University of Asia Pacific
Department of Civil Engineering
Mid Term Examination Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management — Course Code: CE 401
Time: 1 Hour — Credit Hours: 3.00 — Full Marks: 60

Answer all the questions.

1. (a) Briefly explain the problems encountered in Construction Industry. **[08]**

   (b) Give some examples of personal protective equipment in construction site. Also mention which part of the body will these equipment protect? **[07]**

2. A project consists of 8 activities A to H with their times of completion as follows:

Activity	A	B	C	D	E	F	G	H
Duration (weeks)	2	4	2	4	6	4	5	4

The precedence relationships are as: ⇒ A and B can be performed parallel, ⇒ C and D cannot start until A is completed, ⇒ E cannot start until half the work of activity C is completed, ⇒ F can start only after activity D is complete, ⇒ G succeeds C, ⇒ H is the last activity which should succeed E.

(a) Draw the bar chart. [***Use the Graph Paper attached with this Question Paper and attach the graph with your answer script.***] **[12]**

(b) What is the total time of completion of the project? **[03]**

3. The following project represents construction of a new drive-in weighing station for a company.

Activity Name	Description	Preceding Task
A	Lay Foundation	-
B	Dig Hole for Scales	-
C	Insert Scale Bases	B
D	Erect Frames	A, C
E	Complete Building	D
F	Insert Scales	E
G	Insert Display Cases	E
H	Install Office Equipment	G
I	Finish	H, F

Draw **Network Diagram** for the activities of the project identifying each activity. **[10]**

4. A construction company has an opportunity to submit a bid for the construction of a new factory building. From the specification provided by the client, the PERT Network along with the expected completion time (in weeks) for each activity is shown in ***Figure 1***.

(a) Analyze the Network to determine the Earliest Expected Time and Latest Allowable Occurrence Time for each event. **[15]**

(b) Determine the slack for various events. **[02]**

(c) Identify the Critical Path and show it on the Network. **[03]**

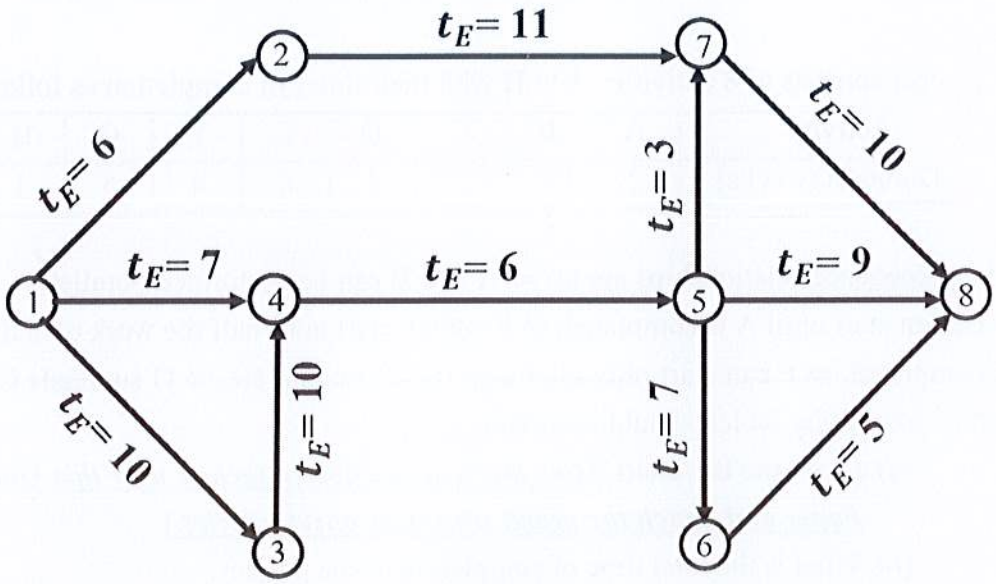


Figure 1

.....

ID:.....

