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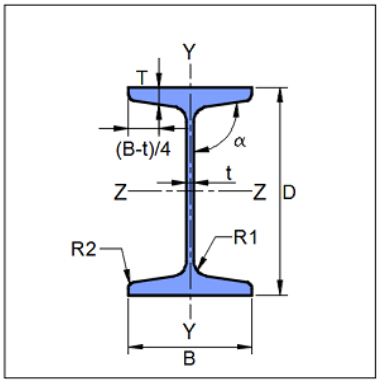
Designer		Job Number	
Date	26 /12 /2024	Client	

1 Input Parameters

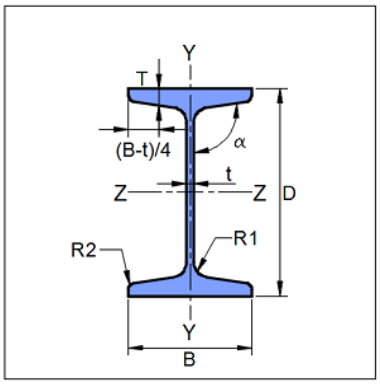
Module	Seated Angle Connection
Main Module	Shear Connection
Connectivity	Column Flange-Beam Web
Shear Force (kN)	27.0

Supporting Section - Mechanical Properties



Supporting Section		HB 150*	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	30.15	I_z (cm^4)	1510.0
Area, A (cm^2)	38.4	I_y(cm^4)	435.0
D (mm)	150.0	r_z (cm)	6.27
B (mm)	150.0	r_y (cm)	3.36
t (mm)	8.4	Z_z (cm^3)	201.0
T (mm)	9	Z_y (cm^3)	58.0
Flange Slope	94	Z_{pz} (cm^3)	228.0
R_1 (mm)	8.0	Z_{py} (cm^3)	94.7
R_2 (mm)	4.0		

Supported Section - Mechanical Properties



Supported Section		JB 225	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	12.78	I_z (cm^4)	1310.0
Area, A (cm^2)	16.2	I_y(cm^4)	40.4
D (mm)	225.0	r_z (cm)	8.97
B (mm)	80.0	r_y (cm)	1.57
t (mm)	3.7	Z_z (cm^3)	116.0
T (mm)	5.0	Z_y (cm^3)	10.1
Flange Slope	91.5	Z_{pz} (cm^3)	134.0
R_1 (mm)	6.5	Z_{py} (cm^3)	16.2
R_2 (mm)	1.5		

Bolt Details - Input and Design Preference

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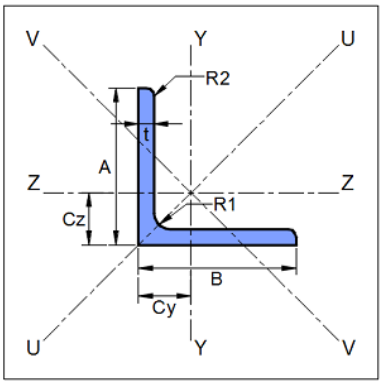
Diameter (mm)	[np.int64(8), np.int64(10), np.int64(12), np.int64(14), np.int64(16), np.int64(18), np.int64(20), np.int64(22), np.int64(24), np.int64(27), np.int64(30), np.int64(33), np.int64(36), np.int64(39), np.int64(42), np.int64(45), np.int64(48), np.int64(52), np.int64(56), np.int64(60), np.int64(64)]
Property Class	[np.float64(3.6), np.float64(4.6), np.float64(4.8), np.float64(5.6), np.float64(5.8), np.float64(6.8), np.float64(8.8), np.float64(9.8), np.float64(10.9), np.float64(12.9)]
Type	Friction Grip Bolt
Hole Type	Standard
Slip Factor, (μ_f)	0.3

