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

# Structural Calculations

# for

# CBKD-166 Series

CBKDSAV2025** SERIES


**Prepared for:**

**PROVENT / RRS**

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

**Date: September 26, 2023**

**Project Number: PV2312**

# HOLD DOWN CLIPS FOR SUNCHOICE UNITS

AV20-25, AD20-25, AE13-15, AW13-15, AH18-20, AL18-20, HV15-20

| ProVent P/N | A | Est. Weight | SEISMIC CLIP P/N: | Est. Weight |
|---|---|---|---|---|
| CBKDSAV202508 | 8" | 220 Lbs. | KDKITSAV2025 | 25 Lbs. |
| CBKDSAV202511 | 11" | 250 Lbs. | | |
| CBKDSAV202514 | 14" | 280 Lbs. | | |
| CBKDSAV202518 | 18" | 400 Lbs. | | |

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

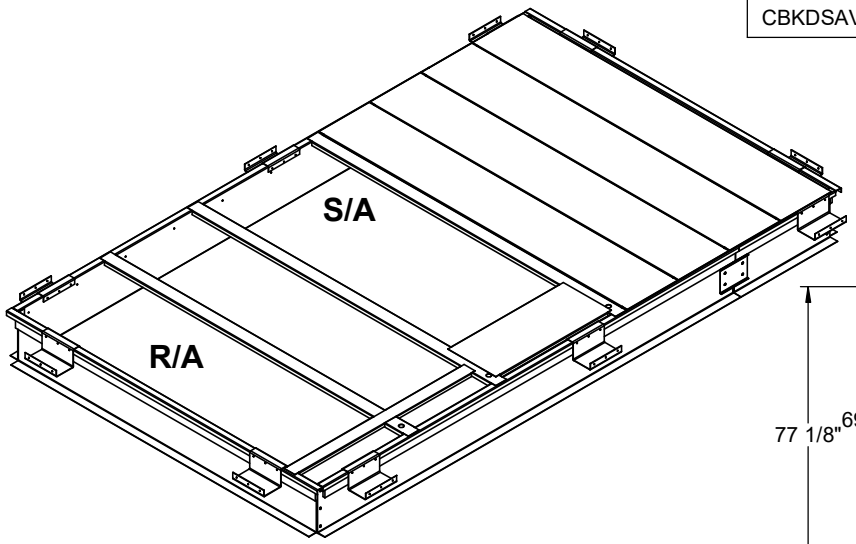
## FEATURES

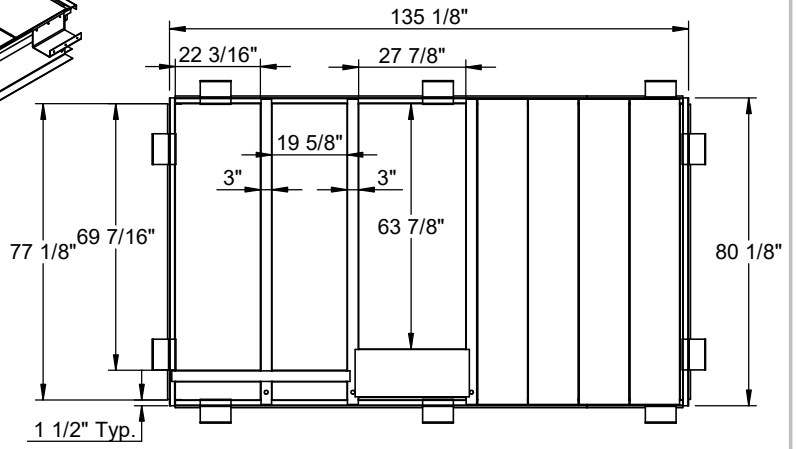
- Roof curb perimeter made of galvanized steel.
- Gasketing package provided.
- Heat treated wood nailer provided.
- Corner flanges are pre-threated for easy bolt on assembly.
- Pitched, adjustable height, welded, different height, isolation and calculated curbs are available.

