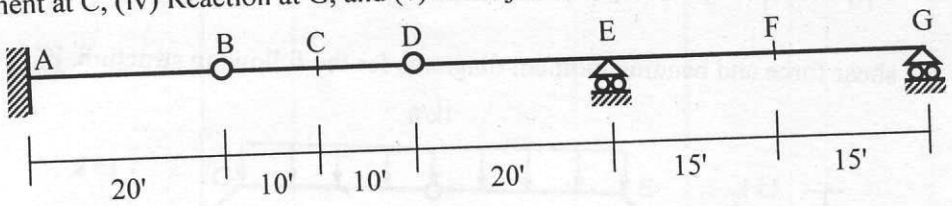
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2013
Program: B.Sc Engineering (Civil)

Course Title: Structural Analysis I
Time: 3.00 Hours

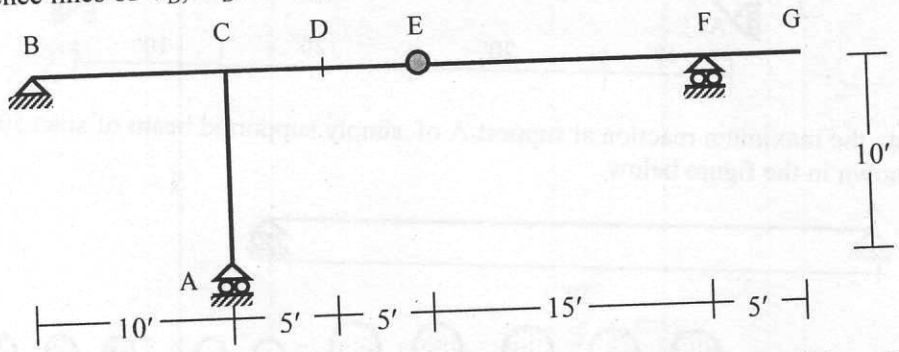
Course Code: CE 311
Full Marks: 100 (=10×10)

*There are **fourteen (14)** questions. Answer any **ten (10)**.*
Assume any missing data reasonably.

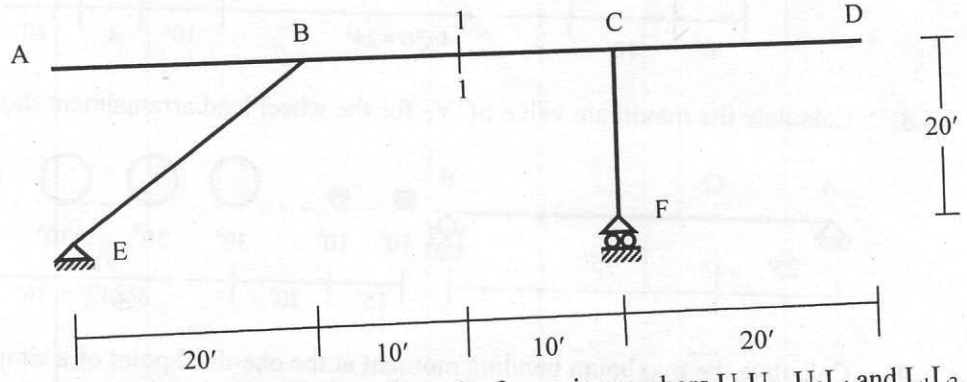
1. For the beam shown below, draw Influence lines for (i) Vertical reaction at A, (ii) Shear at C, (iii) Moment at C, (iv) Reaction at G, and (v) Shear just left of E [B and D are internal hinges].



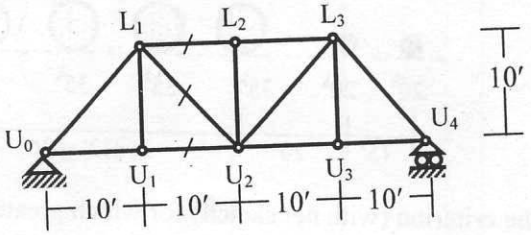
2. Determine the degree of statical indeterminacy (DOSI) of the frame shown below, and draw the influence lines of V_D, M_D and R_B, if the unit load moves over beam BG [E is an internal hinge].



3. Draw the influence Lines of V_1, M_1 and R_F for the frame shown below if the unit load moves over beam AD.



4. For the truss shown below, draw the influence lines for forces in members U_1U_2, U_2L_1 and L_1L_2. Note: There are floor-beams over the bottom-cords.



