08.12.14

L-3/T-2/WRE **Date : 08/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 391** (Transportation Engineering)

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) Discuss briefly the concept of functional classification of roadways. **(10⅔)**

   (b) Name different types of sight distances. **(6)**

   (c) List the ten principles of access management. **(15)**

   (d) An impatient driver approaches an intersection controlled by a two-way stop sign. The through traffic is quite heavy, with an average gap of 5 sec. If this driver can achieve an acceleration of $dV/dT = (3 - 0.04\ V)$ ft/sec^2 and his perception-reaction time is 0.75 sec, determine if he can clear the intersection. Assume that the width of intersection is 24 ft and his car is 20 ft long. **(15)**

2. (a) Define the following terms: **(10)**

   (i) Hourly traffic volume, (ii) Flow rate, (iii) Density, (iv) AADT, (v) Time headway.

   (b) Calculate the time-mean speed if the space-mean speed is 40 km/h and the variance within space-mean speed is 35. **(6)**

   (c) Show that for a linear relationship between speed and density, **(10⅔)**

$$q_{max} = \frac{V_f\ K_j}{4}$$

   The symbols have their usual meanings.

   (d) A study of traffic flow at a particular site has resulted in a speed-density relationship as follows: **(20)**

$$V = 57.5\ (1 - 0.008\ K)$$

   where, V = is in mph and K is in veh/mile. Determine:

   (i) free-flow speed, (ii) Jam density, (iii) Speed-flow relationship, (iv) flow-density relationship, and (v) Capacity.

3. (a) Discuss various types of Runway Configurations. **(16⅔)**

   (b) Show in a diagram the activities occur in major components of an airport terminal area and the corresponding physical facilities provided. **(12)**

   (c) List the factors that are usually considered while selecting a site for a new airport. **(9)**

Contd P/2

CE 391 (WRE)

Contd ... Q. No. 3

(d) The following data were recorded during a traffic volume study: **(9)**

Time	No. of Vehicles
6:00 PM – 6:15 PM	175
6:15 PM – 6:30 PM	250
6:30 PM – 6:45 PM	200
6:45 PM – 7:00 PM	325

It was also found that the maximum volume occurred during 6:00 PM – 7:00 PM. Determine:

(i) Peak Hour Volume, (ii) Peak Hour Factor, and (iii) Design Hour Volume.

4. (a) Draw typical cross-sections of typical 2-lane and 4-lane rural highways showing cross-sectional elements on them. **(8⅔)**

(b) Write short notes on the followings: **(16)**

(i) 30th highest hourly volume

(ii) Shoulders

(iii) Curbs and Gutters, and

(iv) Right of Way

(c) A crest vertical curve is to be designed to join a +2% grade with a –3% grade at a section of a two-lane highway. Determine the minimum length of the curve if the design speed is 60 mph. Assume that f = 0.29 and that the perception-reaction time is 2.5 sec. **(12)**

(d) An existing horizontal curve on a highway has a radius of 268 ft which restricts the maximum speed on this section of the road to only 60% of the design speed. If the curve is to be improved so that its maximum speed will be the design speed of the highway, determine the minimum radius of the new curve. Assume that coefficient of side friction is 0.15 for the existing curve and that the rate of superelevation is 0.08 for both the existing curve and the new curve to be designed. Note that the coefficient side friction is 0.14 for a speed of around 50 mph. **(10)**

SECTION – B

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

5. (a) Briefly describe the desirable properties of aggregates used in asphalt concrete. Write short note on 'Cold Mix Asphalt Concrete'. **(12⅔)**

(b) What are the desirable characteristics of a highway pavement? Make a detailed comparison between 'Flexible Pavement' and 'Rigid Pavement'. **(14)**

(c) Classify road-traffic accidents based on the severity of accident. What are the key-data that should be included in the accident report form for every reported accident? **(10)**

(d) Write down the requirements of ideal fastening and good ballast for a railway track. **(10)**

Contd P/3

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6. (a) Distinguish between 'collision diagram' and 'condition diagram' as a part of the engineering analysis of the accident situation at an accident-prone site. **(10)**

(b) Outline the procedures for identifying, diagnosing and selecting hazardous road sites for remedial treatment in a form of flow-chart. Make sure to show the major tasks at different stages and the overlap of certain tasks on two consecutive stages. **(12⅔)**

(c) Classify the design factors of highway pavement design into four broad categories and write short notes on each of them. **(14)**

(d) What are the basic requirements for a comprehensive transportation plan? Name 'the several committees' that are created in carrying out the urban transportation planning process. **(10)**

7. (a) Write down the advantages of Conning of wheel and Tilting of rail. What is sleeper density? **(10)**

(b) Draw a schematic diagram showing the details of a right hand turnout of a railway track. **(10⅔)**

(c) Classify railway yards. What are the considerations for selecting a site for a railway station? **(10)**

(d) For a particular B.G. Line-super elevation, SE (e) = $1.315\ v^2/R$, allowable cant deficiency, C_d = 70 mm, allowable safe speed, v = 4.4 sqrt (R-70). If actual cant provided for a 3° curve is 2.5 cm, determine (i) train speed for equilibrium cant, (ii) cant excess if the train runs 10 kmph slower that the speed for equilibrium cant (iii) maximum permissible speed of train on this track. **(16)**

If an 8° curve branches out in the opposite direction from the main line (with 3° curve) and the speed restriction on the main line is 5 kmph less than the maximum permissible speed (as determined) on that track, determine the maximum permissible speed on the branch line.

8. (a) List the significant characteristics of transportation system that make it diverse and complex. Identify the changes in four critical dimensions of transportation system due to the societal and technological changes in the world. **(11⅔)**

(b) For the following data, carry out the Fatigue analysis using PCA method. Design period = 25 years, Sub-base/subgrade k = 140 lb/in^3, concrete modulus of rupture = 620 psi, the rigid pavement consists of doweled joints and without concrete shoulders. Assume load safety factor = 1.2 and pavement thickness = 10.5 inch. **(20)**

Single Axle (Kip)	Expected Repetitions	Tandem Axle (Kip)	Expected Repetitions
40	10,000	50	8,500
36	12,500	46	12,500
32	30,000	40	32,000
30	50,000	36	51,000
28	72,000		
26	95,000		
24	140,000		

Contd P/4

CE 391 (WRE)

Contd ... Q. No. 8

(c) A 4 lane divided highway is to be constructed on a new alignment. Traffic volume forecasts indicate that the annual average daily traffic (AADT) in both directions during the first year of operation will be 8,500 with the following vehicle compositions and axle loads. **(15)**

Passenger cars (1,000 lb/axle) = 42%; growth rate = 5%

2-axle single unit truck (3,000 lb/axle) = 25%, growth rate = 3%

3-axle single unit truck (15,000 lb/axle) = 20%; growth rate = 8%

3-axle single unit truck (22,000 lb/axle) = 13%; growth rate = 6%

Determine the design ESAL, given a design period of 25 years. Assume 45% truck volume on design lane.

