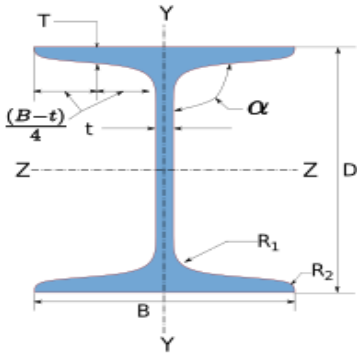
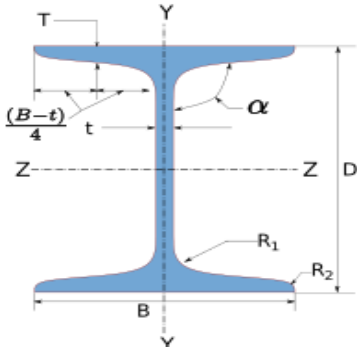




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Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

## 1 Input Parameters

Main Module		Moment Connection		
Module		Beam-Column End Plate		
Connectivity		Column Web-Beam Web		
End Plate Type		Flushed - Reversible Moment		
Bending Moment (kNm)		45.0		
Shear Force (kN)		70.0		
Axial Force (kN)		0.0		
Column Section - Mechanical Properties				
	Column Section		UC 305 x 305 x 118	
	Material		E 250 (Fe 410 W)A	
	Ultimate Strength, Fu (MPa)		410	
	Yield Strength, Fy (MPa)		250	
	Mass, m (kg/m)	117.9	Iz (cm4)	27672.0
	Area, A (cm2)	150.2	Iy(cm4)	9058.0
	D (mm)	314.5	rz (cm)	13.6
	B (mm)	307.4	ry (cm)	7.77
	t (mm)	12.0	Zz (cm3)	1760.0
	T (mm)	18.7	Zy (cm3)	589.0
	Flange Slope	90	Zpz (cm3)	1958.0
	R1 (mm)	15.2	Zpy (cm3)	895.0
	R2 (mm)	0.0		
	Beam Section - Mechanical Properties			
	Beam Section		MB 300	
	Material		E 250 (Fe 410 W)A	
	Ultimate Strength, Fu (MPa)		410	
	Yield Strength, Fy (MPa)		250	
	Mass, m (kg/m)	46.02	Iz (cm4)	8990.0
	Area, A (cm2)	58.6	Iy(cm4)	486.0
	D (mm)	300.0	rz (cm)	12.3
	B (mm)	140.0	ry (cm)	2.87
	t (mm)	7.7	Zz (cm3)	599.0
	T (mm)	13.1	Zy (cm3)	69.4
	Flange Slope	98	Zpz (cm3)	681.0



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	$R_1$ (mm)	14.0	$Z_{py}$ (cm <sup>3</sup> )	117.0
	$R_2$ (mm)	7.0		
Plate Details - Input and Design Preference				
Thickness (mm)			[8, 10, 12, 14, 16, 18, 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 75, 80, 90, 100, 110, 120]	
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]	
Property Class			[9.8]	
Type			Bearing Bolt	
Bolt Tension			Non pre-tensioned	
Hole Type			Standard	
Slip Factor, $(\mu_f)$			0.3	
Weld Details - Input and Design Preference				
Type of Weld Fabrication			Shop Weld	
Material Grade Overwrite, $f_u$ (MPa)			435.0	
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?			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	$B_{req} = B_b + 25$ $= 140.0 + 25$ $= 165.0$	$B_{available} = D_c - (2T_c) - (2R_{1c}) - 10$ $= 314.5 - (2 \times 18.7) - (2 \times 15.2) - 10$ $= 236.7$	Compatible

### 2.2 Member Capacity - Supported Section

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{0.6 \times 273.8 \times 7.7 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 165.98$  [Ref. IS 800 : 2007, Cl.10.4.3]	Restricted to low shear
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} f_y}{\gamma_{mo}}$ $= \frac{1.0 \times 681000.0 \times 250}{1.1 \times 10^6}$ $= 154.77$  [Ref. IS 800 : 2007, Cl. 8.2.1.2]	$V < 0.6 V_{dy}$



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## 2.3 Member Capacity - Supporting Section

Check	Required	Provided	Remarks
Plastic Moment Capacity (kNm)		$M_{dz-z} = \frac{\beta_b Z_{pz} f_y}{\gamma_{mo}}$ $= \frac{0.9 \times 1958000.0 \times 250}{1.1 \times 10^6}$ $= 400.0$ <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>	<b>Semi-compact</b>
Plastic Moment Capacity (kNm)		$M_{dy-y} = \frac{\beta_b Z_{py} f_y}{\gamma_{mo}}$ $= \frac{0.66 \times 895000.0 \times 250}{1.1 \times 10^6}$ $= 133.86$ <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>	<b>Semi-compact</b>

