Name:_____ Index No.: _____/_____

2705/302 2710/302
2709/302
STRUCTURES III
Oct./Nov. 2015
Time: 3 hours

Candidate's Signature: _____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN ARCHITECTURE
MODULE III

STRUCTURES III

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have Mathematical tables/Scientific calculator and drawing instruments for this examination.
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** of the **EIGHT** questions in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as indicated.
Relevant design tables are attached.
*Do **NOT** remove any pages from this booklet.*
Candidates should answer the questions in English.

For Examiner's Use Only

Question	1	2	3	4	5	6	7	8	TOTAL SCORE
Candidate's Score									

This paper consists of 20 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

1. (a) State **three** advantages of the following connections:

(i) Bolted connections;

(ii) Welded connections. (6 marks)

(b) Figure 1 shows a bolted connection required to transmit a tensile force of 250 KN. Check the adequacy of the joint in terms of:

(i) Tensile stress in plates;

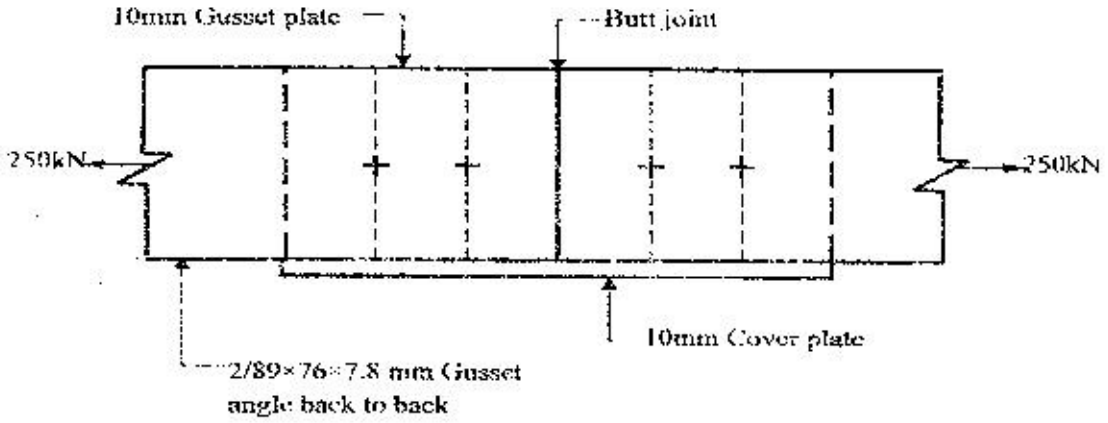
(ii) Tensile stress in angles;

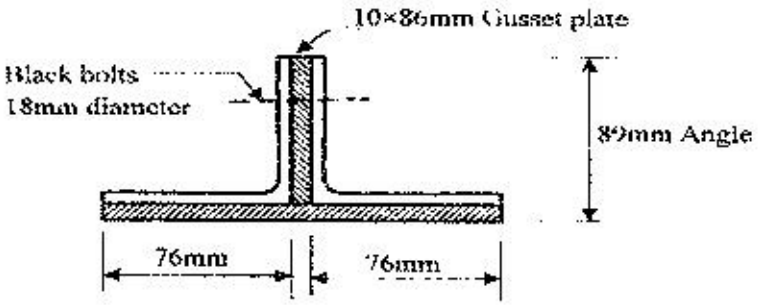
(iii) hear stress in bolts;

(iv) Bearing stress in angles. (14 marks)

Take the area of an 89 x 76 x 7.8 mm angle to be 12.35 cm².

Permissible tensile stress = 155 N/mm²
Permissible shear stress = 80 N/mm²
Permissible bearing stress = 250 N/mm²





SECTION THROUGH SPLICE JOINT

Fig. 1

2. (a) State **four** advantages of casing a steel section. (4 marks)

(b) A universal column used as an edge stanchion in a multi-storey building has an actual length of 3.6 m centre to centre of floor beam. The loading in the bean is as shown in figure 2. Design the stanchion as an encased column in Grade 43 steel, using the tables provided. (16 marks)

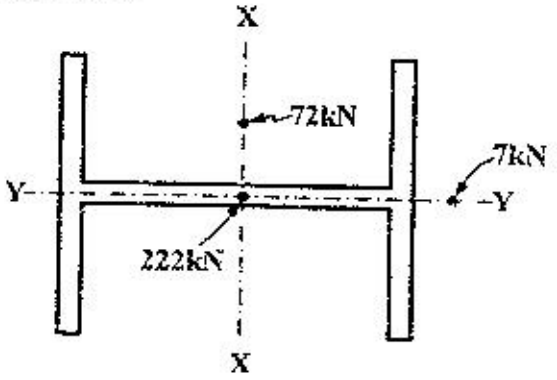


Fig. 2

3. (a) Define the following terms as used to structure timber:

(i) Basic stress;

(ii) Green stress;

(iii) Grade stress. (3 marks)

(b) A solid timber column of 200 mm x 150 mm and of strength of class 50 s is 4 m long. It is restrained in position and direction at both ends and is required to carry an axial load of 85 KN. Check the adequacy of the column.

- Table 9 BS 5268
- Grade stress parallel to grain = 8.7 N/mm^2
- Eminimum = 7.1 KN/mm^2
- K_3 = 1.25, K_g = 1.0, for medium duration.

(17 marks)

4. Using the moment distribution method, analyse the beam in figure 3 and sketch the bending moment diagram, indicating all critical values. (20 marks)

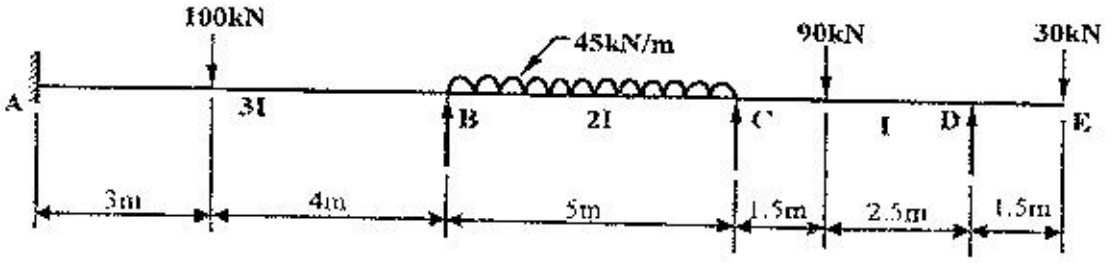


Fig. 3

5. Using the three moment theorem, analyse the bean shown in figure 4 and hence sketch the shear force and bending moment diagrams, indicating values at all critical points. (20 marks)

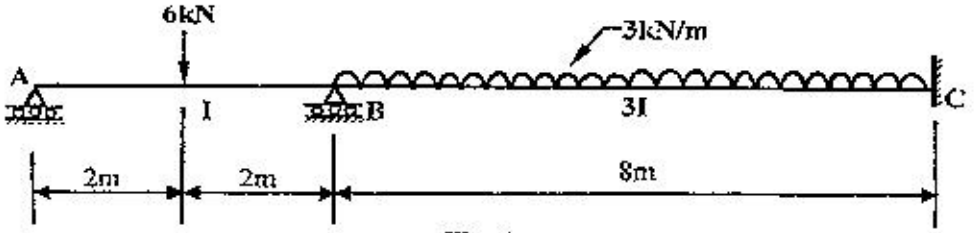


Fig. 4

6. Analyse the frame in figure 5 using moment of distribution method and then plot bending moment diagram, showing the values at all critical points. (20 marks)

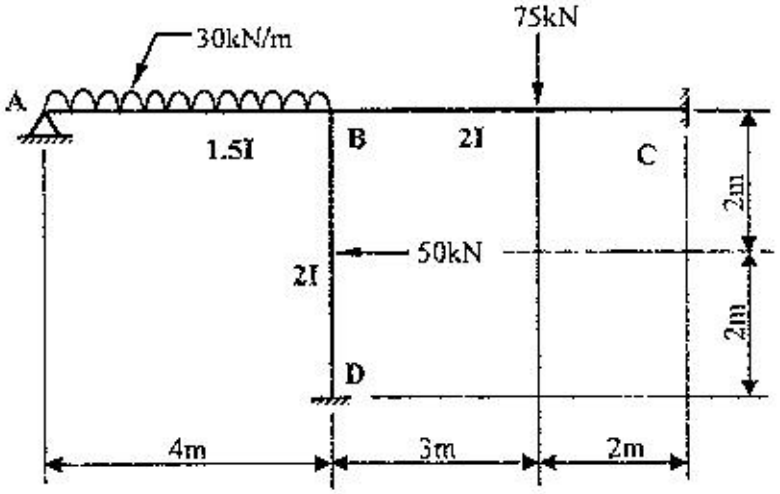


Fig. 5

7. (a) Figure 6 is a simply supported universal beam loaded as shown. Using the data provided below, check if a 533 x 165 x 73 kg/m UB will be satisfactory and hence check for shear and deflection.

Data

- Live loads = 75% of point load
- Compression flanges fully restrained

P_y = 100 N/mm²

E = 210 KN/mm²

(9 marks)

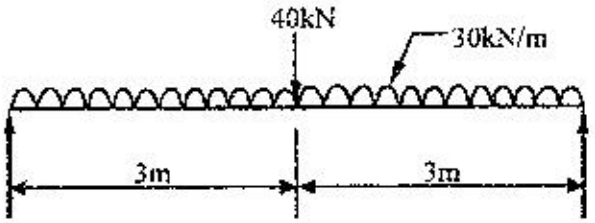


Fig. 6

(b) (i) Sketch any **two** butt welds.

(ii) Design the connection in figure 7 shown using balanced weld design.

(11 marks)

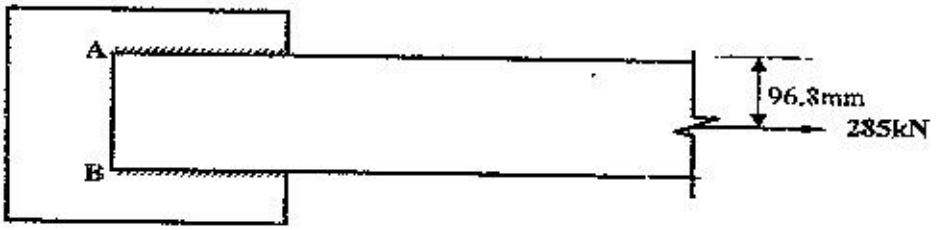


Fig. 7

8. (a) State **five** properties of structural timber as a construction material. (5 marks)

(b) A timber having a clear span of 6.0 m is suspended on 250 mm bearing at each end. The beam carries a uniformly distributed load of 15 KN/m over the entire span.

Design the beam using the following information:

- Permissible deflection = span/300
- Permissible shear stress = 1.2 N/mm^2
- Depth of section is twice the breadth
- Young's modulus of elasticity, E = 8 KN/mm^2

(15 marks)

TABLE 4

Modification factor K_{12} for compression members

$E/\sigma_{c,\parallel}$	Value of K_{12} — Values of slenderness ratio λ ($=L_e/i$): < 5	5	10	20	30	40	50	60	70	80	90	100	120	140	160	180	200	220	240	250
	Equivalent L_e/b (for rectangular sections): < 1.4	1.4	2.9	5.8	8.7	11.6	14.5	17.3	20.2	23.1	26.0	28.9	34.7	40.5	46.2	52.0	57.8	63.6	69.4	72.3
400	1.000	0.975	0.951	0.896	0.827	0.735	0.621	0.506	0.408	0.330	0.271	0.225	0.162	0.121	0.094	0.075	0.061	0.051	0.043	0.040
500	1.000	0.975	0.951	0.899	0.837	0.759	0.664	0.562	0.460	0.385	0.320	0.269	0.195	0.148	0.115	0.092	0.076	0.063	0.053	0.049
600	1.000	0.975	0.951	0.901	0.843	0.774	0.692	0.601	0.511	0.430	0.363	0.307	0.226	0.172	0.135	0.109	0.089	0.074	0.063	0.058
700	1.000	0.975	0.951	0.902	0.848	0.784	0.711	0.629	0.546	0.467	0.399	0.341	0.254	0.195	0.154	0.124	0.102	0.085	0.072	0.067
800	1.000	0.975	0.952	0.903	0.851	0.792	0.724	0.649	0.572	0.497	0.430	0.371	0.280	0.217	0.172	0.139	0.115	0.096	0.082	0.076
900	1.000	0.976	0.952	0.904	0.853	0.797	0.734	0.665	0.593	0.522	0.456	0.397	0.304	0.237	0.188	0.153	0.127	0.106	0.091	0.084
1000	1.000	0.976	0.952	0.904	0.855	0.801	0.742	0.677	0.609	0.542	0.478	0.420	0.325	0.255	0.204	0.167	0.138	0.116	0.099	0.092
1100	1.000	0.976	0.952	0.905	0.856	0.804	0.748	0.687	0.623	0.559	0.497	0.440	0.344	0.272	0.219	0.179	0.149	0.126	0.107	0.100
1200	1.000	0.976	0.952	0.905	0.857	0.807	0.753	0.695	0.634	0.573	0.513	0.457	0.362	0.288	0.233	0.192	0.160	0.135	0.116	0.107
1300	1.000	0.976	0.952	0.905	0.858	0.809	0.757	0.701	0.643	0.584	0.527	0.472	0.378	0.303	0.247	0.203	0.170	0.144	0.123	0.115
1400	1.000	0.976	0.952	0.906	0.859	0.811	0.760	0.707	0.651	0.595	0.539	0.486	0.392	0.317	0.259	0.214	0.180	0.153	0.131	0.122
1500	1.000	0.976	0.952	0.906	0.860	0.813	0.763	0.712	0.658	0.603	0.550	0.498	0.405	0.330	0.271	0.225	0.189	0.161	0.138	0.129
1600	1.000	0.976	0.952	0.906	0.861	0.814	0.766	0.716	0.664	0.611	0.559	0.508	0.417	0.342	0.282	0.235	0.198	0.169	0.145	0.135
1700	1.000	0.976	0.952	0.906	0.861	0.815	0.768	0.719	0.668	0.618	0.567	0.518	0.428	0.353	0.292	0.245	0.207	0.177	0.152	0.142
1800	1.000	0.976	0.952	0.906	0.862	0.816	0.770	0.722	0.673	0.624	0.574	0.526	0.438	0.363	0.302	0.254	0.215	0.184	0.159	0.148
1900	1.000	0.976	0.952	0.907	0.862	0.817	0.772	0.725	0.677	0.629	0.581	0.534	0.447	0.373	0.312	0.262	0.223	0.191	0.165	0.154
2000	1.000	0.976	0.952	0.907	0.863	0.818	0.773	0.728	0.681	0.634	0.587	0.541	0.465	0.382	0.320	0.271	0.230	0.198	0.172	0.160

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