University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2019
Program: B. Sc. Engineering (Civil)

Course Title: Project Planning & Management | Course Code: CE 401
Time: 3 Hours | Full Marks: 100

PART – A

Answer all of the following questions.
(Assume reasonable values for any missing data)

1. The total construction cost of a refinery with a production capacity of 200,000 bbl/day in Indiana, completed in 2009 was $100 million. It is proposed that a similar refinery with a production capacity of 300,000 bbl/day be built in California, for completion in 2019. Considering the additional information given below, make an order of magnitude estimate of the cost of the proposed plant. **(10)**

- In the total construction cost for the Indiana plant, there was an item of $5 million for site preparation which is not typical for other plants
- The variation of sizes of the refineries can be approximated by the exponential rule with m = 0.6
- The inflation rate is expected to be 8% per year from 2009 to 2019
- The location index was 0.92 for Indiana and 1.14 for California in 1999. These indices are deemed to be appropriate for adjusting the costs between these two cities
- New air pollution equipment for the LA plant costs $7 million in 2019 dollars (not required in the Indiana plant).
- The contingency cost due to inclement weather delay will be reduced by the amount of 1% of total construction cost because of the favorable climate in California (compared to Indiana)

2. A dump truck with a capacity of 6 cubic yards is used to dispose of excavated materials at a dump site 4 miles away. The average speed of the dump truck is 30 mph and the dumping time is 30 seconds. Find the daily standard production rate of the truck. If a fleet of dump trucks of this capacity is used to dispose of the 960 cubic yards of excavated materials for 8 hours per day, determine the number of trucks needed daily, assuming a swell factor of 1.1 for the soil. Given, relative capacity of excavator = 1 cubic yards. **(10)**

3. Established at contract award: **(10)**

Target Cost	=	$1000
Target Fee	=	$100
Maximum Cost	=	$130
Minimum Cost	=	$80
Share Ratio	=	75/25

If the actual cost is $1300, what is the final contract price?

If the actual cost is $800, what is the final contract price?

4. A pricing actuary at an insurance company conducted a study and found the probabilities of the number of accidents and the claim amount per accident as shown below: **(10)**

Number of Claims	Probability
0	40%
1	35%
2	10%
3	10%
4	5%

Cost of Claim	Probability
$5,000	20%
$10,000	50%
$15,000	20%
$20,000	10%

Calculate the premium the company should charge its clients.

5. Every hour a quality control inspector measures the outside diameter of four parts. The results of the measurements are shown below. **(10)**

	Sample Piece			
Time	1	2	3	4
9 A.M.	1	4	5	2
10 A.M.	2	3	2	1
11 A.M.	1	7	3	5

Subgroup Sample Size, n	d2	A2	E2
2	1.128	1.880	2.659
3	1.693	1.023	1.772
4	2.059	0.729	1.457
5	2.326	0.577	1.290

Compute the mean outside diameter, the mean range, and determine the control limits for the mean and the range.

PART – B

Answer all of the following questions.
(Assume reasonable values for any missing data)

6. Detailed time and activities of a project is given below. The project manager wants to complete the project within 14 days. What is the probability to meet the deadline? (Use Table - 1 in appendix if necessary). **(10)**

Activity	Preceding Activity	Optimistic Time	Most Likely Time	Pessimistic Time
A	-	4	5	12
B	-	1	2	6
C	A	2	3	4
D	A	3	4	11
E	A	2	3	4
F	C	1	2	3

7. Mr. Tony Stark took a loan of $100,000 from a bank where the stated interest rate is 10% p.a. What is the effective annual rate on the loan after 10 years if the interest rate is compounded half **(10)**

yearly? How much money will Mr. Stark pay after 10 years?

8. Cash flow of a project is given below: **(10)**

Year	0	1	2
Cash Flow	-500	1150	-660

Find the IRR. Is anything wrong with the result? Explain graphically.

9. In which cases EOQ model is used for inventory management? Graphically represent cost identification of EOQ model. **(10)**

10. What is Linear Programming? Explain the characteristics of Linear Problems. **(10)**

APPENDIX

Table – 1: Positive z – score table

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2019
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 ALL THE QUESTIONS

1. Use Stiffness Method (neglecting axial deformations) to calculate the value of ***F*** required to cause buckling of the frame ***abcde*** loaded as shown in ***Fig.1***
   [Given: $EI = 40 \times 10^3$ *k-ft*^{2}].

2. Use Stiffness Method (neglect axial deformations) to calculate rotation at joint ***c*** of the frame loaded as shown in ***Fig.2***, if the roller support at ***c*** is replaced by a circular foundation (***Fig.2a***) of radius 4 ft on the surface of subsoil (half-space) with shear wave velocity(v_s) equal to 1000 ft/sec
   [Given: $EI = 70 \times 10^3$ *k-ft*^{2}, *Unit weight of soil = 120 pcf, Poisson's ratio = 0.25*].

3. Use Stiffness Method considering geometric nonlinearity and flexural deformations only to calculate the unknown rotation at ***a*** and deflection at ***b*** of the frame ***abcde*** loaded as shown in ***Fig.3***
   [Given: $EI = 60 \times 10^3$ *k-ft*^{2}].

