Structural Calculations

for

CBWC-123 Series

CBWCSAV28** SERIES

Prepared for:

PROVENT / RRS

**3847 Wabash Drive
Mira Loma, CA 91725**

Date: September 25, 2023

Project Number: PV2312

STRUCTURALLY CALCULATED WELDED ROOF CURBS FOR SUNCORE UNITS

For wood, concrete and steel attachments see Roof Anchorage Detail, Form Nos. CB-60

AV28, AD28, AE18-23, AW18-23, AH25, AL25, HV25

PROVENT P/N	A	EST. WEIGHT
CBWCSAV2808	08"	305 Lbs.
CBWCSAV2811	11"	340 Lbs.
CBWCSAV2814	14"	375 Lbs.
CBWCSAV2824	24"	490 Lbs.

Meets seismic requirements for the following codes:
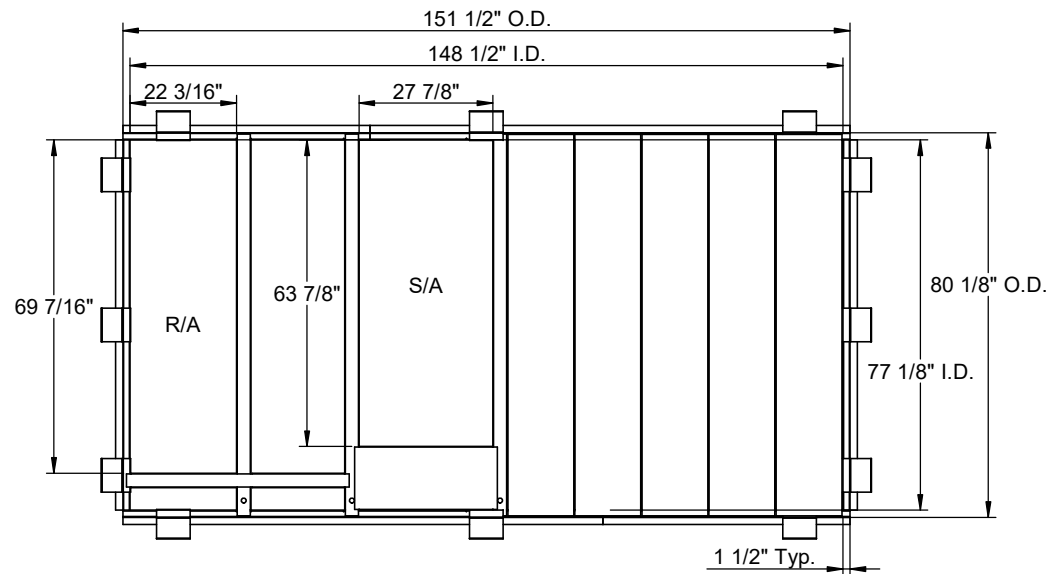CBC 2022
IBC 2021

FEATURES

- Roof curb sides and ends are 14 Ga. galvanized steel.
- Gasketing package provided.
- Heat treated wood nailer provided.
- Insulated sloped deck pans provided.
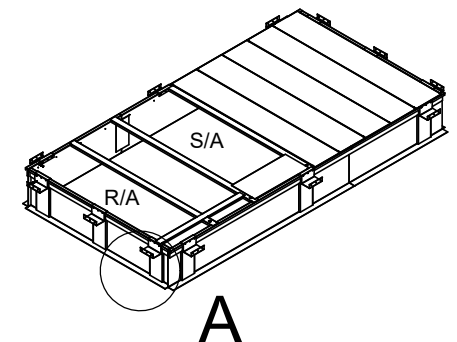- Pitched curbs and taller curbs are available.

Notes

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

151 1/2" O.D.
148 1/2" I.D.
22 3/16"
27 7/8"
69 7/16"
63 7/8"
R/A
S/A
80 1/8" O.D.
77 1/8" I.D.
1 1/2" Typ.

