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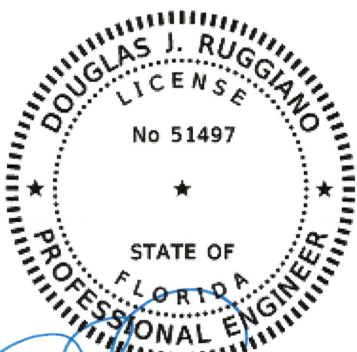
Miami, FL. 33196

786-210-0881

Reference: Product Certification Statement
Rooftop Mounted Mechanical Equipment
Westinghouse Outdoor HVAC Unit (Group 1)
Model Nos.: **WHS09SZA21S; WHS12SZA21S**
WHS09SZA11S; WHS12SZA11S
WHP09SZA21S

Based on the manufacturers cut sheets for the referenced rooftop equipment, I have performed a wind load analysis to determine compliance with wind load criteria set forth by 2017 Florida Building Code Mechanical Section 301.15, Florida Building Code Building Chapter 16 and ASCE 7-10. Analysis results demonstrate that the equipment without retrofit is structurally adequate to withstand wind loads at the specified mounting heights for Exposure Categories identified in Table 1. This wind certification includes anchorage of equipment with 5/16" diameter anchors at the four base mount locations. Anchor material strength shall meet or exceed ASTM A307 requirements. Specifications for anchor attachment to host structure and certification for structural adequacy of host support structure is not included and is to be determined by others. For analysis results, refer to Summary of Results at the end of the structures report associated with this certification.

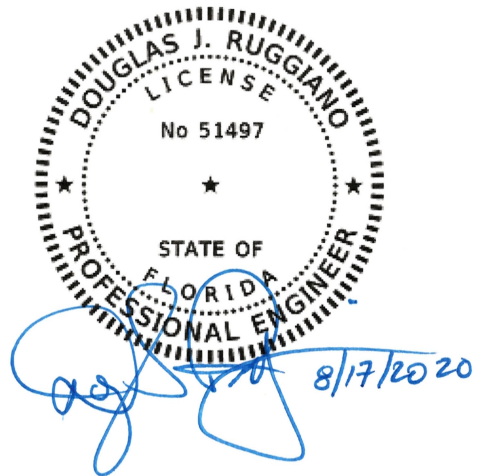
TABLE 1			
Design Wind Speed	Max Mounting Height Above Natural Grade (ft)		Kz
	Exposure C	Exposure D	
120	500	500	3.44
130	500	500	2.93
140	500	500	2.52
150	500	500	2.20
160	500	500	1.93
170	400	275	1.71
175	325	200	1.62
180	250	140	1.53
186	180	100	1.43
190	140	75	1.37
200	90	45	1.24




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WIND LOAD ANALYSIS AND STRUCTURAL CALCULATIONS
FOR
WIND CERTIFICATION
OF
ROOFTOP MECHANICAL EQUIPMENT
WESTINGHOUSE OUTDOOR HVAC UNIT (GROUP 1)

MODEL NOS:
WHS09SZA21S; WHS12SZA21S
WHS09SZA11S; WHS12SZA11S
WHP09SZA21S



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AUGUST 2020

Wind Load Analysis for Rooftop Mounted Equipment: Equipment:

Westinghouse 0.75 - 1.0 Ton Chassis

Model Nos: WHS09SZA21S; WHS12SZA21S
WHS09SZA11S; WHS12SZA11S
WHP09SZA21S

Approximate Weight of Unit (wt_{unit}):

$$wt_{unit} := 55 \cdot \text{lb}$$

Length of Unit (L_e):

$$L_e := 28.1 \cdot \text{in}$$

Width of Unit (W_e):

$$W_e := 9.4 \cdot \text{in}$$

Height of Unit (H_e):

$$H_e := 19 \cdot \text{in}$$

Mount Hole spacing Along Length (MH_L):

$$MH_L := 17.4 \cdot \text{in}$$

Mount Hole spacing Along Width (MH_W):

$$MH_W := 10.4 \cdot \text{in}$$

Cornet Weight at Point A (Rdl_A):

