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

Structural Calculations
for
CBWC-115 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

ZJ/ZR 180-300: ZF 210-300: XP 180-240

ProVent P/N	A	WEIGHT
CBWCSLM183008	8"	159 Lbs
CBWCSLM183011	11"	185 Lbs
CBWCSLM183014	14"	211 Lbs
CBWCSLM183024	24"	370 Lbs

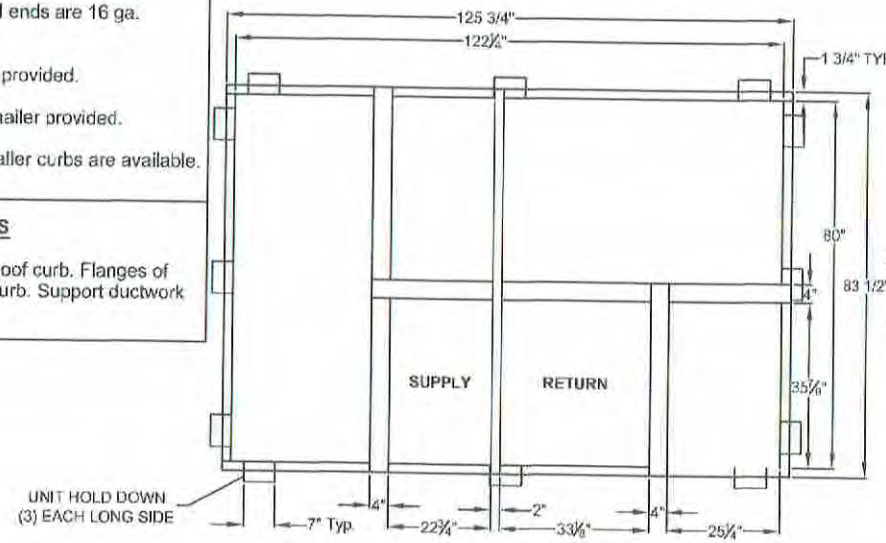
Meets seismic requirements for the following codes:
CBC 2016
IBC 2015

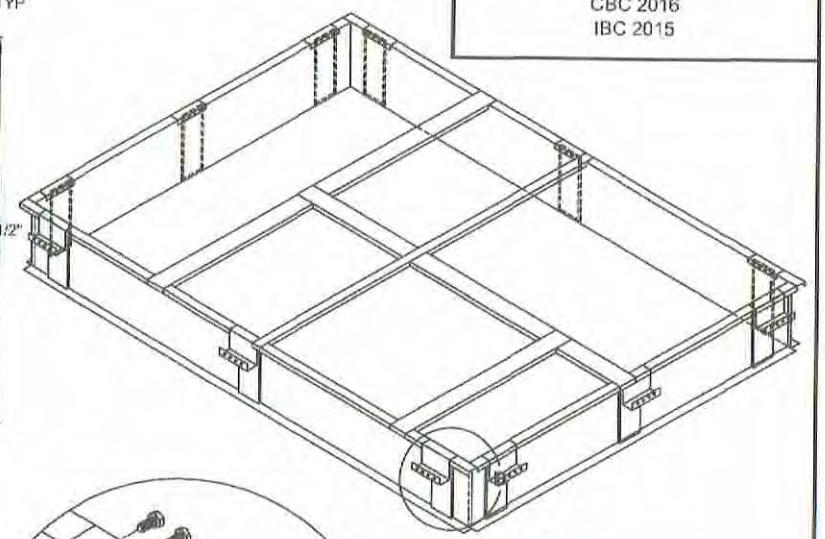
FEATURES

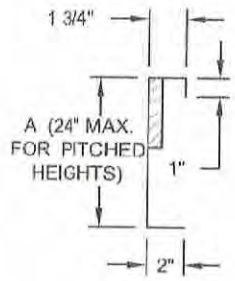
- Roof curb sides and ends are 16 ga. galvanized steel.
- Gasketing package provided.
- Heat treated wood nailer provided.
- Pitched curbs and taller curbs are available.

