L-3/T-2/WRE **Date : 06/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2017-2018

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

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) Show, with neat sketches, seismic detailing requirements for two-way slabs without beams in moderate seismic region as per ACI code. **(6)**

(b) How could you ensure ductility in RC members? **(5)**

(c) A reinforced concrete circular column as shown in Figure 2 (gross diameter = 25 inch) of a building is subjected to following axial loads & moments (unfactored). Determine the necessary main reinforcements for the column. Given: $f_c' = 4$ ksi, $f_y = 60$ ksi & interaction diagram is supplied at the end. **(12)**

(*unfactored)	Dead load	Live load
Axial force *	200 kip	255 kip
Moment*	165 kip-ft	215 kip-ft

(d) Compute frictional loss of the post-tensioned beam having three tendons (as shown in Figure 1) at location A-A and at anchor end. Given : jacking stress = 200 ksi, μ (friction co-efficient) = 0.15 and k (Wobble co-efficient) = 0.0001. **(12)**

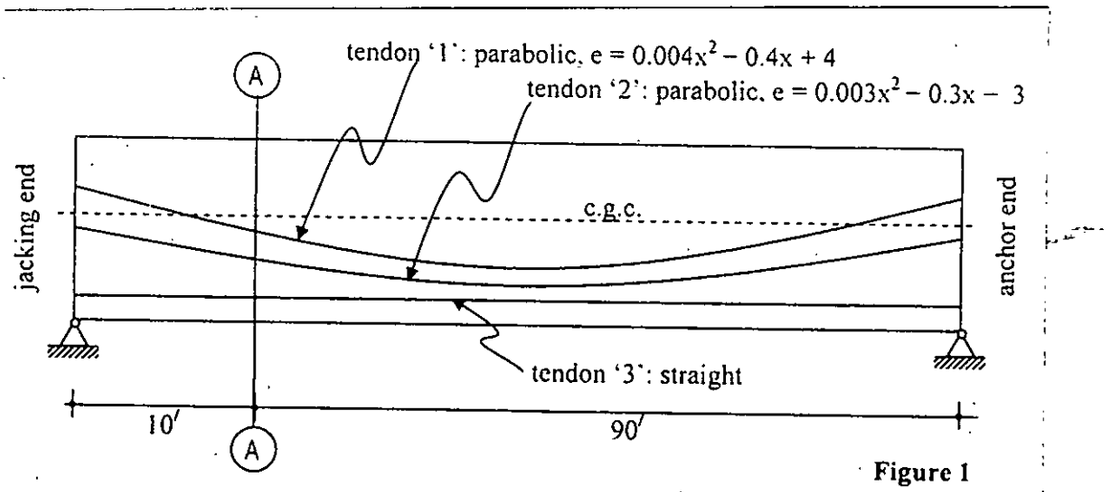

Figure 1

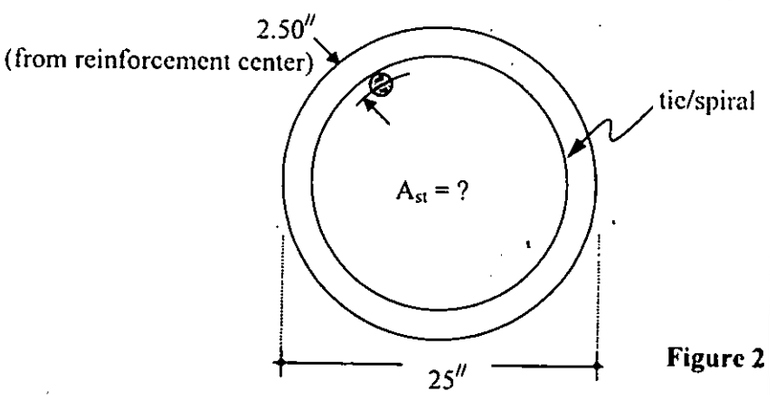

Figure 2

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2. (a) What are stages of loading needs to be considered in designing pe-stressed concrete members? **(4)**

(b) A reinforced concrete rectangular tied column (16 inch × 20 inch) of a building is reinforced with eight No. 8 and six No. 7 bars as shown in Figure 3. The column is subjected to following axial loads & bi-axial moments (unfactored). Check the adequacy of the column section using Bresler Reciprocal Load method. Given : $f_c' = 4$ ksi, $f_y = 60$ ksi & interaction diagram is supplied at the end. **(15)**

(*unfactored)	Dead load	Live load
Axial force *	130 kip	155 kip
Moment* about X-X axis	55 kip-ft	60 kip-ft
Moment* about Y-Y axis	85 kip-ft	105 kip-ft

(c) Compute elastic shortening loss of the pre-stressed concrete simple beam at location A-A as shown in Figure-4. **(16)**

(i) If the beam was a pre-tensioned one.

(ii) If the beam was a post-tensioned one and all tendons are tensioned simultaneously.

(iii) If the beam was a post-tensioned one and two tendons are tensioned at a time.

Given: initial pre-stress = 200 ksi, pre-stressing strand = 12 nos. 0.50 inch nominal diameter (270 grade 7-wire strand), $f_{ci}' = 4500$ psi, $E_{ps} = 28500$ ksi, beam cross-sectional area (A) = 1920 in^2, moment of inertia of beam section (I) = 1450000 $inch^4$, centroid to top ($\bar{y}_{top}$) = 26 inch & to bottom ($\bar{y}_{bottom}$) = 34 inch and eccentricity of tendon at end (over support) = 0 inch.

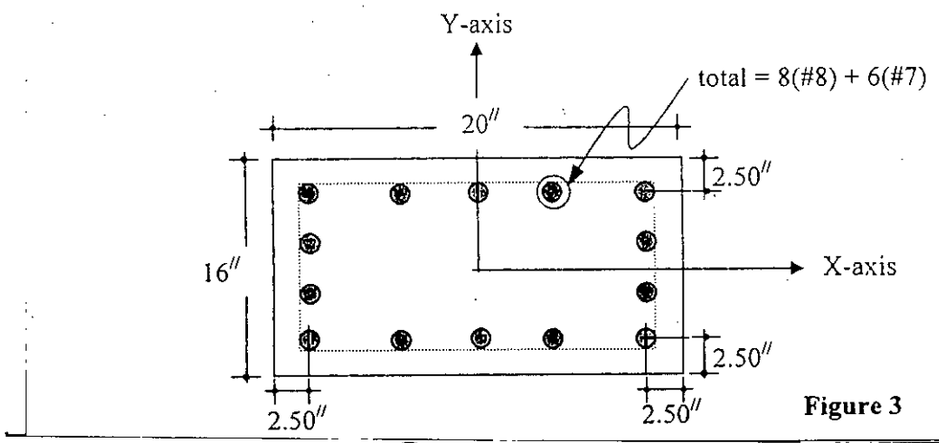

Figure 3

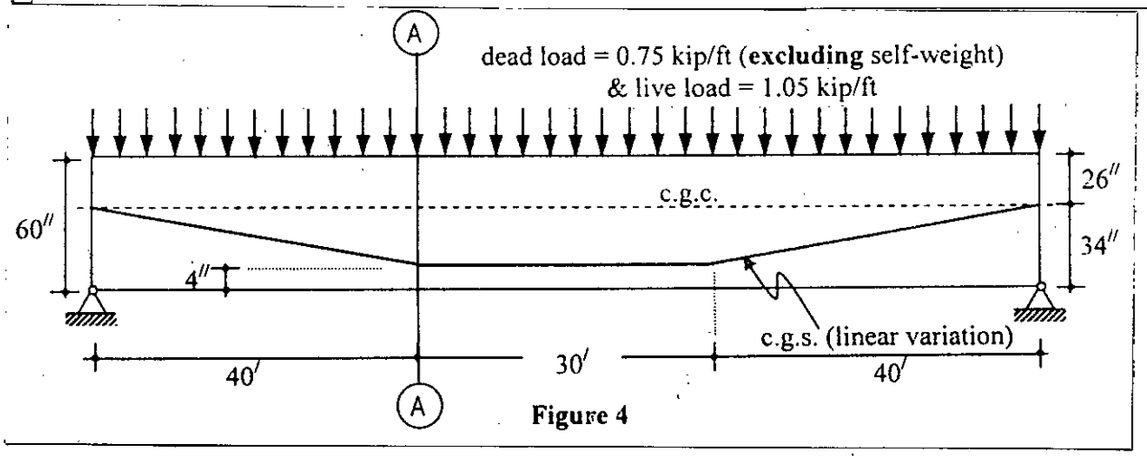

Figure 4

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3. (a) Why 'φ' factor is different in column & in beam? **(5)**

(b) A 15 × 20 inch column is reinforced with eight No. 9 bars as shown in Figure 5. Construct the nominal strength interaction diagram for the column with five points corresponding to pure axial load, pure bending, balance condition, $\varepsilon_s = 0.001$ (tensile) and $\varepsilon_s = 0.004$ (tensile). Also, find corresponding φ for the above points. Assume bending about major/strong axis. Given: $f_c' = 4$ ksi, $f_y = 60$ ksi and $E_s = 30000$ ksi. **(30)**

