MOUR GROUP
ENGINEERING + DESIGN

6593 Riverdale St.
San Diego, CA 92120

619-727-4800

Structural Calculations

for

CBISC-05 Roof Curb

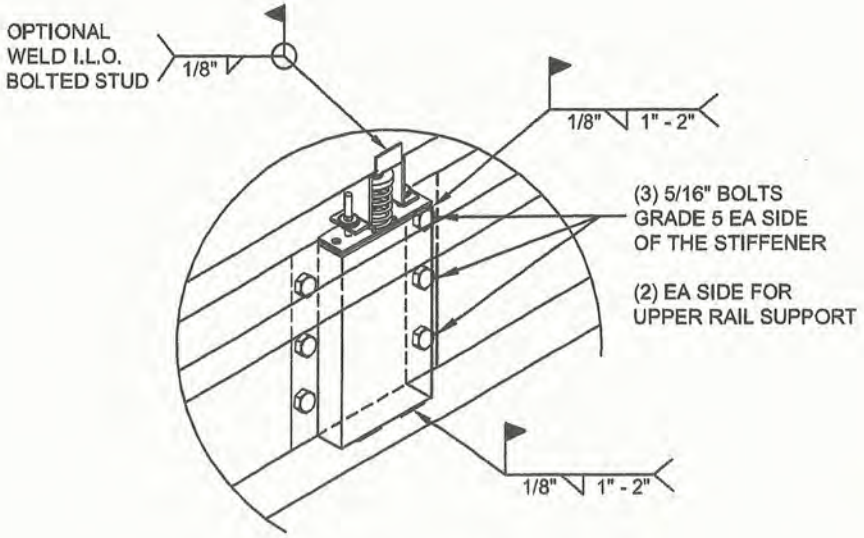
Kit #CBISPRS18**; CBISPRS21**; CBISPRS24**
2016 California Building Code requirements

Prepared for:

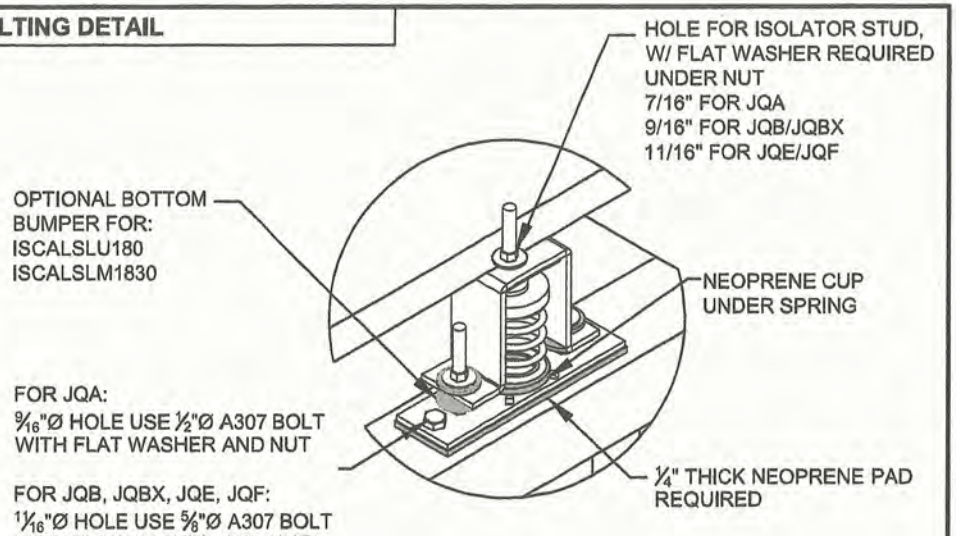
PROVENT
3847 Wabash Drive
Mira Loma, CA 91725

