Name: _____ Index No: _____/_____

2705/103 2709/103
2707/103 2710/103
STRUCTURES I AND
CONSTRUCTION MATERIALS
Oct./Nov. 2014
Time: 3 hours

Candidate's Signature: _____

Date: _____

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

*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 a calculator for this examination.*
*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 **A** or **B** in the spaces provided in this question paper.*
*All questions carry equal marks.*
*Maximum marks for each part of a question are indicated.*
***Candidates should answer the questions in English.***

**For Examiner's Use Only**

| Section | Question | Maximum Marks | Candidate's Score |
|---|---|---|---|
| A | 1 | 20 | |
| | 2 | 20 | |
| | 3 | 20 | |
| | 4 | 20 | |
| B | 5 | 20 | |
| | 6 | 20 | |
| | 7 | 20 | |
| | 8 | 20 | |
| | | TOTAL 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.**



**Turn over**

## SECTION A: STRUCTURES

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

1. (a) Differentiate between the following terms:

(i) modulus of elasticity and bulk modulus;
(ii) modular ratio and Poisson's ratio.

(4 marks)

(b) (i) Sketch and label a stress-strain graph for typical results obtained from a test on a mild steel rod tested under tension to destruction.

(ii) From the graph in (i), define **three** ranges of stress.

($7\frac{1}{2}$ marks)

(c) A mild steel specimen was tested under tension to destruction from which the following data was collected:

| | |
|---|---|
| Gauge length | 195 mm |
| Original diameter | 18 mm |
| Final length | 205 mm |
| Diameter at fracture | 16.5 mm |
| Extension at an early load of 48 kN | 0.05 mm |
| Yield load | 56 kN |
| Maximum load | 190 kN |

Determine:

(i) modulus of elasticity for the material;
(ii) yield stress;
(iii) ultimate stress;
(iv) percentage elongation;
(v) percentage area reduction;
(vi) working stress with a factor of safety of 1.75 applied on maximum stress.

($8\frac{1}{2}$ marks)

2. (a) (i) Derive the temperature stress equation and state its main limitation.

(ii) A hollow circular copper section of external diameter 225 mm and thickness 4 mm is to be used as a strut. It is initially subjected to a pre-compressive force of 175 kN axially. Determine the stress and hence the thrust against the supports at the ends if it undergoes a change in temperature from 20°C to 125°C. Take the coefficient of thermal expansion for the material as $11 \times 10^{-6}$ per °C and $E = 105 kN/mm^2$

(11 marks)

(b) For the section shown in figure 1, determine:

(i) $I_{yy}$;

(ii) $r_{yy}$;

(iii) $z_{yyB}$

(9 marks)

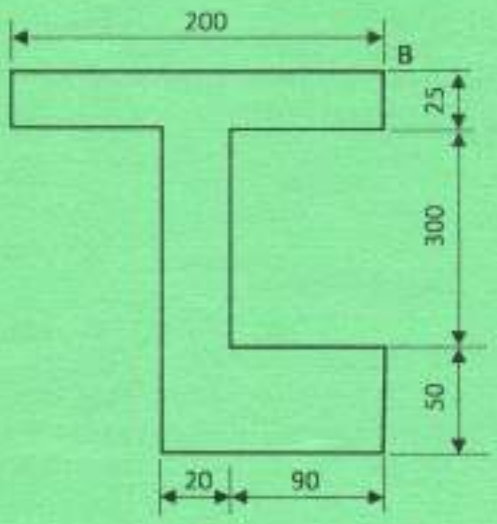


Fig. 1

3. (a) Analyse the beam shown in figure 2 for reactions, shear forces, bending moments and hence sketch the shear forces, bending moments diagrams indicating all the critical values. (10 marks)

(b) (i) Illustrate **two** end fixity conditions for columns showing how effective lengths are determined in each case.

(ii) Define the term 'slenderness ratio'.

(iii) Using Rankine's formula determine the critical buckling load for a 4 m long column of equilateral triangular hollow section of side 120 mm and 5 mm thickness. One end of the column is held in position and direction while the other end is only held in position but not in direction.

Take $a = \frac{1}{6500}$

Actual height = 2.5 m

Yield stress = 115 N/mm$^2$

(10 marks)

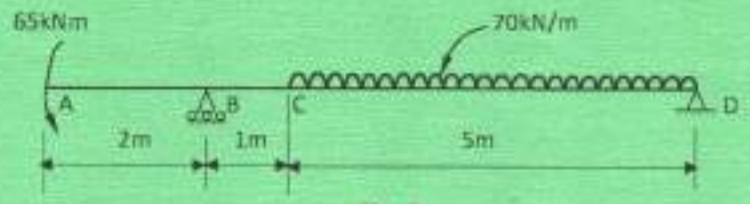


Fig. 2

4. (a) (i) Define the term 'bending stress'.

(ii) Determine the value of the maximum bending stress and the radius of currature at the point of maximum bending moment for a rectangular cantilever beam of width 120 mm, depth 400 mm and span 2.6 m. The beam carries a uniformly distributed load (UDL) of 30 kN/m together with a point load of 75 kN at the free end.

Take E = 185 kN/mm$^2$

($6\frac{1}{2}$ marks)

(b) Using the method of joint resolution, determine the magnitude and nature of forces for all the members of the frame shown in figure 3. ($13\frac{1}{2}$ marks)

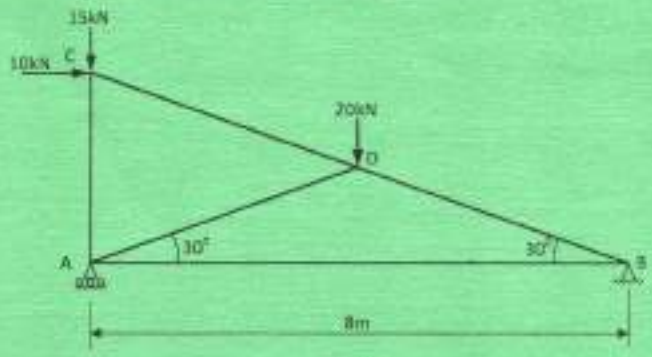


Fig. 3

## SECTION B: CONSTRUCTION MATERIALS

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

5. (a) Describe the glass manufacturing process. (8 marks)

(b) Outline **six** types of glass, stating their uses. (12 marks)

6. (a) Explain the manufacturing process of bricks. (15 marks)

(b) Describe the water absorption test on bricks. (5 marks)

7. (a) Describe the following types of paints:

(i) distemper;
(ii) emulsions;
(iii) oil paint.

(6 marks)

(b) Explain the following paint defects, stating how they can be eliminated:

(i) blistering;
(ii) bittiness;
(iii) chalking;
(iv) cissing.

(10 marks)

(c) (i) Describe bitumen;

(ii) State **two** properties of bitumen.

(4 marks)

8. (a) With reference to iron ores, distinguish between magnetite and haematite. (4 marks)

(b) Explain annealing as a heat treatment process for metals. (4 marks)

(c) Describe the following timber defects:-

(i) knots;
(ii) burl;
(iii) shake;
(iv) pitch.

(6 marks)

(d) Explain the production of pozzolanic portland cement by the dry process.

(6 marks)