L-3/T-2/CE Date : 17/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 313** (Structural Analysis & Design - II)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

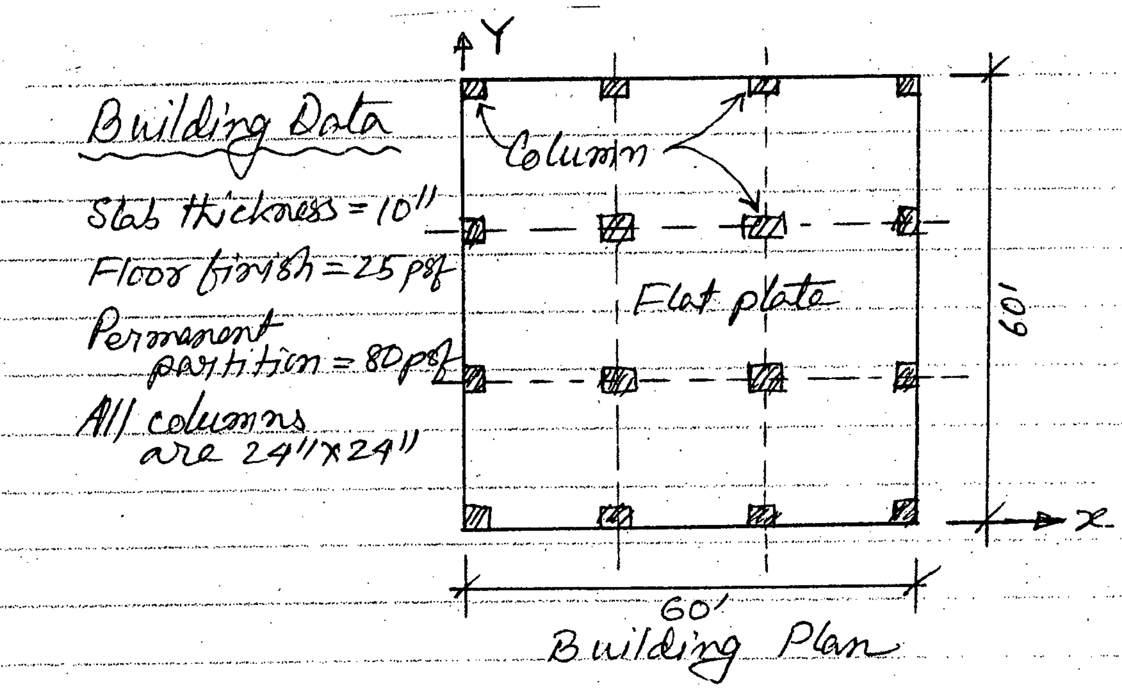
SECTION – A

There are **SEVEN** questions in this Section. Question 1 is compulsory.

Answer any **FOUR** from the rest. Assume reasonable value of any missing data.

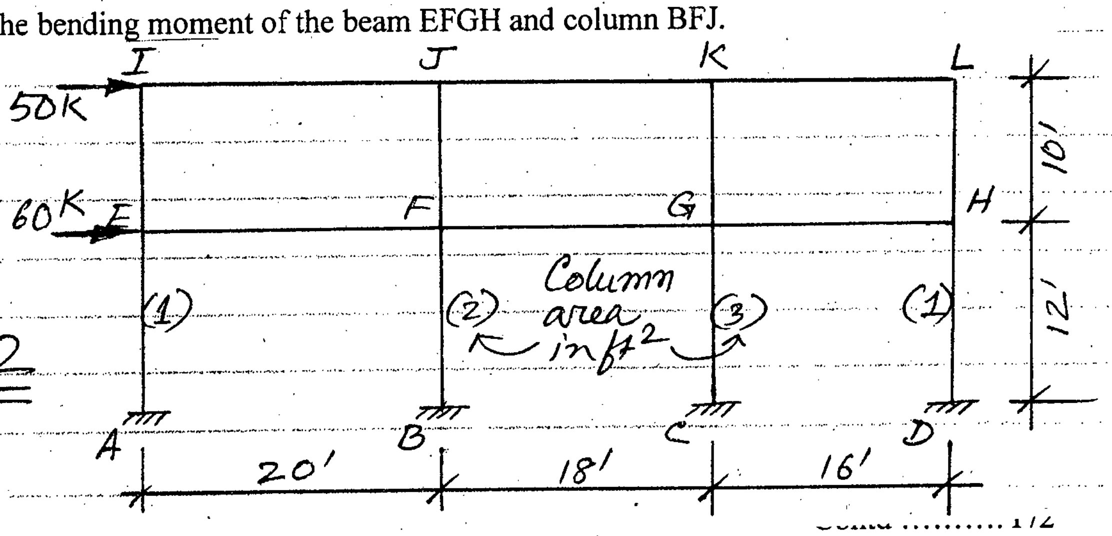
1. The plan of a reinforced concrete building having flat plate floor system is shown in Fig. 1. It is a ten storied building to be used as a hospital in Khulna City. Floor-to-floor height is 11′ and the column bases are located 2′ below ground level. Soil condition is unknown. Following the equivalent static force method of BNBC-1993, compute earthquake forces at each story level. **(21)**

Fig. 1



2. Analyze the plane frame of Fig. 2 using approximate cantilever method of analysis and draw the bending moment of the beam EFGH and column BFJ. **(21)**

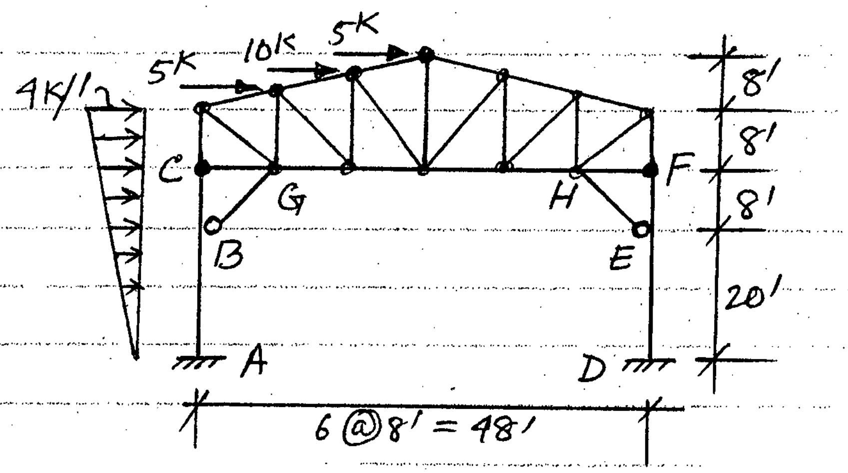
Fig. 2



CE 313

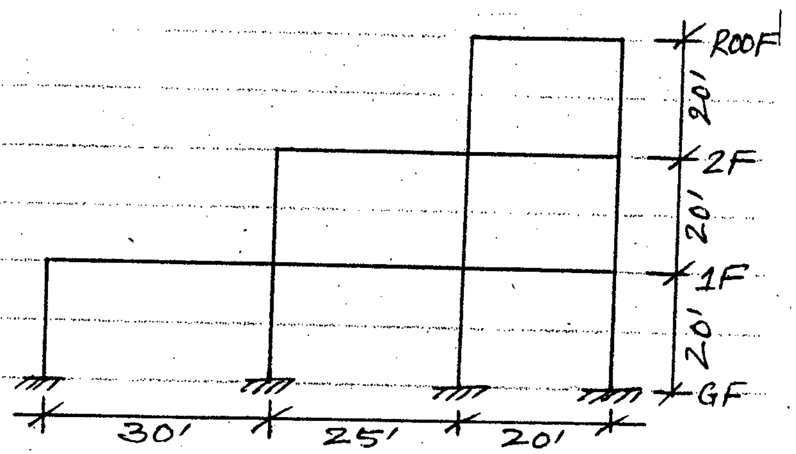
3. Draw the shear force and bending moment diagrams for the column ABC of the mill bent shown in Fig. 3 and find bar force in the knee brace EH. **(21)**

Fig. 3



4. Analyze the plane frame of Fig. 4 by approximate method and draw the shear force and bending moment diagrams of the beam of 1st floor and the axial force diagram of the columns. All beams are acted upon by 5 k/ft of dead load and 3 k/ft of live load in the direction of gravity. **(21)**

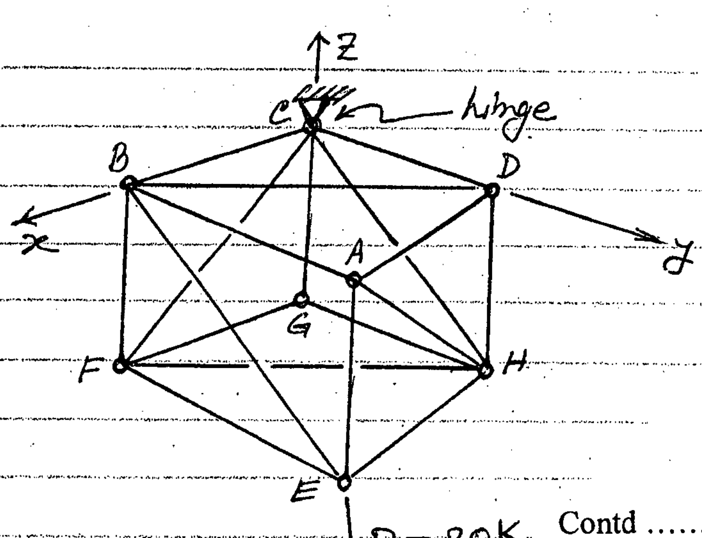
Fig. 4



5. For the building described in question 1 and Fig. 1, determine the total thrust of wind based on BNBC-1993 code. The wind blows in x direction. **(21)**

6. The space truss of Fig. 5 is in the form of a cube. Determine the force in each member due to force P = 20 kip acting at joint E along line CE. **(21)**

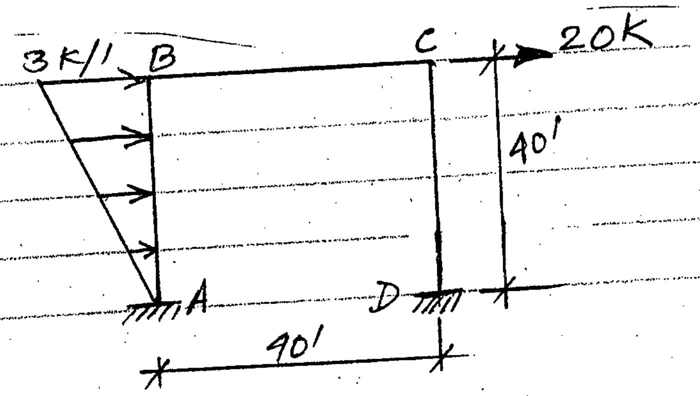
Fig. 5



CE 313

7. Analyze the plane frame of Fig. 6 by an approximate method and draw the axial force, shear force and bending moment diagrams. **(21)**

