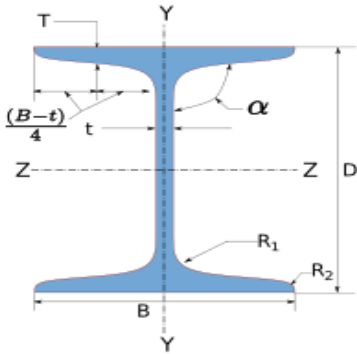
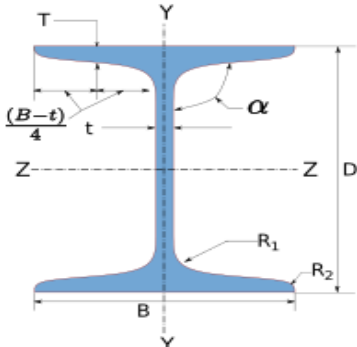




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Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

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)		180.0		
Shear Force (kN)		100.0		
Axial Force (kN)		0.0		
Column Section - Mechanical Properties				
	Column Section		PBP 400 X 158.1	
	Material		E 350 (Fe 490)	
	Ultimate Strength, Fu (MPa)		490	
	Yield Strength, Fy (MPa)		350	
	Mass, m (kg/m)	158.1	Iz (cm4)	45900.0
	Area, A (cm2)	201.0	Iy(cm4)	18300.0
	D (mm)	356.0	rz (cm)	15.1
	B (mm)	394.0	ry (cm)	9.6
	t (mm)	18.0	Zz (cm3)	2570.0
	T (mm)	18	Zy (cm3)	932.0
	Flange Slope	90	Zpz (cm3)	2880.0
	R1 (mm)	15.0	Zpy (cm3)	1420.0
	R2 (mm)	0.0		
Beam Section - Mechanical Properties				
	Beam Section		MB 500	
	Material		E 300 (Fe 440)	
	Ultimate Strength, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	Mass, m (kg/m)	86.88	Iz (cm4)	45200.0
	Area, A (cm2)	110.0	Iy(cm4)	1360.0
	D (mm)	500.0	rz (cm)	20.2
	B (mm)	180.0	ry (cm)	3.51
	t (mm)	10.2	Zz (cm3)	1800.0
	T (mm)	17.2	Zy (cm3)	152.0
	Flange Slope	98	Zpz (cm3)	2070.0



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	R_1 (mm)	17.0	Z_{py} (cm ³)	259.0
	R_2 (mm)	8.5		
Plate Details - Input and Design Preference				
Thickness (mm)			[16, 20, 22]	
Material			E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)			410	
Yield Strength, F_y (MPa)			240	
Bolt Details - Input and Design Preference				
Diameter (mm)			[20, 24, 30]	
Property Class			[6.8, 8.8, 9.8]	
Type			Bearing Bolt	
Bolt Tension			Non pre-tensioned	
Hole Type			Standard	
Slip Factor, (μ_f)			0.3	
Weld Details - Input and Design Preference				
Type of Weld Fabrication			Shop Weld	
Material Grade Overwrite, f_u (MPa)			590.0	
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			Sheared or hand flame cut	
Gap Between Members (mm)			0.0	
Are the Members Exposed to Corrosive Influences?			True	



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2 Design Checks

Design Status	Pass
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2.1 Beam to Column - Compatibility Check

Check	Required	Provided	Remarks
Beam Section Compatibility	$B_{req} = B_b + 25$ $= 180.0 + 25$ $= 205.0$	$B_{available} = B_c$ $= 394.0$	Compatible

2.2 Member Capacity - Supported Section

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{0.6 \times 465.6 \times 10.2 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 448.68$ <p>[Ref. IS 800 : 2007, Cl.10.4.3]</p>	Restricted to low shear
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} f_y}{\gamma_{mo}}$ $= \frac{1.0 \times 2070000.0 \times 300}{1.1 \times 10^6}$ $= 564.55$ <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	$V < 0.6 V_{dy}$

2.3 Member Capacity - Supporting Section

Check	Required	Provided	Remarks
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Check	Required	Provided	Remarks
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} f_y}{\gamma_{mo}}$ $= \frac{0.89 \times 2880000.0 \times 350}{1.1 \times 10^6}$ $= 817.73$ <p><i>Note : The capacity of the section is not based on the beam – column or column design. The actual capacity might vary.</i></p> <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	Semi-compact
Plastic Moment Capacity (kNm)		$M_{dy-y} = \frac{\beta_b Z_{py} f_y}{\gamma_{mo}}$ $= \frac{0.66 \times 1420000.0 \times 350}{1.1 \times 10^6}$ $= 296.55$ <p><i>Note : The capacity of the section is not based on the beam – column or column design. The actual capacity might vary.</i></p> <p>[Ref. IS 800 : 2007, Cl. 8.2.1.2]</p>	Semi-compact

