



MOUR GROUP
ENGINEERING + DESIGN

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

**Structural Calculations
for
CBISC-01 Series**



Prepared for:
PROVENT / RRS
3847 Wabash Drive
Mira Loma, CA 91725

Date: July 29, 2019
Project Number: PV1805

For wood, concrete and steel attachment see Roof Anchorage Detail, Form No. CB-60.

Welded isolation springs housing are standard. For bolted spring housing, neoprene pads and spring cups see Weldment and Bolting Detail, Form No. CB-61

FEATURES

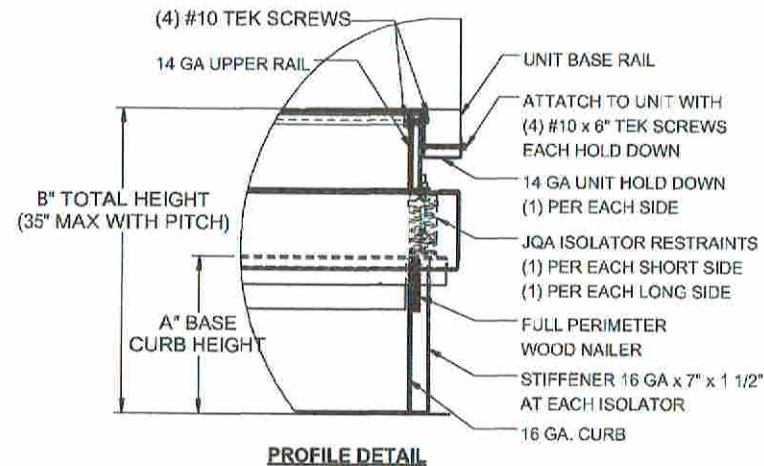
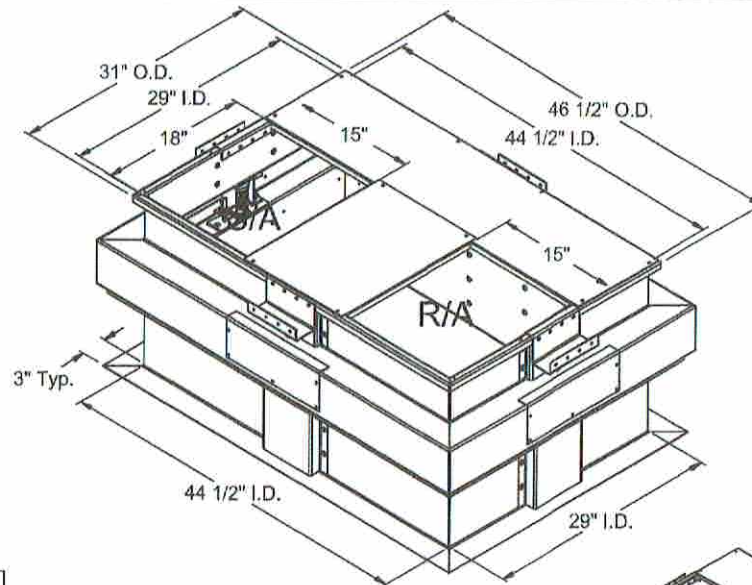
- Roof curbs sides and ends are 14 ga.
- Fully welded construction.
- Gasketing package provided.
- Heat treated wood nailer provided.
- Insulated deck pans provided.
- Pitched curbs and taller curbs are available.

NOTES

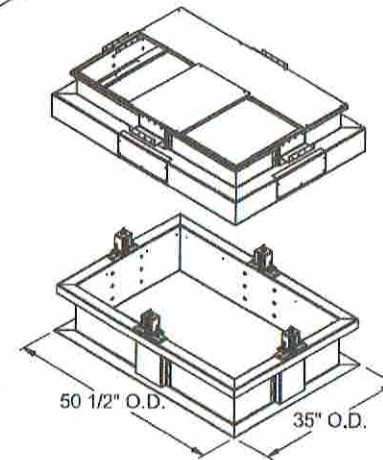
- Attach ductwork to roof curb. Flanges of duct rest on top of the curb, Support ductwork below the curb.
- Thru the curb utilities are available. Contact your York distributor or Provent directly.

STRUCTURALLY CALCULATED VIBRATION ISOLATION ROOF CURB FOR YORK UNITS

P***A CABINET



PROFILE DETAIL



PROVENT P/N	A	B	EST. WEIGHT
CBISCLXS18*	8"	18"	180 Lbs.
CBISCLXS21**	11"	21"	195 Lbs.
CBISCLXS24**	14"	24"	210 Lbs.

