BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2   B. Sc. Engineering Examinations 2016-2017

Sub : **CE 325** (Design of Concrete Structures 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 **FOUR** questions in this section. Answer any **THREE**.

Assume reasonable values for any missing data

1. (a) A flat plate floor has a thickness h = 8″ and is supported by 18″×18″ columns spaced 20ft on centers each way. The floor will carry a DL = 180 psf including self weight and a live load of 100 psf. Check the adequacy of the slab in resisting punching shear. If inadequate, design the punching sheer reinforcement using bent ber arrangement. Consider, d = 6.5″; fc′ = 3500 psi and fy = 60,000 psi. **(18)**

    (b) Why is seismic detailing essential for earthquake resistant design of structure? Draw and explain seismic detailing provisions for beam of an intermediate moment resisting fame as per ACI/BNBC. **(10)**

    (c) As per ACI/BNBC code, slenderness effects can be neglected if slenderness ratio of a column is below certain limits, write these limits for columns of sway and non-sway frame. **(7)**

2. (a) What are the limitations of Direct Design method for analysis of two way slab. **(10)**

    (b) A flat plate floor system without edge beam is supported by 20″×20″ square columns spaced at 25′×25′ grid. The floor will carry 30 psf floor finish, 80 psf partition wall load and 40 psf live load in addition to its own weight. Design a typical interior panel using Direct Design Method and show reinforcement in detail. Use relevant charts provided. **(25)**

3. (a) Why ties are provided is column? State the requirements of ties according to ACI code. **(16)**

    (b) What is ACI spiral? Explain failure behaviors of ACI spirally reinforced column. **(7)**

    (c) For the column section shown in Fig.1, draw the strength interaction diagram (for bending about X-X axis) with five points corresponding to balanced failure, pure axial load, pure bending, tension failure and compression failure. **(20)**

4. (a) A ground floor column of a multistoried building is to be designed for the following load combinations (axial force and uni axial bending) **(25)**

    Starting load condition : P_u = 700 kip; M_u = 8- kip-ft. Lateral load combination: P_u = 600 kip; M_u = 500 kip-ft. Architectural considerations require that a rectangular column with b = 16 in and h = 25 in is to be used. Material strength are $f_c' = 4$ ksi and $f_y = 60$ ksi. Find the required column reinforcement and show in a sketch. Use supplied chart and assume that the reinforcement are distributed along the perimeter. Also design ties as per ACI/BNBC code. **(25)**

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Contd... Q. No. 4

(b) Why 'ϕ' value is low for columns? **(6)**

(c) Why factor 'α' is introduced in the column capacity equation? **(4)**

SECTION-B

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

5. (a) A 16 inch concrete wall supports a dead load, DL = 14 kip/ft and a live load, LL = 10 kips/ft. The allowable bearing pressure, q_a = 5 kips/ft² at the level of the bottom of the footing, which is 4 ft below the grade. Design a footing for this wall using f'_c = 4000 psi and f_y = 60000 psi. Also, check the provisions for development length. **(17)**

(b) An exterior and interior columns are to be supported by a combined rectangular footing whose outer end cannot produce beyond the outer facing of the exterior column. Column sizes and their respective loads are shown in Fig. 2. The bottom of the footing is 6.0 ft below the grade where net allowable bearing pressure after deducing soil load, self wt. of footing and other surcharges is 4000 psf. Determine size of the footing. If d = 18 inch, check the adequacy against punching. Also, design the transverse beam. **(18)**

Fig. 2
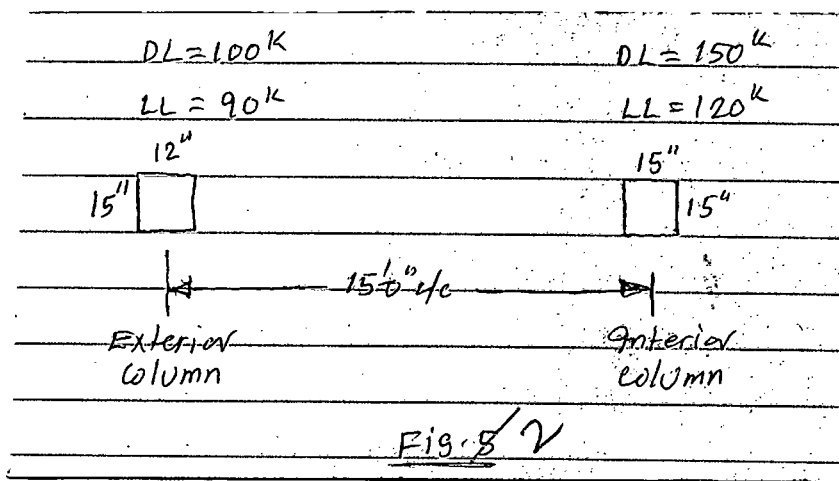
6. (a) Design a square footing for an interior column that carries total working DL = 600 kip and LL = 400 kip. The column is 25″ × 25″ in cross section. Allowable bearing capacity of Soil is 4200 psf. The bottom of the footing is 6 ft below the grade. Show the reinforcement in plan and section with neat sketch. Given: f'_c = 3000 psi and f_y = 60000psi. **(17)**