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ble 3 Equivalent Stress Values for Single Axles and Tandem Axles (Without Concrete Shoulder) Q. 8(b)

Slab Thickness (in.)	k of Subgrade–Subbase (lb/in.³) (Single Axle/Tandem Axle)						
	50	100	150	200	300	500	700
4	825/67[illegible]	726/585	671/542	634/516	584/486	523/457	484/443
4.5	699/586	616/500	571/460	540/435	498/406	448/378	417/363
5	602/516	531/436	493/399	467/376	432/349	390/321	363/307
5.5	526/461	464/387	431/353	409/331	379/305	343/278	320/264
6	465/418	411/348	382/316	362/296	336/271	304/246	285/232
6.5	417/380	367/317	341/286	324/267	300/244	273/220	256/207
7	375/349	331/290	307/262	292/244	271/222	246/199	231/186
7.5	340/323	300/268	279/241	265/224	246/203	224/181	210/169
8	311/300	274/249	255/223	242/208	225/188	205/167	192/155
8.5	285/281	252/232	234/208	222/193	206/174	188/154	177/143
9	264/264	232/218	216/195	205/181	190/163	174/144	163/133
9.5	245/248	215/205	200/183	190/170	176/153	161/134	151/124
10	228/235	200/193	186/173	177/160	164/144	150/125	141/117
10.5	213/222	187/183	174/164	165/151	153/136	140/119	132/110
11	200/211	175/174	163/155	154/143	144/129	131/113	123/104
11.5	188/201	165/165	153/148	145/136	135/122	123/107	116/98
12	177/192	155/158	144/141	137/130	127/116	116/102	109/93
12.5	168/183	147/151	136/135	129/124	120/111	109/97	103/89
13	159/176	139/144	129/129	122/119	113/106	103/93	97/85
13.5	152/168	132/138	122/123	116/114	107/102	98/89	92/81
14	144/162	125/133	116/118	110/109	102/98	93/85	88/78

Figure 1: Allowable Load Repetitions for Fatigue Analysis Based on Stress Ratio

Q. 8(c)

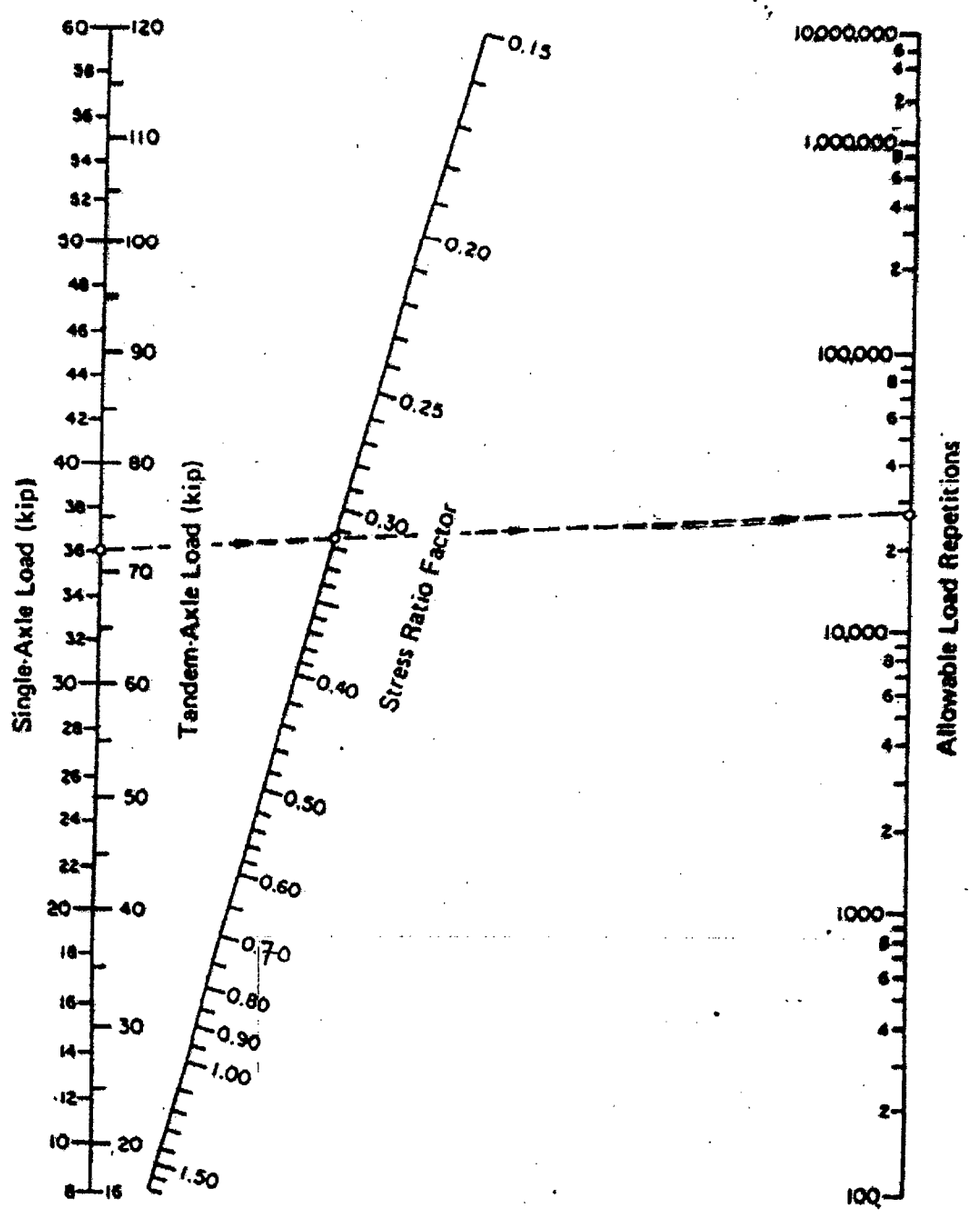

Table 1. Growth Factors — 2.8(c)

Design Period, Years (n)	Annual Growth Rate, Percent (r)							
	No Growth	2	4	5	6	7	8	10
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2	2.0	2.02	2.04	2.05	2.06	2.07	2.08	2.10
3	3.0	3.06	3.12	3.15	3.18	3.21	3.25	3.31
4	4.0	4.12	4.25	4.31	4.37	4.44	4.51	4.64
5	5.0	5.20	5.42	5.53	5.64	5.75	5.87	6.11
6	6.0	6.31	6.63	6.80	6.98	7.15	7.34	7.72
7	7.0	7.43	7.90	8.14	8.39	8.65	8.92	9.49
8	8.0	8.58	9.21	9.55	9.90	10.26	10.64	11.44
9	9.0	9.75	10.58	11.03	11.49	11.98	12.49	13.58
10	10.0	10.95	12.01	12.58	13.18	13.82	14.49	15.94
11	11.0	12.17	13.49	14.21	14.97	15.78	16.65	18.53
12	12.0	13.41	15.03	15.92	16.87	17.89	18.98	21.38
13	13.0	14.68	16.63	17.71	18.88	20.14	21.50	24.52
14	14.0	15.97	18.29	19.16	21.01	22.55	24.21	27.97
15	15.0	17.29	20.02	21.58	23.28	25.13	27.15	31.77
16	16.0	18.64	21.82	23.66	25.67	27.89	30.32	35.95
17	17.0	20.01	23.70	25.84	28.21	30.84	33.75	40.55
18	18.0	21.41	25.65	28.13	30.91	34.00	37.45	45.60
19	19.0	22.84	27.67	30.54	33.76	37.38	41.45	51.16
20	20.0	24.30	29.78	33.06	36.79	41.00	45.76	57.28
25	25.0	32.03	41.65	47.73	54.86	63.25	73.11	98.35
30	30.0	40.57	56.08	66.44	79.06	94.46	113.28	164.49
35	35.0	49.99	73.65	90.32	111.43	138.24	172.32	271.02

Note: Factor $= [(1 + r)^n - 1]/r$, where $r = \frac{\text{rate}}{100}$ and is not zero. If annual growth is zero, growth factor = design period.

Source: Reproduced from *Thickness Design—Asphalt Pavements for Highways and Streets*, Manual Series No. 1, The Asphalt Institute, College Park, Md., September 1981.

