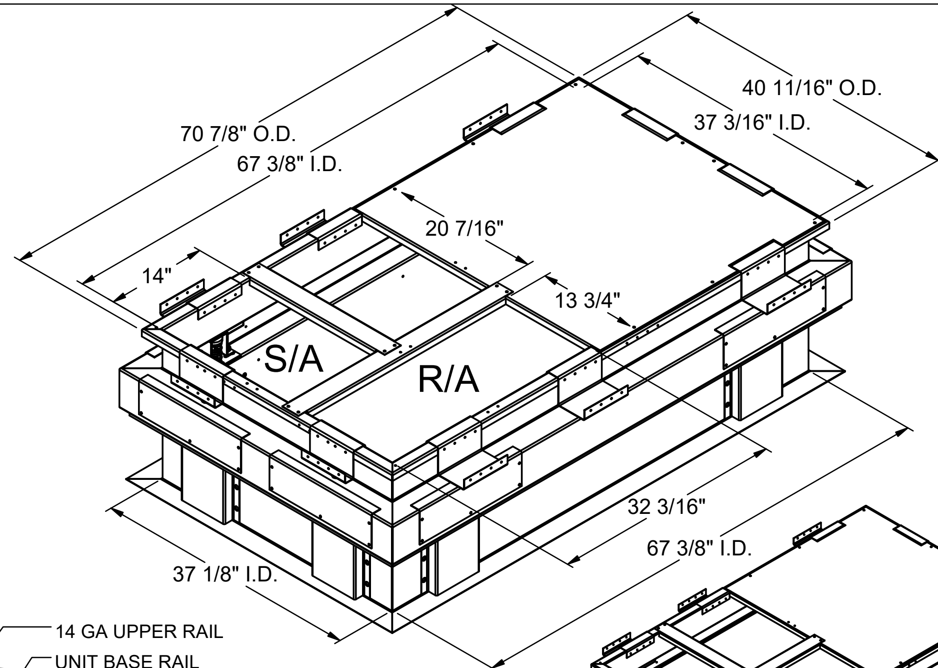
Meets seismic requirements for the following codes:
CBC 2022
IBC 2021

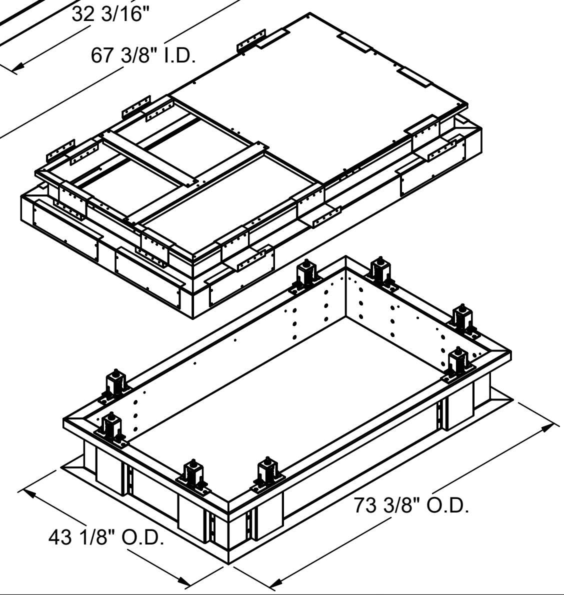
FEATURES

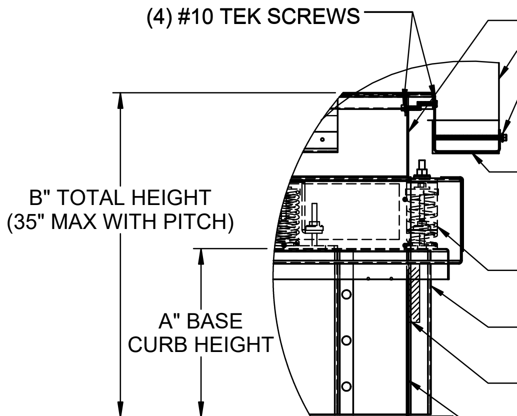
- Roof curbs sides and ends are 14 ga.
- Fully welded construction.
- Gasketing package provided.
- Heat treated wood nailer provided.
- insulated deck pans provided.
- Pitched curbs and taller curbs are available.
- CalDyn OSHPd pre-approved seismic restraints. (OPM-0401-13), (CQA).

