L3-/T-I/CE Date: 04/09/2025

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-I B.Sc. Engineering Examinations 2023-2024

Sub: **CE 301 (Professional Practice and Communication)**

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value for missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Define communication and briefly describe the process of human communication. Name (without describing) the basic communication skills and the traits of an effective communicator. **(18)**

(b) Explain what is slanted abstract and what is its purpose. **(8)**

(c) What are the different formats of short report? **(9)**

2. (a) Explain in your own words what is the Engineer supposed to do in the following cases (as per ASCE code of ethics) **(12)**

i. conflict of interest

ii. confidential information

iii. undertaking engineering assignments

(b) As per ASCE Code of Ethics, what are the responsibilities of an engineer towards his/her peers? **(23)**

3. (a) Briefly explain the leadership styles followed in meetings? In your opinion, which method is more effective and why? **(20)**

(b) Name different types of project delivery system, procurement method and contract format. **(10)**

(c) Briefly discuss "Fiduciary risk". **(5)**

4. (a) What general guidelines should be followed in dealing with contract risk? **(10)**

(b) Name specific concerns for professional liability insurance. **(8)**

(c) Name the most important aspects of the inquiry that surety companies usually undertake before issuing bonds. **(7)**

(d) Name "Think Twice" contract clauses. **(10)**

Contd …… P/2

CE 301

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) What is the difference between an Act and a Regulation? **(5)**

   (b) Why is the Open Tender Method a preferred method of tendering? **(15)**

   (c) Describe the tender process using a flow-chart. **(15)**

6. (a) Describe the steps for the procurement of intellectual services, as per the PPA, 2006. **(7)**

   (b) According to the PPA, 2006 what are the different methods of procurement for intellectual services? Describe the applicability of each of these methods. **(28)**

7. (a) For the procurement of a 30-story building, with an estimated cost of Tk. 120 crore, having an expected duration of 60 months, prepare the Tender Data Sheet for the following items. **(25)**

   i. General Experience
   ii. Specific Experience
   iii. Construction Turnover
   iv. Liquid Asset
   v. Tender Security

   (b)State the conditions that would require forfeiture of the tender security of a tenderer. **(10)**

8. (a) Define "Civil Engineers" as per ASCE Body of Knowledge. **(5)**

   (b) Discuss "Attributes" of Civil Engineer as a profession. **(15)**

   (c) What are common client concerns duration pre-design phase? **(5)**

   (d) What are the attributes of an effective brief? **(10)**

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L-3/T-1/CE **Date: 30/08/2025**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2023-2024

Sub: **CE 311** (Structural Analysis)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks

Assume reasonable values for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

16.10.25

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE.**

One Chart, Seven Figures, Six Tables are attached.

1. (a) The left support of a girder **a-d** shown in Fig. 1 needs repair service. For this repair, the girder had to be supported temporarily at joint **b** on a hydraulic jack. The gross reaction due to self-weight of the girder at **a** is 60 kip and at **d** is 40 kip. Compute the vertical displacement at **b** caused by the jack to free the support at **a** and lift it (joint **a**) 1 in above its normal position when there is only girder's self-weight. At this lift, if an additional downward load of 20 kip is applied at **c**, find net vertical deflection at **b** after application of this live load. Given, **E** = 29000 *ksi*, **I** = 250 in^4. **E** and **I** are same for every section of the girder. Consider the deflection of the girder is primarily caused by the bending strain energy. Use relevant chart as attached. **(23⅔)**

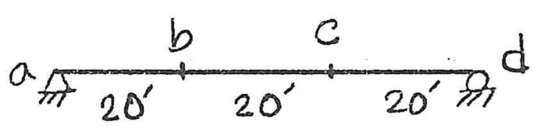

Fig. 1

(b) Using the method of virtual work, determine the relative deflection between b and D along line connecting b-D of the loaded truss shown in Fig. 2. Each member's cross-sectional area is shown in the figure in brackets (unit of the numerical value of Area is in^2). Given that E = 29000 ksi. **(23)**

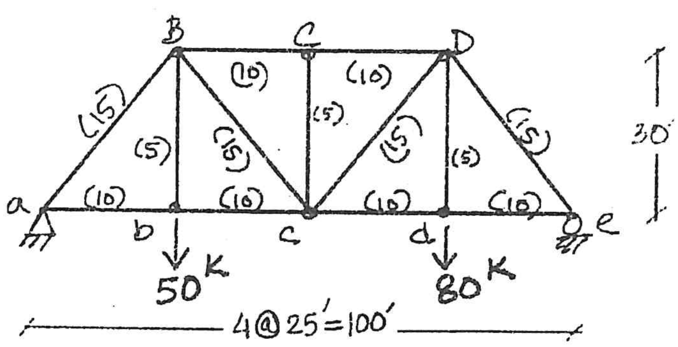

Fig. 2

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2. (a) Using the method of virtual work, find horizontal deflection of point **a** of the column shown in Fig. 3. Consider that deflection of each member is caused by the axial, shear and bending strain energy. Given that $E = 29000$ *ksi*, $\vartheta = 0.3$ and $K = 1.2$, $A_1 = 50$ in^2, A_1 A_2 = 1.2 A_1, $I_1 = 200$ in^4, $I_2 = 1.5\ I_1$ (note: segment a-b is designated as 1 and segment b-c designated as 2). E, ϑ and K are same for all sections. Use relevant chart as attached. **(23⅔)**

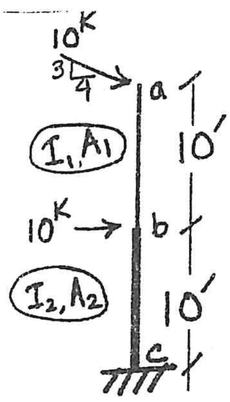

Fig. 3

(b) A typical 3-storied RC office building is located at Mirpur, Dhaka. Building plan dimension is 20 m × 20 m, each story height is 3 m. Occupancy category is II and exposure category is A. Basic wind speed of Dhaka is 65.7 m/s. Gust effect factor (G) = 0.85. Assume that the building is classified as enclosed. Equations of velocity pressure exposure coefficient are given below, where symbols have their usual meanings. **(23)**

$$K_z = 2.01\left(z/z_g\right)^{2/\alpha} \text{ for } 4.57\ m \le z \le z_g$$

$$K_z = 2.01\left(4.57/z_g\right)^{2/\alpha} \text{ for } z < 4.57\ m$$

Determine the design wind pressure, and horizontal base reaction due to the design wind load. (Parapet wind load may be disregarded.)

See Tables 1 and 2 for solving this problem. Assume reasonable values for any missing data.

3. (a) A 3 storied reinforced concrete building is located at Sylhet. The building is planned to be used for hurricane/emergency shelter. Each story height of the building is 3 m, depth of the base is 1.5 m. Building plan dimension is 50 m × 50 m. Seismic zone coefficient (Z) = 0.36 and damping correction factor (η) = 1.2. Dead load including self-weight is 12 kN/m^2 and live load is 2 kN/m^2 for typical floors. Roof live load is 1 kN/m^2. Self-weight of all pedestals below GF is 100 kN. Assume that GF having an RC floor will occupy typical floor loads. **(30⅔)**

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Contd.... for Q. No. 3(a)

Equations of normalized acceleration response spectrum (C_s) are given below.

$$C_s = S\left(1+\frac{T}{T_B}(2.5\eta-1)\right) \text{ for } 0 \le T \le T_B \qquad C_s = 2.5S\eta \text{ for } T_B \le T \le T_C$$

$$C_s = 2.5S\eta\left(\frac{T_C}{T}\right) \text{ for } T_C \le T \le T_D \qquad C_s = 2.5S\eta\left(\frac{T_C T_D}{T^2}\right) \text{ for } T_D \le T \le 4\text{sec}$$

SPT result of top 100 *ft* soil of the building site is given below.

Depth (ft)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
SPT-N	0	7	8	8	10	12	15	25	27	31	34	36	36	37	42	38	38	39	45	48	50

Answer the following questions. Follow BNBC 2020. Use Tables 3-5.

(i) Find harmonic average value of SPT in the top 100 *ft* soil of the building site.

(ii) Determine occupancy category, seismic design category, site class and frame system of the building.

(iii) Determine earthquake base shear and story forces.

(b) Column layout plan of a three storied residential building is shown in Fig. 4. Find reduced live load for the column at Grid B-2 at Level-1, Level-2 and Level-3. Follow BNBC 2020. Given, $L = L_o\left(0.25+\frac{4.57}{\sqrt{K_{LL}A_T}}\right)$, where symbols have their usual meanings.

Given that live load for a residential building is 2.4 kN/m^2 according to BNBC 2020 and $K_{LL} = 4$ for an interior column. **(10)**

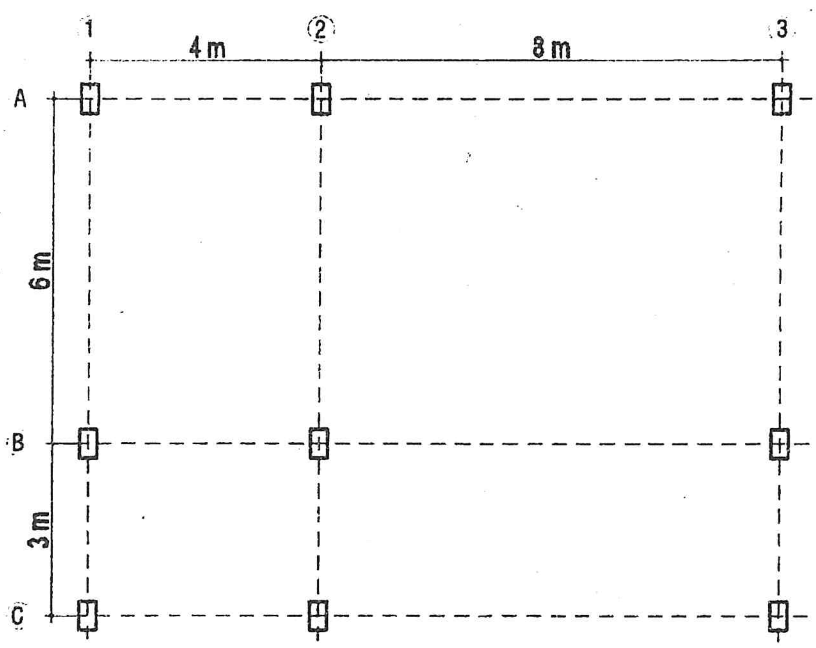

Fig. 4

(Ct)

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Contd.... for Q. No. 3

(c) Determine degree of static indeterminacy (DOSI) and degree of kinematic indeterminacy (DOKI) for the structures shown in Fig. 5. **(6)**

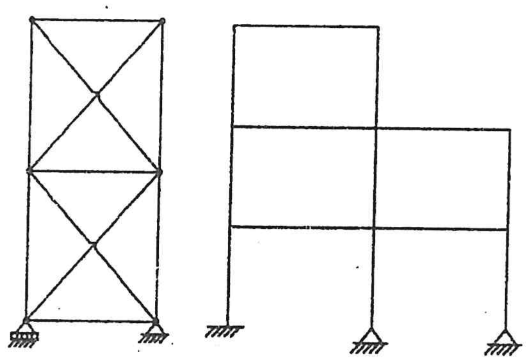

Fig. 5

4. (a) Briefly answer following questions. **(5⅔)**

(i) What was Hammurabi's Code, and how was it relevant to building design?

