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1 Input Parameters

Module	Flexural Members - Simply Supported
Shear Force (kN)*	56.0
Bending Moment (kNm)*	48.0
Effective Span (m)*	4.8
Section Profile*	Beams and Columns
Section Size*	Ref List of Input Section
Material	E 250 (Fe 410 W)A
Support Type	Major Laterally Supported
End Conditions	Simply Supported
Ultimate Strength, F_u (MPa)	410
Yield Strength, F_y (MPa)	250
End Conditions - Simply Supported	
Torsional restraint	Fully Restrained
Warping restraint	Both flanges fully restrained
Design Preference	
Effective Area Parameter	1.0
Semi-compact sections	Yes
Loading Condition	Normal
Effective Length Parameter	NA
Bearing Length (mm)	NA


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1.1 List of Input Section

Section Size*	'WPB 850 X 300 X 195.74','WPB 100 X 100 X 12.24','UB 406 x 178 x 74','NPB 700 X 250 X 128.41','WPB 850 X 300 X 230.56','NPB 450 X 190 X 77.58','UB 762 x 267 x 173','HB 450','PBP 300 X 95','UB 406 x 178 x 67','LB 500','LB 275','UB 254 x 146 x 37','NPB 200 X 150 X 30.46','UB 686 x 254 x 152','WPB 300 X 300 X 117.03','WPB 360 X 370 X 150.87','UB 1016 x 305 x 349','UB 305 x 127 x 37','LB 400','WPB 160 X 160 X 22.75','NPB 250 X 150 X 39.78','NPB 550 X 210 X 105.52','LB 200','LB(P) 300','NPB 200 X 100 X 18.43','UB 356 x 171 x 57','WPB 500 X 300 X 270.28','NPB 330 X 160 X 49.15','NPB 400 X 180 X 75.67','UB 406 x 178 x 54','UB 457 x 152 x 52','NPB 270 X 135 X 30.73','UC 305 x 305 x 158','UC 152 x 152 x 23','WPB 850 X 300 X 253.69','WPB 140 X 140 X 33.72','WPB 160 X 160 X 42.59','WPB 280 X 280 X 76.36','NPB 200 X 100 X 22.36','HB 150*','SC 250','UC 356 x 368 x 153','SC 160','UB 457 x 191 x 98','NPB 140 X 70 X 12.89','WPB 220 X 220 X 115.61','MB 150','HB 250*','NPB 500 X 200 X 107.32','PBP 320 X 88.48','HB 350','NPB 400 X 180 X 57.38','NPB 700 X 250 X 153.87','UB 203 x 133 x 30','WPB 500 X 300 X 187.34','NPB 300 X 165 X 53.46','UB 305 x 102 x 25','UB 254 x 146 x 31','NPB 700 X 250 X 113.46','WPB 450 X 300 X 139.76','WB 200','WPB 340 X 300 X 290.64','WPB 500 X 300 X 107.46','LB 150','MB 600','UC 254 x 254 x 132','LB 125','SC 140','UC 356 x 406 x 340','WPB 850 X 300 X 214.25','WPB 600 X 300 X 177.78','NPB 200 X 130 X 27.37','LB 300','NPB 550 X 210 X 122.52','PBP 260 X 