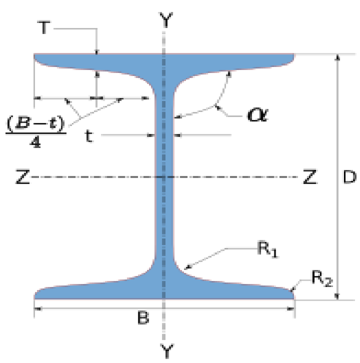
Company Name	IIT Bombay	Project Title	Moment Connection
Group/Team Name	Osdag	Subtitle	Beam-to-Column End Plate
Designer	Engineer#1	Job Number	1.2.2.1.2.1.2
Date	04 /02 /2021	Client	Dr. Harshvardhan Subbarao, Mumbai

Created with Osdag®

1 Input Parameters

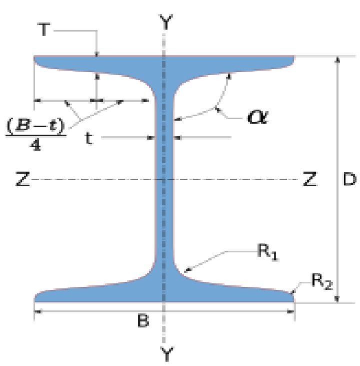
Main Module	Moment Connection
Module	Beam-to-Column End Plate Connection
Connectivity	Column Web-Beam Web
End Plate Type	Flushed - Reversible Moment
Bending Moment (kNm)	45.0
Shear Force (kN)	70.0
Axial Force (kN)	0.0

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	I_z (cm^4)	27672.0
Area, A (cm^2)	150.2	I_y(cm^4)	9058.0
D (mm)	314.5	r_z (cm)	13.6
B (mm)	307.4	r_y (cm)	7.77
t (mm)	12.0	Z_z (cm^3)	1760.0
T (mm)	18.7	Z_y (cm^3)	589.0
Flange Slope	90	Z_{pz} (cm^3)	1958.0
R_1 (mm)	15.2	Z_{py} (cm^3)	895.0
R_2 (mm)	0.0		

Beam Section - Mechanical Properties



Beam Section		MB 300	
Material		E 250 (Fe 410 W)A	
Ultimate Strength, F_u (MPa)		410	
Yield Strength, F_y (MPa)		250	
Mass, m (kg/m)	46.02	I_z (cm^4)	8990.0
Area, A (cm^2)	58.6	I_y(cm^4)	486.0
D (mm)	300.0	r_z (cm)	12.3
B (mm)	140.0	r_y (cm)	2.87
t (mm)	7.7	Z_z (cm^3)	599.0
T (mm)	13.1	Z_y (cm^3)	69.4
Flange Slope	98	Z_{pz} (cm^3)	681.0

	R_1 (mm)	14.0	Z_{py} (cm^3)	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, Fu (MPa)	410
Yield Strength, Fy (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, (μ_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

2 Design Checks

Design Status	**Pass**

2.1 Beam to Column - Compatibility Check

Check	Required	Provided	Remarks
Beam Section Compatibility	$B_{\text{req}} = B_b + 25$ $= 140.0 + 25$ $= 165.0$	$B_{available} = D_c - (2T_c) - (2R_{1c}) - 10$ $= 314.5 - (2 \times 18.7) - (2 \times 15.2) - 10$ $= 236.7$	**Compatible**

2.2 Member Capacity - Supported Section

Check	Required	Provided	Remarks
Shear Capacity (kN)		$V_{d_y} = \frac{A_v f_y}{\sqrt{3}\gamma_{m0}}$ $= \frac{0.6 \times 273.8 \times 7.7 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 165.98$ [Ref. IS 800:2007, Cl.10.4.3]	**Restricted to low shear**
Plastic Moment Capacity (kNm)		$M_{d_z} = \frac{\beta_b Z_{p_z} fy}{\gamma_{m0}}$ $= \frac{1.0 \times 681000.0 \times 250}{1.1 \times 10^6}$ $= 154.77$ [Ref. IS 800:2007, Cl.8.2.1.2]	**V < 0.6 Vdy**

