



MACHAKOS UNIVERSITY
University Examinations for 2021/2022 Academic Year
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
SECOND YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (CIVIL ENGINEERING)
ECV 209: THEORY OF STRUCTURES II

DATE: 27/5/2022

TIME: 11.00-1.00 PM

INSTRUCTIONS:

- This paper comprises of FIVE questions. Answer **THREE** questions
- Question one is **compulsory** and carry 30 marks
- Answer any other **TWO** questions

QUESTION ONE (30 MARKS)

- a) Briefly discuss TWO types of cable structures. (4 marks)
- b) Determine the slope and deflection at point B of the cantilever beam shown in figure 1 by direct integration method. (5 marks)

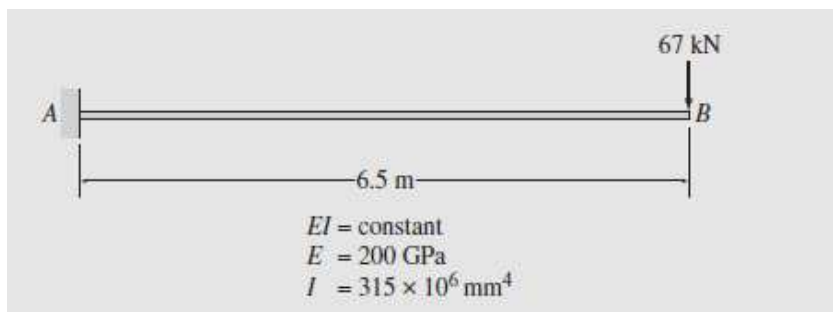


Figure 1

- c) Analyse the non-prismatic fixed beam shown in figure 2 using method of consistent deformations. (7 marks)

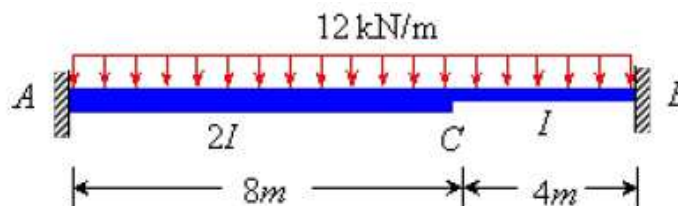


Figure 2

- d) Draw the influence lines for the vertical reactions at supports A and C of the beam shown in figure 3. (6 marks)

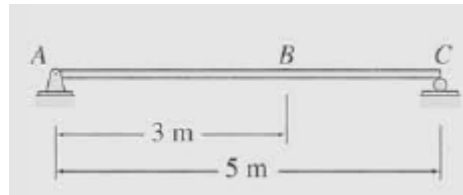


Figure 3

- e) A beam of length 8m is simply supported at its ends. It carries a uniformly distributed load of 40 kN/m as shown in figure 4. Determine the deflection of the beam at its mid-point. Take $E=2 \times 10^5 \text{ N/mm}^2$ and $I=4.3 \times 10^8 \text{ mm}^4$. Use Macaulay's method. (8 marks)

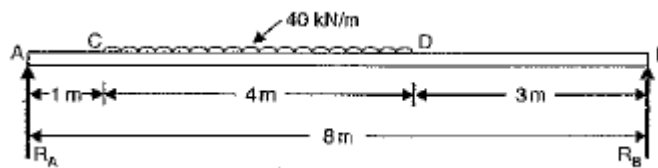


Figure 4

QUESTION TWO (20 MARKS)

Using three moment equation, determine the reactions for the continuous beam shown in figure 5 due to the uniformly distributed load and support settlements of; 10mm at A, 50mm at B, 20mm at C and 40mm at D. $E=200 \text{ GPa}$ and $I=700 \times 10^6 \text{ mm}^4$.