75.01','WPB 340 X 300 X 134.16','NPB 700 X 250 X 143.42','WB 600','WPB 280 X 280 X 188.54','UB 457 x 191 x 74','UB 533 x 210 x 82','NPB 350 X 170 X 50.22','WPB 200 X 200 X 50.92','WB 350','WPB 150 X 150 X 30.11','MB 400','WPB 100 X 100 X 16.67','HB 350*','WPB 650 X 300 X 137.98','WPB 220 X 220 X 50.51','WPB 180 X 180 X 35.52','WPB 150 X 150 X 23.5','WPB 260 X 260 X 141.52','WPB 280 X 280 X 61.26','NPB 220 X 110 X 22.18','UC 356 x 368 x 202','WPB 600 X 300 X 285.48','UB 762 x 267 x 134','WPB 250 X 250 X 97.04','NPB 220 X 110 X 29.35','WPB 450 X 300 X 99.75','UB 610 x 229 x 140','WPB 240 X 240 X 47.4','WPB 240 X 240 X 83.2','WPB 240 X 240 X 156.68','SC 180','LB 550','UC 305 x 305 x 283','WPB 360 X 300 X 250.27','UB 457 x 191 x 82','MB 350','MB 550','UB 305 x 165 x 40','WPB 550 X 300 X 199.44','WPB 320 X 300 X 126.66','WPB 340 X 300 X 78.9','UC 356 x 406 x 235','UB 914 x 305 x 253','WPB 360 X 370 X 136.21','UB 356 x 171 x 51','WPB 320 X 300 X 244.97','UC 254 x 254 x 89','UC 356 x 368 x 129','UC 356 x 406 x 467','WPB 900 X 300 X 291.46','UB 254 x 146 x 43','WPB 360 X 300 X 125.81','UC 305 x 305 x 240','PBP 300 X 180.12','WPB 700 X 300 X 240.51','PBP 260 X 87.3','PBP 300 X 76.92','NPB 300 X 150 X 36.53','UB 305 x 165 x 54','UC 305 x 305 x 97','LB 350','HB 225','PBP 400 X 212.5','UB 254 x 102 x 22','UC 356 x 368 x 177','NPB 300 X 150 X 42.24','UB 356 x 171 x 45','HB 400','SC 120','WPB 100 X 100 X 41.79','WPB 360 X 370 X 182.02','UC 305 x 305 x 137','LB(P) 100','WPB 550 X 300 X 278.19','PBP 400 X 230.9','PBP 300 X 150.01','UB 610 x 305 x 149','PBP 200 X 53.49','WPB 700 X 300 X 300.68','WPB 200 X 200 X 83.52','HB 450*','UC 152 x 152 x 37','WPB 600 X 300 X 128.79','UB 178 x 102 x 19','LB(P) 200','UB 356 x 127 x 39','WPB 200 X 200 X 61.3','NPB 300 X 165 X 39.88','UC 305 x 305 x 198','UC 356 x 406 x 634','WB 550','PBP 300 X 124.2','NPB 450 X 190 X 92.37','NPB 160 X 80 X 15.77','WPB 200 X 200 X 74.01','WPB 140 X 140 X 24.66','WB 400','NPB 600 X 220 X 154.47','NPB 750 X 270 X 202.49','UB 305 x 102 x 28','WPB 180 X 180 X 88.9','SC 100','LB 325','PBP 320 X 102.84','MB 250','MB 200','NPB 200 X 100 X 25.09','UB 406 x 140 x 39','WB 175','WPB 260 X 260 X 68.16','UC 254 x 254 x 73','UB 254 x 102 x 25','UC 203 x 203 x 86','UC 356 x 406 x 551','NPB 300 X 200 X 