A

HOLD DOWN DETAIL

ATTACH TO CURB WITH TEK SCREW
UNIT BASE RAIL
ATTACH TO UNIT WITH 1/4" TEK SCREWS (3) PER CLIP
14 GA. UNIT HOLD DOWN (3) EACH SIDE
FULL PERIMETER WOOD NAILER
CURB, 14 GA
STIFFENER 14 GA 3/4" x 7" x CURB HEIGHT

CURB DETAIL

1 1/2"
1"
"A" (24" MAX. FOR PITCHED HEIGHTS)
3"

DETAIL A

1 7/16"
7"

REGISTERED PROFESSIONAL ENGINEER
GLENN A. MOURITZEN
SE 3578
Exp. 6/30/25
STRUCTURAL
STATE OF CALIFORNIA

ProVent
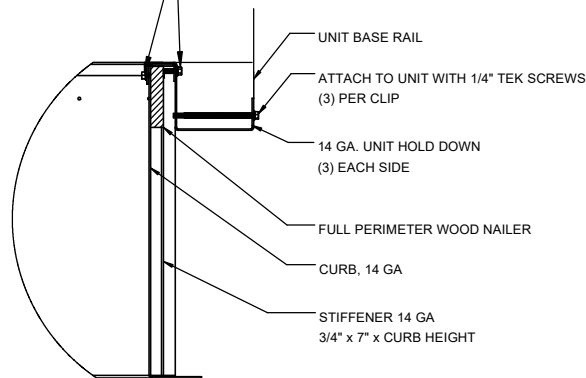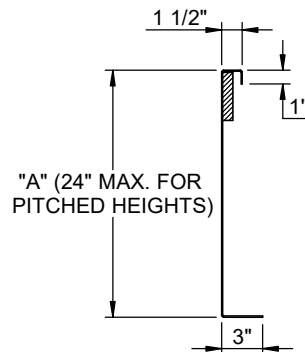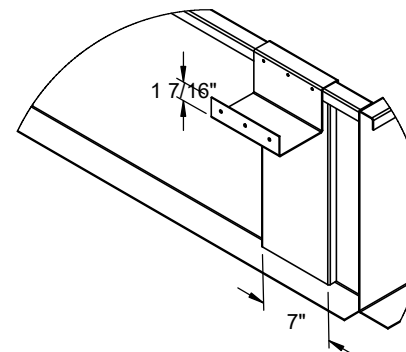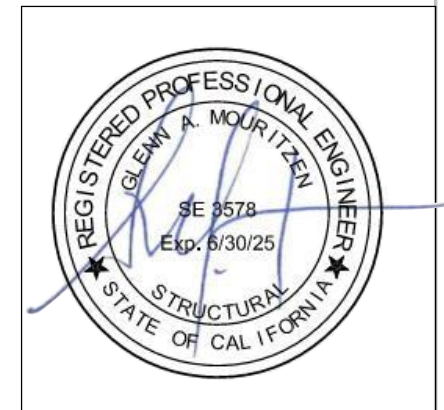
3847 WABASH DRIVE
MIRA LOMA, CA 91752

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

SUBMITED TO: _____
COMPANY: _____
JOB NAME: _____
EQUIPMENT: _____
NOTES: _____

FORM NO:	PART NUMBER:
CBWC-123	CBWCSAV28 SERIES

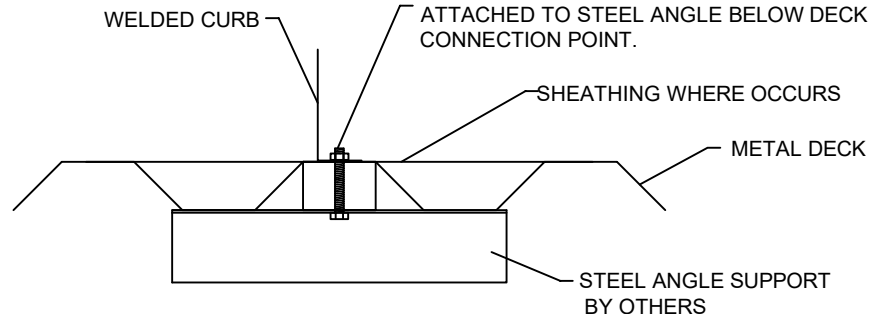| DATE:	REV:	DRAWN BY:
8/28/2023	1	FMM

STEEL ATTACHMENT

WELDED CURB

CENTER ON CURB FLANGE. SEE TABLE FOR QUANTITY OF EVENLY SPACED 1/2 " Ø A307 BOLTS ATTACHED TO STEEL ANGLE BELOW DECK AT EACH CONNECTION POINT.

