University of Asia Pacific
Department of Civil Engineering
Mid Term Examination Spring 2023
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. "Administration is a thinking and decision-making function whereas Management is an executing function."

   In reference to the above quoted statement, demonstrate the discrepancies between management and administration on the basis of nature, functions and required skills. **[08]**

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 follows:
   - ⇒ 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 completed
   - ⇒ G succeeds C
   - ⇒ H is the last activity which should succeed E

   (a) Construct a bar chart for the project. **[15]**
   (b) Predict the total time of completion of the project. **[05]**

3. Demonstrate the differences between PERT and CPM network. **[07]**

4. A construction company has an opportunity to submit a bid for the construction of a new commercial 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***. Apply PERT network analysis technique to determine the followings:

(a) The Earliest Expected Time and Latest Allowable Occurrence Time for each event. [15]

(b) The slack for various events. [05]

(c) The Critical Path. **Show the Critical Path on the Network.** [05]

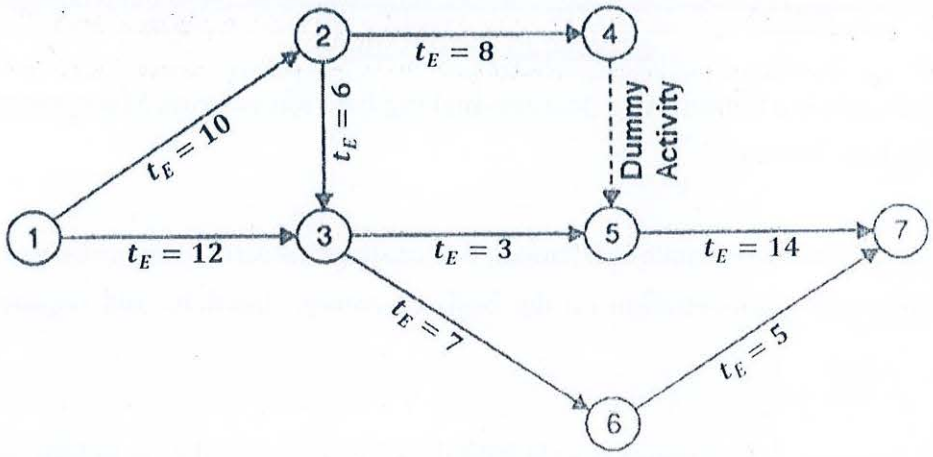

Figure 1

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University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2023
Program: B.Sc. in Engineering (Civil)

Course Title: Structural Engineering III | Course Code: CE 411
Time: 1 hour | Credit Hour: 3.0 | Full Marks: 4 × 10 = 40

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

1. Ignore zero-force members of the space truss ***abcdefgh*** shown in ***Fig.1*** 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(0,0,8), c(0,-20,0), d(0,–20,8), e(5, -15,0), f(5,-15,8), g(10,-20,0) and *h(10,-20,8)*].

2. Use stiffness method to calculate the displacement of joint ***f*** and rotations of joint ***b*** of the grid system ***abcdefg*** loaded as shown in ***Fig.2***
   [Given: $EI = 20\times10^3$ *k-ft*^{2} and $GJ = 10\times10^3$ *k-ft*^{2}].

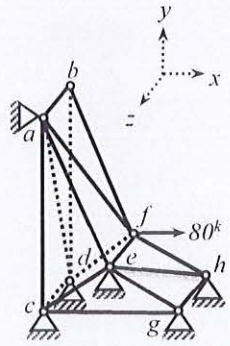


Fig.1

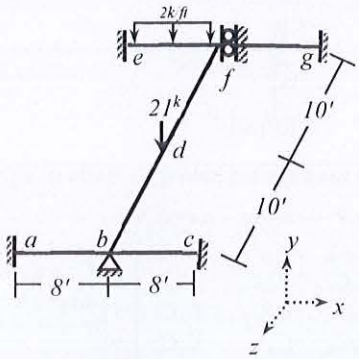


Fig.2

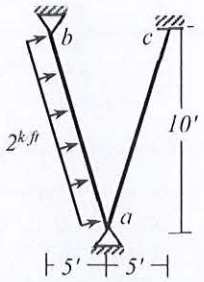


Fig.3

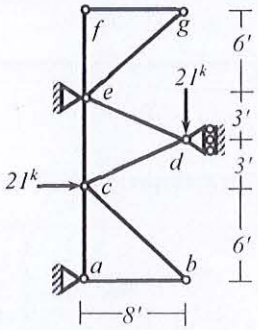


Fig.4

3. Use stiffness method (neglecting axial deformations) to calculate the rotations of joints ***a*** and ***b*** of the frame ***abc*** loaded as shown in ***Fig.3***
   [Given: $EI = 20\times10^3$ *k-ft*^{2}].

