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Structural Calculations
for
CBISC-02 Series

Prepared for:

PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

Date: August 22, 2018

Project Number: PV1805

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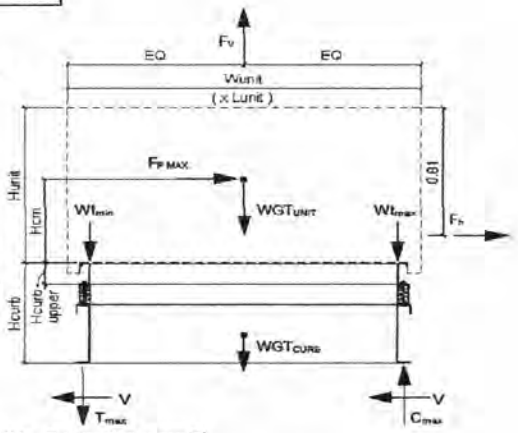
Client: ProVent PV1805
Project: CBISC-02 Iso Curb (CBISCLXL**) Upper curb rail
Unit: ALL YORK P***B CABINETS

Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	46.5	in	(Length of curb)
wcurb =	41	in	(Width of curb)
WGTcurb =	239	lbs	(Weight of curb)
# Clips long side =	1	# Clips short side =	1

Unit Information

WGTunit =	420	lbs	(Weight of Unit)
Wtmax =	141	lbs	(Maximum corner weight)
Wtmin =	78	lbs	(Minimum corner weight)
Hunit =	55	in	(Height of unit above curb)
Hcm =	27.5	in	(Height to center of mass)
Lunit =	51.25	in	(Length of unit)
Wunit =	45.75	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 =	1117	lbs	(0.7*Fpmax) FpmaxASD = 1753 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)
$F_{h\ ASD\ trans}$ =	798	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb upper) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	713	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb upper)
$F_{vert\ ASD}$ =	477	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	1106	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	966	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	466	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	691	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Longitudinal:

$Compression_{SEISMIC}$ =	1018	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	877	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	352	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	577	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	1106	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	966	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	1018	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	877	lbs	---> Along short edge of curb.

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

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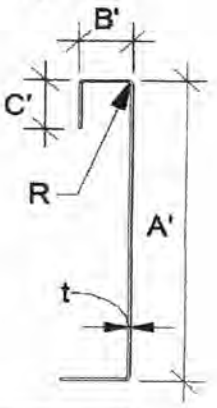
Curb Design

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+a(r+t/2)]
a =	0.000 (0 - no Lip; 1 w/ lip)	b' =	1.464 in	= B'-(t/2+at/2)
R =	0.1069 (Inside bend radius)	c =	0.000 in	= a[C'-(r+t/2)]
t =	0.0713 in	c' =	0.000 in	= a(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 in²
rx = 2.03 in
ry = 0.432 in
rmin = 0.432 in

Axial Compression

Pu = 0.559 k (Max Axial Comp) Ωc = 1.80
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)

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

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

Compression Check = O.K.

Check Web Crippling

h = 5.5 in -- Check limits:
t = 0.0713 in h/t = 77.14 ≤ 200 C = 7.50
N = 7.00 N/t = 98.18 ≤ 210 C_R = 0.08
Ω_w = 1.75 N/h = 1.273 ≤ 2.0 C_N = 0.12
P_n = 1.947 k R/t = 1.50 ≤ 12.0 C_h = 0.048
P_n/Ω_w = 1.112 k
Long side: Pu_{Trans} = 1.106 k **O.K.** # clips = 1
Short side: Pu_{Long} = 1.018 k **O.K.** # clips = 1

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

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

Check Web Stiffener N/A

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 = 1.947 k Ae = 0.474 in²
Pn = 17.942 k
Pn/Ω_c = 10.554 k **Not Req'd**

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

Tcrnmax = 279 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 483 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: 0.553 O.K. StressComb = 0.277 **O.K.**