2.3 Member Capacity - Supporting Section

Check	Required	Provided	Remarks
Plastic Moment Capacity (kNm)		$M_{d_z} = \frac{\beta_b Z_{p_z} fy}{\gamma_{m0}}$ $= \frac{0.9 \times 1958000.0 \times 250}{1.1 \times 10^6}$ $= 400.0$ 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)		$M_{d_y} = \frac{\beta_b Z_{py} fy}{\gamma_{m0}}$ $= \frac{0.66 \times 895000.0 \times 250}{1.1 \times 10^6}$ $= 133.86$ 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
Axial Force (kN)		$P_x = 0.0$	**OK**

Check	Required	Provided	Remarks
Shear Force (kN)	$V_y = 70.0$	$V_{y\,\mathrm{min}} = \min(0.15V_{d_y},\ 40.0)$ $= \min(0.15 \times 165.98,\ 40.0)$ $= \min(24.9,\ 40.0)$ $= 24.9$ $V_u = \max(V_y,\ V_{y\,\mathrm{min}})$ but, $\leq V_{dy}$ $= \max(70.0,\ 24.9)$ but, ≤ 165.98 $= 70.0$ [Ref. IS 800:2007, Cl.10.7]	**Pass**
Bending Moment (major axis) (kNm)	$M = 45.0$	$M_{z\,\mathrm{min}} = 0.5M_{dz}$ $= 0.5 \times 154.77$ $= 77.39$ $M_u = \max(M_z,\ M_{z\,\mathrm{min}})$ but, $\leq M_{dy}$ of the column section $= \max(45.0, 77.39)$ ≤ 133.86 $= 77.39$ [Ref. IS 800:2007, Cl.8.2.1.2]	**Pass**
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**

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)	$p_{\min} = 2.5d$ $= 2.5 \times 20.0$ $= 50.0$ [Ref. IS 800:2007, Cl.10.2.2]	70	**Pass**
Max. Pitch Distance (mm)	$p_{\max} = \min(32t,\ 300)$ $= \min(32 \times 36.0,\ 300)$ $= \min(1152.0,\ 300)$ $= 300$ Where, $t = \min(36.0, 36.0)$ [Ref. IS 800:2007, Cl.10.2.3]	70	**Pass**
Min. End Distance (mm)	$e_{\min} = 1.5d_0$ $= 1.5 \times 22.0$ $= 33.0$ [Ref. IS 800:2007, Cl.10.2.4.2]	35	**Pass**

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

2.7 Critical Bolt Design

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

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

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

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

Check	Required	Provided	Remarks
Tension Demand (kN)	$T_b = T_1 + Q$ $= 153.32 + 0.0$ $= 153.32$	$T_{\text{db}} = 0.90 f_{ub} A_n \ / \ \gamma_{mb}$ $< \ f_{yb} A_{sb} (\gamma_{mb} \ / \ \gamma_{m0})$ $= \min\left(0.90 \times 900.0 \times 245 \ / \ 1.25, \ 720.0 \times 314.0 \times (1.25/1.1)\right)$ $= \min(158.76, \ 256.91)$ $= 158.76$ [Ref. IS 800:2007, Cl.10.3.5]	Pass
Combined Capacity (I.R.)	≤ 1	$\left(\frac{V_{sb}}{V_{\text{db}}}\right)^2 + \left(\frac{T_{\text{b}}}{T_{\text{db}}}\right)^2 \leq 1.0$ $\left(\frac{17.5}{101.84}\right)^2 + \left(\frac{153.32}{158.76}\right)^2 = 0.96$ [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)	$R_c = n_c \sum_{n_r=1}^{n_r} T_{n_r}$ $= 2 \times \sum_{n_r=1}^{2} T_{n_r}$ $= 2 \times 179.28$ $= 358.56$	$F_c = A_g f_y \ / \ \gamma_{m0}$ $= \frac{B T f_y}{\gamma_{m0}}$ $= \frac{140.0 \times 13.1 \times 250}{1.1 \times 1000}$ $= 416.82$	Pass