(ii) What is the primary purpose of a building code?

(b) Illustrate four wind load cases with diagrams. **(10)**

(c) A five storied residential building is located on a 2-D escarpment (shown in Fig. 6) at Rangamati. The building plan dimension is 75 ft by 100 ft. The total height of the building is 50 ft. Basic wind speed of Rangamati is 56.7 m/s. Assume that building's site conditions and locations of the structure meet the first two conditions of wind speed up effect. Given that the building classification is enclosed and exposure category is C. Determine topographic factors (K_{zt}) at each story of the building. Use Table 6 for solving this problem. **(15)**

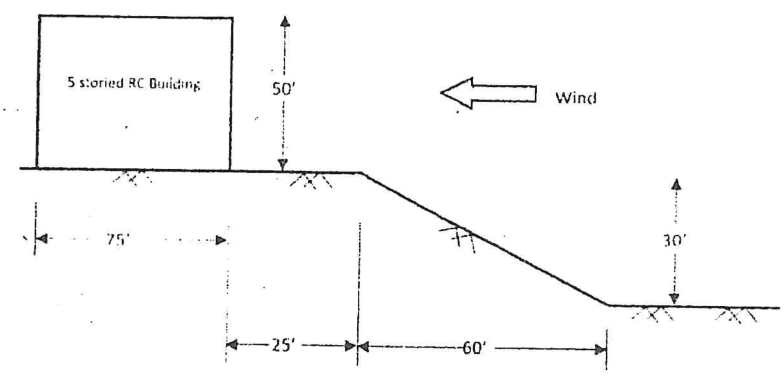

Fig. 6

(d) A one-storied RC building has a plan dimension of 40 ft × 40 ft. The openings in the windward, leeward and side walls of the building are shown in Fig. 7. Determine whether the building is an ENCLOSED, PARTIALLY ENCLOSED or OPEN for wind load calculation according to BNBC 2020.

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Contd.... for Q. No. 4(b)

Note that (1) Buildings having each wall 80% open are defined as OPEN BUILDING; (2) Buildings having conditions (i) to (iii) are defined as PARTIALLY ENCLOSED BUILDING: (i) $A_0 \geq 1.10 A_{oi}$, (ii) $A_0 > 4\ ft^2$ or $> 0.01\ A_g$, (iii) $A_{0i} / A_{gi} \leq 0.20$; and (3) remaining are defined as ENCLOSED BUILDING. **(16)**

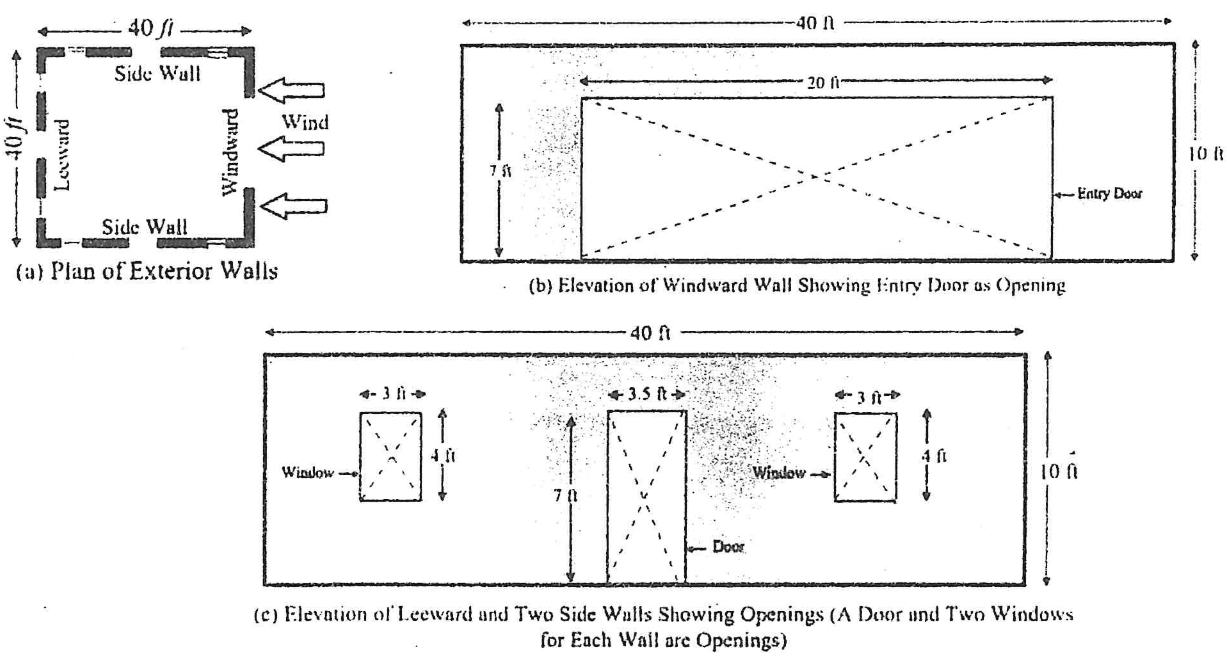

Fig. 7

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Using Portal Method, analyze the multi-storied frame for the lateral loads shown in Fig. 8. Furthermore, draw shear force diagram, bending moment diagram, and axial force diagram for columns and beams. **(30)**

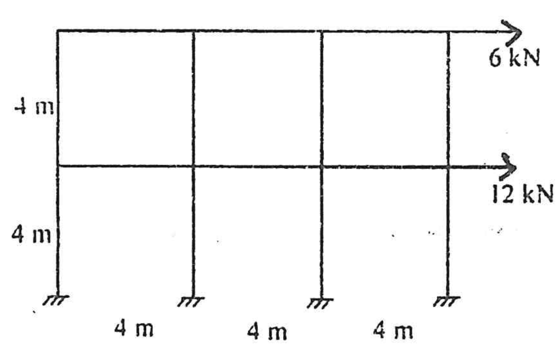

Fig. 8

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(b) Calculate the maximum shear at a point 25 ft from the left support of a simply supported beam of 100 ft span for a series of concentrated loads as shown in Fig. 9. **($16\frac{2}{3}$)**

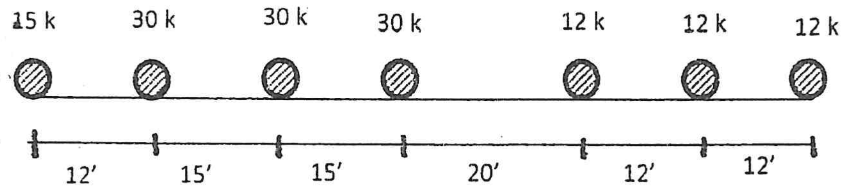

Fig. 9

6. (a) Using Cantilever Method, analyze the frame as shown in Fig. 10 and draw shear force diagram, bending diagram, and axial force diagram. Relative cross-sectional areas of the columns are shown in Fig. 10. **(30)**

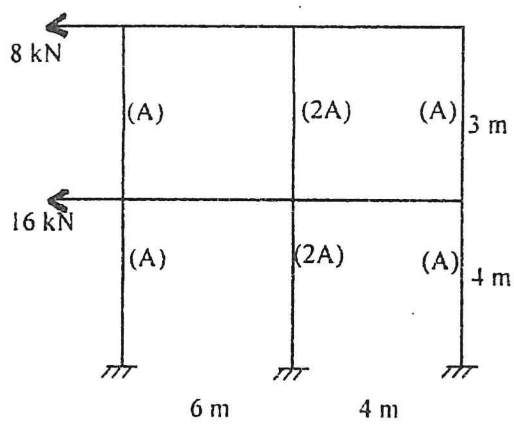

Fig. 10

(b) Given that the truss shown in Fig. 11 supports the following load, **($16\frac{2}{3}$)**

Track Load = 600 lb/ft; Floor = 640 lb/ft; Truss and Bracings = 3000 lb/ft

Calculate the axial force in Members GF, CD, and FC for the dead load. Assume all members are pin connected.

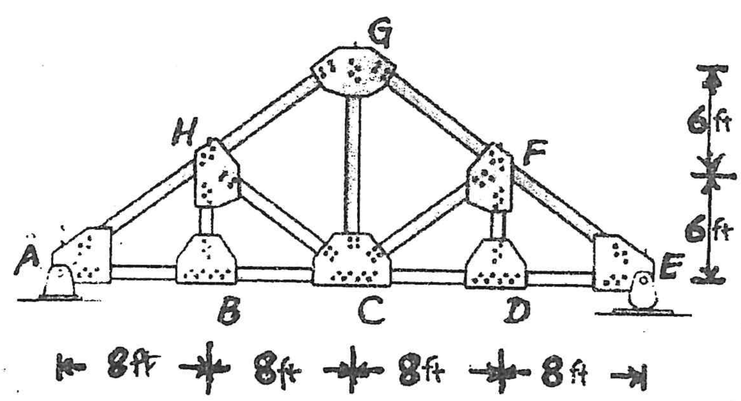

Fig. 11

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7. (a) Draw the influence line for the force in member CF, GF, BC, and FD for the truss as shown in Fig. 12.

