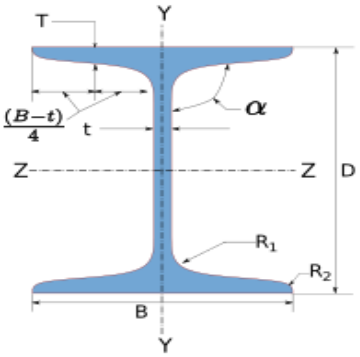
		Created with Osdag®	
Company Name		Project Title	column to column end plate connection
Group/Team Name		Subtitle	
Designer		Job Number	
Date	21 /01 /2025	Client	

1 Input Parameters

Module			Column-to-Column End Plate Connection	
Main Module			Moment Connection	
Bending Moment (kNm) *			43.0	
Shear Force (kN) *			43.0	
Axial Force (kN)			43.0	
Column Section - Mechanical Properties				
	Beam Section *		HB 450*	
	Material *		E 165 (Fe 290)	
	Ultimate Strength, F_u (MPa)		290	
	Yield Strength, F_y (MPa)		165	
	Mass, m (kg/m)	92.19	I_z (cm^4)	40100.0
	Area, A (cm^2)	117.0	I_y(cm^4)	2990.0
	D (mm)	450.0	r_z (cm)	18.4
	B (mm)	250.0	r_y (cm)	5.04
	t (mm)	11.3	Z_z (cm^3)	1780.0
	T (mm)	13.7	Z_y (cm^3)	239.0
	Flange Slope	94	Z_{pz} (cm^3)	2020.0
	R_1 (mm)	15.0	Z_{py} (cm^3)	398.0
	R_2 (mm)	7.5		
Bolt Details - Input and Design Preference				
Diameter (mm) *			[8, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 42, 45, 48, 52, 56, 60, 64]	
Property Class *			[3.6, 4.6, 4.8, 5.6, 5.8, 6.8, 8.8, 9.8, 10.9, 12.9]	
Type *			Bearing Bolt	
Bolt Tension			Non pre-tensioned	
Hole Type			Standard	
Slip Factor, (μ_f)			0.3	
Detailing - Design Preference				
Edge Preparation Method			Sheared or hand flame cut	
Are the Members Exposed to Corrosive Influences?			False	

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)	43	$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{11700.0 \times 165}{1.1 \times 10^3}$ $= 1755.0$ [Ref. IS 800:2007, Cl.6.2]	Pass
Shear Capacity Member (kN)	43	$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{422.6 \times 11.3 \times 165}{\sqrt{3} \times 1.1 \times 1000}$ $= 413.56$ [Ref. IS 800:2007, Cl.10.4.3]	Pass
Plastic Moment Capacity (kNm)		$M_{dz} = \frac{\beta_b Z_p fy}{\gamma_{m0}}$ $= \frac{1 \times 2020000.0 \times 165}{1.1 \times 10^6}$ $= 303.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Moment Deformation Criteria (kNm)		$M_{dc} = \frac{1.5 Z_e fy}{\gamma_{m0} \times 10^6}$ $= \frac{1.5 \times 1780000.0 \times 165}{1.1 \times 10^6}$ $= 400.5$ [Ref. IS 800:2007, Cl.8.2.1.2]	

Check	Required	Provided	Remarks
Moment Capacity Member (kNm)	43	$M_{d_z} = \min(M_{d_z},\ M_{d_c})$ $= \min(303.0, 400.5)$ $= 303.0$ [Ref. IS 800:2007, Cl.8.2]	**Pass**

2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		I.R. axial $= P_x/T_{dg}$ $= 43.0/1755.0$ $= 0.02$ I.R. moment $= M_z/M_{d_z}$ $= 43.0/303.0$ $= 0.14$ I.R. sum $=$ I.R. axial + I.R. moment $= 0.02 + 0.14$ $= 0.17$	

