

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY  
FACULTY OF ARCHITECTURE AND QUANTITY SURVEYING  
BACHELOR OF QUANTITY SURVEYING (HONOURS) DEGREE  
BACHELOR OF ARCHITECTURAL STUDIES  
PART II FIRST SEMESTER EXAMINATIONS – DECEMBER 2002

STRUCTURAL DESIGN I – AAR 2105

TIME: 3 Hours

TOTAL MARKS: 100

INSTRUCTIONS:

Answer all questions.

QUESTION 1

Answer (a) or (b)

(a) The word design is used to describe the whole creative process of finding a safe and efficient solution to an Engineering problem of many possible solutions. Briefly discuss the steps a structural designer should undergo to arrive at a satisfactory solution.

(9 marks)

(b) Write brief notes on loads considered during structural design.

(9 marks)

(c) Differentiate between permissible stress design and limit state design.

(2 marks)

(d) Fig. 1 below shows the corner of a hostel building which is supported on a short brickwork column. The load on the column is estimated to be as follows:

Load from weight of the building = 750 kN  
Load contents of the building = 570 kN

LIBRARY USE ONLY

Determine the required cross-section area of the column if the design is based on

(i) Permissible stress principles given that permissible basic stress of the column is  $3.3 \text{ N/mm}^2$ .

(ii) Limit state principle given that design strength of column is  $6.0 \text{ N/mm}^2$ .

(9 marks)

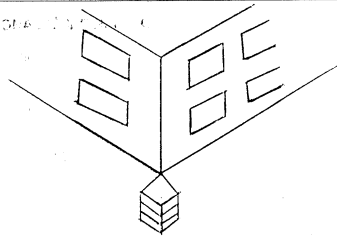
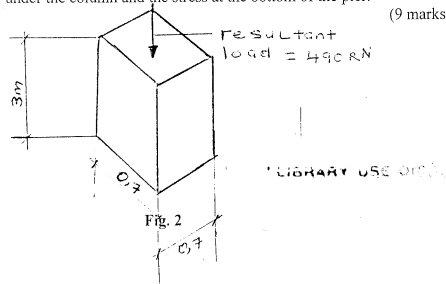


Fig. 1

- (e) (i) Define stress, strain and Young's Modulus of elasticity and give an equation connecting the three. (4 marks)
- (ii) A brick pier is 0.7 square and 3m high and weighs  $19\text{kN/m}^3$ . It is supporting an axial load from a column of  $490\text{ kN}$  (see fig.2. below). The load is uniformly spread over the top of the pier so the arrow shown merely represents the resultant of the load. Calculate the stress in the brickwork immediately under the column and the stress at the bottom of the pier. (9 marks)



**QUESTION 2**

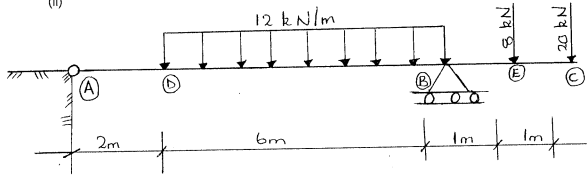
Answer a (i) or (ii)

- (a) Write brief notes on
- (i) Supports and types of beams that can be obtained due to various beam supporting systems. (8 marks)

(ii) The conditions for a structure. Also explain what you understand by the terms statically determined and statically indeterminate structures. (8 marks)

(b) (i) Differentiate between shear and torsion forces. (2 marks)

(ii)



A beam ABC is supported at A and B as shown. For the loading case shown.  
 - Calculate the reactions at A and B  
 - Draw the shearing force and bending moment diagram, indicating all important values.  
 - Determine the position and magnitude of the maximum sagging bending moment in Span AB. (15 marks)

(c) A timber beam is required to span 4m carrying a total uniform load (inclusive of the beam's self weight) of 40 kN. Choose a suitable depth for the beam if the width is to be 120mm. (8 marks)

QUESTION 3 -

a) (i) Derive a formula used to calculate the second moment of area (moment of inertia) about the x-x principal axis of a rectangular beam. (8 marks)

(ii) Define the principal of parallel axes in determination of the moment of inertia. (2 marks)

(iii) Calculate the second moment of area (moment of Inertia) of the section beam shown on Fig. 3 below. (10marks)

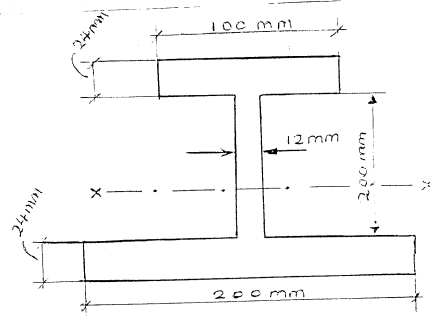


Fig. 3

(d) Answer (i) or (ii)

Discuss (i) factors affecting depth of footings (6 marks)  
(ii) principle for designing footings (6 marks)

(e) A short reinforced concrete column is to support the following axial loads:  
Characteristic dead load = 758 kN  
Characteristic imposed load = 630 kN

Determine the dimensions for a suitable square foundation if it bears on stiff to firm clay with permissible bearing pressure of 150 kN/m<sup>2</sup>. (8 marks)

END OF EXAMINATION