(b) A three storied reinforced concrete wall is subjected to factored load as shown in Fig.3. The wall is 15 ft long and 10 inch thick. Design reinforcement for the wall at the first level between the base and first floor. Given: f_y = 60 ksi; f'_c = 4.0 ksi. **(18)**

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Contd... Q. No. 6(b)

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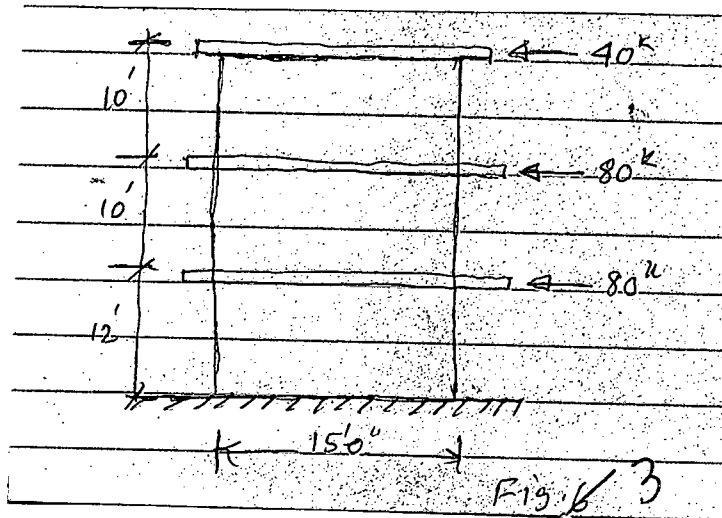
$$Auu \geq 0.0025 S_1 h$$

$$Auh \geq 0.0025 S_2 h$$

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

$$\frac{z}{L_w} = \cfrac{1}{2 + 0.85\left(\beta_1 L_w \cfrac{hf_c'}{A_{st} f_y}\right)}; \beta_1 = 0.85$$

Where symbols have their usual meanings.

Fig. 3

7. (a) Write down the sources of loss of prestress. **(10)**

(b) A post-tensiones bonded concrete beam as shown in Fig. 4 has a prestress of 1580 KN in the steel immediately after prestressing and reduces to 1370 KN due losses. In addition to self wt. of 4.5 KN/m, there is a live load of 10 KN/m. Compute the extreme fibre stresses at midspan, **(25)**

     (i) Under the initial condition with full prestress and no live load.

     (ii) At final condition with live load and considering losses.

Fig. 4
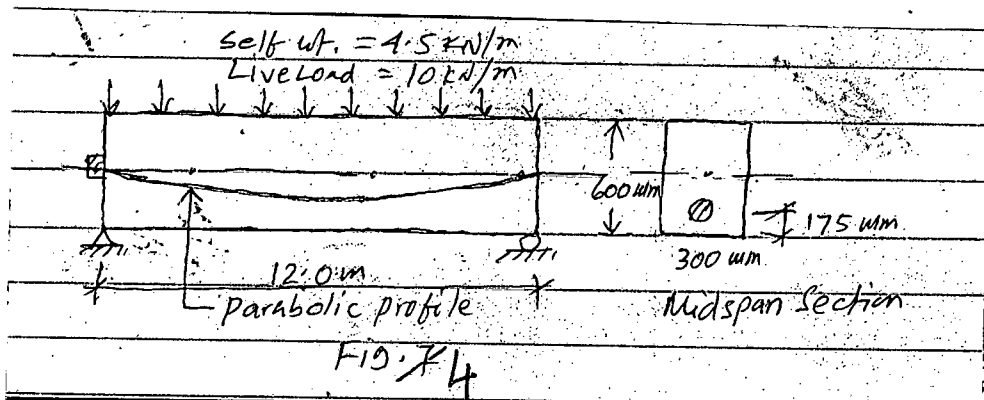
CE 325

8. (a) Write down the advantages and disadvantages of pretressed concerte as compared to reinforced concrete. **(10)**

    (b) Differentiate. **(9)**

    (i) Strand and Wires

    (ii) Pre tensioning and post tensioning

    (iii) Bonded and unbonded tendons.