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)		$M_{cr} = T_1\ l_v - Q\ l_e$ $= (153.32 \times 28.0 - 0.0 \times 35) \times 10^{-3}$ $= 4.29$ Note: The critical section is at the toe of the weld or the edge of the flange from bolt center-line	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)		$L_{st} = 2W_{st}$ $= 2 \times 78.65$ $= 157.3$	Pass
Thickness (mm)	$t = 7.7$	$t_{st} = 8$	Pass

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

2.11 Weld Design - Beam Web to End Plate Connection

Check	Required	Provided	Remarks
Weld Strength (N/mm2)	$f_{u_w} = \min(f_{\mathrm{w}},\ f_u)$ $= \min(435.0,\ 410)$ [Ref. IS 800:2007, Cl.10.5.7.1.1]	$f_{u_w} = 410$	Pass
Total Weld Length (mm)		$L_w = 2 \times \left[D - (2 \times T) - (2 \times R1) - 20\right]$ $= 2 \times \left[300.0 - (2 \times 13.1) - (2 \times 14.0) - 20\right]$ $= 443.9$ Note: Weld is provided on both sides of the web	OK
Weld Size (mm)	$t_w = \frac{V_u}{f_{uw} k L_w} \times \sqrt{3}\ \gamma_{mw}$ $= \frac{70.0 \times 10^3}{410 \times 0.7 \times 443.9} \times \sqrt{3} \times 1.25$ $= 1.19$ [Ref. IS 800:2007, Cl.10.5.7]	8	Pass

Check	Required	Provided	Remarks
Min. Weld Size (mm)	1) $t_{w\,\min}-$ based on thickness of the thicker part $t_{\text{thicker}} = \max(36.0,\ 7.7)$ $= 36.0$ $t_{w\,\min} = 7.7$ 2) $t_{w\,\min}-$ based on thickness of the thinner part $t_{\text{thinner}} = \min(36.0,\ 7.7)$ $= 7.7$ $t_{w\,\min} \leq \min(7.7,\ 7.7)$ [Ref. IS 800:2007, Table 21, Cl 10.5.2.3]	$t_w = \max(t_w,\ t_{w\,\min})$ $= \max(1.19,\ 7.7)$ $= 8$	**Pass**
Max. Weld Size (mm)	$t_{w\,\max}$ based on thickness of the thinner part $t_{\text{thinner}} = \min(36.0,\ 7.7)$ $= 7.7$ $t_{w\,\max} = 7.7$ [Ref. IS 800:2007, Cl.10.5.3.1]	$t_w \leq t_{w\,\max}$ $8 \leq 7.7$	**Fail**

2.12 Continuity Plate Design

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

Check	Required	Provided	Remarks
Length (mm)		l_{cp1} = Outer length $l_{cp1} = D_c - 2T_c$ $= 314.5 - (2 \times 18.7)$ $= 277.1$ l_{cp2} = Inner length $l_{cp2} = D_c - 2(T_c + n)$ $= 314.5 - \left[2 \times (18.7 + 24)\right]$ $= 229.1$	**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/mm2)	$f_{uw} = \min(f_{\mathrm{w}},\ f_{u_{cp}})$ $= \min(435.0,\ 410)$ $[Ref.\ IS\ 800:2007,\ Cl.\ 10.5.7.1.1]$	$f_{u_w} = 410$	**Pass**
Total (effective) Weld Length (mm)		$L_{w_{cp}} = 217.1$ Note: Provide weld on one side of the continuity plate	**OK**
Weld Size (mm)	5	6	**Pass**