4. Identify zero-force members of the truss ***abcdefg*** loaded as shown in ***Fig.4***.
   Determine the displacements of joints ***c*** and ***d***.
   Also, calculate the member force of ***cd***
   [Given: $EA/L = 1200$ *k/ft*].

List of Useful Formulae for CE 411

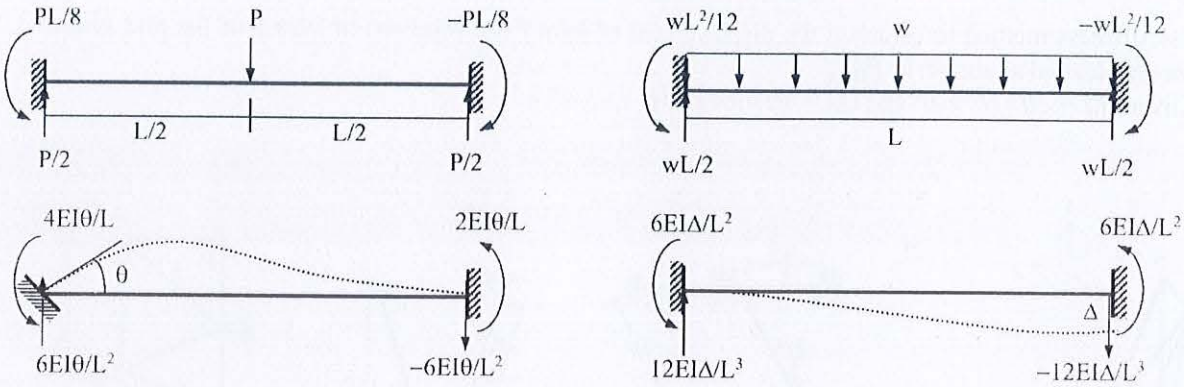
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

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

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
Mid-Term Examination, Spring 2023

Course # CE 441 — Course Title: Geotechnical Engineering II
Full Marks: 40 (10 X 4 = 40) — Time: 1 hour

Answer all questions

1. (a) Mention three major purposes of geotechnical subsurface exploration. 3
   (b) Mention the steps/phases of a geotechnical sub-surface exploration program. 2
   (c) Write down any three general guidelines used for the selection of depth of boreholes. 3
   (d) Briefly discuss regarding disturbances of cohesionless soil due to sampling. 5

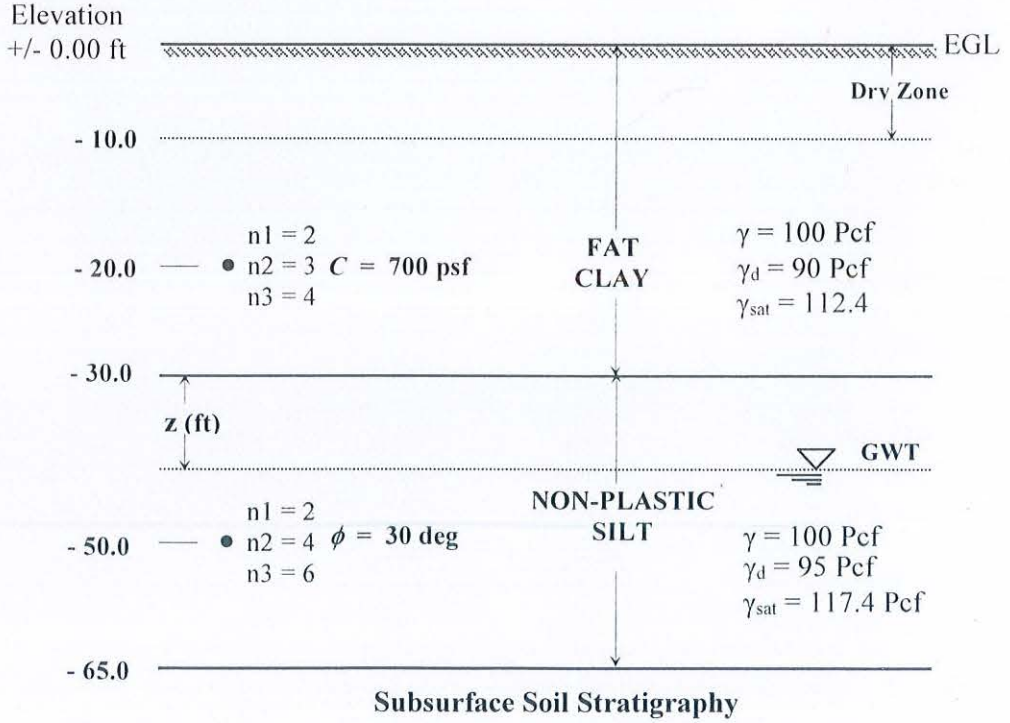
2. Determine and comment on the factor of safety of a building for the following two cases: 7