## 2.4 Load Consideration

Check	Required	Provided	Remarks
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Check	Required	Provided	Remarks
Shear Force (kN)	$V_y = 70.0$	$V_{ymin} = \min(0.15 \times V_{dy}, 40.0)$ $= \min(0.15 \times 165.98, 40.0)$ $= \min(24.9, 40.0)$ $= 24.9$ $V_u = \max(V_y, V_{ymin})$ $= \max(70.0, 24.9)$ $= 70.0$ [Ref. IS 800 : 2007, Cl. 10.7]	OK
Axial Force (kN)		$P_x = 0.0$	OK
Bending Moment (major axis) (kNm)	$M = 45.0$	$M_{zmin} = 0.5 \times M_{dz-z}$ $= 0.5 \times 154.77$ $= 77.39$ $M_u = \max(M_z, M_{zmin})$ but, $\leq M_{dy-y}$ of the column section $= \max(45.0, 77.39)$ $\leq 133.86$ $= 77.39$ [Ref. IS 800 : 2007, Cl. 8.2.1.2]	OK
Effective Bending Moment (major axis) (kNm)		$M_{ue} = M_u + P_x \times \left( \frac{D}{2} - \frac{T}{2} \right) \times 10^{-3}$ $= 77.39 +$ $0.0 \times \left( \frac{300.0}{2} - \frac{13.1}{2} \right) \times 10^{-3}$ $= 77.39$	OK



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## 2.5 Bolt Optimization

Check	Required	Provided	Remarks
Diameter (mm)	Bolt Diameter Optimization	$d = 20$	Pass
Property Class	Bolt Property Class Optimization	9.8	Pass
Hole Diameter (mm)		$d_0 = 22.0$	OK
No. of Bolt Columns		$n_c = 2$	Pass
No. of Bolt Rows		$n_r = 2$	Pass
Total No. of Bolts		$n = n_r X n_c = 4$	Pass

## 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)	$p_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 36.0, 300 \text{ mm})$ $= \min(1152.0, 300 \text{ mm})$ $= 300$  Where, $t = \min(36.0, 36.0)$  [Ref. IS 800 : 2007, Cl. 10.2.3]	70	Pass
Min. End Distance (mm)	$e_{min} = 1.5 d_0$ $= 1.5 \times 22.0$ $= 33.0$  [Ref. IS 800 : 2007, Cl. 10.2.4.2]	35	Pass



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Check	Required	Provided	Remarks
Max. End Distance (mm)	$e_{max} = 40 + 4t$ $\text{Where, } t = \min(36.0, 36.0)$ $= 40 + (4 \times 36)$ $e_{max} = 184.0$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.3]</p>	35	Pass
Min. Edge Distance (mm)	$e'_{min} = 1.5 d_0$ $= 1.5 \times 22.0$ $= 33.0$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.2]</p>	35	Pass
Max. Edge Distance (mm)	$e'_{max} = 40 + 4t$ $\text{Where, } t = \min(36.0, 36.0)$ $= 40 + (4 \times 36)$ $e'_{max} = 184.0$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.3]</p>	35	Pass
Cross-centre Gauge Distance (mm)		92	Pass

## 2.7 Critical Bolt Design

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{dsb} = \frac{f_{ub} n_n A_{nb}}{\sqrt{3} \gamma_{mb}}$ $= \frac{900.0 \times 1 \times 245}{1000 \times \sqrt{3} \times 1.25}$ $= 101.84$ <p>[Ref. IS 800 : 2007, Cl. 10.3.3]</p>	OK



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Check	Required	Provided	Remarks
Kb		$k_b = \min \left( \frac{e}{3d_0}, \frac{p}{3d_0} - 0.25, \frac{f_{ub}}{f_u}, 1.0 \right)$ $= \min \left( \frac{35}{3 \times 22.0}, \frac{70}{3 \times 22.0} - 0.25, \frac{900.0}{410}, 1.0 \right)$ $= \min(0.53, 0.81, 2.2, 1.0)$ $= 0.53$ <p>[Ref. IS 800 : 2007, Cl. 10.3.4]</p>	OK
Bearing Capacity (kN)		$V_{dpb} = \frac{2.5 k_b d t f_u}{\gamma_{mb}}$ $= \frac{2.5 \times 0.53 \times 20.0 \times 36.0 \times 410}{1000 \times 1.25}$ $= 312.91$ <p>[Ref. IS 800 : 2007, Cl. 10.3.4]</p>	OK
Bolt Capacity (kN)		$V_{db} = \min (V_{dsb}, V_{dpb})$ $= \min (101.84, 312.91)$ $= 101.84$ <p>[Ref. IS 800 : 2007, Cl. 10.3.2]</p>	
Large Grip Length Reduction Factor		$l_g = \sum (t_p + t_{member})$ $= \sum (36.0 + 12.0)$ $= 48.0 \text{ mm}$ $5d = 5 \times 20.0 = 100.0$ $8d = 8 \times 20.0 = 160.0$ <p>Since, <math>l_g &lt; 5d</math></p> $\beta_{lg} = 1.0$ <p>[Ref. IS 800 : 2007, Cl. 10.3.3.2]</p>	Pass