2.4 Load Consideration

Check	Required	Provided	Remarks
Shear Force (kN)	$V_y = 100.0$	$V_{ymin} = \min(0.15 \times V_{dy}, 40.0)$ $= \min(0.15 \times 448.68, 40.0)$ $= \min(67.3, 40.0)$ $= 40.0$ $V_u = \max(V_y, V_{ymin})$ $= \max(100.0, 40.0)$ $= 100.0$ <p>[Ref. IS 800 : 2007, Cl. 10.7]</p>	OK



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Check	Required	Provided	Remarks
Axial Force (kN)		$P_x = 0.0$	OK
Bending Moment (major axis) (kNm)	$M_z = 180.0$	$M_{zmin} = 0.5 * M_{dz-z}$ $= 0.5 \times 564.55$ $= 282.27$ $M_u = \max(M_z, M_{zmin})$ $\text{but, } \leq M_{dz-z} \text{ of the column section}$ $= \max(180.0, 282.27)$ ≤ 817.73 $= 282.27$ $[Ref. IS 800 : 2007, Cl. 8.2.1.2]$	OK
Effective Bending Moment (major axis) (kNm)		$M_{ue} = M_u + P_x \times \left(\frac{D}{2} - \frac{T}{2} \right) \times 10^{-3}$ $= 282.27 +$ $0.0 \times \left(\frac{500.0}{2} - \frac{17.2}{2} \right) \times 10^{-3}$ $= 282.27$	OK

2.5 Bolt Optimization

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Diameter Optimization	$d = 20$	Pass
Property Class	Bolt Property Class Optimization	6.8	Pass
Hole Diameter (mm)		$d_0 = 22.0$	OK
No. of Bolt Columns		$n_c = 2$	Pass
No. of Bolt Rows		$n_r = 8$	Pass
Total No. of Bolts		$n = n_r X n_c = 16$	Pass



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2.6 Detailing

Check	Required	Provided	Remarks
Min. Pitch Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 20.0$ $= 50.0$ [Ref IS 800 : 2007, Cl. 10.2.2]	70	Pass
Max. Pitch Distance (mm)	$p_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 20.0, 300 \text{ mm})$ $= \min(640.0, 300 \text{ mm})$ $= 300$ Where, $t = \min(20.0, 20.0)$ [Ref. IS 800 : 2007, Cl. 10.2.3]	70	Pass
Min. End Distance (mm)	$e_{min} = 1.7 d_0$ $= 1.7 \times 22.0$ $= 37.4$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	40	Pass
Max. End Distance (mm)	$e_{max} = 40 + 4t$ Where, $t = \min(20.0, 20.0)$ $= 40 + (4 \times 20)$ $e_{max} = 120.0$ [Ref. IS 800 : 2007, Cl. 10.2.4.3]	40	Pass
Min. Edge Distance (mm)	$e'_{min} = 1.7 d_0$ $= 1.7 \times 22.0$ $= 37.4$ [Ref. IS 800 : 2007, Cl. 10.2.4.2]	40	Pass



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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 40 + 4t$ $\text{Where, } t = \min(20.0, 20.0)$ $= 40 + (4 \times 20)$ $e'_{max} = 120.0$ [Ref. IS 800 : 2007, Cl. 10.2.4.3]	40	Pass
Cross-centre Gauge Distance (mm)		114	Pass

2.7 Critical Bolt Design

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3} \gamma_{mb}}$ $= \frac{600.0 \times 1 \times 245}{1000 \times \sqrt{3} \times 1.25}$ $= 67.9$ [Ref. IS 800 : 2007, Cl. 10.3.3]	OK
Kb		$k_b = \min\left(\frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0\right)$ $= \min\left(\frac{40}{3 \times 22.0}, \frac{70}{3 \times 22.0} - 0.25, \frac{600.0}{440}, 1.0\right)$ $= \min(0.61, 0.81, 1.36, 1.0)$ $= 0.61$ [Ref. IS 800 : 2007, Cl. 10.3.4]	OK
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.61 \times 20.0 \times 20.0 \times 410}{1000 \times 1.25}$ $= 200.08$ [Ref. IS 800 : 2007, Cl. 10.3.4]	OK



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Check	Required	Provided	Remarks
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (67.9, 200.08)$ $= 67.9$ [Ref. IS 800 : 2007, Cl. 10.3.2]	
Large Grip Length Reduction Factor		$l_g = \sum (t_p + t_{member})$ $= \sum (20.0 + 18)$ $= 38.0 \text{ mm}$ $5d = 5 \times 20.0 = 100.0$ $8d = 8 \times 20.0 = 160.0$ Since, $l_g < 5d$ $\beta_{lg} = 1.0$ [Ref. IS 800 : 2007, Cl. 10.3.3.2]	Pass
Bolt Capacity (post reduction factor) (kN)		$V_{db} = V_{db}\beta_{lg}$ $= 67.9 \times 1.0$ $= 67.9$ [Ref. IS 800 : 2007, Cl. 10.3.3.2]	OK
Shear Demand (kN)	$V_{sb} = \frac{V_u}{n}$ $= \frac{100.0}{16}$ $= 6.25$	Vdb = 67.9	Pass



