Structural Calculations

for

CBWC-122 Series

CBWCSAV2025** SERIES

Prepared for:

PROVENT / RRS

3847 Wabash Drive
Mira Loma, CA 91725

Date: September 25, 2023

Project Number: PV2312

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

STRUCTURALLY CALCULATED WELDED ROOF CURBS FOR SUNCORE UNITS

PROVENT P/N	A	EST. WEIGHT
CBWCSAV202508	08"	305
CBWCSAV202511	11"	340
CBWCSAV202514	14"	375
CBWCSAV202524	24"	469

AV 20-25, AD 20-25, AE 13-15, AW 13-15, AH 18-20, AL 18-20, HV 15-20

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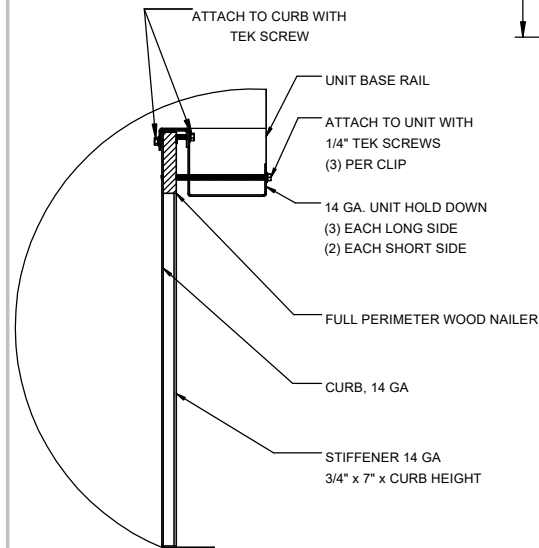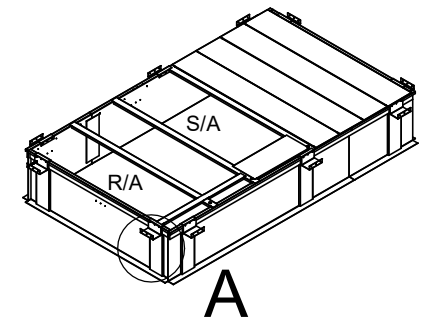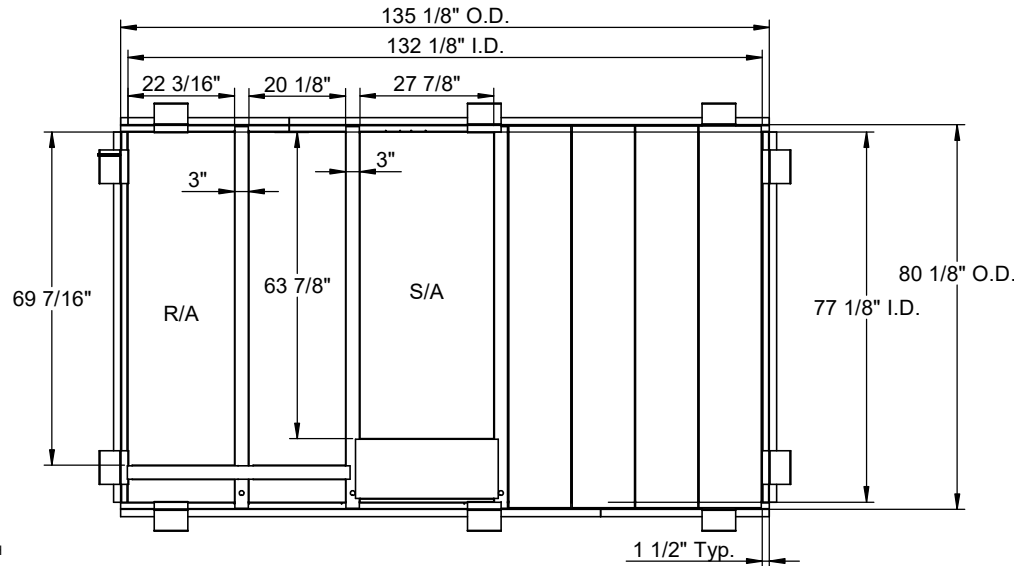CBC 2022
IBC 2021

FEATURES

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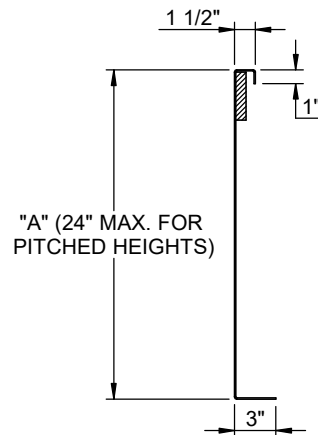- Pitched curbs and taller curbs are available.