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Check	Required	Provided	Remarks
Bolt Capacity (post reduction factor) (kN)		$V_{db} = V_{db}\beta_{lg}$ $= 101.84 \times 1.0$ $= 101.84$ [Ref. IS 800 : 2007, Cl. 10.3.3.2]	OK
Shear Demand (kN)	$V_{sb} = \frac{V_u}{n}$ $= \frac{70.0}{4}$ $= 17.5$	Vdb = 101.84	Pass
Lever Arm (mm)	$r = [245.35, 41.55]$ <i>Note : <math>r_1</math> is the first row inside tension/top flange</i> <i><math>r_2</math> is the first row inside compression/bottom flange</i> <i>Further row(s) are added in a symmetrical manner with odd row placed near the tension/top flange and even row placed near the compression/bottom flange respectively</i> <i>Note : The lever arm is computed by considering the NA at the centre of the bottom flange.</i> <i>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)	$T_1 = \frac{M_{ue}}{n_c \times \left( r_1 + \sum_{i=2}^{n_r} \frac{r_i^2}{r_1} \right)}$ $= \frac{77.39 \times 10^3}{2 \times \left( 245.35 + \sum_{i=2}^2 \frac{r_i^2}{245.35} \right)}$ $= 153.32$ <i>Note : <math>T_1</math> is the tension in the critical bolt</i> <i>The critical bolt is the bolt nearest to the tension flange</i>		OK



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Check	Required	Provided	Remarks
Prying Force (kN)	$Q = \frac{l_v}{2 \times l_e} \left[ T_e - \frac{\beta \times \eta \times f_o \times b_e \times t^4}{27 \times l_e \times l_v^2} \right]$ $l_v = e - \frac{R_1}{2}$ $= 35 - \frac{14.0}{2} = 28.0 \text{ mm}$ $f_o = 0.7 \times f_{ub}$ $= 0.7 \times 900.0$ $= 630.0 \text{ N/mm}^2$ $l_e = \min \left( e, 1.1 t \sqrt{\frac{\beta f_o}{f_y}} \right)$ $= \min \left( 35, 1.1 \times 36 \times \sqrt{\frac{2 \times 630.0}{240}} \right)$ $= \min(35, 90.73) = 35 \text{ mm}$ $\beta = 2 \text{ (non pre-tensioned bolt)}$ $\eta = 1.5$ $b_e = \frac{B}{n_c}$ $= \frac{140.0}{2} = 70.0 \text{ mm}$ $Q = \frac{28.0}{2 \times 35} \times \left[ 153.32 - \left( \frac{2 \times 1.5 \times 630.0 \times 70.0 \times 36^4}{27 \times 35 \times 28.0^2} \right) \times 10^{-3} \right]$ $Q = 0.0$ <p><i>Note : The end plate is sufficiently thick to prevent yielding of the plate. Thus, Q = 0</i>  [Ref. IS 800 : 2007, Cl. 10.4.7]</p>		OK



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Check	Required	Provided	Remarks
Tension Demand (kN)	$T_b = T_1 + Q$ $= 153.32 + 0.0$ $= 153.32$	$T_{db} = 0.90 f_{ub} A_n / \gamma_{mb}$ $< f_{yb} A_{sb} (\gamma_{mb} / \gamma_{m0})$ $= \min \left( 0.90 \times 900.0 \times 245 / 1.25, \right.$ $\quad \left. 720.0 \times 314.0 \times (1.25/1.1) \right)$ $= \min(158.76, 256.91)$ $= 158.76$  [Ref. IS 800 : 2007, Cl. 10.3.5]	Pass
Combined Capacity, (I.R)	$\leq 1$	$\left( \frac{V_{sb}}{V_{db}} \right)^2 + \left( \frac{T_b}{T_{db}} \right)^2 \leq 1.0$ $\left( \frac{17.5}{101.84} \right)^2 + \left( \frac{153.32}{158.76} \right)^2 = 0.96$  [Ref. IS 800 : 2007, Cl. 10.3.6]	Pass

