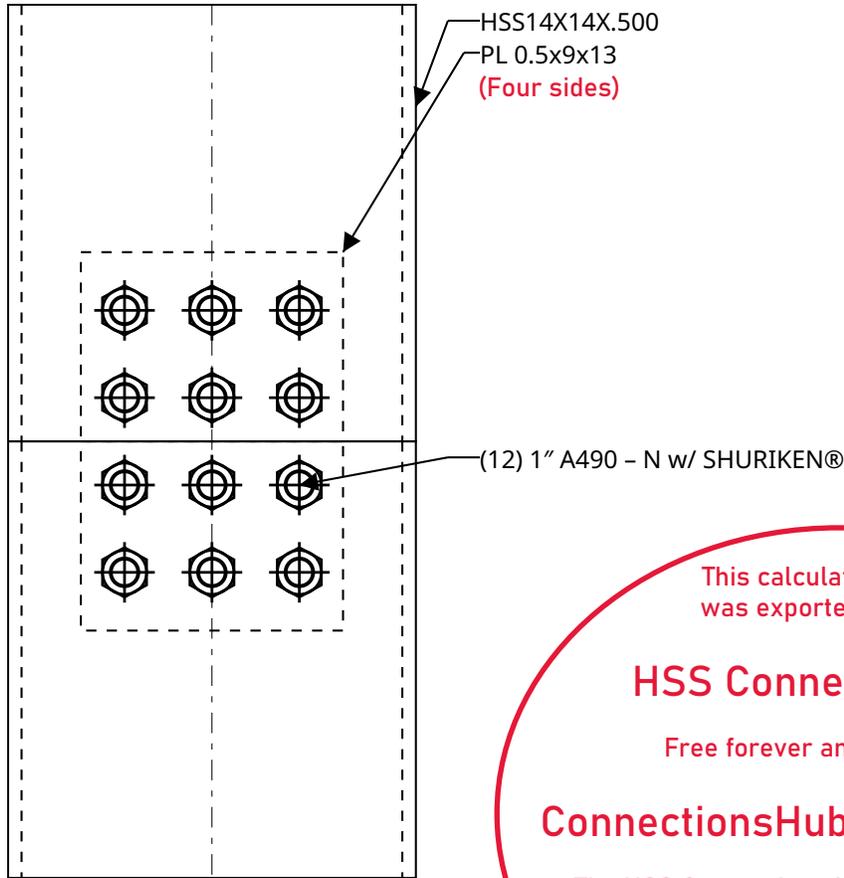




Client:	Author: Ted Goldstein	Date: Apr 2, 2025
Project: Example HSS Design Project		Job #: 00001
Address: 1855 East 122nd Street, Chicago, IL, USA		Subject: Example HSS Splice PASS
References: AISC 360-2022		

Summary



This calculation report was exported from the

HSS Connections Hub™

Free forever and available at

ConnectionsHub.AtlasTube.com

The HSS Connections Hub was developed to help engineers design and understand HSS connections, and has an ever-growing list of connection types, including beam connections, splices, truss connections, and more.

Read more about Shuriken details [here](#).

Ultimate Moment Demand

$$M_u = 100 \text{ kip} \cdot \text{ft}$$

Ultimate Tensile Demand

$$P_u^- = 120 \text{ kip}$$

Ultimate Compressive Demand

$$P_u^+ = 400 \text{ kip}$$

Governing Load Combination for Axial Loads

$$P_{LC} = 1.2D + 1.6L + 0.5Lr$$

Governing Load Combination for Moment

$$M_{LC} = 1.2D + 1.0L + 0.2S + 1.0Ev + 1.0Eh$$

Summary of Compression Capacities

24% HSS Column Capacity in Bearing

$$\phi R_{n,c,c} = 1661 \text{ kip}$$

AISC 360-22, Section J7.

