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Structural Calculations

for

CBISC-01 Series

REGISTERED PROFESSIONAL ENGINEER
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NO. SE 3578
EXP. 6/30/19
STRUCTURAL
STATE OF CALIFORNIA

Prepared for:

PROVENT / RRS

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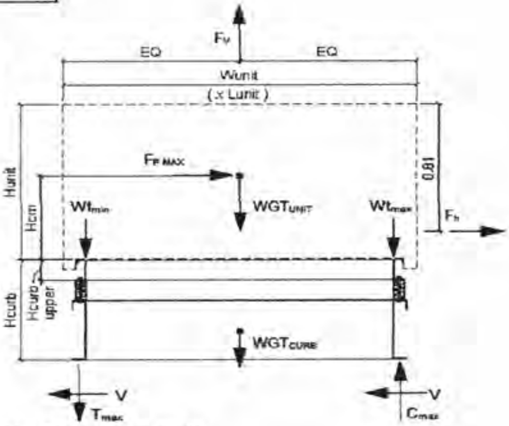
Date: August 22, 2018

Project Number: PV1805

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

Client: ProVent PV1805
Project: CBISC-01 Iso Curb (CBISCLXS**) Upper curb rail
Unit: ALL YORK P***A CABINETS



Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	46.5	in	(Length of curb)
wcurb =	31	in	(Width of curb)
WGTcurb =	210	lbs	(Weight of curb)
# Clips long side =	1	# Clips short side =	1

Unit Information

WGTunit =	367	lbs	(Weight of Unit)
Wtmax =	120	lbs	(Maximum corner weight)
Wtmin =	71	lbs	(Minimum corner weight)
Hunit =	49	in	(Height of unit above curb)
Hcm =	24.5	in	(Height to center of mass)
Lunit =	51.25	in	(Length of unit)
Wunit =	35.75	in	(Width of unit)

Seismic Loading - 2015 IBC/2016 CBC

Ss =	2.850		(Worst case for majority of CA - Design Category D)
Fa =	1.000		(Interpolated from Table 11.4-1 ASCE 7-10)
Sms =	2.850		(Fa*Ss)
Sds =	1.900		(2/3*Sms)
Ip =	1.25		(Importance Factor Category III Building)
Fpmax =	3.800	Wp	(1.6*Sds*Ip)*Wp
FpmaxASD =	976	lbs	(0.7*Fpmax) FpmaxASD = 1535 lbs
	(unit only)		(unit and curb)

Wind Loading - 2015 IBC/2016 CBC

*** Exposure Category C ***

Kz =	1.13		(For 60 ft roof height, Exposure C - Table 29.3-1 ACSE 7-10)
Kzt =	1.0		(No topographic effects assumed for rooftop mounted units)
Kd =	0.85		(Directionality factor Table 26.6-1 ASCE 7-10)
V =	115		(Max wind velocity, mph for Cat III & IV bldgs Exp. Cat C)
$GCr_{(horiz)}$ =	1.9		(Refer Sect 29.5.1 ASCE 7-10)
$GCr_{(vert)}$ =	1.5		(Refer Sect 29.5.1 ASCE 7-10)
qz	32.5	psf	= 0.00256*Kz*Kzt*Kd*V^2 (Eq. 29.3-1 ASCE 7-10)
$F_{h\ ASD\ trans}$ =	719	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb upper) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	502	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb upper)
$F_{vert\ ASD}$ =	372	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	1075	lbs	=(FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb)/wcurb
$Tension_{SEISMIC}$ =	953	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	526	lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2)/wcurb
$Tension_{WIND}$ =	678	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Longitudinal:

$Compression_{SEISMIC}$ =	818	lbs	=(FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb)/Lcurb
$Tension_{SEISMIC}$ =	696	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	222	lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2)/Lcurb
$Tension_{WIND}$ =	374	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

---> Negative values indicate Compression load rather than Tension.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	1075	lbs	—> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	953	lbs	—> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	818	lbs	—> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	696	lbs	—> Along short edge of curb.

---> Negative values indicate Compression load rather than Tension.

