4-1

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2016
Program: B.Sc Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 3 hrs | Full Marks: 50

A. Answer any ten (10x2= 20)

1. Explain load distribution in Rigid Pavement.
2. What are the desirable properties of soil? You are a pavement engineer after lab examination, calculation and analysis you found that Group index value of your soil sample is -12, give comment on your soil sample.
3. What is the purpose of Plate Bearing test of soil? Briefly explain Plate Bearing test.
4. What is penetration value of bitumen? Explain 80/100, 60/70 and 30/40 penetration grade bitumen.
5. Define break of gauge. State two problems of multi gauge system. In a hilly area what are the factors will you consider while choosing railway alignment and railway gauge?
6. Explain Present Serviceability Index (PSI) and Present Serviceability Rating (PSR)?
7. What is Westergaards Modulus of Subgrade Reaction (k)? Write factors that effect k value?
8. Briefly explain methods to measure pavement structural condition.
9. How will you understand different severity levels of fatigue cracking?
10. What is Ballast? State four reasons to use Ballast in railway track?
11. Briefly explain Broken Edge failure of pavement.

B. Answer any two (2x10= 20)

1. An eight lane divided highway is to be constructed on a new alignment. It is expected to be completed in year 2020. Average two-way traffic per day on an existing eight lane highway counted in 2015= 10000 vehicles. Annual growth rate is 7%. What will be the design ESAL for the following vehicle mix and axle loads: Passenger cars= 50%, 2 axle single unit trucks (26.7 kN/axle) = 33%, 3 axle single unit truck (44.4 kN/axle) = 17%. The vehicle mix is expected to remain the same throughout the design life of the pavement for the design period of 20 years. The percent of traffic on the design lane is 45%, percent truck volume on design lane is 45%, load equivalency factors for passenger cars (4.44 kN/axle) = 0.00002, 2 axle single unit trucks (26.7 kN/axle) = 0.010, and for 3 axle single unit trucks (44.44 kN/axle) = 0.088.

2. For a pavement system elasticity modulus of first layer is 40,000 psi, layer coefficient is 0.42; elasticity modulus of second layer is 30,000 psi, layer coefficient is 0.14, drainage coefficient is 1.2; elasticity modulus of third layer is 11,000 psi, layer coefficient is 0.08, drainage coefficient is 1.2. If predicted ESAL = 18 .6 x 10^6, R = 95%, S_o = 0.35, and ΔPSI = 2 .1, select thicknesses D1, D2, and D3. Refer to charts given with the question. M_r 5700 psi

3. Classify a soil sample using AASHTO method. Data obtained for a soil sample given in the Table 1.

Table 1: Data for Soil Sample

Mechanical Analysis		
Sieve No.	Percent Finer	Plasticity Testes
4	97	LL= 48%

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Mechanical Analysis		
Sieve No.	Percent Finer	Plasticity Testes
10	93	PL= 26%
40	88	
100	78	
200	70	

Using the AASHTO method for classifying soils, determine the classification of the soil and state whether this material is suitable in its natural state for use as a subbase material.

Table2: AASHTO Classification of Soils and Soil Aggregate Mixture

General Classification	General Materials (35% or less passing 0.075 mm)							Silt-clay materials (more than 35% passing 0.075 mm)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis % passing 2.00 mm (No10) 0.425 mm (No40) 0.725 mm (No200)	50max 30max 15max	50max 25max	51min 10max	35max	35max	35max	35max	36min	36min	36min	36min
Characteristics of fraction passing Liquid limit Plastic Index	6max		N.P	40max 10max	41min 10max	40max 11min	41min 11min	40max 10max	41min 10max	40max 11min	40min 11min
Usual types of significant Constituent material	Stone fragment Gravel and sand		Fine Sand	Silty or clayey Gravel and sand				Silty soils		Clayey soils	
General rating	Excellent to Good							Fair to poor			

C. Answer any one (1x10=10)

1. A 15 cm layer of cement treated granular material is to be used as subbase for a rigid pavement. In October roadbed modulus, M_r =48.3x10^3 kN/m^2, Subbase Modulus, E_{sb} = 138x10^3 kN/m^2, composite modulus of subgrade reaction = 108x10^3 kN/m^3, If the rock depth is located 1.5 m below the subgrade surface and the projected slab thickness is 22.5 cm, loss of support = 1.0, average relative damage= 0.60, estimate the effective modulus of subgrade reaction for the month of October using AASHTO method. Refer charts given with the question.

2. A six lane concrete roadway is being designed for a metropolitan area. This roadway will be constructed on a subgrade with an effective modulus of subgrade reaction k of 45900 kN/m^3. The ESAL used for the design period is 2.5x10^6. Provided that mean concrete modulus of rupture's 4485 kN/m^2 and the modulus of elasticity is 34.5x10^6 kN/m^2. Assume the initial serviceability is 4.75 and the terminal serviceability is 2.5. Assume the overall standard deviation as 0.35, load transfer coefficient 3.2, drainage coefficient 1.15 and reliability 95%. Refer charts given with the question.

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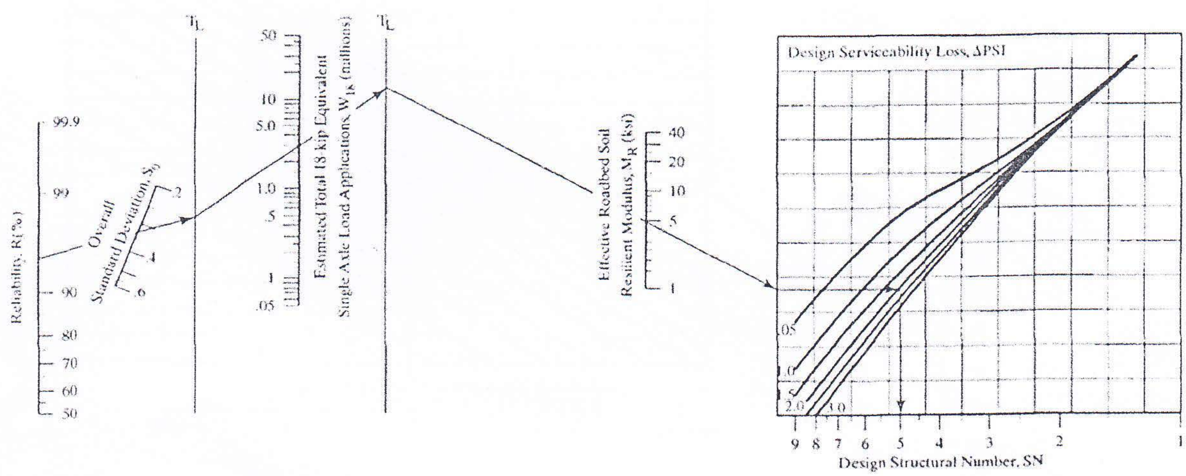

FIGURE 1

Design chart for flexible pavements based on mean values for each input (1 ksi = 6.9 MPa). (From the *AASHTO Guide for Design of Pavement Structures*. Copyright 1986. American Association of State Highway and Tranportation Officials, Washington, DC. Used by permission.)

