(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY REGULAR EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF:
BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING
BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: CSE 312

COURSE TITLE: PLASTIC ANALYSIS OF STRUCTURES

DATE: FRIDAY 29TH APRIL 2022 TIME: 12.00 – 2.00 PM

INSTRUCTIONS:

1. This paper contains **FIVE** questions
2. Answer **QUESTION ONE** and any other **TWO** Questions
3. Marks for each question are indicated in the parenthesis.
4. Examination duration is **2 Hours**

MMUST observes ZERO tolerance to examination cheating

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

QUESTION ONE (*30 MARKS*)

a) A rectangular section has a shape factor of 1.5. State the term "shape factor" and explain its significance in plastic analysis. **(4mks)**

b) A structural engineer had three different steel sections (shown in Figure Q1(b)) to choose from. You are required to calculate the shape factors of these sections and advice on the most suitable section. All dimensions in mm. **(10mks)**

c) Discuss the THREE methods of plastic analysis of structures. **(6mks)**

d) For the two beams shown in Figure Q1(d), calculate and compare the collapse load that each beam would carry. Assume the plastic moment, M_P is constant throughout the beams. **(7mks)**

e) If beam (ii) in Figure Q1(d) is made of a section as recommended in part (b) above, the length $L = 8\text{m}$ and the yield stress is $\sigma_y = 500\text{MPa}$, determine the value of the collapse load, W_c. **(3mks)**

QUESTION TWO (*20 Marks*)

a) In plastic analysis of slabs, one is required to postulate the yield line patterns. State any SIX rules for postulating yield line patterns on slabs. **(6mks)**

b) For the slab configurations shown in Figure Q2, postulate the yield line patterns. **(6mks)**

c) A rectangular slab measuring L and αL is simply supported in two parallel edges measuring αL and free on the remaining edges. The slab is isotropically reinforced and $\alpha < L$. Find the ultimate moment of resistance of the slab m. **(8mks)**

QUESTION THREE (*20 Marks*)

a) Differentiate between plastic hinge and mechanical hinge. **(4mks)**

b) Discuss the THREE types of plastic collapse. **(6mks)**

c) Using neat sketches, explain how axial load affects the plastic moment of a rectangular section. **(6mks)**

d) Postulate the collapse mechanisms of the structures under the influence of monotonically increasing static load configurations given in Figure Q3. **(4mks)**

QUESTION FOUR (*20 Marks*)

A rigid-jointed frame with the relative M_p value and the applied collapse loads is as shown in Figure Q4. You are required to:

a) Determine the required M_p value. **(10Mks)**
b) Determine the value of the support reactions. **(3Mks)**
c) Sketch the bending moment diagram at collapse. **(7Mks)**

QUESTION FIVE (*20 Marks*)

Figure Q5 shows an isotropically reinforced rectangular slab which is simply supported along all four sides and subjected to a uniformly distributed load of W kN/m^2. Calculate the ultimate load W_u that the slab can carry using mechanism method of plastic analysis. **(20mks)**

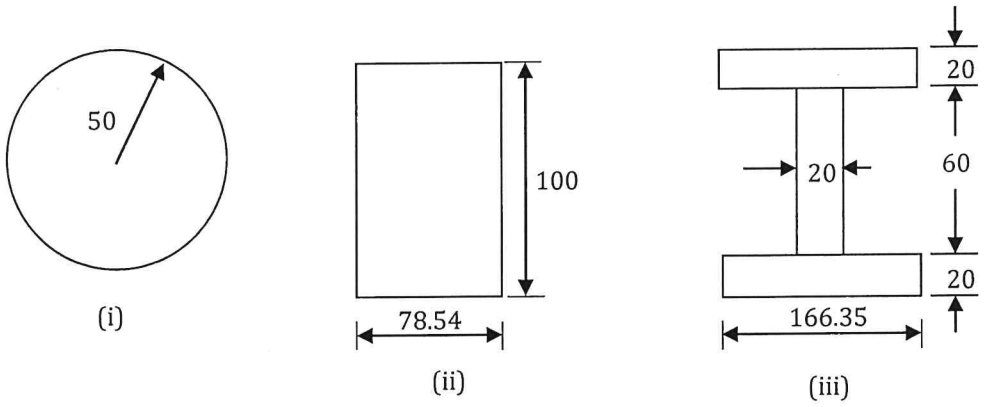


Figure Q1 (b)

