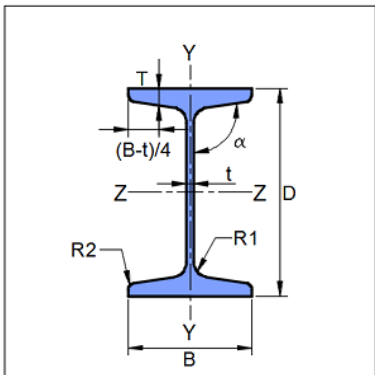
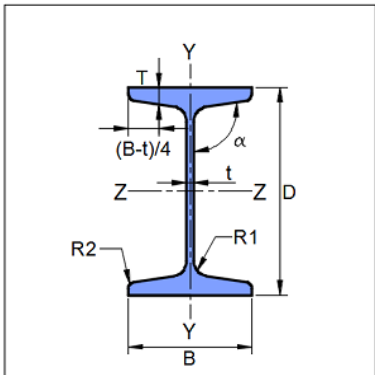




Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Fin Plate
Designer	Engineer #1	Job Number	1.1.1.1.1
Date	17 /12 /2020	Client	S R Satish Kumar, Professor, IIT Madras

1 Input Parameters

Main Module		Shear Connection		
Module		Fin Plate		
Connectivity		Column Flange-Beam Web		
Shear Force (kN)		180.0		
Axial Force (kN)		50.0		
Supporting Section - Mechanical Properties				
	Supporting Section		HB 450	
	Material		E 250 (Fe 410 W)A	
	Ultimate Strength, Fu (MPa)		410	
	Yield Strength, Fy (MPa)		250	
	Mass, m (kg/m)	87.22	Iz (cm4)	39200.0
	Area, A (cm2)	111.0	Iy(cm4)	2980.0
	D (mm)	450.0	rz (cm)	18.7
	B (mm)	250.0	ry (cm)	5.18
	t (mm)	9.8	Zz (cm3)	1740.0
	T (mm)	13.7	Zy (cm3)	238.0
	Flange Slope	94	Zpz (cm3)	1950.0
	R1 (mm)	15.0	Zpy (cm3)	394.0
	R2 (mm)	7.5		
Supported Section - Mechanical Properties				
	Supported Section		MB 350	
	Material		E 250 (Fe 410 W)A	
	Ultimate Strength, Fu (MPa)		410	
	Yield Strength, Fy (MPa)		250	
	Mass, m (kg/m)	52.33	Iz (cm4)	13600.0
	Area, A (cm2)	66.7	Iy(cm4)	537.0
	D (mm)	350.0	rz (cm)	14.2
	B (mm)	140.0	ry (cm)	2.83
	t (mm)	8.1	Zz (cm3)	779.0
	T (mm)	14.2	Zy (cm3)	76.8
	Flange Slope	98	Zpz (cm3)	889.0
	R1 (mm)	14.0	Zpy (cm3)	129.0
	R2 (mm)	7.0		



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Bolt Details - Input and Design Preference	
Diameter (mm)	[12, 16, 20, 24, 30]
Property Class	[4.6, 4.8, 5.6, 6.8, 8.8]
Type	Friction Grip Bolt
Hole Type	Standard
Bolt Tension	Pre-tensioned
Slip Factor, (μ_f)	0.3
Detailing - Design Preference	
Edge Preparation Method	Rolled, machine-flame cut, sawn and planed
Gap Between Members (mm)	15.0
Are the Members Exposed to Corrosive Influences?	False
Plate Details - Input and Design Preference	
Thickness (mm)	[10, 12, 16, 18, 20]
Material	E 350 (Fe 490)
Ultimate Strength, F_u (MPa)	490
Yield Strength, F_y (MPa)	350
Weld Details - Input and Design Preference	
Weld Type	Fillet
Type of Weld Fabrication	Shop Weld
Material Grade Overwrite, F_u (MPa)	410.0



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2 Design Checks

Design Status	Pass
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2.1 Initial Section Check