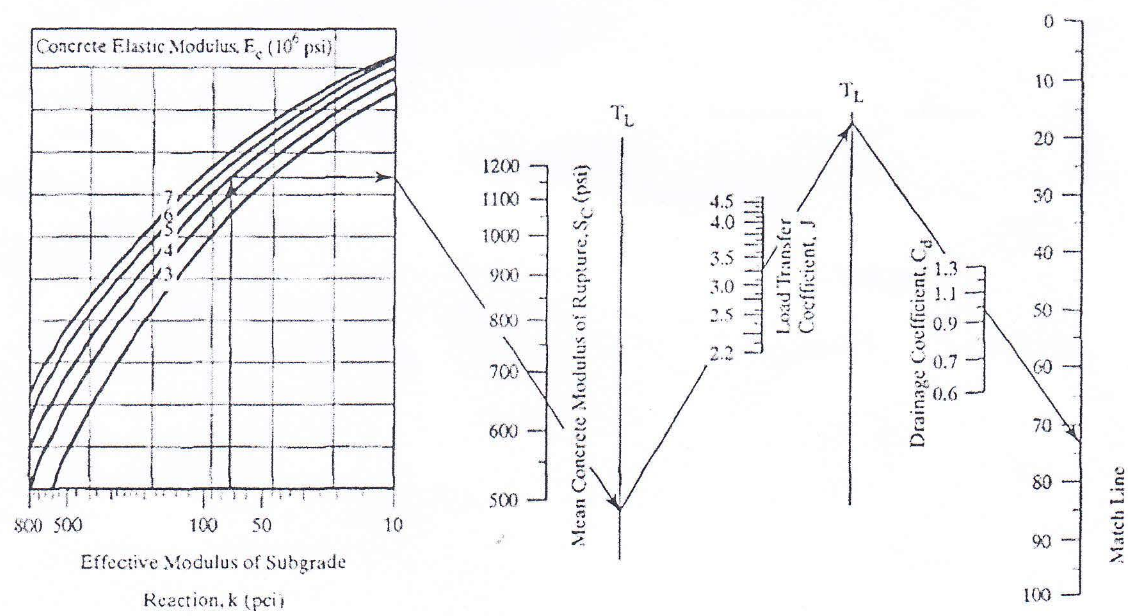

FIGURE 2

Design chart for rigid pavements based on mean values (1 in. = 25.4 mm, 1 psi = 6.9 kPa, 1 pci = 271.3 kN/m^3). (From the *AASHTO Guide for Design of Pavement Structures*. Copyright 1986. American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.)

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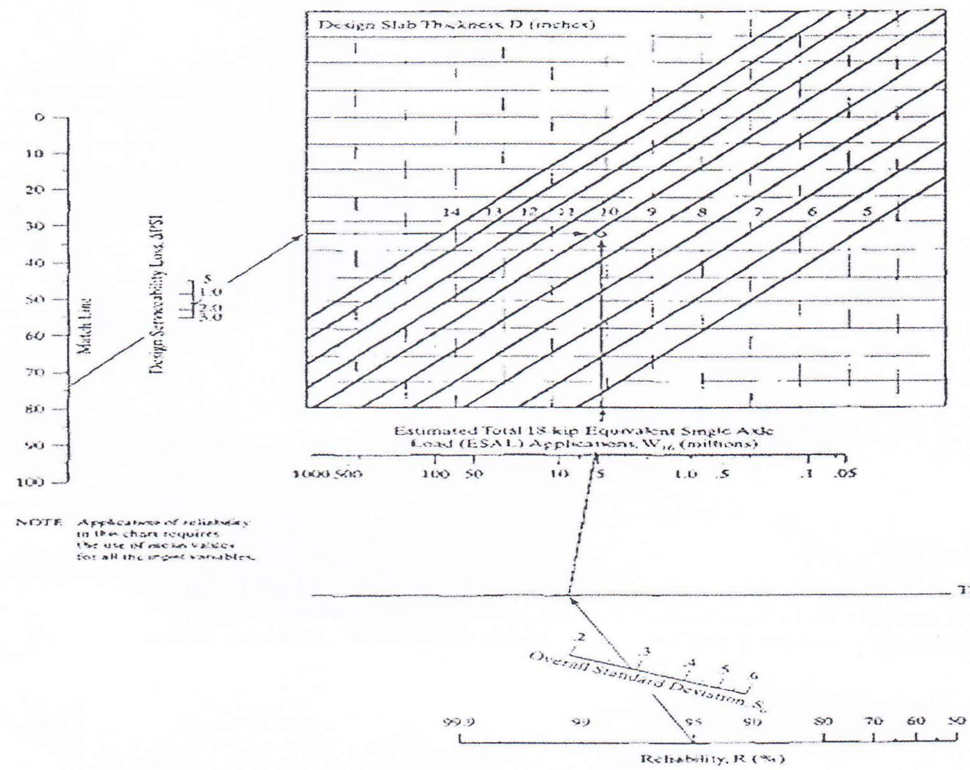

FIGURE 2 (Continued)

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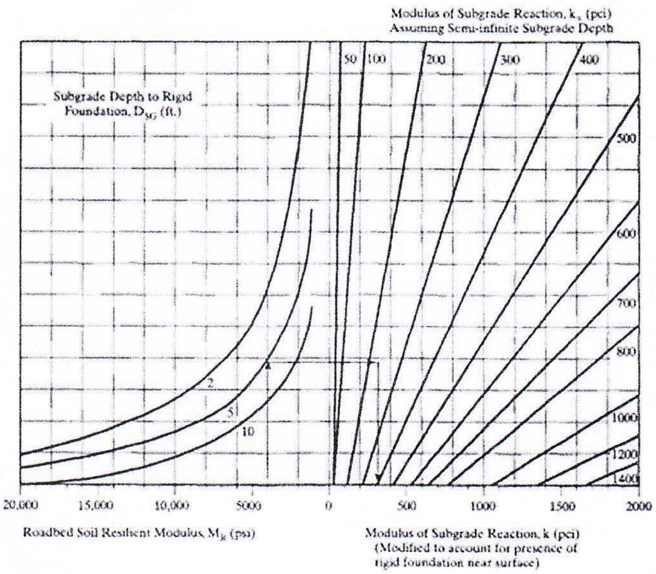


FIGURE 12.19

Chart for modifying modulus of subgrade reaction due to rigid foundation near surface (1 ft = 0.305 m, 1 psi = 6.9 kPa, 1 pci = 271.3 kN/m³). (From the *AASHTO Guide for Design of Pavement Structures*. Copyright 1986. American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.)

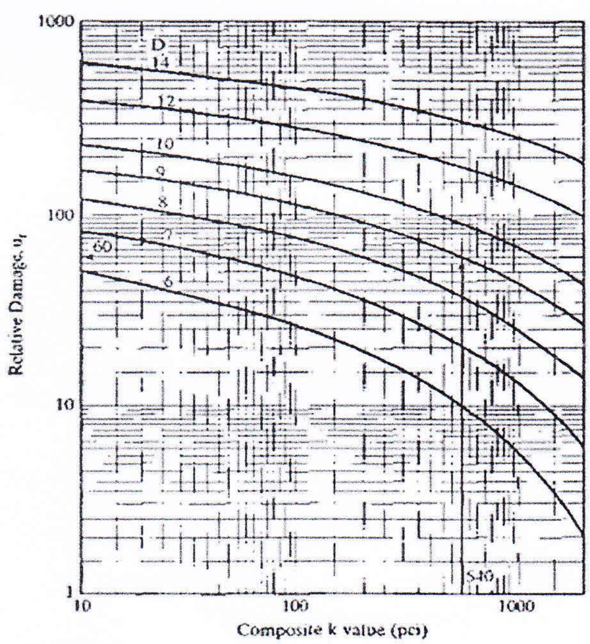


FIGURE 12.20

Chart for estimating relative damage to rigid pavements (1 in. = 25.4 mm, 1 pci = 271.3 kN/m³). (From the *AASHTO Guide for Design of Pavement Structures*. Copyright 1986. American Association of State Highway and Transportation Officials, Washington, DC. Used by permission.)

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2016
Program: B.Sc. Engineering (Civil)

Course Title: Geotechnical Engineering II — Course Code: CE 441(A)
Time: 3 hours — Full Marks: 100

PART-1

There are 6 questions. Answer any 5 questions. **(5x10=50 marks)**

1.(a) During soil exploration, standard penetration tests were carried out at a test site. Given that $\gamma = 15.5$ kN/m^3. Water table is located at 12 m depth below the ground level. 6

(i) Calculate the field SPT N and N_{60}, if the numbers of blows (in each 150 mm of penetration) are recorded 7, 7 and 8. Hammer efficiency is 0.73. Assume that other correction factors equal 1.