## 2.8 Compression Flange Check

Check	Required	Provided	Remarks
Tension in Bolt Rows (kN)		$T = [153.32, 25.96]$	OK
Reaction at Compression Flange (kN)	$R_c = n_c \sum_{n_r=1}^{n_r} T_{n_r}$ $= 2 \times \sum_{n_r=1}^2 T_{n_r}$ $= 2 \times 179.28$ $= 358.56$	$F_c = A_g f_y / \gamma_{m0}$ $= \frac{B \times T \times f_y}{\gamma_{m0}}$ $= \frac{140.0 \times 13.1 \times 250}{1.1 \times 1000}$ $= 416.82$	Pass



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## 2.9 End Plate Checks

Check	Required	Provided	Remarks
Height (mm)		$H_p = D + 25$ $= 300.0 + 25$ $= 325.0$	Pass
Width (mm)		$B_p = B + 25$ $= 140.0 + 25$ $= 165.0$	Pass
Moment at Critical Section (kNm)		$M_{cr} = T_1 l_v - Q l_e$ $= (153.32 \times 28.0 - 0.0 \times 35) \times 10^{-3}$ $= 4.29$  <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)	$t_p = \sqrt{\frac{4M_{cr}}{b_e(f_y/\gamma_{m0})}}$ $= \sqrt{\frac{4 \times 4.29 \times 10^6}{70 \times (240/1.1)}}$ $= 33.53$	36	Pass
Moment Capacity (kNm)	4.29	$M_p = \left(\frac{b_e t_p^2}{4}\right) \times \frac{f_y}{\gamma_{m0}}$ $= \frac{70 \times 36^2}{4} \times \frac{240}{1.1} \times 10^{-6}$ $= 4.95$	Pass

## 2.10 Longitudinal Stiffener Design

Check	Required	Provided	Remarks
Width (mm)		$W_{st} = B_p - \frac{t}{2}$ $= 165.0 - \frac{7.7}{2}$ $= 78.65$	78.65
Length (mm)		$L_{st} = 2 * W_{st}$ $= 2 * 78.65$ $= 157.3$	Pass
Thickness (mm)	$t = 7.7$	$t_{st} = 8$	Pass



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Check	Required	Provided	Remarks
Weld Size (mm)	8	tw = 8	Pass

## 2.11 Weld Design - Beam Web to End Plate Connection

Check	Required	Provided	Remarks
Weld Strength (N/mm <sup>2</sup> )	$f_{uw} = \min(f_w, f_u)$ $= \min(435.0, 410)$ <i>[Ref. IS 800 : 2007, Cl. 10.5.7.1.1]</i>	$f_{uw} = 410$	Pass
Total Weld Length (mm)		$L_w = 2 \times [D - (2 \times T) - (2 \times R1) - 20]$ $= 2 \times [300.0 - (2 \times 13.1) - (2 \times 14.0) - 20]$ $= 443.9$ <i>Note : Weld is provided on both sides of the web</i>	OK
Weld Size (mm)	$t_w = \frac{V_u}{f_{uw} k L_w} \times \sqrt{3} \gamma_{mw}$ $= \frac{70.0 \times 10^3}{410 \times 0.7 \times 443.9} \times \sqrt{3} \times 1.25$ $= 1.19$ <i>[Ref. IS 800 : 2007, Cl. 10.5.7]</i>	8	Pass



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Check	Required	Provided	Remarks
Min. Weld Size (mm)	<p>1) <math>t_{wmin}</math> – based on thickness of the thicker part</p> $t_{thicker} = \max(36.0, 7.7)$ $= 36.0$ $t_{wmin} = 7.7$ <p>2) <math>t_{wmin}</math> – based on thickness of the thinner part</p> $t_{thinner} = \min(36.0, 7.7)$ $= 7.7$ $t_{wmin} \leq \min(7.7, 7.7)$ <p>[Ref IS 800 : 2007, Table 21 , Cl10.5.2.3]</p>	$t_w = \max(t_w, t_{wmin})$ $= \max(1.19, 7.7)$ $= 8$	Pass
Max. Weld Size (mm)	<p><math>t_{wmax}</math> based on thickness of the thinner part</p> $t_{thinner} = \min(36.0, 7.7)$ $= 7.7$ $t_{wmax} = 7.7$ <p>[Ref. IS 800 : 2007, Cl. 10.5.3.1]</p>	$t_w \leq t_{wmax}$ $8 \leq 7.7$	Fail

