UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BET *CIVIL ENGINEERING*
SUBJECT	:	**STRUCTURAL ANALYSIS 2B**
CODE	:	**STRCIB2**
DATE	:	SUMMER EXAMINATION 19 NOVEMBER 2019
DURATION	:	3 HOURS
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

EXAMINER	:	MR F THAIMO
MODERATOR	:	DR J MAHACHI
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	SCIENTIFIC POCKET CALCULATOR MAY BE USED
REQUIREMENTS	:	2 SHEETS OF A4 GRAPH PAPER PER CANDIDATE.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

The statically determinate frame **ABC,** Figure 1 below, is pinned at both supports A and C, and the members are connected by a frictionless pin (hinge) at B. The frame is subjected to loading as shown on the Figure.

1.1 Determine the reactions at the supports A and C, and sketch a free body diagram of the frame showing the loading and support reactions.

1.2 Draw the Shear Force, Bending Moment and Axial Force Diagrams for the frame on the graph paper provided. (**Please note that bending moment is drawn on the side of the member where it causes tensile bending stresses)**.

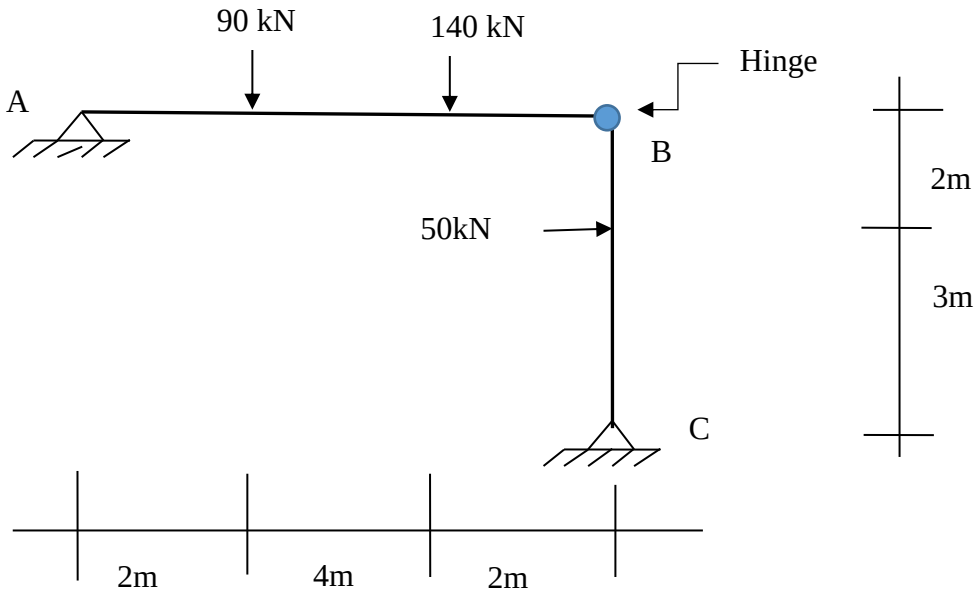


FIGURE 1

[25]

QUESTION2

The simply supported beam shown as Figure 2 is subjected to a uniformly distributed load of 90 kN/m applied over the central half of the length of the beam as shown on the Figure. The flexural rigidity (EI) value for the beam-section is equal to $90x10^3$ kNm^2.

Using **MOMENT-AREA** method, calculate the length (L) of the beam if the maximum deflection is 15 mm.

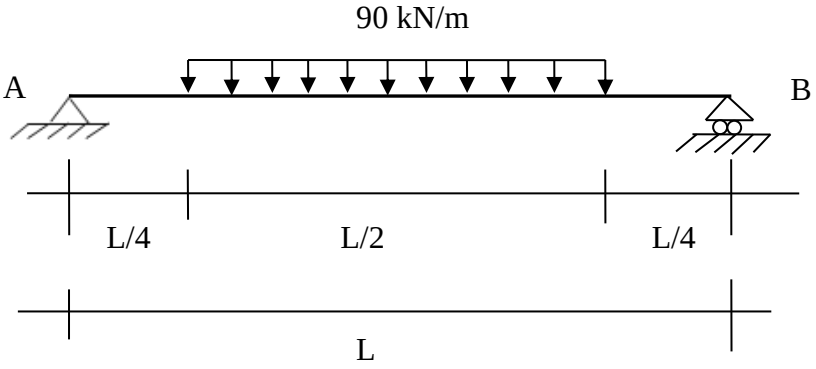


FIGURE 2

[20]

