1 Input Parameters

Module	Tension Member Design - Welded to End Gusset
Axial Force (kN)	500.0
Length (mm) *	3000.0
Section Profile*	Back to Back Channels
Section Size*	Ref List of Input Section
Plate Details - Input and Design Preference	
Thickness (mm)	[16, 18, 20]
Material	E 250 (Fe 410 W)A
Ultimate Strength, F_u (MPa)	410
Yield Strength, F_y (MPa)	250
Weld Details - Input and Design Preference	
Weld Type	Fillet
Type of Weld Fabrication	Shop Weld
Material Grade Overwrite, F_u (MPa)	440.0

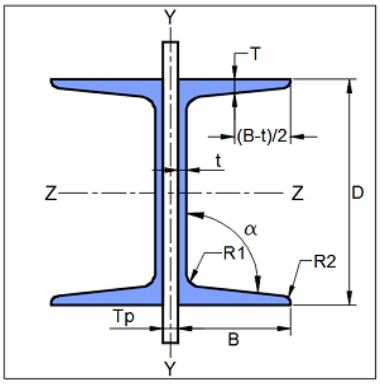
1.1 List of Input Section

Section Size*	'MC 75', 'MC 125', 'MC 125*', 'MC 150', 'MC 150*', 'MC 175', 'MC 175*', 'MC 200', 'MC 200*', 'MC 225', 'MC 225*', 'MC 250', 'MC 250*', 'MC 250*', 'MC 300', 'MC 300*', 'MC 300*', 'MC 350', 'MC 400', 'JC 100', 'JC 125', 'JC 150', 'JC 175', 'JC 200', 'LC 75', 'LC 100', 'LC 125', 'LC (P) 125', 'LC 150', 'LC (P) 150', 'LC 175', 'LC 200', 'LC (P) 200', 'LC 225', 'LC 250', 'LC 300', 'LC (P) 300', 'LC 350', 'LC 400', 'MPC 75', 'MPC 125', 'MPC 125*', 'MPC 150', 'MPC 150*', 'MPC 175', 'MPC 175*', 'MPC 200', 'MPC 200*', 'MPC 225', 'MPC 225*', 'MPC 250', 'MPC 250*', 'MPC 250*', 'MPC 300', 'MPC 300*', 'MPC 300*', 'MPC 350', 'MPC 400'

2 Design Checks

Design Status	Pass

2.1 Selected Member Data



Section Size*		('JC 125', 'Back to Back Channels')	
Material		E 300 (Fe 440)	
Mass, m (kg/m)		15.8	
Area, A (cm^2)		2000.0	
D (mm)	125	I_y(cm^4)	103.99
B (mm)	50	r_z (cm)	5.19
t (mm)	3.0	r_y (cm)	2.28
T (mm)	6.6	Z_z (cm^3)	86.08
T_p (mm)	18.0	Z_y (cm^3)	20.8
Flange Slope	91.5	Z_{pz} (cm^3)	96.89
R_1 (mm)	6.0	Z_{py} (cm^3)	34.2
R_2 (mm)	2.4	Radius of gyration, r (cm)	22.8
I_z (cm^4)	538.0		

2.2 Member Check

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{1000.0 \times 300}{1.1 \times 10^3}$ $= 545.45$ [Ref. IS 800:2007, Cl.6.2]	

Company Name	IIT Bombay	Project Title	Tension Member
Group/Team Name	Osdag	Subtitle	Welded to End Gusset
Designer	Engineer#1	Job Number	2.2.5
Date	04 /02 /2021	Client	Prof. S R Satish Kumar, IIT Madras

Check	Required	Provided	Remarks
Tension Rupture Capacity (kN)		$\beta = 1.4 - 0.076 \times \frac{w}{t} \times \frac{f_y}{0.9 f_u} \times \frac{b_s}{L_c}$ $\leq \frac{0.9 f_u \gamma_{m0}}{f_y \gamma_{m1}} \geq 0.7$ $= 1.4 - 0.076 \times \frac{50}{3.0} \times \frac{300}{0.9 \times 440} \times \frac{50}{177}$ $\leq \frac{0.9 \times 440 \times 1.1}{300 \times 1.25} \geq 0.7$ $= 1.13$ $T_{\text{dn}} = 2 \times \left(\frac{0.9 A_{nc} f_u}{\gamma_{m1}} + \frac{\beta A_{go} f_y}{\gamma_{m0}} \right)$ $= 2 \times \left(\frac{0.9 \times 335.4 \times 440}{1.25} + \frac{1.13 \times 660.0 \times 300}{1.1} \right)$ $= 619.31$ [Ref. IS 800:2007, Cl.6.3.3]	
Tension Capacity (kN)	500.0	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{dn}})$ $= \min(545.45, 619.31)$ $= 545.45$ [Ref.IS 800:2007, Cl.6.1]	**Pass**
Slenderness	$\frac{KL}{r} \leq 400$	$\frac{KL}{r} = \frac{1 \times 3000.0}{22.8}$ $= 131.58$ [Ref. IS 800:2007, Cl.7.1.2]	**Pass**
Utilization Ratio	≤ 1	Utilization Ratio $= \frac{F}{T_d} = \frac{500.0}{545.45}$ $= 0.92$	