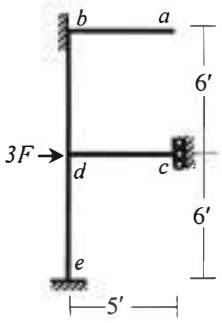


Fig.1

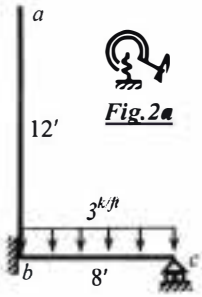


Fig.2

Fig.2a

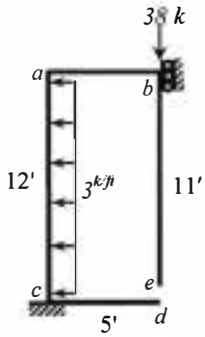


Fig.3

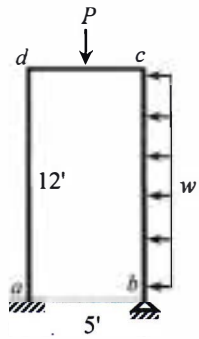


Fig.4

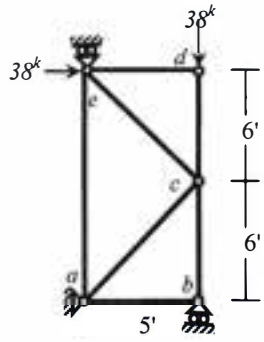


Fig.5

4. Use the Energy Method to calculate the load
   (i) ***P*** needed to form beam mechanism,
   (ii) ***w*** needed to form the sidesway mechanism in the frame ***abcd*** loaded as shown in ***Fig.4***
   [Given: $M_{P(beam)} = 100$ *k-ft*, $M_{P(column)} = 200$ *k-ft*].

5. Identify zero-force members of the 2D truss ***abcde*** loaded as shown in ***Fig.5***.
   Determine the displacements of joint ***c*** considering settlement of support ***a*** is 0.02 ft.
   Also calculate member forces
   [Given: $EA/L = 1200$ *k/ft*].

6. Frame structure ***abcd*** shown in ***Fig.6*** is subjected to a dynamic load, $w = 10t$ (k/ft).
Use *Constant Average Acceleration* (*CAA*) Method to calculate the rotation of joint ***c*** at time $t = 0.10$ sec
[Given: $EI = 10^4$ $k\text{-}ft^2$, $\mu = 0.005$ $k\text{-}sec^2/ft^2$, *Damping ratio of the system* = 5%].

7. Calculate the Yield Moment (M_y) and Plastic Moment (M_p) capacity of the section shown in ***Fig.7*** if the section is made of elastic-fully plastic material [Given: $\sigma_y = \sigma_{yp} = 60$ ksi].

8. Use Stiffness Method considering flexural deformations only to calculate the unknown rotations at joint ***d*** and ***e*** of the frame ***abcde*** loaded as shown in ***Fig.8***
[Given: $EI = 60 \times 10^3$ $k\text{-}ft^2$].

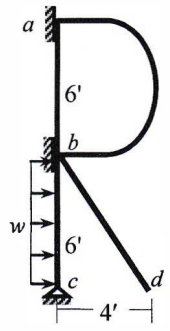


Fig.6

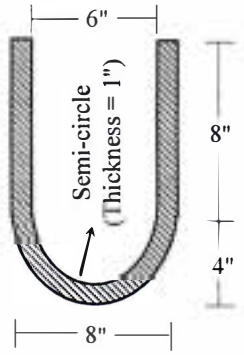


Fig.7

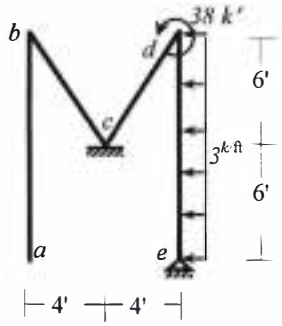


Fig.8

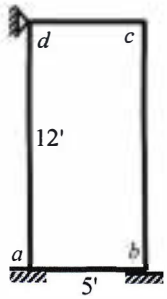


Fig.9

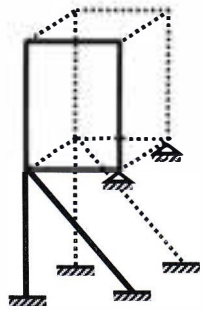


Fig.10

9. Calculate 1st natural frequency of the frame ***abcd*** shown in ***Fig.9*** using consistent mass matrices (neglecting axial deformation).

$EI = 40 \times 10^3$ $k\text{-}ft^2$ $\mu = 0.005$ $k\text{-}s^2/ft^2$

10. Determine the degree of kinematic indeterminacy (**doki**) and show the corresponding deflections and rotations of the 2D frame (***Fig.8***) and 3D frame (***Fig.10***), for the following cases
    (i) Not considering boundary conditions,
    (ii) Considering boundary conditions,
    (iii) Neglecting axial deformations.

List of Useful Formulae for CE 411

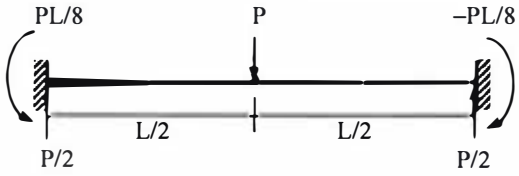
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

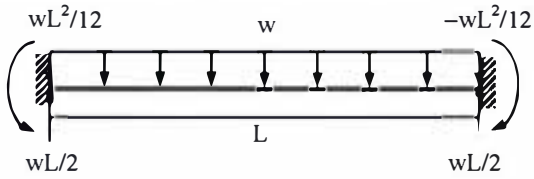
$$\mathbf{K_m}^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

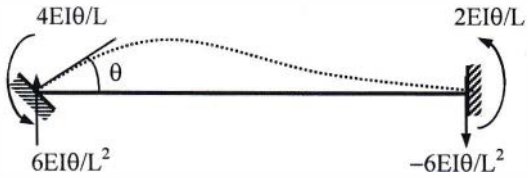
and Truss member force, $P_{AB} = S_x [(u_B - u_A) C + (v_B - v_A) S]$

[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 $P_{AB} = S_x [(u_B - u_A) C_x + (v_B - v_A) C_y + (w_B - w_A) C_z]$
* Torsional stiffness $T_l = GJ/L$
* 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
$K_{Halfspace}$	$8G_sR/(2-\nu)$	$4G_sR/(1-\nu)$	$8G_sR^3/(3-3\nu)$	$16G_sR^3/3$

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2019
Program: B.Sc. Engineering (Civil)

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

Answer the following questions.