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:	PART NUMBER:	
CBISC-05	-	
DATE:	**REV:**	**DRAWN BY:**
7/28/2023	**4**	JG

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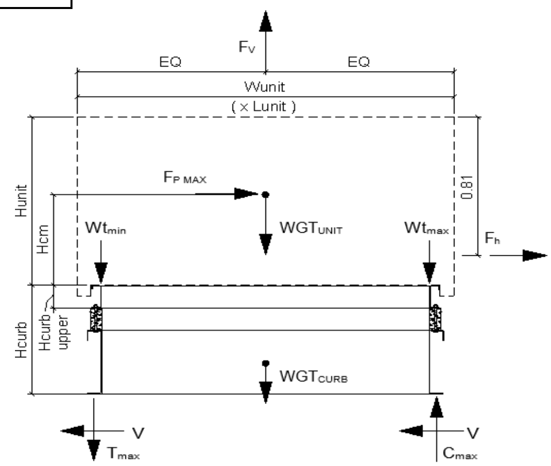
6593 Riverdale St.
San Diego, CA 92120
(619)727-4800

Client:	ProVent PV2312	Upper curb rail
Project:	CBISC-05 Iso Curb CBISCPRS	
Unit:	YORK ZX 04-07; XX A7; ZY, ZQ, XY, XQ 04-06	



Upper Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	70.375	in	(Length of upper curb)
wcurb =	40.1875	in	(Width of upper curb)
WGTupper =	188	lbs	(Weight of upper curb)
# Clips long side =	3		# Clips short side = 2

Unit Information

WGTunit =	916	lbs	(Weight of Unit)
Wtmax =	275	lbs	(Maximum corner weight)
Wtmin =	195	lbs	(Minimum corner weight)
Hunit =	40.56	in	(Height of unit above curb)
Hcm =	20.28	in	(Height to center of mass)
Lunit =	74.05	in	(Length of unit)
Wunit =	48.88	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 =	3289	lbs	(0.7*Fpmax)	FpmaxASD =	3964 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)
$F_{h\ ASD\ trans}$ =	803	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	530	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	673	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Upper Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	2385	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	1551	lbs	=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb)]/wcurb
$Compression_{WIND}$ =	399	lbs	=[$F_{h\ ASD\ trans}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	508	lbs	=[$F_{h\ ASD\ trans}$*Hcm-2*0.6*Wtmin*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	1673	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	839	lbs	=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb)]/Lcurb
$Compression_{WIND}$ =	146	lbs	=[$F_{h\ ASD\ long}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	256	lbs	=[$F_{h\ ASD\ long}$*Hcm-2*0.6*Wtmin*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	2385	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1551	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	1673	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	839	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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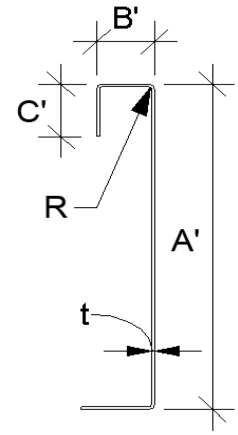
Curb Design

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 =	1.645 k	(Max Axial Comp)	Ω_c = 1.80
Pn/Ωc =	13.768 k		
Fe =	91.64 ksi		
λc =	0.74		
Fn =	39.79 ksi		
Ly =	36.69 in	Lateral unbraced length	
k_yL_y/r_y =	56	(assume k=0.8)	

$$\frac{P_n}{\Omega_c} = \frac{F_nA}{\Omega_c}$$

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

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

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

Compression Check = O.K.

