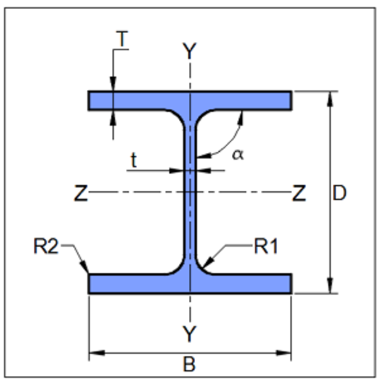
1 Input Parameters

Module	Beam-to-Beam Cover Plate Bolted Connection
Main Module	Moment Connection
Bending Moment (kNm)	300.0
Shear Force (kN)	160.0
Axial Force (kN)	40.0

Beam Section - Mechanical Properties



Beam Section		UB 610 x 305 x 179	
Material		E 300 (Fe 440)	
Ultimate Strength, F_u (MPa)		440	
Yield Strength, F_y (MPa)		290	
Mass, m (kg/m)	179.0	I_z (cm^4)	153024.0
Area, A (cm^2)	22810.0	I_y(cm^4)	11407.0
D (mm)	620.0	r_z (cm)	25.9
B (mm)	307.1	r_y (cm)	7.1
t (mm)	14.1	Z_z (cm^3)	4935.0
T (mm)	23.6	Z_y (cm^3)	743.0
Flange Slope	90	Z_{pz} (cm^3)	5547.0
R_1 (mm)	16.5	Z_{py} (cm^3)	1144.0
R_2 (mm)	0.0		

Bolt Details - Input and Design Preference

Diameter (mm)	[20, 24, 30, 36]
Property Class	[6.8, 8.8, 9.8]
Type	Bearing Bolt
Hole Type	Standard
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
Ultimate Strength, F_u (MPa)	410
Yield Strength, F_y (MPa)	240

Material	E 250 (Fe 410 W)A
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]

2 Design Checks

Design Status	Pass

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)	$P_x = 40.0$	$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{22810.0 \times 290}{1.1 \times 10^3}$ $= 6013.55$ [Ref. IS 800:2007, Cl.6.2]	
Shear Capacity Member (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{572.8 \times 14.1 \times 290}{\sqrt{3} \times 1.1 \times 1000}$ $= 1229.33$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	$V_y = 160.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 1229.33$ $= 737.6$ [Limited to low shear]	Pass
Plastic Moment Capacity (kNm)		$M_{dz} = \frac{\beta_b Z_p fy}{\gamma_{m0} \times 10^6}$ $= \frac{1 \times 5547000.0 \times 290}{1.1 \times 10^6}$ $= 1462.39$ [Ref. IS 800:2007, Cl.8.2.1.2]	

Check	Required	Provided	Remarks
Moment Deformation Criteria (kNm)		$M_{dc} = \frac{1.5 Z_e fy}{\gamma_{m0} \times 10^6}$ $= \frac{1.5 \times 4935000.0 \times 290}{1.1 \times 10^6}$ $= 1951.57$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Moment Capacity Member (kNm)	$M_z = 300.0$	$M_{dz} = \min(M_{dz},\ M_{d_c})$ $= \min(1462.39, 1951.57)$ $= 1462.39$ [Ref. IS 800:2007, Cl.8.2]	

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		I.R. axial $= P_x/T_{dg}$ $= 40.0/6013.55$ $= 0.0067$ I.R. moment $= M_z/M_{dz}$ $= 300.0/1462.39$ $= 0.2051$ I.R. sum $=$ I.R. axial + I.R. moment $= 0.0067 + 0.2051$ $= 0.2118$	