1. A standard penetration test has been conducted on sand at a depth of 16 ft below the ground surface, The blow counts obtained were as follows:

Penetration (inch)	Blows
0 – 6	4
6 – 12	6
12 - 18	6

The test was conducted using US style Donut hammer in a 6 inch boring using a standard sampler with the liner installed.
Consider GWT at GL and γ_{sat} = 110 lb/ft^3. 6
(i) Determine N_{60} and $(N_1)_{60}$. 2
(ii) Estimate D_r. 2
(iii) How dense/loose is the sand?

2.(a) Calculate the immediate settlement of sand layer below the center of the rectangular column footing (dimension 2 m x 3 m) for the following cases (Fig.1) using elastic theory. 4
(i) h= 4 m 4
(ii) h = 8 m

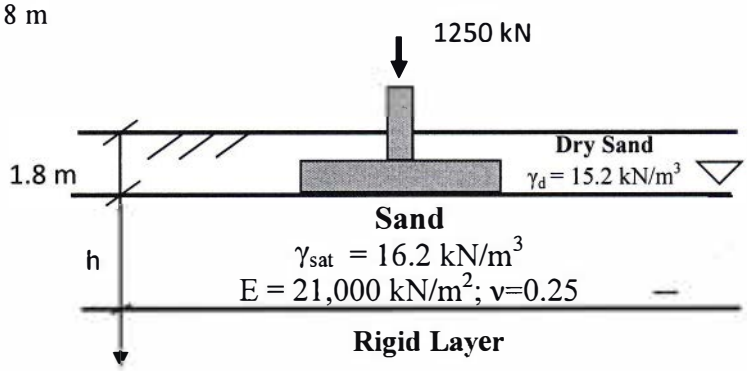


Fig. 1

2.(b) Calculate the primary consolidation settlement of soft clay around a group of 9 piles. The soil profile is given in Fig. 2. 12

Given that

Pile length (L) = 15 m, Pile diameter (D) = 0.8 m, and c/c pile spacing (s) = D.

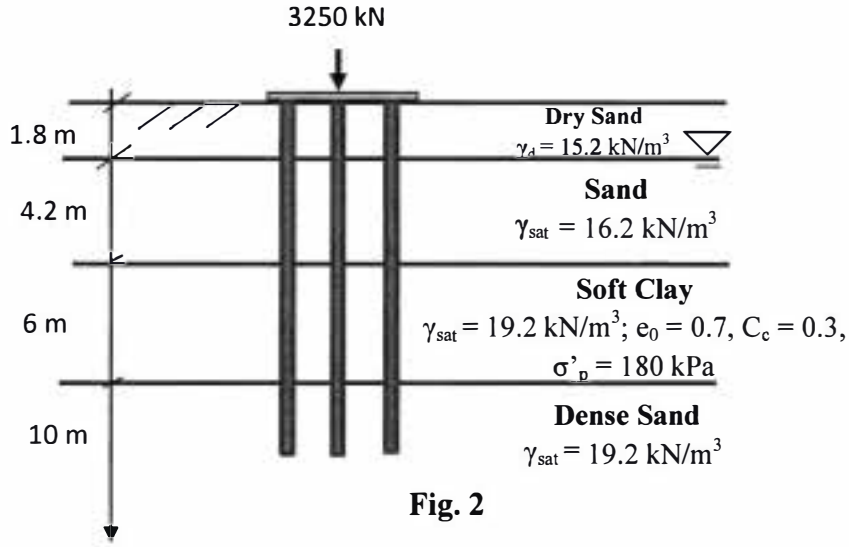


Fig. 2

3. The arrangement of 12 piles (in a group) and the soil profile are shown in Fig. 3.

Pile diameter (D) = 1.0 m, Pile Length (L) = 15 m, c/c pile spacing (s) = 0.9 m.

Given that $\alpha = 0.45$, $K_s = 0.7\ K_0$, $\delta/\varphi = 0.75$.

(i) Calculate the capacity of an individual pile (D = 1.0 m, L = 15 m) in the soil profile given in Fig. 3. 8

(ii) Calculate the capacity of a pile in the group of pile. 5

(ii) The group of vertical piles are subjected to an eccentric force Q, magnitude of 4650kN. Q is located 0.25 m (along x-axis) and 0.1 m (along z-axis) away from the center of the pile group.

Identify the piles carrying the maximum and the minimum forces and determine the maximum and minimum pile loads. 7

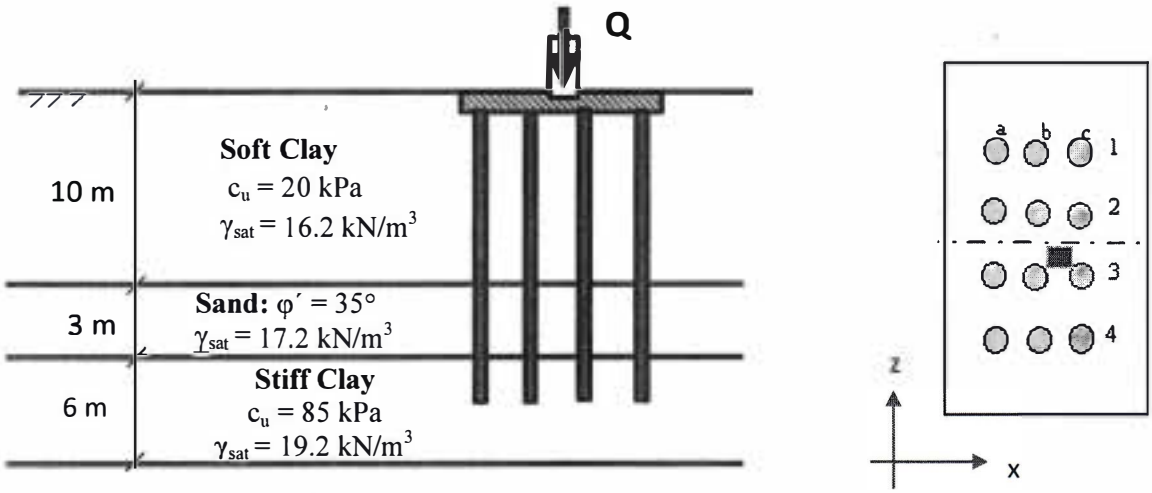


Fig. 3

4. The soil exploration report is simplified as given in Fig. 4. The ground water table is located at EGL. Provide a factor of safety equal 2. The footing width was chosen 2.5 m.