Check	Required	Provided	Remarks
Axial Load Considered (kN)	$A_{cmin} = 0.3A_c$ $= 0.3 \times 545.45$ $= 163.64$ $A_{cmax} = 545.45$ [Ref. IS 800:2007, Cl.10.7]	$A = 500.0$	Pass

2.3 Weld Design

Check	Required	Provided	Remarks
Min. Weld Size (mm)	$t_{w_{min}}$ based on thinner part $= \max(3,\ 2)$ s_{min} based on thicker part $= 5$ [Ref. IS 800:2007, Table 21, Cl.10.5.2.3]	3	Pass
Max. Weld Size (mm)	Thickness of thinner part $= \min(18.0,\ 3.0) = 3.0$ $s_{max} = 16.0$ [Ref. IS 800:2007, Cl.10.5.3.1]	3	Pass
Throat Thickness (mm)	$t_t \geq 3$ [Ref. IS 800:2007, Cl.10.5.3.1]	$t_t = 0.7t_w$ $= 0.7 \times 3$ $= 3$ [Ref. IS 800:2007, Cl.10.5.3.1]	Pass
Effective Length (mm)		$l_w = 886$	

Check	Required	Provided	Remarks
Weld Strength (N/mm)	$R_{\mathrm{w}} = \sqrt{(A_{\mathrm{wh}})^2 + (V_{\mathrm{wv}})^2}$ $V_{\mathrm{wv}} = \frac{V}{l_w} = \frac{0.0}{886}$ $A_{\mathrm{wh}} = \frac{A}{l_w} = \frac{500000.0}{886}$ $R_{\mathrm{w}} = \sqrt{(564.33)^2 + (0.0)^2}$ $= 564.33$	$f_w = \frac{t_t f_u}{\sqrt{3}\gamma_{mw}}$ $= \frac{3 \times 410}{\sqrt{3} \times 1.25}$ $= 568.11$ [Ref. IS 800:2007, Cl.10.5.7.1.1]	**Pass**
Weld Strength (post long joint) (N/mm)	if $l \geq 150t_t$, then $V_{\mathrm{rd}} = \beta_{l_w} V_{\mathrm{db}}$ if $l < 150t_t$, *then* $V_{\mathrm{rd}} = V_{\mathrm{db}}$ where, l = plate length or height $\beta_{l_w} = 1.2 - \frac{(0.2l)}{(150t_t)}$ but, $0.6 \leq \beta_{l_w} \leq 1.0$ [Ref. IS 800:2007, Cl.10.5.7.3]	l = plate length or height $l_l = \max(155, 192)$ $= 192$ $150t_t = 150 \times 3 = 450$ since, $l < 150t_t$ *then* $f_{\mathrm{wrd}} = f_{\mathrm{w}}$ $f_{\mathrm{wrd}} = 568.11$ [Ref. IS 800:2007, Cl.10.5.7.3.]	
Weld Strength (N/mm)	564.33	568.11	**Pass**

2.4 Gusset Plate Check

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)	500.0	$T_{\mathrm{dg}} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 400 \times 18.0$ $= \frac{7200.0 \times 250}{1.1 \times 10^3}$ $= 511.36$ [Ref. IS 800:2007, Cl.6.2]	**Pass**

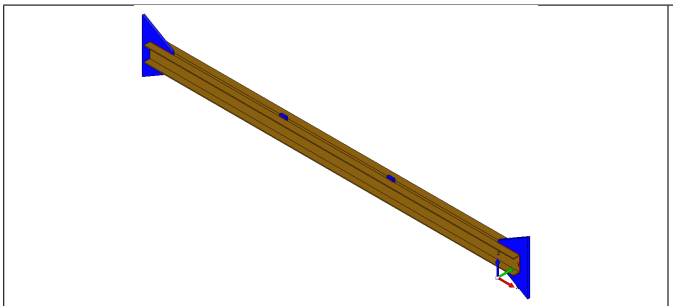
Company Name	IIT Bombay	Project Title	Tension Member
Group/Team Name	Osdag	Subtitle	Welded to End Gusset
Designer	Engineer#1	Job Number	2.2.5
Date	04 /02 /2021	Client	Prof. S R Satish Kumar, IIT Madras

