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

Structural Calculations
for
CBWC-119 Series

Prepared for:

PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

Date: July 29, 2019

Project Number: PV1806

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

STRUCTURALLY CALCULATED WELDED ROOF CURBS FOR YORK UNITS

P***B ALL MODELS

ProVent P/N	A	WEIGHT
CBWCLXL08	8"	74 Lbs
CBWCLXL11	11"	85 Lbs
CBWCLXL14	14"	97 Lbs
CBWCLXL24	24"	171 Lbs

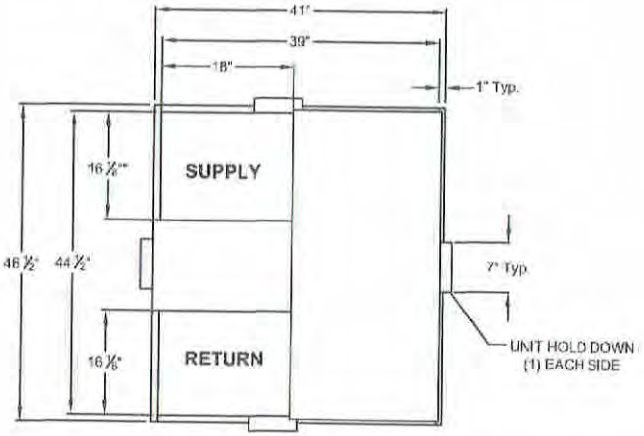
Meets seismic requirements for the following codes:
CBC 2016
IBC 2015

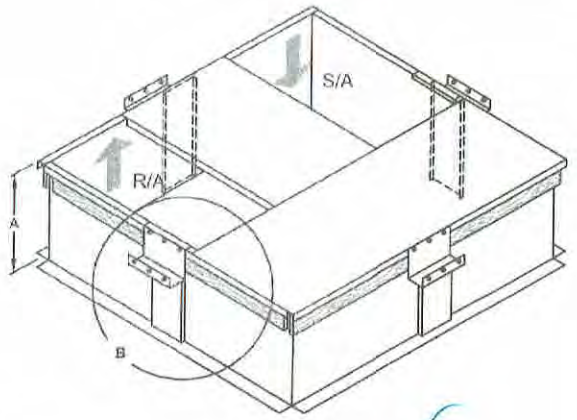
FEATURES

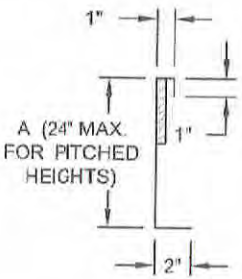
- Roof curb sides and ends are 16 ga. galvanized steel.
- Gasketing package provided.
- Heat treated wood nailer provided.
- Insulated deck pans provided.
- Pitched curbs and taller curbs are available.

NOTES

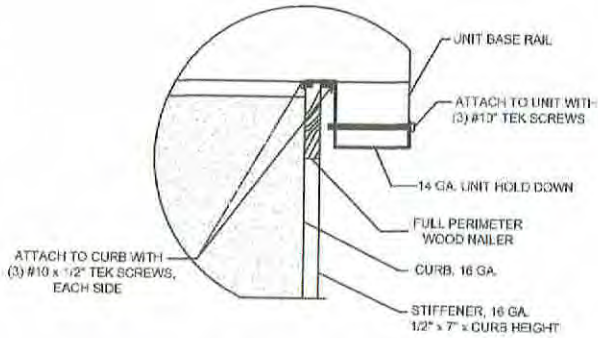
- Attach ductwork to roof curb. Flanges of duct rest on top of curb. Support ductwork below the curb.
- Thru the curbs utilities are available. Contact your York distributor or Provent directly.