    (c) Make a preliminary design for section of a prestressed concrete beam to resist a total moment M_T = 450 KN-m, and girder moment M_{cr} = 60 KN-m. Total depth of the section is given as 950 mm. The effective prestress for steel, f_{se} = 860 MPa and allowable compressive stress for concrete under working load, f_c = -12 MPa. **(16)**

l of 4#9.

l of 4 #9

Fig. 1.
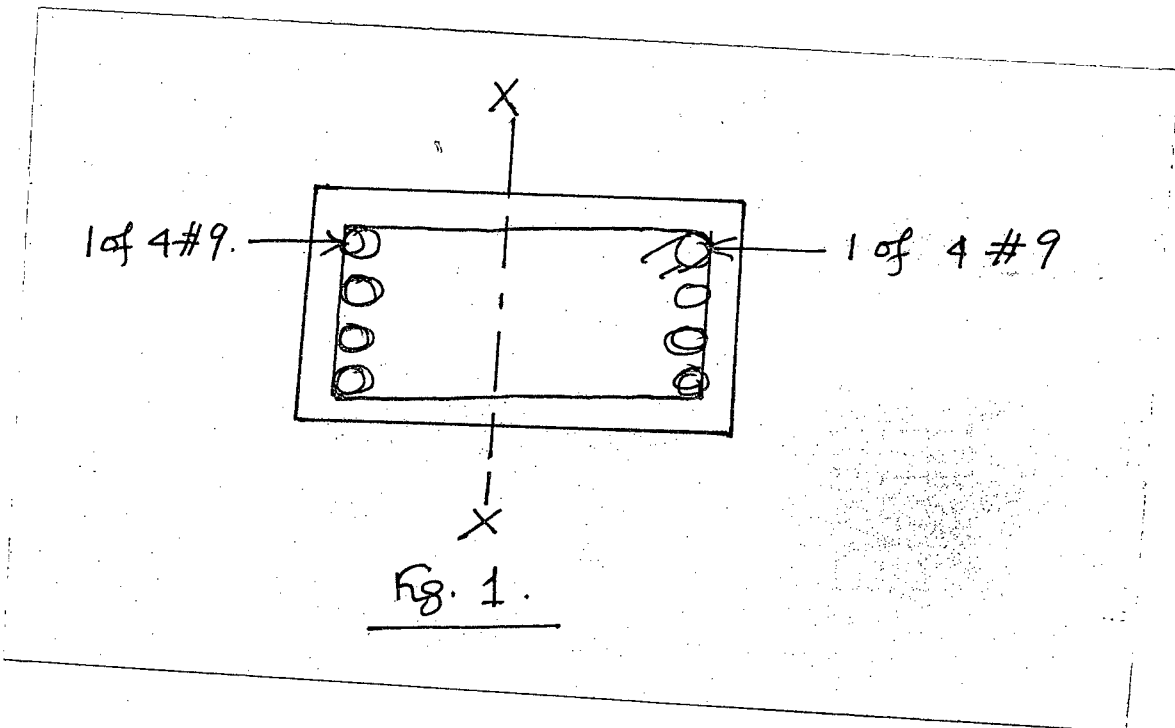
Interpolation charts for lateral distribution of slab moments.