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)	180.0	$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{350.0 \times 8.1 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 372.0$ <p>[Ref. IS 800 : 2007, Cl.10.4.3]</p>	Pass
Allowable Shear Capacity (kN)	180.0	$V_d = 0.6 V_{dy}$ $= 0.6 \times 372.0$ $= 223.2$ <p>[Limited to low shear]</p>	Pass
Tension Yielding Capacity (kN)	50.0	$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 350.0 \times 8.1$ $= \frac{2835.0 \times 250}{1.1 \times 10^3}$ $= 644.32$ <p>[Ref. IS 800 : 2007, Cl. 6.2]</p>	Pass

2.2 Load Consideration

Check	Required	Provided	Remarks
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Company Name	IIT Bombay	Project Title	Sample Connection Design
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Check	Required	Provided	Remarks
Applied Shear Force (kN)	180.0	$V_{ymin} = \min(0.15 \times V_{dy}, 40.0)$ $= \min(0.15 \times 372.0, 40.0)$ $= 40$ $V_u = \max(V_y, V_{ymin})$ $= \max(180.0, 40)$ $= 180.0$ $[Ref. IS 800 : 2007, Cl. 10.7]$	
Applied Axial Force (kN)	50.0	50.0	

2.3 Bolt Design

Check	Required	Provided	Remarks
Diameter (mm)		30.0	
Property Class		8.8	
Plate Thickness (mm)	$t_w = 8.1$	10.0	Pass
No. of Bolt Columns		2	Pass
No. of Bolt Rows		3	
Min. Pitch Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 30.0$ $= 75.0$ $[Ref IS 800 : 2007, Cl. 10.2.2]$	75	Pass
Max. Pitch Distance (mm)	$p/g_{max} = \min(32 t, 300 mm)$ $= \min(32 \times 8.1, 300 mm)$ $= \min(259.2, 300 mm)$ $= 259.2$ $Where, t = \min(10.0, 8.1)$ $[Ref. IS 800 : 2007, Cl. 10.2.3]$	75	Pass



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Check	Required	Provided	Remarks
Min. Gauge Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 30.0$ $= 75.0$ [Ref. IS 800 : 2007, Cl. 10.2.2]	75	Pass
Max. Gauge Distance (mm)	$p/g_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 8.1, 300 \text{ mm})$ $= \min(259.2, 300 \text{ mm})$ $= 259.2$ Where, $t = \min(10.0, 8.1)$ [Ref. IS 800 : 2007, Cl. 10.2.3]	75	Pass
Min. End Distance (mm)	$e_{min} = 1.5 d_0$ $= 1.5 \times 33.0$ $= 49.5$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	50	Pass
Max. End Distance (mm)	$e_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 10.0 \times \sqrt{\frac{250}{350}} = 101.42$ $e_2 = 12 \times 8.1 \times \sqrt{\frac{250}{250}} = 97.2$ $e_{max} = \min(e_1, e_2) = 97.2$ [Ref. IS 800 : 2007, Cl. 10.2.4.3]	50	Pass
Min. Edge Distance (mm)	$e'_{min} = 1.5 d_0$ $= 1.5 \times 33.0$ $= 49.5$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	50	Pass



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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 10.0 \times \sqrt{\frac{250}{350}} = 101.42$ $e_2 = 12 \times 8.1 \times \sqrt{\frac{250}{250}} = 97.2$ $e'_{max} = \min(e_1, e_2) = 97.2$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.3]</p>	50	Pass
Moment Demand (kNm)		$M_d = (V_u \times ecc + M_w)$ <p><i>ecc = eccentricity</i> <i>M_w = external moment acting on web</i></p> $= \frac{(180.0 \times 10^3 \times 102.5 + 0.0 \times 10^6)}{10^6}$ $= 18.45$	
Bolt Force Parameter(s) (mm)	$l_n = \text{length available}$ $l_n = p (n_r - 1)$ $= 75 \times (3 - 1)$ $= 150$ $y_{max} = l_n / 2$ $= 150 / 2$ $= 75.0$ $x_{max} = g(n_c - 1) / 2$ $= 75 \times (2 - 1) / 2$ $= 37.5$		