Table 2 Load Equivalency Factors — 2.8(c)

Gross Axle Load		Load Equivalency Factors		Gross Axle Load		Load Equivalency Factors	
kN	lb	Single Axles	Tandem Axles	kN	lb	Single Axles	Tandem Axles
4.45	1,000	0.00002		182.5	41,000	23.27	2.29
8.9	2,000	0.00018		187.0	42,000	25.64	2.51
13.35	3,000	0.00072		191.3	43,000	28.22	2.75
17.8	4,000	0.00209		195.7	44,000	31.00	3.00
22.25	5,000	0.00500		200.0	45,000	34.00	3.27
26.7	6,000	0.01043		204.5	46,000	37.24	3.55
31.15	7,000	0.0196		209.0	47,000	40.74	3.85
35.6	8,000	0.0343		213.5	48,000	44.50	4.17
40.0	9,000	0.0562		218.0	49,000	48.54	4.51
44.5	10,000	0.0877	0.00688	222.4	50,000	52.88	4.86
48.9	11,000	0.1311	0.01008	226.8	51,000		5.23
53.4	12,000	0.189	0.0144	231.3	52,000		5.63
57.8	13,000	0.264	0.0199	235.7	53,000		6.04
62.3	14,000	0.360	0.0270	240.2	54,000		6.47
66.7	15,000	0.478	0.0360	244.6	55,000		6.93
71.2	16,000	0.623	0.0472	249.0	56,000		7.41
75.6	17,000	0.796	0.0608	253.5	57,000		7.92
80.0	18,000	1.000	0.0773	258.0	58,000		8.45
84.5	19,000	1.24	0.0971	262.5	59,000		9.01
89.0	20,000	1.51	0.1206	267.0	60,000		9.59
93.4	21,000	1.83	0.148	271.3	61,000		10.20
97.8	22,000	2.18	0.180	275.8	62,000		10.84
102.3	23,000	2.58	0.217	280.2	63,000		11.52
106.8	24,000	3.03	0.260	284.5	64,000		12.22
111.2	25,000	3.53	0.308	289.0	65,000		12.96
115.6	26,000	4.09	0.364	293.5	66,000		13.73
120.0	27,000	4.71	0.426	298.0	67,000		14.54
124.5	28,000	5.39	0.495	302.5	68,000		15.38
129.0	29,000	6.14	0.572	307.0	69,000		16.26
133.5	30,000	6.97	0.658	311.5	70,000		17.19
138.0	31,000	7.88	0.753	316.0	71,000		18.15
142.3	32,000	8.88	0.857	320.0	72,000		19.16
146.8	33,000	9.98	0.971	325.0	73,000		20.22
151.2	34,000	11.18	1.095	329.0	74,000		21.32
155.7	35,000	12.50	1.23	333.5	75,000		22.47
160.0	36,000	13.93	1.38	338.0	76,000		23.66
164.5	37,000	15.50	1.53	342.5	77,000		24.91
169.0	38,000	17.20	1.70	347.0	78,000		26.22
173.5	39,000	19.06	1.89	351.5	79,000		27.58
178.0	40,000	21.08	2.08	356.0	80,000		28.99

Note: kN converted to lb are within 0.1 percent of lb shown.

Source: Reproduced from *Thickness Design—Asphalt Pavements for Highways and Streets*, Manual Series No. 1, The Asphalt Institute, College Park, Md., September 1981.

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15/12/14

L-3/T-2/WRE **Date : 15/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examinations 2012-2013

Sub : **CE 325** (Design of Concrete Structures - II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume appropriate value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Why is comparatively high strength concrete necessary for prestressed concrete? **(5)**

   (b) Show the stress distribution in concrete for different location of 'C' (compressive force) with respect to centre of gravity of concrete (c.s.c) in a prestressed concrete member under increasing load. **(10)**

   (c) Compute the value of the live load that the beam of Fig. 1 can carry without producing tension at midspan. Use any method for your calculation. Use the effective prestress =900 kN. f_r = 3.0 MPa and n = 7. **(20)**

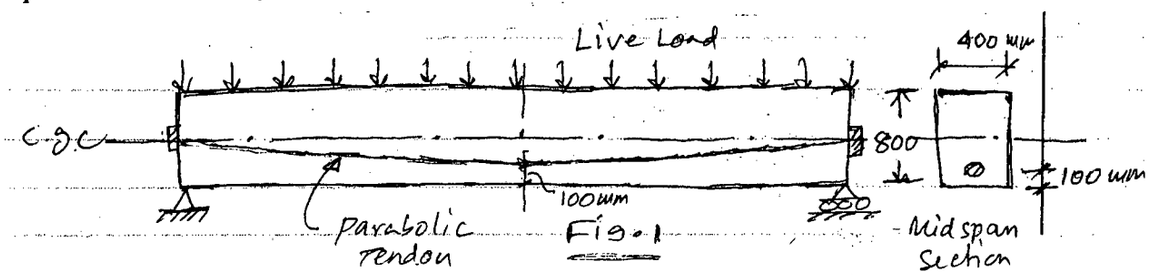


Fig. 1

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

   (b) Compute the loss of prestress due to elastic shortening of concrete at section 1 - 1 of pretensioned concrete beam as shown in Fig. 2. Use F_i = 800 kN and n = 6. Solve the problem considering both gross and transformed area of concrete. **(20)**

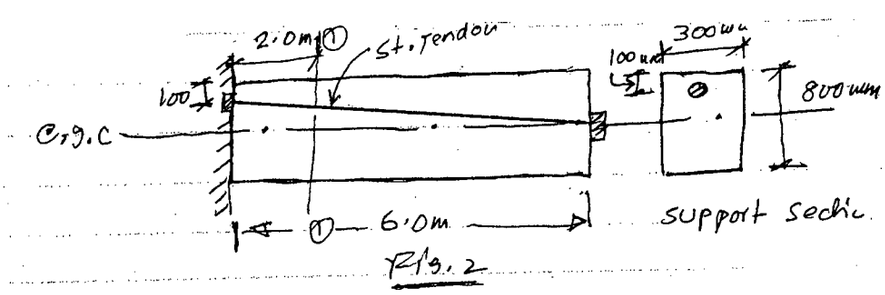


Fig. 2

3. A reinforced concrete floor consists of rectangular panels measuring 20 ft × 25 ft , as shown in Fig. 3. The floor is ~~desired~~ designed to carry a service live load of 100 psf uniformly distributed over its surface in addition to its own weight, using a concrete strength of 3500 psi and reinforcement having f_y = 50000 psi. (35)

Contd P/2

CE 325
Contd ... Q. No. 3

Design a typical interior panel using ACI direct design method Show the reinforcements in a neat sketch with spacing and a cross section of the panel. Use any method for your calculation.

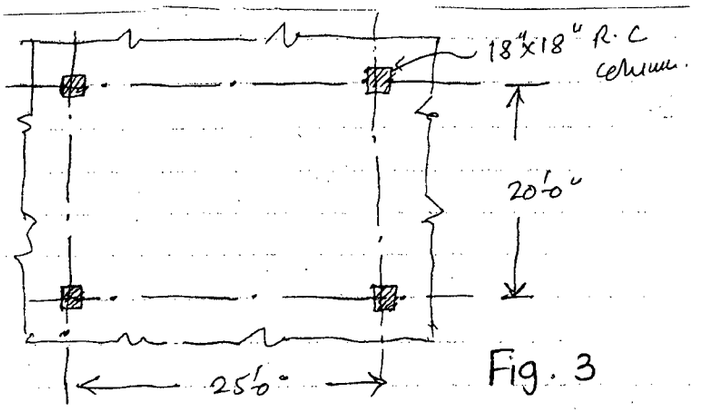


Fig. 3

4. (a) When do you prefer pile foundation? Describe briefly a method used to calculate the bearing capacity of individual bored pile in a sandy soil. **(10)**

(b) A pile cap is to be designed to distribute a concentric load from a single column (20" square column, reinforced with 16 # 8 bass) to a nine-pile group, with geometry as shown in Fig. 4. The column transfer 400^k of dead load and 320^k of live load to the pile cap. The permissible load per pile is 80 kips. Find the required effective depth and total depth of the pile cap and the reinforcement. Use any method for your calculation. **(25)**

