



ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION,  
INNOVATION, SCIENCE AND TECHNOLOGY  
DEVELOPMENT

HIGHER EDUCATION EXAMINATIONS COUNCIL  
(HEXCO)

HIGHER NATIONAL DIPLOMA

IN

CIVIL ENGINEERING

SUBJECT: Structural Engineering Design

PAPER NO: 778/17/S03

DURATION: 4 Hours

**MARCH/APRIL 2022 EXAMINATION**

REQUIREMENTS

Open Book

INSTRUCTIONS TO CANDIDATE

Answer any four (4) questions.

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*This paper consists of 3 printed pages.*

QUESTION 1

- a) List the type of reinforced concrete beams with their respective span to effective depth ratios. (6 marks)
- b) Outline the step by step design procedure for flat slabs. (19 marks)

QUESTION 2

- a) What factors influence buckling resistance in steel unrestrained beams? (5 marks)
- b) Outline the design procedure of an unrestrained steel beam, giving relevant references. (20 marks)

QUESTION 3

A cross-section of a long rectangular tank which is to be designed is shown in Figure 1 below. The floor slab spans on to supporting beams at B and C. Use the following data to design:

- a) Walls
- b) Floor

Design data

Plain mild steel bars are to be used

Grade of concrete C35A

Unit weight of water  $\gamma_w = 9.81 \text{KN/m}^3$

Aesthetic appearance is critical

Assume that  $\alpha_c = 10 \mu\text{s}/^\circ\text{C}$

$E_s = 27 \text{KN/mm}^2$

For walls:  $h = 200 \text{mm}$ ,  $d = 150 \text{mm}$  with  $T_1 = 20^\circ\text{C}$  and  $T_2 = 20^\circ\text{C}$

For floors:  $h = 300 \text{mm}$  and  $d = 250 \text{mm}$

With  $T_1 = 15^\circ\text{C}$  and  $T_2 = 15^\circ\text{C}$

(25 marks)

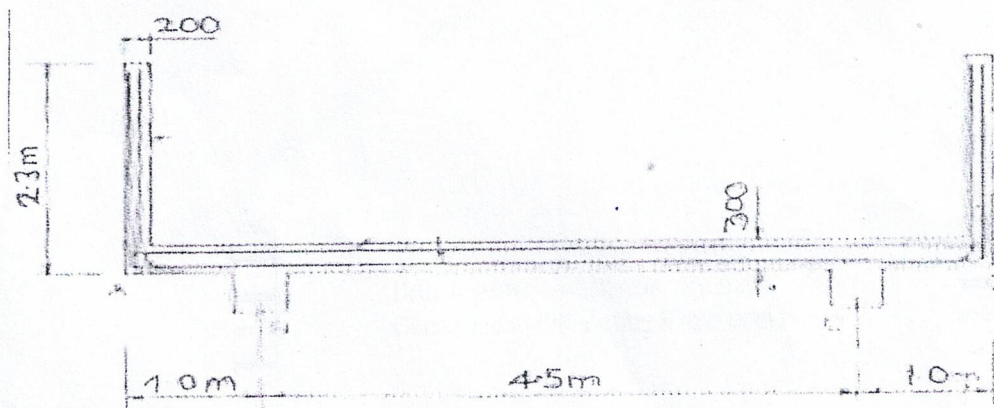


Figure 1

QUESTION 4

Design the plate girder simply supported over a span of 22m carrying the loads shown in the Figure 2 below. (25 marks)

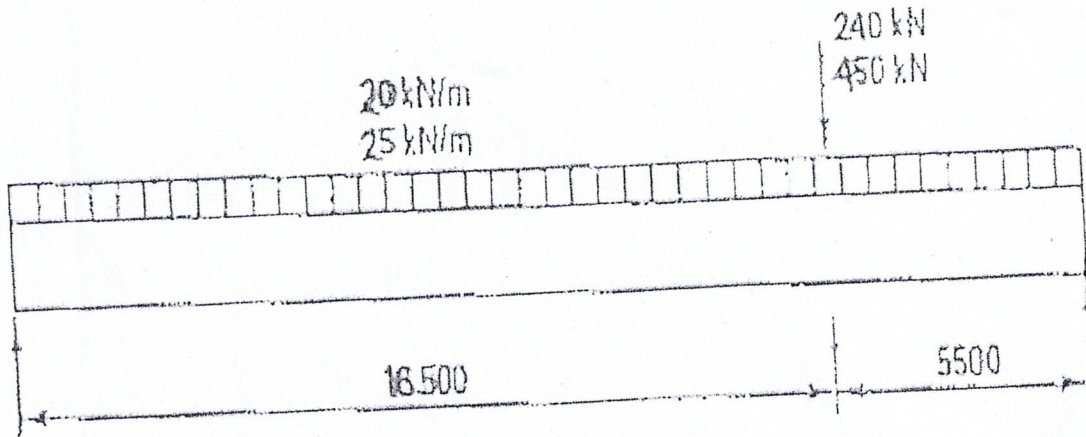


Figure 2

QUESTION 5

- a) What are the principal considerations in the design of timber beams? (5 marks)
- b) A close coupled roof construction comprises a tie (175 × 63mm) connect to two rafters M8 steel bolts as shown in Figure 3 below. Check the suitability of the tie to transmit a long-term tensile load of 3.0kN and a medium-term tensile load of 5.0kN. (20 marks)

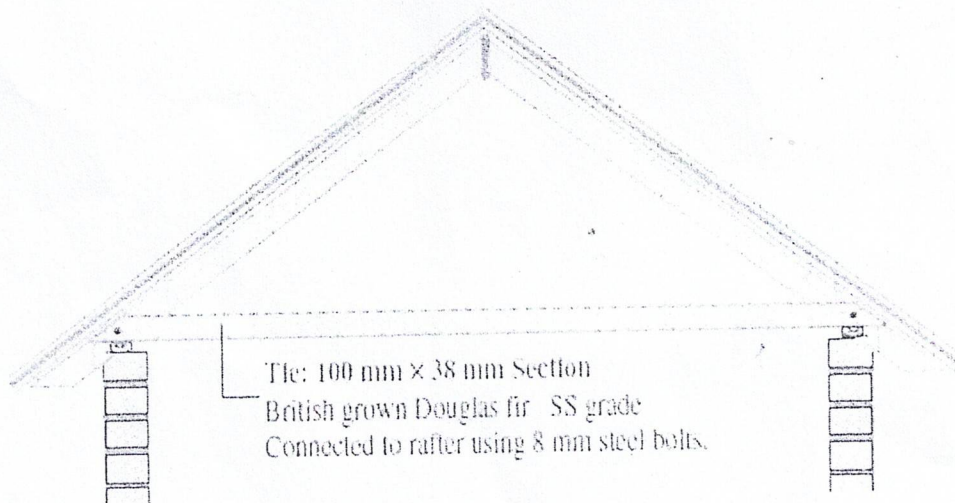


Figure 3

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