59.57','NPB 250 X 175 X 43.94','HB 300*','WPB 100 X 100 X 20.44','HB 225*','UB 1016 x 305 x 249','UB 457 x 152 x 82','HB 300','UC 203 x 203 x 60','UB 457 x 191 x 67','SC 200','SC 150*','MB 500','PBP 400 X 122.4','MB 125','PBP 320 X 184.1','JB 225','NPB 120 X 60 X 10.37','WPB 800 X 300 X 224.38','UB 1016 x 305 x 272','UB 686 x 254 x 125','WPB 800 X 300 X 179.9','NPB 250 X 150 X 46.48','NPB 750 X 270 X 174.54','MB 450','WPB 900 X 300 X 198.01','WPB 140 X 140 X 18.08','UC 356 x 406 x 287','PBP 360 X 178.4','UB 152 x 89 x 16'
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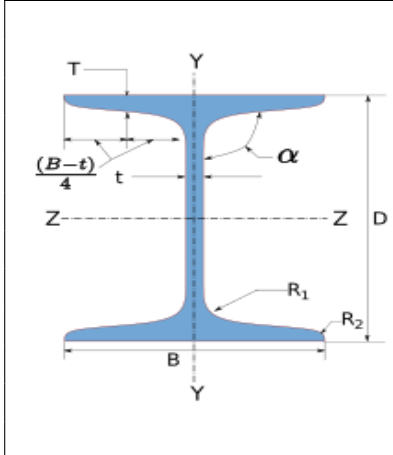
Section Size*	'NPB 300 X 165 X 45.76','UB 305 x 165 x 46','WPB 320 X 300 X 97.64','UB 610 x 229 x 101','UC 152 x 152 x 30','UB 762 x 267 x 147','WPB 200 X 200 X 42.26','WPB 800 X 300 X 262.34','WPB 120 X 120 X 52.13','UB 457 x 191 x 89','WPB 250 X 250 X 117.58','UB 254 x 102 x 28','WPB 700 X 300 X 149.89','UB 914 x 305 x 289','HB 150','UB 457 x 152 x 67','PBP 300 X 222.58','WPB 250 X 250 X 67.22','UB 1016 x 305 x 487','NPB 330 X 160 X 57.01','JB 150','NPB 300 X 200 X 75.37','WPB 320 X 300 X 74.25','PBP 300 X 109.54','NPB 600 X 220 X 122.45','NPB 200 X 165 X 48.0','WPB 250 X 250 X 73.15','UC 203 x 203 x 71','WPB 550 X 300 X 166.24','NPB 550 X 210 X 92.08','UB 203 x 102 x 23','UB 305 x 127 x 42','LB 225','WPB 260 X 260 X 172.43','WPB 160 X 160 X 76.19','LB 100','LB 600','MB 225','SC 220','WPB 450 X 300 X 171.12','UB 356 x 127 x 33','WPB 120 X 120 X 26.7','WPB 700 X 300 X 204.48','UB 127 x 76 x 13','UB 610 x 229 x 125','NPB 220 X 110 X 26.2','UC 305 x 305 x 118','UB 533 x 210 x 92','WB 450','NPB 250 X 150 X 34.08','WPB 300 X 300 X 237.92','UB 457 x 152 x 74','PBP 400 X 140.2','WPB 400 X 300 X 255.74','UC 254 x 254 x 167','NPB 180 X 90 X 21.27','UC 203 x 203 x 52','WPB 400 X 400 X 191.11','WPB 250 X 250 X 103.97','WPB 650 X 300 X 189.69','WPB 360 X 370 X 197.66','UB 533 x 210 x 101','MB 100','JB 175','NPB 270 X 135 X 36.07','PBP 400 X 158.1','WPB 250 X 250 X 148.38','NPB 180 X 90 X 15.37','NPB 400 X 200 X 67.28','WPB 280 X 280 X 284.13','WPB 900 X 300 X 251.62','NPB 450 X 190 X 67.16','NPB 100 X 55 X 8.1','NPB 500 X 200 X 90.69','NPB 350 X 170 X 57.1','HB 200','WB 150','UB 762 x 267 x 197','LB 75','LB 450','WB 500','WPB 360 X 300 X 