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

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.327 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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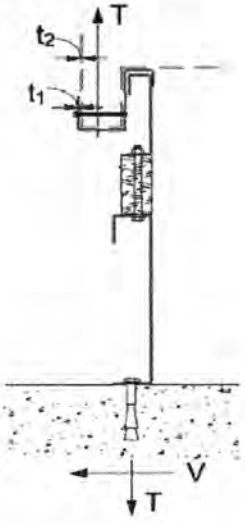
Connection Unit to Curb Clip | #10 SMS screw | Ω = 3.0

t1 = 0.0713 in (clip thickness) | 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 #
Shear: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ 3.86 k
$P_{ns} = 2.7t_1 dF_{u1}$ 2.38 k
$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k
Pns/Ω = 792 #
Pss/Ω = 540 # <- Controls

For t2/t1 ≥ 2.5: | Pns = 2377 #
$P_{ns} = 2.7t_1 dF_{u1}$ 2.38 k
$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k

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:	1.117	1	1.12	540 #	4	2.00 in
Short side:	1.117	1	1.12	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 in² | Anv = 0.416 in² | Ant = 0.082 in²
Rn/Ω = 8.674 k | $R_n = 0.6F_y A_{gv} + F_u A_{nt} \le 0.6F_u A_{nv} + F_u A_{nt}$ (AISI Sect. E5.3)
BSR O.K.

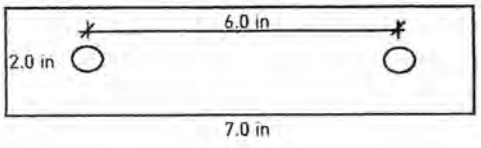
Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	1106	lbs
	$Tens_{MAX}$ =	966	lbs
	$Shear_{MAX}$ =	559	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	1018	lbs
	$Tens_{MAX}$ =	877	lbs
	$Shear_{MAX}$ =	559	lbs

Loads at each Isolator Type: **JQA**

Transverse loading: (on long edge) # isolators: 1	$Comp_{MAX}$ =	1106.4	lbs
	$Tens_{MAX}$ =	966.1	lbs
	$Shear_{MAX}$ =	558.6	lbs
Longitudinal loading: (on short edge) # isolators: 1	$Comp_{MAX}$ =	1017.7	lbs
	$Tens_{MAX}$ =	877.4	lbs
	$Shear_{MAX}$ =	558.6	lbs

Max compression force on isolator: 1.106 k ≤ 1.660 k **O.K.**
Max uplift on isolator: 0.966 k ≤ 1.660 k **O.K.**
Max shear on isolator: 0.559 k ≤ 0.800 k **O.K.**



Forces on top bolt:
d_b = 0.375 in
upper rail, t = 0.1017 in
Tension = 0.966 k
Shear = 0.559 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 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.**

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \le F_{nt}$ | fv = 5.06 ksi O.K.
Combined Not Applicable | F'nt = 32.17 ksi | Fnv/Ω = 10.00 ksi

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Client: ProVent PV1805
Project: CBISC-02 Iso Curb (CBISCLXL**) Base curb
Unit: ALL YORK P***B CABINETS

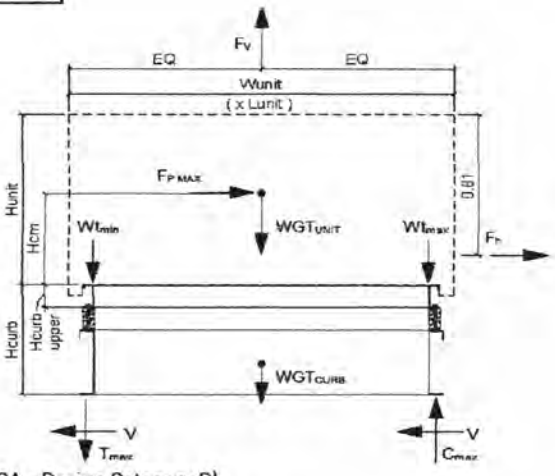
Curb Information

Hcurb =	25	in	(Height of curb)
Lcurb =	50.5	in	(Length of curb)
wcurb =	45	in	(Width of curb)
WGTcurb =	239	lbs	(Weight of curb)