Also, calculate the maximum forces (tension or compression) in member CF and GF for a concentrated live load of 24 kip and a uniform live load of 6 k/ft. **(30)**

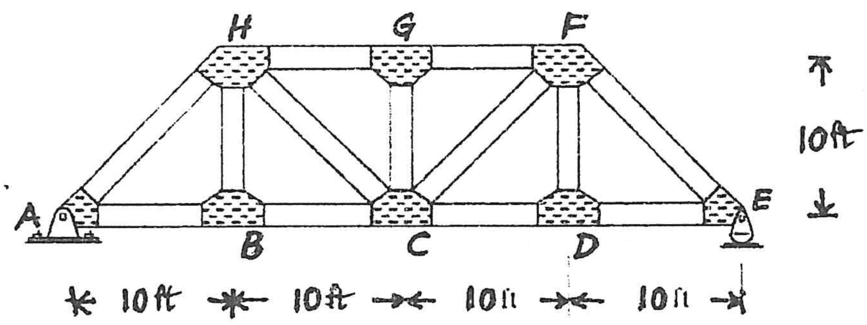

Fig. 12

(b) Calculate the absolute maximum moment at midspan of a simply supported beam of 80 ft span due to the series of wheel loads shown in Fig. 13. **(16⅔)**

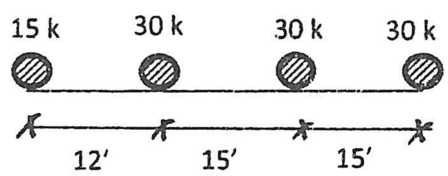

Fig. 13

8. (a) For the floor beam system shown in Fig. 14, draw influence lines for **(30)**

(i) FBR_A, FRB_B, FBR_C, FBR_D

(ii) V_{BC}, V_{CD}

(iii) M_B, M_E, M_C

A uniform live load of 6 k/ft and a single concentrated live force of 25 k are placed on the floor beams. The beams also support a uniform dead load of 2 k/ft. Determine the maximum negative shear in Panel CD and the Maximum positive moment at E.

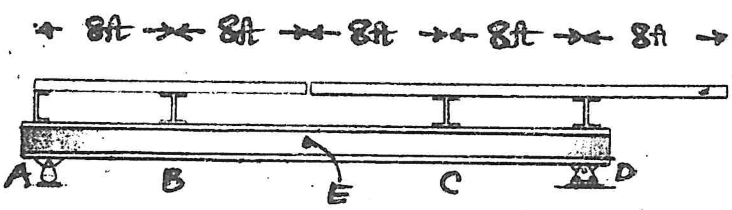

Fig. 14

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Contd.... for Q. No. 8

(b) Using Muller-Breslau principle, draw influence lines for, **(16⅔)**

(i) R_A, R_C,

(ii) V_{AR}, V_D, V_E

(iii) M_A, M_D, M_E, for the beam as shown in Fig. 15.

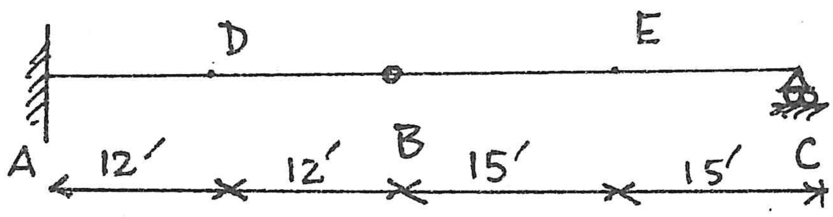


Fig. 15

Chart 1: Integration Chart

Table for Evaluating $\int_0^L m\, m'\, dx$

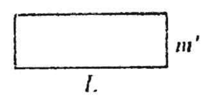
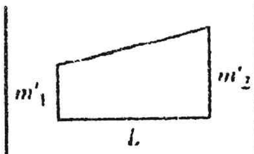
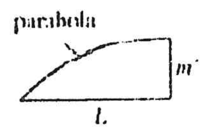
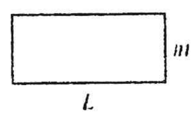
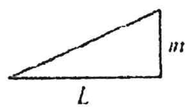
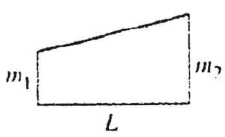
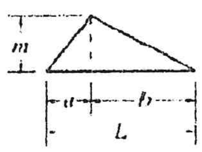
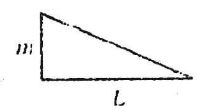
$\int_0^L m\,m'\,dx$				
	$mm'L$	$\frac{1}{2}mm'L$	$\frac{1}{2}m(m'_1 + m'_2)L$	$\frac{2}{3}mm'L$
	$\frac{1}{2}mm'L$	$\frac{1}{3}mm'L$	$\frac{1}{6}m(m'_1 + 2m'_2)L$	$\frac{5}{12}mm'L$
	$\frac{1}{2}m'(m_1 + m_2)L$	$\frac{1}{6}m'(m_1 + 2m_2)L$	$\frac{1}{6}[m'_1(2m_1 + m_2) + m'_2(m_1 + 2m_2)]L$	$\frac{1}{12}m'(3m_1 + 5m_2)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'(L + a)$	$\frac{1}{6}m[m'_1(L + b) + m'_2(L + a)]$	$\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$
	$\frac{1}{2}mm'L$	$\frac{1}{6}mm'L$	$\frac{1}{6}m(2m'_1 + m'_2)L$	$\frac{1}{4}mm'L$

Table 1: External Pressure Coefficient

Wall Pressure Coefficients, C_p			
Surface	L/B	C_p	Use With
Windward Wall	All values	0.8	q_z
Leeward Wall	0-1	-0.5	q_h
	2	-0.3	
	≥4	-0.2	
Side Wall	All values	-0.7	q_h

Table 2: Terrain Exposure Constants

Exposure	α	z_g (m)	$\hat{a}$	$\hat{b}$	$\bar{\alpha}$	$\bar{b}$	c	l (m)	$\bar{\epsilon}$	z_{min} (m)*
A	7.0	365.76	1/7	0.84	1/4.0	0.45	0.30	97.54	1/3.0	9.14
B	9.5	274.32	1/9.5	1.00	1/6.5	0.65	0.20	152.4	1/5.0	4.57
C	11.5	213.36	1/11.5	1.07	1/9.0	0.80	0.15	198.12	1/8.0	2.13

*z_{min} = Minimum height used to ensure that the equivalent height $\bar{z}$ is greater of $0.6h$ or z_{min}.
For buildings with $h \le z_{min}$, $\bar{z}$ shall be taken as z_{min}.

Table 3

Table 6.2.19: Response Reduction Factor, Deflection Amplification Factor and Height Limitations for Different Structural Systems

Seismic Force–Resisting System	Response Reduction Factor, R	System Overstrength Factor, Ω_o	Deflection Amplification Factor, C_d	Seismic Design Category B	Seismic Design Category C	Seismic Design Category D
				Height limit (m)		
C. MOMENT RESISTING FRAME SYSTEMS (no shear wall)						
1. Special steel moment frames	8	3	5.5	NL	NL	NL
2. Intermediate steel moment frames	4.5	3	4	NL	NL	10.7 35
3. Ordinary steel moment frames	3.5	3	3	NL	NL	NP
4. Special reinforced concrete moment frames	8	3	5.5	NL	NL	NL
5. Intermediate reinforced concrete moment frames	5	3	4.5	NL	NL	NP
6. Ordinary reinforced concrete moment frames	3	3	2.5	NL	NP	NP

Table 4

Site Class	Occupancy Category I, II and III				Occupancy Category IV			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
SA	B	C	C	D	C	D	D	D
SB	B	C	D	D	C	D	D	D
SC	B	C	D	D	C	D	D	D
SD	C	D	D	D	D	D	D	D
SE, S_1, S_2	D	D	D	D	D	D	D	D

Table 5

Site Dependent Soil Factor and Other Parameters Defining Elastic Response Spectrum

Soil type	S	$T_B(s)$	T_C (s)	T_D (s)
SA	1.0	0.15	0.40	2.0
SB	1.2	0.15	0.50	2.0
SC	1.15	0.20	0.60	2.0
SD	1.35	0.20	0.80	2.0
SE	1.4	0.15	0.50	2.0

Table 6: Parameters for K_{zt}

Parameters for Speed-Up Over Hills and Escarpments

Hill Shape	$K_1/(H/L_h)$			γ	μ	
	Exposure A	Exposure B	Exposure C		Upwind of crest	Downwind of Crest
2-dimensional ridges (or valleys with negative H in $K_1/(H/L_h)$	1.30	1.45	1.55	3	1.5	1.5
2-dimensional escarpments	0.75	0.85	0.95	2.5	1.5	4
3-dimensional axisym. Hill	0.95	1.05	1.15	4	1.5	1.5

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L3-/T-I/CE Date: 09/09/2025

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-I B.Sc. Engineering Examinations 2023-2024

Sub: **CE 315 (Design of Concrete Structures-I)**

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Use USD Method of Design if not mentioned otherwise.

1. (a) Discuss the behaviour of RC rectangular beam in flexure under increasing load by drawing neat sketches for strain and stress distribution of uncracked, cracked and ultimate condition. **(7)**

(b) A simply supported rectangular beam with a span of 20 ft has a width b = 14 in., an effective depth of d = 18.5 in., and a total depth of h = 21 in. It is made using concrete of $f_c' = 6.0$ ksi and steel of $f_y = 60$ ksi. The concrete modulus of rupture $f_r = 581$ psi. The elastic moduli of the concrete and steel are respectively, $E_c = 4415$ ksi and $E_s = 29000$ ksi. The tensile steel consists of four No. 8 bars. Assume n = 7.

(i) Determine the cracking moment M_{cr}. **(8)**

(ii) Determine steel stresses and strains just before the cracking. **(4)**

(iii) Find the maximum service load moment that can be resisted without either stressing the concrete above 0.45 f_c' or the steel above 0.4 f_y. **(8)**

(iv) What is the maximum moment that this beam can carry before failure? Find the concrete and steel strains at this moment. **(8)**

2. (a) What are the sources of uncertainties in the analysis, design, and construction of RC structures? How does the Strength Design method take care of these uncertainties and ensure safety in design? **(7)**

(b) If $f_c' = 4$ ksi, $f_y = 60$ ksi, find the following **(8)**

(i) Balanced reinforcement ratio, ρ_b

(ii) Maximum reinforcement ratio, $\rho_{max} = \rho_{0.004}$

(iii) Reinforcement ratio, $\rho_{0.005}$

(iv) Minimum reinforcement ratio, ρ_{min}

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CE 315

Contd... Q. No. 2

(c) A beam section is limited to width b = 16 in. and total depth h = 30 in. Calculate the required reinforcement if the beam has to resist a factored moment M_u = 1200 kip-ft. Assume two layers of tensile reinforcement with d = 26in. and d_t = 27.5. Also, assume d′ = 2.5 in. if compression steel is required. **(20)**

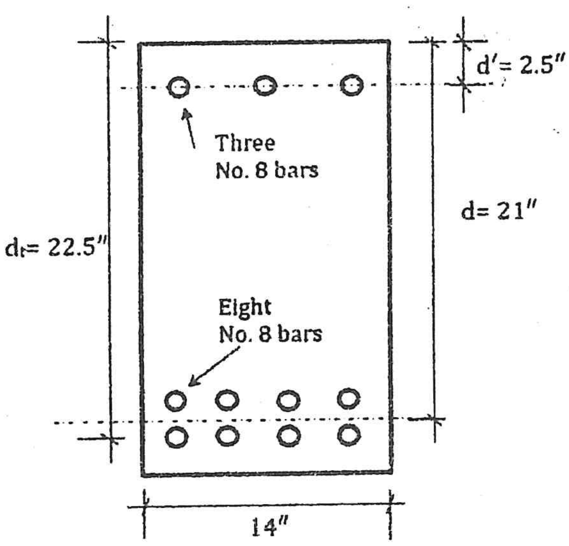
Given: $f_c' = 5$ ksi, $f_y = 60$ ksi.