163.0','NPB 250 X 125 X 30.11','NPB 200 X 165 X 35.69','NPB 700 X 250 X 171.48','PBP 300 X 88.46','WPB 300 X 300 X 100.85','UB 457 x 152 x 60','WPB 200 X 200 X 103.06','PBP 200 X 43.85','WPB 360 X 370 X 165.35','NPB 270 X 135 X 42.26','WPB 160 X 160 X 30.44','WPB 300 X 300 X 88.34','LB 175','WB 300','UB 406 x 140 x 46','UC 356 x 406 x 393','WPB 650 X 300 X 293.39','WB 250','NPB 500 X 200 X 79.36','LB(P) 175','WPB 800 X 300 X 171.52','WPB 180 X 180 X 51.22','WPB 300 X 300 X 69.8','NPB 200 X 130 X 31.56','HB 250','UB 533 x 210 x 122','UB 1016 x 305 x 222','WPB 400 X 400 X 219.67','UB 203 x 133 x 25','WPB 450 X 300 X 263.33','NPB 240 X 120 X 26.15','UB 1016 x 305 x 437','WPB 200 X 200 X 34.65','WPB 260 X 260 X 54.15','PBP 400 X 194.3','NPB 330 X 160 X 42.97','PBP 320 X 117.33','WB 225','NPB 240 X 120 X 34.32','WPB 360 X 300 X 91.04','NPB 600 X 220 X 107.57','WPB 250 X 250 X 85.04','UB 914 x 305 x 201','UC 254 x 254 x 107','UB 305 x 127 x 48','WPB 120 X 120 X 14.56','UB 356 x 171 x 67','PBP 220 X 57.28','WPB 260 X 260 X 92.99','WPB 550 X 300 X 119.99','UB 406 x 178 x 60','WPB 140 X 140 X 63.24','WPB 400 X 300 X 155.26','WPB 500 X 300 X 155.08','PBP 360 X 152.2','HB 200*','UC 203 x 203 x 46','WPB 400 X 300 X 92.4','WPB 260 X 260 X 114.4','HB 400*','WPB 500 X 300 X 129.78','UB 1016 x 305 x 314','UB 610 x 305 x 179','NPB 750 X 270 X 145.29','WPB 220 X 220 X 40.4','WPB 120 X 120 X 19.89','PBP 400 X 176.1','LB 250','NPB 300 X 150 X 49.32','NPB 200 X 165 X 42.48','UB 610 x 305 x 238','UB 305 x 102 x 33','WPB 220 X 220 X 71.47','UB 914 x 305 x 224','WPB 240 X 240 X 60.32','UB 610 x 229 x 113','WPB 800 X 300 X 317.36','NPB 180 X 90 X 18.8','MB 300','PBP 320 X 146.69','WPB 150 X 150 X 36.97','PBP 300 X 184.12','MB 175','UB 686 x 254 x 140','WPB 650 X 300 X 224.78','NPB 300 X 200 X 66.75','UB 533 x 210 x 109','UB 686 x 254 x 170','WPB 250 X 250 X 133.92','WPB 200 X 200 X 37.34','WPB 400 X 300 X 124.81','NPB 350 X 170 X 66.05','NPB 400 X 180 X 66.31','UB 1016 x 305 x 393','UB 914 x 419 x 343','NPB 350 X 250 X 79.18','WPB 340 X 300 X 104.78','WPB 180 X 180 X 28.68','NPB 240 X 120 X 30.71','UB 914 x 419 x 388','PBP 360 X 174.2','WPB 600 X 300 X 211.92','JB 200','WPB 400 X 400 X 239.62'
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2 Design Checks