Summary of Tension Capacities

20% HSS Column Capacity

$$\phi R_{n,c,t} = 596 \text{ kip}$$

Tensile yielding: AISC 360-22, Section J4.1(a).
Tensile rupture: AISC 360-22, Section J4.1(b). **Block shear rupture:** AISC 360-22, Section J4.3.

23% Bolt Capacity

$$\phi R_{n,bolt} = 521 \text{ kip}$$

AISC 360-22, Section J3.

23% Plate Capacity

$$\phi R_{n,p} = 530 \text{ kip}$$

Tensile yielding: AISC 360-22, Section J4.1(a).
Tensile rupture: AISC 360-22, Section J4.1(b). **Block shear rupture:** AISC 360-22, Section J4.3. **Strength at bolt holes in the plate:** AISC 360-22, Section J3.11.

Summary of Moment Capacities

Moment Arm for the Splice

$$d_s = 12.6 \text{ in}$$

29% HSS Column Net Section Moment Capacity

$$\phi M_{nb} = 343 \text{ kip} \cdot \text{ft}$$

AISC 360-22, Section F13.1.

64% Moment Capacity Based on Column Face

$$\phi R_{n,f,m} = 156 \text{ kip} \cdot \text{ft}$$

Block shear rupture: AISC 360-22, Section J4.3. **Strength at bolt holes:** AISC 360-22, Section J3.11(a).

73% Moment Capacity Based on Bolts

$$\phi R_{n,bolt,m} = 136 \text{ kip} \cdot \text{ft}$$

AISC 360-22, Section J3.

72% Moment Capacity Based on Plate

$$\phi R_{n,p,m} = 139 \text{ kip} \cdot \text{ft}$$

Tensile yielding: AISC 360-22, Section J4.1(a).
Tensile rupture: AISC 360-22, Section J4.1(b). **Block shear rupture:** AISC 360-22, Section J4.3. **Strength at bolt holes in the plate:** AISC 360-22, Section J3.11.

Combined Bending and Compression

Ultimate Compression in One Face

$$P_{u,face}^+ = 105 \text{ kip}$$

25% Compression Capacity of One Face

$$\phi R_{n,face,c} = 415 \text{ kip}$$

Combined Bending and Tension

Ultimate Tension in One Face

$$P_{u,face}^- = 125 \text{ kip}$$

(See load combination table below)

96% Tension Capacity of One Face

$$\phi R_{n,face,t} = 130 \text{ kip}$$

(1/4 of governing tensile capacity for the whole column)

Key Properties

Design Method

LRFD

Type of Connection

Single-Shear

Column Section

HSS14X14X.500

Plate Thickness

$$t_p = 0.5 \text{ in}$$

Modulus of Elasticity

$$E = 29\,000 \text{ ksi}$$

AISC 360-22.

Bolt Inputs

Bolt Size

1"

ASTM F1325.

Bolt Grade

Gr 150 (e.g. A490)

ASTM F3125-18, Table 1.

Recommended Number of Bolts per Horizontal Row

$$n_{bolts,row,h,r,sq} = 4$$

Number of Bolts per Horizontal Row

$$n_{bolts,row,h,sq} = 3$$

Number of Bolts in a Single Vertical Row

$$n_{bolts,row,v} = 2$$

Number of Bolts Per Face of HSS Column

$$n_{bolts} = 12$$

Bolt Spacing

$$s_{bolt} = 3 \text{ in}$$

AISC 360-22, Section J3.4.

Thread Condition

I(N)cluded

AISC Steel Construction Manual (16th ed.), p. 7-4.

Allow Bolt Hole Deformation at Service Loads?

No

AISC 360-22, Section J3.11(a).

Slip-Critical Connection

Yes

AISC 360-22, Section J3.2.

Faying Surface Class

Class A

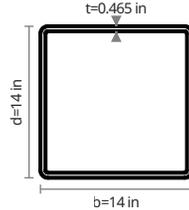
AISC 360-22, Section J3.9.