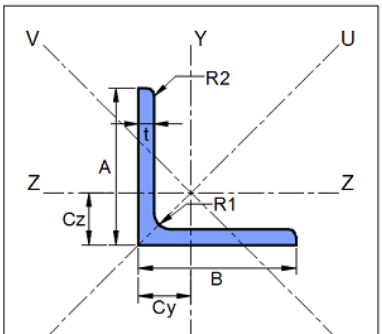
Detailing - Design Preference

Edge Preparation Method	Sheared or hand flame cut
Gap Between Members (mm)	10.0
Are the Members Exposed to Corrosive Influences?	False

Seated and Top Angle Details



Section Size*		50 x 50 x 7	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	2.34	I_u (cm^4)	11.4
Area, A (cm^2)	2.99	I_v(cm^4)	3.01
A (mm)	50.0	r_z (cm)	1.55
B (mm)	50.0	r_y (cm)	1.55
t (mm)	3.0	r_u (cm)	1.96
R_1 (mm)	6.0	r_v (cm)	1.0
R_2 (mm)	0.0	Z_z (cm^3)	1.97
C_y (mm)	13.4	Z_y (cm^3)	1.97
C_z (mm)	13.4	Z_{pz} (cm^3)	3.53
I_z (cm^4)	7.21	Z_{py} (cm^3)	1.97
I_y(cm^4)	7.21		
Section Size*		60 x 60 x 6	



Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	5.44	I_u (cm^4)	37.1
Area, A (cm^2)	6.93	I_v(cm^4)	9.69
A (mm)	60.0	r_z (cm)	1.84
B (mm)	60.0	r_y (cm)	1.84
t (mm)	6.0	r_u (cm)	2.31
R_1 (mm)	6.5	r_v (cm)	1.18
R_2 (mm)	0.0	Z_z (cm^3)	5.46
C_y (mm)	17.1	Z_y (cm^3)	5.46
C_z (mm)	17.1	Z_{pz} (cm^3)	9.81
I_z (cm^4)	23.4	Z_{py} (cm^3)	5.46
I_y(cm^4)	23.4		

1.1 List of Input Section

Seated Angle List	'50 x 50 x 3', '50 x 50 x 4', '50 x 50 x 5', '50 x 50 x 6', '55 x 55 x 4', '55 x 55 x 5', '55 x 55 x 6', '55 x 55 x 8', '60 x 60 x 4', '60 x 60 x 5', '60 x 60 x 6', '60 x 60 x 8', '65 x 65 x 4', '65 x 65 x 5', '65 x 65 x 6', '65 x 65 x 8', '70 x 70 x 5', '70 x 70 x 6', '70 x 70 x 8', '70 x 70 x 10', '75 x 75 x 5', '75 x 75 x 6', '75 x 75 x 8', '75 x 75 x 10', '80 x 80 x 6', '80 x 80 x 8', '80 x 80 x 10', '80 x 80 x 12', '90 x 90 x 6', '90 x 90 x 8', '90 x 90 x 10', '90 x 90 x 12', '100 x 100 x 6', '100 x 100 x 8', '100 x 100 x 10', '100 x 100 x 12', '110 x 110 x 8', '110 x 110 x 10', '110 x 110 x 12', '110 x 110 x 16', '130 x 130 x 8', '130 x130 x 10', '130 x130 x 12', '130 x130 x 16', '150 x 150 x 10', '150 x 150 x 12', '150 x 150 x 16', '150 x 150 x 20', '200 x 200 x 12', '200 x 200 x 16', '200 x 200 x 20', '200 x 200 x 25', '50 x 50 x 7', '50 x 50 x 8', '55 x 55 x 10', '60 x 60 x 10', '65 x 65 x 10', '70 x 70 x 7', '100 x 100 x 7', '100 x 100 x 15', '120 x 120 x 8', '120 x 120 x 10', '120 x 120 x 12', '120 x 120 x 15', '130 x 130 x 9', '150 x 150 x 15', '150 x 150 x 18', '180 x 180 x 15', '180 x 180 x 18', '180 x 180 x 20', '200 x 200 x 24'

