	Date:	June 25	Engineer: D G Brown	Sheet 1 of 4	Rev
BLINDBOLT® The smart solution for steelwork connections **www.BlindBolt.com**	Title	HSS Splice Design under axial load			
	Subject	HD bolts and cover plate verification LRFD			

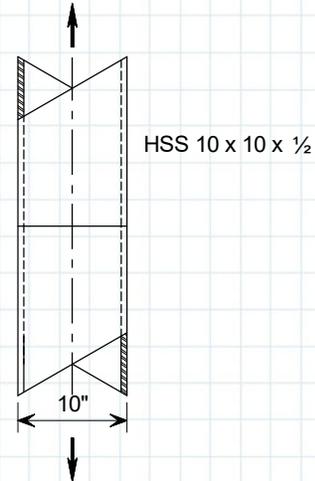## Splice design for HSS 10 × 10 × $^1/_2$

In compression, the members transfer the axial load in direct bearing, so splice plates and bolts are required to keep the members aligned and provide continuity of stiffness. This example demonstrates the design of a splice in tension.

Column axial loads

Dead load P_D = 80 kips

Live load P_L = 140 kips

P_u = 1.2 × 80 + 1.6 × 140 = 320 kips

HSS 10 x 10 x ½

10"

AISC Manual

Table 2-4

Table 2-5

Material strengths

HSS from ASTM A500/A500M Grade C : F_y = 50 ksi; F_u = 62 ksi

Cover plates from ASTM A572/A572M Grade 50: F_y = 50 ksi; F_u = 65 ksi

Load in each cover plate

With a cover plate on four sides, load/plate = $^{320}/_4 = 80$ kips

HD Bolts

Try $^3/_4$" carbon steel HD Bolts (expansion type fixings).

From www.Blindbolt.com shear resistance = 21.2 kips

DESIGN RESISTANCES DETERMINED IN ACCORDANCE WITH AC437

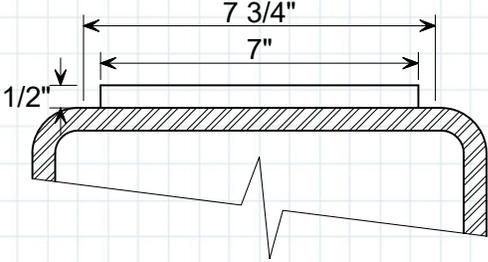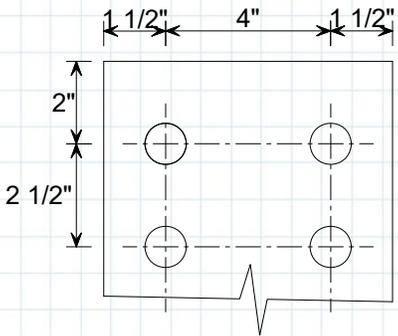| Diameter	Tension Resistance				Shear Resistance			
	LRFD		ASD		LRFD		ASD	
inch	kN	kips	kN	kips	kN	kips	kN	kips
$^1/_2$	35.4	8.0	22.1	5.0	33.3	7.5	20.8	4.7
$^5/_8$	52.7	11.8	32.9	7.4	65.1	14.6	43.4	9.8
$^3/_4$	68.5	15.4	42.8	9.6	94.1	21.2	62.5	14.4

Clamping range is from $^1/_2$" to 1". OK

Number of HD bolts per side = $^{80}/_{21.2} = 3.8$, **provide 4 No. $^3/_4$" HD Bolts**

Load per bolt = $^{320}/_{4 \times 4} = 20$ kips

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Cover plates

Table 1-12

Workable flat = $7\frac{3}{4}$"

Try plate 7" wide and $\frac{1}{2}$" thick

7 3/4"
7"
1/2"

AISC 360-22

Cover plate resistance

J4.1(a)

Tensile yielding

$R_n = F_y A_g = 50 \times 7 \times \frac{1}{2} = 175$ kips

$\phi = 0.90$

Design strength = $\phi R_n = 0.90 \times 175 = 157.5$ kips > 80 kips, OK

J4.1(b)

Tensile rupture

$R_n = F_u A_e$

D3: Table D3.1

$U = 1.0$ (no unconnected elements)

B4.3b

For net area calculations, bolt hole width taken as hole width + $\frac{1}{16}$"

For $\frac{3}{4}$" Blindbolt, hole diameter is $\frac{3}{4}$"

$A_n = A_g - 2(d_n + \frac{1}{16})t_p = (7 \times \frac{1}{2}) - 2(\frac{3}{4} + \frac{1}{16}) \times \frac{1}{2} = 2.69\ in^2$

$R_n = F_u A_e = 65 \times 2.69 = 174.9$ kips

$\phi = 0.75$

Design strength = $\phi R_n = 0.75 \times 174.9 = 131$ kips > 80 kips, OK

Bolt bearing in cover plate

Table J3.4

Minimum edge distance = 1"

Try bolts at 4" gauge, so edge distance is $1\frac{1}{2}$", OK

Try bolts at an end distance of 2"

J3.4

Minimum spacing = $2\frac{2}{3} \times \frac{3}{4} = 2$" Try bolts at $2\frac{1}{2}$" pitch, OK

1 1/2" 4" 1 1/2"
2"
2 1/2"

J3.11a(1)(a)

