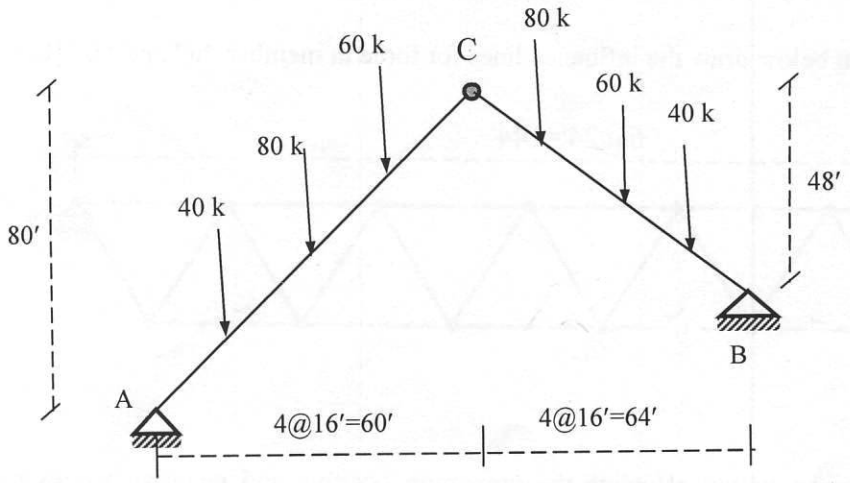
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring2012
Program: B.Sc. Engineering (Civil)

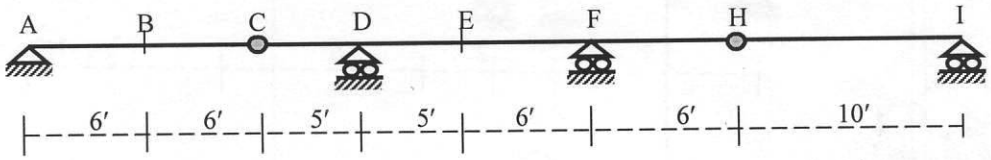
Course Title: Structural Engineering I — Time: 3.0 hours
Course Code: CE 311 (Y) Credit: 3.00 — Full Marks:**100**(=10×10)

[Answer any 10 (Ten) of the following 14 questions]

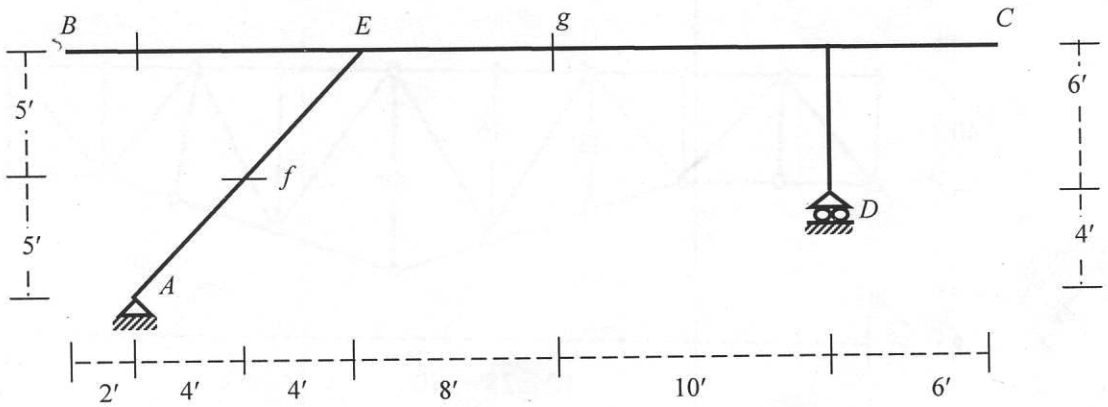
1. Draw the shear force and bending moment diagram of the frame shown below.



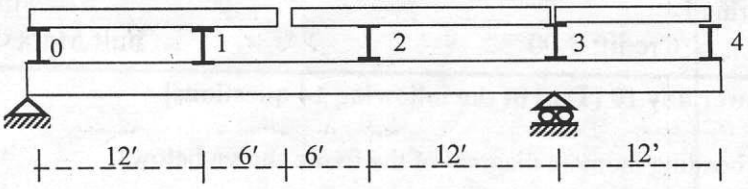
2. Draw the influence lines of V_E, V_{DL}, M_F, M_B and R_F for the beam shown below [C and H are internal hinges].



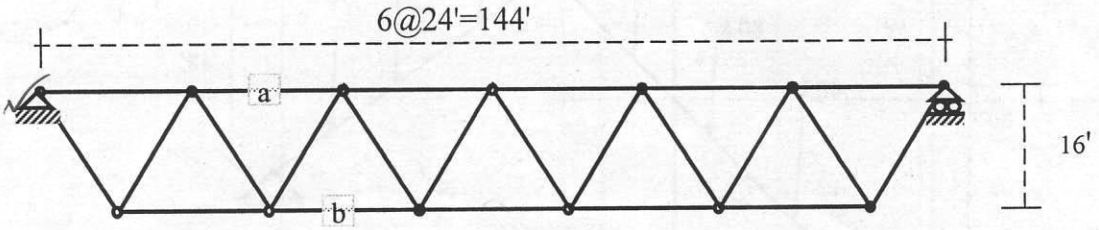
3. Draw the influence lines of V_g and M_f for the frame shown below if the unit load moves over beam *BC*.



