 Date : 07/06/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2012-2013

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

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value(s) of any data, if missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **EIGHT** questions in this section. Answer any **SIX**.

1. (a) Classify the natural soil deposits based on their origin and briefly indicate the characteristics of each of them. **($11\frac{1}{3}$)**

   (b) Deduce a formula for shear strength of soil determined by vane shear test, considering triangular distribution of stresses at the edge surfaces of the blade. Hence, prove that for a special condition the approximate relationship for shear strength of soil is given by $\tau = \dfrac{3T}{11D^3}$. The symbols have their usual meanings. **(12)**

2. The following data of consistency limits are available for two soils A and B. Find which soil is (i) more plastic, (ii) better foundation material on remoulding, (iii) better strength as a function of water content, and (iv) better shear strength at plastic limit. **($23\frac{1}{3}$)**

   Classify soil A as per USCS and soil B using AASHTO classification system. Both the soils contain 52 percent fines (passing No. 200 sieve).

	SOIL-A	SOIL-B
Liquid limit	30	52
Plastic limit	16	19
Flow Index	12	6
Natural water content	32	40

3. A triaxial sample was subjected to an ambient (cell) pressure of 200 kN/m^2, and the pore pressure recorded was 50 kN/m^2. In this state, the sample was found to be fully saturated. Then the cell pressure was raised to 300 kN/m^2. What would be the value of pore pressure? Then a deviator stress of 150 kN/m^2 was applied to the sample. Assuming the pore pressure parameter A to be 0.5, determine the pore pressure value. **($23\frac{1}{3}$)**

4. In a consolidated drained triaxial test, a specimen of saturated sand failed under an additional axial stress of 250 kN/m^2 when the cell pressure was 100 kN/m^2. Draw the Mohr circle considering initial and failure stress conditions. Determine ϕ' and the inclination of the failure plane to the horizontal. What is the shear stress on the failure plane and the maximum shear stress, τ_{max} that developed? What is the orientation of the plane of τ_{max}? Compare maximum obliquity with the obliquity of τ_{max}. If the factor of safety with respect to shear strength more than 1 on the plane of τ_{max}? **($23\frac{1}{3}$)**

23

Contd P/2

CE 341

5. Direct shear test was performed in a 60 mm × 60 mm square shear box on a silty sand. At zero normal load, it sheared at 30 kN/m^2. An identical sample was then subjected to a normal stress of 200 kN/m^2. It failed at a shear stress of 130 kN/m^2. Determine – $(23\frac{1}{3})$

   (i) The angle of internal friction ϕ.

   (ii) The magnitude of principal stresses by drawing a Mohr circle tangent at (200, 130).

   (iii) The normal and shear stresses on a property oriented failure plane.

6. A vertical smooth back retaining wall supports a dry cohesionless soil having unit weight γ = 16 kN/m^3 and angle of internal friction of 35°. The upper surface of the backfill is horizontal. Determine the total active thrust by Culmann's graphical method. Compare the thrust with that obtained from Rankine's method. $(23\frac{1}{3})$

7. What are the basic considerations of Rankine and Coulomb theories of earth pressure? Draw the lateral pressure distribution diagram and compute the total lateral thrust coming to the basement wall as shown in Fig. 1 with the given data. $(23\frac{1}{3})$

Layer Thickness	Soil 1	Soil 2
H_1 = 2.5 m	γ_1 = 18.5 kN/m^3	γ_2 = 19.5 kN/m^3
H_2 = 3.0 m	φ_1 = 33°	φ_2 = 38°
	OCR_1 = 1.0	OCR_2 = 2.0

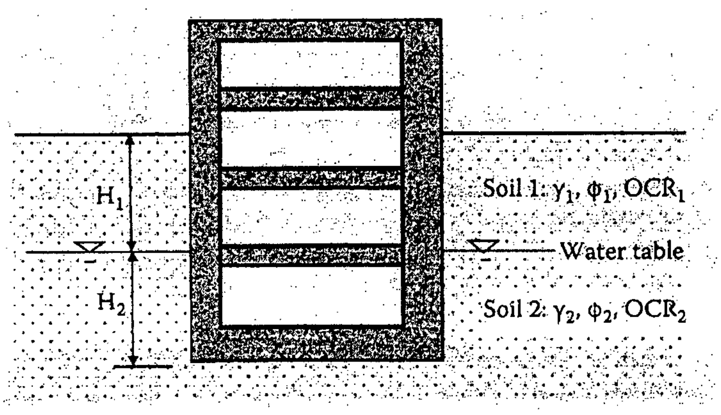


Fig. 1 Illustration for Question No. 7

8. Figure below (Fig. 2) shows a vertical retaining wall with a horizontal backfill, which may fail in passive mode. Compute and draw all lateral pressures that may act on the wall. Compute also the total lateral thrust and the point of application of the resultant force.

CE 341

Contd ... Q. No. 8

Layer Thickness	Soil 1	Soil 2
$H_1 = 2.0$ m	$\gamma_1 = 18.0$ kN/m^3	$\gamma_2 = 19.0$ kN/m^3
$H_2 = 4.0$ m	$c_1 = 20$ kN/m^2	$c_2 = 25$ kN/m^2
	$\varphi_1 = 14°$	$\varphi_2 = 17°$

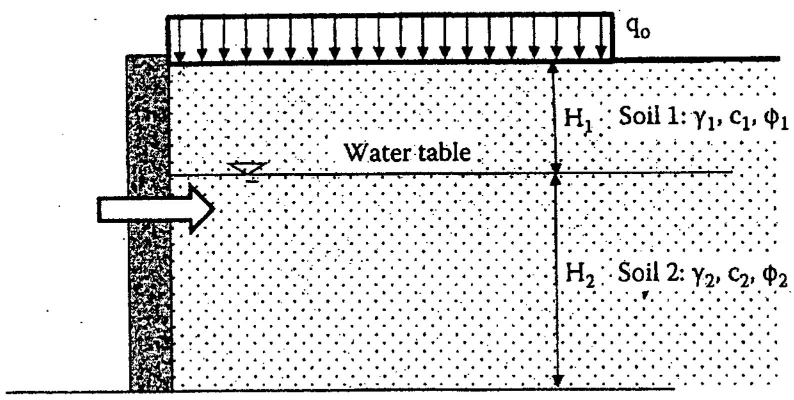


Fig. 2 Illustration for Question No. 8

SECTION – B

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

9. (a) Derive an expression for submerged density of soil in terms of its water content, void ratio, specific gravity and density of water. Define the term degree of saturation. **($16\frac{2}{3}$)**

(b) A borrow soil has a natural water content of 10% at a bulk density of 1.8 Ton/m^3. The soil is used for an embankment to be compacted at 18% moisture content to a dry density of 1.85 Ton/m^3. Determine the weight of water to be added to 10 m^3 of borrow soil. How many cubic meters of excavation is required for 1.0 m^3 of compacted embankment? **(15)**

(c) For what value of β (Fig. 3) the magnitude of vertical stress will be maximum on a line at a constant radial distance, r from the axis of a vertical load, Q. Find also the maximum vertical stress on a line at r = 2 m from the axis of a concentrated load of 20 kN. **(15)**

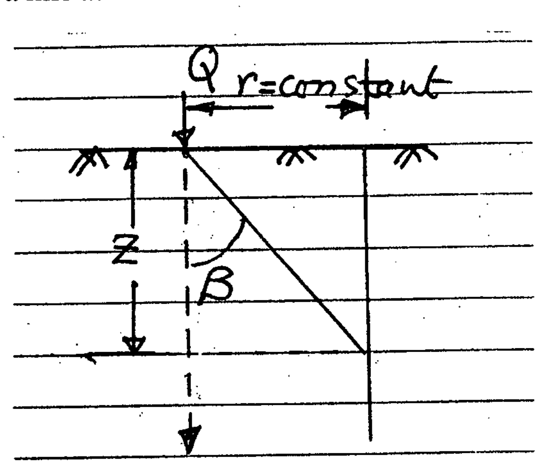


Fig 3. for Q No. 9(c)