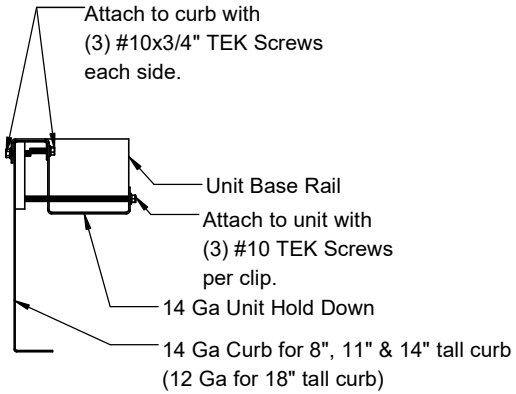
## NOTES

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

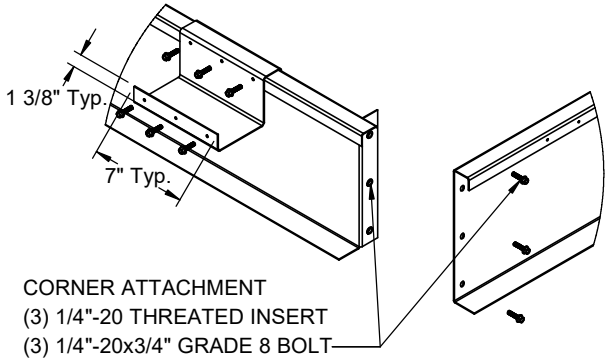
**For wood, concrete and steel attachments see Roof Anchorage Detail, Form No. CB-60**



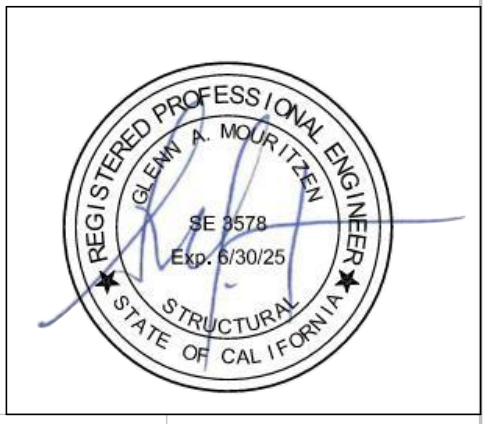




## HOLD DOWN DETAIL




## CORNER & HOLD DOWN DETAIL





ProVent

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MIRA LOMA, CA 91752

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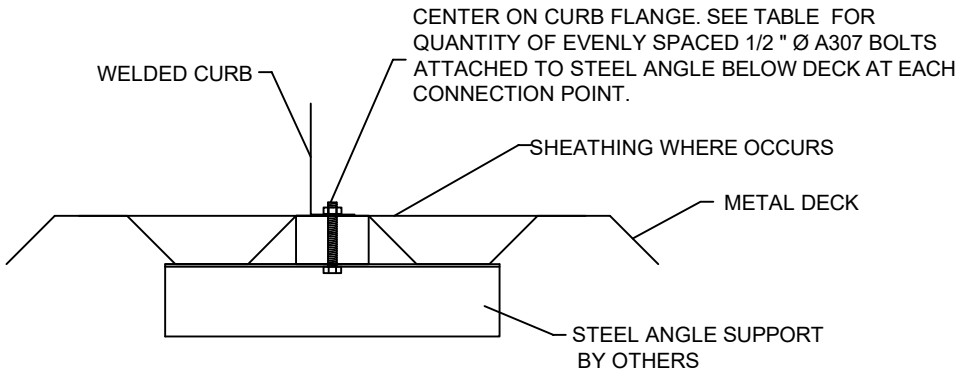
SUBMITED TO:
COMPANY:
JOB NAME:
EQUIPMENT:
NOTES:

| PART NUMBER: | PART NUMBER: |
|---|---|
| CBKD-166 | CBKD-166 |

| DATE: | REV: | DRAWN BY: |
|---|---|---|
| 8/25/2023 | 2 | FMM |

## STEEL ATTACHMENT



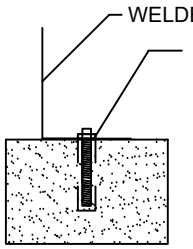

| | NO. OF ANCHORAGE BOLTS REQUIRED | |
|---|---|---|
| CURB | LONG SIDE | SHORT SIDE |
| LXS | 2 @ 34.5" O.C. | 2 @ 19" O.C. |
| LXL | 2 @ 34.5" O.C. | 2 @ 29" O.C. |
| SUN3672 | 2 @ 60.5" O.C. | 2 @ 24.75" O.C. |
| PRD3715 | 2 @ 68.88" O.C. | 2 @ 39" O.C. |
| PRS | 2 @ 58.88" O.C. | 2 @ 28.69" O.C. |
| 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

