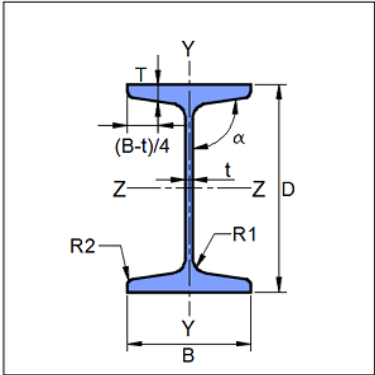




Company Name	IIT Bombay	Project Title	Moment Connection
Group/Team Name	Osdag	Subtitle	Column-to-Column Cover Plate (bolted)
Designer	Engineer#1	Job Number	1.2.3.1.1
Date	04 /02 /2021	Client	Prof. S R Satish Kumar, IIT Madras

1 Input Parameters

Module		Column-to-Column Cover Plate Bolted Connection		
Main Module		Moment Connection		
Bending Moment (kNm)		127.0		
Shear Force (kN)		0.0		
Axial Force (kN)		320.0		
Column Section - Mechanical Properties				
	Beam Section *		HB 300	
	Material		E 300 (Fe 440)	
	Ultimate Strength, F_u (MPa)		440	
	Yield Strength, F_y (MPa)		300	
	Mass, m (kg/m)	58.74	I_z (cm ⁴)	12500.0
	Area, A (cm ²)	74.8	I_y (cm ⁴)	2190.0
	D (mm)	300.0	r_z (cm)	12.9
	B (mm)	250.0	r_y (cm)	5.41
	t (mm)	7.6	Z_z (cm ³)	836.0
	T (mm)	10.6	Z_y (cm ³)	175.0
	Flange Slope	94	Z_{pz} (cm ³)	921.0
	R_1 (mm)	11.0	Z_{py} (cm ³)	291.0
	R_2 (mm)	5.5		
Bolt Details - Input and Design Preference				
Diameter (mm)		[20, 24, 30]		
Property Class		[10.9, 12.9]		
Type		Bearing Bolt		
Bolt Tension		Non pre-tensioned		
Hole Type		Over-sized		
Slip Factor, (μ_f)		0.3		
Detailing - Design Preference				
Edge Preparation Method		Rolled, machine-flame cut, sawn and planed		
Gap Between Columns (mm)		0.0		
Are the Members Exposed to Corrosive Influences?		False		
Plate Details - Input and Design Preference				
Preference		Outside + Inside		



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Material	E 300 (Fe 440)
Ultimate Strength, F_u (MPa)	440
Yield Strength, F_y (MPa)	300
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		Semi-Compact [Ref: Table 2, Cl.3.7.2 and 3.7.4, IS 800:2007]	
Axial Capacity Member (kN)	$P_x = 320.0$	$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{7480.0 \times 300}{1.1 \times 10^3}$ $= 2040.0$ [Ref. IS 800:2007, Cl.6.2]	
Shear Capacity Member (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{m0}}$ $= \frac{278.8 \times 7.6 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 333.64$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	$V_y = 0.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 333.64$ $= 200.18$ [Limited to low shear]	
Plastic Moment Capacity (kNm)		$M_{dz} = \frac{\beta_b Z_p f_y}{\gamma_{m0} \times 10^6}$ $= \frac{0.91 \times 921000.0 \times 300}{1.1 \times 10^6}$ $= 228.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	



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Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$M_{dc} = \frac{1.5Z_e f_y}{\gamma_{m0} \times 10^6}$ $= \frac{1.5 \times 836000.0 \times 300}{1.1 \times 10^6}$ $= 342.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Moment Capacity Member (kNm)	$M_z = 127.0$	$M_{dz} = \min(M_{dz}, M_{dc})$ $= \min(228.0, 342.0)$ $= 228.0$ [Ref. IS 800:2007, Cl.8.2]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		<p>I.R. axial $= P_x / T_{dg}$ $= 320.0 / 2040.0$ $= 0.1569$</p> <p>I.R. moment $= M_z / M_{dz}$ $= 127.0 / 228.0$ $= 0.557$</p> <p>I.R. sum $= \text{I.R. axial} + \text{I.R. moment}$ $= 0.1569 + 0.557$ $= 0.7139$</p>	