(i) Estimate the net allowable bearing capacity of the strip footing. Given that **Z** = 2.5 m. 6

(ii) Estimate the net allowable bearing capacity of the strip footing. Given that Z =10.5 m. 3

(iii) Mention the type of foundation failure for which bearing capacity is calculated in above questions. 1

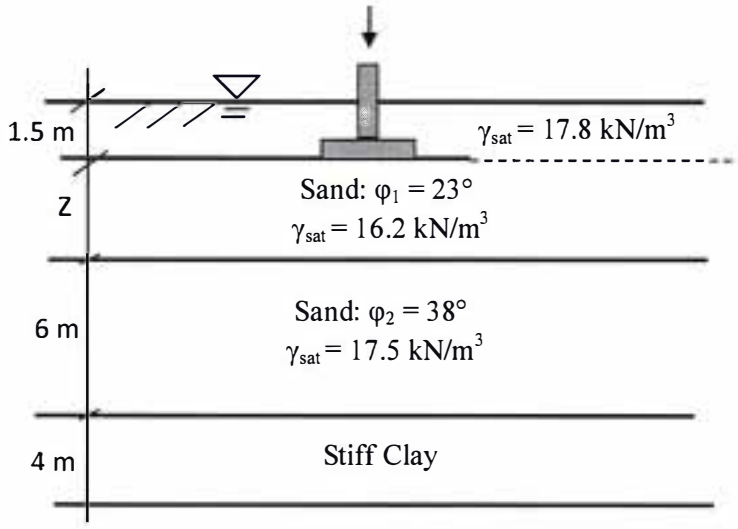


Fig. 4

5.(a) Design a rectangular shallow foundation (placed at a depth 1.8 m below the ground level) to support 480 kN load for the following soil data. Provide a factor of safety equal 3. 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. Use Meyerhof's theory of bearing capacity. The length to width ratio of the footing may be taken between 2 to 2.5. 15

Given data: γ_{sat} = 18.8 kN/m^3; c = 8 kPa; φ = 35°.

5.(b) Determine the depth of fully compensated mat foundation with a dimension of 14 m x 8 m for two different applied loads: (i) 12 MN and (ii) 20 MN. The mat will be constructed on a deep bed of saturated clay with c_u = 50 kPa and γ_{sat} = 17.75 kN/m^3. 4

Mention about the factor of safety of the mat foundation for both cases. 1

6. Apply the ordinary method of slices to compare the factor of safety for a given trial slip surface for two differently compacted embankment. Use the same data, given in Table 1, for estimating FS for the following cases.

(i) Estimate FS for the condition demonstrated in Fig. 5a. 7

(ii) Estimate FS for the condition demonstrated in Fig. 5b. 15

(iii) Compare the stability of the two embankments interms of FS calculated above. 3

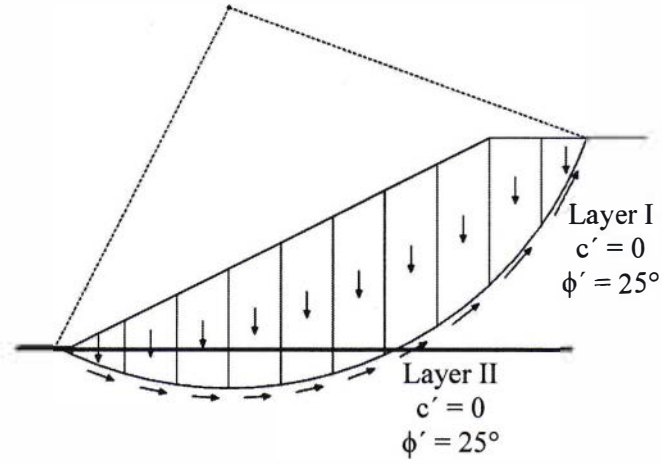


Figure 5a

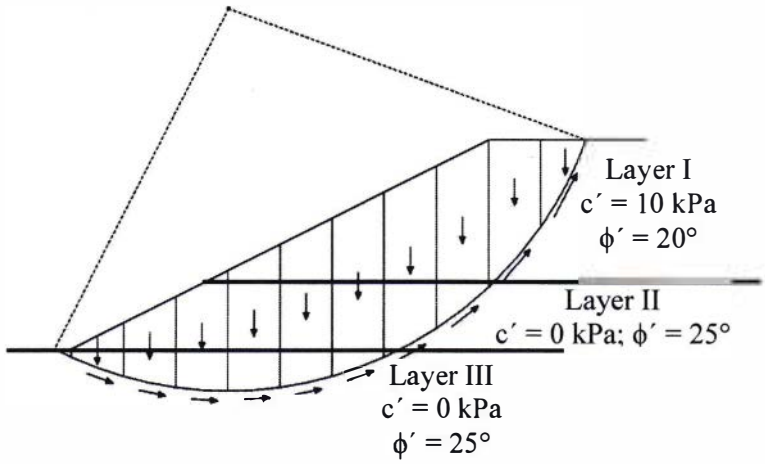


Figure 5b

Table 1

Slice No.	α (°)	b (m)	u (kPa)	W (kN/m)
1	-18	2.5	5	68
2	-10	2.5	10	160
3	0	2.5	14	204
4	15	2.5	12	221
5	21	2.5	12	238
6	27	2.5	10	229
7	33	2.5	7	221
8	48	2.5	6	221
9	53	2.5	5	204
10	65	1.6	0	108