Check	Required	Provided	Remarks
Min. Weld Size (mm)	1) $t_{w\,\mathrm{min}}-$ based on thickness of the thicker part $t_{\mathrm{thicker}} = \max(12,\ 12.0)$ $= 12$ $t_{w\,\mathrm{min}} = 5$ 2) $t_{w\,\mathrm{min}}-$ based on thickness of the thinner part $t_{\mathrm{thinner}} = \min(12,\ 12.0)$ $= 12$ $t_{w\,\mathrm{min}} \leq \min(5,\ 12)$ [Ref. IS 800:2007, Table 21, Cl 10.5.2.3]	$t_w = \max(t_w,\ t_{w\,\mathrm{min}})$ $= \max(6,\ 5)$ $= 6$	**Pass**
Max. Weld Size (mm)	$t_{w\,\mathrm{max}}$ based on thickness of the thinner part $t_{\mathrm{thinner}} = \min(12,\ 12.0)$ $= 12$ $t_{w\,\mathrm{max}} = 12$ [Ref. IS 800:2007, Cl.10.5.3.1]	$t_w \leq t_{w\,\mathrm{max}}$ $6 \leq 12$	**Pass**

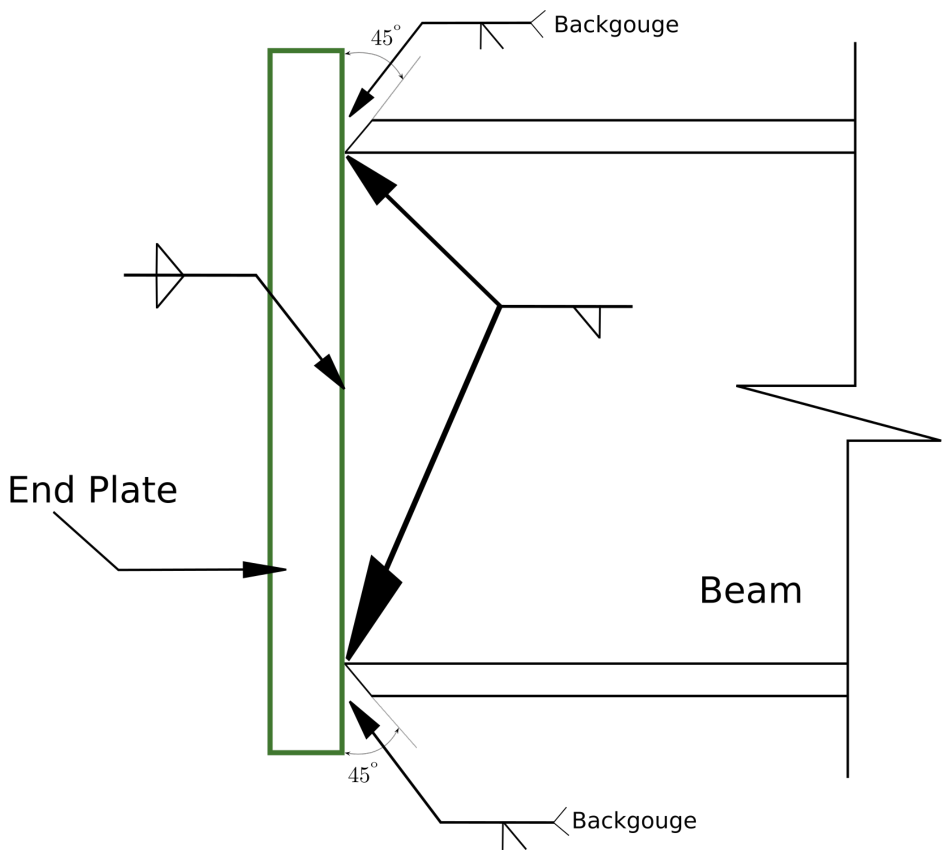


Figure 1: Typical Weld Details -- Beam to End Plate Connection

3 2D Drawings (Typical)