Check	Required	Provided	Remarks
Minimum Required Load	if I.R. axial < 0.3 and I.R. moment < 0.5 $P_{x\min} = 0.3T_{dg}$ $M_{z\min} = 0.5M_{dz}$ elif sum I.R. <= 1.0 and I.R. moment < 0.5 if $(0.5 - \text{I.R. moment}) < (1 - \text{sum I.R.})$ $M_{z\min} = 0.5 \times M_{dz}$ else $M_{z\min} = M_z + ((1 - \text{sum I.R.}) \times M_{dz})$ $P_{x\min} = P_x$ elif sum I.R. <= 1.0 and I.R. axial < 0.3 if $(0.3 - \text{I.R. axial}) < (1 - \text{sum I.R.})$ $P_{x\min} = 0.3T_{dg}$ else $P_{x\min} = P_x + ((1 - \text{sum I.R.}) \times T_{dg})$ $M_{z\min} = M_z$ else $P_{x\min} = P_x$ $M_{z\min} = M_z$ Note: AL is the user input for load	$M_{z\min} = 151.5$ $P_{x\min} = 526.5$ [Ref. IS 800:2007, Cl.10.7]	
Applied Axial Force (kN)	43.0	$P_u = \max(P_x,\ P_{x\min})$ $= \max(43.0, 526.5)$ $= 526.5$	

Check	Required	Provided	Remarks
Applied Shear Force (kN)	43.0	$V_{y_{\min}} = \min(0.15V_{d_y},\ 40.0)$ $= \min(0.15 \times 689.27,\ 40.0)$ $= 40.0$ $V_u = \max(V_y,\ V_{y_{\min}})$ $= \max(43.0, 40.0)$ $= 43.0$ [Ref. IS 800:2007, Cl.10.7]	
Applied Moment (kNm)	43.0	$M_u = \max(M_z,\ M_{z\min})$ $= \max(43.0,\ 151.5)$ $= 151.5$ [Ref. IS 800:2007, Cl.8.2.1.2]	

2.3 Bolt Check

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimization	$d = 27.0$	
Property Class	Bolt Grade Optimization	5.6	
Hole Diameter (mm)		$d_0 = 30.0$	
No. of Bolts (along one side of the web) (n)	$n_{bw} = 2 \times (\frac{D - (2 \times T_f) - (2 \times e)}{p} + 1)$ $= 2 \times (\frac{450.0 - (2 \times 13.7) - (2 \times 55)}{67.5} + 1)$ $= 10$	10	**Pass**
No. of Bolts (along one side of the flange overhang) (n)	$n_{bf} = 2 \times (\frac{b/2 - (T_w/2) - (2 \times e)}{p} + 1)$ $= 2 \times (\frac{250.0/2 - (0.5 \times 11.3) - (2 \times 55)}{67.5} + 1)$ $= 2$	2	**Pass**
Total No. of Bolts		10	

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3}\gamma_{mb}}$ $= \frac{500.0 \times 1 \times 459}{1000 \times \sqrt{3} \times 1.25}$ $= 106.0$ [Ref. IS 800:2007, Cl.10.3.3]	
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.53 \times 27.0 \times 56.0 \times 290}{1000 \times 1.25}$ $= 464.79$ [Ref. IS 800:2007, Cl.10.3.4]	
Capacity (kN)	$V_{sb} = \frac{V}{n_{wb}}$ $= \frac{43.0}{10}$ $= 4.3$	$V_{db} = \min(V_{dsb}, V_{dpb})$ $= \min(106.0, 464.79)$ $= 106.0$ [Ref. IS 800:2007, Cl.10.3.2]	**Pass**
Tension due to Moment and Axial Force (kN)	$T_1 = \frac{P}{n} + \frac{M \times y_{max}}{y_{sqr}}$ $= \frac{526.5 \times 10^3}{10} + \frac{151500.0 \times 10^6 \times 374.45}{605154.75}$ $= 146.39$		

