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

Course Title: Structural Engineering VI | Course Code: CE 417
Time: 1 hour | Credit Hour: 2.00 | Full Marks: 40

Answer all the questions

QUESTION 1 [12 MARKS]

(i) With a neat sketch, explain the residual stress of structural steel members. Explain the effect of the residual stress on a steel member. [3+3]

(ii) With neat sketches, state the limit states that control the strength of a bolted connection. [6]

QUESTION 2 [14 MARKS]

Determine the design tension capacity (P) of the channel section C15×40 attached to a gusset plate with the bolt configuration shown in **Figure 1**. The material is A36 (F_u= 58 ksi) steel and bolts are 5/8- inch dia. with standard holes. Neglect block shear failure, and assume the gusset plate and bolts have adequate strength against tension. Given: a = 3 in, b = 2 in, and e = 2.5 in. [14]

Section properties of C15×40 section:

A_g (in^2)	d (in)	$\bar{x}$ (in)	$\bar{y}$ (in)	r_x (in)	r_y (in)	t_f (in)	t_w (in)
11.8	15	0.778	7.5	5.43	0.883	0.650	0.520

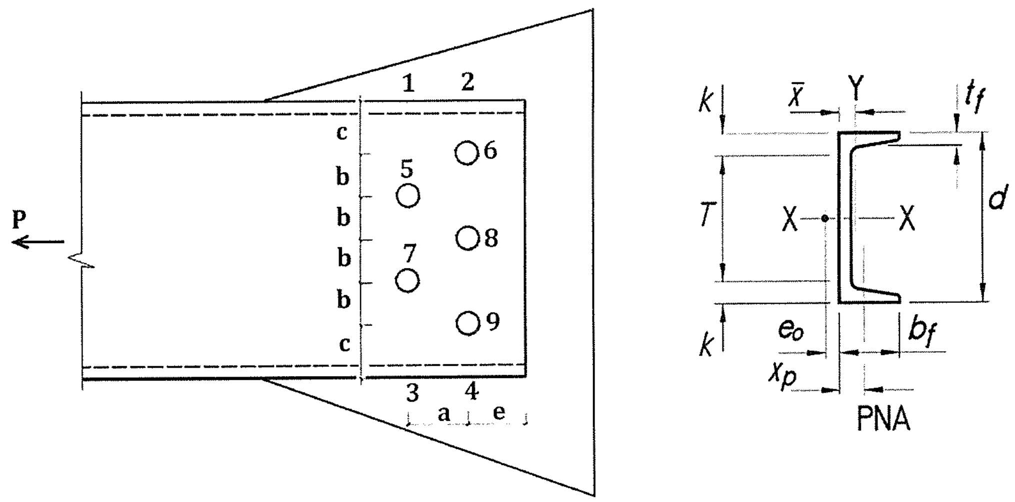


Figure 1

QUESTION 3 [14 MARKS]

Figure 2 shows an eccentrically loaded bolt group where A449 (F_{by} = 90 ksi, F_{bu} = 120 ksi) bolts are used. Determine the required diameter of the bolts to resist the maximum shear. Assume single shear plane for the calculation, and follow **AISC-ASD** approach. [14]

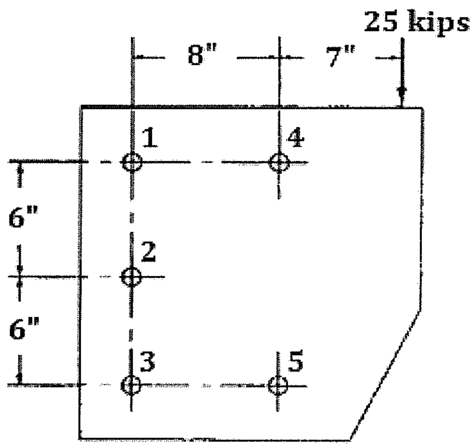


Figure 2

FORMULA

1. $R_n = mA_bF_{nv}$
2. $R_n = 0.6F_yA_{gv} + U_{bs}F_uA_{nt}$
3. $R_n = 0.6F_uA_{nv} + U_{bs}F_uA_{nt}$
4. $R_n = 1.5L_ctF_u \leq 3.0dtF_u$
5. $R_n = 1.2L_ctF_u \leq 2.4dtF_u$
6. $R_n = 1.0L_ctF_u \leq 2.0dtF_u$
7. $R_x = \frac{My}{\Sigma d^2}$ and $R_y = \frac{Mx}{\Sigma d^2}$

