University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2022
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: $S_x = 1952$ *k/ft*, Nodal Coordinates (ft) are
a(0,0,0), b(0,0,10), c(10,0,5), d(0,–10,0), e(0, -10,10), f(10,-10,5), g(0,-20,0) and *h(0,-20,10)*].

2. Use stiffness method (neglecting axial deformations) to calculate the rotations of joints ***c*** and ***e*** of the frame ***abcdef*** loaded as shown in ***Fig.2***
[Given: $EI = 21\times10^3$ *k-ft*^{2}].

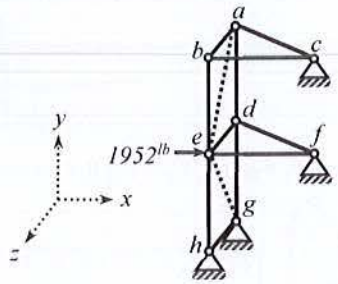


Fig.1

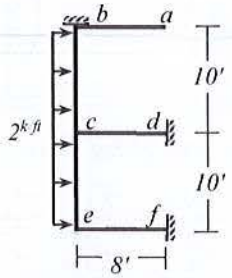


Fig.2

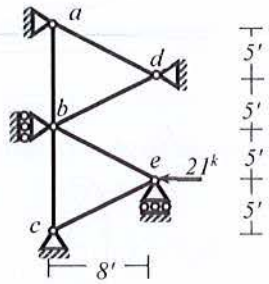


Fig.3

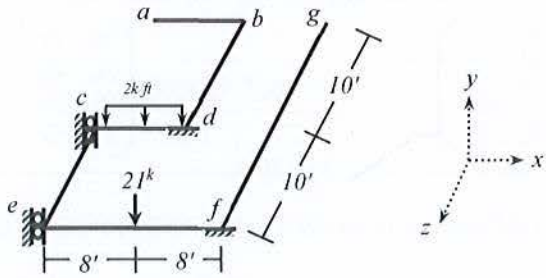


Fig.4

3. Identify zero-force members of the truss loaded as shown in ***Fig.3***.
Determine the horizontal displacement of joint ***e*** and vertical displacement of joint ***b***.
Also calculate member forces
[Given: $EA/L = 1952$ *k/ft*].

4. Use stiffness method to calculate displacements of joint ***c*** *and* ***e*** of the grid system loaded as shown in ***Fig.4***
[Given: $EI = 21\times10^3$ *k-ft*^{2} and $GJ = 18\times10^3$ *k-ft*^{2}].

List of Useful Formulae for CE 411

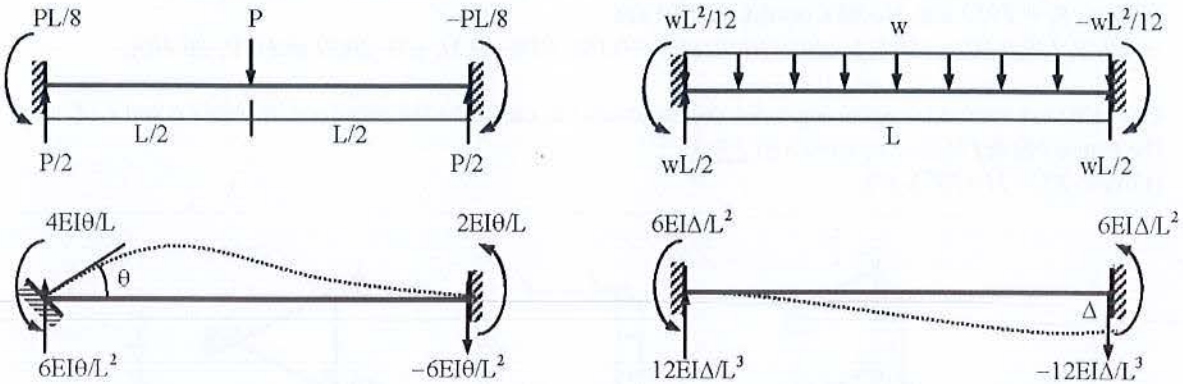
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

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

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 – Fall 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) Compare the different types of joints in rigid pavement. (3.0)

   b) Describe the basic requirements needed to check for the bituminous mix design. (5.0)

   c) What is the major difference between bulk, apparent and effective specific gravity of aggregate? (2.0)

   d) Briefly discuss about the following tests: (5.0)
      i) Ductility test of bitumen mixes
      ii) Abrasion test of Aggregate

2. a) Design an asphalt concrete mixture for a highway pavement supporting light 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 2 in.). Comment on stability and flow of the mixture. (20.0+5.0)

Table 1: Sieve Analysis Results

Retained on Sieve designation	% by weight	Bulk Specific Gravity
4.75 mm	7-47	3.44
2.00 mm	50-67	2.96
0.425 mm	10-25	3.55
0.180 mm	8-28	2.15
0.075 mm	5-15	3.08