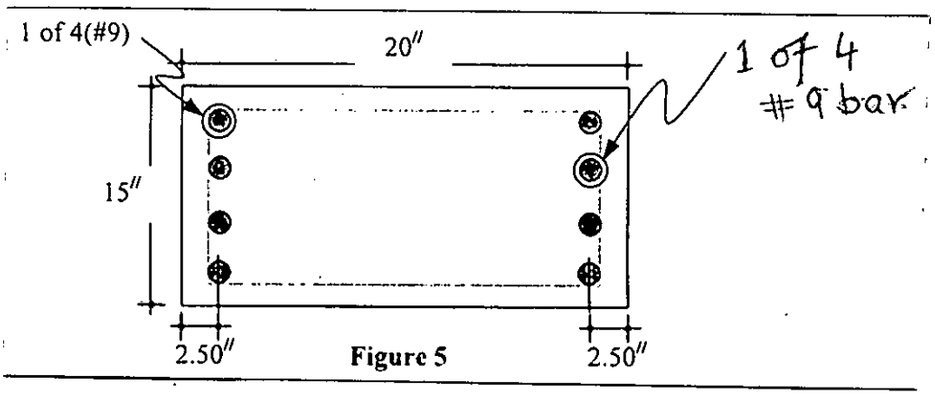


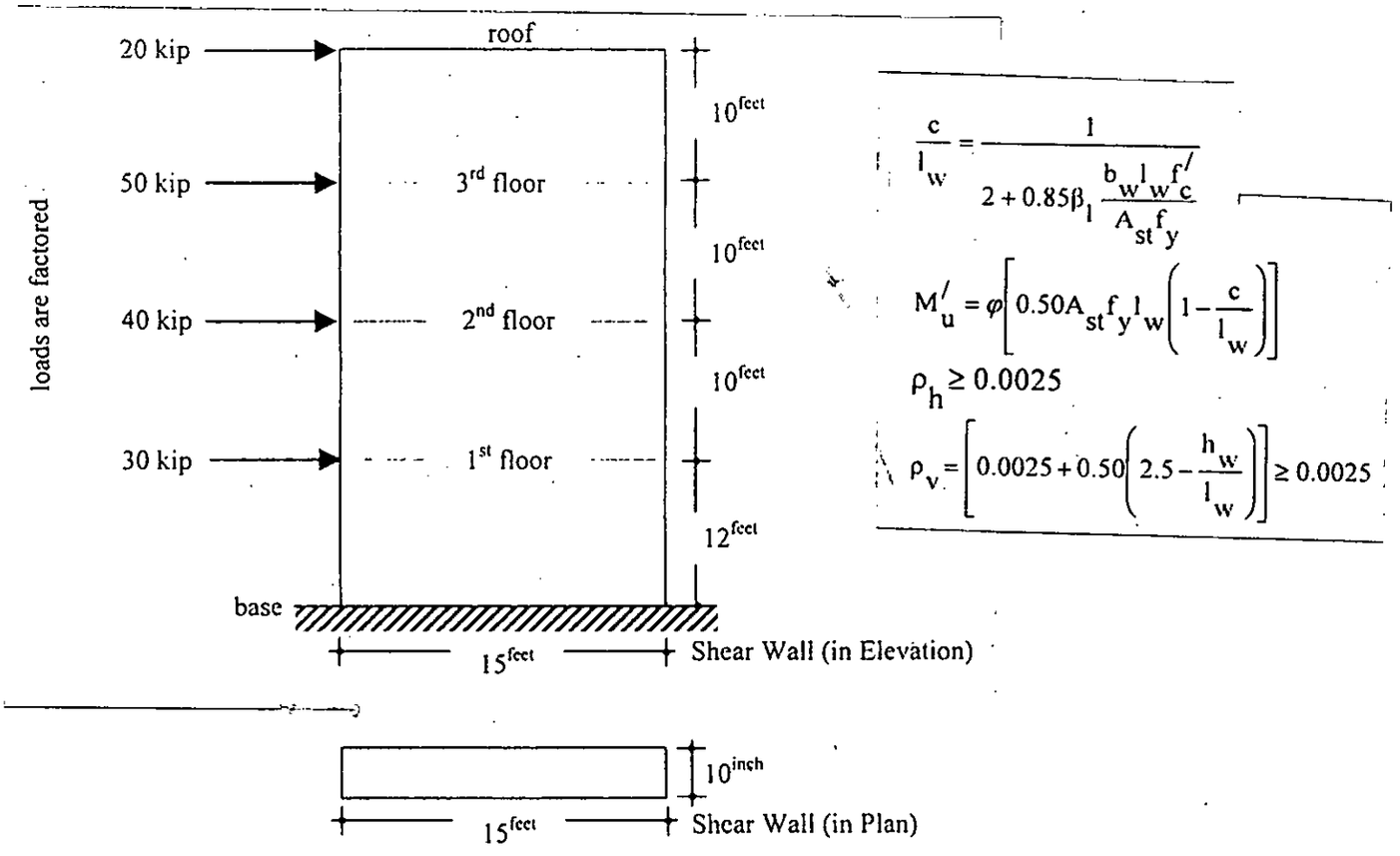
Figure 5

4. (a) A reinforced concrete shear wall (height = 42 feet, length = 15 feet, thickness = 10 inch) of a 4-storeid building are subjected to the factored lateral loads as shown in Figure 6. Design necessary reinforcements for the shear wall between the base and first floor. Show reinforcements both in plan and elevation. Given: $f_c' = 4$ ksi, $f_y = 60$ ksi. You need not to consider self-weight of the wall as it is less than the balanced axial load of the section. **(22)**

(b) Write down the ACI code provisions on slenderness ratio for slender columns. **(6)**

(c) Draw neat sketches of "shearhead" and "shear stud" type shear reinforcement as used in flat plate slab. **(4)**

(d) What are dimensional limits of beams and columns in SMRF? **(3)**



$$\frac{c}{l_w} = \frac{1}{2 + 0.85\beta_1 \frac{b_w l_w f_c'}{A_{st} f_y}}$$

$$M_u' = \varphi\left[0.50 A_{st} f_y l_w \left(1 - \frac{c}{l_w}\right)\right]$$

$$\rho_h \geq 0.0025$$

$$\rho_v = \left[0.0025 + 0.50\left(2.5 - \frac{h_w}{l_w}\right)\right] \geq 0.0025$$

Figure 6

Contd..... P/4

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SECTION – B

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

5. (a) Design a rectangular footing for an interior column of 12 in. × 18 in. in cross section, reinforced with eight no. 8 bars, that carries working dead load of 500 kip and live load of 350 kip. Allowable bearing capacity and unit weight of the soil is 5000 psf and 100 pcf, respectively. The bottom of the footing is 6 ft below the grade. Show the reinforcement in plan and section with neat sketch. Given: $f_c' = 4000$ psi, and $f_y = 60000$ psi. **(27)**

   (b) Show seismic detailing requirements of beams in IMRF. **(8)**

6. (a) An exterior and interior column, as shown in Figure 7 with assigned loads, are to be supported by a combined rectangular footing whose outer end cannot protrude beyond the outer facing of the exterior column. The bottom of the footing is 5ft below the grade in a soil having an allowable bearing capacity of 6000 psf. A surcharge of 120 psf is specified on the surface. Design the footing with detailing of reinforcement in section with neat sketch. Given , Given: $f_c' = 4000$ psi and $f_y = 60000$ psi. *(There is no need to design the transverse beam)* **(30)**

   (b) Describe the situations when combined footings are used. **(5)**

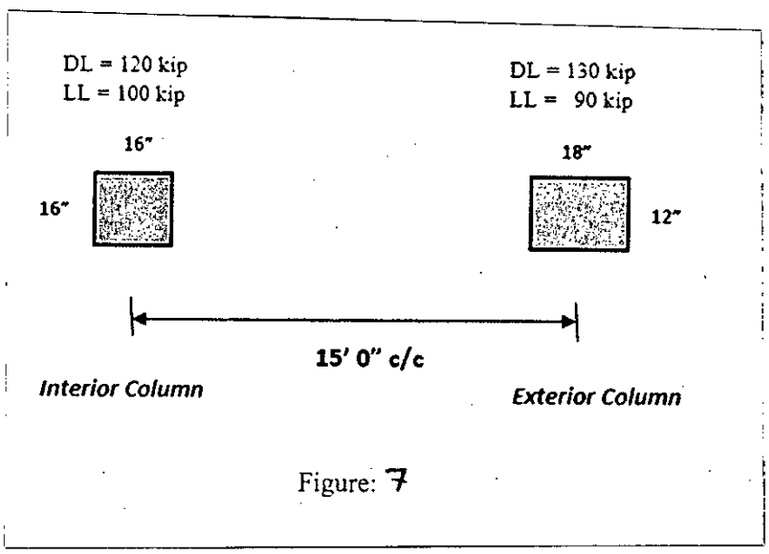

Figure: 7

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7. (a) The plan of a pile cap with 9 nos 24 in. diameter cast-in-situ piles with the column (25″ × 25″) is shown in Figure 8. The column carries a working dead load of 650 kip and live load of 500 kip. The individual pile capacity is adequate. Design the pile cap. Given: f_c' = 4000 psi and f_y = 60000 psi. **(27)**

   (b) Describe the modes of failure of a shear wall with neat sketches. **(8)**

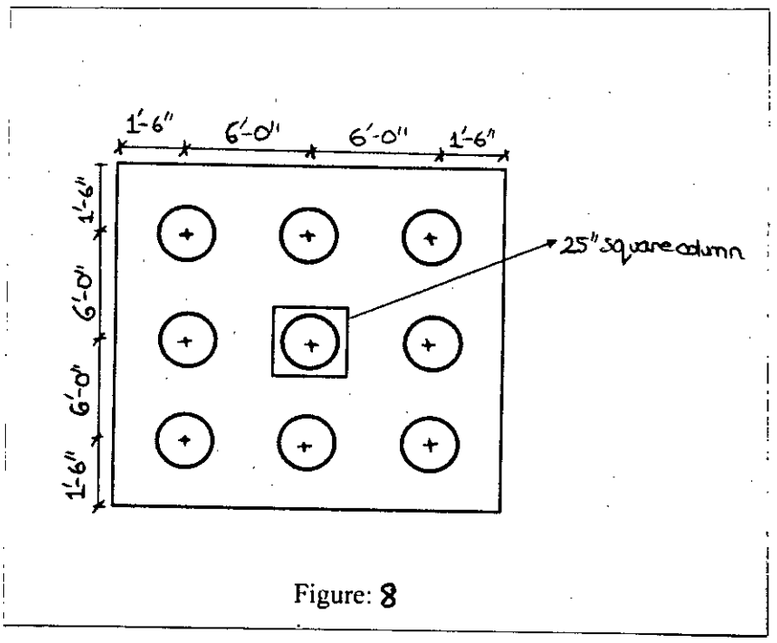

Figure: 8

8. (a) A residential building is to be designed using a flat plate floor system. The interior columns are 24″ × 24″ and they are spaced 22 ft c/c in one direction and 24 ft c/c in other direction. Design the interior panel (22′ × 24′) and show reinforcement in long direction only with neat sketch. Assume slab thickness of 8″. Specified live load = 40 psf. Floor finish and partition wall load = 60 psf in addition to the self weight of floor. Design the slab panel in the long direction. Given, f_c = 4000 psi and f_y = 60000 psi. **(30)**