Bearing

$R_n = 2.4dtF_u = 2.4 \times \frac{3}{4} \times \frac{1}{2} \times 65 = 58.5$ kips

$\phi = 0.75$

Available strength = $0.75 \times 58.5 = 43.9$ kips > 20 kips, OK

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J3.11a(1)(b) **Tearout**

$$R_n = 1.2 l_c t F_u$$

Interior bolts: $l_c = 2\frac{1}{2} - \frac{3}{8} - \frac{3}{8} = 1\frac{3}{4}"$

Edge bolts: $l_c = 2 - \frac{3}{8} = 1\frac{5}{8}"$ Edge bolts are critical

$$R_n = 1.2 l_c t F_u = 1.2 \times 1\frac{5}{8} \times \frac{1}{2} \times 65 = 63.4 \text{ kips}$$
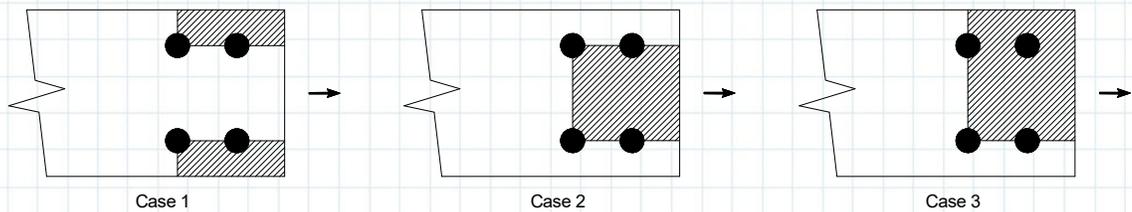
$\phi = 0.75$

Available strength = $0.75 \times 63.4 = 47.5$ kips > 20 kips, OK

Shear strength of HD bolt at 21.2 kips is critical.

J4.3 **Block shear**

Case 1   Case 2   Case 3

$$R_n = 0.60 F_u A_{nv} + U_{bs} F_u A_{nt} \le 0.60 F_y A_{gv} + U_{bs} F_u A_{nt}$$

Case1, case 2

$$A_{gv} = 2 \times (2 + 2\frac{1}{2}) \times \frac{1}{2} = 4.5 \ in^2$$
$$A_{nv} = 4.5 - 2(2 - 0.5)(\frac{3}{4} + \frac{1}{16}) \times \frac{1}{2} = 3.28 \ in^2$$

Case 3

$$A_{gv} = \frac{4.5}{2} = 2.25 \ in^2$$
$$A_{nv} = 2.25 - (2 - 0.5)(\frac{3}{4} + \frac{1}{16}) \times \frac{1}{2} = 1.64 \ in^2$$

Case 1

$$A_{nt} = \left(3 - (\frac{3}{4} + \frac{1}{16})\right) \times \frac{1}{2} = 1.09 \ in^2$$

Case 2

$$A_{nt} = \left(4 - (\frac{3}{4} + \frac{1}{16})\right) \times \frac{1}{2} = 1.59 \ in^2$$

Case 3

$$A_{nt} = \left(5\frac{1}{2} - 1.5 \times (\frac{3}{4} + \frac{1}{16})\right) \times \frac{1}{2} = 2.14 \ in^2$$

Case 1

$$R_n = 0.60 \times 65 \times 3.28 + 1.0 \times 65 \times 1.09 \le 0.60 \times 50 \times 4.5 + 1.0 \times 65 \times 1.09$$
$$R_n = 199 \le 206 \text{ kips}$$

Case 2

$$R_n = 0.60 \times 65 \times 3.28 + 1.0 \times 65 \times 1.59 \le 0.60 \times 50 \times 4.5 + 1.0 \times 65 \times 1.59$$
$$R_n = 231 \le 238 \text{ kips}$$

Case 3

$$R_n = 0.60 \times 65 \times 1.64 + 1.0 \times 65 \times 2.14 \le 0.60 \times 50 \times 2.25 + 1.0 \times 65 \times 2.14$$
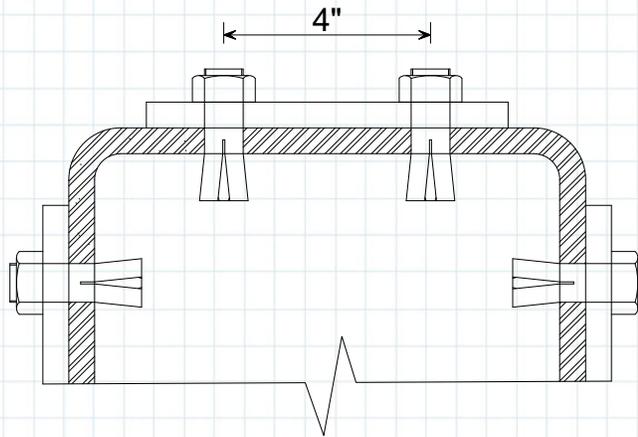$$R_n = 203 \le 207 \text{ kips}$$

Case 1 is critical

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$\phi = 0.75$

Available strength = 0.75 × 199 = 149 kips > 80 kips, OK

By inspection, bearing and tearout are not critical in the HSS

Check clearance internally

From www.Blindbolt.com depth clearance for $^3/_4 \times 2\,^1/_2$" HD bolt = 1"
As shown, there is no clash with other bolts.

Final detail