SHEATHING WHERE OCCURS

METAL DECK

STEEL ANGLE SUPPORT BY OTHERS

NO. OF ANCHORAGE BOLTS REQUIRED

CURB	LONG SIDE	SHORT SIDE
LXS	2 @ 34.5" O.C.	2 @ 19" O.C.
LXL	2 @ 34.5" O.C.	2 @ 29" O.C.
SUN3672	2 @ 60.5" O.C.	2 @ 24.75" O.C.
PRD3715	2 @ 68.88" O.C.	2 @ 39" O.C.
PRS	2 @ 58.88" O.C.	2 @ 28.69" O.C.
PRL	2 @ 72" O.C.	2 @ 41.5" O.C.
SAV1518	3 @ 54.56" O.C	2 @ 68.13" O.C.
SAV2025	3 @ 61.56" O.C	2 @ 68.13" O.C.
SAV28	3 @ 69.75" O.C	2 @ 68.13" O.C.

ASSUMES:
CONC SLAB
f'c= 4000PSI MINIMUM
4" MIN THICKNESS
NORMAL WEIGHT CONCRETE
MIN. 7-1/4" EDGE DISTANCE

CONCRETE ATTACHMENT

WELDED CURB

CENTER ON CURB FLANGE. SEE TABLE FOR QUANTITY OF EVENLY SPACED 1/2" Ø THREADED ROD IN HILTI HIT-HY 200 V3 EPOXY WITH 2-1/2" EMBED

Meets seismic requirements for the following codes:
CBC 2022
IBC 2021

ROOF ANCHORAGE DETAIL

CBKD Series	CBWC Series
LXS	LXS
LXL	LXL
SUN3672	SUN3672
PRD3715	PRD3715
PRS	PRS
PRL	PRL
SAV1518	SAV1518
SAV2025	SAV2025
SAV28	SAV28
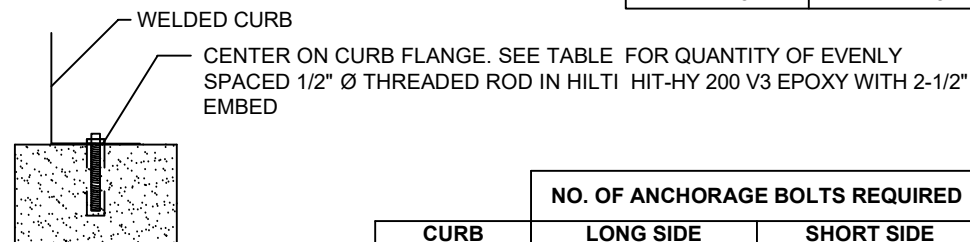
NO. OF ANCHORAGE BOLTS REQUIRED

CURB	LONG SIDE	SHORT SIDE
LXS	2 @ 34.5" O.C.	2 @ 19.0" O.C.
LXL	2 @ 34.5" O.C.	2 @ 29" O.C.
SUN3672	2 @ 60.5" O.C.	2 @ 24.75" O.C.
PRD3715	4 @ 22.96" O.C.	2 @ 39" O.C.
PRS	2 @ 58.88" O.C.	2 @ 28.69" O.C.
PRL	3 @ 36" O.C.	2 @ 41.5" O.C.
SAV1518	4 @ 36.38" O.C.	2 @ 68.13" O.C.
SAV2025	4 @ 41.04" O.C.	3 @ 34.06" O.C.
SAV28	5 @ 34.88" O.C.	3 @ 34.06" O.C.

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

WOOD ATTACHMENT

WELDED CURB

CENTER ON CURB FLANGE. SEE TABLE FOR QUANTITY OF EVENLY SPACED ¼" Ø x 3.5" SIMPSON SDS SCREWS W/2.25" THREADED EMBED INTO WOOD FRAMING
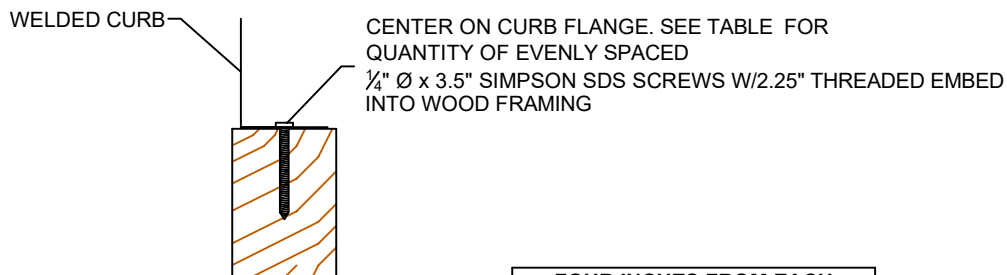
NO. OF ANCHORAGE SCREWS REQUIRED