Fig. 6



SECTION – B

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

8. Compute vertical displacement and rotation at B of the structure shown in Fig. 7 due to the 100 kip load applied of E. Given: E = 30,000 ksi; I = 360 in^4; A = 16 in^2 throughout. **(21)**

9. Determine the forces in the bars AD, BC, GH, GE, HF, GF and EH of the structure shown in Fig. 8. Use approximate method of analysis. **(21)**

10. Using method of consistent deformation, draw axial force, shear force and bending moment diagrams for the frame shown in Fig. 9. EI is constant throughout. Neglect axial force effect. **(21)**

11. For the truss shown in Fig. 10, determine all reactions and member forces. Use method of consistent deformation. Given: E = 29 × 10^3 ksi and cross sectional area, A = 2 in^2 for all bars. **(21)**

12. Compute the amount of translation and its direction of the joint at B of the truss shown in Fig. 11. The temperature of AB and CD falls by 50°F and that of all other members rises by 80°F. Given: $\alpha_t = \frac{1}{1,50,000} 1/^\circ F$ **(21)**

13. Compute the relative displacement of joints C and F along the line joining them (Fig. 12) due to the loads shown. Cross sectional areas of members in in^2. are shown in parentheses alongside each member. Given: E = 30000 ksi. **(21)**

14. Draw shear force and bending moment diagrams for the beam shown in Fig. 13. Given: EI = constant throughout. **(21)**

Contd... P/4

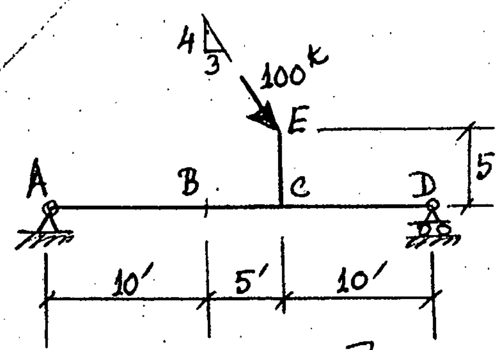


Fig. 7

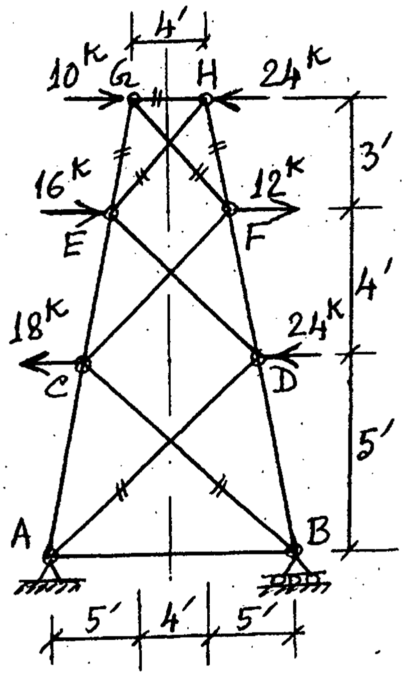


Fig. 8

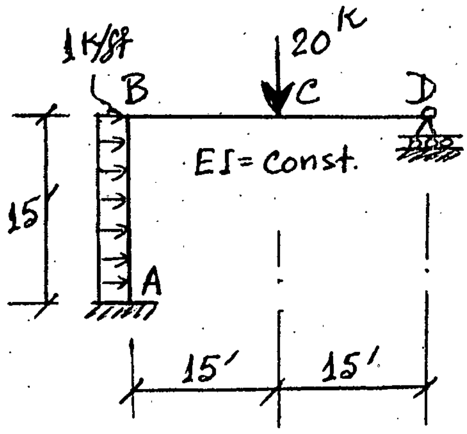


Fig. 9

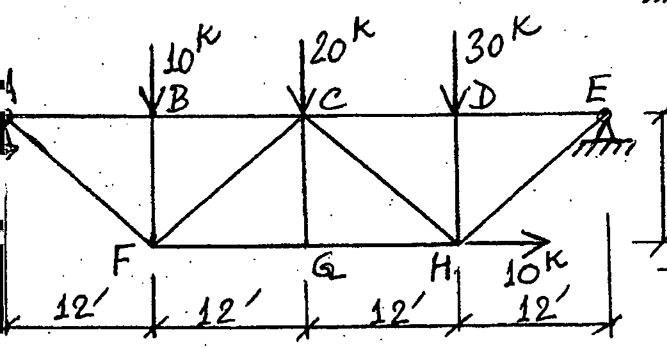


Fig. 10

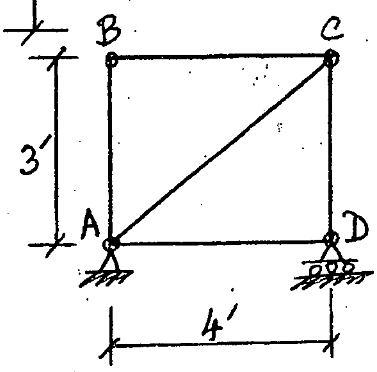


Fig. 11

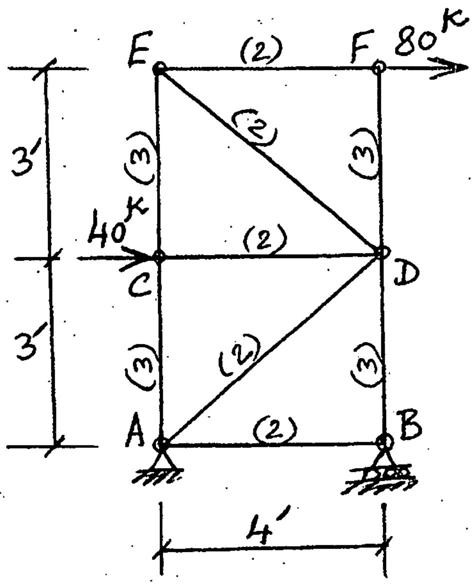


Fig. 12

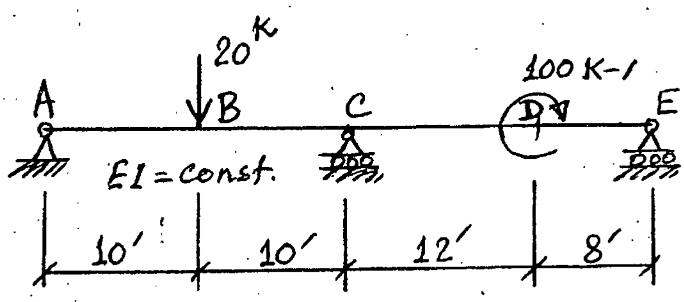


Fig. 13

Contd --- P/5

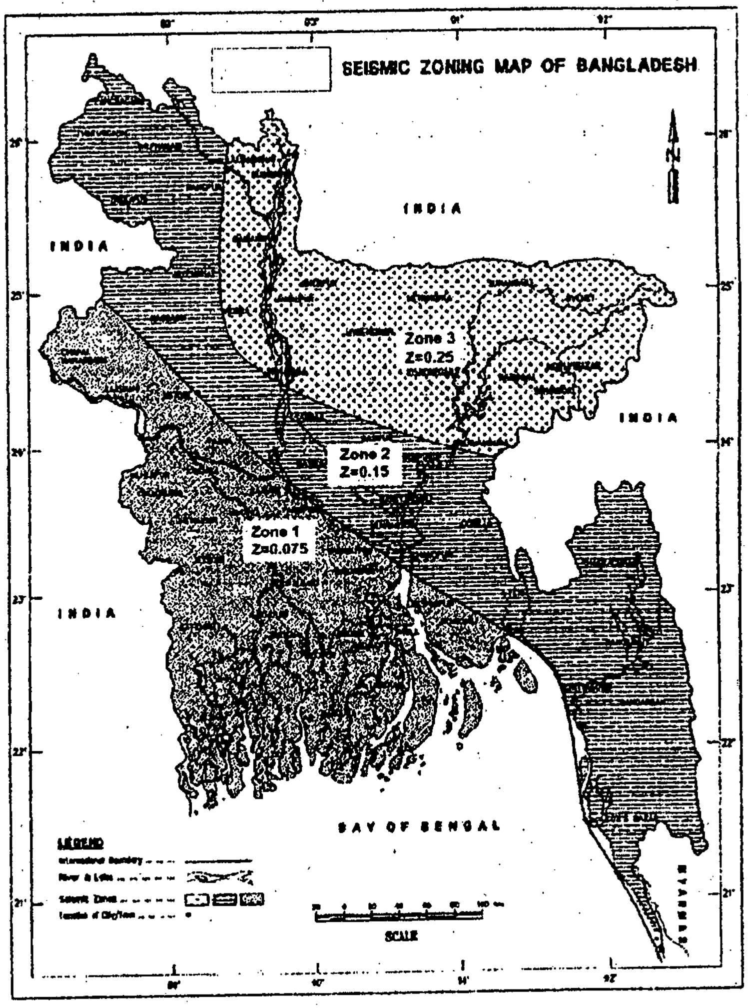
Tables and figures for equivalent static method of earthquake force using BNBC 1993 code

Seismic Zone Coefficients, Z

Seismic Zone (see Fig 6.2.10)	Zone Coefficient
1	0.075
2	0.15
3	0.25

Structure Importance Coefficients I, I'

Structure Importance Category (see Table 6.1.1 for occupancy)	Structure Importance Coefficient I	I'
I Essential facilities	1.25	1.50
II Hazardous facilities	1.25	1.50
III Special occupancy structures	1.00	1.00
IV Standard occupancy structures	1.00	1.00
V Low-risk Structures	1.00	1.00



Site Coefficient, S, for Seismic Lateral Forces (1)

Site Soil Characteristics: Type	Description	Coefficient, S
S_1	A soil profile with either : a) A rock-like material characterized by a shear-wave velocity greater than 762 m/s or by other suitable means of classification, or b) Stiff or dense soil condition where the soil depth is less than 61 metres	1.0
S_2	A soil profile with dense or stiff soil conditions, where the soil depth exceeds 61 metres	1.2
S_3	A soil profile 21 metres or more in depth and containing more than 6 metres of soft to medium stiff clay but not more than 12 metres of soft clay	1.5
S_4	A soil profile containing more than 12 metres of soft clay characterized by a shear wave velocity less than 152 m/s	2.0

Note : (1) The site coefficient shall be established from properly substantiated geotechnical data. In locations where the soil properties are not known in sufficient detail to determine the soil profile type, soil profile S_3 shall be used. Soil profile S_4 need not be assumed unless the building official determines that soil profile S_4 may be present at the site, or in the event that soil profile S_4 is established by geotechnical data.