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

Meets seismic requirements for the following codes:
CBC 2016
IBC 2015



3847 WABASH DRIVE
MIRA LOMA, CA 91752
PHONE (951) 685-1101
FAX (619) 872-9799

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

FORM NO:
CBISC-01

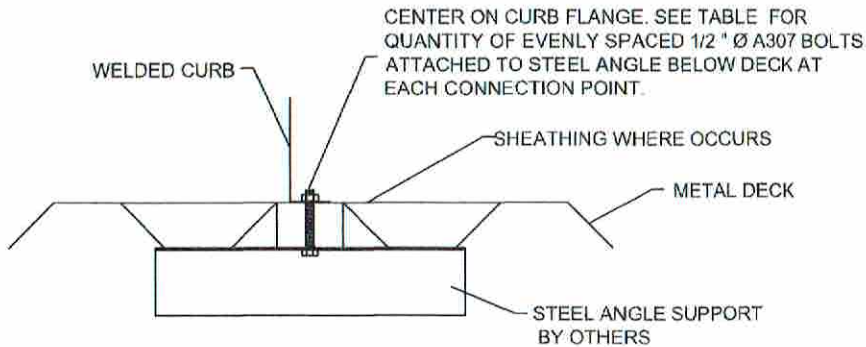
DATE:
10/3/2018

PART NUMBER: 7/29/19

REV:
1

DRAWN BY:
ALL

STEEL ATTACHMENT



NO. OF ANCHORAGE BOLTS REQUIRED		
CURB	LONG SIDE	SHORT SIDE
LXS	2 @ 34.5" O.C	XX @ 2 @ 19" O.C
LXL	2 @ 34.5" O.C.XX	2 @ 29" O.C
SUN3672	2 @ 60" O.C	2 @ 24.25" O.C
PRD3715	2 @ 68.38" O.C	2 @ 38.5" O.C
PRS	2 @ 58.38" O.C	2 @ 28.19" O.C.
PRL	2 @ 72" O.C	2 @ 41" O.C
SLU180	2 @ 102.25" O.C.	2 @ 71" O.C.
SLM1830	2 @ 113.25" O.C	2 @ 71" O.C.

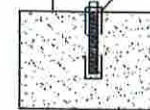
Meets seismic requirements for the following codes:
CBC 2016
IBC 2015

ASSUMES:
CONC SLAB
 $f_c = 4000$ PSI MINIMUM
6" MIN THICKNESS
NORMAL WEIGHT CONCRETE
OR SAND LIGHT WEIGHT

CONCRETE ATTACHMENT

WELDED CURB

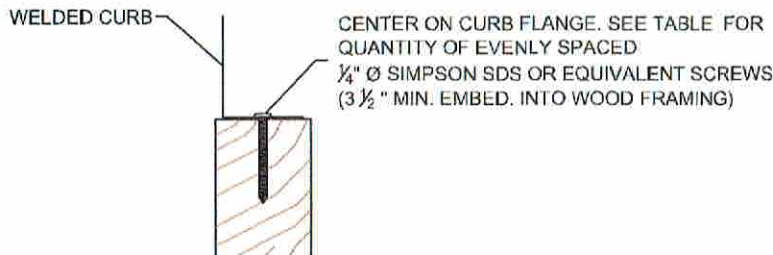
CENTER ON CURB FLANGE. SEE TABLE FOR QUANTITY OF EVENLY SPACED 3/4" Ø THREADED ROD IN HILTI HIT-HY 200 EPOXY WITH 4" EMBED



NO. OF ANCHORAGE BOLTS REQUIRED		
CURB	LONG SIDE	SHORT SIDE
LXS	10 @ 3.73" O.C.	9 @ 2.38" O.C.
LXL	8 @ 4.93" O.C.	7 @ 4.83" O.C.
SUN3672	9 @ 7.5" O.C.	6 @ 4.85" O.C.
PRD3715	17 @ 4.27" O.C.	13 @ 3.21" O.C.
PRS	9 @ 7.3" O.C.	7 @ 4.7" O.C.
PRL	11 @ 7.2" O.C.	9 @ 5.13" O.C.
SLU180	16 @ 6.82" O.C.	13 @ 5.92" O.C.
SLM1830	18 @ 6.66" O.C.	13 @ 5.92" O.C.

* SIX INCHES FROM EACH CORNER EVENLY SPACED.
** CENTERED.

WOOD ATTACHMENT



NO. OF ANCHORAGE SCREWS REQUIRED		
CURB	LONG SIDE	SHORT SIDE
LXS	7 @ 6.42" O.C.	4 @ 7.67" O.C.
LXL	7 @ 6.42" O.C.	6 @ 6.6" O.C.
SUN3672	4 @ 21.33" O.C.	3 @ 14.13" O.C.
PRD3715	8 @ 10.34" O.C.	6 @ 8.5" O.C.
PRS	4 @ 20.79" O.C.	3 @ 16.09" O.C.
PRL	4 @ 25.33" O.C.	3 @ 22.5" O.C.
SLU180	7 @ 17.71" O.C.	7 @ 12.5" O.C.
SLM1830	8 @ 16.75" O.C.	6 @ 15" O.C.

