NATIONAL EXAMS MAY 2011

98-CIV-B1 ADVANCED STRUCTURAL ANALYSIS

3 HOURS DURATION

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper a clear statement of any assumption made.

2. Each candidate may use an approved model of Sharp or Casio calculator; otherwise, this is a CLOSED BOOK Examination.

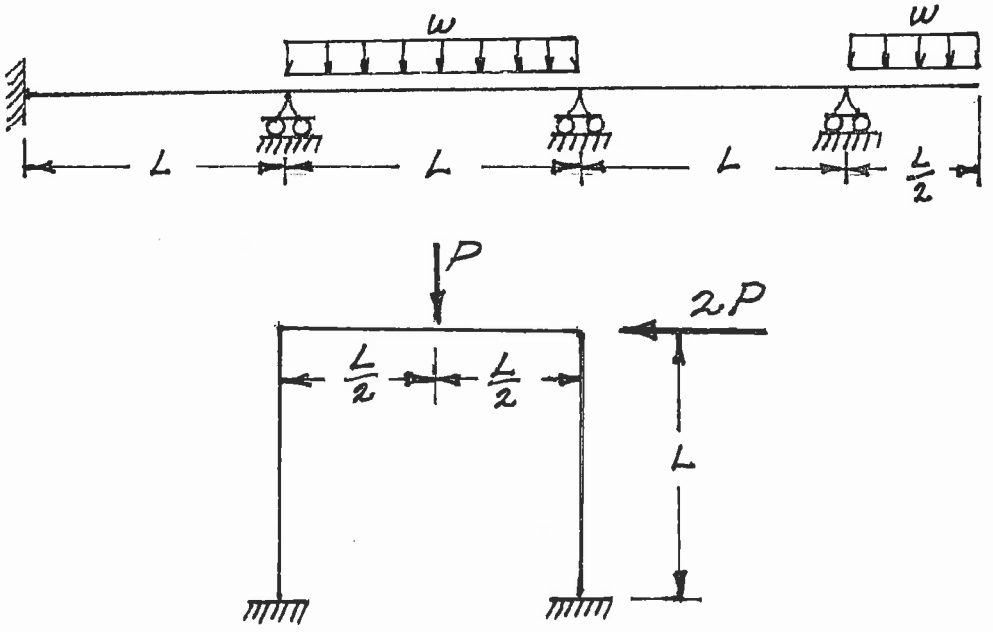
3. Answer BOTH questions #1, and #2. Answer ONLY TWO of questions #3, #4, or #5. Answer ONLY ONE of questions #6 OR #7 and ONLY ONE of questions #8 OR #9. SIX questions constitute a complete paper.

4. The marks assigned to each question are shown in the left margin.

FRONT PAGE

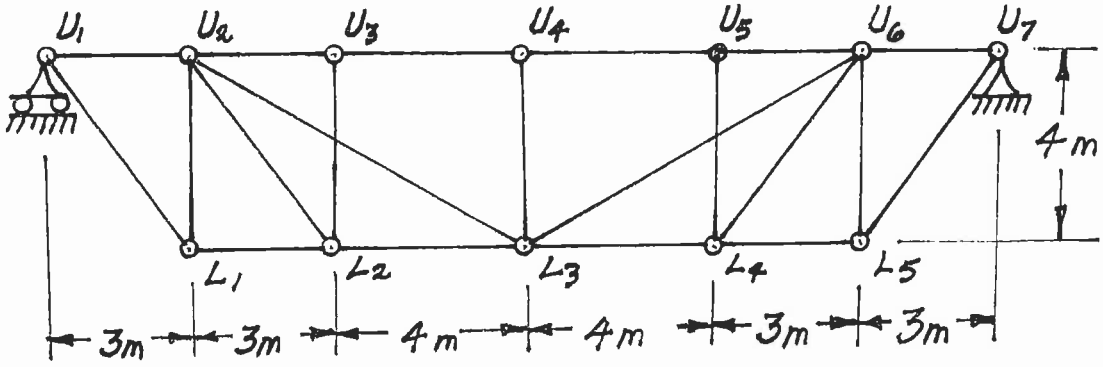
QUESTIONS #1 AND #2 MUST BE ANSWERED.

(8) 1. Schematically show the shear force and bending moment diagrams for the following structures. All members have the same EI and are inextensible.