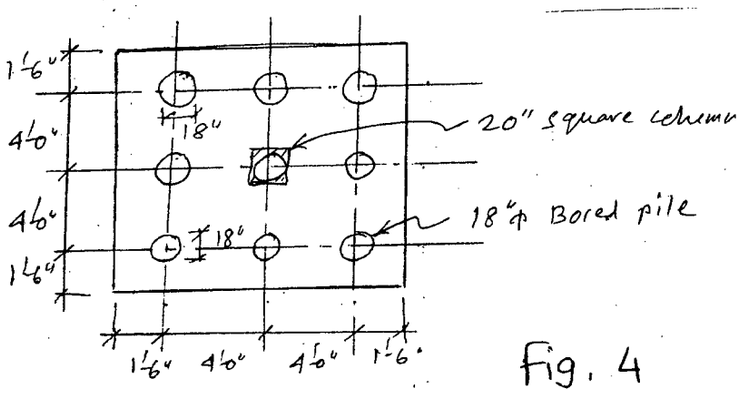


Fig. 4

SECTION – B

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

5. (a) Why ties and spirals are provided in RC columns? State the requirements of ties and spirals according to ACI/BNBC code. **(10)**

(b) Design a square tied column as well as a circular spiral column with reasonable reinforcements to support dead load, P_{DL} = 200 kips and live load, P_{LL} = 100 kips Use f'_c = 4 ksi, f_y = 60 ksi and the same amount of reinforcement for both the columns. If the length of the column is 14 ft, which column you will prefer in design and why? **(19+6)**

6. (a) Write down the ACI/BNBC code detailing requirements for beams and columns in regions of moderate seismic risk. **(10)**

Contd P/3

CE 325

Contd ... Q. No. 6

(b) For the column section shown in Figure 5, draw the strength interaction diagram with five points corresponding to balanced failure, pure axial load, pure bending, tension failure, and compression failure. **(25)**

7. (a) A 16" × 16" square RC column is reinforced with 8 # 11 bars as shown in Figure 6. Check the adequacy of the column section if a factored axial load of 600 kips is applied with eccentricities e_x = 3" and c_y = 4". Given: f'_c = 4 ksi, f_y = 60 ksi and use the reciprocal load method. **(17)**

   (b) A five-storied reinforced concrete shear wall is subjected to factored lateral loads as shown in Figure 7. The wall is 12 ft long and 10 inch thick. Design reinforcements and show on neat sketches for the wall at the first level between the base and first floor. Given: f'_c = 4 ksi, f_y = 60 ksi. **(18)**

8. (a) Describe briefly with neat sketches the different types of footings that may be used to support building columns or walls. **(10)**

   (b) Design a single footing to support a 22" × 20" tied interior column reinforced with 12 # 9 bars. The column carries an unfactored axial dead load of 300 kips and an axial live load of 250 kips. The base of the footing is 8 ft below the final grade and allowable soil pressure is 5 ksf. Use : f'_c = 4 ksi, f_y = 60 ksi. **(25)**

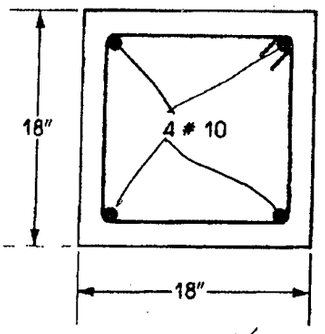


Figure 15

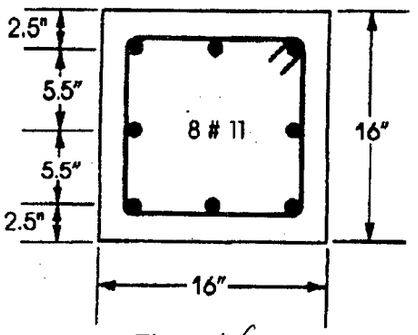


Figure 16

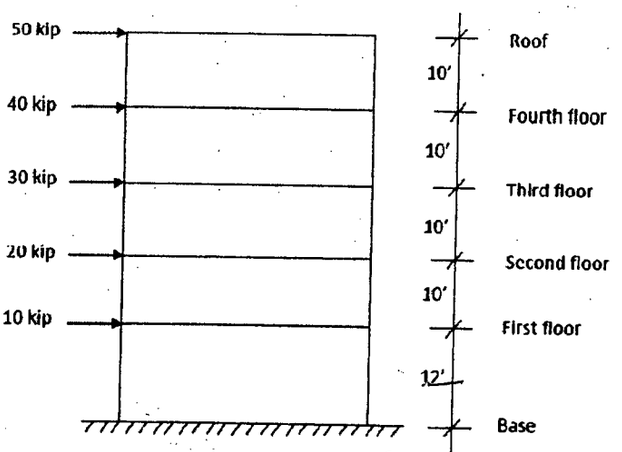
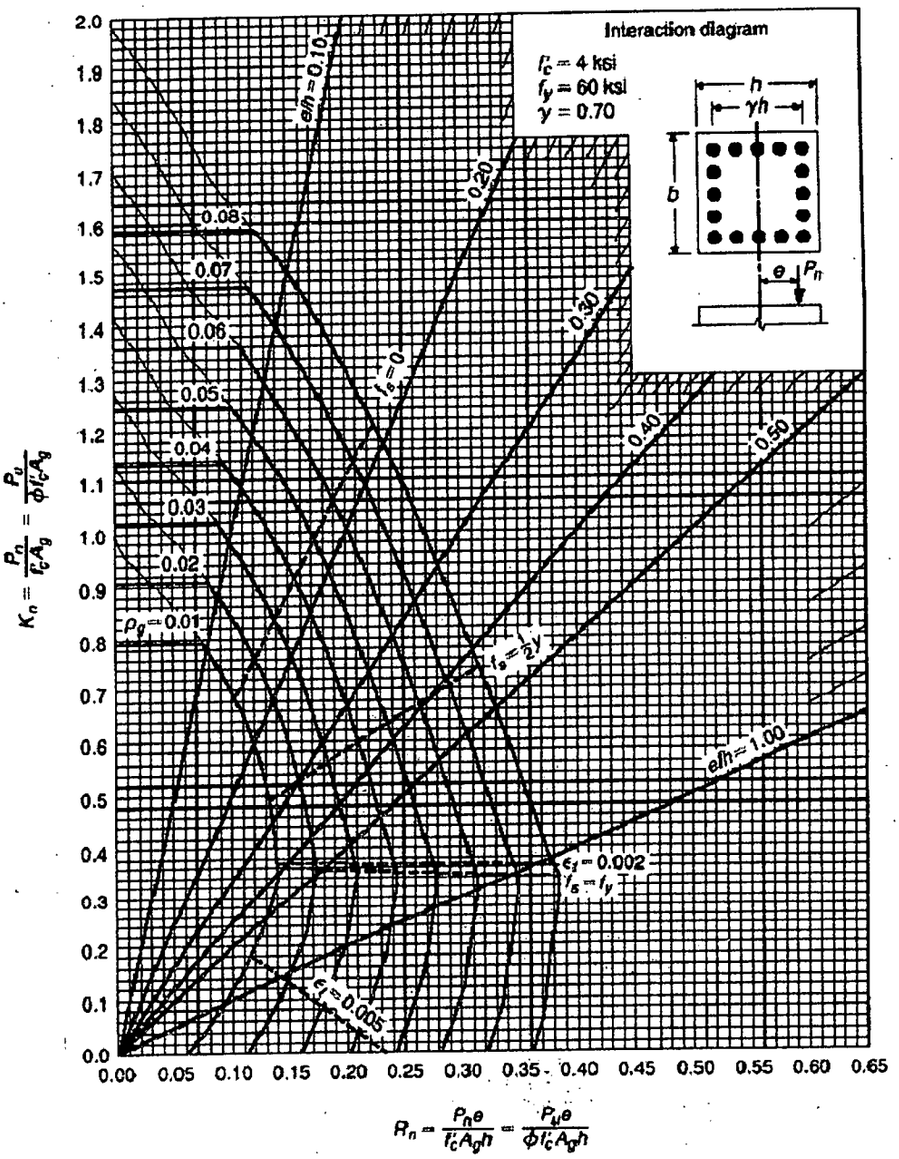


Figure 17

$$\frac{A_{vv}}{S_1} \geq \left[0.0025 + 0.5\left(2.5 - \frac{h_w}{l_w}\right)\left(\frac{A_{vh}}{S_2 h} - 0.0025\right)\right] h$$

$$M_u = \phi\left[0.5 A_{st} f_y l_w \left(1 - \frac{z}{l_w}\right)\right]$$

$$\frac{z}{l_w} = \frac{1}{2 + 0.85\beta_1 l_w \dfrac{h f_c'}{A_{st} f_y}}$$



GRAPH A.6
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.70$ (for instructional use only).