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50	(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} =	0.795 k	**O.K.**	# clips = 3		
Short side: Pu_{Long} =	0.836 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

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

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

Not Req'd

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

Tcrnmax =	991 lbs	Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax =	1192 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 =	0.4
# of Bolts required for Shear =	1.1
# of Bolts Used =	3.0
Check Combined Stress in Bolts & Inserts:	0.496 **O.K.**

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

Assume L/t > 25: 25*t =	1.783 in
Lreq'd =	0.806 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 =	0.0713	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)

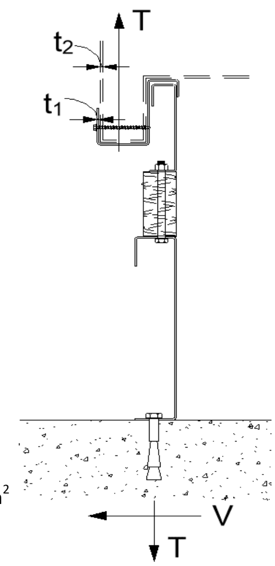
Pts/Ω = 249 # <- Controls

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:	1.645	3	0.55	540 #	4	2.00 in
Short side:	1.645	2	0.82	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:	$Comp_{MAX}$ =	3271	lbs
(on long edge)	$Tens_{MAX}$ =	2388	lbs
	$Shear_{MAX}$ =	3964	lbs
Longitudinal:	$Comp_{MAX}$ =	2180	lbs
(on short edge)	$Tens_{MAX}$ =	1297	lbs
	$Shear_{MAX}$ =	3964	lbs

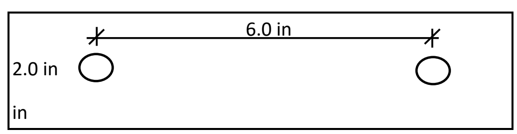
Loads at each Isolator Type: **CQA**

Transverse loading:	$Comp_{MAX}$ =	1635.7	lbs
(on long edge)	$Tens_{MAX}$ =	1194.1	lbs
# isolators: 2	$Shear_{MAX}$ =	495.6	lbs
Longitudinal loading:	$Comp_{MAX}$ =	1090.2	lbs
(on short edge)	$Tens_{MAX}$ =	648.6	lbs
# isolators: 2	$Shear_{MAX}$ =	495.6	lbs

Max compression force on isolator: 1.636 k ≤ 3.176 k **O.K.**

Max uplift on isolator: 1.194 k ≤ 3.176 k **O.K.**

Max shear on isolator: 0.496 k ≤ 1.163 k **O.K.**



Forces on top bolt:

Tension = 1.194 k | d_b = 0.375

Shear = 0.496 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: $P_n = A_n F_t$ | 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 = 10.81 ksi | fv = 4.49 ksi O.K.

F'nt = 34.48 ksi | Fnv/Ω = 10.00 ksi

$P'_{nt} = A_b F'_{nt}$ | P'nt/Ω = 1.692 k **Combined O.K.**

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

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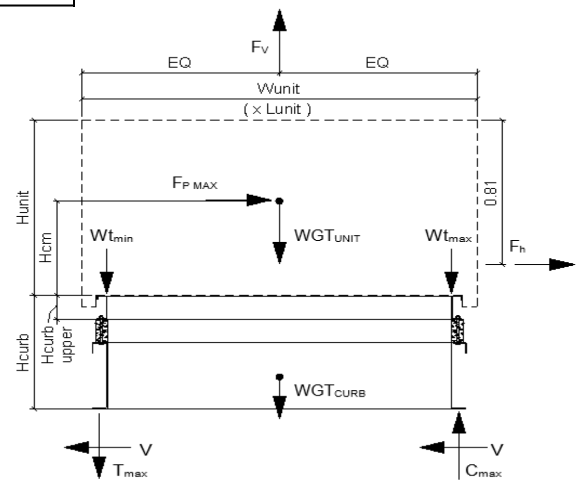
Client:	ProVent	PV2312		Base curb
Project:	CBISC-05	Iso Curb	CBISCPRS	
Unit:	YORK ZX 04-07; XX A7; ZY, ZQ, XY, XQ 04-06			



Base Curb Information

Hbase curb = 25 in (Height of base curb)
Lcurb = 73.375 in (Length of base curb)
wcurb = 43.125 in (Width of base curb)
WGTbase = 147 lbs (Weight of base curb)
# Springs long side = 2 # Springs short side = 2