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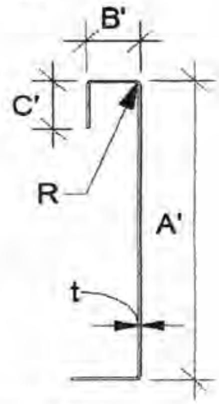
Curb Design

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



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'=	0.000	in (0 if no lips)	b =	1.322 in	= B'-(r+t/2+α(r+t/2))
α =	0.000	(0 - no Lip; 1 w/ lip)	b'=	1.464 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 =	0.261 in	(Distance between centroid and web centerline)			
Ix =	2.424 in	(Moment of Inertia about X-Axis)			
Iy =	0.109 in	(Moment of Inertia about Y-Axis)			
A =	0.59 in^2				
rx =	2.03 in				
ry =	0.432 in				
rmin =	0.432 in				

Axial Compression

Pu =	0.488 k	(Max Axial Comp)
Pn/Ωc =	9.561 k	
Fe =	39.18 ksi	
λc =	1.13	
Fn =	29.31 ksi	
Ly =	46.50 in	Lateral unbraced length
k_yL_y/r_y =	86	(assume k=0.8)

$\Omega_c =$ 1.80

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

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

Compression Check = O.K.

Check Web Crippling

h =	5.5 in	-- Check limits:		C = 7.50
t =	0.0713 in	h/t =	77.14 ≤ 200	C_R = 0.08
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} =	1.075 k	**O.K.**	# clips = 1	
Short side: Pu_{Long} =	0.818 k	**O.K.**	# clips = 1	

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

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

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

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

Pwc =	1.947 k	Ae =	0.380 in^2
Pn =	14.669 k		
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 =	244 lbs	Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax =	476 lbs	(Max Ten/2 corner connections per side)

Bolt:	Tall = 2480 lbs	Vall = 1096 lbs
Threaded Insert:	Tall = 2860 lbs	Vall = 1714 lbs

# of Bolts required for Tension = 0.1

# of Bolts required for Shear = 0.4 ***If combined fails:

# of Bolts Used = 1.0 USE --> 2.0

Check Combined Stress in Bolts & Inserts: 0.533 O.K. StressComb = 0.267 **O.K.**

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

Assume L/t > 25: 25*t =	1.783 in
Lreq'd =	0.322 in

$$P_n/_{\Omega} = \frac{1}{\Omega} 0.75 t L F_u \ge V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75 t F_u}$$

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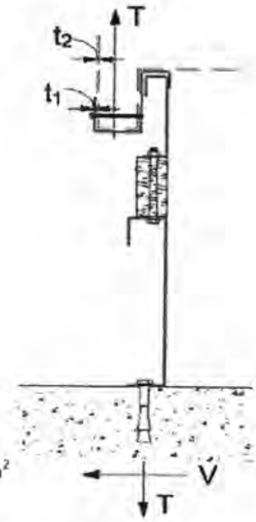
Connection Unit to Curb Clip #10 SMS screw Ω = 3.0

t1 = 0.0713 in (clip thickness) Fu1 = 65 ksi
t2 = 0.1017 in (unit base rail thickness) Fu2 = 65 ksi
d = 0.190 in (screw diameter) dw = 0.375 in (nom. washer diameter)
t2/t1 = 1.4

For t2/t1 ≤ 1.0: Pns = 2377 # For t2/t1 ≥ 2.5:

Shear: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ 3.86 k Pns = 2377 #
$P_{ns} = 2.7t_1 dF_{u1}$ 2.38 k $P_{ns} = 2.7t_1 dF_{u1}$ 2.38 k
$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k $P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k
Pns/Ω = 792 #
Pss/Ω = 540 # <- Controls

Tension: Pnot = 1.068 k (screw pull-out strength) $P_{not} = 0.85t_c dF_{u2}$, $t_c = \min(t_1, t_2)$
Pnov = 2.607 k (screw pull-over strength) $P_{nov} = 1.5t_1 d_w F_{u1}$
Pts/Ω = 356 # <- Controls
Pts/Ω = 820 # (full tensile screw capacity)