Check	Required	Provided	Remarks
Minimum Required Load	if I.R. axial $<$ 0.3 and I.R. moment $<$ 0.5 $P_{\text{x min}} = 0.3T_{\text{dg}}$ $M_{\text{z min}} = 0.5M_{d\text{z}}$ elif sum I.R. $<=$ 1.0 and I.R. moment $<$ 0.5 if $(0.5 - \text{I.R. moment}) < (1 - \text{sum I.R.})$ $M_{\text{z min}} = 0.5 \times M_{d\text{z}}$ else $M_{\text{z min}} = M_{\text{z}} + ((1 - \text{sum I.R.}) \times M_{d\text{z}})$ $P_{\text{x min}} = P_{\text{x}}$ elif sum I.R. $<=$ 1.0 and I.R. axial $<$ 0.3 if $(0.3 - \text{I.R. axial}) < (1 - \text{sum I.R.})$ $P_{\text{x min}} = 0.3T_{\text{dg}}$ else $P_{\text{x min}} = P_{\text{x}} + ((1 - \text{sum I.R.}) \times T_{\text{dg}})$ $M_{\text{z min}} = M_{\text{z}}$ else $P_{\text{x min}} = P_{\text{x}}$ $M_{\text{z min}} = M_{\text{z}}$ Note: AL is the user input for load	$M_{\text{z min}} = 731.2$ $P_{\text{x min}} = 1804.06$ [Ref. IS 800:2007, Cl.10.7]	
Applied Axial Force (kN)	$P_x = 40.0$	$P_u = \max(P_{\text{x}},\ P_{\text{x min}})$ $= \max(40.0, 1804.06)$ $= 1804.06$	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	$V_y = 160.0$	$V_{y_{\min}} = \min(0.15V_{d_y},\ 40.0)$ $= \min(0.15 \times 1229.33,\ 40.0)$ $= 40.0$ $V_u = \max(V_y,\ V_{y_{\min}})$ $= \max(160.0, 40.0)$ $= 160.0$ [Ref. IS 800:2007, Cl.10.7]	
Applied Moment (kNm)	$M_z = 300.0$	$M_u = \max(M_z,\ M_{z_{\min}})$ $= \max(300.0,\ 731.2)$ $= 731.2$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Force Carried by Web		$A_w =$ Axial force in web $= \frac{(D-2T)tAu}{A}$ $= \frac{(620.0 - 2 \times 23.6) \times 14.1 \times 1804.06}{22810.0}$ $= 638.78$ kN $M_w =$ Moment in web $= \frac{Z_w Mu}{Z}$ $= \frac{1156551.94 \times 731.2}{5547000.0}$ $= 152.45$ kNm	

Check	Required	Provided	Remarks
Force Carried by Flange		A_f = Axial force in flange $= \frac{AuBT}{A}$ $= \frac{1804.06 \times 307.1 \times 23.6}{22810.0}$ $= 573.22$ kN M_f = Moment in flange $= Mu - M_w$ $= 731.2 - 152.45$ $= 578.74$ kNm F_f = flange force $= \frac{M_f \times 10^3}{D-T} + A_f$ $= \frac{578.74 \times 10^3}{620.0 - 23.6} + 573.22$ $= 1543.61$ kN	

2.3 Flange Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 36.0$	
Property Class	Bolt Grade Optimization	6.8	
Bolt Ultimate Strength (N/mm2)		$f_{ub} = 600.0$	
Bolt Yield Strength (N/mm2)		$f_{yb} = 480.0$	
Nominal Stress Area (mm2)		$A_{nb} = 817\ (Ref\ IS\ 1367-3\ (2002))$	
Hole Diameter (mm)		$d_0 = 39.0$	
Min. Flange Plate Thickness (mm)	$T = 23.6$	$t_{fp} = 25.0$	Pass
No. of Bolt Columns		$n_c = 8$	
No. of Bolt Rows		$n_r = 2$	

Check	Required	Provided	Remarks
Min. Pitch Distance (mm)	$p_{min} = 2.5d$ $= 2.5 \times 36.0$ $= 90.0$ [Ref. IS 800:2007, Cl.10.2.2]	90	Pass
Max. Pitch Distance (mm)	$p/g_{max} = \min(32t,\ 300)$ $= \min(32 \times 23.6,\ 300)$ $= \min(755.2,\ 300)$ $= 300$ Where, $t = \min(25.0, 23.6)$ [Ref. IS 800:2007, Cl.10.2.3]	90	Pass
Min. Gauge Distance (mm)	$p_{min} = 2.5d$ $= 2.5 \times 36.0$ $= 90.0$ [Ref. IS 800:2007, Cl.10.2.2]	0	
Max. Gauge Distance (mm)	$p/g_{max} = \min(32t,\ 300)$ $= \min(32 \times 23.6,\ 300)$ $= \min(755.2,\ 300)$ $= 300$ Where, $t = \min(25.0, 23.6)$ [Ref. IS 800:2007, Cl.10.2.3]	0	
Min. End Distance (mm)	$e_{min} = 1.5d_0$ $= 1.5 \times 39.0$ $= 58.5$ [Ref. IS 800:2007, Cl.10.2.4.2]	60	Pass

Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{\max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 25.0 \times \sqrt{\frac{250}{240}} = 306.19$ $e_2 = 12 \times 23.6 \times \sqrt{\frac{250}{290}} = 262.94$ $e_{\max} = \min(e_1,\ e_2) = 262.94$ [Ref. IS 800:2007, Cl.10.2.4.3]	60	Pass
Min. Edge Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 39.0$ $= 58.5$ [Ref. IS 800:2007, Cl.10.2.4.2]	65.0	Pass
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 25.0 \times \sqrt{\frac{250}{240}} = 306.19$ $e_2 = 12 \times 23.6 \times \sqrt{\frac{250}{290}} = 262.94$ $e'_{\max} = min(e_1,\ e_2) = 262.94$ [Ref. IS 800:2007, Cl.10.2.4.3]	65.0	Pass
Shear Capacity (kN)		$V_{\text{dsb}} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{600.0 \times 1 \times 817}{1000 \times \sqrt{3}\ \times\ 1.25}$ $= 226.41$ [Ref. IS 800:2007, Cl.10.3.3]	

Check	Required	Provided	Remarks
Kb		$k_b = \min\left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right)$ $= \min\left(\frac{60}{3 \times 39.0}, \frac{90}{3 \times 39.0} - 0.25, \frac{600.0}{410}, 1.0\right)$ $= \min(0.51, 0.52, 1.46, 1.0)$ $= 0.51$ [Ref. IS 800:2007, Cl.10.3.4]	
Bearing Capacity (kN)		$V_{\text{dpb}} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.51 \times 36.0 \times 25.0 \times 410}{1000 \times 1.25}$ $= 376.38$ [Ref. IS 800:2007, Cl.10.3.4]	
Bolt Capacity (kN)		$V_{\text{db}} = \min\ (V_{\text{dsb}},\ V_{\text{dpb}})$ $= \min\ (226.41,\ 376.38)$ $= 226.41$ [Ref. IS 800:2007, Cl.10.3.2]	

Check	Required	Provided	Remarks
Long Joint Reduction Factor	if $l_j \geq 15d$ then $V_{\text{rd}} = \beta_{lj} V_{\text{db}}$ if $l_j < 15d$ then $V_{\text{rd}} = V_{\text{db}}$ where, $l_j = ((nc \text{ or } nr) - 1) \times (p \text{ or } g)$ $\beta_{lj} = 1.075 - l/(200d)$ but $0.75 \leq \beta_{lj} \leq 1.0$ [Ref. IS 800:2007, Cl.10.3.3.1]	$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $l_r = 2 \times \left(\left(\frac{8}{2} - 1 \right) \times 90 + 60 \right) + 0.0$ $= 660.0$ $l_c = 2 \times \left(\left(\frac{2}{2} - 1 \right) \times 0 + 65.0 \right)$ $+ 16.5) + 14.1 = 177.1$ $l = 660.0$ $15d = 15 \times 36.0 = 540.0$ since, $l \geq 15d$ then $V_{\text{rd}} = \beta_{lj} \times V_{\text{db}}$ $\beta_{lj} = 1.075 - 660.0/(200 \times 36.0)$ $= 0.98$ $V_{\text{rd}} = 0.98 \times 226.41 = 221.89$ [Ref. IS 800:2007, Cl.10.3.3.1]	
Large Grip Length Reduction Factor	if $l_g \geq 5d$, then $V_{\text{rd}} = \beta_{lg} V_{\text{db}}$ if $l_g < 5d$ then $V_{\text{rd}} = V_{\text{db}}$ $l_g \leq 8d$ where, $l_g = \Sigma(t_{\text{ep}} + t_{\text{member}})$ $\beta_{lg} = 8d/(3d + l_g)$ but $\beta_{lg} \leq \beta_{lj}$ [Ref. IS 800:2007, Cl.10.3.3.2]	$l_g = \Sigma\ (t_p + t_{\text{member}})$ $= 48.6$ $5d = 180.0$ $8d = 288.0$ since, $l_g < 5d$; $\beta_{lg} = 1.0$ [Ref. IS 800:2007, Cl.10.3.3.2]	

