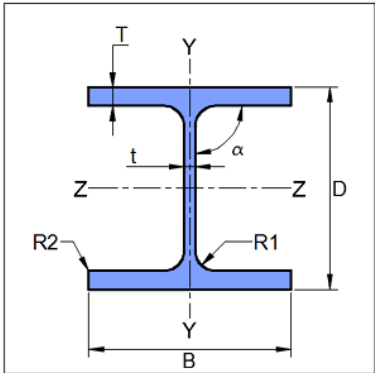




Company Name	IIT Bombay	Project Title	Moment Connection
Group/Team Name	Osdag	Subtitle	Beam-to-Beam Cover Plate (bolted)
Designer	Engineer#1	Job Number	1.2.1.1.2
Date	04 /02 /2021	Client	Dr. Pradyumna M, Bengaluru

1 Input Parameters

Module		Beam-to-Beam Cover Plate Bolted Connection		
Main Module		Moment Connection		
Bending Moment (kNm)		395.0		
Shear Force (kN)		110.0		
Axial Force (kN)		0.0		
Beam Section - Mechanical Properties				
	Beam Section		WPB 900 X 300 X 198.01	
	Material		E 350 (Fe 490)	
	Ultimate Strength, F_u (MPa)		490	
	Yield Strength, F_y (MPa)		330	
	Mass, m (kg/m)	198.01	I_z (cm ⁴)	301000.0
	Area, A (cm ²)	25200.0	I_y (cm ⁴)	9040.0
	D (mm)	870.0	r_z (cm)	34.5
	B (mm)	300.0	r_y (cm)	5.98
	t (mm)	15.0	Z_z (cm ³)	6920.0
	T (mm)	20.0	Z_y (cm ³)	602.0
	Flange Slope	90	Z_{pz} (cm ³)	7990.0
	R_1 (mm)	30.0	Z_{py} (cm ³)	957.0
	R_2 (mm)	0.0		
Bolt Details - Input and Design Preference				
Diameter (mm)		[24]		
Property Class		[8.8]		
Type		Bearing Bolt		
Hole Type		Over-sized		
Slip Factor, (μ_f)		0.3		
Edge Preparation Method		Rolled, machine-flame cut, sawn and planed		
Gap Between Beams (mm)		0.0		
Are the Members Exposed to Corrosive Influences?		False		
Plate Details - Input and Design Preference				
Preference		Outside + Inside		
Ultimate Strength, F_u (MPa)		440		
Yield Strength, F_y (MPa)		300		



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Material	E 300 (Fe 440)
Thickness (mm)	[8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 75, 80, 90, 100, 110, 120]



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2 Design Checks

Design Status	Pass
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2.1 Member Capacity

Check	Required	Provided	Remarks
Section Classification		Plastic [Ref: Table 2, Cl.3.7.2 and 3.7.4, IS 800:2007]	
Axial Capacity Member (kN)	$P_x = 0.0$	$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{25200.0 \times 330}{1.1 \times 10^3}$ $= 7560.0$ [Ref. IS 800:2007, Cl.6.2]	
Shear Capacity Member (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{m0}}$ $= \frac{830.0 \times 15.0 \times 330}{\sqrt{3} \times 1.1 \times 1000}$ $= 2156.4$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	$V_y = 110.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 2156.4$ $= 1293.84$ [Limited to low shear]	Pass
Plastic Moment Capacity (kNm)		$M_{dz} = \frac{\beta_b Z_p f_y}{\gamma_{m0} \times 10^6}$ $= \frac{1 \times 7990000.0 \times 330}{1.1 \times 10^6}$ $= 2397.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	



