**BANGLADESH UNIVERSITY OF PROFESSIONALS**
**Military Institute of Science and Technology**
**B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Spring) Examination 2025: Oct - Nov 2025**

**Student Group: 72<Earned Credit Hours ≤ 108**

**Subject: EWCE 311, Structure Analysis and Design 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.

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## SECTION-A

**Question 1 (Compulsory)**

a. State the main differences between truss and frame; arch and suspension cable. Also identify the application of each of these in the application of real life structure construction purposes. **10**

b. Write down the conditions for unstable structures with the sketch and also state the difference between semi-rigid, rigid and roller joints with examples in terms of structural analysis purposes. **10**

c. Analyze the following truss member shown in Figure 1 and calculate all the member forces in EF, FI and HI. Also identify the zero member forces in the truss in Figure 1. Consider, P = 100 kN. **10**

**Question 2**

a. For the beam shown in Figure 2, draw the quantitative influence lines for (i) $R_B$ , $R_D$ ; (ii) $V_{BL}$,$V_{DL}$, $V_C$ ; (iii) $M_B$, $M_C$. **15**

b. Calculate the maximum shear at Point C for the given beam, when it is loaded with a series of concentrated moving loads (wheels) as shown in Figure 3. The loads are moving from right to left of the beam. **15**

**Question 3**

a. A cable structure supported by frictionless roller which is located on top of tower shown in Figure 4. Determine the maximum and minimum tensile force exerted by the cable and the vertical reaction force exerted by tower at A and B. **15**

b. For the arch shown in Figure 5, calculate the support reactions and also determine the internal forces at point E. **15**

**Question 4**

a. Derive the equation of a parabolic arch upon calculation of it's slope/tangential angle. **15**

b. Draw a frame of ABCD and plot the IL (Influence line) for reactions at both supports A and D; IL for shear and moment at mid point of beam portion BC; if the unit load moves over the beam portion BC and if it moves over the column portion AB. **15**

## SECTION-B

**Question 5 (Compulsory)**

a. Compute vertical distribution of earthquake force for a 30 m high 10 storied hospital building with equal storey height for Dhaka City. The structural system will be special moment resisting frame in concrete (R = 8). The building will be 30 m × 30 m in plan. Use equivalent static method as per BNBC-2020. **18**

Given data:
Dead load = 9 kN/m$^2$ for each floor,
Partition Wall load = 2.5 kN/m$^2$ for each floor,
Live load = 4 kN/m$^2$ for each floor.
Z = 0.20, I = 1.5, site class SD, $C_t$ = 0.0466, m = 0.9.
Notations convey usual meanings and figures are given in Annex A.

b. Using the method of strain energy, determine the horizontal deflection at point C shown in Figure 6. Given, E = 200 GPa, A = 1500 mm$^2$. **12**

**Question 6**

a. Using the approximate method, draw bending moment diagrams for all the beams and columns. Also calculate the axial force in all the columns at the GF (Ground Floor). The building frame is shown in Figure 7 carries a uniform vertical load of 6 k/ft on each girder. Columns are of constant cross section over its height. **15**

b. Using the portal method, draw bending moment and shear force diagrams for the beam ABCD and the column PBQ shown in Figure 8. **15**

**Question 7**

a. Using the cantilever method draw shear force and bending moment diagrams for the girder ABC and column PAR of the building frame in Figure 9. Also draw the axial force diagram for the column PAR. Cross sectional area of the columns are shown by side of the columns. **15**

b. Sketch shear force and bending moment diagrams for the column PQR of the Mill bent shown in Figure 10 and find bar force in the knee braces QS and MN. **15**

**Question 8**

a. Determine the forces in the bars EF, ED, FG, GH and DC of the structure shown in Figure 11. Use approximate method of analysis. **15**

b. Compute vertical deflection and slope at 'B' of the beams shown in Figure 12 using the method of virtual work. **15**
Given, I = 600 in$^4$ and E = 30 × 10$^3$ ksi.

