

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
4th Year 2nd Semester

A-2

Course Title: Structural Engineering VI
 Time: 2 hours

Credit Hour: 2.00

Course Code: CE 417
 Full Marks: 100

Answer all the questions

QUESTION 1 [15 MARKS]

Determine the effective length factor (K) for AB, BC, CD, and JK columns of the frame shown in **Figure 1**. Given: $I_{\text{column}} = 1200 \text{ in}^4$ and $I_{\text{beam}} = 500 \text{ in}^4$.

[15]

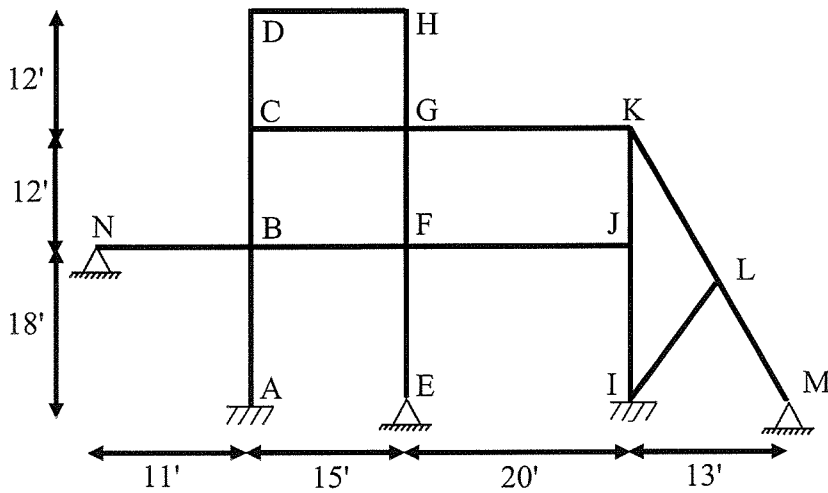


Figure 1

QUESTION 2 [20 MARKS]

Considering safety and economy, select the best W section from **Table 1** to carry a service superimposed dead load of 1.5 kip/ft and a service live load of 2 kip/ft on a simply supported beam. The length of the beam is 32 ft, and the spacing of lateral supports is 8 ft. Use A572 Grade 60 steel, and follow the **AISC-LRFD** approach. Note: Beam self-weight is not negligible and hence it must be accounted for.

[20]

Table 1

Shape	b_f (in)	t_f (in)	I_x (in ⁴)	r_x (in)	Z_x (in ³)	I_y (in ⁴)	r_y (in)	Z_y (in ³)
W18×60	7.56	0.695	984	7.47	123	50.1	1.68	20.6
W24×90	9.04	0.840	2530	9.76	237	104	1.98	35.8
W24×84	9.02	0.770	2370	9.79	224	94.4	1.95	32.6
W16×90	10.3	0.855	1230	6.81	171	167	2.51	51.8
W16×45	7.04	0.565	586	6.65	82.3	32.8	1.57	14.5
W14×90	14.5	0.710	999	6.14	157	362	3.70	75.6
W12×84	11.97	0.915	709	5.35	126	175	2.66	45.4
W12×45	8.05	0.575	348	5.15	64.2	50.0	1.95	19.0
W18×84	11.80	0.66	1490	7.76	185	191	2.78	54.0

QUESTION 3 [25 MARKS]

Determine the allowable moment capacity of W10×33 section of A572 Grade 60 steel for the beam shown in **Figure 2**. The beam has no lateral bracings in between support points A and D. Use the **AISC-ASD** method. If intermediate lateral supports are provided along the beam to increase its moment capacity, determine the spacing of the lateral supports that will produce a most economical design. Calculate the allowable moment capacity of the beam for this case also. Assume $C_b = 1$.

[15+5+5]

Section properties of W10×33:

D (in)	t_w (in)	b_f (in)	t_f (in)	S_x (in ³)	Z_x (in ³)	r_x (in)	r_y (in)	r_{ts} (in)	h_o (in)	T (in)	J (in ⁴)
9.71	0.29	7.96	0.435	35	38.8	4.19	1.94	2.2	9.30	7.5	0.583

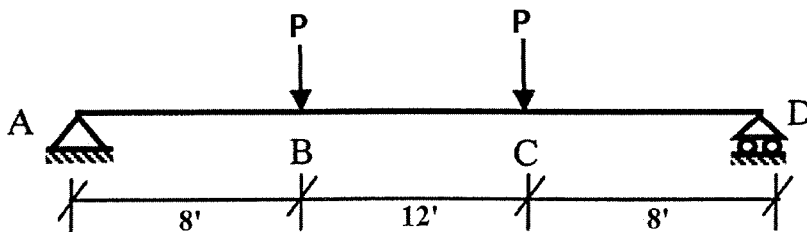
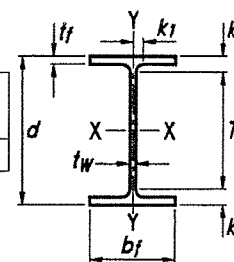


Figure 2

QUESTION 4 [15 MARKS]

By following the elastic vector method, compute the required size of **E60XX** fillet weld for the weld configuration and loading condition shown in **Figure 3**. Assume the plate thickness does not affect the result. Use the **AISC-LRFD** method for the calculation. Given: Ultimate load, $P = 60$ kips.

[15]

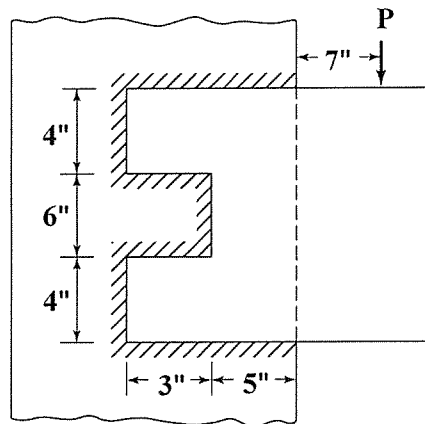


Figure 3

QUESTION 5 [25 MARKS]

- (i) How does the failure mode of a long column differ from that of a short column? Explain in your own words using neat sketches. [8]
- (ii) With neat sketches, explain the reason of imposing minimum weld size in a metal connection. [7]
- (iii) Explain all of the welding symbols (location, size, length, type and any other specification of welding) shown in **Figure 4**. [10]

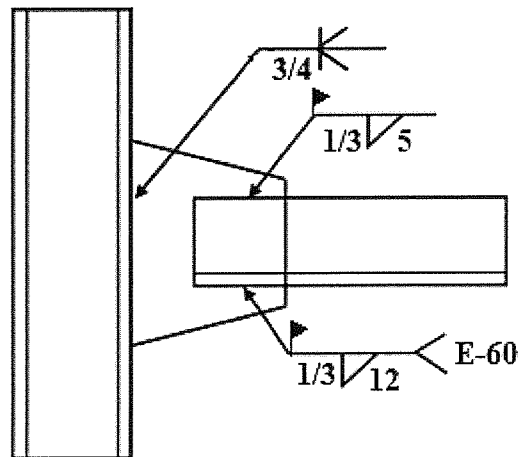


Figure 4

FORMULA

$$F_{cr} = \left[0.658 \frac{F_y}{F_c} \right] F_y \quad \text{For } \frac{KL}{r} \leq 4.71 \sqrt{\frac{E}{F_y}}$$