10. (a) Briefly discuss the properties and utility of the flow net diagram. **($8\frac{2}{3}$)**

(b) Prove that the effective stress at a point in a submerged saturated soil is independent of the height of water above the soil sample. **(8)**

CE 341

Contd ... Q. No. 10

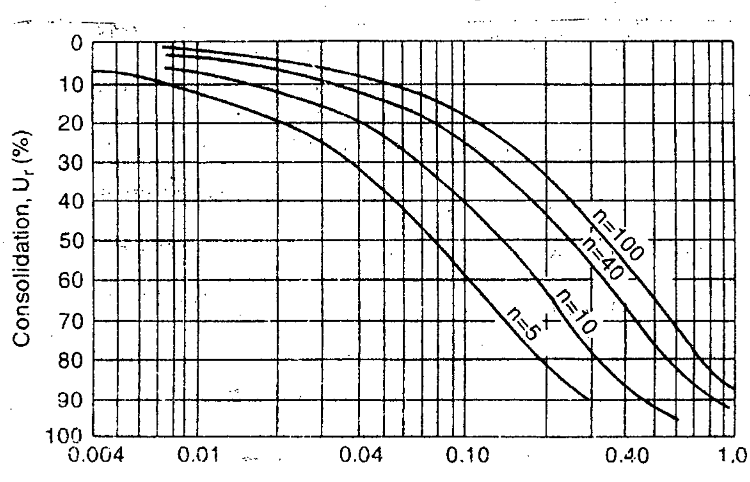
(c) The discharge of water collected from a constant permeameter in a period of 15 minutes is 500 ml. The internal diameter of the permeameter is 5 cm and the measured difference in head between two gauging points, 15 cm vertically apart is 40 cm. Calculate coefficient of permeability and comment on its value. If the dry weight of 15 cm long sample is 486 gm and specific gravity of solids is 2.65, calculate seepage velocity. **(15)**

(d) A 1.25 m layer of soil (G_s = 2.65, and n = 35%) is subjected to an upward seepage head of 1.80 m. What depth of coarse sand (fitler material) would be required above the soil to provide a factor of safety 2.0 against piping, assuming that the coarse sand has the same void ratio and specific gravity as the soil and there is negligible head loss in the coarse sand. **(15)**

11. (a) What is coefficient of consolidation? What is its use and how it is determined? **($13\frac{2}{3}$)**

(b) Describe sand drains. How are these designed? Discuss their use. **(13)**

(c) It is required to consolidate the soft clay layer formed near the sea coast of Chittagong port by providing sand drains and subjecting the soil to a surcharge load. The depth of compressible stratum is 6 m and rest on an impermeable base. Sand drains of 30 cm diameter are provided in a square grid pattern at 3 m apart. Compute the average degree of consolidation of the clay stratas with sand drains for the time when the degree of consolidation without drain would be equal to 25%. Assume soil is isotropic. Use Fig. 4. **(20)**



Radial consolidation rates (after Barron, 1948).

Fig 4. for Q. No. 11 (c)

12. (a) Describe the consolidation test. Show how the results of this test are used to predict the rate of settlement and the magnitude of settlement. **($16\frac{2}{3}$)**

(b) A footing is placed on the silty clay stratum, with properties shown in Fig. 5. Then a 4 feet fill layer is added, as shown. Find **(15)**

(i) Settlement of silty clay layer,

(ii) Time required for 6″ settlement to occur, and

(iii) Settlement in 6 months.

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CE 341

Contd ... Q. No. 12

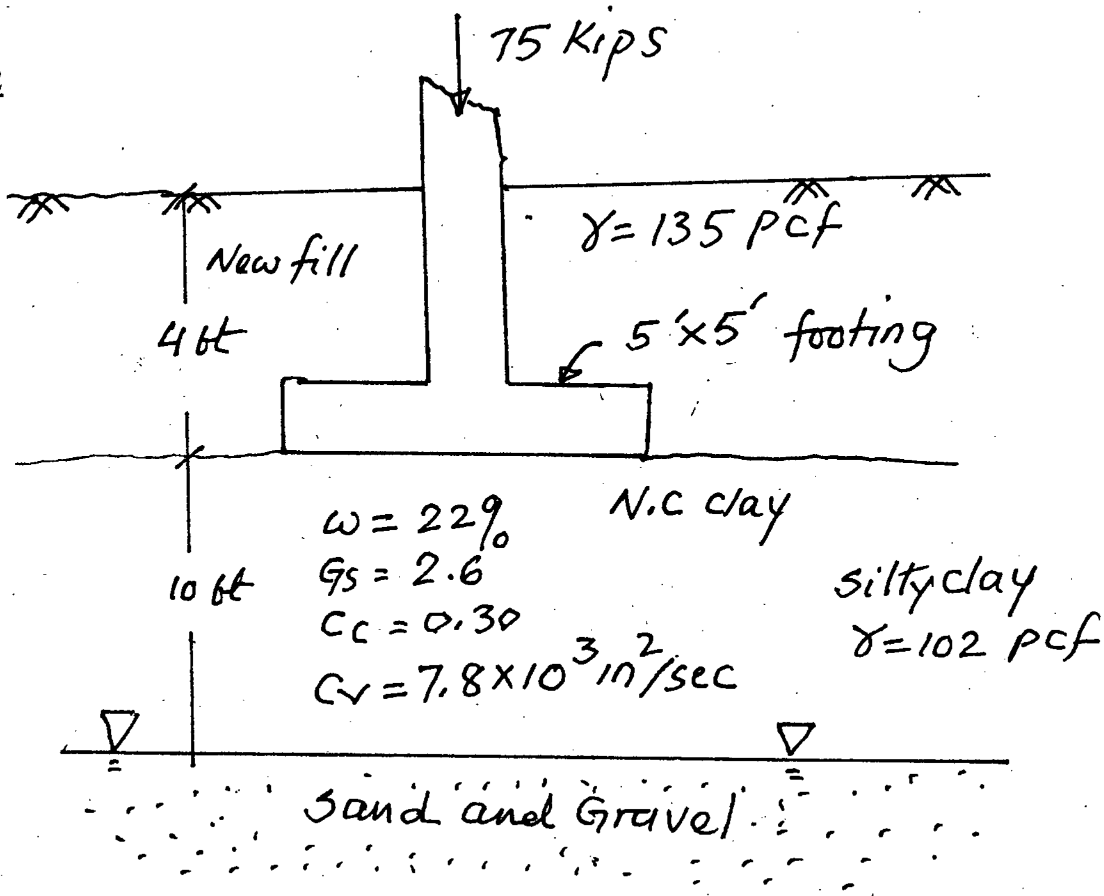


Fig. 5. for Q. No. 12(b)

(c) Two load bearing walls (BA and CD) meet at a point 'A' as shown in Fig. 6. Assume their loads to act as line loads. Determine the vertical stress at a point 3 m below the point A. **(15)**