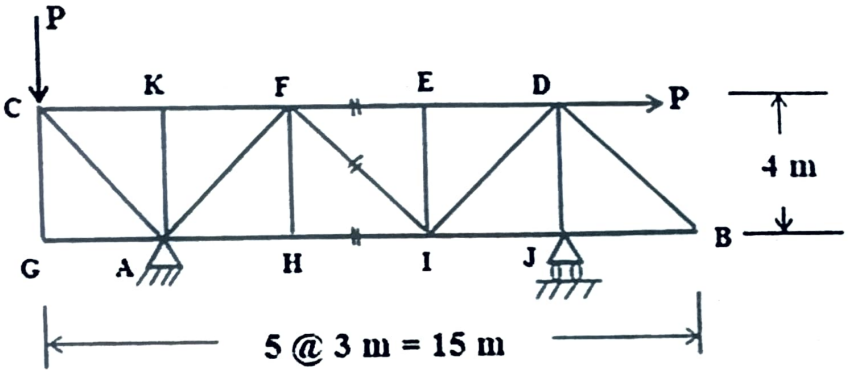



**Figure 1 for Question 1 (c)**

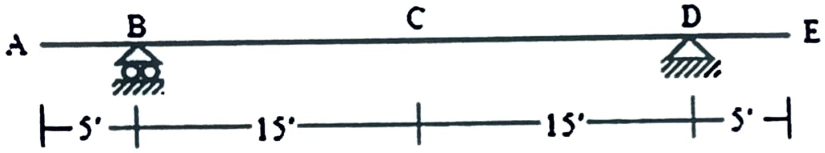



**Figure 2 for Question 2 (a)**

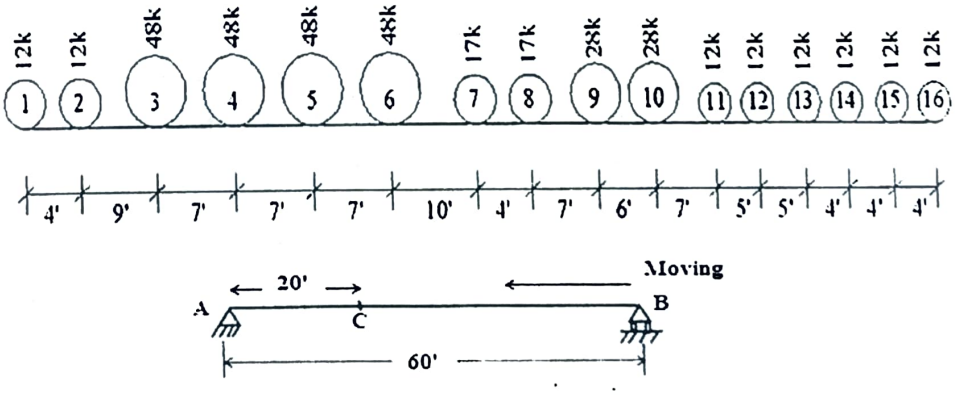



**Figure 3 for Question 2 (b)**

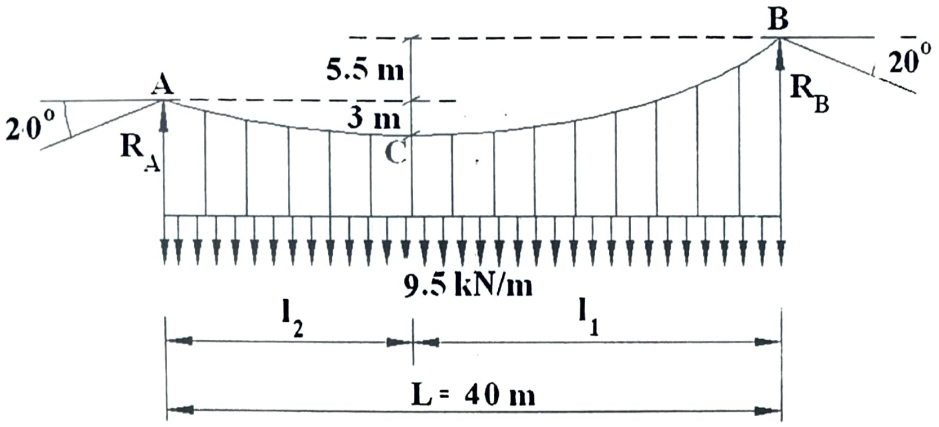



**Figure 4 for Question 3 (a)**

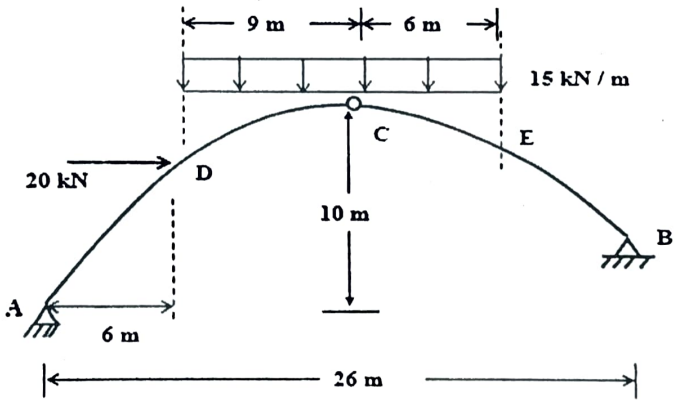



**Figure 5 for Question 3 (b)**

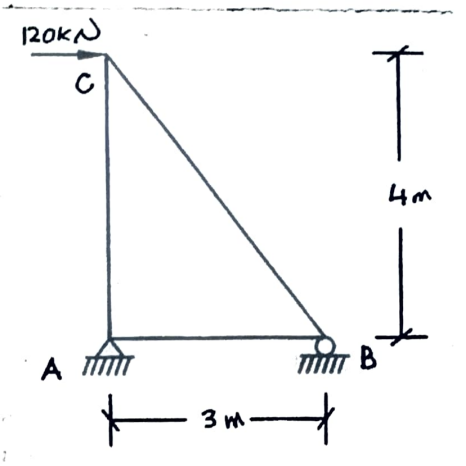



**Figure 6 for Question 5 (b)**

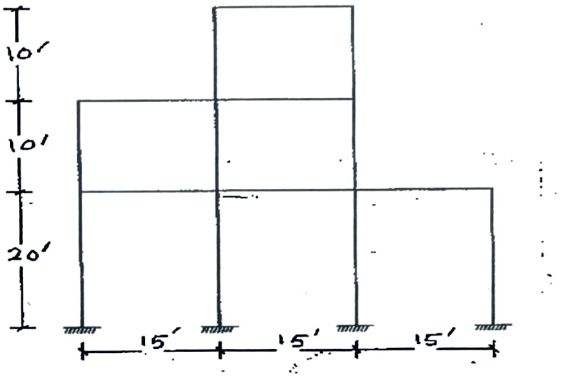



**Figure 7 for Question 6 (a)**

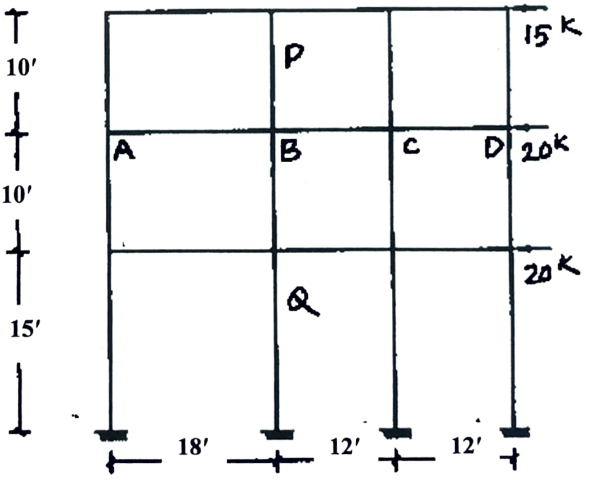



**Figure 8 for Question 6 (b)**

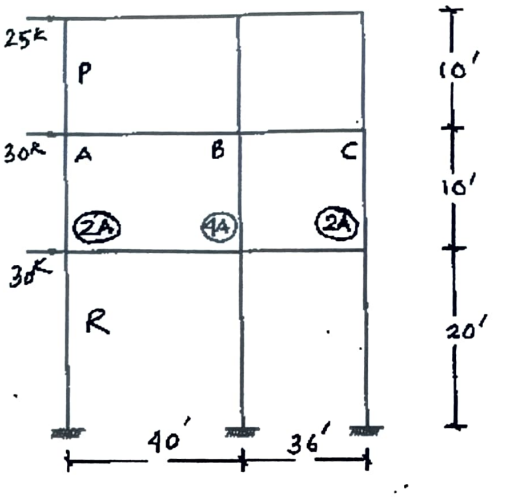



**Figure 9 for Question 7 (a)**

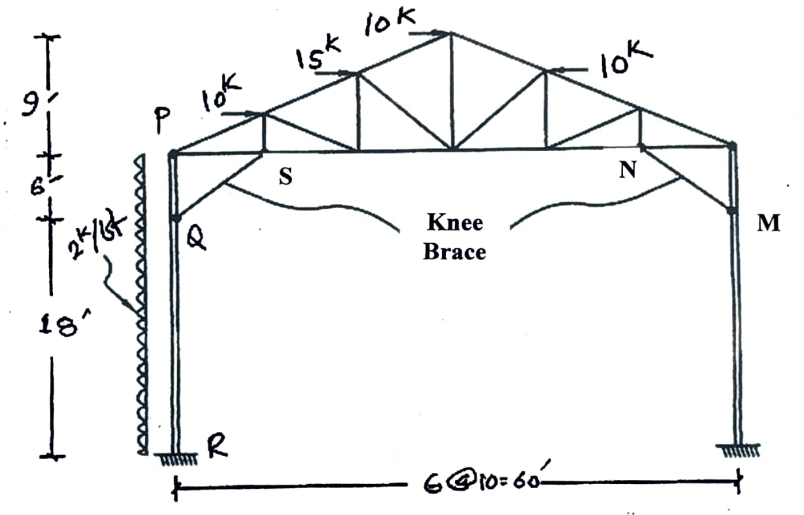



**Figure 10 for Question 7 (b)**

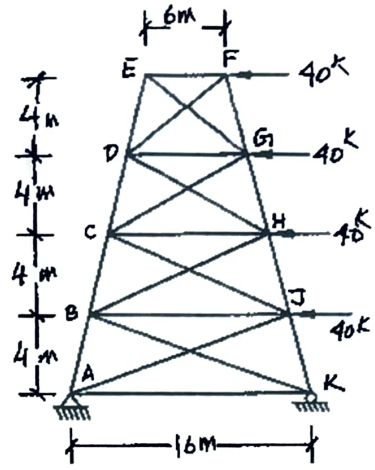