Table 2: Marshall Method

Asphalt %	Weight of specimen in Air (gm)	Weight of specimen in Water (gm)	Stability (lb)	Flow (in)	Maximum Specific gravity
4.0	1252	670	1410	5.5	2.53
4.5	1327	813	1650	3.8	2.70
5.0	1431	725	1370	6.4	2.63

   b) Determine the asphalt absorbed for optimum mix based on the optimum asphalt content found in previous question [Q.2 (a)]. the maximum specific gravity for the mixture is 3.44 and the specific gravity of the asphalt content is 2.03. The aggregate characteristics are shown in table 1 of the previous [Q.2 (a)]. (20.0)

Required Formula:

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

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

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 to 11	5 to 15	7 to 20
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
Mid Term Examination Fall 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) "An Engineer is hired for his or her Technical skills, fired for Poor skills and promoted for Leadership and Management skills."

   To what extent do you agree with the above quoted statement? Justify your answer with relevant explanation. **[08]**

   (b) How will you ensure the quality of construction materials prior to the beginning of erection work and during the erection work? **[07]**

2. Draw the bar chart for "**Finalization of designs and work order**" for a **Bridge Construction Project**. Assume appropriate activities and their relationships. The duration of the project should be **25 weeks**. **[15]**

3. ***Table 1*** shows a list of activities and their immediate predecessors for a project.

Table 1

Activity	Immediate Predecessors
A	-
B	-
C	A
D	A, B
E	C
F	C
G	D, E
H	F, G

   Construct **Network Diagram** for the activities of the project. **[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) Analyze your results to determine the slack for various events. **[02]**

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

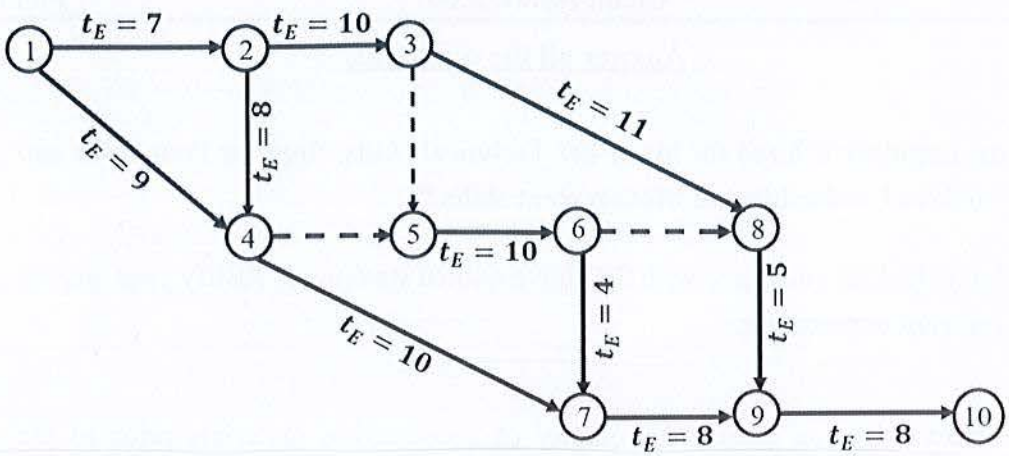


Figure 1

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

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

Answer the following questions

1. (a) Mention some other fields than geotechnical engineering where subsurface exploration is required. Compare their objectives. 4.5

   (b) Mention the preliminary information that should be available to conduct a subsurface exploration program for (i) a building project, and (ii) a bridge project. 3

   (c) Write short note on any one of the following: (i) Logging (ii) Site reconnaissance 2.5

2. Consider the following scenario of a geotechnical subsurface exploration performed: 7

   - Theoretical depth of exploration as calculated using 10% stress criterion, $D_E = 27.3$ ft
   - Depth of foundation considered, $D_F = 10$ ft
   - Considered column for a square footing, $P_{app} = 320$ kips

   Determine the footing dimensions considered for estimating depth of exploration. Also calculate the allowable bearing capacity considered.