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r} \right)^2}$$

$$F_{cr} = 0.877 F_e \quad \text{For } \frac{KL}{r} > 4.71 \sqrt{\frac{E}{F_y}}$$

$$P_n = F_{cr} A_g$$

$$C_b = \frac{12.5 M_{\max}}{2.5 M_{\max} + 3 M_A + 4 M_B + 3 M_C} R_m \leq 3.0$$

$$L_p = 1.76 r_y \sqrt{\frac{E}{F_y}}$$

$$L_r = 1.95 r_{ts} \frac{E}{0.7 F_y} \sqrt{\frac{Jc}{S_x h_o}} \sqrt{1 + \sqrt{1 + 6.76 \left(\frac{0.7 F_y S_x h_o}{E Jc} \right)^2}}$$

$$M_n = C_b \left[M_p - (M_p - 0.7 F_y S_x) \left(\frac{L_b - L_p}{L_r - L_p} \right) \right] \leq M_p$$

$$M_n = M_p - (M_p - 0.7 F_y S_x) \left(\frac{\lambda - \lambda_p}{\lambda_r - \lambda_p} \right)$$

$$F_{cr} = \frac{C_b \pi^2 E}{\left(\frac{L_b}{r_{ts}} \right)^2} \sqrt{1 + 0.078 \frac{Jc}{S_x h_o} \left(\frac{L_b}{r_{ts}} \right)^2}$$

$$k_c = \frac{4}{\sqrt{h/t_w}}, \text{ where } 0.35 \leq k_c \leq 0.763$$

$$M_n = F_{cr} S_x \leq M_p$$

$$\lambda_r = 0.56 \sqrt{\frac{E}{F_y}} \quad \lambda_r = 1.49 \sqrt{\frac{E}{F_y}}$$

$$\lambda_{pf} = 0.38 \sqrt{\frac{E}{F_y}} \quad \lambda_{rf} = 1.0 \sqrt{\frac{E}{F_y}}$$

$$f'_x = \frac{P_x}{A} \quad f'_y = \frac{P_y}{A}$$

$$M_n = \frac{0.9 E k_c S_x}{\lambda^2}$$

$$f''_x = \frac{T_y}{I_p} \quad f''_y = \frac{T_x}{I_p}$$

Alignment chart

Sidesway prevented
(Braced frame)

Sidesway not prevented
(Unbraced frame)

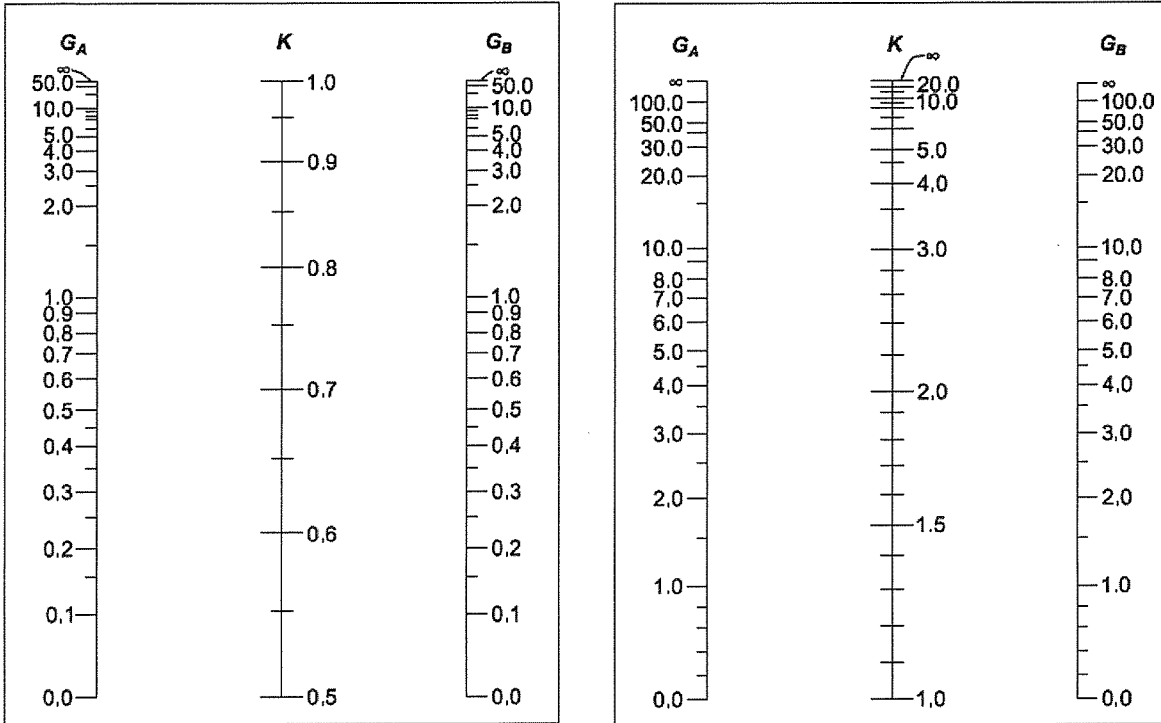


Table: Stiffness modification factors

<u>Condition</u>	<u>Sidesway (unbraced)</u>	<u>No sidesway (braced)</u>
Far end of beam hinged	0.5	1.5
Far end of beam fixed	0.667	2.0

Table: Minimum size of fillet welds

Material Thickness of Thinner Part Joined, in. (mm)	Minimum Size of Fillet Weld, ^[a] in. (mm)
To 1/4 (6) inclusive	1/8 (3)
Over 1/4 (6) to 1/2 (13)	3/16 (5)
Over 1/2 (13) to 3/4 (19)	1/4 (6)
Over 3/4 (19)	5/16 (8)



University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
4th Year 2nd Semester

Course Title: Project Planning and Management
 Time: 3 hours

Credit Hour: 3.00

Course Code: CE 401
 Full Marks: 50

Answer all the questions

QUESTION 1 [10 MARKS]

a. A civil engineering firm is planning a new road construction project and needs to manage its steel rebar inventory. The estimated annual demand for steel rebar is 50,000 kg. The cost to place a single order is \$150, and the annual holding cost per kg of rebar is 12% of its unit cost of \$2.20 per kg.