NOTES

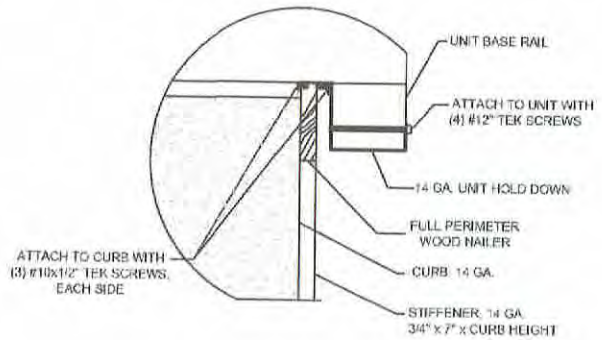
- Attach ductwork to roof curb. Flanges of duct rest on top of curb. Support ductwork below the curb.



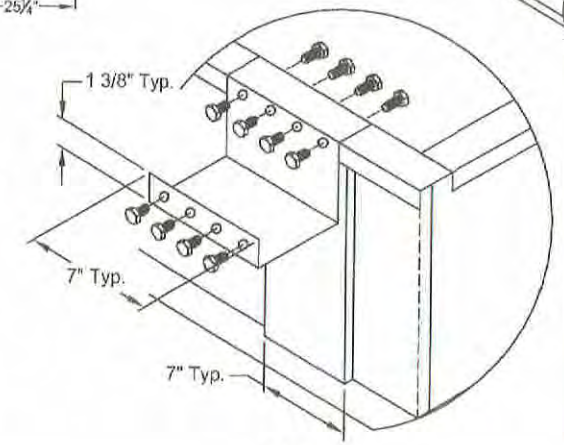




CURB DETAIL



HOLD DOWN DETAIL



DETAIL B

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

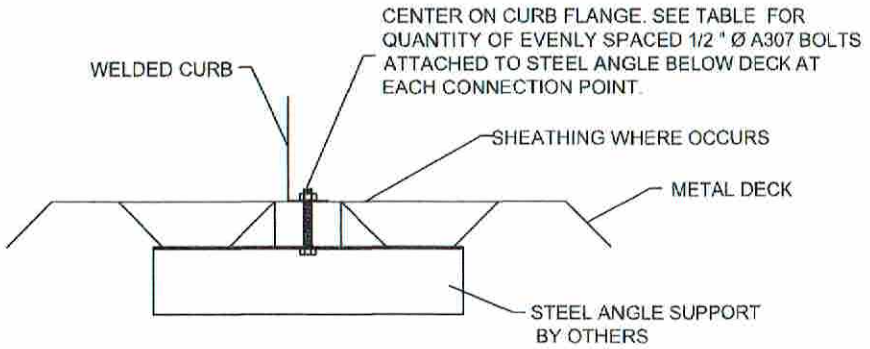
9/27/18

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-115		CBWCSLM1830 SERIES
DATE: 09/27/18	REV: 5	DRAWN BY: ALL

STEEL ATTACHMENT



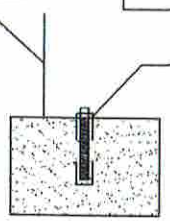
CURB	NO. OF ANCHORAGE BOLTS REQUIRED	
	LONG SIDE	SHORT SIDE
LXS	2 @ 34.5" O.C	XX @ 2 @ 19" O.C
LXL	2 @ 34.5" O.C.XX	2 @ 29" O.C
SUN3672	2 @ 60" O.C	2 @ 24.25" O.C
PRD3715	2 @ 68.38" O.C	2 @ 38.5" O.C
PRS	2 @ 58.38" O.C	2 @ 28.19" O.C.
PRL	2 @ 72" O.C	2 @ 41" O.C
SLU180	2 @ 102.25" O.C.	2 @ 71" O.C.
SLM1830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

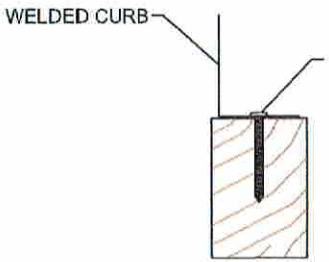
CONCRETE ATTACHMENT



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.