FOUR INCHES FROM EACH CORNER EVENLY SPACED



3847 WABASH DRIVE
MIRA LOMA, CA 91725

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

SUBMITTED TO: _____
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NOTES: _____

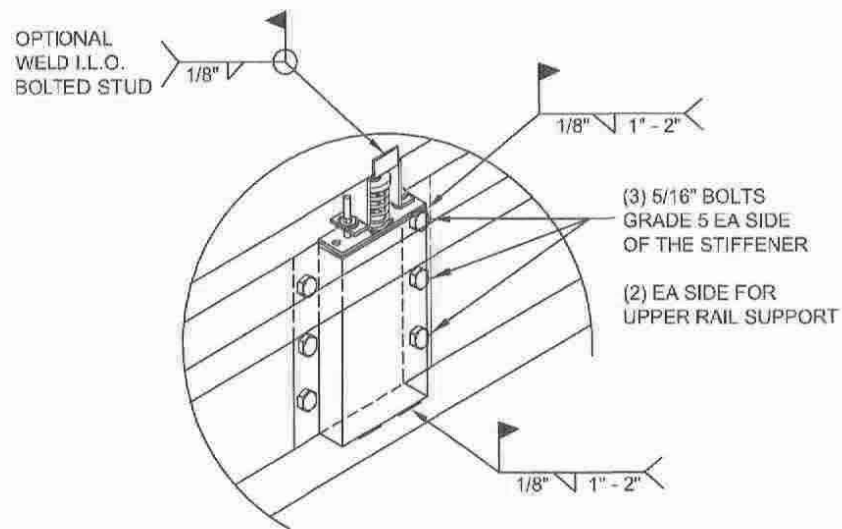
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CB-60

DATE:
07/31/18

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WELDMENT AND BOLTING DETAIL

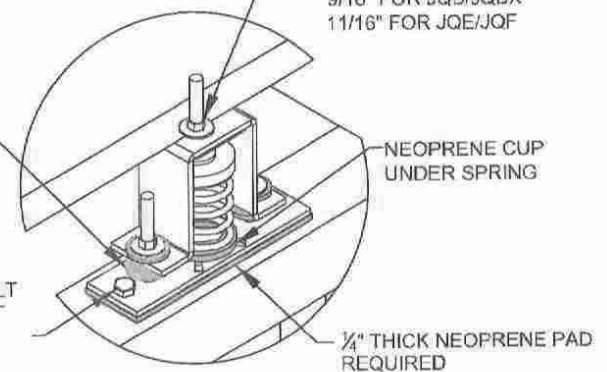


BASE CURB SUPPORT

OPTIONAL BOTTOM
BUMPER FOR:
ISCALSLU180
ISCALSLM1830

FOR JQA:
 $\frac{5}{16}$ " $\varnothing$ HOLE USE $\frac{1}{2}$ " $\varnothing$ A307 BOLT
WITH FLAT WASHER AND NUT

FOR JQB, JQBX, JQE, JQF:
 $\frac{3}{4}$ " $\varnothing$ HOLE USE $\frac{5}{8}$ " $\varnothing$ A307 BOLT
WITH FLAT WASHER AND NUT



FOR BOLT ON ISOLATORS



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:
02/08/18

REV:
1

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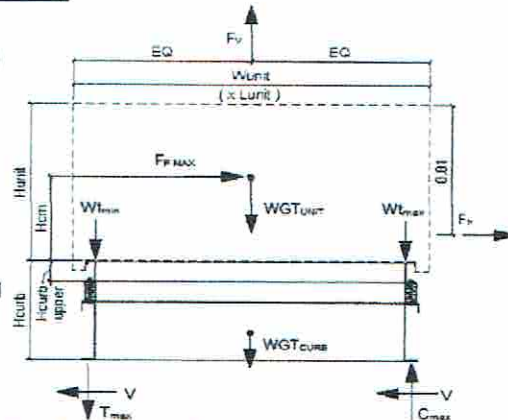
Client: ProVent PV1805
Project: CBISC-01 Iso Curb (CBISCLXS**) Upper curb rail
Unit: ALL YORK P***A CABINETS

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 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 ASCE 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)
GCrf(horiz) = 1.9 (Refer Sect 29.5.1 ASCE 7-10)
GCrf(vert) = 1.5 (Refer Sect 29.5.1 ASCE 7-10)
qz = 32.5 psf
Fn ASD trans = 719 lbs
Fn ASD long = 502 lbs
Fvert ASD = 372 lbs

Curb Loading

Transverse:

CompressionSEISMIC = 1075 lbs
TensionSEISMIC = 953 lbs
CompressionWIND = 526 lbs
TensionWIND = 678 lbs

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

Longitudinal:

CompressionSEISMIC = 818 lbs
TensionSEISMIC = 696 lbs
CompressionWIND = 222 lbs
TensionWIND = 374 lbs

---> 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.

