NATIONAL EXAMS DECEMBER 2007

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.

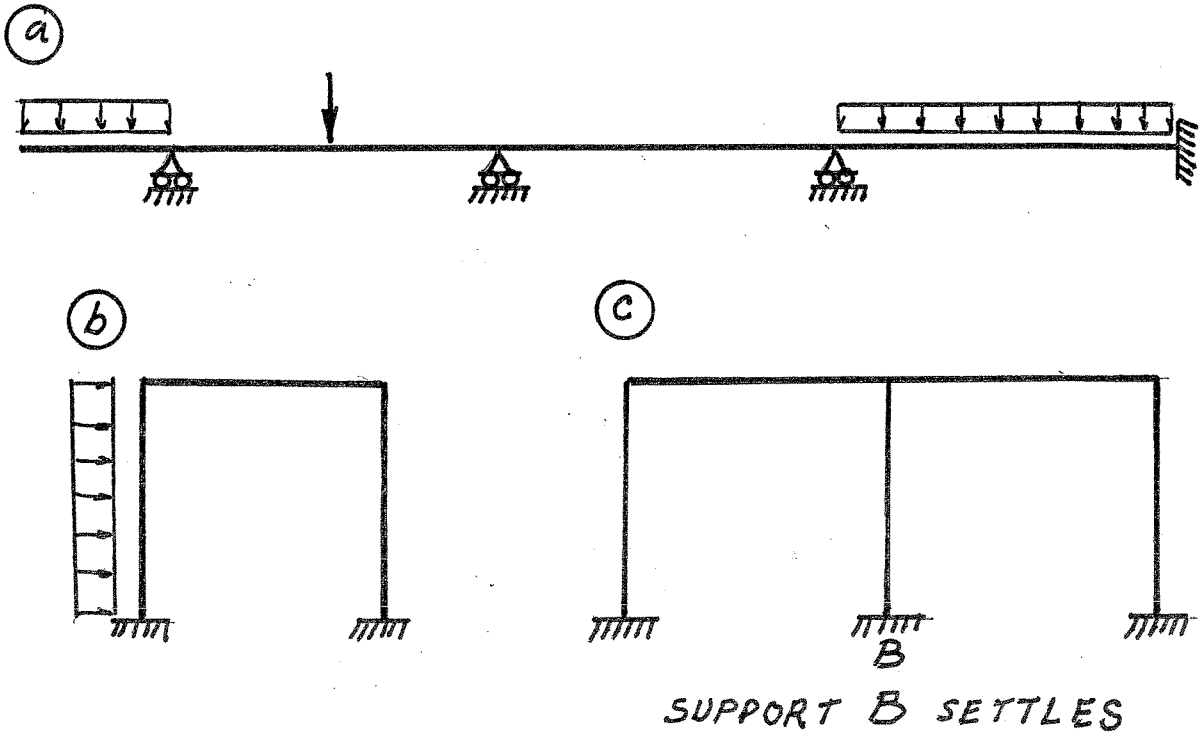
3. Answer BOTH questions #1, and #2. Answer ONLY TWO of questions #3, #4, or #5. Answer ONLY TWO of questions #6, #7, #8 OR #9. SIX questions constitute a complete paper.

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

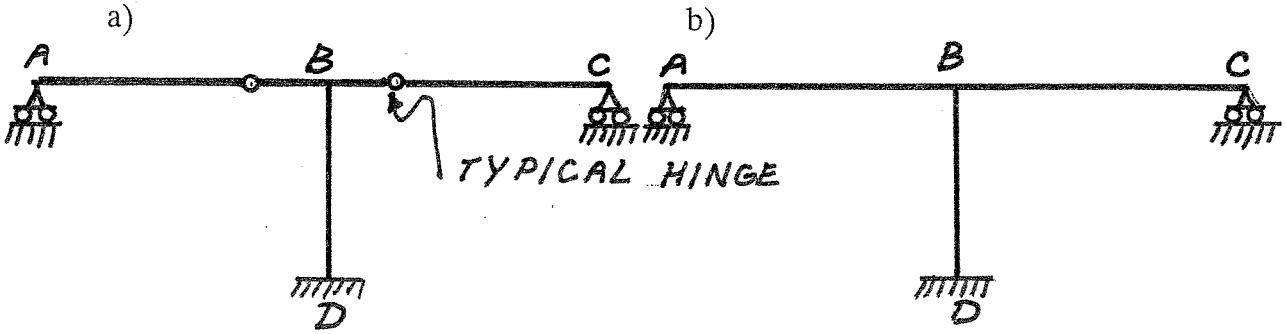
FRONT PAGE

QUESTIONS #1 AND #2 MUST BE ANSWERED.