Clips long side = 1 # Clips short side = 1

Unit Information

WGTunit =	420	lbs	(Weight of Unit)
Wtmax =	141	lbs	(Maximum corner weight)
Wtmin =	78	lbs	(Minimum corner weight)
Hunit =	55	in	(Height of unit above curb)
Hcm =	27.5	in	(Height to center of mass)
Lunit =	51.25	in	(Length of unit)
Wunit =	45.75	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 =	1117 lbs (unit only)	(0.7*Fpmax) FpmaxASD = 1753 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)
$F_{h\ ASD\ trans}$ =	1056 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	942 lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	477 lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	1040 lbs	=(FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb)/wcurb
$Tension_{SEISMIC}$ =	899 lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	576 lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2)/wcurb
$Tension_{WIND}$ =	800 lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Longitudinal:

$Compression_{SEISMIC}$ =	965 lbs	=(FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb)/Lcurb
$Tension_{SEISMIC}$ =	825 lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	444 lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2)/Lcurb
$Tension_{WIND}$ =	669 lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	1040	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	899	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	965	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	825	lbs	---> Along short edge of curb.

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

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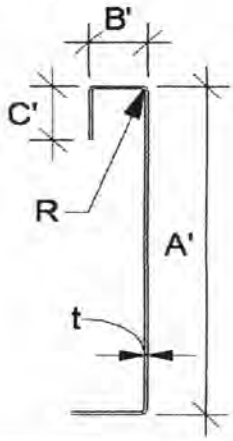
Curb Design

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+a(r+t/2)]
a =	[0.000] (0 - no Lip; 1 w/ lip)	b' =	1.714 in	= B'-(t/2+at/2)
R =	0.1069 (Inside bend radius)	c =	0.000 in	= a[C'-(r+t/2)]
t =	0.0713 in	c' =	0.000 in	= a(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 in²
rx = 8.00 in
ry = 0.329 in
rmin = 0.329 in

Axial Compression

Pu = 0.559 k (Max Axial Comp) Ωc = 1.80
Pn/Ωc = 18.917 k
Fe = 19.29 ksi
λc = 1.61
Fn = 16.91 ksi
Ly = 50.50 in Lateral unbraced length
k_yL_y/r_y = 123 (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:
t = 0.0713 in h/t = 350.63 ≤ 200 C = 4.00
N = 7.00 N/t = 98.18 ≤ 210 C_R = 0.14
Ω_w = 1.75 N/h = 0.28 ≤ 2.0 C_N = 0.35
P_n = 2.105 k R/t = 1.50 ≤ 9.0 C_h = 0.02

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

P_n/Ω_w = 1.203 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} = 1.040 k **O.K.** # clips = 1
Short side: Pu_{Long} = 0.965 k **O.K.** # clips = 1

***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

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

Pwc = 2.105 k Ae = 0.380 in²
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 = 279 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 450 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
# of Bolts Used = [1.0]

***If combined fails: USE --> 4.0

Check Combined Stress in Bolts & Inserts: 0.523 O.K. StressComb = 0.131 **O.K.**

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

Assume L/t > 25: 25*t = 1.783 in $P_n/\Omega = \frac{1}{\Omega} 0.75tLF_u \geq V_{req}$ $L_{req'd} = \frac{V_{req}\Omega}{0.75tF_u}$

Lreq'd = 0.304 in

Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	1106	lbs
	$Tens_{MAX}$ =	966	lbs
	$Shear_{MAX}$ =	559	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	1018	lbs
	$Tens_{MAX}$ =	877	lbs
	$Shear_{MAX}$ =	559	lbs

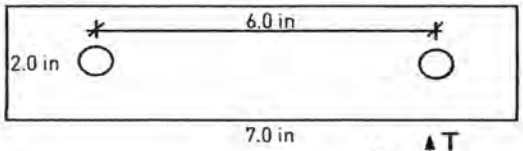
Loads at each isolator Type: JQA

Transverse loading: (on long edge)	$Comp_{MAX}$ =	1106.4	lbs
	$Tens_{MAX}$ =	966.1	lbs
# isolators: 1	$Shear_{MAX}$ =	558.6	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	1017.7	lbs
	$Tens_{MAX}$ =	877.4	lbs
# isolators: 1	$Shear_{MAX}$ =	558.6	lbs