(ii) Find the missing blow count X, if the number of blows (in each 75 mm of penetration) are recorded 3, 4, 3, 5, X and 7. Given that field SPT N is 20.

(iii) Determine $(N_1)_{60}$ if $N_{60} = 14$ at a depth of 4 m.

(b) Briefly discuss on different factors for giving consideration to shape of the foundation, inclination of the load, depth of the foundation, used in the estimation of ultimate bearing capacity for general shear failure. 4

2. Calculate the total settlement (primary consolidation settlement and immediate settlement) of the square footing of size 2 m x 2 m, shown in Figure 1. Use 2:1 pressure distribution.

$I\rho = 1.12$, $\upsilon = 0.3$, $E = 20{,}500$ kN/m^2, Depth correction factor = 0.88

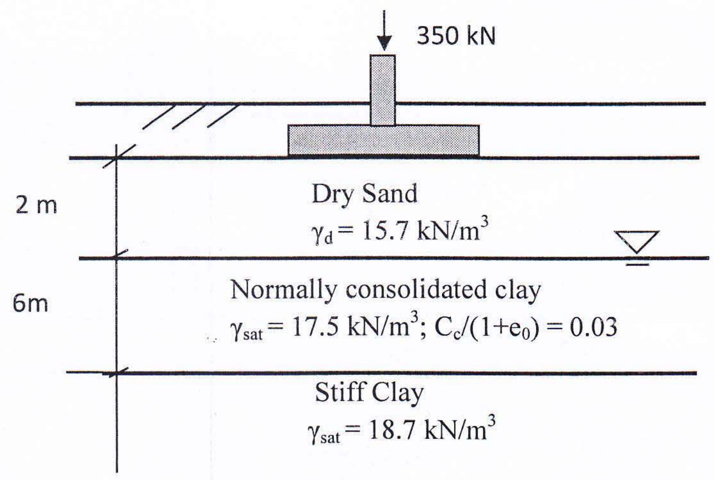


Figure 1

3. Eight piles (in a group, shown in Figure 2) are arranged in 1.5 m centre to centre spacing. The pile group consisted of 10 m long end bearing piles.

(a) Calculate maximum and minimum vertical Pile load in the pile group, when Q_1 = 1400 kN, Q_2 = 1800 kN and M_2 = 1450 kN-m.

(b) Determine the consolidation settlement of the pile group in the soil profile, shown in Figure 2(b). Given that $Q_1 + Q_2$ = 4000 kN and M_2 = 0. The total of $Q_1 + Q_2$ includes the weight of the pile cap. Use 2:1 pressure distribution and divide the layer into two equal layers.

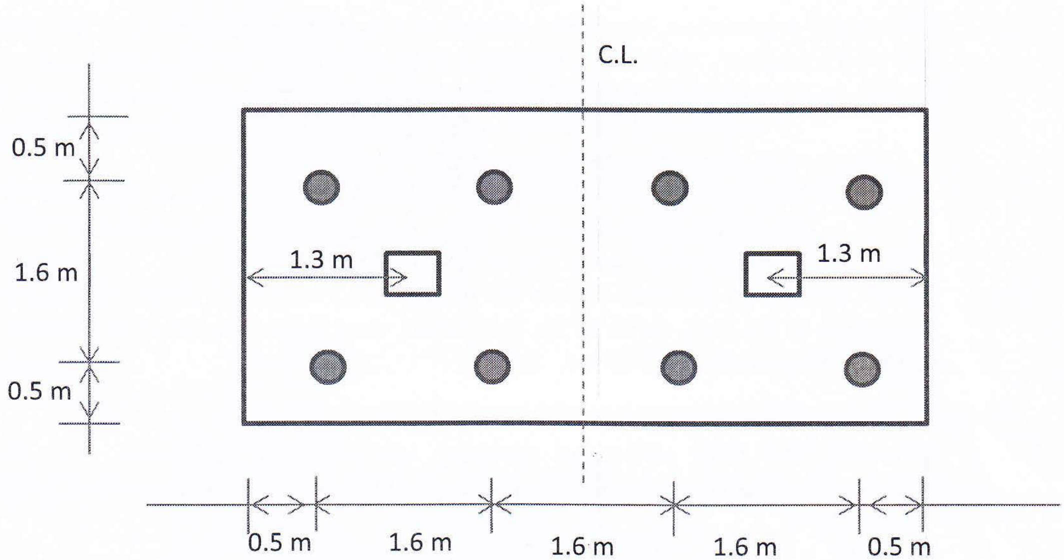


Figure 2 (a)

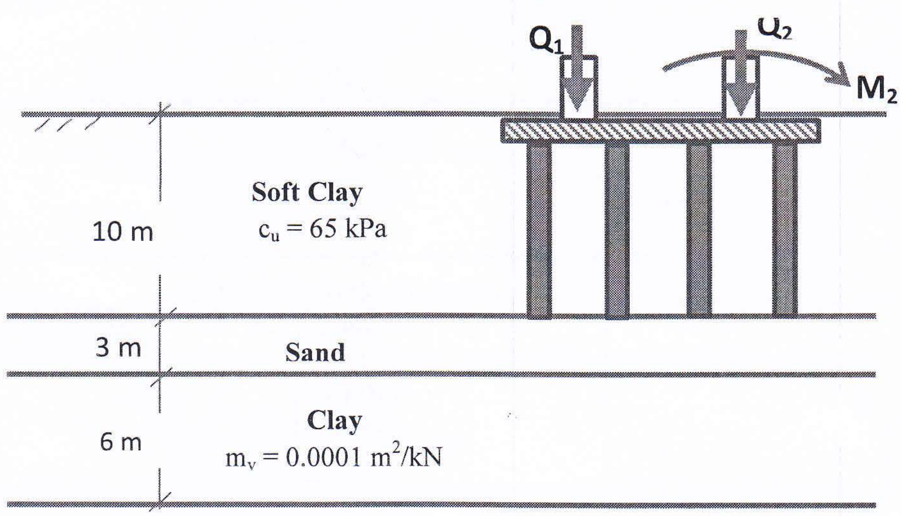


Figure 2 (b)

4. Estimate the allowable bearing capacity of a 2 m wide strip footing, placed at a depth 1.5 m below the ground level. Provide a factor of safety equal 2. Use Meyerhof's theory of bearing capacity and Hanna's design charts for modified bearing capacity factors.

According to the soil exploration report, the upper loose sand layer is found homogeneous and overlying medium dense sand. The ground water table is located at 1.5 m below GL. Upper layer extends upto 4.5 m below the ground level. The data of the soil layers is as follows:

Given data:

Layer-1: $\varphi_1 = 20°$

Layer-2: $\varphi_2 = 35°$

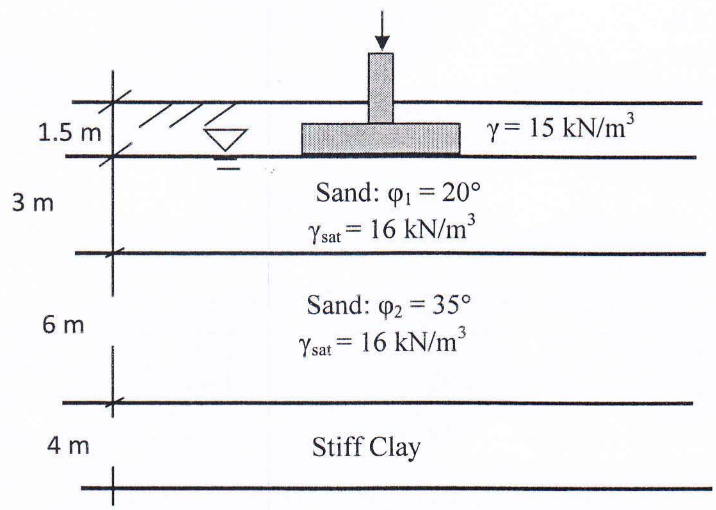


Figure 3

5. Calculate the factor of safety of a rectangular footing (placed at a depth 1.5 m below the ground level) if it supports 300 kN load for the following soil data. The size of the footing is 1.4 m x 2 m.