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Check	Required	Provided	Remarks
Bolt Force (kN)	$v_b v_r = V_u / (n_r \times n_c)$ $= \frac{180.0}{(3 \times 2)}$ $= 30.0$ $t_m h = \frac{M_d \times y_{max}}{\sum r_i^2}$ $= \frac{18.45 \times 75.0}{30.94}$ $= 44.73$ $t_m v = \frac{M_d \times x_{max}}{\sum r_i^2}$ $= \frac{18.45 \times 37.5}{30.94}$ $= 22.36$ $a_b h = \frac{A_u}{(n_r \times n_c)}$ $= \frac{50.0}{(3 \times 2)}$ $= 8.33$ $v_{res} = \sqrt{(v_b v_r + t_m v)^2 + (t_m h + a_b h)^2}$ $= \sqrt{(30.0 + 22.36)^2 + (44.73 + 8.33)^2}$ $= 74.55$		
Slip Resistance (kN)		$V_{dsf} = \frac{\mu_f n_e K_h F_o}{\gamma_{mf}}$ <p>Where , $F_o = 0.7 f_{ub} A_{nb}$</p> $V_{dsf} = \frac{0.3 \times 1 \times 1.0 \times 0.7 \times 830.0 \times 561}{1.25 \times 10^3}$ $= 78.23$ <p>[Ref. IS 800 : 2007, Cl. 10.4.3]</p>	



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Check	Required	Provided	Remarks
Long Joint Reduction Factor	$\text{if } l_j \geq 15d \text{ then } V_{rd} = \beta_{lj} V_{db}$ $\text{if } l_j < 15d \text{ then } V_{rd} = V_{db}$ where, $l_j = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $\beta_{lj} = 1.075 - l/(200d)$ $\text{but } 0.75 \leq \beta_{lj} \leq 1.0$ $[\text{Ref. IS 800 : 2007, Cl. 10.3.3.1}]$	$l_j = (n_r - 1) \times p$ $= (3 - 1) \times 75 = 150$ $l = 150$ $15 \times d = 15 \times 30.0 = 450.0$ $\text{since, } l_j < 15 \times d \text{ then } \beta_{lj} = 1.0$ $[\text{Ref. IS 800 : 2007, Cl. 10.3.3.1}]$	
Capacity (kN)	74.55	78.23	Pass

2.4 Plate Design

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (350.0 - 2 \times 14.2 - 2 \times 14.0)$ $= 176.16$ $[\text{Ref. INSDAG - Chpt.5, Sect.5.2.3}]$	250	Pass
Max. Plate Height (mm)	$d_b - 2(t_{bf} + r_{b1} + \text{gap})$ $= 350.0 - 2 \times (14.2 + 14.0 + 10)$ $= 293.6$	250	Pass
Min. Plate Width (mm)	$2e_{min} + (n_c - 1)p_{min}$ $= 2 \times 49.5 + (2 - 1) \times 75.0$ $= 189.0$	190.0	Pass
Min. Plate Thickness (mm)	$t_w = 8.1$	10.0	Pass
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{250 \times 10.0 \times 350}{\sqrt{3} \times 1.1 \times 1000}$ $= 459.26$ $[\text{Ref. IS 800 : 2007, Cl.10.4.3}]$	



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Check	Required	Provided	Remarks
Allowable Shear Capacity (kN)	$V = 180.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 459.26$ $= 275.55$ $[Limited\ to\ low\ shear]$	Pass
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75 A_{vn} f_u}{\sqrt{3} \gamma_{m1}}$ $= 1 \times \frac{(250 - (3 \times 33.0)) \times 10.0 \times 490}{\sqrt{3} \times 1.25}$ $= 554.92$ $[Ref. AISC\ Sect. J4]$	
Block Shear Capacity in Shear (kN)		$V_{db1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 633.77$ $[Ref. IS\ 800 : 2007, Cl. 6.4]$	
Shear Capacity (kN)	180.0	$V_d = \min(V_c, V_{dn}, V_{db})$ $= \min(275.55, 554.92, 633.77)$ $= 275.55$ $[Ref. IS\ 800 : 2007, Cl. 6.1]$	Pass
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = l \times t = 250 \times 10.0$ $= \frac{2500.0 \times 350}{1.1 \times 10^3}$ $= 795.45$ $[Ref. IS\ 800 : 2007, Cl. 6.2]$	