$$Rdl_A := \frac{wt_{unit}}{4}$$

$$Rdl_A = 13.8 \cdot \text{lb}$$

Cornet Weight at Point B (Rdl_B):

$$Rdl_B := \frac{wt_{unit}}{4}$$

$$Rdl_B = 13.8 \cdot \text{lb}$$

Cornet Weight at Point C (Rdl_C):

$$Rdl_C := \frac{wt_{unit}}{4}$$

$$Rdl_C = 13.8 \cdot \text{lb}$$

Cornet Weight at Point D (Rdl_D):

$$Rdl_D := \frac{wt_{unit}}{4}$$

$$Rdl_D = 13.8 \cdot \text{lb}$$

Material Data:

Ultimate Tensile Strength of Cold Formed
Sheet Metal Casing in Contact with Screw
Head ($Fu1_{case}$):

$$Fu1_{case} := 45 \cdot \text{ksi}$$

Ultimate Tensile Strength of Cold Formed
Sheet Metal Casing Not in Contact with Screw
Head ($Fu2_{cas}$):

$$Fu2_{case} := 45 \cdot \text{ksi}$$

Ultimate Strength of Metal Fasteners (Fu_{fas}):

$$Fu_{fas} := 50 \cdot \text{ksi}$$

Yield Strength of Metal Casing (F_y)

$$F_y := 30 \cdot \text{ksi}$$

Calculate Wind Load (Per ASCE 7-10)

Building Risk Category (B_{Risk}):

$Bldg_{Risk} := "IV"$

Design Wind Speed (V):

$V := 186 \text{ mph}$

Mounting Height above Grade (H):

$H := 100 \cdot \text{ft}$

Velocity pressure exposure coefficient at height from ground to Centroid of Equipment (K_z):

$K_z := 1.43$

Topographic Factor (K_{zt}):

$K_{zt} := 1.0$

Directionality Factor From Table 6-4 (Similar Structures) (K_d):

$K_d := 0.90$

Ultimate Design Velocity Pressure Evaluated at height z of the Centroid of the Effective Area (q_{zULT}):

$$q_{zULT} := 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2 \cdot \text{psf}$$

$$q_{zULT} = 114 \cdot \text{psf}$$

Allowable Design Velocity Pressure Evaluated at height z of the Centroid of the Effective Area (q_z):

$$q_z := q_{zULT} \cdot 0.6$$

$$q_z = 68.4 \cdot \text{psf}$$

Lateral Pressure Coefficient

$$GCf_{lat} := 1.9$$

Uplift Pressure Coefficient

$$GCf_{upl} := 1.5$$

Lateral Wind Pressure (p_{lat}):

$$p_{lat} := q_z \cdot GCf_{lat}$$

$$p_{lat} = 129.9 \cdot \text{psf}$$

Uplift Wind Pressure (p_{upl}):

$$p_{upl} := q_z \cdot GCf_{upl}$$

$$p_{upl} = 102.6 \cdot \text{psf}$$

Projected Area Normal to Wind (A_n):

$$A_n := L_e \cdot H_e$$

$$A_n = 3.7 \cdot \text{ft}^2$$

Projected Area Parallel to Wind (A_p):

$$A_p := L_e \cdot W_e$$

$$A_p = 1.8 \cdot \text{ft}^2$$

Calculate the Wind Load Reactions at Unit to Curb (Refer to Figure I)

$$F_h := p_{lat} \cdot A_n$$

$$F_h = 0.5 \cdot \text{kip}$$

$$F_{up} := p_{upl} \cdot A_p$$

$$F_{up} = 0.2 \cdot \text{kip}$$

$$Rwl_A := \frac{F_h \cdot \frac{H_e}{2}}{2 \cdot MH_W} - \frac{F_{up}}{4}$$

$$Rwl_A = 0.2 \cdot \text{kip} \quad (\text{Downward})$$

$$Rwl_B := \frac{F_h \cdot \frac{H_e}{2}}{2 \cdot MH_W} - \frac{F_{up}}{4}$$

$$Rwl_B = 0.2 \cdot \text{kip} \quad (\text{Downward})$$

$$Rwl_C := \frac{F_h \cdot \frac{H_e}{2}}{2 \cdot MH_W} + \frac{F_{up}}{4}$$

$$Rwl_C = 0.3 \cdot \text{kip} \quad (\text{Upward})$$

$$Rwl_D := \frac{F_h \cdot \frac{H_e}{2}}{2 \cdot MH_W} + \frac{F_{up}}{4}$$

$$Rwl_D = 0.3 \cdot \text{kip} \quad (\text{Upward})$$

Calculate Combined Reactions at each Anchorage Location (Dead + Wind x FSstab):

Vertical Reactions:

$$R_{totA} := R_{dlA} + Rwl_A$$

$$R_{totA} = 0.2 \cdot \text{kip}$$

$$R_{totB} := R_{dlB} + Rwl_B$$

$$R_{totB} = 0.2 \cdot \text{kip}$$

$$R_{totC} := R_{dlC} - Rwl_C$$

$$R_{totC} = -0.3 \cdot \text{kip}$$

$$R_{totD} := R_{dlD} - Rwl_D$$

$$R_{totD} = -0.3 \cdot \text{kip}$$

Horizontal Reactions:

$$R_{hor} := \frac{F_h}{4}$$

$$R_{hor} = 0.1 \cdot \text{kip}$$

Therefore, with the assumption of 4 anchor points (1 at each corner of the unit); each anchorage to curb and corresponding building support components must be designed to withstand the Uplift Reaction of $R_{totC} = -0.3 \cdot \text{kip}$ and a Horizontal Shear Reaction of $R_{hor} = 0.1 \cdot \text{kip}$.

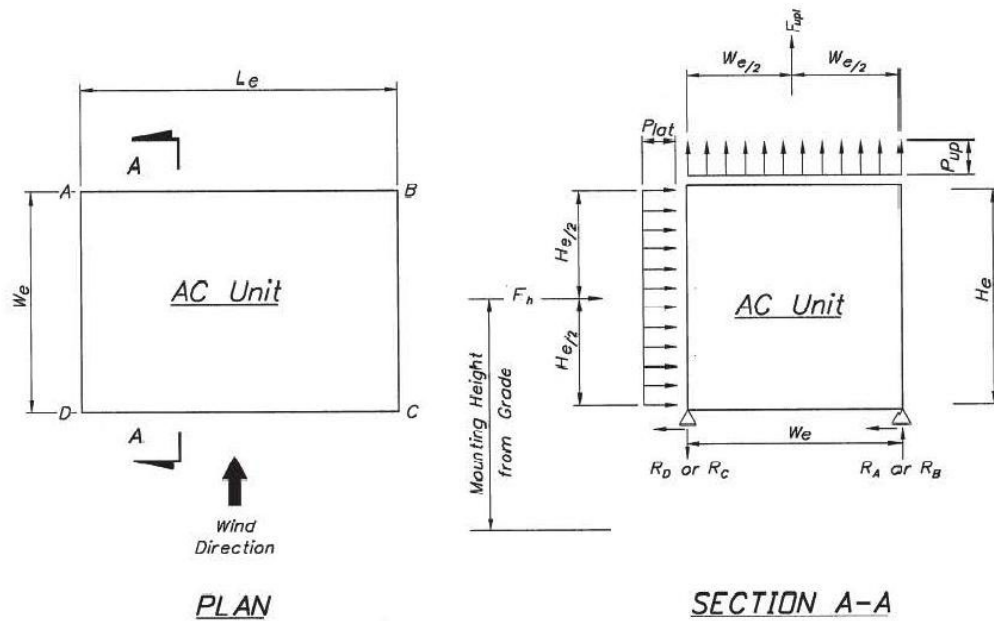


FIGURE I

Calculate No. of Fasteners Req'd for Panel No. 1

Attachment Data:

Nominal Screw Diameter (Φ_{screw}):

$$\Phi_{\text{screw}} := 0.157 \cdot \text{in}$$

Thread Series, threads per in (unc):

$$\text{unc} := 14$$

Affective Shear Stress Area of Screw (A_v):

$$A_v := \frac{\pi}{4} \cdot \left(\frac{\Phi_{\text{screw}}}{\text{in}} - \frac{1.2269}{\text{unc}} \right)^2 \cdot \text{in}^2$$

$$A_v = 0.0038 \cdot \text{in}^2$$

Thickness of Metal Casing in Contact with Screw Head (t1):

$$t1 := 0.0236 \cdot \text{in}$$

Thickness of Metal Casing Not in Contact with Screw Head (t2):

$$t2 := 0.0236 \cdot \text{in}$$

Casing Thickness Ratio (rc):

$$rc := \frac{t2}{t1}$$

$$rc = 1$$

Panel Length (L_{pan}):

$$L_{\text{pan}} := L_e = 28.1 \cdot \text{in}$$

Panel Width (W_{pan}):

$$W_{\text{pan}} := W_e = 9.4 \cdot \text{in}$$

Calculate Nominal Shear per Fastener Based on Bearing for $rc \leq 1.0$ (Pns_{case}):

$$Pns1 := 4.2 \cdot \sqrt{t1^3 \cdot \Phi_{\text{screw}} \cdot Fu1_{\text{case}}}$$

$$Pns1 = 0.272 \cdot \text{kip}$$

$$Pns2 := 2.7 \cdot t1 \cdot \Phi_{\text{screw}} \cdot Fu1_{\text{case}}$$

$$Pns2 = 0.450 \cdot \text{kip}$$

$$Pns3 := 2.7 \cdot t2 \cdot \Phi_{\text{screw}} \cdot Fu2_{\text{case}}$$

$$Pns2 = 0.450 \cdot \text{kip}$$

$$Pns_{\text{case}} := \text{if}(Pns1 \leq Pns2, \text{if}(Pns1 \leq Pns3, Pns1, Pns3), \text{if}(Pns2 \leq Pns3, Pns2, Pns3))$$

$$Pns_{\text{case}} = 0.272 \cdot \text{kip}$$

Calculate Nominal Shear per Fastener Based on Shear Capacity of Screw (Pns_{screw}):

$$Pns_{\text{screw}} := Fu_{\text{fas}} \cdot A_v$$

$$Pns_{\text{screw}} = 0.189 \cdot \text{kip}$$

Calculate Allowable Shear per Fastener (Pas):

$$\Omega_{\text{brg}} := 3.0$$

$$Pas1 := \frac{Pns_{\text{case}}}{\Omega_{\text{brg}}}$$

$$Pas1 = 0.091 \cdot \text{kip}$$

$$\Omega_{\text{screw}} := \frac{\sqrt{3}}{0.40}$$

$$Pas2 := \frac{Pns_{\text{screw}}}{\Omega_{\text{screw}}}$$

$$Pas2 = 0.044 \cdot \text{kip}$$

$$Pas := \text{if}(Pas1 \leq Pas2, Pas1, Pas2)$$

$$Pas = 0.044 \cdot \text{kip}$$

Calculate Total Uplift on Panel (F_{upl}):

$$F_{\text{upl}} := P_{\text{upl}} \cdot L_{\text{pan}} \cdot W_{\text{pan}}$$

$$F_{\text{upl}} = 0.2 \cdot \text{kip}$$

Calculate Total No. of Screws Required (No_{screws}):

$$No_{\text{screws}1} := \text{ceil}\left(\frac{F_{\text{upl}}}{Pas}\right)$$

$$No_{\text{screws}1} = 5$$

Calculate No. of Fasteners Req'd for Panel No. 2

Attachment Data:

Nominal Screw Diameter (Φ_{screw}): $\Phi_{\text{screw}} := 0.157 \cdot \text{in}$ Dia of Hex Head: $\Phi_{\text{head}} := 0.32 \cdot \text{in}$

Thread Series, threads per in (unc): $\text{unc} := 14$

Affective Tensile Stress Area of Screw (A_t):

$$A_t := \frac{\pi}{4} \cdot \left(\frac{\Phi_{\text{screw}}}{\text{in}} - \frac{0.9743}{\text{unc}} \right)^2 \cdot \text{in}^2 \quad A_t = 0.006 \cdot \text{in}^2$$

Thickness of Metal Casing in Contact with Screw Head (t1): $t1 := 0.0236 \cdot \text{in}$

Thickness of Metal Casing Not in Contact with Screw Head (t2): $t2 := 0.0236 \cdot \text{in}$

Casing Thickness Ratio (rc): $rc := \frac{t2}{t1} \quad rc = 1$

Panel Length (L_{pan}): $L_{\text{pan}} := H_e = 19 \cdot \text{in}$

Panel Width (W_{pan}): $W_{\text{pan}} := W_e = 9.4 \cdot \text{in}$

Calculate Nominal Tension or Pullout per Fastener Based on Bearing (Pnt_{case}):

$Pnt1 := 0.85 \cdot t2 \cdot \Phi_{\text{screw}} \cdot Fu2_{\text{case}} \quad Pnt1 = 0.142 \cdot \text{kip}$

$Pnt2 := 1.5 \cdot t1 \cdot \Phi_{\text{head}} \cdot Fu1_{\text{case}} \quad Pnt2 = 0.51 \cdot \text{kip}$

$Pnt_{\text{case}} := \text{if}(Pnt1 \leq Pnt2, Pnt1, Pnt2) \quad Pnt_{\text{case}} = 0.142 \cdot \text{kip}$

Calculate Nominal Tensile or Pullout per Fastener Based on Tensile Capacity of Screw (Pnt_{screw}):

$Pnt_{\text{screw}} := Fu_{\text{fas}} \cdot A_t \quad Pnt_{\text{screw}} = 0.300 \cdot \text{kip}$

Calculate Allowable Pullout per Fastener (Pat):

$\Omega_{\text{brg}} := 3.0 \quad Pat1 := \frac{Pnt_{\text{case}}}{\Omega_{\text{brg}}} \quad Pat1 = 0.047 \cdot \text{kip}$

$\Omega_{\text{screw}} := \frac{1}{0.40} \quad Pat2 := \frac{Pnt_{\text{screw}}}{\Omega_{\text{screw}}} \quad Pat2 = 0.120 \cdot \text{kip}$

$Pat := \text{if}(Pat1 \leq Pat2, Pat1, Pat2) \quad Pat = 0.047 \cdot \text{kip}$

Calculate Total Horizontal Force on Panel (F_{horiz}):

$F_{\text{horiz}} := Plat \cdot L_{\text{pan}} \cdot W_{\text{pan}} \quad F_{\text{horiz}} = 0.161 \cdot \text{kip}$

Calculate Total No. of Screws Required (No_{screws}):

$No_{\text{screws2}} := \text{ceil}\left(\frac{F_{\text{horiz}}}{Pat}\right) \quad No_{\text{screws2}} = 4$

Calculate No. of Fasteners Req'd for Panel No. 3

Attachment Data:

Nominal Screw Diameter (Φ_{screw}): $\Phi_{\text{screw}} := 0.157 \cdot \text{in}$ Dia of Hex Head: $\Phi_{\text{head}} := 0.32 \cdot \text{in}$

Thread Series, threads per in (unc): $\text{unc} := 14$

Affective Tensile Stress Area of Screw (A_t):

$$A_t := \frac{\pi}{4} \cdot \left(\frac{\Phi_{\text{screw}}}{\text{in}} - \frac{0.9743}{\text{unc}} \right)^2 \cdot \text{in}^2 \quad A_t = 0.006 \cdot \text{in}^2$$

Thickness of Metal Casing in Contact with Screw Head (t1): $t1 := 0.0236 \cdot \text{in}$

Thickness of Metal Casing Not in Contact with Screw Head (t2): $t2 := 0.0236 \cdot \text{in}$

Casing Thickness Ratio (rc): $rc := \frac{t2}{t1}$ $rc = 1$

Panel Length (L_{pan}): $L_{\text{pan}} := L_e = 28.1 \cdot \text{in}$

Panel Width (W_{pan}): $W_{\text{pan}} := H_e = 19 \cdot \text{in}$

Calculate Nominal Tension or Pullout per Fastener Based on Bearing (Pnt_{case}):

$Pnt1 := 0.85 \cdot t2 \cdot \Phi_{\text{screw}} \cdot Fu2_{\text{case}}$ $Pnt1 = 0.142 \cdot \text{kip}$

$Pnt2 := 1.5 \cdot t1 \cdot \Phi_{\text{head}} \cdot Fu1_{\text{case}}$ $Pnt2 = 0.51 \cdot \text{kip}$

$Pnt_{\text{case}} := \text{if}(Pnt1 \leq Pnt2, Pnt1, Pnt2)$ $Pnt_{\text{case}} = 0.142 \cdot \text{kip}$

Calculate Nominal Tension or Pullout per Fastener Based on Tensile Capacity of Screw (Pnt_{screw}):

$Pnt_{\text{screw}} := Fu_{\text{fas}} \cdot A_t$ $Pnt_{\text{screw}} = 0.300 \cdot \text{kip}$

Calculate Allowable Pullout per Fastener (Pat):

$\Omega_{\text{brg}} := 3.0$ $Pat1 := \frac{Pnt_{\text{case}}}{\Omega_{\text{brg}}}$ $Pat1 = 0.047 \cdot \text{kip}$

$\Omega_{\text{screw}} := \frac{1}{0.40}$ $Pat2 := \frac{Pnt_{\text{screw}}}{\Omega_{\text{screw}}}$ $Pat2 = 0.120 \cdot \text{kip}$

$Pat := \text{if}(Pat1 \leq Pat2, Pat1, Pat2)$ $Pat = 0.047 \cdot \text{kip}$

Calculate Total Horizontal Force on Panel (F_{horiz}):

$\%open := 50\%$

$F_{\text{horiz}} := Pat \cdot L_{\text{pan}} \cdot W_{\text{pan}} \cdot (1 - \%open)$ $F_{\text{horiz}} = 0.241 \cdot \text{kip}$

Calculate Total No. of Screws Required (No_{screws}):

$No_{\text{screws}3} := \text{ceil}\left(\frac{F_{\text{horiz}}}{Pat}\right)$ $No_{\text{screws}3} = 6$

Check Adequacy of Base Plate and Anchorage Hardware

Attachment Data:

Nominal Bolt Diameter (Φ_{bolt}):

$$\Phi_{\text{bolt}} := 0.3125 \cdot \text{in}$$

Affective Bolt Area (A_{eff}):

$$A_{\text{eff}} := \frac{\pi}{4} \cdot \left(\frac{\Phi_{\text{bolt}}}{\text{in}} \right)^2 \cdot \text{in}^2$$

$$A_{\text{eff}} = 0.077 \cdot \text{in}^2$$

BoltMaterial := "ASTM A307 or Greater"

Allowable Tensile Strength (F_t):

$$F_t := 20 \cdot \text{ksi}$$

Allowable Shear Strength (F_v):

$$F_v := 9.9 \cdot \text{ksi}$$

Bolt Shear Capacity (V_{all}):

$$V_{\text{all}} := A_{\text{eff}} \cdot F_v = 0.8 \cdot \text{kip}$$

Bolt Tension Capacity (T_{all}):

$$T_{\text{all}} := A_{\text{eff}} \cdot F_t = 1.5 \cdot \text{kip}$$

Check Bolt Adequacy with Wind Perpendicular to Long Side

Number of Bolts Provided to resist Tension ($\text{NoBolts}_{\text{provtens}}$):

$$\text{NoBolts}_{\text{provtens}} := 2$$

$$t_{\text{bolt}} := \frac{|2R_{\text{totC}}|}{\text{NoBolts}_{\text{provtens}}}$$

$$t_{\text{bolt}} = 0.3 \cdot \text{kip}$$

Number of Bolts Provided to resist Shear ($\text{NoBolts}_{\text{provshear}}$):

$$\text{NoBolts}_{\text{provshear}} := 4$$

$$v_{\text{bolt}} := \frac{2 \cdot R_{\text{hor}}}{\text{NoBolts}_{\text{provshear}}}$$

$$v_{\text{bolt}} = 0.1 \cdot \text{kip}$$

$$\text{CSR}_{\text{bolt}} := \frac{t_{\text{bolt}}}{T_{\text{all}}} + \frac{v_{\text{bolt}}}{V_{\text{all}}}$$