5. Girder AB supports a floor system as shown in the figure below. Draw the Influence lines for

(i) Floor beam reaction at panel point "2"
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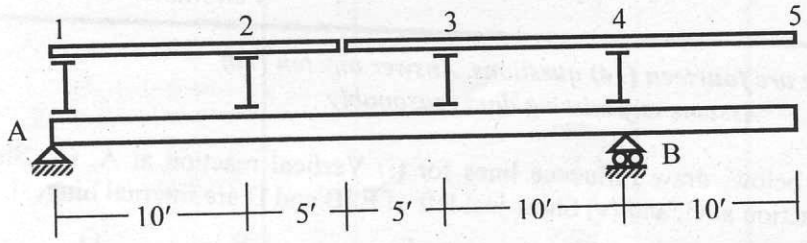
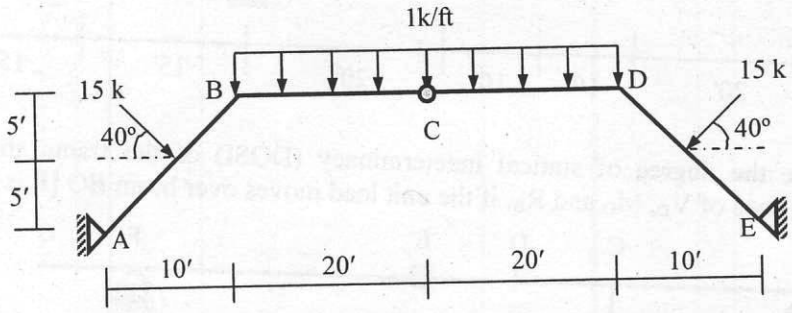
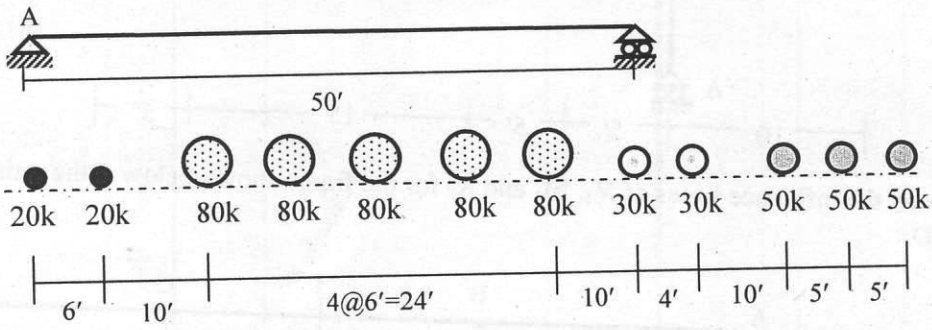


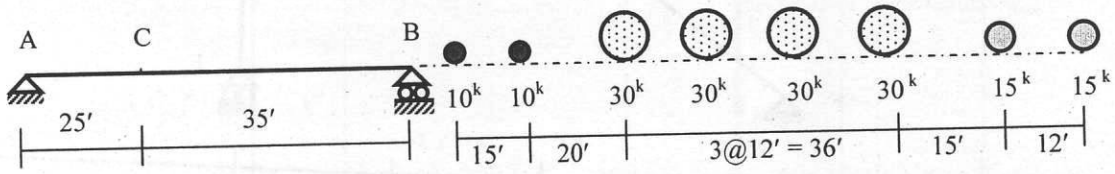
6. Draw the shear force and bending moment diagrams for the following structure. [C is an internal hinge]



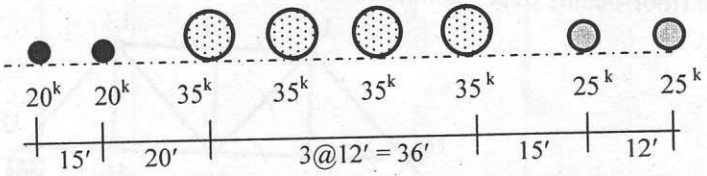
7. Calculate the maximum reaction at support A of simply supported beam of span 50 ft due to the wheel loads shown in the figure below