Formulas

$$S_e = \Delta\sigma\, B \left(\frac{1-\mu_s^2}{E_s}\right) I_P$$

$$D_r = \left[\frac{N_{60}}{17 + 24\left(\frac{\sigma_0'}{P_a}\right)}\right]^{0.5}$$

$$C_N = \left[\frac{P_a}{\sigma_0'}\right]^{0.5}$$

$$F_s = \frac{\sum[c'\Delta L_n + (W_n \cos\alpha_n - u_n \Delta L_n)\tan\varphi']}{W_n \sin\alpha_n}$$

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

SPT N-Value Correction Factor

Factor	Equipment Variables	Value
Borehole Diameter facto, C_B	2.5 to 4.5 inch	1.00
	6 inch	1.05
	8 inch	1.15
Sampling Method Factor, C_s	Standard sampler	1.00
	Sampler without Liner	1.20
Rod length Factor, C_R	10 to 13 ft	0.75
	13 to 20 ft	0.85
	20 to 30 ft	0.95
	> 30 ft	1.00
Energy Ratio, ER	US Donut Hammer	52

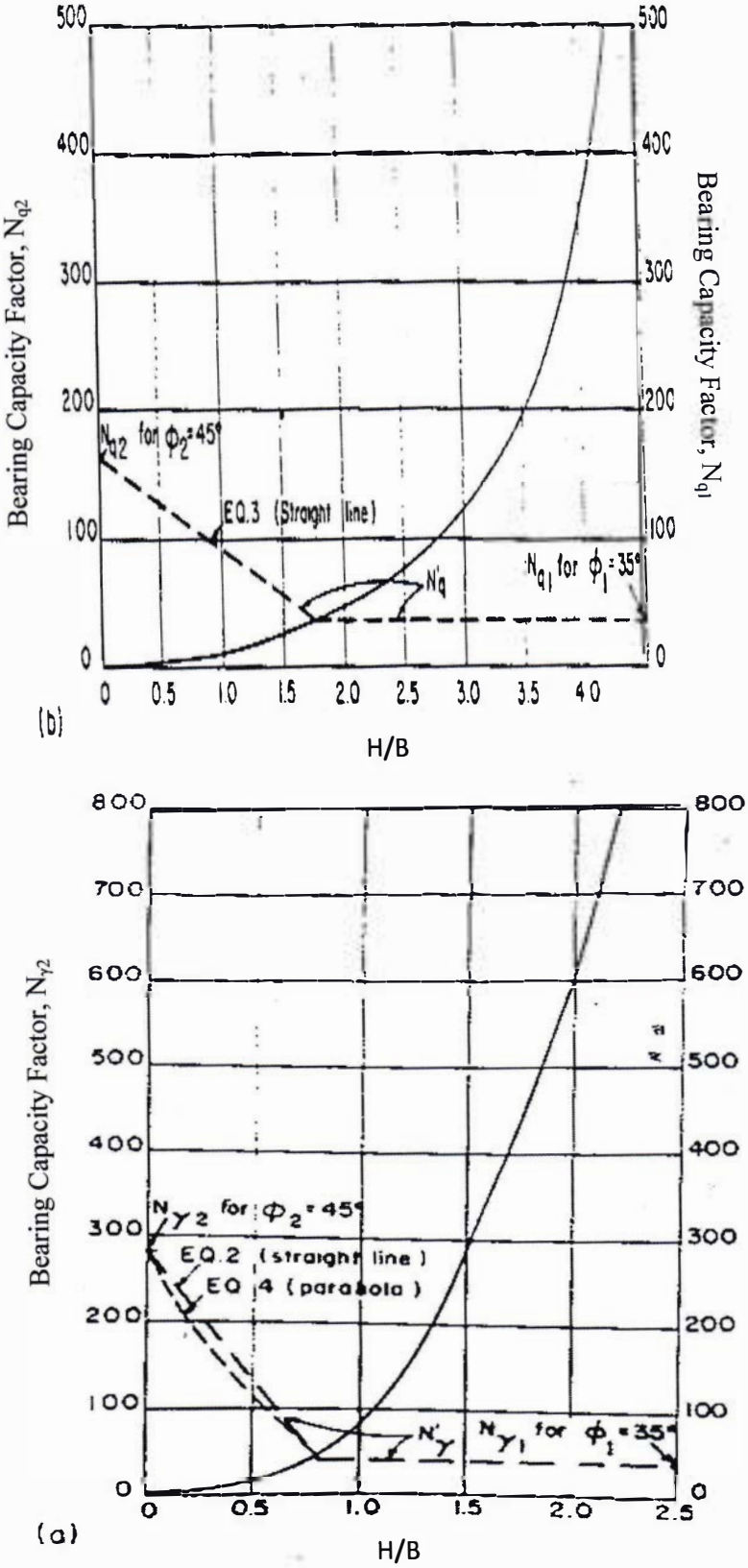
Influence Factor I_P Chart

		I_p		
		Flexible		
Shape	m_1	Center	Corner	Rigid
Circle	—	1.00	0.64	0.79
Rectangle	1	1.12	0.56	0.88
	1.5	1.36	0.68	1.07
	2	1.53	0.77	1.21
	3	1.78	0.89	1.42
	5	2.10	1.05	1.70
	10	2.54	1.27	2.10
	20	2.99	1.49	2.46
	50	3.57	1.80	3.00
	100	4.01	2.00	3.43

Shape, Depth and Inclination Factors

Factor	Condition	Equation
Shape	$\varphi = 0^{\circ}$	$F_{cs} = 1 + 0.2\,(\frac{B}{L})$ $F_{qs} = F_{\gamma s} = 1$
	$\varphi \geq 10^{\circ}$	$F_{cs} = 1 + 0.2\,(\frac{B}{L})tan^2(45^{\circ} + \frac{\varphi}{2})$ $F_{qs} = F_{\gamma s} = 1 + 0.1\,(\frac{B}{L})tan^2(45^{\circ} + \frac{\varphi}{2})$
Depth	$\varphi = 0^{\circ}$	$F_{cd} = 1 + 0.2\,(\frac{D_f}{B})$ $F_{qd} = F_{\gamma d} = 1$
	$\varphi \geq 10^{\circ}$	$F_{cd} = 1 + 0.2\left(\frac{D_f}{B}\right).tan(45^{\circ} + \frac{\varphi}{2})$ $F_{qd} = F_{\gamma d} = 1 + 0.1\left(\frac{D_f}{B}\right).tan(45^{\circ} + \frac{\varphi}{2})$
Inclination	Any φ	$F_{ci} = F_{qi} = (1 - \frac{\alpha^{\circ}}{90^{\circ}})^2$
	$\varphi > 0^{\circ}$	$F_{\gamma i} = (1 - \frac{\alpha^{\circ}}{\varphi^{\circ}})^2$
	$\varphi = 0^{\circ}$	$F_{\gamma i} = 0$