Applied Loads

Axial Loads and Mc
Connection

Load Type	Vertical Load P (kip)	Connection Moment Loads M (kip · ft)
(D) Dead Load	200	
(L) Live Load	100	
(Eh) Horizontal Earthquake	-300	100

Column Properties



Column Grade	ASTM A500 Grade C	ASTM A500, Table 2; ASTM A1085, Table 2.
Column Width	$B_c = 14$ in	
Column Inside Width	$b_c = 12.6$ in	
Column Depth	$H_c = 14$ in	
Column Inside Depth	$h_c = 12.6$ in	
Column Thickness	$t_c = 0.465$ in	
Horizontal Workable Flat	$WF_{ch} = 11.8$ in	AISC Steel Construction Manual (16th ed.), p. 1-6.
Vertical Workable Flat	$WF_{cv} = 11.8$ in	AISC Steel Construction Manual (16th ed.), p. 1-6.
Column Elastic Section Modulus	$S_c = 106$ in ³	
Column Plastic Section Modulus	$Z_c = 124$ in ³	
Column Gross Section Area	$A_{g,c} = 24.6$ in ²	
Column Yield Strength	$F_{yc} = 50$ ksi	ASTM A500, Table 2; ASTM A1085, Table 2.
Column Ultimate Strength	$F_{uc} = 62$ ksi	ASTM A500, Table 2; ASTM A1085, Table 2.

Bolt Properties

Ultimate Strength	$F_{u,bolt} = 150$ ksi	ASTM F3125-18, Table 1.
Standard Hole Diameter	$d_{hole} = 1.13$ in	ASTM 360-22, Table J3.3.
Bolt Diameter	$d_{bolt} = 1$ in	ASTM F1325.
Effective Hole Diameter	$d'_{hole} = 1.19$ in	

Plate Properties

Plate Grade	ASTM A572 Grade 50	ASTM A36, Table 2; ASTM A572, Table 4.
Plate Yield Strength	$F_{yp} = 50$ ksi	ASTM A36, Table 2; ASTM A572, Table 4.
Plate Ultimate Strength	$F_{up} = 65$ ksi	ASTM A36, Table 2; ASTM A572, Table 4.
Plate Length	$L_p = 13$ in	
Plate Width For Calculations	$W_p = 9$ in	
Plate Width	$W_{p,sq} = 9$ in	
Plate Gross Section Area For Calculations	$A_{g,p} = 4.5$ in ²	
Plate Gross Section Area	$A_{g,p,sq} = 4.5$ in ²	
Minimum Distance Between Corner Bolts and Plate on Perpendicular Face	$S_{s,min} = 2.13$ in	
Distance Between Corner Bolts and Plate on Perpendicular Face For Calculations	$S_s = 3.04$ in	

Actual Distance Between Corner Bolts and Plate on Perpendicular Face

$$S_{s,sg} = 3.04 \text{ in}$$

Plate Vertical Edge Distance

$$l_{ev} = 2 \text{ in}$$

AISC 360-22, Table J3.4.

Plate Horizontal Edge Distance

$$l_{eh} = 1.5 \text{ in}$$

AISC 360-22, Table J3.4.

Minimum Edge Distance

$$l_{edge,m} = 1.25 \text{ in}$$

AISC 360-22, Table J3.4.

Recommended Plate Horizontal Edge Distance

$$l_{eh,r} = 1.25 \text{ in}$$

AISC 360-22, Table J3.4.

Recommended Plate Vertical Edge Distance

$$l_{ev,r} = 2 \text{ in}$$

AISC 360-22, Table J3.4.

LRFD Load Combinations (ASCE 7-16, Ch. 2)

Reduce Live Load when Combined with Snow/Rain/Wind?

No

ASCE 7-16 2.3.1.1.

