

2705/103 2709/103

2707/103 2710/103

STRUCTURES I AND CONSTRUCTION  
MATERIALS

June/July 2017

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;*

*Drawing instruments;*

*Scientific calculator.*

*This paper consists of EIGHT questions in TWO sections; A and B.*

*Answer FIVE questions choosing TWO questions from section A, TWO questions from section B and ONE 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 5 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. Figure 1 shows a simply supported beam with an overhanging end loaded as shown.

- (i) Calculate the shearforce and bending moments at points A, C, D, E and B. (16 marks)
- (ii) Determine the point of contraflexure from support A. (4 marks)

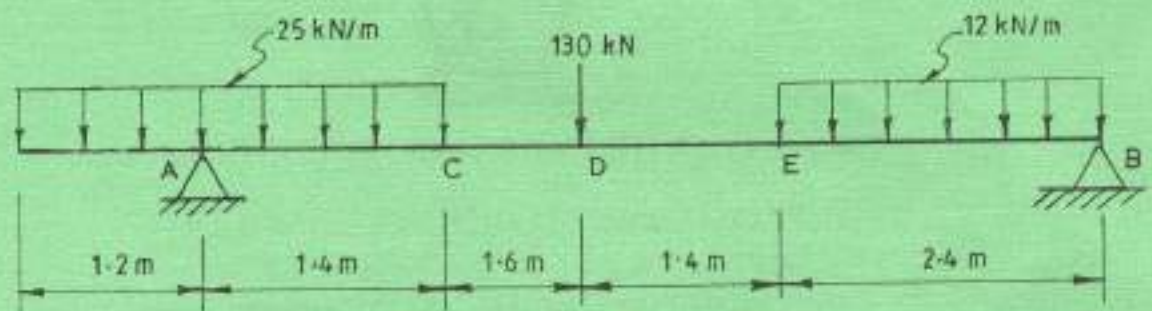


Figure 1

2. (a) Define the following terms in relation to properties of materials:

- (i) modulus of elasticity;
- (ii) bulk modulus;
- (iii) elastic limit;
- (iv) strain.

(4 marks)

(b) A solid steel bar, 500 mm long and 70 mm diameter is placed inside an aluminium tube having 75 mm inside diameter and 100 mm outside diameter. The aluminium cylinder is 0.15 mm longer than the steel bar. An axial load of 600 kN is applied to the bar and cylinder through rigid cover plates as shown in figure 2. Find the stresses developed in the steel bar and the aluminium tube.

Take  $E_s = 220 \text{ kN/mm}^2$ ,  $E_A = 70 \text{ kN/mm}^2$ .

(10 marks)

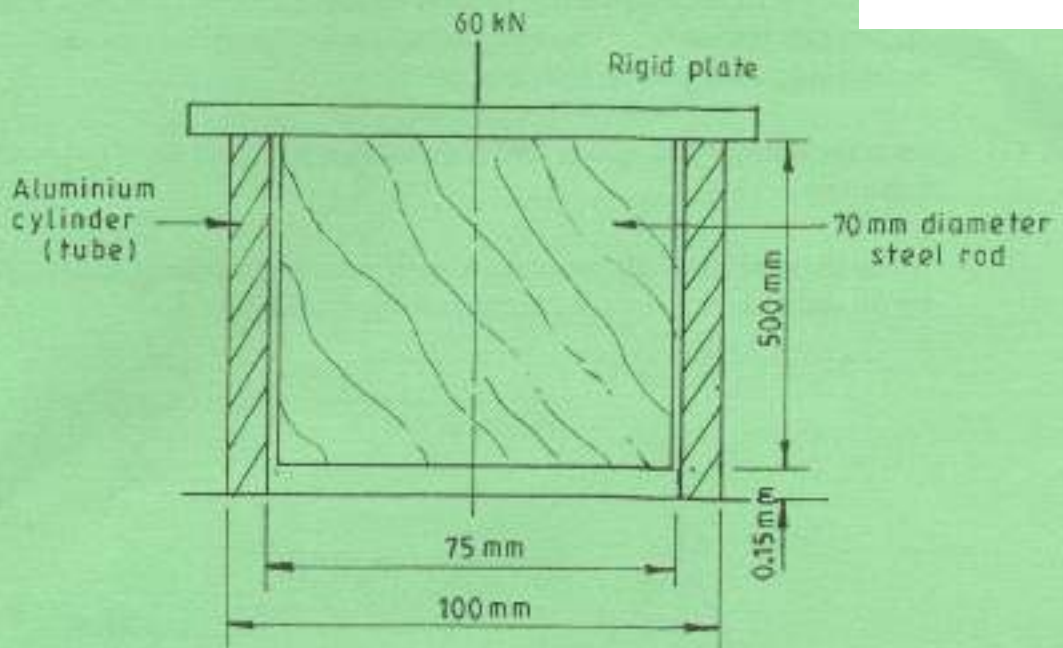


Figure 2

- (c) A metal bar 50 mm x 50 mm section, is subjected to an axial load (compressive) of 500 kN. The contraction of a 200 mm gauge length is found to be 0.5 mm. Find the value of Young's modulus for the metal bar in  $\text{kN/mm}^2$ . (6 marks)
3. (a) A beam of an I-section shown in figure 3 is simply supported over a span of 4.3 m. Determine the load that the beam can carry per meter length if the allowable stress in tension is  $100 \text{ N/mm}^2$ . (12 marks)