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P-5

L-3/T-2/WRE **Date : 06/01/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B.Sc. Engineering Examinations 2012-2013

Sub : **WRE 303** (Hydrology)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values in needed. Symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) What is unit hydrograph? List the assumptions involved in the unit hydrograph theory. **(5)**

(b) Given below are the ordinates of 4-hour unit hydrograph. Derive a 3-hour unit hydrograph from it using the S-curve method. **(15)**

Time (hrs)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
UH ordinates (m^3/sec)	0	20	36	60	80	112	120	105	73	40	24	14	9	7	5	3	2	0

(c) Two catchments A and B are considered meteorologically similar. Their catchment characteristics are given below: **(15)**

Catchment	A	B
Basin length	50 km	80 km
Length of watercourse from outlet to the point opposite to centroid of the basin	30 km	60 km
Basin area	5000 km^2	1000 km^2

For catchment A, a 2-hour unit hydrograph was developed and was found to have a peak discharge of 80 m^3/s. The time to peak from beginning of rainfall in A is 13 hours. Using Snyder's method, develop a unit hydrograph for catchment B and show its elements in a neat sketch.

2. (a) The following data represent the ordinates of 1-hr unit hydrograph. **(15)**

Time (hrs)	0	1	2	3	4	5	6	7	8	9	10	11	12	13
UH ordinates (m^3/sec)	0	58	110	96	53	26	14	8	5	4	3	1.5	1	0

Compute the flood hydrograph resulting from the storm given below:

Time	1st hr	2nd hr	3rd hr
Rainfall depth (cm)	4	3	2.5

The storm loss rate (ϕ index) for the catchment is estimated as 2 cm/hr. Assume a base flow of 2 m^3/s.

(b) Following are the ordinates of a 3 hour storm hydrograph of a river draining a catchment area of 190.8 km^2. Derive the ordinates of a (i) 3-hr unit hydrograph and (ii) 6-hr unit hydrograph for this catchment. Use a constant value 15 m^3/s for separating base flow. **(16)**

Time (h)	0	3	6	9	12	14	18	21	24
Flow (cumecs)	15	20	55	80	60	48	32	20	15

(c) What are the limitations to be considered during the use of unit hydrograph? **(4)**

Contd P/2

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3. (a) Distinguish between (i) prism storage and wedge storage (ii) reservoir routing and channel routing. **(5)**

(b) In a river, the following inflow hydrograph was recorded. Route the hydrograph in the reach by the Muskingum method when k = 10 hours, X = 0.25, initial outflow = 10 m^3/s. Also find the attenuation of the peak flow and lag of peak time. **(15)**

Time (hrs)	0	6	12	18	24	30	36	42	48	54	60	66
Inflow (m^3/s)	10	25	50	75	80	74	65	50	40	30	20	10

(c) A 100 ha watershed has the following characteristics **(15)**

(i) Maximum length of travel of water in the catchment = 3500 m.

(ii) Difference in elevation between the most remote point on the catchment and the outlet = 65 m.

(ii) Land use/cover details:

Land use/cover	Area (ha)	Runoff coefficient
Forest	30	0.25
Pasture	10	0.16
Cultivated land	60	0.40

The maximum intensity-duration-frequency relationship for the watershed is given by

$$i = \frac{3.97T^{0.165}}{(D+0.15)^{0.733}}$$

Where i = intensity in cm/hr, T = return period in years and D = duration of rainfall in hours. Estimate the 25-yr peak runoff from the watershed that can be expected at the outlet of the watershed.

4. (a) Following are the cumulative rainfall during a storm event. Determine the cumulative abstractions and excess rainfall hyetograph. Given, curve number value was 80 and the antecedent moisture condition was type II. **(10)**

Time (hr)	0	1	2	3	4	5	6	7
Cumulative rainfall (in)	0	0.2	0.9	1.27	2.31	4.65	5.29	5.36

(b) Write a short note on the characteristics of the flow duration curve. **(5)**

(c) For a reservoir with constant gate openings for the sluices and spillway, pool elevation vs storage and discharge (outflow) relationships are given below: **(20)**

Elevation (m)	Storage (10^6 m^3)	Outflow (m^3/s)
106	32	100
108	40	110
110	49.1	124
112	58.3	138
113	63	310
114	68.3	550
115	73.5	800
116	78.8	1030

Contd P/3

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Contd ... Q. No. 4(c)

When the pool elevation is 110 m then following hydrograph entered the reservoir. Route the flood to obtain (i) the outflow hydrograph and (ii) the reservoir elevation vs time curve during the passage of the flood wave.

Time (hr)	0	6	12	18	24	30	36	42
Inflow (cumec)	50	70	160	300	460	540	510	440
Time (hr)	48	54	60	66	72	78	84	90
Inflow (cumec)	330	250	190	150	120	90	80	70

SECTION – B

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

5. (a) Describe with a schematic diagram the general atmospheric circulation. **(5)**

(b) Explain how actual vapor pressure is related to saturation vapor pressure at dew point temperature with appropriate example. **(5)**

(c) At a climate station, the saturation vapor pressure and the relative humidity are found 2300 Pa and 75% respectively. Assuming standard air pressure, calculate air temperature, Dew point temperature, actual vapor pressure at air temperature, specific humidity, gas constant for moist air and density of moist air. **(15)**

(d) What do you mean by (i) Coriolis force (ii) Hadley circulation (iii) Specific humidity (iv) Orographic precipitation (v) Residence time. **(10)**

6. (a) What is hyetograph? For a drainage basin, isohyets drawn for a storm gave the following data:

Isohyetals (interval) (cm)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (km^2)	92	128	120	175	85

Estimating the average volume of precipitation over the drainage basin. **(9)**

(b) Write the essential conditions for formation of precipitation. Show in a schematic diagram the cycle of formation of raindrops in the atmosphere. **(2+4)**

(c) Test the consistency of the 22 years of data of the annual precipitation measured at station A. Rainfall data for station A as well as the average annual rainfall measured at a group of eight neighboring stations located in a meteorologically homogenous region are given as follows:

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Contd ... Q. No. 6(c)

Year	Annual Rainfall of Station A (mm)	Average Annual Rainfall of 8 Station groups (mm)	Year	Annual Rainfall of Station A (mm)	Average Annual Rainfall of 8 Station groups (mm)
1946	177	143	1957	158	164
1947	144	132	1958	145	155
1948	178	146	1959	132	143
1949	162	147	1960	95	115
1950	194	161	1961	148	135
1951	168	155	1962	142	163
1952	196	152	1963	140	135
1953	144	117	1964	130	143
1954	160	128	1965	137	130
1955	196	193	1966	130	146
1956	141	156	1967	163	161

Correct the record if there is any discrepancy. Estimate the mean annual precipitation at station A. **(20)**

7. (a) Briefly describe with a neat diagram the distribution of soil moisture in the infiltration process. **(5)**

(b) What do you mean by infiltration capacity? An isolated An isolated storm in a catchment produce a runoff 3.5 cm. the mass curve of average rainfall depth over the catchment was as below: **(1+8)**

Time from beginning of the storm (h)	1	2	3	4	5	6
Accumulated average rainfall (cm)	0.5	1.65	3.55	5.65	6.80	7.75

Calculate the Φ- index for the storm.