According to the soil exploration report, the upper layer is found homogeneous and extends up to 10 m below the ground level. The ground water table is located at GL.

The data of this soil layer is as follows:

Given data: $\gamma_{sat} = 18.2$ kN/m^3; c= 10 kPa; $\varphi = 35°$

$S_c = S_q = 1 + 0.2\ (^B/_L)$;

$S_\gamma = 1 - 0.4\ (^B/_L)$;

$$d_\gamma = 1 + 0.2\left(^{D_f}/_B\right).\tan(45° + \frac{\varphi}{2})$$

6. Calculate the allowable pile capacity of a single pile in a group of 6 piles in homogeneous clay soil, using both the methods:
(a) Converse-Labarre method,
(b) Terzaghi-Peck method.

Given Data:

Pile geometry/arrangement	Soil data
Pile length = 18 m Pile diameter = 0.9 m Factor of safety = 2.5 Pile spacing: 1 m (centre to centre)	c_u = 50 kPa γ = 17 kN/m^3

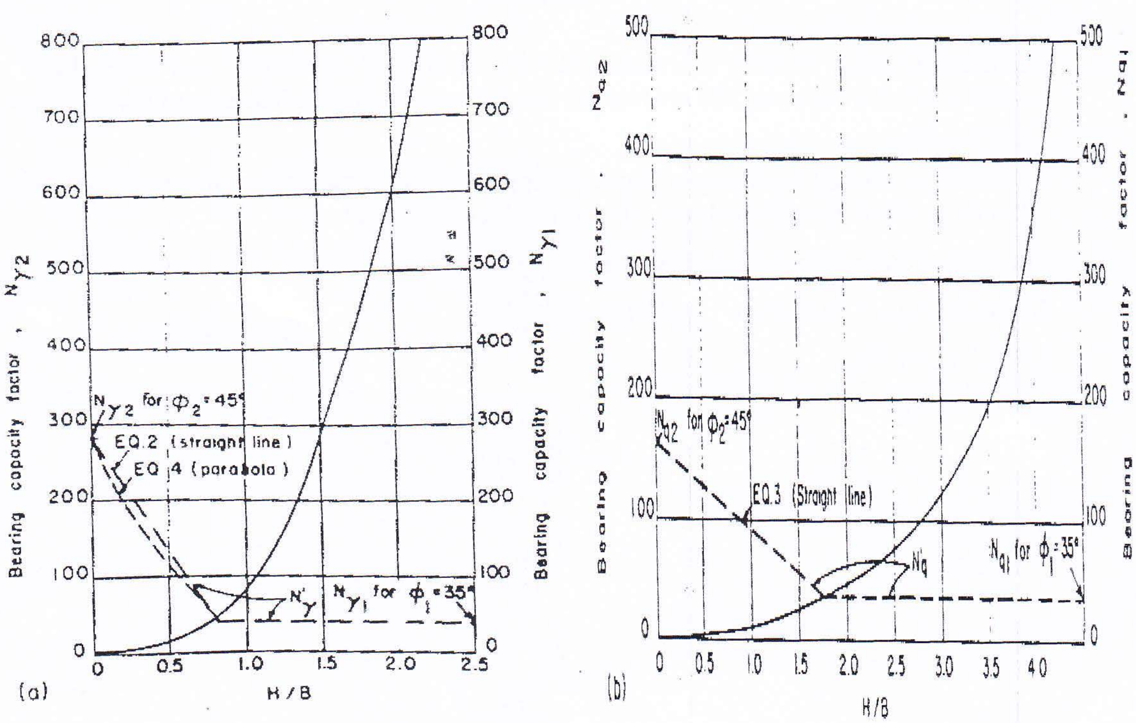
The group action reduction function is as follows:

$$E = 1 - \theta[\frac{(n-1)m + (m-1)n}{90\,mn}$$

Table: Bearing Capacity Factors

φ	N_c	N_q	N_γ
20°	17	7.5	4.8
35°	46.1	33.3	37.1

Design Charts for N_γ' and N_q' (Hanna, 1982)



PART–2

Answer **any 3 (THREE)** of the following **4 (FOUR)** questions

7. (a) What do you understand by a fully compensated foundation? How is it useful in the construction of a building? $(2 + 1 = 3)$

   (b) Discuss the differences between a finite slope and an infinite slope. Give practical examples of each type. $(2 + 1 = 3)$

   (c) A mat foundation on a saturated clay soil has dimension of 40 m × 25 m with $c = 100$ kN/m^2 and $\gamma_{sat} = 19.81$ kN/m^3. The total dead and live load on the mat is 250 MN. Determine the depth, D_f, of the mat assuming a fully compensated foundation. What will be the depth of the mat (D_f) for a factor of safety of 3 against the bearing capacity failure? Use Meyerhof's bearing capacity factors. $(10\frac{2}{3})$

8. (a) What do you understand by the factor of safety of a slope? (2)

   (b) Derive an expression for the factor of safety (F_s) of an infinite slope without seepage. $(8\frac{2}{3})$

   (c) For the infinite slope shown in the following figure (Fig. 4), determine: $(3 + 3 = 6)$

      i. The factor of safety (F_s)

      ii. The height when $F_s = 1$

   Assume that, there is ground water seepage and the ground water table coincides with the ground surface.

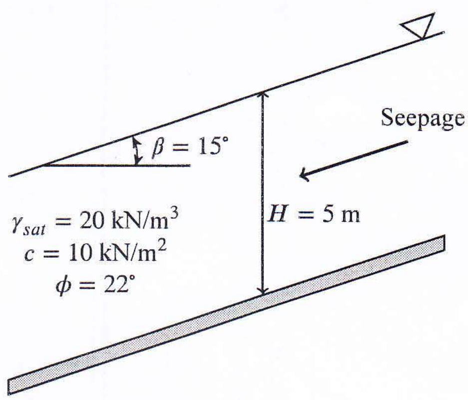


Figure 4: for QUESTION 8(c)

9. (a) Discuss the different modes of failure of finite slopes with circular failure surface. Also discuss the types of failure circles associated with each mode of failure. (4)

   (b) A cut slope in saturated clay (Fig. 5) makes an angle of 60° with the horizontal. $(3 + 3 = 6)$

      i. Determine the maximum depth up to which the cut could be made assuming the critical surface for sliding is circularly cylindrical. What will be the nature of the critical circle (i.e., toe, slope or midpoint)?

      ii. How deep should the cut be made if a factor of safety of 2 against sliding is required?