**Figure 11 for Question 8 (a)**

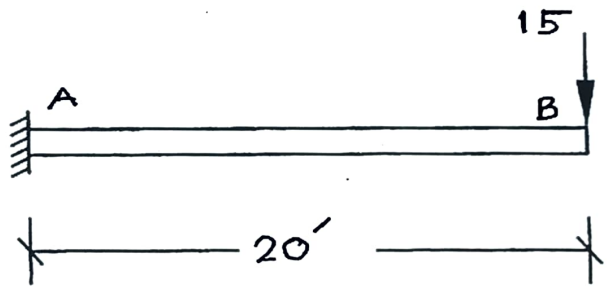



**Figure 12 for Question 8 (b)**

## ANNEX A

**Table: Site Dependent Soil Factor and Other Parameters Defining Elastic Response Spectrum**

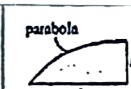
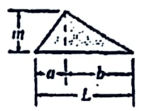
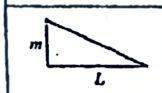
| Soil type | $S$ | $T_B$(s) | $T_C$(s) | $T_D$(s) |
|---|---|---|---|---|
| SA | 1.0 | 0.15 | 0.40 | 2.0 |
| SB | 1.2 | 0.15 | 0.50 | 2.0 |
| SC | 1.15 | 0.20 | 0.60 | 2.0 |
| SD | 1.35 | 0.20 | 0.80 | 2.0 |
| SE | 1.4 | 0.15 | 0.50 | 2.0 |

$$C_S = S\left(1 + \frac{T}{T_B}(2.5\eta - 1)\right) \quad \text{for} \quad 0 \le T \le T_B$$

$$C_S = 2.5S\eta \quad \text{for} \quad T_B \le T \le T_C$$

