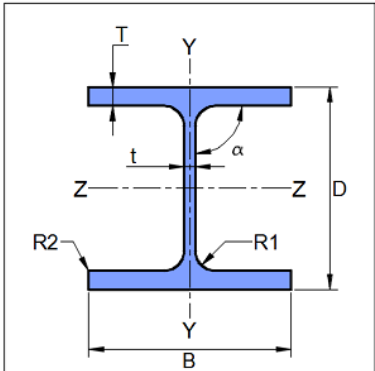
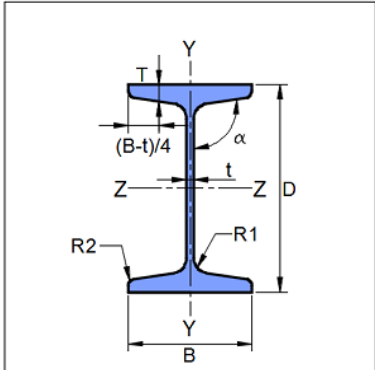




Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Fin Plate
Designer	Engineer #1	Job Number	1.1.1.1.2
Date	17 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

1 Input Parameters

Main Module		Shear Connection		
Module		Fin Plate		
Connectivity		Column Flange-Beam Web		
Shear Force (kN)		175.0		
Axial Force (kN)		35.0		
Supporting Section - Mechanical Properties				
	Supporting Section		PBP 320 X 88.48	
	Material		E 300 (Fe 440)	
	Ultimate Strength, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	Mass, m (kg/m)	88.48	Iz (cm4)	18700.0
	Area, A (cm2)	112.0	Iy(cm4)	5630.0
	D (mm)	303.0	rz (cm)	12.8
	B (mm)	304.0	ry (cm)	7.07
	t (mm)	12.0	Zz (cm3)	1230.0
	T (mm)	12	Zy (cm3)	370.0
	Flange Slope	90	Zpz (cm3)	1370.0
	R1 (mm)	27.0	Zpy (cm3)	572.0
	R2 (mm)	0.0		
	Supported Section - Mechanical Properties			
	Supported Section		WB 300	
	Material		E 300 (Fe 440)	
	Ultimate Strength, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	Mass, m (kg/m)	48.12	Iz (cm4)	9820.0
	Area, A (cm2)	61.3	Iy(cm4)	990.0
	D (mm)	300.0	rz (cm)	12.6
	B (mm)	200.0	ry (cm)	4.01
	t (mm)	7.4	Zz (cm3)	654.0
	T (mm)	10.0	Zy (cm3)	99.0
	Flange Slope	96	Zpz (cm3)	731.0
	R1 (mm)	11.0	Zpy (cm3)	171.0
	R2 (mm)	5.5		



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Bolt Details - Input and Design Preference	
Diameter (mm)	[20]
Property Class	[6.8]
Type	Bearing Bolt
Hole Type	Standard
Bolt Tension	Non pre-tensioned
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
Plate Details - Input and Design Preference	
Thickness (mm)	[14]
Material	E 300 (Fe 440)
Ultimate Strength, F_u (MPa)	440
Yield Strength, F_y (MPa)	300
Weld Details - Input and Design Preference	
Weld Type	Fillet
Type of Weld Fabrication	Shop Weld
Material Grade Overwrite, F_u (MPa)	440.0



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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)	175.0	$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{300.0 \times 7.4 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 349.56$ <p>[Ref.IS 800 : 2007, Cl.10.4.3]</p>	Pass
Allowable Shear Capacity (kN)	175.0	$V_d = 0.6 V_{dy}$ $= 0.6 \times 349.56$ $= 209.74$ <p>[Limited to low shear]</p>	Pass
Tension Yielding Capacity (kN)	35.0	$T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ $A_g = l \times t = 300.0 \times 7.4$ $= \frac{2220.0 \times 300}{1.1 \times 10^3}$ $= 605.45$ <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)	175.0	$V_{ymin} = \min(0.15 \times V_{dy}, 40.0)$ $= \min(0.15 \times 349.56, 40.0)$ $= 40$ $V_u = \max(V_y, V_{ymin})$ $= \max(175.0, 40)$ $= 175.0$ <i>[Ref. IS 800 : 2007, Cl. 10.7]</i>	
Applied Axial Force (kN)	35.0	35.0	