Notes

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

135 1/8" O.D.
132 1/8" I.D.
22 3/16"   20 1/8"   27 7/8"
3"   3"
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 LONG SIDE (2) EACH SHORT 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 3/4"
7"

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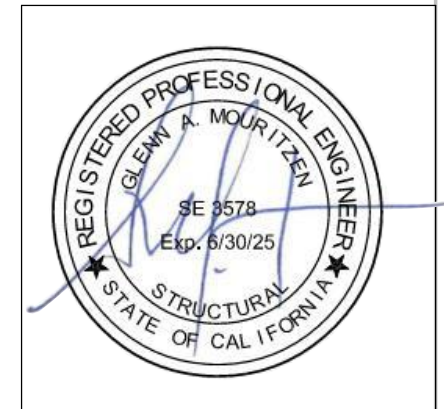GLENN A. MOURITZEN
SE 3578
Exp. 6/30/25
STRUCTURAL
STATE OF CALIFORNIA

ProVent

3847 WABASH DRIVE
MIRA LOMA, CA 91752

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

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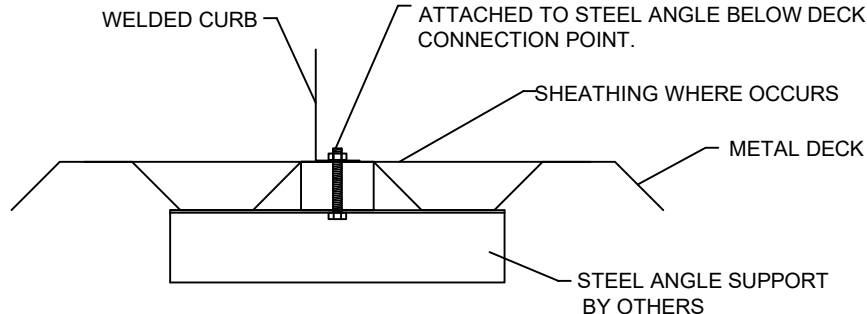JOB NAME: _____
EQUIPMENT: _____
NOTES: _____

FORM NO:	PART NUMBER:
CBWC-122	CBWCSAV2025 Series

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

STEEL ATTACHMENT

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.

WELDED CURB

SHEATHING WHERE OCCURS
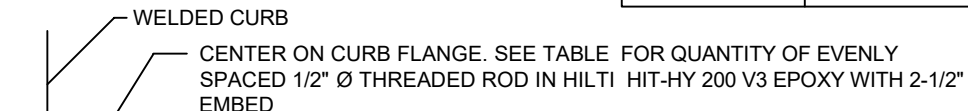
METAL DECK

STEEL ANGLE SUPPORT BY OTHERS

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

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

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

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.

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
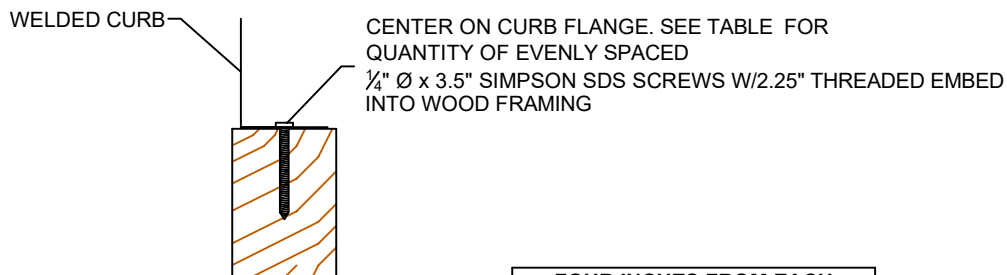
NO. OF ANCHORAGE SCREWS REQUIRED		
CURB	LONG SIDE	SHORT SIDE
LXS	4 @ 12.83" O.C.	3 @ 11.5" O.C.
LXL	4 @ 12.83" O.C.	3 @ 16.5" O.C.
SUN3672	4 @ 21.5" O.C.	3 @ 14.38" O.C.
PRD3715	7 @ 12.15" O.C.	5 @ 10.75" O.C.
PRS	4 @ 20.96" O.C.	3 @ 16.35" O.C.
PRL	6 @ 15.2" O.C.	4 @ 15.17" O.C.
SAV1518	6 @ 22.63" O.C.	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
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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-122 SAV2025
Unit:	AV/AD 20-25; AE/AW 13-15; AH/AL 18-20; HV 15-20