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Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$M_{dc} = \frac{1.5Z_e f_y}{\gamma_{m0} \times 10^6}$ $= \frac{1.5 \times 6920000.0 \times 330}{1.1 \times 10^6}$ $= 3114.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Moment Capacity Member (kNm)	$M_z = 395.0$	$M_{dz} = \min(M_{dz}, M_{dc})$ $= \min(2397.0, 3114.0)$ $= 2397.0$ [Ref. IS 800:2007, Cl.8.2]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		<p>I.R. axial = P_x/T_{dg}</p> $= 0.0/7560.0$ $= 0.0$ <p>I.R. moment = M_z/M_{dz}</p> $= 395.0/2397.0$ $= 0.1648$ <p>I.R. sum = I.R. axial + I.R. moment</p> $= 0.0 + 0.1648$ $= 0.1648$	



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Date	04 /02 /2021	Client	Dr. Pradyumna M, Bengaluru

Check	Required	Provided	Remarks
Minimum Required Load	<p>if I.R. axial < 0.3 and I.R. moment < 0.5</p> $P_{x\min} = 0.3T_{dg}$ $M_{z\min} = 0.5M_{dz}$ <p>elif sum I.R. <= 1.0 and I.R. moment < 0.5</p> <p>if (0.5 – I.R. moment) < (1 – sum I.R.)</p> $M_{z\min} = 0.5 \times M_{dz}$ <p>else</p> $M_{z\min} = M_z + ((1 - \text{sum I.R.}) \times M_{dz})$ $P_{x\min} = P_x$ <p>elif sum I.R. <= 1.0 and I.R. axial < 0.3</p> <p>if (0.3 – I.R. axial) < (1 – sum I.R.)</p> $P_{x\min} = 0.3T_{dg}$ <p>else</p> $P_{x\min} = P_x + ((1 - \text{sum I.R.}) \times T_{dg})$ $M_{z\min} = M_z$ <p>else</p> $P_{x\min} = P_x$ $M_{z\min} = M_z$ <p>Note: AL is the user input for load</p>	$M_{z\min} = 1198.5$ $P_{x\min} = 2268.0$ <p>[Ref. IS 800:2007, Cl.10.7]</p>	
Applied Axial Force (kN)	$P_x = 0.0$	$P_u = \max(P_x, P_{x\min})$ $= \max(0.0, 2268.0)$ $= 2268.0$	



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Date	04 /02 /2021	Client	Dr. Pradyumna M, Bengaluru

Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 110.0$	$V_{y\min} = \min(0.15V_{dy}, 40.0)$ $= \min(0.15 \times 2156.4, 40.0)$ $= 40.0$ $V_u = \max(V_y, V_{y\min})$ $= \max(110.0, 40.0)$ $= 110.0$ [Ref. IS 800:2007, Cl.10.7]	
Applied Moment (kNm)	$M_z = 395.0$	$M_u = \max(M_z, M_{z\min})$ $= \max(395.0, 1198.5)$ $= 1198.5$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Force Carried by Web		$A_w = \text{Axial force in web}$ $= \frac{(D - 2T)tAu}{A}$ $= \frac{(870.0 - 2 \times 20.0) \times 15.0 \times 2268.0}{25200.0}$ $= 1120.5 \text{ kN}$ $M_w = \text{Moment in web}$ $= \frac{Z_w M_u}{Z}$ $= \frac{2583375.0 \times 1198.5}{7990000.0}$ $= 387.51 \text{ kNm}$	



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Check	Required	Provided	Remarks
Force Carried by Flange		$A_f = \text{Axial force in flange}$ $= \frac{AuBT}{A}$ $= \frac{2268.0 \times 300.0 \times 20.0}{25200.0}$ $= 540.0 \text{ kN}$ $M_f = \text{Moment in flange}$ $= Mu - M_w$ $= 1198.5 - 387.51$ $= 810.99 \text{ kNm}$ $F_f = \text{flange force}$ $= \frac{M_f \times 10^3}{D - T} + A_f$ $= \frac{810.99 \times 10^3}{870.0 - 20.0} + 540.0$ $= 1494.11 \text{ kN}$	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 24.0$	
Property Class	Bolt Grade Optimization	8.8	
Bolt Ultimate Strength (N/mm ²)		$f_{ub} = 830.0$	
Bolt Yield Strength (N/mm ²)		$f_{yb} = 660.0$	
Nominal Stress Area (mm ²)		$A_{nb} = 353$ (Ref IS 1367 – 3 (2002))	
Hole Diameter (mm)		$d_0 = 30.0$	
Min. Flange Plate Thickness (mm)	$T/2 = 10.0$	$t_{ifp} = 12.0$	Pass
No. of Bolt Columns		$n_c = 12$	
No. of Bolt Rows		$n_r = 2$	