Case I:
- B = 8 ft; L = 10 ft
- Estimated column load on this footing = 240 kips
- Estimated ultimate bearing capacity as determined from geotechnical analysis performed for this site = 9,000 psf.

Case II:
- Another story is built on the top of the building
- Additional estimated column load for one-story vertical extension of the building = 160

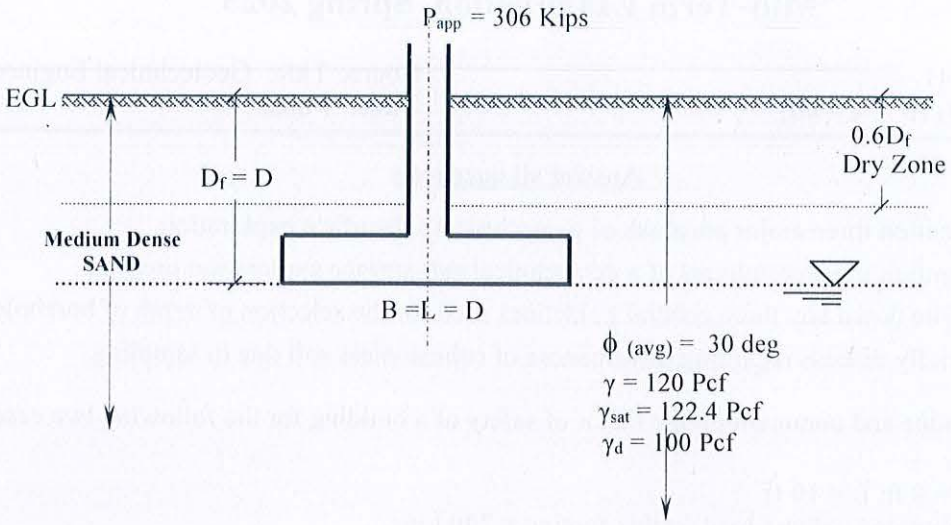
3. A geotechnical site investigation was conducted at a site in Bangladesh. Estimate z as shown in the figure below. Use *APPENDIX A* in conjunction with the following information: 10
- Borehole dia = 4 inches
- No liner was used during drilling
- Notice that hammer efficiency is not provided

n1 = SPT blow counts for first 6-inch penetration
n2 = SPT blow counts for second 6-inch penetration
n3 = SPT blow counts for third 6-inch penetration



Subsurface Soil Stratigraphy

4. Using Terzaghi's bearing capacity equation (TBCE), determine the allowable column load for the following spread footing. Use F. S. = 2.5. Also determine the allowable bearing capacity. 10



University of Asia Pacific
Department of Civil Engineering
Midterm Examination – Spring 2023
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) Discuss the load distribution mechanism of flexible pavement. (5.0)

   b) What are the basic differences between the CBR test and the Plate Bearing test of soil? (4.0)

   c) Briefly discuss about the following tests: (6.0)
      i) Soundness test of aggregates
      ii) Water content test of bitumen