Interior negative moment

$\beta_t = 0$

$0 \leqslant \alpha_{f1} l_2/l_1 \leqslant \infty$

$\alpha_{f1} l_2/l_1 = 0$

0.2
0.4
0.6
0.8
$\geqslant 1.0$

Exterior negative moment

$\beta_t \geqslant 2.5$

$\alpha_{f1} l_2/l_1 = 0$

0.2
0.4
0.6
0.8
$\geqslant 1.0$

Positive moment

$1.0 \leqslant \alpha_{f1} l_2/l_1$
0.8
0.6
0.4
0.2
0

Column strip moment, percent

Volume of β_t

Ratio l_2/l_1
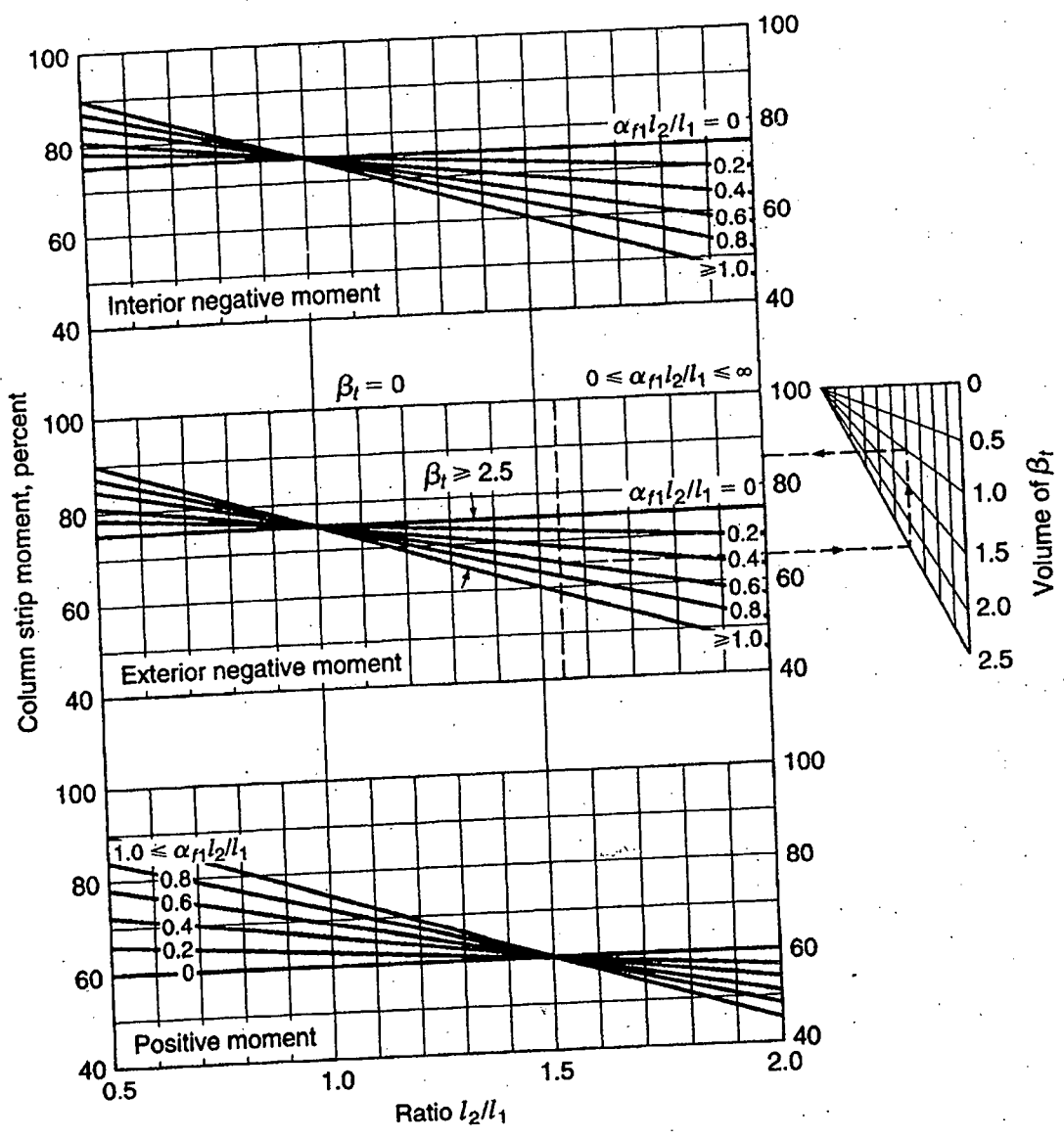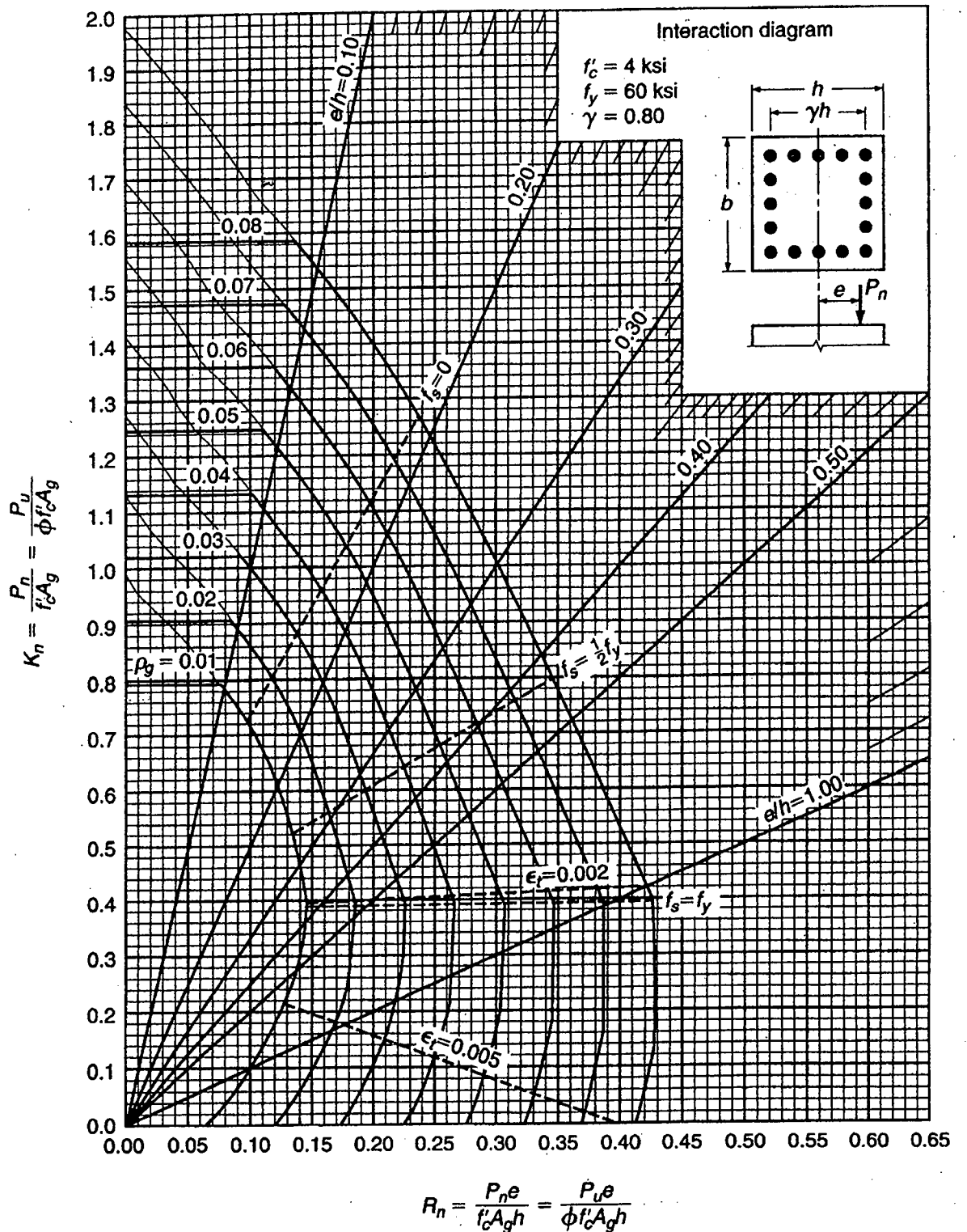
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.80$.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2   B. Sc. Engineering Examinations 2016-2017