Check	Required	Provided	Remarks
Prying force (kN)	$Q = \frac{l_v}{2l_e}\left[T_e - \frac{\beta\eta f_o b_e t^4}{27 l_e l_v^2}\right]$ $l_v = e - t_w$ $= 55 - 0 = 55$ mm $f_o = 0.7 f_{ub}$ $= 0.7 \times 500.0$ $= 350.0$ N/mm^2 $l_e = \min\left(e, 1.1t\sqrt{\frac{\beta f_o}{f_y}}\right)$ $= \min\left(55, 1.1 \times 56.0 \times \sqrt{\frac{2 \times 350.0}{165}}\right)$ $= \min(55,\ 89.72) = 55$ mm $\beta = 2$ (non pre-tensioned bolt) $\eta = 1.5$ $b_e = \frac{B}{n_c}$ $= \frac{250.0}{2} = 125.0$ mm $Q = \frac{55}{2 \times 55} \times$ $\left[146.39 - \left(\frac{2 \times 1.5 \times 350.0 \times 125.0 \times 56.0^4}{27 \times 55 \times 55^2}\right) \times 10^{-3}\right]$ $Q = 2.72$ [Ref. IS 800:2007, Cl.10.4.7]		OK

Check	Required	Provided	Remarks
Tension demand (kN)	$T_b = T_1 + Q$ $= 146 + 2.72$ $= 149.11$	$T_{\text{db}} = 0.90 f_{ub} A_n \ / \ \gamma_{mb}$ $< \ f_{yb} A_{sb} (\gamma_{mb} \ / \ \gamma_{m0})$ $= \min\left(0.90 \times 500.0 \times 459 \ / \ 1.25,\right.$ $\left. 300.0 \times 573 \times (1.25/1.1)\right)$ $= \min(165.24,\ 195.34)$ $= 156.27$ [Ref. IS 800:2007, Cl.10.3.5]	**Pass**
Min. Pitch Distance (mm)	$p_{\min} = 2.5d$ $= 2.5 \times 27.0$ $= 67.5$ [Ref. IS 800:2007, Cl.10.2.2]	67.5	**Pass**
Max. Pitch Distance (mm)	$p/g_{\max} = \min(32t,\ 300)$ $= \min(32 \times 56.0,\ 300)$ $= \min(1792.0,\ 300)$ $= 300$ Where, $t = \min(56.0, 56.0)$ [Ref. IS 800:2007, Cl.10.2.3]	67.5	**Pass**
Min. End Distance (mm)	$e_{\min} = 1.7 d_0$ $= 1.7 \times 30.0$ $= 51.0$ [Ref. IS 800:2007, Cl.10.2.4.2]	55	**Pass**

Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{max} = 12t\varepsilon;\ \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 56.0 \times \sqrt{\frac{250}{165}} = 827.17$ $e_2 = 12 \times 56.0 \times \sqrt{\frac{250}{165}} = 827.17$ $e_{max} = \min(e_1,\ e_2) = 827.17$ [Ref. IS 800:2007, Cl.10.2.4.3]	55	**Pass**