By applying the EOQ model, determine the following:

- i. The Economic Order Quantity (EOQ) for the steel rebar. [02]
- ii. The number of orders per year required to maintain the inventory. [01]
- iii. The total annual inventory cost. [02]

b. The network of a construction project is shown in **Figure 1**, along with the duration of each activity. Apply network analysis technique to determine the Earliest and Latest Event Time of each event. [05]

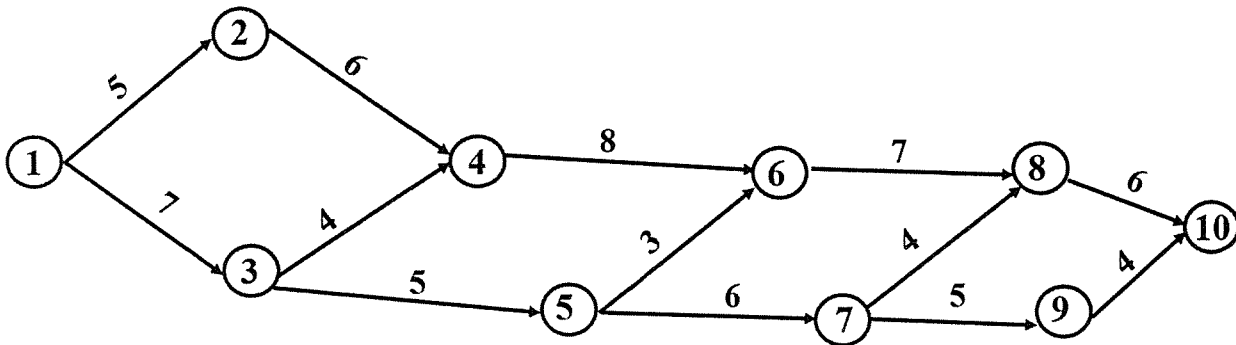


Figure 1. Network diagram along with activity duration

QUESTION 2 [10MARKS]

Apply CPM technique to the network shown in **Figure 1** to determine the followings:

- a. Activity Time (EST, EFT, LST, LFT) of each activity. [06]
- b. Total Float of each activity. [02]
- c. The Critical Path. **Show the Critical Path on the Network.** [02]

QUESTION 3 [10MARKS]

Suppose you are the Project Manager for a major civil works package in Bangladesh (e.g., earthworks, structures, and utilities). Your Assistant Project Manager prepared a preliminary CPM network with estimated activity durations. After reviewing constructability, crew productivity, and resource availability, you believe several activities can be shortened through schedule compression

(crashing). You revise the plan as shown in **Figure 2**, where the normal duration for each activity is written below the arrow and the crash duration is shown in parentheses. The corresponding direct cost data for normal and crash options are provided in **Table 1**. The project's indirect cost is Tk. 1,000 per week.

Employ duration–cost analysis to crash appropriate activities in the network to determine the optimum duration and the corresponding minimum cost of the project. [10]

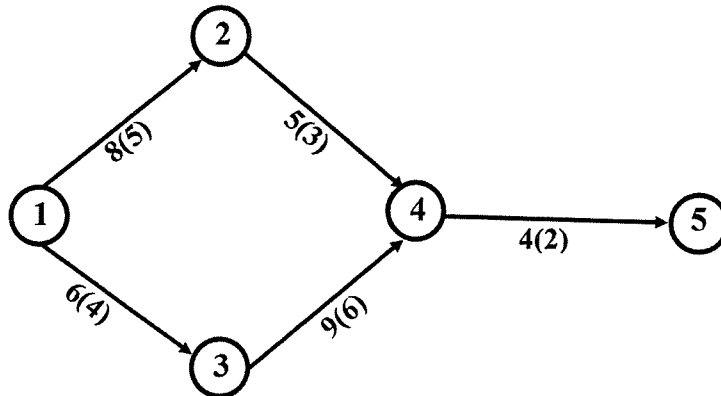


Figure 2. Network diagram along with normal and crash duration

Table 1. Direct Cost Data for Normal and Crash Option

Activity	Normal Duration (weeks)	Normal Cost (Tk.)	Crash Duration (weeks)	Crash Cost (Tk.)
1 - 2	8	10,000	5	14,500
1 - 3	6	7,000	4	11,000
2 - 4	5	8,000	3	12,000
3 - 4	9	12,000	6	21,000
4 - 5	4	6,000	2	11,000

QUESTION 4 [08 MARKS]

- A public entity needs to hire a consultancy firm for a specialized engineering study. The Public Procurement Rules 2008 outlines a specific procedure for this. How would the PE apply the procurement process for consultancy services, from start to finish? [03]
- The Local Government of a small Municipality is considering a new project to construct a bridge. The initial investment for the project is \$5,000,000. The expected annual cash inflows for the next five years are shown in **Table 2**:

Table 2. Projected net cash inflows obtained by financial analysts

Year	1	2	3	4	5
Cash Inflow (\$)	1,500,000	1,800,000	1,400,000	1,200,000	1,000,000

- Calculate the Internal Rate of Return (IRR) for the bridge construction project. [04]
- Evaluate the calculated IRR and determine if the project is financially viable if Municipality has a required rate of return of 15%. [01]

QUESTION 5 [07 MARKS]

A city authority is planning to construct two types of Water Supply Systems: Pipelines and Canals. The project must be executed within constraints of budget, land availability, and manpower. Relevant data is provided in **Table 3**.

Table 3. Information about Pipelines and Canals type of Water Supply System

Water Supply Systems	Cost per km (\$)	Land Required per km (m ²)	Manpower Hours per km (hrs.)	Flow Capacity (m ³ /s)
Pipeline	600,000	2,000	250	80
Canal	400,000	4,000	180	120

A total of 150,000 m² of land is available and the total budget and total working hours should not exceed \$20,000,000 and 9,000 hours respectively. Both types of systems (Pipelines and Canals) must be constructed.

Apply linear programming techniques to:

- a. Construct the objective function and constraint equations to represent the problem mathematically. [02]
- b. Analyze and determine the optimal kilometers of Pipelines and Canals to be built that maximize water flow capacity while satisfying all constraints. [05]

QUESTION 6 [05 MARKS]

A municipal authority is considering the construction of a **stormwater drainage system** to reduce flooding in an urban area. The project involves excavation, installation of reinforced concrete pipes, and construction of manholes. The financial and social aspects of the project are summarized below:

Initial Construction Cost: \$12,000,000
Annual Maintenance Cost: \$500,000 (for 5 years)
Annual Benefits (due to reduced flood damage, improved traffic flow, and public health savings): \$1,800,000 (for 5 years)
Salvage Value (residual value at the end of 5 years): \$1,500,000
Discount Rate: 8%

- a. Compute the Present Value (PV) of Costs and the Present Value of Benefits over the 5-year project life using Net Present Value (NPV) analysis. [03]
- b. Calculate the Benefit–Cost Ratio (BCR) for the project. [01]
- c. State whether the project is economically feasible based on the BCR criterion. [01]



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Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering III

Course Code: CE 411

Time: 3 hours

Credit Hour: 3.00

Full Marks: 100 (= 10 × 10)

Answer all the questions. Any missing data can be assumed reasonably.

- Identify zero-force members of the 2D truss loaded as shown in **Fig.1**. 4. Use Stiffness Method to determine the displacements of joints **a** and **b** [Given: $EA/L = 500 \text{ k/ft}$].
- Use the Energy Method to calculate the load (i) P needed to form beam mechanism, (ii) w needed to form the sidesway mechanism in the frame **abcdef** loaded as shown in **Fig.2** [Given: $M_p(\text{beam}) = 250 \text{ k-ft}$, $M_p(\text{column}) = 300 \text{ k-ft}$].