   (c) Following are the results of a standard penetration test in the field (sandy soil). Estimate the net allowable bearing capacity of a mat foundation which is 12 m × 8 m in plan. Given that, the depth of the mat, D_f, is 3 m, and, the allowable settlement of the mat, S_e, is 40 mm. $(6\frac{2}{3})$

Depth (m)	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5	18.0
N_{60}	7	9	12	15	19	21	24	26	25	23	24	27

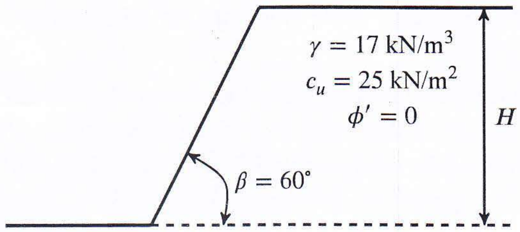


Figure 5: for QUESTION 9(b)

10. (a) A new highway embankment is to be constructed for a proposed 4-lane highway. The height of the embankment is required to be 10 m above the existing ground surface. From the slope stability analysis, it has been found that the critical height of the slope for a slope angle of 45° is 9.5 m. If the embankment (10 m height) is constructed with that slope angle (assuming that other strength parameters of soil are constant), will the embankment be safe? If not, how can the embankment be made safe if the height can not be reduced? (4)

(b) For the slope shown in Fig. 6, find the factor of safety (F_s) against sliding for the trial slip surface ABC using the Bishop's modified method of slices. Perform two trials assuming $F_s = 1$ and $F_s = 1.5$. ($12\frac{2}{3}$)

Given:

$c' = 10$ kN/m^2, $\phi' = 30°$, $\gamma = 18$ kN/m^3

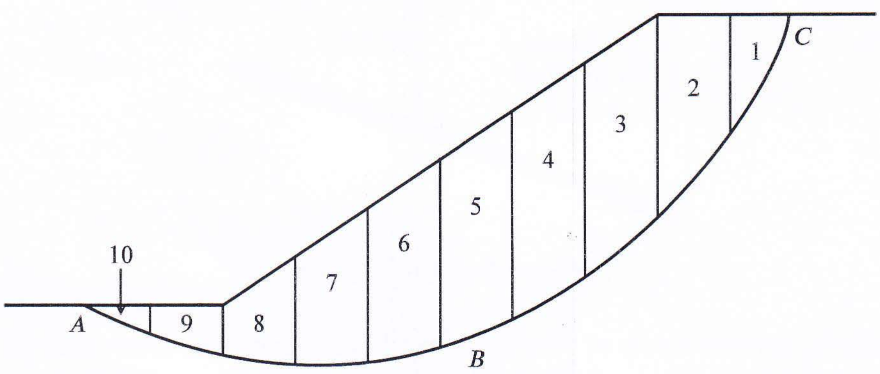


Figure 6: for QUESTION 10(b)

Slice No.	Width, b_n (m)	Average depth, z_n (m)	α_n (degrees)
1	3.5	9.5	78°
2	5	17.3	61°
3	5	20.5	44°
4	5	19.8	32°
5	5	17.9	21°
6	5	15	12°
7	5	11.2	6°
8	5	6.6	−3°
9	5	3.1	−9°
10	3.5	1.1	−14°

Necessary Equations and Tables

Table 1: Bearing capacity factors for general bearing capacity equation

ϕ	N_c	N_q	N_γ (Meyerhof)
0°	5.10	1.00	0.00
1°	5.38	1.09	0.00
2°	5.63	1.20	0.01
3°	5.90	1.31	0.02

Table 2: Shape, and depth factors for general bearing capacity equation

Author	**Factor**	**Condition**	**Equation**
Meyerhof	Shape	$\phi = 0^\circ$	$F_{cs} = 1 + 0.2\left(\frac{B}{L}\right)$ $F_{qs} = F_{\gamma s} = 1$
		$\phi \geq 10^\circ$	$F_{cs} = 1 + 0.2\left(\frac{B}{L}\right)\tan^2\left(45 + \frac{\phi}{2}\right)$ $F_{qs} = F_{\gamma s} = 1 + 0.1\left(\frac{B}{L}\right)\tan^2\left(45 + \frac{\phi}{2}\right)$
	Depth	$\phi = 0^\circ$	$F_{cd} = 1 + 0.2\left(\frac{D_f}{B}\right)$ $F_{qd} = F_{\gamma d} = 1$
		$\phi \geq 10^\circ$	$F_{cd} = 1 + 0.2\left(\frac{D_f}{B}\right)\tan\left(45 + \frac{\phi}{2}\right)$ $F_{qd} = F_{\gamma d} = 1 + 0.1\left(\frac{D_f}{B}\right)\tan\left(45 + \frac{\phi}{2}\right)$

$$q_{net} = \frac{N_{60}}{0.08}\left(\frac{B+0.3}{B}\right)^2 F_d\left(\frac{S_e}{25}\right) \qquad (1)$$

Where,

q_{net} = net allowable bearing capacity (kN/m^2)

$$F_d = 1 + 0.33\left(\frac{D_f}{B}\right) \leq 1.33$$

$$F_s = \frac{\sum\left[(c' b_n + W_n \tan\phi')\frac{1}{m_{\alpha(n)}}\right]}{\sum W_n \sin\alpha_n} \qquad (2)$$

$$m_{\alpha(n)} = \cos\alpha_n + \frac{\tan\phi' \sin\alpha_n}{F_s} \qquad (3)$$

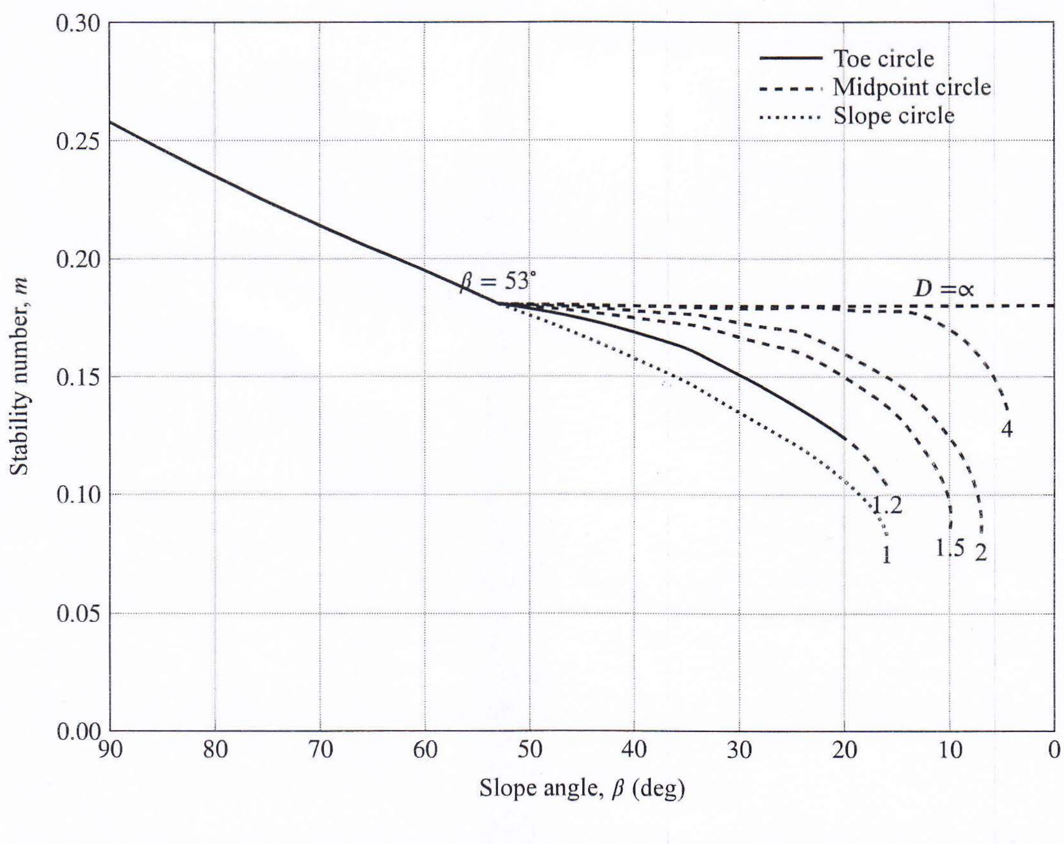


Figure 7: Plot of stability number against slope angle (redrawn after Terzaghi & Peck, 1967)

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Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering III | Credit Hours: 3.0 | Course Code: CE 411
Time: 3 hours | Full Marks: 100 (= 10 × 10)

[Answer **any 10 (ten)** of the following 14 questions]

1. Use Stiffness Method to calculate the applied forces P and all deflections in the plane truss *oabcdef* shown in Fig. 1, if horizontal deflection at joint c is 10-mm [Given: S_x = 10 kN/mm].

