



BOWEN UNIVERSITY
(Of the Nigerian Baptist Convention)
IWO

College of Environmental Science (COEVS)
FIRST SEMESTER EXAMINATION, 2023/2024
ARCHITECTURE PROGRAMME
ARC 309: BUILDING STRUCTURES III (2 UNITS)

INSTRUCTION: Answer Question number One (1) and any Three (3) others only.

TIME ALLOWED: 2 hours

Use well labeled diagram(s) where applicable

WARNING: Please note that you are not allowed to bring mobile phone(s) into the examination hall. Non-compliance will amount to examination misconduct and attract stiff penalty.

1. Calculate the forces in the members of a roof truss shown in figure 1. State whether the respective members are struts or ties. **(25 marks)**

2. A hollow steel pipe of 150mm external and 100mm internal diameter, as shown in figure 2 is to span between two buildings. What is the greatest permissible span in meters if the stresses in tension and compression must not exceed 150N/mm^2 .
Note: The unit of weight of steel is 78KN/m^3 . **(15 marks)**

3. A Timber beam is required to span 4m carrying a total uniform load (Inclusive of the beam's self-weight) of 40KN. The safe allowable bending stress is 8N/mm^2 . Choose a suitable depth for the beam if the width is to be 120mm. **(15 marks)**

4. A steel beam is required to span 5.5m between centres of simple supports carrying a 220mm thick brick wall as shown in figure 3. Choose from the table of properties, a suitable beam given that the permissible stress in bending is 165N/mm^2 . **(15 marks)**

5. A welded steel girder is made up of steel plates as in figure 4. What safe, uniformly distributed load can this girder carry on a simply supported span of 4m, if the permissible bending stress is limited to 175N/mm^2 . **(15 marks)**

6. A timber cantilever beam projects 2.4m and carries a 7.5KN point load at the free end. The beam is 160mm wide throughout, varies in depth from 160mm to 240mm, as shown in figure 5. Calculate the stress in the extreme fibres;
 - a) At the support (point A)
 - b) At the midpoint (point B)**(15 marks)**

ARC 309 - BUILDING STRUCTURE

#1.

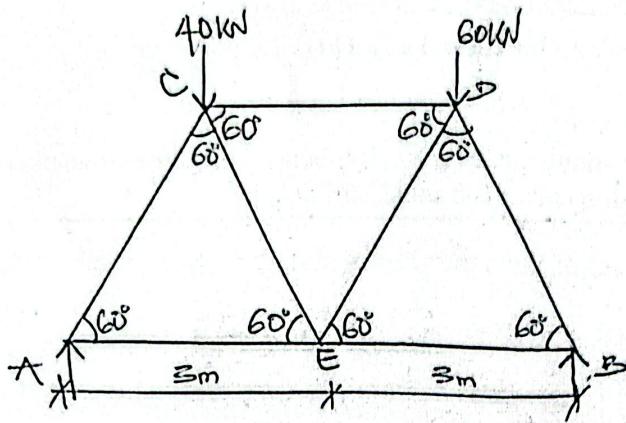


Figure 1.

#2.

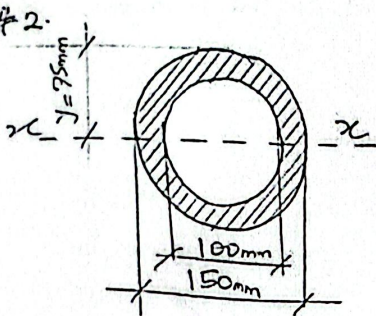


Figure 2.

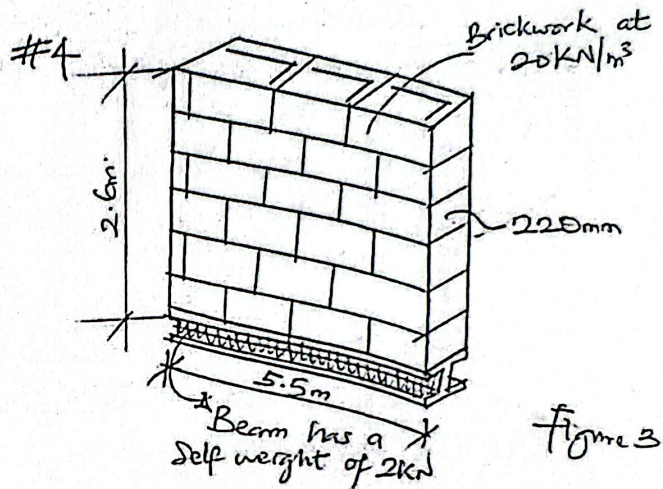


Figure 3.