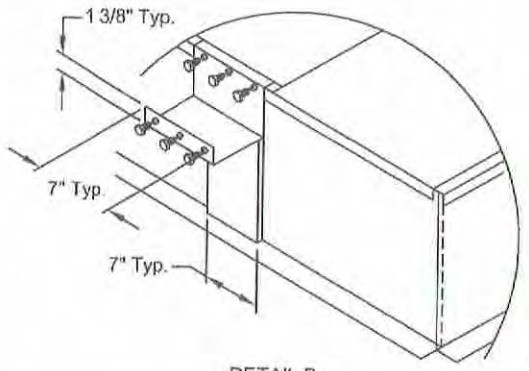




CURB DETAIL



HOLD DOWN DETAIL



DETAIL B

REGISTERED PROFESSIONAL ENGINEER
GLENN A. MOURITZEN
NO. 3578
EXP. 06/30/2021
STRUCTURAL
STATE OF CALIFORNIA

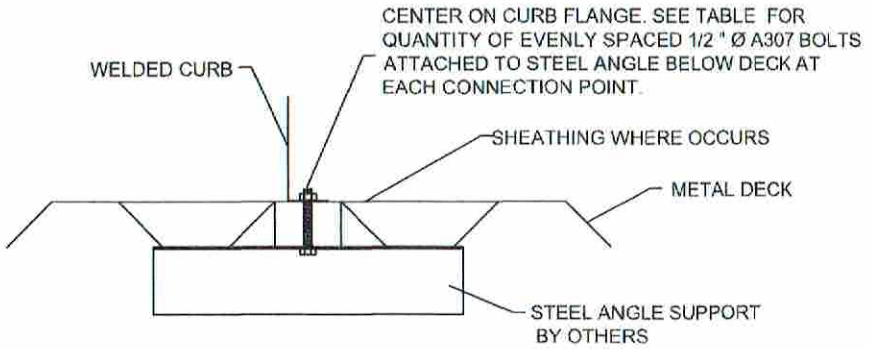
7/24/19

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:		PART NUMBER:
CBWC-119		CBWCLXL SERIES
DATE: 07/31/18	REV: 4	DRAWN BY: ALL

STEEL ATTACHMENT



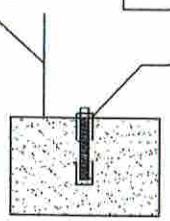
CURB	NO. OF ANCHORAGE BOLTS REQUIRED	
	LONG SIDE	SHORT SIDE
LXS	2 @ 34.5" O.C	XX @ 2 @ 19" O.C
LXL	2 @ 34.5" O.C.XX	2 @ 29" O.C
SUN3672	2 @ 60" O.C	2 @ 24.25" O.C
PRD3715	2 @ 68.38" O.C	2 @ 38.5" O.C
PRS	2 @ 58.38" O.C	2 @ 28.19" O.C.
PRL	2 @ 72" O.C	2 @ 41" O.C
SLU180	2 @ 102.25" O.C.	2 @ 71" O.C.
SLM1830	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= 4000PSI MINIMUM
6" MIN THICKNESS
NORMAL WEIGHT CONCRETE
OR SAND LIGHT WEIGHT

ROOF ANCHORAGE DETAIL		
CBKD Series	CBWC Series	CBISC Series
LXS	LXS	LXS
LXL	LXL	LXL
SUN3672	SUN3672	SUN3672
PRD3715	PRD3715	PRD3715
PRS	PRS	PRS
PRL	PRL	PRL
	SLU180	SLU180
	SLM1830	SLM1830

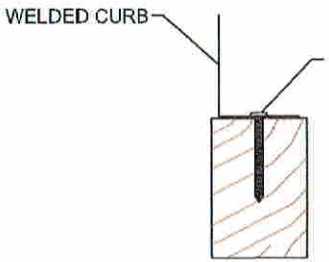
CONCRETE ATTACHMENT



CURB	NO. OF ANCHORAGE BOLTS REQUIRED	
	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.

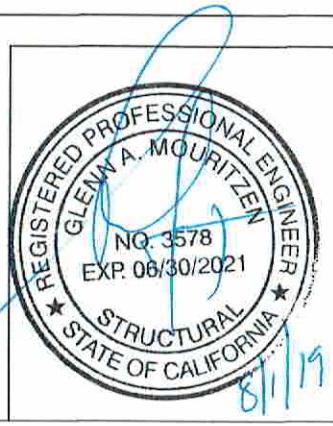
* SIX INCHES FROM EACH CORNER EVENLY SPACED.
** CENTERED.