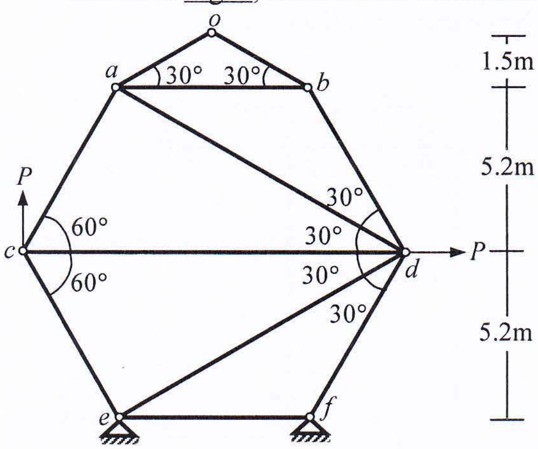


Fig. 1

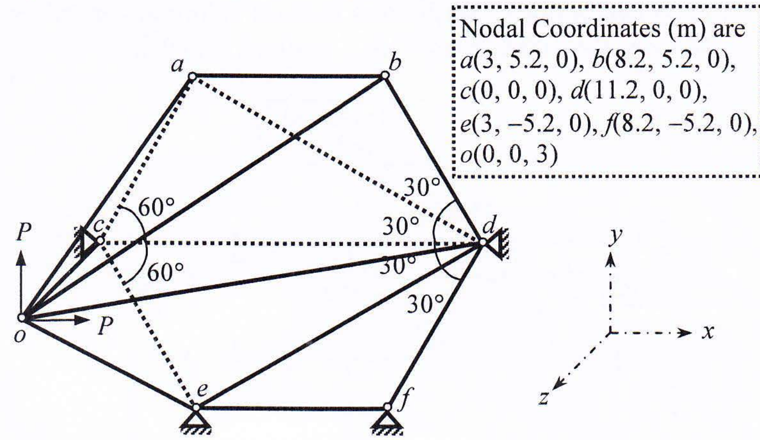


Fig. 2

2. Use Stiffness Method to calculate the applied forces P and all deflections in the space truss *oabcdef* shown in Fig. 2, if deflection along x-axis at joint o is 10-mm [Given: S_x = 10 kN/mm].

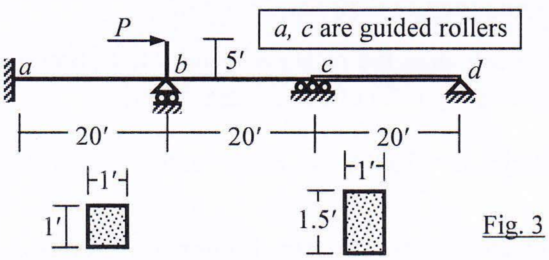
3. 

Fig. 3

Consider both the axial and flexural deformations to calculate deflections and rotations of all joints of the beam *abcd* loaded as shown in Fig. 3

[Given: P = 100 k, $E = 400 \times 10^3$ k/ft^2].

4. Fig. 4 shows a frame *oabcdef* whose joints o and c rotate 1° (clockwise) due to the applied loads.
Use Stiffness Method considering flexural deformations only to calculate the distributed load (w_0) and moment (M_0) applied as well as the rotation at joint d of the frame [Given: $EI = 40 \times 10^3$ k-ft^2].

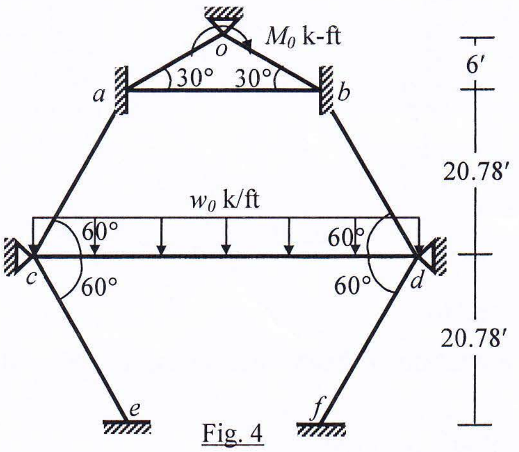


Fig. 4

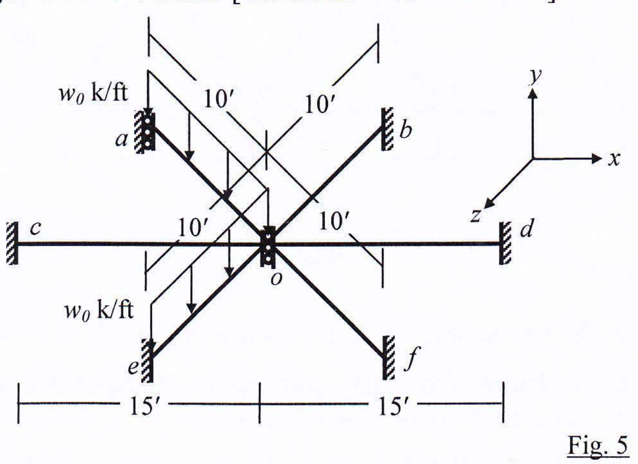


Fig. 5

5. Fig. 5 shows a grid *oabcdef* whose joint a deflects 0.10′ downward due to the applied distributed loads.
Use Stiffness Method to calculate the distributed loads (w_0 k/ft) as well as the deflection at joint o

6. Consider flexural deformations and geometric nonlinearity to calculate the distributed load w (k/ft) required to cause buckling of the frame ABC loaded as shown in Fig. 6 [Given: $E = 45 \times 10^4$ k/ft^2].

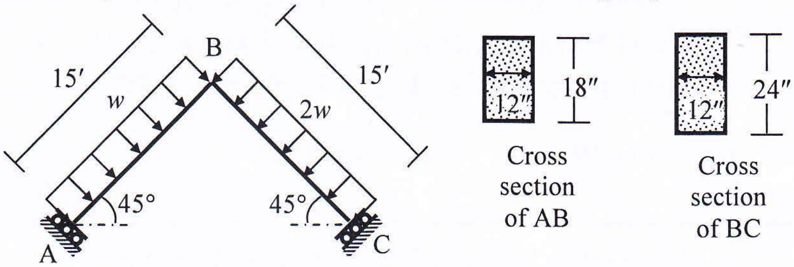


Fig. 6

7. Use Stiffness Method to calculate the unknown joint deflections and rotations of the beam ABC loaded as shown in Fig.7, considering flexural deformations only with geometric nonlinearity [Given: $P = 100$ k, $EI_{AB} = 2EI_{BC} = 40 \times 10^3$ k-ft^2].

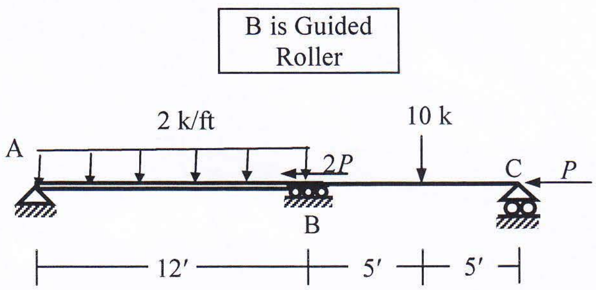


Fig. 7

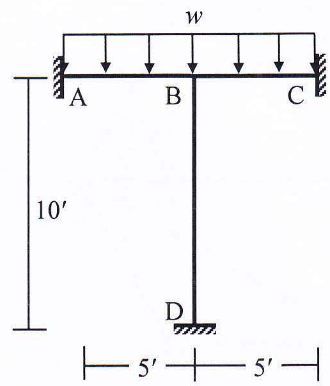


Fig. 8

8. Consider flexural deformations only (with consistent mass matrix) to calculate the natural frequencies of the frame $ABCD$ shown in Fig. 8 [Given: $EI = 45\times 10^3$ k-ft^2, $w = 3$ k/ft, $\mu = 0.0045$ k-sec^2/ft^2].

