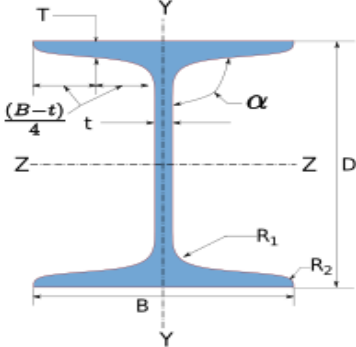




Company Name	IIT Bombay	Project Title	Moment Connection
Group/Team Name	Osdag	Subtitle	Column-to-Column End Plate
Designer	Engineer#1	Job Number	1.2.3.3.1.2
Date	04 /02 /2021	Client	Mr. Manas M Ghosh, Kolkata

## 1 Input Parameters

Module		Column-to-Column End Plate Connection		
Main Module		Moment Connection		
Bending Moment (kNm)		50.0		
Shear Force (kN)		20.0		
Axial Force (kN)		250.0		
Column Section - Mechanical Properties				
	Beam Section *		PBP 300 X 95	
	Material		E 300 (Fe 440)	
	Ultimate Strength, $F_u$ (MPa)		440	
	Yield Strength, $F_y$ (MPa)		300	
	Mass, $m$ (kg/m)	95.0	$I_z$ (cm <sup>4</sup> )	20000.0
	Area, $A$ (cm <sup>2</sup> )	121.0	$I_y$ (cm <sup>4</sup> )	6540.0
	$D$ (mm)	304.0	$r_z$ (cm)	12.8
	$B$ (mm)	309.0	$r_y$ (cm)	7.36
	$t$ (mm)	13.3	$Z_z$ (cm <sup>3</sup> )	1320.0
	$T$ (mm)	13.3	$Z_y$ (cm <sup>3</sup> )	423.0
	Flange Slope	90	$Z_{pz}$ (cm <sup>3</sup> )	1470.0
	$R_1$ (mm)	15.0	$Z_{py}$ (cm <sup>3</sup> )	649.0
	$R_2$ (mm)	0.0		
Bolt Details - Input and Design Preference				
Diameter (mm)		[30]		
Property Class		[9.8]		
Type		Bearing Bolt		
Bolt Tension		Non pre-tensioned		
Hole Type		Standard		
Slip Factor, ( $\mu_f$ )		0.3		
Detailing - Design Preference				
Edge Preparation Method		Rolled, machine-flame cut, sawn and planed		
Are the Members Exposed to Corrosive Influences?		False		



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## 2 Design Checks

Design Status	Fail
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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)	250	$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{12100.0 \times 300}{1.1 \times 10^3}$ $= 3300.0$ [Ref. IS 800:2007, Cl.6.2]	Pass
Shear Capacity Member (kN)	20	$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{m0}}$ $= \frac{277.4 \times 13.3 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 580.93$ [Ref. IS 800:2007, Cl.10.4.3]	Pass
Plastic Moment Capacity (kNm)		$M_{dz} = \frac{\beta_b Z_p f_y}{\gamma_{m0} \times 10^6}$ $= \frac{0.9 \times 1470000.0 \times 300}{1.1 \times 10^6}$ $= 360.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	
Moment Deformation Criteria (kNm)		$M_{dc} = \frac{1.5 Z_e f_y}{\gamma_{m0} \times 10^6}$ $= \frac{1.5 \times 1320000.0 \times 300}{1.1 \times 10^6}$ $= 540.0$ [Ref. IS 800:2007, Cl.8.2.1.2]	



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Check	Required	Provided	Remarks
Moment Capacity Member (kNm)	50	$M_{dz} = \min(M_{dz}, M_{dc})$ $= \min(360.0, 540.0)$ $= 360.0$  [Ref. IS 800:2007, Cl.8.2]	Pass

## 2.2 Load Consideration

Check	Required	Provided	Remarks
Interaction Ratio		I.R. axial $= P_x/T_{dg}$ $= 250.0/3300.0$ $= 0.08$  I.R. moment $= M_z/M_{dz}$ $= 50.0/360.0$ $= 0.14$  I.R. sum $= \text{I.R. axial} + \text{I.R. moment}$ $= 0.08 + 0.14$ $= 0.21$	



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Check	Required	Provided	Remarks
Minimum Required Load	<p>if I.R. axial <math>&lt; 0.3</math> and I.R. moment <math>&lt; 0.5</math></p> $P_{x\min} = 0.3T_{dg}$ $M_{z\min} = 0.5M_{dz}$ <p>elif sum I.R. <math>\leq 1.0</math> and I.R. moment <math>&lt; 0.5</math></p> <p>if <math>(0.5 - \text{I.R. moment}) &lt; (1 - \text{sum I.R.})</math></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. <math>\leq 1.0</math> and I.R. axial <math>&lt; 0.3</math></p> <p>if <math>(0.3 - \text{I.R. axial}) &lt; (1 - \text{sum I.R.})</math></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>	$M_{z\min} = 180.0$ $P_{x\min} = 990.0$ <p>[Ref. IS 800:2007, Cl.10.7]</p>	
Applied Axial Force (kN)	250.0	$P_u = \max(P_x, P_{x\min})$ $= \max(250.0, 990.0)$ $= 990.0$	



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Check	Required	Provided	Remarks
Applied Shear Force (kN)	20.0	$V_{ymin} = \min(0.15V_{dy}, 40.0)$ $= \min(0.15 \times 968.22, 40.0)$ $= 40.0$  $V_u = \max(V_y, V_{ymin})$ $= \max(20.0, 40.0)$ $= 40.0$  [Ref. IS 800:2007, Cl.10.7]	
Applied Moment (kNm)	50.0	$M_u = \max(M_z, M_{zmin})$ $= \max(50.0, 180.0)$ $= 180.0$  [Ref. IS 800:2007, Cl.8.2.1.2]	

## 2.3 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 Design Log

2021-02-04 15:07:59 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2021-02-04 15:07:59 - 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 15:07:59 - Osdag - ERROR - The number of bolts for given bolt size(s) are not sufficient to cater for the given section and loads combination.

2021-02-04 15:07:59 - Osdag - INFO - Try different material or try Extended Both Ways Connection