## 2.12 Continuity Plate Design

Check	Required	Provided	Remarks
Notch Size (mm)		$n = 24$	OK



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Check	Required	Provided	Remarks
Length (mm)		$l_{cp1} = \text{Outer length}$  $l_{cp1} = D_c - 2 \times T_c$ $= 314.5 - (2 \times 18.7)$ $= 277.1$  $l_{cp2} = \text{Inner length}$  $l_{cp2} = D_c - 2(T_c + n)$ $= 314.5 - [2 \times (18.7 + 24)]$ $= 229.1$	OK
Width (mm)		$w_{cp} = \frac{B_c - T_c - 2n}{2}$ $= \frac{307.4 - 12.0 - 2 \times 24}{2}$ $= 123.0$	OK
Thickness (mm)	tc = 12.0	12	Pass

## 2.13 Weld Design - Continuity Plate

Check	Required	Provided	Remarks
Weld Strength (N/mm <sup>2</sup> )	$f_{uw} = \min(f_w, f_{u_{cp}})$ $= \min(435.0, 410)$  [Ref. IS 800 : 2007, Cl. 10.5.7.1.1]	$f_{uw} = 410$	Pass
Total (effective) Weld Length (mm)		$L_{w_{cp}} = 217.1$  <i>Note : Provide weld on one side of the continuity plate</i>	OK
Weld Size (mm)	5	6	Pass



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Check	Required	Provided	Remarks
Min. Weld Size (mm)	<p>1) <math>t_{wmin}</math> – based on thickness of the thicker part</p> $t_{thicker} = \max(12, 12.0)$ $= 12$ $t_{wmin} = 5$ <p>2) <math>t_{wmin}</math> – based on thickness of the thinner part</p> $t_{thinner} = \min(12, 12.0)$ $= 12$ $t_{wmin} \leq \min(5, 12)$ <p>[Ref IS 800 : 2007, Table 21 , Cl10.5.2.3]</p>	$t_w = \max(t_w, t_{wmin})$ $= \max(6, 5)$ $= 6$	Pass
Max. Weld Size (mm)	<p><math>t_{wmax}</math> based on thickness of the thinner part</p> $t_{thinner} = \min(12, 12.0)$ $= 12$ $t_{wmax} = 12$ <p>[Ref. IS 800 : 2007, Cl. 10.5.3.1]</p>	$t_w \leq t_{wmax}$ $6 \leq 12$	Pass





Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

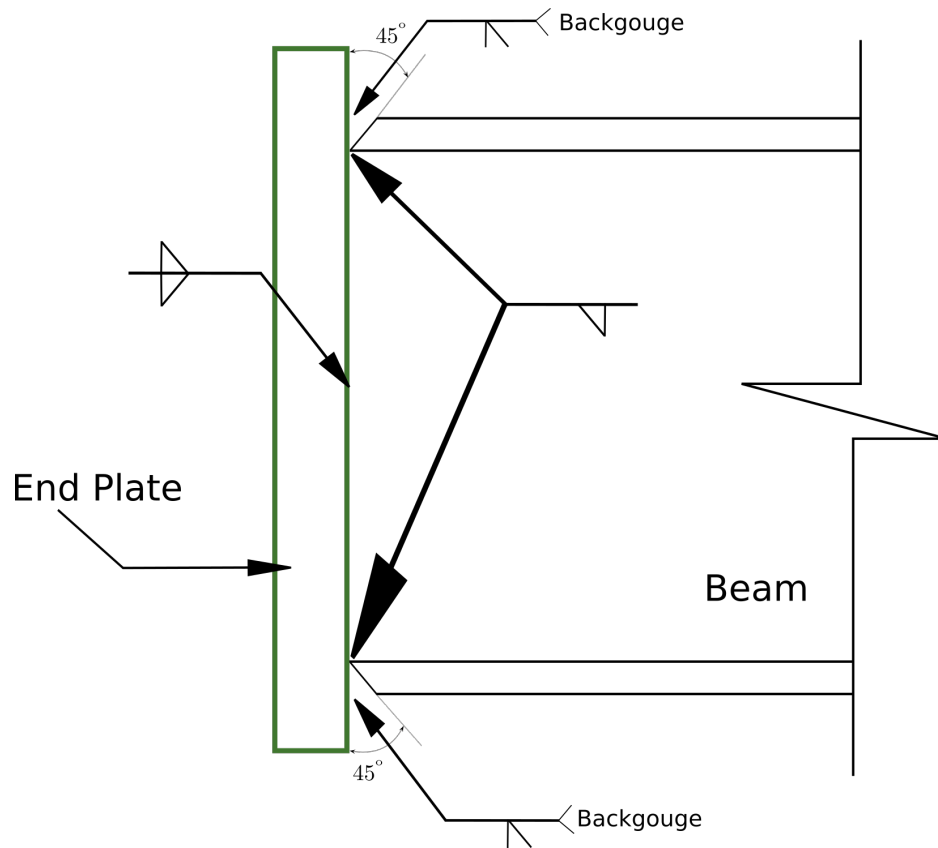


Figure 1: Typical Weld Details - Beam to End Plate Connection

### 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	1.2.2.1.2.1.2
Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