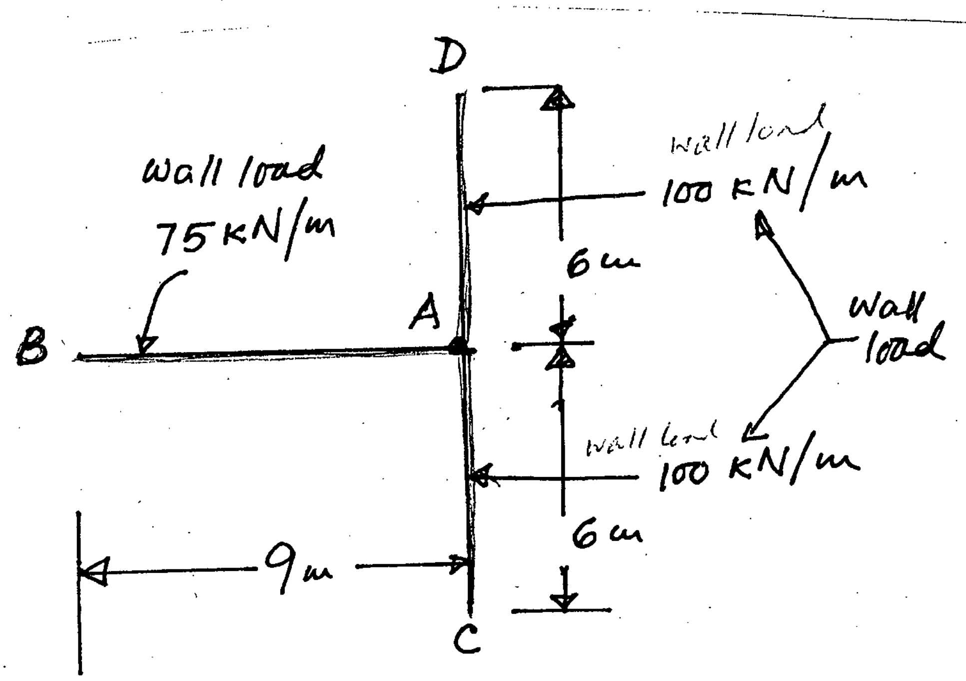


Fig 6. T shaped Wall Footing for Question No. 12(C)

L-3/T-1/CE **Date : 10/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 311** (Structural Analysis and Design I)

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **SEVEN** questions in this section. Answer any **FIVE**.

1. Draw influence lines for (a) shear force in panel 1-2 (b) bending moment at panel points 2 and 3 and (c) floor beam reaction of panel point 2 of the girder with floor beam system in Fig. 1. (28)

2. Draw influence lines for shear force at P and bending moment at P and Q of the frame in Fig. 2. (28)

3. Find the bar force in bars C2, D1, E2, K1 and F1 of the truss in Fig. 3. (28)

4. Draw influence lines for reaction at 5, shear force at A, bending moments at 3, 5, and 6 of the beam in Fig. 4. (28)

5. Due to the wheel loading shown in Fig. 5, calculate the maximum moment at the point 20 ft from the left end of a simply supported beam of 80 ft. (28)

6. Due to a moving uniform load of 4 kips per ft combined with a moving concentrated load of 60 kips calculate the maximum force in bars E1 and F2 of the truss in Fig. 3. (Ignore all the external loads applied on the truss). (28)

7. Due to a moving uniform load of 5 kips per ft combined with a moving concentrated load of 80 kips calculate (a) maximum shear force at the section just right of 5, and (b) maximum bending moment at 5 of the beam in Fig. 4. (28)

Contd P/2

SECTION – B

There are **SEVEN** questions in this section. Answer any **FIVE**.

Notations convey their usual meanings.

8. Calculate the wind load at different floor levels perpendicular to long side of a 15 m high 5-storied hospital building with storey height 3 m each and located in Dhaka city. The building is a rectangular one 60 m × 30 m in plan. Use projected area method. (28)

   Given: Basic wind speed for Dhaka = 210 kph

   Importance coefficient = 1.25

   Exposure Condition is A

   $C_c = 47.2 \times 10^{-6}$

   See Annexure-1 for relevant tables.

9. Draw shear force and bending moment diagrams for the stiffening girder of the suspension bridge shown in Fig. 6. (28)

10. Calculate how close B and D come along BD after application of 100^k load at B of the truss shown in Fig. 7. Given: Cross sectional area of the diagonal AC = 0.5 in^2 and that for all other members = 1 in^2. E = 30000 ksi. (28)

11. Using cantilever method draw bending moment diagrams on compression side for all the columns and girders and also the shear force diagrams for the girders of the building frame shown in Fig. 8. Areas of the columns are as shown in the figure. (28)

12. By approximate analysis, calculate the bar forces in the truss shown in Fig. 9. (28)

13. Find the rotation at end E of the structure loaded as shown in Fig. 10. Given I = 72 in^4 and E = 30000 ksi. (28)

14. An uniform vertical dead load of 5 kip/ft and live load of 3 kip/ft act on all the beams of the frame shown in Fig. 11. Draw bending moment diagrams for all the beams and columns of the frame by approximate analysis. Also draw axial force diagrams for the columns. Given: EI is constant and same for all the columns. Draw bending moment diagrams on compression side. (28)