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2022
Program: B. Sc. Engineering (Civil)

Course Title: Structural Engineering III | Course Code: CE 411
Time: 1 hour | Credit Hour : 3.0 | Full Marks: 4 × 10

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

1. Use stiffness method (neglect axial deformations) to calculate deflection of joint *a* and rotation of joint ***b*** of the frame ***abcde*** loaded as shown in ***Fig.1***
[Given: $EI = 44\times10^3$ *k-ft*^{2}].

2. Ignore zero-force members of the space truss ***abcdefghij*** shown in ***Fig. 2*** and apply boundary conditions to formulate stiffness matrix and load vector
[Given: S_x = *1200 k/ft*, Nodal Coordinates (ft) are *a(0,0,0), b(-5,0,-10), c(5,0,-10), d(0,–10,0), e(-5,-10,-10), f(5,-10,-10), g(0,-20,0), h(-5,-20,–10)* and *i(5,-20,-10)*].

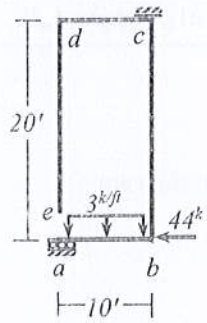


Fig. 1

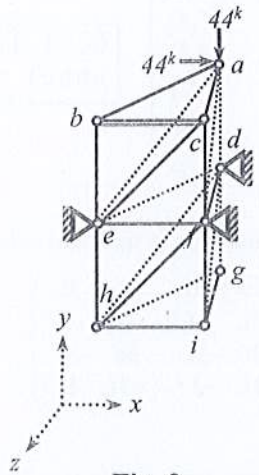


Fig. 2

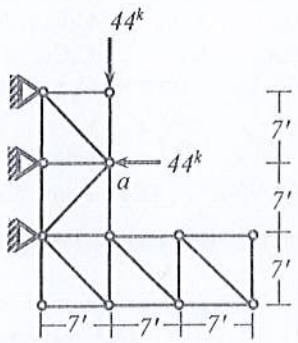


Fig. 3

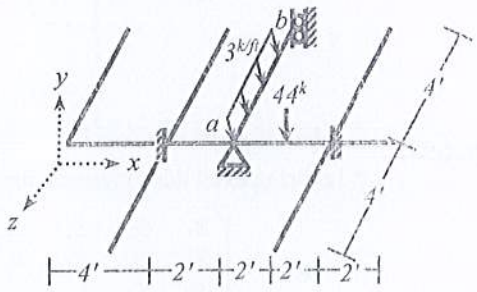


Fig. 4

3. For the truss loaded as shown in ***Fig. 3***
(i) Identify zero-force members
(ii) Determine the horizontal and vertical displacements of joint *a*.
(iii) Calculate the member forces
[Given: *EA/L =1200 k/ft*].

4. Use stiffness method to calculate rotations (θ_x, θ_z) of joint *a* and displacement of joint *b* of the grid system loaded as shown in ***Fig. 4***
[Given: $EI = 44\times10^3$ *k-ft*^{2} and $GJ = 22\times10^3$ *k-ft*^{2}].

List of Useful Formulae for CE 411

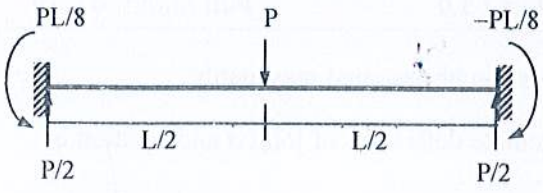
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

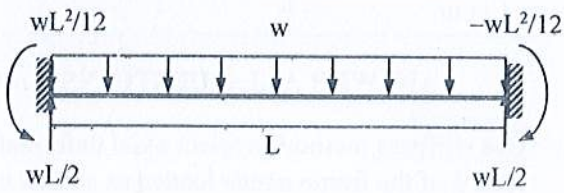
$$\mathbf{K_m}^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