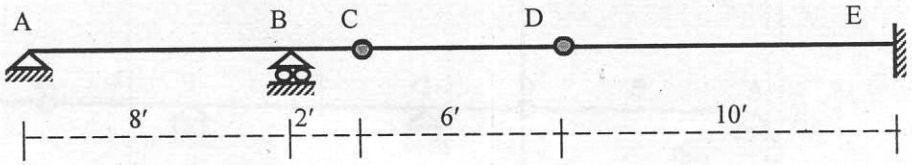
4. For the plate girder shown below, draw the influence lines of $V_{2\text{-}3}$ and M_2.



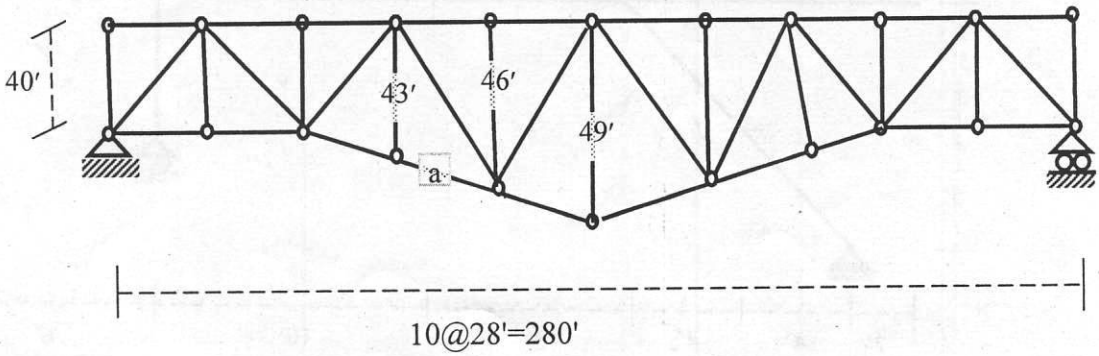
5. For the truss shown below draw the influence lines for force in member **"a"** and **"b"** [Load is moving over top cord].



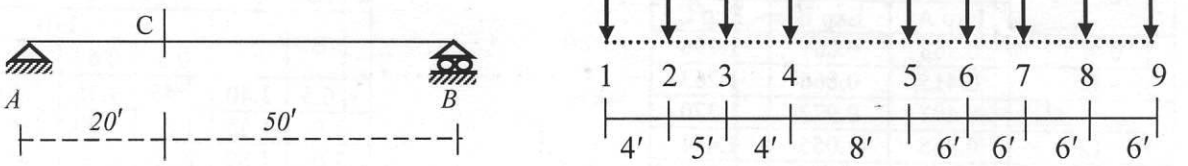
6. For the beam shown below calculate the maximum positive and negative values of reaction at support B and moment at B for a uniformly distributed dead load of 2 k/ft , moving uniformly distributed live load of 3 k/ft and a moving concentrated load of 15 k [C and D are internal hinges].



7. Calculate the maximum tensile /compressive force in member **"a"** of the truss shown below for a uniformly distributed dead load of 5 k/ft, moving uniformly distributed live load of 6 k/ft and a moving concentrated load of 60k.

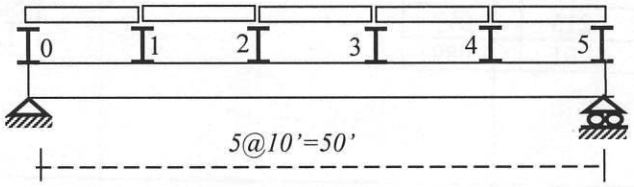


8. For the beam shown below calculate the maximum (+ ve) shear at C due to the moving wheel loads (right ⟶ left).



9. For the truss shown in Question-5 calculate the maximum tensile /compressive force in member **"b"** due to the moving loads (right⟶ left) shown in Question-8.

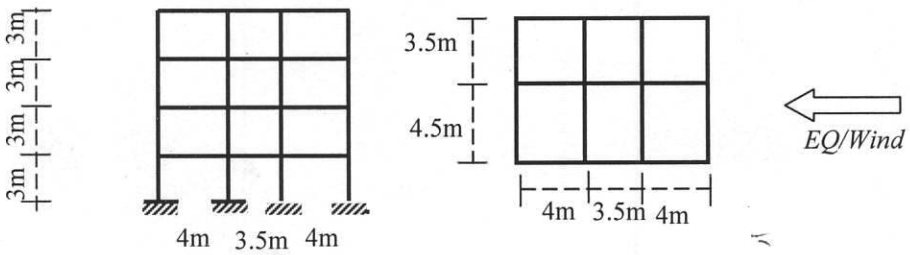
10. For the plate girder shown below calculate the maximum positive shear force of panel 1-2 due to the moving loads (right⟶ left) shown in Question-8.