8. Calculate the maximum value of V_C for the wheel load arrangement shown below.

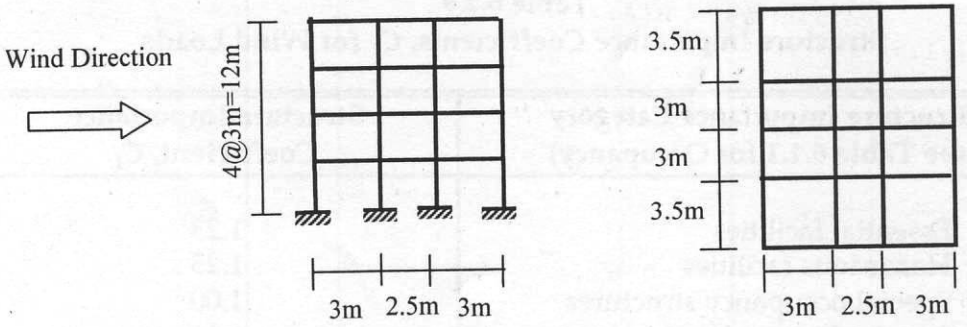


9. Calculate the maximum bending moment at the one-third point of a simply supported beam of span 60 ft due to the wheel loads shown in the figure below.



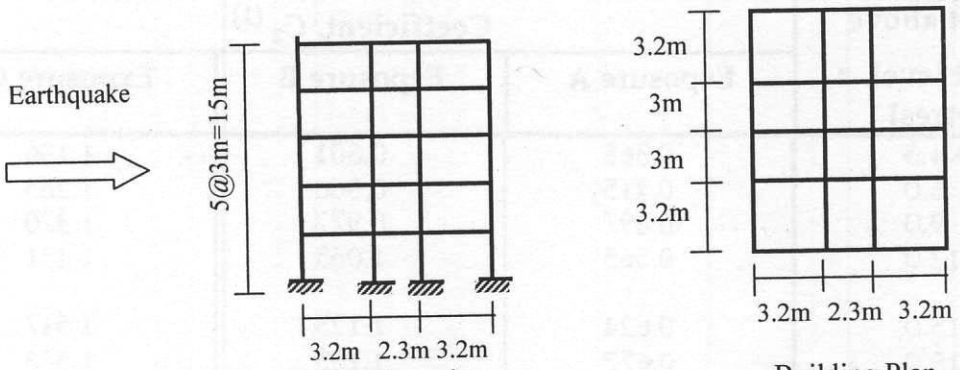
10. Develop the criterion (with net sketch) for which greatest maximum moment in a beam will occur under any wheel load.

11. Calculate the wind load at each story of a four-storied hospital building (shown below) located at a flat terrain in Chittagong (Basic wind speed = 260 km/hr). Assume the structure to be subjected to Exposure B.



Side Elevation Building Plan

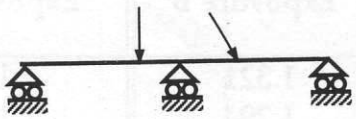
12. Calculate the seismic load at each story of a five-storied hospital building (RCC) shown below located in Dhaka (Zone 2). Assume the structure to be a Special Moment Resisting Frame (SMRF) built on soil condition S_3, carrying a Dead Load of 12 kN/m^2 (including partition load).



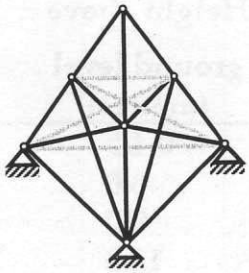
Side Elevation Building Plan

13. a) Derive the "general cable theorem".
b) With the help of General Cable Theorem, derive an expression defining the shape of a cable subjected to uniformly distributed load with respect to horizontal axis with origin at left end of a cable.
c) Hence derive an expression for maximum cable tension under uniform load.

14. a) When is a structure classified as geometrically unstable?
b) Classify each of the structures shown below as statically determinate or statically indeterminate, stable or unstable. If statically indeterminate, determine the number of degrees of indeterminacy.

