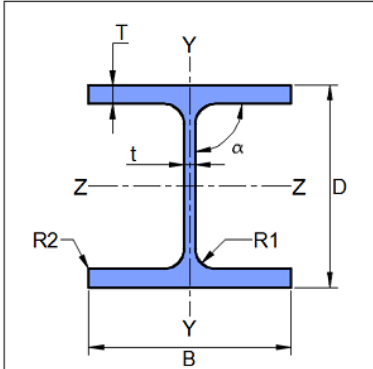
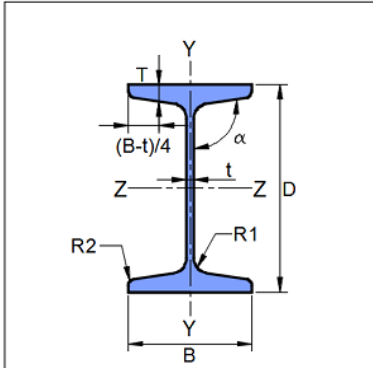




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Designer	Engineer #1	Job Number	1.1.3.2.2
Date	17 /12 /2020	Client	Manas M. Ghosh, INSDAG, Kolkata

## 1 Input Parameters

Main Module		Shear Connection		
Module		Cleat Angle		
Connectivity		Column Web-Beam Web		
Shear Force (kN)		240.0		
Supporting Section - Mechanical Properties				
	Supporting Section		UC 305 x 305 x 118	
	Material		E 300 (Fe 440)	
	Ultimate Strength, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	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		
Supported Section - Mechanical Properties				
	Supported Section		MB 450	
	Material		E 300 (Fe 440)	
	Ultimate Strength, Fu (MPa)		440	
	Yield Strength, Fy (MPa)		300	
	Mass, m (kg/m)	72.38	Iz (cm4)	30400.0
	Area, A (cm2)	92.2	Iy(cm4)	834.0
	D (mm)	450.0	rz (cm)	18.1
	B (mm)	150.0	ry (cm)	3.0
	t (mm)	9.4	Zz (cm3)	1350.0
	T (mm)	17.4	Zy (cm3)	111.0
	Flange Slope	98	Zpz (cm3)	1550.0
	R1 (mm)	15.0	Zpy (cm3)	187.0
	R2 (mm)	7.5		
Bolt Details - Input and Design Preference				



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Diameter (mm)	[20]
Property Class	[12.9]
Type	Friction Grip Bolt
Hole Type	Standard
Slip Factor, ( $\mu_f$ )	0.33
<b>Detailing - Design Preference</b>	
Edge Preparation Method	Rolled, machine-flame cut, sawn and planed
Gap Between Members (mm)	10.0
Are the Members Exposed to Corrosive Influences?	False

## 1.1 List of Input Section

Cleat Angle List	'80 x 80 x 8'
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## 2 Design Checks

Design Status	Fail
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### 2.1 Selected Member Data

	Section Size		80 x 80 x 8	
	Material		E 250 (Fe 410 W)A	
	Ultimate Strength, $F_u$ (MPa)		410	
	Yield Strength, $F_y$ (MPa)		250	
	Mass, $m$ (kg/m)	9.65	$I_u$ (cm <sup>4</sup> )	117.0
	Area, $A$ (cm <sup>2</sup> )	12.3	$I_v$ (cm <sup>4</sup> )	30.5
	$A$ (mm)	80.0	$r_z$ (cm)	2.45
	$B$ (mm)	80.0	$r_y$ (cm)	2.45
	$t$ (mm)	8.0	$r_u$ (cm)	3.09
	$R_1$ (mm)	8.0	$r_v$ (cm)	1.58
	$R_2$ (mm)	0.0	$Z_z$ (cm <sup>3</sup> )	12.9
	$C_y$ (mm)	22.8	$Z_y$ (cm <sup>3</sup> )	12.9
	$C_z$ (mm)	22.8	$Z_{pz}$ (cm <sup>3</sup> )	23.3
	$I_z$ (cm <sup>4</sup> )	74.0	$Z_{py}$ (cm <sup>3</sup> )	12.9
	$I_y$ (cm <sup>4</sup> )	74.0		

