BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Spring) Examination 2024: Oct 2024 - Nov 2024

Student Group: Earned Credit Hours>108

Subject: EWCE 411, Structural Analysis and Design I I

Time: 3.00 hours **Full Marks: 180**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 **(Compulsory)**

a. Determine the moments at the supports using direct Stiffness method of the beam shown in Fig 1. Assume EI is constant. **20**

b. Evaluate the stiffness matrix of the beam shown in Fig 2. **10**

Question 2

a. Determine the stiffness matrix of the frame shown in Fig 3. Assume, E = 200 GPa, I = 300×10^6 mm^4 and A = 10×10^3 mm^2 for each member. **15**

b. Determine the support reactions at the supports of the frame shown in Fig 3 using direct stiffness method. **15**

Question 3

a. A truss structure is shown in Fig 4. Determine the stiffness matrix K for the truss if A = 0.75 in^2 and E = 29×10^3 ksi for each member. **15**

b. Determine the horizontal displacement of the joint 1 shown in Fig 4. Also find the force in member 2. Use the same value of A and E given in question 3 (a). **15**

Question 4

a. Mention 5 primary structural members. Differentiate between supports and connections. **10**

b. A cantilever beam is shown in Fig 5. Find an approximate solution of the deflection due to the point load using Rayleigh Ritz Method. **20**

SECTION-B

Question 5 **(Compulsory)**

a. Analyze the beam shown in Fig 6 using moment distribution method and draw the shear force and bending moment diagrams. In addition to the loads shown, the support at B moves up 0.25ft. consider EI = 4500 k-ft^2. **18**

b. Define carryover moment. Show that half of the applied moment will be carried over to the other end provided that the far end is fixed. **12**

Question 6

a. Calculate the support moment at A and horizontal deflection of support C for the frame shown in Fig 7. Consider EI = 3000 k-ft^2 and use moment distribution method. **18**

b. Estimate the member end moments for the beam shown in Fig 8 due to a settlement of 20 mm at support B and 0.05 radian clock-wise rotation at support A. Use moment distribution method. Consider, E = 70 GPa and I = 8×10^8 mm^4. **12**

Question 7

a. Using moment distribution method, estimate the magnitude of force F that will cause 0.1ft vertical deflection of point C of the frame shown in Fig 9. EI = 2500 k-ft^2 **18**

b. For the continuous beam of Fig 10, draw qualitative shape of influence lines for R_B, V_F, V_G, V_{CL}, M_C, and M_G. **12**

Question 8

a. Draw shear force and bending moment diagrams for the beam ABCD of the frame shown in Fig 11. Consider EI constant and use moment distribution method. **18**

b. Estimate the reaction and moment at support A for the non-prismatic beam shown in Fig 12 using moment distribution method. Given, EI = 3000 k-ft^2 **12**

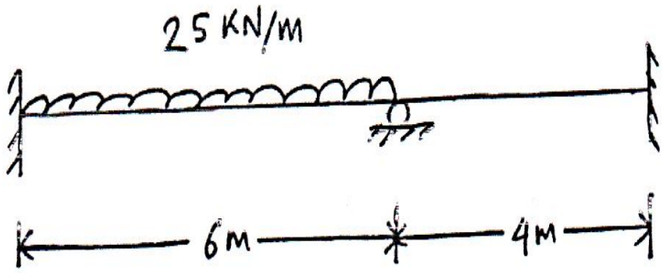


Fig 1 for question 1(a)

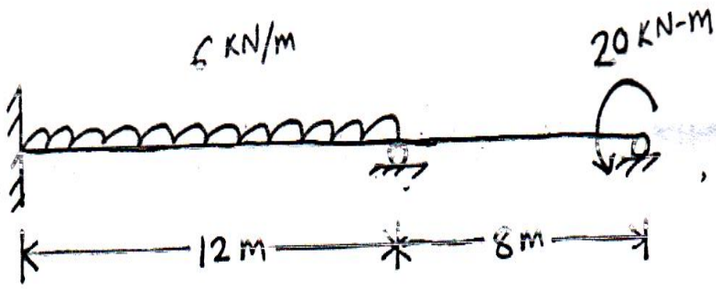


Fig 2 for question 1(b)