WOOD ATTACHMENT



CURB	NO. OF ANCHORAGE SCREWS REQUIRED	
	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



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FORM NO: CB-60

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07/31/18	3	ALL

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Page ___ of ___

Client: ProVent PV1806
Description: CBWC-119 (CBWCLXL**)
Unit: ALL YORK P***B MODELS

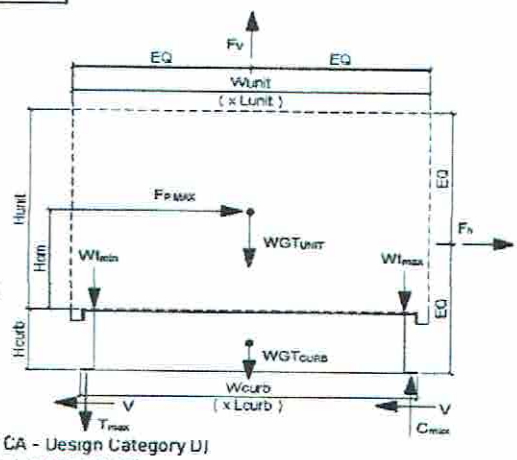
Curb Information

Hcurb =	24	in	(Height of curb)
Lcurb =	46.5	in	(Length of curb)
wcurb =	41	in	(Width of curb)
WGTcurb =	171	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 =	2.85	(Worst case for majority of CA - Design Category D)
Fa =	1	(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 = 1572 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)
$F_{h\ ASD\ trans}$ =	1042 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	930 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:

$Compression_{SEISMIC}$ =	1106 lbs	=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	966 lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	630 lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	855 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
$Compression_{WIND}$ =	481 lbs	=[$F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	706 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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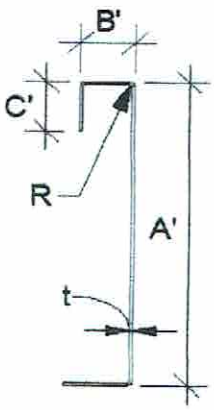
Curb Design

Fy = 50 ksi Fu = 65 ksi t = 0.0566 [16 Gauge]
E = 29500 ksi



Calculate Section Properties of Curb

A' =	24.000 in	a =	23.717 in	= A'-(2r+t)
B' =	3.000 in	a' =	23.943 in	= A'-t
C' =	1.000 in (0 if no lips)	b =	2.717 in	= B'-(r+t/2+a(r+t/2))
a =	1.000 (0 - no Lip; 1 w/ lip)	b' =	2.943 in	= B'-(t/2+at/2)
R =	0.0849 (Inside bend radius)	c =	0.859 in	= a(C'-(r+t/2))
t =	0.0566 in	c' =	0.972 in	= a(C'-t/2)
r' =	0.113 in = R+t/2	u =	0.178 in	= πr/2
x =	0.446 in (Distance between centroid and web centerline)			
Ix =	125.486 in (Moment of Inertia about X-Axis)			
Iy =	1.511 in (Moment of Inertia about Y-Axis)			
A =	1.79 in²			
rx =	8.38 in			
ry =	0.919 in			
rmin =	0.919 in			

Axial Compression

Pu = 0.559 k (Max Axial Comp) Ωc = 1.80
Pn/Ωc = 33.817 k
Fe = 54.49 ksi
λc = 0.96
Fn = 34.06 ksi
Ly = 84 in Lateral unbraced length
k_yL_y/r_y = 73 (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 = 24 in -- Check limits:
t = 0.0566 in h/t = 424.03 ≤ 200
N = 7.00 N/t = 123.67 ≤ 210
Ωw = 1.75 N/h = 0.291667 ≤ 2.0
Pn = 1.366 k R/t = 1.50 ≤ 9.0
Pn/Ωw = 0.780 k
Long side: Pu_{Trans} = 1.106 k **web stiffener REQ'D** # clips = 1
Short side: Pu_{Long} = 1.018 k **web stiffener REQ'D** # clips = 1