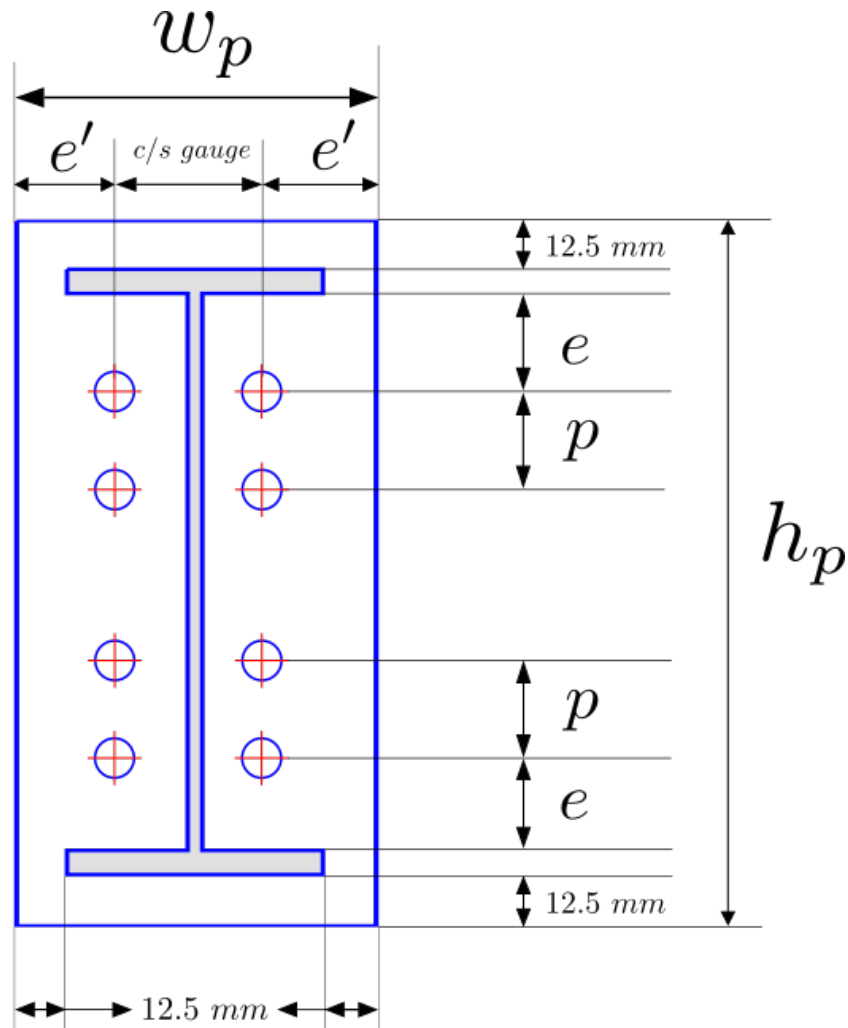


Figure 2: Typical Detailing



Company Name	IIT Bombay	Project Title	Sample Connection Design
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Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
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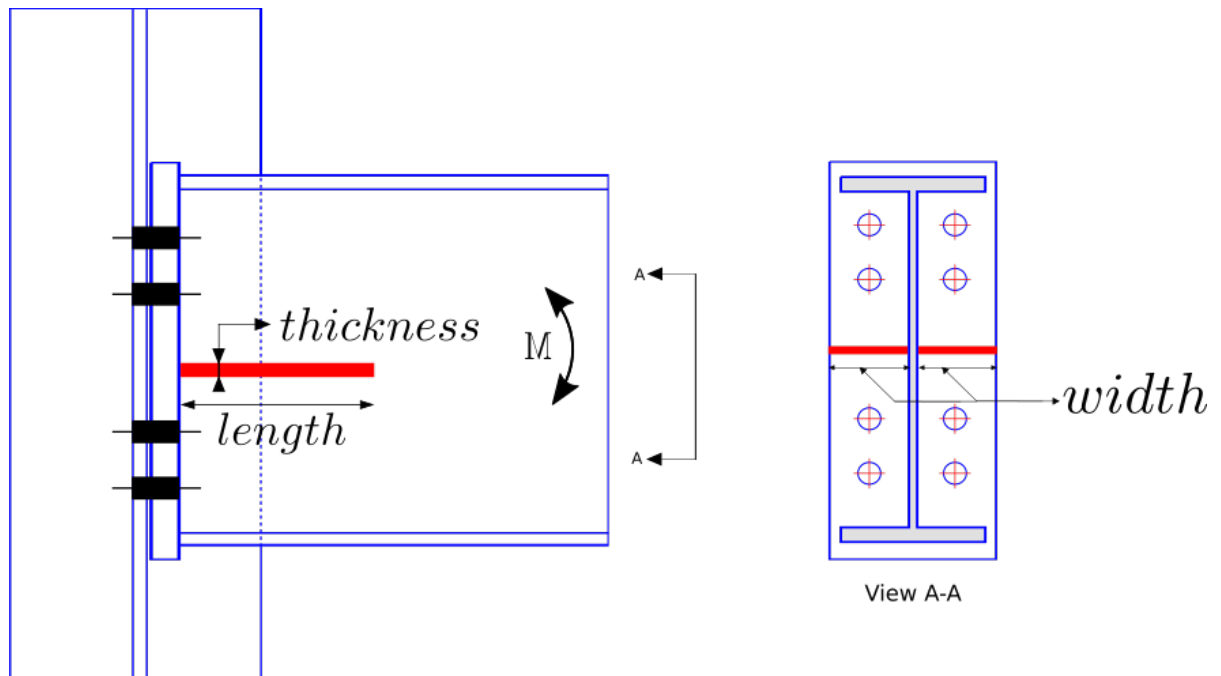
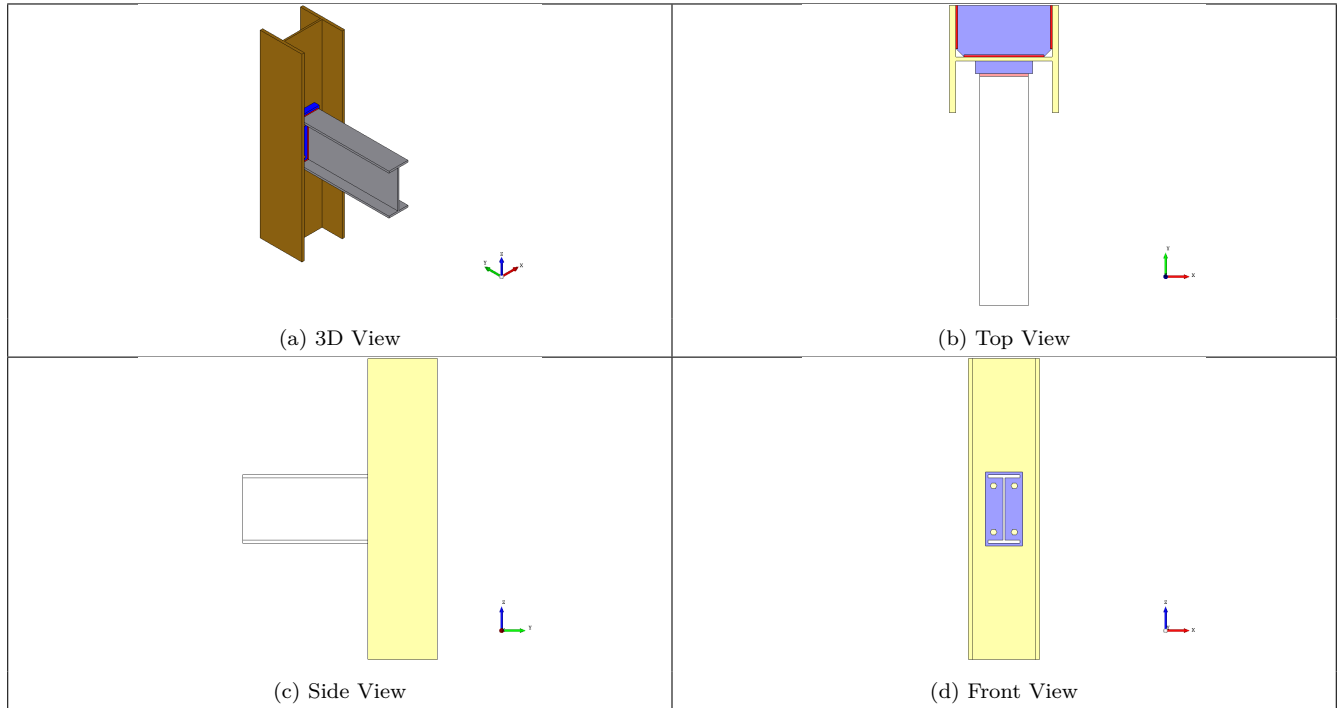