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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 $(0.5 - \text{I.R. moment}) < (1 - \text{sum I.R.})$</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 $(0.3 - \text{I.R. axial}) < (1 - \text{sum I.R.})$</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>	$M_{z\min} = 127.0$ $P_{x\min} = 612.0$ <p>[Ref. IS 800:2007, Cl.10.7]</p>	
Applied Axial Force (kN)	$P_x = 320.0$	$P_u = \max(P_x, P_{x\min})$ $= \max(320.0, 612.0)$ $= 612.0$	



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Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 0.0$	$V_{y\min} = \min(0.15V_{dy}, 40.0)$ $= \min(0.15 \times 333.64, 40.0)$ $= 40.0$ $V_u = \max(V_y, V_{y\min})$ $= \max(0.0, 40.0)$ $= 40.0$ [Ref. IS 800:2007, Cl.10.7]	
Applied Moment (kNm)	$M_z = 127.0$	$M_u = \max(M_z, M_{z\min})$ $= \max(127.0, 127.0)$ $= 127.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Force Carried by Web		$A_w = \text{Axial force in web}$ $= \frac{(D - 2T)tA_u}{A}$ $= \frac{(300.0 - 2 \times 10.6) \times 7.6 \times 612.0}{7480.0}$ $= 173.36 \text{ kN}$ $M_w = \text{Moment in web}$ $= \frac{Z_w M_u}{Z}$ $= \frac{98457.29 \times 127.0}{921000.0}$ $= 13.58 \text{ kNm}$	



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Check	Required	Provided	Remarks
Force Carried by Flange		$A_f = \text{Axial force in flange}$ $= \frac{AuBT}{A}$ $= \frac{612.0 \times 250.0 \times 10.6}{7480.0}$ $= 216.82 \text{ kN}$ $M_f = \text{Moment in flange}$ $= Mu - M_w$ $= 127.0 - 13.58$ $= 113.42 \text{ kNm}$ $F_f = \text{flange force}$ $= \frac{M_f \times 10^3}{D - T} + A_f$ $= \frac{113.42 \times 10^3}{300.0 - 10.6} + 216.82$ $= 608.74 \text{ kN}$	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	$d = 24.0$	
Property Class	Bolt Grade Optimisation	10.9	
Bolt Ultimate Strength (N/mm ²)		$f_{ub} = 1040.0$	
Bolt Yield Strength (N/mm ²)		$f_{yb} = 940.0$	
Nominal Stress Area (mm ²)		$A_{nb} = 353 \text{ (Ref IS 1367 - 3 (2002))}$	
Hole Diameter (mm)		$d_0 = 30.0$	
Min. Plate Thickness (mm)	$T/2 = 5.3$	$t_{ifp} = 8.0$	Pass
No. of Bolt Columns		$n_c = 2$	
No. of Bolt Rows		$n_r = 10$	



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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)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 8.0, 300)$ $= \min(256.0, 300)$ $= 256.0$ Where, $t = \min(8.0, 10.6)$ [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)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 8.0, 300)$ $= \min(256.0, 300)$ $= 256.0$ Where, $t = \min(8.0, 10.6)$ [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)	$e_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 10.6 \times \sqrt{\frac{250}{300}} = 116.12$ $e_{\max} = \min(e_1, e_2) = 116.12$ [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]	55.1	Pass
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 10.6 \times \sqrt{\frac{250}{300}} = 116.12$ $e'_{\max} = \min(e_1, e_2) = 116.12$ [Ref. IS 800:2007, Cl.10.2.4.3]	55.1	Pass
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}n_nA_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{1040.0 \times 2 \times 353}{1000 \times \sqrt{3} \times 1.25}$ $= 339.13$ [Ref. IS 800:2007, Cl.10.3.3]	