   (b) Write down two basic differences between RCC and PCC. **(5)**

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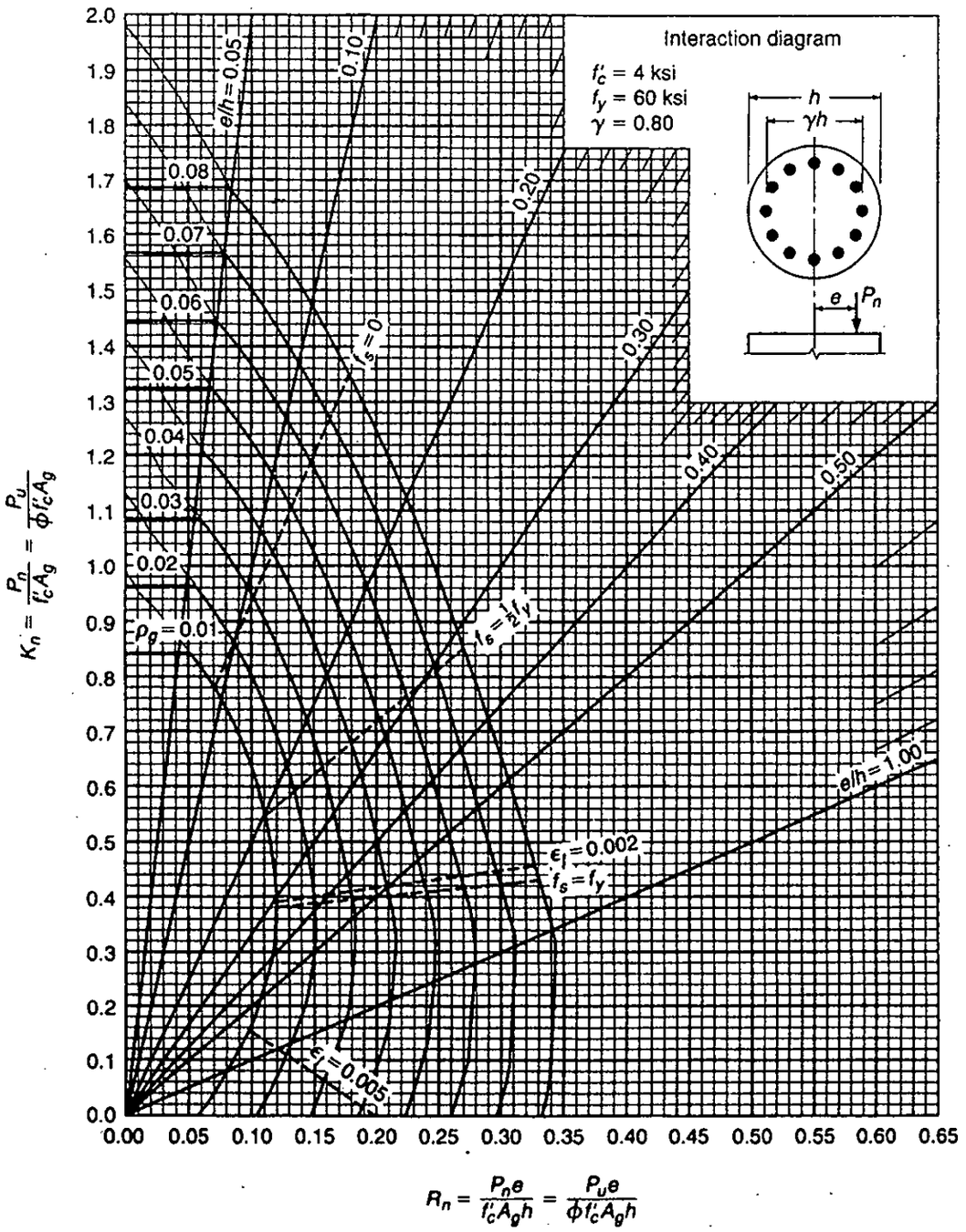

GRAPH A.15
Column strength interaction diagram for circular section with $\gamma = 0.80$.

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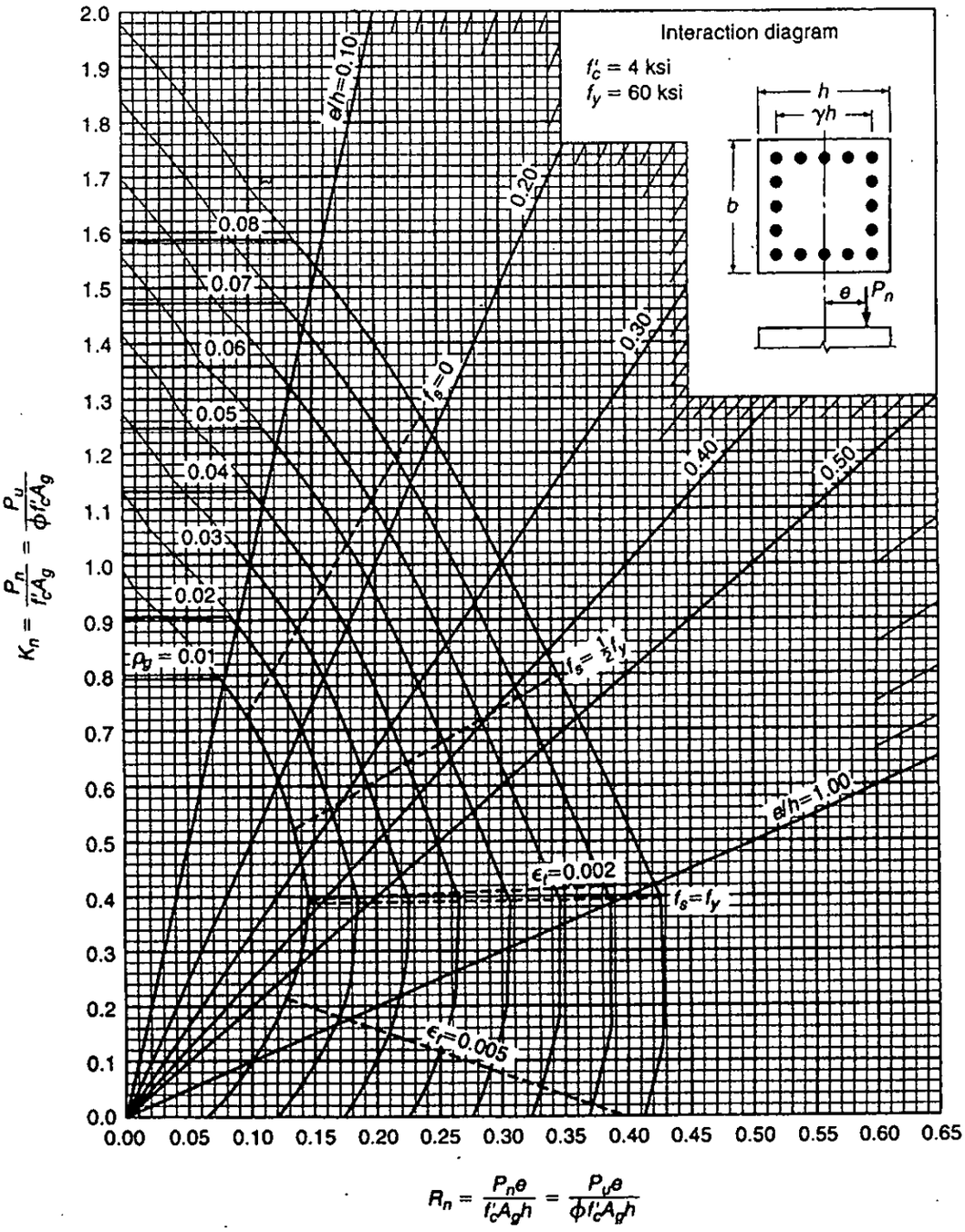

GRAPH A.7
Column strength interaction diagram for rectangular section with bars on four faces

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TABLE : $f_y = 60{,}000$ psi; $f_c = 4000$ psi—U.S. Customary Units

	ρ	$\frac{M_u}{\phi bd^2}$	ρ	$\frac{M_u}{\phi bd^2}$	ρ	$\frac{M_u}{\phi bd^2}$	ρ	$\frac{M_u}{\phi bd^2}$
ρ_{min} for temp. and shrinkage	0.0018	106.3	0.0059	335.5	0.0100	546.9	0.0141	740.4
	0.0019	112.1	0.0060	340.9	0.0101	551.8	0.0142	744.9
	0.0020	117.1	0.0061	346.2	0.0102	556.7	0.0143	749.4
	0.0021	123.7	0.0062	351.6	0.0103	561.7	0.0144	753.9
	0.0022	129.4	0.0063	356.9	0.0104	566.6	0.0145	758.3
	0.0023	135.2	0.0064	362.2	0.0105	571.5	0.0146	762.8
	0.0024	141.0	0.0065	367.6	0.0106	576.3	0.0147	767.2
	0.0025	146.7	0.0066	372.9	0.0107	581.2	0.0148	771.7
	0.0026	152.4	0.0067	378.2	0.0108	586.1	0.0149	776.1
	0.0027	158.1	0.0068	383.4	0.0109	590.9	0.0150	780.5
	0.0028	163.8	0.0069	388.7	0.0110	595.7	0.0151	784.9
	0.0029	169.5	0.0070	394.0	0.0111	600.6	0.0152	789.3
	0.0030	175.2	0.0071	399.2	0.0112	605.4	0.0153	793.7
	0.0031	180.9	0.0072	404.5	0.0113	610.2	0.0154	798.1
	0.0032	186.6	0.0073	409.7	0.0114	615.0	0.0155	802.4
ρ_{min} for flexure	0.0033	192.2	0.0074	414.9	0.0115	619.8	0.0156	806.8
	0.0034	197.9	0.0075	420.1	0.0116	624.5	0.0157	811.1
	0.0035	203.5	0.0076	425.3	0.0117	629.3	0.0158	815.4
	0.0036	209.1	0.0077	430.5	0.0118	634.1	0.0159	819.7
	0.0037	214.7	0.0078	435.7	0.0119	638.8	0.0160	824.1
	0.0038	220.3	0.0079	440.9	0.0120	643.5	0.0161	828.3
	0.0039	225.9	0.0080	446.0	0.0121	648.2	0.0162	832.6
	0.0040	231.5	0.0081	451.2	0.0122	653.0	0.0163	836.9
	0.0041	237.1	0.0082	456.3	0.0123	657.7	0.0164	841.2
	0.0042	242.6	0.0083	461.4	0.0124	662.3	0.0165	845.4
	0.0043	248.2	0.0084	466.5	0.0125	667.0	0.0166	849.7
	0.0044	253.7	0.0085	471.6	0.0126	671.7	0.0167	853.9
	0.0045	259.2	0.0086	476.7	0.0127	676.3	0.0168	858.1
	0.0046	264.8	0.0087	481.8	0.0128	681.0	0.0169	862.3
	0.0047	270.3	0.0088	486.9	0.0129	685.6	0.0170	866.5
	0.0048	275.8	0.0089	491.9	0.0130	690.3	0.0171	870.7
	0.0049	281.2	0.0090	497.0	0.0131	694.9	0.0172	874.9
	0.0050	286.7	0.0091	502.0	0.0132	699.5	0.0173	879.1
	0.0051	292.2	0.0092	507.1	0.0133	704.1	0.0174	883.2
	0.0052	297.6	0.0093	512.1	0.0134	708.6	0.0175	887.4
	0.0053	303.1	0.0094	517.1	0.0135	713.2	0.0176	891.5
	0.0054	308.5	0.0095	522.1	0.0136	717.8	0.0177	895.6
	0.0055	313.9	0.0096	527.1	0.0137	722.3	0.0178	899.7
	0.0056	319.3	0.0097	532.0	0.0138	726.9	0.0179	903.9
	0.0057	324.7	0.0098	537.0	0.0139	731.4	0.0180	907.9
	0.0058	330.1	0.0099	542.0	0.0140	735.9	0.0181	912.0

L-3/T-2/WRE Date : 10/04/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2017-2018

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**.