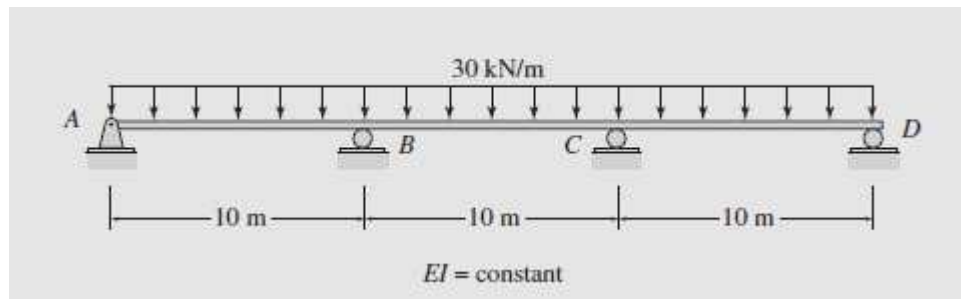


Figure 5

$$\begin{aligned} & \frac{M_\ell L_\ell}{I_\ell} + 2M_c \left(\frac{L_\ell}{I_\ell} + \frac{L_r}{I_r} \right) + \frac{M_r L_r}{I_r} \\ &= -\sum \frac{P_\ell L_\ell^2 k_\ell}{I_\ell} (1 - k_\ell^2) - \sum \frac{P_r L_r^2 k_r}{I_r} (1 - k_r^2) - \frac{w_\ell L_\ell^3}{4I_\ell} - \frac{w_r L_r^3}{4I_r} \\ & \quad - 6E \left(\frac{\Delta_\ell - \Delta_c}{L_\ell} + \frac{\Delta_r - \Delta_c}{L_r} \right) \end{aligned}$$

QUESTION THREE (20 MARKS)

A parabolic arch with supports at the same level is subjected to the combined loading shown in figure 6. Determine the support reactions and the normal thrust and radial shear at a point just to the left of the 150 kN concentrated load.

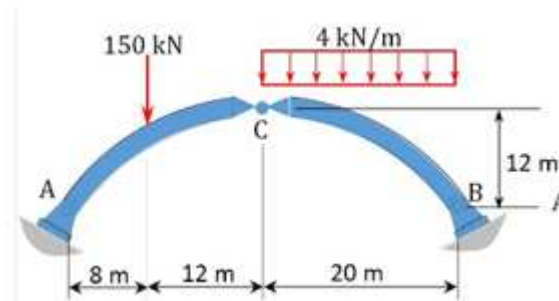


Figure 6

QUESTION FOUR (20 MARKS)

- a) Determine the reactions and draw the shear force and bending moment diagrams for the beam shown in figure 7 using method of consistent deformations. Select the reaction moment at the fixed support to be the redundant. (14 marks)

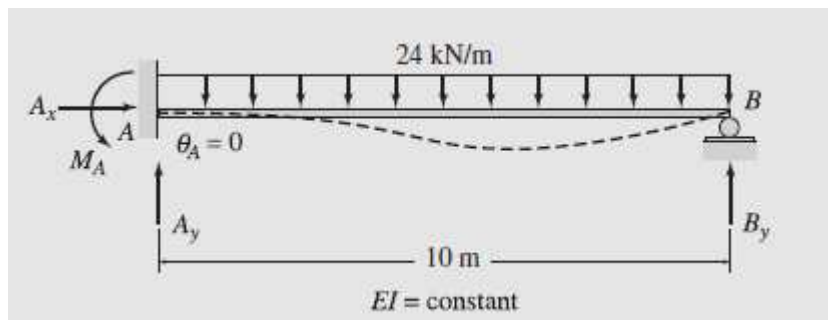


Figure 7

- b) Determine the reactions for the beam shown in figure 8 using method of consistent deformations. (6 marks)

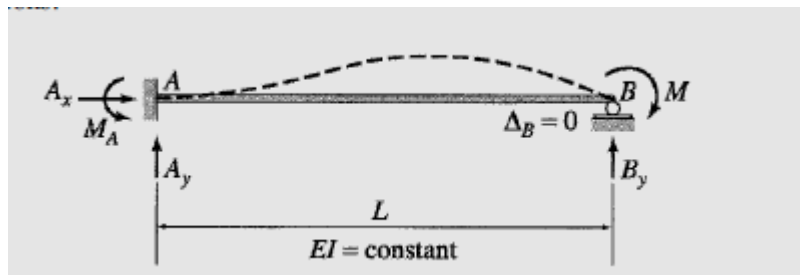


Figure 8

Draw the influence lines for the vertical reactions at the supports and the shear and bending moment at point C of the two-span continuous beam shown in figure 9.