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

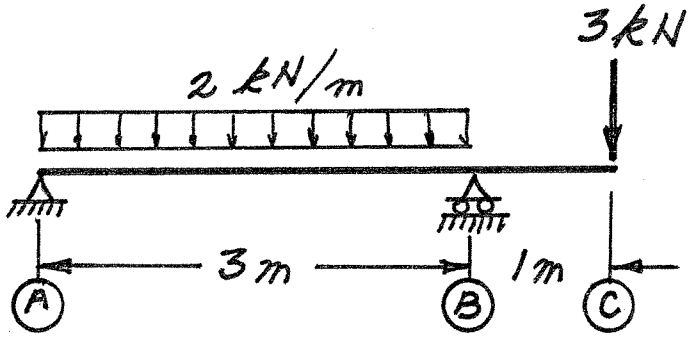


(8) 2. For each frame structure shown below, schematically show the influence line for shear forces immediately left of supports B . Note that structure a) is determinate and b) is indeterminate. Show the value of the ordinate with the maximum absolute value on each influence line.

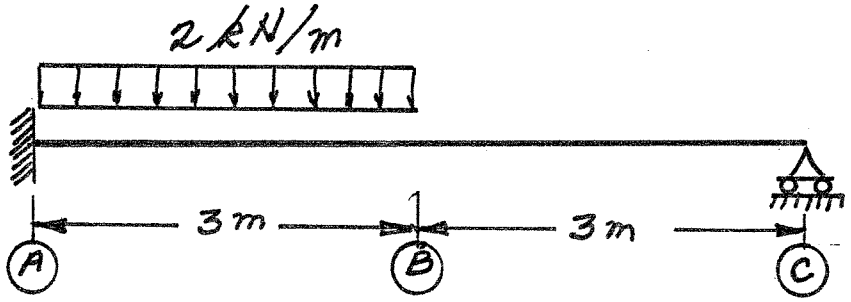


SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS 3, 4, OR 5.

(18) 3. Use Castigliano's theorem to determine the vertical deflection at point C of the beam structure shown. The EI value for both segments of the beam is 250 kN.m^2.

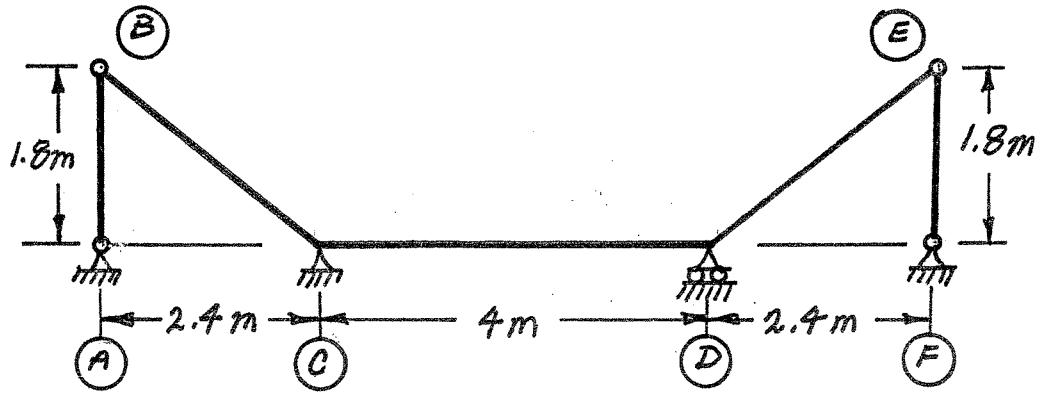


(18) 4. Use Castigliano's theorem (the least work theorem) to analyze the prismatic beam shown. Draw shear force and bending moment diagrams for the beam from A to C. On both diagrams, label the maximum and minimum ordinates (Minimum ordinates are frequently negative.).