Response Modification Coefficient for Structural Systems, R

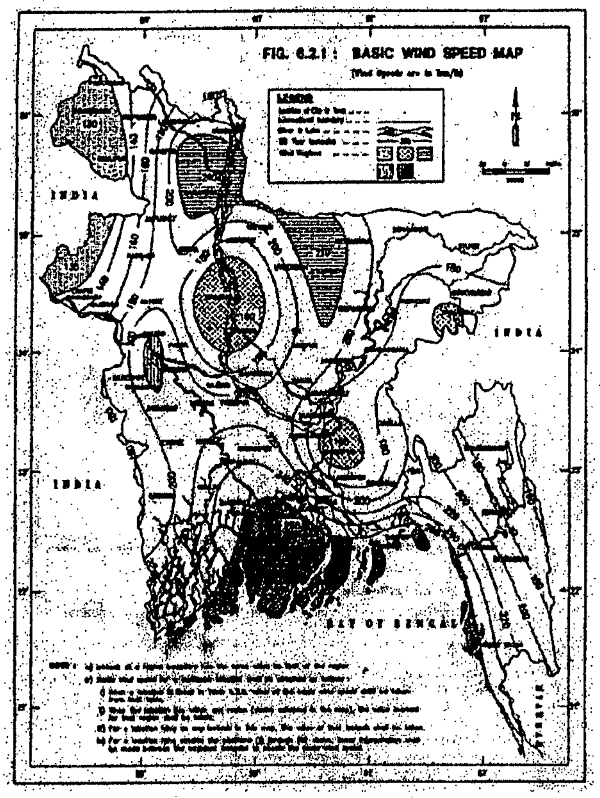
Basic Structural System(1)	Description of Lateral Force Resisting System	R
a. Bearing Wall System	1. Light framed walls with shear panels	
	i) Plywood walls for structures, 3 storeys or less	8
	ii) All other light framed walls	6
	2. Shear walls	
	i) Concrete	6
	ii) Masonry	6
	3. Light steel framed bearing walls with tension only bracing	4
	4. Braced frames where bracing carries gravity loads	
	i) Steel	6
	ii) Concrete (3)	4
	iii) Heavy timber	4
b. Building Frame System	1. Steel eccentric braced frame (EBF)	10
	2. Light framed walls with shear panels	
	i) Plywood walls for structures 3-storeys or less	9
	ii) All other light framed walls	7
	3. Shear walls	
	i) Concrete	8
	ii) Masonry	8
	4. Concentric braced frames (CBF)	
	i) Steel	8
	ii) Concrete (3)	8
	iii) Heavy timber	8
c. Moment Resisting Frame System	1. Special moment resisting frames (SMRF)	
	i) Steel	12
	ii) Concrete	12
	2. Intermediate moment resisting frames (IMRF), concrete(4)	8
	3. Ordinary moment resisting frames (OMRF)	
	i) Steel	6
	ii) Concrete (5)	5

Basic Structural System(1)	Description of Lateral Force Resisting System	R
d. Dual System	1. Shear walls	
	i) Concrete with steel or concrete SMRF	12
	ii) Concrete with steel OMRF	6
	iii) Concrete with concrete IMRF (4)	9
	iv) Masonry with steel or concrete SMRF	8
	v) Masonry with steel OMRF	6
	vi) Masonry with concrete IMRF (3)	7
	2. Steel EBF	
	i) With steel SMRF	12
	ii) With steel OMRF	6
	3. Concentric braced frame (CBF)	
	i) Steel with steel SMRF	10
	ii) Steel with steel OMRF	6
	iii) Concrete with concrete SMRF (3)	9
	iv) Concrete with concrete IMRF (3)	6
e. Special Structural Systems	See Sec 1.3.2, 1.3.3, 1.3.5	

Notes : (1) Basic Structural Systems are defined in Sec 1.3.2, Chapter 1.
(2) See Sec 2.5.6.6 for combination of structural systems, and Sec 1.3.5 for system limitations.
(3) Prohibited in Seismic Zone 3.
(4) Prohibited in Seismic Zone 3 except as permitted in Sec 2.5.9.3.
(5) Prohibited in Seismic Zones 2 and 3. Sec 1.7.2.6.

Contd ---- P/6

Tables and figures for wind load calculation using BNBC 1993



Location	Basic Wind Speed (km/h)	Location	Basic Wind Speed (km/h)
Angarpota	150	Lalmonirhat	204
Bagerhat	252	Madaripur	220
Bandarban	200	Magura	208
Barguna	260	Manikganj	185
Barisal	256	Meherpur	185
Bhola	225	Maheshkhali	260
Bogra	198	Moulvibazar	168
Brahmanbaria	180	Munshiganj	184
Chandpur	160	Mymensingh	217
Chapai Nawabganj	130	Naogaon	175
Chittagong	260	Narail	222
Chuadanga	198	Narayanganj	195
Comilla	196	Narsinghdi	190
Cox's Bazar	260	Natore	198
Dahagram	150	Netrokona	210
Dhaka	210	Nilphamari	140
Dinajpur	130	Noakhali	184
Faridpur	202	Pabna	202
Feni	205	Panchagarh	130
Gaibandha	210	Patuakhali	260
Gazipur	215	Pirojpur	260
Gopalganj	242	Rajbari	188
Habiganj	172	Rajshahi	155
Hatiya	260	Rangamati	180
Ishurdi	225	Rangpur	209
Joypurhat	180	Satkhira	183
Jamalpur	180	Shariatpur	198
Jessore	205	Sherpur	200
Jhalakati	260	Sirajganj	160
Jhenaidah	208	Srimangal	160
Khagrachhari	180	St. Martin's Island	260
Khulna	238	Sunamganj	195
Kutubdia	260	Sylhet	195
Kishoreganj	207	Sandwip	260
Kurigram	210	Tangail	160
Kushtia	215	Teknaf	260
Lakshmipur	162	Thakurgaon	130

Gust Response Factors, G_h and G_z

Height above ground level (metres)	G_h (1) 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

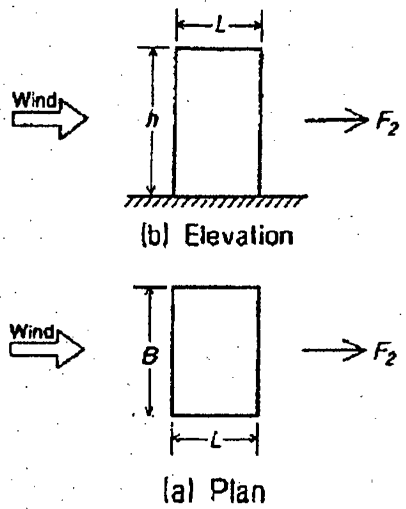
Note : (1) For main wind-force resisting systems, use building or structure height h for z.
(2) Linear interpolation is acceptable for intermediate values of z.

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.

Contd... P/ 7

Tables and figures for wind load calculation using BNBC 1993



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	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.

Structure Importance Category (see Table 6.1.1 for Occupancy)	Structure Importance Coefficient, C_I
I Essential facilities	1.25
II Hazardous facilities	1.25
III Special occupancy structures	1.00
IV Standard occupancy structures	1.00
V Low-risk structures	0.80

Tasnua
24.12.12

L-3/T-2/CE **Date : 24/12/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 317** (Design of concrete structure II)

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) A 16 × 25 in. column is reinforced with ten No. 9 bars as shown in Fig. 1. Construct the nominal strength interaction diagram for the column with five points corresponding to pure axial load, pure bending, balanced condition, ε_s = 0.001 (tensile) and ε_s = 0.004 (tensile). Also find corresponding ϕ for the above points. Assume bending about Y - Y axis. Given: f'_c = 4 ksi and f_y = 60 ksi. **(25)**

   (b) A circular column carries working loads P_{DL} = 900 kip and P_{LL} = 500 kip. Design the spirally reinforced column using reasonable percentage of main reinforcement. Also design the ACI spiral. Use USD. Given f'_c = 4 ksi and f_y = 60 ksi. **(14)**

   (c) What is ACI spiral? Explain the failure behaviour of ACI ~~specially~~ spirally reinforced column. **(7⅔)**

2. (a) A ground floor column of a multistoried building is to be designed for the following load combinations - Gravity load combination P_u = 600 kip, M_u = 70 kip-ft. Lateral load combination P_u = 550 kip, M_u = 400 kip-ft. Architectural considerations require that a rectangular column with b = 15 in and h = 25 in is to be used. Material strengths are f'_c = 4 ksi and f_y = 60 ksi. **(20)**

   Find the required column reinforcement, tie size and spacing and show in sketch. Use relevant design chart assuming reinforcement distributed ~~about~~ along the perimeter.

   (b) Design a tied column with about 3% reinforcement to support unfactored laods P_{DL} = 450 kip and P_{LL} = 350 kip. Due to architectural reason, the width of column b = 12″ should be maintained. Also design tie size and spacing. Use USD and show sketches. Given: f'_c = 5 ksi and f_y = 72.5 ksi. **(14)**

   (c) Why are ϕ values lower for compression than those for flexure or shear? What is the significance of using α in column design? **(12⅔)**

3. (a) Design a single footing to support an 18 × 18 in square tied column reinforced with eight No. 9 bars. One side of the footing is limited to 9.0 ft. The column carries unfactroed axial dead load of 275 kip and live load of 200 kip. The base of the footing is 4-ft below grade and the available soil pressure is 5 ksf. Use f'_c = 3 ksi and f_y = 60 ksi. **(23⅔)**

Contd P/2

CE 317

Contd ... Q. No. 3

(b) A column 19″ × 19″ in size carries working dead load P_{DL} = 300 kip and live load P_{LL} = 150 kip. Cast in-situ piles of diameter 20 in with allowable load carrying capacity of 125 kip are to be used. Pile spacing shall be 3 times the pile diameter. Design the pile cap using USD method. Draw plan and section showing all reinforcements and necessary details. Given: f'_c = 3 ksi and f_y = 60 ksi. (23)

4. (a) A gravity retaining wall as shown in Fig. 2 is to retain a bank 15 ft high whose horizontal surface is subjected to a live load surcharge of 300 psf, The soil is a sand-gravel mix with unit wt = 120 lb/ft^3 and ϕ = 30°. Assume base friction coefficient = 0.5, allowable bearing capacity = 7000 psf and unit wt. of concrete = 150 lb/ft^3. Check if the wall has adequate factors of safety against overturning, bearing and sliding. **(21)**

(b) The section of RC cantilever retaining wall supporting granular soil is shown in Fig. 3. Assuming that there are adequate factors of safety against overturning, bearing and sliding, design the thickness and flexural reinforcement for the arm at the bottom (curtailment is not required). Also find other reinforcements required in the arm. Show all reinforcement in a sketch. Given: f'_c = 3 ksi and f_y = 60 ksi, unit wt of soil = 120 lb/ft^3 ϕ = 30°, surcharge = 400 psf. **(14)**

(c) Why is seismic detailing essential for earthquake resistant design of structures? Draw and explain seismic detailing provisions for column of an intermediate moment resisting frame as per ACI/BNBC code. **(11⅔)**

SECTION – B

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

5. (a) Why is it essential to provide minimum thickness for slabs as per ACI/~~BNC~~ BNBC code? **(8)**

(b) Write in short ACI/BNBC code provisions for one-way joist floor. **(8)**

(c) What are the guidelines generally used for establishing the axes of rotations and yield lines for slabs? **(8)**

(d) Calculate the yield moment for a simply supported square slab subjected to uniformly distributed load by equilibrium method. **(8)**