	Shear (k)	# clips	V_{clip} (k)	V_{allow} (lb)	# screws	spacing
Long side:	0.976	1	0.98	540 #	4	2.00 in
Short side:	0.976	1	0.98	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)

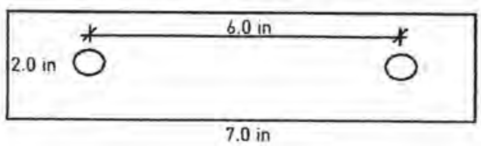
Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	1075	lbs
	$Tens_{MAX}$ =	953	lbs
	$Shear_{MAX}$ =	488	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	818	lbs
	$Tens_{MAX}$ =	696	lbs
	$Shear_{MAX}$ =	488	lbs

Loads at each Isolator Type: **JQA**

Transverse loading:	$Comp_{MAX}$ =	1075.4	lbs
(on long edge)	$Tens_{MAX}$ =	952.8	lbs
# isolators: 1	$Shear_{MAX}$ =	488.1	lbs
Longitudinal loading:	$Comp_{MAX}$ =	818.2	lbs
(on short edge)	$Tens_{MAX}$ =	695.6	lbs
# isolators: 1	$Shear_{MAX}$ =	488.1	lbs

Max compression force on isolator: 1.075 k ≤ 1.660 k **O.K.**
Max uplift on isolator: 0.953 k ≤ 1.660 k **O.K.**
Max shear on isolator: 0.488 k ≤ 0.800 k **O.K.**



Forces on top bolt:
d_b = 0.375 in
upper rail, t = 0.1017 in
Tension = 0.953 k
Shear = 0.488 k

Shear on curb rail: $P_n = teF_u$ Ω = 2.00 (Appendix A, Section E3.1 AISI)
Pn/Ω = 6.611 k e = 1.0 in
Shear O.K.

Net section rupture: $P_n = A_n F_t$ Ω = 2.22 (Appendix A, Section E3.2 AISI)
Pn/Ω = 7.117 k An = 0.165 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 = 2.975 k d/t = 3.69
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.**

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \le F_{nt}$ fv = 4.42 ksi O.K.

Combined Not Applicable F'nt = 34.75 ksi Fnv/Ω = 10.00 ksi

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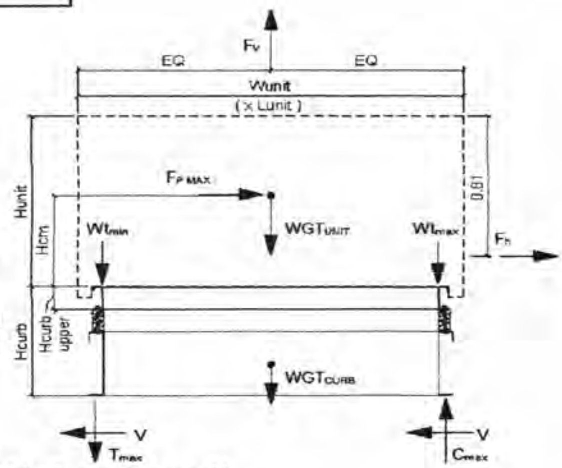
Client:	ProVent PV1805
Project:	CBISC-01 Iso Curb (CBISCLXS**) Base curb
Unit:	ALL YORK P***A CABINETS



Curb Information

Hcurb =	25	in	(Height of curb)
Lcurb =	50.5	in	(Length of curb)
wcurb =	35	in	(Width of curb)
WGTcurb =	210	lbs	(Weight of curb)
# Clips long side =	1	# Clips short side =	1

Unit Information

WGTunit =	367	lbs	(Weight of Unit)
Wtmax =	120	lbs	(Maximum corner weight)
Wtmin =	71	lbs	(Minimum corner weight)
Hunit =	49	in	(Height of unit above curb)
Hcm =	24.5	in	(Height to center of mass)
Lunit =	51.25	in	(Length of unit)
Wunit =	35.75	in	(Width of unit)