Unit Information

WGTunit = 916 lbs (Weight of Unit)
Wt'max = 322 lbs (Wtmax+1/4*WGTupper)
Wt'min = 242 lbs (Wtmin+1/4*WGTupper))
Hunit = 40.56 in (Height of unit above curb)
H'cm = 30.28 in (Hcm+10"(upper+spring))
Lunit = 74.05 in (Length of unit)
Wunit = 48.88 in (Width of unit)
$WGT_{unit+upper+base}$ = 1251 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 =	3964 lbs (unit + upper rail)	(0.7*Fpmax)	FpmaxASD =	4492 lbs (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)
$F_{h\ ASD\ trans}$ =	1318 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hbase curb+10") (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	870 lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hbase curb+10")
$F_{vert\ ASD}$ =	673 lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Base Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	3633 lbs	=[FpmaxASD*H'cm+2*(1+0.14S_{DS})*Wt'max*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2648 lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*wcurb)]/wcurb
$Compression_{WIND}$ =	975 lbs	=[$F_{h\ ASD\ trans}$*H'cm+2*0.6*Wt'max*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	972 lbs	=[$F_{h\ ASD\ trans}$*H'cm-2*0.6*Wt'min*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	2485 lbs	=[FpmaxASD*H'cm+2*(1+0.14*S_{DS})*Wt'max*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1500 lbs	=[FpmaxASD*H'cm-2*(0.6-0.14S_{DS})*Wt'min*Lcurb)]/Lcurb
$Compression_{WIND}$ =	409 lbs	=[$F_{h\ ASD\ long}$*H'cm+2*0.6*Wt'max*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	406 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:	$Comp_{MAX}$ =	3633	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	2648	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2485	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1500	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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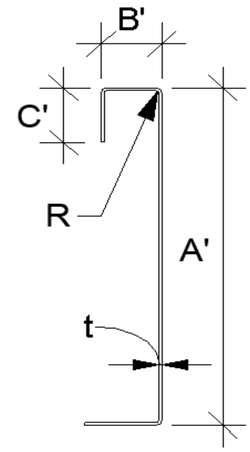

Curb Design

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 = 1.982 k (Max Axial Comp) Ω_c = 1.80

Pn/Ωc = 8.960 k

Fe = 9.14 ksi

λc = 2.34

Fn = 8.01 ksi

Ly = 73.38 in   Lateral unbraced length

k_yL_y/r_y = 179   (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 =	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} = 1.816 k   **web stiffener REQ'D**   # clips = 2

Short side: Pu_{Long} = 1.243 k   **web stiffener REQ'D**   # clips = 2

***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 = 1123 lbs   Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)

Vcrnmax = 1816 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 = 1.7

# of Bolts Used = 3.0

Check Combined Stress in Bolts & Inserts: 0.703 **O.K.**

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

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

Lreq'd = 1.228 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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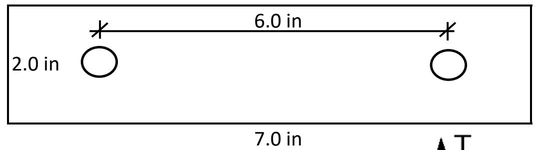
Curb Loads (copied from upper rail calcs)

Transverse:	$Comp_{MAX}$ =	3271	lbs
(on long edge)	$Tens_{MAX}$ =	2388	lbs
	$Shear_{MAX}$ =	3964	lbs
Longitudinal:	$Comp_{MAX}$ =	2180	lbs
(on short edge)	$Tens_{MAX}$ =	1297	lbs
	$Shear_{MAX}$ =	3964	lbs