LRFD Load Combinations

$$LC_{str} =$$

Load Combination	Factored Connection Compression Load P^+ (kip)	Factored Connection Tension Load P^- (kip)	Factored Connection Moment M (kip · ft)	Compression in Column Face P_{face}^+ (kip)	Tension in Column Face P_{face}^- (kip)
1.4D	280	0	0	70	0
1.2D + 1.6L + 0.5Lr	400	0	0	100	0
1.2D + 1.6L + 0.5S	400	0	0	100	0
1.2D + 1.6L + 0.5R	400	0	0	100	0
1.2D + 1.0L + 1.6Lr	340	0	0	85	0
1.2D + 1.6Lr + 0.5W, dn	240	0	0	60	0
1.2D + 1.0L + 1.6S	340	0	0	85	0
1.2D + 1.6S + 0.5W, dn	240	0	0	60	0
1.2D + 1.0L + 1.6R	340	0	0	85	0
1.2D + 1.6R + 0.5W, dn	240	0	0	60	0
1.2D + 1.0L + 0.5Lr + 1.0W, dn	340	0	0	85	0
1.2D + 1.0L + 0.5S + 1.0W, dn	340	0	0	85	0
1.2D + 1.0L + 0.5R + 1.0W, dn	340	0	0	85	0
1.2D + 1.0L + 0.2S + 1.0Ev + 1.0Eh	40	0	100	105	95.5
0.9D + 1.0W, up	180	0	0	45	0
0.9D + -1.0Ev + 1.0Eh	0	120	100	95.5	125

Governing tension demand for a single face of the connection

HSS Column Capacity in Compression (AISC 360-22 Section J7)

Bearing Strength

Projected Area in Bearing

$$A_{bp,c} = 24.6 \text{ in}^2$$

AISC 360-22, Section J7.

Nominal Bearing Strength of the HSS Column

$$R_{n,yc,bp} = 2214 \text{ kip}$$

AISC 360-22, Section J7.

Bearing Strength Resistance Factor

$$\phi_{yc,bp} = 0.75$$

AISC 360-22, Section J7.

24%

Bearing Strength of the HSS Column

$$\phi R_{n,yc,bp} = 1661 \text{ kip}$$

AISC 360-22, Section J7.

Bearing Strength Per Face

$$\phi R_{n,yp,bp} = 415 \text{ kip}$$

AISC 360-22, Section J7.

Tensile Yielding

Gross Area Subjected to Tension	$A_{gt,c} = 24.6 \text{ in}^2$	AISC 360-22, Section B4.3(a).
Nominal Tensile Yielding of the HSS Column	$R_{n,yc,t} = 1230 \text{ kip}$	AISC 360-22, Section J4.1(a).
Tensile Yielding Resistance Factor	$\phi_{yc,t} = 0.9$	AISC 360-22, Section J4.1(a).
11% Tensile Yielding of the HSS Column	$\phi R_{n,yc,t} = 1107 \text{ kip}$	AISC 360-22, Section J4.1(a).

Tensile Rupture

Shear Lag Factor	$U = 1$	AISC 360-22, Table D3.1.
Cross Sectional Net Area of the HSS Column	$A_{nt,c} = 15.8 \text{ in}^2$	AISC 360-22, Section B4.3(b).
Effective Net Area of the HSS Column	$A_{e,c,t} = 15.8 \text{ in}^2$	AISC 360-22, Section D3.
Nominal Tensile Rupture of the HSS Column	$R_{n,uc,t} = 977 \text{ kip}$	AISC 360-22, Section J4.1(b).
Tensile Rupture Resistance Factor	$\phi_{uc,t} = 0.75$	AISC 360-22, Section J4.1(b).
16% Tensile Rupture of the HSS Column	$\phi R_{n,uc,t} = 733 \text{ kip}$	AISC 360-22, Section J4.1(b).