1.2 List of Input Section

Top Angle List	'50 x 50 x 3', '50 x 50 x 4', '50 x 50 x 5', '50 x 50 x 6', '55 x 55 x 4', '55 x 55 x 5', '55 x 55 x 6', '55 x 55 x 8', '60 x 60 x 4', '60 x 60 x 5', '60 x 60 x 6', '60 x 60 x 8', '65 x 65 x 4', '65 x 65 x 5', '65 x 65 x 6', '65 x 65 x 8', '70 x 70 x 5', '70 x 70 x 6', '70 x 70 x 8', '70 x 70 x 10', '75 x 75 x 5', '75 x 75 x 6', '75 x 75 x 8', '75 x 75 x 10', '80 x 80 x 6', '80 x 80 x 8', '80 x 80 x 10', '80 x 80 x 12', '90 x 90 x 6', '90 x 90 x 8', '90 x 90 x 10', '90 x 90 x 12', '100 x 100 x 6', '100 x 100 x 8', '100 x 100 x 10', '100 x 100 x 12', '110 x 110 x 8', '110 x 110 x 10', '110 x 110 x 12', '110 x 110 x 16', '130 x 130 x 8', '130 x130 x 10', '130 x130 x 12', '130 x130 x 16', '150 x 150 x 10', '150 x 150 x 12', '150 x 150 x 16', '150 x 150 x 20', '200 x 200 x 12', '200 x 200 x 16', '200 x 200 x 20', '200 x 200 x 25', '50 x 50 x 7', '50 x 50 x 8', '55 x 55 x 10', '60 x 60 x 10', '65 x 65 x 10', '70 x 70 x 7', '100 x 100 x 7', '100 x 100 x 15', '120 x 120 x 8', '120 x 120 x 10', '120 x 120 x 12', '120 x 120 x 15', '130 x 130 x 9', '150 x 150 x 15', '150 x 150 x 18', '180 x 180 x 15', '180 x 180 x 18', '180 x 180 x 20', '200 x 200 x 24'

2 Design Checks

Design Status	Pass

2.1 Section Design

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{225.0 \times 3.7 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 182.06$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	27.0	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 182.06$ $= 109.237$ [Limited to low shear]	Pass

2.2 Load Consideration

Check	Required	Provided	Remarks
Applied Shear Force (kN)	27.0	$V_{y_{\min}} = \min(0.15 V_{d_y},\ 40.0)$ $= \min(0.15 \times 182.06,\ 40.0)$ $= 40$ $V_u = \max(V_y,\ V_{y_{\min}})$ $= \max(27.0, 40)$ $= 40$ [Ref. IS 800:2007, Cl.10.7]	

2.3 Bolt Design Checks on Column

Check	Required	Provided	Remarks
Diameter (mm)		8	
Property Class		12.9	
Plate Thickness (mm)		7.0	
Large Grip Length Reduction Factor	if $l_g \geq 5d$, then $V_{rd} = \beta_{lg} V_{db}$ if $l_g < 5d$ then $V_{rd} = V_{db}$ $l_g \leq 8d$ where, $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ but $\beta_{lg} \leq \beta_{lj}$ [Ref. IS 800:2007, Cl.10.3.3.2]	$l_g = \Sigma\ (t_p + t_{member})$ $= 16.0$ $5d = 40$ $8d = 64$ since, $l_g < 5d$; $\beta_{lg} = 1.0$ [Ref. IS 800:2007, Cl.10.3.3.2]	**Pass**
No. of Bolt Columns		4	
No. of Bolt Rows	$1 \leq n_r \leq 2$	1	**Pass**
Min. Pitch Distance (mm)	$p_{min} = 2.5d$ $= 2.5 \times 8$ $= 20.0$ [Ref. IS 800:2007, Cl.10.2.2]	20	**Pass**
Max. Pitch Distance (mm)	$p_{max} = \min(32t,\ 300)$ $= \min(32 \times 7.0,\ 300)$ $= \min(224.0,\ 300)$ $= 224.0$ Where, $t = \min(7.0, 9)$ [Ref. IS 800:2007, Cl.10.2.3]	20	**Pass**