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Check	Required	Provided	Remarks
Lever Arm (mm)	$r = [482.8, 482.8, 0, 48.6, 482.8, 482.8, 0, 118.6]$ <i>Note : r_1 and r_2 are the first rows outside and inside the tension/top flange r_3 and r_4 are the first rows outside and inside the compression/bottom flange r_5 is the second row outside tension/top flange and r_6 is the second row inside the tension/top flange r_7 is the second row outside compression/bottom flange and r_8 is the second row inside the compression/bottom flange row(s) r_9 and beyond are rows inside the flange, placed in a symmetrical manner.</i> <i>Note : The lever arm is computed by considering the NA at the centre of the bottom flange. Rows with identical lever arm values mean they are considered acting as bolt group near the tension or compression flange.</i>		Pass
Tension Due to Moment (kN)	$T_1 = \frac{M_{ue}}{4 \times n_c \times \left(r_1 + \frac{r_4^2}{r_1} + \sum_{i=8}^{n_r} \frac{r_i^2}{r_1} \right)}$ $= \frac{282.27 \times 10^3}{4 \times 2 \times \left(482.8 + \frac{48.6^2}{482.8} + \sum_{i=8}^8 \frac{r_i^2}{482.8} \right)}$ $= 68.27$ <i>Note : T_1 is the tension in the critical bolt The critical bolt is the bolt nearest to the tension flange</i>		OK



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Check	Required	Provided	Remarks
Prying Force (kN)	$Q = \frac{l_v}{2 \times l_e} \left[T_e - \frac{\beta \times \eta \times f_o \times b_e \times t^4}{27 \times l_e \times l_v^2} \right]$ $l_v = e - \frac{R_1}{2}$ $= 40 - \frac{17.0}{2} = 31.5 \text{ mm}$ $f_o = 0.7 \times f_{ub}$ $= 0.7 \times 600.0$ $= 420.0 \text{ N/mm}^2$ $l_e = \min \left(e, 1.1 t \sqrt{\frac{\beta f_o}{f_y}} \right)$ $= \min \left(40, 1.1 \times 20 \times \sqrt{\frac{2 \times 420.0}{240}} \right)$ $= \min(40, 41.16) = 40 \text{ mm}$ $\beta = 2 \text{ (non pre-tensioned bolt)}$ $\eta = 1.5$ $b_e = \frac{B}{n_c}$ $= \frac{180.0}{2} = 90.0 \text{ mm}$ $Q = \frac{31.5}{2 \times 40} \times \left[68.27 - \left(\frac{2 \times 1.5 \times 420.0 \times 90.0 \times 20^4}{27 \times 40 \times 31.5^2} \right) \times 10^{-3} \right]$ $Q = 20.21$ <p>[Ref. IS 800 : 2007, Cl. 10.4.7]</p>		OK



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Check	Required	Provided	Remarks
Tension Demand (kN)	$T_b = T_1 + Q$ $= 68.27 + 20.21$ $= 88.48$	$T_{db} = 0.90 f_{ub} A_n / \gamma_{mb}$ $< f_{yb} A_{sb} (\gamma_{mb} / \gamma_{m0})$ $= \min \left(0.90 \times 600.0 \times 245 / 1.25, \right.$ $\quad \left. 480.0 \times 314.0 \times (1.25/1.1) \right)$ $= \min(105.84, 171.27)$ $= 105.84$ [Ref. IS 800 : 2007, Cl. 10.3.5]	Pass
Combined Capacity, (I.R)	≤ 1	$\left(\frac{V_{sb}}{V_{db}} \right)^2 + \left(\frac{T_b}{T_{db}} \right)^2 \leq 1.0$ $\left(\frac{6.25}{67.9} \right)^2 + \left(\frac{88.48}{105.84} \right)^2 = 0.71$ [Ref. IS 800 : 2007, Cl. 10.3.6]	Pass

2.8 Compression Flange Check

Check	Required	Provided	Remarks
Tension in Bolt Rows (kN)		$T = [68.27, 68.27, 0, 27.49, 68.27, 68.27, 0, 67.08]$	OK
Reaction at Compression Flange (kN)	$R_c = n_c \sum_{n_r=1}^{n_r} T_{n_r}$ $= 2 \times \sum_{n_r=1}^8 T_{n_r}$ $= 2 \times 367.65$ $= 735.3$	$F_c = A_g f_y / \gamma_{m0}$ $= \frac{B \times T \times f_y}{\gamma_{m0}}$ $= \frac{180.0 \times 17.2 \times 300}{1.1 \times 1000}$ $= 844.36$	Pass