**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 |

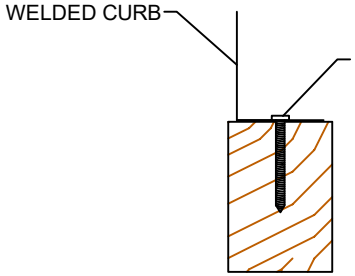
## CONCRETE ATTACHMENT




| | 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




| | 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**


ProVent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**SUBMITTED TO:** _____
**COMPANY:** _____
**JOB NAME:** _____
**EQUIPMENT:** _____
**NOTES:** _____

**FORM NO:** CB-60

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

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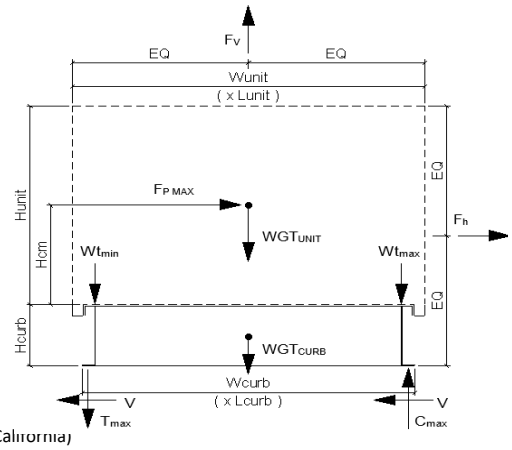
| | |
|---|---|
| Client: | ProVent PV2312 |
| Description: | CBPKD-166 SAV2025 |
| Unit: | AV/AD 20-25; AE/AW 13-15; AH/AL 18-20; HV 15-20 |

**Curb Information**

| | | | |
|---|---|---|---|
| Hcurb = | 18 | in | (Height of curb) |
| Lcurb = | 135.125 | in | (Length of curb) |
| wcurb = | 80.125 | in | (Width of curb) |
| WGTcurb = | 565 | 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 = 3854 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) |
| $F_{h\ ASD\ trans}$ = | 2786 | lbs | = 0.6*qz*GCr*Lunit*(Hunit+Hcurb) (Eq. 29.4-2) |
| $F_{h\ ASD\ long}$ = | 1719 | 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+0.14$S_{DS}$)*Wtmax*wcurb]/wcurb |
| $Tension_{SEISMIC}$ = | 819 | lbs | =[FpmaxASD*Hcm-2*(0.6-0.14$S_{DS}$)*Wtmin*wcurb]/wcurb |
| $Compression_{WIND}$ = | 654 | lbs | =[$F_{h\ ASD\ trans}$*Hcm+2*0.6*Wtmax*wcurb-$F_{vert\ ASD}$*wcurb/2]/wcurb |
| $Tension_{WIND}$ = | 1615 | 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*(0.6-0.14$S_{DS}$)*Wtmin*Lcurb]/Lcurb |
| $Compression_{WIND}$ = | 23 | lbs | =[$F_{h\ ASD\ long}$*Hcm+2*0.6*Wtmax*Lcurb-$F_{vertASD}$*Lcurb/2]/Lcurb |
| $Tension_{WIND}$ = | 984 | 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) | $Tens_{MAX}$ = | 1615 | lbs | ---> Along long edge of curb. |
| Longitudinal: | $Comp_{MAX}$ = | 2775 | lbs | ---> Along short edge of curb. |
| (on short edge) | $Tens_{MAX}$ = | 984 | lbs | ---> Along short edge of curb. |

---> Negative values indicate opposite load.

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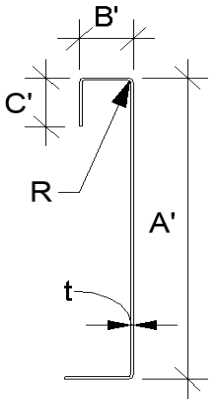
**Curb Design**

| | | | | | |
|---|---|---|---|---|---|
| Fy = | 50 | ksi | Fu = | 65 | ksi |
| E = | 29500 | ksi | t = | 0.1017 | 12 Gauge |