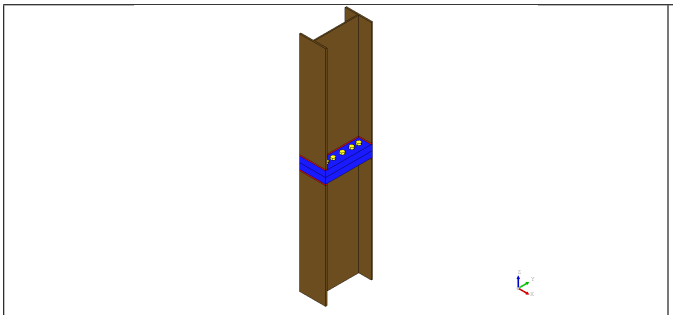
2.4 End Plate Checks

Check	Required	Provided	Remarks
Min. Plate Length (mm)	450.0	450.0	**Pass**
Min. Plate Height (mm)	250.0	250.0	**Pass**
Min. Plate Thickness (mm)	$t_p = max\left(\sqrt{\frac{4M_{cr}}{b_{eff}(f_y/\gamma_{m0})}},\ \sqrt[4]{\left(T_1 - \frac{2Ql_e}{l_v}\right) \times \left(\frac{27l_e l_v^2}{\beta\eta f_o b_e}\right)}\right)$ $= max\left(\sqrt{\frac{4 \times 7.12 \times 10^6}{67 \times (165/1.1)}},\ \sqrt[4]{\left(146393.25 - \frac{2 \times 2.72 \times 55}{55}\right) \times \left(\frac{27 \times 55 \times 55^2}{2 \times 1.5 \times 350.0 \times 125.0}\right)}\right)$ $= 56.0$	56.0	
Moment Capacity (kNm)	M_{ep} = max (0.5 X Tension in first bolt X end distance, Tension in second bolt X end distance) $= \max(0.5T_b 1e,\ T_b 2e)$ $= \max(0.5 \times 146393.25 \times 55,\ 129494.68 \times 55$ $= 7.12$	$M_{dp} = \frac{b_{\text{eff}} t_p^2 f_y}{4\gamma_{m0}}$ $= \frac{67.5 \times 56.0^2 \times 165}{4 \times 1.1}$ $= 7.94$	**Pass**

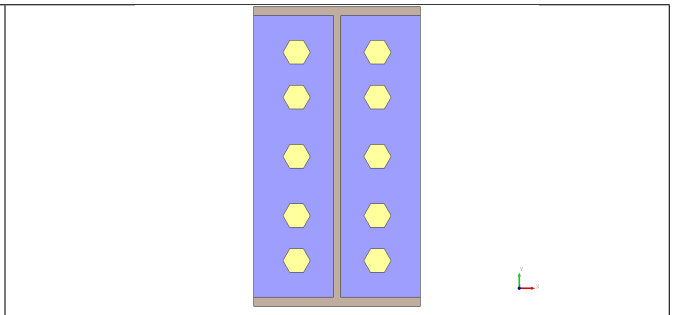
2.5 Bolt Checks

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Quantity Optimisation	The number of bolts for given bolt size(s) are not sufficient to cater for the given section and loads combination.	

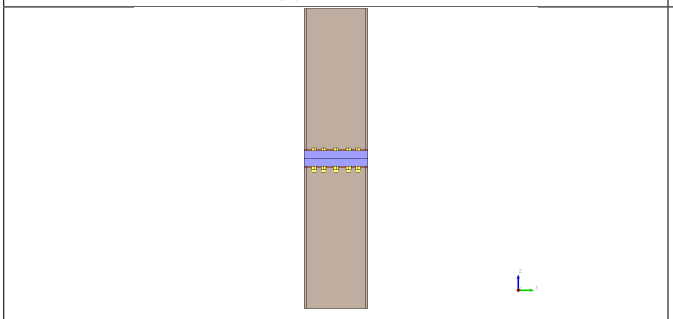
3 3D Views



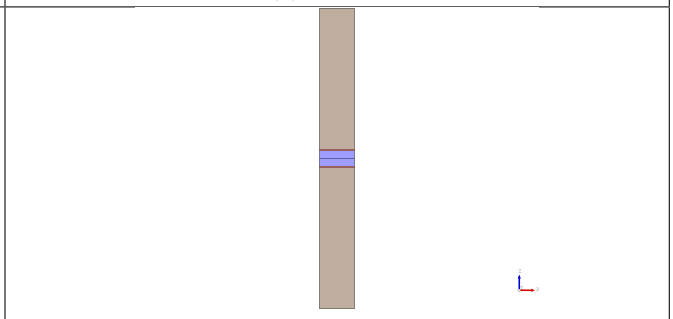
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

2025-01-21 20:23:05 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].
2025-01-21 20:23:05 - Osdag - INFO - The value of load(s) is/are set at minimum recommended value as per IS 800:2007, Cl.10.7.
2025-01-21 20:23:05 - Osdag - INFO - : Overall Column End Plate connection design is SAFE
2025-01-21 20:23:05 - Osdag - INFO - :==========End Of design==========