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Check	Required	Provided	Remarks
Min. Pitch Distance (mm)	$p_{\min} = 2.5d$ $= 2.5 \times 24.0$ $= 60.0$ [Ref. IS 800:2007, Cl.10.2.2]	60	Pass
Max. Pitch Distance (mm)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 12.0, 300)$ $= \min(384.0, 300)$ $= 300$ Where, $t = \min(12.0, 20.0)$ [Ref. IS 800:2007, Cl.10.2.3]	60	Pass
Min. Gauge Distance (mm)	$p_{\min} = 2.5d$ $= 2.5 \times 24.0$ $= 60.0$ [Ref. IS 800:2007, Cl.10.2.2]	0	
Max. Gauge Distance (mm)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 12.0, 300)$ $= \min(384.0, 300)$ $= 300$ Where, $t = \min(12.0, 20.0)$ [Ref. IS 800:2007, Cl.10.2.3]	0	
Min. End Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 30.0$ $= 45.0$ [Ref. IS 800:2007, Cl.10.2.4.2]	45	Pass



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Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 24.0 \times \sqrt{\frac{250}{300}} = 262.91$ $e_2 = 12 \times 20.0 \times \sqrt{\frac{250}{330}} = 208.89$ $e_{\max} = \min(e_1, e_2) = 208.89$ [Ref. IS 800:2007, Cl.10.2.4.3]	45	Pass
Min. Edge Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 30.0$ $= 45.0$ [Ref. IS 800:2007, Cl.10.2.4.2]	56.25	Pass
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 24.0 \times \sqrt{\frac{250}{300}} = 262.91$ $e_2 = 12 \times 20.0 \times \sqrt{\frac{250}{330}} = 208.89$ $e'_{\max} = \min(e_1, e_2) = 208.89$ [Ref. IS 800:2007, Cl.10.2.4.3]	56.25	Pass
Shear Capacity (kN)		$V_{\text{dsb}} = \frac{f_{ub}n_nA_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{830.0 \times 2 \times 353}{1000 \times \sqrt{3} \times 1.25}$ $= 270.65$ [Ref. IS 800:2007, Cl.10.3.3]	



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Check	Required	Provided	Remarks
Kb		$k_b = \min \left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0 \right)$ $= \min \left(\frac{45}{3 \times 30.0}, \frac{60}{3 \times 30.0} - 0.25, \frac{830.0}{490}, 1.0 \right)$ $= \min(0.5, 0.42, 1.69, 1.0)$ $= 0.42$ <p>[Ref. IS 800:2007, Cl.10.3.4]</p>	
Bearing Capacity (kN)		$V_{d_{pb}} = \frac{2.5k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 20.0 \times 490}{1000 \times 1.25}$ $= 138.3$ <p>[Ref. IS 800:2007, Cl.10.3.4]</p>	
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{d_{pb}})$ $= \min (270.65, 138.3)$ $= 138.3$ <p>[Ref. IS 800:2007, Cl.10.3.2]</p>	