Date: June 21, 2018
Project Number: PV1805

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

MOUR GROUP
ENGINEERING + DESIGN

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

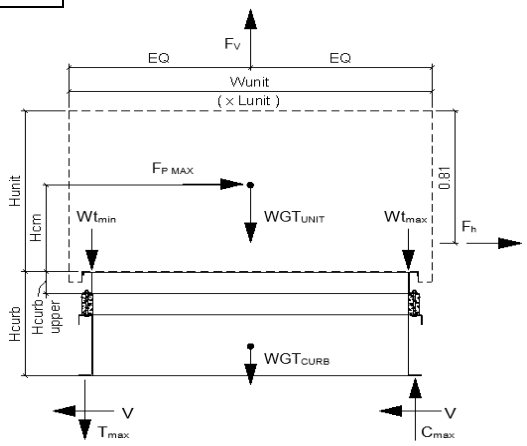
Client: ProVent PV1805
Project: CBISC-05 Iso Curb CBISPRS Upper curb rail
Unit: YORK ZX 04-07; XX A7; ZY, ZQ, XY, XQ 04-06

Curb Information

Hcurb upper =	5.5	in	(Height of upper curb rail)
Lcurb =	70.375	in	(Length of curb)
wcurb =	40.1875	in	(Width of curb)
WGTcurb =	335	lbs	(Weight of curb)
# Clips long side =	2	# Clips short side =	2

Unit Information

WGTunit =	787	lbs	(Weight of Unit)
Wtmax =	243	lbs	(Maximum corner weight)
Wtmin =	151	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 - 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 =	2093	lbs	(0.7*Fpmax) FpmaxASD = 2985 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)
$F_{h\ ASD\ trans}$ =	878	lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb upper) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	580	lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb upper)
$F_{vert\ ASD}$ =	736	lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	1672	lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	1409	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	367	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	630	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Longitudinal:

$Compression_{SEISMIC}$ =	1219	lbs	=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	956	lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	91	lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	354	lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	1672	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1409	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	1219	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	956	lbs	---> Along short edge of curb.

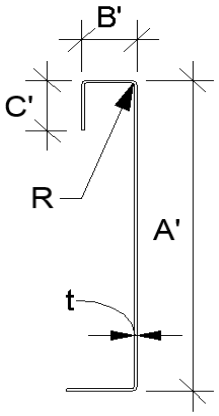
---> Negative values indicate Compression load rather than Tension.

MOUR GROUP
ENGINEERING + DESIGN

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

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 = 1.047 k (Max Axial Comp) Ω_c = 1.80
Pn/Ωc = 4.894 k
Fe = 17.11 ksi
λc = 1.71
Fn = 15.00 ksi
Ly = 70.38 in Lateral unbraced length
k_yL_y/r_y = 130 (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:		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} =	0.836 k	**O.K.**	# clips = 2		
Short side: Pu_{Long} =	0.609 k	**O.K.**	# clips = 2		

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

Check Web Stiffener N/A

width of stiffener = 7.000 in ts = 0.0566 [16 Gauge]
web of stiff. w = 6.717 in Rs = 0.0849 in
***Check w/ts ≤ 1.28√E/Fys Ω_c = 1.70
w/ts = 118.675
1.28√(E/Fys) = 31.091 --> w/ts over limit Use C3.7.2

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

Pwc = 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 = 523 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 704 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 =	0.2			
# of Bolts required for Shear =	0.6		***If combined fails:	
# of Bolts Used =	[1.0]		USE --> 2.0	

Check Combined Stress in Bolts & Inserts: 0.854 O.K. StressComb = 0.427 **O.K.**

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

Assume L/t > 25: 25*t = 1.783 in
Lreq'd = 0.476 in

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

MOUR GROUP
ENGINEERING + DESIGN

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

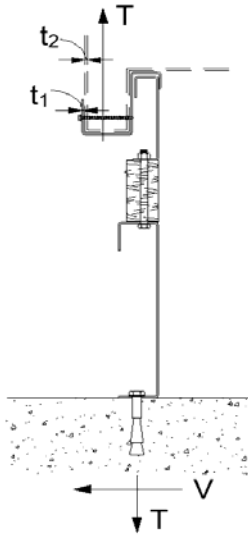
Connection Unit to Curb Clip | #10 SMS screw | Ω = 3.0

t1 = 0.0713 in (clip thickness) | 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: | 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 | $P_{ns} = 2.7t_1 dF_{u1}$ 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:	2.093	2	1.05	540 #	4	2.00 in
Short side:	2.093	2	1.05	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 | $R_n = 0.6F_y A_{gv} + F_u A_{nt} \leq 0.6F_u A_{nv} + F_u A_{nt}$