CURB	LONG SIDE	SHORT SIDE
LXS	4 @ 12.83" O.C.	3 @ 11.5" O.C.
LXL	4 @ 12.83" O.C.	3 @ 16.5" O.C.
SUN3672	4 @ 21.5" O.C.	3 @ 14.38" O.C.
PRD3715	7 @ 12.15" O.C.	5 @ 10.75" O.C.
PRS	4 @ 20.96" O.C.	3 @ 16.35" O.C.
PRL	6 @ 15.2" O.C.	4 @ 15.17" O.C.
SAV1518	6 @ 22.63" O.C.	5 @ 18.03" O.C.
SAV2025	7 @ 21.19" O.C.	5 @ 18.03" O.C.
SAV28	8 @ 20.5" O.C.	5 @ 18.03" O.C.

FOUR INCHES FROM EACH CORNER EVENLY SPACED

REGISTERED PROFESSIONAL ENGINEER
GLENN A. MOURITZEN
SE 3578
Exp. 6/30/25
STRUCTURAL
STATE OF CALIFORNIA

ProVent

3847 WABASH DRIVE
MIRA LOMA, CA 91725

PHONE (951) 685-1101
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FORM NO:
CB-60

DATE:	REV:	DRAWN BY:
8/28/2023	10	FMM

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Client:	ProVent PV2312
Description:	CBWC-123 SAV28
Unit:	AV/AD 28; AE/AW 18-23; AH/AL 25; HV 25

Curb Information

Hcurb =	24	in	(Height of curb)
Lcurb =	151.5	in	(Length of curb)
wcurb =	80.125	in	(Width of curb)
WGTcurb =	490	lbs	(Weight of curb)
# Clips long side =	3	# Clips short side =	3

Unit Information

WGTunit =	3010	lbs	(Oper. Weight of Unit)
Wtmax =	903	lbs	(Maximum corner weight)
Wtmin =	640	lbs	(Minimum corner weight)
Hunit =	57.25	in	(Height of unit above curb)
Hcm =	28.625	in	(Height to center of mass)
Lunit =	160.0625	in	(Length of unit)
Wunit =	88.75	in	(Width of unit)
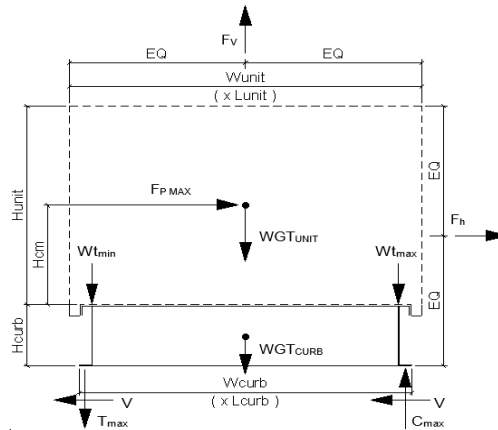
Seismic Loading - 2021 IBC/2022 CBC

Ss =	2.85	(Worst case for majority of California)	
Fa =	1.20	(Default Site Class D - Table 11.4-1 ASCE 7-16)	
Ip =	1.50	(Importance Factor Category III Building)	
Sms =	3.420	(Fa*Ss)	
Sds =	2.280	(2/3*Sms)	$a_p = 2.5$
Fpmax =	1.710 Wp	$(0.4*a_p*S_{ds}*I_p)*W_p*3/R_p <= 1.6*S_{ds}*I_p*W_p$	$R_p = 6$
FpmaxASD =	3603 lbs	(0.7*Fpmax)	FpmaxASD = 4190 lbs
	(unit only)		(unit and curb)