#5

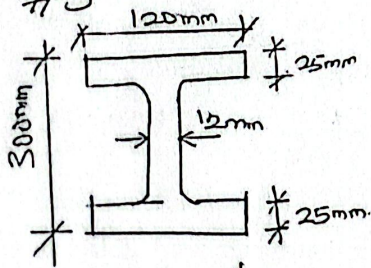


Figure 4.

#6.

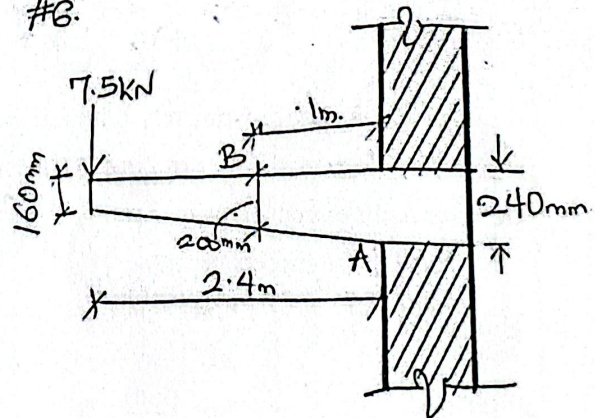
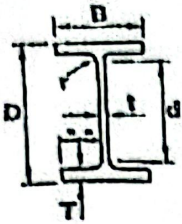


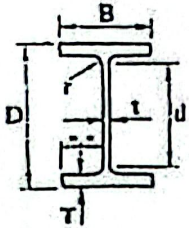
Figure 5.

Table 9.2 (Continued)



Designation		Depth of section D	Width of section B	Thickness		flot radius r	Depth between fillets d	Area of section cm ²
Serial size	Mass per unit length			Web I	Flange T			
mm	kg/m	mm	mm	mm	mm	mm	mm	mm ²
457 × 152	82	465.1	153.5	10.7	18.9	10.2	406.8	104.5
	74	401.3	152.7	9.9	17.0	10.2	406.9	95.0
	67	457.2	151.9	9.1	15.0	10.2	406.9	85.1
	60	454.7	152.9	8.0	13.3	10.2	407.7	75.9
	52	449.8	152.4	7.6	10.9	10.2	407.7	66.5
406 × 178	74	412.0	179.7	9.7	16.0	10.2	360.5	95.0
	67	409.4	178.8	8.8	14.3	10.2	360.5	85.5
	60	406.4	177.8	7.8	12.8	10.2	360.5	76.0
	54	402.6	177.8	7.6	10.9	10.2	360.5	68.4
406 × 140	46	402.3	142.4	6.0	11.2	10.2	359.6	59.0
	39	397.3	141.8	6.3	8.8	10.2	359.6	49.4
356 × 171	67	364.0	173.2	9.1	15.7	10.2	312.2	85.4
	57	358.6	172.1	8.0	13.0	10.2	312.2	77.2
	51	355.6	171.5	7.3	11.5	10.2	312.2	64.6
	45	352.0	171.0	6.9	9.7	10.2	312.2	57.0
356 × 127	39	352.8	120.0	6.5	10.7	10.2	311.1	49.1
	33	348.5	125.4	6.9	8.5	10.2	311.1	41.8
305 × 165	54	310.0	160.8	7.7	13.7	8.9	265.6	68.4
	46	307.1	165.7	6.7	11.8	8.9	265.6	58.9
	40	303.8	165.1	6.1	10.2	8.9	265.6	51.5
305 × 127	48	310.4	125.2	8.9	14.0	8.9	264.6	60.8
	42	306.6	124.3	8.0	12.1	8.9	264.6	53.2
	37	303.0	123.5	7.2	10.7	8.9	264.6	47.5
305 × 102	33	312.7	102.4	6.6	10.8	7.6	275.8	41.9
	28	308.9	101.0	6.1	8.9	7.6	275.8	36.3
	25	304.8	101.6	5.8	6.8	7.6	275.8	31.4
254 × 140	43	259.6	147.3	7.3	12.7	7.6	210.9	55.1
	37	256.0	146.4	6.4	10.9	7.6	210.9	47.5
	31	251.5	146.1	6.1	8.6	7.6	210.9	40.0
254 × 102	28	260.4	102.1	6.4	10.0	7.6	225.0	36.2
	25	257.0	101.9	6.1	8.4	7.6	225.0	32.2
	22	254.0	101.6	5.8	6.8	7.6	225.0	28.4
203 × 133	30	206.8	133.8	6.3	9.0	7.6	172.3	30.0
	25	203.2	133.4	6.8	7.8	7.6	172.3	32.3