**Calculate Section Properties of Curb**

| | | | | | |
|---|---|---|---|---|---|
| A'= | 18.000 | in | a = | 17.492 in | = A'-(2r+t) |
| B'= | 1.500 | in | a'= | 17.898 in | = A'-t |
| C'= | 0.000 | in (0 if no lips) | b = | 1.246 in | = B'-[r+t/2+α(r+t/2)] |
| α = | 0.000 | (0 - no Lip; 1 w/ lip) | b'= | 1.449 in | = B'-(t/2+αt/2) |
| R = | 0.1525 | (Inside bend radius) | c = | 0.000 in | = α[C'-(r+t/2)] |
| t = | 0.1017 | in | c'= | 0.000 in | = α(C'-t/2) |
| r'= | 0.203 | in = R+t/2 | u = | 0.319 in | = πr/2 |
| x = | 0.102 | in (Distance between centroid and web centerline) | | | |
| Ix = | 70.803 | $in^4$ | rx = | 5.81 in | |
| Iy = | 0.185 | $in^4$ | ry = | 0.297 in | |
| A = | 2.10 | $in^2$ | rmin = | 0.297 in | |

**Axial Compression**

| | | | | |
|---|---|---|---|---|
| Pu = | 1.589 | k | (Max Axial Comp) | Ωc = 1.80 |
| Pn/Ωc = | 6.875 | k | | |
| Fe = | 6.73 | ksi | $\frac{P_n}{\Omega_c}=\frac{F_n A}{\Omega_c}$ | $If\ \lambda_c \le 1.5;\ F_n=\left(0.658^{\lambda_c{}^2}\right)F_y$ |
| λc = | 2.73 | | | $If\ \lambda_c > 1.5;\ F_n=\frac{0.877}{\lambda_c{}^2}F_y$ |
| Fn = | 5.90 | ksi | | $\lambda_c=\sqrt{\frac{F_y}{F_e}}$ $\quad F_e=\frac{\pi^2 E}{\left(kl/r\right)^2}$ |
| Ly = | 77.125 | in | Lateral unbraced length | |
| $k_yL_y/r_y$ = | 208 | | (assume k=0.8) | |

**Compression Check = O.K.**

**Check Web Crippling**

| | | | | | |
|---|---|---|---|---|---|
| h = | 18 | in | -- Check limits: | | C = 4.00 |
| t = | 0.1017 | in | h/t = | 176.99 ≤ 260 | $C_R$ = 0.14 |
| N = | 7.00 | | N/t = | 68.83 ≤ 210 | $C_N$ = 0.35 |
| $\Omega_w$ = | 1.75 | | N/h = | 0.388889 ≤ 2.0 | $C_h$ = 0.02 |
| $P_n$ = | 4.390 | k | R/t = | 1.50 ≤ 9.0 | |
| $P_n/\Omega_w$ = | 2.509 | k | | | |
| Long side: $Pu_{Trans}$ = | 1.079 | k | **O.K.** | # clips = 3 | |
| Short side: $Pu_{Long}$ = | 1.387 | k | **O.K.** | # clips = 2 | |

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

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

**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 | | |

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

| | | | | | |
|---|---|---|---|---|---|
| Pwc = | 4.390 | k | Ae = | 0.324 | $in^2$ |
| Pn = | 14.398 | k | Pn/Ω = | 8.470 | k |

**Not Req'd**

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

| | | | | | | |
|---|---|---|---|---|---|---|
| Tcrnmax = | 964 | lbs | Max($F_{pmaxASD}$/4 -OR- $Fh_{ASDtrans}$/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: 0.576 **O.K.**

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

| | | |
|---|---|---|
| Assume L/t > 25: 25*t = | 2.543 | in |
| Lreq'd = | 0.767 | 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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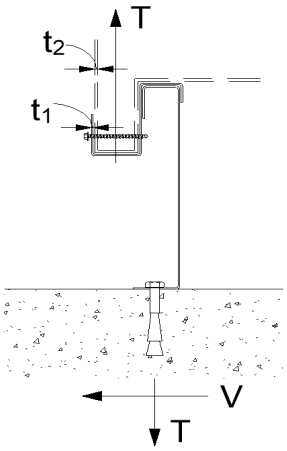
**Connection Unit to Curb Clip** | #10 SMS screw | Ω = 3.0

t1 = 0.1017 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 = 1.0




For t2/t1 ≤ 1.0:

***Shear***: $P_{ns} = 4.2F_{u2}\sqrt{t_2^3 d}$ Pns = 3391 # (3.86 k)
$P_{ns} = 2.7t_1 dF_{u1}$ 3.39 k
$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k
Pns/Ω = 1130 #
Pss/Ω = 540 # <- Controls

For t2/t1 ≥ 2.5:
Pns = 3391 #
$P_{ns} = 2.7t_1 dF_{u1}$ 3.39 k
$P_{ns} = 2.7t_2 dF_{u2}$ 3.39 k