CE 311

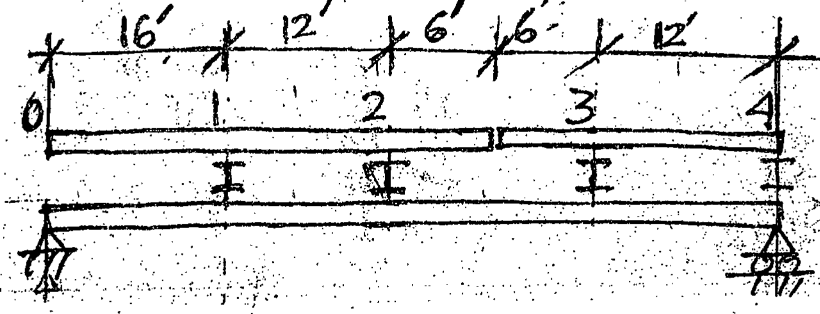


FIG. 1

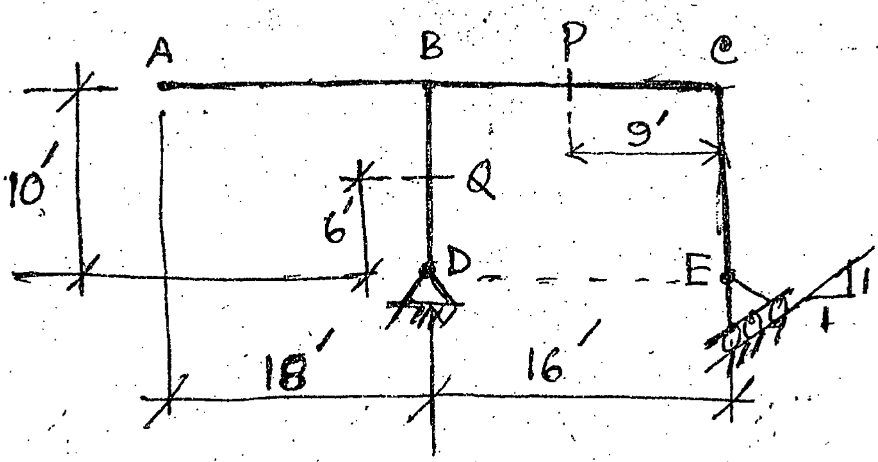


FIG. 2

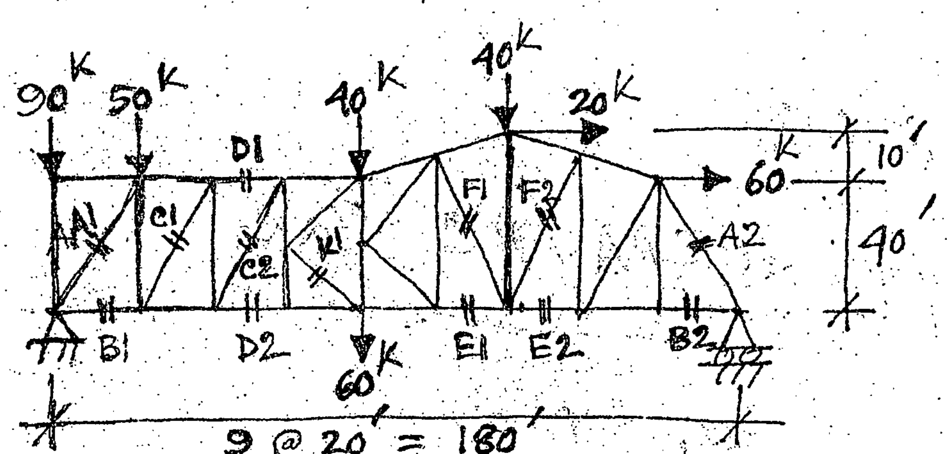


FIG. 3

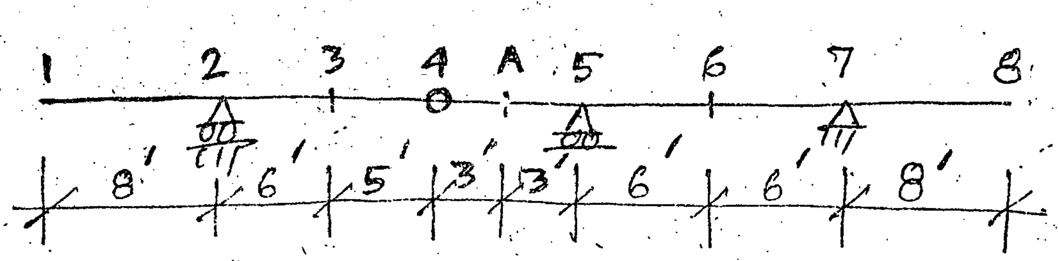


FIG 4

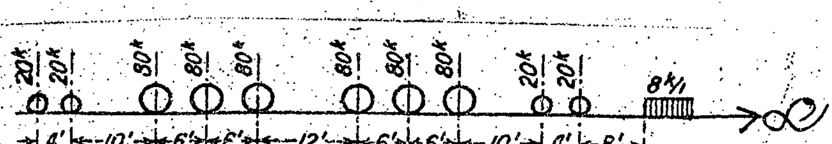


FIG. 5

CE 311

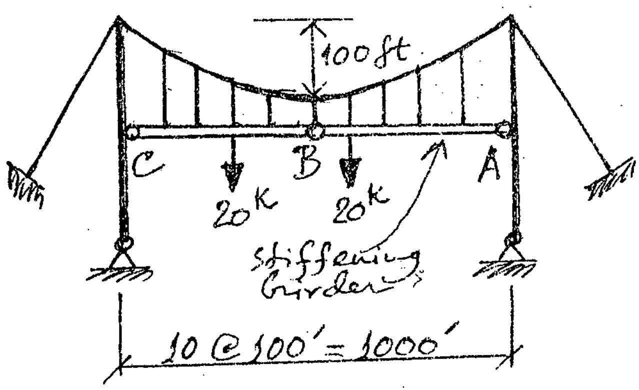


Fig. 6.