Seismic Loading - 2015 IBC/2016 CBC

Ss =	2.850	(Worst case for majority of CA - Design Category D)
Fa =	1.000	(Interpolated from Table 11.4-1 ASCE 7-10)
Sms =	2.850	(Fa*Ss)
Sds =	1.900	(2/3*Sms)
Ip =	1.25	(Importance Factor Category III Building)
Fpmax =	3.800 Wp	(1.6*Sds*Ip)*Wp
FpmaxASD =	976 lbs (unit only)	(0.7*Fpmax) FpmaxASD = 1535 lbs (unit and curb)

Wind Loading - 2015 IBC/2016 CBC

*** Exposure Category C ***

Kz =	1.13	(For 60 ft roof height, Exposure C - Table 29.3-1 ACSE 7-10)
Kzt =	1.0	(No topographic effects assumed for rooftop mounted units)
Kd =	0.85	(Directionality factor Table 26.6-1 ASCE 7-10)
V =	115	(Max wind velocity, mph for Cat III & IV bldgs Exp. Cat C)
$GCr_{(horiz)}$ =	1.9	(Refer Sect 29.5.1 ASCE 7-10)
$GCr_{(vert)}$ =	1.5	(Refer Sect 29.5.1 ASCE 7-10)
qz	32.5 psf	$= 0.00256*Kz*Kzt*Kd*V^2$ (Eq. 29.3-1 ASCE 7-10)
$F_{h\ ASD\ trans}$ =	976 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	681 lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	372 lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	987 lbs	$=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	865 lbs	$= Comp_{SEISMIC}-(0.6-0.14S_{DS})*WGTunit$
$Compression_{WIND}$ =	641 lbs	$=[F_{h\ transASD}*Hcm+2*0.6*Wtmax*wcurb-F_{vertASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	793 lbs	$= Comp_{WIND}+Fvert-0.6*WGTunit$

---> Negative values indicate Compression load rather than Tension.

Longitudinal:

$Compression_{SEISMIC}$ =	777 lbs	$=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	655 lbs	$= Comp_{SEISMIC}-(0.6-0.14S_{DS})*WGTunit$
$Compression_{WIND}$ =	288 lbs	$=[F_{h\ transASD}*Hcm+2*0.6*Wtmax*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	440 lbs	$= Comp_{WIND}+Fvert-0.6*WGTunit$

---> Negative values indicate Compression load rather than Tension.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	987	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	865	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	777	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	655	lbs	---> Along short edge of curb.

---> Negative values indicate Compression load rather than Tension.

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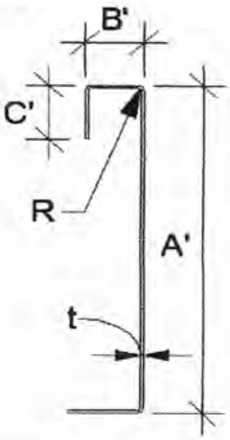
Curb Design

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



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 (Moment of Inertia about X-Axis)			
Iy =	0.218	in (Moment of Inertia about Y-Axis)			
A =	2.01	in^2			
rx =	8.00	in			
ry =	0.329	in			
rmin =	0.329	in			

Axial Compression

Pu =	0.488 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	(See table C3.4.1-2, fastened to support, one flange, end loading)
t =	0.0713 in	h/t =	350.63 ≤ 200	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				
Long side: Pu_{Trans} =	0.987 k	**O.K.**	# clips = 1		
Short side: Pu_{Long} =	0.777 k	**O.K.**	# clips = 1		

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

*****h/t > 200; use web stiffeners**

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

width of stiffener =	7.000 in	ts =	0.0713 14 Gauge
web of stiff. w =	6.644 in	Rs =	0.1069 in
***Check w/ts ≤ 1.28√E/Fys		Ω_c =	1.70
w/ts =	93.178		
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 =	0.474 in^2
Pn =	18.052 k		
Pn/Ω_c =	10.619 k	**O.K.**	

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

Tcrnmax =	244 lbs	Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax =	432 lbs	(Max Ten/2 corner connections per side)

Bolt:	Tall = 2480 lbs	Vall = 1096 lbs
Threaded Insert:	Tall = 2860 lbs	Vall = 1714 lbs

