



2705/103      2709/103  
2707/103      2710/103  
**STRUCTURES I AND  
CONSTRUCTION MATERIALS**  
Oct./Nov. 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 examinations:*

*Mathematical tables/scientific calculator,  
Answer booklet.*

*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 as 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.**



## SECTION A: STRUCTURES I

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

1. (a) Determine the magnitude and nature of the forces in each member of the framework shown in **figure 1** using the method of tension coefficients. (12 marks)

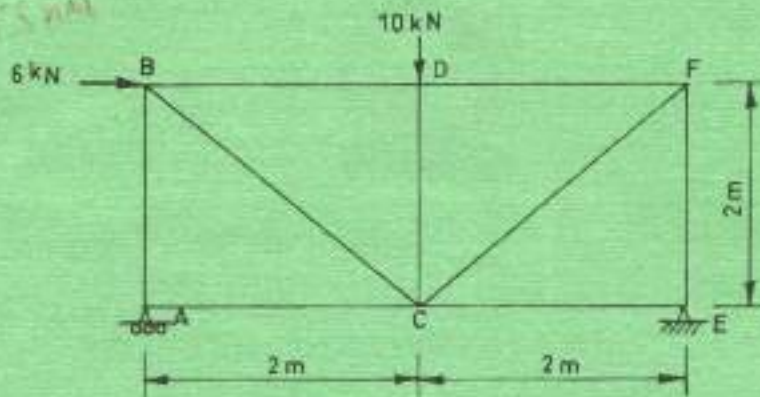


Fig.1

- (b) **Figure 2** shows a loaded beam and its cross section. Plot the horizontal shear stress distribution diagram. (8 marks)

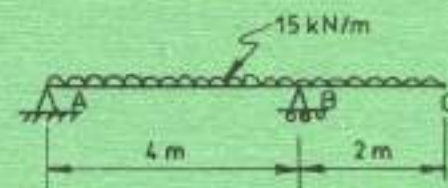
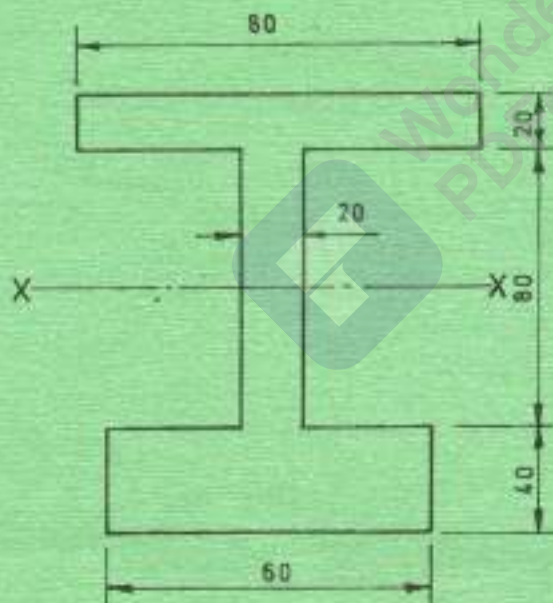


Fig.2



2. (a) Define the following terms:

- (i) point of contraflexure;
- (ii) maximum bending moment.

(2 marks)

(b) (i) Sketch the shear force and bending moment diagram for the beam in figure 3 indicating values at critical points.

(ii) Determine the position of the point of contraflexure from point B.

(18 marks)

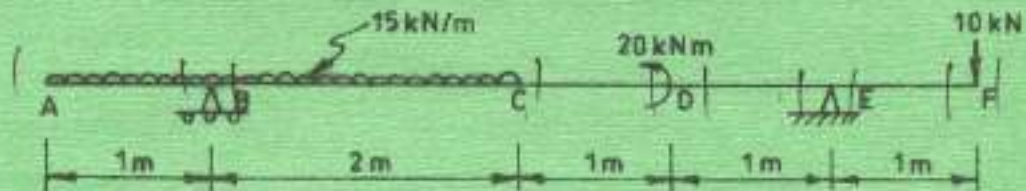


Fig. 3

(a) A composite timber and steel section is as shown in figure 4. Calculate the maximum safe uniformly distributed load that the section can carry when simply supported over a span of 3.5 m, given the following information:

Permissible stress in steel =  $150 \text{ N/mm}^2$

Permissible stress in timber =  $7 \text{ N/mm}^2$

$m = 20$

(9 marks)

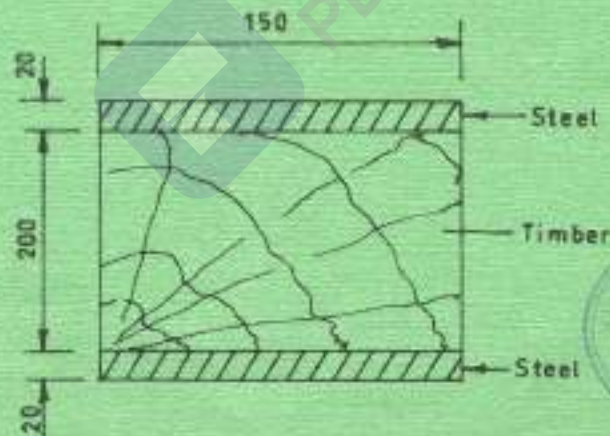


Fig. 4





- (b) A hollow steel tube 100 mm external diameter, 80 mm internal diameter and length 3.2 m is subjected to a tensile load of 40 kN. Calculate:

- the stress in the material;
- extension of the tube, if the Young's modulus of elasticity is  $210 \text{ kN/mm}^2$

(7 marks)

- (c) State **four** assumptions made in Euler's theory.

(4 marks)

4. (a) State **two** assumptions in the theory of simple bending.

(2 marks)

- (b) **Figure 5** shows a loaded beam and its cross section. Calculate the maximum tensile and compressive stresses.

(9 marks)

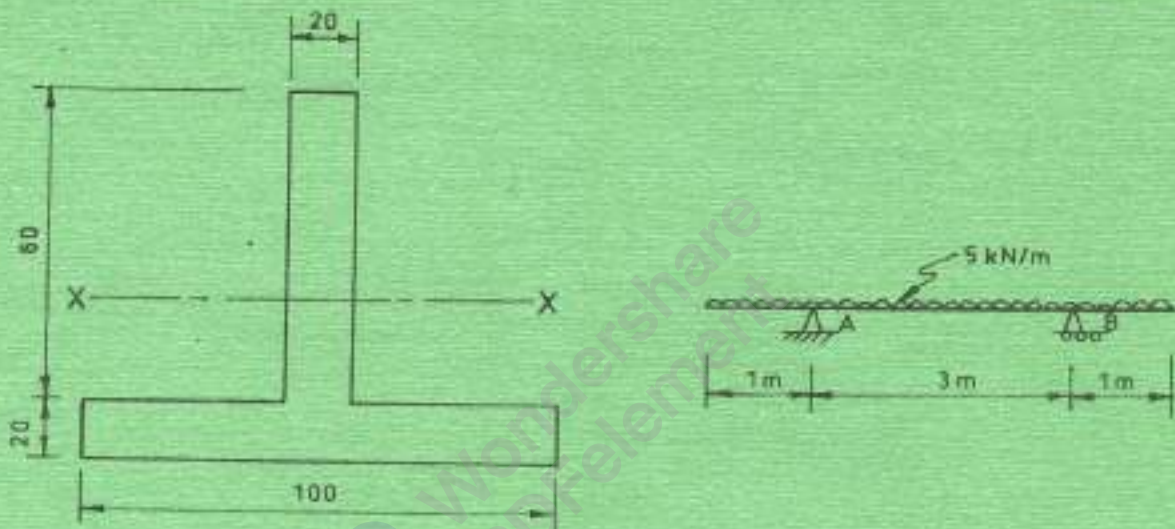


Fig.5

- (c) Calculate the section modulus about the X-X axis for the beam section shown in **figure 6**.