Curb Information

Hcurb =	24	in	(Height of curb)
Lcurb =	135.125	in	(Length of curb)
wcurb =	80.125	in	(Width of curb)
WGTcurb =	469	lbs	(Weight of curb)
# Clips long side =	3		# Clips short side = 2

Unit Information

WGTunit =	2655	lbs	(Oper. Weight of Unit)
Wtmax =	797	lbs	(Maximum corner weight)
Wtmin =	564	lbs	(Minimum corner weight)
Hunit =	57.25	in	(Height of unit above curb)
Hcm =	28.625	in	(Height to center of mass)
Lunit =	143.8125	in	(Length of unit)
Wunit =	88.75	in	(Width of unit)
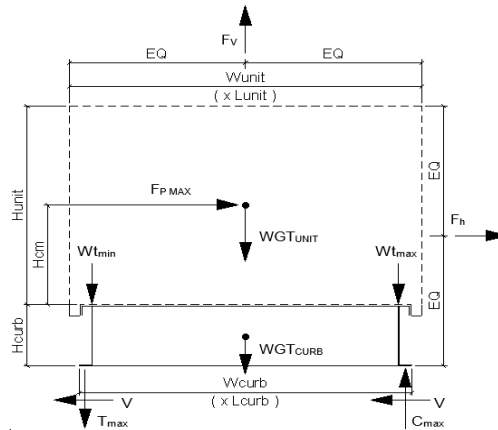
Seismic Loading - 2021 IBC/2022 CBC

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) ap = 2.5
Fpmax =	1.710 Wp		(0.4*ap*Sds*Ip)*Wp*3/Rp <=1.6*Sds*Ip*Wp Rp = 6
FpmaxASD =	3178 lbs		(0.7*Fpmax) FpmaxASD = 3739 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)
$F_{h\ ASD\ trans}$ =	3008 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)
$F_{vert\ ASD}$ =	2594 lbs		= 0.6*qz*GCr*Lunit*Wunit (Eq. 29.4-3)

Curb Loading

Transverse:

$Compression_{SEISMIC}$ =	3237 lbs		=[FpmaxASD*Hcm+2*(1+0.14S_{DS})*Wtmax*wcurb]/wcurb
$Tension_{SEISMIC}$ =	819 lbs		=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*wcurb]/wcurb
$Compression_{WIND}$ =	733 lbs		=[$F_{h\ ASD\ trans}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ =	1695 lbs		=[$F_{h\ ASD\ trans}$*Hcm-2*0.6*Wtmin*wcurb+$F_{vertASD}$*wcurb/2]/wcurb

---> Negative values indicate opposite load.

Longitudinal:

$Compression_{SEISMIC}$ =	2775 lbs		=[FpmaxASD*Hcm+2*(1+0.14*S_{DS})*Wtmax*Lcurb]/Lcurb
$Tension_{SEISMIC}$ =	356 lbs		=[FpmaxASD*Hcm-2*(0.6-0.14S_{DS})*Wtmin*Lcurb]/Lcurb
$Compression_{WIND}$ =	52 lbs		=[$F_{h\ ASD\ long}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ =	1013 lbs		=[$F_{h\ ASD\ long}$*Hcm-2*0.6*Wtmin*Lcurb+$F_{vertASD}$*Lcurb/2]/Lcurb

---> Negative values indicate opposite load.

Governing Reactions:

| Transverse:	$Comp_{MAX}$ =	3237	lbs	---> Along long edge of curb.
(on long edge)	$Tens_{MAX}$ =	1695	lbs	---> Along long edge of curb.
Longitudinal:	$Comp_{MAX}$ =	2775	lbs	---> Along short edge of curb.
(on short edge)	$Tens_{MAX}$ =	1013	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+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 =	0.080 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	
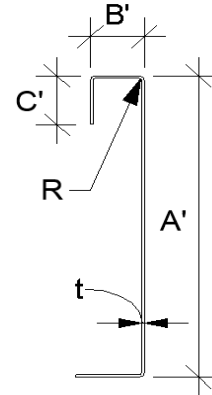
Axial Compression

Pu =	1.589 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)		

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

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

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

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

Compression Check = O.K.