(e) Using the method of ~~vertical~~ virtual work, determine the load carrying capacity of the one-way uniformly loaded continuous slab which has a 12 ft span and is reinforced to provide a resistance to positive bending moment 6.0 kip-ft /ft throughout the span. In addition, negative steel over the supports provides moment capacities of 6.0 kip-ft/ft at one end and 9.0 kip-ft/ft at other end. **(14⅔)**

Contd P/3

CE 315

6. (a) Name different types of reinforced concrete floor slabs commonly used in Bangladesh with neat sketches. **(8)**

   (b) What are the code provisions of drop panel for flat slab structures? **(8)**

   (c) A 10-storied office building at Dhaka is to be designed using a flat plate floor system. The columns are 18″ × 18″ in size and they are spaced 20 ft c/c. Using direct design method, design an interior slab panel and show the reinforcements with neat sketches. Assume slab thickness 7.5″. Specifed LL = 80 psf and superimposed DL = 60 psf in addition to self-weight of slab $f_c' = 3.5$ ksi and $f_y = 60$ ksi. **(30⅔)**

7. (a) Describe briefly the different stages of loading to which a prestressed concrete member is often subjected. **(15)**

   (b) Compute the value of the live load that the beam of Fig. 4 can carry without producing crack at the bttom of Sec 1 - 1. Given: $f_r = 400$ psi; $n = 7$ and Effective prestress = 800 kN. **(31⅓)**

8. (a) Describe briefly the different sources which cause loss of prestress in a prestressed concrete member. **(15)**

   (b) Compute the loss of prestress in steel at sec 2-2 of Fig. 5 due to elastic shortening. The prestress in steel at transfer is 1000 MPa. Given:

   $$A_{ps} = 600\ mm^2\ ;\ E_s = 2 \times 10^5\ MPa;$$

   $$E_c = 2.5 \times 10^4\ MPa \text{ and } f_{ci}' = 30\ MPa.$$

   Neglect the self-weight of the beam. **(31⅓)**

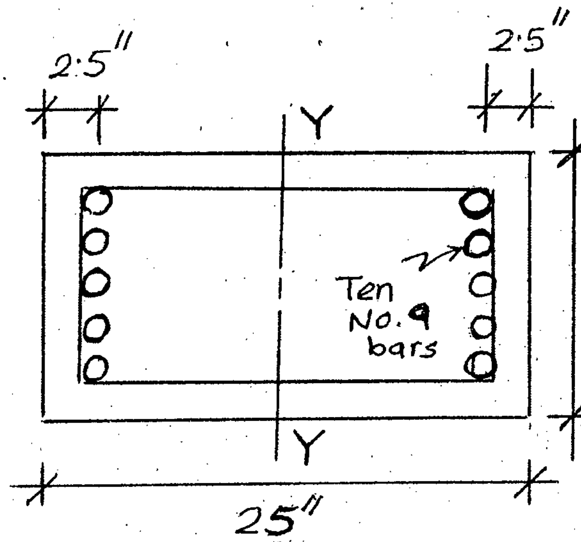


Fig. 1

Givens:
$f_c' = 4\,ksi$
$f_y = 60\,ksi$

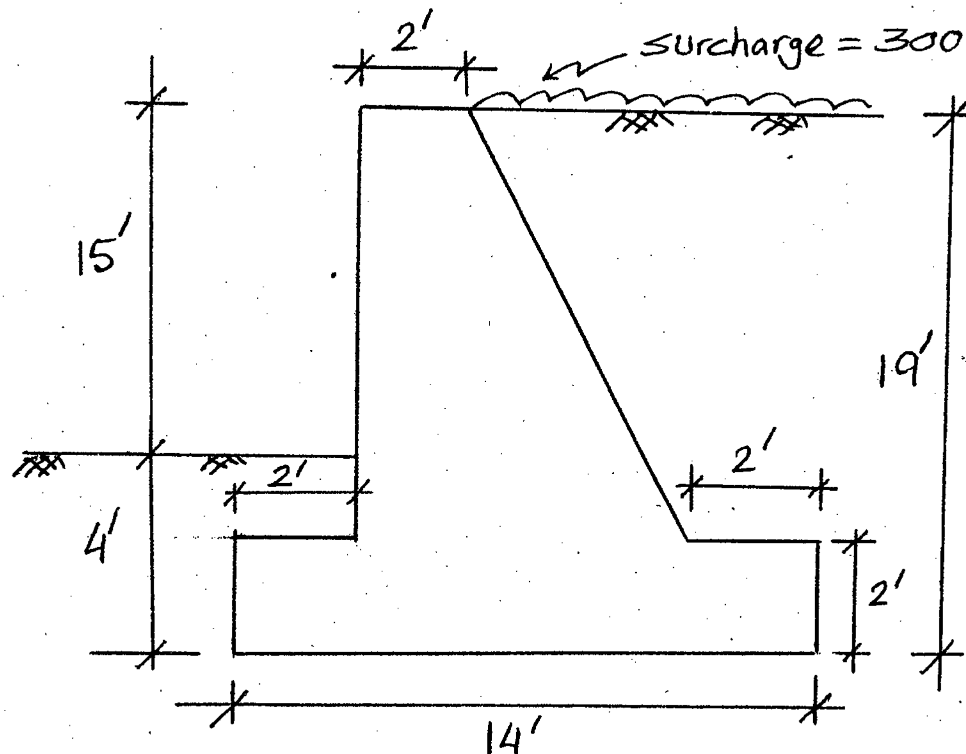


Fig. 2.

$\gamma_{soil} = 120\,lb/ft^3$
$\phi = 30°$
$f = 0.5$
$q_a = 7000\,psf$
$\gamma_{con} = 150\,lb/ft^3$

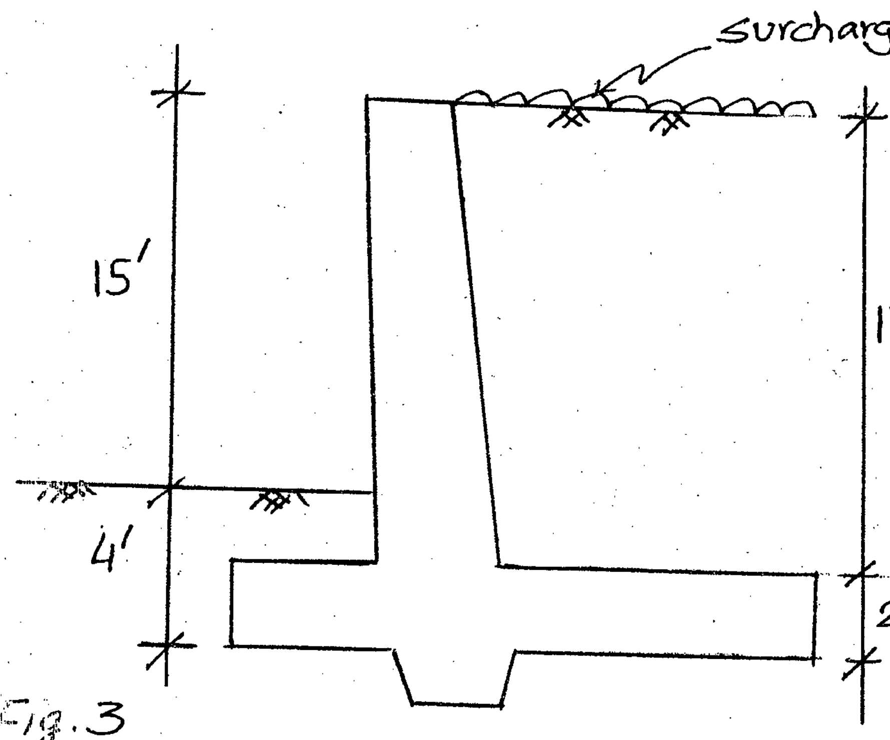


Fig. 3

$\gamma_{soil} = 120\,lb/ft^3$
$\phi = 30°$
$f_c' = 3\,ksi$
$f_y = 60\,ksi$

CE 317 for CE (Session-April 2012)