C = 4.00
C_R = 0.14
C_N = 0.35
C_h = 0.02
(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 3/4" x 7" (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 Ωc = 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 = 1.366 k Ae = 0.380 in²
Pn = 14.262 k Pn/Ω = 8.390 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 = 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
# of Bolts Used = 1.0
***If combined fails: 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 = 1.415 in
Lreq'd = 0.411 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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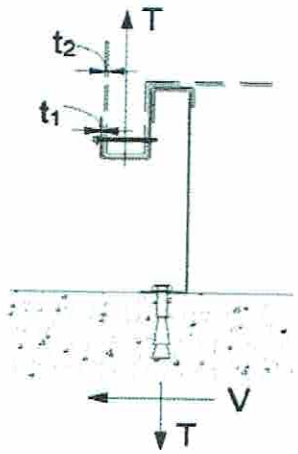
Connection Unit to Curb Clip | #10 SMS screw | Ω = 3.0

t1 = 0.0566 in | 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 = 1.8



For t2/t1 ≤ 1.0:

Shear: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ Pns = 1887 # | 3.86 k

$P_{ns} = 2.7t_1 dF_{u1}$ 1.89 k

$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k

Pns/Ω = 629 #

Pss/Ω = 540 # <- Controls

For t2/t1 ≥ 2.5:

Pns = 1887 #

$P_{ns} = 2.7t_1 dF_{u1}$ 1.89 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 = 2.069 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 #	3	3.00 in
Short side:	1.117	1	1.12	540 #	3	3.00 in

clip width (in) = 7.00 | clip height = 1.4 in

min spacing = 0.57 in | edge distance = 0.5 in (min. 1.5d)

Check Block shear rupture: O.K. | thinnest part = 0.0566 AISI BSR applies

Fy = 50 ksi | Ω = 2.22 bolt/screw connection

Agv = 0.368 in^2 | Anv = 0.341 in^2 | Ant = 0.034 in^2

Rn/Ω = 5.954 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)

Connection of Curb to Supporting Structure

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

Transverse: $Uplift_{MAX}$ = 2151 lbs | $Shear_{MAX}$ = 786 lbs

$Compression_{SEISMIC}$ = 2349 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 2151 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 1248 lbs =[$F_{h\,transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2]/wcurb

$Tension_{WIND}$ = 1370 lbs =[$F_{h\,transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 1918 lbs | $Shear_{MAX}$ = 786 lbs

$Compression_{SEISMIC}$ = 2115 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 1918 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 970 lbs =[$F_{h\,transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb

$Tension_{WIND}$ = 1091 lbs =[$F_{h\,transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

Wood Attachment: **Use 5/8" φ wood lag screws w/ 3.5" Min. Embed**

$Tall_{screw}$ = 6133 lbs | $Vall_{metal}$ = 2744 lbs

Transverse: $Tall_{wood}$ = 1196 lbs | $Vall_{wood}$ = 1024 lbs

# of Screws Req'd for Uplift = 1.80 | COMBINED LOADING: 0.367 O.K.

# of Screws Req'd for Shear = 0.77 | Screw Spacing = 6.4 in o.c.

Total # of screws Required = 7

Use 5/8" ϕ wood lag screws @ 6.4 in o.c. along long side of curb w/ 3.5" Min. Embed

Longitudinal:

# of Screws Req'd for Uplift = 1.6 | COMBINED LOADING: 0.395 O.K.

# of Screws Req'd for Shear = 0.8 | Screw Spacing = 6.6 in o.c.

Total # of screws Required = 6

Use 5/8" ϕ wood lag screws @ 6.6 in o.c. along short side of curb w/ 3.5" Min. Embed

Steel Deck Attachment: **Use 5/8" φ A307 Bolts attached to steel angle below deck**

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

Transverse: 6903 lbs | 3682 lbs

# of Bolts Req'd for Uplift = 0.31 | COMBINED LOADING: 0.069 O.K.

# of Bolts Req'd for Shear = 0.21 | Bolt Spacing = 34.5 in o.c.

Total # of Bolts Required = 2

Use 5/8" ϕ A307 Bolts attached to steel angle below deck @ 34.5 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 0.28 | COMBINED LOADING: 0.061 O.K.