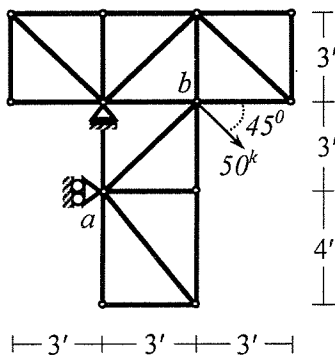


Fig.1

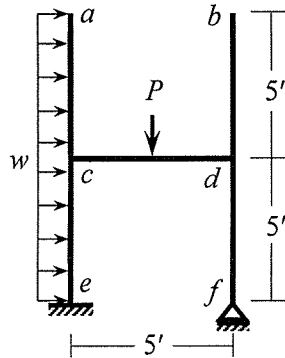


Fig.2

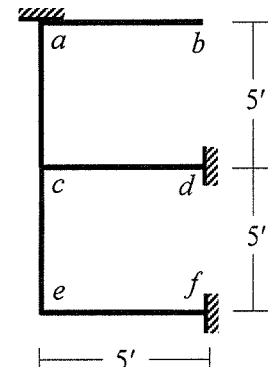


Fig.3

- Calculate 1st natural frequency of the frame **abcdef** shown in **Fig.3** using consistent mass matrices [Given: $EI = 50 \times 10^3 \text{ k-ft}$, $\mu = 0.005 \text{ k-sec}^2/\text{ft}^2$].
- Use Stiffness Method considering geometric nonlinearity and flexural deformations only to calculate the unknown deflection at joint **f** and rotations at joints **c** and **e** of the frame **abcdef** loaded as shown in **Fig.4** [Given: $EI = 50 \times 10^3 \text{ k-ft}^2$].

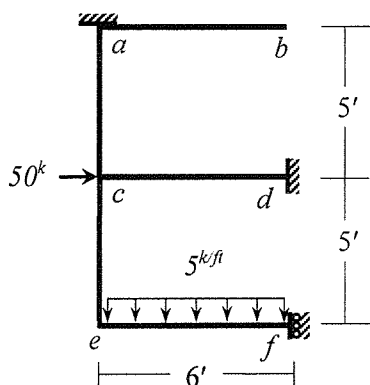


Fig.4

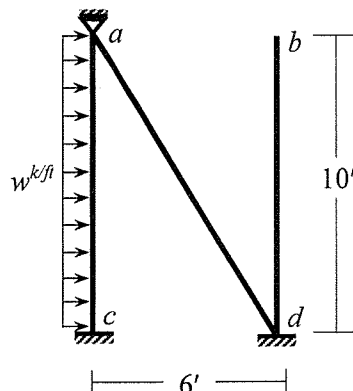


Fig.5

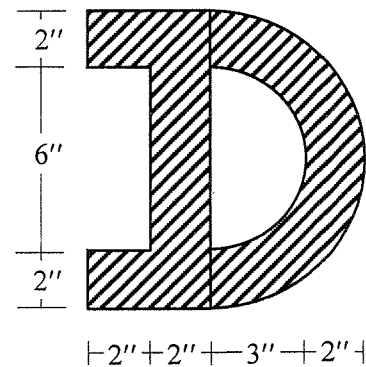
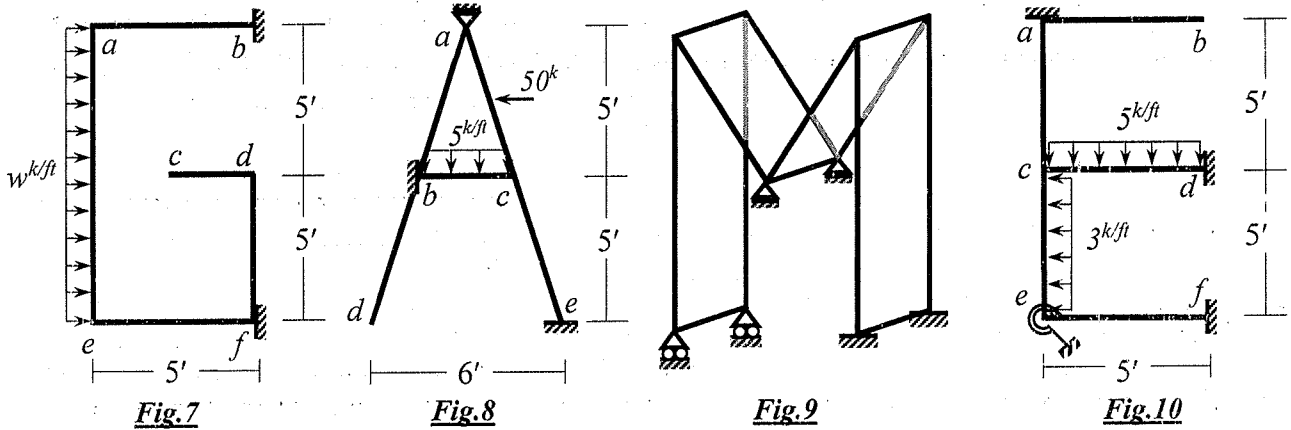


Fig.6

- Frame structure **abcd** shown in **Fig.5** is subjected to a dynamic load, $w = 5e^t \text{ (k/ft)}$. Use *Constant Average Acceleration (CAA)* Method to calculate the rotation of joint **a** at time $t = 0.05 \text{ sec}$ [Given: $EI = 50 \times 10^4 \text{ k-ft}^2$, $\mu = 0.005 \text{ k-sec}^2/\text{ft}^2$, *Damping ratio of the system* = 8%].
- Calculate Yield Moment (M_y) and Plastic Moment (M_p) capacity of the section shown in **Fig.6** about horizontal axis if the section is made of elastic-fully plastic material [Given: $\sigma_{yp} = 50 \text{ ksi}$].

7. Use Stiffness Method (neglecting axial deformations) to calculate the value of applied load w required to cause buckling of the frame $abcdef$ loaded as shown in Fig.7
 [Given: $EI = 50 \times 10^4 \text{ k-ft}^2$].
8. Use stiffness method (neglecting axial deformations) to calculate rotations of joints a and c (θ_a, θ_c) of the 2D frame $abcde$ loaded as shown in Fig.8. 50 kip is applied horizontally at the mid-point of member ac
 [Given: $EI = 50 \times 10^3 \text{ k-ft}^2$].



9. Determine the degree of kinematic indeterminacy (doki) and show the corresponding deflections and rotations of the 2D frame (Fig.7) and 3D frame (Fig.9) for the following cases
- Not considering boundary conditions
 - Considering boundary conditions
 - Neglecting axial deformations.
10. Use Stiffness Method (neglect axial deformations) to calculate rotations at joint c and e of the frame $abcdef$ loaded as shown in Fig.10, if the joint e is a circular foundation of radius 4.5 ft on the surface of subsoil (half-space) with shear wave velocity (v_s) equal to 1250 ft/sec.
 [Given: EI of the frame members = $50 \times 10^3 \text{ k-ft}^2$, Unit weight of soil = 120 pcf, Poisson's ratio of the soil = 0.25].