Wind Loading - 2021 IBC/2022 CBC

Kz =	1.13	(For 60 ft roof height, Exposure C - Table 26.10-1 ACSE 7-16)
Kzt =	1.0	(No topographic effects assumed for rooftop mounted units)
Kd =	0.85	(Directionality factor Table 26.6-1 ASCE 7-16)
V =	115	(Wind velocity, mph for Occupancy Cat III-IV bldgs Exp. Cat C, Fig 25.5-1D, ASCE7-16)
$GCr_{(horiz)}$ =	1.9	(Refer Sect 29.4.1 ASCE 7-16)
$GCr_{(vert)}$ =	1.5	(Refer Sect 29.4.1 ASCE 7-16)
qz	32.5 psf	$= 0.00256*Kz*Kzt*Kd*V^2$ (Eq. 26.10-1 ASCE 7-16)
$F_{h\ ASD\ trans}$ =	3348 lbs	= 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2)
$F_{h\ ASD\ long}$ =	1856 lbs	= 0.6*qz*GCr*Wunit*(Hunit+Hcurb)
$F_{vert\ ASD}$ =	2887 lbs	= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	3670 lbs	$=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb$
$Tension_{SEISMIC}$ =	928 lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb]/wcurb$
$Compression_{WIND}$ =	836 lbs	$=[F_{h\ ASD\ trans}*Hcm+2*0.6*Wtmax*wcurb-F_{vert\ ASD}*wcurb/2]/wcurb$
$Tension_{WIND}$ =	1872 lbs	$=[F_{h\ ASD\ trans}*Hcm-2*0.6*Wtmin*wcurb+F_{vertASD}*wcurb/2]/wcurb$

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	3063 lbs	$=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb$
$Tension_{SEISMIC}$ =	322 lbs	$=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb]/Lcurb$
$Compression_{WIND}$ =	-9 lbs	$=[F_{h\ ASD\ long}*Hcm+2*0.6*Wtmax*Lcurb-F_{vertASD}*Lcurb/2]/Lcurb$
$Tension_{WIND}$ =	1027 lbs	$=[F_{h\ ASD\ long}*Hcm-2*0.6*Wtmin*Lcurb+F_{vertASD}*Lcurb/2]/Lcurb$

---> Negative values indicate opposite load.

Governing Reactions:

Transverse:	$Comp_{MAX}$ =	3670	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1872	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	3063	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1027	lbs	---> Along short edge of curb.

---> Negative values indicate opposite load.

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Curb Design

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

Calculate Section Properties of Curb

A'=	24.000 in	a =	23.644 in $= A'-(2r+t)$
B'=	1.500 in	a'=	23.929 in $= A'-t$
C'=	0.000 in (0 if no lips)	b =	1.322 in $= B'-[r+t/2+\alpha(r+t/2)]$
α =	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 $= \alpha[C'-(r+t/2)]$
t =	0.0713 in	c'=	0.000 in $= \alpha(C'-t/2)$
r'=	0.143 in $= R+t/2$	u =	0.224 in $= \pi r/2$
x =	0.080 in (Distance between centroid and web centerline)		
Ix =	110.108 in^4	rx =	7.60 in
Iy =	0.137 in^4	ry =	0.268 in
A =	1.91 in^2	rmin =	0.268 in
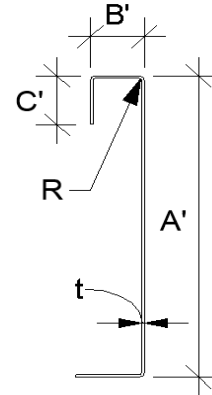
Axial Compression

Pu =	1.801 k	(Max Axial Comp)	Ωc =	1.80
Pn/Ωc =	5.104 k			
Fe =	5.50 ksi			
λc =	3.02			
Fn =	4.82 ksi			
Ly =	77.125 in	Lateral unbraced length		
kyLy/ry =	230	(assume k=0.8)		

$$\frac{P_n}{\Omega_c} = \frac{F_n A}{\Omega_c}$$

$$If\ \lambda_c \leq 1.5;\ F_n = \left(0.658^{\lambda_c^2}\right)F_y$$

$$If\ \lambda_c > 1.5;\ F_n = \frac{0.877}{\lambda_c^2}F_y$$

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

Compression Check = O.K.

