



Company Name	IIT Bombay	Project Title	Tension Member
Group/Team Name	Osdag	Subtitle	Welded to End Gusset
Designer	Engineer#1	Job Number	2.2.4
Date	04 /02 /2021	Client	Dr. Harshvardhan Subbarao, Mumbai

## 1 Input Parameters

Module	Tension Member Design - Welded to End Gusset
Axial Force (kN)	240.0
Length (mm) *	3200.0
Section Profile*	Channels
Section Size*	Ref List of Input Section
<b>Plate Details - Input and Design Preference</b>	
Thickness (mm)	[14]
Material	E 250 (Fe 410 W)A
Ultimate Strength, $F_u$ (MPa)	410
Yield Strength, $F_y$ (MPa)	250
<b>Weld Details - Input and Design Preference</b>	
Weld Type	Fillet
Type of Weld Fabrication	Field weld
Material Grade Overwrite, $F_u$ (MPa)	410.0

### 1.1 List of Input Section

Section Size*	'MC 250'
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## 2 Design Checks

Design Status	Pass
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### 2.1 Selected Member Data

	Section Size*		('MC 250', 'Channels')	
	Material		E 250 (Fe 410 W)A	
	Mass, $m$ (kg/m)		30.6	
	Area, $A$ (cm <sup>2</sup> )		3890.0	
	$D$ (mm)	250	$I_y$ (cm <sup>4</sup> )	218.0
	$B$ (mm)	80	$r_z$ (cm)	9.92
	$t$ (mm)	7.2	$r_y$ (cm)	2.37
	$T$ (mm)	14.1	$Z_z$ (cm <sup>3</sup> )	306.0
	Flange Slope	96	$Z_y$ (cm <sup>3</sup> )	38.2
	$R_1$ (mm)	12.0	$Z_{pz}$ (cm <sup>3</sup> )	358.0
	$R_2$ (mm)	3.2	$Z_{py}$ (cm <sup>3</sup> )	38.2
	$C_y$ (mm)	23.0	Radius of gyration, $r$ (cm)	23.7
	$I_z$ (cm <sup>4</sup> )	3820.0		

### 2.2 Member Check

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)		$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $= \frac{3890.0 \times 250}{1.1 \times 10^3}$ $= 884.09$ <p>[Ref. IS 800:2007, Cl.6.2]</p>	



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Check	Required	Provided	Remarks
Tension Rupture Capacity (kN)		$\beta = 1.4 - 0.076 \times \frac{w}{t} \times \frac{f_y}{0.9f_u} \times \frac{b_s}{L_c}$ $\leq \frac{0.9f_u\gamma_{m0}}{f_y\gamma_{m1}} \geq 0.7$ $= 1.4 - 0.076 \times \frac{80}{7.2} \times \frac{250}{0.9 \times 410} \times \frac{80}{138}$ $\leq \frac{0.9 \times 410 \times 1.1}{250 \times 1.25} \geq 0.7$ $= 1.07$ $T_{dn} = 1 \times \left( \frac{0.9A_{nc}f_u}{\gamma_{m1}} + \frac{\beta A_{go}f_y}{\gamma_{m0}} \right)$ $= 1 \times \left( \frac{0.9 \times 1596.96 \times 410}{1.25} + \frac{1.07 \times 2256.0 \times 250}{1.1} \right)$ $= 1020.04$ <p>[Ref. IS 800:2007, Cl.6.3.3]</p>	
Tension Capacity (kN)	240.0	$T_d = \min(T_{dg}, T_{dn})$ $= \min(884.09, 1020.04)$ $= 884.09$ <p>[Ref.IS 800:2007, Cl.6.1]</p>	Pass
Slenderness	$\frac{KL}{r} \leq 400$	$\frac{KL}{r} = \frac{1 \times 3200.0}{23.7}$ $= 135.02$ <p>[Ref. IS 800:2007, Cl.7.1.2]</p>	Pass
Utilization Ratio	$\leq 1$	$\text{Utilization Ratio} = \frac{F}{T_d} = \frac{240.0}{884.09}$ $= 0.27$	



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Check	Required	Provided	Remarks
Axial Load Considered (kN)	$A_{cmin} = 0.3A_c$ $= 0.3 \times 884.09$ $= 265.23$ $A_{cmax} = 884.09$  [Ref. IS 800:2007, Cl.10.7]	$A = 265.23$	<b>Pass</b>

