2705/103
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STRUCTURES I AND
CONSTRUCTION MATERIALS I
June/July 2019
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 I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Scientific calculator;
Drawing instruments.
*This paper consists of **EIGHT** questions in **TWO** sections: **A** and **B**.*
*Answer **FIVE** questions choosing at least **TWO** questions from each 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 7 printed pages.

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

Turn over

SECTION A: STRUCTURES I

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

1. (a) **Figure 1** shows a longitudinal section through a steel bar of varying sections. If a compressive force of 300 kN is applied to the bar, calculate:

(i) stress in each section;
(ii) total change in length of the section.

Take $E_{steel} = 210\,kN/mm^2$.

(9 marks)

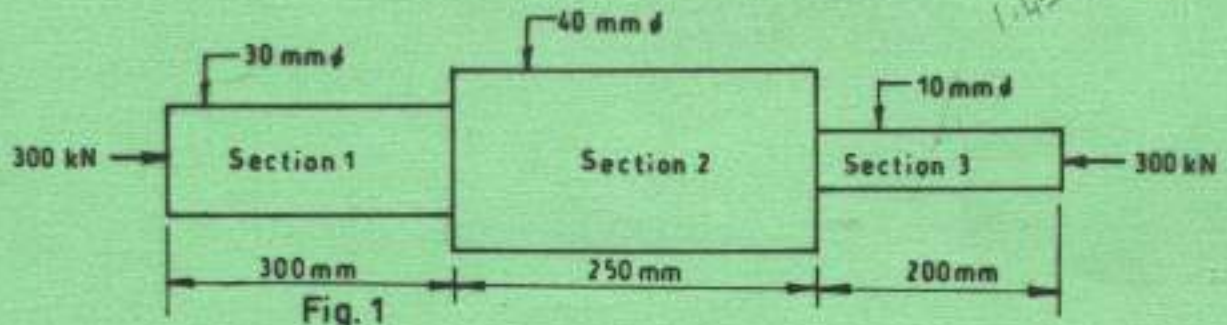

Fig. 1

(b) A concrete column 4 m high and 400 mm × 200 mm in section is reinforced with six No. 20 mm diameter steel bars. Calculate:

(i) safe axial load that can be applied to the column if the permissible stresses are limited to $7\ N/mm^2$ for concrete and 140 N/mm^2 for steel;

(ii) change in length that will take place in the column under this load.

Young's modulus: steel = 210 kN/mm^2
concrete = 14 kN/mm^2.

(11 marks)

2. (a) **Figure 2** shows a cross section of a beam. Calculate second moment of area about both centroidal axes. (12 marks)

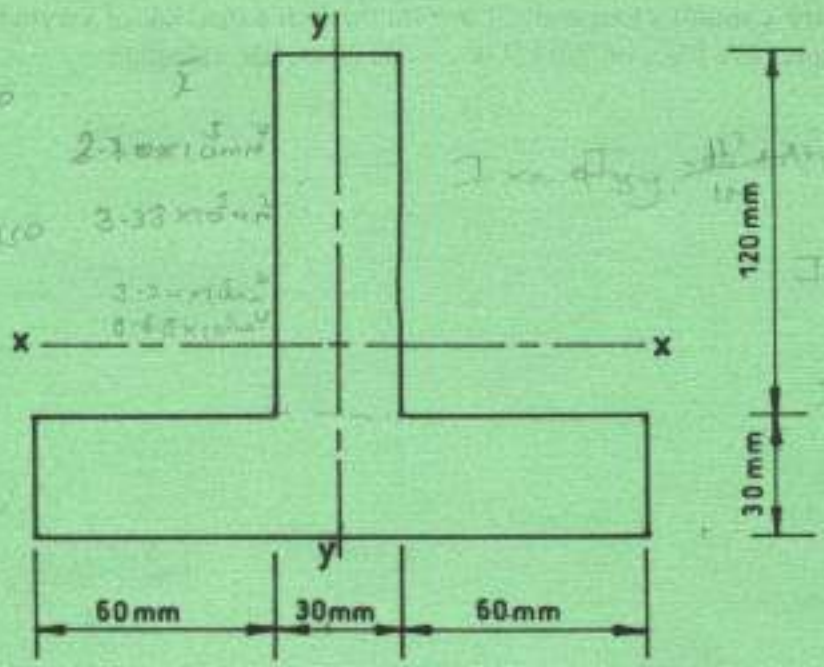

Fig. 2

(b) **Figure 3** shows a cross section through a rectangular beam. Derive the maximum horizontal shear stress. Take the maximum shear force as Q and hence sketch the horizontal stress distribution diagram. (8 marks)

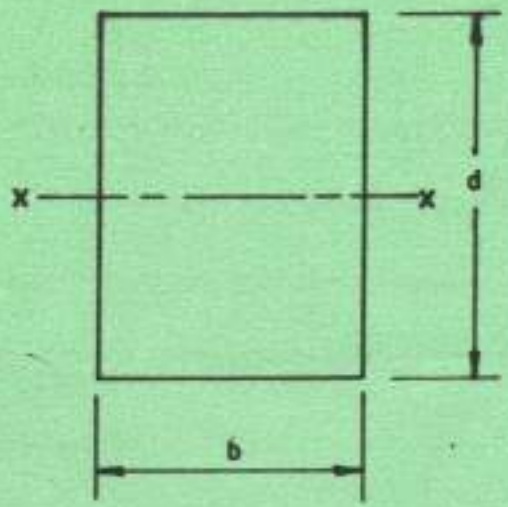

Fig. 3

3. (a) Using the method of section, analyse the forces and state the nature of forces for members x, y and z for the plane frame shown in **figure 4**. (12 marks)