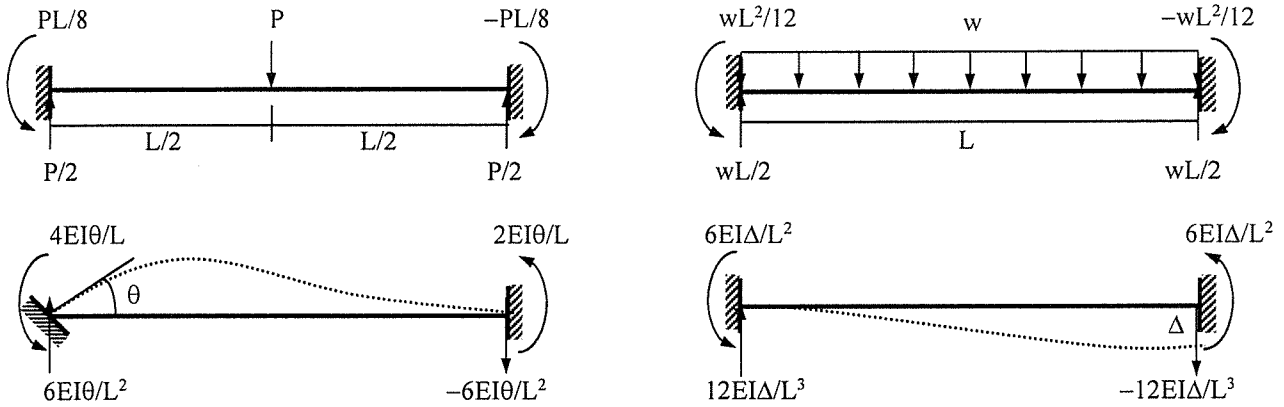
List of Useful Formulae for CE 411

* The stiffness matrix \mathbf{K}_m^G of a 2D truss member in the global axis system is given by

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix} \quad \text{and Truss member force, } P_{AB} = S_x [(u_B - u_A) C + (v_B - v_A) S]$$

[where $C = \cos \theta$, $S = \sin \theta$]

Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



* The stiffness matrix of a 3D truss member in the global axes system [using $C_x = \cos \alpha$, $C_y = \cos \beta$, $C_z = \cos \gamma$] is

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C_x^2 & C_x C_y & C_x C_z & -C_x^2 & -C_x C_y & -C_x C_z \\ C_y C_x & C_y^2 & C_y C_z & -C_y C_x & -C_y^2 & -C_y C_z \\ C_z C_x & C_z C_y & C_z^2 & -C_z C_x & -C_z C_y & -C_z^2 \\ -C_x^2 & -C_x C_y & -C_x C_z & C_x^2 & C_x C_y & C_x C_z \\ -C_y C_x & -C_y^2 & -C_y C_z & C_y C_x & C_y^2 & C_y C_z \\ -C_z C_x & -C_z C_y & -C_z^2 & C_z C_x & C_z C_y & C_z^2 \end{pmatrix} \quad \begin{matrix} C_x = L_x/L, C_y = L_y/L, C_z = L_z/L \\ \text{where } L = \sqrt{L_x^2 + L_y^2 + L_z^2} \end{matrix}$$

* Member force $P_{AB} = S_x [(u_B - u_A) C_x + (v_B - v_A) C_y + (w_B - w_A) C_z]$

* Ignoring axial deformations, the matrices \mathbf{K}_m^L and \mathbf{G}_m^L of a frame member in the local axis system are

$$\mathbf{K}_m^L = \begin{pmatrix} S_1 & S_2 & -S_1 & S_2 \\ S_2 & S_3 & -S_2 & S_4 \\ -S_1 & -S_2 & S_1 & -S_2 \\ S_2 & S_4 & -S_2 & S_3 \end{pmatrix} \quad \mathbf{G}_m^L = (P/30L) \begin{pmatrix} 36 & 3L & -36 & 3L \\ 3L & 4L^2 & -3L & -L^2 \\ -36 & -3L & 36 & -3L \\ 3L & -L^2 & -3L & 4L^2 \end{pmatrix}$$

where $S_1 = 12EI/L^3$, $S_2 = 6EI/L^2$, $S_3 = 4EI/L$, $S_4 = 2EI/L$

*The general form of the stiffness matrix for any member of a 2-dimensional frame is

$$\mathbf{K}_m^G = \begin{pmatrix} S_x C^2 + S_1 S^2 & (S_x - S_1)CS & -S_2 S & -(S_x C^2 + S_1 S^2) & -(S_x - S_1)CS & -S_2 S \\ (S_x - S_1)CS & S_x S^2 + S_1 C^2 & S_2 C & -(S_x - S_1)CS & -(S_x S^2 + S_1 C^2) & S_2 C \\ S_2 S & S_2 C & S_3 & S_2 S & -S_2 C & S_4 \\ -(S_x C^2 + S_1 S^2) & -(S_x - S_1)CS & S_2 S & S_x C^2 + S_1 S^2 & (S_x - S_1)CS & S_2 S \\ -(S_x - S_1)CS & -(S_x S^2 + S_1 C^2) & -S_2 C & (S_x - S_1)CS & (S_x S^2 + S_1 C^2) & -S_2 C \\ -S_2 S & S_2 C & S_4 & S_2 S & -S_2 C & S_3 \end{pmatrix}$$

* $\mathbf{K}_{total} = \mathbf{K} + \mathbf{G}$, buckling occurs (i.e., $P = P_{cr}$) when $|\mathbf{K}_{total}| = 0$

* For sections of Elastic-Fully-Plastic material, $A_t = A_c = A/2$, and $M_p = A_c \bar{y}_c + A_t \bar{y}_t$

* For RC sections, $M_p = A_s f_y (d - a/2)$, where $a = A_s f_y / (0.85 f_c' b)$

* Virtual work done by external forces (δW_E) = Virtual work done by internal forces (δW_I)

* For simply supported beams under (i) concentrated midspan load $P_u = 4 M_p/L$, and (ii) UDL $w_u = 8 M_p/L^2$

* For fixed-ended beams under (i) concentrated midspan load $P_u = 8 M_p/L$, and (ii) UDL $w_u = 16 M_p/L^2$

* For hinged-fixed ended beams under UDL $w_u = 11.66 M_p/L^2$

* Using CAA Method, $(m + c\Delta t/2 + k\Delta t^2/4)a_{i+1} = f_{i+1} - ku_i - (c + k\Delta t)v_i - (c\Delta t/2 + k\Delta t^2/4)a_i$

[m = Total mass, c = Damping = $2\xi\sqrt{km}$, where ξ = Damping Ratio]

Also $v_{i+1} = v_i + (a_i + a_{i+1})\Delta t/2$, and $u_{i+1} = u_i + v_i \Delta t + (a_i + a_{i+1})\Delta t^2/4$, starting with $a_0 = (f_0 - cv_0 - ku_0)/m$

*Stiffness and Mass Matrices of Continuous Systems

Axial Members

$$M_{mij} = \int m \phi_i \phi_j dx, \text{ and } K_{mij} = \int EA \phi_i' \phi_j' dx$$

Flexural Members

$$M_{mij} = \int m \psi_i \psi_j dx, \text{ and } K_{mij} = \int EI \psi_i'' \psi_j'' dx$$

* Lumped-Mass matrix for axial rod

$$\mathbf{M}_m = (\mu L/2) \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

Consistent-Mass matrix for beam [μ = Mass per unit length]

$$\mathbf{M}_m = (\mu L/420) \begin{pmatrix} 156 & 22L & 54 & -13L \\ 22L & 4L^2 & 13L & -3L^2 \\ 54 & 13L & 156 & -22L \\ -13L & -3L^2 & -22L & 4L^2 \end{pmatrix}$$

*Mass matrix for Two-dimensional Trusses

$$\mathbf{M}_m^L = \begin{pmatrix} mL/2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & mL/2 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

(Lumped)

$$\text{or } \mathbf{M}_m^L = \begin{pmatrix} mL/3 & 0 & mL/6 & 0 \\ 0 & 0 & 0 & 0 \\ mL/6 & 0 & mL/3 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

(Consistent)

* At natural frequency (i.e., $\omega = \omega_n$), $|\mathbf{K} - \omega_n^2 \mathbf{M}| = 0$

* Stiffness of Circular Surface Foundations on Half-Space

Motion	Horizontal	Vertical	Rotational	Torsional
$K_{\text{Halfspace}}$	$8G_s R/(2-\nu)$	$4G_s R/(1-\nu)$	$8G_s R^3/(3-3\nu)$	$16G_s R^3/3$

University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025
Program: B.Sc. in Civil Engineering
4th Year 2nd Semester

Course Title: Environmental Engineering VIII
Time: 2 hours

Credit Hour: 2.00

Course Code: CE 531
Full Marks: 80

Keep your answers brief and use bullet points where possible.