Block Shear in Column Face

Gross Area Subjected to Shear (Block Shear)	$A_{gv,c,bs} = 4.19 \text{ in}^2$	AISC 360-22, Section B4.3(a).
Net Area Subjected to Shear (Block Shear)	$A_{nv,c,bs} = 2.53 \text{ in}^2$	AISC 360-22, Section B4.3(b).
Gross Area Subjected to Tension For Calculations	$A_{gt,c,bs} = 2.79 \text{ in}^2$	
Gross Area Subjected to Tension (Block Shear)	$A_{gt,c,bs,sq} = 2.79 \text{ in}^2$	AISC 360-22, Section J4.3.
Net Area Subjected to Tension For Calculations	$A_{nt,c,bs} = 1.69 \text{ in}^2$	
Net Area Subjected to Tension (Block Shear)	$A_{nt,c,bs,sq} = 1.69 \text{ in}^2$	AISC 360-22, Section J4.3.
Tension Stress Uniformity Factor	$U_{bs} = 1$	AISC 360-22, Section J4.3, AISC 360-22, Fig. C-J4.2.
Nominal Block Shear Rupture For Calculations	$R_{n,c,bs} = 199 \text{ kip}$	
Nominal Block Shear Rupture Per Face	$R_{n,c,bs,sq} = 199 \text{ kip}$	AISC 360-22, Section J4.3.
Block Shear Rupture Resistance Factor	$\phi_{c,bs} = 0.75$	AISC 360-22, Section J4.3.
Block Shear Rupture Per Face For Calculations	$\phi R_{n,f,bs} = 149 \text{ kip}$	
Block Shear Rupture Per Face	$\phi R_{n,f,bs,sq} = 149 \text{ kip}$	AISC 360-22, Section J4.3.
20% Block Shear Rupture for Entire Column	$\phi R_{n,c,bs} = 596 \text{ kip}$	AISC 360-22, Section J4.3.

Strength at Bolt Holes in the Column Face

Clear Distance of Interior Bolts	$l_{c,b,i} = 1.81$ in	AISC 360-22, Section J3.11(a).
Clear Distance of Exterior Bolts	$l_{c,b,e} = 0.906$ in	AISC 360-22, Section J3.11(a).
Nominal Bearing Strength per Bolt Holes	$R_{n,b,c,holes} = 69.2$ kip	AISC 360-22, Section J3.11(a).
Nominal Tearout Strength of Interior Bolt Holes	$R_{n,t,c,i,holes} = 62.7$ kip	AISC 360-22, Section J3.11(a).
Nominal Tearout Strength of Exterior Bolt Holes	$R_{n,t,c,e,holes} = 31.4$ kip	AISC 360-22, Section J3.11(a).
Nominal Strength at Bolt Holes Per Face For Calculations	$R_{n,f,holes} = 282$ kip	
Nominal Strength at Bolt Holes Per Face Bearing and Tearout Resistance Factor	$R_{n,f,holes,sq} = 282$ kip $\phi_{f,holes} = 0.75$	AISC 360-22, Section J3.11(a). AISC 360-22, Section J4.3.
Strength at Bolt Holes For Calculations	$\phi R_{n,f,holes} = 212$ kip	
Strength at Bolt Holes Per Face	$\phi R_{n,f,holes,sq} = 212$ kip	AISC 360-22, Section J3.11(a).
14% Strength at Bolt Holes for Entire Column	$\phi R_{n,c,holes} = 847$ kip	AISC 360-22, Section J3.11(a).

Plate Capacity (AISC 360-22 Sections J4.1, J4.3 and J3.11(a))

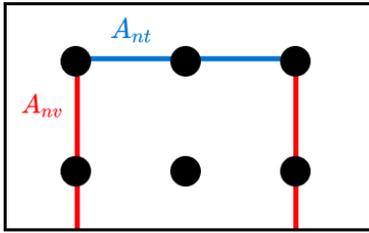
Tensile Yielding

Gross Area Subjected to Tension For Calculations	$A_{gt,p} = 18$ in ²	
Gross Area Subjected to Tension	$A_{gt,p,sq} = 18$ in ²	AISC 360-22, Section B4.3(a).
Nominal Tensile Yielding of the Plates	$R_{n,yp,t} = 900$ kip	AISC 360-22, Section J4.1(a).
Tensile Yielding Resistance Factor	$\phi_{yp,t} = 0.9$	AISC 360-22, Section J4.1(a).
15% Tensile Yielding of the Plate	$\phi R_{n,yp,t} = 810$ kip	AISC 360-22, Section J4.1(a).