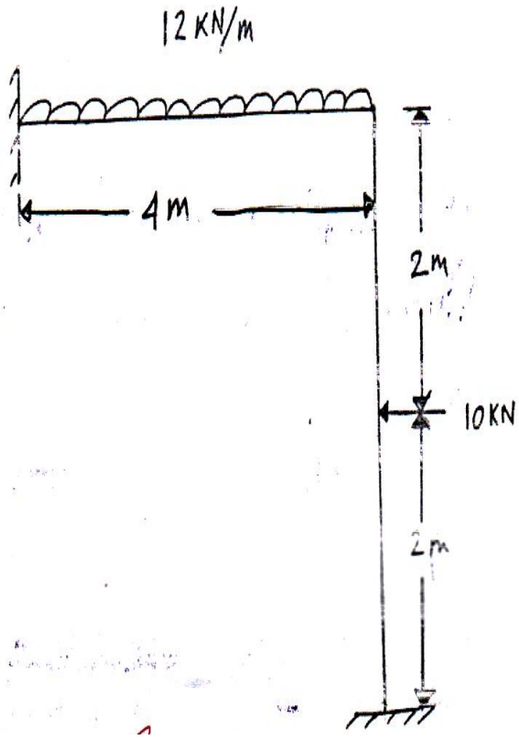


Fig 3 for question 2(a) and (b)

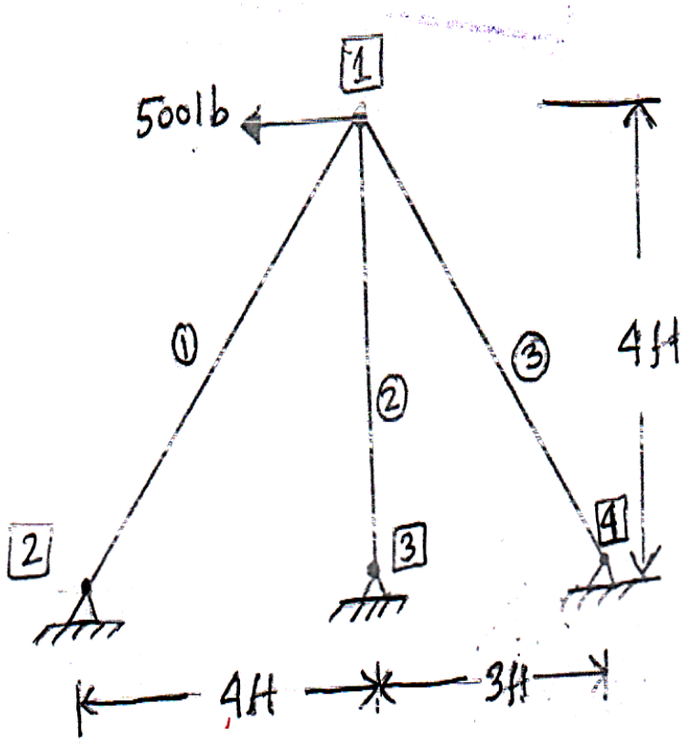


Fig 4 for question 3(a) and (b)

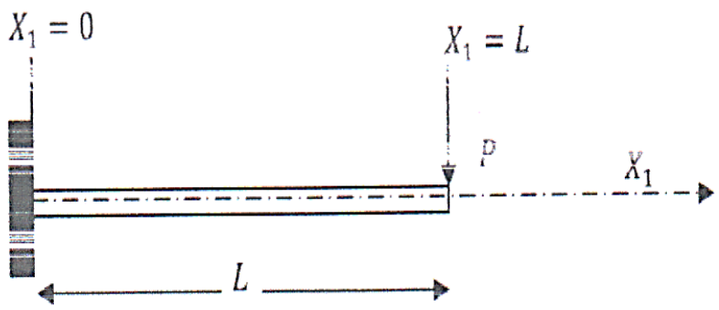


Fig 5 for question 4(b)

$$\mathbf{k} = \frac{AE}{L}\begin{array}{c} \\ N_x \\ N_y \\ F_x \\ F_y \end{array}\begin{array}{c} \begin{array}{cccc} N_x & N_y & F_x & F_y \end{array} \\ \begin{bmatrix} \lambda_x^2 & \lambda_x\lambda_y & -\lambda_x^2 & -\lambda_x\lambda_y \\ \lambda_x\lambda_y & \lambda_y^2 & -\lambda_x\lambda_y & -\lambda_y^2 \\ -\lambda_x^2 & -\lambda_x\lambda_y & \lambda_x^2 & \lambda_x\lambda_y \\ -\lambda_x\lambda_y & -\lambda_y^2 & \lambda_x\lambda_y & \lambda_y^2 \end{bmatrix} \end{array}\begin{array}{c} \\ N_x \\ N_y \\ F_x \\ F_y \end{array}$$