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2.9 End Plate Checks

Check	Required	Provided	Remarks
Height (mm)		$H_p = D + (2 \times (2 \times e)) + (2 \times p)$ $= 500.0 + (2 \times (2 \times 40)) + (2 \times 70)$ $= 800.0$	Pass
Width (mm)		$B_p = B + 25$ $= 180.0 + 25$ $= 205.0$	Pass
Moment at Critical Section (kNm)		$M_{cr} = T_1 l_v - Q l_e$ $= (68.27 \times 31.5 - 20.21 \times 40) \times 10^{-3}$ $= 1.34$ <i>Note : The critical section is at the toe of the weld or the edge of the flange from bolt center – line</i>	OK
Plate Thickness (mm)	$t_p = \sqrt{\frac{4M_{cr}}{b_e(f_y/\gamma_{m0})}}$ $= \sqrt{\frac{4 \times 1.34 \times 10^6}{90 \times (240/1.1)}}$ $= 16.53$	20	Pass
Moment Capacity (kNm)	1.34	$M_p = \left(\frac{b_e t_p^2}{4}\right) \times \frac{f_y}{\gamma_{m0}}$ $= \frac{90 \times 20^2}{4} \times \frac{240}{1.1} \times 10^{-6}$ $= 1.96$	Pass

2.10 Stiffener Design

Check	Required	Provided	Remarks
Height (mm)		$H_{st} = \frac{H_p - D}{2}$ $= \frac{800.0 - 500.0}{2}$ $= 150.0$	150.0
Length (mm)		$L_{st} = \frac{H_{st}}{\tan(30)}$ $= \frac{150.0}{\tan(30)}$ $= 260$	Pass



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Check	Required	Provided	Remarks
Thickness (mm)	$t = 10.2$	$t_{st} = 12$	Pass
Weld Size (mm)	5	$t_w = 6$	Pass

2.11 Weld Design - Beam Web to End Plate Connection

Check	Required	Provided	Remarks
Weld Strength (N/mm ²)	$f_{uw} = \min(f_w, f_u)$ $= \min(590.0, 410)$ [Ref. IS 800 : 2007, Cl. 10.5.7.1.1]	$f_{uw} = 410$	Pass
Total Weld Length (mm)		$L_w = 2 \times [D - (2 \times T) - (2 \times R1) - 20]$ $= 2 \times [500.0 - (2 \times 17.2) - (2 \times 17.0) - 20]$ $= 813.0$ <i>Note : Weld is provided on both sides of the web</i>	OK
Weld Size (mm)	$t_w = \frac{V_u}{f_{uw} k L_w} \times \sqrt{3} \gamma_{mw}$ $= \frac{100.0 \times 10^3}{410 \times 0.7 \times 813.0} \times \sqrt{3} \times 1.25$ $= 0.93$ [Ref. IS 800 : 2007, Cl. 10.5.7]	6	Pass



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Check	Required	Provided	Remarks
Min. Weld Size (mm)	<p>1) t_{wmin} – based on thickness of the thicker part</p> $t_{thicker} = \max(20.0, 10.2)$ $= 20.0$ $t_{wmin} = 5$ <p>2) t_{wmin} – based on thickness of the thinner part</p> $t_{thinner} = \min(20.0, 10.2)$ $= 10.2$ $t_{wmin} \leq \min(5, 10.2)$ <p>[Ref IS 800 : 2007, Table 21 , Cl 10.5.2.3]</p>	$t_w = \max(t_w, t_{wmin})$ $= \max(0.93, 5)$ $= 6$	Pass
Max. Weld Size (mm)	<p>t_{wmax} based on thickness of the thinner part</p> $t_{thinner} = \min(20.0, 10.2)$ $= 10.2$ $t_{wmax} = 10.2$ <p>[Ref. IS 800 : 2007, Cl. 10.5.3.1]</p>	$t_w \leq t_{wmax}$ $6 \leq 10.2$	Pass

2.12 Continuity Plate Check - Compression/Tension Flange

Check	Required	Provided	Remarks
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Check	Required	Provided	Remarks
Local Web Yielding Capacity (kN)		$P_{cw1} = \frac{f_{wc} (5k + T_b)}{\gamma_{m0}}$ $k = T_c + R_{1c}$ $= 18 + 15.0$ $= 33.0$ $f_{wc} = f_{yc} \times t_c$ $= 350.0 \times 18.0$ $= 6300.0$ $P_{cw1} = \frac{6300.0 \times ((5 \times 33.0) + 17.2)}{1.1 \times 1000}$ $= 1043.51$ <p><i>Note : subscript c denotes column section, and, subscript b denotes beam section</i></p>	OK
Web Compression Buckling Capacity (kN)		$P_{cw2} = 10710 \left(\frac{t_c^3}{h_c} \right) \sqrt{\frac{f_{yc}}{\gamma_{m0}}}$ $h_c = D_c - (2 \times k)$ $= 356.0 - (2 \times 33.0)$ $= 290.0$ $P_{cw2} = 10710 \times \frac{18.0^3}{290.0} \times \sqrt{\frac{350.0}{1.1}} \times 10^{-3}$ $= 3841.91$	OK