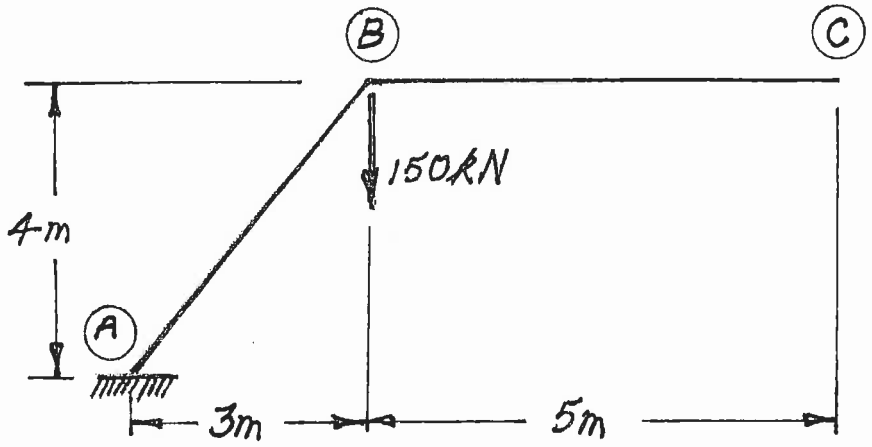
(12) 2. For a load applied to the top chord of the pin-jointed truss shown below, schematically show the influence line and calculate the maximum ordinate for the force in the following members (Diagonals are not connected where they cross):

a) $U_3 - U_4$
b) $U_1 - L_1$
c) $U_2 - L_3$

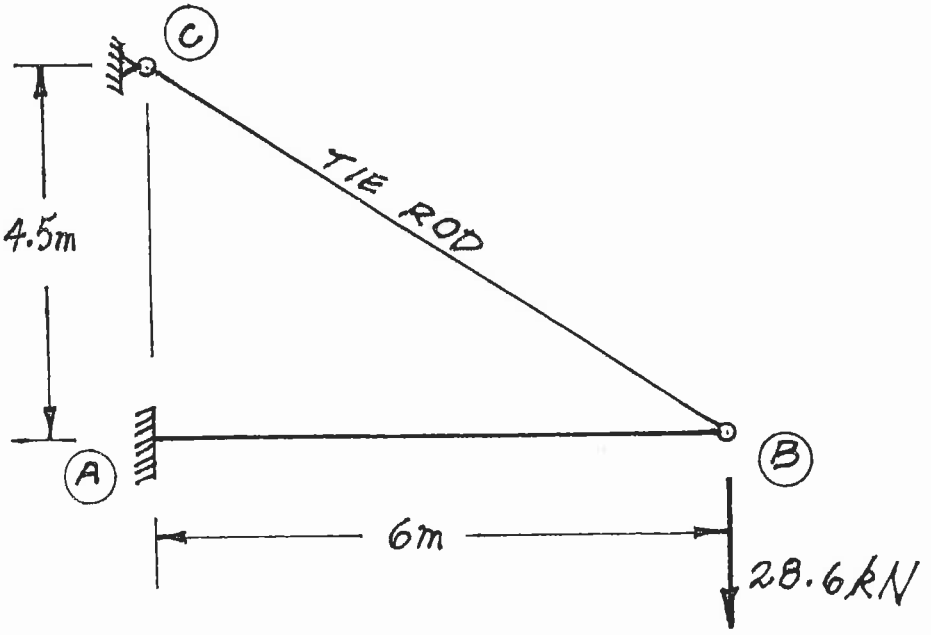


SELECT AND ANSWER TWO QUESTION ONLY FROM QUESTIONS #3, #4, OR #5.

(18) 3. Use Castigliano's theorem to determine the vertical deflection at point Ⓒ, on the structure shown. Both members have the same EI value which is 9.0×10^4 kN.m^2.