Check	Required	Provided	Remarks
Min. End Distance (mm)	$e_{min} = 1.7d_0$ $= 1.7 \times 8$ $= 13.6$ [Ref. IS 800:2007, Cl.10.2.4.2]	22	**Pass**
Max. End Distance (mm)	$e_{max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 7.0 \times \sqrt{\frac{250}{250}} = 84.0$ $e_2 = 12 \times 9 \times \sqrt{\frac{250}{250}} = 108.0$ $e_{max} = \min(e_1,\ e_2) = 84.0$ [Ref. IS 800:2007, Cl.10.2.4.3]	22	**Pass**
Min. Edge Distance (mm)	$e'_{min} = 1.7d_0$ $= 1.7 \times 8$ $= 13.6$ [Ref. IS 800:2007, Cl.10.2.4.2]	15.0	**Pass**
Max. Edge Distance (mm)	$e'_{max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 7.0 \times \sqrt{\frac{250}{250}} = 84.0$ $e_2 = 12 \times 9 \times \sqrt{\frac{250}{250}} = 108.0$ $e'_{max} = min(e_1,\ e_2) = 84.0$ [Ref. IS 800:2007, Cl.10.2.4.3]	15.0	**Pass**

Check	Required	Provided	Remarks
Slip Resistance (kN)		$V_{dsf} = \frac{\mu_f n_e K_h F_o}{\gamma_{mf}}$ Where , $F_o = 0.7 f_{ub} A_{nb}$ $V_{dsf} = \frac{0.3 \times 1 \times 1.0 \times 0.7 \times 1220.0 \times 36.6}{1.25 \times 10^3}$ $= 7.5$ [Ref. IS 800:2007, Cl.10.4.3]	
Capacity (kN)	$V_{bv} = \frac{V}{n}$ $= \frac{27.0}{4}$ $= 6.75$	7.5	
Capacity (kN)	6.75	7.5	**Pass**

2.4 Detailing Check

Check	Required	Provided	Remarks
Minimum Width (mm) (on column)	$4 \times e' + t_w + 2 \times r_r + \left(\frac{n_c}{2} - 1\right) \times g$ $= 4 \times 15 + 8.4 + 2 \times 8.0 + \left(\frac{4}{2} - 1\right) \times 20$ $= 104.4$	150.0	**Pass**
Minimum Width (mm) (on beam)	$4 \times e' + t_w + 2 \times r_r$ $= 4 \times 15 + 8.4 + 2 \times 8.0$ $= 76.7$	80.0	**Pass**
Min. Leg Length (mm) (on column)	$2 \times e' + t + r_{ra} + (n_r - 1) \times p$ $= 2 \times 15 + 7.0 + 6.0 + (1 - 1) \times 20$ $= 43.0$	50.0	**Pass**

2.5 Seated Angle Checks

Check	Required	Provided	Remarks
Designation		50 x 50 x 7	
Shear Capacity (kN)	27.0	$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{125 \times 7.0 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 114.814$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	27.0	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 114.814$ $= 68.89$ [Limited to low shear]	**Pass**
Bearing Length		$b_{l_{\text{req}}} = \frac{V\gamma_{m0}}{t_w f_y} - t_f - r_r$ $= \frac{27.0 \times 1.1}{3.7 \times 250} - 5.0 - 6.5$ $= 20.61$ $k = t_f + r_r$ $k = 5.0 + 6.5 = 11.5$ $b_1 = \max(b_{1_{\text{req}}},\ k) = 20.61$ $b_2 = b_1 + \text{gap} - t - r_{r_a}$ $b_2 = 20.61 + 10.0 - 7.0 - 6.0$ $b_2 = \max(b_2,\ 0) = 17.61$	
Minimum Leg Length (mm)	$b_1 + \text{gap} = 30.61$	50.0	**Pass**

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Check	Required	Provided	Remarks
Moment Capacity (kNm)	$M = V \times ecc$ if $b_2 \leq b_1$, $ecc = \frac{b_2}{b_1} \times \frac{b_2}{2}$ $ecc = \frac{17.61}{20.61} \times \frac{17.61}{2}$ $= 7.52$ $M = 27.0 \times 7.52 \times 10^{-3}$ $= 0.203$	$M_{dz} = \frac{\beta_b Z_p f y}{\gamma_{m0}}$ $= \frac{1.0 \times 1225.0 \times 250}{1.1 \times 10^6}$ $= 0.28$ [Ref. IS 800:2007, Cl.8.2.1.2]	**Pass**