2.3 Bolt Design

Check	Required	Provided	Remarks
Diameter (mm)		20.0	
Property Class		6.8	
Plate Thickness (mm)	$t_w = 7.4$	14.0	Pass
No. of Bolt Columns		2	Pass
No. of Bolt Rows		3	
Min. Pitch Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 20.0$ $= 50.0$ <i>[Ref IS 800 : 2007, Cl. 10.2.2]</i>	65	Pass
Max. Pitch Distance (mm)	$p/g_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 7.4, 300 \text{ mm})$ $= \min(236.8, 300 \text{ mm})$ $= 236.8$ <i>Where, $t = \min(14.0, 7.4)$</i> <i>[Ref. IS 800 : 2007, Cl. 10.2.3]</i>	65	Pass



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Check	Required	Provided	Remarks
Min. Gauge Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 20.0$ $= 50.0$ [Ref IS 800 : 2007, Cl. 10.2.2]	50	Pass
Max. Gauge Distance (mm)	$p/g_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 7.4, 300 \text{ mm})$ $= \min(236.8, 300 \text{ mm})$ $= 236.8$ Where, $t = \min(14.0, 7.4)$ [Ref. IS 800 : 2007, Cl. 10.2.3]	50	Pass
Min. End Distance (mm)	$e_{min} = 1.7 d_0$ $= 1.7 \times 22.0$ $= 37.4$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	40	Pass
Max. End Distance (mm)	$e_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 14.0 \times \sqrt{\frac{250}{300}} = 153.36$ $e_2 = 12 \times 7.4 \times \sqrt{\frac{250}{300}} = 81.06$ $e_{max} = \min(e_1, e_2) = 81.06$ [Ref. IS 800 : 2007, Cl. 10.2.4.3]	40	Pass
Min. Edge Distance (mm)	$e'_{min} = 1.7 d_0$ $= 1.7 \times 22.0$ $= 37.4$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	40	Pass



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Designer	Engineer #1	Job Number	1.1.1.1.2
Date	17 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 14.0 \times \sqrt{\frac{250}{300}} = 153.36$ $e_2 = 12 \times 7.4 \times \sqrt{\frac{250}{300}} = 81.06$ $e'_{max} = \min(e_1, e_2) = 81.06$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.3]</p>	40	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> $= \frac{(175.0 \times 10^3 \times 75.0 + 0.0 \times 10^6)}{10^6}$ $= 13.12$	
Bolt Force Parameter(s) (mm)	$l_n = \text{length available}$ $l_n = p (n_r - 1)$ $= 65 \times (3 - 1)$ $= 130$ $y_{max} = l_n / 2$ $= 130 / 2$ $= 65.0$ $x_{max} = g(n_c - 1) / 2$ $= 50 \times (2 - 1) / 2$ $= 25.0$		



Company Name	IIT Bombay	Project Title	Sample Connection Design
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Check	Required	Provided	Remarks
Bolt Force (kN)	$v_b v_v = V_u / (n_r \times n_c)$ $= \frac{175.0}{(3 \times 2)}$ $= 29.17$ $t_m h = \frac{M_d \times y_{max}}{\sum r_i^2}$ $= \frac{13.12 \times 65.0}{20.65}$ $= 41.31$ $t_m v = \frac{M_d \times x_{max}}{\sum r_i^2}$ $= \frac{13.12 \times 25.0}{20.65}$ $= 15.89$ $a_b h = \frac{A_u}{(n_r \times n_c)}$ $= \frac{35.0}{(3 \times 2)}$ $= 5.83$ $v_{res} = \sqrt{(v_b v_v + t_m v)^2 + (t_m h + a_b h)^2}$ $= \sqrt{(29.17 + 15.89)^2 + (41.31 + 5.83)^2}$ $= 65.21$		
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3} \gamma_{mb}}$ $= \frac{600.0 \times 1 \times 245}{1000 \times \sqrt{3} \times 1.25}$ $= 67.9$ [Ref. IS 800 : 2007, Cl. 10.3.3]	