Assume reasonable values if any data is missing.

1. (a) Write short note on tropical cyclone. **(3)**

   (b) At a climatic station, air pressure is measured as 101 kPa, saturation vapor pressure 2500 Pa and relative humidity 70%. Calculate the corresponding (i) air temperature, (ii) actual vapor pressure, (iii) dew point temperature, (iv) Specific humidity and (v) air density. **(12)**

   (c) For the annual flood series given in the following table, estimate flood discharge for a return period of 100 years using log-pearson Type III distribution. Use Table 1 for necessary information. **(20)**

Year	Flood, χ (m^3/s)	Year	Flood, χ (m^3/s)
1951	2947	1961	4290
1952	3521	1962	4652
1953	2399	1963	5100
1954	4124	1964	6900
1955	3496	1965	4366
1956	2947	1966	3380
1957	5060	1967	7826
1958	4903	1968	3320
1959	3751	1969	6600
1960	4798	1970	3700

2. (a) What are the common causes of inconsistency of records from a raingauge station? **(5)**

   (b) The mass curve of rainfall in a storm of total duration 270 minutes is given below. Plot the maximum intensity-duration curve for this storm. **(15)**

Time (min)	0	30	60	90	120	150	180	210	240	270
Cumulative rainfall (mm)	0	6	18	21	36	43	49	52	53	54

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(c) Estimate from the depth-area relationship, the average depth of precipitation that may be expected over an area of 3000 sq. km due to a strom which lasted for 24 hours. Assume the storm centre to be located at the centre of the area. The isohyetal map for the storm gave the area enclosed between different isohyetes as follows: **(15)**

Isohyet (mm)	21	20	19	18	17	16	15	14	13	12
Enclosed area (km^2)	600	1400	2050	2676	2900	3200	3500	3700	3880	3900

3. (a) "The actual evaporation from a nearby lake is less than that of pan evaporation" – Explain. **(5)**

(b) Calculate the potential evapotranspiration for a reservoir from the following data in the month of July: **(15)**

Latitude = 28°N, Elevation = 230 m (above sea level), Mean monthly temperature = 33.0°C, mean relative humidity = 70%, Mean observed sunshine = 11.5 hr, Wind velocity at 2 m height = 85 km/day, Mean monthly solar radiation at the top of the atmosphere = 16 mm, mean monthly value of possible sunshine hour = 13.5 hr, average surface area = 20 km^2. Given

$$H_n = H_a(1-r)\left(a+b\frac{n}{N}\right) - \sigma T_a^4\left(0.56-0.092\sqrt{e_a}\right)\left(0.10+0.90\frac{n}{N}\right)$$

(c) The mass curve of an isolated storm in a watershed is as follows **(15)**

Time from start (h)	0	0.5	1.0	1.5	2.0	2.5	3	3.5	4	4.5	5
Cumulative rainfall (cm)	0	0.25	0.50	1.10	1.60	2.60	3.50	5.70	6.50	7.30	7.70

If the direct runoff produced by the storm is measured at the outlet of the watershed as 3.5 cm, estimate the φ index of the storm and duration of rainfall excess.

4. (a) How can you use remote sensing in soil moisture monitoring? **(3)**

(b) Analysis of annual flood data of a river yielded a sample mean of 1000 m^3/s and standard deviation of 400 m^3/s. Estimate the design flood of a structure on this river to provide 90% assurance that the structure will not fail in next 50 years. Use Gumbel's method and assume the sample size is very large. **(12)**

(c) Determine the best values of parameters of Horton's infiltration capacity equation for the following data pertaining to infiltration tests on a soil using double ring infiltrometer. **(20)**

Time since start (min)	5	10	15	20	30	40	60	80	100
Cumulative infiltration (mm)	21.5	37.7	52.2	65.8	78.4	89.5	101.8	112.6	123.3

Contd P/3

WRE 303

SECTION – B

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

5. (a) Draw a schematic diagram showing components of hydrological cycle. **(5)**

(b) The areas between different contour elevations for a river basin are given below. Determine the mean and median elevations. Draw the necessary curve "to scale". Also calculate the storage volume of the basin. **(15)**

Contour elevations (m)	Area between contours (km^2)
<225	181
225 – 300	723
300 – 375	1144
375 – 450	814
450 – 525	216
525 – 600	46
>600	140

(c) Annual rainfall and runoff values of a catchment spanning a period of 12 years are given below. Analyze the data to develop a linear correlation equation to estimate annual runoff volume for the given annual rainfall values. Also find the coefficient of correlation, *r*. **(15)**

Year	annual rainfall (cm)	annual runoff (cm)
1990	118	54
1991	98	45
1992	112	51
1993	97	41
1994	84	21
1995	91	32
1996	138	66
1997	89	25
1998	104	42
1999	80	11
2000	97	32
2001	75	17

6. (a) The following table gives the mean monthly flows in a river during 1981. Calculate the minimum storage required to maintain a demand rate of 40 m^3/s. Draw the mass curve "to scale" to estimate the minimum storage. **(15)**

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean Flow (m^3/s)	60	45	35	25	15	22	50	80	105	90	80	70

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Contd ... Q. No. 6

(b) The data pertaining to a stream-gauging operation at a gauging site are given below. The rating equation of the current meter is $v = 0.51\ N_s + 0.03$ m/s where N_s = revolution per second. Calculate the discharge in the stream. **(15)**

Distance from Left water edge (m)	0	1	3	5	7	9	11	12
Depth (m)	0	1.1	2	2.5	2	1.7	1	0
Revolutions of a current meter at 0.6 depth	0	39	58	112	90	45	30	0
duration of observation(s)	0	100	100	150	150	100	100	0

(c) Describe the different classes of streams with relevant sketches. **(5)**

7. (a) Two storms each of 6-h duration and having rainfall excess values of 3 cm and 2 cm respectively occur successively. The 2 cm rain follows the 3 cm rain. The 6-h unit hydrograph for the catchment is given below. Calculate the resulting RDH (Direct Runoff Hydrograph). **(10)**

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
UH ordinate (m^3/s)	0	25	50	85	125	160	185	160	110	60	36	25	16	8	0

(b) Ordinates of a 4-h unit hydrograph are given below. Using this derive the ordinates of a 2-h unit hydrograph for the same catchment using the S-curve method. Hint: Plot the 4-h unit hydrograph on a plain graph paper. **(20)**

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44
4-h UH ordinate (m^3/s)	0	20	80	130	150	130	90	52	27	15	5	0

(c) Briefly explain the straight-line method of base-flow separation. **(5)**

8. (a) Define "prism storage" and "wedge storage" in hydrologic channel routing. **(5)**

(b) The following inflow and outflow hydrographs were observed in a river reach. Estimate the values of K and x applicable to this reach for use in the Muskingum equation. K and x bears their usual meanings as associated with Muskingum method of routing. For approximations of the value of x, use a plain graph paper to plot relevant graphs. **(20)**

Time (h)	0	6	12	18	24	30	36	42	48	54	60	66
Inflow (m^3/s)	5	20	50	50	32	22	15	10	7	5	5	5
Outflow (m^3/s)	5	6	12	29	38	35	29	23	17	13	9	7

(c) Derive the Muskingum routing equation for a hydrologic channel for a time interval t. **(10)**

Contd. P/5

Table 1 $K_T = F(C_s, T)$ for Use in Log-Pearson Type III Distribution

Coefficient of skew, C_s	Recurrence interval T in years						
	2	10	25	50	100	200	1000
3.0	−0.396	1.180	2.278	3.152	4.051	4.970	7.250
2.5	−0.360	1.250	2.262	3.048	3.845	4.652	6.600
2.2	−0.330	1.284	2.240	2.970	3.705	4.444	6.200
2.0	−0.307	1.302	2.219	2.912	3.605	4.298	5.910
1.8	−0.282	1.318	2.193	2.848	3.499	4.147	5.660
1.6	−0.254	1.329	2.163	2.780	3.388	3.990	5.390
1.4	−0.225	1.337	2.128	2.706	3.271	3.828	5.110
1.2	−0.195	1.340	2.087	2.626	3.149	3.661	4.820
1.0	−0.164	1.340	2.043	2.542	3.022	3.489	4.540
0.9	−0.148	1.339	2.018	2.498	2.957	3.401	4.395
0.8	−0.132	1.336	1.998	2.453	2.891	3.312	4.250
0.7	−0.116	1.333	1.967	2.407	2.824	3.223	4.105
0.6	−0.099	1.328	1.939	2.359	2.755	3.132	3.960
0.5	−0.083	1.323	1.910	2.311	2.686	3.041	3.815
0.4	−0.066	1.317	1.880	2.261	2.615	2.949	3.670
0.3	−0.050	1.309	1.849	2.211	2.544	2.856	3.525
0.2	−0.033	1.301	1.818	2.159	2.472	2.763	3.380
0.1	−0.017	1.292	1.785	2.107	2.400	2.670	3.235
0.0	0.000	1.282	1.751	2.054	2.326	2.576	3.090
−0.1	0.017	1.270	1.716	2.000	2.252	2.482	2.950
−0.2	0.033	1.258	1.680	1.945	2.178	2.388	2.810
−0.3	0.050	1.245	1.643	1.890	2.104	2.294	2.675
−0.4	0.066	1.231	1.606	1.834	2.029	2.201	2.540
−0.5	0.083	1.216	1.567	1.777	1.955	2.108	2.400
−0.6	0.099	1.200	1.528	1.720	1.880	2.016	2.275
−0.7	0.116	1.183	1.488	1.663	1.806	1.926	2.150
−0.8	0.132	1.166	1.448	1.606	1.733	1.837	2.035
−0.9	0.148	1.147	1.407	1.549	1.660	1.749	1.910
−1.0	0.164	1.128	1.366	1.492	1.588	1.664	1.880
−1.4	0.225	1.041	1.198	1.270	1.318	1.351	1.465
−1.8	0.282	0.945	1.035	1.069	1.087	1.097	1.130
−2.2	0.330	0.844	0.888	0.900	0.905	0.907	0.910
−3.0	0.396	0.660	0.666	0.666	0.667	0.667	0.668

Table 1 for Q. 1 (c)

L-3/T-2/WRE Date : 31/03/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-II B. Sc. Engineering Examinations 2017-2018

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

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Assume reasonable value (values) for missing data only.

Design charts are given in Appendix I.