Check	Required	Provided	Remarks
Min.Height (mm)		$H = 1 \times \text{Depth} + \text{Clearance}$ $= (1 \times 400) + 30$ $= 155$	
Min.Plate Length (mm)		$L = \text{Flange weld} + \text{Clearance}$ $= 162 + 30$ $= 192$	**Pass**
Min.Member Length (mm)	384	3000.0	**Pass**
Thickness (mm)		$T_p = 18.0$	
Weld Strength (N/mm)	$R_{\text{w}} = \sqrt{(A_{\text{wh}})^2 + (V_{\text{wv}})^2}$ $V_{\text{wv}} = \frac{V}{l_w} = \frac{0.0}{886}$ $A_{\text{wh}} = \frac{A}{l_w} = \frac{500000.0}{886}$ $R_{\text{w}} = \sqrt{(564.33)^2 + (0.0)^2}$ $= 564.33$	$f_w = \frac{t_t f_u}{\sqrt{3}\gamma_{mw}}$ $= \frac{3 \times 410}{\sqrt{3} \times 1.25}$ $= 568.11$ [Ref. IS 800:2007, Cl.10.5.7.1.1]	**Pass**
Block Shear Capacity (kN)		$T_{\text{dbl1}} = \frac{A_{\text{vg}} f_y}{\sqrt{3}\gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$ $T_{\text{dbl2}} = \frac{0.9 A_{vn} f_u}{\sqrt{3}\gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$ $T_{\text{db}} = \min(T_{db1},\ T_{db2}) = 1115.73$ [Ref. IS 800:2007, Cl.6.4]	
Tension Capacity (kN)	$A = 500.0$	$T_{\text{d}} = \min(T_{\text{dg}},\ T_{\text{db}})$ $= \min(511.36, 1115.73)$ $= 511.36$ [Ref.IS 800:2007, Cl.6.1]	**Pass**

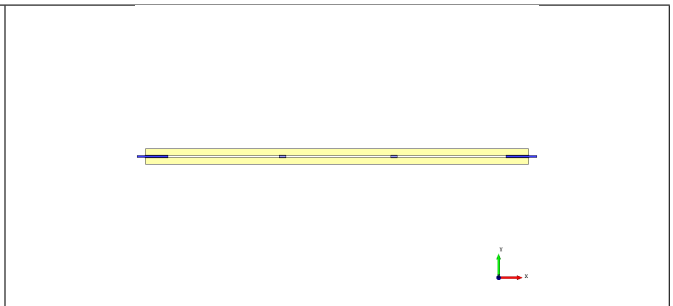
2.5 Intermittent Connection

Check	Required	Provided	Remarks
Connection (nos)		2	
Spacing (mm)	1000	872.0	**Pass**
Min.Height (mm)		155	
Min.Plate Length (mm)		50	

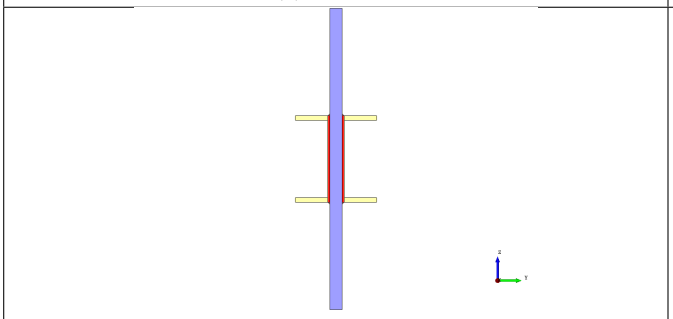
3 3D Views



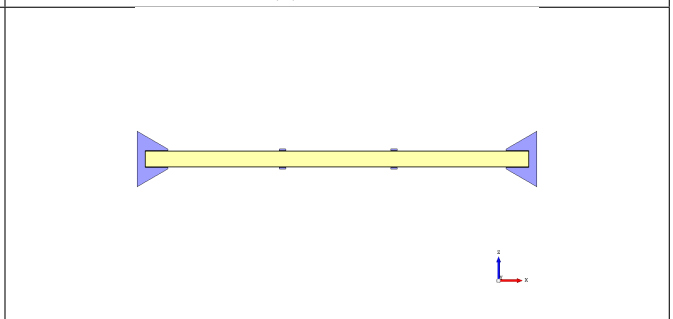
(a) 3D View



(b) Top View



(c) Side View



(d) Front View

4 Design Log

15:43:30 - Osdag - INFO - :In the case of reverse loading, slenderness value shall be less than 180 [Ref. Table 3, IS 800:2007].
15:43:30 - Osdag - INFO - :In the case of reverse loading for double sections, spacing of the intermittent connection shall be less than 600 [Ref. Cl. 10.2.5.5, IS 800:2007].
15:43:30 - Osdag - INFO - Preheating of thicker plate is required (IS 800:2007 Table 21).
15:43:30 - Osdag - INFO - :Overall welded tension member design is safe.
15:43:30 - Osdag - INFO - :==========End Of design==========