Check Web Crippling

		-- Check limits:			C = 4.00
h =	24 in				
t =	0.0713 in	h/t =	336.61 ≤ 260	C_R = 0.14	
N =	7.00	N/t =	98.18 ≤ 210	C_N = 0.35	(See table C3.4.1-2, fastened to support, one flange, end loading)
Ωw =	1.75	N/h =	0.291667 ≤ 2.0	C_h = 0.02	
Pn =	2.130 k	R/t =	1.50 ≤ 9.0		
Pn/Ωw =	1.217 k				

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

Long side: Pu_Trans =	1.079 k	**O.K.**	# clips = 3	
Short side: Pu_Long =	1.387 k	**web stiffener REQ'D**	# clips = 2	

***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	

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

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 =	935 lbs	Max(FpmaxASD/4 -OR- FhASDtrans/4 corner connections)			
Vcrnmax =	1618 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 =		1.3			
# of Bolts Used =		3.0			
Check Combined Stress in Bolts & Inserts:		0.572	**O.K.**		

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

Assume L/t > 25: 25*t =	1.783 in	
Lreq'd =	1.094 in	

$$P_n / \Omega = \frac{1}{\Omega} 0.75 t L F_u \ge V_{req} \qquad L_{req'd} = \frac{V_{req}\Omega}{0.75 t F_u}$$

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

$t_1 = 0.0713$ in $Fu_1 = 65$ ksi

$t_2 = 0.1017$ in (unit base rail thickness) $Fu_2 = 65$ ksi

$d = 0.190$ in (screw diameter) $dw = 0.375$ in (nom. washer diameter)

$t_2/t_1 = 1.4$

For $t_2/t_1 \le 1.0$: $P_{ns} = 2377$ #   For $t_2/t_1 \ge 2.5$:

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

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

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

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

Tension: $P_{not} = 1.068$ k (screw pull-out strength) $P_{not} = 0.85t_c dF_{u2})$

$P_{nov} = 2.607$ k (screw pull-over strength) $t_c = \min(t_1, t_2)$

$P_{ts}/\Omega = 356$ # <- Controls $P_{nov} = 1.5t_1 d_w F_{u1}$

$P_{ts}/\Omega = 820$ #   (full tensile screw capacity)

	Shear (k)	# clips	V_{clip} (k)	V_{allow}(lb)	# screws	spacing
Long side:	3.178	3	1.06	540 #	2	6.00 in
Short side:	3.178	2	1.59	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 $\Omega = 2.22$ bolt/screw connection
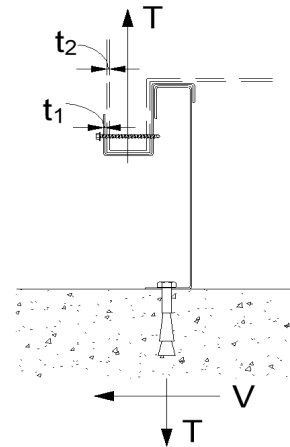
$A_{gv} = 0.463$ in^2 $A_{nv} = 0.430$ in^2 $A_{nt} = 0.042$ in^2

$R_n/\Omega = 7.500$ 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: $(0.6-0.14S_{DS})D + 0.7E$ WIND: $0.6D + W$

Transverse: Uplift$_{MAX}$ = 2336 lbs   Shear$_{MAX}$ = 1870 lbs

Compression$_{SEISMIC}$ = 4517 lbs   =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Tension$_{SEISMIC}$ = 2017 lbs   =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Compression$_{WIND}$ = 1616 lbs   =[F$_{h\ ASD\ trans}$*(Hcm+Hcurb)+0.6*WGT$_{unit+curb}$*wcurb/2-F$_{vert\ ASD}$*wcurb/2]/wcurb

Tension$_{WIND}$ = 2336 lbs   =[F$_{h\ ASD\ trans}$*(Hcm+Hcurb)-0.6*WGT$_{unit+curb}$*wcurb/2+F$_{vertASD}$*wcurb/2]/wcurb

Longitudinal: Uplift$_{MAX}$ = 1083 lbs   Shear$_{MAX}$ = 1870 lbs

Compression$_{SEISMIC}$ = 3517 lbs   =[FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Tension$_{SEISMIC}$ = 1018 lbs   =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Compression$_{WIND}$ = 363 lbs   =[F$_{h\ ASD\ long}$*(Hcm+Hcurb)+0.6*WGT$_{unit+curb}$*Lcurb/2-F$_{vert\ ASD}$*Lcurb/2]/Lcurb

Tension$_{WIND}$ = 1083 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 = 3.79   COMBINED LOADING: 0.939 O.K.