$$\begin{bmatrix} q_{Ny'} \\ q_{Nz'} \\ q_{Fy'} \\ q_{Fz'} \end{bmatrix} = \begin{array}{c} \begin{array}{cccc} N_{y'} & N_{z'} & F_{y'} & F_{z'} \end{array} \\ \begin{bmatrix} \frac{12EI}{L^3} & \frac{6EI}{L^2} & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{4EI}{L} & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ \frac{6EI}{L^2} & \frac{2EI}{L} & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \end{array}\begin{bmatrix} d_{Ny'} \\ d_{Nz'} \\ d_{Fy'} \\ d_{Fz'} \end{bmatrix}$$

$$\begin{bmatrix} q_{Nx'} \\ q_{Ny'} \\ q_{Nz'} \\ q_{Fx'} \\ q_{Fy'} \\ q_{Fz'} \end{bmatrix} = \begin{array}{c} \begin{array}{cccccc} N_{x'} & N_{y'} & N_{z'} & F_{x'} & F_{y'} & F_{z'} \end{array} \\ \begin{bmatrix} \frac{AE}{L} & 0 & 0 & -\frac{AE}{L} & 0 & 0 \\ 0 & \frac{12EI}{L^3} & \frac{6EI}{L^2} & 0 & -\frac{12EI}{L^3} & \frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{4EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{2EI}{L} \\ -\frac{AE}{L} & 0 & 0 & \frac{AE}{L} & 0 & 0 \\ 0 & -\frac{12EI}{L^3} & -\frac{6EI}{L^2} & 0 & \frac{12EI}{L^3} & -\frac{6EI}{L^2} \\ 0 & \frac{6EI}{L^2} & \frac{2EI}{L} & 0 & -\frac{6EI}{L^2} & \frac{4EI}{L} \end{bmatrix} \end{array}\begin{bmatrix} d_{Nx'} \\ d_{Ny'} \\ d_{Nz'} \\ d_{Fx'} \\ d_{Fy'} \\ d_{Fz'} \end{bmatrix}$$

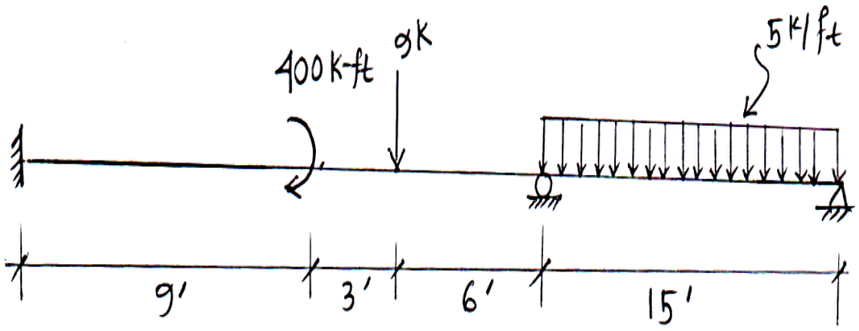


Fig. 6 for question 5(a)

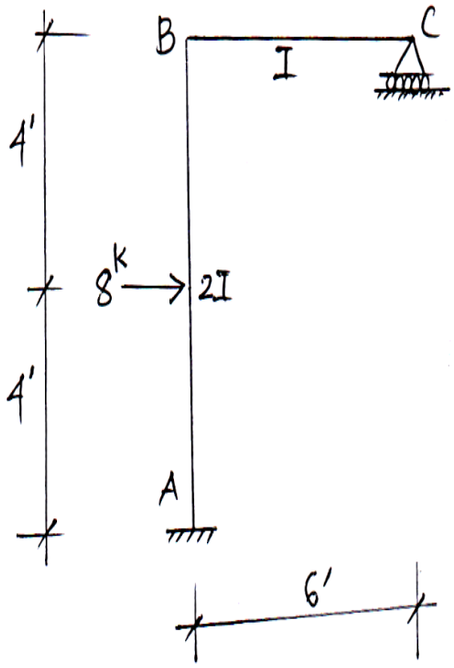


Fig. 7 for question 6(a)