Questions	Marks
A. What are the theoretical steps for watershed delineation in GIS? Briefly describe stream order and the D8 method in 2–3 lines. Draw figures, if needed.	12
B. Give a brief description (3/4 lines each) of the following elevation models, including their specifics and primary uses: (i) DEM, (ii) DTM, (iii) DSM, (iv) TIN, and (v) CHM.	10
C. What does NDVI represent, and how do different NDVI values relate to land use? A pixel from a satellite image has the following reflectance values: Blue = 0.12, Green = 0.25, Red = 0.20, and Near-Infrared = 0.65. Calculate the NDVI for this pixel and explain what the value indicates about the type and condition of land cover in this area.	8
D. What are the three main methods for raster image classification? Briefly explain each method along with its pros, cons, and applications.	8
E. What are some commonly used spatial analyses of network analysis in GIS? Give one example for each.	6
F. A land surveying company has conducted topographic survey at four known locations on a plot of land to determine their elevation. Based on the survey readings, they need to estimate the elevation of two unmeasured points, A and B, to assist with a new construction project. Using the Inverse Distance Weighting method with a power parameter of 2, calculate the elevation for both A and B locations. The surveyed elevation points (in meters) and their coordinates are the following. T1(2, 8, 65m), T2(7, 9, 50m), T3 (8, 3, 80m) and T4 (3, 1, 75m). The coordinates of the two unknown points are: A (4, 6), and B (6, 2).	10
G. Briefly explain the following spatial interpolation techniques (i) Spline, (ii) Nearest Neighbour, (iii) TIN, and (iv) Kriging, including how they work, a typical use case, and any disadvantages or limitations of each technique.	12
H. Explain briefly (i) the different segments in a GPS architecture, (ii) the principle of trilateration, and (iii) the key features and use cases of different types of GPS receivers.	14



University of Asia Pacific
Department of Civil Engineering
Final Examination, Spring 2025

Program: B.Sc. in Civil Engineering
4th Year 2nd Semester

Course Title: Environmental Engineering VII
Time: 2 hour

Credit Hour: 2

Course Code: CE 439
Full Marks: 100

Answer all the questions

QUESTION 1 [15 MARKS]

What methods are used for EIA (Environmental Impact Assessment)? Discuss the advantages [15] and disadvantages of each method.

QUESTION 2 [30 MARKS]

- a. What ratings are generally used by a reviewer of EIA report. Briefly explain the meaning [10] of each rating.
- b. 'The weightage of rating of each chapter of EIA review report should be equal'. Justify [10] your answer whether you agree or disagree with the statement.
- c. A meat processing facility supplying chicken, beef, and lamb discharges its wastewater [10] into a nearby surface stream and disposes of its solid waste by land burial.
If you were part of the monitoring team, what pollutants would you anticipate in the affected environment, and what laboratory tests would you require to ensure the pollution is under control?

QUESTION 3 [30 MARKS]

The Chittagong City Corporation's main landfill sites are Arefin Nagar in Pahartali and Ananda Bazar in Halishahar. These are currently open dumping sites, not sanitary landfills, and are often insufficient for the city's waste disposal needs. To meet the city's waste disposal needs and mitigate the environmental health risk, Chittagong City Corporation is planning to design a sanitary landfill in Fateyabad with an area of 20 acres. The Chittagong City Corporation asked you to lead the team of EIA and prepare the EIA report. Prepare a tentative EIA report for your team to follow.

Hint: The phases of EIA are the chapters of your EIA report. Make a checklist for all the chapters for you and your team.

QUESTION 4 [25 MARKS]

For the EIA report of the **Question 3**, the City Corporation appoints you as a reviewer. Prepare [25] a tentative review report with the mark distribution/weightage of rating/grade of the EIA report for each chapter of the review report.

Hint: In each chapter, list the topics or issues what you need to check in the EIA report



Department of Civil Engineering
Final Examination Spring 2025
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering IX
 Course Code: CE 423 (Earthquake Resistant Design and Retrofitting)
 Time: 2 hours

Credit Hours: 2.0
 Full Marks: 70 (= 7 × 10)

PART 1

[Answer any 5 (Five) of the following 7 questions]

[Given: R_0 = Last Two Digits of Registration Number

$$f_y = (50 + 0.1R_0) \text{ ksi}, E_s = 29000 \text{ ksi}, f'_c = f_y/15, E_c = 1000f'_c, E_{masonry} = 0.5E_c]$$

1. (i) Fig. 1 shows part of the *London Metro Rail* with two circular openings.
 Given: $L = (15 + 0.05R_0)$ ft, Crushing Strength of Brick = $(2 + 0.01R_0)$ ksi, Mortar Grade M_2 .

Assume the wall openings to be 'square-shaped' and determine if the wall satisfies the BNBC-specified in-plane seismic detailing requirements (i.e. for wall openings, distances, heights and materials).

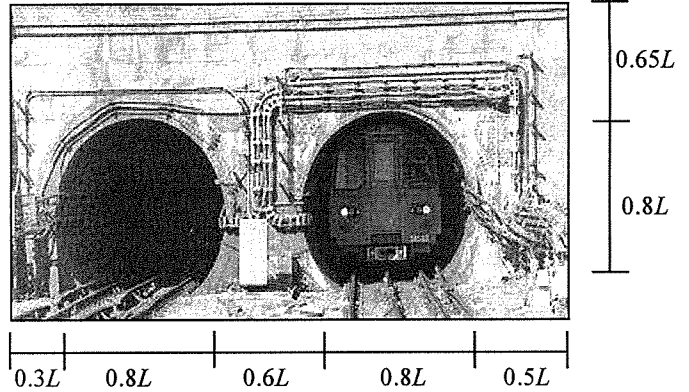


Fig. 1

- (ii) If thickness of the wall (shown in Fig. 1) is $t_{wall} = (15 + 0.05R_0)$ inch
- Determine if the wall satisfies BNBC-specified out-of-plane seismic detailing requirements (i.e. for length, height and thickness).
 - Also calculate the in-plane and out-of-plane stiffness of the wall (ignoring the effect of wall opening).

2. Fig. 2(a) shows a test-run of *Dhaka Metro Rail (MRT-6)* while Fig. 2(b) shows its typical span of length $L_0 = (100 + 0.2R_0)$ ' , supported on $(6' \times 6')$ piers of height $H_0 = 0.3L_0$ and stiffness $k_p = 12EI/H_0^3$ for each pier. The structure carries a rail-deck weighing $(15 + 0.05R_0)$ k/ft, and train weighing $(5 + 0.02R_0)$ k/ft.