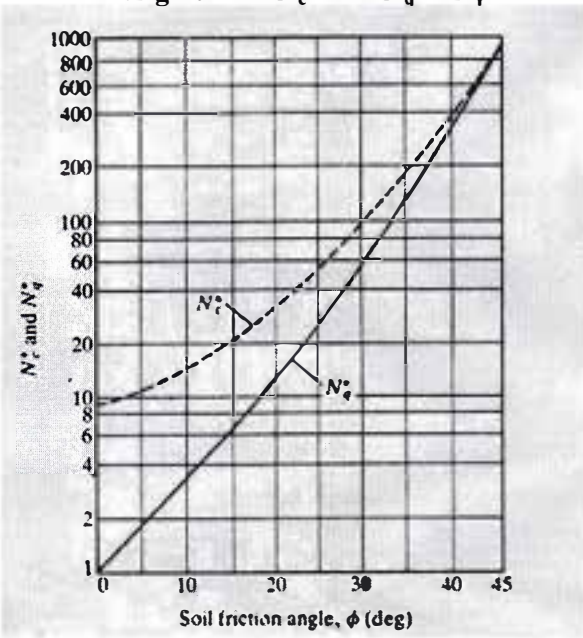
Design Charts for N_q' and N_γ' (applicable to weak sand over strong sand)



Bearing Capacity Factors (Meyerhof's Chart)

ϕ	N_c	N_q	N_γ (Meyerhof)	ϕ	N_c	N_q	N_γ (Meyerhof)	ϕ	N_c	N_q	N_γ (Meyerhof)
0°	5.10	1.00	0.00	17°	12.34	4.77	1.66	34°	42.16	29.44	31.15
1°	5.38	1.09	0.00	18°	13.10	5.26	2.00	35°	46.12	33.30	37.15
2°	5.63	1.20	0.01	19°	13.93	5.80	2.40	36°	50.59	37.75	44.43
3°	5.90	1.31	0.02	20°	14.83	6.40	2.87	37°	55.63	42.92	53.27
4°	6.19	1.43	0.04	21°	15.81	7.07	3.42	38°	61.35	48.93	64.07
5°	6.49	1.57	0.07	22°	16.88	7.82	4.07	39°	67.87	55.96	77.33
6°	6.81	1.72	0.11	23°	18.05	8.66	4.82	40°	75.31	64.20	93.69
7°	7.16	1.88	0.15	24°	19.32	9.60	5.72	41°	83.86	73.90	113.99
8°	7.53	2.06	0.21	25°	20.72	10.66	6.77	42°	93.71	85.37	139.32
9°	7.92	2.25	0.28	26°	22.25	11.85	8.00	43°	105.11	99.01	171.14
10°	8.34	2.47	0.37	27°	23.94	13.20	9.46	44°	118.37	115.31	211.41
11°	8.80	2.71	0.47	28°	25.80	14.72	11.19	45°	133.87	134.87	262.74
12°	9.28	2.97	0.60	29°	27.86	16.44	13.24	46°	152.10	158.50	328.73
13°	9.81	3.26	0.74	30°	30.14	18.40	15.67	47°	173.64	187.21	414.33
14°	10.37	3.59	0.92	31°	32.67	20.63	18.56	48°	199.26	222.30	526.46
15°	10.98	3.94	1.13	32°	35.49	23.18	22.02	49°	229.93	265.50	674.92
16°	11.63	4.34	1.37	33°	38.64	26.09	26.17				

Design chart: N_c^* and N_q^* vs ϕ



University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2019
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 3 hour | Full Marks: 100

Answer all questions.
[Assume Reasonable Values for Any Missing Data]

1. (a) Explain the advantages of flat footed rail over bull headed rail. (5)

(b) If the sleeper density is *M+7* on a broad gauge route and the length of the rail is *13* m and width of sleeper is *25.4* cm, then **calculate ballast density**. (10)

(c) Discuss the significance of: (15)
i. check rail, ii. coning of rail and iii. tilting of rail

(d) Discuss the criteria you will consider for implementing railway line in mountainous area. (10)

2. (a) An eight-lane divided highway is to be constructed on a new alignment. Traffic volume forecasts indicate that the average annual daily traffic (AADT) in both directions during the first year of operation will be *20,000* with the following vehicle mix and axle loads. (15)
Passenger cars (*1000* lb/axle) = *40%*
2-axle single-unit trucks (*6000* lb/axle) = *40%*
3-axle single-unit trucks (*10,000* lb/axle) = *20%*
The vehicle mix is expected to remain the same throughout the design life of the pavement. If the expected annual traffic growth rate is *4%* for all vehicles, determine the design ESAL, given a design period of 20 years. The percent of traffic on the design lane is *45%*. **Compute Accumulated Equivalent Single-Axle Load** for this proposed Eight-Lane Highway.

(b) A flexible pavement for an urban interstate highway is to be designed using the 1993 AASHTO guide procedure to carry a design ESAL of $2 \ X \ 10^6$. It is estimated that it takes about a week for water to be drained from within the pavement and the pavement structure will be exposed to moisture levels approaching saturation for *20%* of the time. The following additional information is available: (15)
Resilient modulus of asphalt concrete at 68°F = *450,000* lb/in^2
CBR value of base course material = *100*, M_r =*31,000* lb/in^2
CBR value of subbase course material = *22*, M_r = *3,500* lb/in^2
CBR value of subgrade material = *6*
M_r of subgrade = *9000* lb/in^2.
Determine a suitable pavement structure. Explain how you determine.