11. For the plate girder shown in Question-10 calculate the maximum M_2 due to the moving loads (left ⟶ right) shown in Question-8.

12. Develop the criterion (with net sketch) for which greatest maximum moment in a beam will occur under any load.

13. Use the Equivalent Static Force Method to calculate the seismic load at each story of the four-storied residential building (RCC) shown below located in Dhaka. Assume the structure to be a Special Moment Resisting Frame (SMRF) built on stiff soil and also assume each floor carries 150 psf D.L and 85 psf L.L. Use Annexure-1.



Side Elevation Plan

14. For the residential building located in Dhaka shown in Question-13 calculate the wind load at each floor. Assume Exposure-B, velocity 210 km/hr. Use Annexure-1.

Annexure-1

Height z (m)	C_z		
	Exp A	Exp B	Exp C
0~4.5	0.368	0.801	1.196
6	0.415	0.866	1.263
9	0.497	0.972	1.370
12	0.565	1.055	1.451
15	0.624	1.125	1.517
18	0.677	1.185	1.573
Height z (m)	C_G (for non-slender structures)		
	Exp A	Exp B	Exp C
0~4.5	1.654	1.321	1.154
6	1.592	1.294	1.140
9	1.511	1.258	1.121
12	1.457	1.233	1.107
15	1.418	1.215	1.097
18	1.388	1.201	1.089

C_p						
h/B	L/B					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤ 0.5	1.40	1.45	1.55	1.40	1.15	1.10
1.0	1.55	1.85	2.00	1.70	1.30	1.15
2.0	1.80	2.25	2.55	2.00	1.40	1.20
≥ 4.0	1.95	2.50	2.80	2.20	1.60	1.25

Category	C_I
Essential facilities	1.25
Hazardous facilities	1.25
Special occupancy	1.00
Standard occupancy	1.00
Low-risk structure	0.80

Site Soil Characteristics		Coefficient, S
Type	Description	
S_1	A soil profile with either: A rock–like material characterized by a shear–wave velocity greater than 762 m/s or by other suitable means of classification, or Stiff or dense soil condition where the soil depth exceeds 61 meters	1.0
S_2	A soil profile with dense or stiff soil conditions, where the soil depth exceeds 61 meters	1.2
S_3	A soil profile 21 meters or more in depth and containing more than 6 meters of soft to medium stiff clay but not more than 12 meters of soft clay	1.5
S_4	A soil profile containing more than 12 meters of soft clay characterized by a shear wave velocity less than 152 m/s	2.0

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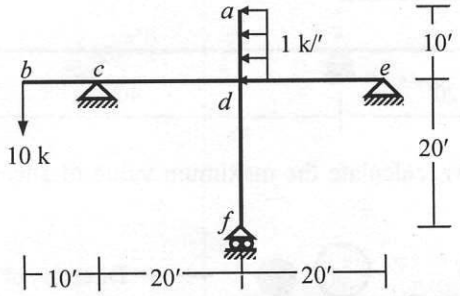
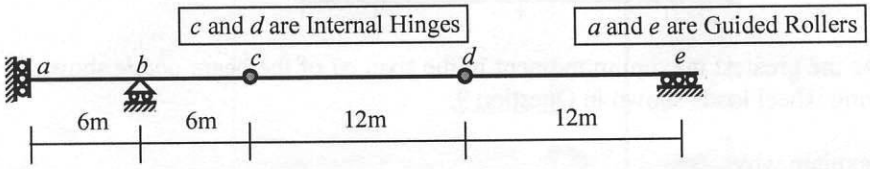
Time: 3 hours | Full Marks: 100 (= 10 × 10)

[Answer **any 10 (ten)** of the following 14 questions]

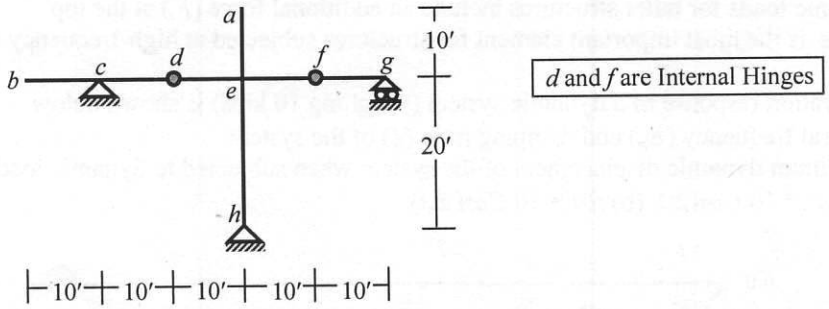
1. Determine the degree of statical indeterminacy (dosi) of the frame *abcdef* shown below. Also draw the Shear Force and Bending Moment diagrams of the frame, assuming (i) no vertical reaction at support *e*, and (ii) equal horizontal reaction at supports *c* and *e*.