1. (a) Why a larger magnitude of settlement is allowed for the design of raft foundation? **(6)**

   (b) Write down the assumptions made in deriving Terzaghi's bearing capacity equation for a shallow foundation of a long footing resting on clay. Derive bearing capacity equation for a wall footing resting on clay assuming failure occurs due to rotation about one of its edges. Compare this equation with Terzahi's equation and state the reasons for the differences in those two equations. **(13)**

   (c) A raft 72 feet x 72 feet in plane has its base 15 feet below the surface of a deposit of clay with a unit weight of 130 lb/cu.ft. The undrained shear strength of the clay, determined in the laboratory is found to be 0.75 ton/st ft. The factor of safety against bearing capacity failure must be 2.5 and the water table exists at the ground level. Draw the schematic diagram and also calculate the total weight of the building plus foundation can safely be supported by the raft. What will be the depth of foundation when factor of safety approaches to the infinity? **(16)**

2. (a) Discuss the factors affecting bearing capacity of a shallow foundation. **(10)**

   (b) Write down the step by step procedure for calculating axial force on each pile of a pile group. The pile group is subjected to a vertical load of "V" and a moment of "M". Piles spacing's and its length are given. **(10)**

   (c) Estimate the settlement of a footing (Fig. 1). Compute the factor of safety against a bearing capacity failure. The N-values have been corrected for over burden pressure. **(15)**

3. A 16 inch x 16 inch concrete pile was driven in a dense sand with 40 feet embedment length. The depth of water table was 10 feet from the ground surface and the unit weight of sand above and below the water table were given as 120 lb/cu.ft and 125 lb/cu.ft Draw the schematic diagram of the problem and estimate the allowable pile capacity with factor of safety 2.5. **(18)**

   (b) Calculate the allowable uplift capacity of the driven pile as described in Ques. 3(a). **(10)**

   (c) "Sometimes use of bored pile is more preferable to driven pile, although capacity of later is larger in compared with bored pile", Explain. **(7)**

Contd. P/2

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4. (a) A group of 4 piles with 2 piles in a row were driven into a soft to medium stiff clay extending from ground level to a greater depth. The diameter and the length of the piles were 20 inch and 40 feet, respectively. The unconfined compressive strength of clay is 1.0 ton per sq.ft. The piles are spaced at 5 feet centre to centre. Compute the group capacity with a factor of safety of 2.5. The thickness of the pile cap is 3 feet and its top surface coincides with existing ground level. Draw the schematic diagrams (plan and sectional view of the pile group). Assume water table exists at the ground surface level and the unit weight of clay is given as 122 lb per. cu. ft. **(15)**

   (b) A bored pile (cast-in-place) with 30 inch dia. with 45 feet length was installed as shown in Fig. 2. Calculate allowable capacity of the pile with a factor of safety of 3.0 by using Reese and O'Neill (AASHTO, 1992) method. **(20)**

SECTION – B

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

5. (a) Comment on the reliability of SPT correlations for cohesive and cohesionless soils. **(5)**

   (b) Briefly, discuss the steps followed in a soil investigation program. **(10)**

   (c) Explain, with sketches, the operations of a piston sampler used for collection of undisturbed soil samples. **(10)**

   (d) What is negative skin friction? What are the causes of it? How can it be mitigated? **(10)**

6. (a) Discuss the importance of sub-soil exploration ? **(8)**

   (b) Discuss the use of disturbed and undisturbed samples that are collected in soil exploration. **(8)**

   (c) Compare the pros and cons of SPT and CPT. **(8)**

   (d) An embankment is planned to be constructed with silty clay soil. From laboratory tests on compacted specimens (γ = 17 kN/m^3) of the soil, shear strength properties were found as: c = 100 kPa and ϕ = 10°. If the required height of the embankment is 15 m, what maximum side slope can be provided with a factor of safety of 1.25 considering that the slope will not be subjected to water? If due to heavy rain, the slope becomes saturated (γ_{sat} = 20 kN/m^3) and seepage forces act, then will the slope fail? Comment after analyzing the problem considering infinite slope for which the equations for Factor of Safety are as follows (symbols designate usual meaning): **(11)**

$$F_s = \frac{c}{\gamma H \cos^2 \tan\beta} + \frac{\tan\varphi}{\tan\beta} \quad \text{and} \quad F_s = \frac{c}{\gamma_{sat} H \cos^2 \beta \tan\beta} + \frac{\gamma'}{\gamma_{sat}} \frac{\tan\varphi}{\tan\beta}$$

Assume that the shear strength properties remain same in dry and saturated state.

Contd. P/3

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7. (a) Write short notes on (i) percussion drilling (ii) inside clearance ratio of a soil sampler (iii) SPT-N value correction for input energy **(3×4=12)**

   (b) Why pile load tests are done? **(6)**

   (c) State at least two criterion to calculate safe load from static pile load test? **(5)**

   (d) Describe SM, QM, and CRP methods as per ASTM D1143. **(12)**

8. (a) For a river bank soil saturated unit weight is 18 kN/m^3, cohesion is 20 kPa and angle of internal friction is 40 degree. The height of the slope is 22 m and draw down is 5m. What bank slope may be provided to have a factor of safety of 2.5? Determine using Morgenstern's method of slices for rapid drawdown condition. (Morgenstern's stability chart is provided in Fig. 3) **(9)**

   (b) State the assumptions for slope stability analysis using mass procedure and circular failure surface. **(5)**

   (c) Fig. 4 shows the cross section of a cut slope made in a homogeneous clay layer. For undrained situation determine the factor of safety (FS) against sliding. Also determine the slope angle if FS = 3 is desired. Use chart for stability number (Fig. 5). **(12)**

   (d) Describe Davisson's, De Beer's and Brinch Hansen's method for estimating failure load of a pile? **(9)**

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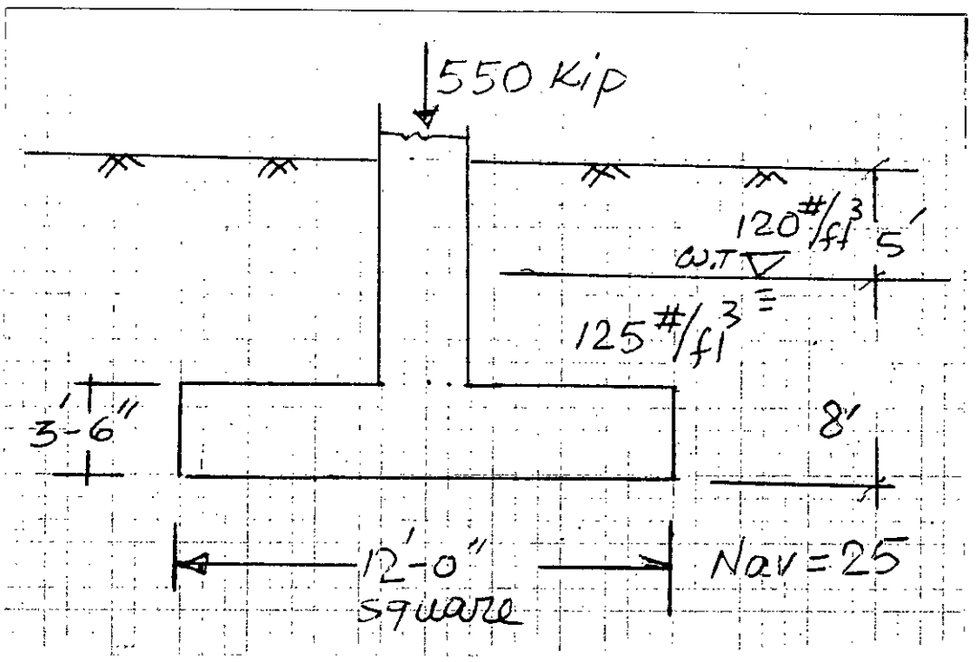


Fig 1

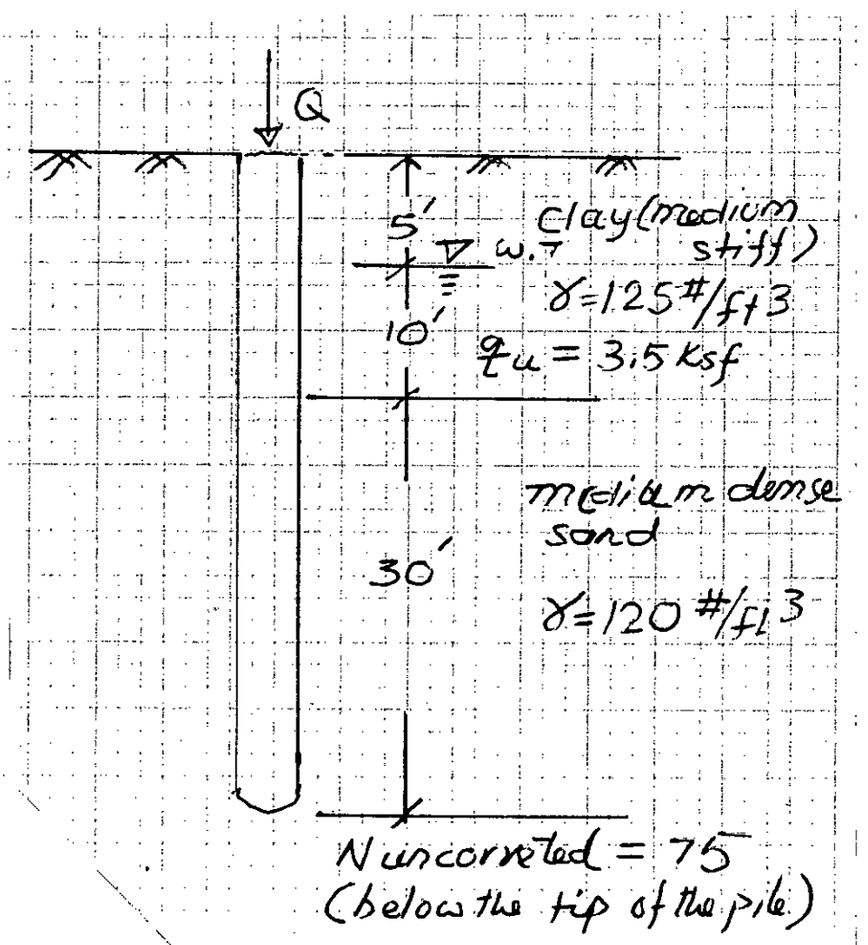


Fig 2

Contd. ---- P/5

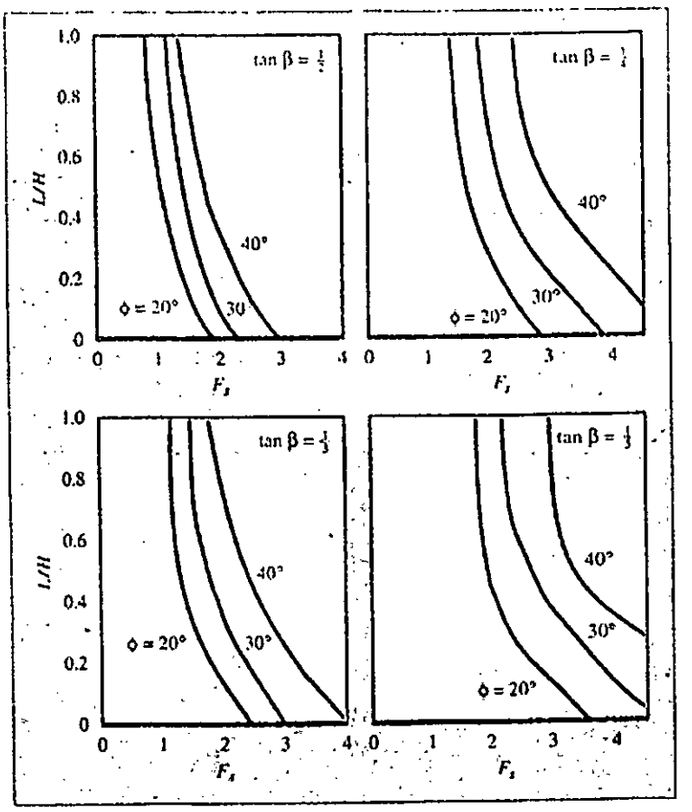


Fig. 3 Morgenstern's stability chart for c/γH=0.05.