Fig. 2(a)

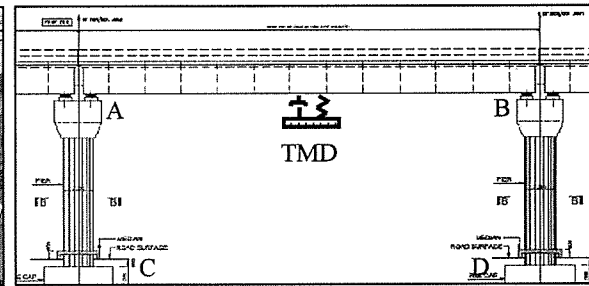


Fig. 2(b)

The rail also carries a Tuned Mass Damper (TMD), as shown in Fig. 2(b).

If ω_{n0} is the natural frequency of the MRT without TMD, calculate the required

- (i) Stiffness k_T of the TMD to make the 1st natural frequency of the MRT-TMD system = $0.8\omega_{n0}$ and its 1st modal-shape = 1: 4
- (ii) Mass m_T of the TMD.
3. For an earthquake of $Z = 0.20$ in Dhaka with epicenter at Manikganj, calculate the
- (i) Magnitude of the earthquake
- (ii) Warning time for an observer in Dhaka, if the earthquake originated from rock with $G = (100 + R_0)$ GPa, Poisson's Ratio = 0.10 and Density = $(2000 + 5R_0)$ kg/m³
- (iii) Seismic force on a $(2' \times 2' \times 6'')$ Elastomeric Bearing Pad of MRT-6 (Fig. 3) and comment if this force can dislodge the pad (unit weight 100 lb/ft³) compressed under vertical force $(100 + R_0)$ kips.

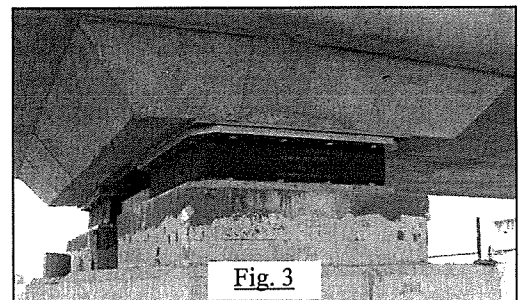


Fig. 3

4. Fig. 4 shows works-men at the MRT-6 pile section, of diameter $D_0 = (5 + 0.02R_0)$ -ft with steel ratio = 3% and 10^{mm}-dia spirals spaced $@(D_0/24)$ c/c.

For the pile section, calculate the

- (i) Maximum axial load capacity
- (ii) Ultimate moment capacity
- (iii) Ductility (according to Kent-Park model).

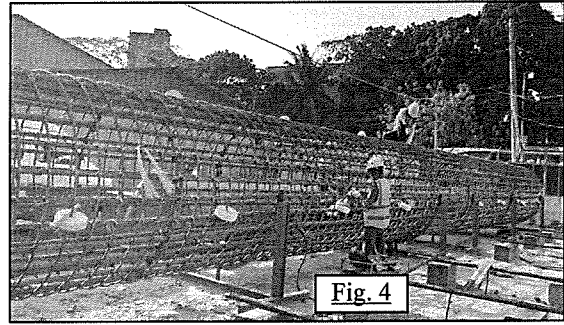


Fig. 4

5. Fig. 5 shows a pile-cap under a $(6' \times 6')$ pier of MRT-6. The pier supports a rail-deck weighing $(15 + 0.05R_0)$ k/ft and train weighing $(5 + 0.02R_0)$ k/ft for an equivalent span-length of $L_0 = (100 + 0.2R_0)$ ft.

If the pile-cap is a $(0.5L_0 \times 0.2L_0)$ rectangle, calculate (i) Uniform soil pressure under the pile-cap

- (ii) Required thickness of the pile cap for an allowable punching shear stress $v_p = 4\phi\sqrt{f'_c}$ around the pier
- (iii) Direct punching shear stress around two circular piles of diameter $D_0 = (6 + 0.02R_0)$ -ft dia, using the pile-cap thickness determined in (ii).
- (iv) Unbalanced moment M_{uv} that will cause a torsional shear stress equal to the direct shear stress calculated in (iii) around each pile.

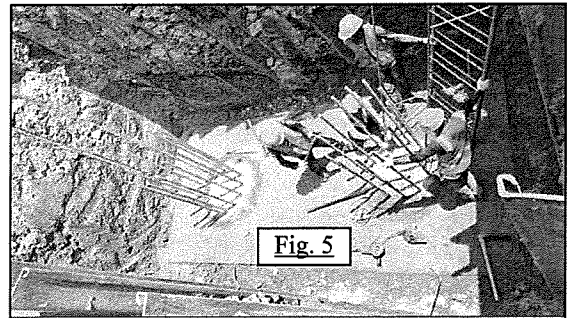


Fig. 5

6. Fig. 6(a) shows the construction and Fig. 6(b) the sections of $(20 + 0.04R_0)$ -ft long steel beams and $(20 + 0.04R_0)$ -ft high steel columns of the Skywalk Deck of MRT-6.

- (i) For distributed load $w_u = (2 + 0.01R_0)$ k/ft on beam ab_1 and beam ab_2 , check if 'Weak-Beam-Strong-Column' condition is satisfied at joint a .
- (ii) Check width-thickness ratio of beam flange and web
- (iii) Calculate the spacing of lateral bracing of the beams.

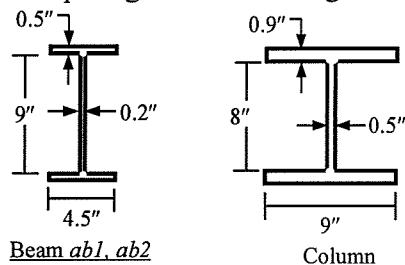


Fig. 6(b)

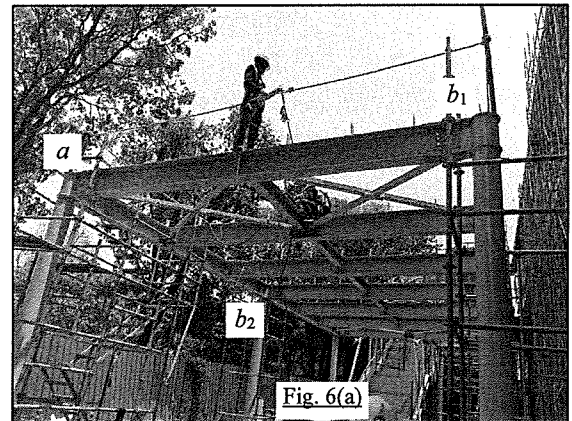


Fig. 6(a)

7. Fig. 7 shows a completed Skywalk Station of MRT-6 with the beam and column sections shown in Question 6. Each floor contains four beams [loaded $w_u = (2 + 0.01R_0)$ k/ft] supported on six columns.

- (i) Calculate the lateral stiffness of the $(10 + 0.02R_0)$ -ft high first floor (including 3'-high 5"-thick brick wall) and $(20 + 0.04R_0)$ -ft high ground floor.
- (ii) Determine modal shape of the first mode of vibration of the Skywalk Station.