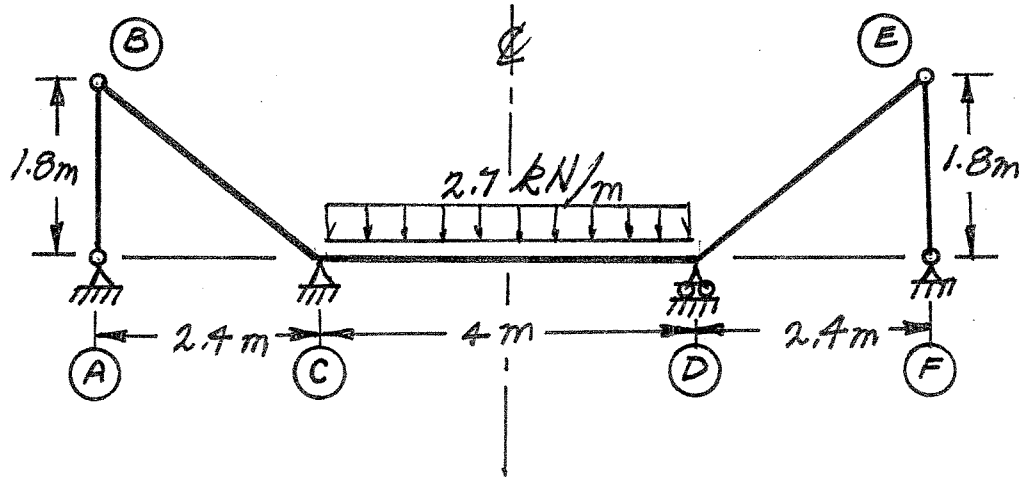
SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS 3, 4, OR 5

(18) 5. Use the slope-defection method or moment-distribution method to analyze the frame structure shown. Draw shear and bending moment diagrams. On both diagrams for each member, indicate the magnitude of maximum and minimum ordinates (Minimum ordinates are frequently negative.). There are no loads on the structure, but the support at (D) settles (moves downward) exactly 6 mm. All members have the same EI value which is 1.8×10^5 kN.m^2 and all members are inextensible.



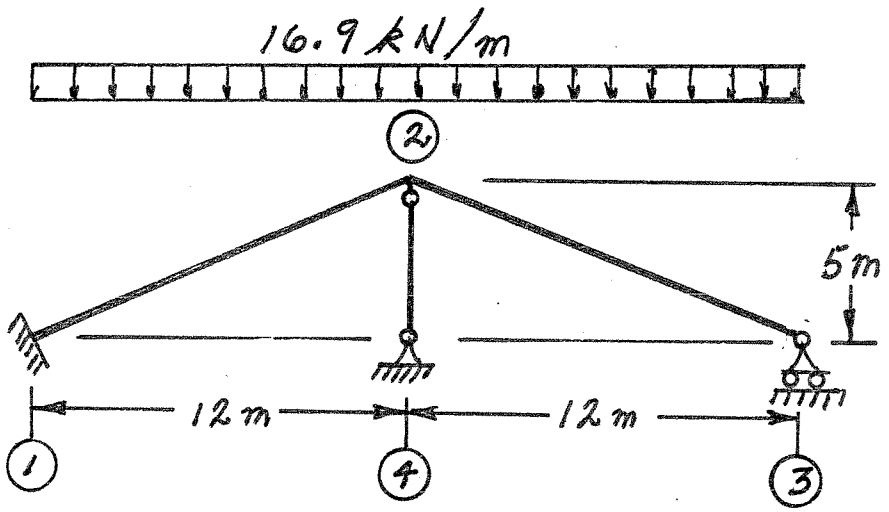
SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS 6, 7, 8 OR 9.

(22) 6. Use any flexibility (force) method, to analyze the frame structure shown. Draw shear and bending moment diagrams. On both diagrams for each member, indicate the magnitude of maximum and minimum ordinates (Minimum ordinates are frequently negative.). All members are inextensible. Taking the forces in members (A)-(B) and (E)-(F) as redundants is suggested. Take advantage of symmetry.