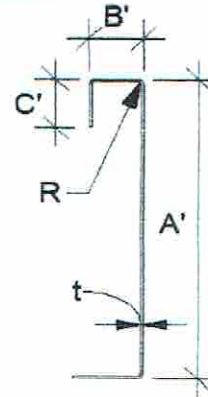


Curb Design

$F_y = 50$ ksi $F_u = 65$ 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 $= B' - [r + t/2 + a(r + t/2)]$
$\alpha = 0.000$ (0 - no Lip; 1 w/ lip)	$b' = 1.464$ in $= B' - [t/2 + \alpha t/2]$
$R = 0.1069$ (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 $= \pi r/2$
$x = 0.261$ in (Distance between centroid and web centerline)	
$I_x = 2.424$ in (Moment of Inertia about X-Axis)	
$I_y = 0.109$ in (Moment of Inertia about Y-Axis)	
$A = 0.59$ in ²	
$r_x = 2.03$ in	
$r_y = 0.432$ in	
$r_{min} = 0.432$ in	



Axial Compression

$P_u = 0.488$ k (Max Axial Comp) $\Omega_c = 1.80$
 $P_n/\Omega_c = 9.561$ k
 $F_e = 39.18$ ksi
 $\lambda_c = 1.13$
 $F_n = 29.31$ ksi
 $L_y = 46.50$ in
 $k_y L_y/r_y = 86$

If $\lambda_c \leq 1.5$: $F_n = (0.658^{\lambda_c^2}) F_y$
If $\lambda_c > 1.5$: $F_n = \frac{0.877}{\lambda_c^2} F_y$

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

Lateral unbraced length
(assume $k=0.8$)

Compression Check = O.K.

Check Web Crippling

$h = 5.5$ in
 $t = 0.0713$ in
 $N = 7.00$
 $\Omega_w = 1.75$
 $P_n = 1.947$ k
 $P_n/\Omega_w = 1.112$ k
Long side: $P_{u,trans} = 1.075$ k
Short side: $P_{u,Long} = 0.818$ k

-- Check limits:

$h/t = 77.14 \leq 200$	$C = 7.50$
$N/t = 98.18 \leq 210$	$C_R = 0.08$
$N/h = 1.273 \leq 2.0$	$C_N = 0.12$
$R/t = 1.50 \leq 12.0$	$C_h = 0.048$

[See table C3.4.1-2, fastened to support, two flange, end loading]

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

O.K. # clips = 1
O.K. # clips = 1

Check Web Stiffener

N/A
width of stiffener = 7.000 in
web of stiff. $w = 6.717$ in
***Check $w/t_s \leq 1.28 E/F_y$
 $w/t_s = 118.675$
 $1.28 E/F_y = 31.091$ --> w/t_s over limit Use C3.7.2
 $P_n = 0.7(P_{wc} + A_e F_y) \geq P_{wc}$
 $P_{wc} = 1.947$ k
 $P_n = 14.669$ k
 $P_n/\Omega_c = 8.629$ k
 $A_e = 0.380$ in²

Not Req'd

Corner Connections

1/4" ϕ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts
 $T_{crnmax} = 244$ lbs $\text{Max}(F_{pmaxASD}/4 - OR - F_{ASDtrans}/4 \text{ corner connections})$
 $V_{crnmax} = 476$ lbs $[\text{Max Ten}/2 \text{ corner connections per side}]$
Bolt: Tall = 2480 lbs
Threaded Insert: Tall = 2860 lbs
of Bolts required for Tension = 0.1
of Bolts required for Shear = 0.4
of Bolts Used = 1.0
Check Combined Stress in Bolts & Inserts: 0.533 **O.K.**

$V_{all} = 1096$ lbs
 $V_{all} = 1714$ lbs

***If combined fails:
USE --> 2.0
StressComb = 0.267 **O.K.**

Check 1/8" welded connection

--- USE WELD $\Omega = 2.35$
Assume $L/t > 25$: $25 \cdot t = 1.783$ in
 $L_{req'd} = 0.322$ in
 $P_n/\Omega = \frac{1}{\Omega} 0.75 t L F_u \geq V_{req}$ $L_{req'd} = \frac{V_{req} \Omega}{0.75 t F_u}$