3. (a) A rectangular beam carries a service live load (unfactored) of 2.0 kip/ft and an unfactored superimposed dead load of 1.0 kip/ft (in addition to self-weight of the beam) on a 25 ft simple span. The beam will have a cross-section of 12" × 25" for architectural reasons. Design the beam for flexure using the USD method. Check minimum and maximum reinforcements.

Given: $f_c' = 4.0$ ksi, $f_y = 60$ ksi. **(15)**

(b) A rectangular RC beam as shown in Fig. 1 measure 14 in. wide and has an effective depth of 21 in. Tension steel consists of Eight No. 8 bars in two layers (d = 21 in., d_t = 22.5 in.) and compression steel consists of Three No. 8 bars located 2.5 in. from the compression face. Find the nominal and design moment capacities of the beam according to the ACI/BNBC code? Check for yielding of compression steel and ε_t.

Given: $f_c' = 5$ ksi, $f_y = 72.5$ ksi. **(20)**



Given:
f_c' = 5.0 ksi
f_y = 72.5 ksi

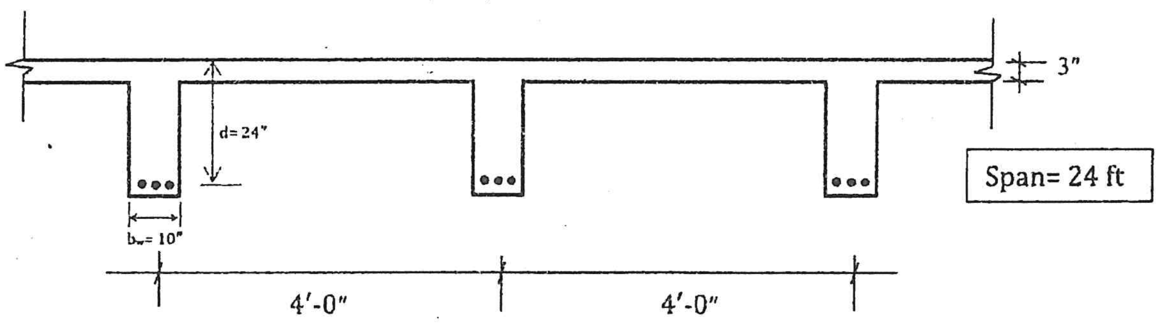
Fig. 1

Contd P/3

(49)

4. (a) A floor system consists of a 3 in. slab supported by continuous beams with a 24 ft clear span and centre-tocentre spacing of 4 ft. as shown in Fig. 2. Slab and beam are monolithically cast. Beam web width b_w = 10 in. and effective depth, d = 24 in. At the mid-span of the beam, the required factored moment is M_u = 700 kip-ft. Design the flexural reinforcement at the mid-span. Check ε_t for the designed section. **(17)**

Given: $f_c' = 3.0$ ksi, $f_y = 60$ ksi.



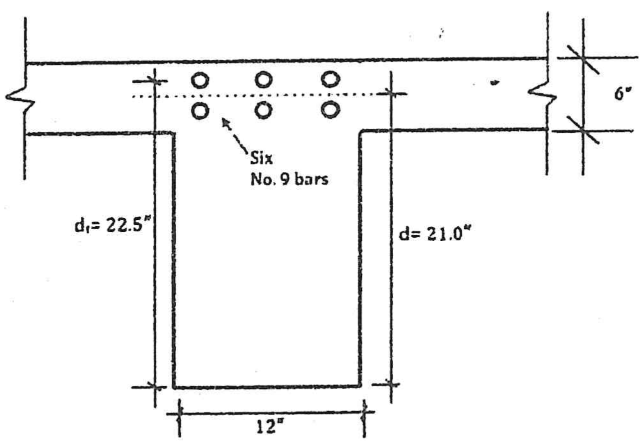
Section at mid-span

Fig. 2

(b) There are Six No. 9 bars in two rows at the top of the support, as shown in the beam section in Fig. 3. What is the nominal and design negative moment capacity of the beam at the support? Check ε_t and minimum reinforcement. **(18)**

Given: d = 21.0", d_t = 22.5"

$f_c' = 5.0$ ksi, $f_y = 60$ ksi.



Beam Section at Support

Fig. 3

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CE 315

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) What are the components that resist shear in a diagonally cracked section of beam without any shear reinforcement? Show them with neat sketches. **(6)**

(b) Differentiate between equilibrium and compatibility torsion. **(5)**

(c) Design the stirrups for the beam shown in Fig. 4. All loads are factored. Calculate stirrups with 3 sets of spacing. Width of the beam, b = 14" and effective depth, d = 25".

Given: $f'_c = 3.5$ ksi, $f_y = 60$ ksi. **(24)**

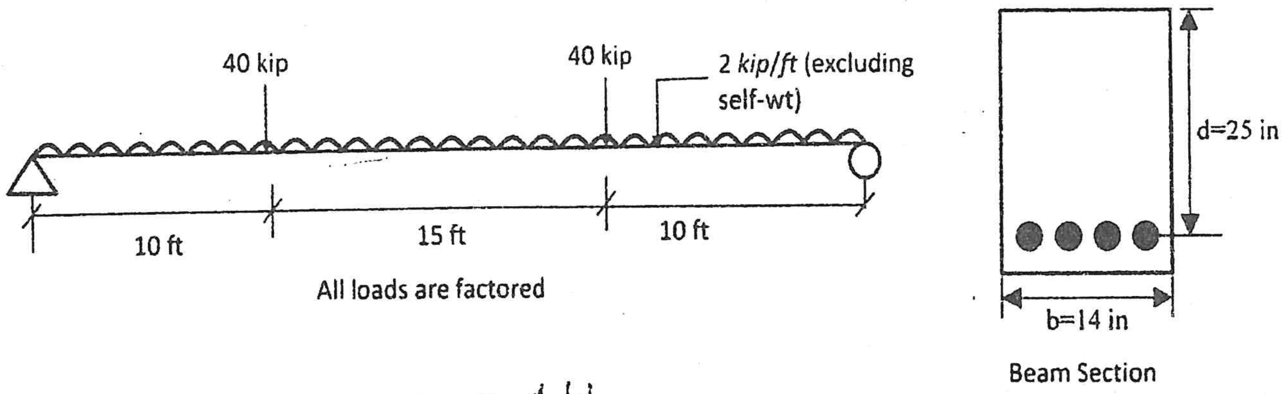

Fig. ~~1~~ 4

6. (a) Discuss briefly the factors that influence development length of a reinforcing barrier. **(7)**

(b) What is splicing? Explain briefly the class A and class B splices in tension. **(7)**

(c) What are the minimum lengths of lap for column splices as per ACI code? **(7)**

(d) Show with neat sketches cut off or bend point for bars in approximately equal span with uniformly distributed loads. **(6)**

(e) Why hooks are provided in the reinforcing bars? Draw the standard hook dimensions according to ACI code. **(8)**

7. (a) A reinforced concrete one-way slab is built integrally with its supports and consists of two equal spans, each with a clear span of 16 ft. The slab is to carry a service live load (LL) of 80 psf in addition to its self-weight. Assume floor finish load of 30 psf and partition wall load of 50 psf. Given: $f'_c = 3$ *ksi*, $f_y = 60$ ksi. Design the slab and show the reinforcement with neat sketches. Use ACI moment coefficients table provided herewith. **(23)**

(b) Discuss why and how temperature and shrinkage reinforcement is provided in one way slab. **(6)**

Contd P/5

CE 315

Contd... Q. No. 7

(c) Provide the list of minimum thicknesses for slabs with different support system as per ACI code. Why minimum thickness is necessary even though not required from flexural or shear criterion? **(6)**

8. (a) Design slab panel S1 shown in Fig. 5 to support a uniform live load of 40 psf. The panel is a corner panel of a group. Consider 50 *psf* partition wall load and 25 psf floor finish load in addition to self weight of slab. Given: $f_c' = 3.5$ *ksi*, $f_y = 60$ ksi. Assume that beams are stiff (α_m is greater than 2.0). Show all reinforcement in sketches. Use moment coefficient method with the help of supplied tables. **(28)**

(b) Elaborate on special reinforcement provided at exterior corners of a two way slab system. **(7)**