3. Compare among: i) Bitumen Emulsion, ii) Modified Bitumen, iii) Cutback Bitumen (15)

4. (a) A concrete pavement is to be constructed for a four-lane urban expressway on a subgrade with an effective modulus of subgrade reaction k of *100* lb/in^3. The accumulated equivalent axle load for the design period is *3.25 X 10^6*. Using the AASHTO design method, **design the concrete pavement** if the working stress of the concrete is *600* lb/in^2 and the modulus of elasticity is *5 X 10^6* lb/in^2. The overall standard deviation as *0.30*, the load-transfer coefficient as *3.2*, the drainage coefficient as *0.9*, and Reliability as *95%*. (5)

(b) A given pavement rating method uses six distress types to establish the Distress Rating (DR). These are corrugation, alligator cracking, ravelling, longitudinal cracking, rutting, and patching. For a stretch of highway, the number of points assigned to each category were *6, 4, 2, 4, 3*, and *3*. If the weighing factors are *2, 1, 0.75, 1, 1*, and *1.5*, **determine the DR for the section**. (5)

(c) A *5000* lb load is placed on two tires which are then locked in place. A force of *2400* lb is necessary to cause the trailer to move at a speed of *20* mi/hr. **Determine the value of the skid number. If treaded tires were used, how would you characterize the pavement type?** (5)

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2019
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 both sections according to the instruction mentioned on each section.

SECTION A
MARKS: 72

There are FOUR (4) questions. Answer question no. 01 (COMPULSORY) and any TWO (2) from the rest (36+ 2*18=72). (Assume any missing data.)

1. a) Explain the contributions of irrigation and flood management toward the socio-economic and environmental development of Bangladesh. 4

   b) An irrigation project located in Kurigram disctrict of Bangladesh divert surface water from Teesta river through a canal for irrigating an area of 5200 hectares, Based on the data and information provided in the **figure 1** and **table 1** below, calculate the following for the period from January to March: 16
   - Consumptive Water Use (C_U);
   - Consumptive Irrigation Requirement (C.I.R.);
   - Net Irrigation Requirement (NI.R.);
   - Field Irrigation Requirement (F.I.R.);
   - Gross Irrigation Requirement (G.I.R.);
   - Volume of water required to be diverted from the head works.

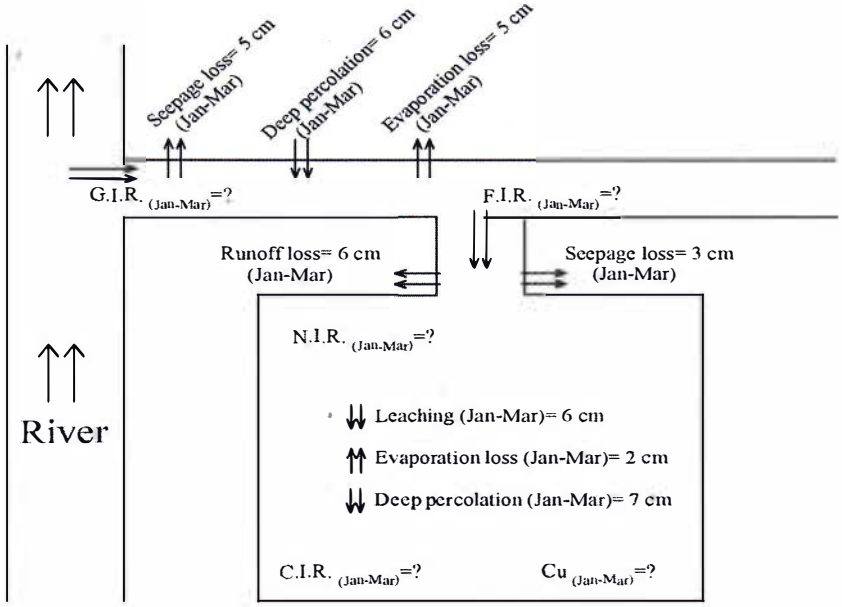


Figure 1

Table 1

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	Crop factor
January	21.0	7.40	1.60	0.70
February	18.6	7.20	1.95	0.75
March	20.5	7.50	2.40	0.60

c) Find out the following by analyzing the data and information provided in **figure 2** below: 16

- Discharge required at the potato field (Q_1);
- Discharge required at the wheat field (Q_2);
- Discharge required at rice field (Q_3);
- Actual discharge required at the head of the distributary canal (Q);
- Design discharge required at the head if time factor is 0.8;
- Average discharge required at the head of the distributary canal if capacity factor is 0.75.