Connection Unit to Curb Clip

#10 SMS screw

$\Omega = 3.0$

$t_1 = 0.0713$ in (clip thickness)

$F_u1 = 65$ ksi

$t_2 = 0.1017$ in (unit base rail thickness)

$F_u2 = 65$ ksi

$d = 0.190$ in (screw diameter)

$d_w = 0.375$ in (nom. washer diameter)

$t_2/t_1 = 1.4$

For $t_2/t_1 \leq 1.0$:

Shear: $P_{ns} = 4.2 F_{u2} \sqrt{t_2^3 d}$

$P_{ns} = 2377$ #

For $t_2/t_1 \geq 2.5$:

$P_{ns} = 2377$ #

$P_{ns} = 2.7 t_1 d F_{u1}$

$P_{ns} = 2.7 t_1 d F_{u1}$

$P_{ns} = 2.7 t_2 d F_{u2}$

$P_{ns} = 2.7 t_2 d F_{u2}$

$P_{ns}/\Omega = 792$ #

$P_{ss}/\Omega = 540$ # < Controls

Tension: $P_{not} = 1.068$ k (screw pull-out strength)

$P_{not} = 0.85 t_c d F_{u2}$

$P_{nov} = 2.607$ k (screw pull-over strength)

$t_c = \min(t_1, t_2)$

$P_{ts}/\Omega = 356$ # < Controls

$P_{nov} = 1.5 t_1 d_w F_{u1}$

$P_{ts}/\Omega = 820$ #

(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

$F_y = 50$ ksi

$\Omega = 2.22$ bolt/screw connection

$A_{gv} = 0.463$ in²

$A_{nv} = 0.416$ in²

$A_{nt} = 0.082$ in²

$R_n/\Omega = 8.674$ k

$R_n = 0.6 F_y A_{gv} + F_u A_{nt} \leq 0.6 F_u A_{nv} + F_u A_{nt}$

(AISI Sect. E5.3)

BSR O.K.

Curb Loads (copied from above)

Transverse:	Comp _{MAX} = 1075 lbs
(on long edge)	Tens _{MAX} = 953 lbs
	Shear _{MAX} = 488 lbs
Longitudinal:	Comp _{MAX} = 818 lbs
(on short edge)	Tens _{MAX} = 696 lbs
	Shear _{MAX} = 488 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:

$P_n = t e F_u$

$\Omega = 2.00$ (Appendix A, Section E3.1 AISI)

$P_n/\Omega = 6.611$ k

$e = 1.0$ in

Shear O.K.

Net section rupture:

$P_n = A_n F_t$

$\Omega = 2.22$ (Appendix A, Section E3.2 AISI)

$P_n/\Omega = 7.117$ k

$A_n = 0.165$ in

N.S.R. O.K.

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

Bolt Bearing Strength:

$P_n = C m_f d t F_u$

$\Omega = 2.50$ (Section E3.3.1 AISI)

$P_n/\Omega = 2.975$ k

$d/t = 3.69$

$C = 3.00$

$m_f = 1.00$

Bearing O.K.

Shear and tension in bolt:

(Appendix A, Section E3.4 AISI)

Tension $P_{nt} = A_b F_{nt}$

$F_{nt} = 40.5$ ksi

$A_b = 0.1104$ in²

$P_{nt}/\Omega = 1.988$ k

Bolt tension O.K.

$\Omega t = 2.25$ (Table E3.4-1, AISI)

Shear $P_{nv} = A_b F_{nv}$

$F_{nv} = 24.0$ ksi

$\Omega v = 2.40$ (Table E3.4-1, AISI)

$P_{nv}/\Omega = 1.104$ k

Bolt shear O.K.

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

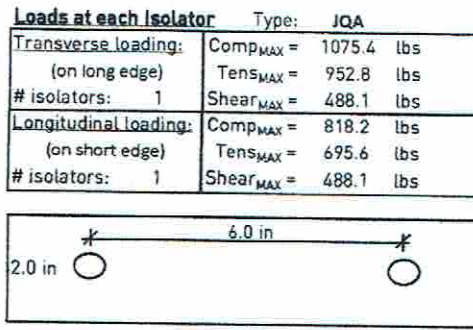
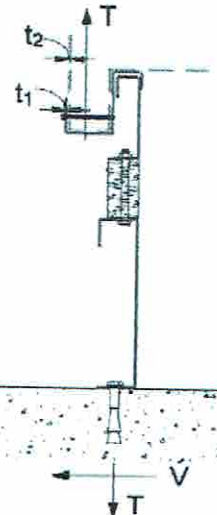
$f_v = 4.42$ ksi

O.K.