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Check	Required	Provided	Remarks
Kb		$k_b = \min \left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0 \right)$ $= \min \left(\frac{40}{3 \times 22.0}, \frac{65}{3 \times 22.0} - 0.25, \frac{600.0}{440}, 1.0 \right)$ $= \min(0.61, 0.73, 1.36, 1.0)$ $= 0.61$ <p>[Ref. IS 800 : 2007, Cl. 10.3.4]</p>	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.61 \times 20.0 \times 7.4 \times 440}{1000 \times 1.25}$ $= 79.45$ <p>[Ref. IS 800 : 2007, Cl. 10.3.4]</p>	
Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (67.9, 79.45)$ $= 67.9$ <p>[Ref. IS 800 : 2007, Cl. 10.3.2]</p>	
Long Joint Reduction Factor	<p>if $l_j \geq 15d$ then $V_{rd} = \beta_{lj} V_{db}$</p> <p>if $l_j < 15d$ then $V_{rd} = V_{db}$</p> <p>where,</p> $l_j = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $\beta_{lj} = 1.075 - l/(200d)$ <p>but $0.75 \leq \beta_{lj} \leq 1.0$</p> <p>[Ref. IS 800 : 2007, Cl. 10.3.3.1]</p>	$l_j = (n_r - 1) \times p$ $= (3 - 1) \times 65 = 130$ $l = 130$ $15 \times d = 15 \times 20.0 = 300.0$ <p>since, $l_j < 15 \times d$ then $\beta_{lj} = 1.0$</p> <p>[Ref. IS 800 : 2007, Cl. 10.3.3.1]</p>	
Capacity (kN)	65.21	67.9	Pass



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2.4 Plate Design

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (300.0 - 2 \times 10.0 - 2 \times 11.0)$ $= 154.8$ <i>[Ref. INSDAG – Chpt.5, Sect.5.2.3]</i>	210	Pass
Max. Plate Height (mm)	$d_b - 2(t_{bf} + r_{b1} + gap)$ $= 300.0 - 2 \times (10.0 + 11.0 + 10)$ $= 258.0$	210	Pass
Min. Plate Width (mm)	$2e_{min} + (n_c - 1)p_{min}$ $= 2 \times 37.4 + (2 - 1) \times 50.0$ $= 134.8$	140.0	Pass
Min. Plate Thickness (mm)	$t_w = 7.4$	14.0	Pass
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{210 \times 14.0 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 462.93$ <i>[Ref.IS 800 : 2007, Cl.10.4.3]</i>	
Allowable Shear Capacity (kN)	$V = 175.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 462.93$ $= 277.76$ <i>[Limited to low shear]</i>	Pass
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75 A_{vn} f_u}{\sqrt{3} \gamma_{m1}}$ $= 1 \times \frac{(210 - (3 \times 22.0)) \times 14.0 \times 440}{\sqrt{3} \times 1.25}$ $= 665.28$ <i>[Ref.AISC Sect.J4]</i>	



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Check	Required	Provided	Remarks
Block Shear Capacity in Shear (kN)		$V_{db1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 627.56$ <p>[Ref. IS 800 : 2007, Cl. 6.4]</p>	
Shear Capacity (kN)	175.0	$V_d = \min(S_c, V_{dn}, V_{db})$ $= \min(277.76, 665.28, 627.56)$ $= 277.76$ <p>[Ref. IS 800 : 2007, Cl. 6.1]</p>	Pass
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = l \times t = 210 \times 14.0$ $= \frac{2940.0 \times 300}{1.1 \times 10^3}$ $= 801.82$ <p>[Ref. IS 800 : 2007, Cl. 6.2]</p>	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (210 - 3 \times 22.0) \times 14.0 \times 440}{1.25}$ $= 736.24$ <p>[Ref. IS 800 : 2007, Cl. 6.3.1]</p>	