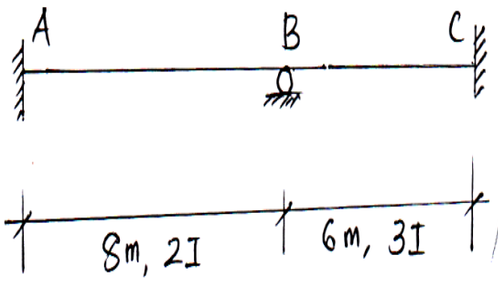


Fig. 8 for question 6(b)

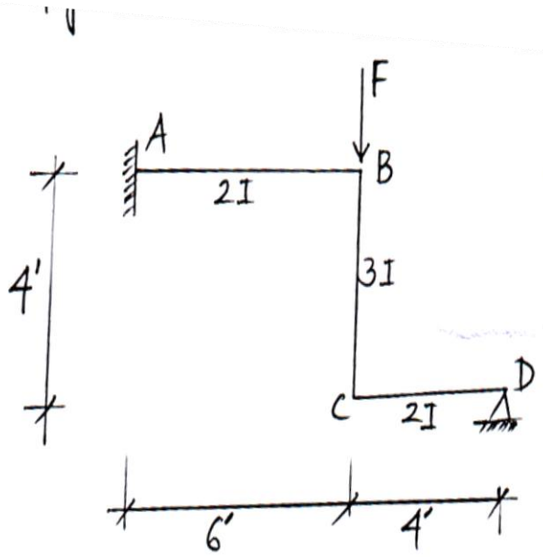


Fig. 9 for question 7(a)

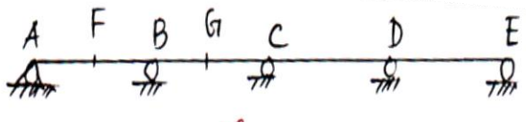


Fig. 10 for question 7(b)

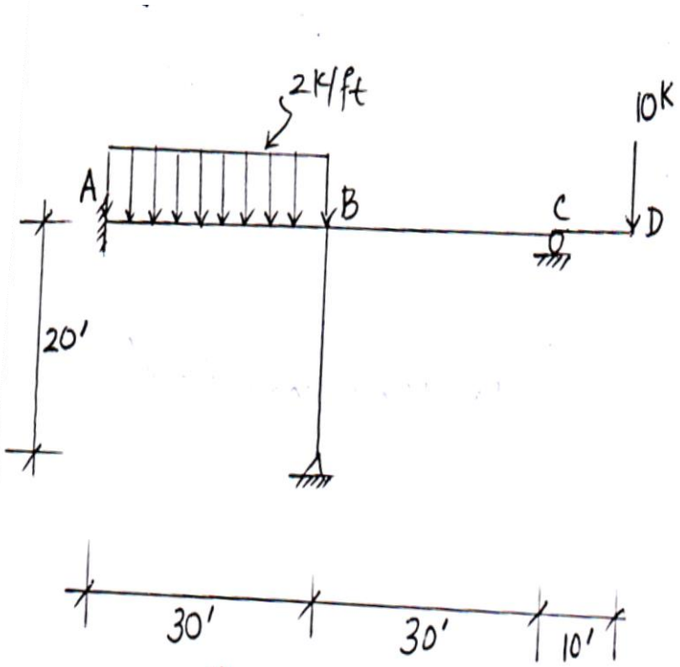


Fig. 11 for question 8(a)

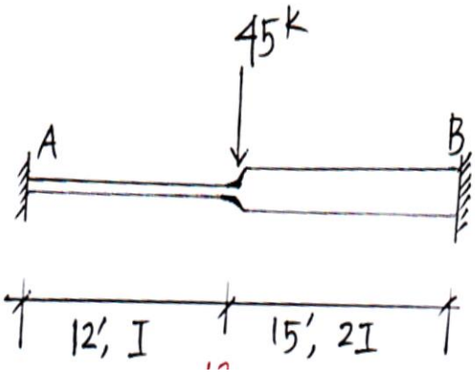


Fig. 12 for question 8(b)