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Check	Required	Provided	Remarks
Web Crippling Capacity (kN)		$P_{cw3} = \left(\frac{300t_c^2}{\gamma_{m1}} \right) \left[1 + 3 \left(T_b/D_c \right) \left(t_c/T_c \right)^{1.5} \right] \sqrt{f_{yc} \left(T_c/t_c \right)}$ $= \left(\frac{300 \times 18.0^2}{1.25} \right) \times \left[1 + 3 \times \left(17.2/356.0 \right) \times \left(18.0/18 \right)^{1.5} \right] \times$ $\sqrt{350.0 \times \left(18/18.0 \right) \times 10^{-3}}$ $= 1665.61$	OK
Compression Strength (kN)		$P_{cw} = \min(P_{cw1}, P_{cw2}, P_{cw3})$ $= \min(1043.51, 3841.91, 1665.61)$ $= 1043.51$	OK
Continuity Plate Required?	$R_c = 735.3$	$P_{cw} = 1043.51$	No

2.13 Column Web Shear Check

Check	Required	Provided	Remarks
Web Stiffener Plate Required ?	$t_{wc} = \frac{1.9M_{ue}}{D_c D_b f_{yc}}$ $= \frac{1.9 \times 282.27}{356.0 \times 500.0 \times 350.0}$ $= 8.61$	$t_c = 18.0$	No



Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

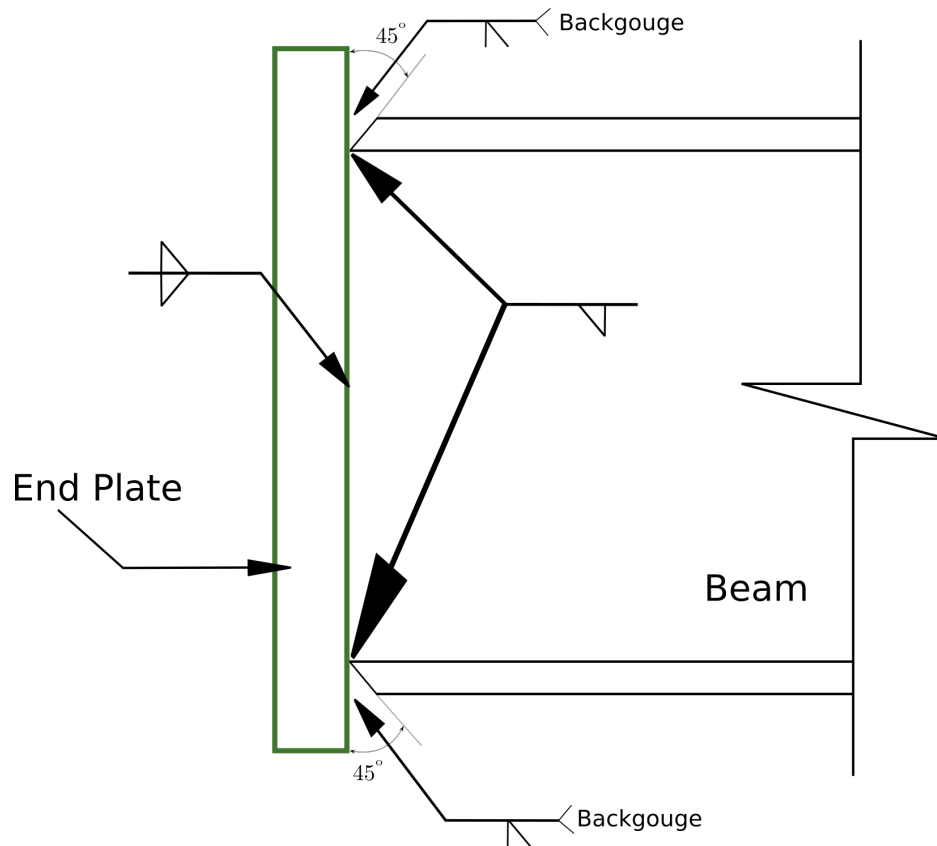


Figure 1: Typical Weld Details - Beam to End Plate Connection

3 2D Drawings (Typical)

Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

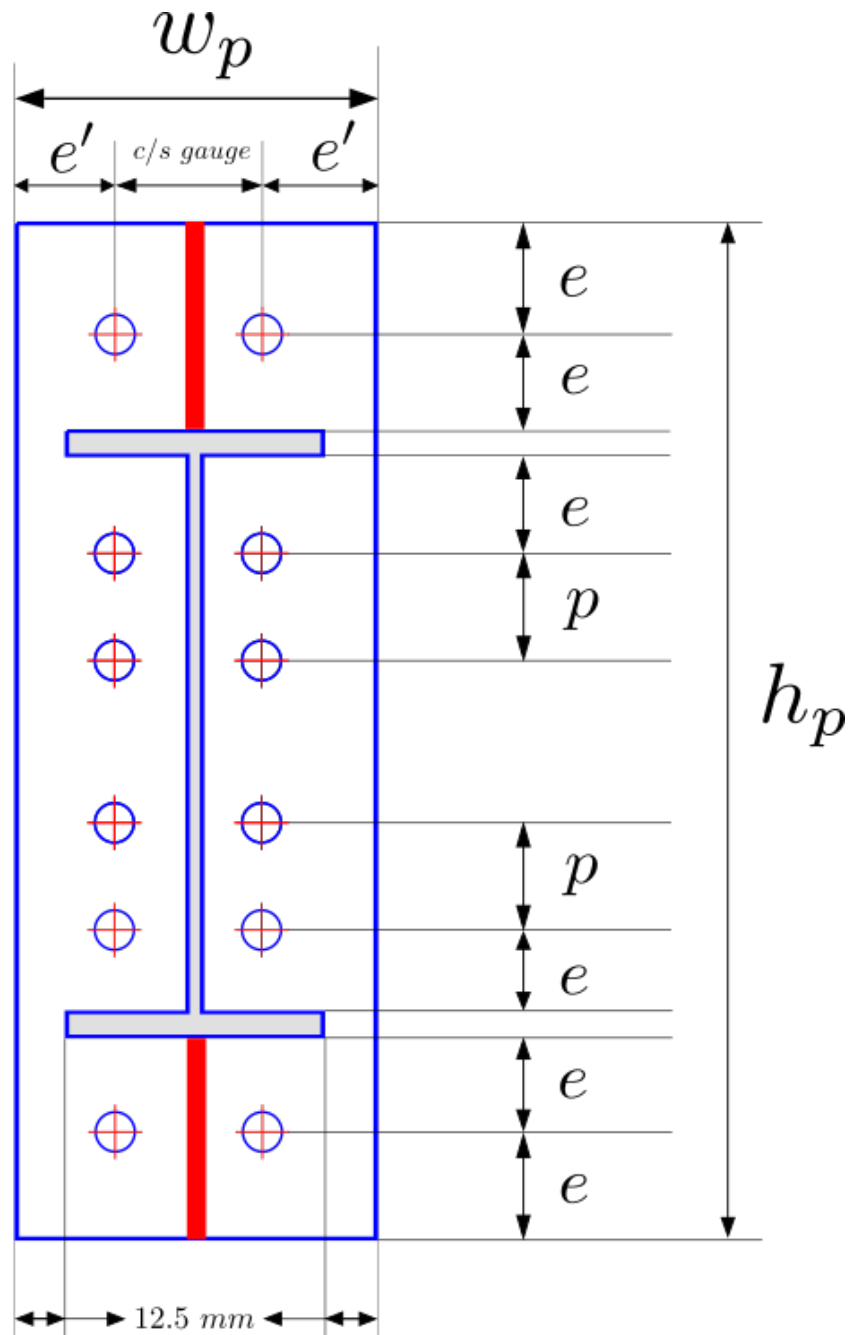


Figure 2: Typical Detailing



Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

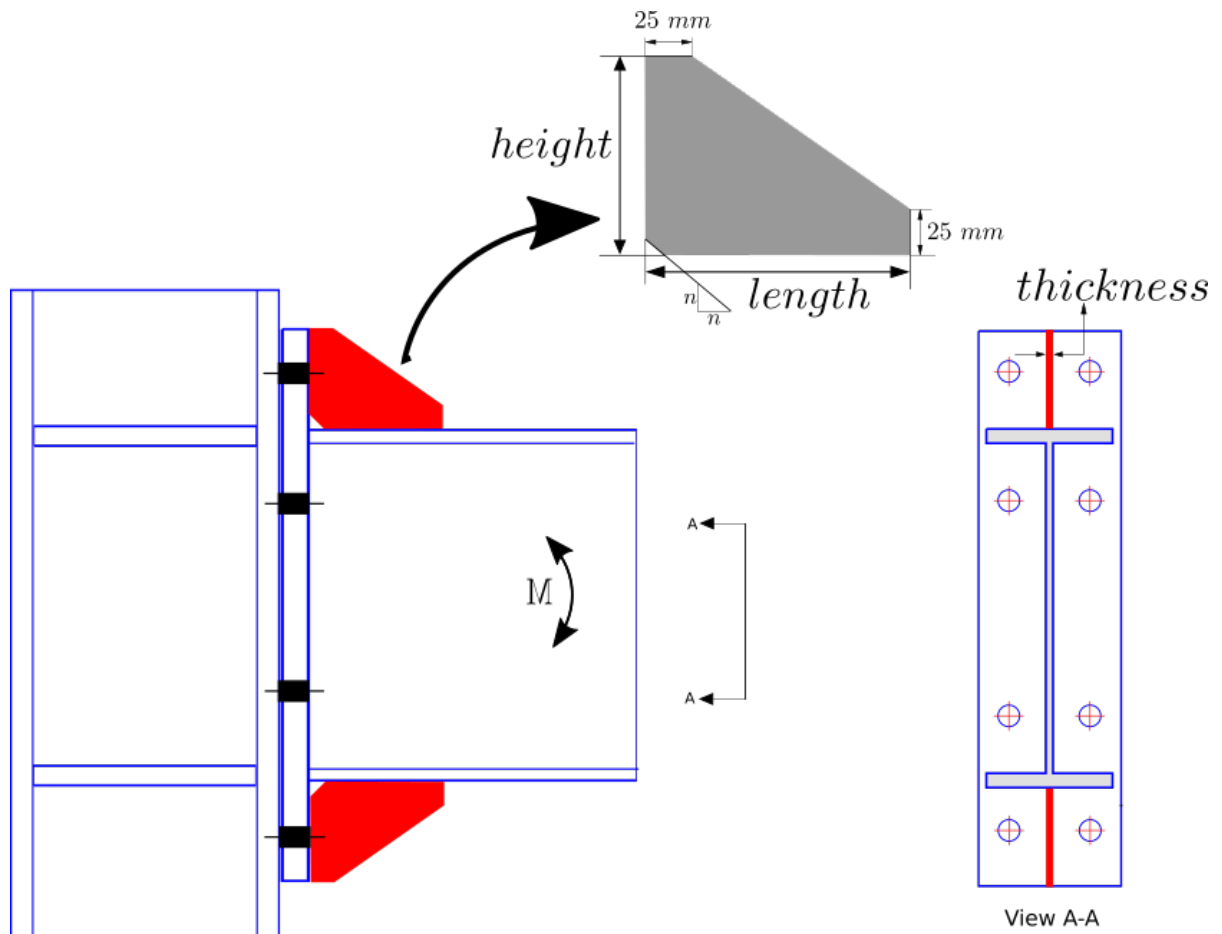


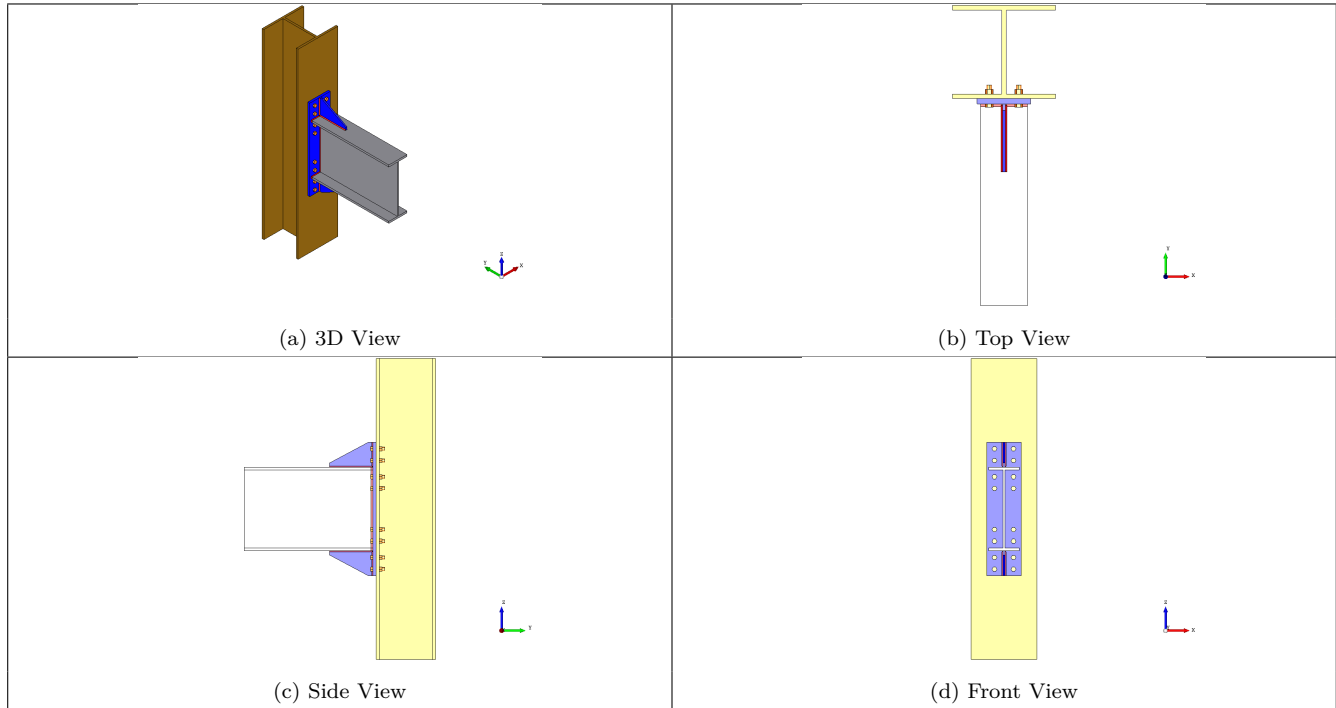


Figure 3: Typical Stiffener Details

		Created with  Osdag®	
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

4 3D Views



5 Design Log

2020-12-18 00:15:15 - Osdag - WARNING - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2020-12-18 00:15:15 - Osdag - WARNING - [Minimum Factored Load] The external factored bending moment (180.0 kNm) is less than 0.5 times the plastic moment capacity of the beam (564.55 kNm)

2020-12-18 00:15:15 - Osdag - INFO - The minimum factored bending moment should be at least 0.5 times the plastic moment capacity of the beam to qualify the connection as rigid connection (Annex. F-4.3.1, IS 800:2007)

2020-12-18 00:15:15 - Osdag - INFO - The value of load(s) is/are set at minimum recommended value as per Cl.10.7 and Annex. F, IS 800:2007



2020-12-18 00:15:15 - Osdag - INFO - Designing the connection for a factored moment of 282.27 kNm

2020-12-18 00:15:15 - Osdag - WARNING - [End Plate] The end plate of 16.0 mm is thinner than the thickest of the elements being connected

2020-12-18 00:15:15 - Osdag - INFO - Selecting a plate of higher thickness which is at least 18 mm thick

2020-12-18 00:15:15 - Osdag - INFO - [Bolt Design] Bolt diameter and grade combination ready to perform bolt design

2020-12-18 00:15:15 - Osdag - INFO - The solver has selected 9.0 combinations of bolt diameter and grade to perform optimum bolt design in an iterative manner

			