## 2.3 Weld Design

Check	Required	Provided	Remarks
Min. Weld Size (mm)	$t_{wmin}$ based on thinner part $= \max(7, 5)$ $s_{min}$ based on thicker part = 5  [Ref. IS 800:2007, Table 21, Cl.10.5.2.3]	5	<b>Pass</b>
Max. Weld Size (mm)	Thickness of thinner part $= \min(14.0, 7.2) = 7.2$ $s_{max} = 16.0$  [Ref. IS 800:2007, Cl.10.5.3.1]	5	<b>Pass</b>
Throat Thickness (mm)	$t_t \geq 3$  [Ref. IS 800:2007, Cl.10.5.3.1]	$t_t = 0.7t_w$ $= 0.7 \times 5$ $= 3.5$  [Ref. IS 800:2007, Cl.10.5.3.1]	<b>Pass</b>
Effective Length (mm)		$l_w = 486$	



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Check	Required	Provided	Remarks
Weld Strength (N/mm)	$R_w = \sqrt{(A_{wh})^2 + (V_{wv})^2}$ $V_{wv} = \frac{V}{l_w} = \frac{0.0}{486}$ $A_{wh} = \frac{A}{l_w} = \frac{265227.273}{486}$ $R_w = \sqrt{(545.74)^2 + (0.0)^2}$ $= 545.74$	$f_w = \frac{t_t f_u}{\sqrt{3} \gamma_{mw}}$ $= \frac{3.5 \times 410}{\sqrt{3} \times 1.5}$ $= 552.33$ [Ref. IS 800:2007, Cl.10.5.7.1.1]	Pass
Weld Strength (post long joint) (N/mm)	<p>if <math>l \geq 150t_t</math>, then <math>V_{rd} = \beta_{lw} V_{db}</math></p> <p>if <math>l &lt; 150t_t</math>, then <math>V_{rd} = V_{db}</math></p> <p>where,</p> <p><math>l</math> = plate length or height</p> $\beta_{lw} = 1.2 - \frac{(0.2l)}{(150t_t)}$ <p>but, <math>0.6 \leq \beta_{lw} \leq 1.0</math></p> [Ref. IS 800:2007, Cl.10.5.7.3]	<p><math>l</math> = plate length or height</p> $l_t = \max(280, 153)$ $= 280$ $150t_t = 150 \times 3.5 = 525.0$ <p>since, <math>l &lt; 150t_t</math></p> <p>then <math>f_{wrd} = f_w</math></p> $f_{wrd} = 552.33$ [Ref. IS 800:2007, Cl.10.5.7.3.]	
Weld Strength (N/mm)	545.74	552.33	Pass

## 2.4 Gusset Plate Check

Check	Required	Provided	Remarks
Tension Yielding Capacity (kN)	265.23	$T_{dg} = \frac{A_g f_y}{\gamma_{m0}}$ $A_g = lt = 250 \times 14.0$ $= \frac{3500.0 \times 250}{1.1 \times 10^3}$ $= 795.45$ [Ref. IS 800:2007, Cl.6.2]	Pass