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Check	Required	Provided	Remarks
Bearing Capacity (kN)		$V_{d_{pb}} = \frac{2.5k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 10.6 \times 440}{1000 \times 1.25}$ $= 65.82$ [Ref. IS 800:2007, Cl.10.3.4]	
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (339.13, 65.82)$ $= 65.82$ [Ref. IS 800:2007, Cl.10.3.2]	
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> [Ref. IS 800:2007, Cl.10.3.3.1]	$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $l_c = 2 \times \left(\left(\frac{10}{2} - 1 \right) \times 60 + 45 \right) + 0.0$ $= 570.0$ $l_r = 2 \times \left(\left(\frac{2}{2} - 1 \right) \times 0 + 55.1 \right)$ $+ 11.0) + 7.6 = 139.8$ $l = 570.0$ $15d = 15 \times 24.0 = 360.0$ <p>since, $l \geq 15d$</p> <p>then $V_{rd} = \beta_{lj} \times V_{db}$</p> $\beta_{lj} = 1.075 - 570.0/(200 \times 24.0)$ $= 0.96$ $V_{rd} = 0.96 \times 65.82 = 63.19$ [Ref. IS 800:2007, Cl.10.3.3.1]	



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Check	Required	Provided	Remarks
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>$= 26.6$</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>	
Capacity (kN)	$V_{res} = \frac{2 \sqrt{V_u^2 + A_u^2}}{bolts_{req}}$ $= \frac{2 \times \sqrt{0.0^2 + 608.74^2}}{20}$ $= 60.87$	<p>$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$</p> <p>$= 0.96 \times 1.0 \times 65.82$</p> <p>$= 63.19$</p>	Pass

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	$d = 24.0$	
Property Class	Bolt Grade Optimisation	10.9	
Min. Plate Thickness (mm)	$t/2 = 3.8$	$t_{wp} = 8.0$	Pass
No. of Bolt Rows		$n_r = 8$	
No. of Bolt Columns		$n_c = 3$	
Min. Pitch Distance (mm)	<p>$p_{min} = 2.5d$</p> <p>$= 2.5 \times 24.0$</p> <p>$= 60.0$</p> <p>[Ref. IS 800:2007, Cl.10.2.2]</p>	60	Pass



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Check	Required	Provided	Remarks
Max. Pitch Distance (mm)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 7.6, 300)$ $= \min(243.2, 300)$ $= 243.2$ <p>Where, $t = \min(8.0, 7.6)$</p> <p>[Ref. IS 800:2007, Cl.10.2.3]</p>	60	Pass
Min. Gauge Distance (mm)	$p_{\min} = 2.5d$ $= 2.5 \times 24.0$ $= 60.0$ <p>[Ref. IS 800:2007, Cl.10.2.2]</p>	60	Pass
Max. Gauge Distance (mm)	$p/g_{\max} = \min(32t, 300)$ $= \min(32 \times 7.6, 300)$ $= \min(243.2, 300)$ $= 243.2$ <p>Where, $t = \min(8.0, 7.6)$</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



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Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 7.6 \times \sqrt{\frac{250}{300}} = 83.25$ $e_{\max} = \min(e_1, e_2) = 83.25$ <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
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 16.0 \times \sqrt{\frac{250}{300}} = 175.27$ $e_2 = 12 \times 7.6 \times \sqrt{\frac{250}{300}} = 83.25$ $e'_{\max} = \min(e_1, e_2) = 83.25$ <p>[Ref. IS 800:2007, Cl.10.2.4.3]</p>	45	Pass
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub}n_nA_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{1040.0 \times 2 \times 353}{1000 \times \sqrt{3} \times 1.25}$ $= 339.13$ <p>[Ref. IS 800:2007, Cl.10.3.3]</p>	



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Check	Required	Provided	Remarks
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.42 \times 24.0 \times 7.6 \times 440}{1000 \times 1.25}$ $= 47.19$ [Ref. IS 800:2007, Cl.10.3.4]	
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (339.13, 47.19)$ $= 47.19$ [Ref. IS 800:2007, Cl.10.3.2]	
Bolt Force Parameter(s) (mm)	$l_n = \text{length available}$ $l_n = g (n_c - 1)$ $= 60 \times (3 - 1)$ $= 450.0$ $y_{max} = l_n / 2$ $= 450.0 / 2$ $= 60.0$ $x_{max} = p(\frac{n_r}{2} - 1) / 2$ $= 60 \times (\frac{8}{2} - 1) / 2$ $= 90.0$		
Moment Demand (kNm)	$M_d = (V_u \times ecc + M_w)$ ecc = eccentricity M_w = external moment acting on web $= \frac{(40.0 \times 10^3 \times 135.0 + 13.58 \times 10^6)}{10^6}$ $= 18.98$		