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Check	Required	Provided	Remarks
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> <p>$l_j = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$</p> <p>$\beta_{lj} = 1.075 - l/(200d)$</p> <p>but $0.75 \leq \beta_{lj} \leq 1.0$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.1]</p>	<p>$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$</p> <p>$l_r = 2 \times \left(\left(\frac{12}{2} - 1 \right) \times 60 + 45 \right) + 0.0$</p> <p>$= 690.0$</p> <p>$l_c = 2 \times \left(\left(\frac{2}{2} - 1 \right) \times 0 + 56.25 \right)$</p> <p>$+ 30.0) + 15.0 = 187.5$</p> <p>$l = 690.0$</p> <p>$15d = 15 \times 24.0 = 360.0$</p> <p>since, $l \geq 15d$</p> <p>then $V_{rd} = \beta_{lj} \times V_{db}$</p> <p>$\beta_{lj} = 1.075 - 690.0/(200 \times 24.0)$</p> <p>$= 0.93$</p> <p>$V_{rd} = 0.93 \times 138.3 = 128.62$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.1]</p>	
Large Grip Length Reduction Factor	<p>if $l_g \geq 5d$, then $V_{rd} = \beta_{lg} V_{db}$</p> <p>if $l_g < 5d$ then $V_{rd} = V_{db}$</p> <p>$l_g \leq 8d$</p> <p>where,</p> <p>$l_g = \Sigma(t_{ep} + t_{member})$</p> <p>$\beta_{lg} = 8d/(3d + l_g)$</p> <p>but $\beta_{lg} \leq \beta_{lj}$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.2]</p>	<p>$l_g = \Sigma(t_p + t_{member})$</p> <p>$= 44.0$</p> <p>$5d = 120.0$</p> <p>$8d = 192.0$</p> <p>since, $l_g < 5d$; $\beta_{lg} = 1.0$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.2]</p>	



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Check	Required	Provided	Remarks
Capacity (kN)	$V_{res} = \frac{2 \sqrt{V_u^2 + A_u^2}}{bolts_{req}}$ $= \frac{2 \times \sqrt{0.0^2 + 1494.11^2}}{24}$ $= 124.51$	$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$ $= 0.93 \times 1.0 \times 138.3$ $= 128.62$	Pass

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 24.0$	
Property Class	Bolt Grade Optimization	8.8	
Min. Web Plate Thickness (mm)	$t/2 = 7.5$	$t_{wp} = 16.0$	Pass
No. of Bolt Columns		$n_c = 8$	
No. of Bolt Rows		$n_r = 11$	
Min. Pitch Distance (mm)	$p_{min} = 2.5d$ $= 2.5 \times 24.0$ $= 60.0$ [Ref. IS 800:2007, Cl.10.2.2]	60	Pass
Max. Pitch Distance (mm)	$p/g_{max} = \min(32t, 300)$ $= \min(32 \times 15.0, 300)$ $= \min(480.0, 300)$ $= 300$ Where, $t = \min(16.0, 15.0)$ [Ref. IS 800:2007, Cl.10.2.3]	60	Pass
Min. Gauge Distance (mm)	$p_{min} = 2.5d$ $= 2.5 \times 24.0$ $= 60.0$ [Ref. IS 800:2007, Cl.10.2.2]	60	Pass



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Check	Required	Provided	Remarks
Max. Gauge Distance (mm)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 15.0, 300)$ $= \min(480.0, 300)$ $= 300$ <p>Where, $t = \min(16.0, 15.0)$</p> <p>[Ref. IS 800:2007, Cl.10.2.3]</p>	60	Pass
Min. End Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 30.0$ $= 45.0$ <p>[Ref. IS 800:2007, Cl.10.2.4.2]</p>	45	Pass
Max. End Distance (mm)	$e_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 32.0 \times \sqrt{\frac{250}{300}} = 350.54$ $e_2 = 12 \times 15.0 \times \sqrt{\frac{250}{330}} = 156.67$ $e_{\max} = \min(e_1, e_2) = 156.67$ <p>[Ref. IS 800:2007, Cl.10.2.4.3]</p>	45	Pass
Min. Edge Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 30.0$ $= 45.0$ <p>[Ref. IS 800:2007, Cl.10.2.4.2]</p>	45	Pass