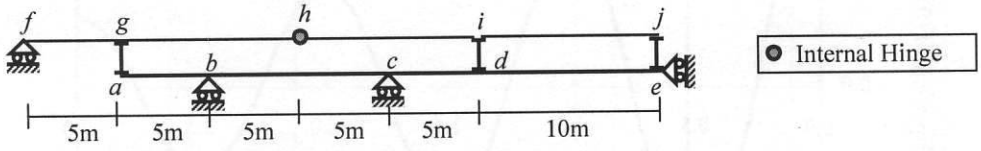
2. Determine the degree of statical indeterminacy (dosi) of the beam *abcde* shown below. Also draw the influence lines of (i) R_b, R_e, (ii) $V_{b(Right)}$, V_c, (iii) M_b and M_e.



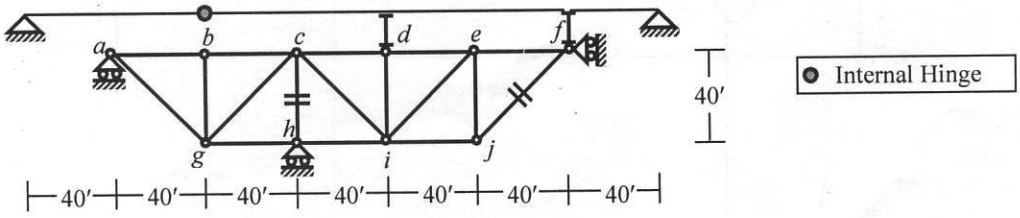
3. Determine the degree of statical indeterminacy (dosi) of the frame shown below and draw influence lines of support reactions X_c, X_h, Y_h, if unit load moves over (i) beam *bg* and (ii) column *ah*.



4. Draw the influence lines of R_b, $V_{b(Right)}$, $V_{c(Left)}$ and M_c for the plate girder *abcde* shown below, if unit load moves over the stringers at the top.



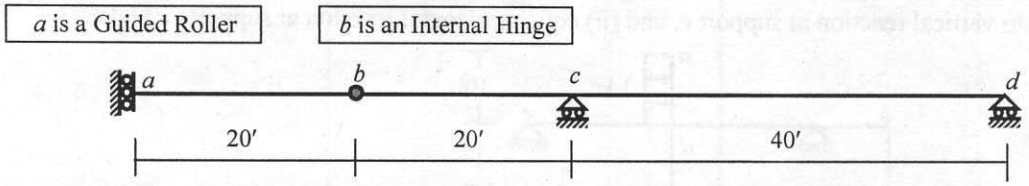
5. Draw the influence lines of the support reaction at *a* and forces in members *fj* and *ch* for the truss shown below, if unit load moves over the stringers at the top.



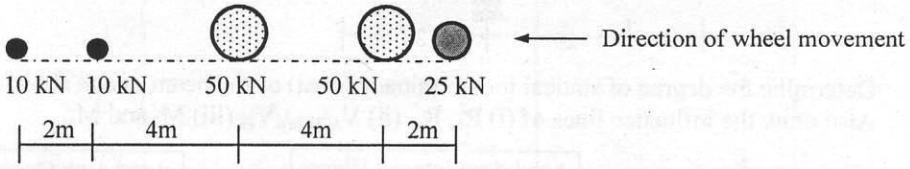
6. Calculate the maximum positive and negative values of V_d and M_a for the beam *abcde* shown in Question 2, for a uniformly distributed dead load of 10 kN/m, a moving uniformly distributed live load of 5 kN/m and a moving concentrated live load of 60 kN.

7. Calculate the maximum tensile and compressive force in member *id* and *ef* for the truss *abcdefghij* shown in Question 5, for a uniformly distributed dead load of 1 k/ft, a moving uniformly distributed live load of 0.5 k/ft and a moving concentrated live load of 10 k.

8. Draw the design shear force diagram of the beam *abcd* shown below [based on influence lines of shear forces at support *d* and the right of support *c*] for a uniformly distributed dead load of 1 k/ft and a moving uniformly distributed live load of 0.5 k/ft.