Sub : **WRE 303** (Hydrology)

Full Marks: 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1.   (a) The annual maximum recorded floods in a river for the period of 2004 to 2017 are
     given below. Estimate the flood discharge with return period of (i) 100 years and (ii)
     500 years. Given $\overline{y_n} = 0.51$ and $S_n = 1.0095$ for n = 14.   **(15)**

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Maximum flood (m³/s)	3800	2900	4800	3900	3350	6650	5400	4250	3760	4160	8890	3980	4200	5700

     (b) The time distribution of a storm event is given in the following table: **(15)**

Time from start (hour)	1	2	3	4	5	6	7	8
Incremental rainfall (cm)	0.5	1.4	3	2.4	1.9	0.7	1.2	0.9

         (i) The φ-index is computed to be 1.3 cm/hour. Find out the volume of direct
         runoff if the catchment area is 0.9 Km².
         (ii) Compute the total volume of infiltration.
         (iii) Find out the time of rainfall excess.
         (iv) Find out the runoff coefficient for the catchment.

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

2.   (a) Consider the following two catchment areas: **(15)**

Catchment A	Catchment B
Slope = 0.002	Slope = 0.02
L = 1500 m	L = 2000 m
Sandy Soil	Clay Soil
High vegetative cover	No vegetative cover
Area = 2 Km²	Area = 3 Km²

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<u>Contd... Q. No. 2(a)</u>

where , L = maximum length of travel of water.

(i) Two runoff coefficients of 0.2 and 0.8 are given for the two catchments. Which runoff coefficients will be applicable to which catchment and why?

(ii) Find out the time of concentration for catchment A.

(iii) Compute the peak discharge for catchment A for a return period of 100 years using Rational Method. Use IDF curves shown in Figure 1.

(b) The relative humidity and saturation vapor pressure are computed to be 70% and 2400 Pa respectively. Assuming standard air pressure, find out the following: **(15)**

(i) air temperature, (ii) actual vapor pressure at air temperature, (iii) dew-point temperature, (iv) specific humidity, and (v) density of moist air.

(c) Discuss infiltration capacity regarding (i) forest soil, and (ii) water with heavy suspended particles. **(5)**

3. (a) The design precipitation intensity for a storm with a T-year return period with slope of 0.00425 and maximum length of travel of water of 1100 m for the catchment is 3 in/hr. The area of the catchment is 2 Km^2 and runoff coefficient is 0.5. **(15)**

(i) Design return period, (ii) Design precipitation volume (m^3), and (iii) Peak discharge (m^3/s) using Rational Method. Use the IDF curves (Figure 1) for your estimation.

(b) In a 180-min storm, the following intensities of rainfall were observed in successive 30-min intervals: 3.3, 3.6, 9.0, 6.6, 0.6 and 0.9 cm/hr. Assume the φ-index value to be 2.0 cm/hr, compute (i) total volume of runoff, (ii) total volume of infiltration, and (iii) duration of rainfall excess. The catchment area is 3 km^2. **(15)**

(c) Explain why vapor pressure at air temperature can be taken equal to saturation vapor pressure at dew-point temperature. **(5)**

4. (a) Four rain gages located within a rectangular area with four corners at (0,0), (0,13), (14,13) and (14,0) have the following coordinates and recorded rainfalls: **(15)**

Rain gage Location	Rainfall (mm)
(2,9)	20
(7,11)	25
(12,10)	30
(6,2)	40

All coordinates are expressed in kilometers. Compute the average rainfall in the area by Thiessen Polygon Method. Use plain graph paper.