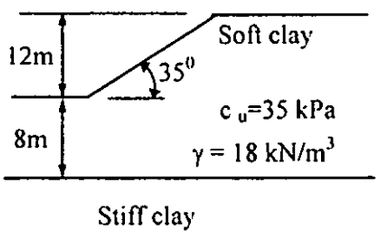


Fig. 4

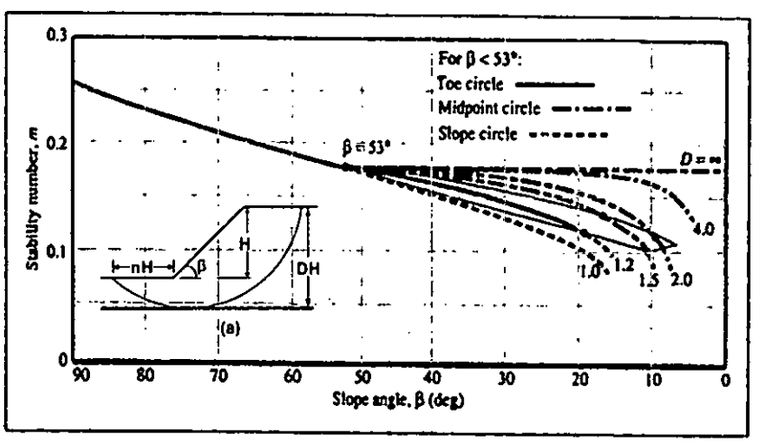
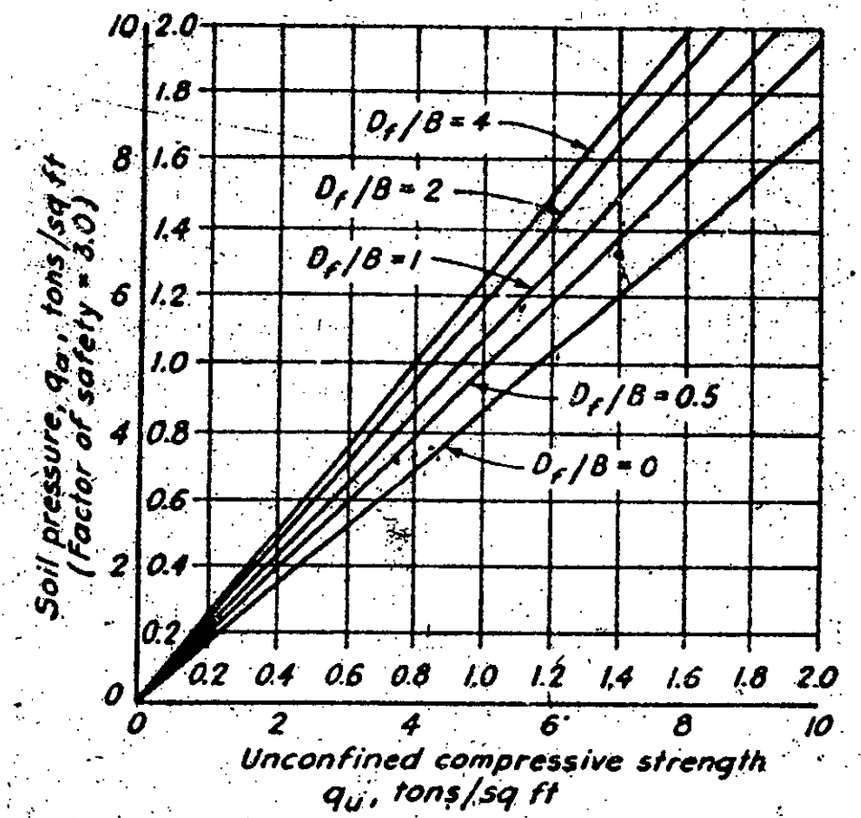


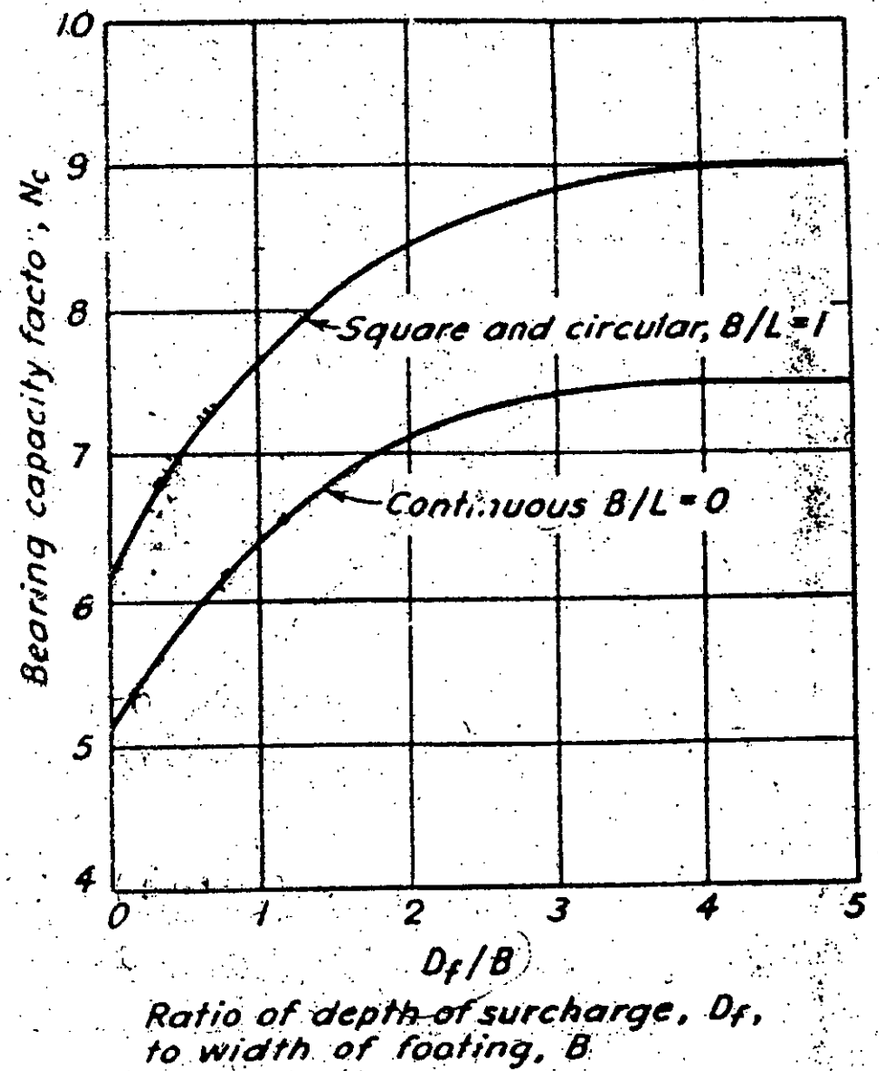
Fig. 5 Chart for stability number against slope angles for different values of depth factor D for slope stability analysis using Fellenious method.

Contd.... P/6



..... 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.

Chart 2



Bearing capacity factors for foundations on clay under $\phi = 0$ conditions (after Skempton, 1951).

