Bejera

ZIMBABWE

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

HIGHER EDUCATION EXAMINATIONS COUNCIL (HEXCO)

NATIONAL DIPLOMA

IN

CIVIL ENGINEERING

MODULE: Strength of Materials and Civil Engineering Calculations

PAPER NO: 578/23/M04

DURATION: 3 hours

MAY/JUNE 2025 EXAMINATION

REQUIREMENTS

Non-programmable calculator

INSTRUCTIONS TO CANDIDATE

1. Answer all questions in Section A in separate booklet.
2. Answer question 2 and any other two (2) from Section B.
3. Do not tear off pages from the answer booklet.
4. Do not write anything on the question paper.

This paper consists of 5 printed pages.

SECTION A

QUESTION 1

a) Solve for x.

$5\cosh x - 2\sinh x = 18.56$ (6 marks)

b) Express $\frac{2x+4}{(x-2)^2(x+1)}$ into partial fractions. (6 marks)

c) Find $\int x^2 \ln x \, dx$ (4 marks)

d) Given $y = \frac{e^{x^2}\sin x}{\sqrt{x^2+1}}$, find $^{dy}/_{dx}$ using logarithmic differentiation or otherwise. (5 marks)

e) Find $\int \sqrt{9-4x^2}\, dx$ (5 marks)

f) Solve the differential equation $2x\, ^{dy}/_{dx} = y + xy$ (4 marks)

SECTION B

QUESTION 2

a) A horizontal strut $2.5m$ long is constructed from rectangular section steel, $50mm$ wide by $100mm$ deep and mounted with pinned ends. The strut carries an axial load of $120kN$ together with a uniformly distributed load of $5kN/m$ along its complete length. If E= $200GN/m^2$ determine the maximum stress set up in the strut.

Check the result using appropriate Pery method with $M_{max} = M_0\left[\frac{P_e}{P_e - P}\right]$ (6 marks)

b) A steel rod is stretched between two rigid walls and carries a tensile load of 5000N at 20°C. If the allowable stress is not to exceed 130MPa at −20°C, what is the minimum diameter of the rod? Assume $\propto$= $11{,}7\mu m(m°C)$. E= $200GPa$. (6 marks)

c) For a simple frame in Fig. 1. Use the Moment Distribution Method to analyse the frame. (18 marks)