Check Web Crippling

h =	24 in	-- Check limits:
t =	0.0713 in	h/t = 336.61 ≤ 260
N =	7.00	N/t = 98.18 ≤ 210
Ωw =	1.75	N/h = 0.291667 ≤ 2.0
Pn =	2.130 k	R/t = 1.50 ≤ 9.0
Pn/Ωw =	1.217 k	

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

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

Long side: PuTrans = 1.223 k **web stiffener REQ'D** # clips = 3

Short side: PuLong = 1.021 k **O.K.** # clips = 3

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

***h/t > 260; use web stiffeners

Check Web Stiffener   16Ga x 3/4" x 6" (C-channel)

width of stiffener =	6.000 in	ts =	0.0566 [16 Gauge]
web of stiff. w =	5.717 in	Rs =	0.0849 in
***Check w/ts ≤ 1.28√E/Fys		Ωc =	1.70
w/ts =	101.007		
1.28√(E/Fys) =	31.091	--> w/ts over limit Use C3.7.2	

$$P_n = 0.7\left(P_{wc} + A_e F_y\right) \geq P_{wc}$$

Pwc =	2.130 k	Ae =	0.324 in^2
Pn =	12.817 k	Pn/Ω =	7.539 k

O.K.

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

Tcrnmax =	1047 lbs	Max(FpmaxASD/4 -OR- FhASDtrans/4 corner connections)
Vcrnmax =	1835 lbs	Max(Tens/2 -OR- Comp/2 corner connections per side)

Bolt:	Tall =	2480 lbs	Vall =	1208 lbs
Threaded Insert:	Tall =	2860 lbs	Vall =	1536 lbs

# of Bolts required for Tension =	0.4
# of Bolts required for Shear =	1.5
# of Bolts Used =	3.0
Check Combined Stress in Bolts & Inserts:	0.647 **O.K.**

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

Assume L/t > 25: 25*t =	1.783 in
Lreq'd =	1.241 in

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

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Connection Unit to Curb Clip #10 SMS screw $\Omega = 3.0$

$t_1 =$	0.0713 in		$F_{u1} =$	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 t2/t1 ≤ 1.0:   Pns = 2377 #   For t2/t1 ≥ 2.5:

Shear:
$P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ 3.86 k   Pns = 2377 #

$P_{ns} = 2.7t_1 dF_{u1}$ 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) $P_{not} = 0.85 t_c dF_{u2})$

Pnov = 2.607 k (screw pull-over strength) $t_c = min(t_1, t_2)$

Pts/Ω = 356 # <- Controls $P_{nov} = 1.5 t_1 d_w F_{u1}$

Pts/Ω = 820 #   (full tensile screw capacity)

	Shear (k)	# clips	V_{clip} (k)	V_{allow}(lb)	# screws	spacing
Long side:	3.603	3	1.20	540 #	3	3.00 in
Short side:	3.603	3	1.20	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 = 0.0713   AISI BSR applies

Fy = 50 ksi Ω = 2.22 bolt/screw connection
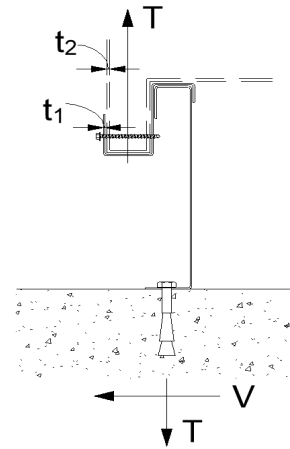
A_{gv} = 0.463 in² A_{nv} = 0.430 in² A_{nt} = 0.042 in²

R_n/Ω = 7.500 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)

T t_2 t_1 V T

Connection of Curb to Supporting Structure

Roof Loading SEISMIC: (0.6-0.14S_{DS})D + 0.7E   WIND: 0.6D + W

Transverse: $Uplift_{MAX} =$ 2593 lbs $Shear_{MAX} =$ 2095 lbs

Compression$_{SEISMIC}$ = 5060 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*WGT$_{unit+curb}$*wcurb/2]/wcurb

Tension$_{SEISMIC}$ = 2260 lbs =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_{DS})*WGT$_{unit+curb}$*wcurb/2]/wcurb

Compression$_{WIND}$ = 1805 lbs =[F$_{h\ ASD\ trans}$*(Hcm+Hcurb)+0.6*WGT$_{unit+curb}$*wcurb/2-F$_{vert\ ASD}$*wcurb/2]/wcurb

Tension$_{WIND}$ = 2593 lbs =[F$_{h\ ASD\ trans}$*(Hcm+Hcurb)-0.6*WGT$_{unit+curb}$*wcurb/2+F$_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX} =$ 1038 lbs $Shear_{MAX} =$ 2095 lbs