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination, Spring 2025
Program: B.Sc. in Civil Engineering
3rd Year 1st Semester

Course Title: Environmental Engineering VII — Course Code: CE 439
Time: 1 hour — Credit Hour: 2 — Full Marks: 40

Answer all the questions

QUESTION 1 [15 MARKS]

Briefly discuss the stages of Environmental Impact Assessment (EIA). [15]

QUESTION 2 [10 MARKS]

Discuss briefly the players/stakeholders of EIA. [10]

QUESTION 3 [5 MARKS]

Discuss the types of environmental impacts. [5]

QUESTION 4 [10 MARKS]

a. What are the criterion air pollutants? Characterize the air based on the value of AQI (Air Quality Index). [5]

b. Discuss why environmental science is an interdisciplinary study. [5]

University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination Spring 2025

Course #: CE 423 | Course Title: Structural Engineering IX

Full Marks: 40 (= 4 × 10) | Time: 1 hour

[Given: $E_c = (3000 + 10R_0)$ ksi, $f_c' = E_c/1000$, $f_y = 20f_c'$, where R_0 = Last three digits of your Registration #]

1. (i) Fig. 1(a) shows fault-line of the Myanmar-Thailand earthquake (March 2025, $M_w = 7.7$) for a zone with Z values ranging between 0.10 and 1.40.

   Use the Esteva and Villaverde (1974) equation to calculate the corresponding (a) Hypocentral distances, (b) Epicentral distances if depth of focus is 10 km.

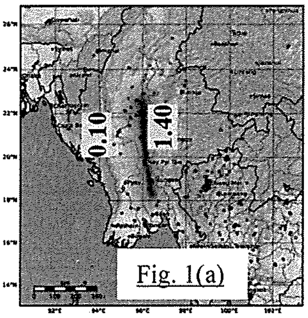


Fig. 1(a)

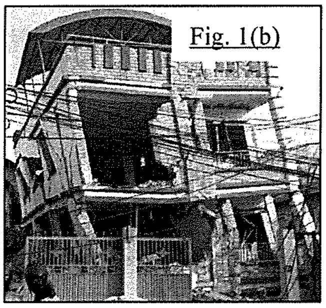


Fig. 1(b)

(ii) Fig. 1(b) shows a RC building damaged in the Myanmar-Thailand earthquake.

Write briefly on the
- Likely reasons for its damages
- Code -based measures that could have reduced such damages.

2.

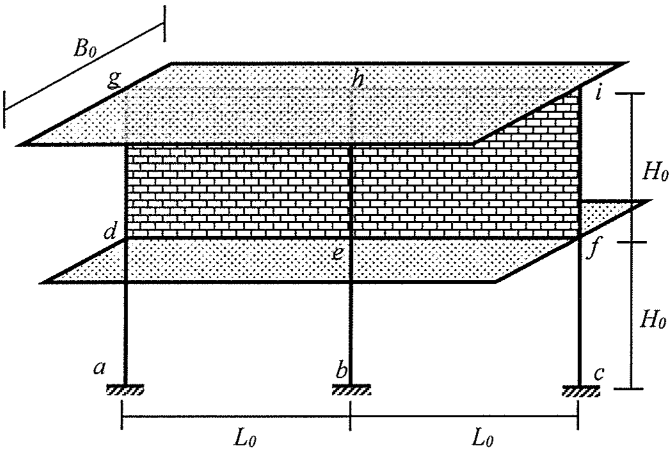


Fig. 2

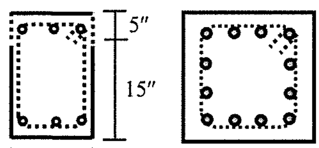
The 2-storied frame shown in Fig. 2 [schematic model of the frame in Fig. 1(b)] weighs 300 psf per floor area and is supported by three (14″×14″) RC columns (Fig. 3) at each floor.

Assume the 2nd floor has a 5″ thick brick masonry infill wall in addition to the columns (dg, eh, fi).

For the 2-DOF system, determine the
(i) Stiffness (k_1, k_2) and mass (m_1, m_2)
(ii) Natural frequencies and modal shapes

[Given: $H_0 = (10 + 0.03R_0)$ ft, $B_0 = 1.2H_0$, $L_0 = 1.5H_0$, For brick masonry, $E_m = E_c/1.5$]

3.