# of Screws Req'd for Shear = 2.78   Screw Spacing = 21.2 in o.c.

Total # of screws Required = 7

1/4"φ x 3.5" Simpson SDS screws @ 21.2 in o.c. along long side of curb w/ 2.25" threaded embed

Longitudinal:

# of Screws Req'd for Uplift = 1.8   COMBINED LOADING: 0.908 O.K.

# of Screws Req'd for Shear = 2.8   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 = 1.12   COMBINED LOADING: 0.316 O.K.

# of Bolts Req'd for Shear = 0.85   Bolt Spacing = 61.6 in o.c.

Total # of Bolts Required = 3

1/2" φ A307 Bolts to steel angle below deck @ 61.6 in o.c. along long side of curb

Longitudinal:

# of Bolts Req'd for Uplift = 0.52   COMBINED LOADING: 0.347 O.K.

# of Bolts Req'd for Shear = 0.85   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_Na=	7.15	in (min. edge distance for full capacity); $c_{Na} = 10d_a\sqrt{\frac{\tau_{uncr}}{1100}}$

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

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

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: Vsa,eq = 4940 (from ESR4868, Table 11) $\alpha_{v,seismic}$ = 0.6

Steel strength øVsa,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$_{MAX}$ = 4473 lbs	Shear$_{MAX}$ = 3739 lbs

Compression$_{SEISMIC}$ = 6973 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Tension$_{SEISMIC}$ = 4473 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*wcurb/2]/wcurb

Shear$_{SEISMIC}$ = 3739 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 3.17 spacing = 41.04 in o.c. Tapplied = 1118.4 lbs

Min Bolts Req'd Shear = 2.08 spacing = 61.56 in o.c. Vapplied = 534.2 lbs

Try using 4 bolts	COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 1.09	O.K.
spaced at 41.04 in o.c.		

Use 4 - 1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 41 in o.c. max. along long side of curb w/ 2.75in embed

Longitudinal:	Uplift$_{MAX}$ = 2474 lbs	Shear$_{MAX}$ = 3739 lbs

Compression$_{SEISMIC}$ = 4973 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Tension$_{SEISMIC}$ = 2474 lbs =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14S$_{DS}$)*WGT$_{unit+curb}$*Lcurb/2]/Lcurb

Shear$_{SEISMIC}$ = 3739 lbs =Ωo*FpmaxASD/2

Min Bolts Req'd Uplift = 1.75 spacing = 34.06 in o.c. Tapplied = 824.7 lbs

Min Bolts Req'd Shear = 2.08 spacing = 34.06 in o.c. Vapplied = 534.2 lbs

Try using 3 bolts	COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \leq 1.2$ = 0.88	O.K.
spaced at 34.06 in o.c.		

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-122 SAV2025		Unit:	AV/AD 20-25; AE/AW 13-15;
CURB RAIL THICKNESS: 0.0713 in	14 Gauge			AH/AL 18-20; HV 15-20
UNIT CLIP THICKNESS: 0.0713 in	14 Gauge			
# OF CLIPS (LONG SIDE) - 3 clips with 2 - #10 SMS screws each clip				
WEB STIFFENER: 16Ga x 3/4" x 6" (C-channel) stiffener at each clip				
# OF CLIPS (SHORT SIDE) - 2 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 1/4"φ x 3.5" Simpson SDS screws w/ 2.25" threaded embed	STEEL 1/2" φ A307 Bolts to steel angle below deck	CONCRETE 1/2"φ HAS rods in Hilti HIT-HY 200 V3 epoxy w/ 2.75in embed	
LONG DIRECTION	7 @ 21.19 in o.c.	3 @ 61.56 in o.c.	4 @ 41.04 in o.c.	
SHORT DIRECTION	5 @ 18.03 in o.c.	2 @ 68.13 in o.c.	3 @ 34.06 in o.c.	