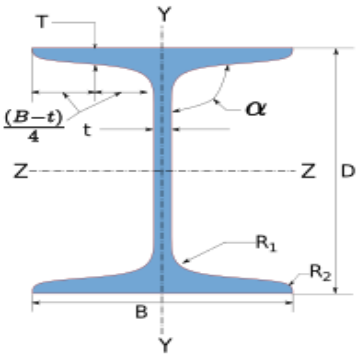
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.2
Date	18 /12 /2020	Client	Yogesh D Pisal, Aker Powergas, Mumbai

1 Input Parameters

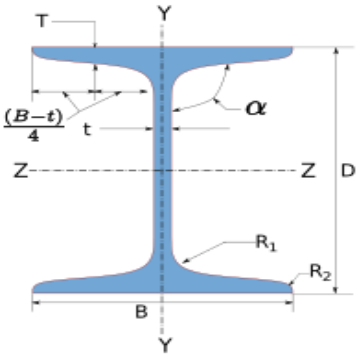
Main Module	Moment Connection
Module	Beam-Column End Plate
Connectivity	Column Flange-Beam Web
End Plate Type	Extended Both Ways - Reversible Moment
Bending Moment (kNm)	90.0
Shear Force (kN)	45.0
Axial Force (kN)	10.0

Column Section - Mechanical Properties



Column Section		HB 300	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, Fu (MPa)		410	
Yield Strength, Fy (MPa)		250	
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		

Beam Section - Mechanical Properties



Beam Section		LB(P) 300	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, Fu (MPa)		410	
Yield Strength, Fy (MPa)		250	
Mass, m (kg/m)	41.5	I_z (cm^4)	8140.0
Area, A (cm^2)	52.8	I_y(cm^4)	414.0
D (mm)	300.0	r_z (cm)	12.4
B (mm)	140.0	r_y (cm)	2.79
t (mm)	7.0	Z_z (cm^3)	542.0
T (mm)	11.6	Z_y (cm^3)	59.2
Flange Slope	98	Z_{pz} (cm^3)	614.0

Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.2
Date	18 /12 /2020	Client	Yogesh D Pisal, Aker Powergas, Mumbai

	R_1 (mm)	15.0	Z_{py} (cm^3)	101.0
	R_2 (mm)	7.5		
Plate Details - Input and Design Preference				
Thickness (mm)		[18]		
Material		E 250 (Fe 410 W)A		
Ultimate Strength, Fu (MPa)		410		
Yield Strength, Fy (MPa)		250		
Bolt Details - Input and Design Preference				
Diameter (mm)		[20]		
Property Class		[8.8]		
Type		Friction Grip Bolt		
Bolt Tension		Pre-tensioned		
Hole Type		Standard		
Slip Factor, (mu_f)		0.33		
Weld Details - Input and Design Preference				
Type of Weld Fabrication		Shop Weld		
Material Grade Overwrite, f_u (MPa)		410.0		
Beam Flange to End Plate		Groove Weld		
Beam Web to End Plate		Fillet Weld		
Stiffener		Fillet Weld		
Continuity Plate		Fillet Weld		
Detailing - Design Preference				
Edge Preparation Method		Rolled, machine-flame cut, sawn and planed		
Gap Between Members (mm)		0.0		
Are the Members Exposed to Corrosive Influences?		False		

2 Design Checks

Design Status	Fail

2.1 Beam to Column - Compatibility Check

Check	Required	Provided	Remarks
Beam Section Compatibility	$B_{req} = B_b + 25$ $= 140.0 + 25$ $= 165.0$	$B_{available} = B_c$ $= 250.0$	**Compatible**

2.2 Member Capacity - Supported Section

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dy} = \frac{A_v\ f_y}{\sqrt{3}\ \gamma_{mo}}$ $= \frac{0.6 \times 276.8 \times 7.0 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 152.55$ $[Ref. IS\ 800 : 2007, Cl. 10.4.3]$	**Restricted to low shear**
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} fy}{\gamma_{mo}}$ $= \frac{1.0 \times 614000.0 \times 250}{1.1 \times 10^6}$ $= 139.55$ $[Ref.\ IS\ 800 : 2007,\ Cl.\ 8.2.1.2]$	**V < 0.6 Vdy**

