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

Splice design for HSS 10 × 10 × $^{1}/_{2}$

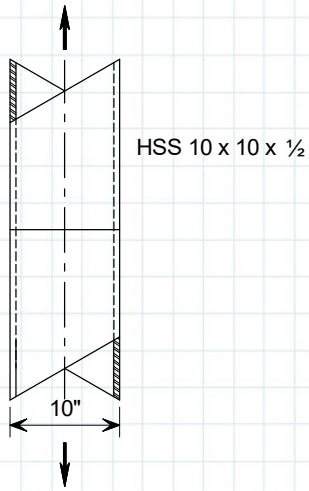
In compression, the members transfer the axial load in direct bearing, so splice plates and bolts are required to keep the members aligned and provide continuity of stiffness. This example demonstrates the design of a splice in tension.

Column axial loads

Dead load P_D = 100 kips

Live load P_L = 165 kips

P_a = 100 + 165 = 265 kips



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 = $^{265}/_{4} = 66.3$ kips

Blindbolts

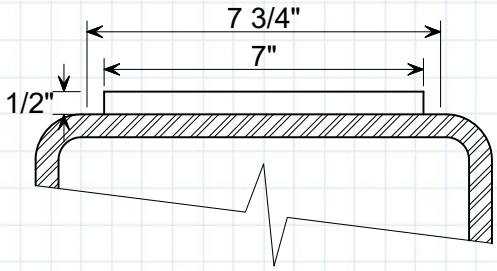
Try 0.945" carbon steel standard BlindBolts (toggle type anchor).
From www.Blindbolt.com shear resistance = 10.63 kips (conservative assumption that the shear plane is through the slotted region).

CARBON STEEL BLINDBOLT

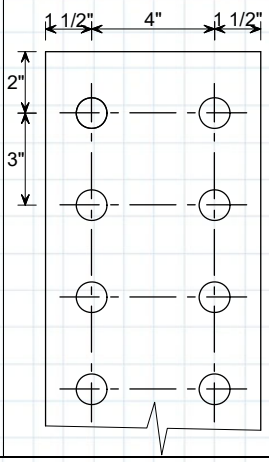
DESIGN RESISTANCES DETERMINED IN ACCORDANCE WITH AC 437 AND AISC 360-22

Diameter	Tension Resistance				Shear Resistance Through Slot				Shear Resistance Through Unslotted Threaded Shank				Recommended Tightening Torque
	LRFD		ASD		LRFD		ASD		LRFD		ASD		
inch (mm)	kN	kips	kN	kips	kN	kips	kN	kips	kN	kips	kN	kips	(lbf)
0.345 (8)	6.8	1.53	4.2	0.94	5.8	1.30	3.6	0.81	17.0	3.82	11.3	2.54	11
0.394 (10)	9.5	2.14	5.9	1.33	13.7	3.08	8.6	1.93	26.5	5.96	17.7	3.98	18
0.472 (12)	15.1	3.39	9.4	2.11	17.8	4.00	11.1	2.50	38.2	8.59	25.4	5.71	22
0.551 (14)	22.7	5.10	14.2	3.19	24.5	5.51	15.3	3.44	52.0	11.69	34.6	7.78	28
0.630 (16)	28.4	6.38	17.8	4.00	30.7	6.90	19.2	4.32	67.9	15.26	45.2	10.16	36
0.787 (20)	45.4	10.21	28.4	6.38	54.0	12.14	33.7	7.58	106.0	23.83	70.7	15.89	48
0.945 (24)	75.4	16.95	46.5	10.45	75.7	17.02	47.3	10.63	152.7	34.33	101.8	22.89	55
1.181 (30)	110.2	24.77	68.9	15.49	110.7	24.89	69.2	15.56	238.6	53.64	159.0	35.74	63

	Number of Blindbolts per side = $^{66.3}/_{10.63} = 6.2$, **provide 8 No. 0.945" Blindbolts**
	Load per bolt = $^{265}/_{4 \times 8} = 8.3$ kips
	Cover plates
Table 1-12	Workable flat = $7\,^{3}/_{4}$"
	Try plate 7" wide and $^{1}/_{2}$" thick



AISC 360-22	**Cover plate resistance**
J4.1(a)	**Tensile yielding**
	$R_n = F_y A_g = 50 \times 7 \times {}^{1}/_{2} = 175$ kips
	$\Omega = 1.67$
	Design strength = $^{R_n}/_{\Omega} = {}^{175}/_{1.67} = 104.8$ kips > 66.3 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 + $^{1}/_{16}$"
	For 0.945" Blindbolt, hole diameter is 1"
	$A_n = A_g - 2(d_n + {}^{1}/_{16})t_p = (7 \times {}^{1}/_{2}) - 2(1 + {}^{1}/_{16}) \times {}^{1}/_{2} = 2.44\ in^2$
	$R_n = F_u A_e$ = 65 × 2.44 = 158.6 kips
	$\Omega = 2.0$
	Design strength = $^{R_n}/_{\Omega} = {}^{158.6}/_{2} = 79.3$ kips > 66.3 kips, OK
	Bolt bearing in cover plate
Table J3.4	Minimum edge distance = $1\,^{1}/_{4}$"
	Try bolts at 4" gauge, so edge distance is $1\,^{1}/_{2}$", OK
	Try bolts at an end distance of 2"
J3.4	Minimum spacing = $2\,^{2}/_{3} \times 0.945 = 2.52$" Try bolts at 3" pitch, OK