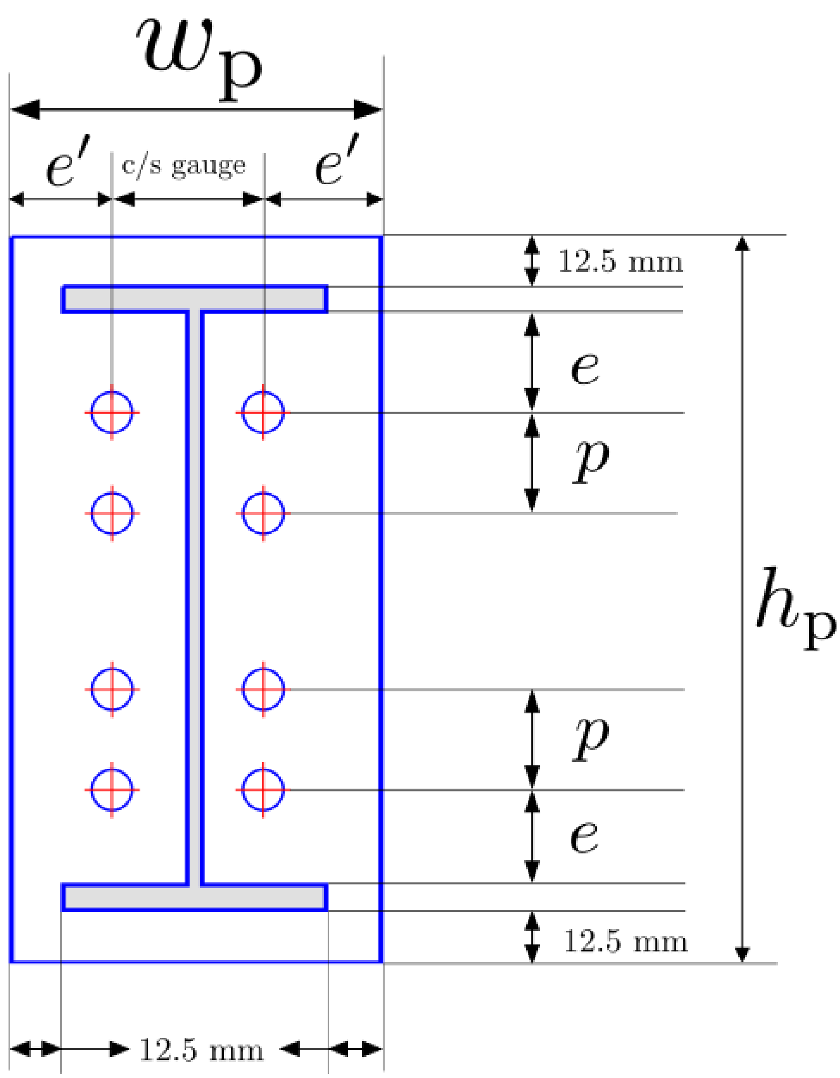


Figure 2: Typical Detailing

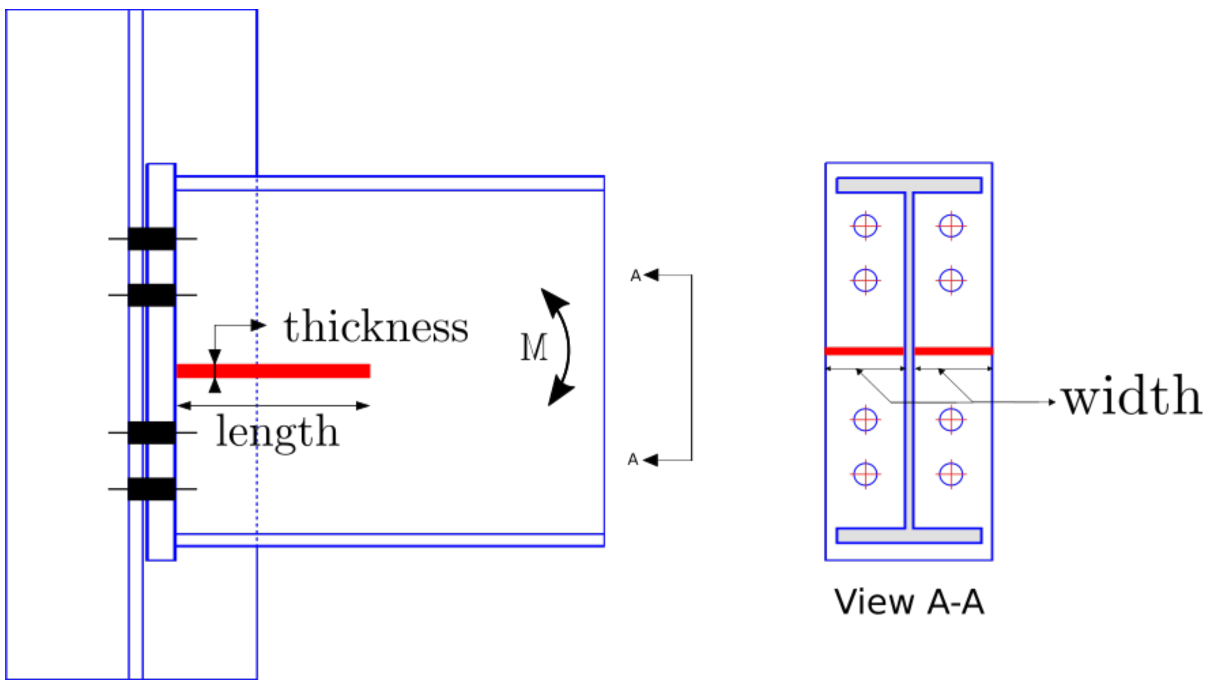