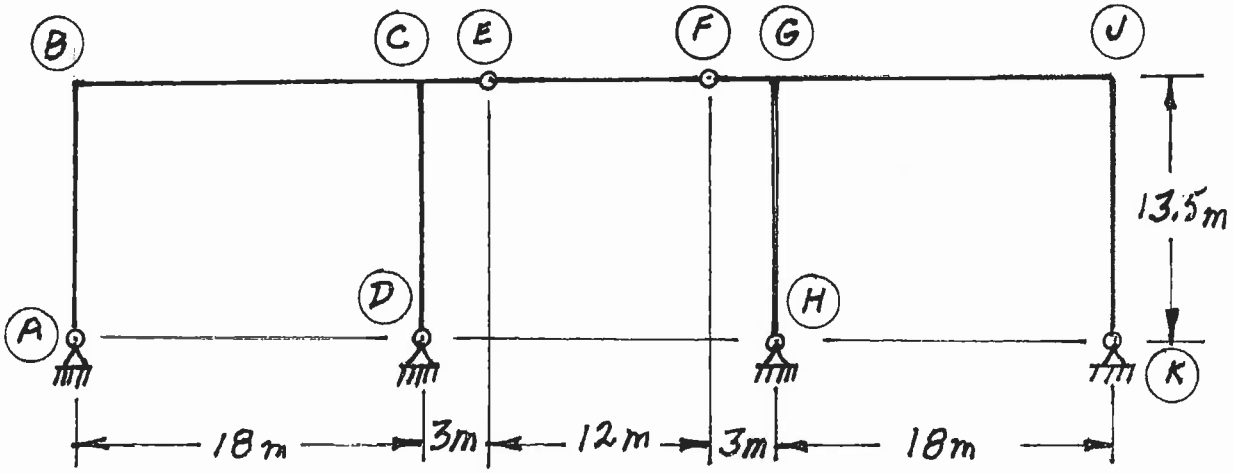


(18) 4. Use Castigliano's theorem (the least work theorem) to analyze the indeterminate structure shown. Calculate the maximum bending moment and shear on the beam Ⓐ – Ⓑ. The beam is inextensible and has an EI = 1.8×10^5 kN.m^2 and the tie rod does not take moment and has an EA = 7500 kN.



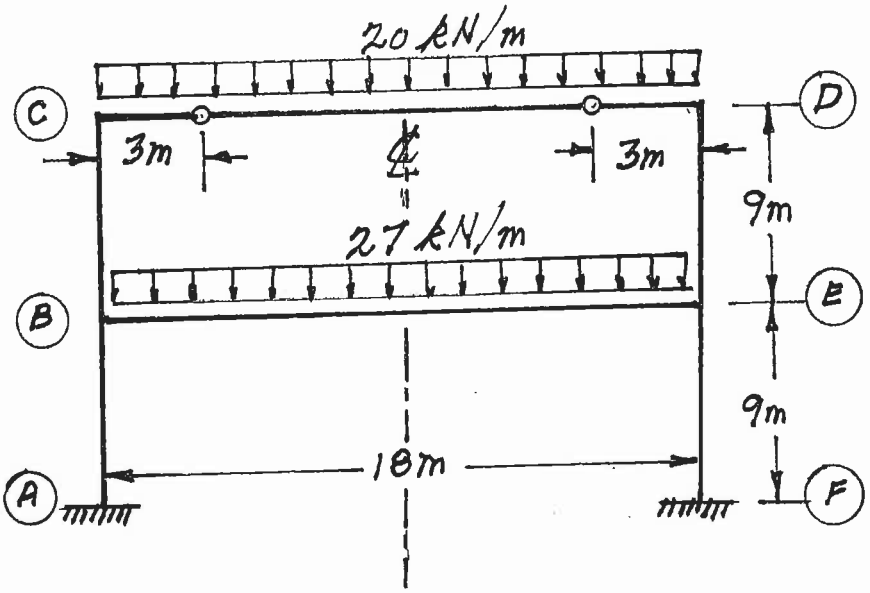
SELECT AND ANSWER TWO QUESTION ONLY FROM QUESTIONS #3, #4, OR #5.

(18) 5. Use the slope-defection method or the moment-distribution method to analyze the frame structure shown. Draw shear and bending moment diagrams. Indicate on both diagrams the magnitude of maximum and minimum ordinates (Minimum ordinates are frequently negative). There are no loads on the structure, but member (E)–(F) was fabricated exactly 0.027 m too long; the member was forced into place after all other members were erected. All members of the structure are inextensible and have the same EI value which is 2.7×10^6 kN.m^2. **Take advantage of symmetry and anti-symmetry where they apply.**