# of Bolts Req'd for Shear = 0.21 | Req'd Min Spacing = 29.0 in o.c.

Total # of Bolts Required = 2

Use 5/8" ϕ A307 Bolts attached to steel angle below deck @ 29 in o.c. along short side of curb

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For Concrete anchorage: SEISMIC (0.6-0.14SDS)D + 0.7Ω_oE (Ω_o = 2.5)

Concrete Attachment: 3/4" φ Hilti Hit-HY 200 adhesive anchors w/ 4" embed

$Tall_{LRFD}$ = 1722 lbs $Vall_{LRFD}$ = 2032 lbs $\alpha = (1 + 0.2SDS)D + 2.5E = 1.87$

$Tall_{ASD} = Tall_{LRFD}/\alpha$ = 920.9 lbs $Vall_{ASD} = Vall_{LRFD}/\alpha$ = 1086.6 lbs $(D = 0.465, E = 0.535)$

Transverse: $Uplift_{MAX}$ = 5113 lbs $Shear_{MAX}$ = 1965 lbs

$Compression_{SEISMIC}$ = 5311 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*(WGT$_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 5113 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 1965 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 5.55 spacing = 4.50 in o.c. Tapplied = 639.2 lbs

Min Bolts Req'd Shear = 2.00 spacing = 22.5 in o.c. Vapplied = 245.6 lbs

Try using 8 bolts spaced at 4.93 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{applied}}{V_{allow,ASD}} \leq 1.2$ = 0.92

Use 8 - 3/4" φ Hilti Hit-HY 200 adhesive anchors @ 4.9 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 4529 lbs $Shear_{MAX}$ = 1965 lbs

$Compression_{SEISMIC}$ = 4727 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*(WGT$_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 4529 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 1965 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 4.92 spacing = 4.25 in o.c. Tapplied = 647.1 lbs

Min Bolts Req'd Shear = 2.00 spacing = 17 in o.c. Vapplied = 280.7 lbs

Try using 7 bolts spaced at 4.83 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{applied}}{V_{allow,ASD}} \leq 1.2$ = 0.96

Use 7 - 3/4" φ Hilti Hit-HY 200 adhesive anchors @ 4.8 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY: CBWC-119

CURB RAIL THICKNESS: 0.0566 in 16 Gauge

UNIT CLIP THICKNESS: 0.0566 in 16 Gauge

 # OF CLIPS (LONG SIDE) - 1 clips with 3 - #10 SMS screws each clip

WEB STIFFENER: 16Ga x 3/4" x 7" (C-channel) stiffener at each clip

 # OF CLIPS (SHORT SIDE) - 1 clips with 3 - #10 SMS screws each clip

WEB STIFFENER: 16Ga x 3/4" x 7" (C-channel) stiffener at each clip

CORNER CONNECTION: Use 2 - 1/4" φ SAE Grade 8 bolts w/ 1/4-20-UNC Threaded inserts

CURB ANCHORAGE	WOOD	STEEL	CONCRETE
	5/8" φ lag screw w/ min. 3.5" embed (SGmin=0.43)	5/8" φ A307 bolts	3/4" φ thrd'd rod in Hilti HIT-HY 200 epoxy, min. 4" embed
LONG DIRECTION	7 @ 6.42 in o.c.	2 @ 34.5 in o.c.	8 @ 4.93 in o.c.
SHORT DIRECTION	6 @ 6.6 in o.c.	2 @ 29 in o.c.	7 @ 4.83 in o.c.