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.1.3.1
Date	18 /12 /2020	Client	V Kalyanaraman, Retd. Professor, IIT Madras

2020-12-18 00:15:15 - Osdag - INFO - Checking the design with the following bolt diameter-grade combination [(20.0, 6.8), (20.0, 8.8), (20.0, 9.8), (24.0, 6.8), (24.0, 8.8), (24.0, 9.8), (30.0, 6.8), (30.0, 8.8), (30.0, 9.8)]

2020-12-18 00:15:15 - Osdag - WARNING - [Column Web] The web of the column is not susceptible to shear buckling due to the reaction transferred by the beam to the column

2020-12-18 00:15:15 - Osdag - INFO - The minimum required thickness of the web i.e. 8.61 mm is satisfied

2020-12-18 00:15:15 - Osdag - INFO - Additional stiffening of the column web is not required

2020-12-18 00:15:15 - Osdag - INFO - [Optimisation] Performing the design by optimising the plate thickness, using the thin plate and large (suitable) bolt diameter approach

2020-12-18 00:15:15 - 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 00:15:15 - Osdag - INFO - The provided beam can accommodate a single column of bolt on either side of the web [Ref. based on detailing requirement]

2020-12-18 00:15:15 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:15:15 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 637.06 kN is less than the flange capacity 844.36 kN. The flange strength requirement is satisfied.

2020-12-18 00:15:15 - Osdag - ERROR - [End Plate] The selected trial end plate of 20.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:15:15 - Osdag - INFO - The minimum required thickness of end plate is 22.77 mm

2020-12-18 00:15:15 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:15:15 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 6.8 grade fails the tension check

2020-12-18 00:15:15 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 195.0067949246107 kN and exceeds the bolt tension capacity (105.84 kN)

2020-12-18 00:15:15 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:15:15 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 6.8 grade fails the combined shear + tension check

2020-12-18 00:15:15 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 3.429

2020-12-18 00:15:15 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:15:15 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 749.1 kN is less than the flange capacity 844.36 kN. The flange strength requirement is satisfied.

2020-12-18 00:15:15 - Osdag - INFO - [End Plate] The end plate of 20.0 mm passes the moment capacity check. The end plate is checked for yielding due tension caused by bending moment and prying force

2020-12-18 00:15:15 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 6.8 grade fails the tension check

2020-12-18 00:15:15 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 117.58985239375413 kN and exceeds the bolt tension capacity (105.84 kN)

2020-12-18 00:15:15 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:15:15 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 6.8 grade fails the combined shear + tension check

2020-12-18 00:15:15 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.249

2020-12-18 00:15:15 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter