HSS 3x3x1/4 x 10 ft Steel Column Verification Calculations:

$R_{Dead} := 1.075\ kip$ $R_{Snow} := 2.50\ kip$ $R_{Wind} := -1.5\ kip$

Column Dimensions: Length: $L := 10\ ft$ Unbraced Length: $L_x := \frac{L}{2} = 5\ ft$ $L_y := L = 10\ ft$

Shape: Use HSS3x3x1/4 $F_y := 50\ ksi$ $E := 29000\ ksi$ $A := 2.44\ in^2$ $r_x := 1.11\ in$ $r_y := 1.11\ in$

$hTw := 9.88$ $bTf := 9.88$ $W := 8.81\ plf$

Check for compact flange and web per AISC B4.1b:

$$\text{if}\left(bTf \le 1.40 \cdot \sqrt{\frac{E}{F_y}}, \text{“Compact”}, \text{“Slender”}\right) = \text{“Compact”}$$

$$\text{if}\left(hTw \le 1.40 \cdot \sqrt{\frac{E}{F_y}}, \text{“Compact”}, \text{“Slender”}\right) = \text{“Compact”}$$

Total column loads including self weight:

$Dead := R_{Dead} + W \cdot L = 1.163\ kip$ $Snow := R_{Snow} = 2.5\ kip$ $Wind := R_{Wind} = -1.5\ kip$

$$P_{asd} := \begin{bmatrix} Dead \\ Dead + Snow \\ Dead + 0.75 \cdot Wind + 0.75 \cdot Snow \\ 0.6 \cdot Dead + 0.6 \cdot Wind \end{bmatrix} = \begin{bmatrix} 1.163 \\ 3.663 \\ 1.913 \\ -0.202 \end{bmatrix} kip$$

$$P_u := \begin{bmatrix} 1.4 \cdot Dead \\ 1.2 \cdot Dead + 1.6 \cdot Snow \\ 1.2 \cdot Dead + 1.0 \cdot Wind + 0.5 \cdot Snow \\ 1.2 \cdot Dead + 0.5 \cdot Wind + 1.6 \cdot Snow \\ 0.9 \cdot Dead + 1.0 \cdot Wind \end{bmatrix} = \begin{bmatrix} 1.628 \\ 5.396 \\ 1.146 \\ 4.646 \\ -0.453 \end{bmatrix} kip$$

Axial Capacity: $K := 1.0$

$F_{e\_x} := \frac{\pi^2 \cdot E}{\left(\frac{K \cdot L_x}{r_x}\right)^2} = 97.958\ ksi$ $F_{e\_y} := \frac{\pi^2 \cdot E}{\left(\frac{K \cdot L_y}{r_y}\right)^2} = 24.49\ ksi$ AISC E2

Calculate critical bucking stress per AISC E3-2 and AISC E3-3:

$F_{cr\_1} :=$ if $\frac{1 \cdot L_x}{r_x} \le 200$
  if $\frac{K \cdot L_x}{r_x} \le 4.71 \cdot \sqrt{\frac{E}{F_y}}$
    $F_{cr\_1} \leftarrow 0.658^{\frac{F_y}{F_{e\_x}}} \cdot F_y$
  else
    $F_{cr\_1} \leftarrow 0.877 \cdot F_{e\_x}$
else
  $F_{cr\_1} \leftarrow 0\ ksi$
$= 40.382\ ksi$

$F_{cr\_2} :=$ if $\frac{1 \cdot L_y}{r_y} \le 200$
  if $\frac{K \cdot L_y}{r_y} \le 4.71 \cdot \sqrt{\frac{E}{F_y}}$
    $F_{cr\_2} \leftarrow 0.658^{\frac{F_y}{F_{e\_y}}} \cdot F_y$
  else
    $F_{cr\_2} \leftarrow 0.877 \cdot F_{e\_y}$
else
  $F_{cr\_2} \leftarrow 0\ ksi$
$= 21.274\ ksi$

Calculate nominal compression capacity:

$P_n := min\left(F_{cr\_1}, F_{cr\_2}\right) \cdot A = 51.908$ ***kip*** AISC E3-1

ASD Axial Capacity: $\Omega := 1.67$ $\frac{P_n}{\Omega} = 31.083$ ***kip*** $P_{asd} = \begin{bmatrix} 1.163 \\ 3.663 \\ 1.913 \\ -0.202 \end{bmatrix}$ ***kip***

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Steel Member Size: HSS3X3X1/4
Steel Member Grade: A500 Grade C 50ksi
Axial Code Check = 0.12 at 10.00 ft
    A = -3.66 K vs 31.08 K
    for Dead + Snow
    Horizontal Axis OK, KL/r = 54.05
    Vertical Axis OK, KL/r = 108.11
No Moment Forces
No Shear Forces
No Deflection
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$\frac{P_{asd}}{\frac{P_n}{\Omega}} = \begin{bmatrix} 0.037 \\ 0.118 \\ 0.062 \\ -0.007 \end{bmatrix}$

LRFD Axial Capacity: $\phi := 0.9$ $\phi P_n := \phi \cdot P_n = 46.717$ ***kip*** $P_u = \begin{bmatrix} 1.628 \\ 5.396 \\ 1.146 \\ 4.646 \\ -0.453 \end{bmatrix}$ ***kip***

```
Steel Member Size: HSS3X3X1/4
Steel Member Grade: A500 Grade C 50ksi
Axial Code Check = 0.12 at 10.00 ft
    A = -5.40 K vs 46.72 K
    for 1.2 Dead + 1.6 Snow
    Horizontal Axis OK, KL/r = 54.05
    Vertical Axis OK, KL/r = 108.11
No Moment Forces
No Shear Forces
No Deflection
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$\frac{P_u}{\phi P_n} = \begin{bmatrix} 0.035 \\ 0.115 \\ 0.025 \\ 0.099 \\ -0.01 \end{bmatrix}$