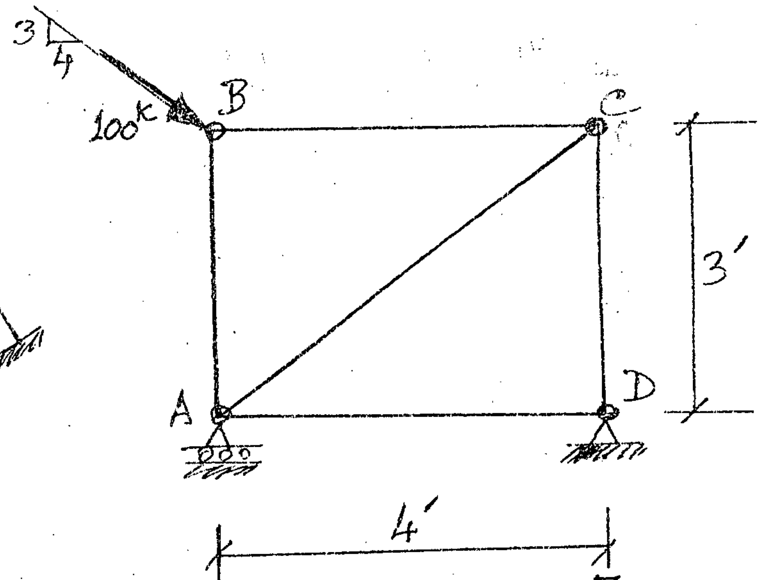


Fig. 7

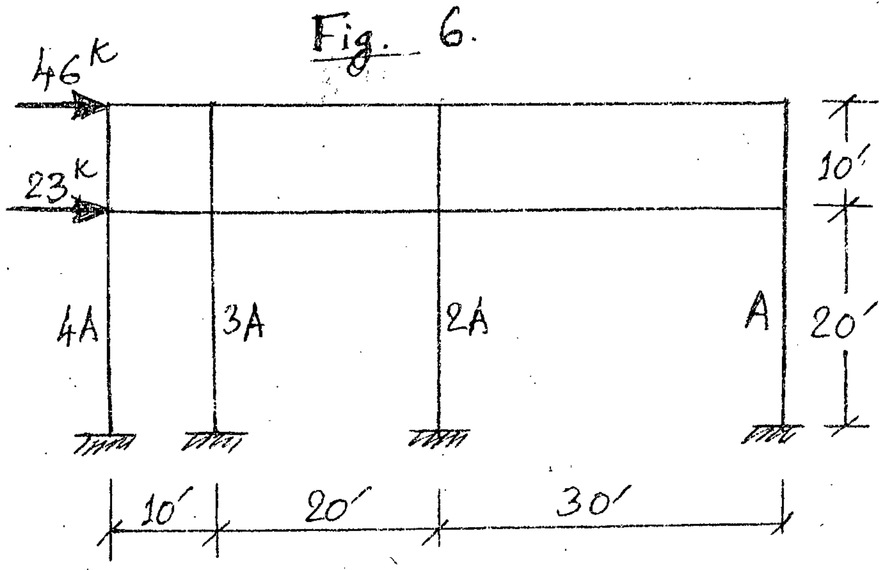


Fig. 8

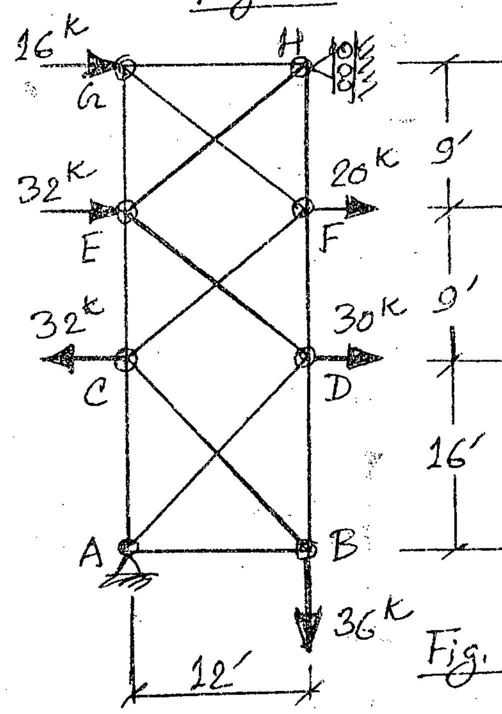


Fig. 9

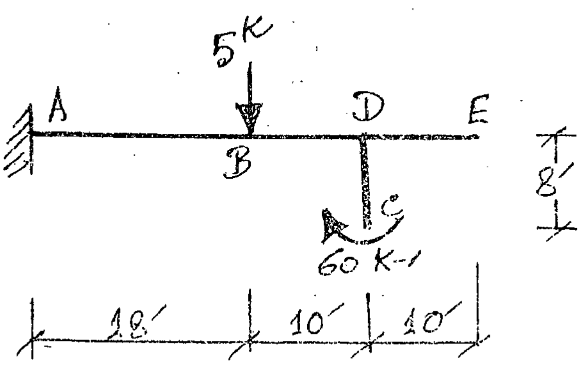


Fig. 10

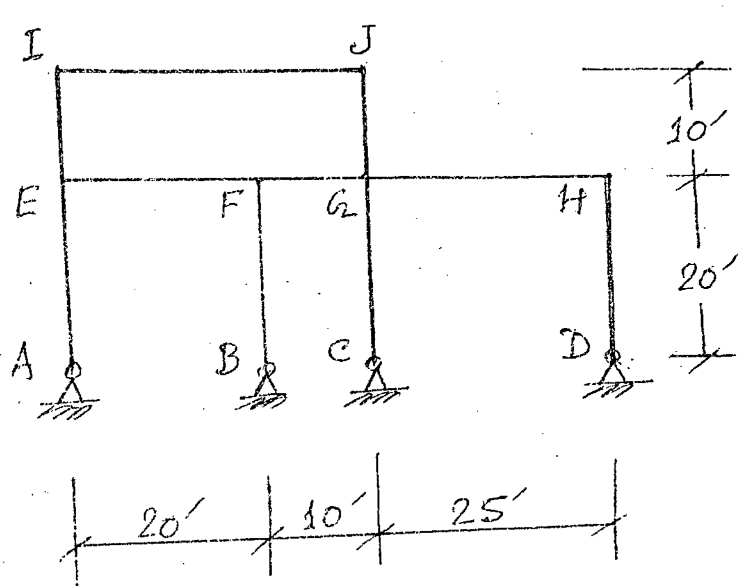


Fig. 11

CE 311

ANNEXURE - 1

Combined Height and Exposure Coefficient, C_z

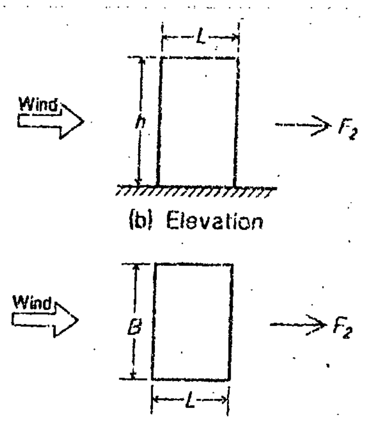
Height above ground level, z (metres)	Coefficient, C_z (1)		
	Exposure A	Exposure B	Exposure C
0-4.5	0.368	0.801	1.196
6.0	0.415	0.866	1.263
9.0	0.497	0.972	1.370
12.0	0.565	1.055	1.451
15.0	0.624	1.125	1.517
18.0	0.677	1.185	1.573
21.0	0.725	1.238	1.623
24.0	0.769	1.286	1.667
27.0	0.810	1.330	1.706
30.0	0.849	1.371	1.743
35.0	0.909	1.433	1.797
40.0	0.965	1.488	1.846
45.0	1.017	1.539	1.890
50.0	1.065	1.586	1.930
60.0	1.155	1.671	2.002
70.0	1.237	1.746	2.065
80.0	1.313	1.814	2.120
90.0	1.383	1.876	2.171
100.0	1.450	1.934	2.217
110.0	1.513	1.987	2.260
120.0	1.572	2.037	2.299
130.0	1.629	2.084	2.337
140.0	1.684	2.129	2.371
150.0	1.736	2.171	2.404
160.0	1.787	2.212	2.436
170.0	1.835	2.250	2.465
180.0	1.883	2.287	2.494
190.0	1.928	2.323	2.521
200.0	1.973	2.357	2.547
220.0	2.058	2.422	2.596
240.0	2.139	2.483	2.641
260.0	2.217	2.541	2.684
280.0	2.910	2.595	2.724
300.0	2.362	2.647	2.762

Note : (1) Linear interpolation is acceptable for intermediate values of z

Gust Response Factors, G_h and G_z (1)

Height above ground level (metres)	G_h (2) and G_z		
	Exposure A	Exposure B	Exposure C
0-4.5	1.654	1.321	1.154
6.0	1.592	1.294	1.140
9.0	1.511	1.258	1.121
12.0	1.457	1.233	1.107
15.0	1.418	1.215	1.097
18.0	1.388	1.201	1.089
21.0	1.363	1.189	1.082
24.0	1.342	1.178	1.077
27.0	1.324	1.170	1.072
30.0	1.309	1.162	1.067
35.0	1.287	1.151	1.061
40.0	1.268	1.141	1.055
45.0	1.252	1.133	1.051
50.0	1.238	1.126	1.046
60.0	1.215	1.114	1.039
70.0	1.196	1.103	1.033
80.0	1.180	1.095	1.028
90.0	1.166	1.087	1.024
100.0	1.154	1.081	1.020
110.0	1.114	1.075	1.016
120.0	1.134	1.070	1.013
130.0	1.126	1.065	1.010
140.0	1.118	1.061	1.008
150.0	1.111	1.057	1.005
160.0	1.104	1.053	1.003
170.0	1.098	1.049	1.001
180.0	1.092	1.046	1.000
190.0	1.087	1.043	1.000
200.0	1.082	1.040	1.000
220.0	1.073	1.035	1.000
240.0	1.065	1.030	1.000
260.0	1.058	1.026	1.000
280.0	1.051	1.022	1.000
300.0	1.045	1.018	1.000

Note : (1) For main wind-force resisting systems, use building or structure height h for z.
(2) Linear interpolation is acceptable for intermediate values of z.



(b) Elevation

(a) Plan

Rectangular Building

Table 6.2.15 (1)

Overall Pressure Coefficients, $\bar{C}_p$ (2) for Rectangular Buildings with Flat Roofs

h/B	L/B					
	0.1	0.5	0.65	1.0	2.0	≥ 3.0
≤0.5 (5.0)	1.40	1.45	1.55	1.40	1.15	1.10
10.0	1.55	1.85	2.00	1.70	1.30	1.15
20.0	1.80	2.25	2.55	2.00	1.40	1.20
≥40.0	1.95	2.50	2.80	2.20	1.60	1.25

Note: (1) These coefficients are to be used with Method-2 given in Sec 2.4.6.6a(ii). Use $\bar{C}_p = \pm 0.7$ for roof in all cases.
(2) Linear interpolation may be made for intermediate values of h/B and L/B.

L-3/T-1/CE **Date : 17/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2012-2013

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 values of missing data (in any).

1. (a) Discuss branched and looped distribution networks with their merits and demerits. What are the two guiding principles for computing flow in a piped network using the Hardy Cross Method? **(10)**

(b) The pump head-capacity curve and system head-capacity curve at the minimum water surface level in the reservoir is as follows. Using the data, determine the operating heads and capacities at minimum and maximum reservoir water levels for one pump, two pumps in parallel and two pumps in series. The difference between maximum and minimum water level in the reservoir is 2 m. **(14)**

Pump head capacity data		System head capacity data	
Head (m)	Capacity (m^3/s)	Head (m)	Capacity (m^3/s)
40	0	30	0
39	0.02	32	0.02
36	0.04	34	0.04
29	0.06	37	0.06
20	0.08	40	0.08
8	0.1	44	0.1

(c) Calculate the Langelier Index and Ryznar Index of the following water sample. Does the water cause scaling or corrosion? **(6)**

$pH = 8.0$; $pK_2 - pK_s = 2.54$

Calcium ion concentration = 60 mg/L as Ca^{2+}

Total alkalinity (bicarbonate only) = 91 mg/L as $CaCO^3$

(d) What is Non Revenue Water (NRW)? What are the benefits of reducing NRW? **(5)**

2. (a) Write short notes on (i) Water hammer (ii) External corrosion (iii) Shallow Shrouded Tubewell (SST) (iv) Salinity intrusion in coastal areas. **(12)**

(b) What factors should be considered for selecting a site for raw water intake structure? **(5)**

Contd P/2

CE 331

Contd ... Q. No. 2

(c) Calculate the flow in the following pipe network for the inflow and outflow shown in Figure 1 using Hardy Cross method. Use Williams formula for C = 120 to compute the headloss [$h_L = 1.59 \times 10^6 Q^{1.85} D^{-4.87}$; Q in lps, D in mm, h_L in m/m]. The pipe details (as well as the first assumption of flow) are given below. Perform two iterations. **(18)**

Pipe	Length (m)	Diameter (mm)	First assumption of flow (lps)
AB	400	200	2
BC	300	100	1.2
CD	400	200	1.8
DA	300	100	3
BD	500	150	0.8