(b) Define: (i) Orographic lifting, and (ii) Biological water. **(5)**

(c) Discuss the logic behind forming polygons in Thiessen Polygon Method. **(5)**

(d) Compute the base flow contributions between Perennial and Intermittent streams. **(5)**

(e) Explain the importance of infiltration index in hydrologic calculations. **(5)**

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

(One semi.log graph paper and two normal graph papers should be supplied)

5. (a) Briefly describe (i) the backwater effects on a rating curve, (ii) estimation of flood discharge by slope area method. **(8)**

(b) Explain the procedure of measuring (i) stage by float gauge recorder, (ii) velocity by vertical axis current meter and (iii) stream flow by dilution technique. **(12)**

(c) In moving boat method of flow measurement, the magnitude (V_R and direction (θ) of the velocity of the stream relative to the moving boat are measured. The flow depths are also simultaneously recorded. The measured data are given below. The sections are spaced at a constant distance of 58 m. Assume that the mean velocity of a vertical is 0.85 times the surface velocity of that vertical. Estimate the discharge of that stream. **(15)**

Section	0	1	2	3	4	5	6	7	8	9
V_R (m/s)	-	1.5	2.2	2.5	2.8	2.6	2.4	2.1	1.7	-
θ (deg)	-	52	56	60	66	65	60	55	50	-
Depth (m)	-	2.2	2.9	3.8	5.0	4.1	3.0	2.6	2.1	-

6. (a) Describe the basin characteristics which affect the shape of a hydrograph. **(8)**

(b) Explain (i) the procedure of derivation of unit hydrographs, (ii) use and limitations of unit hydrograph. **(12)**

(c) The flood hydrograph of a stream is given below. Neglecting interflow, analyze the recession limb and determine the recession coefficients. **(15)**

Time (days)	0	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
Discharge(cumec)	0	5	110	140	90	40	20	15	14	13	12	10	9	8	7

7. (a) Explain the procedure of deriving a synthetic unit hydrograph for a catchment by using Snyder's method. **(8)**

(b) A flood hydrograph of a river draining a catchment of 420 sq.km due to a 6 hour isolated storm is in the form of a triangle with a base of 66 hours and a peak ordinate of 216 cumec occurring at 18 hours from the start of rain. Assuming no base flow, develop a 6 hour unit hydrograph with ordinates at 6 hour interval. **(12)**

(c) Using the ordinate of 2-h unit hydrograph below, computes the ordinates of 3-h unit hydrograph. **(15)**

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Contd... Q. No. 7(c)

Time (hr)	0	2	4	6	8	10	12	14	16	18
Ordinates of 2-h UH (cumec)	0	30	42	66	56	48	40	30	20	0

8.   (a) What is hydrologic channel routing? Explain the Muskingum method of channel routing. **(10)**

(b) A reservoir has the following elevation-discharge-storage relationship. **(25)**

Elevation (m)	50	51	52	53	54	55	56	57	58	59
Storage ($10^6 m^3$)	5.50	5.90	6.40	6.80	7.60	8.40	9.20	9.80	10.00	10.50
Outflow (cumec)	0	25	80	140	160	180	210	230	270	300

When the reservoir level was at 52 m, the following flood hydrograph entered the reservoir.

Time (hr)	0	6	12	18	24	30	36	42	48	54
Discharge(cumec)	20	80	210	240	200	170	120	70	30	15