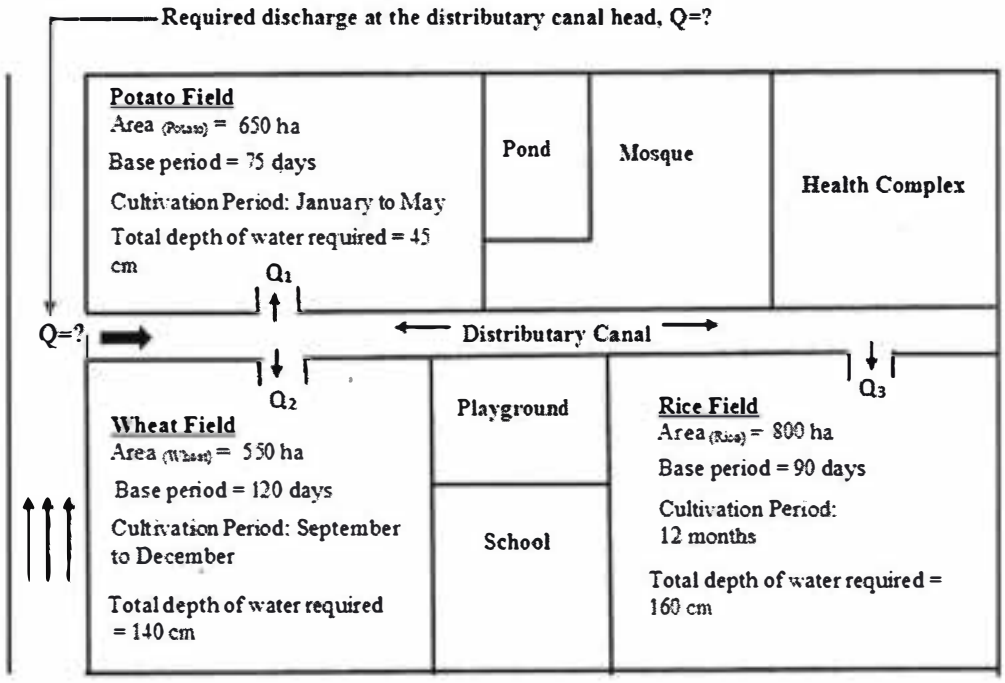


Figure 2

2. a) Draw the typical layout of diversion head works. 4

b) Do you agree that in Bangladesh *border flooding method* is more appropriate than *basin flooding method*? Justify your answer. 8

c) In a rural village of Bangladesh, the farmers together decided to install a centrifugal pump to supply irrigation water to the agricultural fields at a rate of 99 liters/second through an existing earthen canal network. Calculate the brake horse power of the pump from the following data: 6

- Suction head = 5 m
- Delivery head = 2 m
- Coefficient of friction = 0.01
- Efficiency of pump = 71%
- Diameter of pipe = 16 cm

3. a) Classify the irrigation water based on the electrical conductivity and sodium hazards. 4

b) By analyzing the data and information provided in **figure 3**, find out the following: 14

- water conveyance efficiency
- water application efficiency
- water storage efficiency
- water distribution efficiency

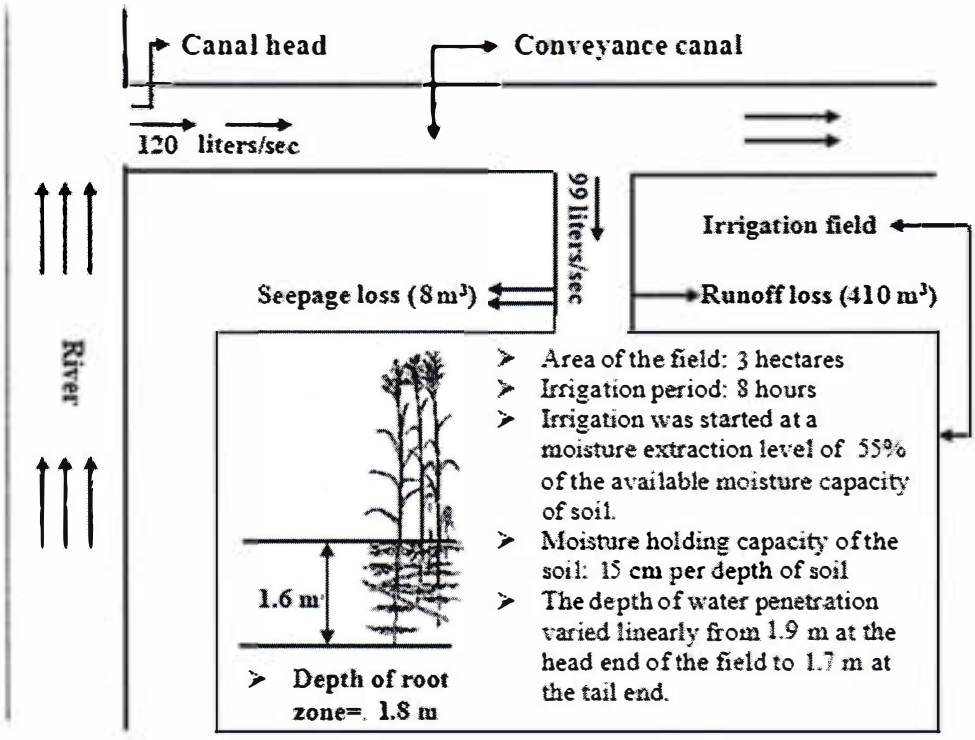


Figure 3

4. a) Explain the following with neat sketch: i) Weir ii) Groyne ii) Aqueduct. 5

b) Explain the following: i) Borrow pit ii) Critical velocity ratio iii) Berm. 5

c) An irrigation project is located in an area where irrigation water efficiency is very low due to excessive seepage loss. The responsible engineering department is planning to construct a new irrigation canal to provide sufficient water in the agricultural plots located in the project area. To decrease seepage loss and increase irrigation water efficiency, the engineering department decided to construct a lined canal instead of an earthen canal. 8

As a newly recruited engineer, you need to design that canal having the following data:
Full supply discharge = 65 m^3/sec
Side slope = 1.5:1
Bed slope = 1 in 5000
Rugosity coefficient = 0.018
Permissible velocity = 1.60 m/sec
Assume other reasonable data for the design.

SECTION B
MARKS: 28

There are THREE (3) questions. Answer <u>question no. 05 (COMPULSORY)</u> and any ONE (1) from the rest (16+12=28). (Assume any missing data.)

5. a) Summarize delta formation process and how delta formation process relates to flood. 6

a) Select three structural and three non-structural measures of flood management that you think are most important for flood management in Bangladesh. Justify your answer. 2+8

6. a) Identify four reasons of water logging in Dhaka during monsoon season. Justify your answer. 2+4

b) Identify four internationally accepted principles of transboundary water resources management that are important for increasing food production and mitigating and minimizing flood hazards along the Ganges and Brahmaputra rivers basins inside Bangladesh. Justify your answer. 2+4

7. a) Graphically explain how flood hazards vary with different geological conditions in Bangladesh. 3

b) Explain the following: 9
   i. Integrated water resources management;
   ii. Flood;
   iii. Spillways.