Chart 1

CE 481

=6=

Cont'd. - - - P/7

CE 481

Appendix - I

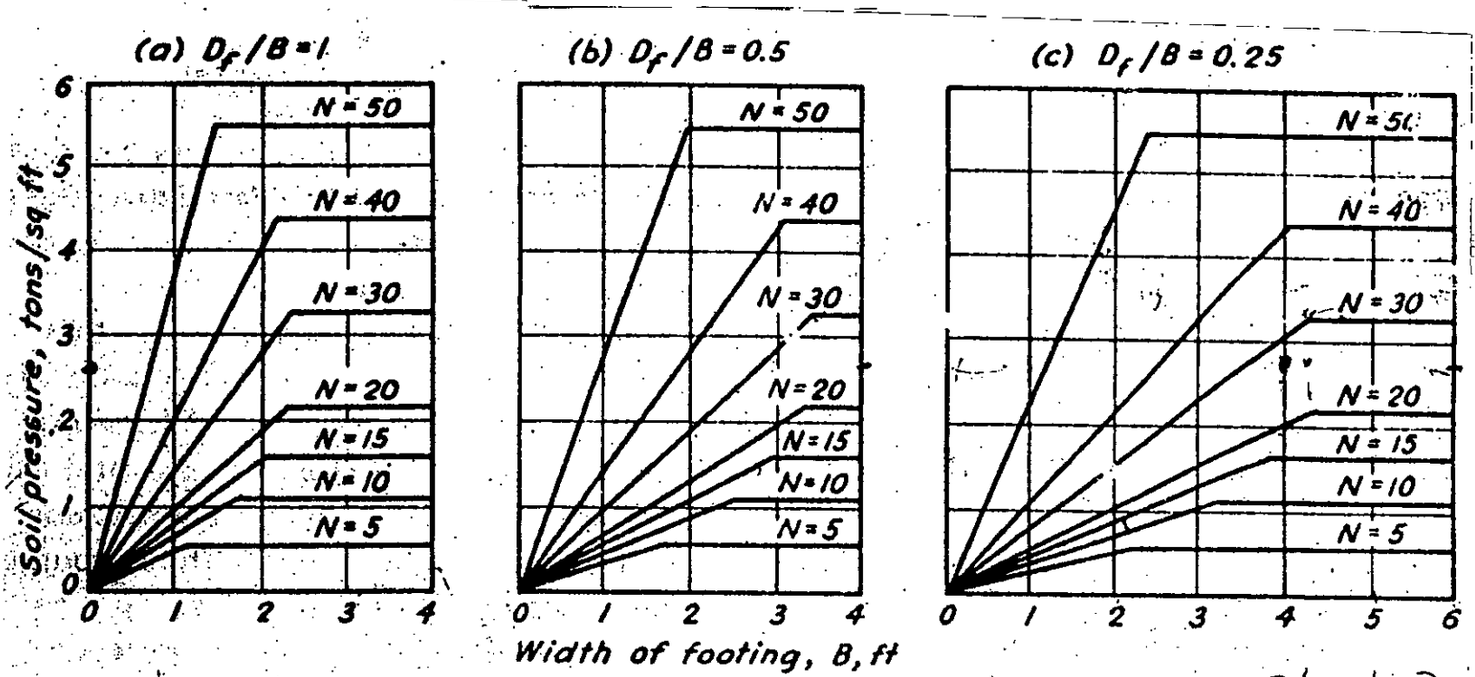
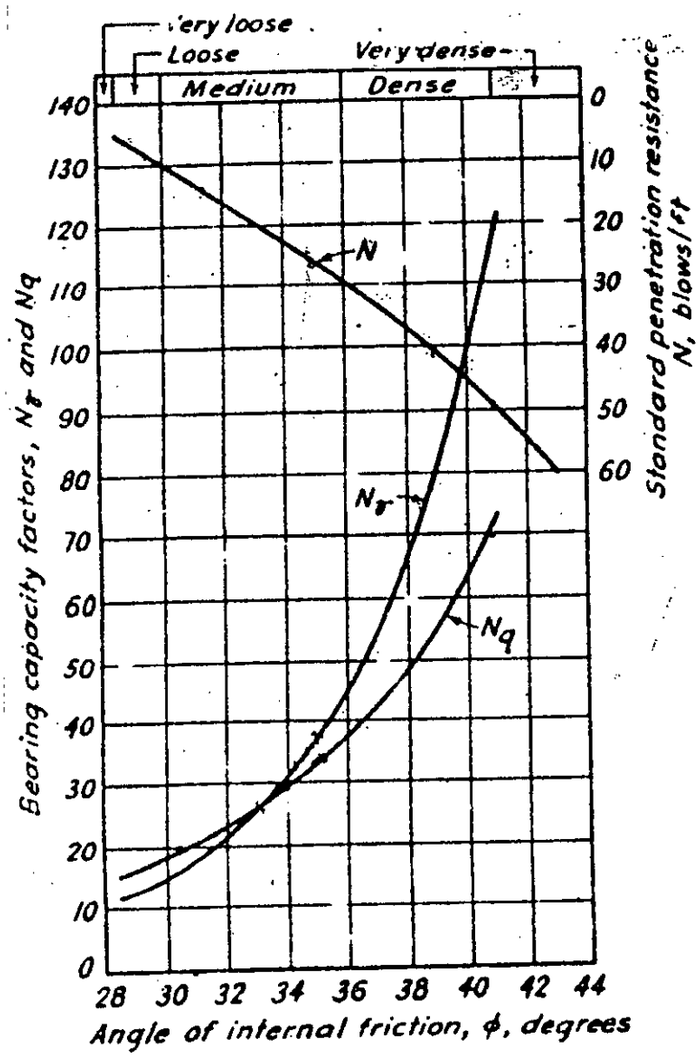


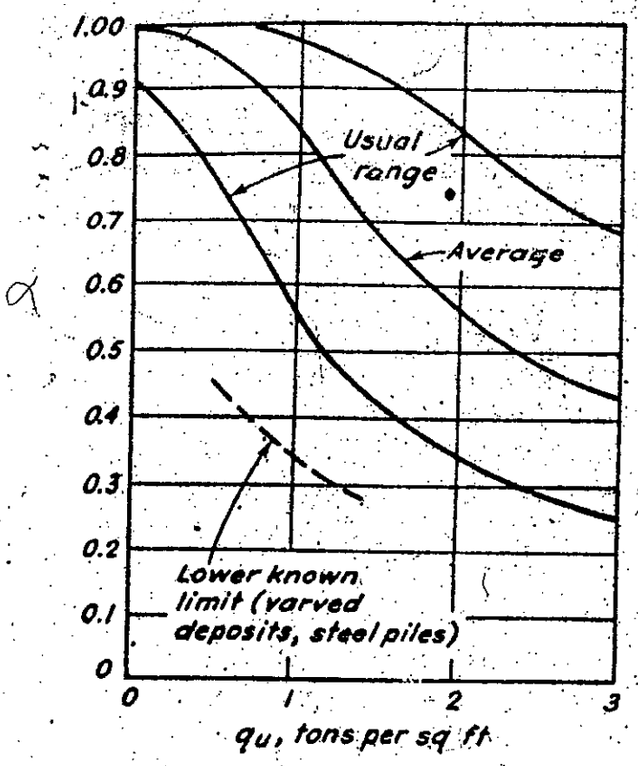
Chart 3

Design chart for proportioning shallow footings on sand.



Curves showing the relationship between bearing-capacity factors and ϕ, as determined by theory, and rough empirical relationship between bearing capacity factors or ϕ and values of standard penetration resistance N.

Chart 4



Values of reduction factor α_1 for calculation of static capacity of friction piles in clays of different unconfined compressive strengths q_u.

Chart 5

Contd. ---- P/8

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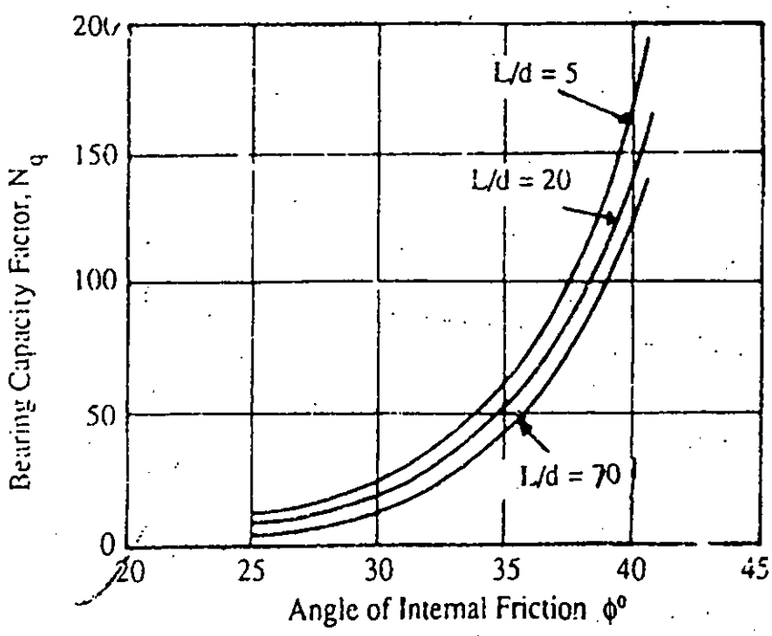
Appendix - I



(b) Berezantsev's Bearing Capacity Factor, N_q

Bearing capacity factors by various investigators for deep foundations.

chart 6

L-3/T-2/WRE Date : 25/03/2019

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-II B. Sc. Engineering Examinations 2017-2018

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) Distinguish between Environmental Science and Environmental Engineering with some examples. Why is hydrologic cycle important? **(22)**

   (b) What are the basic requirements of drinking water? State the hydraulics of groundwater flow towards a well. Deduce the mathematical expression for the yield of a well in a confined aquifer. **(24 2/3)**

2. (a) What are the different unit processes commonly used to treat water for domestic and industrial water supply? What are the different types of settling? State the theory of Filtration. **(24)**

   (b) The population of a town as per the census records are given below for the years 1955 to 2015. Estimate the population for the years 2035 and 2050 using Logistic Method. **(22 2/3)**

Year	Population
1955	45190
1965	49520
1975	65400
1985	80620
1995	103890
2005	129230
2015	163800

3. (a) Briefly explain the common methods of water distribution systems. What are the main advantages and disadvantages of Dead End Distribution System? **(24)**

   (b) From a clear water reservoir 2.5 m deep and maximum water level at R. L. 10 m water is to be pumped to an elevated reservoir (the bottom of the reservoir at R. L. of 60 m). The depth of the elevated reservoir is 5 m. The water will be pumped at a constant rate of 900,000 liter per hour. The total length of the pipe is 2000 m. Design he pumps and rising main. (Use most economical pipe diameter) **(22 2/3)**

4. (a) What are the major effects of air pollution on health and climate? Derive the stokes law for discrete particle settling. **(23)**

(b) What are the main purposes of EIA? List the important methodologies used for EIA. What are the main goals of Environmental Management? Distinguish between guideline and standard with examples. **(23 2/3)**

Contd. P/2

CE 371

SECTION – B

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

5. (a) Discuss the role of bacteria in Sewage Treatment. **(16⅔)**

(b) Define BOD and COD. Why COD of a sewage sample is greater than BOD? Draw BOD curves for different BOD removal constant (k). **(15)**

(c) BOD_5 at 20°C is 200 mg/l. Ultimate BOD is 296 mg/l. Determine the BOD removal constant at 30°C. **(15)**

6. (a) State and prove Marais theorem. **(16⅔)**

(b) State the factors affecting quantity of storm water. **(10)**

(c) A 1.2 km long storm sewer collects water from a catchment area of 60 hectares, where 50% of the area is covered by roof (c=0.9), 20% area is covered by pavement (c=0.8) and rest area covered by open land (c=0.13). Determine the diameter of the storm sewer assessing the time of entry=3 mins, velocity at full flow = 2.45 m/s, n = 0.013, slope = 0.001 and intensity of rainfall=70 mm/hr. **(20)**

7. (a) State the design considerations of pit latrine. Mention the advantages and disadvantages of pit latrines. **(15)**

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

(c) A septic tank is to be designed for 21 users. The average wastewater flow rate is 180 l/capita/day. (Assume reasonable value for any data required). **(16⅔)**

8. (a) Define the functional elements of solid waste management. What are the effects of solid waste mismanagement? **(12⅔)**

(b) Compare the merits and demerits of hauled container and stationary container systems of solid waste collection. Which method do you think would be suitable for Dhaka City? Explain. **(13)**

(c) Discuss sanitary landfill with a typical sectional view. What are the important aspects that need to be considered in the design and operation of sanitary landfill? **(15)**

(d) Define the following: **(6)**

(i) Refuse (ii) Garbage, (iii) Rubbish and (iv) Hazardous waste.

L-3/T-2/WRE **Date : 14/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2 B. Sc. Engineering Examinations 2017-2018

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

Full Marks : 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonable value for any missing data

SECTION – A

There are **FOUR** questions in this section. Answer **Q. No. 1** and any **TWO** from the rest. Q. No. 1 carries 40 marks and rest of the questions carry 50 marks each.