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Check	Required	Provided	Remarks
Block Shear Capacity in Tension (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 778.22$ [Ref. IS 800 : 2007, Cl. 6.4]	
Tension Capacity (kN)	35.0	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(801.82, 736.24, 778.22)$ $= 736.24$ [Ref. IS 800 : 2007, Cl. 6.1]	Pass
Moment Capacity (kNm)	13.12	$M_{dzz} = \frac{\beta_b \times Z_p \times f_y}{\gamma_{mo} \times 10^6}$ $= \frac{1.0 \times 154350.0 \times 300}{1.1 \times 10^6}$ $= 42.1$ [Ref. IS 800 : 2007, Cl. 8.2.1.2]	Pass
Interaction Ratio	≤ 1	$\frac{13.12}{42.1} + \frac{35.0}{736.24} = 0.36$ [Ref. IS 800 : 2007, Cl. 10.7]	Pass

2.5 Section Design

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{300.0 \times 7.4 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 349.56$ [Ref. IS 800 : 2007, Cl. 10.4.3]	



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Check	Required	Provided	Remarks
Allowable Shear Capacity (kN)	$V = 175.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 349.56$ $= 209.74$ <i>[Limited to low shear]</i>	Pass
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75 A_{vn} f_u}{\sqrt{3} \gamma_{m1}}$ $= 1 \times \frac{(300.0 - (3 \times 22.0)) \times 7.4 \times 440}{\sqrt{3} \times 1.25}$ $= 571.43$ <i>[Ref. AISC Sect. J4]</i>	
Block Shear Capacity in Shear (kN)		$V_{db1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 331.71$ <i>[Ref. IS 800 : 2007, Cl. 6.4]</i>	
Shear Capacity (kN)	175.0	$V_d = \min(V_{sc}, V_{dn}, V_{db})$ $= \min(209.74, 571.43, 331.71)$ $= 209.74$ <i>[Ref. IS 800 : 2007, Cl. 6.1]</i>	Pass
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = l \times t = 300.0 \times 7.4$ $= \frac{2220.0 \times 300}{1.1 \times 10^3}$ $= 605.45$ <i>[Ref. IS 800 : 2007, Cl. 6.2]</i>	



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Check	Required	Provided	Remarks
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (300.0 - 3 \times 22.0) \times 7.4 \times 440}{1.25}$ $= 548.57$ <p>[Ref. IS 800 : 2007, Cl. 6.3.1]</p>	
Block Shear Capacity in Tension (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{db2} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 411.35$ <p>[Ref. IS 800 : 2007, Cl. 6.4]</p>	
Tension Capacity (kN)	35.0	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(605.45, 548.57, 411.35)$ $= 411.35$ <p>[Ref. IS 800 : 2007, Cl. 6.1]</p>	Pass
Moment Capacity (kNm)	13.12	$M_{dzz} = \frac{\beta_b \times Z_p \times f_y}{\gamma_{mo} \times 10^6}$ $= \frac{1.0 \times 731000.0 \times 300}{1.1 \times 10^6}$ $= 199.36$ <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	Pass
Interaction Ratio	≤ 1	$\frac{13.12}{199.36} + \frac{35.0}{411.35} = 0.15$ <p>[Ref. IS 800 : 2007, Cl. 10.7]</p>	Pass