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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{\max} = 12t\epsilon; \epsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 32.0 \times \sqrt{\frac{250}{300}} = 350.54$ $e_2 = 12 \times 15.0 \times \sqrt{\frac{250}{330}} = 156.67$ $e'_{\max} = \min(e_1, e_2) = 156.67$ <p>[Ref. IS 800:2007, Cl.10.2.4.3]</p>	45	Pass
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}n_nA_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{830.0 \times 2 \times 353}{1000 \times \sqrt{3} \times 1.25}$ $= 270.65$ <p>[Ref. IS 800:2007, Cl.10.3.3]</p>	
Kb		$k_b = \min \left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0 \right)$ $= \min \left(\frac{45}{3 \times 30.0}, \frac{60}{3 \times 30.0} - 0.25, \frac{830.0}{490}, 1.0 \right)$ $= \min(0.5, 0.42, 1.69, 1.0)$ $= 0.42$ <p>[Ref. IS 800:2007, Cl.10.3.4]</p>	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5k_bdtf_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 15.0 \times 490}{1000 \times 1.25}$ $= 103.72$ <p>[Ref. IS 800:2007, Cl.10.3.4]</p>	
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (270.65, 103.72)$ $= 103.72$ <p>[Ref. IS 800:2007, Cl.10.3.2]</p>	



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Check	Required	Provided	Remarks
Bolt Force Parameter(s) (mm)	l_n = length available $l_n = g (n_r - 1)$ $= 60 \times (11 - 1)$ $= 600$ $y_{\max} = l_n/2$ $= 600/2$ $= 300.0$ $x_{\max} = p(\frac{n_c}{2} - 1)/2$ $= 60 \times (\frac{8}{2} - 1)/2$ $= 90.0$		
Moment Demand (kNm)	$M_d = (V_u \times ecc + M_w)$ ecc = eccentricity M_w = external moment acting on web $= \frac{(110.0 \times 10^3 \times 135.0 + 387.51 \times 10^6)}{10^6}$ $= 402.36$		



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Check	Required	Provided	Remarks
Bolt Force (kN)	$v_b v = V_u / (n_r \times (n_c / 2))$ $= \frac{110.0}{(11 \times (8/2))}$ $= 2.5$ $t_m h = \frac{M_d \times y_{\max}}{\sum r_i^2}$ $= \frac{402.36 \times 300.0}{1782.0}$ $= 67.74$ $t_m v = \frac{M_d \times x_{\max}}{\sum r_i^2}$ $= \frac{402.36 \times 90.0}{1782.0}$ $= 20.32$ $a_b h = \frac{A_u}{(n_r \times n_c / 2)}$ $= \frac{1120.5}{(11 \times (8/2))}$ $= 25.47$ $v_{\text{res}} = \sqrt{(v_b v + t_m v)^2 + (t_m h + a_b h)^2}$ $= \sqrt{(2.5 + 20.32)^2 + (67.74 + 25.47)^2}$ $= 95.96$		



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Check	Required	Provided	Remarks
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>	$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $l_r = 2 \times \left(\left(\frac{8}{2} - 1 \right) \times 60 + 45 \right) + 0.0$ $= 450.0$ $l_c = (11 - 1) \times 60 = 600$ $l = 600$ $15d = 15 \times 24.0 = 360.0$ <p>since, $l \geq 15d$</p> <p>then $V_{rd} = \beta_{lj} \times V_{db}$</p> $\beta_{lj} = 1.075 - 600/(200 \times 24.0)$ $= 0.95$ $V_{rd} = 0.95 \times 103.72 = 98.54$ <p>[Ref. IS 800:2007, Cl.10.3.3.1]</p>	
Large Grip Length Reduction Factor	<p>if $l_g \geq 5d$, then $V_{rd} = \beta_{lg} V_{db}$</p> <p>if $l_g < 5d$ then $V_{rd} = V_{db}$</p> $l_g \leq 8d$ <p>where,</p> $l_g = \Sigma(t_{ep} + t_{member})$ $\beta_{lg} = 8d/(3d + l_g)$ <p>but $\beta_{lg} \leq \beta_{lj}$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.2]</p>	$l_g = \Sigma(t_p + t_{member})$ $= 47.0$ $5d = 120.0$ $8d = 192.0$ <p>since, $l_g < 5d$; $\beta_{lg} = 1.0$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.2]</p>	
Capacity (kN)	95.96	$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$ $= 0.95 \times 1.0 \times 103.72$ $= 98.54$	Pass