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Check	Required	Provided	Remarks
Bolt Force (kN)	$v_{bv} = V_u / ((n_r / 2) \times n_c)$ $= \frac{40.0}{(3 \times (8/2))}$ $= 3.33$ $t_{mh} = \frac{M_d \times y_{\max}}{\sum r_i^2}$ $= \frac{18.98 \times 60.0}{82.8}$ $= 13.75$ $t_{mv} = \frac{M_d \times x_{\max}}{\sum r_i^2}$ $= \frac{18.98 \times 90.0}{82.8}$ $= 20.63$ $a_{bh} = \frac{A_u}{((n_r / 2) \times n_c)}$ $= \frac{173.36}{(3 \times (8/2))}$ $= 14.45$ $v_{\text{res}} = \sqrt{(v_{bv} + t_{mv})^2 + (t_{mh} + a_{bh})^2}$ $= \sqrt{(3.33 + 20.63)^2 + (13.75 + 14.45)^2}$ $= 37.0$		



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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>	$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $l_c = 2 \times \left(\left(\frac{8}{2} - 1 \right) \times 60 + 45 \right) + 0.0$ $= 450.0$ $l_r = (3 - 1) \times 60 = 120$ $l = 450.0$ $15d = 15 \times 24.0 = 360.0$ <p>since, $l \geq 15d$</p> <p>then $V_{rd} = \beta_{lj} \times V_{db}$</p> $\beta_{lj} = 1.075 - 450.0/(200 \times 24.0)$ $= 0.98$ $V_{rd} = 0.98 \times 47.19 = 46.25$ <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>	$l_g = \Sigma(t_p + t_{member})$ $= 23.6$ $5d = 120.0$ $8d = 192.0$ <p>since, $l_g < 5d$; $\beta_{lg} = 1.0$</p> <p>[Ref. IS 800:2007, Cl.10.3.3.2]</p>	
Capacity (kN)	37.0	$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$ $= 0.98 \times 1.0 \times 47.19$ $= 46.25$	Pass



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2.5 Flange Plate Dimensions Check - Outside/Inside

Check	Required	Provided	Remarks
Min. Plate Height (mm)	min. flange plate height = beam width = 250.0	250.0	Pass
Min. Plate Length (mm)	$2 \times [2e_{\min} + (\frac{n_r}{2} - 1)p_{\min}] + \frac{\text{gap}}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{10}{2} - 1) \times 60.0 + \frac{0.0}{2}]$ $= 660.0$	660.0	Pass
Min. Inner Plate Width (mm)	≥ 50	110	Pass
Max. Inner Plate Width (mm)	$= \frac{B - t - (2R1)}{2}$ $= \frac{250.0 - 7.6 - 2 \times 11.0}{2}$ $= 110$	110	Pass
Min. Inner Plate Length (mm)	$2 \times [2e_{\min} + (\frac{n_r}{2} - 1)p_{\min}] + \frac{\text{gap}}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{10}{2} - 1) \times 60.0 + \frac{0.0}{2}]$ $= 660.0$	660.0	Fail
Min. Plate Thickness (mm)	$T/2 = 5.3$	$t_{ifp} = 8.0$	Pass
Plate Area Check (mm ²)	plate area $>=$ 1.05 X connected member area = 2782.5 [Ref: Cl.8.6.3.2, IS 800:2007]	plate area $= (B_{fp} + (2 \times B_{ifp})) \times t_{ifp}$ $= (250.0 + (2 \times 110)) \times 8.0$ $= 3760.0$	Pass



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2.6 Web Plate Dimensions Check

Check	Required	Provided	Remarks
Min. Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (300.0 - 2 \times 10.6 - 2 \times 11.0)$ $= 180.0$ [Ref. INSDAG, Ch.5, sec.5.2.3]	210	Pass
Min. Plate Length (mm)	$2 \times [2e_{\min} + (\frac{n_r}{2} - 1)p_{\min}]$ $+ \frac{\text{gap}}{2}$ $= 2 \times [(2 \times 45.0 + (\frac{8}{2} - 1) \times 60.0$ $+ \frac{0.0}{2}]$ $= 540.0$	540.0	Pass
Min. Plate Thickness (mm)	$t/2 = 3.8$	$t_{wp} = 8.0$	Pass
Plate Area Check (mm ²)	plate area \geq 1.05 X connected member area $= 2224.82$ [Ref: Cl.8.6.3.2, IS 800:2007]	plate area $= 2 \times W_{wp} \times t_{wp}$ $= 2 \times 210 \times 8.0$ $= 3360.0$	Pass