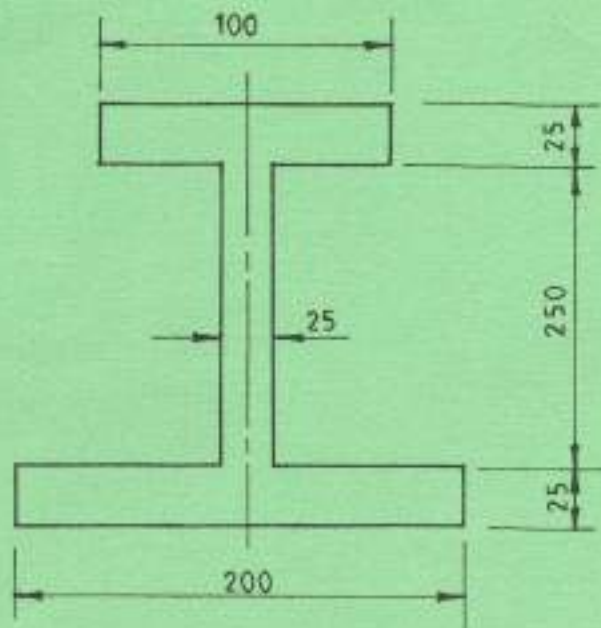


Figure 3



- (b) The cross-section of a T-section beam is 80 mm x 130 mm x 10 mm with the 80 mm side horizontal. Determine the maximum intensity of shear stress at the section subjected to a shear force of 60 kN. (8 marks)
4. (a) State the Rankine's crippling load for a column giving all the symbols and their meanings. (4 marks)
- (b) Using the method of joint resolution, determine the magnitude and nature of forces for all the members of the Warren girder shown in figure 4. (16 marks)

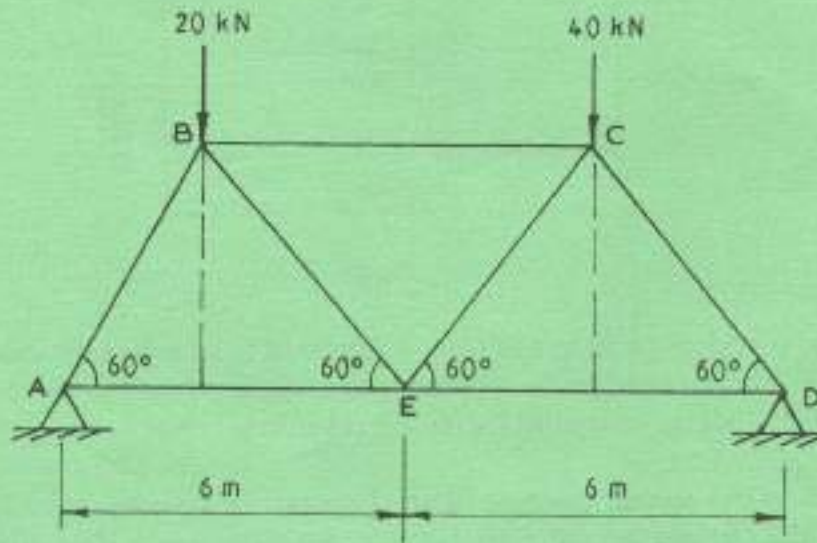


Figure 4

**SECTION B: CONSTRUCTION MATERIALS**

*Answer at least TWO questions in this section.*

5. (a) Name the **two** classes of timber and outline four differences of each. (6 marks)
- (b) Sketch a cross-section through a tree trunk and label **five** parts stating the function of each. (10 marks)
- (c) Sketch **two** methods of timber conversion. (4 marks)
6. (a) Describe the standard penetration test for bitumen carried out in a laboratory. (7 marks)
- (b) (i) Distinguish between flash point and fire point with respect to bituminous materials. (4 marks)
- (ii) State **two** properties of each of the following:
- (I) bitumen; (4 marks)
- (II) pitch. (4 marks)
- (c) State **five** uses of bituminous products in construction. (5 marks)
7. (a) Outline the 'dry process' of manufacturing cement. (8 marks)
- (b) With the aid of sketches, describe the following **two** tests on fresh concrete:
- (i) compaction factor test;
- (ii) slump test. (8 marks)
- (c) Explain how water/cement ratio affects:
- (i) workability of freshly mixed concrete;
- (ii) strength of hardened concrete. (4 marks)
8. (a) State classes of materials used in construction giving **two** examples in each class. (4 marks)
- (b) Describe the principal types of stones under the given classes and give **two** uses of each in construction:
- (i) igneous rocks;
- (ii) sedimentary rocks;
- (iii) metamorphic rocks. (9 marks)
- (c) State the methods of manufacturing plastics. (3 marks)
- (d) Give **four** reasons for using plastics in construction works. (4 marks)

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