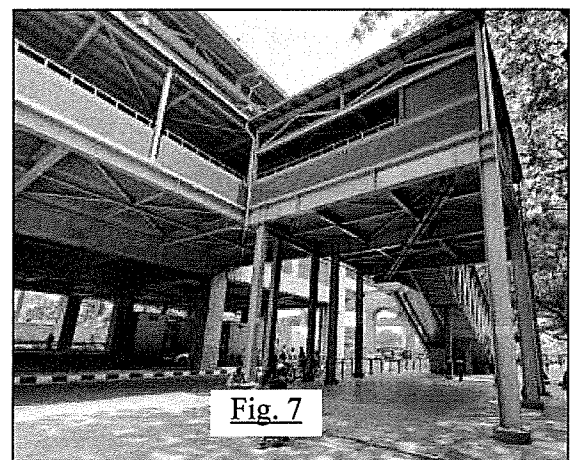


Fig. 7

PART 2

[Answer any 2 (Two) of the following 3 questions]

8. Briefly describe the structural repair and retrofit measures shown in Figs. 8(a)~8(d).

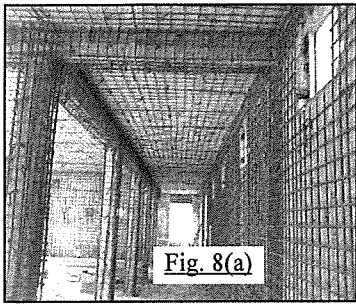


Fig. 8(a)

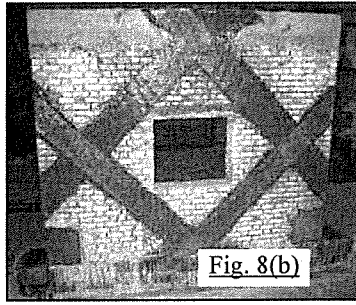


Fig. 8(b)

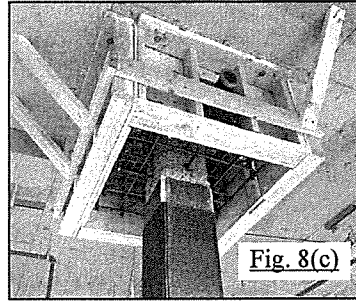


Fig. 8(c)

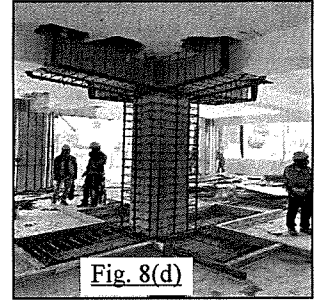


Fig. 8(d)

9. (i) Fig. 9(a) shows the structural plan (with columns and shear walls) and Fig. 9(b) shows the elevation of the 30-storied RC building that collapsed in the Myanmar-Thailand earthquake in 2025.

Use the figures to identify the likely reasons for the collapse of the building.

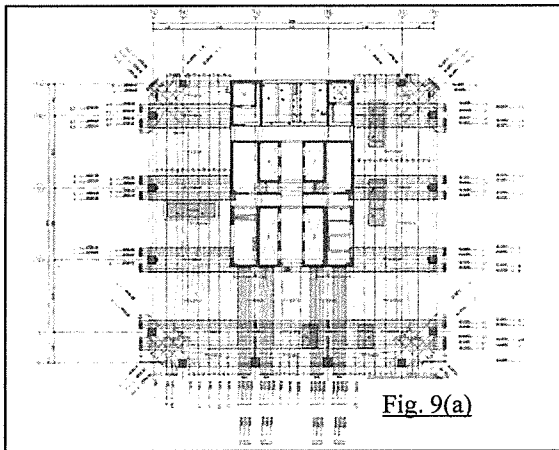


Fig. 9(a)

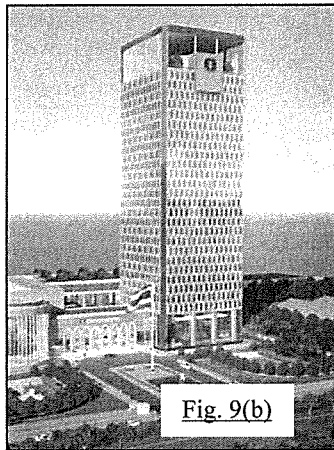


Fig. 9(b)

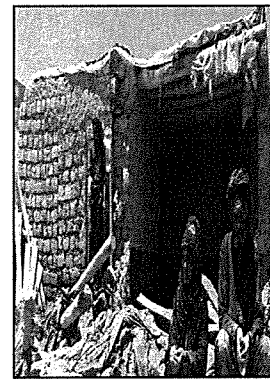


Fig. 9(c)

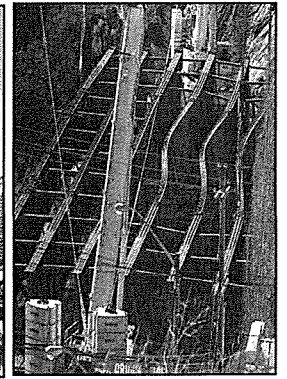


Fig. 9(d)

(ii) Identify the possible reasons for the structural damage of brick masonry in Fig. 9(c) [Afghanistan earthquake (2025)] and steel structure in Fig. 9(d).

10. Briefly describe the measures of structural safety [Figs. 10(a), (b)] and personal safety [Figs. 10(c), (d)] in earthquake.

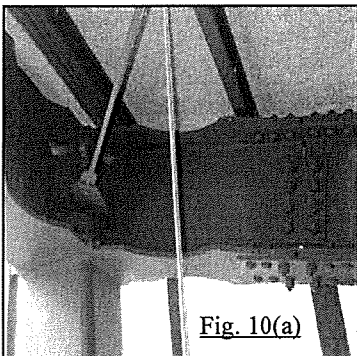


Fig. 10(a)

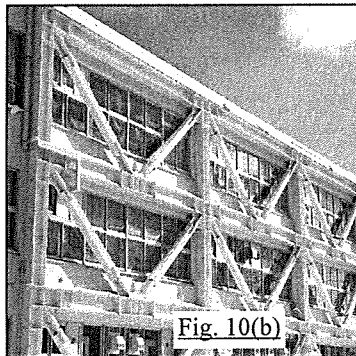


Fig. 10(b)

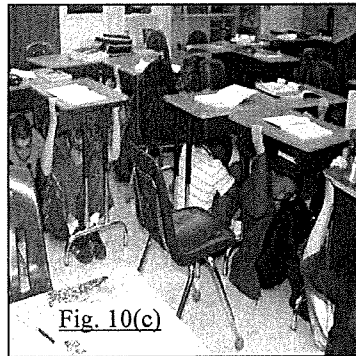


Fig. 10(c)

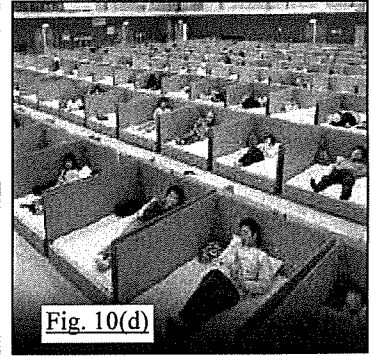


Fig. 10(d)