Compression$_{SEISMIC}$ = 3764 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S_{DS})*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Tension$_{SEISMIC}$ = 964 lbs =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S_{DS})*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Compression$_{WIND}$ = 251 lbs =[F$_{h\ ASD\ long}$*(Hcm+Hcurb)+0.6*WGT$_{unit+curb}$*Lcurb/2-F$_{vert\ ASD}$*Lcurb/2]/Lcurb

Tension$_{WIND}$ = 1038 lbs =[F$_{h\ ASD\ long}$*(Hcm+Hcurb)-0.6*WGT$_{unit+curb}$*Lcurb/2+F$_{vertASD}$*Lcurb/2]/Lcurb

Wood Attachment: 1/4"φ x 3.5" Simpson SDS screws w/ 2.25" threaded emb (SGmin = 0.43)

Tall$_{metal}$ = 997 lbs   Vall$_{metal}$ = 1097 lbs

Transverse: Tall$_{wood}$ = 616 lbs   Vall$_{wood}$ = 672 lbs

# of Screws Req'd for Uplift = 4.21   COMBINED LOADING: 0.916 O.K.

# of Screws Req'd for Shear = 3.12   Screw Spacing = 20.5 in o.c.

Total # of screws Required = 8

1/4"φ x 3.5" Simpson SDS screws @ 20.5 in o.c. along long side of curb w/ 2.25" threaded embed

Longitudinal:

# of Screws Req'd for Uplift = 1.7   COMBINED LOADING: 0.961 O.K.

# of Screws Req'd for Shear = 3.1   Screw Spacing = 18.0 in o.c.

Total # of screws Required = 5

1/4"φ x 3.5" Simpson SDS screws @ 18 in o.c. along short side of curb w/ 2.25" threaded embed

Steel Deck Attachment: 1/2" φ A307 Bolts to steel angle below deck

Tall$_{bolt}$ = 3927 lbs   Vall$_{bolt}$ = 2209 lbs

Transverse: Tall$_{metal}$ = 2086 lbs   Vall$_{metal}$ = 2192 lbs

# of Bolts Req'd for Uplift = 1.24   COMBINED LOADING: 0.379 O.K.

# of Bolts Req'd for Shear = 0.96   Bolt Spacing = 69.8 in o.c.

Total # of Bolts Required = 3

1/2" φ A307 Bolts to steel angle below deck @ 69.8 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 0.50   COMBINED LOADING: 0.391 O.K.

# of Bolts Req'd for Shear = 0.96   Req'd Min Spacing = 68.1 in o.c.

Total # of Bolts Required = 2

1/2" φ A307 Bolts to steel angle below deck @ 68.1 in o.c. along short side of curb

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6593 Riverdale St.
San Diego, CA 92120
(619)727-4800
Page 4 of 4

For Concrete anchorage: SEISMIC $(0.6-0.14S_{DS})D + 0.7\Omega_o E$ $\Omega o = 2.0$

Concrete Attachment: 1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy   w/ 2.75in embed

Epoxy: Hilti HIT-HY 200 V3 (ICC ESR 4868)

f'c =	3000	psi
h =	4	in (concrete thickness, t_min = h_ef + 2do) O.K.
h_ef =	2.75	in (effective embedment)
da =	0.5	in (anchor diameter) do = 0.625 in (hole diameter)
n =	2	(number of dummy anchors to check capacity with spacing effect)
s =	16.9	in (initial spacing estimate)

τk,cr / uncr = 1135   2220 psi (from ESR 4868, Table 14, Temp range B)

τk,cr / uncr = 1156   2261 psi   If $f'_c > 2500$, $multiply\ by\ (f'_c/2500)^{0.1}$

$c_N a$= 7.15 in (min. edge distance for full capacity); $c_{Na} = 10d_a\sqrt{\frac{t_{uncr}}{1100}}$

Tension:
Bond strength

$$N_{ag} = \frac{A_{Na}}{A_{Nao}}\varphi_{ec,Na}\varphi_{ed,Na}\varphi_{cp,Na}N_{ba}$$ (ACI318-14, 17.4.5.1b)

$$\varphi_{ec,Na}\varphi_{ed,Na}\varphi_{cp,Na} = 1.0$$

***Bond strength will govern over concrete breakout

A_{Na}=	408.98 in^2
A_{Nao}=	204.49 in^2
N_{ba} =	4943 lbs $N_{ba} = \lambda_a\tau_{cr}\pi d_a h_{ef}\alpha_{n,seismic}$ $\alpha_{n,seismic} = 0.99$
N_{ag} =	9886 lbs (group) $\lambda_a = 1.0$
$\varnothing N_{ag}$ =	4820 lbs (group) CONTROLS $\lambda_a = 1.0$ for normal weight conc; 0.6 for lightw