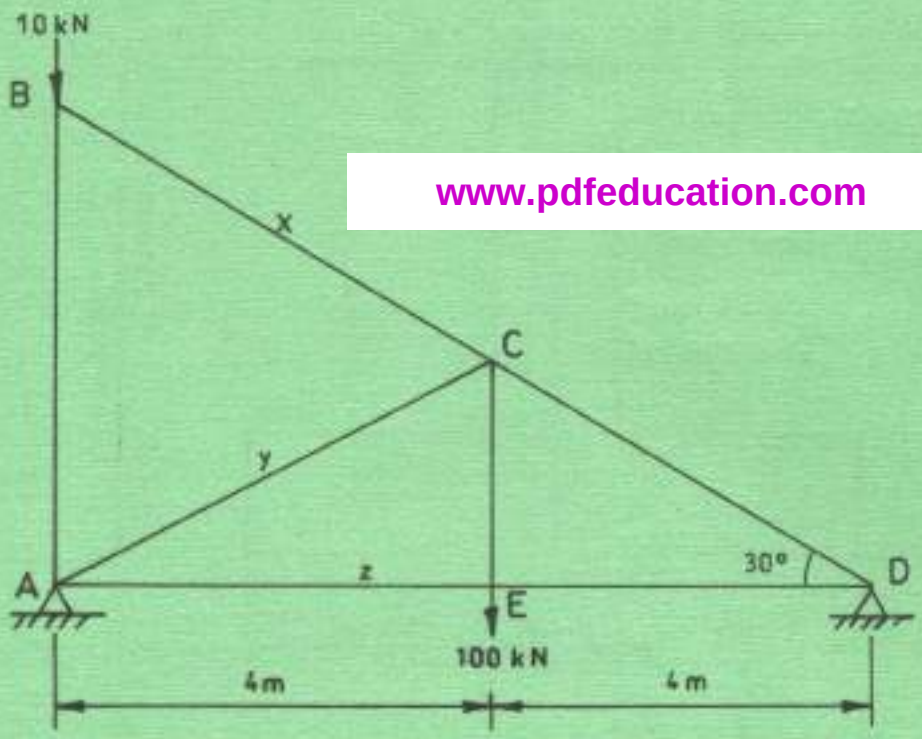

Fig. 4

(b) A solid timber column of cross-section 125 mm × 125 mm and actual length of 3.5 m is restrained at both ends in position and at one end in direction only. Calculate the safe buckling load the column can carry using Euler's formula.

Take $E_{timber} = 10\,kN/mm^2$. (8 marks)

4. (a) Differentiate between imposed load and dead load on a building. (4 marks)

(b) **Figure 5** shows a loaded beam which is simply supported.

(i) sketch the shear force diagram indicating values at critical points;

(ii) sketch the bending moment diagram indicating values at critical points. (11 marks)

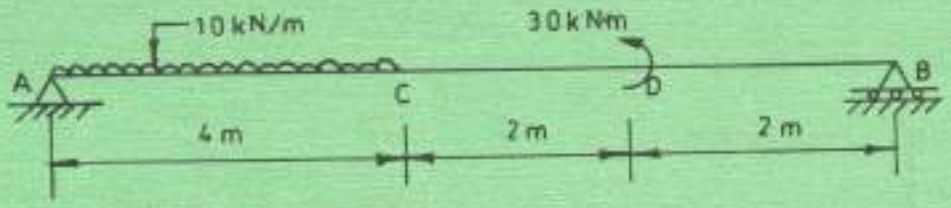

Fig. 5

(c) Calculate the extreme fibre stress for a rectangular section of a beam 200 mm in breadth and 500 mm deep, when subjected to a bending moment of 150 kN/m. (5 marks)

SECTION B: CONSTRUCTION MATERIALS I

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

5. (a) Define the term quarrying. (2 marks)

(b) Outline the following characteristics of building stones:

(i) appearance;

(ii) structure;

(iii) strength;

(iv) workability. (6 marks)

(c) Describe the following factors affecting hardening of portland cement:

(i) the mixing amount of gypsum;

(ii) cement fineness.

(4 marks)

(d) Describe the following constituents of plastics:

(i) resin;

(ii) filler;

(iii) lubricant;

(iv) catalyst.

(8 marks)

6. (a) State **four** reasons for using timber as a construction material. (4 marks)

(b) With the aid of a sketch, describe the cause of each of the following defects in timber:

(i) bowing;

(ii) cupping;

(iii) warping;

(iv) springing.

(10 marks)

(c) Explain the function of each of the following materials in the manufacture of glass:

(i) silica;

(ii) broken glass;

(iii) soda ash.

(6 marks)

7. (a) Name **four** defects in painting. (2 marks)

(b) Explain the function of each of the following oil paint gradients:

(i) base;

(ii) vehicle;

(iii) pigment;

(iv) solvent.

(8 marks)

(c) State **six** properties of bituminous materials. (6 marks)

(d) Explain the function of the following materials in construction industry:

(i) bitumen felt;

(ii) tar macadam.

(4 marks)

8. (a) Differentiate between ferrous and non-ferrous metals. (4 marks)

(b) State **six** defects in bricks. (6 marks)

(c) Describe the **three** geological formation of rocks. (6 marks)

(c) Describe the following types of heat treatments in steel:

(i) annealing;

(ii) hardening.

(4 marks)

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