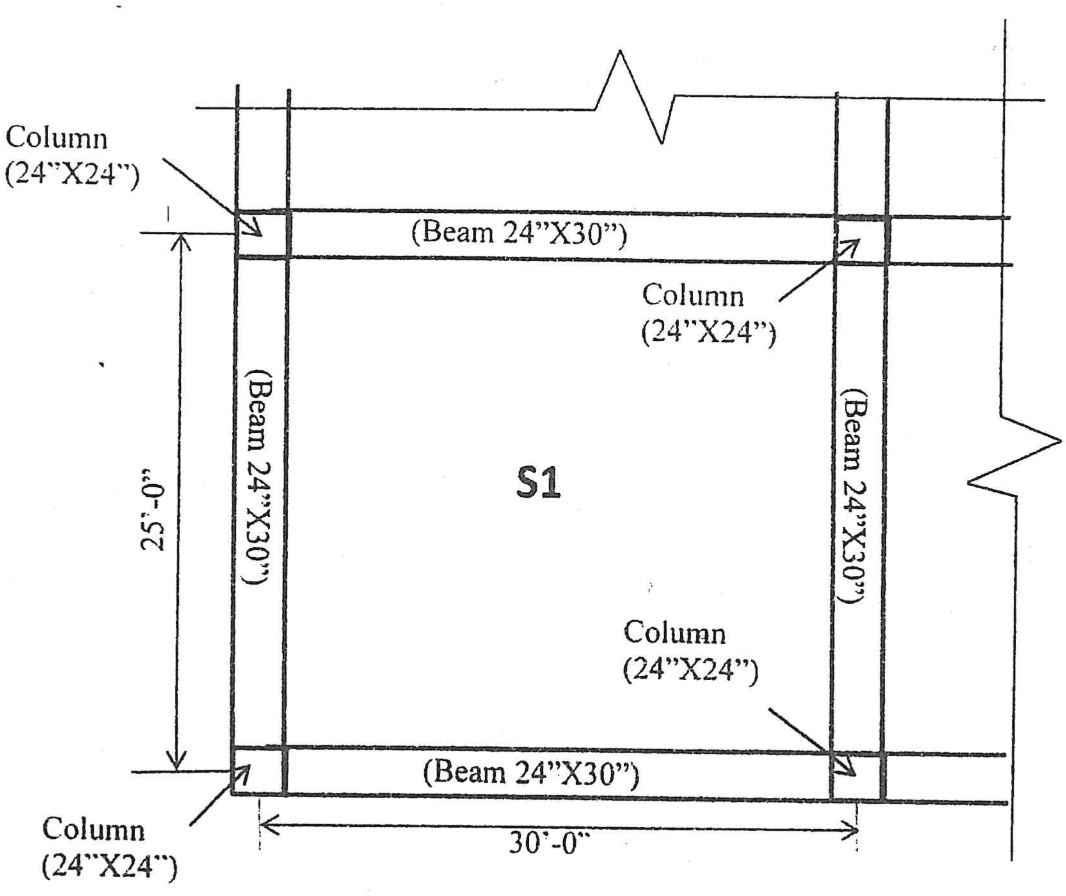

Fig. 5

Moment and shear values using ACI coefficients†

Positive moment	
End spans	
If discontinuous end is unrestrained	$\frac{1}{11} w_u l_n^2$
If discontinuous end is integral with the support	$\frac{1}{14} w_u l_n^2$
Interior spans	$\frac{1}{16} w_u l_n^2$
Negative moment at exterior face of first interior support	
Two spans	$\frac{1}{9} w_u l_n^2$
More than two spans	$\frac{1}{10} w_u l_n^2$
Negative moment at other faces of interior supports	$\frac{1}{11} w_u l_n^2$
Negative moment at face of all supports for (1) slabs with spans not exceeding 10 ft and (2) beams and girders where ratio of sum of column stiffness to beam stiffness exceeds 8 at each end of the span	$\frac{1}{12} w_u l_n^2$
Negative moment at interior faces of exterior supports for members built integrally with their supports	
Where the support is a spandrel beam or girder	$\frac{1}{24} w_u l_n^2$
Where the support is a column	$\frac{1}{16} w_u l_n^2$
Shear in end members at first interior support	$1.15 \frac{w_u l_n}{2}$
Shear at all other supports	$\frac{w_u l_n}{2}$

† w_u = total factored load per unit length of beam or per unit area of slab.
l_n = clear span for positive moment and shear and the average of the two adjacent clear spans for negative moment.

Table 12.3 Coefficients for negative moments in slabs[a]

$M_{a,neg} = C_{a,neg} w l_a^2$
$M_{b,neg} = C_{b,neg} w l_b^2$ where w = total uniform dead plus live load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,neg}$		0.045		0.050	0.075	0.071		0.033	0.061
	$C_{b,neg}$		0.045	0.076	0.050			0.071	0.061	0.033
0.95	$C_{a,neg}$		0.050		0.055	0.079	0.075		0.038	0.065
	$C_{b,neg}$		0.041	0.072	0.045			0.067	0.056	0.029
0.90	$C_{a,neg}$		0.055		0.060	0.080	0.079		0.043	0.068
	$C_{b,neg}$		0.037	0.070	0.040			0.062	0.052	0.025
0.85	$C_{a,neg}$		0.060		0.066	0.082	0.083		0.049	0.072
	$C_{b,neg}$		0.031	0.065	0.034			0.057	0.046	0.021
0.80	$C_{a,neg}$		0.065		0.071	0.083	0.086		0.055	0.075
	$C_{b,neg}$		0.027	0.061	0.029			0.051	0.041	0.017
0.75	$C_{a,neg}$		0.069		0.076	0.085	0.088		0.061	0.078
	$C_{b,neg}$		0.022	0.056	0.024			0.044	0.036	0.014
0.70	$C_{a,neg}$		0.074		0.081	0.086	0.091		0.068	0.081
	$C_{b,neg}$		0.017	0.050	0.019			0.038	0.029	0.011
0.65	$C_{a,neg}$		0.077		0.085	0.087	0.093		0.074	0.083
	$C_{b,neg}$		0.014	0.043	0.015			0.031	0.024	0.008
0.60	$C_{a,neg}$		0.081		0.089	0.088	0.095		0.080	0.085
	$C_{b,neg}$		0.010	0.035	0.011			0.024	0.018	0.006
0.55	$C_{a,neg}$		0.084		0.092	0.089	0.096		0.085	0.086
	$C_{b,neg}$		0.007	0.028	0.008			0.019	0.014	0.005
0.50	$C_{a,neg}$		0.086		0.094	0.090	0.097		0.089	0.088
	$C_{b,neg}$		0.006	0.022	0.006			0.014	0.010	0.003

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

7

Table 12.4 Coefficients for dead load positive moments in slabs[a]

$M_{a,pos,dl} = C_{a,dl} w l_a^2$
$M_{b,pos,dl} = C_{b,dl} w l_b^2$ where w = total uniform dead load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,dl}$	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	$C_{b,dl}$	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	$C_{a,dl}$	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	$C_{b,dl}$	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	$C_{a,dl}$	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	$C_{b,dl}$	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	$C_{a,dl}$	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	$C_{b,dl}$	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	$C_{a,dl}$	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	$C_{b,dl}$	0.023	0.011	0.020	0.016	0.009	0.015	0.022	0.015	0.010
0.75	$C_{a,dl}$	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	$C_{b,dl}$	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	$C_{a,dl}$	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	$C_{b,dl}$	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	$C_{a,dl}$	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	$C_{b,dl}$	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	$C_{a,dl}$	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	$C_{b,dl}$	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	$C_{a,dl}$	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	$C_{b,dl}$	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	$C_{a,dl}$	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	$C_{b,dl}$	0.006	0.002	0.007	0.004	0.001	0.003	0.007	0.004	0.002

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

8

Table 12.5 Coefficients for live load positive moments in slabs[a]

$M_{a,pos,ll} = C_{a,ll} w l_a^2$
$M_{b,pos,ll} = C_{b,ll} w l_b^2$ where w = total uniform live load

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{a,ll}$	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	$C_{b,ll}$	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	$C_{a,ll}$	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	$C_{b,ll}$	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	$C_{a,ll}$	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	$C_{b,ll}$	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	$C_{a,ll}$	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	$C_{b,ll}$	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	$C_{a,ll}$	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	$C_{b,ll}$	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	$C_{a,ll}$	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	$C_{b,ll}$	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	$C_{a,ll}$	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	$C_{b,ll}$	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	$C_{a,ll}$	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	$C_{b,ll}$	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	$C_{a,ll}$	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	$C_{b,ll}$	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	$C_{a,ll}$	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	$C_{b,ll}$	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	$C_{a,ll}$	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	$C_{b,ll}$	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

Table 12.6 Ratio of load W in l_a and l_b directions for shear in slab and load on supports[a]

Ratio $m = \frac{l_a}{l_b}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	W_a	0.50	0.50	0.17	0.50	0.83	0.71	0.29	0.33	0.67
	W_b	0.50	0.50	0.83	0.50	0.17	0.29	0.71	0.67	0.33
0.95	W_a	0.55	0.55	0.20	0.55	0.86	0.75	0.33	0.38	0.71
	W_b	0.45	0.45	0.80	0.45	0.14	0.25	0.67	0.62	0.29
0.90	W_a	0.60	0.60	0.23	0.60	0.88	0.79	0.38	0.43	0.75
	W_b	0.40	0.40	0.77	0.40	0.12	0.21	0.62	0.57	0.25
0.85	W_a	0.66	0.66	0.28	0.66	0.90	0.83	0.43	0.49	0.79
	W_b	0.34	0.34	0.72	0.34	0.10	0.17	0.57	0.51	0.21
0.80	W_a	0.71	0.71	0.33	0.71	0.92	0.86	0.49	0.55	0.83
	W_b	0.29	0.29	0.67	0.29	0.08	0.14	0.51	0.45	0.17
0.75	W_a	0.76	0.76	0.39	0.76	0.94	0.88	0.56	0.61	0.86
	W_b	0.24	0.24	0.61	0.24	0.06	0.12	0.44	0.39	0.14
0.70	W_a	0.81	0.81	0.45	0.81	0.95	0.91	0.62	0.68	0.89
	W_b	0.19	0.19	0.55	0.19	0.05	0.09	0.38	0.32	0.11
0.65	W_a	0.85	0.85	0.53	0.85	0.96	0.93	0.69	0.74	0.92
	W_b	0.15	0.15	0.47	0.15	0.04	0.07	0.31	0.26	0.08
0.60	W_a	0.89	0.89	0.61	0.89	0.97	0.95	0.76	0.80	0.94
	W_b	0.11	0.11	0.39	0.11	0.03	0.05	0.24	0.20	0.06
0.55	W_a	0.92	0.92	0.69	0.92	0.98	0.96	0.81	0.85	0.95
	W_b	0.08	0.08	0.31	0.08	0.02	0.04	0.19	0.15	0.05
0.50	W_a	0.94	0.94	0.76	0.94	0.99	0.97	0.86	0.89	0.97
	W_b	0.06	0.06	0.24	0.06	0.01	0.03	0.14	0.11	0.03

[a] A crosshatched edge indicates that the slab continues across, or is fixed at, the support; an unmarked edge indicates a support at which torsional resistance is negligible.

L-3/T-I/CE **Date: 14/09/2025**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-I B. Sc. Engineering Examinations 2023-2024

Sub: **CE 331** (Environmental Engineering I)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Assume reasonable value for any missing data.