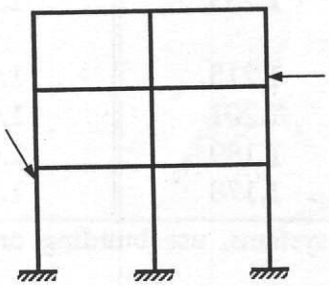


(i)



[3D Truss]

(ii)



(iii)

Table 6.2.9
Structure Importance Coefficients, C_I for Wind Loads

Structure Importance Category (see Table 6.1.1 for Occupancy)	Structure Importance Coefficient, C_I
I Essential facilities	1.25
II Hazardous facilities	1.25
III Special occupancy structures	1.00
IV Standard occupancy structures	1.00
V Low-risk structures	0.80

Table 6.2.10
Combined Height and Exposure Coefficient, C_z

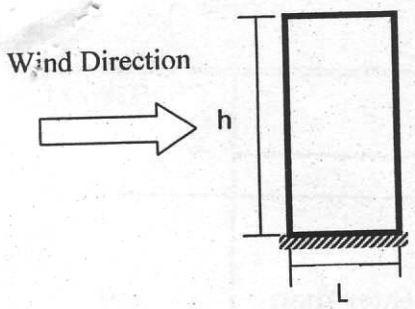
Height above ground level, z (metres)	Coefficient, C_z (1)		
	Exposure A	Exposure B	Exposure C
0-4.5	0.368	0.801	1.196
6.0	0.415	0.866	1.263
9.0	0.497	0.972	1.370
12.0	0.565	1.055	1.451
15.0	0.624	1.125	1.517
18.0	0.677	1.185	1.573
21.0	0.725	1.238	1.623
24.0	0.769	1.286	1.667

Note : (1) Linear interpolation is acceptable for intermediate values of z.

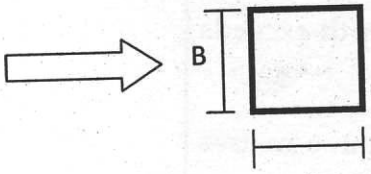
Table 6.2.11
Gust Response Factors, G_h and G_z (1)

Height above ground level (metres)	G_h (2) and G_z		
	Exposure A	Exposure B	Exposure C
0-4.5	1.654	1.321	1.154
6.0	1.592	1.294	1.140
9.0	1.511	1.258	1.121
12.0	1.457	1.233	1.107
15.0	1.418	1.215	1.097
18.0	1.388	1.201	1.089
21.0	1.363	1.189	1.082
24.0	1.342	1.178	1.077

Note : (1) For main wind-force resisting systems, use building or structure height h for z.
(2) Linear interpolation is acceptable for intermediate values of z.



Elevation



Plan

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	2.30	2.80	2.20	1.60	1.25

Note:(1) These coefficients are to be used with Method-2 given in Sec 2.4.6.6a(ii). Use $\bar{C}_p = \pm 0.7$ for roof in all cases.

(2) Linear interpolation may be made for intermediate values of $\bar{h}/B$ and L/B.

Earthquake Load Calculation

Table 6.2.23
Structure Importance Coefficients *I*, *I′*

Structure Importance Category (see Table 6.1.1 for occupancy)	Structure Importance Coefficient	
	I	*I′*
I Essential facilities	1.25	1.50
II Hazardous facilities	1.25	1.50
III Special occupancy structures	1.00	1.00
IV Standard occupancy structures	1.00	1.00
V Low-risk Structures	1.00	1.00

Table 6.2.24
Response Modification Coefficient for Structural Systems, *R*

Basic Structural System(1)	Description of Lateral Force Resisting System	*R* (2)
c. Moment Resisting Frame System	1. Special moment resisting frames (SMRF)	
	i) Steel	12
	ii) Concrete	12
	2. Intermediate moment resisting frames (IMRF), concrete(4)	8
	3. Ordinary moment resisting frames (OMRF)	
	i) Steel	6
	ii) Concrete (5)	5

Table 6.2.25

Site Coefficient, S for Seismic Lateral Forces [1]

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

Note : (1) The site coefficient shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S_3 shall be used. Soil profile S_4 need not be assumed unless the building official determines that soil profile S_4 may be present at the site, or in the event that soil profile S_4 is established by geotechnical data.