(c)What do you mean by (i) Potential evapotranspiration (ii) Field capacity. **(2+2)**

(d) Calculate total potential evapotranspiration from the water surface of a lake (28°N latitude) for the month of December by penman method. The data and equation are given: **(17)**

Mean temperature = 25°C, mean relative humidity = 65%,

mean observed sunshine hours = 9 h, wind speed at 2 m height = 3.55 km/hr,

Slope of the saturation vapour pressure – temperature curve at 25°C = 1.4 mm of H_g per °C,

extraterrestrial radiation = 11 mm of water per day, maximum possible sunshine hours = 10.8 hr.

$$H_b = 2.01\times10^{-9}(T_{avg})^4[0.56-0.092\sqrt{e_a}](0.1+0.9\ n/N)$$

8. (a) Write the advantage of (i) Bubble gauge stage recorder (ii) Ultrasonic method (iii) Dilution method. **(6)**

Contd P/5

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Contd ... Q. No. 8

(b) State the guidelines to select the number of segments in Area-velocity method. The depth and width of a stream is 30 m and 10 m respectively. The co-efficient of roughness of the stream bed is 35. Calculate the mixing length of the stream. **(3+4)**

(c) Why loop rating curve occurs in unsteady flow? Explain the Running's Method for estimation of stage for zero discharge. **(3+4)**

(d) What do you mean by risk and safety factor? The mean and standard deviation of 60 years of annual peak flows of Brahmaputra River at Bahadurabad are 67,975 m^3/s and 12,917 m^3/s respectively. Estimate peak flows for return periods of 50 and 100 years using Gumbel's distribution. Also determine the 95% confidence Intervals for these estimated values. The value of confidence probability function for 95% confidence level is 1.96. **(3+12)**

TABLE 7.3 REDUCED MEAN $\bar{y}_n$ IN GUMBEL'S EXTREME VALUE DISTRIBUTI

N = sample size

N	0	1	2	3	4	5	6	7	8	9
10	0.4952	0.4996	0.5035	0.5070	0.5100	0.5128	0.5157	0.5181	0.5202	0.5220
20	0.5236	0.5252	0.5268	0.5283	0.5296	0.5309	0.5320	0.5332	0.5343	0.5353
30	0.5362	0.5371	0.5380	0.5388	0.5396	0.5402	0.5410	0.5418	0.5424	0.5430
40	0.5436	0.5442	0.5448	0.5453	0.5458	0.5463	0.5468	0.5473	0.5477	0.5481
50	0.5485	0.5489	0.5493	0.5497	0.5501	0.5504	0.5508	0.5511	0.5515	0.5518
60	0.5521	0.5524	0.5527	0.5530	0.5533	0.5535	0.5538	0.5540	0.5543	0.5545
70	0.5548	0.5550	0.5552	0.5555	0.5557	0.5559	0.5561	0.5563	0.5565	0.5567
80	0.5569	0.5570	0.5572	0.5574	0.5576	0.5578	0.5580	0.5581	0.5583	0.5585
90	0.5586	0.5587	0.5589	0.5591	0.5592	0.5593	0.5595	0.5596	0.5598	0.5599
100	0.5600									

TABLE 7.4 REDUCED STANDARD DEVIATION s_n IN GUMBEL'S EXTREME VALUE DISTRIBUTION

N = sample size

N	0	1	2	3	4	5	6	7	8	9
10	0.9496	0.9676	0.9833	0.9971	1.0095	1.0206	1.0316	1.0411	1.0493	1.0565
20	1.0628	1.0696	1.0754	1.0811	1.0864	1.0915	1.0961	1.1004	1.1047	1.1086
30	1.1124	1.1159	1.1193	1.1226	1.1255	1.1285	1.1313	1.1339	1.1363	1.1388
40	1.1413	1.1436	1.1458	1.1480	1.1499	1.1519	1.1538	1.1557	1.1574	1.1590
50	1.1607	1.1623	1.1638	1.1658	1.1667	1.1681	1.1696	1.1708	1.1721	1.1734
60	1.1747	1.1759	1.1770	1.1782	1.1793	1.1803	1.1814	1.1824	1.1834	1.1844
70	1.1854	1.1863	1.1873	1.1881	1.1890	1.1898	1.1906	1.1915	1.1923	1.1930
80	1.1938	1.1945	1.1953	1.1959	1.1967	1.1973	1.1980	1.1987	1.1994	1.2001
90	1.2007	1.2013	1.2020	1.2026	1.2032	1.2038	1.2044	1.2049	1.2055	1.2060
100	1.2065									

L-3/T-2/WRE Date : 11/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 371**(Environmental Engineering)

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) Discuss briefly the role of micro organism in sewage treatment. **(25)**

   (b) State the merits and demerits of aerobic and anaerobic process of sewage treatment. **(11⅔)**

   (c) Define BOD and COD. Draw qualitative BOD curves for different temperatures. **(10)**

2. (a) Draw the flow diagrams of the following treatment processes. **(12)**

   (i) Waste stabilization pond

   (ii) Activated sludge process

   (iii) Aerated Lagoon

   (iv) Single stage Trickling Filter.

   (b) What are the purposes of using skiming task and cutting screen in sewage treatment plant? **(8⅔)**

   (c) Write down the chemical reactions involved in (i) Catabolism (ii) Anabolism and (iii) Autolysis. **(9)**

   (d) Determine the No. of maturation pond for the following data **(17)**

   $N_i = 4 \times 10^7/100$ ml; $N_e = 1000/100$ ml; T = 20°C

   detention time of anaerobic pond = 5d;

   detention time of facultative pond = 20d.

3. (a) What are the basic elements of a VIP Latrine technology? How can the main disadvantage of a simple pit latrine be improved in a VIP Latrine system. **(15)**

   (b) Discuss briefly the various important processed that take place in a septic tank. Briefly describe the design procedure of a septic tank. **(15⅔)**

   (c) Design a Low-cost pit Latrine for a family of six persons. The ground water table is 5 m below ground level. The pit is required for a period of five years. The family uses water for anal cleansing. **(16)**

Contd P/2

CE 371

4. (a) Define the functional elements of solid waste management. Discuss briefly the solid waste disposal system of Dhaka city. **(20)**

(b) Discuss briefly Autotrophic and Heterotrophic organisms. Which type of organisms (among these two) are important for sewage treatment and why? **(10)**

(c) Design an aerated lagoon (size only) from the following data Q = 1000 m^3/d, T = 20°C, K = $5d^{-1}$ (Assumed reasonable data if required) **(16⅔)**

SECTION – B

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

5. (a) Discuss how man and environment interact with each other. What is the role of Environmental Engineering in this aspect? As a Water Resource Engineer, how can you relate environmental engineering in your professional field? Explain. **(16)**

(b) How does 'Water rates and metering' affect per capita water consumption? Describe briefly 'Fire demand is a function of population with minimum limit' - Explain this. What factors should be considered in estimating water requirements for industrial use? **(12)**

(c) The population data for a town is given below. Find the population in year 2033 by (i) Arithmetic Progression method and (ii) Geometric Progression method. **(18⅔)**

Year	1983	1993	2003	2013
Population	84,000	1,15,000	2,05,000	2,50,000

What are the limitations of these two methods?

6. (a) Name the different sources of water and show how they are interrelated. Do your think Bottled water is a source of water supply? Justify your answer.

Deduce the mathematical expression for the yield of an unconfined aquifer. **(18)**

(b) A sedimentation basin has the following dimensions: **(18⅔)**

20 m Length × 6 m Width × 3 m height. Flow rate is 0.6 m^3/sec. Will particles that have a settling velocity of 0.004 m/sec be completely removed? If not, what % of the particles would be removed? What should be the dimension of the basin to remove 100% particles with a settling velocity of 0.004 m/sec?

(c) Define the terms 'Coagulation' and 'Flocculation'. What happens when coagulants is added to raw water? Explain. How is microorganism removed in Slow Sand Filter? Explain.