6-16mm bars
Beam

(14″×14″)
12-16mm bars
Column

Fig. 3

Fig. 3 shows the beam and column sections of the 2-storied frame (Fig. 2) described in Question 2.

Check if the '*Weak Beam Strong Column*' condition is satisfied at joint d and e of the frame.

4.

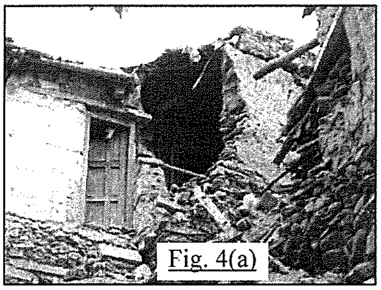


Fig. 4(a)

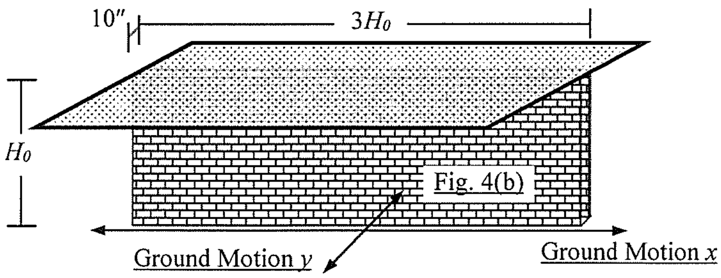


Fig. 4(b)

Ground Motion y

Ground Motion x

Fig. 4(a) shows a 'plain masonry building' damaged in the Afghanistan earthquake (August 2025) and Fig. 4(b) shows a 10″-thick brick wall remaining after the damage. If $H_0 = (10 + 0.03R_0)$ ft, $E_m = E_c/1.5$, and the wall carries weight of $w_0 = (3 + 0.01R_0)$ k/ft, use BNBC 2020 [for Damping Ratio = $(5 + 0.01R_0)$%] to calculate the Ductility Demand (μ) and inelastic base shear (V_b) on the wall due to an 'aftershock' (with Z = 0.15) for (i) Ground motion x (in plane of the wall), (ii) Ground motion y (out of plane of the wall).

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

Course Title: Project Planning and Management — Course Code: CE 401
Time: 1 hour — Credit Hour: 3.00 — Full Marks: 20

Answer all the questions

QUESTION 1 [03 MARKS]

Apply the criteria of continued use, operator deployment, hiring scope, and technological advancements to justify whether purchasing new equipment is the most suitable option for a construction company with a long-term project pipeline and a focus on maximizing productivity. **[03]**

QUESTION 2 [03 MARKS]

Prepare a quality control checklist for RCC work, incorporating specific checks and procedures at each stage of the construction process. **[03]**

QUESTION 3 [05 MARKS]

Table 1 represents the information regarding different activities, their durations and dependencies of a small pedestrian bridge construction project.

Table 1. Activities, their durations and dependencies of the project

Activity	Description	Duration (Weeks)	Predecessors
A	Site Survey & Design	2	-
B	Foundation Excavation	3	A
C	Concrete Pouring	4	B
D	Steel Truss Assembly	5	B
E	Decking & Railing Installation	4	C
F	Electrical & Lighting	2	E
G	Final Inspection	1	E, F

a. Employ your knowledge of bar diagram construction to create a visual representation of the project schedule. Predict the total project completion time. **[04]**

b. The project manager reports that at the end of week 10, activities A, B, and C are completed, activity D is 60% completed, and activity E has not started yet. Analyze the project's progress using your bar diagram and determine the impact on the overall project schedule. Propose specific actions the project manager should take to mitigate potential delays, justifying your recommendations. **[01]**

QUESTION 4 [09 MARKS]

A university research group is launching a study on the durability of ultra-high-performance concrete (UHPC) in marine environments. The research involves multiple stages, including material selection, specimen casting, curing under different conditions, accelerated aging tests, mechanical testing, microstructural analysis, and statistical data interpretation. Based on the experimental plan, the team has developed a **PERT network** showing the three estimated durations (i.e., **optimistic**, **most likely**, and **pessimistic**) for each research task, as illustrated in **Figure 1**. Apply PERT network analysis techniques to determine the following critical project parameters:

a. The Expected Time for each activity. **[01]**

b. The Earliest Expected Time and Latest Allowable Occurrence Time for each event. **[06]**

c. The Slack Time for various events. **[01]**

d. The Critical Path and Expected Project Duration. **Illustrate the Critical Path on the Network Diagram.** **[01]**