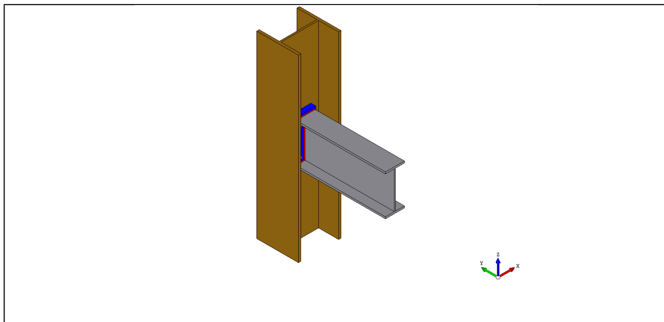
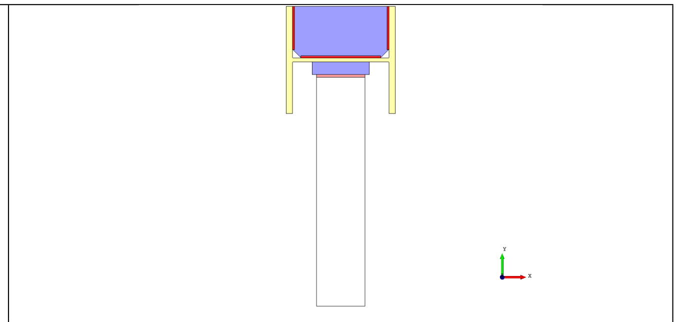