# of Bolts required for Tension = 0.1

# of Bolts required for Shear = 0.4   ***If combined fails:

# of Bolts Used = 1.0   USE --> 4.0

Check Combined Stress in Bolts & Inserts: 0.493 O.K.   StressComb = 0.123 **O.K.**

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Check 1/8" welded connection <--- USE WELD $\Omega =$ 2.35

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.292 in

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

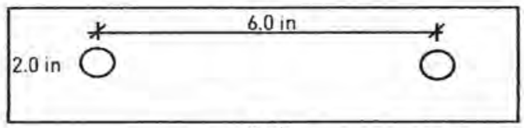
Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	1075	lbs
	$Tens_{MAX}$ =	953	lbs
	$Shear_{MAX}$ =	488	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	818	lbs
	$Tens_{MAX}$ =	696	lbs
	$Shear_{MAX}$ =	488	lbs

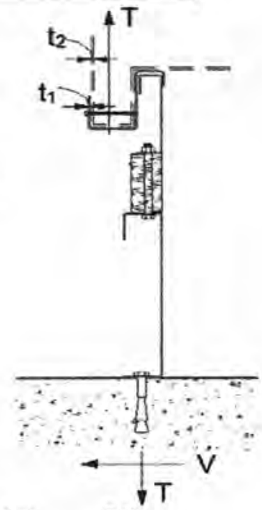
Loads at each Isolator Type: **JQA**

Transverse loading:	$Comp_{MAX}$ =	1075.4	lbs
(on long edge)	$Tens_{MAX}$ =	952.8	lbs
# isolators: 1	$Shear_{MAX}$ =	488.1	lbs
Longitudinal loading:	$Comp_{MAX}$ =	818.2	lbs
(on short edge)	$Tens_{MAX}$ =	695.6	lbs
# isolators: 1	$Shear_{MAX}$ =	488.1	lbs

Max compression force on isolator: 1.075 k ≤ 1.660 k **O.K.**
Max uplift on isolator: 0.953 k ≤ 1.660 k **O.K.**
Max shear on isolator: 0.488 k ≤ 0.800 k **O.K.**



Forces on bottom bolts:
d_b = 0.5 in
base curb, t = 0.0713 in
Tension = 0.476 k / bolt
Shear = 0.244 k / bolt



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

Net section rupture: $P_n = A_nF_t$ $\Omega =$ 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: $P_n = Cm_fdtF_u$ $\Omega =$ 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)***

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

fv = 1.24 ksi O.K.
Combined Not Applicable F'nt = 45.0 ksi Fnv/Ω = 11.25 ksi

Connection of Curb to Supporting Structure

Roof Loading SEISMIC: (0.6-0.14SDS)D + 0.7E WIND: 0.6D + W

Transverse:	$Uplift_{MAX}$ = 2343 lbs	$Shear_{MAX}$ = 767 lbs
$Compression_{SEISMIC}$ =	2536 lbs	=[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb
$Tension_{SEISMIC}$ =	2343 lbs	=$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)
$Compression_{WIND}$ =	1368 lbs	=[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1394 lbs	=[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2]/wcurb
Longitudinal:	$Uplift_{MAX}$ = 1677 lbs	$Shear_{MAX}$ = 767 lbs
$Compression_{SEISMIC}$ =	1870 lbs	=[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	1677 lbs	=$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)
$Compression_{WIND}$ =	654 lbs	=[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	681 lbs	=[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

Wood Attachment: **1/4" φ wood lag screws** **w/ 3.5" Min. Embed** (SGmin = 0.43)

	$Tall_{metal}$ = 946.67 lbs	$Vall_{metal}$ = 1043.33 lbs	
Transverse:	$Tall_{wood}$ = 671.25 lbs	$Vall_{wood}$ = 224 lbs	
# of Screws Req'd for Uplift =	3.49	COMBINED LOADING:	0.865 O.K.
# of Screws Req'd for Shear =	3.43	Req'd Min Spacing =	6.1 in o.c.
Total # of screws required =	8		

