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SRI LANKA INSTITUTE OF ADVANCED TECHNOLOGICAL EDUCATION
(Established in the Ministry of Higher Education, vide in Act No. 29 of 1995)

Higher National Diploma in (civil) Engineering
Second Year, Second Semester Examination – 2016
CE2215- Structural Analysis

Instructions for Candidates:
Answer only five questions

No. of questions : 06
No. of pages : 03
Time : Three hours

Q1) A horizontal cantilever steel rod AB is fixed at A and loaded as shown in figure 1.

Flexural rigidity of beam is EI and length is L .

- Find the vertical deflection at point B by using energy theory (Castigliano's theorem or Virtual work method).
- Determine the rotation at point B due to the flexural deformation.
Hint- If the castigliano's theorem is used, apply the fictitious moment M_o at B and in final answer set $M_o = 0$
- Above steel rod has following properties and loading conditions. Length $L = 6\text{m}$, Young's modulus $E = 210\text{ GPa}$, Second moment of area $I = 1.5 \times 10^{-5}\text{ m}^4$, Point load $P = 500\text{N}$ and Uniform distributed load $w = 1\text{kN/m}$. Find the vertical deflection at B in mm.
- Mention one assumption made for these calculations.

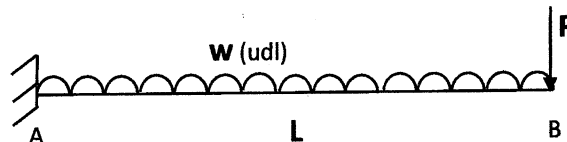


Figure 1

(Total Marks 20)

Q2) A portal frame is subjected to a loading and different sectional properties of members are shown in figure 2. This is a non- sway condition analysis due to the lateral bracing at C.

- Determine the end moments of each members using **Slope deflection method**.
- Roughly** draw the bending moment diagram by using end moment values and general pattern knowledge without calculating support reactions, critical values (maximum/minimum) etc.

A. A. Kandara

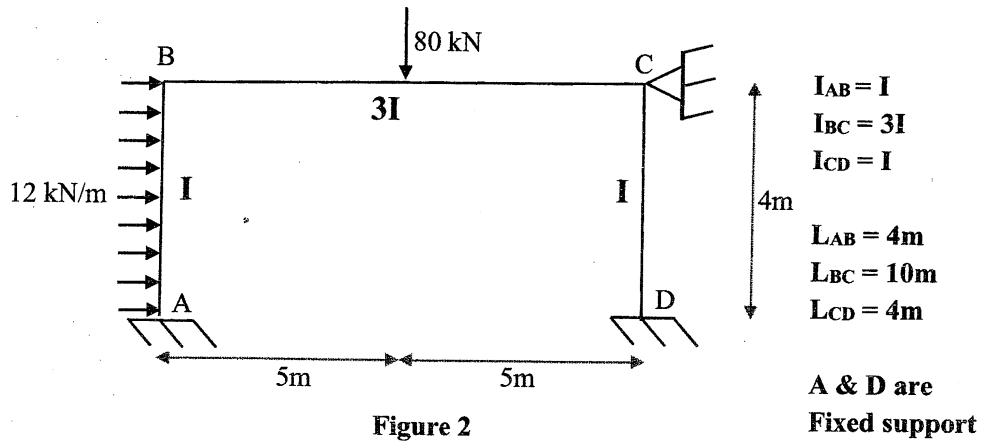


Figure 2

(Total Marks 20)

(Q3) A continuous beam shown below is fixed at A, is on roller support at C. The beam is subjected to a loading condition as shown in figure 3. There is a vertical downward settlement of 1mm at internal support B. $EI = 48000\text{kNm}^2$ throughout the beam

- Analyse the beam by **Moment Distribution Method** and find the end moments.
- Determine the end support reactions and draw the shear force and Bending moment diagram with all necessary critical values.

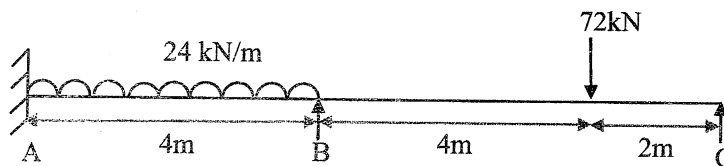


Figure 3

(Total Marks 20)

(Q4) A continuous beam rests on support A, B, C and D at same level and loaded as shown in figure 4. Sectional properties of members are also indicated clearly.

- Determine the end moments using **Three Moment Equation**. Clearly indicate the Sign convention used for this calculation.
- Roughly** draw the bending moment diagram. Not required to calculate support reactions and critical values.

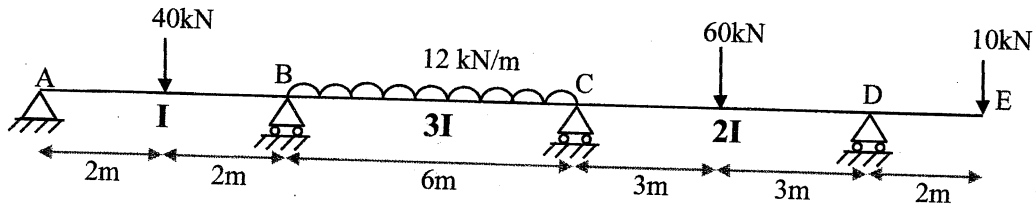


Figure 4

$$I_{AB} = I \quad I_{BC} = 3I \quad I_{CD} = 2I$$

(Total Marks 20)

- Q5) A non-uniform member frame is shown in figure 5. The columns have a full plastic moment value of $2M_p$ and beam has M_p . Determine the value of W in the terms of M_p and L at which there is plastic collapse of the frame. Clearly draw the collapse mechanism and plastic hinge details for each analysis case.

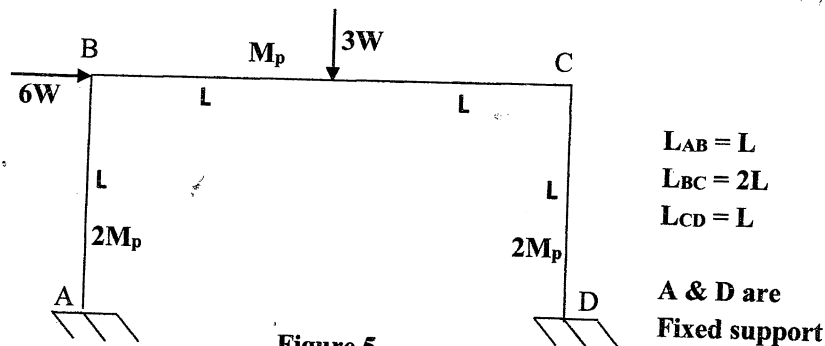


Figure 5

A & D are Fixed support

(Total Marks 20)

- Q6) Answer to all questions

- What is meant by shape factor in plastic analysis? Determine the shape factor for rectangular section.
- Explain the strain energy resulting from pure torsion in linear elastic body by using the equation. Clearly mention the each parameters and units.
- What is statically indeterminate structure?
Consider the continuous beam AE as shown in Figure 4. Determine the degree of static indeterminacy.
State the static indeterminacy of three hinged arch and two hinged arch.
- Explain the application of trusses in civil engineering works. What are the assumptions made in truss analysis calculations?
- Define the following terms involved in structural analysis
Spring constant, Young's modulus, Yield strength and Dynamic loads.

(Total Marks 20)