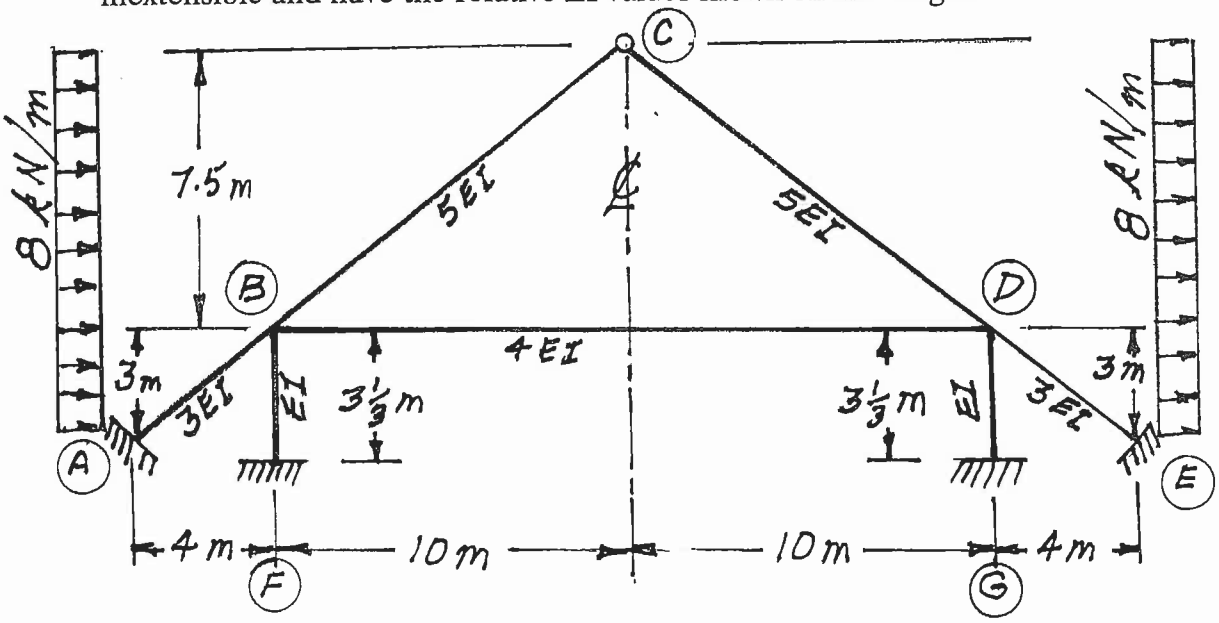


SELECT AND ANSWER ONE QUESTION ONLY FROM QUESTIONS #6, OR #7.

(22) 6. Using the slope-defection method or the moment-distribution method, analyse the structure shown below. Plot shear force and bending moment diagrams. On each diagram for each member, indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative). All members are inextensible and have the same EI value.

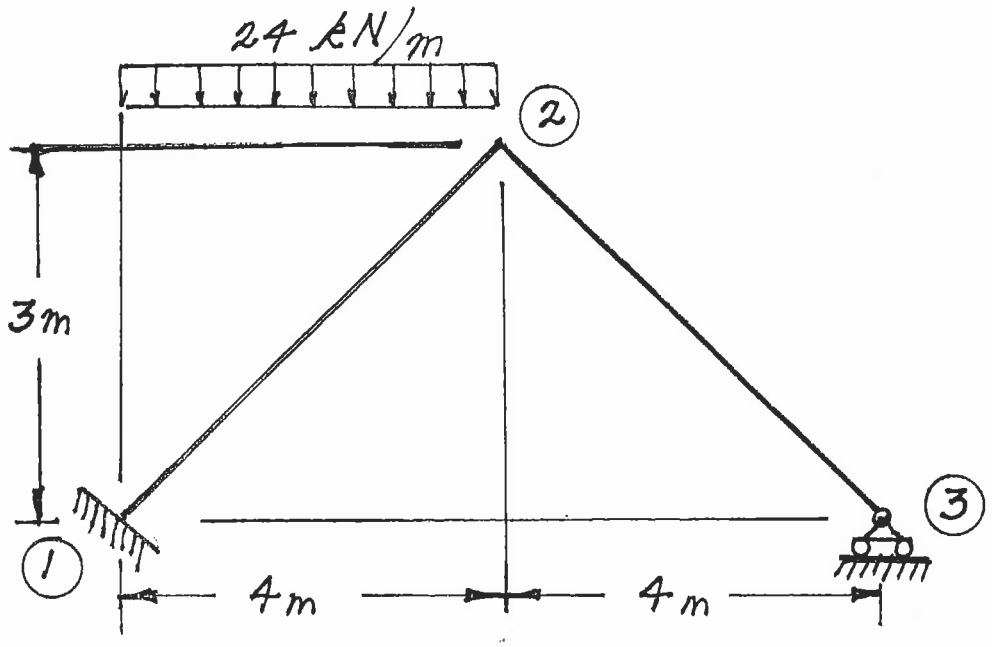


(22) 7. Using the slope-defection method or the moment-distribution method, analyse the structure shown below. Plot shear force and bending moment diagrams. On each diagram for each member, indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative). All members are inextensible and have the relative EI values shown on the diagram.



SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS #8 OR #9.

(22) 8. Using the slope-defection method, analyse the structure shown below. Plot shear force and bending moment diagrams. On each diagram for each member, indicate the magnitudes of the maximum and minimum ordinates (Minimum ordinates are frequently negative). Both members are inextensible and have the same EI value.



(22) 9. a) For the frame shown, derive the equilibrium equation for the horizontal translation shown at joint (3). Neglect the effects of axial strain. EI has the same value for both members.

b) Derive the equilibrium equations for moment equilibrium at joints (2) and (3).

c) Present your results in matrix form by giving the terms of the stiffness matrix [K] and the load vector {P} in the following equation:

$$[K]\begin{Bmatrix}\delta\\ \theta_2\\ \theta_3\end{Bmatrix} = \{P\}$$

DO NOT SOLVE THE EQUATIONS.

The unknowns of the problem shall be:

δ = translation at joint (3) (positive to the right)

θ_2 = rotation of joint (2)

θ_3 = rotation of joint (3)

(counter clockwise positive)