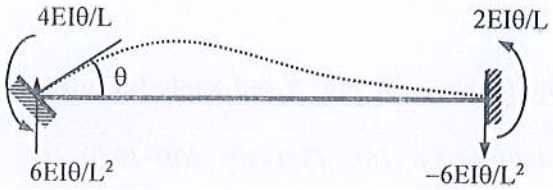
and Truss member force, $P_{AB} = S_x [(u_B - u_A) C + (v_B - v_A) S]$

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

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

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

$C_x = L_x/L$, $C_y = L_y/L$, $C_z = L_z/L$
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

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

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering II | Course Code: CE ~~203~~ 441
Time: 1.0 hour | Credit Hour: 3.0 | Full Marks: 40

Answer the following questions

1. (a) Mention the steps/phases of a geotechnical sub-surface exploration program. 2

(b) Write down the names of any five (5) in-situ testing performed in the field under the field investigation phase of a sub-surface exploration program. Which one is most commonly used? 2

(c) Write a very short note on the occurrence degree of disturbances that are inherent during sampling of cohesive and cohesionless soil. Is it possible to collect absolutely undisturbed sample? Justify your answer 7

(d) Discuss, in brief, on any one (except standard penetration test) of the in-situ tests. 4

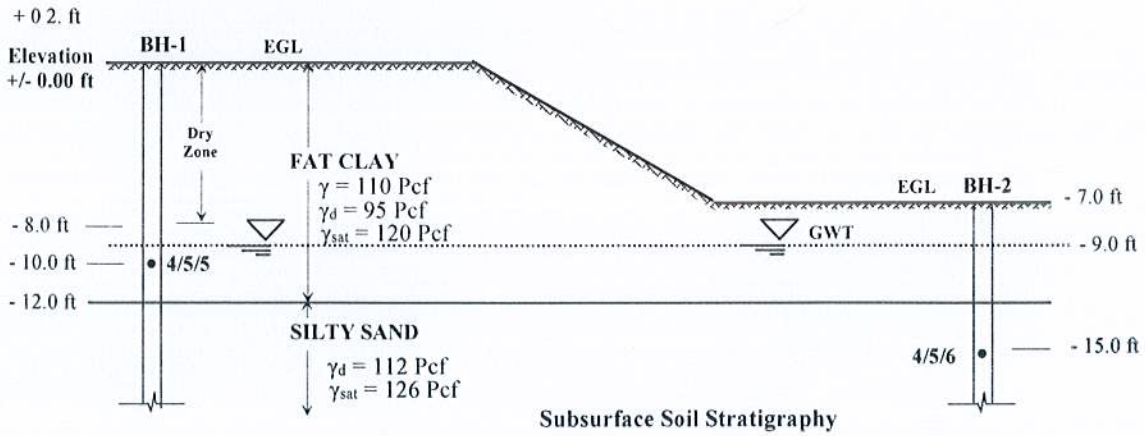
2. Utilizing 10% stress criterion and the following considerations the depth of exploration for a project is estimated 30 feet below EGL. 9

Considerations:
- Maximum column load = P_{max}
- Allowable bearing capacity = 2.0 ksf
- Depth of footing = 9 feet
- L = 1.5B

Determine the dimensions of the footing and P_{max} considered for the above scenario.

3. Subsurface stratigraphy as obtained at a site in Japan for **BH-1** and **BH-2** are summarized and depicted in the figure below. 9