Design Status	Pass
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2.1 Selected Member Data


	Section Size*		('HB 150', 'Beams and Columns')	
	Column Section		HB 150	
	Material		E 250 (Fe 410 W)A	
	Mass, m (kg/m)		27.06	
	Area, A (cm ²)	34.4	I_z (cm ⁴)	1450.0
	D (mm)	150.0	I_y (cm ⁴)	431.0
	B (mm)	150.0	r_z (cm)	6.49
	t (mm)	5.4	r_y (cm)	3.53
	T (mm)	9	Z_z (cm ³)	194.0
	Flange Slope	94	Z_y (cm ³)	57.5
	R_1 (mm)	8.0	Z_{pz} (cm ³)	215.0
	R_2 (mm)	4.0	Z_{py} (cm ³)	92.7

2.2 Effective Area

Check	Required	Provided	Remarks
Effective Area (mm ²)		= Effective Area Parameter \times Area of Section = 1.0×3440.0 = 3440.0	

2.3 Section Classification

Check	Required	Provided	Remarks
Web Class	Neutral Axis at Mid-Depth	$d = D - 2(T + R_1) = 116.0$ $\frac{d}{t_w} = \frac{116.0}{5.4} \leq 84\epsilon$ $= 21.48 \leq 84.0$ Plastic	

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Check	Required	Provided	Remarks
Flange Class	Rolled	$\frac{b}{t_f} = \frac{75.0}{9} \leq 9.4\epsilon$ $= 8.33 \leq 9.4$ Plastic	
Section Class		Plastic [Ref: Table 2, Cl.3.7.2 and 3.7.4, IS 800:2007]	

2.4 Web Slenderness Check

Check	Required	Provided	Remarks
Web Buckling	$= 67 \times \epsilon$ $= 67 \times 1.0$ $= 67.0$	$= \frac{d_{web}}{t_{web}} = \frac{(D - 2(T + R1))}{t_{web}}$ $= \frac{116.0}{5.4}$ $= 21.48$ [Ref. IS 800:2007, Cl.8.2.1.1]	Pass

2.5 Shear Strength Results

Check	Required	Provided	Remarks
Shear Strength (kN)	56.0	$V_d = \frac{A_v f_y}{\sqrt{3} \gamma_{m0}}$ $= \frac{150.0 \times 5.4 \times 250}{\sqrt{3} \times 1.1 \times 1000}$ $= 106.28$ [Ref. IS 800:2007, Cl.10.4.3]	Pass
Allowable Shear Capacity (kN)		$= 0.6 V_d$ $= 0.6 \times 106.28$ $= 63.77 > 56.0$ [Limited to low shear]	Low Shear


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2.6 Moment Strength Results

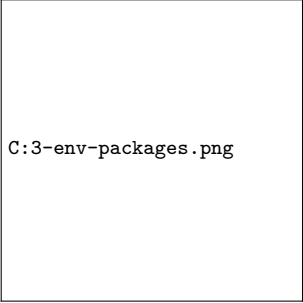
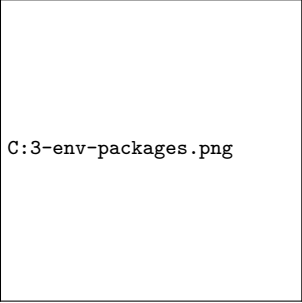


Check	Required	Provided	Remarks
Moment Strength (kNm)	48.0	$\beta_b = 1.0$ <i>Section is Plastic</i> $M_d = \frac{\beta_b Z_p f_y}{\gamma_{m0}} \leq \frac{1.2 Z_e f_y}{\gamma_{mo}}$ $= \frac{1 \times 215000.0 \times 250}{1.1 \times 10^6} \leq \frac{1.2 \times 194000.0 \times 250}{1.1 \times 10^6}$ $= 48.86 \leq 52.91$ [Ref. IS 800:2007, Cl.8.2.1.2]	Pass

2.7 Utilization

Check	Required	Provided	Remarks
Utilization Ratio	1.0	$UR = \text{MAX} \left(\frac{\text{Shear Force}}{\text{Shear Strength}}, \frac{\text{Bending Moment}}{\text{Bending Strength}} \right)$ $= \text{MAX} \left(\frac{56.0}{106.28}, \frac{48.0}{48.86} \right)$ $= \text{MAX} (0.527, 0.982)$ $= 0.982$	Pass

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3 3D Views

 (a) 3D View	 (b) Top View
 (c) Side View	 (d) Front View

4 Design Log

2024-12-28 10:38:49 - Osdag - INFO - Provided appropriate design preference, now checking input.

2024-12-28 10:38:52 - Osdag - INFO - The effective sectional area is taken as 100% of the cross-sectional area [Reference: Cl. 7.3.2, IS 800:2007].

2024-12-28 10:39:03 - Osdag - INFO - The section is Plastic. The HB 150 section has Plastic flange(8.33) and Plastic web(21.48). [Reference: Cl 3.7, IS 800:2007].