Combined Not Applicable

$F'_{nt} = 34.75$ ksi

$F_{nv}/\Omega = 10.00$ ksi





MOUR GROUP

ENGINEERING + DESIGN

6593 Riverdale St.

San Diego, CA 92120

(619) 727-4800

Page ___ of ___

Client: ProVent PV1805

Project: CBISC-01 Iso Curb (CBISCLXS**) Base curb

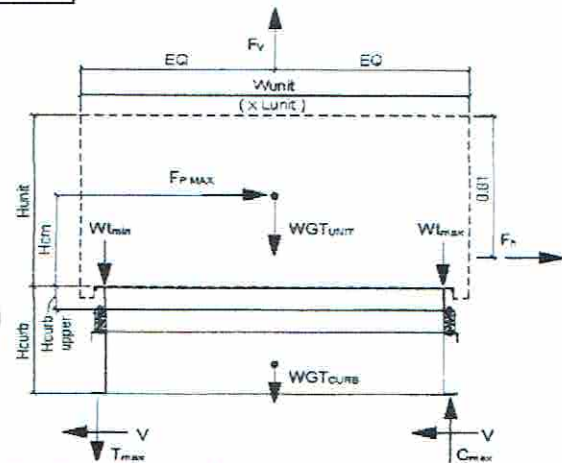
Unit: ALL YORK P***A CABINETS

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

WGUnit =	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)
	(unit only)	
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 ASCE 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)
Fh ASD trans =	976 lbs	$= 0.6 * qz * GCr * Lunit * (Hunit + Hcurb)$ (Eq. 29.5-2)
Fh ASD long =	681 lbs	$= 0.6 * qz * GCr * Wunit * (Hunit + Hcurb)$
Fvert ASD =	372 lbs	$= 0.6 * qz * GCr * Lunit * Wunit$ (Eq. 29.5-3)

Curb Loading

Transverse:

Compression _{SEISMIC} =	987 lbs	$= [FpmaxASD * Hcm + 2 * (1 + 0.14 * Sds) * Wtmax * wcurb] / wcurb$
Tension _{SEISMIC} =	865 lbs	$= Comp_{SEISMIC} - (0.6 - 0.14 * Sds) * WGTunit$
Compression _{WIND} =	641 lbs	$= [Fh trans ASD * Hcm + 2 * 0.6 * Wtmax * wcurb - Fvert ASD * wcurb / 2] / wcurb$
Tension _{WIND} =	793 lbs	$= Comp_{WIND} + Fvert - 0.6 * WGTunit$

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

Longitudinal:

Compression _{SEISMIC} =	777 lbs	$= [FpmaxASD * Hcm + 2 * (1 + 0.14 * Sds) * Wtmax * Lcurb] / Lcurb$
Tension _{SEISMIC} =	655 lbs	$= Comp_{SEISMIC} - (0.6 - 0.14 * Sds) * WGTunit$
Compression _{WIND} =	288 lbs	$= [Fh trans ASD * Hcm + 2 * 0.6 * Wtmax * Lcurb - Fvert ASD * Lcurb / 2] / Lcurb$
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.



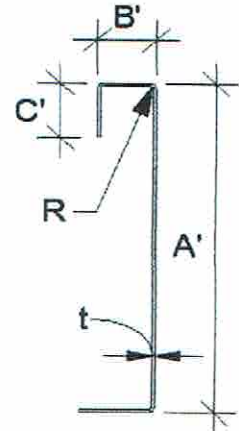
Curb Design

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

Calculate Section Properties of Curb

A' = 25.000 in
B' = 1.750 in
C' = 0.000 in (0 if no lips)
a = 0.000 in (0 - no Lip; 1 w/ lip)
R = 0.1069 in (Inside bend radius)
t = 0.0713 in
r' = 0.143 in = R+t/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

a = 24.644 in = A' - (2r+t)
a' = 24.929 in = A' - t
b = 1.572 in = B' - [r+t/2 + a(r+t/2)]
b' = 1.714 in = B' - [t/2 + a(t/2)]
c = 0.000 in = a[C' - (r+t/2)]
c' = 0.000 in = a[C' - t/2]
u = 0.224 in = πr/2



Axial Compression

Pu = 0.488 k (Max Axial Comp)
Pn/Ωc = 8.960 k
Fe = 9.14 ksi
λc = 2.34
Fn = 8.01 ksi
Ly = 73.38 in
kyLy/ry = 179

Ωc = 1.80

If λc ≤ 1.5: $F_n = (0.658^{\lambda_c^2}) F_y$
If λc > 1.5: $F_n = \frac{0.877}{\lambda_c^2} F_y$

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

Lateral unbraced length (assume k=0.8)