Use 8 - 1/4" φ wood lag screws @ 6.1 in o.c. along long side of curb w/ 3.5" Min. Embed

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Longitudinal:

# of Screws Req'd for Uplift =	2.50	COMBINED LOADING:	0.846 O.K.
# of Screws Req'd for Shear =	3.43	Screw Spacing =	4.5 in o.c.
Total # of screws required =	7		

Use 7 - 1/4" ϕ wood lag screws @ 4.5 in o.c. along short side of curb w/ 3.5" Min. Embed

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

$Tall_{bolt}$ = 6903 lbs $Vall_{bolt}$ = 3682 lbs

6903 lbs 3682 lbs

Transverse:

# of Bolts Req'd for Uplift =	0.34	COMBINED LOADING:	0.274 O.K.
# of Bolts Req'd for Shear =	0.21	Bolt Spacing =	38.5 in o.c.
Total # of bolts required =	2		

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 38.5 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift =	0.24	COMBINED LOADING:	0.226 O.K.
# of Bolts Req'd for Shear =	0.21	Bolt Spacing =	23.0 in o.c.
Total # of bolts required =	2		

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 23 in o.c. along short side of curb

For Concrete anchorage: SEISMIC (0.6-0.14SDS)D + $0.7\Omega_o E$ (Ω_o = 2.5)

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

$Tall_{LRFD}$ = 1919 lbs $Vall_{LRFD}$ = 3188 lbs $\alpha = (1 + 0.2SDS)D + 2.5E = 1.87$

$Tall_{ASD} = Tall_{LRFD}/\alpha$ = 1026.2 lbs $Vall_{ASD} = Vall_{LRFD}/\alpha$ = 1704.8 lbs $(D = 0.465, E = 0.535)$

Transverse: $Uplift_{MAX}$ = 5599 lbs $Shear_{MAX}$ = 1919 lbs

$Compression_{SEISMIC}$ = 5792 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 5599 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 1919 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 5.46 spacing = 5.30 in o.c. Tapplied = 799.9 lbs

Min Bolts Req'd Shear = 1.13 spacing = 26.5 in o.c. Vapplied = 274.1 lbs

Try using 7 bolts spaced at 6.42 in o.c. COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \leq 1.2$ = 0.94

Use 7 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 6.4 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 3934 lbs $Shear_{MAX}$ = 1919 lbs

$Compression_{SEISMIC}$ = 4126 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 3934 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 1919 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 3.83 spacing = 3.666667 in o.c. Tapplied = 786.7 lbs

Min Bolts Req'd Shear = 1.13 spacing = 11 in o.c. Vapplied = 383.7 lbs

Try using 5 bolts spaced at 5.75 in o.c. COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \leq 1.2$ = 0.99

Use 5 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 5.8 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY: (CBISCLXS* (CBISCLXS** Unit: ALL YORK P***A CABINETS

UPPER CURB RAIL THICKNESS: 0.0713 in 14 Gauge
UNIT CLIP THICKNESS: 0.0713 in 14 Gauge
 # OF CLIPS (LONG SIDE) - 1 clips with 4 - #10 SMS screws each clip
WEB STIFFENER: NOT REQUIRED
 # OF CLIPS (SHORT SIDE) - 1 clips with 4 - #10 SMS screws each clip
WEB STIFFENER: NOT REQUIRED

VIBRATION ISOLATOR TYPE: JQA Top stud diameter: 3/8
Anchor bolt diameter: 1/2 Anchor hole diamter: 9/16

BASE CURB THICKNESS: 0.0713 in 14 Gauge
WEB STIFFENER: 16Ga x 1.5in x 7in (C-channel) stiffener at each clip on base curb

CORNER CONNECTION: Use minimum 4 - 1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts

CURB ANCHORAGE	WOOD 1/4" ϕ wood lag screws w/ 3.5" Min. Embed (SGmin = 0.43)	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	8 @ 6.07 in o.c.	2 @ 38.5 in o.c.	7 @ 6.42 in o.c.
SHORT DIRECTION	7 @ 4.5 in o.c.	2 @ 23 in o.c.	5 @ 5.75 in o.c.