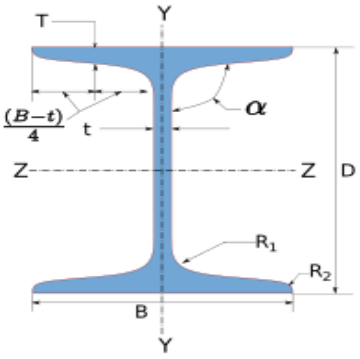
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Column-Column End Plate
Designer	Engineer #1	Job Number	1.2.3.3.1.2
Date	18 /12 /2020	Client	Somnath Mukherjee, MN Dastur, Kolkata

1 Input Parameters

Module			Column End Plate	
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, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	Mass, m (kg/m)	95.0	I_z (cm^4)	20000.0
	Area, A (cm^2)	121.0	I_y(cm^4)	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^3)	1320.0
	T (mm)	13.3	Z_y (cm^3)	423.0
	Flange Slope	90	Z_{pz} (cm^3)	1470.0
	R_1 (mm)	15.0	Z_{py} (cm^3)	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	

2 Design Checks

Design Status	Fail

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

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

2.2 Load Consideration

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

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Check	Required	Provided	Remarks
Minimum Required Load	*if IR axial* < 0.3 *and IR moment* < 0.5 $P_{x\,min} = 0.3 \times T_{dg}$ $M_{z\,min} = 0.5 \times M_{dzz}$ *elif sum IR* $<= 1.0$ *and IR moment* < 0.5 *if* $(0.5 - IR\ moment) < (1 - sum\ IR)$ $M_{z\,min} = 0.5 \times M_{dzz}$ *else* $M_{z\,min} = M_z + ((1 - sum\ IR) \times M_{dzz})$ $P_{x\,min} = P_x$ *elif sum IR* $<= 1.0$ *and IR axial* < 0.3 *if* $(0.3 - IR\ axial) < (1 - sum\ IR)$ $P_{x\,min} = 0.3 \times T_{dg}$ *else* $P_{x\,min} = P_x + ((1 - sum\ IR) \times T_{dg})$ $M_{z\,min} = M_z$ *else* $P_{x\,min} = P_x$ $M_{z\,min} = M_z$ *Note : AL = User Applied Load*	$M_{z\,min} = 180.0$ $P_{x\,min} = 990.0$ [*Ref. IS* 800 : 2007, *Cl.* 10.7]	
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	$V_{y_{min}} = min(0.15 \times V_{dy}, 40.0)$ $= min(0.15 \times 968.22, 40.0)$ $= 40.0$ $V_u = max(V_y,\ V_{y_{min}})$ $= max(20.0, 40.0)$ $= 40.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.7]$	
Applied Moment (kNm)	50.0	$M_u = max(M_z,\ M_{z_{min}})$ $= max(50.0,\ 180.0)$ $= 180.0$ $[Ref.\ IS\ 800:2007,\ Cl.\ 8.2.1.2]$	

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

2020-12-18 01:30:56 - Osdag - INFO - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2020-12-18 01:30:56 - Osdag - INFO - The value of load(s) is/are set at minimum recommended value as per IS 800:2007, Cl.10.7.
2020-12-18 01:30:56 - Osdag - ERROR - The number of bolts for given bolt size(s) are not sufficient to cater for the given section and loads combination.
2020-12-18 01:30:56 - Osdag - INFO - Try different material or try Extended Both Ways Connection