2. a) You have to design an asphalt concrete mixture for a highway pavement supporting heavy traffic. Table 1 and 2 shows data obtained from sieve analysis and Marshall method. Determine the optimum asphalt content for this mix for the specified limits given in Table 3. (The nominal maximum particle size in the aggregate mixture is 3/8 in.). Comment on stability of the mixture. Also determine the aggregate proportions to obtain the required gradation for the mix. (20+5 +5)

Table 1: Sieve Analysis Results

Sieve designation	% by weight	Bulk Specific Gravity
Retained on ½ in	2-30	3.74
Retained on 3/8 in	15-50	2.46
Retained on No 10	30-75	3.15
Passing on No 10	20-65	2.58
Passing No 200	5-20	2.60

Table 2: Marshall Method

Asphalt %	Weight of specimen in Air (gm)	Weight of specimen in Water (gm)	Stability with error (lb)	Volume of specimen (cm^3)	Flow (in)	Maximum Specific gravity
3.0	1362	780	1540	478	5.7	2.46
3.5	1457	920	1890		4.6	2.87
4.0	1511	845	1475		6.2	2.35

3. The following results were obtained by a mechanical sieve analysis. Classify the soil according to the AASHTO classification system and give the group index. Discuss whether this material is suitable in its natural state for use as a subbase material. (10+5)

Sieve No.	Percent Finer	Plasticity Test
4	78	LL=45%, PL= 19%
10	83	
200	35	

Required Formula:

$$P_{ba} = 100\frac{G_{se} - G_{sb}}{G_{sb}G_{se}}G_b \qquad VMA = 100 - \frac{G_{mb}P_s}{G_{sb}} \qquad P_a = 100\frac{G_{mm} - G_{mb}}{G_{mm}}$$

$$G_{se} = \frac{100 - P_b}{(100/G_{mm}) - (P_b/G_b)} \qquad G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}}$$

:1: Correction factors for Marshall stability values

Volume of specimen (cm^3)	Thickness of specimen (mm)	Correction Factor
457 - 470	57.1	1.19
471 - 482	68.7	1.14
483 - 495	60.3	1.09
496 - 508	61.9	1.04
509 - 522	63.5	1.00
523 - 535	65.1	0.96
536 - 546	66.7	0.93
547 - 559	68.3	0.89
560 - 573	69.9	0.86

Table 3 Suggested Test Limit

Marshall Method Mix Criteria	Light Traffic	Medium Traffic	Heavy Traffic
Compaction (No. of blows each end of Specimen)	35	50	75
Stability N (lb)	3336(750)	5338(1200)	8006(1800)
Flow 0.25 mm (0.01 in)	8 to 18	8 to 16	8 to 14
Air Voids (%)	3	3 to 5	- .. 5
Mineral Percentage of Voids in Mineral Aggregates			
Standard Sieve Designation		%	
No. 16		23.5	
No. 4		21	
No. 8		18	
3/8 in.		16	
½ in.		15	
¾ in.		14	
1 in.		13	
1 ½ in.		12	
2 in.		11.5	
2 ½ in.		11	

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Spring 2023
Program: B.Sc. Engineering (Civil)

Course Title: Irrigation and flood control **Course Code: CE 461**
Time: 1 hour **Credit Hour: 3** **Full Marks: 20**

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1. a) Explain why leaching requirement increases near the coastal areas. **(3)**

   b) Do you agree that too much reliance on "surface water" for irrigation management in Bangladesh is unsustainable in the long run? Justify your answer. **(4)**

2. a) Do you agree that *furrow irrigation method* is an appropriate irrigation method for the food production in Bangladesh? Justify your answer. **(3)**

   b) Estimate depth of ground water evaporation that may turn **X** cm depth of soil saline over a period of **Y** months. The electrical conductivity of groundwater is 4.5 mmhos/cm. The electric conductivity (EC) value of saturated extract of soil is 1 mmhos/cm. The soil has a mean bulk density of 1.45 g/cm^3 and saturation point of 40 percent. The density of water is assumed as 1 g/cm^3. (**X** = your roll number; **Y** = 4 + your roll number) **(2)**

3. a) Select one structural and one non-structural measures of flood management that you think most appropriate for reducing flood related hazards in Bangladesh. Justify your answer. **(4)**

   b) Summarize five benefits of international cooperation to reduce water scarcity in Bangladesh during non-monsoon season. **(4)**