1. (a) With a neat sketch, describe the natural processes that contribute to hardness and alkalinity in groundwater. **(4+6=10)**
Briefly explain the environmental significance of the following water quality parameters.
(i) Chloride (ii) Fluoride (iii) Nitrogen
(b) Water contains 6.9×10^{-8} moles Trichloroethylene (TCE, MW = 131.4) gas per mole of water. What is the concentration of TCE in water? If Henry's constant, H = 560 atm at 20°C, what will be the concentration in water in the presence of 0.01 mole air? **(10)**
(c) A settling column analysis of flocculent suspension (Type-II settling) has been carried out. The resulting iso-removal lines for suspended solid removal are shown in **Figure 1**. Estimate the minimum detention time required to achieve 85% efficiency in a settling basin with 2.5 m depth. [**Note**: attach the worked-out version of Figure 1 with your answer script]. **(15)**

2. (a) Briefly describe the mechanisms for particle removal in filtration units. Compare slow sand filter with rapid sand filter. **(5+5=10)**
(b) Gas above the soda in a bottle of soft drink is pure CO_2 at a pressure of 2 atm at 25°C. Calculate the pH of the soft drink. Concentration of CO_2 can be found from the equation: $[CO_2] = K_H P_g$; where K_H is the Henry's law constant (0.033363 mol/L.atm for CO_2 at 25°C) and P_g is the partial pressure of the gas in air. **(10)**
(c) Design a split treatment lime-soda softening process (flow scheme/split and chemical dose) for the water composition shown in **Table 1**. The final hardness must be less than 120 mg/L as $CaCO_3$. Assume the quick lime is 87 percent pure and the soda ash is 97 percent pure. Estimate the final hardness also. **(15)**

Table 1: Concentration of constituents in water sample

Constituents	Concentration (mg/L)
CO_2	9
Ca^{2+}	102
Mg^{2+}	45
HCO_3^-	364
SO_4^{2-}	138

Contd P/2

(92)

3. (a) Define ecosystem. What are the ecosystem services? Describe with examples. **(5)**

(b) Define and list 'Hard to Reach (HtR)' areas of Bangladesh. Describe and assess "BUET Water Supply System" aligning with the conventional system. **(3+7=10)**

(c) Describe the "Drinking Water Service Ladder". What are the challenges for Bangladesh in achieving SDG 6.1 Target? Describe. **(4+6=10)**

(d) A household of 7 family in a rural area is planning to install a Rainwater Harvesting (RWH) system. The water demand of this family for drinking and cooking is 15 lpcd and area of concrete roof is 150 m^2. The average annual rainfall in that area is 1070 mm. Design a rainwater tank with a capacity of 3 dry months storage. Runoff coefficient of concrete roof is 0.7. **(10)**

4. (a) What are the major activities involved in preparation of Water Safety Plan (WSP)? List the steps for the development of a WSP for an urban area. **(3+3+4=10)**
Draw an appropriate process flow diagram for simultaneous removal of iron and arsenic from groundwater with low alkalinity and no organic matter.

(b) Briefly describe the mechanism of destabilizing the colloidal particles with appropriate sketches. **(10)**

(c) Briefly explain the mechanisms of adsorption processes. **(3+12=15)**
An ion exchange softener with exchange capacity of 95 kg/m^3 is to be used to treat water having the properties shown in **Table 1** of **Question 2(c)**. Flow to the treatment plant is 25,000 m^3/d and it is desired to soften the water to less than 120 mg/L as $CaCO_3$. The unit is operated at a flow rate of 0.35 m^3/min.m^2. The regeneration capacity is 150 kg NaCl per m^3 of resin with 10% solution. Determine:

(i) Flow amount to be bypassed
(ii) The volume of medium required
(iii) Size of the tank for continuous operation in fixed beds
(iv) Determine the chemical requirement for regeneration and the regeneration cycle time.

Contd P/3

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Assume any reasonable data, if needed

5. (a) Classify and define the types of water bearing ground formation on the basis of water transmitting and water storage capacity. **(8+7)**

Why the Specific Yield of an unconfined aquifer is sometimes called "unconfined storativity"? Show with a neat sketch.

(b) In Chandpur, a groundwater based water supply system is to be provided for a residential community. From grain size distribution analysis, the obtained information are given in the table below. It is to be noted that the salinity in water is very high in that area. Calculate the total yield from the well using the given data. Also draw the 'well log' of the designed well. **(12)**

Sl No.	Depth (ft)	FM	D_{60} (mm)	D_{10} (mm)	Cu
	200-400	Clayey soil			
1	400-550	1.12	0.27	0.14	1.59
2	550-640	1.34	0.3	0.17	1.76
3	640-740	0.67	0.2	0.09	2.22
	740-880	Clayey soil			
4	880-930	1.28	0.28	0.16	1.75
5	930-1020	1.38	0.31	0.18	1.72
6	1020-1090	0.73	0.23	0.13	1.77
	1090-1150	Clayey soil			

Table: Separate slot sizes have different opening area

Slot Size	Assumed Opening (Steel Screen)
40 slot	20%
30 slot	15%
20 slot	10%
For uPVC screen, opening area is considered to be half of the above mentioned areas	

Given,

Piezometric level (static) of water = 80 ft

Diameter if he strainer = 8 inch

Strainer pipe material = uPVC

D_{60}, D_{30} and D_{10} of the supplied gravel pack material = 1.35 mm, 1.0 mm and 0.7 mm respectively.

Assume gravel pack thickness = 8 inch

(c) Write short note on – water demand for firefighting (on a city scale). **(8)**

6. (a) Following information are obtained during calculation of a water distribution network for a residential zone. Calculate the diameter of the water distribution pipes using dead-end method. Do necessary checks for selecting correct size of the pipes. **(17)**

Given, available pressure at OH tank = 70 psi and minimum required pressure at end of each branch is 30 psi.

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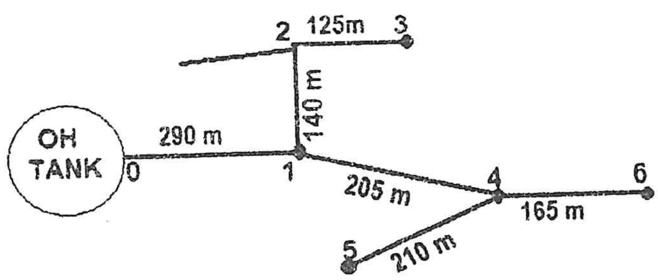
Contd ... Q. No. 6(a)

Length of each pipe is marked in the figure below. Consider flow velocity, V = 5 fps and friction factor = 0.01. Assume any reasonable value, if needed.

Pipe line	Supply (m^3/d)
1-2	275
2-2	195.5
4-5	135.5
4-6	205



(b) Name the common methods of population forecasting. Also write the applicability of the methods depending on type of city/area for which the population is forecasted. **(8)**

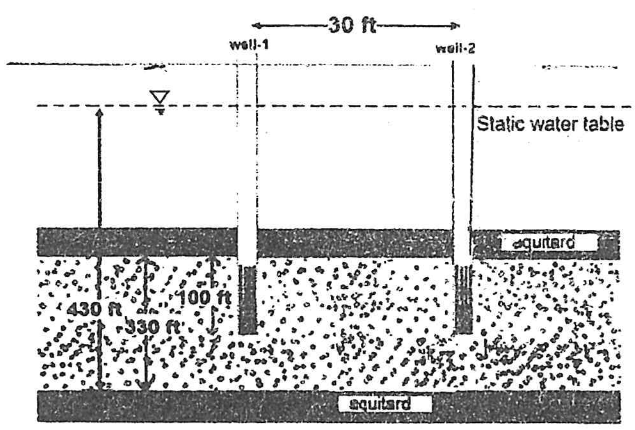
(c) What are the major elements of a water supply? Write down the sustainability of rain water harvesting as a potential source of water supply. **(3+7)**

7. (a) Name the major issues associated with groundwater extraction in Bangladesh. What are the major reasons of tubewell failure? Explain briefly. **(4+6)**

(b) In an aquifer two 12 inch diameter (each) tubewells are installed as shown in the image below. When a single tubewell is operated the pumping water level within the well drops 18 ft from its original position during no pumping hour. It is also found that the diameter of zone of influence is 160 ft. Assume the coefficient of permeability of the aquifer material is 0.001 $ft^3/sec\text{-}ft^2$. Calculate- **(15)**

(i) The flow rate (Q) when a single well is operated

(ii) The drop in drawdown when both of the wells are operated simultaneously for same well discharge (Q) from both wells.



(c) Write down the merits and demerits of the following methods of water distribution- **(8)**

(i) system with indirect pumping and storage

(ii) system with direct connection to water main

Contd P/5

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8. (a) Differentiate between 'Dry Intake' and 'Wet Intake'. What factors should be considered in selecting the intake location? Describe. **(4+7)**

(b) Why is 'Priming' not required in a submersible pump? **(2+4+10)**

What is 'Cavitation'? How is it avoided in a submersible pump? Explain.

Design a submersible pump used in a deep tubewell to deliver water to a reservoir using the following data:

Water demand: 65 gpcd

Population: 3800

RL of ground surface: 100.0 ft

RL of the reservoir: 103.5 ft

Water table depth from GL: 120 ft

Pump position: 30 ft below the water table

Pumping duration: 8 hrs/day

Friction factor: 0.01

Horizontal pipe length: 700 ft

Water velocity 8 ft/sec

Pump efficiency: 70%

(Neglect minor losses)

(c) What are the causes of 'Water Hammer' in water supply pipeline and how can this problem be solved? Describe. **(8)**

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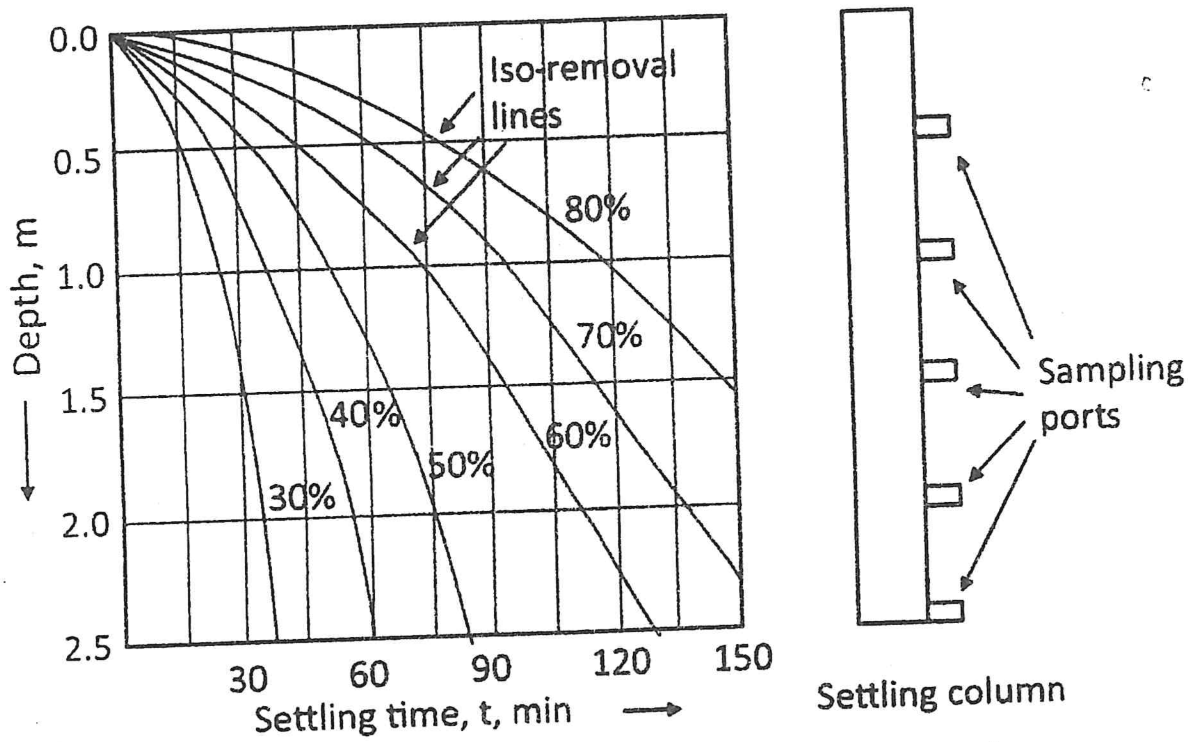

Figure 1: Iso-removal lines for a Type-II settling test using 2.5 m deep column.
(~~Attached~~ the worked-out version of the figure with your Answer Script.)