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2.5 Flange Plate Dimension Check - Outside/Inside

Check	Required	Provided	Remarks
Min. Flange Plate Width (mm)	min. flange plate height = beam width = 300.0	300.0	Pass
Min. Flange Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min}] + \frac{gap}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{12}{2} - 1) \times 60.0 + \frac{0.0}{2}]$ $= 780.0$	780.0	Pass
Min. Inner Plate Width (mm)	≥ 50	110	Pass
Max. Inner Plate Width (mm)	$= \frac{B - t - (2R1)}{2}$ $= \frac{300.0 - 15.0 - 2 \times 30.0}{2}$ $= 112$	110	Pass
Min. Inner Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min}] + \frac{gap}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{12}{2} - 1) \times 60.0 + \frac{0.0}{2}]$ $= 780.0$	780.0	Pass
Min. Flange Plate Thickness (mm)	$T/2 = 10.0$	$t_{ifp} = 12.0$	Pass
Plate Area Check (mm ²)	plate area \geq 1.05 X connected member area = 6300.0 [Ref: Cl.8.6.3.2, IS 800:2007]	$\text{plate area} = (B_{fp} + (2 \times B_{ifp})) \times t_{ifp}$ $= (300.0 + (2 \times 110)) \times 12.0$ $= 6240.0$	Fail



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2.6 Web Plate Dimension Check

Check	Required	Provided	Remarks
Min. Web Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (870.0 - 2 \times 20.0 - 2 \times 30.0)$ $= 462.0$ [Ref. INSDAG, Ch.5, sec.5.2.3]	690	Pass
Min. Web Plate Width (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min}]$ $+ \frac{gap}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{8}{2} - 1) \times 60.0$ $= + \frac{0.0}{2}]$ $= 540.0$	540.0	Pass
Min. Web Plate Thickness (mm)	$t/2 = 7.5$	$t_{wp} = 16.0$	Pass
Plate Area Check (mm ²)	plate area \geq 1.05 X connected member area $= 13072.5$ [Ref: Cl.8.6.3.2, IS 800:2007]	plate area $= 2 \times W_{wp} \times t_{wp}$ $= 2 \times 690 \times 16.0$ $= 22080.0$	Pass

2.7 Member Check

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 300.0 \times 20.0$ $= \frac{6000.0 \times 330}{1.1 \times 10^3}$ $= 1800.0$ [Ref. IS 800:2007, Cl.6.2]	



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Check	Required	Provided	Remarks
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (300.0 - 2 \times 30.0) \times 20.0 \times 490}{1.25}$ $= 1693.44$ <p>[Ref. IS 800:2007, Cl.6.3.1]</p>	
Flange Block Shear Capacity (kN)		$T_{db11} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{db12} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 2141.56$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Flange Tension Capacity (kN)	$F_f = 1494.11$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(1800.0, 1693.44, 2141.56)$ $= 1693.44$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 830.0 \times 15.0$ $= \frac{12450.0 \times 330}{1.1 \times 10^3}$ $= 3735.0$ <p>[Ref. IS 800:2007, Cl.6.2]</p>	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (830.0 - 11 \times 30.0) \times 15.0 \times 490}{1.25}$ $= 2646.0$ <p>[Ref. IS 800:2007, Cl.6.3.1]</p>	



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Check	Required	Provided	Remarks
Web Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 2994.87$ [Ref. IS 800:2007, Cl.6.4]	
Web Tension Capacity (kN)	$A_w = 1120.5$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(3735.0, 2646.0, 2994.87)$ $= 2646.0$ [Ref. IS 800:2007, Cl.6.1]	Pass