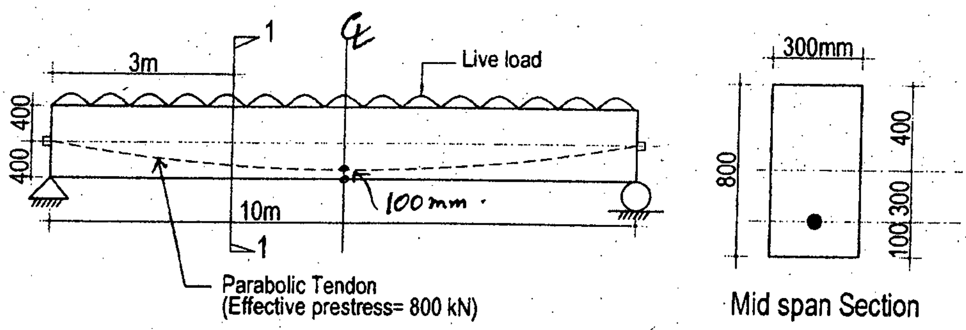


Fig- 4

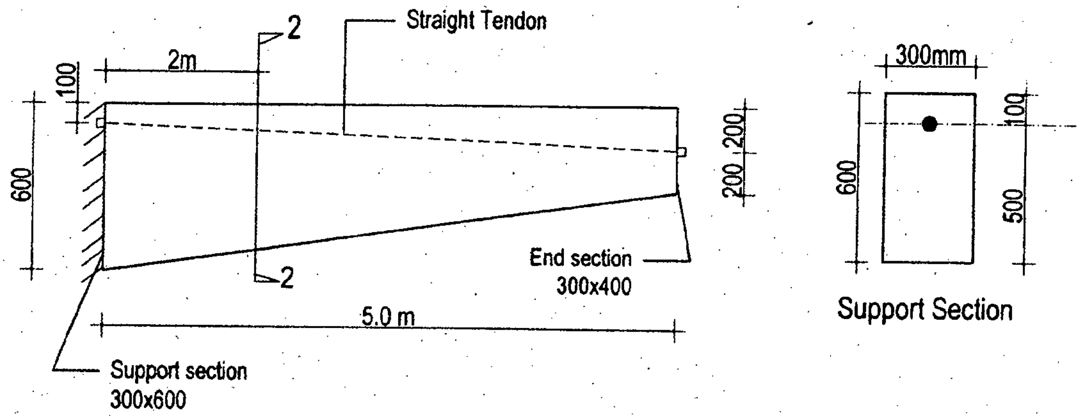
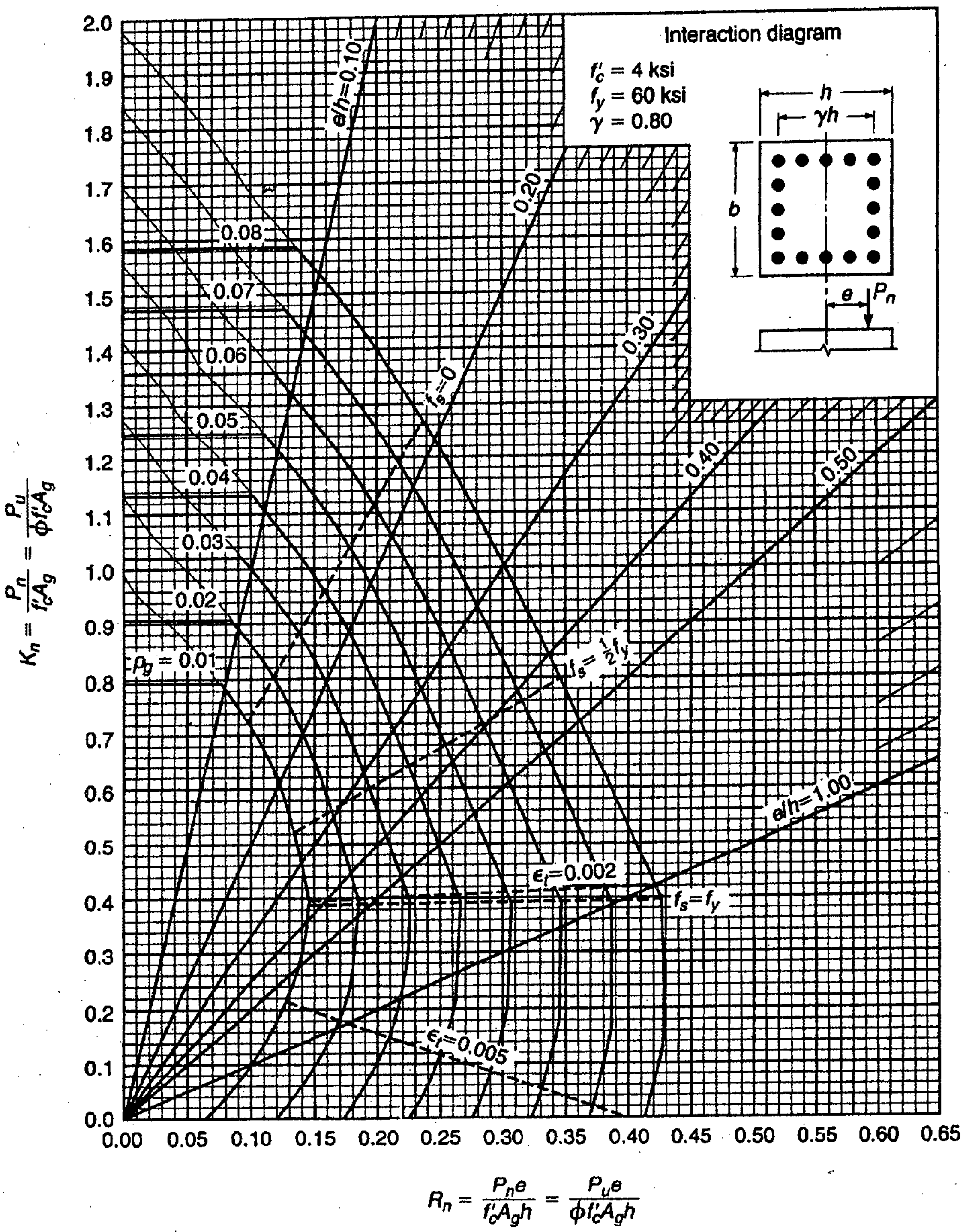


Fig- 5

= 6 =



GRAPH A.7
Column strength interaction diagram for rectangular section with bars on four faces and γ = 0.80.

L-3/T-2/CE

Date : 31/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 343** (Geotechnical Engineering II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values of any data, if missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1** and any **TWO** from the rest.

Q. No. 1 is Compulsory.

1. (COMPULSORY QUESTION). Answer any seven of the following nine short questions. Answer should be brief and to the point. Preferably all the answers should be given in sequential order. **(7×5=35)**

(a) What is negative skin friction? What are the remedial measures for skin friction?

(b) What is the purpose of conducting load test for piling works?

(c) What are the information obtained from a subsoil investigation?

(d) How would you classify soil sample and soil samplers?

(e) Show in a Table the classification of piles considering various criteria.

(f) A pile group consisting of four piles is in a square pattern with equal spacing in both directions. Find the centre to centre spacing in terms of the diameter of the piles, if efficiency of the group is 75% as per Converse-Labarre formula.

(g) What are the contents of a good subsoil investigation report?

(h) What are the terms and limiting values used to describe the percentage of gravel, sand and fines in a soil sample?

(i) The inner diameter of a sampling tube and that of a cutting edge are 70 mm and 68 mm respectively; their outer diameter are 72 mm and 74 mm respectively. Determine the area ratio and inside clearance ratio.

2. (a) Describe briefly the principal considerations of a subsoil investigation Programme. **(13)**

(b) A 400 mm diameter × 15 m long precast concrete pile is driven in the soil stratigraphy shown in Fig. 1. **(22)**

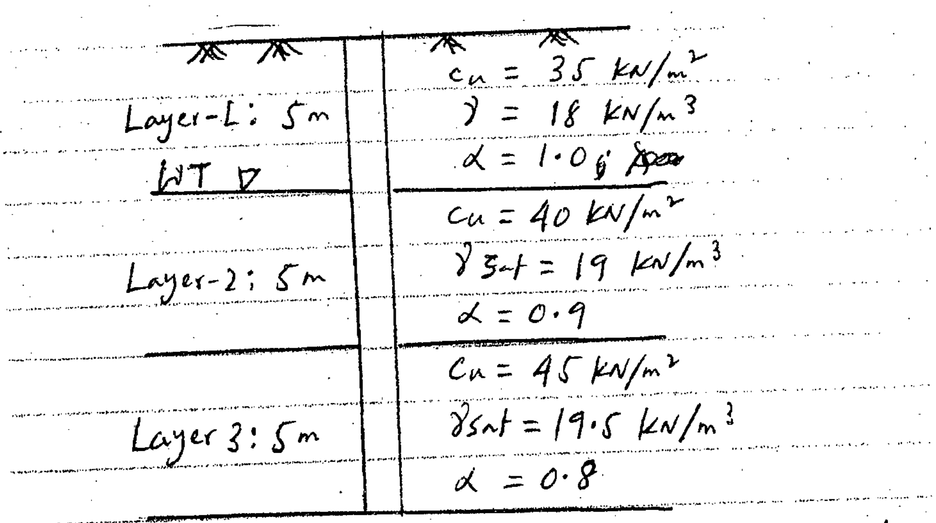


Fig. 1 (For Q. No. 2b): Soil Properties of clay Layers.

Contd P/2

CE 343

Contd ... Q. No. 2(b)

All soil layers are clay. The properties of each clay layer are shown in Fig. 1. The effective angle of internal friction of all clay layers is 25°. The compressive strength of the concrete used to manufacture the pile is 35 MPa. Calculate the skin friction capacities of the pile using α-method, β-method and λ-method.

Layer 1 and 2: Normally consolidated, Use $k = 1 - \sin\phi$

Layer 3: Over consolidated with OCR = 2, Use $k = (1 - \sin\phi)\sqrt{OCR}$

Assume $\lambda = 0.21$ for an embedment length of 15 m.

3. (a) Describe with a neat sketch the wash boring method of soil exploration. What are its merits and demerits? **(13)**

(b) Estimate the allowable load bearing capacity of a precast concrete driven pile 500 mm × 500 mm in section and 17 m long in a stratified soil with the following data using Meyerhof's method based on SPT value. **(22)**

Layer No.	Depth (m)	Soil Type	N-value
1	0 – 5	Fill clay	4
2	5 – 15	Sand	20
3	15 – 25	Sand	25

Use a global factor of safety of 3.0. If the settlement of single pile is estimated as 15 mm, what would be the settlement of a group of the above pile consisting of 9 piles in a square pattern with a c/c spacing of 1.5 m?

4. (a) Explain the "Conventional method" and "Meyerhof's effective width concept" for an eccentrically loaded footing. Draw and explain typical soil pressure – settlement curves for footings of different widths on surface of a homogeneous sand deposit. **(13)**

(b) Determine the allowable load on the footing resting on a clay deposit. **(22)**

Footing size:	2.0 × 3.0 m
Depth of footing:	2 m
Thickness of footing:	0.5 m
Unit weight of soil:	18 kN/m^3
q_u of soil:	120 kN/m^2
Water table:	3.0 m level

Given the following chart:

D_f/B	0.5	1.0	2.0	3.0	4.0
N_c (strip)	6.0	6.5	7.0	7.4	7.5

Contd P/3

SECTION – B

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

5. Using design charts of Fig. 2, determine **(35)**
   (i) Allowable load on a wall footing 2 ft wide resting at 5 ft depth.
   (ii) Allowable load on a 10 ft by 10 ft square footing resting at 7.5 ft depth. Calculate factor of safety against bearing capacity failure.

Given:
Corrected SPT value for the given site.

Depth	2.5′	5.0′	7.5′	10.0′	12.5′	15.0′	20.0′	25.0′
N_{Corr}	20	22	21	22	23	25	25	27

Unit weight of soil is 120 pcf
Ground water table at 10 ft below ground level
Thickness of 2 ft wide footing = 12″
thickness of square footing = 30″

6. (a) Calculate the settlement of footing resting on a deep deposit of clay at 8 ft below ground level. **(23)**

Given: Footing size: 10′ × 12′
Dead load: 150^k
Live load: 100^k
Average unit weight of soil = 125 pcf
$C_c = 0.16$ $C_r = 0.03$
$e_0 = 0.85$ $\sigma_{v\,max} = 6$ ksf
Water table is at 20 ft below ground level.