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

Curb Loads (copied from above)

Transverse: (on long edge)	$Comp_{MAX}$ =	1672	lbs
	$Tens_{MAX}$ =	1409	lbs
	$Shear_{MAX}$ =	1047	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	1219	lbs
	$Tens_{MAX}$ =	956	lbs
	$Shear_{MAX}$ =	1047	lbs

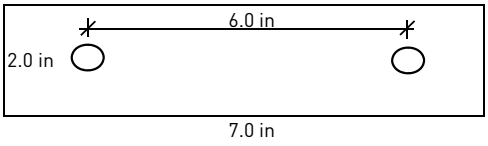
Loads at each Isolator Type: **JQA**

Transverse loading: (on long edge)	$Comp_{MAX}$ =	835.8	lbs
	$Tens_{MAX}$ =	704.4	lbs
# isolators: 2	$Shear_{MAX}$ =	523.4	lbs
Longitudinal loading: (on short edge)	$Comp_{MAX}$ =	609.3	lbs
	$Tens_{MAX}$ =	477.8	lbs
# isolators: 2	$Shear_{MAX}$ =	523.4	lbs

Max compression force on isolator: 0.836 k ⩽ 1.660 k **O.K.**

Max uplift on isolator: 0.704 k ⩽ 1.660 k **O.K.**

Max shear on isolator: 0.523 k ⩽ 0.800 k **O.K.**



Forces on top bolt:

d_b = 0.375 in

upper rail, t = 0.1017 in

Tension = 0.704 k

Shear = 0.523 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. | $F_t = (0.1 + 3d/s)F_u \leq F_u =$ 43.063 ksi

Bolt Bearing Strength: $P_n = Cm_f dtF_u$ | Ω = 2.50 (Section E3.3.1 AISI)

Pn/Ω = 2.975 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.**

$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$ | fv = 4.74 ksi O.K.

Combined Not Applicable | F'nt = 33.46 ksi | Fnv/Ω = 10.00 ksi

MOUR GROUP
ENGINEERING + DESIGN

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

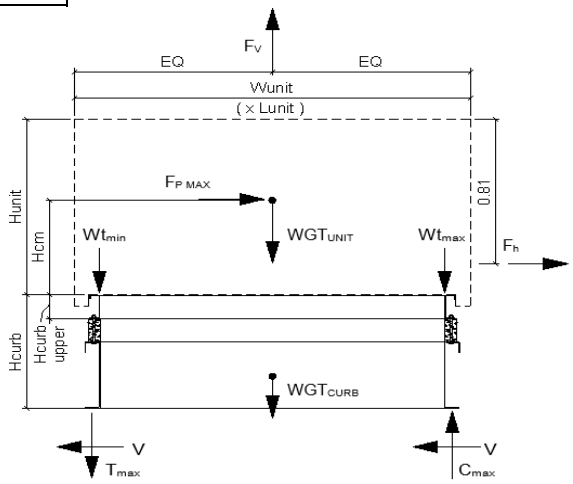
Client: ProVent PV1805
Project: CBISC-05 Iso Curb CBISPRS Base curb
Unit: YORK ZX 04-07; XX A7; ZY, ZQ, XY, XQ 04-06

Curb Information

Hcurb =	25	in	(Height of curb)
Lcurb =	73.375	in	(Length of curb)
wcurb =	43.125	in	(Width of curb)
WGTcurb =	335	lbs	(Weight of curb)
# Clips long side =	2		# Clips short side = 2