$$\text{CSR}_{\text{bolt}} = 0.244$$

$$\text{Check}_{\text{bolt}} := \text{if}(\text{CSR}_{\text{bolt}} \leq 1.0, \text{"OK"}, \text{"NG"})$$

$$\text{Check}_{\text{bolt}} = \text{"OK"}$$

Check Base Plate

Width of Base Plate:

$$b_{\text{bp}} := 1.9 \cdot \text{in}$$

Thickness of Base Plate:

$$t_{\text{bp}} := 0.032 \cdot \text{in}$$

Moment Arm:

$$\text{arm} := 1.5 \cdot \text{in}$$

Calculate Effective Section Properties of Base Plate (Unit - Inches)														
b	t	hflange	I1	I2	d1	d2	A1	A2	ybar	y1	y2	Itotal	Stotal	Atotal
1.9	0.032	0.66	5.19E-06	0.000660	0.644	0.314	0.0608	0.0201	0.64	0.02	0.64	0.028523	0.044566	0.080896

Area:

$$A_x := 0.080896 \cdot \text{in}^2$$

Section Modulus:

$$S_x := 0.044566 \cdot \text{in}^3$$

Bending Stress:

$$f_b := \frac{t_{\text{bolt}} \cdot \text{arm}}{S_x} = 8.5 \cdot \text{ksi}$$

Shear Stress:

$$f_v := \frac{t_{\text{bolt}}}{A_x} = 3.1 \cdot \text{ksi}$$

Allowable Bending Stress

$$F_b := 0.6 \cdot F_y = 18000 \text{ psi}$$

Allowable Shear Stress

$$F_v := 0.4 \cdot F_y = 12000 \text{ psi}$$

$$\text{CSR}_{\text{bp}} := \frac{f_b}{F_b} + \left(\frac{f_v}{F_v} \right)^2 = 0.5$$

$$\text{CheckBasePlate} := \text{if}(\text{CSR}_{\text{bp}} \leq 1.0, \text{"OK"}, \text{"NG"}) = \text{"OK"}$$

Summary of Results:

$$\text{BuildingRisk} := \text{BldgRisk} = \text{"IV"}$$

$$\text{DesignWindSpeed} := V \cdot \text{mph} = 186 \cdot \text{mph}$$

$$\text{ExposureCategory} := \text{ExpCat} = \text{"D"}$$

$$\text{MountingHeight} := H = 100 \cdot \text{ft}$$

Number of Panel Fasteners Provided By Manufacturer:

$$\text{Panel No. 1: } \text{No}_{\text{screws.std1}} := 6$$

$$\text{Panel No. 2: } \text{No}_{\text{screws.std2}} := 4$$

$$\text{Panel No. 3: } \text{No}_{\text{screws.std3}} := 8$$

Number of Panel Fasteners Required By Analysis:

$$\text{Panel No. 1: } \text{No}_{\text{screws1}} = 5$$

$$\text{Panel No. 2: } \text{No}_{\text{screws2}} = 4$$

$$\text{Panel No. 3: } \text{No}_{\text{screws3}} = 6$$

Panel Fastening Check:

$$\text{check}_{\text{panel1}} := \text{if}(\text{No}_{\text{screws.std1}} \geq \text{No}_{\text{screws1}}, \text{"OK"}, \text{"NG"}) = \text{"OK"}$$

$$\text{check}_{\text{panel2}} := \text{if}(\text{No}_{\text{screws.std2}} \geq \text{No}_{\text{screws2}}, \text{"OK"}, \text{"NG"}) = \text{"OK"}$$

$$\text{check}_{\text{panel3}} := \text{if}(\text{No}_{\text{screws.std3}} \geq \text{No}_{\text{screws3}}, \text{"OK"}, \text{"NG"}) = \text{"OK"}$$

Equipment Tie Down to Support By Others:

$$\text{BoltMaterial} = \text{"ASTM A307 or Greater"}$$

$$\text{TieDownBoltDia} := \phi_{\text{bolt}} = 0.3125 \cdot \text{in}$$

$$\text{CSR}_{\text{bolt}} = 0.2$$

$$\text{CSR}_{\text{bp}} = 0.5$$