Check	Required	Provided	Remarks
Capacity (kN)	$V_{res} = \frac{2\sqrt{V_u^2 + A_u^2}}{bolts_{\text{req}}}$ $= \frac{2 \times \sqrt{0.0^2 + 1543.61^2}}{16}$ $= 192.95$	$V_{\text{rd}} = \beta_{lj}\beta_{lg}V_{\text{db}}$ $= 0.98 \times 1.0 \times 226.41$ $= 221.89$	**Pass**

2.4 Web Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 36.0$	
Property Class	Bolt Grade Optimization	6.8	
Min. Web Plate Thickness (mm)	$t/2 = 7.05$	$t_{wp} = 14.0$	**Pass**
No. of Bolt Columns		$n_c = 4$	
No. of Bolt Rows		$n_r = 5$	
Min. Pitch Distance (mm)	$p_{\text{min}} = 2.5d$ $= 2.5 \times 36.0$ $= 90.0$ [Ref. IS 800:2007, Cl.10.2.2]	90	**Pass**
Max. Pitch Distance (mm)	$p/g_{\text{max}} = \min(32t,\ 300)$ $= \min(32 \times 14.0,\ 300)$ $= \min(448.0,\ 300)$ $= 300$ Where, $t = \min(14.0, 14.1)$ [Ref. IS 800:2007, Cl.10.2.3]	90	**Pass**
Min. Gauge Distance (mm)	$p_{\text{min}} = 2.5d$ $= 2.5 \times 36.0$ $= 90.0$ [Ref. IS 800:2007, Cl.10.2.2]	100	**Pass**

Check	Required	Provided	Remarks
Max. Gauge Distance (mm)	$p/g_{\max} = \min(32t,\ 300)$ $= \min(32 \times 14.0,\ 300)$ $= \min(448.0,\ 300)$ $= 300$ Where, $t = \min(14.0, 14.1)$ [Ref. IS 800:2007, Cl.10.2.3]	100	**Pass**
Min. End Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 39.0$ $= 58.5$ [Ref. IS 800:2007, Cl.10.2.4.2]	60	**Pass**
Max. End Distance (mm)	$e_{\max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 28.0 \times \sqrt{\frac{250}{250}} = 336.0$ $e_2 = 12 \times 14.1 \times \sqrt{\frac{250}{290}} = 157.1$ $e_{\max} = \min(e_1,\ e_2) = 157.1$ [Ref. IS 800:2007, Cl.10.2.4.3]	60	**Pass**
Min. Edge Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 39.0$ $= 58.5$ [Ref. IS 800:2007, Cl.10.2.4.2]	60	**Pass**

Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{\max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 28.0 \times \sqrt{\frac{250}{250}} = 336.0$ $e_2 = 12 \times 14.1 \times \sqrt{\frac{250}{290}} = 157.1$ $e'_{\max} = min(e_1,\ e_2) = 157.1$ [Ref. IS 800:2007, Cl.10.2.4.3]	60	**Pass**
Shear Capacity (kN)		$V_{\text{dsb}} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{600.0 \times 2 \times 817}{1000 \times \sqrt{3} \times 1.25}$ $= 452.83$ [Ref. IS 800:2007, Cl.10.3.3]	
Kb		$k_b = \min\left(\frac{e}{3d_0},\ \frac{p}{3d_0} - 0.25,\ \frac{f_{ub}}{f_u},\ 1.0\right)$ $= \min\left(\frac{60}{3 \times 39.0},\ \frac{90}{3 \times 39.0} - 0.25,\ \frac{600.0}{440},\ 1.0\right)$ $= \min(0.51, 0.52, 1.36, 1.0)$ $= 0.51$ [Ref. IS 800:2007, Cl.10.3.4]	
Bearing Capacity (kN)		$V_{\text{dpb}} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.51 \times 36.0 \times 14.1 \times 440}{1000 \times 1.25}$ $= 227.81$ [Ref. IS 800:2007, Cl.10.3.4]	
Bolt Capacity (kN)		$V_{\text{db}} = \min\ (V_{\text{dsb}},\ V_{\text{dpb}})$ $= \min\ (452.83,\ 227.81)$ $= 227.81$ [Ref. IS 800:2007, Cl.10.3.2]	