Figure 3: Typical Stiffener Details



Company Name	IIT Bombay	Project Title	Sample Connection Design
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Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

## 4 3D Views



## 5 Design Log

2020-12-18 00:32:49 - Osdag - WARNING - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2020-12-18 00:32:49 - Osdag - WARNING - [Minimum Factored Load] The external factored bending moment (45.0 kNm) is less than 0.5 times the plastic moment capacity of the beam (154.77 kNm)

2020-12-18 00:32:49 - 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 00:32:49 - 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 00:32:49 - Osdag - INFO - Designing the connection for a factored moment of 77.39 kNm

2020-12-18 00:32:49 - Osdag - WARNING - [End Plate] The end plate of 8.0 mm is thinner than the thickest of the elements being connected

2020-12-18 00:32:49 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

2020-12-18 00:32:49 - Osdag - WARNING - [End Plate] The end plate of 10.0 mm is thinner than the thickest of the elements being connected

2020-12-18 00:32:49 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

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Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

2020-12-18 00:32:49 - Osdag - WARNING - [End Plate] The end plate of 12.0 mm is thinner than the thickest of the elements being connected

2020-12-18 00:32:49 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

2020-12-18 00:32:49 - Osdag - INFO - [Bolt Design] Bolt diameter and grade combination ready to perform bolt design

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Checking the design with the following bolt diameter-grade combination [(20.0, 9.8)]

2020-12-18 00:32:49 - Osdag - INFO - [Optimisation] Performing the design by optimising the plate thickness, using the thin plate and large (suitable) bolt diameter approach

2020-12-18 00:32:49 - 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 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 8.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 23.33 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 261.04644812248756 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 2.767

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 10.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 23.42 mm



2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 238.79644812248756 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension

			
Company Name	IIT Bombay	Project Title	Sample Connection Design
Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
Designer	Engineer #1	Job Number	1.2.2.1.2.1.2
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check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 2.303

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 12.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 23.56 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 223.68644812248758 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 2.015

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 14.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 23.75 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 212.58644812248758 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check



2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.823

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

			
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Group/Team Name	Osdag	Subtitle	Beam-Column End Plate
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2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 16.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 24.1 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 209.96644812248758 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.779

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 18.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 24.61 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 207.14644812248758 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.732

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 25.82 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 203.21644812248758 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

		Created with 	
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Date	18 /12 /2020	Client	Pradyumna M, Independent Consultant, Bengaluru

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.668

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 22.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 26.75 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 197.90644812248757 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.583

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 25.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 28.6 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 186.73644812248756 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.413

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the





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flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 28.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 31.06 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the tension check

2020-12-18 00:32:49 - Osdag - ERROR - Total tension demand on bolt (due to direct tension + prying action) is 170.73644812248756 kN and exceeds the bolt tension capacity (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - Osdag - ERROR - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade fails the combined shear + tension check

2020-12-18 00:32:49 - Osdag - ERROR - The Interaction Ratio (IR) of the critical bolt is 1.186

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a bolt of higher grade and/or diameter

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side

2020-12-18 00:32:49 - Osdag - INFO - [Flange Strength] The reaction at the compression flange of the beam 358.56 kN is less than the flange capacity 416.82 kN. The flange strength requirement is satisfied.

2020-12-18 00:32:49 - Osdag - ERROR - [End Plate] The selected trial end plate of 32.0 mm is insufficient and fails in the moment capacity check

2020-12-18 00:32:49 - Osdag - INFO - The minimum required thickness of end plate is 33.53 mm

2020-12-18 00:32:49 - Osdag - INFO - Re-designing the connection with a plate of available higher thickness

2020-12-18 00:32:49 - Osdag - INFO - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade passes the tension check

2020-12-18 00:32:49 - Osdag - INFO - Total tension demand on bolt (due to direct tension + prying action) is 153.31644812248757 kN and the bolt tension capacity is (158.76 kN)

2020-12-18 00:32:49 - Osdag - INFO - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade passes the combined shear + tension check

2020-12-18 00:32:49 - Osdag - INFO - The Interaction Ratio (IR) of the critical bolt is 0.962

2020-12-18 00:32:49 - 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 00:32:49 - Osdag - INFO - Performing the design with a single column of bolt on each side