(9 marks)

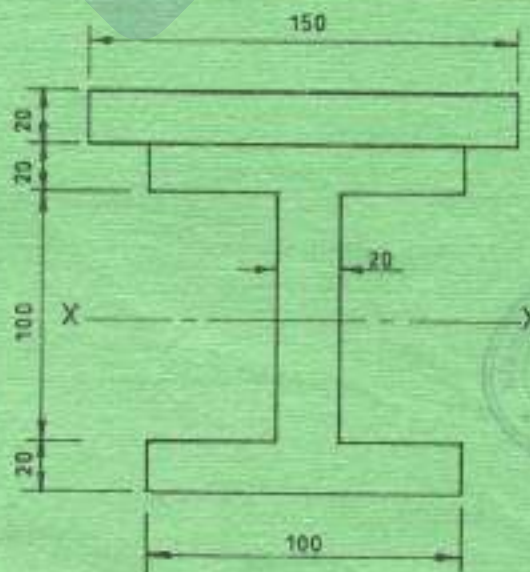


Fig.6



## SECTION B: CONSTRUCTION MATERIALS

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

5. (a) (i) Describe the following building stones in terms of composition, characteristic and use:
- (I) granite; ✓ ~~metamorphic~~ ✓ ~~igneous~~ ✓ ~~crystalline~~ ✓ ~~hard~~ ✓ ~~heavy~~ ✓ ~~expensive~~ ✓ ~~used for decorative purposes~~
- (II) basalt; ✓ ~~sedimentary~~ ✓ ~~igneous~~ ✓ ~~crystalline~~ ✓ ~~hard~~ ✓ ~~heavy~~ ✓ ~~expensive~~ ✓ ~~used for decorative purposes~~
- (III) slate; ✓ ~~metamorphic~~ ✓ ~~igneous~~ ✓ ~~crystalline~~ ✓ ~~hard~~ ✓ ~~heavy~~ ✓ ~~expensive~~ ✓ ~~used for decorative purposes~~
- (ii) List **four** advantages of artificial stones over natural stones. (11 marks)
- (b) (i) State **six** requirements of clay bricks.
- (ii) Describe the following types of kilns used in brickwork:
- (I) open kilns; ✓ ~~intermittent~~ ✓ ~~continuous~~ ✓ ~~open~~ ✓ ~~intermittent~~ ✓ ~~continuous~~ ✓ ~~open~~
- (II) intermittent kilns; ✓ ~~intermittent~~ ✓ ~~continuous~~ ✓ ~~open~~ ✓ ~~intermittent~~ ✓ ~~continuous~~ ✓ ~~open~~
- (III) continuous kilns. (9 marks)
6. (a) (i) Describe the following tests in cements:
- (I) consistency test; ✓ ~~fineness~~ ✓ ~~soundness~~ ✓ ~~consistency~~ ✓ ~~fineness~~ ✓ ~~soundness~~ ✓ ~~consistency~~
- (II) fineness test; ✓ ~~fineness~~ ✓ ~~soundness~~ ✓ ~~consistency~~ ✓ ~~fineness~~ ✓ ~~soundness~~ ✓ ~~consistency~~
- (III) soundness test. (11 marks)
- (b) (i) State **four** properties of cements.
- (ii) Explain the effect of the following impurities in iron:
- (I) silicon; ✓ ~~silicon~~ ✓ ~~phosphorous~~ ✓ ~~silicon~~ ✓ ~~phosphorous~~ ✓ ~~silicon~~ ✓ ~~phosphorous~~
- (II) phosphorous. (9 marks)
- (ii) Explain the purpose of heat treatment in steel.





7. (a) (i) Explain the function of each of the following constituents of paint:
- (I) base;
  - (II) vehicle;
  - (III) pigment.
- (ii) State **four** characteristics of paint. ✓
- (iii) State **two** functions of varnishes. ✓ (10 marks)
- (b) (i) Describe the following forms of asphalt:
- (I) cut-back;
  - (II) mastic;
  - (III) asphaltic emulsion;
  - (IV) asphaltic cement.
- (ii) State **four** uses of bitumen. (10 marks)
8. (a) Describe the following moulding processes in the manufacture of plastics:
- (i) injection moulding;
  - (ii) compression moulding. (6 marks)
- (b) Explain the function of the following constituents in glass:
- (i) sodium;
  - (ii) cullet;
  - (iii) lime. (6 marks)
- (c) (i) Define the following terms as used in timber:
- (I) log;
  - (II) batten;
  - (III) plank.
- (ii) Calculate the moisture content of a timber specimen after being oven dried for 24 hours given that the wet weight and dry weight was 150 g and 135 g respectively.
- (iii) Explain the uses of the following manufactured boards:
- (I) lamin boards;
  - (II) batten boards. (8 marks)

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