QUESTION 3

The support conditions of the frame ABCD shown as Figure 3 below are such that the frame is fixed at C and D and supported by pin rollers at A. The frame is subjected to loading as shown. The flexural rigidity (EI) for the members is constant.

Using **SLOPE DEFLECTION** method, draw the Shear Force, Bending Moment and Axial Force Diagrams for the frame on the graph paper provide.

Slope deflection equations are as follows:

$$M_{AB} = \frac{2EI}{l}\left[2\theta_A + \theta_B - \frac{3(\Delta_B - \Delta_A)}{l}\right] \qquad M_{BA} = \frac{2EI}{l}\left[\theta_A + 2\theta_B - \frac{3(\Delta_B - \Delta_A)}{l}\right]$$

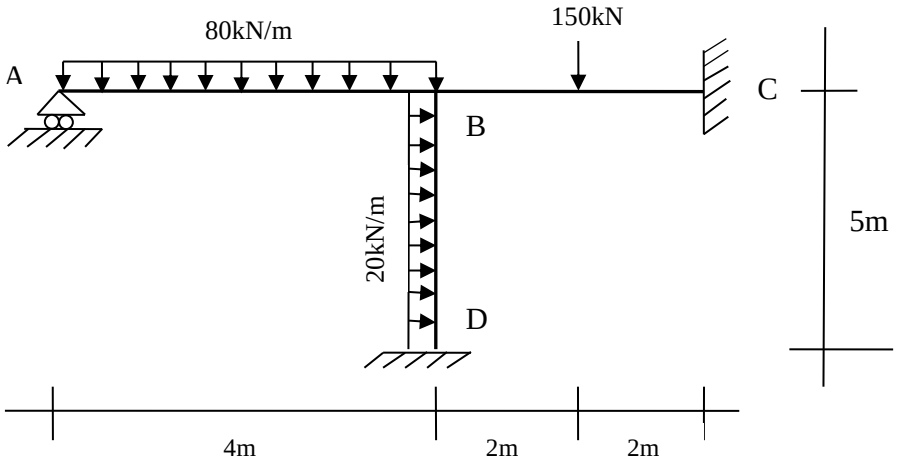
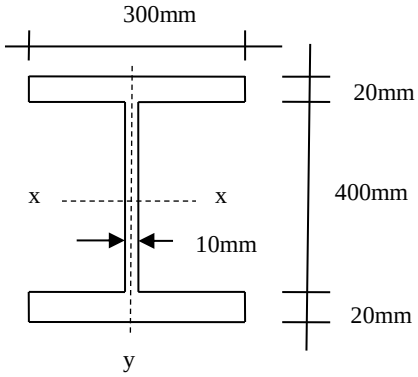


FIGURE 3

[35]

QUESTION 4

A built-up symmetrical **(H)** steel section shown below is to be used as a column 5 m long. The column is to be fixed at one end and pinned at the other about X-X and fixed at both ends for bending about Y-Y axis. The Young's Modulus for the steel is 200 GPa and the Yield stress is 400 MPa.



4.1 Calculate the Euler buckling stress.

4.2 If Perry-Robertson equation is used, what would be the stress at failure and the force to produce this stress?

Perry-Robertson equation is as follows:

$$\boldsymbol{\sigma_c} = \frac{1}{2}\left[\sigma_y + (1+\eta)\sigma_e\right] - \sqrt{\left\{\frac{1}{4}\left[\sigma_y + (1+\eta)\sigma_e\right]^2 - \sigma_y\sigma_e\right\}}$$

and

$$\eta = 0.003 \times \frac{L_e}{r}$$

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