Unit Information

WGTunit =	787	lbs	(Weight of Unit)
Wtmax =	243	lbs	(Maximum corner weight)
Wtmin =	151	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 - 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 =	2093	lbs	(0.7*Fpmax) FpmaxASD = 2985 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)
$F_{h\ ASD\ trans}$ =	1250	lbs	$= 0.6*qz*GCr*Lunit*(Hunit+Hcurb)$ (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	825	lbs	$= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)$
$F_{vert\ ASD}$ =	736	lbs	$= 0.6*qz*GCr*Lunit*Wunit$ (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	1600	lbs	$=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	1337	lbs	$= Comp_{SEISMIC}-(0.6-0.14S_{DS})*WGTunit$
$Compression_{WIND}$ =	512	lbs	$=[F_{h\ transASD}*Hcm+2*0.6*Wtmax*wcurb-F_{vertASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	775	lbs	$= Comp_{WIND}+Fvert-0.6*WGTunit$

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

Longitudinal:

$Compression_{SEISMIC}$ =	1194	lbs	$=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	931	lbs	$= Comp_{SEISMIC}-(0.6-0.14S_{DS})*WGTunit$
$Compression_{WIND}$ =	152	lbs	$=[F_{h\ transASD}*Hcm+2*0.6*Wtmax*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	415	lbs	$= Comp_{WIND}+Fvert-0.6*WGTunit$

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

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	1600	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1337	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	1194	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	931	lbs	---> Along short edge of curb.

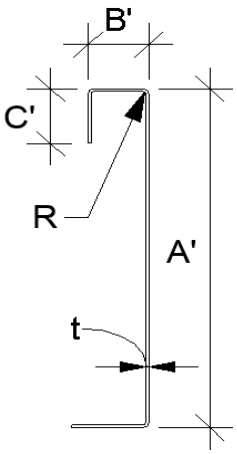
---> Negative values indicate Compression load rather than Tension.

MOUR GROUP
ENGINEERING + DESIGN

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

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 = 1.047 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 ≤ 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} = 0.800 k O.K. # clips = 2
Short side: Pu_{Long} = 0.597 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

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

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 = 523 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 668 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 = 0.2
# of Bolts required for Shear = 0.6 ***If combined fails:
# of Bolts Used = [1.0] USE --> 4.0

Check Combined Stress in Bolts & Inserts: 0.821 O.K. StressComb = 0.205 **O.K.**

MOUR GROUP
ENGINEERING + DESIGN

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

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 = 0.452 in

Curb Loads (copied from upper rail calcs)

Transverse: (on long edge)	$Comp_{MAX}$ =	1672	lbs
	$Tens_{MAX}$ =	1409	lbs
	$Shear_{MAX}$ =	1047	lbs
Longitudinal: (on short edge)	$Comp_{MAX}$ =	1219	lbs
	$Tens_{MAX}$ =	956	lbs
	$Shear_{MAX}$ =	1047	lbs

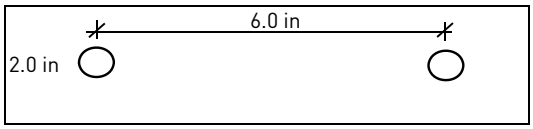
Loads at each Isolator Type: **JQA**

Transverse loading: (on long edge) # isolators: 2	$Comp_{MAX}$ =	835.8	lbs
	$Tens_{MAX}$ =	704.4	lbs
	$Shear_{MAX}$ =	523.4	lbs
Longitudinal loading: (on short edge) # isolators: 2	$Comp_{MAX}$ =	609.3	lbs
	$Tens_{MAX}$ =	477.8	lbs
	$Shear_{MAX}$ =	523.4	lbs

Max compression force on isolator: 0.836 k ≤ 1.660 k **O.K.**

Max uplift on isolator: 0.704 k ≤ 1.660 k **O.K.**

Max shear on isolator: 0.523 k ≤ 0.800 k **O.K.**



Forces on bottom bolts:

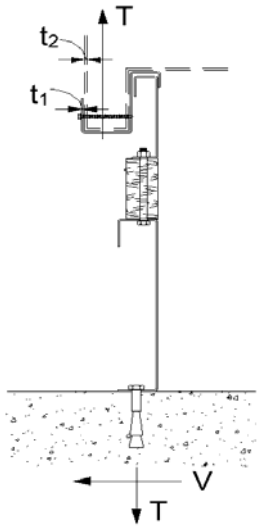
d_b = 0.5 in

base curb, t = 0.0713 in

Tension = 0.352 k / bolt

Shear = 0.262 k / bolt

7.0 in



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 = 1.33 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: $Uplift_{MAX}$ = 3469 lbs $Shear_{MAX}$ = 1492 lbs

$Compression_{SEISMIC}$ = 3844 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 3469 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 1281 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2]/wcurb

$Tension_{WIND}$ = 1343 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 2177 lbs $Shear_{MAX}$ = 1492 lbs

$Compression_{SEISMIC}$ = 2552 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 2177 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 478 lbs =[$F_{h\ transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb

$Tension_{WIND}$ = 540 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 = 5.17 COMBINED LOADING: 0.986 O.K.

# of Screws Req'd for Shear = 6.66 Req'd Min Spacing = 5.9 in o.c.

Total # of screws required = 12

Use 12 - 1/4" φ wood lag screws @ 5.9 in o.c. along long side of curb w/ 3.5" Min. Embed

MOUR GROUP
ENGINEERING + DESIGN

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

Longitudinal:

# of Screws Req'd for Uplift =	3.24	COMBINED LOADING:	0.991 O.K.
# of Screws Req'd for Shear =	6.66	Screw Spacing =	3.9 in o.c.
Total # of screws required =	10		

Use 10 - 1/4" ϕ wood lag screws @ 3.9 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 =	0.50	COMBINED LOADING:	0.454 O.K.
# of Bolts Req'd for Shear =	0.41	Bolt Spacing =	61.4 in o.c.
Total # of bolts required =	2		

Use 2 - 1/2" ϕ A307 Bolts to steel angle below deck @ 61.4 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift =	0.32	COMBINED LOADING:	0.360 O.K.
# of Bolts Req'd for Shear =	0.41	Bolt Spacing =	31.1 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 $(0.6-0.14SDS)D + 0.7\Omega_o E$ (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 $\propto = (1 + 0.2SDS)D + 2.5E$ =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: $Uplift_{MAX}$ = 8170 lbs $Shear_{MAX}$ = 3731 lbs

$Compression_{SEISMIC}$ = 8544 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 8170 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 3731 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 7.96 spacing = 7.05 in o.c. Tapplied = 907.7 lbs

Min Bolts Req'd Shear = 2.19 spacing = 24.6875 in o.c. Vapplied = 414.5 lbs

Try using 9 bolts
spaced at 7.67 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.13

Use 9 - 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: $Uplift_{MAX}$ = 4940 lbs $Shear_{MAX}$ = 3731 lbs

$Compression_{SEISMIC}$ = 5315 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 4940 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 3731 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 4.81 spacing = 4.78125 in o.c. Tapplied = 823.3 lbs

Min Bolts Req'd Shear = 2.19 spacing = 9.5625 in o.c. Vapplied = 621.8 lbs

Try using 6 bolts
spaced at 6.23 in o.c.

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

Use 6 - 3/4" ϕ thrd'd rods in Hilti Hit-HY 200 epoxy @ 6.2 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY:	CBISPRS		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) -	2 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:	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	12 @ 5.94 in o.c.	2 @ 61.38 in o.c.	9 @ 7.67 in o.c.
SHORT DIRECTION	10 @ 3.9 in o.c.	2 @ 31.13 in o.c.	6 @ 6.23 in o.c.