*Tension*: Pnot = 1.068 k (screw pull-out strength)
Pnov = 3.718 k (screw pull-over strength)
Pts/Ω = 356 # <- Controls
Pts/Ω = 820 # (full tensile screw capacity)

$P_{not} = 0.85t_c dF_{u2})$
$t_c = \min(t_1, t_2)$
$P_{nov} = 1.5t_1 d_w F_{u1}$

| | 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 = 0.1017 AISI BSR applies
Fy = 50 ksi | Ω = 2.22 bolt/screw connection
Agv = 0.661 in² | Anv = 0.613 in² | Ant = 0.060 in²
Rn/Ω = 10.697 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)

**Connection of Curb to Supporting Structure**

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

Transverse: $Uplift_{MAX}$ = 1952 lbs | $Shear_{MAX}$ = 1927 lbs

$Compression_{SEISMIC}$ = 4367 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14$S_{DS}$)*$WGT_{unit+curb}$*wcurb/2]/wcurb
$Tension_{SEISMIC}$ = 1791 lbs =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14$S_{DS}$)*$WGT_{unit+curb}$*wcurb/2]/wcurb
$Compression_{WIND}$ = 1290 lbs =[$F_{h\ ASD\ trans}$*(Hcm+Hcurb)+0.6*$WGT_{unit+curb}$*wcurb/2-$F_{vert\ ASD}$*wcurb/2]/wcurb
$Tension_{WIND}$ = 1952 lbs =[$F_{h\ ASD\ trans}$*(Hcm+Hcurb)-0.6*$WGT_{unit+curb}$*wcurb/2+$F_{vertASD}$*wcurb/2]/wcurb

Longitudinal: $Uplift_{MAX}$ = 924 lbs | $Shear_{MAX}$ = 1927 lbs

$Compression_{SEISMIC}$ = 3454 lbs =[FpmaxASD*(Hcm+Hcurb)+(1+0.14$S_{DS}$)*$WGT_{unit+curb}$*Lcurb/2]/Lcurb
$Tension_{SEISMIC}$ = 878 lbs =[FpmaxASD*(Hcm+Hcurb)-(0.6-0.14$S_{DS}$)*$WGT_{unit+curb}$*Lcurb/2]/Lcurb
$Compression_{WIND}$ = 262 lbs =[$F_{h\ ASD\ long}$*(Hcm+Hcurb)+0.6*$WGT_{unit+curb}$*Lcurb/2-$F_{vert\ ASD}$*Lcurb/2]/Lcurb
$Tension_{WIND}$ = 924 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)

Transverse: $Tall_{metal}$ = 997 lbs | $Vall_{metal}$ = 1097 lbs
$Tall_{wood}$ = 616 lbs | $Vall_{wood}$ = 672 lbs
# of Screws Req'd for Uplift = 3.17 | COMBINED LOADING: 0.862 O.K.
# of Screws Req'd for Shear = 2.87 | 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 = 1.5 | COMBINED LOADING: 0.874 O.K.
# of Screws Req'd for Shear = 2.9 | 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 = 0.94 | COMBINED LOADING: 0.273 O.K.
# of Bolts Req'd for Shear = 0.88 | 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 = 0.44 | COMBINED LOADING: 0.335 O.K.
# of Bolts Req'd for Shear = 0.88 | 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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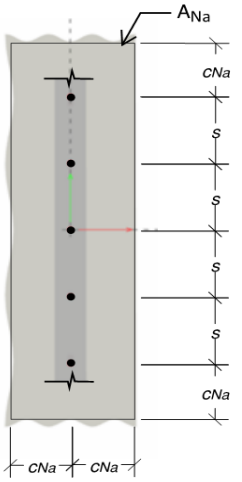
**For Concrete anchorage:** SEISMIC $(0.6\text{-}0.14S_{DS})D + 0.7\Omega_o E$ $\Omega o$ = 2.0

**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); | $c_{Na} = 10d_a\sqrt{\frac{\tau_{uncr}}{1100}}$ | |

*Tension*:

*Bond strength*

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

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

***Bond strength will govern over concrete breakout

| | | | | |
|---|---|---|---|---|
| $A_{Na}$= | 408.98 | in² | | |
| $A_{Nao}$= | 204.49 | in² | | |
| $N_{ba}$ = | 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 |
| ø$N_{ag}$ = | 4820 | lbs (group) | CONTROLS | $\lambda_a$ =1.0 for normal weight conc; 0.6 for lightv |