$$C_S = 2.5S\eta\left(\frac{T_C}{T}\right) \quad \text{for} \quad T_C \le T \le T_D$$

$$C_S = 2.5S\eta\left(\frac{T_C T_D}{T^2}\right) \quad \text{for} \quad T_D \le T \le 4\ sec$$

| $\int_0^L m\,m'\,dx$ |  |  |  |  |
|---|---|---|---|---|
|  | $mm'L$ | $\frac{1}{2}mm'L$ | $\frac{1}{2}m(m_1' + m_2')L$ | $\frac{2}{3}mm'L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{3}mm'L$ | $\frac{1}{6}m(m_1' + 2m_2')L$ | $\frac{5}{12}mm'L$ |
|  | $\frac{1}{2}m'(m_1 + m_2)L$ | $\frac{1}{6}m'(m_1 + 2m_2)L$ | $\frac{1}{6}[m_1'(2m_1 + m_2) + m_2'(m_1 + 2m_2)]L$ | $\frac{1}{12}[m'(3m_1 + 5m_2)]L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{6}mm'(L + a)$ | $\frac{1}{6}m[m_1'(L + b) + m_2'(L + a)]$ | $\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{6}mm'L$ | $\frac{1}{6}m(2m_1' + m_2')L$ | $\frac{1}{4}mm'L$ |