Check	Required	Provided	Remarks
Bolt Force Parameter(s) (mm)	l_n = length available $l_n = g\ (n_r - 1)$ $= 100 \times (5 - 1)$ $= 400$ $y_{\text{max}} = l_n/2$ $= 400/2$ $= 200.0$ $x_{\text{max}} = p(\frac{n_c}{2} - 1)/2$ $= 90 \times (\frac{4}{2} - 1)/2$ $= 45.0$		
Moment Demand (kNm)	$M_d = (V_u \times \text{ecc} + M_w)$ ecc = eccentricity M_w = external moment acting on web $= \frac{(160.0 \times 10^3 \times 105.0 + 152.45 \times 10^6)}{10^6}$ $= 169.25$		

Check	Required	Provided	Remarks
Bolt Force (kN)	$vbv = V_u/(n_r \times (n_c/2)) = \frac{160.0}{(5 \times (4/2))} = 16.0$ $tmh = \frac{M_d \times y_{\max}}{\Sigma r_i^2} = \frac{169.25 \times 200.0}{220.25} = 153.69$ $tmv = \frac{M_d \times x_{\max}}{\Sigma r_i^2} = \frac{169.25 \times 45.0}{220.25} = 34.58$ $abh = \frac{A_u}{(n_r \times n_c/2)} = \frac{638.78}{(5 \times (4/2))} = 63.88$ $v_{\text{res}} = \sqrt{(vbv + tmv)^2 + (tmh + abh)^2} = \sqrt{(16.0 + 34.58)^2 + (153.69 + 63.88)^2} = 223.37$		

Check	Required	Provided	Remarks
Long Joint Reduction Factor	if $l_j \geq 15d$ then $V_{\rm rd} = \beta_{lj} V_{\rm db}$ if $l_j < 15d$ then $V_{\rm rd} = V_{\rm db}$ where, $l_j = ((nc \text{ or } nr) - 1) \times (p \text{ or } g)$ $\beta_{lj} = 1.075 - l/(200d)$ but $0.75 \leq \beta_{lj} \leq 1.0$ [Ref. IS 800:2007, Cl.10.3.3.1]	$l = ((n_c \text{ or } n_r) - 1) \times (p \text{ or } g)$ $l_r = 2 \times \left(\left(\frac{4}{2} - 1\right) \times 90 + 60\right) + 0.0$ $= 300.0$ $l_c = (5 - 1) \times 100 = 400$ $l = 400$ $15d = 15 \times 36.0 = 540.0$ since, $l < 15d$ then, $V_{\rm rd} = V_{\rm db}$ $V_{\rm rd} = 227.81$ [Ref. IS 800:2007, Cl.10.3.3.1]	
Large Grip Length Reduction Factor	if $l_g \geq 5d$, then $V_{\rm rd} = \beta_{lg} V_{\rm db}$ if $l_g < 5d$ then $V_{\rm rd} = V_{\rm db}$ $l_g \leq 8d$ where, $l_g = \Sigma(t_{\rm ep} + t_{\rm member})$ $\beta_{lg} = 8d/(3d + l_g)$ but $\beta_{lg} \leq \beta_{lj}$ [Ref. IS 800:2007, Cl.10.3.3.2]	$l_g = \Sigma\ (t_p + t_{\rm member})$ $= 42.1$ $5d = 180.0$ $8d = 288.0$ since, $l_g < 5d$; $\beta_{lg} = 1.0$ [Ref. IS 800:2007, Cl.10.3.3.2]	
Capacity (kN)	223.37	$V_{\rm rd} = \beta_{lj} \beta_{lg} V_{\rm db}$ $= 1.0 \times 1.0 \times 227.81$ $= 227.81$	Pass