### 2.2 Initial Section Check

Check	Required	Provided	Remarks
Shear Yielding Capacity (kN)	240.0	$V_{dy} = \frac{A_v f_y}{\sqrt{3} \gamma_{mo}}$ $= \frac{450.0 \times 9.4 \times 300}{\sqrt{3} \times 1.1 \times 1000}$ $= 666.05$ [Ref.IS 800 : 2007, Cl.10.4.3]	Pass
Allowable Shear Capacity (kN)	240.0	$V_d = 0.6 V_{dy}$ $= 0.6 \times 666.05$ $= 399.63$ [Limited to low shear]	Pass



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## 2.3 Load Consideration

Check	Required	Provided	Remarks
Applied Shear Force (kN)	240.0	$V_{ymin} = \min(0.15 \times V_{dy}, 40.0)$ $= \min(0.15 \times 666.05, 40.0)$ $= 40$  $V_u = \max(V_y, V_{ymin})$ $= \max(240.0, 40)$ $= 240.0$  [Ref. IS 800 : 2007, Cl. 10.7]	

## 2.4 Bolt Design - Connected to Beam

Check	Required	Provided	Remarks
Diameter (mm)		20.0	
Property Class		12.9	
Cleat Angle		80 x 80 x 8	
No. of Bolt Columns		1	
No. of Bolt Rows		3	
Min. Pitch Distance (mm)	$p_{min} = 2.5 d$ $= 2.5 \times 20.0$ $= 50.0$  [Ref IS 800 : 2007, Cl. 10.2.2]	85	Pass
Max. Pitch Distance (mm)	$p_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 8.0, 300 \text{ mm})$ $= \min(256.0, 300 \text{ mm})$ $= 256.0$  Where, $t = \min(8.0, 9.4)$  [Ref. IS 800 : 2007, Cl. 10.2.3]	85	Pass



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Check	Required	Provided	Remarks
Min. Gauge Distance (mm)	$g_{min} = 2.5 d$ $= 2.5 \times 20.0$ $= 50.0$  [Ref IS 800 : 2007, Cl. 10.2.2]	N/A	
Max. Gauge Distance (mm)	$g_{max} = \min(32 t, 300 \text{ mm})$ $= \min(32 \times 8.0, 300 \text{ mm})$ $= \min(256.0, 300 \text{ mm})$ $= 256.0$  Where, $t = \min(8.0, 9.4)$  [Ref. IS 800 : 2007, Cl. 10.2.3]	N/A	
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
Max. End Distance (mm)	$e_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 8.0 \times \sqrt{\frac{250}{250}} = 96.0$ $e_2 = 12 \times 9.4 \times \sqrt{\frac{250}{300}} = 102.97$ $e_{max} = \min(e_1, e_2) = 96.0$  [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



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Check	Required	Provided	Remarks
Max. Edge Distance (mm)	$e'_{max} = 12 t \varepsilon; \varepsilon = \sqrt{\frac{250}{f_y}}$ $e_1 = 12 \times 8.0 \times \sqrt{\frac{250}{250}} = 96.0$ $e_2 = 12 \times 9.4 \times \sqrt{\frac{250}{300}} = 102.97$ $e'_{max} = \min(e_1, e_2) = 96.0$ <p>[Ref. IS 800 : 2007, Cl. 10.2.4.3]</p>	35	Pass
Moment Demand (kNm)		$M_d = (V_u \times ecc + M_w)$ <p><i>ecc = eccentricity</i>  <i>M<sub>w</sub> = external moment acting on web</i></p> $= \frac{(240.0 \times 10^3 \times 51.0 + 0.0 \times 10^6)}{10^6}$ $= 12240.0$	
Bolt Force Parameter(s) (mm)	$l_n = \text{length available}$ $l_n = p (n_r - 1)$ $= 85 \times (3 - 1)$ $= 170$ $y_{max} = l_n / 2$ $= 170 / 2$ $= 85.0$ $x_{max} = g(n_c - 1) / 2$ $= 0.0 \times (1 - 1) / 2$ $= 0.0$		