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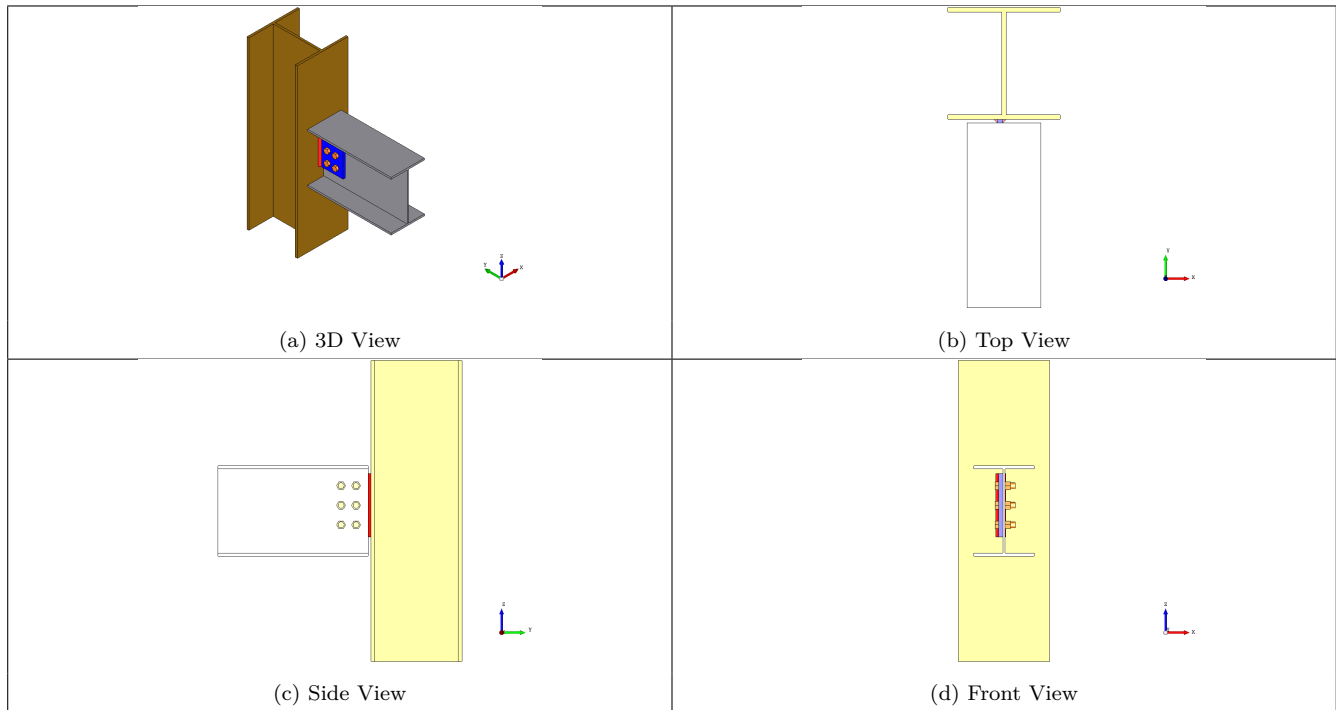
2.6 Weld Design

Check	Required	Provided	Remarks
Min. Weld Size (mm)	$t_{w_{min}}$ based on thinner part $= 12 \text{ or } 12$ s_{min} based on thicker part $= 5$ [Ref IS 800 : 2007, Table 21 (Cl 10.5.2.3)]	10	Pass
Max. Weld Size (mm)	Thickness of thinner part $= \min(12, 14.0) = 12$ $s_{max} = 12$ [Ref. IS 800 : 2007, Cl. 10.5.3.1]	10	Pass
Weld Strength (N/mm)	$R_w = \sqrt{(T_{wh} + A_{wh})^2 + (T_{wv} + V_{wv})^2}$ $T_{wh} = \frac{M \times y_{max}}{I_{pw}} = \frac{13125000.0 \times 95.0}{1143166.67}$ $T_{wv} = \frac{M \times x_{max}}{I_{pw}} = \frac{13125000.0 \times 0.0}{1143166.67}$ $V_{wv} = \frac{V}{l_w} = \frac{175000.0}{380}$ $A_{wh} = \frac{A}{l_w} = \frac{35000.0}{380}$ $R_w = \sqrt{(1090.72 + 92.11)^2 + (0.0 + 460.53)^2}$ $= 1269.32$	$f_w = \frac{t_t f_u}{\sqrt{3} \gamma_{mw}}$ $= \frac{7.0 \times 440}{\sqrt{3} \times 1.25}$ $= 1422.59$ [Ref. IS 800 : 2007, Cl. 10.5.7.1.1]	Pass



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3 3D Views



4 Design Log