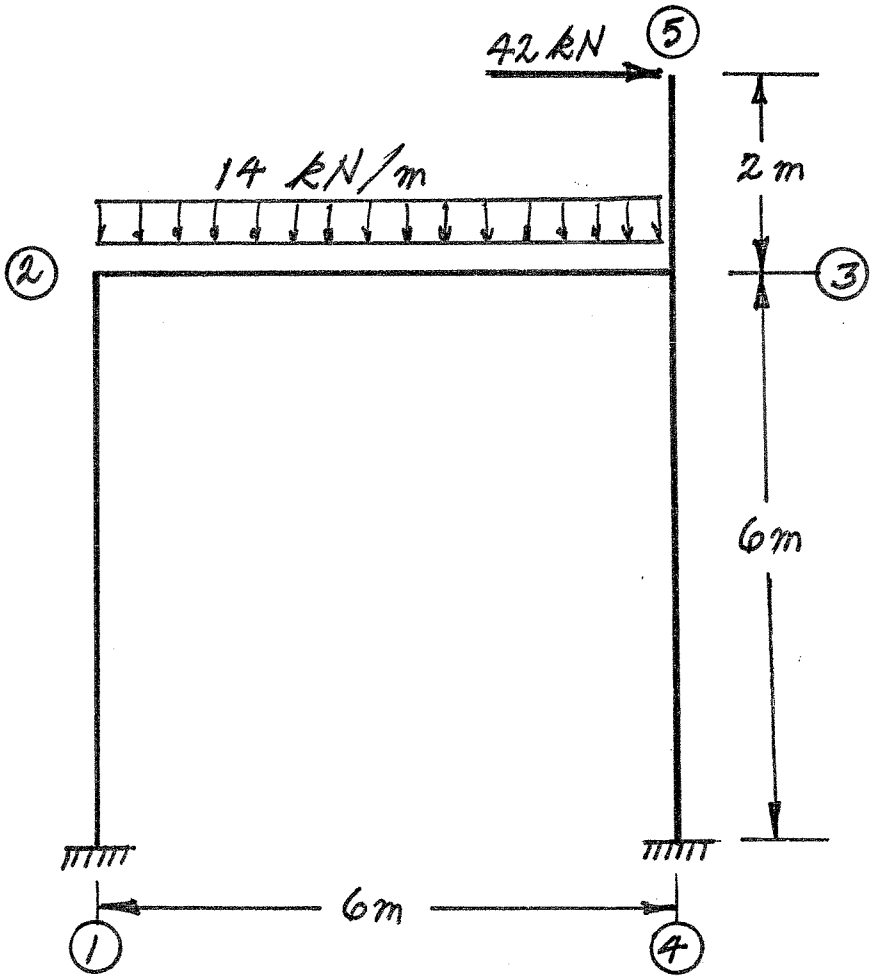
SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS 6, 7, 8 OR 9.

(22) 7. Using the slope-defection method or the moment-distribution method, analyze the structure shown below. In addition to the loading shown on the sketch below, after erection, the support at (4) settles (moves downward) exactly 24 mm. Plot shear force and bending moment diagrams. For each member on each diagram, indicate the magnitude of the maximum and minimum ordinates (Minimum ordinates are frequently negative values.). Both members are inextensible and have the same EI value which is 53300 kN.m^2.



SELECT AND ANSWER TWO QUESTIONS ONLY FROM QUESTIONS 6, 7, 8 OR 9.

(22) 8. Using the slope-defection method, analyze the structure shown. Draw 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 values.). All members have the same EI value and are inextensible. Take advantage of symmetry or anti-symmetry if and when it applies.



SELECT AND ANSWER TWO QUESTIONS ONLY FORM QUESTIONS 6, 7, 8 OR 9.

(22) 9. a) For the frame shown, derive the equilibrium equation for translation at joint (2). Neglect the effects of axial strain. Relative EI values are shown on each member.

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:

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

DO NOT SOLVE THE EQUATIONS.

The unknowns of the problem shall be:

δ = translation at joint (2) (positive in the direction shown)

θ_2 = rotation of joint (2)

θ_3 = rotation of joint (3)

(Both above joint rotations are to be counter clockwise positive.)