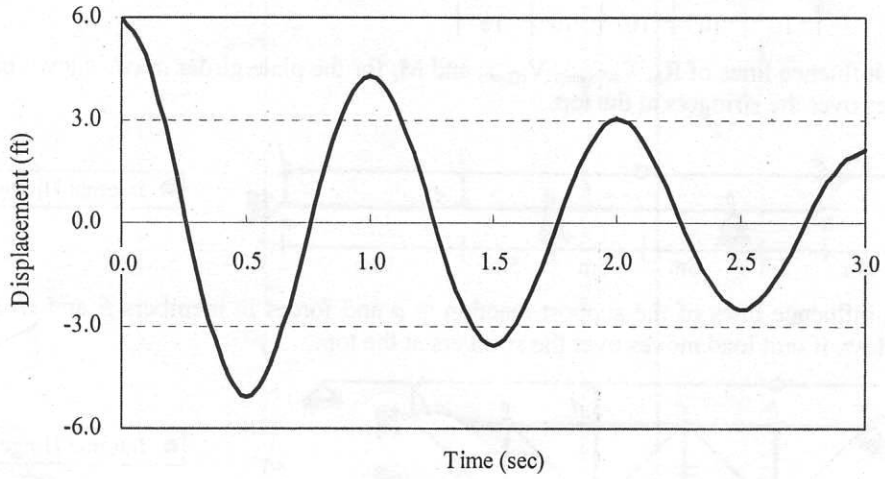
9. For the moving wheel loads shown below, calculate the maximum value of shear force at *h* in the plate girder shown in Question 4.



10. Calculate the greatest maximum moment in the span *cd* of the beam *abcde* shown in Question 2, for the moving wheel loads shown in Question 9.

11. Briefly explain why
    (i) trusses with very small angle of inclination (α) are not recommended against wind loads
    (ii) seismic loads are reduced for larger values of Response Modification Coefficient (R)
    (iii) seismic loads for taller structures include an additional force (F_t) at the top
    (iv) mass is the most important element for structures subjected at high-frequency dynamic loads.

12. Free vibration response of a dynamic system (weighing 10 kips) is shown below. Calculate the
    (i) natural frequency (ω_n) and damping ratio (ξ) of the system
    (ii) maximum dynamic displacement of the system when subjected to dynamic loads
    (a) $f(t) = 10\ Cos(2t)$, (b) $f(t) = 10\ Cos(\omega_n t)$.

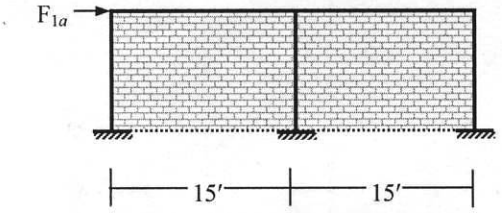


13. Figure below shows wind flowing in a particular direction and applying pressure on 1-storied residential Building *a* and 2-storied residential Building *b*.

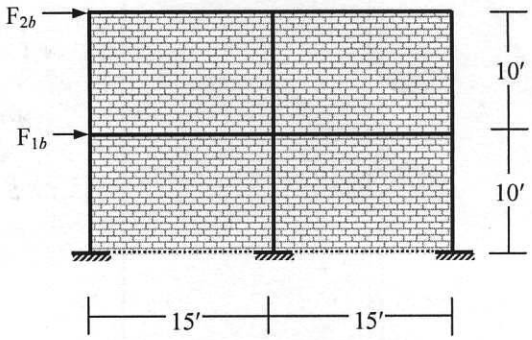
If both buildings are designed for Exposure C at the same location and flat terrain and the design wind force (F_{1a}) on Building *a* is 10 kips, calculate the

(i) basic wind velocity,

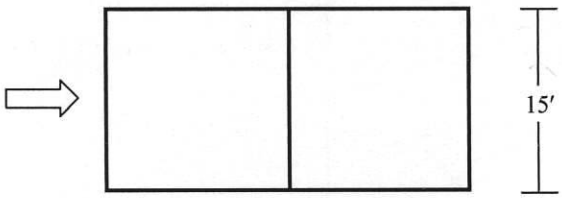
(ii) design wind forces F_{1b} and F_{2b} on Building *b*.



Side Elevation of Building *a*



Side Elevation of Building *b*



Plan View of both buildings

14. The residential RC buildings (*a* and *b*) described in Question 13 carry design dead loads of 100 lb per ft^2 and live loads of 40 lb per ft^2 of floor area.

If both buildings are designed as Ordinary Moment Resisting Frame (*OMRF*) at the same location on very soft soil and the design earthquake force (F_{1a}) on Building *a* is 5 kips, calculate the

(i) seismic zone coefficient (*Z*),

(ii) design earthquake forces F_{1b} and F_{2b} on Building *b*.