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Check	Required	Provided	Remarks
Bolt.Force (kN)	$v_b v_u = V_u / (n_r \times n_c)$ $= \frac{240.0}{(3 \times 1)}$ $= 80.0$ $t_m h = \frac{M_d \times y_{max}}{\sum r_i^2}$ $= \frac{12240.0 \times 85.0}{14.45}$ $= 72.0$ $t_m v = \frac{M_d \times x_{max}}{\sum r_i^2}$ $= \frac{12240.0 \times 0.0}{14.45}$ $= 0.0$ $a_b h = \frac{A_u}{(n_r \times n_c)}$ $= \frac{0.0}{(3 \times 1)}$ $= 0.0$ $v_{res} = \sqrt{(v_b v_u + t_m v)^2 + (t_m h + a_b h)^2}$ $= \sqrt{(80.0 + 0.0)^2 + (72.0 + 0.0)^2}$ $= 107.63$		
Slip Resistance		$V_{dsf} = \frac{\mu_f n_e K_h F_o}{\gamma_{mf}}$ <p>Where, <math>F_o = 0.7 f_{ub} A_{nb}</math></p> $V_{dsf} = \frac{0.33 \times 1 \times 1.0 \times 0.7 \times 1220.0 \times 245}{1.25 \times 10^3}$ $= 110.47$ <p>[Ref. IS 800 : 2007, Cl. 10.4.3]</p>	



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Check	Required	Provided	Remarks
Long Joint Reduction Factor		$l_j = (n_r - 1) \times p$ $= (3 - 1) \times 85 = 170$ $l = 170$ $15 \times d = 15 \times 20.0 = 300.0$ $\text{since, } l_j < 15 \times d \text{ then } \beta_{lj} = 1.0$ $[\text{Ref. IS 800 : 2007, Cl. 10.3.3.1}]$	
Large Grip Length Reduction Factor		$l_g = \Sigma (t_p + t_{member})$ $= 25.4$ $5d = 100.0$ $8d = 160.0$ $\text{since, } l_g < 5d ; \beta_{lg} = 1.0$ $[\text{Ref. IS 800 : 2007, Cl. 10.3.3.2}]$	N/A
Bolt Capacity (post reduction factor) (kN)		$V_{rd} = \beta_{lj} \beta_{lg} V_{db}$ $= 1.0 \times 1.0 \times 110.47$ $= 110.47$	
Capacity (kN)	107.63	110.47	Pass

## 2.5 Cleat Angle Check

Check	Required	Provided	Remarks
Min. Cleat Angle Height	$0.6 \times (d_b - 2 \times t_f - 2 \times r_r)$ $= 0.6 \times (450.0 - 2 \times 17.4 - 2 \times 15.0)$ $= 231.12$ $[\text{Ref. INSDAG - Chpt.5, Sect.5.2.3}]$	240	Pass
Max. Cleat Angle Height	$d_b - 2(t_{bf} + r_{b1} + gap)$ $= 314.5 - 2 \times (18.7 + 15.2 + 10)$ $= 385.2$	240	Pass
Min. Leg Length (mm) on supported leg	$max(gap, t_{cleat} + r_{r-angle}) + 2e'_{min} + (n_c - 1)g_{min}$ $= max(10.0, 8.0 + 8.0) + 2 \times 33.0 + (1 - 1) \times 50.0$ $= 82.0$	80.0	Fail





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Check	Required	Provided	Remarks
Min. Leg Length (mm) on supporting leg	$t_{cleat} + r_{r-angle} + 2e'_{min} + (n_c - 1)g_{min}$ $= 8.0 + 8.0 + 2 \times 33.0 + (1 - 1) \times 50.0$ $= 82.0$	80.0	<b>Fail</b>
Min. Cleat Angle Thickness (mm)	$t_w = 0.5 * 9.4 = 4.7$	8.0	<b>Pass</b>

### 3 Design Log

2020-12-17 23:14:54 - Osdag - INFO - 3rows 1columns 20.0mm diameter bolts needs leg length of 86.0

2020-12-17 23:14:54 - Osdag - INFO - Available width is 80.0

2020-12-17 23:14:54 - Osdag - ERROR - The connection cannot be designed with provided bolt diameters or cleat angle list