2.5 Flange Plate Dimension Check - Outside

Check	Required	Provided	Remarks
Min. Flange Plate Width (mm)	min. flange plate height = beam width $= 307.1$	307.1	Pass
Min. Flange Plate Length (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 58.5 + (\frac{8}{2} - 1) \times 90.0$ $= + \frac{0.0}{2}]$ $= 774.0$	780.0	Pass
Min. Flange Plate Thickness (mm)	$T = 23.6$	$t_{fp} = 25.0$	Pass
Plate Area Check (mm2)	plate area >= 1.05 X connected member area $= 7609.94$ [Ref: Cl.8.6.3.2, IS 800:2007]	plate area $= B_{fp} \times t_{ifp}$ $= 307.1 \times 25.0$ $= 7677.500000000001$	Pass

2.6 Web Plate Dimension Check

Check	Required	Provided	Remarks
Min. Web Plate Height (mm)	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (620.0 - 2 \times 23.6 - 2 \times 16.5)$ $= 323.88$ [Ref. INSDAG, Ch.5, sec.5.2.3]	520	Pass

Check	Required	Provided	Remarks
Min. Web Plate Width (mm)	$2 \times [2e_{min} + (\frac{n_c}{2} - 1) \times p_{min})]$ $+ \frac{gap}{2}]$ $= 2 \times [(2 \times 58.5 + (\frac{4}{2} - 1) \times 90.0$ $= + \frac{0.0}{2}]$ $= 414.0$	420.0	**Pass**
Min. Web Plate Thickness (mm)	$t/2 = 7.05$	$t_{wp} = 14.0$	**Pass**
Plate Area Check (mm2)	plate area >= 1.05 X connected member area $= 8480.3$ [Ref: Cl.8.6.3.2, IS 800:2007]	plate area $= 2 \times W_{wp} \times t_{wp}$ $= 2 \times 520 \times 14.0$ $= 14560.0$	**Pass**

2.7 Member Check

Check	Required	Provided	Remarks
Flange Tension Yielding Capacity (kN)		$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 307.1 \times 23.6$ $= \frac{7247.56 \times 290}{1.1 \times 10^3}$ $= 1910.72$ [Ref. IS 800:2007, Cl.6.2]	
Flange Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times \ 0.9 \times (307.1 - 2 \times 39.0) \times 23.6 \times 440}{1.25}$ $= 1712.86$ [Ref. IS 800:2007, Cl.6.3.1]	

Check	Required	Provided	Remarks
Flange Block Shear Capacity (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 2479.34$ [Ref. IS 800:2007, Cl.6.4]	
Flange Tension Capacity (kN)	$F_f = 1543.61$	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(1910.72, 1712.86, 2479.34)$ $= 1712.86$ [Ref.IS 800:2007, Cl.6.1]	Pass
Web Tension Yielding Capacity (kN)		$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 572.8 \times 14.1$ $= \frac{8076.48 \times 290}{1.1 \times 10^3}$ $= 2129.25$ [Ref. IS 800:2007, Cl.6.2]	
Web Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (572.8 - 5 \times 39.0) \times 14.1 \times 440}{1.25}$ $= 1687.59$ [Ref. IS 800:2007, Cl.6.3.1]	

Check	Required	Provided	Remarks
Web Block Shear Capacity (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 2001.78$ [Ref. IS 800:2007, Cl.6.4]	
Web Tension Capacity (kN)	$A_w = 638.78$	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(2129.25, 1687.59, 2001.78)$ $= 1687.59$ [Ref.IS 800:2007, Cl.6.1]	**Pass**

2.8 Flange Plate Capacity Check for Axial Load - Outside

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 307.1 \times 25.0$ $= \frac{7677.5 \times 240}{1.1 \times 10^3}$ $= 1675.09$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{1 \times\ 0.9 \times (307.1 - 2 \times 39.0) \times 25.0 \times 410}{1.25}$ $= 1690.76$ [Ref. IS 800:2007, Cl.6.3.1]	

Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 2358.04$ [Ref. IS 800:2007, Cl.6.4]	
Flange Plate Tension Capacity (kN)	$F_f = 1543.61$	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(1675.09, 1690.76, 2358.04)$ $= 1675.09$ [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)		$T_{\text{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = 2lt = 2 \times 520 \times 14.0$ $= \frac{7280.0 \times 250}{1.1 \times 10^3}$ $= 3309.09$ [Ref. IS 800:2007, Cl.6.2]	
Tension Rupture Capacity (kN)		$T_{\text{dn}} = \frac{0.9 A_n f_u}{\gamma_{m1}}$ $= \frac{2 \times\ 0.9 \times (520 - 5 \times 39.0) \times 14.0 \times 410}{1.25}$ $= 2686.32$ [Ref. IS 800:2007, Cl.6.3.1]	

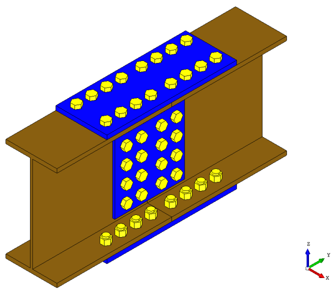
Check	Required	Provided	Remarks
Block Shear Capacity (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 3614.96$ [Ref. IS 800:2007, Cl.6.4]	
Web Plate Tension Capacity (kN)	$A_w = 638.78$	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}},\ T_{\text{db}})$ $= \min(3309.09, 2686.32, 3614.96)$ $= 2686.32$ [Ref.IS 800:2007, Cl.6.1]	Pass

2.10 Web Plate Capacity Checks for Shear Load

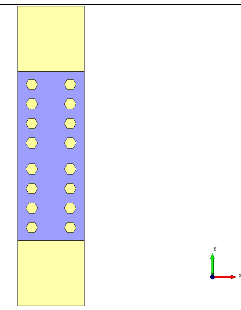
Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{2 \times 520 \times 14.0 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 1910.5$ [Ref. IS 800:2007, Cl.10.4.3]	
Allowable Shear Capacity (kN)	$V = 160.0$	$V_d = 0.6\ V_{dy}$ $= 0.6 \times 1910.5$ $= 1146.3$ [Limited to low shear]	Pass

Check	Required	Provided	Remarks
Shear Rupture Capacity (kN)		$V_{d_n} = \frac{0.75 A_{v_n} f_u}{\sqrt{3}\gamma_{m1}}$ $= 2 \times \frac{(520 - (5 \times 39.0)) \times 14.0 \times 410}{\sqrt{3} \times 1.25}$ $= 1292.46$ [Ref. AISC, sect. J4]	
Block Shear Capacity (kN)		$V_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $V_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $V_{\text{db}} = \min(V_{db1},\ V_{db2}) = 2312.22$ [Ref. IS 800:2007, Cl.6.4]	
Web Plate Shear Capacity (kN)		$V_d = \min(S_c,\ V_{d_n},\ V_{d_b})$ $= \min(1146.3,\ 1292.46,\ 2312.22)$ $= 1146.3$ [Ref. IS 800:2007, Cl.6.1]	Pass

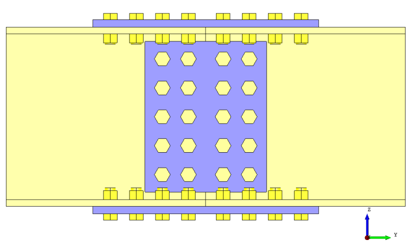
3 3D Views



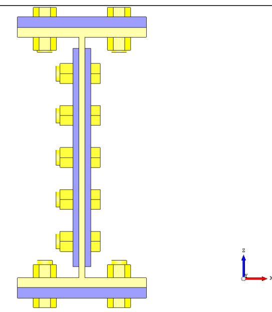
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2021-02-04 13:10:09 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2021-02-04 13:10:09 - 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 13:10:09 - Osdag - INFO - : Overall bolted cover plate splice connection design is safe
2021-02-04 13:10:09 - Osdag - INFO - :=========End Of design===========