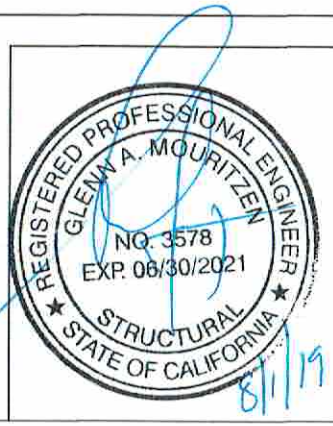
* SIX INCHES FROM EACH CORNER EVENLY SPACED.
** CENTERED.

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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SUBMITTED TO: _____
COMPANY: _____
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NOTES: _____

FORM NO: CB-60

DATE:	REV:	DRAWN BY:
07/31/18	3	ALL

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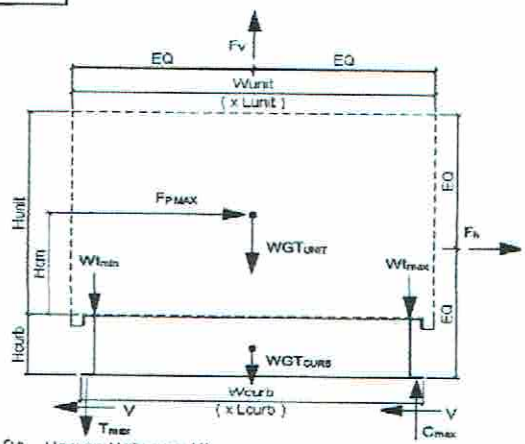
Client: ProVent PV1806
Description: CBWC-115 (CBWCSLM1830**)
Unit: ZJ,ZR 180-300; ZF 210-300; XP 180-240

Curb Information

Hcurb =	24	in	(Height of curb)
Lcurb =	125.25	in	(Length of curb)
wcurb =	83	in	(Width of curb)
WGTcurb =	370	lbs	(Weight of curb)
# Clips long side =	3	# Clips short side =	3

Unit Information

WGTunit =	3061.3	lbs	(Weight of Unit)
Wtmax =	908	lbs	(Maximum corner weight)
Wtmin =	306	lbs	(Minimum corner weight)
Hunit =	52.625	in	(Height of unit above curb)
Hcm =	26.3125	in	(Height to center of mass)
Lunit =	136.25	in	(Length of unit)
Wunit =	92	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 =	8143 lbs (unit only)	(0.7*Fpmax) FpmaxASD = 9127 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)
$F_{h\ ASD\ trans}$ =	2688 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.5-2)
$F_{h\ ASD\ long}$ =	1815 lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	2548 lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.5-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	4881 lbs	=(FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb)/wcurb
$Tension_{SEISMIC}$ =	3858 lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	668 lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vertASD}$*wcurb/2)/wcurb
$Tension_{WIND}$ =	1379 lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Longitudinal:

$Compression_{SEISMIC}$ =	4010 lbs	=(FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb)/Lcurb
$Tension_{SEISMIC}$ =	2987 lbs	= $Comp_{SEISMIC}$-(0.6-0.14S_{DS})*WGTunit
$Compression_{WIND}$ =	197 lbs	=($F_{h\ transASD}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2)/Lcurb
$Tension_{WIND}$ =	908 lbs	= $Comp_{WIND}$+Fvert-0.6*WGTunit

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

Governing Reactions:

Transverse: (on long edge)	$Comp_{MAX}$ =	4881	lbs	---> Along long edge of curb.
	$Tens_{MAX}$ =	3858	lbs	---> Along long edge of curb.
Longitudinal: (on short edge)	$Comp_{MAX}$ =	4010	lbs	---> Along short edge of curb.
	$Tens_{MAX}$ =	2987	lbs	---> Along short edge of curb.