Compare the cleaning operation between Slow sand filter and Rapid sand filter. What factors should you consider in selecting a good chemical disinfectant? **(10)**

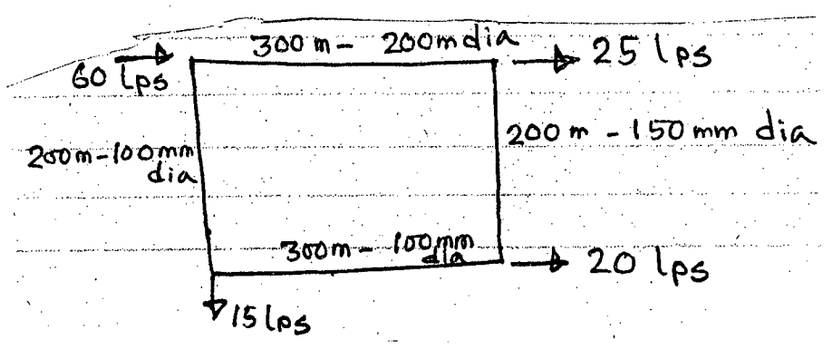
Contd P/3

CE 371

7. (a) How does fluctuations in the rate of water consumption effect the design of water works system such as reservoir, pipeline, pumps etc? Explain with diagram. **(12)**

(b) What are the objectives of Water Distribution System? Why is it called a collective system? What are the methods available for distributing water to the consumers? Which one do you think is preferable and why? **(18)**

(c) Calculate the flow in the following pipe network for the inflow and outflow shown in the figure. (Nomograph for Head loss determination is attached) **(16⅔)**



8. (a) 'Environmental Management is not only the management of environment but rather the management of humans' interaction with and impact upon the environment' – Explain this statement with examples. **(10)**

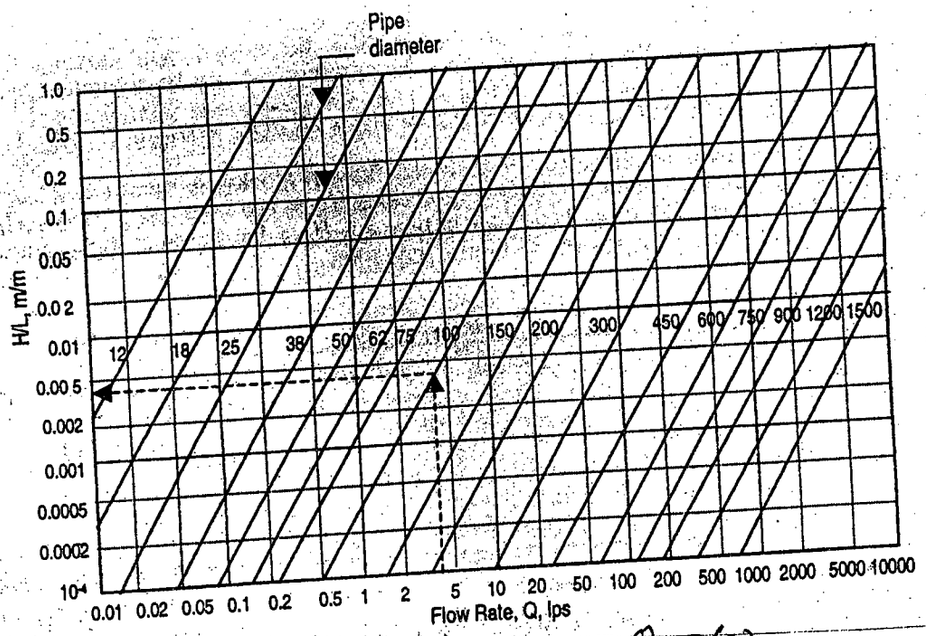
(b) Define the following terms:

(i) IEE (ii) EIS and (iii) EQS

What is the role of EQS in Environmental Management? Describe.

Describe the importance of conducting EIA in Bangladesh context. **(18)**

(c) An irrigation project is proposed to be launched in a village to produce High Yielding Variety (HYV) crops. The ground water and agrochemicals will be extensively used in this project to make it a bumper production. Identify the possible impacts due to this project and state how you can mitigate and enhance those impacts. **(18⅔)**



Nomograph for Q.3(c).

L-3/T-2/WRE Date : 16/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 481** (Foundation Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data, if any.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Give Terzaghis general expression for ultimate bearing capacity of a continuous footing resting on cohesion less soil. Also give the meaning of each term. **(10)**

   (b) Describe the factors affecting bearing capacity of shallow foundations resting on sand and clay. **(10)**

   (c) If the footing shown in Fig 1 is not to settle more than 0.75 in, what is the maximum load it can carry? The N-values have been corrected for over burden pressure. **(15)**

2. (a) Derive the ultimate bearing capacity equation of a strip footing with width 'B', resting on clay. Assume the failure occurs by rotation of footing along a circular slip surface. Given 'Z' is the depth of foundation. **(10)**

   (b) Define and distinguish between safe bearing capacity and allowable bearing pressure. **(5)**

   (c) 'It is reasonable to permit larger allowable soil pressure for raft foundations', explain. **(5)**

   (d) A footing 9 feet square rests at a depth of 4′–6″ on clay that has an unconfined compressive strength of 1.5 ton/sq.ft. If the factor of safety is not to be less than 2.0, what is the maximum column load that can be supported by the footing. Assume water table is at the ground level and unit weight of clay is 130 lb/ft^3. (Use Fig. 2). **(15)**

3. (a) Describe α, β and γ methods for calculating skin resistance of a pile resting in clayey soil. **(15)**

   (b) 'It is convenient to use net allowable bearing pressure instead of gross allowable pressure in the design of footing foundation', Explain. **(5)**

   (c) The skin and base resistance of a pile embedded in sand are estimated as 30 kip and 15 kip respectively. What is the uplift capacity of the pile? **(5)**

   (d) A driven pile resting in sand with embedment length of 10 m, has a diameter of 600 mm. The average SPT value is given as 20. Calculate the pile capacity. What will be its capacity if it would have been a cast-in-place bored pile? **(10)**

Contd P/2

CE 481

4. (a) Critically examine the ordinary Method of Slices/Fellcrious Method and Modified/Simplified Bishop's Method. **(10)**

(b) An embankment is inclined at an angle of 35° and its height is 15 m, the angle of shearing resistance is 15°, and the cohesion intercept is 200 kN/m^2. The unit weight of soil is 18 kN/m^3. If the Taylor's stability number is 0.06, find the factor of safety with respect to cohesion, What will be the factor of safety if the slope is submerged? **(10)**

(c) A cut is to be made in a soil having γ = 105 lb/ft^3, C = 600 psf and φ = 15°. The side of the cut slope will make an angle of 45° with the horizontal. What should be the depth of the cut slope for a factor of safety of 3.0. **(15)**

SECTION – B

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

5. (a) Explain typical steps in a grading operation during construction. **(15)**

(b) Explain different available borehole stabilization techniques. **(10)**

(c) A sampling tube has an outside diameter D_t = 3.5 inch, a tip diameter D_e = 3.35 inch, a wall thickness of 0.055 inch. If $D_w = D_t$, estimate the clearance ratios, area ratio and indicate if the sampling tube meets the criteria for undisturbed soil sampling. **(10)**

6. (a) Describe different types of fills, their characteristics, uses and possible problems. **(15)**

(b) Explain the general requirements for foundation engineering projects. **(5)**

(c) Write the factor that affect SPT. **(5)**

(d) SPT was performed on a near surface deposit of sand, where the number of blows is shown below. Assume E_m = 45%, the borehole diameter is 95 mm the drill rod length is 4.5 m and γ_s = 16 kN/m^3. Estimate the measured SPT-N value, N_{60} and $(N_1)_{60}$. Also indicate the density condition of the sand. **(10)**

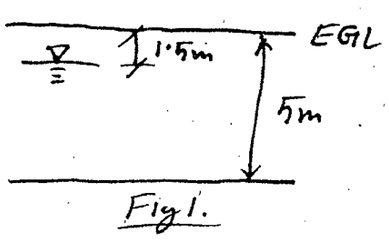


Fig 1.