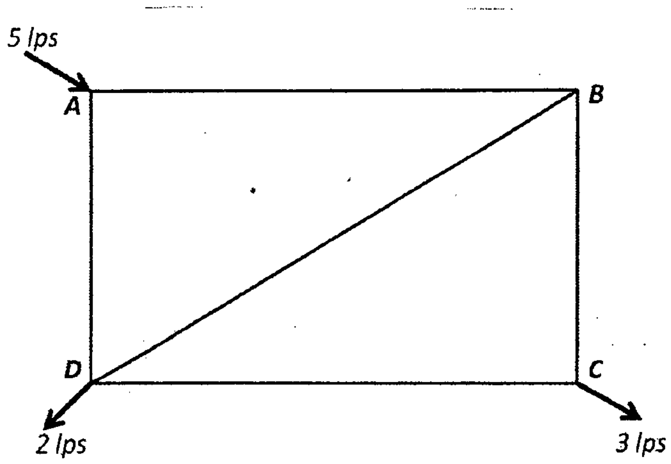


Figure 1

3. (a) What are the factors that need to be considered for selecting a pump? **(7)**

(b) What power must be supplied by the pump that delivers water at 20°C at a rate of 0.2 m^3/s through a 25 cm-diameter steel pipe? What would be the Net Positive Suction Head (NPSH) available at the pump? **(10)**

The following information is given:

Water surface elevation in the wet well (suction reservoir) = 38 m above m.s.l.
Location of the pump = 40 m above m.s.l.
Water surface elevation of the discharge unit = 60 m above m.s.l.
Total length of pipe = 30 m
One 25-cm gate valve, K = 0.10
Two 25-cm 45° elbows, K = 0.20
Two 25-cm 90° elbows, K = 0.25
One 46-cm entrance suction bell, K = 0.04
Unit weight of water = 9982 N/m^3
At 20°C, vapor pressure of water = 2.3 kPa
Atmospheric pressure = 101.3 kPa
Darcy Weisbach friction factor = 0.022

Contd P/3

CE 331

Contd ... Q. No. 3

(c) Distinguish between the following water treatment processes: **(14)**

(i) Coagulation and Flocculation

(ii) Ion Exchange and Activated Carbon Filtration

(iii) Reserve Osmosis and Electrodialysis

(d) How can THMs formation be controlled in a water Chlorination process? **(4)**

4. (a) What are the sanitary significance of the following impurities in water? **(8)**

(i) SO_4, (ii) F, (iii) CO_2 and (iv)As

(b) Show the variation of Carbonic Acid Species (Natural Acidity, Bi-carbonate, Carbonate etc.) with pH value. **(8)**

(c) Under which environmental conditions soda ash is used and re-carbonation is required in a 'Precipitation Softening' process? **(7)**

(d) Explain the mechanisms of removal of Manganese through 'Catalytic-Contact Oxidation and Sorption' processes with equation. **(12)**

SECTION – B

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

5. (a) What are the main causes of climate change? What are the general impacts of climate change in Bangladesh? Describe the factors affecting per capita demand of water. **(18)**

(b) The population of a city was 25 million in 1970, 29 million in 1980, 38 million 1990, 55 million in 2000, and 80 million in 2010. Estimate the probable population of the city in 2020 and 2030 respectively by the least square parabola method. **(17)**

6. (a) What are the different sources of water for water supply system? Briefly explain hydrologic cycle. State the hydraulics of groundwater flow towards a well. **(18)**

(b) A 300 mm diameter well in a water table aquifer is being pumped at a rate of 1800 litre/min with a drawdown of 10 m. The static depth of water in the well is 50 m. During pumping, the depth of water in a similar well, not being pumped situated at a distance of 7.5 m is 47 m. At what rate could water be pumped from the two wells, if both the wells are being pumped together with a drawdown in each well of 9 m? **(17)**

Contd P/4

CE 331

7. (a) What are the characteristics differences between RSF and SSF in respect of: **(8)**

(i) Bacteria removal mechanisms;

(ii) Method of cleaning;

(iii) Rate of Filtration; and

(iv) Effective grain size (D_{10}).

(b) What are the three theory (hypothesis) of water 'Disinfection' process? **(6)**

(c) Design a tubewell with the following sieve analysis data of a soil sample: **(21)**

Sieve No.	Sieve Size (mm)	Wt of material retained (gm)
30	0.60	0.3
40	0.425	1.2
50	0.30	20.8
100	0.15	69.4
200	0.075	7.2
Pan	---	1.1

The diameter of the strainer is 150 mm and the opening area of the strainer is 13% of the total surface area of the strainer.

8. (a) What are the sources (origin) of the following impurities in water? **(8)**

(i) E. Coli; (ii) Chromium; (iii) Odor and Taste; and (iv) NO_3

(b) What are the two alternative methods of 'Arsenic' removal from low iron content groundwater through 'co-precipitation' process? Describe the factors affecting 'Iron Oxidation and Precipitation' of groundwater. **(18)**

(c) What is effect of 'Surface Overflow Rate' on the performance of a 'Plain Sedimentation' Process? Explain with diagram. **(9)**

Extra

L-3/T-1/CE **Date : 24/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2012-2013

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

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**.

1. (a) Discuss the different types of tender under national and international competitive bidding. Describe the applicability of each of these methods. **(25)**

   (b) Describe special provisions to be made for international competitive bidding. **(10)**

2. (a) Roads and Highways Department is to build a bridge with an estimated cost of Tk. 200 crore. The bridge has a total length of 240 m with four equal span of 60 m each. For tendering of the work, prepare Tender Data Sheet (TDS) items. Include at least five TDS items. **(25)**

   (b) List the tender accompanyments that a tenderer has to submit along with the tender for the above mentioned project. **(10)**

3. (a) Describe at least five provisions of General Conditions of Contract (GCC) with relevant provisions of Particular Conditions of Contract (PCC) for any assumed project. **(25)**

   (b) Prepare a sample BoQ for a major Civil Work item of construction with detail description. **(10)**

4. (a) Describe the different types of communication activities of an organization. **(17)**

   (b) Describe what needs to be done for the following written or oral communications: **(18)**

   (i) Completeness

   (ii) Conciseness

   (iii) Consideration

SECTION – B

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

5. (a) Briefly describe two-phased approach to risk management. **(5)**

   (b) Write down the names of "Think Twice" contract clauses. What are the common methods of procurement in project delivery system? **(7+3=10)**

Contd P/2

CE 301

Contd ... Q. No. 5

(c) Write short notes on: **(5×4=20)**

(i) Design-Bid-Built (DBB)

(ii) Deductible

(iii) Project professional liability insurance

(iv) General liability insurance

(v) Fiduciary Risk.

6. (a) Graphically show the flow of work in project development. **(5)**

(b) What is Pre-Design? What data should be included during Pre-Design phase? What are the key activities in Pre-Design? **(12)**

(c) Briefly describe QCP and Project Characteristics. **(8)**

(d) Describe the role of Actuaries and Underwriters in professional liability insurance industry. What is bond? Define Bid Bond and Performance bond. **(5+5=10)**

7. (a) Describe in general what different parts of a business proposal contains. **(20)**

(b) Give a complete chronological description of the various steps followed during the entire process of a major solicited proposal. **(15)**

8. (a) Define Civil Engineers. Describe five basic attributes of Civil engineering profession. **(2+8=10)**

(b) Write down the names of common project delivery system and contract format. **(5+5=10)**

(c) Write short notes on: **(15)**

(i) Abstracting

(ii) Inferring

(iii) Denotation and Connotation.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 315** (Design of Concrete Structures 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**.

1. (a) What are the sources of uncertainties in analysis, design and construction of RC structures? Discuss how safety is ensured against these uncertainties in USD method. **(8)**

(b) Discuss the behaviour of reinforced concrete rectangular beam in flexure under increasing load by drawing neat sketches for strain and stress distribution of uncracked, cracked and ultimate conditions. **(9)**

(c) A singly reinforced RC beam section, as shown in Fig. 1, has a width of 12 in. effective depth of 24 in. and total depth of 27 in. The tension reinforcement consists of three No. 10 bars in one row.