(b) A raft 100 × 120 ft in plan has its base 16 ft below surface of a clay deposit with unit weight of 120 pcf. The unconfined compressive strength of the clay is 0.8 tsf. The factor of safety against bearing capacity failure is 3. What total weight of building plus foundation can safely be supported on the raft ? Use N_c value from Q. No. 4(b). **(12)**

7. (a) A pile group consists of 20 piles spaced at 5 ft centre to centre. The pile group is subjected to vertical load of 1200 kip at centre and a moment 1000 kip-ft and 600 kip-ft in long and short direction, respectively. Draw necessary sketches and calculate load on piles at four corners. **(20)**
(b) Calculate the factor of safety of slip circle shown in Fig. 3. The figure is drawn to scale. Attach the figure with answer script. **(15)**

8. (a) Draw and explain typical shore protection systems for excavation of 20 ft deep and 100 × 120 ft in plan. **(12)**
(b) Calculate the factor of safety for slice 1 and 2 shown in Fig. 4. The figure is drawn to scale. Attach the figure with answer script. **(23)**

Contd. P/4

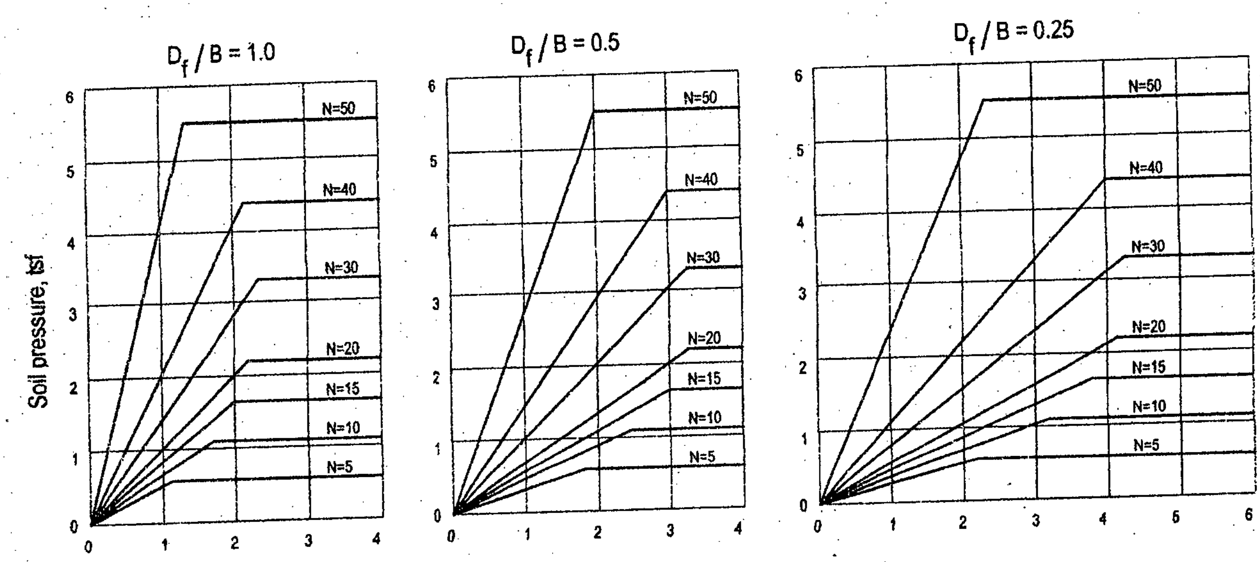
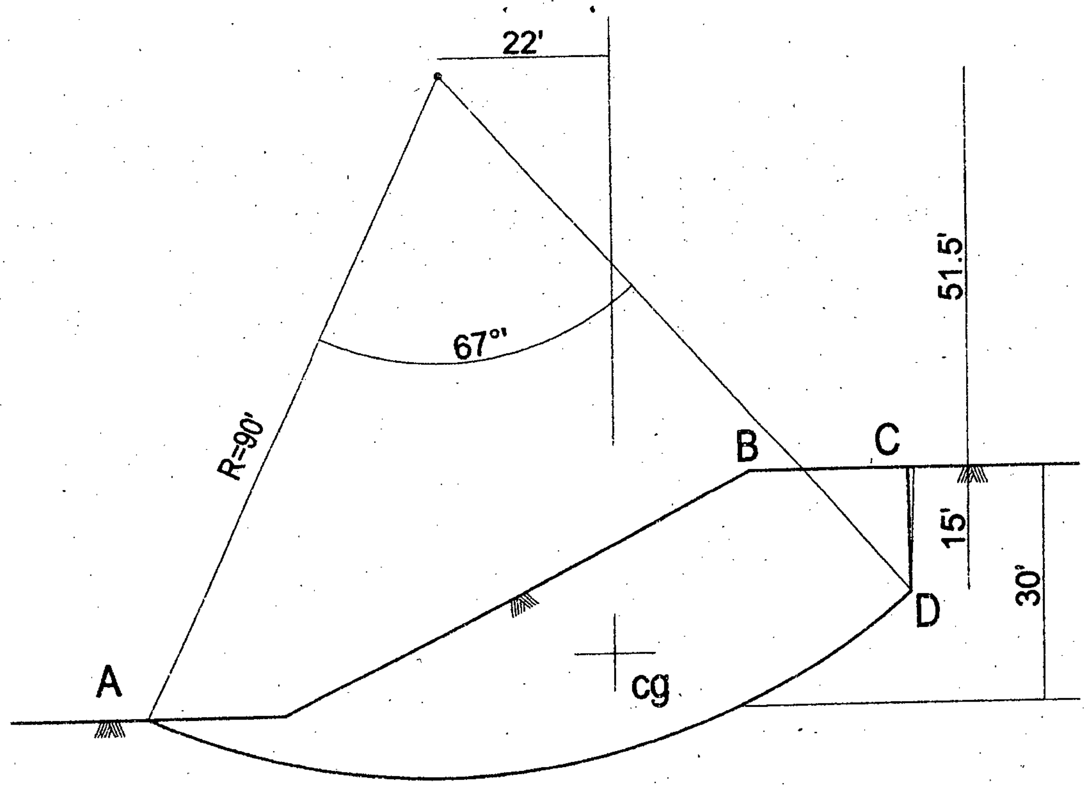


FIG.- 2 DESIGN CHART FOR PROPORTIONING FOOTINGS ON SAND

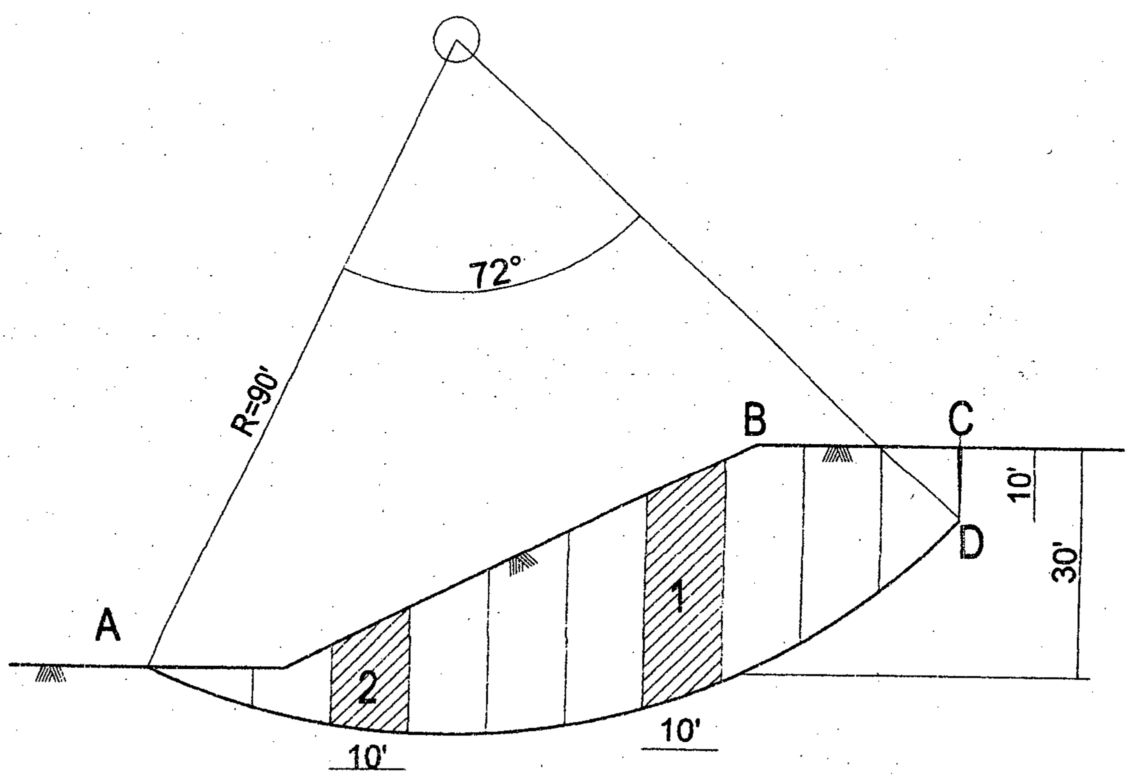
Contd . . . P/5



Area of ABCD =1800 sft
unit wt. of soil =120 pcf
cohesion of soil =1000 psf
tension crack filled with water

FIG.- 3 (For Q. No. 7(b))

(is to be attached with the answer script)



unit wt. of soil =120 pcf
cohesion of soil =400 psf
angle of internal friction =25 degree

FIG.- 4 (For Q. No. 8(b))

(is to be attached with the answer script)

L-3/T-2/CE Date : 07/01/2013

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **WRE 303** (Hydrology)

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) Explain why the temperature increases with altitude in the stratosphere. **(5)**

(b) Discuss in brief the logic behind forming polygons in Thiessen polygon Method. **(5)**

(c) Define Trade Wind. Explain why most of the deserts are located in the horse latitudes. **(5)**

(d) With a neat sketch show Hadley cell, Polar cell, Westerlies, and belts of high and low pressures in the Northern Hemisphere. **(5)**

(e) Calculate precipitable water for surface temperature of 10 °C in first 1 km of saturated atmospheric column if the surface pressure = 101.3 kPa and lapse rate = 6.5 °C/km. Also compute precipitable water for surface temperature of 25 °C in first 1 km of similar column and calculate the percent increase or decrease from the previously computed value. Justify your calculations. Assume any reasonable value for missing data. **(15)**

2. (a) Define 'extreme value'. Why Gumbel's distribution is known as extreme value distribution? **(5)**

(b) Classify and explain streams according to annual hydrograph. **(5)**

(c) Name the forces associated with a falling raindrop. Define terminal velocity. **(5)**

(d) Maximum recorded precipitation intensities in a catchment for the period 1991 to 2005 are given below: **(20)**

Year	Maximum Precipitation Intensity (in/hour)	Year	Maximum Precipitation Intensity (in/hour)
1991	0.5	1999	5.0
1992	3.0	2000	3.8
1993	2.6	2001	3.2
1994	2.8	2002	3.3
1995	2.2	2003	0.7
1996	3.6	2004	1.0
1997	3.4	2005	0.8
1998	4.2		

Contd P/2

WRE 303 (CE)

Contd ... Q. No. 2(d)

(i) Use the Gumbel's extreme value distribution to estimate design precipitation intensities with return periods of 50 and 100 years. Given, $\bar{y}_n = 0.5128$ and $s_n = 1.0206$ for N = 15.

(ii) Use the IDF curves shown in Fig. 1 to estimate the design durations of precipitation for return periods of 50 and 100 years.

(iii) Compute the design depths of rainfall for return periods of 50 and 100 years.

(iv) Compute the 90% confidence limits for return periods of 50 and 100 years for precipitation intensity. Given, f(c) = 1.645 for c = 90%.

3. (a) Differentiate between condensation nuclei and freezing nuclei. **(5)**

(b) Define residence time. Give a qualitative comparison between atmospheric moisture and water in the rivers in terms of residence time. **(5)**

(c) Explain why the actual vapor pressure is taken equal to saturation vapor pressure at dew point temperature. **(5)**

(d) Explain in brief the possible flow paths of infiltrated water. **(5)**

(e) In a 140-min storm, the following intensities of rainfall were observed in successive 20-min intervals: 3.3, 3.6, 9.0, 6.6, 0.6, 0.9 and 6.0 cm/hour. Assume the ϕ-index value as 3.0 cm/hour, compute, **(15)**

(i) total volume of runoff, (ii) total volume of infiltration, and (iii) time of rainfall excess. The catchment area is 2 km^2.