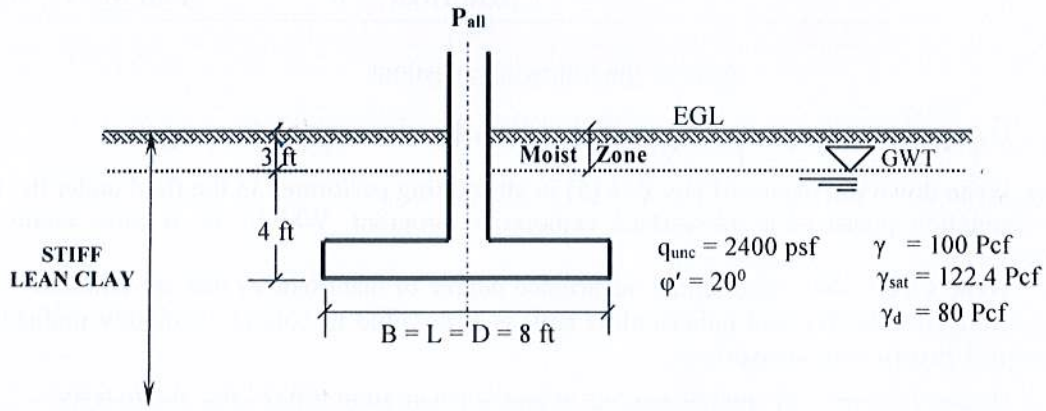
- Same hammer was used for both boreholes
- Liner was used
- Borehole diameter = 8 inches
- Shear strength parameter (C) at 10 feet below EGL for FAT CLAY as determined using correlation $q_{unc} = 300\ N_{60}$, is 1800 psf



Subsurface Soil Stratigraphy

Determine Hammer Efficiency (E_m). Also determine the angle of internal friction for SILTY SAND of BH-2.

4. Using Terzaghi's bearing capacity equation, determine the allowable bearing capacity for the circular footing for the conditions shown in the figure below. Also determine the allowable load (P_{all}) that can be safely applied on the footing. 7



University of Asia Pacific
Department of Civil Engineering
Midterm Examination – Spring 2022
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 1 hour | Credit Hour: 3:00 | Full Marks: 60

1. a) Briefly discuss three major layers of flexible pavement with a neat sketch. (5.0)

   b) What are the basic differences between the CBR test and the Plate Bearing test of soil? (2.0)

   c) How will you get bitumen as long residue from petroleum crude oil? (3.0)

2. a) Determine the proportions of separate aggregates (coarse, fine, and filler materials) to make a typical mix for highway pavement construction that will give a gradation within the specified limits shown in Table 1. Table 1 also shows the results of the sieve analysis of samples from the materials available. (20.0)

   b) Design an asphalt concrete mixture for the pavement [question 2(a)] you have to construct to support heavy traffic. Use the aggregate proportions obtained from previous question 2 (a). Table 2 shows data obtained from the Marshall method. Determine the required asphalt content for this mixture against (i) the maximum unit weight and (ii) the maximum percent voids in mineral aggregates. Aggregate characteristics are given in Table 3. (25.0)

   c) Do you think this mixture is suitable for the construction of highway pavement? Can the bitumen content found in the mix design resist deformation under heavily loaded traffic? Justify your answer. (5.0)

Table 1: Sieve Analysis Results

Sieve Designation	Required Gradation Range	Percent by Weight		
		Coarse Aggregate	Fine Aggregate	Mineral Filler
Retained on ½ in	2-35	25	-	-
Retained on 3/8 in	5-50	29	-	-
Retained on No 10	32-70	46	22	10
Passing on No 10	20-55	-	42	52
Passing No 200	5-20	-	36	38
Total		100	100	100

Table 2: Marshall Test Data

Asphalt % by Weight of Total Mix	Weight of Specimen in Air (gm)	Weight of Specimen in Water (gm)	Stability (lb)	Flow (0.01 in)	Maximum Specific Gravity
5.0	1344	778	1290	3.8	2.67
5.5	1570	912	1520	4.5	3.45
6.0	1298	633	1080	2.7	1.78

Table 3: Aggregate Characteristics

Aggregate Type	Bulk Specific gravity
Coarse	2.65
Fine	2.70
Filler	2.75

Required Formula:

$$G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{(P_{ca}/G_{bca}) + (P_{fa}/G_{bfa}) + (P_{mf}/G_{bmf})}$$

$$VMA = 100 - \frac{G_{mb}P_s}{G_{sb}}$$

$$P_a = 100\,\frac{G_{mm} - G_{mb}}{G_{mm}}$$