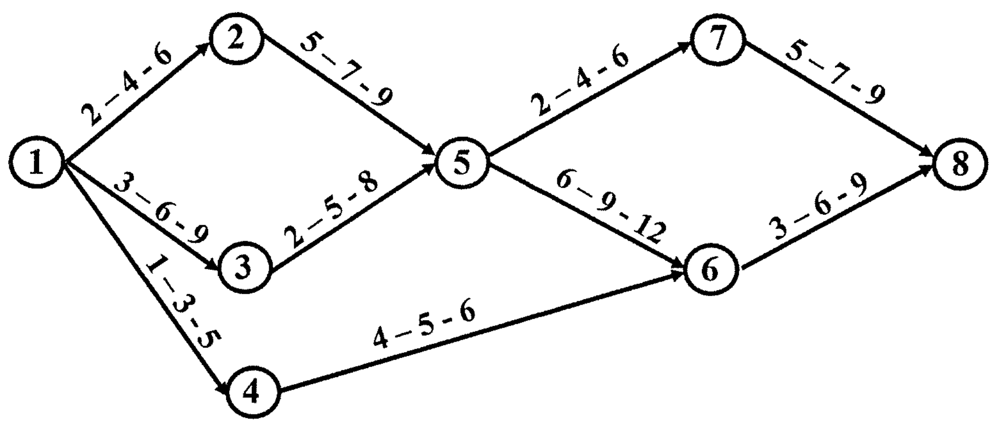


Figure 1. PERT network with different time estimates

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University of Asia Pacific
Department of Civil Engineering
Mid Semester Examination, Spring 2025
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering III | Course Code: CE 411
Time: 1 hours | Credit Hour: 3.00 | Full Marks: 40

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. Use stiffness method (neglecting axial deformations) to calculate deflection of joints ***a, c, e*** and rotation of joint ***d*** of the frame ***abcdef*** loaded as shown in ***Fig.1***.
   [Given: EI = 50×10^3 k-ft^2] [10]
2. Identify zero-force members of the 2D truss loaded as shown in ***Fig.2***. Determine the displacements of joints ***a*** and ***b***.
   [Given: EA/L =500 k/ft]. [10]