9. Frame structure shown in Fig. 8 is subjected to a dynamic load, $w = 10\, Sin(2\pi t)$ (k/ft).

   Use *Constant Average Acceleration* (*CAA*) Method to calculate the rotation of joint B at time $t = 0.10$ sec [Given: $EI = 45\times 10^3$ k-ft^2, $\mu = 0.0045$ k-sec^2/ft^2, Damping ratio of the system = 5%].

10. For the plane truss shown in Fig. 9, modulus of elasticity $E = 30000$ ksi, cross-sectional area $A = 2$ in^2, mass per length $\mu = 1.5 \times 10^{-6}$ k-sec^2/in^2.

    Calculate its natural frequencies (neglecting zero-force members) using consistent mass matrices.

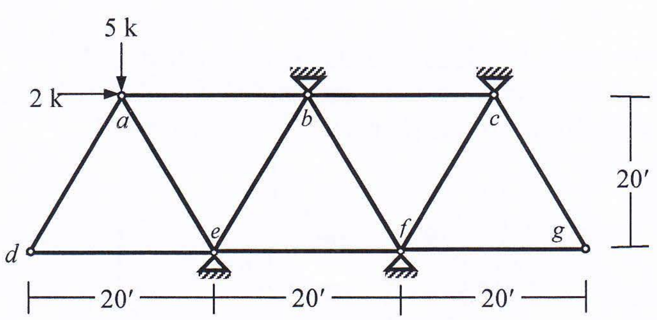


Fig. 9

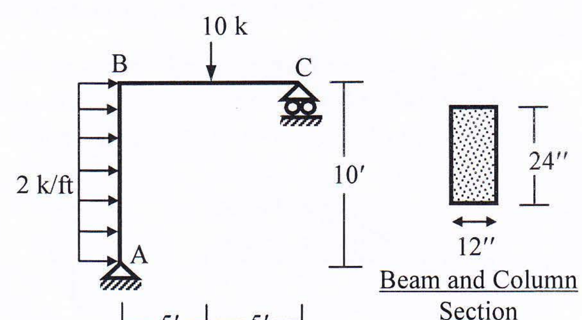


Fig. 10

11. In the frame ABC loaded as shown in Fig. 10, use Energy Method to

    (i) Calculate the Plastic moment (M_p) required to prevent formation of beam mechanism of BC and sidesway mechanism of the frame.

    (ii) Also calculate the required yield strength (f_y) of the elasto-plastic material.

12. Use bending moment diagram to calculate the distributed load w (k/ft) needed to develop plastic hinge mechanism in the RC beam *ABCDE* loaded as shown in Fig. 11 [Given: $f_c' = 3$ ksi, $f_y = 72$ ksi].

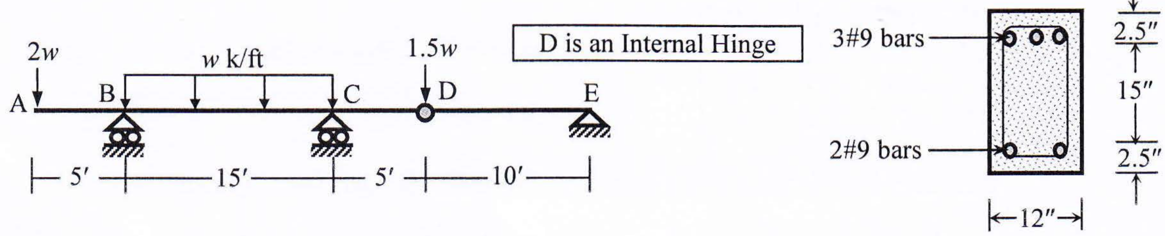


Fig. 11

Beam Section

13. Use Stiffness Method considering flexural deformations only to calculate the rotation at node B of the beam AB loaded as shown in Fig. 12 [Given: $EI = 45\times 10^3$ k-ft^2], if the node A is

(i) Guided Roller, as shown in Fig. 12(i)

(ii) Supported by circular foundation of radius 5-ft on the surface of sub-soil (half-space) with shear modulus $G_s = 400$ k/ft^2 and Poisson's ratio $\nu = 0.30$, as represented in Fig. 12(ii).

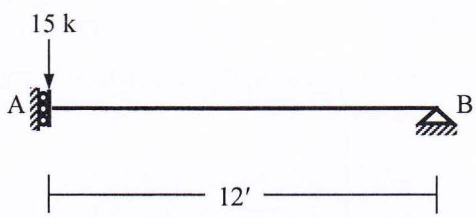


Fig. 12(i)

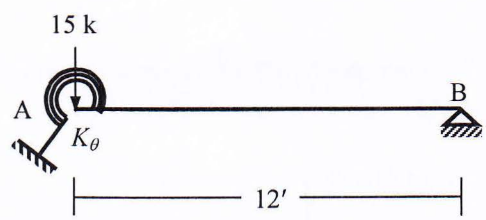


Fig. 12(ii)

14. Briefly explain the

(i) Basic assumption of Constant Average Acceleration method of numerical time-step integration

(ii) Effect of foundation flexibility on the structural response to seismic ground motion.

Briefly explain why

(iii) A structure becomes unstable at buckling load (explain in terms of stiffness matrix)

(iv) The terms material nonlinearity, plastic moment and collapse mechanism.

List of Useful Formulae for CE 411

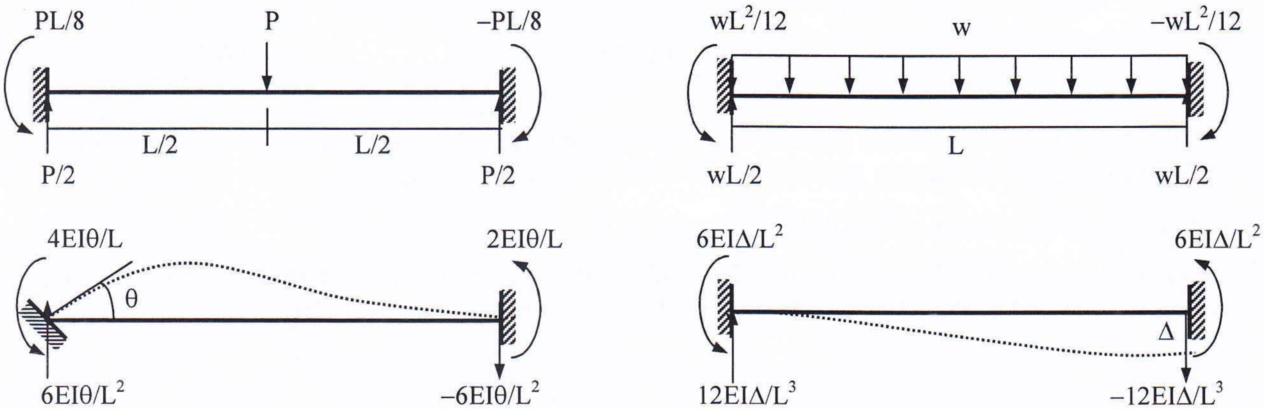
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

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

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 $P_{AB} = S_x\,[(u_B - u_A)\,C_x + (v_B - v_A)\,C_y + (w_B - w_A)\,C_z]$
* Torsional stiffness $T_1 = GJ/L$