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

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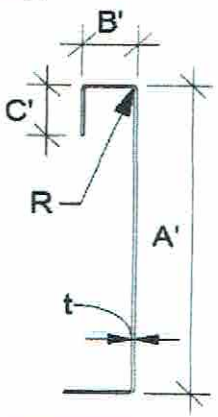
Curb Design

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+α(r+t/2)]
α =	1.000	(0 - no Lip; 1 w/ lip)	b'=	2.943 in	= B'-(t/2+αt/2)
R =	0.0849	(Inside bend radius)	c =	0.859 in	= α[C'-(r+t/2)]
t =	0.0566 in		c'=	0.972 in	= α[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 = 4.072 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

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)

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

Long side: Pu_{Trans} = 1.627 k **web stiffener REQ'D** # clips = 3
Short side: Pu_{Long} = 1.337 k **web stiffener REQ'D** # clips = 3

*****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 = 2036 lbs Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/4 corner connections)
Vcrnmax = 1929 lbs (Max Ten/2 corner connections per side)

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

# of Bolts required for Tension = 0.8
# of Bolts required for Shear = 1.8
# of Bolts Used = 2.0

***If combined fails: USE --> 3.0

Check Combined Stress in Bolts & Inserts: 1.290 N.G. StressComb = 0.860 **O.K.**

Check 1/8" welded connection

<--- USE WELD Ω = 2.35

Assume L/t > 25: 25*t = 1.415 in
Lreq'd = 1.643 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 — #12 SMS screw — Ω = 3.0

t1 = 0.0566 in — Fu1 = 65 ksi

t2 = 0.1017 in (unit base rail thickness) — Fu2 = 65 ksi

d = 0.216 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 = 2146 #

$P_{ns} = 2.7t_1 dF_{u1}$ = 4.12 k

$P_{ns} = 2.7t_2 dF_{u2}$ = 2.15 k

$P_{ns} = 2.7t_2 dF_{u2}$ = 3.86 k

Pns/Ω = 715 # <- Controls

Pss/Ω = 840 #

For t2/t1 ≥ 2.5:

Pns = 2146 #

$P_{ns} = 2.7t_1 dF_{u1}$ = 2.15 k

$P_{ns} = 2.7t_2 dF_{u2}$ = 3.86 k

Tension: Pnot = 1.214 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 = 405 # <- Controls

Pts/Ω = 845 # (full tensile screw capacity)

	Shear (k)	# clips	V_{clip} (k)	V_{allow} (lb)	# screws	spacing
Long side:	8.143	3	2.71	715 #	4	2.00 in
Short side:	8.143	3	2.71	715 #	4	2.00 in

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

min spacing = 0.65 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 in² — Anv = 0.325 in² — Ant = 0.033 in²

Rn/Ω = 5.932 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.

Connection of Curb to Supporting Structure

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

Transverse: $Uplift_{MAX}$ = 6559 lbs — $Shear_{MAX}$ = 4564 lbs

$Compression_{SEISMIC}$ = 7705 lbs =(FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb)/wcurb

$Tension_{SEISMIC}$ = 6559 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 1385 lbs =($F_{h\,transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*wcurb-$F_{vertASD}$*wcurb/2)/wcurb

$Tension_{WIND}$ = 1874 lbs =($F_{h\,transASD}$*(Hcm+Hcurb)-0.6*($WGT_{unit+curb}$/2)*wcurb+$F_{vertASD}$*wcurb/2)/wcurb

Longitudinal: $Uplift_{MAX}$ = 4692 lbs — $Shear_{MAX}$ = 4564 lbs

$Compression_{SEISMIC}$ = 5838 lbs =(FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb)/Lcurb

$Tension_{SEISMIC}$ = 4692 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Compression_{WIND}$ = 485 lbs =($F_{h\,transASD}$*(Hcm+Hcurb)+0.6*($WGT_{unit+curb}$/2)*Lcurb-$F_{vertASD}$*Lcurb/2)/Lcurb