Figure 3: Typical Stiffener Details

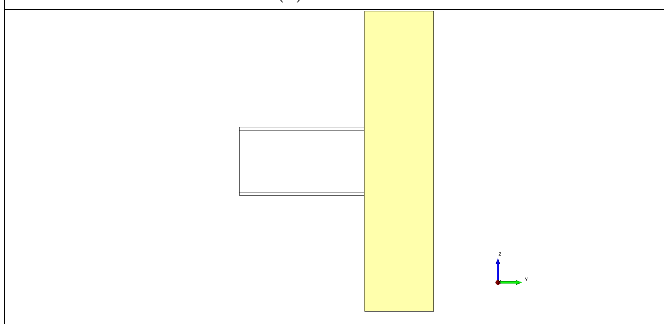
4 3D Views



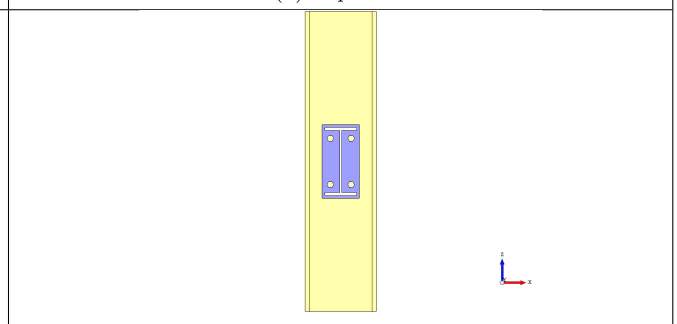
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

5 Design Log

2021-02-04 13:56:26 - Osdag - WARNING - The Load(s) defined is/are less than the minimum recommended value [Ref. IS 800:2007, Cl.10.7].

2021-02-04 13:56:26 - 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)

2021-02-04 13:56:26 - 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)

2021-02-04 13:56:26 - 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

2021-02-04 13:56:26 - Osdag - INFO - Designing the connection for a factored moment of 77.39 kNm

2021-02-04 13:56:26 - Osdag - WARNING - [End Plate] The end plate of 8.0 mm is thinner than the thickest of the elements being connected

2021-02-04 13:56:26 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

2021-02-04 13:56:26 - Osdag - WARNING - [End Plate] The end plate of 10.0 mm is thinner than the thickest of the elements being connected

2021-02-04 13:56:26 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

2021-02-04 13:56:26 - Osdag - WARNING - [End Plate] The end plate of 12.0 mm is thinner than the thickest of the elements being connected

2021-02-04 13:56:26 - Osdag - INFO - Selecting a plate of higher thickness which is at least 13 mm thick

2021-02-04 13:56:26 - Osdag - INFO - [Bolt Design] Bolt diameter and grade combination ready to perform bolt design

2021-02-04 13:56:26 - Osdag - INFO - The solver has selected 1.0 combinations of bolt diameter and grade to perform optimum bolt design in an iterative manner

2021-02-04 13:56:26 - Osdag - INFO - [Optimisation] Performing the design by optimising the plate thickness, using the most optimum plate and a suitable bolt diameter approach

2021-02-04 13:56:26 - Osdag - INFO - If you wish to optimise the bolt diameter-grade combination, pass a higher value of plate thickness using the Input Dock

2021-02-04 13:56:26 - 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.

2021-02-04 13:56:26 - Osdag - INFO - [End Plate] The end plate of 36.0 mm passes the moment capacity check. The end plate is checked for yielding due tension caused by bending moment and prying force

2021-02-04 13:56:26 - Osdag - INFO - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade passes the tension check

2021-02-04 13:56:26 - 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)

2021-02-04 13:56:26 - Osdag - INFO - [Bolt Design] The bolt of 20.0 mm diameter and 9.8 grade passes the combined shear + tension check

2021-02-04 13:56:26 - Osdag - INFO - The Interaction Ratio (IR) of the critical bolt is 0.962

2021-02-04 13:56:26 - Osdag - INFO - : ========== Design Status ============

2021-02-04 13:56:26 - Osdag - INFO - : Overall beam to column end plate connection design is SAFE

2021-02-04 13:56:26 - Osdag - INFO - : ========== End Of Design ============