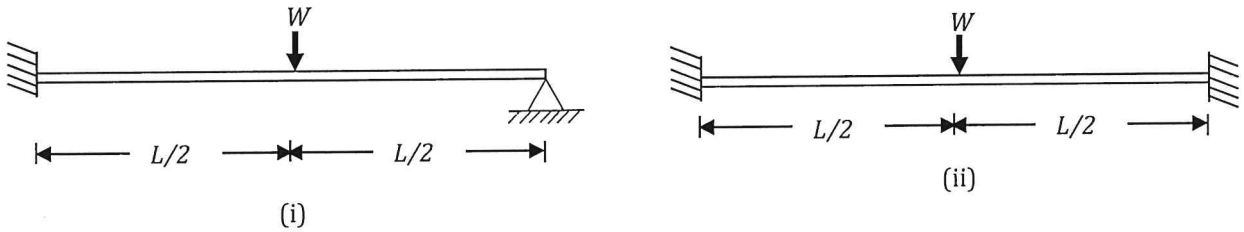
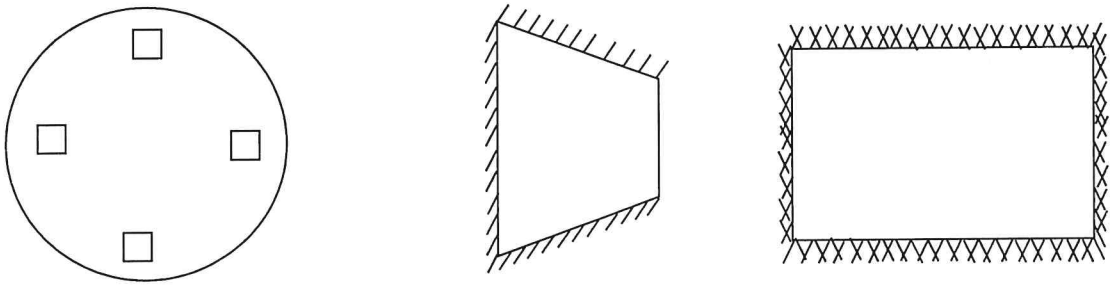
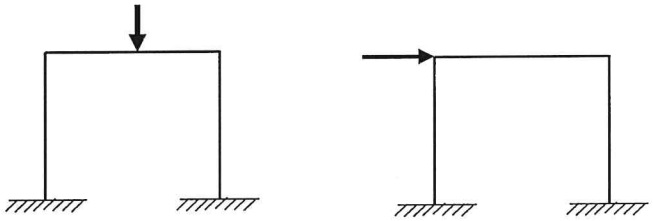


Figure Q1 (d)



(i) (ii) (iii)

Figure Q2



(i) (ii)

Figure Q3

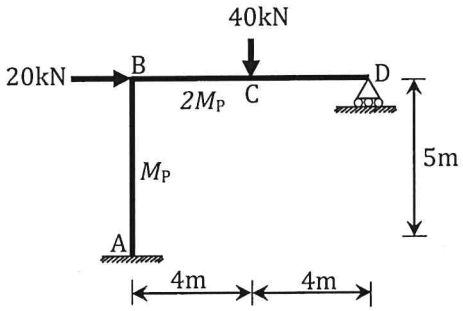


Figure Q4

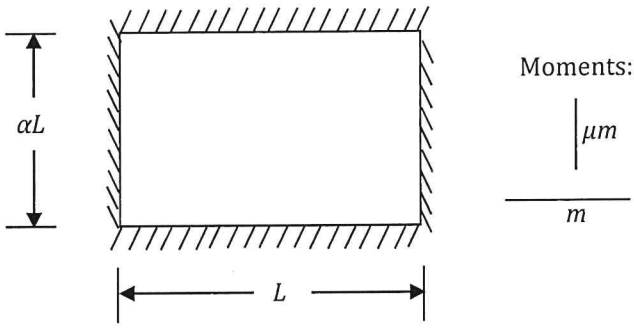


Figure Q5

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