2.7 Member Check

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 250.0 \times 10.6$ $= \frac{2650.0 \times 300}{1.1 \times 10^3}$ $= 722.73$ [Ref. IS 800:2007, Cl.6.2]	



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Check	Required	Provided	Remarks
Flange Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (250.0 - 2 \times 30.0) \times 10.6 \times 440}{1.25}$ $= 638.04$ [Ref. IS 800:2007, Cl.6.3.1]	
Flange Block Shear Capacity (kN)		$T_{db11} = \frac{A_{vg} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn} f_u}{\gamma_{m1}}$ $T_{db12} = \frac{0.9A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 900.21$ [Ref. IS 800:2007, Cl.6.4]	
Flange Tension Capacity (kN)	$F_f = 608.74$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(722.73, 638.04, 900.21)$ $= 638.04$ [Ref. IS 800:2007, Cl.6.1]	Pass
Web Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 278.8 \times 7.6$ $= \frac{2118.88 \times 300}{1.1 \times 10^3}$ $= 577.88$ [Ref. IS 800:2007, Cl.6.2]	
Web Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (278.8 - 3 \times 30.0) \times 7.6 \times 440}{1.25}$ $= 454.57$ [Ref. IS 800:2007, Cl.6.3.1]	



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Check	Required	Provided	Remarks
Web Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 675.62$ [Ref. IS 800:2007, Cl.6.4]	
Web Tension Capacity (kN)	$A_w = 173.36$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(577.88, 454.57, 675.62)$ $= 454.57$ [Ref. IS 800:2007, Cl.6.1]	Pass

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

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 470.0 \times 8.0$ $= \frac{3760.0 \times 300}{1.1 \times 10^3}$ $= 1025.45$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times 0.9 \times (470.0 - 2 \times 30.0) \times 8.0 \times 440}{1.25}$ $= 1039.1$ [Ref. IS 800:2007, Cl.6.3.1]	



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Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 1358.81$ [Ref. IS 800:2007, Cl.6.4]	
Flange Plate Tension Capacity (kN)	$F_f = 608.74$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(1025.45, 1039.1, 1358.81)$ $= 1025.45$ [Ref.IS 800:2007, Cl.6.1]	Pass

2.9 Web Plate Capacity Check for Axial Load

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = 2lt = 2 \times 210 \times 8.0$ $= \frac{1680.0 \times 300}{1.1 \times 10^3}$ $= 916.36$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{dn} = \frac{0.9A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times 0.9 \times (210 - 3 \times 30.0) \times 8.0 \times 440}{1.25}$ $= 608.26$ [Ref. IS 800:2007, Cl.6.3.1]	



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Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{dbl1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $T_{dbl2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $T_{db} = \min(T_{db1}, T_{db2}) = 1422.35$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Web Plate Tension Capacity (kN)	$A_w = 173.36$	$T_d = \min(T_{dg}, T_{dn}, T_{db})$ $= \min(916.36, 608.26, 1422.35)$ $= 608.26$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass

2.10 Web Plate Capacity Check for Shear Load

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{2 \times 210 \times 8.0 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 529.06$ <p>[Ref. IS 800:2007, Cl.10.4.3]</p>	
Allowable Shear Capacity (kN)	$V = 0.0$	$V_d = 0.6 V_{dy}$ $= 0.6 \times 529.06$ $= 317.44$ <p>[Limited to low shear]</p>	