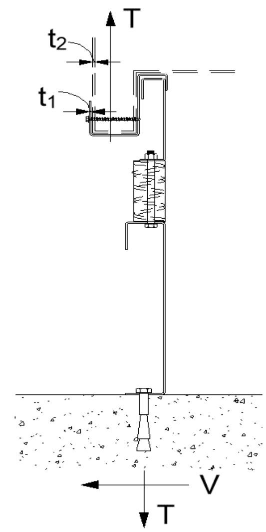
Loads at each Isolator Type: **CQA**

Transverse loading:	$Comp_{MAX}$ =	1635.7	lbs
(on long edge)	$Tens_{MAX}$ =	1194.1	lbs
# isolators: 2	$Shear_{MAX}$ =	495.6	lbs
Longitudinal loading:	$Comp_{MAX}$ =	1090.2	lbs
(on short edge)	$Tens_{MAX}$ =	648.6	lbs
# isolators: 2	$Shear_{MAX}$ =	495.6	lbs

Max compression force on isolator: 1.636 k ≤ 3.176 k **O.K.**
Max uplift on isolator: 1.194 k ≤ 3.176 k **O.K.**
Max shear on isolator: 0.496 k ≤ 1.163 k **O.K.**



Forces on bottom bolts:
d_b = 0.5 in
base curb, t = 0.0713 in
Tension = 0.597 k / bolt
Shear = 0.248 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. $F_t = (0.1 + 3d/s)F_u \leq F_u =$ 55.250 ksi

Bolt Bearing Strength: $P_n = Cm_f dtF_u$ Ω = 2.50 (Section E3.3.1 AISI)
Pn/Ω = 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:
$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$ ft = 6.08 ksi fv = 1.26 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:	$Uplift_{MAX}$ = 5583 lbs	$Shear_{MAX}$ = 2246 lbs	
$Compression_{SEISMIC}$ =	6584 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb	
$Tension_{SEISMIC}$ =	5583 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*wcurb/2]/wcurb	
$Compression_{WIND}$ =	1728 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*wcurb/2-$F_{vert\ ASD}$*wcurb/2]/wcurb	
$Tension_{WIND}$ =	1651 lbs	=[$F_{h\ ASD\ trans}$*(H'cm+Hbase curb)-0.6*$WGT_{unit+upper+base}$*wcurb/2+$F_{vertASD}$*wcurb/2]/wcurb	
Longitudinal:	$Uplift_{MAX}$ = 3209 lbs	$Shear_{MAX}$ = 2246 lbs	
$Compression_{SEISMIC}$ =	4210 lbs	=[FpmaxASD*(H'cm+Hbase curb)+(1+0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb	
$Tension_{SEISMIC}$ =	3209 lbs	=[FpmaxASD*(H'cm+Hbase curb)-(0.6-0.14S_{DS})*$WGT_{unit+upper+base}$*Lcurb/2]/Lcurb	
$Compression_{WIND}$ =	694 lbs	=[$F_{h\ ASD\ long}$*(H'cm+Hbase curb)+0.6*$WGT_{unit+upper+base}$*Lcurb/2-$F_{vert\ ASD}$*Lcurb/2]/Lcurb	
$Tension_{WIND}$ =	617 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)

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

# of Screws Req'd for Uplift = 7.35 COMBINED LOADING: 0.943 O.K.
# of Screws Req'd for Shear = 3.34 Req'd Min Spacing = 7.26 in o.c.
Total # of screws required = 10

Use 10 - 1/4"ϕ x 4.5" Simpson SDS screws @ 7.3 in o.c. along long side of curb w/ 2.75" threaded embed

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Longitudinal:

# of Screws Req'd for Uplift =	4.22	COMBINED LOADING:	0.913	O.K.
# of Screws Req'd for Shear =	3.34	Screw Spacing =	7.03	in o.c.
Total # of screws required =	6			

Use 6 - 1/4"ϕ x 4.5" Simpson SDS screws @ 7 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 =	2.68	COMBINED LOADING:	0.840	O.K.
# of Bolts Req'd for Shear =	1.02	Bolt Spacing =	20.46	in o.c.
Total # of bolts required =	4			

Use 4 - 1/2" ϕ A307 Bolts to steel angle below deck @ 20.5 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift =	1.54	COMBINED LOADING:	0.555	O.K.
# of Bolts Req'd for Shear =	1.02	Bolt Spacing =	31.13	in o.c.
Total # of bolts required =	2			