11/10/25

L-3/T-1/CE **Date: 24/08/2025**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2023-2024

Sub: **CE 341** (Principles of Soil Mechanics)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Following are the data obtained form an unconfined compression strength test on a clay specimen: **(20)**

Diameter: 1.5 inch, Height: 3.0 inch, Weight of wet specimen: 186.5 gm, Weight of dry specimen: 160.0 gm and Specific gravity: 2.65.

Determine: moisture content, degree of saturation, moist unit weight (gm/cc), dry unit weight (gm/cc), void ratio and porosity of the soil specimen.

Is the moist unit weight equal to saturated unit weight for this particular specimen? Comment.

(b) Draw three phase presentations of a soil at plastic limit and liquid limit. At which natural moisture content between liquid limit and plastic limit a high plasticity soil is expected to exhibit higher shear strength? Show on a qualitative scale and give reasoning. **$(10\frac{2}{3})$**

(c) Write short notes on: **(16)**

(i) Single grained structure of soil

(ii) Honeycomb structure of soil

(iii)Dispersed structure of soil

(iv)Swelling potential of Kaolinite, Montmorillonite and Illite

2. (a) A retaining wall has a height of 6.0m from its base. There is a water table at 2.0m below the top surface of the retained fill. The unit weights of retained fill above and below water table are 16 kN/m^3 and 18 kN/m^3, respectively. The effective angle of friction and effective cohesion of the retained fill are 35° and 10 kN/m^2, respectively. The retained fill carries a surcharge load of 20 kN/m^2. Draw the active earth pressure diagrams and hydrostatic pressure diagram for the wall. Calculate total sliding force at the base of the wall. Also, calculate the overturning moment about the toe of the wall. **(30)**

(b) Draw typical variation of lateral earth pressures with tilt of a wall. Which one of the three types of earth pressures is the maximum for a given cohesionless soil? Provide reasoning. **$(6\frac{2}{3})$**

Contd P/2

(c) Show the major and minor principal planes on a 2D element of a backfill material behind a retaining wall at at-rest, active and passive earth pressure states. Also, show potential failure planes in a backfill behind a retaining wall at active and passive earth pressure states with respect to major principal planes. **(10)**

3. (a) A triaxial CU test with pore pressure measurement was conducted on three specimens of a clay sample. Following are the data obtained from the tests on three specimens: **($26\frac{2}{3}$)**

Specimen Serial	Cell pressure (kN/m^2)	Deviator stress at failure (kN/m^2)	Pore pressure at failure (kN/m^2)
1	430	250	25
2	470	298	35
3	550	390	73

Determine total stress and effective stress shear strength parameters of the clay sample. Also, determine the angle of the failure plane with respect to the major principal plane for each specimen. Use graph paper for solving the problem.

(b) Give your answer in terms of 'True' of 'False' for the following statements: **(20)**

I. Soil specimen fails along a predefined plane in a direct shear test.

II. In triaxial CU test with pore pressure measurement, drainage valve remains open during consolidation phase and closed during shear phase.

III. During shear phase in a triaxial CD test, pore pressure gauge measures no reading.

IV. Both total and effective stress shear strength parameters may be obtained from a CU test with pore pressure measurement.

V. Effective stress angle of friction is always higher than total stress angle of friction for a normally consolidated clay soil.

VI. Effective stress cohesion is always less than total cohesion for an over consolidated clay soil.

VII. Confining pressure is applied in a direct shear test.

VIII. In triaxial UU test, the drainage valve is always open.

IX. In triaxial CD test, the drainage valve remains closed during consolidation phase and open during shear phase.

X. Triaxial CD test provides only total stress shear strength parameters.

Contd P/3

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4. (a) Following are the results of sieve analysis of a soil sample: $(26\frac{2}{3})$

Sieve no.	Sieve opening size (mm)	Mass of soil retained on each sieve (gm)
4	4.750	0
10	2.000	40
20	0.850	60
40	0.425	89
60	0.250	140
80	0.180	122
100	0.150	210
200	0.075	56
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Draw the particle size distribution curve on a semi-log graph paper for the soil and determine the following:

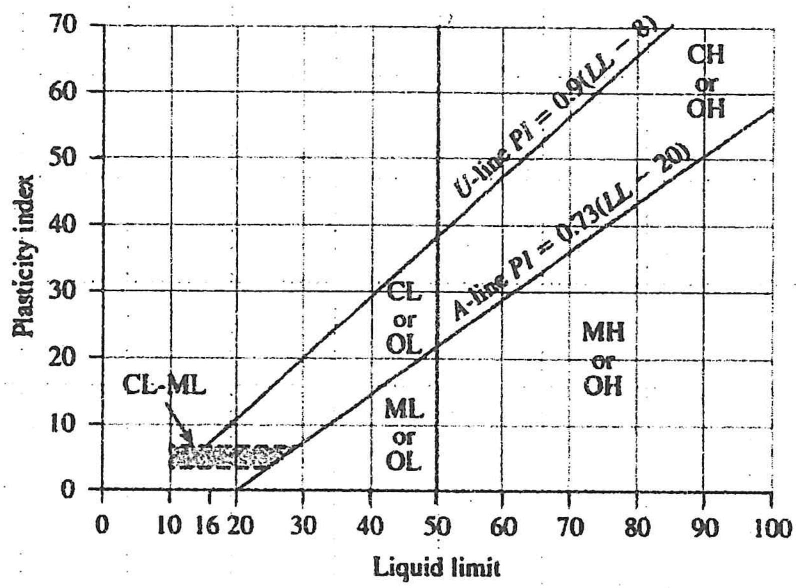
(i) % Gravel, % Sand and % Fines according to AASHTO and USCS soil classification systems.

(ii) Determine coefficient of uniformity and coefficient of curvature of the soil.

(iii) Is the soil well graded, poorly graded or gap graded? Comment.

(b) Following are the data obtained form a liquid limit test on an inorganic soil. Determine the liquid limit of the soil. Plastic limit of the soil was determined to be 27%. Using the plasticity chart, determine the type of the soil. (20)

Specimen no.	Unit	1	2	3	4	5
No. of blows		11	17	23	30	38
Wt. of container	gm	7.10	7.00	6.90	10.60	10.90
Wt. of container + wet soil	gm	29.90	30.10	30.80	34.00	31.00
Wt. of container + dry soil	gm	20.60	20.90	21.60	25.20	23.70



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CE 341

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Explain the 'Sand Cone Method' for determination of field density of soils. **(12)**

(b) The soil profile at a site consists of a 7 m thick clay layer (γ_{sat} = 17 kN/m^3) underlain by a sand layer (γ_{sat} = 18 kN/m^3). The clay layer extends from the ground surface. If water table is at the ground surface, determine the safe depth of excavation in the clay layer. Water level in the excavation will be maintained at the excavation bottom. **(10)**

(c) A 6 m thick stratum of clay is located at a depth of 8 m below the ground surface. For the clay layer: LL = 45, NMC = 40% and G_s = 2.7. A sand layer, that extends from the ground surface, exists above this clay stratum. Water table is at a depth of 4 m below the ground surface. For the sand layer: γ = 17 kN/m^3 (above water table) and γ' = 10.5 kN/m^3 (below water table). A 2 m $\times$ 3 m footing, carrying a column load of 250 kN is placed at the top of the clay layer. Schematically show the sub-soil profile at the site and estimate the total primary consolidation settlement of the clay layer. **(12)**

(d) Discuss the compaction characteristics of various soil types. Also, state the significance of 'zero air void line' on compaction curve. **$(8+4\frac{2}{3})$**

6. (a) Discuss the advantages and limitations of using of values of co-efficient of consolidation obtained by logarithm-of-time method and square-root-of-time method. **$(10\frac{2}{3})$**

(b) Compare the increase in vertical stress with depth below the center of circular, square and strip loads. **(6)**

(c) Fig 1 shows a section through a sheet pile wall along with flow net. Analyze and comment on the stability of the wall against heaving and piping failure. **(10+8)**

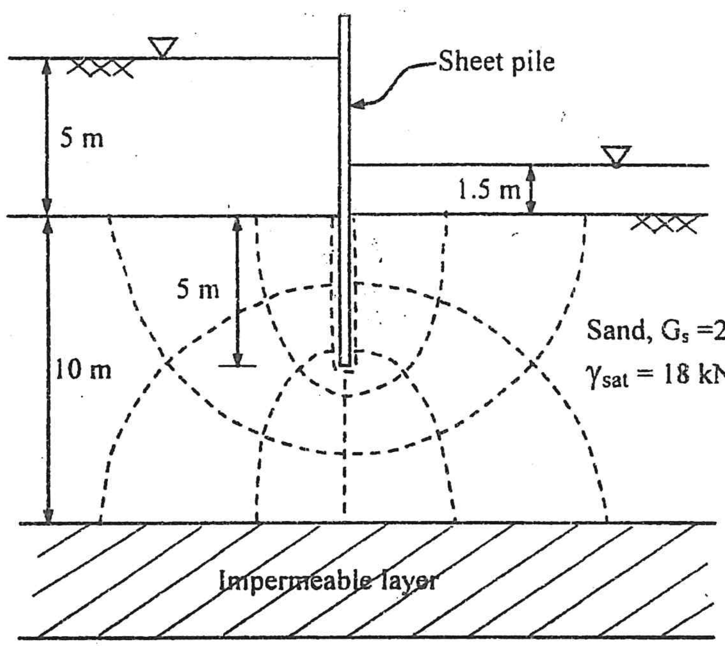

Fig.1 for Q.6(c)

(d) Derive expression for 'equivalent coefficient of permeability' of layered deposits with flow direction perpendicular to bedding plane. **(12)**

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7. (a) An area (Fig. 2) is loaded with a uniform pressure of 150 kPa. Using Newmarks's influence chart (provided) determine the increase in vertical stress at a point which is 3 m below point 'P' as shown in the figure. (Attach the chart with the answer script). $(12\frac{2}{3})$

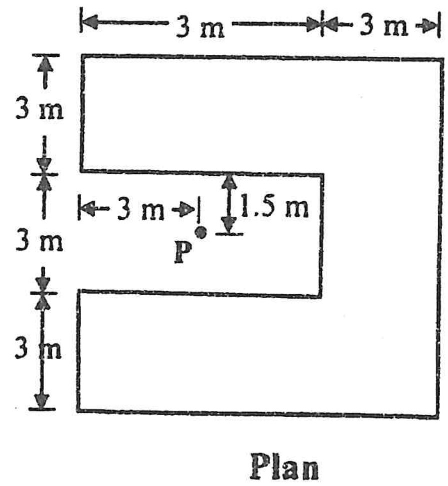

Fig.2 for Q.7(a)

(b) A clay layer at a site is 5 m thick and is drained at the top only. Total consolidation settlement of the clay layer, due to application of a surcharge on the ground surface, is estimated as 310 mm. Given, $c_v = 9.5$ m^2/year for the clay, determine: **(8+6+6)**

(i) Average degree of consolidation of the clay layer at the time when settlement is 90 mm.