Using Goodrich method, route the flood and obtain (i) the outflow hydrograph and (ii) the reservoir elevation vs time curve during the passage of flood wave.
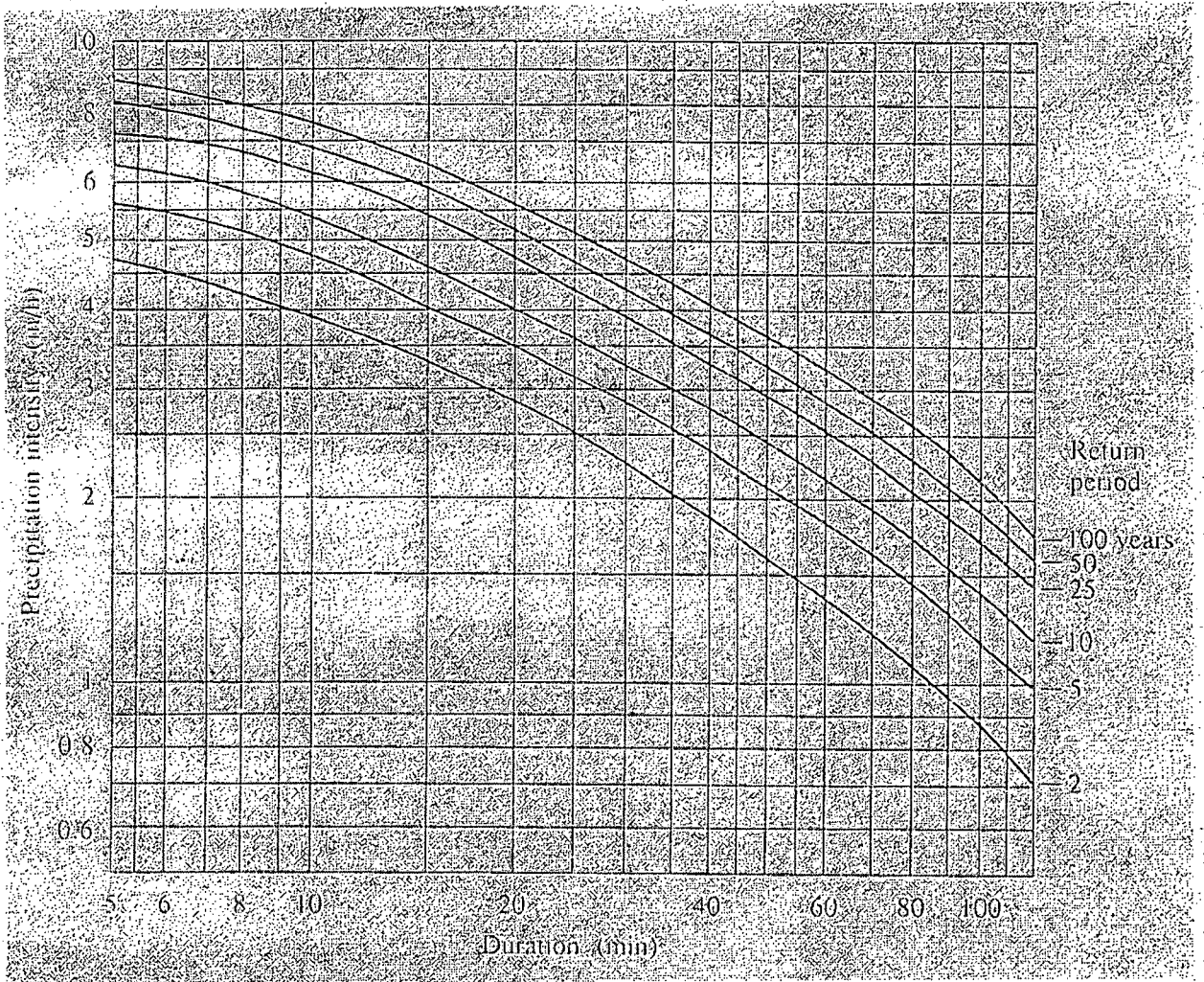

Figure 1 : Intensity – duration – frequency (IDF) curves for Q. No. 2(a) and 3(a).

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2   B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 210   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Define the terms: Ultimate bearing capacity, safe bearing pressure and allowable bearing pressure. **(10)**

    (b) Write down the assumptions made in deriving Terzaghi's bearing capacity equation for a shallow foundation of a long footing resting on clay. Draw and explain the schematic diagram of the failure surface. **(10)**

    (c) A footing 9 feet square, rests at a depth of 4.5 feet on clay has an unconfined compressive strength of 1.2 tons/sq. ft. If the factor of safety is not less than 2.0, what is the maximum column load that can be supported by the footing? Assume thickness of the footing is 2.5 feet and water table exists at base of the footing level. Draw the schematic diagram of the problem. **(15)**

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

    (b) Write down the step by step procedure in deriving soil pressure versus width of footing as a function of SPT values in sand for a shallow foundation. **(10)**

    (c) A footing 12 feet square and 3 feet thick is supported by sand with average N value of 30 blows/feet. The surface of the ground is 3 feet above the top of the footing and the water table is 2 feet below the base. Compute the maximum column load that can be supported by the footing if the settlement must not exceed 0.75 inch. Draw the schematic diagram of the described problem. **(15)**

3. (a) A 15 inch × 15 inch concrete pile was driven in a medium dense sand with 45 feet embedment length. Prior to installation, direct shear test was performed on the sand collected from the site and the value of the angle of internal friction was calculated as 35°. The depth of the water table was 10 feet from the ground surface and the unit weight of sand above and below the water table were given as 115 lb/cu.ft and 120 lb/cu.ft. Estimate the allowable pile capacity with factor of safety 2.5. **(15)**

    (b) A bored pile (cast-in-place) with 24 inch dia is installed in a steady soil as shown in Fig. 1. Calculate allowable capacity of the pile with a factor of safety of 3.0 using Reese and O'Neill (AASHTO, 1992) method. **(20)**