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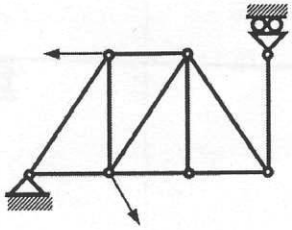
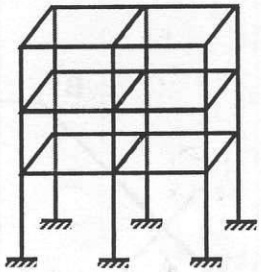
Course Title: Structural Engineering I — Course Code: CE 311
Time: 3 hours — Full Marks: 100(=10 x 10)

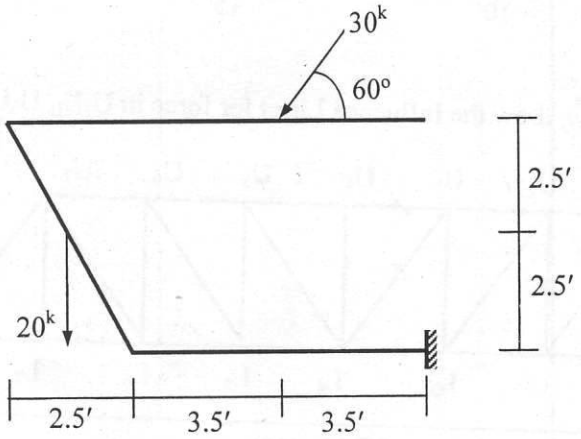
[Answer **any 10 (ten)** of the following 14 questions]

1. Determine the degree of statical indeterminacy (DOSI) of the truss and frame structure shown in the following figure.

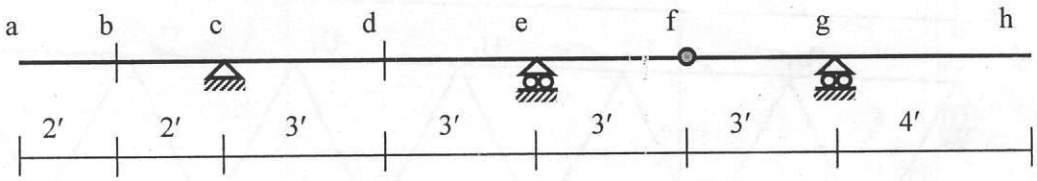




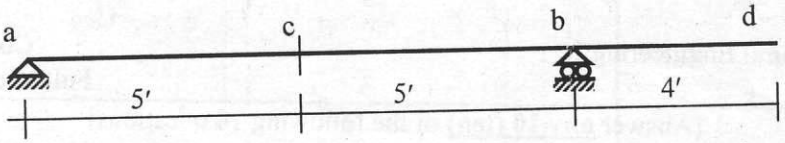
2. Draw the Axial Force Diagram (AFD), Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) of the frame structure shown below.



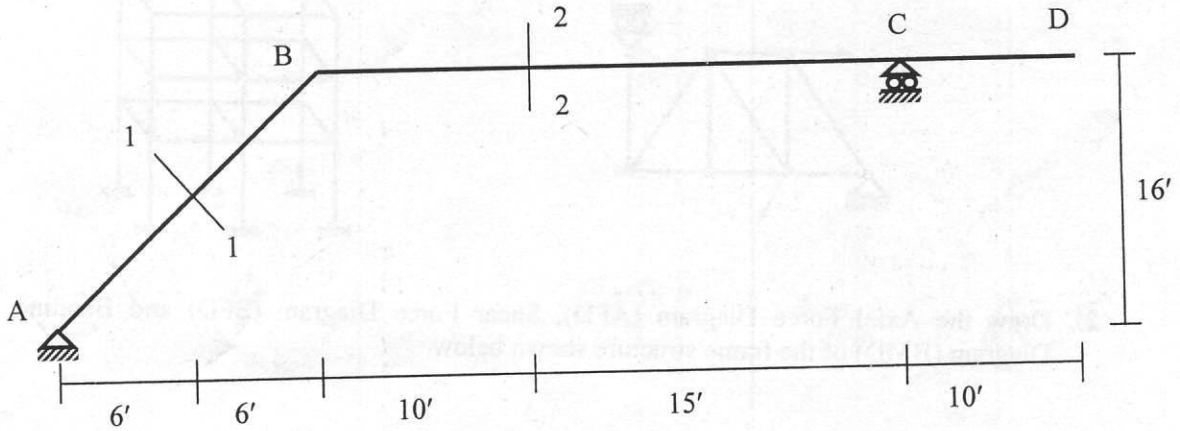
3. Draw the Influence Lines of (i)R_c , R_e(ii)V_b , V_d(iii)M_b , M_d for the beam shown in the following figure.



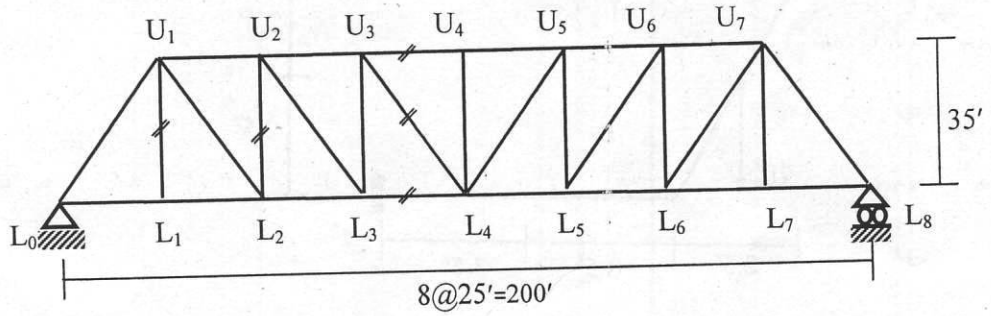
4. For the beam shown in the following figure, calculate the maximum live load shear and moment at section c for a moving uniformly distributed live load of 0.5 kip/ft and a moving concentrated load of 15 kip.