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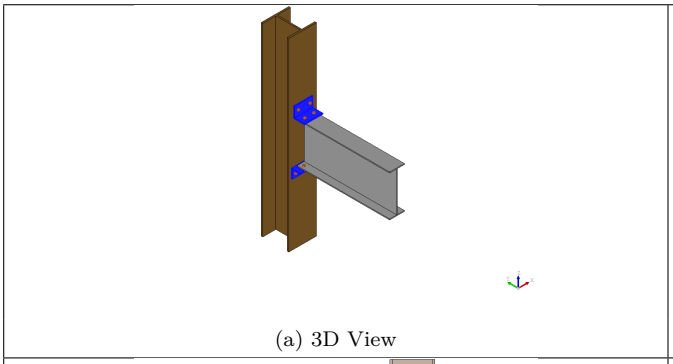
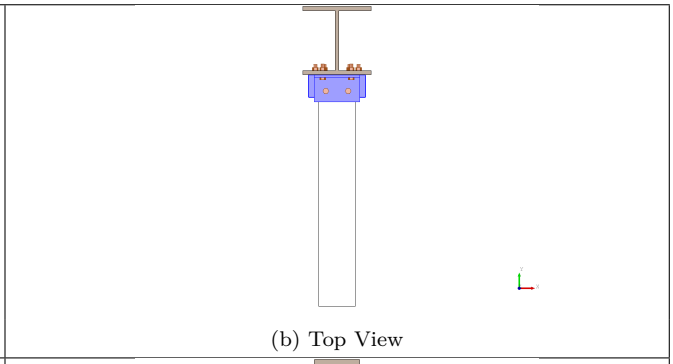
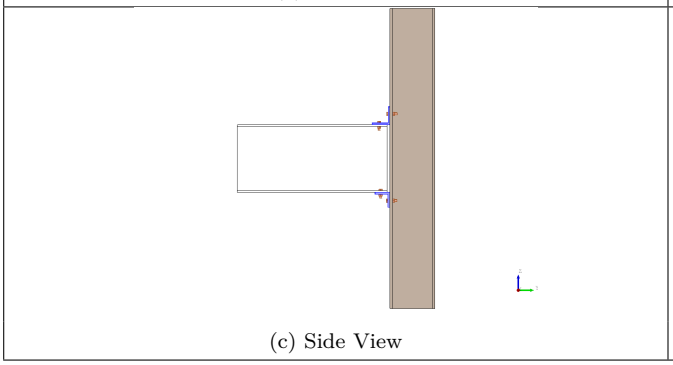
3 3D Views



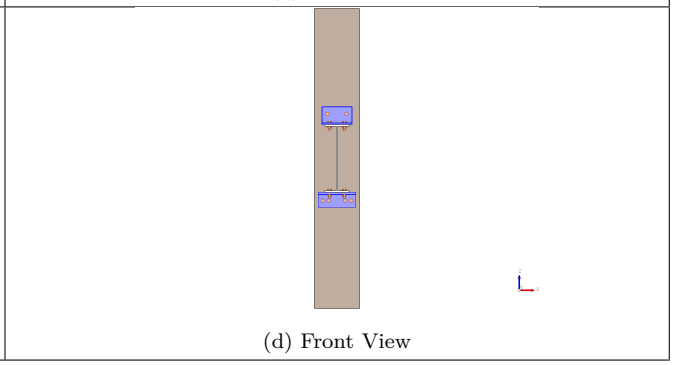
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2024-12-26 08:59:47 - Osdag - INFO - Based on the thumb rules, a minimum top angle leg size of 56.25 mm and a thickness of 6 mm is required to provide stability to JB 225.
2024-12-26 08:59:47 - Osdag - INFO - === End Of Design ===