



(University of Choice)

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FOURTH YEAR SEMESTER TWO EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION**

**COURSE TITLE: BTB 411**

**COURSE TITLE: STRUCTURAL DESIGN II**

**DATE: TUESDAY 19<sup>TH</sup> APRIL 2022 TIME: 3:00 – 5:00 PM**

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**INSTRUCTIONS:**

1. This paper contains THREE questions
2. QUESTION ONE IS COMPULSORY
3. Attempt any other ONE questions
4. BS standards are allowed
5. Marks for each question are indicated in the parenthesis.

Examination duration is **2 Hour**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

## SECTION A

### Question ONE (20 marks)

(a) Differentiate between the following terms;

- i. Ultimate Limit State (ULS) and Serviceability Limit State (SLS)
- ii. Braced and unbraced frames
- iii. Doubly reinforced and singly reinforced beams

(6 marks)

(b) Outline **FOUR** ways in which the durability of concrete structures is largely achieved (4 marks)

(c) An internal column in a braced two-storey building supporting an approximately symmetrical arrangement of beams (320 mm wide × 560 mm deep) results in characteristic dead and imposed loads of 900 kN and 300kN respectively being applied to the column. The column is 300 mm square and has a clear height of 3.8 m as shown in **Figure Q1c**. Design the longitudinal reinforcement and links assuming  $f_{cu} = 35 \text{ Nmm}^{-2}$  and  $f_y = 460 \text{ Nmm}^{-2}$

(10 marks)

## SECTION B

### Question TWO (20 marks)

(a) A floor system consisting of a solid in-situ reinforced concrete slab cast integrally with the support beams is simply supported over a span of 5.8 m as shown in **Figure Q2a**.

- i. Design suitable reinforcement for a typical T-section to satisfy flexure and shear (9 Marks)
- ii. Check the suitability of a typical T-section with respect to deflection (3 Marks)
- iii. Determine the transverse reinforcement required for the flanges of the T-beams (2 Marks)
- iv. Prepare a sketch indicating all reinforcement (3 Marks)

#### Design Data:

*Characteristic dead load (excluding self-weight)  $g_k = 0.8 \text{ kN/m}^2$*

*Characteristic imposed load  $q_k = 3.0 \text{ kN/m}^2$*

*Concrete grade  $f_{cu} = 30 \text{ N/mm}^2$*

*Characteristic strength of reinforcing steel  $f_y = 460 \text{ N/mm}^2$*

*Exposure condition = mild*

*Fire resistance = 1hr minimum*

*Slab thickness  $h_f = 160 \text{ mm}$*

*Rib width  $b = 350 \text{ mm}$*

*Overall depth  $h = 500 \text{ mm}$*

*Span of main beams  $L = 5.8 \text{ m}$*

*Centers of main beams = 2.6 m*

(b) Outline the general procedure to be adopted for the design of pad footings (3 Marks)

**Question THREE (20 marks)**

- (a) A floor slab in an office building measures  $4.8 \text{ m} \times 7.2 \text{ m}$  and is simply supported at the edges with no provision to resist torsion at the corners or to hold the corners down. Using the design data given, determine suitable reinforcement.

**Design data**

Characteristic dead load due to finishes and services  $g_k = 1.15 \text{ kN/m}^2$

Characteristic imposed load  $q_k = 2.25 \text{ kN/m}^2$

Concrete grade  $f_{cu} = 35 \text{ N/mm}^2$

Characteristic strength of reinforcing steel  $f_y = 460 \text{ N/mm}^2$

Self-weight of concrete  $\gamma_{conc} = 24 \text{ kN/m}^3$

Exposure condition mild

(17 Marks)

- (b) Differentiate between Pre-tensioning and post-tensioning methods of construction of prestressed concrete  
(3 Marks)

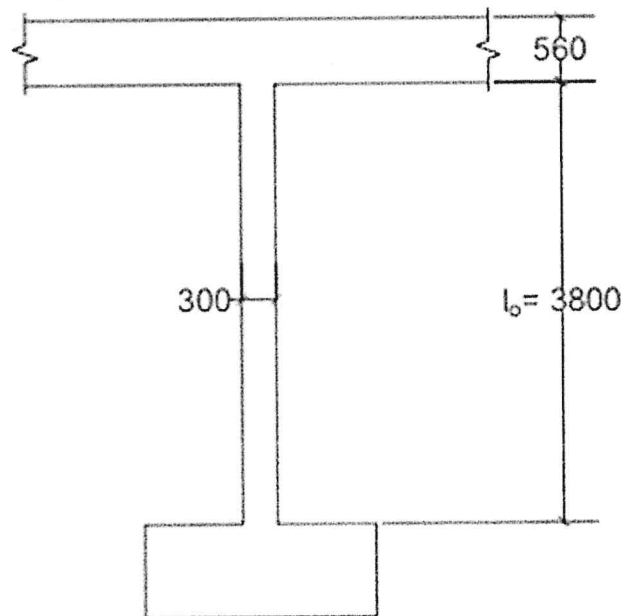


Figure Q1c

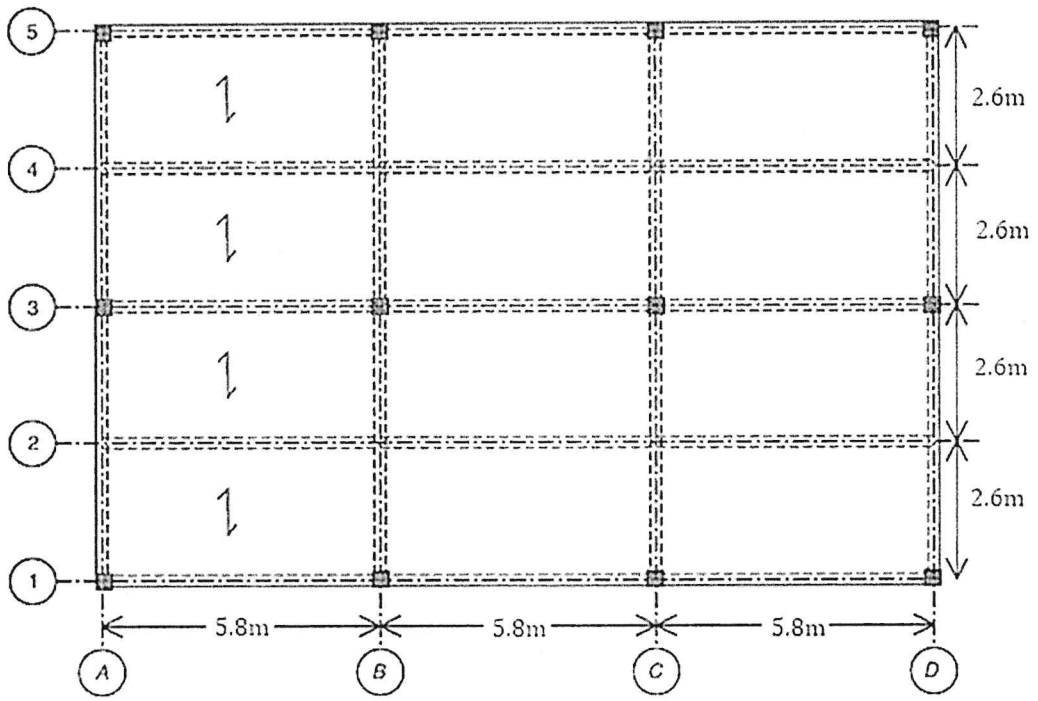


Figure Q2a