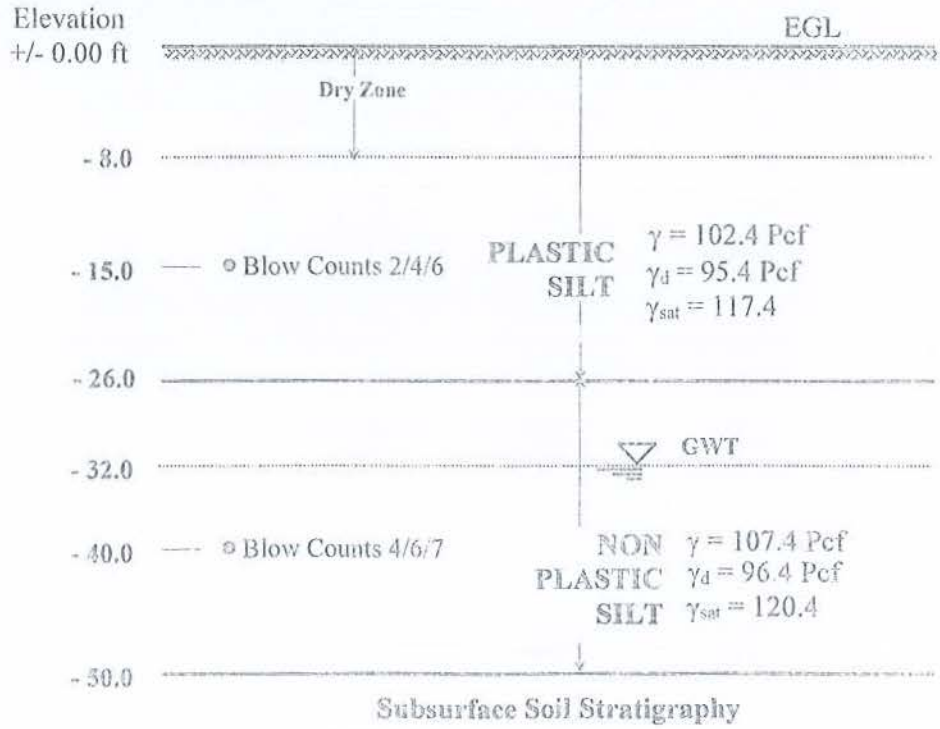
3. Consider the following scenario for an existing four-storied building already constructed at an area of Dhaka City: 6

   - An existing footing is found to have dimension of 8 ft x 10 ft
   - Estimated column load on this footing for existing condition = 400 kips
   - Estimated allowable bearing capacity as determined from geotechnical analysis performed for this site = 4000 psf (analysis considered a factor of safety of 2.5).

   Assess the actual factor of safety of the foundation for existing condition and comment on your result.

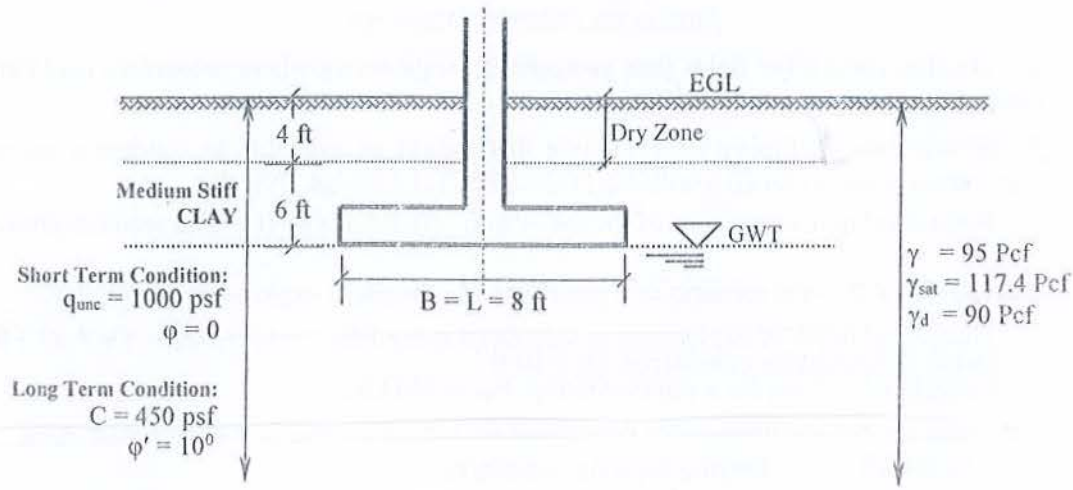
4. A geotechnical site investigation was conducted at a site in Bangladesh. Determine the corrected SPT-N values as applicable and estimate the shear strength parameters. Use the following information: 8

   - Hammer Efficiency = 0.44
   - No liner was used during drilling.



Subsurface Soil Stratigraphy

5. Using Terzaghi's bearing capacity equation, determine the allowable bearing capacity for the square footing for short and long term conditions. The building is conventionally designed for short term condition and is constructed accordingly. Estimate its available actual factor of safety in the long term. 9



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

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

1. a) Propose five benefits that Bangladesh can achieve through promoting less water consuming crops production during non-monsoon (December to May) months. **(3)**

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

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

   b) Determine the time required to irrigate a strip of land containing clay loam soil from a tube-well with a discharge of 0.15 m^3/s by using border flooding method. The infiltration capacity of the soil may be taken as 6 cm/h and the average depth of flow on the field as **Z** cm.
   (**Z** = 2 + last digit of your roll number). **(2)**

3. a) Do you agree that promoting non-structural measures of flood management will be beneficial for reducing flood hazards in Bangladesh in the long run? Justify your answer. **(4)**

   b) Summarize five benefits of international cooperation for flood management in Bangladesh. **(4)**