2.8 Flange Plate Capacity Check for Axial Load - Outside/Inside

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 520.0 \times 12.0$ $= \frac{6240.0 \times 300}{1.1 \times 10^3}$ $= 1701.82$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (520.0 - 2 \times 30.0) \times 12.0 \times 440}{1.25}$ $= 1748.74$ [Ref. IS 800:2007, Cl.6.3.1]	



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Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 2316.66$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Flange Plate Tension Capacity (kN)	$F_f = 1494.11$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(1701.82, 1748.74, 2316.66)$ $= 1701.82$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass

2.9 Web Plate Capacity Check for Axial Load

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = 2lt = 2 \times 690 \times 16.0$ $= \frac{11040.0 \times 300}{1.1 \times 10^3}$ $= 6021.82$ <p>[Ref. IS 800:2007, Cl.6.2]</p>	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times 0.9 \times (690 - 11 \times 30.0) \times 16.0 \times 440}{1.25}$ $= 3649.54$ <p>[Ref. IS 800:2007, Cl.6.3.1]</p>	



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Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 5764.88$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Web Plate Tension Capacity (kN)	$A_w = 1120.5$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(6021.82, 3649.54, 5764.88)$ $= 3649.54$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass

2.10 Web Plate Capacity Checks for Shear Load

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{2 \times 690 \times 16.0 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 3476.7$ <p>[Ref. IS 800:2007, Cl.10.4.3]</p>	
Allowable Shear Capacity (kN)	$V = 110.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 3476.7$ $= 2086.02$ <p>[Limited to low shear]</p>	Pass



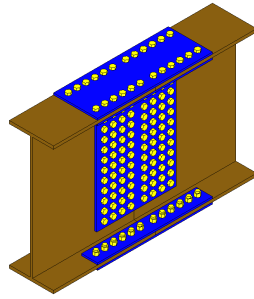
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Check	Required	Provided	Remarks
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75A_{vn}f_u}{\sqrt{3}\gamma_{m1}}$ $= 2 \times \frac{(690 - (11 \times 30.0)) \times 16.0 \times 440}{\sqrt{3} \times 1.25}$ $= 1755.88$ <p>[Ref. AISC, sect. J4]</p>	
Block Shear Capacity (kN)		$V_{db1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 3895.11$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Web Plate Shear Capacity (kN)		$V_d = \min(S_c, V_{dn}, V_{db})$ $= \min(2086.02, 1755.88, 3895.11)$ $= 1755.88$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass

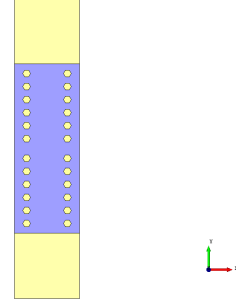


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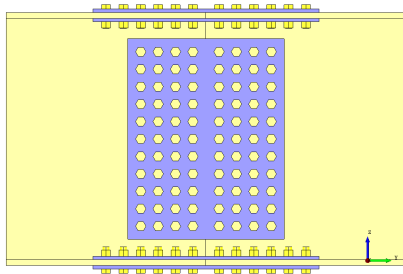
3 3D Views



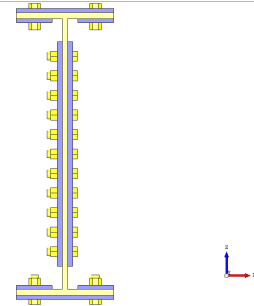
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2021-02-04 13:12:25 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2021-02-04 13:12:25 - Osdag - INFO - The value of load(s) is/are set at minimum recommended value as per IS 800:2007, Cl.10.7.

2021-02-04 13:12:25 - Osdag - INFO - : Overall bolted cover plate splice connection design is safe

2021-02-04 13:12:25 - Osdag - INFO - :=====End Of design=====