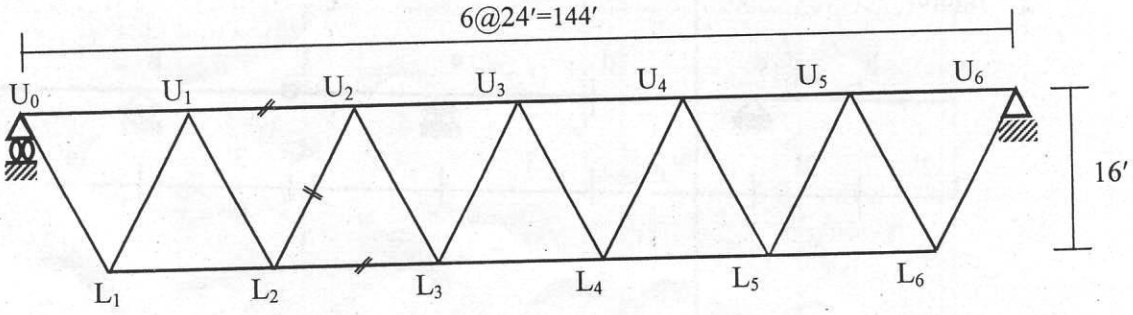
5. Draw the Influence Lines of (i)V_1 , V_2 (ii) M_1 , M_2 for the frame shown in the following figure considering live load movement from point B to point D.



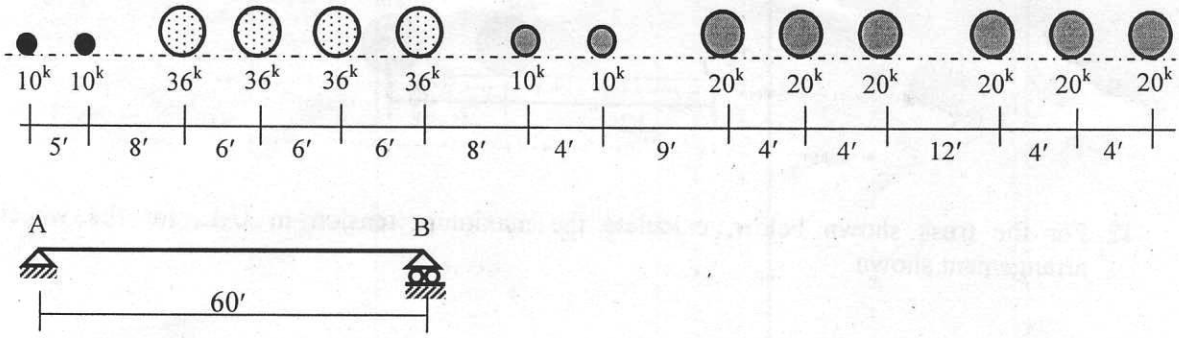
6. For the truss shown below, draw the Influence Lines for force in U_1L_1, U_3U_4, L_3L_4, U_3L_4, U_2L_2.



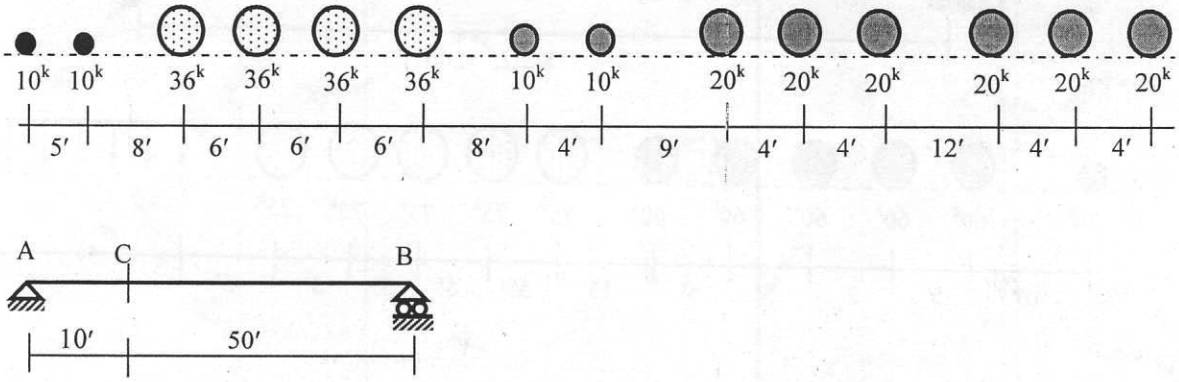
7. For the truss shown below, draw the Influence Lines for force in L_2L_3, L_2U_2, U_1U_2.