Compression Check = **O.K.**

Check Web Crippling

h = 25 in
t = 0.0713 in
N = 7.00
Ωw = 1.75
Pn = 2.105 k
Pn/Ωw = 1.203 k
Long side: PuTrans = 0.987 k
Short side: PuLong = 0.777 k

-- Check limits:

h/t = 350.63 ≤ 200
N/t = 98.18 ≤ 210
N/h = 0.28 ≤ 2.0
R/t = 1.50 ≤ 9.0

C = 4.00
CR = 0.14
CN = 0.35
Cn = 0.02

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

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

O.K. # clips = 1
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
web of stiff. w = 6.644 in
***Check w/ts ≤ 1.28VE/Fys
w/ts = 93.178
1.28v(E/Fys) = 31.091 --> w/ts over limit Use C3.7.2
Pn = 0.7(Pwc + AeFy) ≥ Pwc
Pwc = 2.105 k
Pn = 18.052 k
Pn/Ωc = 10.619 k

ts = 0.0713 [14 Gauge]
Rs = 0.1069 in
Ωc = 1.70

Ae = 0.474 in²

O.K.

Corner Connections

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

Tcrnmax = 244 lbs Max(FpmaxASD/4 -OR- FhASDtrans/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

of Bolts Used = 1.0

***If combined fails:

USE --> 4.0

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

StressComb = 0.123 **O.K.**



Check 1/8" welded connection

USE WELD

$\Omega = 2.35$

Assume $L/t > 25: 25 \cdot t =$

1.783 in

Lreq'd = 0.292 in

$$P_n/\Omega = \frac{1}{\Omega} 0.75 t L F_u \geq V_{req}$$

$$L_{req'd} = \frac{V_{req} \Omega}{0.75 t F_u}$$

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

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:

$$P_n = t F_u$$

$$P_n/\Omega = 4.635 \text{ k}$$

$\Omega = 2.00$

[Appendix A, Section E3.1 AISI]

$e = 1.0$ in

Shear O.K.

Net section rupture:

$$P_n = A_n F_t$$

$$P_n/\Omega = 5.909 \text{ k}$$

$\Omega = 2.22$

[Appendix A, Section E3.2 AISI]

$$A_n = 0.107 \text{ in}$$

$$F_t = (0.1 + 3d/s) F_u \leq F_u = 55.250 \text{ ksi}$$

N.S.R. O.K.

Bolt Bearing Strength:

$$P_n = C m_f d t F_u$$

$$P_n/\Omega = 2.781 \text{ k}$$

$\Omega = 2.50$

[Section E3.3.1 AISI]

$$d/t = 7.01$$

$$C = 3.00$$

$$m_f = 1.00$$

Bearing O.K.

Shear and tension in bolt:

[Appendix A, Section E3.4 AISI]

Tension

$$P_{nt} = A_b F_{nt}$$

$$P_{nt}/\Omega = 3.927 \text{ k}$$

$$F_{nt} = 45.0 \text{ ksi}$$

$$A_b = 0.1963 \text{ in}^2$$

Bolt tension O.K.

$$\Omega_t = 2.25$$

Shear

$$P_{nv} = A_b F_{nv}$$

$$P_{nv}/\Omega = 2.209 \text{ k}$$

$$F_{nv} = 27.0 \text{ ksi}$$

$$\Omega_v = 2.40$$

Bolt shear O.K.

[Table E3.4-1, AISI]

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

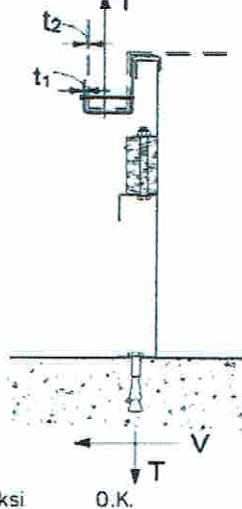
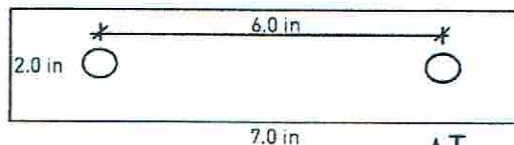
$$f_v = 1.24 \text{ ksi}$$

O.K.