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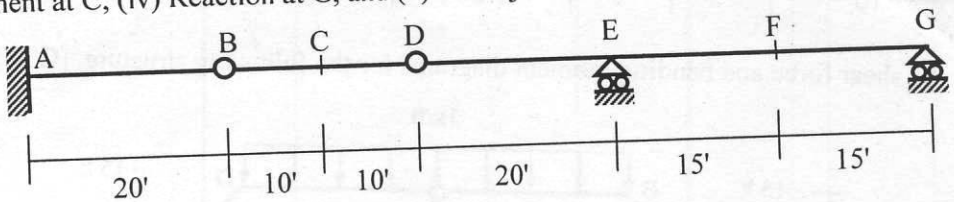
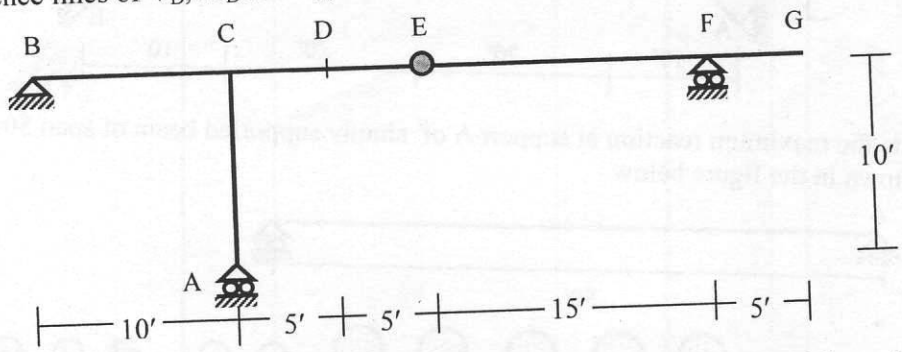


2. Determine the degree of statical indeterminacy (DOSI) of the frame shown below, and draw the influence lines of V_D, M_D and R_B, if the unit load moves over beam BG [E is an internal hinge].



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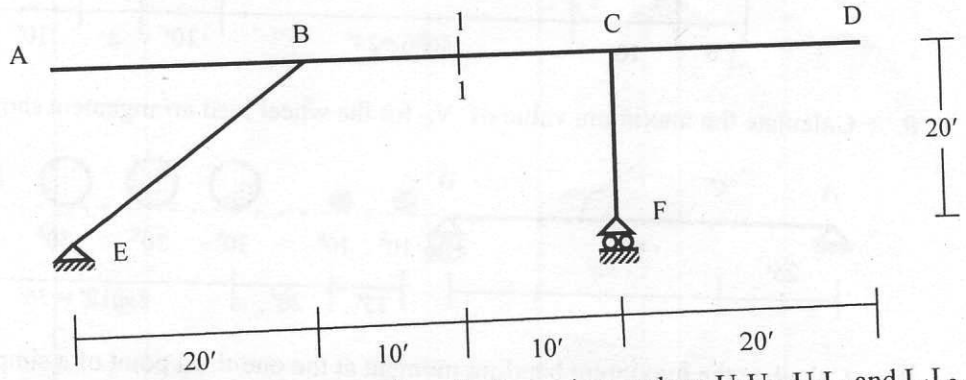

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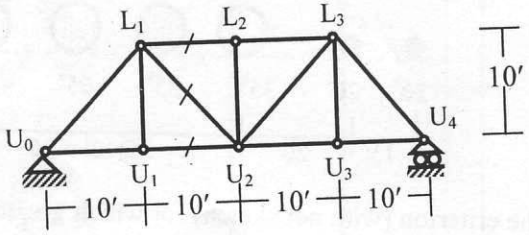

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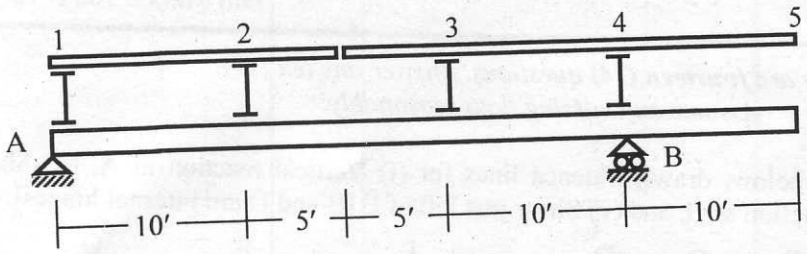