$Tension_{WIND}$ = 973 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**

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

$Tall_{wood}$ = 1195.95 lbs — $Vall_{wood}$ = 1024 lbs

# of Screws Req'd for Uplift = 6.93 — COMBINED LOADING: 1.243 NO GOOD

# of Screws Req'd for Shear = 4.46 — Screw Spacing = 16.8 in o.c.

Total # of screws Required = 8

Use 5/8" φ wood lag screws @ 16.8 in o.c. along long side of curb

Longitudinal:

# of Screws Req'd for Uplift = 5.0 — COMBINED LOADING: 1.397 NO GOOD

# of Screws Req'd for Shear = 4.5 — Screw Spacing = 15.0 in o.c.

Total # of screws Required = 6

Use 5/8" φ wood lag screws @ 15 in o.c. along short side of curb

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

Transverse: $Tall_{bolt}$ = 6903 lbs — $Vall_{bolt}$ = 3682 lbs

6903 lbs — 3682 lbs

# of Bolts Req'd for Uplift = 0.95 — COMBINED LOADING: 0.740 O.K.

# of Bolts Req'd for Shear = 1.24 — Bolt Spacing = 113.3 in o.c.

Total # of Bolts Required = 2

Use 5/8" φ A307 Bolts attached to steel angle below deck @ 113.3 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 0.68 — COMBINED LOADING: 0.616 O.K.

# of Bolts Req'd for Shear = 1.24 — Req'd Min Spacing = 71.0 in o.c.

Total # of Bolts Required = 2

Use 5/8" φ A307 Bolts attached to steel angle below deck @ 71 in o.c. along short side of curb

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

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: $Uplift_{MAX}$ = 14858 lbs $Shear_{MAX}$ = 11409 lbs

$Compression_{SEISMIC}$ = 16004 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*wcurb]/wcurb

$Tension_{SEISMIC}$ = 14858 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 11409 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 16.13 spacing = 6.33 in o.c. Tapplied = 825.4 lbs

Min Bolts Req'd Shear = 10.50 spacing = 10.125 in o.c. Vapplied = 633.8 lbs

Try using 18 bolts spaced at 6.66 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \leq 1.2$ = 1.48

Use 18 - 3/4" φ Hilti Hit-HY 200 adhesive anchors @ 6.7 in o.c. max. along long side of curb w/ 4" embed

Longitudinal: $Uplift_{MAX}$ = 10192 lbs $Shear_{MAX}$ = 11409 lbs

$Compression_{SEISMIC}$ = 11338 lbs =[2.5*FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*($WGT_{unit+curb}$/2)*Lcurb]/Lcurb

$Tension_{SEISMIC}$ = 10192 lbs =$Comp_{SEISMIC}$-(0.6-0.14S_{DS})*(WGTunit+curb)

$Shear_{SEISMIC}$ = 11409 lbs =2.5*FpmaxASD/2

Min Bolts Req'd Uplift = 11.07 spacing = 5.363636 in o.c. Tapplied = 784.0 lbs

Min Bolts Req'd Shear = 10.50 spacing = 5.9 in o.c. Vapplied = 877.6 lbs

Try using 13 bolts spaced at 5.92 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \leq 1.2$ = 1.66

Use 13 - 3/4" φ Hilti Hit-HY 200 adhesive anchors @ 5.9 in o.c. max. along short side of curb w/ 4" embed

CURB DESIGN SUMMARY: CBWC-115

CURB RAIL THICKNESS: 0.0566 in 16 Gauge

UNIT CLIP THICKNESS: 0.0566 in 16 Gauge

 # OF CLIPS (LONG SIDE) - 3 clips with 4 - #12 SMS screws each clip

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

 # OF CLIPS (SHORT SIDE) - 3 clips with 4 - #12 SMS screws each clip

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

CORNER CONNECTION: Use 3 - 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	8 @ 16.75 in o.c.	2 @ 113.25 in o.c.	18 @ 6.66 in o.c.
SHORT DIRECTION	6 @ 15 in o.c.	2 @ 71 in o.c.	13 @ 5.92 in o.c.