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2705/103 2709/103
2707/103 2710/103
STRUCTURES I AND CONSTRUCTION MATERIALS
June/July 2018
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE

MODULE I

STRUCTURES I AND CONSTRUCTION MATERIALS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Mathematical tables/Scientific calculator.
*This paper consists of **EIGHT** questions in **TWO** sections, **A** and **B**.*
*Answer **FIVE** questions choosing **TWO** questions from each section and **ONE** other question from either section.*
All questions carry equal marks.
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 6 printed pages.

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

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SECTION A: STRUCTURES

*Answer at least **TWO** questions from this section.*

1. (a) Define the following terms used in properties of materials:

(i) thermal stress;

(ii) thermal strain. (3 marks)

(b) A metal rod 20 mm diameter screwed at the ends passes through an aluminium tube of 25 mm and 30 mm internal and external diameters respectively. The nuts on the rods are screwed tightly on the ends of the tube. Find:

(i) the intensity of stress in each metal when the common temperature rises by 150° C; (14 marks)

(ii) load in each material. (3 marks)

Take:

Coefficient of expansion per °C for steel $= 10 \times 10^{-6}$.
Coefficient of expansion per °C for aluminium $= 23 \times 10^{-6}$.
Modulus of elasticity for steel $= 200\ \text{kN/mm}^2$.
Modulus of elasticity for aluminium $= 90\ \text{kN/mm}^2$.

2. **Figure 1** shows a loaded beam and its cross-section. Determine:

(i) the maximum horizontal shear stress developed in the beam section; (14 marks)

(ii) the maximum extreme fibre stress in bending developed in the beam section from the applied loads. (6 marks)

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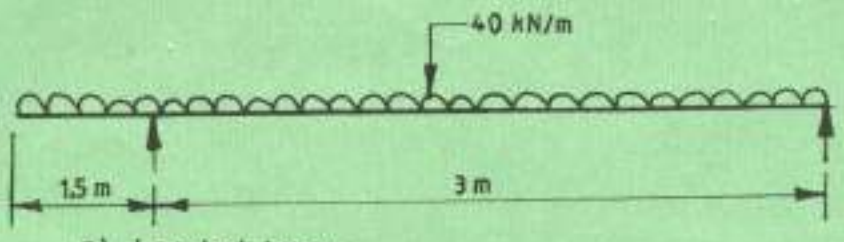
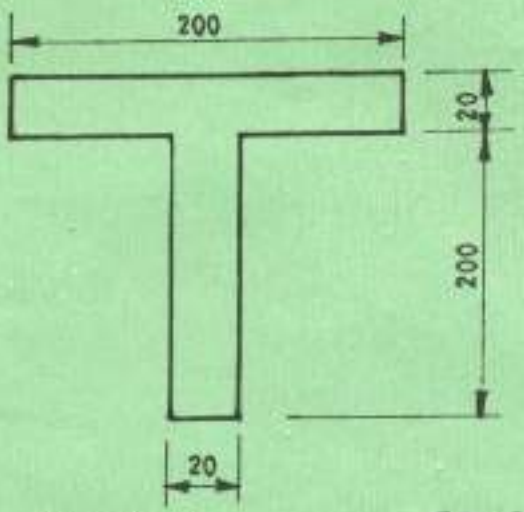


a) Loaded beam



b) Section

Fig. 1

3. (a) State **three** assumptions made in Euler's column theory on buckling loads. (3 marks)

(b) A hollow allow tube 5 m long with diameters 40 mm and 25 mm external and internal respectively was found to extend 6.5 mm under a tensile load of 60 kN. Find:

(i) the buckling load for the tube, when used as a strut both ends pinned;

(ii) the safe load on the tube, taking factor of safety as 4. (7 marks)
Take E as 210 kN/mm^2.

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(c) A mild steel specimen was tested in tension and the following results were obtained:

Diameter of specimen	-	20 mm
Length of specimen	-	200 mm
Extension under load of 10 kN	-	0.032 mm
Load at yield point	-	82 kN ✓
Maximum load	-	133 kN ✓
Length of specimen after fracture	-	252 mm
Diameter at the neck	-	12.6 mm

Calculate:

(i) Young's modulus E; (4 marks)
(ii) ultimate stress ; (3 marks)
(iii) percentage elongation. (3 marks)

4. **Figure 2** shows a loaded beam:

(a) Determine the reactions on both supports; (2 marks)

(b) Plot the shear force and bending moment diagrams to show values at critical points. (14 marks)

(c) Determine the point of centraflexture from support B. (4 marks)

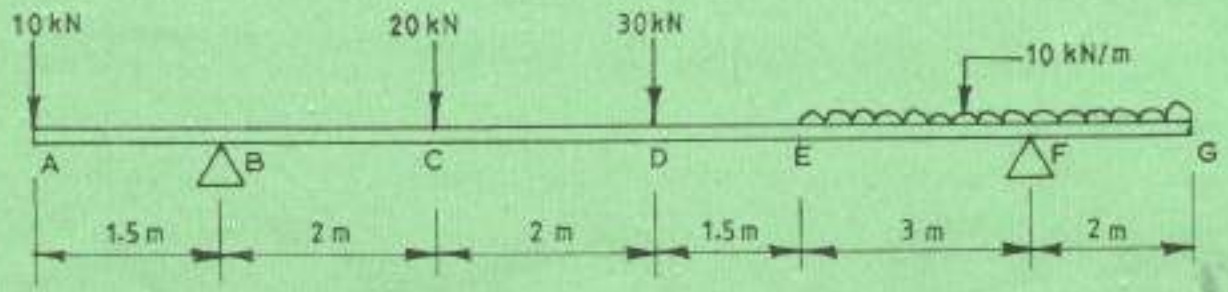

Fig. 2

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SECTION B: CONSTRUCTION MATERIALS

*Answer at least **TWO** questions from this section.*

5. (a) List **four** conditions which contribute to the deterioration of natural stones. (2 marks)

(b) Describe the **three** principal types of stones, giving **two** examples in each case. (9 marks)

(c) (i) Using an elaborate sketch, explain a typical cross-section of a tree trunk. (6 marks)

(ii) Give **three** reasons for seasoning timber. (3 marks)

6. (a) Explain the purpose of the following constituents of paints:

(i) thinners;

(ii) driers;

(iii) pigments. (6 marks)

(b) Describe the following defects in paintwork:

(i) blistering;

(ii) chalking;

(iii) bleeding. (6 marks)

(c) With reference to plastics, distinguish between thermosetting and thermoplastic plastics. (4 marks)

(d) With the aid of a sketch, describe how plastic products are produced by calendering mould method. (4 marks)

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7. (a) List **six** properties of bituminous products which make bitumen a road construction material. (6 marks)

(b) Explain the difference between the following commercial forms of glass:

(i) wired glass;
(ii) laminated glass. (4 marks)

(c) Define the following properties in relation to metals:

(i) ductility;
(ii) malleability. (2 marks)

(d) (i) Discuss the following methods of coating application to metals:

(I) electroplating;
(II) sheradizing. (6 marks)

(ii) Give **two** reasons why steel is subjected to head treatment. (2 marks)

8. (a) Define the following terms in relation to fresh concrete:

(i) bleeding;
(ii) segregation;
(iii) consistency;
(iv) workability. (8 marks)

(b) With the aid of a line diagram, explain the wet process of cement manufacture. (12 marks)

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