J3.11a(1)(a) **Bearing**

$R_n = 2.4dtF_u = 2.4 \times 1 \times {}^{1}/_{2} \times 65 = 78$ kips

$\Omega = 2.0$

Available strength = ${}^{78}/_{2} = 39$ kips > 8.3 kips, OK

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

$R_n = 1.2l_c tF_u$

Interior bolts: $l_c = 3 - {}^{1}/_{2} - {}^{1}/_{2} = 2$”

Edge bolts: $l_c = 2 - {}^{1}/_{2} = 1\,{}^{1}/_{2}$” Edge bolts are critical

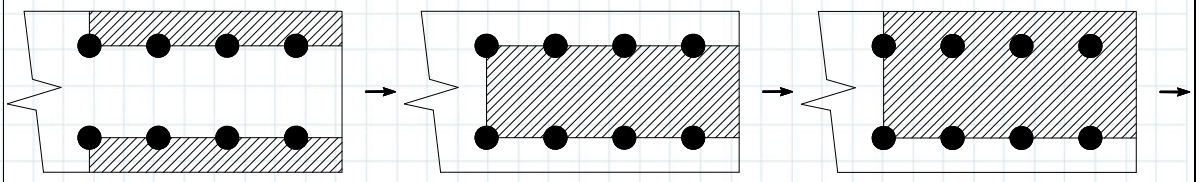
$R_n = 1.2l_c tF_u = 1.2 \times 1\,{}^{1}/_{2} \times {}^{1}/_{2} \times 65 = 58.5$ kips

$\Omega = 2.0$

Available strength = ${}^{58.5}/_{2} = 29.3$ kips > 8.3 kips, OK

Shear strength of Blindbolt at 10.63 kips is critical.

J4.3 **Block shear**



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

Case1, case 2

$A_{gv} = 2 \times (2 + 3 + 3 + 3) \times {}^{1}/_{2} = 11\ in^2$

$A_{nv} = 11 - 2(4 - 0.5)(1 + {}^{1}/_{16}) \times {}^{1}/_{2} = 7.28\ in^2$

Case 3

$A_{gv} = {}^{11}/_{2} = 5.5\ in^2$

$A_{nv} = 5.5 - (4 - 0.5)(1 + {}^{1}/_{16}) \times {}^{1}/_{2} = 3.64\ in^2$

Case 1

$A_{nt} = \left(3 - (1 + {}^{1}/_{16})\right) \times {}^{1}/_{2} = 0.97\ in^2$

Case 2

$A_{nt} = \left(4 - (1 + {}^{1}/_{16})\right) \times {}^{1}/_{2} = 1.47\ in^2$

Case 3

$A_{nt} = \left(5\,{}^{1}/_{2} - 1.5 \times (1 + {}^{1}/_{16})\right) \times {}^{1}/_{2} = 1.95\ in^2$

Case 1

$R_n = 0.60 \times 65 \times 7.28 + 1.0 \times 65 \times 0.97 \leq 0.60 \times 50 \times 11 + 1.0 \times 65 \times 0.97$

$R_n = 347 \leq 393$ kips

Case 2

$R_n = 0.60 \times 65 \times 7.28 + 1.0 \times 65 \times 1.47 \leq 0.60 \times 50 \times 11 + 1.0 \times 65 \times 1.47$

$R_n = 379 \leq 425$ kips

Case 3

$R_n = 0.60 \times 65 \times 3.64 + 1.0 \times 65 \times 1.95 \leq 0.60 \times 50 \times 5.5 + 1.0 \times 65 \times 1.95$

$R_n = 268 \leq 291$ kips

Case 3 is critical

$\Omega = 2.0$

Available strength = $^{268}/_{2}$ = 134 kips > 66.3 kips, OK

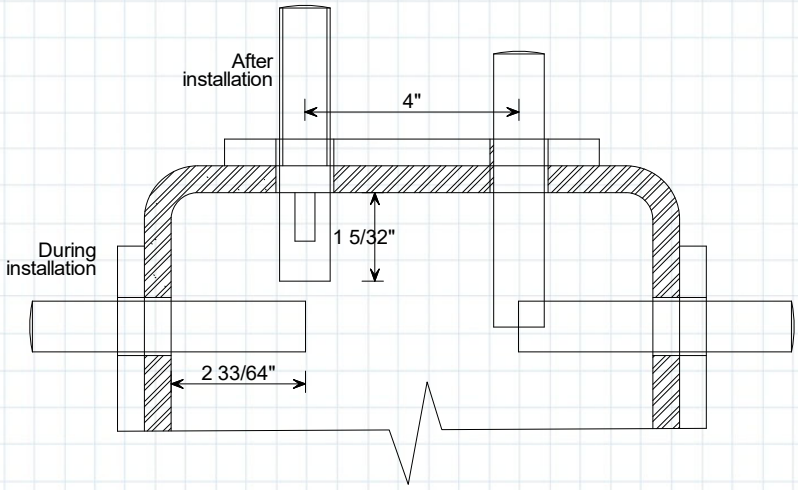
By inspection, bearing and tearout are not critical in the HSS

Check clearance internally

From www.Blindbolt.com depth clearance for 0.945" (M24) Blindbolt = $2\ ^{33}/_{64}$

Although the depth clearance suggests the bolts may clash (as shown) this only occurs if the bolts are installed simultaneously.

As shown, once one bolt is installed, there is no clash with subsequent bolts.



Final detail