4. (a) Explain in brief the rainfall-runoff correlation method in computing annual runoff volume. **(5)**

(b) Define return period. 'The exceedence probability for a flood with a 100-year return period is 0.01' – explain the sentence above in brief. **(5)**

(c) Define time of concentration. How is it related to peak discharge from a catchment area? **(5)**

(d) Write down the factors that affect the infiltration capacity and explain in brief. **(5)**

(e) Consider a catchment with longitudinal slope = 0.005, area = 2 km^2 and runoff coefficient = 0.1. The peak discharge is computed to be 4.2 m^3/s. Compute the corresponding intensity of rainfall, time of concentration for the catchment and maximum length of travel of water for a return period of 100 years. Use Rational Method, IDE curves, (Fig. 1) and Kirpich formula for your estimation. **(15)**

Contd P/3

WRE 303 (CE)

SECTION – B

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

5. (a) Write short notes on (i) sounding weight (ii) echo-depth recorder (iii) flow measuring structures. **(6)**

(b) Explain how a current meter is calibrated. Describe the unsteady flow effect on rating curve. **(3+6)**

(c) A 320 g/l solution of Rhodamine dye was discharged into a stream at a constant rate of 40 l/s. The background concentration of that dye in the stream water was found to be 15 ppm. The average width, depth and Chezy's coefficient of that stream are 250 m, 8 m and 22 $m^{1/2}/s$ respectively. (i) Determine the safe mixing length of the stream. (ii) If the equilibrium dye concentration at a downstream section is 36 ppm, estimate the discharge in the stream. **(4+4)**

(d) The stream discharges for various stages at a particular section were observed to be as follows. Obtain the rating curve equation and determine the discharge for a stage of 6.5 m. **(12)**

Stage (m)	1.8	2.0	2.3	2.9	3.7	4.5	5.4	6.1	7.3	7.7	8.1
Discharge (cumec)	1.0	1.5	2.5	5.6	11.7	20.2	32.5	44.5	70.0	80.0	90.0

6. (a) Mention the importance of telemetry system in hydrological data acquisition. Write down the operational uses of satellite data in estimating precipitation and land use/land cover. **(4+6)**

(b) List the factors which affect the shape of flood hydrograph. Discuss the role of these factors. **(10)**

(c) The characteristics of two meteorologically similar catchments P and Q are as follows. For catchment P: L = 318 km, L_{ca} = 198 km, A = 4480 km^2. For catchment Q: L = 284 km, L_{ca} = 184 km, A = 3780 km^2. The following are the ordinates of 9 hour unit hydrograph of catchment P. **(15)**

Time hr)	0	9	18	27	36	45	54	72	90
Discharge (cumec)	0	69	1000	210	118	74	46	13	0

Using Snyder's method, develop a 9 hour unit hydrograph for catchment Q and plot the hydrograph.

7. (a) Explain the use, limitation and duration of unit hydrograph. **(10)**

(b) Describe the procedure of deriving D-hour unit hydrograph for a catchment. **(10)**

(c) The ordinates of a 4 hour unit hydrograph for a particular basin are given below. Determine the ordinates of S-curve hydrograph and there from the ordinates of 6 hour unit hydrograph (with necessary corrections). **(15)**

Time (hr)	0	2	4	6	8	10	12	16	18	20	24	26	30
Discharge (cumec)	0	25	100	160	190	170	110	60	30	20	8	4	0

WRE 303 (CE)

8. (a) Define and also explain the importance of channel routing and reservoir routing? **(8)**

(b) Describe the procedure of hydrologic storage routing. **(12)**

(c) The inflow hydrograph for a stream reach are given below for which the Muskingum coefficients of K = 36 hr and x = 0.15. At the beginning of the flood, the value of outflow is same as inflow. Route the flood through the reach and determine the outflow hydrograph. Also determine the value of attenuation and lag. **(15)**

Time (hr)	0	12	24	36	48	60	72	84	96	108	120	132	144
Discharge (cumec)	42	45	88	272	~~343~~ 342	288	240	198	162	133	85	60	50

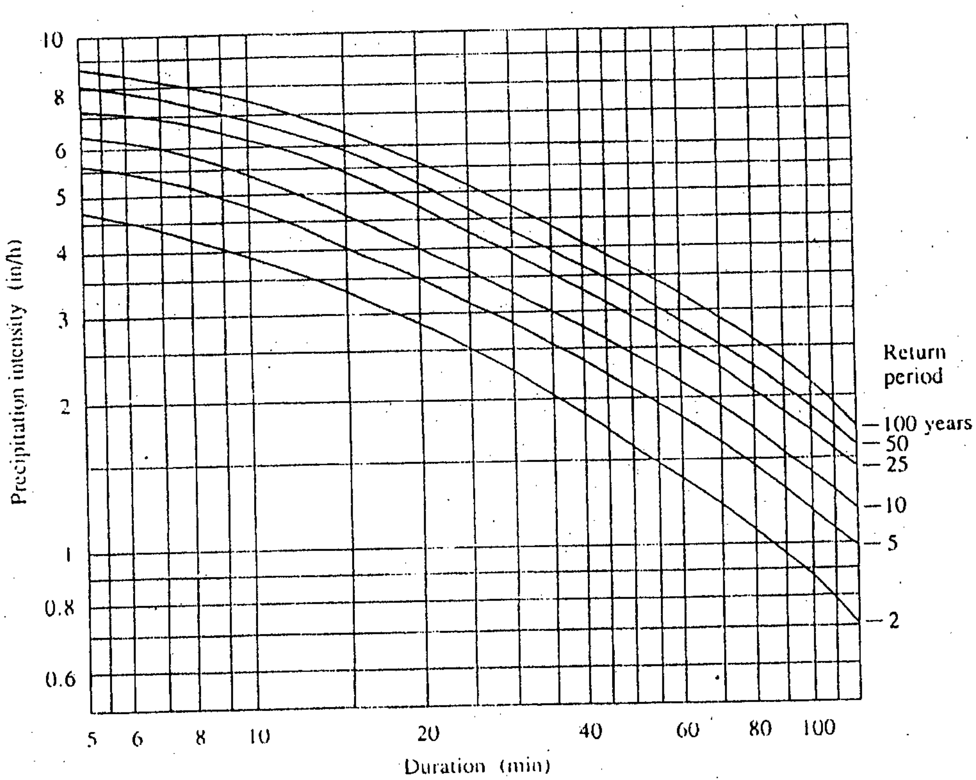


Fig 1: Intensity-duration-frequency (IDF) curves for Q. No. 2(d) and 4(e)

L-3/T-2/CE

Date : 31/12/2012

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **CE 343** (Geotechnical Engineering II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values of any data, if missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1** and any **TWO** from the rest.

Q. No. 1 is Compulsory.

1. (COMPULSORY QUESTION). Answer any seven of the following nine short questions. Answer should be brief and to the point. Preferably all the answers should be given in sequential order. **(7×5=35)**

(a) What is negative skin friction? What are the remedial measures for skin friction?

(b) What is the purpose of conducting load test for piling works?

(c) What are the information obtained from a subsoil investigation?

(d) How would you classify soil sample and soil samplers?

(e) Show in a Table the classification of piles considering various criteria.

(f) A pile group consisting of four piles is in a square pattern with equal spacing in both directions. Find the centre to centre spacing in terms of the diameter of the piles, if efficiency of the group is 75% as per Converse-Labarre formula.

(g) What are the contents of a good subsoil investigation report?

(h) What are the terms and limiting values used to describe the percentage of gravel, sand and fines in a soil sample?

(i) The inner diameter of a sampling tube and that of a cutting edge are 70 mm and 68 mm respectively; their outer diameter are 72 mm and 74 mm respectively. Determine the area ratio and inside clearance ratio.

2. (a) Describe briefly the principal considerations of a subsoil investigation Programme. **(13)**

(b) A 400 mm diameter × 15 m long precast concrete pile is driven in the soil stratigraphy shown in Fig. 1. **(22)**

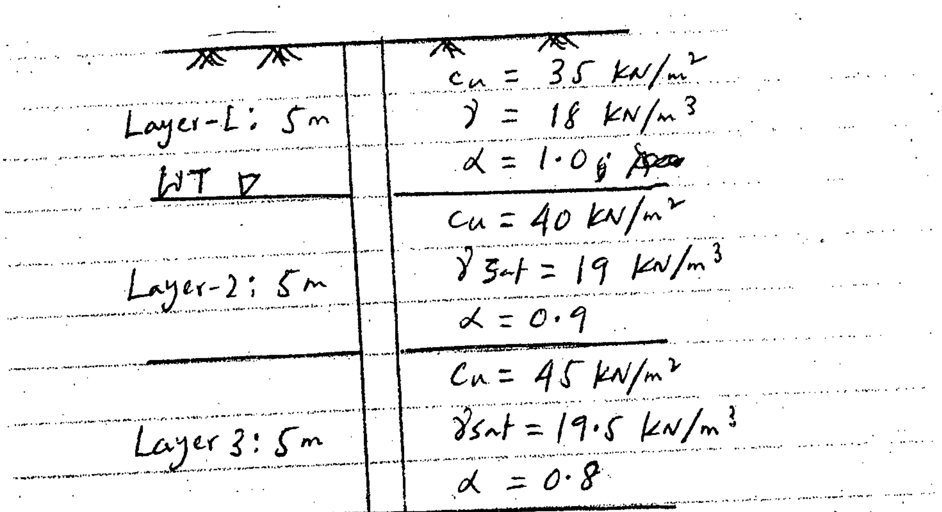


Fig.1 (For Q.NO. 2b): Soil Properties of clay Layers.

Contd P/2

CE 343

Contd ... Q. No. 2(b)

All soil layers are clay. The properties of each clay layer are shown in Fig. 1. The effective angle of internal friction of all clay layers is 25°. The compressive strength of the concrete used to manufacture the pile is 35 MPa. Calculate the skin friction capacities of the pile using α-method, β-method and λ-method.

Layer 1 and 2: Normally consolidated, Use $k = 1 - \sin\phi$

Layer 3: Over consolidated with OCR = 2, Use $k = (1 - \sin\phi)\sqrt{OCR}$

Assume $\lambda = 0.21$ for an embedment length of 15 m.

3. (a) Describe with a neat sketch the wash boring method of soil exploration. What are its merits and demerits? **(13)**

(b) Estimate the allowable load bearing capacity of a precast concrete driven pile 500 mm × 500 mm in section and 17 m long in a stratified soil with the following data using Meyerhof's method based on SPT value. **(22)**

Layer No.	Depth (m)	Soil Type	N-value
1	0 – 5	Fill clay	4
2	5 – 15	Sand	20
3	15 – 25	Sand	25

Use a global factor of safety of 3.0. If the settlement of single pile is estimated as 15 mm, what would be the settlement of a group of the above pile consisting of 9 piles in a square pattern with a c/c spacing of 1.5 m?