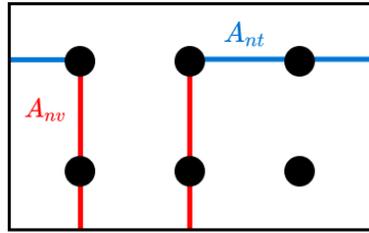
Tensile Rupture

Cross Sectional Net Area of the Plates	$A_{nt,p} = 10.9$ in ²	AISC 360-22, Section B4.3(b).
Effective Net Area of the Plate	$A_{e,p,t} = 10.9$ in ²	AISC 360-22, Section D3.
Nominal Tensile Rupture of the Plate	$R_{n,up,t} = 707$ kip	AISC 360-22, Section J4.1(b).
Tensile Rupture Resistance Factor	$\phi_{up,t} = 0.75$	AISC 360-22, Section J4.1(b).
23% Tensile Rupture of the Plate	$\phi R_{n,up,t} = 530$ kip	AISC 360-22, Section J4.1(b).

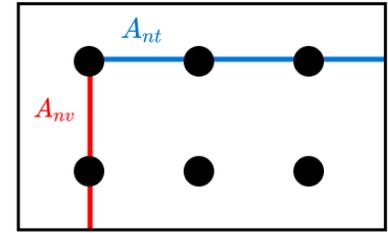
Block Shear



Case 1



Case 2



Case 3

Nominal Block Shear Rupture

$$R_{n,p,bs} =$$

AISC 360-22, Section J4.3.

Case #	Gross Length Subjected to Shear $L_{gv,p,bs}$ (in)	Gross Area Subjected to Shear $A_{gv,p,bs}$ (in ²)	Net Length Subjected to Shear $L_{nv,p,bs}$ (in)	Net Area Subjected to Shear $A_{nv,p,bs}$ (in ²)	Gross Length Subjected to Tension $L_{gt,p,bs}$ (in)	Net Length Subjected to Tension $L_{nt,p,bs}$ (in)	Net Area Subjected to Tension $A_{nt,p,bs}$ (in ²)	Nominal Block Shear Rupture $R_{n,p,bs}$ (kip)
Case 1	9	18	5.44	10.9	6	3.62	7.25	895
Case 2	9	18	5.44	10.9	6	3.62	7.25	895
Case 3	4.5	9	2.72	5.44	7.5	4.53	9.06	801

Nominal Block Shear Rupture

$$R_{n,p,bs} = 801 \text{ kip}$$

AISC 360-22, Section J4.3.

Block Shear Rupture Resistance Factor

$$\phi_{p,bs} = 0.75$$

AISC 360-22, Section J4.3.

20%

Block Shear Rupture

$$\phi R_{n,p,bs} = 601 \text{ kip}$$

AISC 360-22, Section J4.3.

Strength at Bolt Holes

Clear Distance for Interior Bolts

$$l_{ci} = 1.81 \text{ in}$$

AISC 360-22, Section J3.11.

Clear Distance for Exterior Bolts

$$l_{ce} = 1.41 \text{ in}$$

AISC 360-22, Section J3.11.

Nominal Bearing Strength per Bolt Holes

$$R_{n,b,p,holes} = 78 \text{ kip}$$

AISC 360-22, Section J3.11.

Nominal Tearout Strength per Interior Bolt Holes

$$R_{n,t,i,p,holes} = 70.7 \text{ kip}$$

AISC 360-22, Section J3.11.

Nominal Tearout Strength per Bolt Holes

$$R_{n,t,e,p,holes} = 54.8 \text{ kip}$$

AISC 360-22, Section J3.11.

Nominal Strength at Bolt Holes in the Plate

$$R_{n,holes} = 1506 \text{ kip}$$

AISC 360-22, Section J3.11.