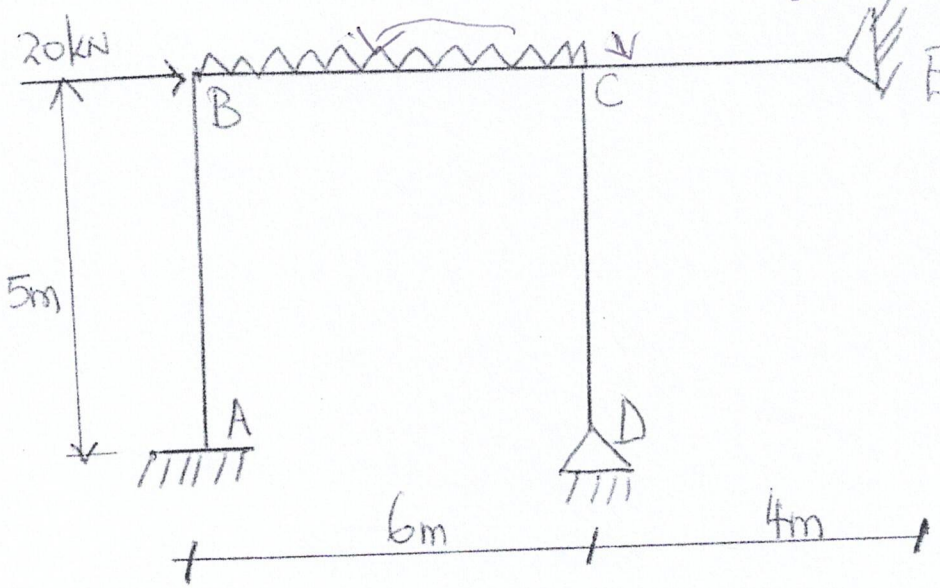

Fig. 1

QUESTION 3

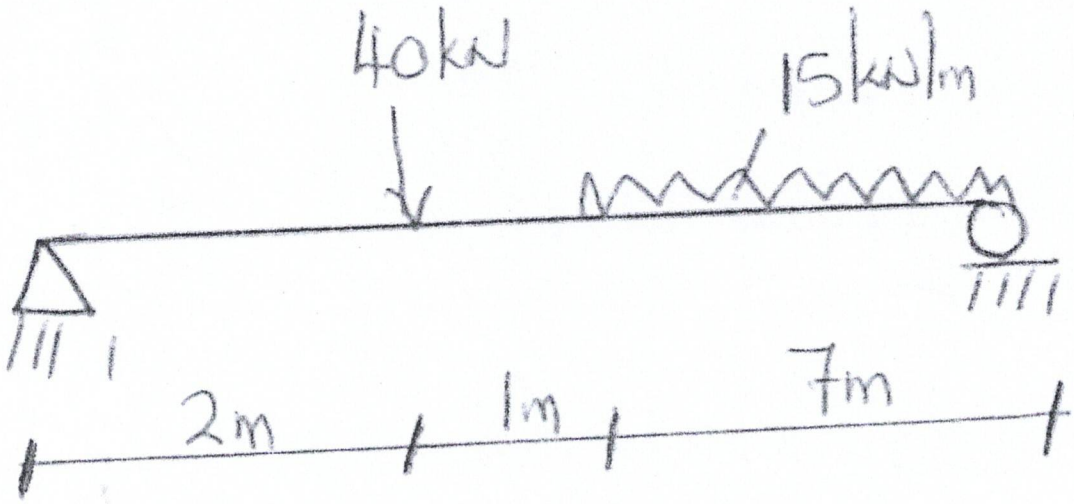

Fig. 2

Analyse using three moment equation the beam shown in Figure 2 and hence draw the Bending moment diagram. (20 marks)

QUESTION 4

a) A cantilever of length $3m$ is carrying a part load of 25kN at the free end. If the moment of inertia of the beam is $10^8 mm^4$ and value of E= $2{,}1 \times 10^5 N/mm^2$.

Calculate:

i) Slope of the cantilever at free end. (3 marks)
ii) Deflection at the free end. (3 marks)

b) A simply supported beam is subjected to point load and uniformity distributed load as shown in Fig. 3. Calculate the slope and deflection at point C using the Macaulay method in terms of EI. (14 marks)

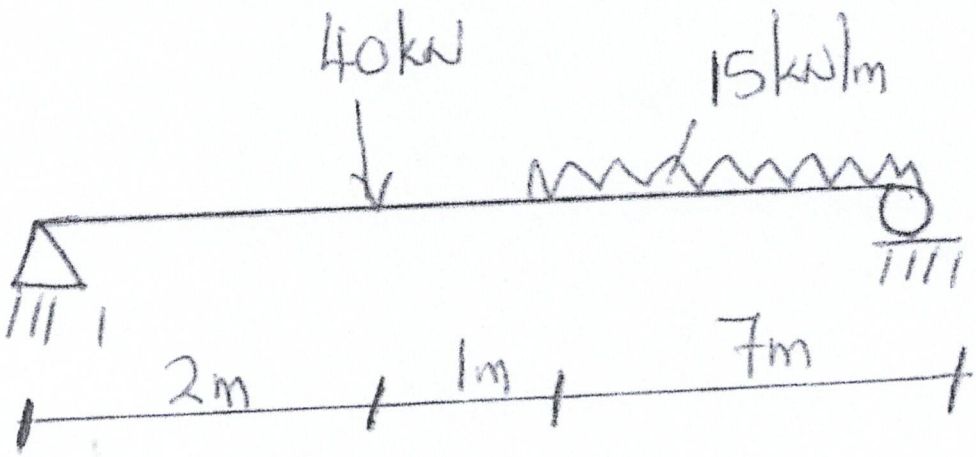

Fig. 3

QUESTION 5

Analyse the continuous beam ABCD by Slope Deflection Method and then draw the Bending Moment diagram. Take EI to be constant. Use Fig. 4. (20 marks)

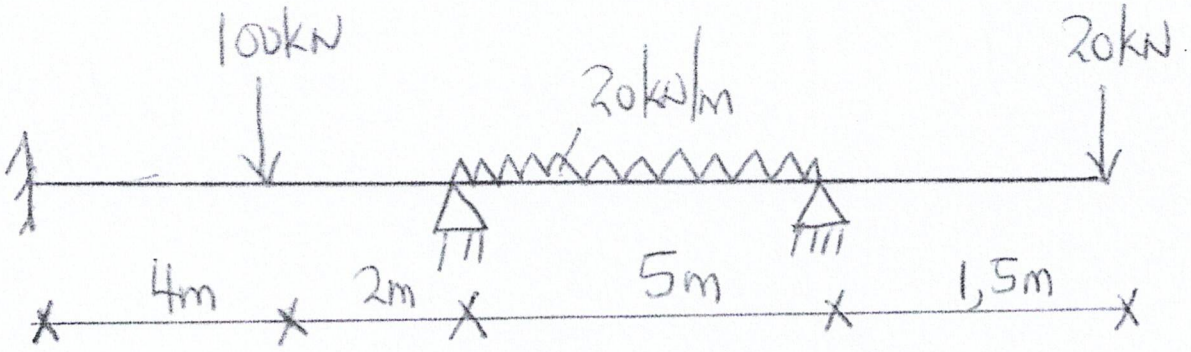

Fig. 4

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