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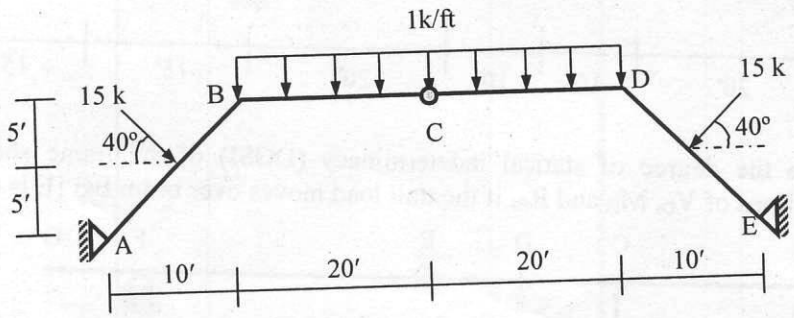

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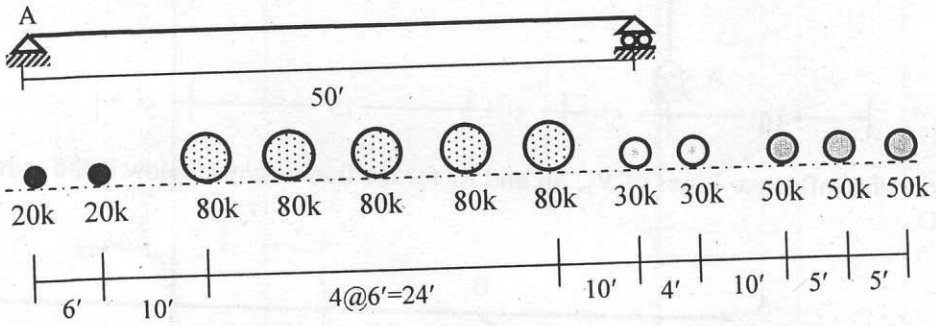

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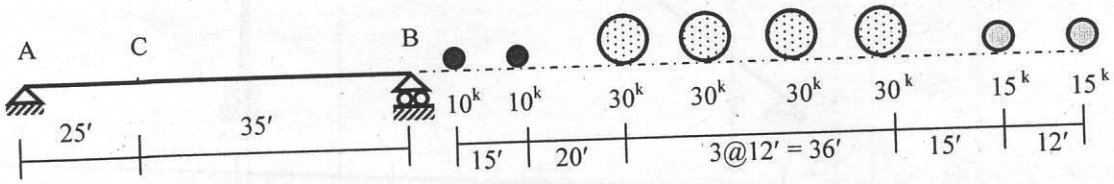

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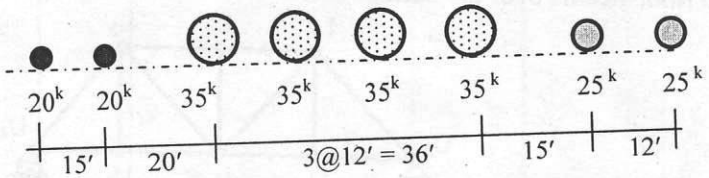

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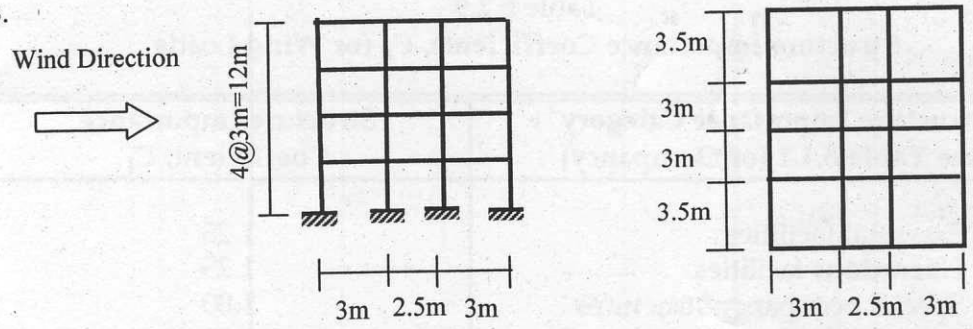