Bearing and Tearout Resistance Factor

$$\phi_{p,holes} = 0.75$$

AISC 360-22, Section J4.3.

11%

Strength at Bolt Holes in the Plate

$$\phi R_{n,holes} = 1130 \text{ kip}$$

AISC 360-22, Section J3.11.

Bolt Capacity (AISC 360-22, Section J3.7 and J3.9)

Shear Strength

Nominal Area of the Bolt

$$A_{bolt} = 0.785 \text{ in}^2$$

AISC 360-22, Section J3.7.

Nominal Shear Stress of the Bolt

$$F_{nv} = 68 \text{ ksi}$$

AISC 360-22, Table J3.2.

Nominal Shear Strength of One Bolt

$$R_{n,s,bolt} = 53.4 \text{ kip}$$

AISC 360-22, Section J3.7.

Shear Strength Resistance Factor

$$\phi_{bolt} = 0.75$$

AISC 360-22, Section J3.7.

Shear Strength of One Bolt

$$\phi R_{n,s,bolt} = 40.1 \text{ kip}$$

AISC 360-22, Section J3.7.

Shear Strength of the Bolt Group For Calculations

$$\phi R_{n,s,bolt,gr,f} = 240 \text{ kip}$$

Shear Strength of the Bolt Group Per Face $\phi R_{n,s,bolt,gr,f,sq} = 240$ kip

AISC 360-22, Section J3.7.

12%

Shear Strength of the Bolt Group for Entire Column $\phi R_{n,s,bolt,gr,c} = 961$ kip

AISC 360-22, Section J3.7.

Slip Resistance

Bolt Pre-Tension Multiplier $D_u = 1.13$

AISC 360-22, Section J3.9.

Factor for Fillers $h_f = 1$

AISC 360-22, Section J3.9.

Minimum Bolt Pretension $T_b = 64$ kip

AISC 360-22, Table J3.1.

Number of Slip Planes $n_s = 1$

AISC 360-22, Section J3.9.

Mean Slip Coefficient $\mu = 0.3$

AISC 360-22, Section J3.9.

Nominal Slip Resistance of One Bolt $R_{n,sr,bolt} = 21.7$ kip

AISC 360-22, Section J3.9.

Slip Resistance Factor $\phi_{bolt,sr} = 1$

AISC 360-22, Section J3.9.

Slip Resistance of One Bolt $\phi R_{n,s,bolt,sr} = 21.7$ kip

AISC 360-22, Section J3.9.

Slip Resistance of the Bolt Group For Calculations $\phi R_{n,s,bolt,sr,gr,f} = 130$ kip

Slip Resistance of the Bolt Group Per Face $\phi R_{n,s,bolt,sr,gr,f,sq} = 130$ kip

AISC 360-22, Section J3.9.

Slip Resistance of the Bolt Group for Entire Column $\phi R_{n,s,bolt,sr,gr,c} = 521$ kip

AISC 360-22, Section J3.9.

Moment: HSS Column Capacity (AISC 360-22 Section F)

Flexural Strength of the HSS Column

Gross Area of Tension Flange $A_{fg,c} = 5.46$ in²

Gross area: AISC 360-22, Section B4.3a. **Flexural Strength:** AISC 360-22, Section F13.1.

Net Area of Tension Flange $A_{fn,c} = 3.81$ in²

Gross area: AISC 360-22, Section B4.3b. **Flexural Strength:** AISC 360-22, Section F13.1.

Yield-to-Tensile Strength Factor $Y_{t,c} = 1.1$

AISC 360-22, Section F13.1.

Nominal Flexural Strength $M_{nc} = 382$ kip · ft

AISC 360-22, Section F13.1.

Flexural Strength Resistance Factor $\phi_{f,fs} = 0.9$

AISC 360-22, Section F1(a).

29%

Flexural Strength in the Tension Flange of the Column $\phi M_{nc} = 343$ kip · ft

AISC 360-22, Section F13.1.

Comments

Assumptions