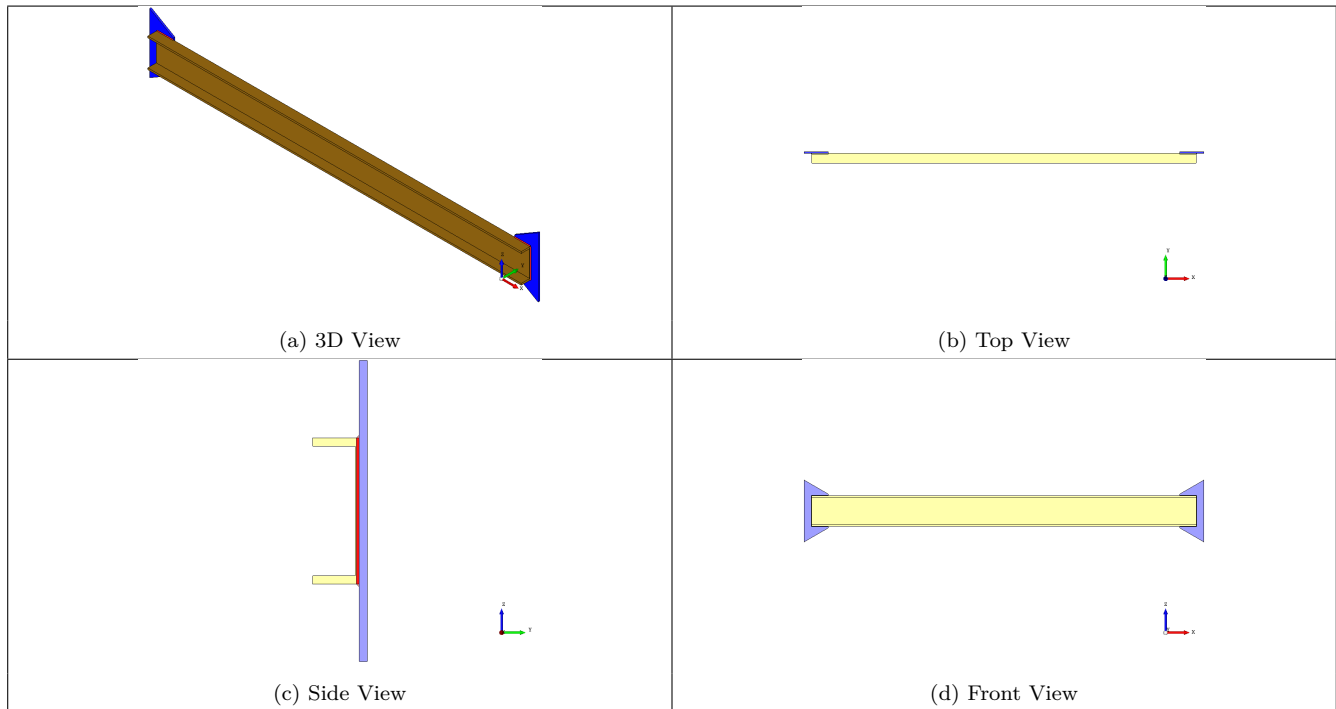
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Check	Required	Provided	Remarks
Min.Height (mm)		$H = 1 \times \text{Depth} + \text{Clearance}$ $= (1 \times 250) + 30$ $= 280$	
Min.Plate Length (mm)		$L = \text{Flange weld} + \text{Clearance}$ $= 123 + 30$ $= 153$	Pass
Min.Member Length (mm)	306	3200.0	Pass
Thickness (mm)		$T_p = 14.0$	
Weld Strength (N/mm)	$R_w = \sqrt{(A_{wh})^2 + (V_{wv})^2}$  $V_{wv} = \frac{V}{l_w} = \frac{0.0}{486}$ $A_{wh} = \frac{A}{l_w} = \frac{265227.273}{486}$  $R_w = \sqrt{(545.74)^2 + (0.0)^2}$ $= 545.74$	$f_w = \frac{t_t f_u}{\sqrt{3} \gamma_{mw}}$ $= \frac{3.5 \times 410}{\sqrt{3} \times 1.5}$ $= 552.33$  [Ref. IS 800:2007, Cl.10.5.7.1.1]	Pass
Block Shear Capacity (kN)		$T_{db1} = \frac{A_{vg} f_y}{\sqrt{3} \gamma_{m0}} + \frac{0.9 A_{tn} f_u}{\gamma_{m1}}$  $T_{db2} = \frac{0.9 A_{vn} f_u}{\sqrt{3} \gamma_{m1}} + \frac{A_{tg} f_y}{\gamma_{m0}}$  $T_{db} = \min(T_{db1}, T_{db2}) = 1172.46$  [Ref. IS 800:2007, Cl.6.4]	
Tension Capacity (kN)	$A = 265.23$	$T_d = \min(T_{dg}, T_{db})$ $= \min(795.45, 1172.46)$ $= 795.45$  [Ref. IS 800:2007, Cl.6.1]	Pass



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### 3 3D Views



### 4 Design Log

15:42:32 - Osdag - INFO - :In the case of reverse loading, slenderness value shall be less than 180 [Ref. Table 3, IS 800:2007].

15:42:32 - Osdag - INFO - :The minimum design force based on the member size is used for performing the connection design, i.e. 265.23 kN [Ref. Cl. 10.7, IS 800:2007].

15:42:32 - Osdag - INFO - Size of weld is calculated based on the edge type i.e. square edge or round edge (IS 800:2007 Clause 10.5)).

15:42:32 - Osdag - INFO - :Overall welded tension member design is safe.

15:42:32 - Osdag - INFO - :=====End Of design=====