1. Figure 1 shows peak-hour volumes for a major intersection on an expressway. Using the Webster method, determine a suitable signal timing for the intersection using the four-phase system shown below. Also, draw the phase and cycle time bar diagram. Use the saturation flow given in Table 1. **(20+10+10=40)**

Table 1

Phase	*Lane Group*	*Saturation Flow*
A	①	1615
	②	3700
B	①	3700
	②	1615
C	①	1615
	②	3700
D	①	1615
	②	3700

Note: The influence of heavy vehicles and turning movements and all other factors that affect the saturation flow have already been considered.

2. (a) With neat sketches illustrate the traffic movement for a grade separated T-intersection in the context of traffic conditions in Bangladesh. **(6)**

(b) State the basic approaches mostly used for traffic assignment. Which assignment technique would you use to assign trips into road network of Dhaka city? Why? **(4+2+2=8)**

(c) A student trying to test the braking ability of a car determined that she needed 18.5 ft more to stop the car when driving downhill on a road segment of 5% grade than when driving downhill at the same speed along another segment of 3% grade. Determine the speed at which the student conducted her test and the braking distance on the 5% grade if the student is traveling at the test speed in the uphill direction. **(5+5=10)**

Contd P/2

CE 391

Contd ... Q. No. 2

(d) Briefly explain the followings: **(4×3=12)**

(i) PIEV time (ii) ITS (iii) Traffic Calming Device

(e) Assuming linear density relationship, the mean free speed is observed to be 60 mph near to zero density. The jam density of the road is 140 veh/mile. **(4+6+4=14)**

(i) Write down the speed-density and flow-density equation.

(ii) Draw the v-k, v-q and q-k diagrams indicating critical value.

(iii) Compute speed and density corresponding to a flow of 1000 veh/hr.

3. (a) Explain schematically the relationship between access and movement function of road. **(6)**

(b) Speed data were collected at a section of highway during and after utility maintenance work. The speed characteristics are given in Table-2 as shown below. Determine whether there was any significant difference between the average speed at the 95% confidence level. **(8)**

Table 2

	Study 1	Study 2
Mean Speed, $\bar{u}$, mph	35.5	38.7
Standard Deviation, S, mph	7.5	7.4
Vehicles Observed	250	280

(c) Differentiate between traffic signs and markings. Briefly discuss about the new trend of roadway sign and marking. **(5+5=10)**

(d) Define Road Safety Engineering. 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? **(4+4+4=12)**

(e) State the problems associated with uncontrolled On-street Parking. What are the common causes of parking related accidents? Mention locations where parking should be prohibited. **(5+5+4=14)**

4. (a) What is the criterion for selecting Travel Analysis Zone? **(6)**

(b) Table 3 shows 15-miniute volume counts during the peak hour on an approach of an intersection. Determine the PHF and the design hourly volume of the approach. **(8)**

Table 3

Time	*Volume*
6:00–6:15 p.m.	375
6:15–6:30 p.m.	380
6:30–6:45 p.m.	412
6:45–7:00 p.m.	390

Contd P/3

CE 391

Contd ... Q. No. 4

(c) Show with neat sketches the minimum passing sight distance for a two-way Highway for traffic conditions in Bangladesh. **(10)**

(d) Briefly state the function of the following cross section elements of a highway: **(4×3=12)**

(i) Median (ii) Shoulder (iii) Curb & Gutters (iiii) Side & Cross slopes

(e) A 3-by-3 trip table (Table 4) representing a total of 2500 trips is shown in the following table for the base year 2018. **(14)**

Table 4

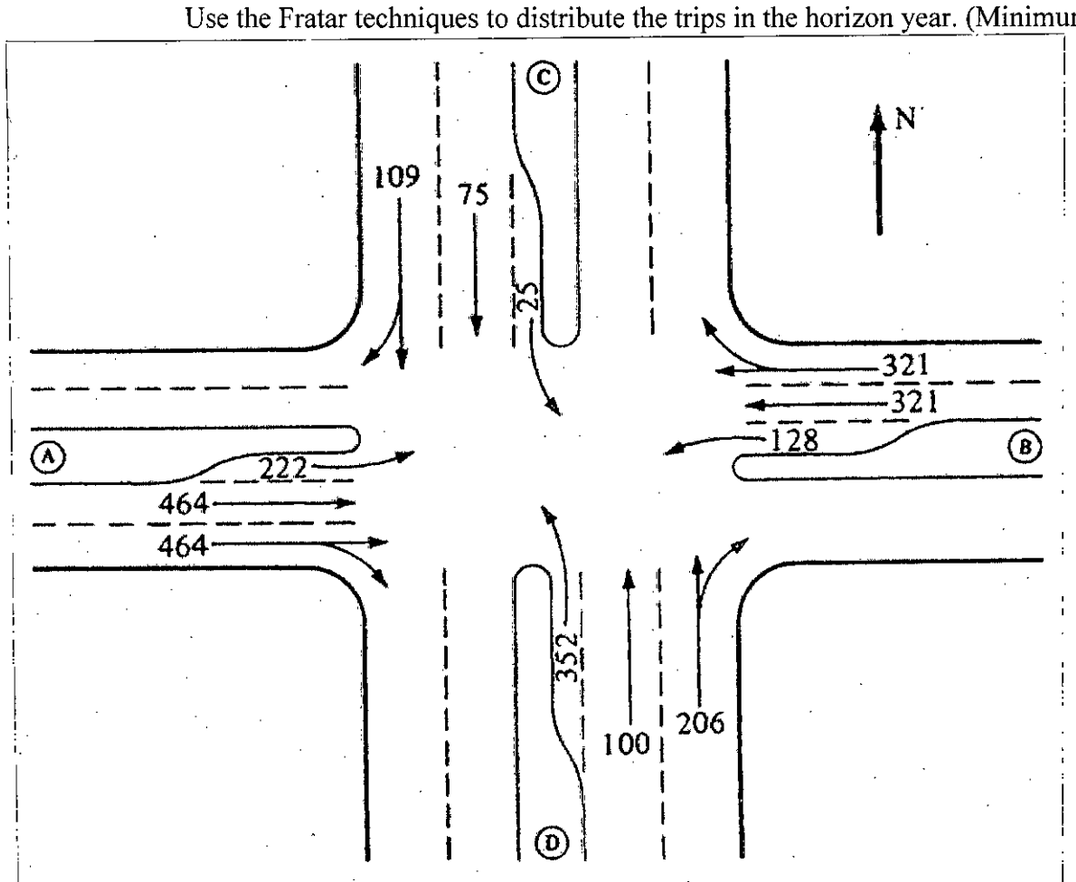
i \ j	1	2	3	Total (in hundreds)
1	1	4	2	7
2	6	2	3	11
3	4	1	2	7
Total	11	7	7	**25**

Table 5 indicates the origin and destination growth factors for the horizon year.

Table 5

Zone	1	2	3
Origin Factor (production)	2.0	3.0	4.0
Destination Factor (attraction)	3.0	4.0	2.0

Use the Fratar techniques to distribute the trips in the horizon year. (Minimum 2 iteration)



PHF = 0.95

Pedestrian volume is negligible.

Contd P/4

Figure 1 for Q. No. 1

CE 391

SECTION – B

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

5. (a) Compare between railway and roadway transportation system. State the key characteristics of railway as a transportation mode. **(9+7)**

(b) State the different resistive forces acting on trains during its movement. Mention different types of rail gauges used in various countries. Write down the factors affecting the choice of gauge. **(4+3+5)**

(c) Calculate the maximum permissible load that a B.G. stream locomotive with 3 pairs of driving wheels with axle load of 22 tonnes each on a straight level track at a speed of 80 kmph. Also, calculate the reduction in speed if the train has to run on a rising gradient of 1 in 200. What would be the further reduction in speed if the train has to negotiate a 4° curve on the rising gradient? Assume coefficient of friction as 0.2. **(18⅔)**

6. (a) Classify different types of rails. What are the requirements of an ideal rail section? Describe the advantages of flat footed rails. **(3+7+5)**

(b) What are the purposes of railway stations? Classify different types of railway yards. Write short notes on: **(5+3+6)**

(i) Wayside stations

(ii) Junctions

(iii) Terminals

(c) With a neat sketch, show different constituents of a railway right-hand turnout. What are the factors to be considered while selecting an airport site? **(10+7⅔)**

7. (a) What are the desirable properties of aggregates to be used in road construction? Mention various tests that are performed on road aggregates. **(6+6)**

(b) Compare between tar and bitumen. Briefly describe and mention the uses of slow-curing asphalt, medium curing asphalt and rapid curing asphalt. **(6+9)**

(c) Mention the tests for asphaltic materials. Write short notes on: **(4⅔+15)**

(i) Fog Seal

(ii) Slurry Seal

(iii) Aggregate Seal

(iv) Prime Coat

(v) Tack Coat

Contd P/5

CE 391

8. (a) What are the desirable characteristics of a pavement? Draw cross-sections of rigid pavement and flexible pavement. **(8+9)**

(b) Compare between rigid and flexible pavements. What are the requirements of a joint in rigid pavement? **(9+4)**

(c) An existing 6.2 m Regional Road that is located on an embankment requires full reconstruction. A check has been made and the existing road surface is 1.0 m above the Highest Flood Level for a 50 year return period. Accordingly, the embankment does not require to be raised. A number of trial pits were undertaken and the CBR of the sub-grade beneath the existing road was found to be 4%. Design a flexible pavement based on the 24 hour classified traffic count which was carried out on a typical weekday shown below and show the thicknesses of different layers of the pavement using a neat sketch. (Use necessary charts) **(16⅔)**

	Existing Flow/day (0.5 x two-way flow	ESA Factor
Heavy truck	40	4.8
Medium truck	160	4.62
Light truck	70	1.00
Large Bus	120	1.00

mm	Surfacing (mm)		Roadbases (mm)* (Select one type)			Sub-bases (mm)** *Subgrade CBR %*		
Traffic ESA (mill)	Asphalt Wearing Course	Asphalt Base-Course	Cement-bound Granular	Granular Base Type I	Granular Base Type II	5	8 - 25	> 25
60 - 80	40	155	Refer to BRRL for design advice	N/A	N/A	300	150	0
40 - 60		140						
30 - 40		125						
25 - 30		110		250	300	250		
17 - 25		105						
15 - 17		95				200		
11 - 15		90						
9 - 11		80		200	250			
7 - 9		70						
6 - 7		65						
5 - 6		60						
4 - 5		55						
3 - 4		45		175	200	175		
< 3		35		150	175	150		

* CBR of granular base type I is min. 80%
* CBR of granular base type II is min. 50%
** CBR of sub-base material is 25%
N/A. = not applicable

Table : Thickness Design Table for Flexible Pavements

CBR Required	Compacted Thickness of additional layer to provide required CBR			
	CBR of Underlying layer			
	2%	3%	4%	5%
5%	250 mm	150 mm	100 mm	-

Table : Improved Sub-grade Requirements

For Q. 8(c)