Side Elevation Building Plan

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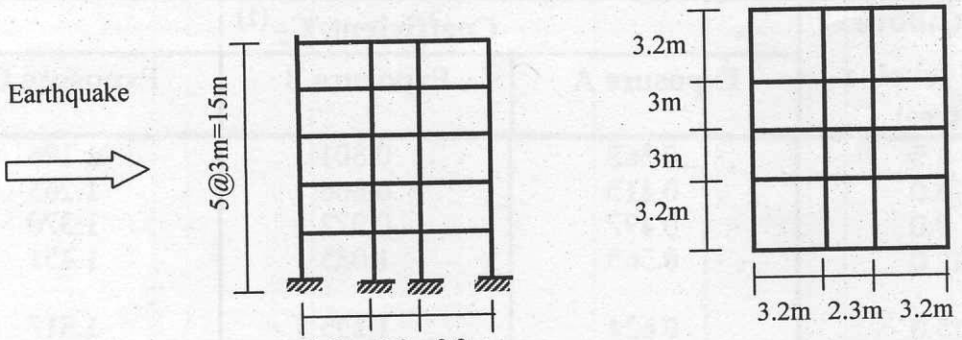

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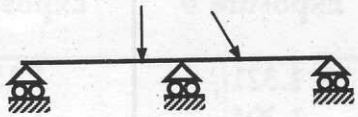
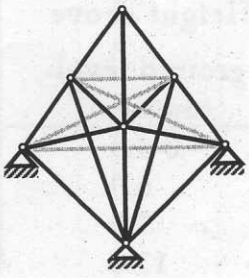
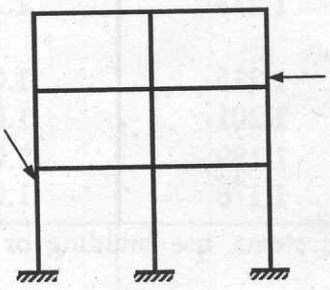


(i)



[3D Truss]

(ii)



(iii)

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Structure Importance Category (see Table 6.1.1 for Occupancy)	Structure Importance Coefficient, C_I
I Essential facilities	1.25
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Table 6.2.10
Combined Height and Exposure Coefficient, C_z

Height above ground level, z (metres)	Coefficient, C_z (1)		
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Note : (1) Linear interpolation is acceptable for intermediate values of z.

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Gust Response Factors, G_h and G_z (1)

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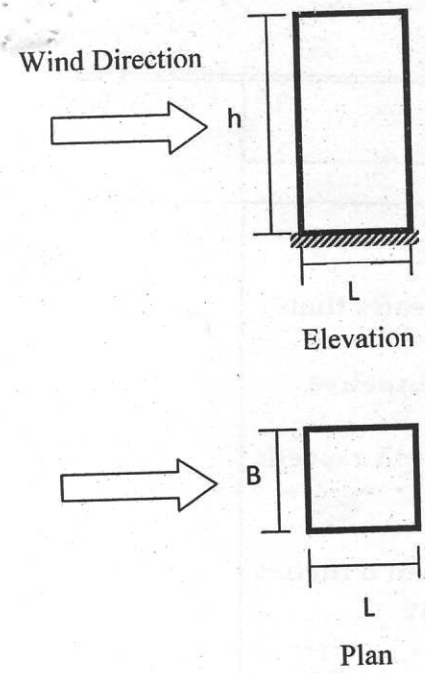

h/B	L/B					
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1.0	1.55	1.85	2.00	1.70	1.30	1.15
2.0	1.80	2.25	2.55	2.00	1.40	1.20
≥4.0	1.95	2.30	2.80	2.20	1.60	1.25

Note:(1) These coefficients are to be used with Method-2 given in Sec 2.4.6.6a(ii). Use $\bar{C}_p = \pm 0.7$ for roof in all cases.

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Earthquake Load Calculation

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Table 6.2.24
Response Modification Coefficient for Structural Systems, *R*

Basic Structural System(1)	Description of Lateral Force Resisting System	*R* (2)
c. Moment Resisting Frame System	1. Special moment resisting frames (SMRF)	
	i) Steel	12
	ii) Concrete	12
	2. Intermediate moment resisting frames (IMRF), concrete(4)	8
	3. Ordinary moment resisting frames (OMRF)	
	i) Steel	6
	ii) Concrete (5)	5

Table 6.2.25

Site Coefficient, S for Seismic Lateral Forces (1)

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

Note : (1) The site coefficient shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S_3 shall be used. Soil profile S_4 need not be assumed unless the building official determines that soil profile S_4 may be present at the site, or in the event that soil profile S_4 is established by geotechnical data.