(ii) Time for 75% consolidation to occur.

(iii) Time for 65% consolidation to occur if the layer is drained on both sides.

Time factor T_v for various degree of consolidation are given in the table.

Values of T_v for different U%

U%	T_v	U%	T_v
10	0.008	60	0.287
20	0.031	70	0.403
30	0.071	80	0.567
40	0.126	90	0.848
50	0.197	100	∞

(c) The soil at a site has water content of 18% and bulk unit weight of 16.5 kN/m^3. The specific gravity is 2.70. Soil from this site will be used to construct an embankment section of 1000 cum. The soil will be compacted at 95% relative compaction with respect to MDD of 17.0 kN/m^3 and OMC of 15%. Determine the required volume of excavation at the borrow site. **(14)**

8. (a) Fig. 3 shows a section through a 20 m long retaining wall. Draw a flow-net. Also, determine the seepage pressure and hydrostatic pressure at point A. $(18\frac{2}{3})$

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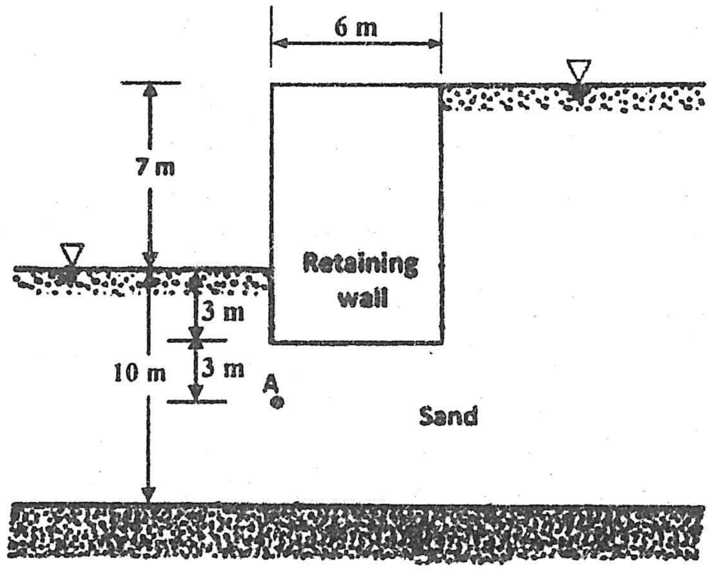


Fig.3 for Q.8(a)

(b) A foundation of size 4 m × 6 m transmits a total load of 4800 kN to the soil at its base. Determine the increase in vertical stress at a point which is 6 m below the center of the foundation. Use Newmark's solution, $\sigma_z = q\ I$. Steinbrener's chart for Newmark's influence coefficient, I is provided (Fig. 4). **(12)**

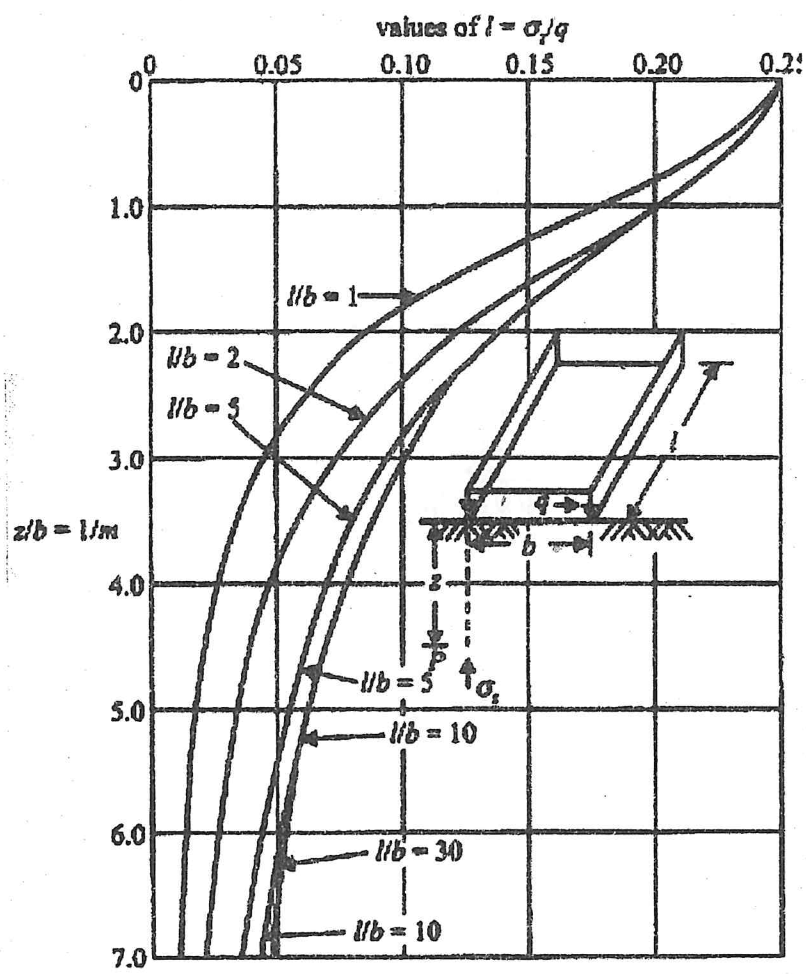
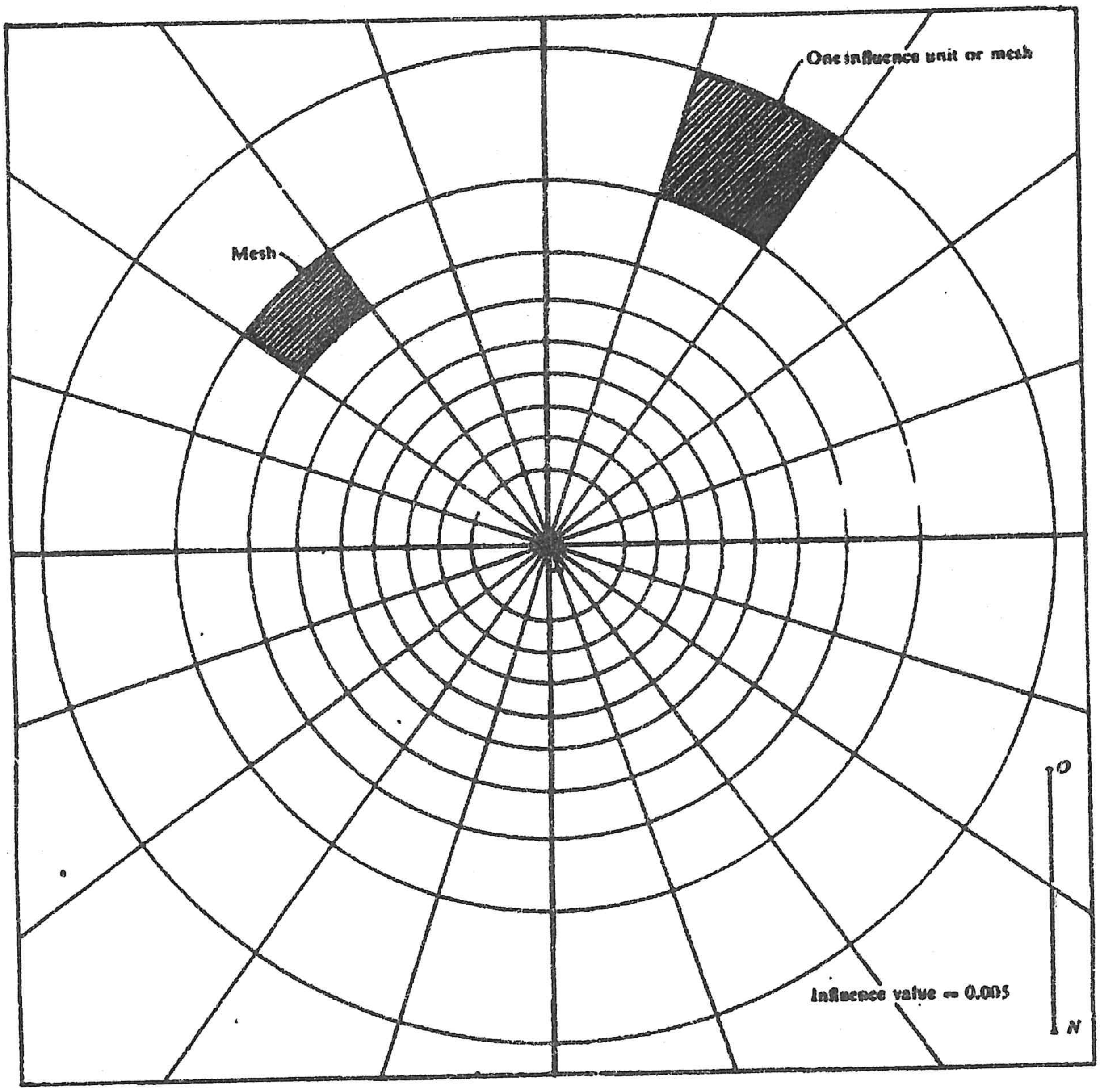


Fig. 4 for Q. 8(b)

Steinbrener's chart for obtaining Newmark's influence coefficient, *I*

(c) Define 'hydraulic gradient' and 'critical hydraulic gradient' relevant to flow through soils. Derive an expression for 'critical hydraulic gradient' in terms of effective unit weight of soil and unit weight of water. **(8+8)**

— For Q.7(a) —



Newmark's influence chart