Depth (m)	SPT-N
1·0	1
2·0	2
3·0	2
4·0	4
5·0	6

7. (a) Explain the factors which affect compaction. **(10)**

(b) Explain Auger boring and Wash boring with neat sketches. **(10)**

(c) Explain special features of cone penetration test with neat sketches. **(15)**

CE 481

8. (a) Write short notes on: **(20)**

(i) Group efficiency of pile

(ii) Negative skin friction

(b) The size of a pile cap is 18'x14' where total load is 650 kip. The length of the pile is 35 ft. For the following soil condition estimate the total pile settlement. **(15)**

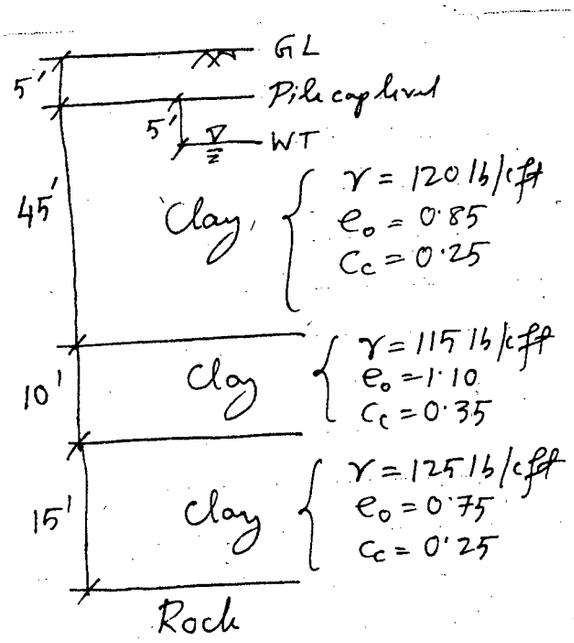
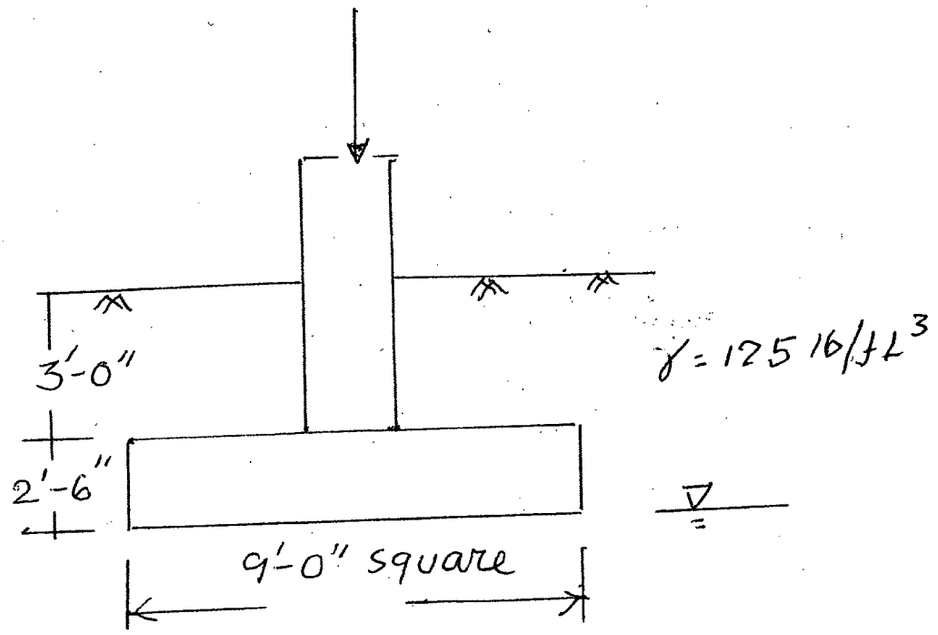
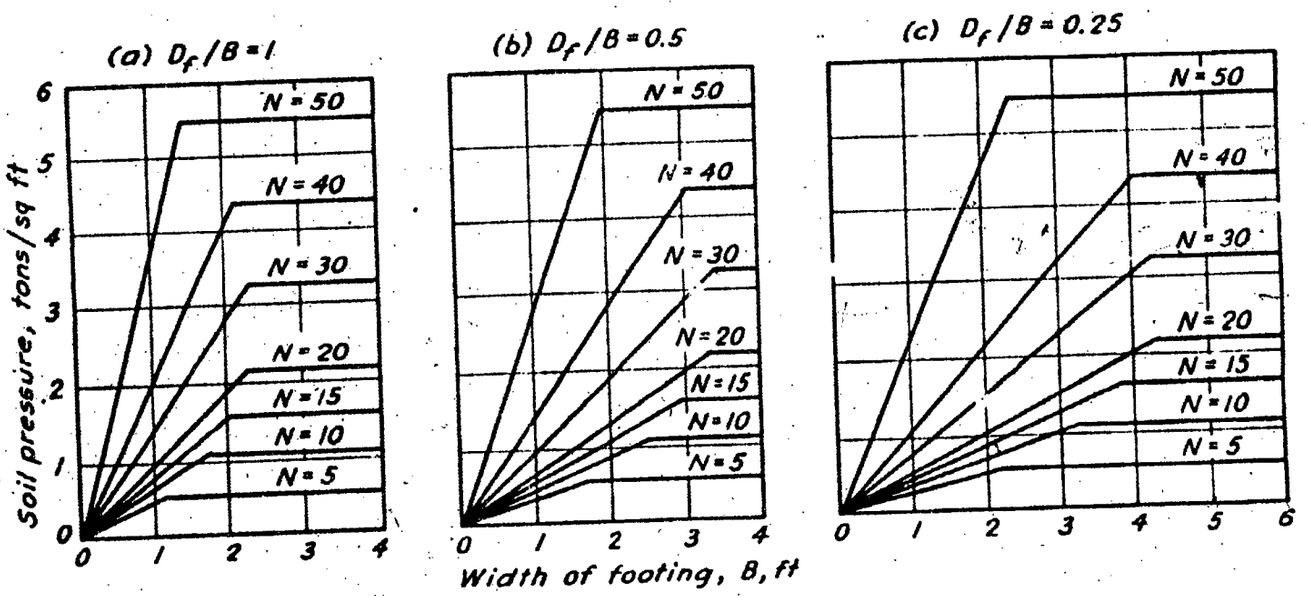


Fig 2.



(a)

Footings on Sand



Design chart for proportioning shallow footings on sand.

(b)

Fig. 1

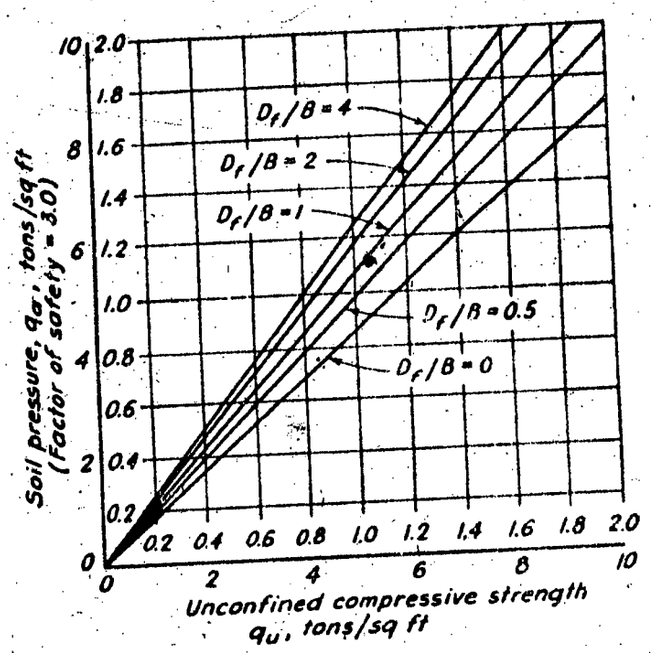


FIGURE 2. Net allowable soil pressure for footings on clay and plastic silt, determined for a factor of safety of 3 against bearing capacity failure ($\phi = 0$ conditions). Chart values are for continuous footings ($B/L = 0$); for rectangular footings, multiply values by $1 + 0.2\ B/L$; for square and circular footings, multiply values by 1.2.