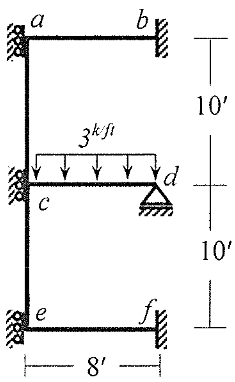


Fig.1

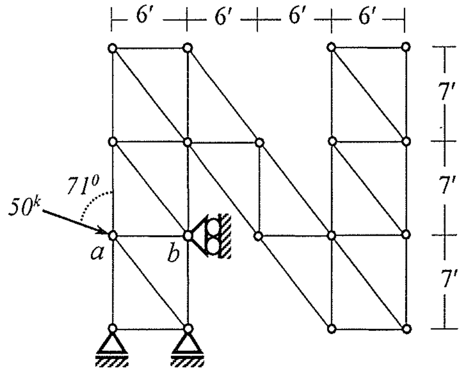


Fig.2

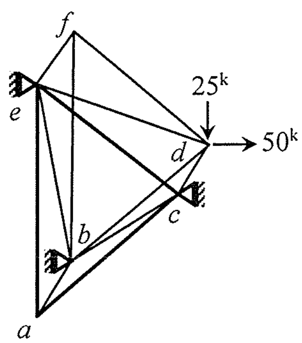


Fig.3

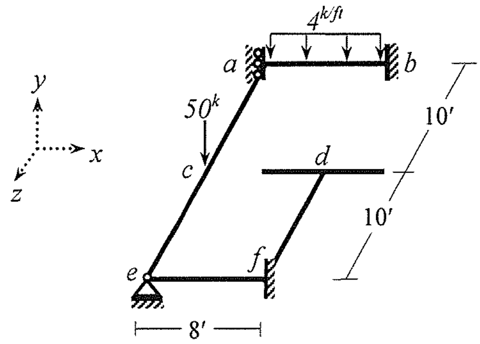


Fig.4

3. Ignore zero-force members of the space truss ***abcdef*** shown in ***Fig.3*** and apply boundary conditions to formulate stiffness matrix and load vector.
   [Given: S_x = 500 k/ft, Nodal Coordinates (ft) are *a*(0,0,0), *b*(0,0,-5), *c*(10,10,0), *d*(10,10,-5), *e*(0,20,0) and *f*(0,20,-5)]. [10]
4. Use stiffness method to calculate deflection of joint ***a*** and rotations of joint ***e*** of the grid system ***abcdef*** loaded as shown in ***Fig.4***.
   [Given: EI = 50×10^3 k-ft^2 and GJ = 5×10^3 k-ft^2]. [10]

List of Useful Formulae for CE 411

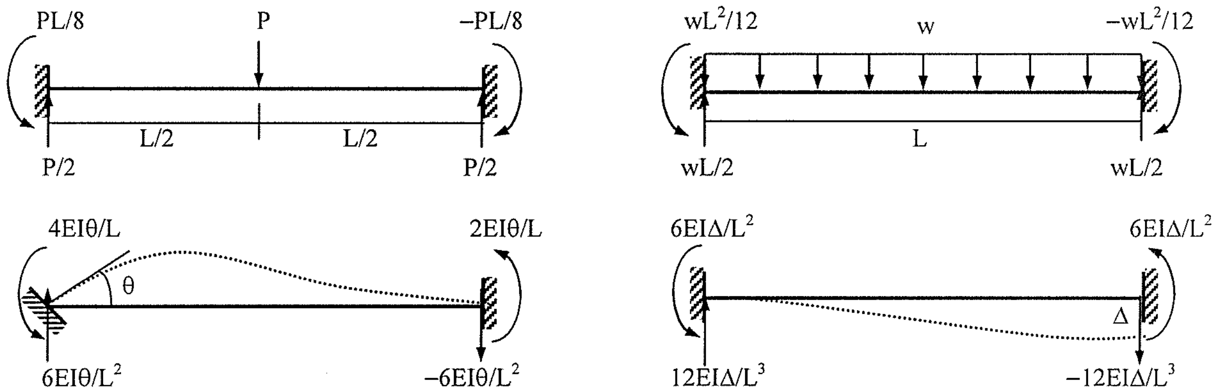
* The stiffness matrix $\mathbf{K}_m^G$ of a 2D truss member in the global axis system is given by

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

and Truss member force, $P_{AB} = S_x\,[(u_B - u_A)\,C + (v_B - v_A)\,S]$

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

<u>Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings</u>



* 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

$$\mathbf{K}_m^G = S_x \begin{pmatrix} C_x^2 & C_xC_y & C_xC_z & -C_x^2 & -C_xC_y & -C_xC_z \\ C_yC_x & C_y^2 & C_yC_z & -C_yC_x & -C_y^2 & -C_yC_z \\ C_zC_x & C_zC_y & C_z^2 & -C_zC_x & -C_zC_y & -C_z^2 \\ -C_x^2 & -C_xC_y & -C_xC_z & C_x^2 & C_xC_y & C_xC_z \\ -C_yC_x & -C_y^2 & -C_yC_z & C_yC_x & C_y^2 & C_yC_z \\ -C_zC_x & -C_zC_y & -C_z^2 & C_zC_x & C_zC_y & C_z^2 \end{pmatrix}$$

$C_x = L_x/L$, $C_y = L_y/L$, $C_z = L_z/L$ where $L = \sqrt{[L_x^2 + L_y^2 + L_z^2]}$

* 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

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

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

$$\mathbf{K}_m^G = \begin{pmatrix} S_xC^2+S_1S^2 & (S_x-S_1)CS & -S_2S & -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & -S_2S \\ (S_x-S_1)CS & S_xS^2+S_1C^2 & S_2C & -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & S_2C \\ S_2S & S_2C & S_3 & S_2S & -S_2C & S_4 \\ -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & S_2S & S_xC^2+S_1S^2 & (S_x-S_1)CS & S_2S \\ -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & -S_2C & (S_x-S_1)CS & (S_xS^2+S_1C^2) & -S_2C \\ -S_2S & S_2C & S_4 & S_2S & -S_2C & S_3 \end{pmatrix}$$