2.3 Member Capacity - Supporting Section

Check	Required	Provided	Remarks

Check	Required	Provided	Remarks
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} fy}{\gamma_{mo}}$ $= \frac{0.91 \times 921000.0 \times 250}{1.1 \times 10^6}$ $= 190.0$ *Note : The capacity of the section is not based on the beam – colum or column design. The actual capacity might vary.* [*Ref. IS* 800 : 2007, *Cl.* 8.2.1.2]	**Semi-compact**
Plastic Moment Capacity (kNm)		$M_{dy-y} = \frac{\beta_b Z_{py} fy}{\gamma_{mo}}$ $= \frac{0.6 \times 291000.0 \times 250}{1.1 \times 10^6}$ $= 39.77$ *Note : The capacity of the section is not based on the beam – colum or column design. The actual capacity might vary.* [*Ref. IS* 800 : 2007, *Cl.* 8.2.1.2]	**Semi-compact**

2.4 Load Consideration

Check	Required	Provided	Remarks
Shear Force (kN)	$V_y = 45.0$	$V_{y_{min}} = min(0.15 \times V_{dy}, 40.0)$ $= min(0.15 \times 152.55,\ 40.0)$ $= min(22.88,\ 40.0)$ $= 22.88$ $V_u = max(V_y,\ V_{y_{min}})$ $= max(45.0,\ 22.88)$ $= 45.0$ [*Ref. IS* 800 : 2007, *Cl.* 10.7]	**OK**

Check	Required	Provided	Remarks
Axial Force (kN)		P_x = 10.0	OK
Bending Moment (major axis) (kNm)	$M_z = 90.0$	$M_{zmin} = 0.5 * M_{dz-z}$ $= 0.5 \times 139.55$ $= 69.78$ $M_u = max(M_z,\ M_{zmin})$ $but,\ \leq M_{dz-z}\ of\ the\ column\ section$ $= max(90.0, 69.78)$ ≤ 190.0 $= 90.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	OK
Effective Bending Moment (major axis) (kNm)		$M_{ue} = M_u\ +\ P_x \times \left(\frac{D}{2} - \frac{T}{2}\right) \times 10^{-3}$ $= 90.0 +$ $10.0 \times \left(\frac{300.0}{2} - \frac{11.6}{2}\right) \times 10^{-3}$ $= 91.44$	OK

2.5 Bolt Optimization

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Diameter Optimization	$d = 20$	Fail
Property Class	Bolt Property Class Optimization	8.8	Fail
Hole Diameter (mm)		$d_0 = 22.0$	OK
No. of Bolt Columns		$n_c = 0$	Fail
No. of Bolt Rows		$n_r = 0$	Fail
Total No. of Bolts		$n = n_r X n_c = 0$	Fail

3 Design Log

2020-12-18 12:41:15 - Osdag - INFO - [Bolt Design] Bolt diameter and grade combination ready to perform bolt design
2020-12-18 12:41:15 - Osdag - INFO - The solver has selected 1.0 combinations of bolt diameter and grade to perform optimum bolt design in an iterative manner
2020-12-18 12:41:15 - Osdag - INFO - Checking the design with the following bolt diameter-grade combination [(20.0, 8.8)]
2020-12-18 12:41:15 - Osdag - WARNING - [Column Web] The web of the column is susceptible to shear bucking due to the reaction transferred by the beam to the column
2020-12-18 12:41:15 - Osdag - INFO - The minimum required thickness of the web is 7.72 mm
2020-12-18 12:41:15 - Osdag - INFO - Providing stiffening to the column web
2020-12-18 12:41:15 - Osdag - INFO - [Optimisation] Performing the design by optimising the plate thickness, using the thin plate and large (suitable) bolt diameter approach
2020-12-18 12:41:15 - Osdag - INFO - If you wish to optimise the bolt diameter-grade combination, pass a higher value of plate thickness using the Input Dock
2020-12-18 12:41:15 - Osdag - ERROR - [Detailing] The beam is not wide enough to accommodate a single column of bolt on either side
2020-12-18 12:41:15 - Osdag - ERROR - The defined beam is not suitable for performing connection design
2020-12-18 12:41:15 - Osdag - INFO - Please define another beam which has sufficient width (minimum, 176 mm) and re-design