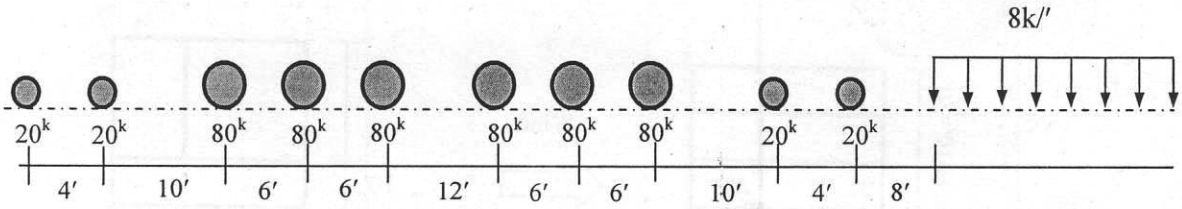
8. Calculate the maximum value of R_A for the beam AB for the wheel load arrangement shown in the following figure.



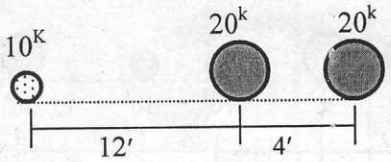
9. Calculate the maximum value of V_C for the beam AB for the wheel load arrangement shown in the following figure.



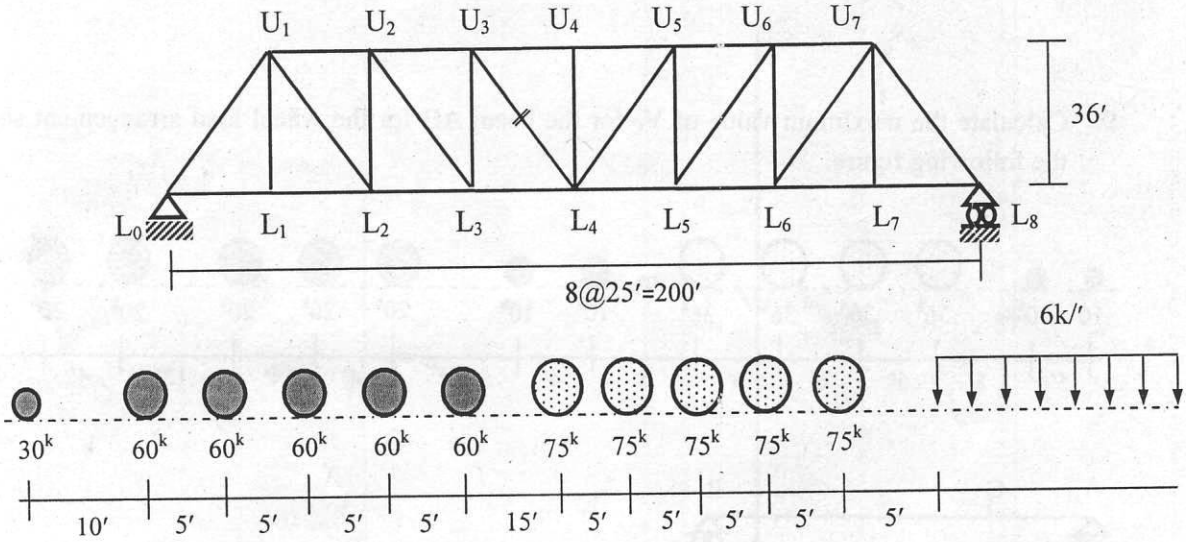
10. Due to the wheel load shown below, calculate the maximum moment at the quarter point of a simply supported span of 80′.



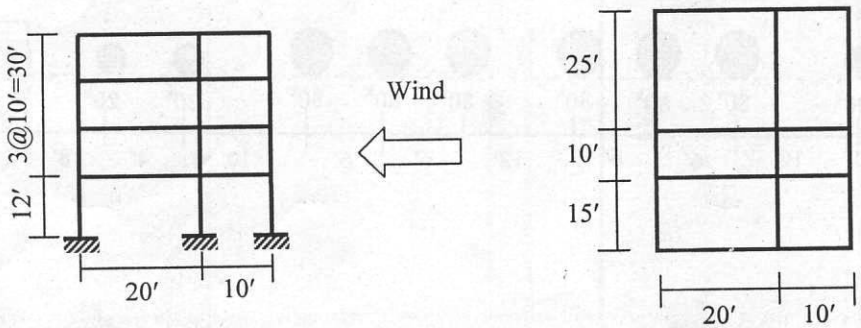
11. Calculate the absolute maximum moment on a span of 24′ for the wheel load arrangement shown in the following figure.



12. For the truss shown below, calculate the maximum tension in U_3L_4 for the wheel load arrangement shown.



13. Calculate the wind load at each storey of a four-storied low-risk-structure type building (shown in the following figure) located at a flat terrain in Rajshahi. Assume the structure to be subjected to Exposure C. (Necessary charts are attached with the question paper).



Side Elevation

Plan View