Table 9.2 Universal beams: dimensions and properties (from Table 5 of BS4: Part 1: 1980)



Designation		Depth of section <i>D</i>	Width of section <i>B</i>	Thickness		Flout radius <i>r</i>	Depth between fillets <i>d</i>	Area of section <i>A</i>
Serial size	Mass per unit length			Web <i>t</i>	Flange <i>T</i>			
mm	kg/m	mm	mm	mm	mm	mm	mm	cm ²
914 x 419	308	920.5	420.5	21.5	36.6	24.1	799.0	494.5
	343	911.4	418.5	19.4	32.0	24.7	799.0	437.5
914 x 305	289	926.6	307.8	10.6	32.0	19.1	824.4	368.8
	253	918.5	305.5	17.3	27.9	19.1	824.4	322.0
	224	910.3	304.1	15.9	23.9	19.1	824.4	285.3
	201	903.0	303.4	15.2	20.2	19.1	824.4	256.4
838 x 292	226	850.9	293.0	16.1	26.8	17.8	761.7	286.7
	194	840.7	292.4	14.7	21.7	17.8	761.7	247.2
	176	834.0	291.6	14.0	18.8	17.8	761.7	224.1
762 x 267	197	769.6	268.0	15.6	26.4	16.5	685.0	250.8
	173	762.0	265.7	14.3	21.6	16.5	685.0	220.5
	147	753.9	265.3	12.9	17.5	16.5	685.7	188.1
686 x 254	170	692.9	255.0	14.5	23.7	15.2	615.0	216.6
	152	687.6	254.5	13.2	21.0	15.2	615.0	193.8
	140	683.5	253.7	12.4	19.0	15.2	615.0	178.6
	125	677.9	253.0	11.7	16.2	15.2	615.0	159.6
610 x 305	238	633.0	311.5	18.6	31.4	16.5	537.2	303.8
	179	617.5	307.0	14.1	23.6	16.5	537.2	227.9
	149	609.6	304.8	11.9	19.7	16.5	537.2	190.1
610 x 229	140	617.0	230.1	13.1	22.1	12.7	547.2	170.4
	125	611.9	229.0	11.9	19.6	12.7	547.2	159.6
	113	607.3	228.2	11.2	17.3	12.7	547.2	144.5
	101	602.2	227.6	10.6	14.8	12.7	547.2	129.2
533 x 210	122	544.6	211.9	12.8	21.3	12.7	476.5	155.0
	109	539.5	210.7	11.5	18.9	12.7	476.5	138.6
	101	536.7	210.1	10.9	17.4	12.7	476.5	129.3
	82	533.1	209.3	10.2	15.6	12.7	476.5	117.8
	82	528.3	208.7	9.6	13.2	12.7	476.5	104.4
457 x 191	98	478.4	192.8	11.4	19.6	10.2	407.9	125.3
	89	463.6	192.0	10.6	17.7	10.2	407.9	113.9
	82	460.2	191.3	9.9	16.0	10.2	407.9	104.5
	74	457.2	190.6	8.1	14.5	10.2	407.9	95.0
	67	453.6	189.9	8.5	12.7	10.2	407.9	85.4