

**Quiz10**

Exam starts at 4.00 PM

Maximum Marks:15

Ends at 5.30 PM

**Topic: Eccentrically Loaded Connection**

Note: After completion, please convert your answer-script to pdf. **Rename** the file as “Quiz10” and upload in the google drive, link of which is shared with you. Upload your files by **5.40 PM**. **While answering, you must state your assumptions, show steps, and calculations or marks will be deducted.** Please take 3 digits after decimal for calculations. If cheating is found you will be awarded -20 and it will be counted in grade evaluation.

**Question**

A simply supported beam with all the joint details is shown below. The beam is subjected to a factored load  $P$  as shown. ISMB300 section is used for the beam, and ISHB300x58.8 kg/m sections are used for the columns. All sections are plastic. Grade of steel is E250A. Bearing type M18 bolts of grade 6.8 are used. All bolt holes are drilled and having standard clearance. The beam is laterally supported along its length. End and edge distances are 30 mm. a) Determine the value of  $P$  ensuring the member will not fail through flexure. b) Assess the safety of the bolted connection at the left support that is connecting the angle section with the flange of the column. c) Assess the safety of the bolted connection at the right support. You may take help of Annex H to determine the plastic section modulus. Neglect the self weight of the beam. Assume any data that you think is missing.

2+8+5

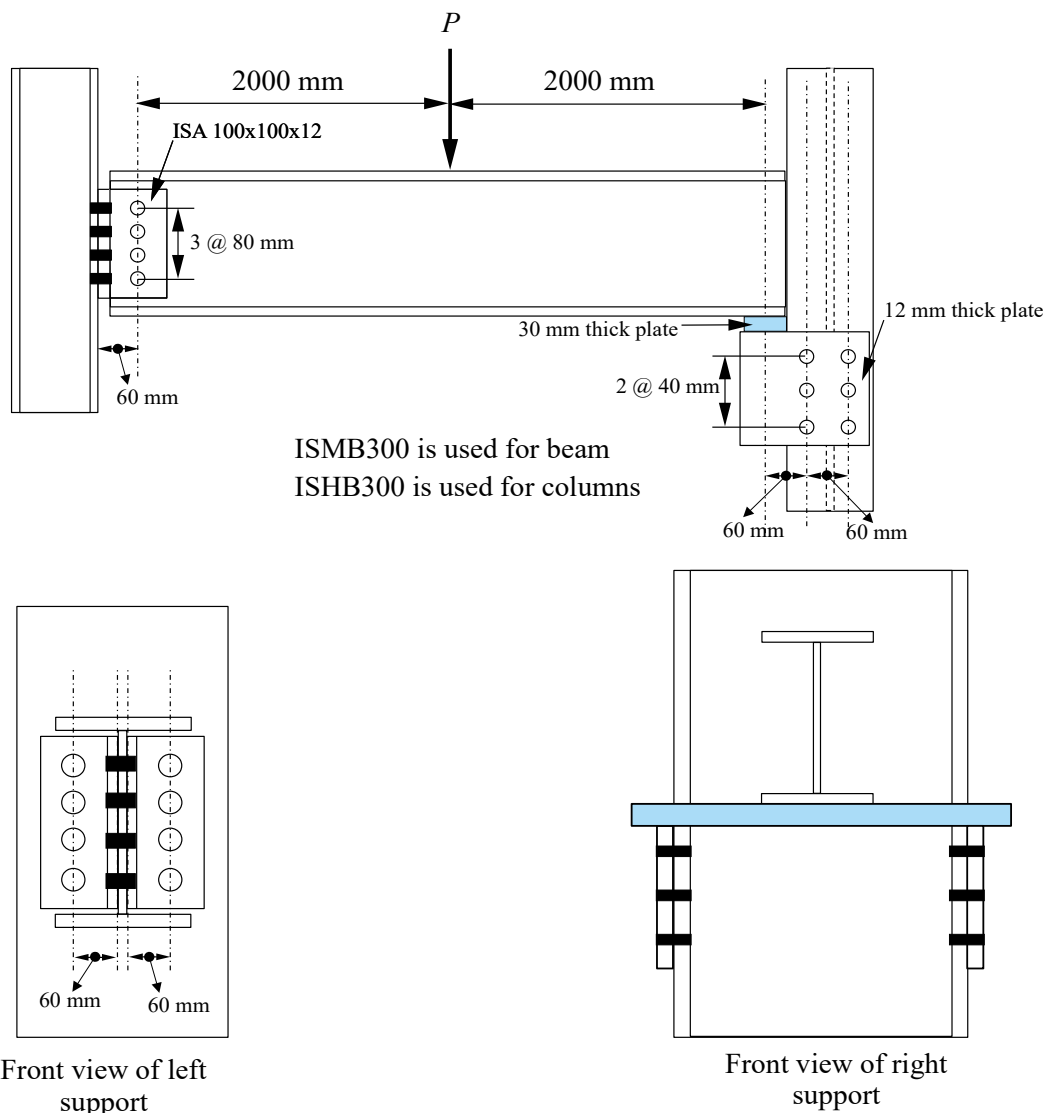
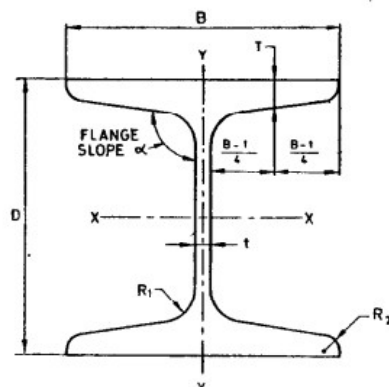
**FIGURE 1**

Table 46 (Continued)

Designation	Weight per Metre	Sectional Area	Depth of Section ( $D$ )	Width of Flange ( $b_f$ )	Thickness of Flange ( $t_f$ )	Thickness of Web ( $t_w$ )	Radii of Gyration ( $r_x$ ) ( $r_y$ )		Section Modulus ( $Z_x$ )	Plastic Modulus ( $Z_{px}$ )	Shape Factor ( $Z_{px}/Z_x$ )
(1)	kg/m	cm <sup>2</sup>	mm	mm	mm	mm	cm	cm	cm <sup>3</sup>	cm <sup>3</sup>	(12)
ISHB 250	51.0	64.96	250	250	9.7	6.9	10.91	5.49	618.9	678.73	1.096 7
ISMC 350	*42.1	53.66	350	100	13.5	8.1	13.66	2.83	571.9	672.19	1.175 4
ISMB 300	*44.2	56.26	300	140	12.4	7.5	12.37	2.84	573.6	651.74	1.136 2
ISLC 350	*38.8	49.47	350	100	12.5	7.4	13.72	2.82	532.1	622.95	1.170 7
ISLB 300	*37.7	48.08	300	150	9.4	6.7	12.35	2.80	488.9	554.32	1.133 8
ISHB 225	46.8	59.66	225	225	9.1	8.6	9.58	4.84	487.0	542.22	1.113 4
ISWB 250	40.9	52.05	250	200	9.0	6.7	10.69	4.06	475.4	527.57	1.109 7
ISHB 225	43.1	54.94	225	225	9.1	6.5	9.80	4.96	469.3	515.82	1.098 7
ISMC 300	*35.8	45.64	300	90	13.6	7.6	11.81	2.61	424.2	496.77	1.171 1
ISMB 250	37.3	47.55	250	125	12.5	6.9	10.39	2.65	410.5	465.71	1.134 5
ISLC 300	*33.1	42.11	300	100	11.6	6.7	11.98	2.87	403.2	466.73	1.157 6
ISLB 275	*33.0	42.02	275	140	8.8	6.4	11.31	2.61	392.4	443.09	1.130 5
ISHB 200	40.0	50.94	200	200	9.0	7.8	8.55	4.42	372.2	414.23	1.112 9
ISHB 200	37.3	47.54	200	200	9.0	6.1	8.71	4.51	360.8	397.23	1.101 0
ISWB 225	33.9	43.24	225	150	9.9	6.4	9.52	3.22	348.5	389.93	1.118 9
ISMC 250	*30.4	38.67	250	80	14.1	7.1	9.94	2.38	305.3	356.72	1.168 4
ISMB 225	31.2	39.72	225	110	11.8	6.5	9.31	2.34	305.9	348.27	1.138 5
ISLB 250	*27.9	35.53	250	125	8.2	6.1	10.23	2.33	297.4	338.69	1.138 8
ISLC 250	28.0	35.65	250	100	10.7	6.1	10.17	2.89	295.0	338.11	1.146 2
ISWB 200	28.8	36.71	200	140	9.0	6.1	8.46	2.99	262.5	293.99	1.120 0
ISMC 225	*25.9	33.01	225	80	12.4	6.4	9.03	2.38	239.5	277.93	1.160 5
ISLC 225	*24.0	30.53	225	90	10.2	5.8	9.14	2.62	226.5	260.13	1.148 5
ISLB 225	*23.5	29.92	225	100	8.6	5.8	9.15	1.94	222.4	254.72	1.145 3
ISMB 200	25.4	32.33	200	100	10.8	5.7	8.32	2.15	223.5	253.86	1.135 8
ISHB 150	34.6	44.08	150	150	9.0	11.8	6.09	3.35	218.1	251.64	1.153 8
ISHB 150	30.6	38.98	150	150	9.0	8.4	6.29	3.44	205.3	232.52	1.132 6
ISHB 150	27.1	34.48	150	150	9.0	5.4	6.50	3.54	194.1	215.64	1.111 0
ISMC 200	*22.1	28.21	200	75	11.4	6.1	8.03	2.23	181.9	211.25	1.161 4
ISLC 200	*20.6	26.22	200	75	10.8	5.5	8.11	2.37	172.6	198.77	1.151 6
ISWB 175	22.1	28.11	175	125	7.4	5.8	7.33	2.59	172.5	194.20	1.125 8
ISLB 200	*19.8	25.27	200	100	7.3	5.4	8.19	2.13	169.7	184.34	1.137 0
ISMB 175	*19.3	24.62	175	90	8.6	5.5	7.19	1.86	145.4	166.08	1.142 2
ISMC 175	*19.1	24.38	175	75	10.2	5.7	7.08	2.23	139.8	161.65	1.156 3
ISLC 175	*17.6	22.40	175	75	9.5	5.1	7.16	2.38	131.3	150.36	1.145 2
ISLB 175	*16.7	21.30	175	90	6.9	5.1	7.17	1.93	125.3	143.30	1.143 7
ISJB 225	*12.8	16.28	225	80	5.0	3.7	8.97	1.58	116.3	134.15	1.153 5
ISJC 200	13.9	17.8	200	70	7.1	4.1	8.08	2.18	116.1	133.12	1.146 5
ISWB 150	17.0	21.67	150	100	7.0	5.4	6.22	2.09	111.9	126.86	1.133 7

### SECTION 3 COLUMN/HEAVY WEIGHT BEAM SECTIONS

Table 3.1 Nominal Dimensions, Mass and Sectional Properties of Indian Standard Columns and Heavy Weight Beams