Breakout strength

$$N_{cbg} = \frac{A_{Nc}}{A_{Nco}}\varphi_{ec,N}\varphi_{ed,N}\varphi_{cp,N}N_b$$ $N_b = \lambda_a k_c\sqrt{f'_c}h_{ef}^{1.5}$

A_{Nc} =	207.4875 in^2	$N_b = 4246$	lbs	$\varnothing_{conc}$ = 0.75
A_{Nco} =	68.0625 in^2	kc = 17		$\varnothing_{bond}$ = 0.65
N_{cbg} =	12945 lbs (group)			$\varnothing_{seis}$ = 0.75
$\varnothing N_{cbg}$ =	7281 lbs (group)			$\varnothing_{steel}$ = 0.65

Shear:
Steel strength

Vsa,eq =	4940	(from ESR4868, Table 11) $\alpha_{v,seismic}$ = 0.6
$\varnothing$Vsa,eq =	1927	
Tall$_{LRFD}$ =	2410 lbs (anchor)	Vall$_{LRFD}$ = 3067 lbs $\propto= (1 + 0.2SDS)D + 2.5E$
Tall$_{ASD}$ = Tall$_{LRFD}$/α =	1411 lbs	Vall$_{ASD}$ = Vall$_{LRFD}$/α = 1796 lbs D =0.758 E =0.242 $\propto$ =1.709

Transverse:

Uplift$_{MAX}$ =	5012 lbs	Shear$_{MAX}$ =	4190 lbs

Compression$_{SEISMIC}$ =   7812 lbs   =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Tension$_{SEISMIC}$ =   5012 lbs   =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Shear$_{SEISMIC}$ =   4190 lbs   =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift =   3.55 spacing =   46.50 in o.c.   Tapplied =   1002.4 lbs

Min Bolts Req'd Shear =   2.33 spacing =   69.75 in o.c.   Vapplied =   523.7 lbs

Try using	5	bolts	
spaced at	34.88	in o.c.	

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \le 1.2$ = 1.00   O.K.

Use 5 - 1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 34.9 in o.c. max. along long side of curb w/ 2.75in embed

Longitudinal:

Uplift$_{MAX}$ =	2419 lbs	Shear$_{MAX}$ =	4190 lbs

Compression$_{SEISMIC}$ =   5219 lbs   =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Tension$_{SEISMIC}$ =   2419 lbs   =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Shear$_{SEISMIC}$ =   4190 lbs   =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift =   1.71 spacing =   34.06 in o.c.   Tapplied =   806.4 lbs

Min Bolts Req'd Shear =   2.33 spacing =   34.06 in o.c.   Vapplied =   523.7 lbs

Try using	3	bolts	
spaced at	34.06	in o.c.	

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{aplied}}{V_{allow,ASD}} \le 1.2$ = 0.86   O.K.

Use 3 - 1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 34.1 in o.c. max. along short side of curb w/ 2.75in embed

CURB DESIGN SUMMARY:	CBWC-123 SAV28		Unit:	AV/AD 28; AE/AW 18-23; AH/AL
CURB RAIL THICKNESS:	0.0713 in	14 Gauge		25; HV 25
UNIT CLIP THICKNESS:	0.0713 in	14 Gauge		
# OF CLIPS (LONG SIDE) - 3 clips with 3 - #10 SMS screws each clip				
WEB STIFFENER: 16Ga x 3/4" x 6" (C-channel) stiffener at each clip				
# OF CLIPS (SHORT SIDE) - 3 clips with 3 - #10 SMS screws each clip				
WEB STIFFENER: 16Ga x 3/4" x 6" (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
	1/4"φ x 3.5" Simpson SDS screws w/ 2.25" threaded embed	1/2" φ A307 Bolts to steel angle below deck		1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy w/ 2.75in embed
LONG DIRECTION	8 @ 20.5 in o.c.	3 @ 69.75 in o.c.		5 @ 34.88 in o.c.
SHORT DIRECTION	5 @ 18.03 in o.c.	2 @ 68.13 in o.c.		3 @ 34.06 in o.c.