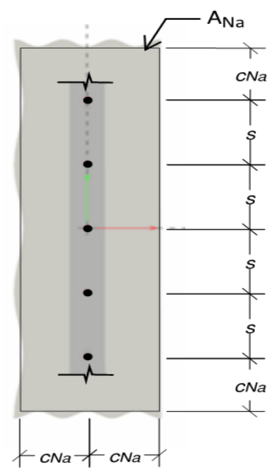
Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 31.1 in o.c. along short side of curb

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 = 10 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); $c_{Na} = 10 d_a \sqrt{\frac{\tau_{uncr}}{1100}}$



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} = 1053.52 in²
A_{Nao} = 328.52 in²
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} = 30578 lbs (group) $\lambda_a = 1.0$
ϕN_{ag} = 14907 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} = 624 in² N_b = 8601 lbs ϕ_{conc} = 0.75
A_{Nco} = 144 in² kc = 17 ϕ_{bond} = 0.65
N_{cbg} = 37273 lbs (group) ϕ_{seis} = 0.75
ϕN_{cbg} = 20966 lbs (group) ϕ_{steel} = 0.65

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

$T_{all,LRFD}$ = 2981 lbs (anchor) $V_{all,LRFD}$ = 3067 lbs $\propto = (1 + 0.2SDS)D + 2.5E$ = 1.421
$T_{all,ASD} = T_{all,LRFD}/\alpha$ = 1745 lbs $V_{all,ASD} = V_{all,LRFD}/\alpha$ = 1795 lbs D = 0.758 E = 0.242 $\propto$ = 1.709

Transverse:	$Uplift_{MAX}$ =	6778 lbs	$Shear_{MAX}$ =	5615 lbs

$Compression_{SEISMIC}$ = 7808 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_DS)*WGT_unit+curb*wcurb/2]/wcurb
$Tension_{SEISMIC}$ = 6778 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_DS)*WGT_unit+curb*wcurb/2]/wcurb
$Shear_{SEISMIC}$ = 5615 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 3.88 spacing = 20.46 in o.c. Tapplied = 1355.7 lbs
Min Bolts Req'd Shear = 3.13 spacing = 20.46 in o.c. Vapplied = 701.9 lbs

Try using	5	bolts
spaced at	15.34	in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.17 O.K.

Use 5 - 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 15.3 in o.c. max. along long side of curb w/ 4in embed

Longitudinal:	$Uplift_{MAX}$ =	3909 lbs	$Shear_{MAX}$ =	5615 lbs

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$Compression_{SEISMIC}$ =	4939	lbs	=[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*$WGT_{unit+curb}$*Lcurb/2]/Lcurb
$Tension_{SEISMIC}$ =	3909	lbs	=[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_{DS})*$WGT_{unit+curb}$*Lcurb/2]/Lcurb
$Shear_{SEISMIC}$ =	5615	lbs	=Ωo*FpmaxASD/2

Min Bolts Req'd Uplift =	2.24	spacing =	15.56	in o.c.	Tapplied =	1303.1	lbs
Min Bolts Req'd Shear =	3.13	spacing =	10.38	in o.c.	Vapplied =	701.9	lbs

Try using	3	bolts
spaced at	15.56	in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.14 O.K.

Use 3 - 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 15.6 in o.c. max. along short side of curb w/ 4in embed

CURB DESIGN SUMMARY:	CBISC-05 CBISCPRS	**Unit:**	YORK ZX 04-07; XX A7; ZY, ZQ, XY, XQ 04-06
UPPER CURB RAIL THICKNESS:	0.0713 in 14 Gauge		
UNIT CLIP THICKNESS:	0.0713 in 14 Gauge		
# OF CLIPS (LONG SIDE) -	3 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	NOT REQUIRED		
# OF CLIPS (SHORT SIDE) -	2 clips with 4 - #10 SMS screws each clip		
WEB STIFFENER:	NOT REQUIRED		
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:	0.0713 in 14 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 0.625in ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy w/ 4in embed
LONG DIRECTION	10 @ 7.26 in o.c.	4 @ 20.46 in o.c.	5 @ 15.34 in o.c.
SHORT DIRECTION	6 @ 7.03 in o.c.	2 @ 31.13 in o.c.	3 @ 15.56 in o.c.