4. (a) Explain the "Conventional method" and "Meyerhof's effective width concept" for an eccentrically loaded footing. Draw and explain typical soil pressure – settlement curves for footings of different widths on surface of a homogeneous sand deposit. **(13)**

(b) Determine the allowable load on the footing resting on a clay deposit. **(22)**

Footing size:	2.0 × 3.0 m
Depth of footing:	2 m
Thickness of footing:	0.5 m
Unit weight of soil:	18 kN/m^3
q_u of soil:	120 kN/m^2
Water table:	3.0 m level

Given the following chart:

D_f/B	0.5	1.0	2.0	3.0	4.0
N_c (strip)	6.0	6.5	7.0	7.4	7.5

Contd P/3

CE 343

SECTION – B

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

5. Using design charts of Fig. 2, determine **(35)**
   (i) Allowable load on a wall footing 2 ft wide resting at 5 ft depth.
   (ii) Allowable load on a 10 ft by 10 ft square footing resting at 7.5 ft depth. Calculate factor of safety against bearing capacity failure.

   Given:
   Corrected SPT value for the given site.

Depth	2.5′	5.0′	7.5′	10.0′	12.5′	15.0′	20.0′	25.0′
N_{Corr}	20	22	21	22	23	25	25	27

   Unit weight of soil is 120 pcf
   Ground water table at 10 ft below ground level
   Thickness of 2 ft wide footing = 12″
   thickness of square footing = 30″

6. (a) Calculate the settlement of footing resting on a deep deposit of clay at 8 ft below ground level. **(23)**

   Given: Footing size: 10′ × 12′
   Dead load: 150^k
   Live load: 100^k
   Average unit weight of soil = 125 pcf
   $C_c = 0.16$ $C_r = 0.03$
   $e_0 = 0.85$ $\sigma_{v\,max} = 6$ ksf
   Water table is at 20 ft below ground level.

   (b) A raft 100 × 120 ft in plan has its base 16 ft below surface of a clay deposit with unit weight of 120 pcf. The unconfined compressive strength of the clay is 0.8 tsf. The factor of safety against bearing capacity failure is 3. What total weight of building plus foundation can safely be supported on the raft ? Use N_c value from Q. No. 4(b). **(12)**

7. (a) A pile group consists of 20 piles spaced at 5 ft centre to centre. The pile group is subjected to vertical load of 1200 kip at centre and a moment 1000 kip-ft and 600 kip-ft in long and short direction, respectively. Draw necessary sketches and calculate load on piles at four corners. **(20)**
   (b) Calculate the factor of safety of slip circle shown in Fig. 3. The figure is drawn to scale. Attach the figure with answer script. **(15)**

8. (a) Draw and explain typical shore protection systems for excavation of 20 ft deep and 100 × 120 ft in plan. **(12)**
   (b) Calculate the factor of safety for slice 1 and 2 shown in Fig. 4. The figure is drawn to scale. Attach the figure with answer script. **(23)**

Contd. P/4

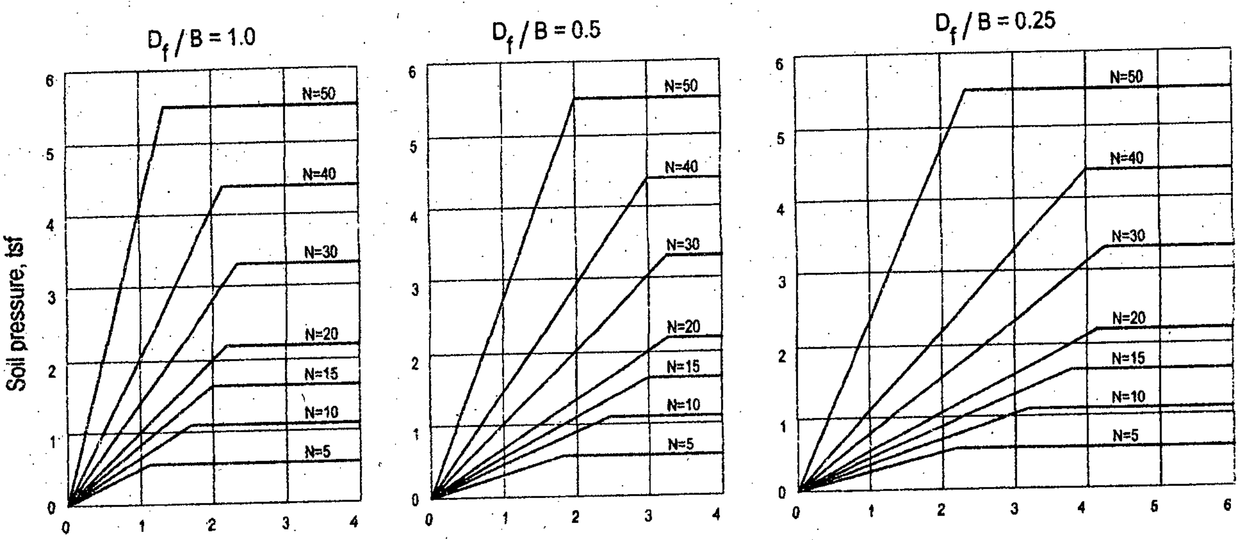
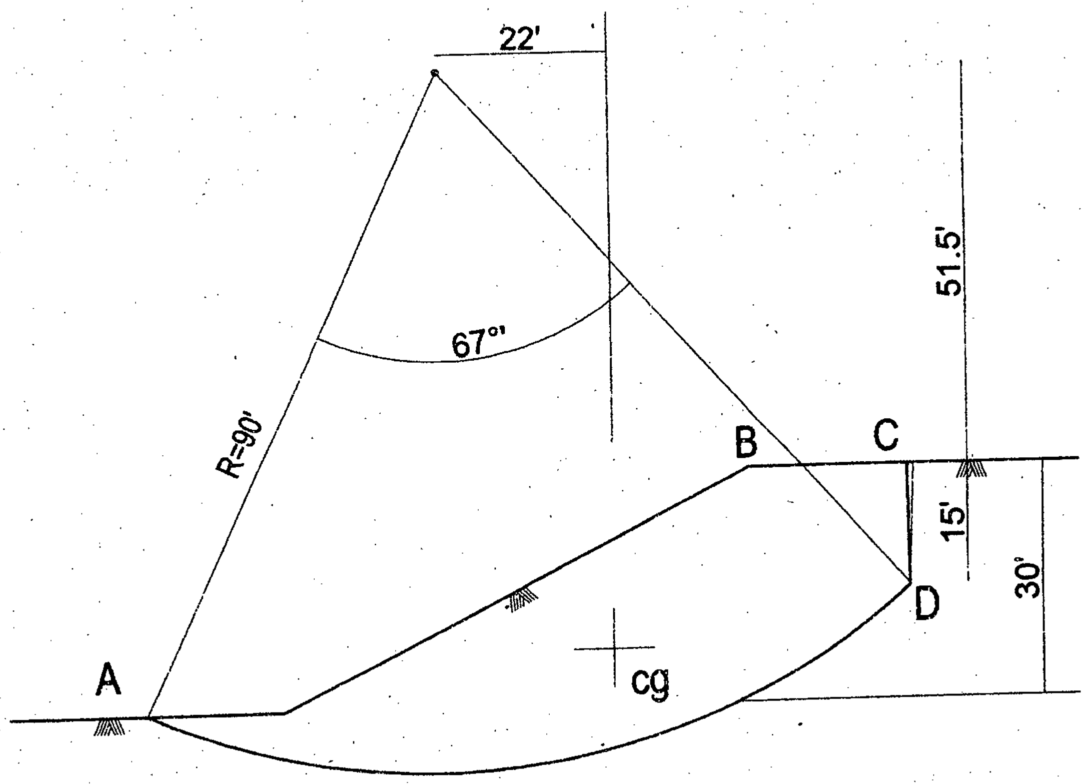


FIG.- 2 DESIGN CHART FOR PROPORTIONING FOOTINGS ON SAND

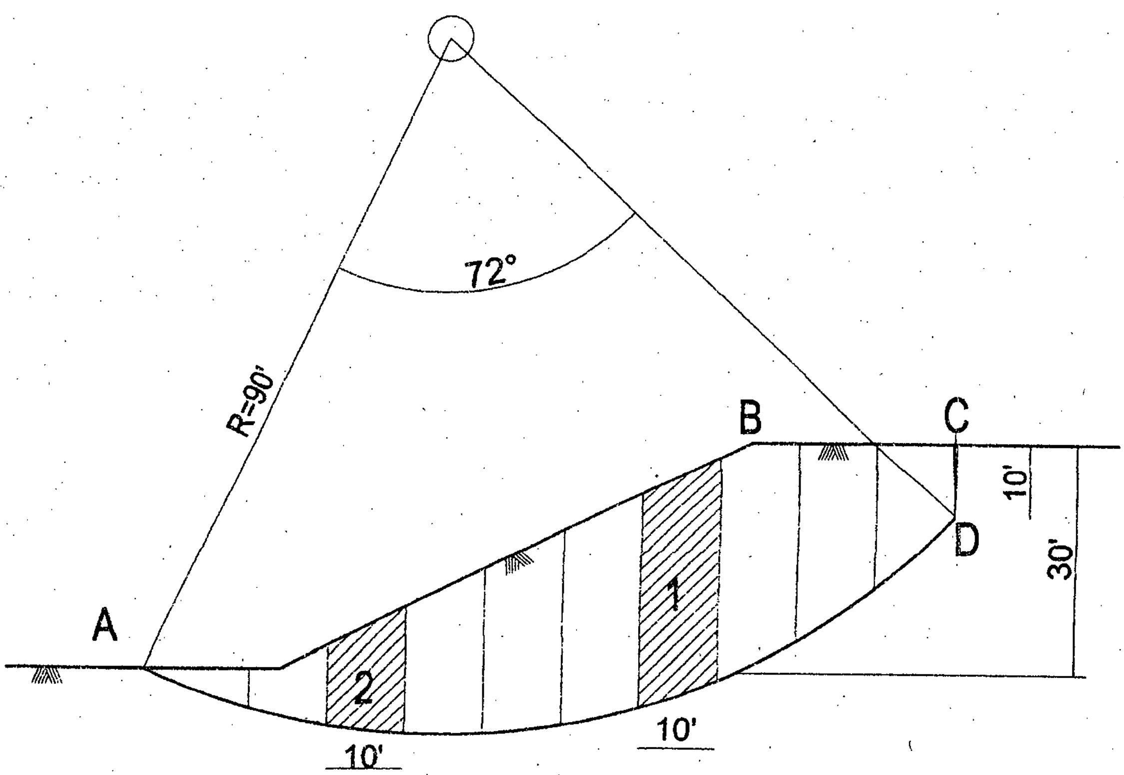
Contd... P/5



Area of ABCD =1800 sft
unit wt. of soil =120 pcf
cohesion of soil =1000 psf
tension crack filled with water

FIG.- 3 (For Q. No. 7(b))

(is to be attached with the answer script)



unit wt. of soil =120 pcf
cohesion of soil =400 psf
angle of internal friction =25 degree

FIG.- 4 (For Q. No. 8(b))

(is to be attached with the answer script)