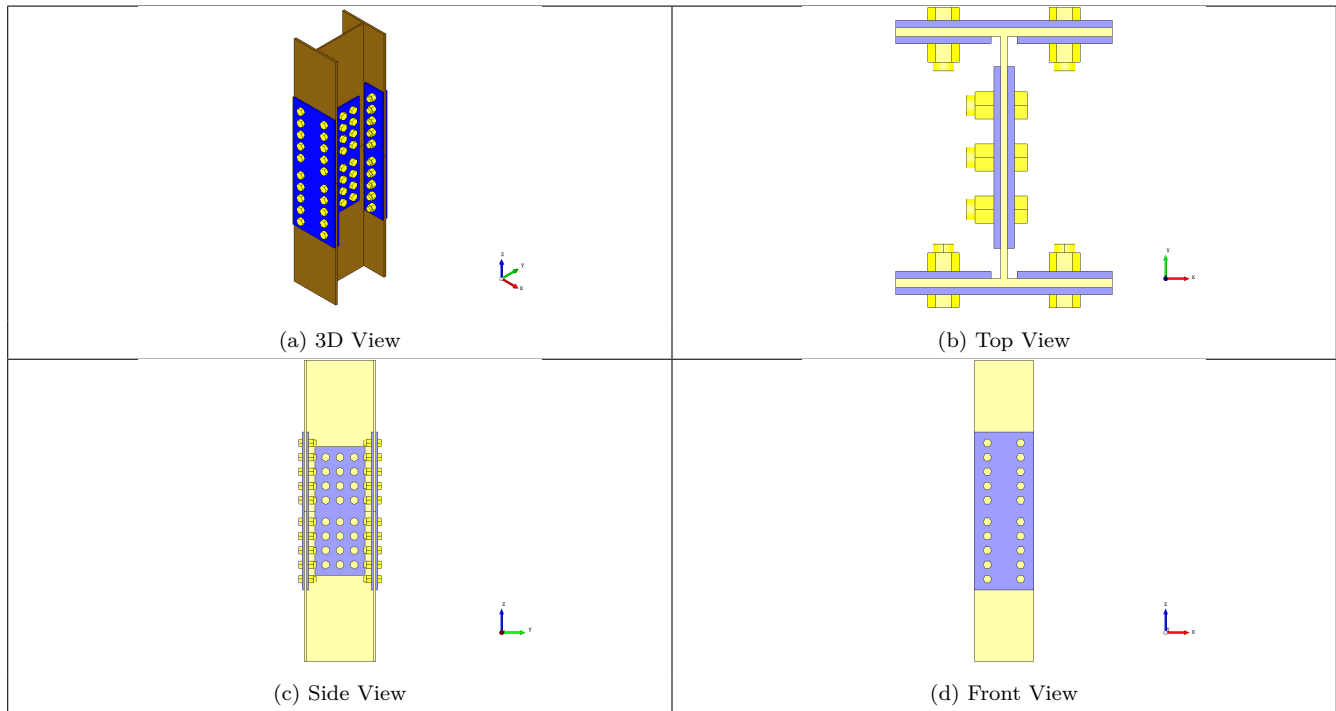
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Check	Required	Provided	Remarks
Shear Rupture Capacity (kN)		$V_{dn} = \frac{0.75A_{vn}f_u}{\sqrt{3}\gamma_{m1}}$ $= 2 \times \frac{(210 - (3 \times 30.0)) \times 8.0 \times 440}{\sqrt{3} \times 1.25}$ $= 292.65$ <p>[Ref. AISC, sect. J4]</p>	
Block Shear Capacity (kN)		$V_{db1} = \frac{A_{vg}f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9A_{tn}f_u}{\gamma_{m1}}$ $V_{db2} = \frac{0.9A_{vn}f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg}f_y}{\gamma_{m0}}$ $V_{db} = \min(V_{db1}, V_{db2}) = 1023.95$ <p>[Ref. IS 800:2007, Cl.6.4]</p>	
Web Plate Shear Capacity (kN)	$V_u = 40.0$	$V_d = \min(S_c, V_{dn}, V_{db})$ $= \min(317.44, 292.65, 1023.95)$ $= 292.65$ <p>[Ref. IS 800:2007, Cl.6.1]</p>	Pass



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3 3D Views



4 Design Log

2021-02-04 14:48:25 - Osdag - WARNING - The defined factored Axial Force is less than the minimum recommended value [Cl.10.7, IS 800:2007]

2021-02-04 14:48:25 - Osdag - INFO - The value of Axial Force is set at 612.0 kN

2021-02-04 14:48:25 - Osdag - INFO - : Overall Bolted Cover Plate Splice Connection design is SAFE

2021-02-04 14:48:25 - Osdag - INFO - : =====End of Design=====