*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 | in² | $N_b$ = 4246 | lbs | $ø_{conc}$ = | 0.75 |
| $A_{Nco}$ = | 68.0625 | in² | kc = 17 | | $ø_{bond}$ = | 0.65 |
| $N_{cbg}$ = | 12945 | lbs (group) | | | $ø_{seis}$ = | 0.75 |
| ø$N_{cbg}$ = | 7281 | lbs (group) | | | $ø_{steel}$ = | 0.65 |

*Shear*:

*Steel strength*

| | | | | | | |
|---|---|---|---|---|---|---|
| Vsa,eq = | 4940 | (from ESR4868, Table 11) | | | $\alpha_{v,seismic}$ = | 0.6 |
| øVsa,eq = | 1927 | | | | | |
| $Tall_{LRFD}$ = | 2410 | lbs (anchor) | $Vall_{LRFD}$ = | 3067 lbs | $\propto = (1 + 0.2SDS)D + 2.5E$ | |
| $Tall_{ASD} = Tall_{LRFD}/\alpha$ = | 1411 | lbs | $Vall_{ASD} = Vall_{LRFD}/\alpha$ = | 1796 lbs | $D$ =0.758 $E$ =0.242 | $\propto$ =1.709 |

| Transverse: | Uplift$_{MAX}$ = | 4034 lbs | Shear$_{MAX}$ = | 3854 lbs |
|---|---|---|---|---|

| | | | |
|---|---|---|---|
| $Compression_{SEISMIC}$ = | 6610 lbs | =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14$S_{DS}$)*$WGT_{unit+curb}$*wcurb/2]/wcurb | |
| $Tension_{SEISMIC}$ = | 4034 lbs | =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14$S_{DS}$)*$WGT_{unit+curb}$*wcurb/2]/wcurb | |
| $Shear_{SEISMIC}$ = | 3854 lbs | =Ωo*FpmaxASD/2 | |
| Min Bolts Req'd Uplift = | 2.86 | spacing = 61.56 in o.c. | Tapplied = 1008.4 lbs |
| Min Bolts Req'd Shear = | 2.15 | spacing = 61.56 in o.c. | Vapplied = 642.4 lbs |

Try using 4 bolts spaced at 41.04 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \le 1.2$ = 1.07 O.K.

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$_{MAX}$ = | 2208 lbs | Shear$_{MAX}$ = | 3854 lbs |
|---|---|---|---|---|

| | | | |
|---|---|---|---|
| $Compression_{SEISMIC}$ = | 4784 lbs | =[Ωo*FpmaxASD*(Hcm+Hcurb)+(1+0.14$S_{DS}$)*$WGT_{unit+curb}$*Lcurb/2]/Lcurb | |
| $Tension_{SEISMIC}$ = | 2208 lbs | =[Ωo*FpmaxASD*(Hcm+Hcurb)-(0.6-0.14$S_{DS}$)*$WGT_{unit+curb}$*Lcurb/2]/Lcurb | |
| $Shear_{SEISMIC}$ = | 3854 lbs | =Ωo*FpmaxASD/2 | |
| Min Bolts Req'd Uplift = | 1.56 | spacing = 34.06 in o.c. | Tapplied = 1103.9 lbs |
| Min Bolts Req'd Shear = | 2.15 | spacing = 34.06 in o.c. | Vapplied = 642.4 lbs |

Try using 2 bolts spaced at 68.13 in o.c.

COMBINED LOADING = $\frac{T_{applied}}{T_{allow,ASD}} + \frac{V_{apllied}}{V_{allow,ASD}} \le 1.2$ = 1.14 O.K.

Use 2 - 1/2"ϕ HAS rods in Hilti HIT-HY 200 V3 epoxy @ 68.1 in o.c. max. along short side of curb w/ 2.75in embed

| **CURB DESIGN SUMMARY:** | CBPKD-166 SAV2025 | **Unit:** | AV/AD 20-25; AE/AW 13-15; AH/AL 18-20; HV 15-20 |
|---|---|---|---|
| **CURB RAIL THICKNESS:** | 0.1017 in 12 Gauge | | |
| **UNIT CLIP THICKNESS:** | 0.1017 in 12 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<br>1/4"ϕ x 3.5" Simpson SDS screws w/ 2.25" threaded embed | STEEL<br>1/2" ϕ A307 Bolts to steel angle below deck | CONCRETE<br>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. | 2 @ 68.13 in o.c. |