Designation (1)	Mass <i>M</i> kg/m (2)	Sectional Area, <i>a</i> cm <sup>2</sup> (3)	Dimensions							Sectional Properties					
			<i>D</i>	<i>B</i>	<i>t</i>	<i>T</i>	Flange Slope, $\alpha$	<i>R</i> <sub>1</sub>	<i>R</i> <sub>2</sub>	<i>I</i> <sub>x</sub>	<i>I</i> <sub>y</sub>	<i>r</i> <sub>x</sub>	<i>r</i> <sub>y</sub>	<i>Z</i> <sub>x</sub>	<i>Z</i> <sub>y</sub>
			mm	mm	mm	mm	deg	mm	mm	cm <sup>4</sup>	cm <sup>4</sup>	cm	cm	cm <sup>3</sup>	cm <sup>3</sup>
<b>Column Sections</b>															
SC 100	20.0	25.5	100	100	6.0	10.0	98.0	12	6.0	436	136	4.13	2.31	87.2	27.2
SC 120	26.2	33.4	120	120	6.5	11.0	98.0	12	6.0	842	255	5.02	2.76	140	42.6
SC 140	33.3	42.4	140	140	7.0	12.0	98.0	12	6.0	1 470	438	5.89	3.21	211	62.5
SC 150*	37.1	47.4	152	152	7.9	11.9	98.0	11.7	3.0	1 970	700	6.45	3.84	259	91.9
SC 160	41.9	53.4	160	160	8.0	13.0	98.0	15	7.5	2 420	695	6.74	3.61	303	86.8
SC 180	50.5	64.4	180	180	8.5	14.0	98.0	15	7.5	3 740	1 060	7.62	4.05	415	117
SC 200	60.3	76.8	200	200	9.0	15.0	98.0	18	9.0	5 530	1 530	8.48	4.46	553	153
SC 220	70.4	89.8	220	220	9.5	16.0	98.0	18	9.0	7 880	2 160	9.35	4.90	716	196
SC 250	85.6	109	250	250	10.0	17.0	98.0	23	11.5	12 500	3 260	10.7	5.46	997	260
SC 150* (BFB Section) is mainly used for railway electrification.															
<b>Heavy Weight Beams/Columns</b>															
HB 150	27.1	34.5	150	150	5.4	9.0	94.0	8.0	4.0	1 460	432	6.50	3.54	194	57.6
HB 150*	30.6	39.0	150	150	8.4	9.0	94.0	8.0	4.0	1 540	460	6.29	3.44	205	60.2
HB 150*	34.6	44.1	150	150	11.8	9.0	94.0	8.0	4.0	1 640	495	6.09	3.35	218	63.2
HB 200	37.3	47.5	200	200	6.1	9.0	94.0	9.0	4.5	3 600	967	8.71	4.51	361	96.7
HB 200*	40.0	50.9	200	200	7.8	9.0	94.0	9.0	4.5	3 720	995	8.55	4.42	372	98.6
HB 225	43.1	54.9	225	225	6.5	9.1	94.0	10.0	5.0	5 300	1 350	9.80	4.96	469	120
HB 225*	46.8	59.7	225	225	8.6	9.1	94.0	10.0	5.0	5 480	1 400	9.58	4.84	487	123
HB 250	51.0	65.0	250	250	6.9	9.7	94.0	10.0	5.0	7 740	1 960	10.9	5.49	619	156
HB 250*	54.7	69.7	250	250	8.8	9.7	94.0	10.0	5.0	7 980	2 010	10.7	5.37	639	160
HB 300	58.8	74.8	300	250	7.6	10.6	94.0	11.0	5.5	12 600	2 200	13.0	5.41	836	175
HB 300*	63.0	80.2	300	250	9.4	10.6	94.0	11.0	5.5	13 000	2 250	12.7	5.29	863	178
HB 350	67.4	85.9	350	250	8.3	11.6	94.0	12.0	6.0	19 200	2 450	14.9	5.34	1 090	196
HB 350*	72.4	92.2	350	250	10.1	11.6	94.0	12.0	6.0	19 800	2 510	14.7	5.22	1 130	199
HB 400	77.4	98.7	400	250	9.1	12.7	94.0	14.0	7.0	28 100	2 730	16.9	5.26	1 400	218
HB 400*	82.2	105	400	250	10.6	12.7	94.0	14.0	7.0	28 800	2 780	16.6	5.16	1 440	221
HB 450	87.2	111	450	250	9.8	13.7	94.0	15.0	7.5	39 200	3 000	18.8	5.18	1 740	239
HB 450*	92.5	118	450	250	11.3	13.7	94.0	15.0	7.5	40 300	3 050	18.5	5.08	1 790	242

NOTE—HB sections are also used as column sections.

\*These heavier sections in each size are obtained from the same set of rolls as the lighter sections by spreading of the rolls. The width of flanges of these sections gets increased by an amount equal to the difference between the thicknesses of the webs. Therefore, while ordering these heavier sections, mass should be mentioned.

-END-