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

* $\mathbf{K_{total}} = \mathbf{K} + \mathbf{G}$, 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 $a_0 = (f_0 - cv_0 - ku_0)/m$

* Lumped- and Consistent-Mass matrix for axial rod

$$\mathbf{M_m} = (\mu L/2)\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \qquad \mathbf{M_m} = (\mu L/3)\begin{pmatrix} 1 & 0.5 \\ 0.5 & 1 \end{pmatrix}$$

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

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

* 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

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2016
Program: B.Sc. Engineering (Civil)

Course Title: Project Planning and Management — Course Code: CE401
Time: 3 hour — Full Marks: 50

(Answer No 1 and any 4 Questions)

1. A firm has estimated the following time for its project. The company has quoted 17 days for the project to be completed. What would be the probability of success that the project will be completed on time? 10

Activity	Predecessor	Optimistic Time (days)	Most likely Time (days)	Pessimistic Time (days)
a	-	3	4	5
b	-	3	5	7
c	-	5	6	7
d	a	2	3	4
e	b	6	8	10
f	b	5	3	7
g	c	5	6	7
h	d, e	5	3	7
i	f, g	1	2	3

Also determine the total duration of the project, Free float, Total Float of each activity and critical path of the project.

2.(a) Why construction safety in Bangladesh is not up to the standard? Please explain. 4

(b) What should be a general contractor's responsibility to ensure safety in construction site? 3

(c) Describe 7 principles to prevent accident in construction site. 4

3. Write short notes of the following: (2x5) 10

(a) Ergonomic hazard
(b) PPE
(c) Economic Life
(d) Opportunity Cost
(e) MARR

4.(a) Why OTM is considered to be the best procurement method? Please explain. 2.5

(b) Briefly describe the points to remember while purchasing/procurement. 2.5

(c) Describe Open Tendering Method (OTM) 5

5.(a) What do you understand by 'Time Value of Money'? 1

(b) What are the reasons for replacement of an asset? 2

(c) An asset purchased 2 years ago for $40,000 is harder to maintain than expected. It can be sold now for $12,000 or kept for a maximum of 2 more years, in which case its operating cost will be $20,000 each year, with a salvage value of $10,000 after 1 year or $9000 after two years. A suitable challenger will have an annual worth of $-24,000 per year. At an interest rate of 10% per year, should the defender be replaced now, one year from now, or two years from now? 7

... Continued

Course Title: Project Planning and Management
Time: 3 hour

Course Code: CE401
Full Marks: 50

6.(a) What should we do with the existing asset if we consider replacing of it? 3

(b) When should LTM be followed for procurement? 1

(c) A factory has a current market value of $60,000 and can be kept in service for 4 more years. Annual operation and maintenance cost is $15,000/year. With an MARR of 12%/year, when should it be abandoned? The following data are projected for future years: 6

	Year 1	Year 2	Year 3	Year 4
Net revenue	$50,000	$50,000	$15,000	$30,000
Market value	$35,000	$20,000	$15,000	$15,000
Repairing cost	-	$10,000	-	$30,000

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2016
Program: B.Sc. Engineering (Civil)

Course title: Irrigation and Flood Control | Course code: CE 461
Time: 3 hours | Full marks: 100

There are TWO sections in the question paper namely "SECTION A" and "SECTION B". You have to answer from the both sections according to the instruction mentioned on each section.

SECTION A
MARKS: 75

There are FIVE questions. Answer <u>question no. 01 (COMPULSORY)</u> and any THREE from the rest (21 + 3*18=75). (Assume any missing data.)

1. a) Define irrigation. Write the benefits of irrigation and the harmful effects of excess irrigation. 6
   b) What is meant by "Border Flooding", and how does it differ from "Check Flooding" and "Free Flooding"? 7
   c) Explain river training works. What are the purposes of guide banks? 4
   d) Explain the procedures for determining the required discharge capacity and number of spillways. 4

2. a) Explain the following: i) Free board ii) Berms iii) Spoil Banks iv) Borrow Pits. 4
   b) A sample of water from a well showed that it has an electrical conductivity of 1.5 mmhos/cm and a density of 1 gm/cm^3. A field with a bulk density of soil of 1.43 gm/cm^3 and saturation point of 40 percent will be irrigated. The electric conductivity (EC) value of saturated extract of soil is 2 mmhos/cm. Find out the depth of irrigation that may turn the 30 cm depth of soil saline ignoring the precipitation and leaching of salts that may occur. 5
   c) Determine the consumptive use and net irrigation requirement of wheat crop. Also determine the field irrigation requirement if the water application efficiency is 77%. Use Blaney-Criddle equation and a crop factor is 0.75. 9

Month	Monthly temperature (°C) averaged over the last 5 years	Monthly percent of day time hour of the year computed from the Sun-shine	Useful rainfall in cm averaged over the last 5 years	Leaching requirement (cm)

November	20.0	7.40	1.50	4
December	18.0	7.25	1.35	6
January	14.5	7.30	2.01	5
February	14.5	7.10	2.50	3

3. a) Explain different types of spur with neat sketch. 3
   b) Design a lined canal having the following data: 7
   - Full supply discharge = 200 cumec
   - Side slope = 1.25:1
   - Bed slope = 1 in 5000
   - Rugosity coefficient = 0.018
   - Permissible velocity = 1.75 m/sec

   c) A stream of 120 liters per second was diverted from a canal and 105 liters per second was delivered to the field. An area of 2 hectares was irrigated in 9 hours. The effective depth of root zone was 1.8 m. The runoff loss in the field was 500 m^3. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 18 cm per meter depth of soil. Irrigation was started at a moisture extraction level of 55% of the available moisture. 8

   Find out the following:
   - water conveyance efficiency
   - water application efficiency
   - water storage efficiency
   - water distribution efficiency

4. a) Differentiate between weir and barrage with neat sketch. 4
   b) The cultivable command area for a distributary is 15000 hectares. The intensity of irrigation for Rabi (Wheat) is 40% and for Kharif (Rice) is 15%. If the total water requirements (Δ) of the two crops are 37.4 cm and 120 cm and their periods of growth (B) are 160 days and 140 days respectively; determine the outlet discharge from average discharge consideration. 6
   c) After how many days will you supply water to soil in order to ensure sufficient irrigation of the given crop, if, 8
   - Available moisture = 18%
   - Unavailable moisture = 15%
   - Optimum moisture content = 16%
   - Dry density of soil = 1.3 gm/cc
   - Effective depth of root zone = 59 cm
   - Daily consumptive use of water for the given crop = 13 mm

5. a) Explain the following with neat sketch: i) Aqueduct ii) Super passage iii) Level crossing. 5
   b) Describe how air lift pump works with neat sketch. 5
   c) Draw the typical layout of diversion head works. 3

d) A centrifugal pump is required to lift water at the rate of 150 liters/sec. Calculate the brake horse power of the engine from the following data: 5

- Suction head = 5 m
- Delivery head = 2 m
- Coefficient of friction = 0.01
- Efficiency of pump = 70%
- Diameter of pipe = 18 cm

SECTION B

MARKS: 25

There are FOUR questions. Answer <u>question no. 07 (COMPULSORY)</u> and any TWO from the rest (13 + 2*6 = 25).

6. a) What are the structural and non-structural measures of flood control and management in Bangladesh? 7

   b) What is integrated water resources management (IWRM)? Explain the key principles of IWRM. 6

7. Explain the following (any four) 6
   1. Flood hazard map
   2. Embankment
   3. Flood
   4. Polder
   5. Flood risk assessment

8. Explain delta formation process and how delta formation process relates to flood. 6

9. What are the main impacts of flood? Draw a flood risk map for your own village/ward/neighborhood. 2+4