Given: $f'_c = 4$ ksi, $f_y = 60$ ksi, $f_s = 24$ ksi, $f_r = 7.5\sqrt{f'_c}$ psi, $n = 8$

Find: (i) Cracking moment **(9)**

(ii) Stresses in concrete and steel caused by a bending moment M = 125 kip-ft. **(9)**

2. (a) What is the purpose of providing minimum amount of flexural steel in a beam? Write ACI/BNBC code provisions for minimum reinforcement ratios. **(5)**

(b) What is the justification of selecting strength reduction factor ϕ based on net tensile strain ε_t? Discuss the variation of ϕ with ε_t as given in ACI code? Also, explain how ε_t controls maximum reinforcement ratio. **(10)**

(c) A beam section is limited to width b = 12 in. and total depth h = 24 in. Calculate the required reinforcement if the beam has to resist a factored moment $M_u = 375$ kip-ft. **(20)**

Assume two layer tensile reinforcement with d = 20 in. and $d_t = 21.5$ in. Also, assume $d' = 2.5$ in. if compression steel is required.

Given: $f'_c = 3$ ksi and $f_y = 50$ ksi

3. (a) Why is concrete cover over rebar important? What are the recommended values of 'cover' as per ACI code? **(6)**

(b) A rectangular beam carries a service live load (unfactored) of 2.0 kip/ft and an unfactored superimposed dead load of 1.5 kip/ft (in addition to self weight of beam) on a 22 ft simple span as shown in Fig. 2. The beam will have a cross-section of 14″ × 26″ for architectural reasons. **(16)**

Given: $f'_c = 3$ ksi and $f_y = 60$ ksi

Design the beam for flexure.

Contd P/2

CE 315

Contd ... Q. No. 3

(c) A rectangular beam has a width 12 in. and an effective depth 27 in. as shown in Fig. 3. It is reinforced with eight No. 8 bars in two rows ($d = 27$ in. $d_t = 28.5$ in.). If $f_y = 60$ ksi and $f'_c = 4$ ksi, what is the nominal flexural strength M_n and what is the maximum moment ϕM_n that can be utilized in the design? **(13)**

4. (a) A floor system consists of a 3 in. slab supported by continuous T-beams with 25 ft span, 48 in. on centres as shown in Fig. 4. Web dimensions as determined by negative moment requirement at support are $b_w = 12$ in. and $d = 21$ in. What tensile reinforcement is required at midspan to resist a factored moment $M_u = 600$ kip-ft, if $f_y = 60$ ksi and $f'_c = 3$ ksi? **(18)**

   Also, check minimum reinforcement and ε_t.

   (b) A rectangular RC beam as shown in Fig. 5 measures 12 in. wide and has an effective depth of 27 in. Tension steel consists of eight No. 8 bars in two layers ($d = 27$ in., $d_t = 28.5$ in.) and compression steel consisting of three No. 7 bars is located 2.5 in. from the compression face. If $f'_c = 3.5$ ksi and $f_y = 60$ ksi, what is the design moment capacity of the beam according to ACI code. Check for yielding of compression steel. **(17)**

SECTION – B

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

5. (a) A simply supported beam carries the factored load as shown in Fig. 6. Design the stirrups and make a neat sketch showing the stirrups. Given: **(20)**

   $f'_c = 3$ ksi and $f_y = 60$ ksi

   (b) Design a singly reinforced beam shown in Fig. 7. The dead load does not include self weight of the beam. Given: $f'_c = 3.5$ ksi and $f_y = 60$ ksi. **(15)**

6. (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 service live load on the slab is 120 psf. Design the slab by USD method and show the reinforcements with neat sketches. Give: $f'_c = 3.0$ ksi and $f_y = 60$ ksi. **(20)**

   (b) Write down the minimum thickness for RC beams and one-way slabs for different end conditions as per ACI code. **(6)**

   (c) What is meant by temperature and shrinkage reinforcement? Discuss their importances mentioning the limitations for minimum amount and spacing of such reinforcements as per ACI/BNBC code. **(9)**

Contd P/3

CE 315

7. (a) Show with neat sketches cut off or bend points for bars in approximately equal spans with uniformly distributed loads. **(8)**

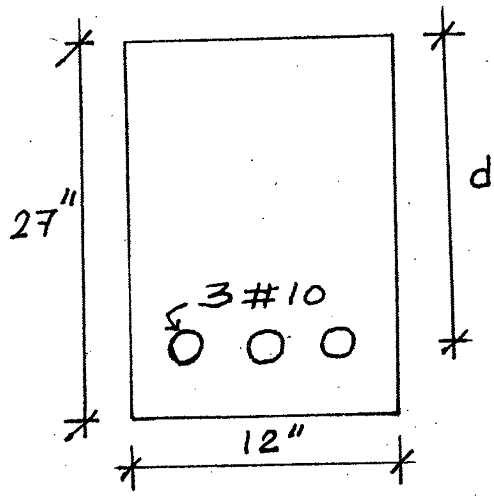
(b) Discuss briefly the factors that influence development length of a reinforcing bar. **(8)**

(c) Describe in brief the factors affecting failure in concrete structures. **(9)**

(d) Calculate the development length by USD method for 16 mm and 25 mm bars when used as (i) top bars, (ii) for other bars. Given: $f'_c = 3500$ psi and $f_y = 60{,}000$ psi. **(10)**

8. (a) For the slabs shown in Fig. 8, calculate design moments by USD method and corresponding reinforcements. Show all the reinforcements in neat sketches (in plan and in two sections). Given: LL = 80 psf; FF = 25 psf (as DL), random partition wall = 30 psf (as DL). $f'_c = 3$ ksi and $f_y = 60$ ksi. Use Tables. **(25)**

(b) Describe with neat sketches five reinforced concrete floor systems commonly used in Bangladesh. **(10)**



Given:

$f_c' = 4$ ksi

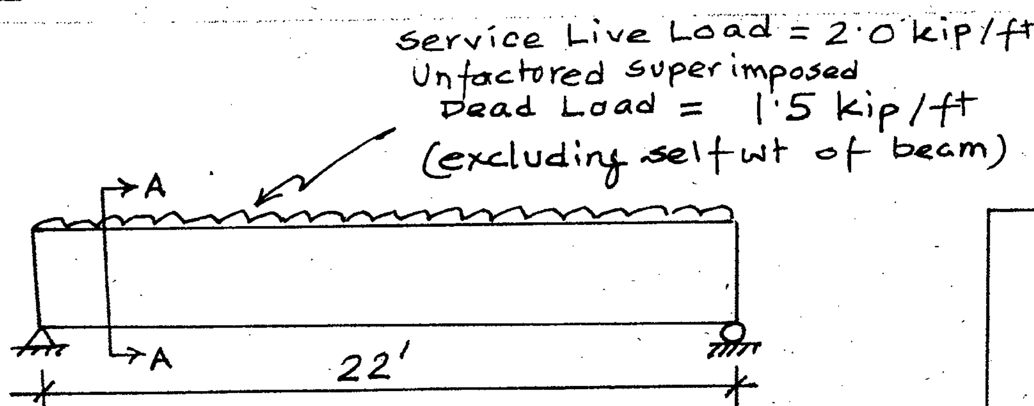
$f_y = 60$ ksi

$f_s = 24$ ksi

$f_r = 7.5\sqrt{f_c'}$ psi

$n = 8$

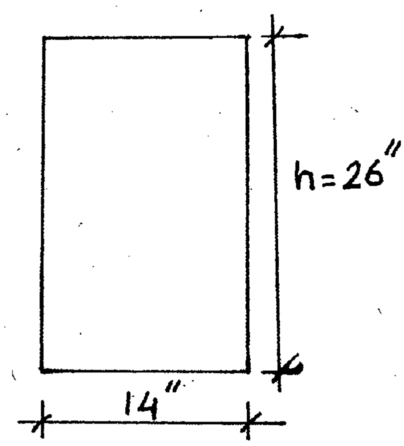
Fig. 1



Given:

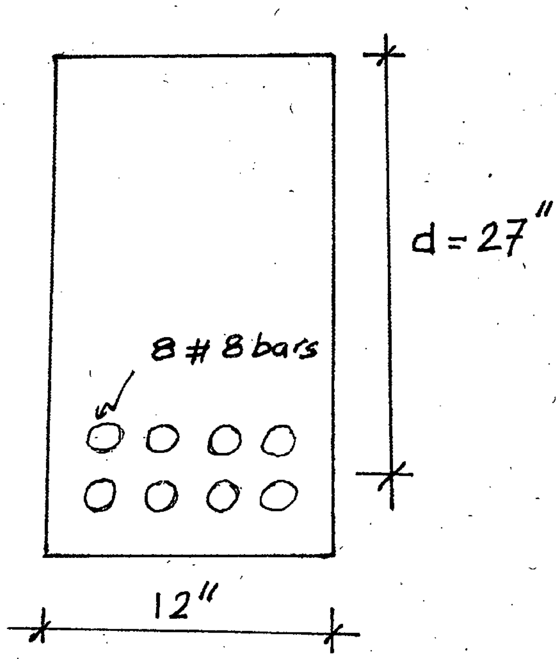
$f_c' = 3$ ksi

$f_y = 60$ ksi



Section A-A

Fig. 2



Given:

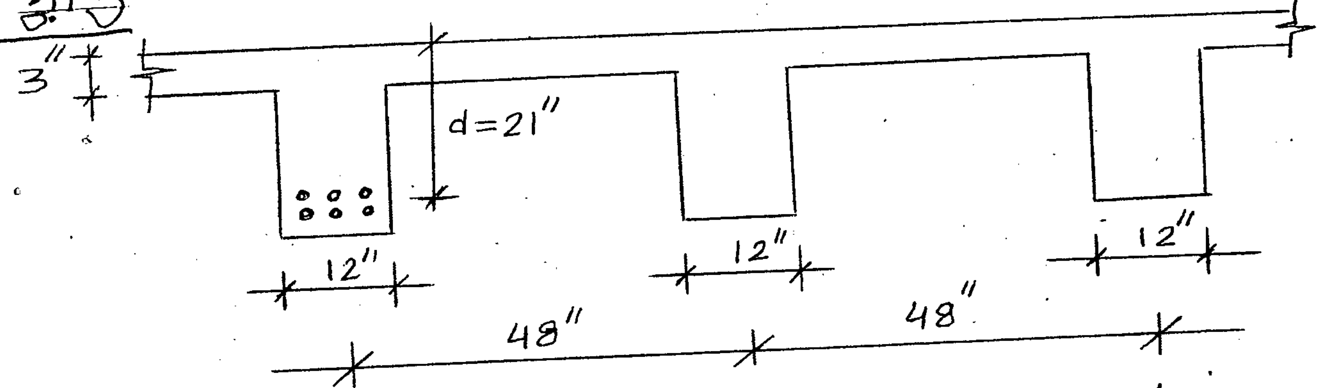
$f_c' = 4$ ksi

$f_y = 60$ ksi

$d = 27$ in.

$d_t = 28.5$ in.

Fig. 3



Given: $f_c' = 3$ ksi, $f_y = 60$ ksi
Beam span = 25 ft
M_u = 600 kip-ft

Fig. 4

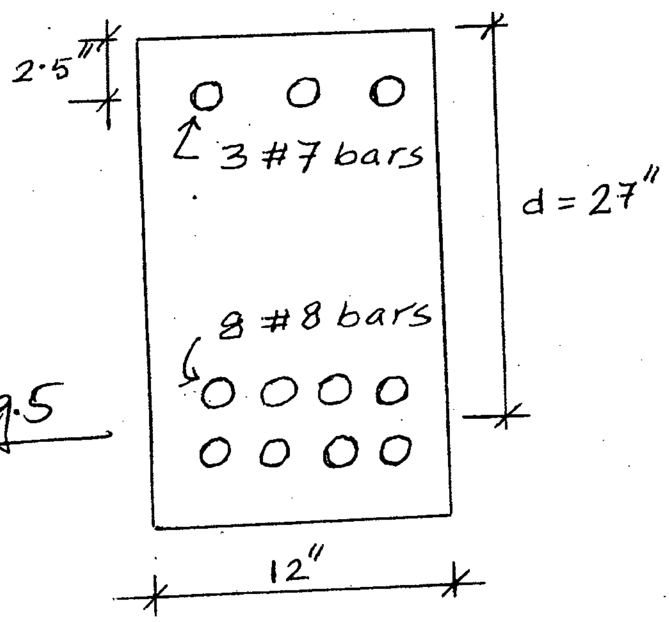
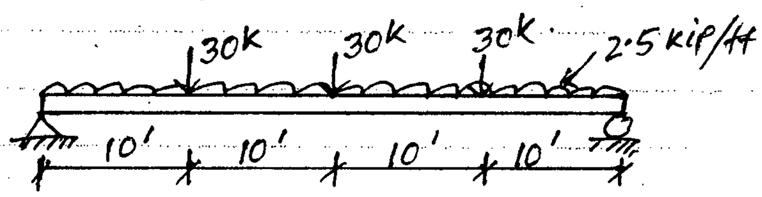


Fig. 5

Given:
$f_c' = 3.5$ ksi
$f_y = 60$ ksi

$d = 27"$
$d_t = 28.5"$



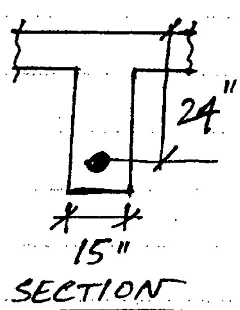


Fig. 6 All Loads are Factored.

Fig. 7

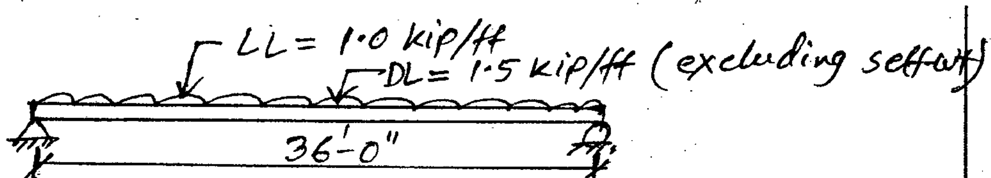
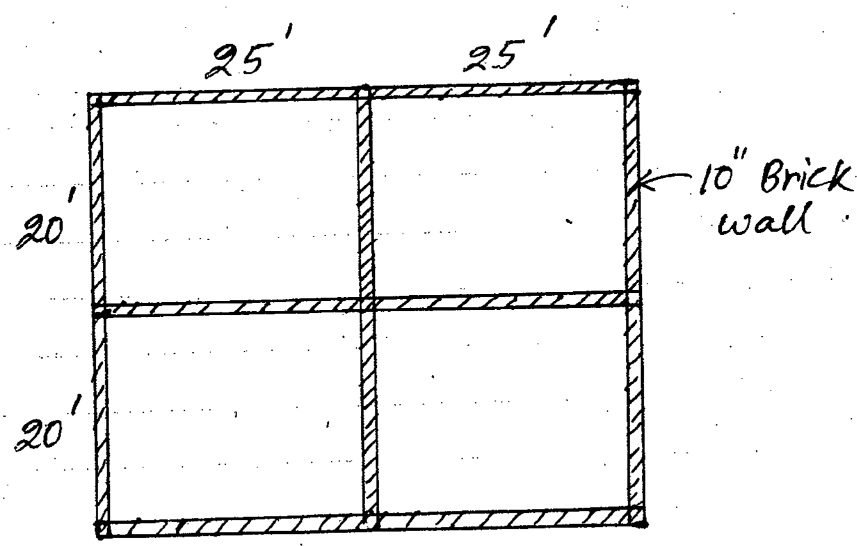


Fig. 8



CE 315

TABLE

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.

TABLE

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.

CE 315

Coefficients for live load positive moments in slabs[a]

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

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.