Combined Not Applicable

$$F'_{nt} = 45.0 \text{ ksi}$$

$$F_{nv}/\Omega = 11.25 \text{ ksi}$$



Connection of Curb to Supporting Structure

Roof Loading

SEISMIC: $(0.6-0.14 S_{DS})D + 0.7E$

WIND: $0.6D + W$

Transverse:	Uplift _{MAX} = 2343 lbs	Shear _{MAX} = 767 lbs
Compression _{SEISMIC} =	2536 lbs	$= [F_{pmaxASD} (H_{cm} + H_{curb}) + (1 + 0.14 S_{DS}) (WGT_{unit+curb}/2) w_{curb}] / w_{curb}$
Tension _{SEISMIC} =	2343 lbs	$= \text{Comp}_{SEISMIC} - (0.6 - 0.14 S_{DS}) (WGT_{unit+curb})$
Compression _{WIND} =	1368 lbs	$= [F_{htransASD} (H_{cm} + H_{curb}) + 0.6 (WGT_{unit+curb}/2) w_{curb} - F_{vertASD} w_{curb}/2] / w_{curb}$
Tension _{WIND} =	1394 lbs	$= [F_{htransASD} (H_{cm} + H_{curb}) - 0.6 (WGT_{unit+curb}/2) w_{curb} + F_{vertASD} w_{curb}/2] / w_{curb}$
Longitudinal:	Uplift _{MAX} = 1677 lbs	Shear _{MAX} = 767 lbs
Compression _{SEISMIC} =	1870 lbs	$= [F_{pmaxASD} (H_{cm} + H_{curb}) + (1 + 0.14 S_{DS}) (WGT_{unit+curb}/2) L_{curb}] / L_{curb}$
Tension _{SEISMIC} =	1677 lbs	$= \text{Comp}_{SEISMIC} - (0.6 - 0.14 S_{DS}) (WGT_{unit+curb})$
Compression _{WIND} =	654 lbs	$= [F_{htransASD} (H_{cm} + H_{curb}) + 0.6 (WGT_{unit+curb}/2) L_{curb} - F_{vertASD} L_{curb}/2] / L_{curb}$
Tension _{WIND} =	681 lbs	$= [F_{htransASD} (H_{cm} + H_{curb}) - 0.6 (WGT_{unit+curb}/2) L_{curb} + F_{vertASD} L_{curb}/2] / L_{curb}$

Wood Attachment:

1/4" ϕ wood lag screws

w/ 3.5" Min. Embed (SGmin = 0.43)

$$T_{allmetal} = 946.67 \text{ lbs}$$

$$V_{allmetal} = 1043.33 \text{ lbs}$$

$$T_{allwood} = 671.25 \text{ lbs}$$

$$V_{allwood} = 224 \text{ lbs}$$

Transverse:

of Screws Req'd for Uplift = 3.49

of Screws Req'd for Shear = 3.43

Total # of screws required = 8

COMBINED LOADING: 0.865 **O.K.**

Req'd Min Spacing = 6.1 in o.c.

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

Transverse:

6903 lbs

3682 lbs

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 Ω_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}/ α = 1026.2 lbs

Vall_{ASD} = Vall_{LRFD}/ α = 1704.8 lbs

(D = 0.465, E = 0.535)

Transverse: Uplift_{MAX} = 5599 lbs

Shear_{MAX} = 1919 lbs

Compression_{SEISMIC} = 5792 lbs

= [2.5 * F_{maxASD} * (H_{cm} + H_{curb}) + (1 + 0.14SDS) * (WGT_{unit+curb} / 2) * w_{curb}] / w_{curb}

Tension_{SEISMIC} = 5599 lbs

= Comp_{SEISMIC} - (0.6 - 0.14SDS) * (WGT_{unit+curb})

Shear_{SEISMIC} = 1919 lbs

= 2.5 * F_{maxASD} / 2

Min Bolts Req'd Uplift = 5.46

spacing = 5.30 in o.c.

T_{applied} = 799.9 lbs

Min Bolts Req'd Shear = 1.13

spacing = 26.5 in o.c.

V_{applied} = 274.1 lbs

Try using 7 bolts spaced at 6.42 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{applied}}{V_{allow,ASD}} \leq 1.2 = 0.94$

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 * F_{maxASD} * (H_{cm} + H_{curb}) + (1 + 0.14SDS) * (WGT_{unit+curb} / 2) * L_{curb}] / L_{curb}

Tension_{SEISMIC} = 3934 lbs

= Comp_{SEISMIC} - (0.6 - 0.14SDS) * (WGT_{unit+curb})

Shear_{SEISMIC} = 1919 lbs

= 2.5 * F_{maxASD} / 2

Min Bolts Req'd Uplift = 3.83

spacing = 3.66667 in o.c.

T_{applied} = 786.7 lbs

Min Bolts Req'd Shear = 1.13

spacing = 11 in o.c.

V_{applied} = 383.7 lbs

Try using 5 bolts spaced at 5.75 in o.c.

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

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: (CBISCLX5* (CBISCLX5** 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 diameter: 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	STEEL	CONCRETE
	1/4" ϕ wood lag screws w/ 3.5" Min. Embed (SGmin = 0.43)	1/2" ϕ A307 Bolts to steel angle below deck	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.