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Designer	Engineer #1	Job Number	1.1.1.1.1
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Check	Required	Provided	Remarks
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (250 - 3 \times 33.0) \times 10.0 \times 490}{1.25}$ $= 649.15$ <p>[Ref. IS 800 : 2007, Cl. 6.3.1]</p>	
Block Shear Capacity in Tension (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 755.61$ <p>[Ref. IS 800 : 2007, Cl. 6.4]</p>	
Tension Capacity (kN)	50.0	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(795.45, 649.15, 755.61)$ $= 649.15$ <p>[Ref. IS 800 : 2007, Cl. 6.1]</p>	Pass
Moment Capacity (kNm)	18.45	$M_{dzz} = \frac{\beta_b \times Z_p \times f_y}{\gamma_{mo} \times 10^6}$ $= \frac{1.0 \times 156250.0 \times 350}{1.1 \times 10^6}$ $= 49.72$ <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	Pass
Interaction Ratio	≤ 1	$\frac{18.45}{49.72} + \frac{50.0}{649.15} = 0.45$ <p>[Ref. IS 800 : 2007, Cl. 10.7]</p>	Pass



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2.5 Section Design

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{m0}}$ $= \frac{350.0 \times 8.1 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 372.0$ <p>[Ref.IS 800 : 2007, Cl.10.4.3]</p>	
Allowable Shear Capacity (kN)	$V = 180.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 372.0$ $= 223.2$ <p>[Limited to low shear]</p>	Pass
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75 A_{vn} f_u}{\sqrt{3} \gamma_{m1}}$ $= 1 \times \frac{(350.0 - (3 \times 33.0)) \times 8.1 \times 410}{\sqrt{3} \times 1.25}$ $= 625.18$ <p>[Ref.AISC Sect.J4]</p>	
Block Shear Capacity in Shear (kN)		$V_{db1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 392.32$ <p>[Ref. IS 800 : 2007, Cl. 6.4]</p>	
Shear Capacity (kN)	180.0	$V_d = \min(V_{d1}, V_{dn}, V_{db})$ $= \min(223.2, 625.18, 392.32)$ $= 223.2$ <p>[Ref. IS 800 : 2007, Cl. 6.1]</p>	Pass



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Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = l \times t = 350.0 \times 8.1$ $= \frac{2835.0 \times 250}{1.1 \times 10^3}$ $= 644.32$ <p>[Ref. IS 800 : 2007, Cl. 6.2]</p>	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (350.0 - 3 \times 33.0) \times 8.1 \times 410}{1.25}$ $= 600.17$ <p>[Ref. IS 800 : 2007, Cl. 6.3.1]</p>	
Block Shear Capacity in Tension (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 466.57$ <p>[Ref. IS 800 : 2007, Cl. 6.4]</p>	
Tension Capacity (kN)	50.0	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(644.32, 600.17, 466.57)$ $= 466.57$ <p>[Ref. IS 800 : 2007, Cl. 6.1]</p>	Pass
Moment Capacity (kNm)	18.45	$M_{dzz} = \frac{\beta_b \times Z_p \times f_y}{\gamma_{m0} \times 10^6}$ $= \frac{1.0 \times 889000.0 \times 250}{1.1 \times 10^6}$ $= 202.05$ <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	Pass



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Check	Required	Provided	Remarks
Interaction Ratio	≤ 1	$\frac{18.45}{202.05} + \frac{50.0}{466.57} = 0.2$ [Ref. IS 800 : 2007, Cl. 10.7]	Pass