Max compression force on isolator: 1.106 k ≤ 1.660 k **O.K.**

Max uplift on isolator: 0.966 k ≤ 1.660 k **O.K.**

Max shear on isolator: 0.559 k ≤ 0.800 k **O.K.**



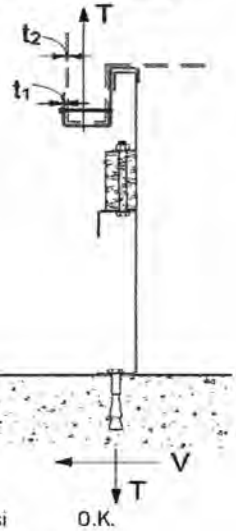
Forces on bottom bolts:

d_b = 0.5 in

base curb, t = 0.0713 in

Tension = 0.483 k / bolt

Shear = 0.279 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: $P_n = Cm_fdtF_u$ 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)***

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$ fv = 1.42 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: $Uplift_{MAX}$ = 2242 lbs $Shear_{MAX}$ = 876 lbs

$Compression_{SEISMIC}$ = 2462 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 2242 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 1191 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2]/wcurb

$Tension_{WIND}$ = 1272 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 2019 lbs $Shear_{MAX}$ = 876 lbs

$Compression_{SEISMIC}$ = 2240 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 2019 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 939 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb

$Tension_{WIND}$ = 1020 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)

Transverse: $Tall_{metal}$ = 946.67 lbs $Vall_{metal}$ = 1043.33 lbs

$Tall_{wood}$ = 671.25 lbs $Vall_{wood}$ = 224 lbs

# of Screws Req'd for Uplift = 3.34 COMBINED LOADING: 0.907 O.K.

# of Screws Req'd for Shear = 3.91 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 = 3.01 COMBINED LOADING: 0.865 O.K.

# of Screws Req'd for Shear = 3.91 Screw Spacing = 5.3 in o.c.

Total # of screws required = 8

Use 8 - 1/4" ϕ wood lag screws @ 5.3 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

Transverse: 6903 lbs 3682 lbs

# of Bolts Req'd for Uplift = 0.32 COMBINED LOADING: 0.281 O.K.

# of Bolts Req'd for Shear = 0.24 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 = 0.29 COMBINED LOADING: 0.265 O.K.

# of Bolts Req'd for Shear = 0.24 Bolt Spacing = 33.0 in o.c.

Total # of bolts required = 2

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 33 in o.c. along short side of curb

For Concrete anchorage: SEISMIC (0.6-0.14SDS)D + 0.7Ω_oE (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: $Uplift_{MAX}$ = 5310 lbs $Shear_{MAX}$ = 2191 lbs

$Compression_{SEISMIC}$ = 5530 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*(WGT$_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 5310 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 2191 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 5.17 spacing = 5.30 in o.c. Tapplied = 885.0 lbs

Min Bolts Req'd Shear = 1.29 spacing = 26.5 in o.c. Vapplied = 365.2 lbs

Try using 6 bolts spaced at 7.70 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{applied}}{V_{allow,ASD}} \leq 1.2$ = 1.08

Use 6 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 7.7 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 4753 lbs $Shear_{MAX}$ = 2191 lbs

$Compression_{SEISMIC}$ = 4973 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*(WGT$_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 4753 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 2191 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 4.63 spacing = 5.25 in o.c. Tapplied = 792.2 lbs

Min Bolts Req'd Shear = 1.29 spacing = 21 in o.c. Vapplied = 365.2 lbs

Try using 6 bolts spaced at 6.60 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{applied}}{V_{allow,ASD}} \leq 1.2$ = 0.99

Use 6 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 6.6 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY: (CBISCLXL*)(CBISCLXL** Unit: ALL YORK P***B 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.	6 @ 7.7 in o.c.
SHORT DIRECTION	8 @ 5.29 in o.c.	2 @ 33 in o.c.	6 @ 6.6 in o.c.