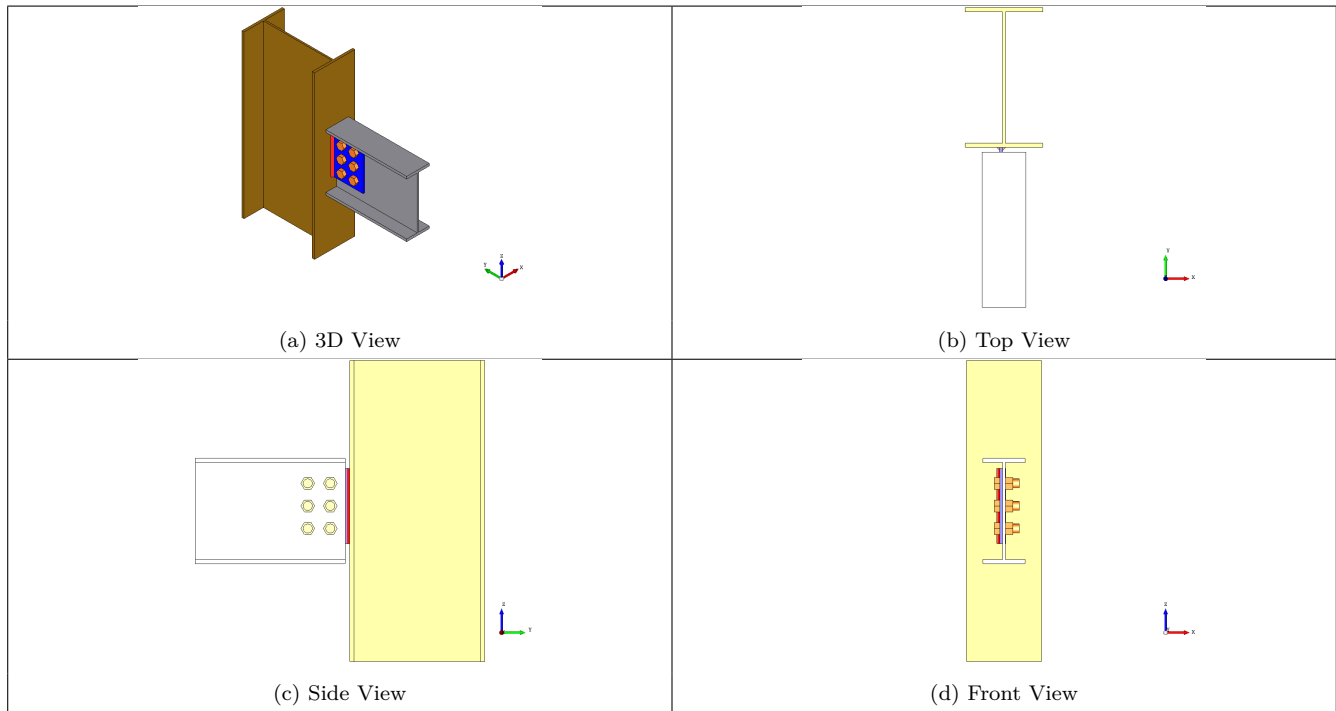
2.6 Weld Design

Check	Required	Provided	Remarks
Min. Weld Size (mm)	t_{wmin} based on thinner part $= 10$ or 10 s_{min} based on thicker part $= 5$ [Ref IS 800 : 2007, Table 21 (Cl10.5.2.3)]	10	Pass
Max. Weld Size (mm)	Thickness of thinner part $= \min(13.7, 10.0) = 10.0$ $s_{max} = 10$ [Ref. IS 800 : 2007, Cl. 10.5.3.1]	10	Pass
Weld Strength (N/mm)	$R_w = \sqrt{(T_{wh} + A_{wh})^2 + (T_{wv} + V_{wv})^2}$ $T_{wh} = \frac{M \times y_{max}}{I_{pw}} = \frac{18450000.0 \times 115.0}{2027833.33}$ $T_{wv} = \frac{M \times x_{max}}{I_{pw}} = \frac{18450000.0 \times 0.0}{2027833.33}$ $V_{wv} = \frac{V}{l_w} = \frac{180000.0}{460}$ $A_{wh} = \frac{A}{l_w} = \frac{50000.0}{460}$ $R_w = \sqrt{(1046.31 + 108.7)^2 + (0.0 + 391.3)^2}$ $= 1219.49$	$f_w = \frac{t_t f_u}{\sqrt{3} \gamma_{mw}}$ $= \frac{7.0 \times 410}{\sqrt{3} \times 1.25}$ $= 1325.6$ [Ref. IS 800 : 2007, Cl. 10.5.7.1.1]	Pass



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3 3D Views



4 Design Log