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Contd... Q. No. 3(b)

$\gamma = 108\ lb/ft^3$ 10 feet

$\gamma = 118\ lb/ft^3$ 40 feet

6 feet

N(uncorrected) =60

Fig-1
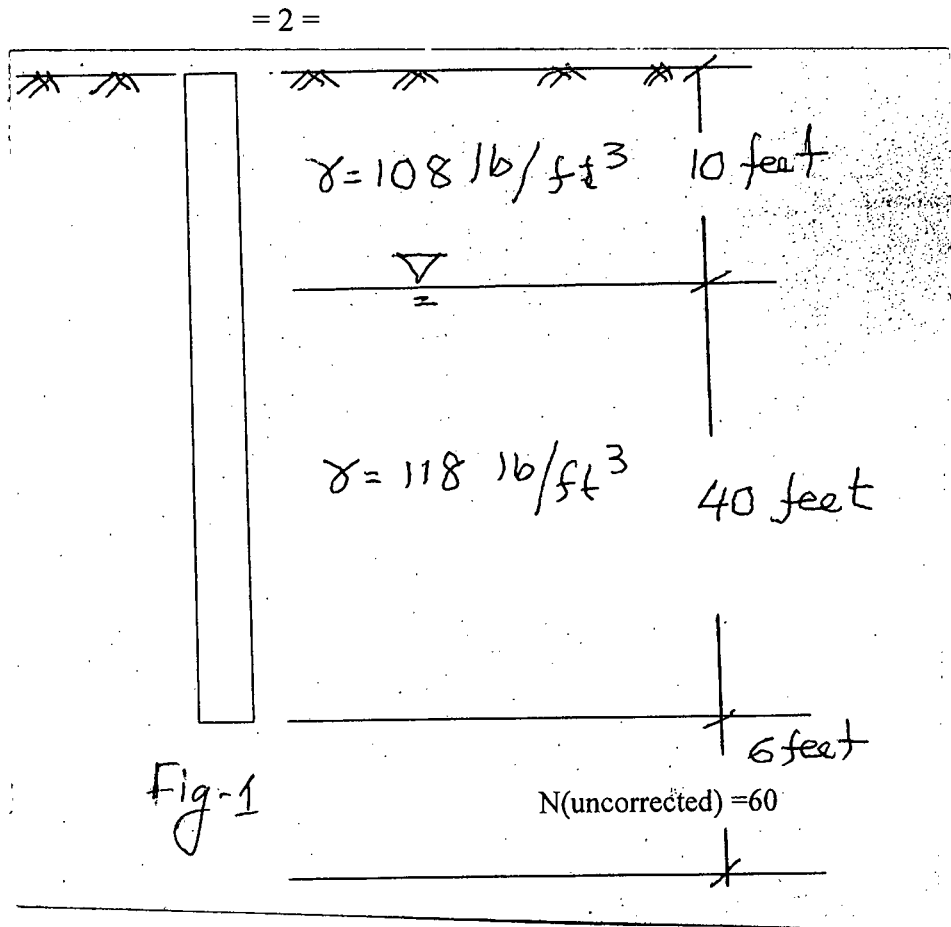
4. (a) Discuss the factors affecting axial load carrying capacity of piles. **(10)**

(b) A group of 9 piles with 3 piles in a row were driven into a soft to medium stiff clay. The diameter and the length of the piles were 18 inch and 35 feet. The unconfined compressive strength is of clay is 1.0 ton per sq.ft. The piles are spaced at 4.5 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. **(15)**

(c) Calculate the allowable uplift capacity of pile located at the centre of the pile group as mentioned in the problem no. 4(b). **(10)**

SECTION-B

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

5. (a) Mention the principal objectives of soil exploration. Briefly describe the wash boring method for advancing a borehole. **(10)**

(b) Show neatly the dimensions of an open-drive tube sampler and hence define the terms area ratio, inside clearance ratio, outside clearance ratio and cutting edge taper angles. Also mention the advantages of piston sampler over open-dive tube sampler. **(9)**

(c) A standard Penetration Test (SPT) performed on an over consolidated fine sand provided a field N-value of 35. The following conditions prevailed during the test: **(10)**

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— Rod length = 8 m

— Borelwle diameter = 150 mm

— Donut hammer pulled and released manually (ER_r = 55%)

— Standard rod energy ratio = 60%

— Standard sampler was used

— Effective overburden pressure at test depth = 0.75 kg/cm^2; OCR = 8

Find corrected N-value, relative density and angle of internal friction of the soil.

(d) Saturated unit weight and effective angle of internal friction (ϕ') of a cohesion less soil are 18 kN/m^3 and 30°, respectively. A slope is to be made of this material. If the factor of safety is to be 1.25, determine the safe angle of slope for the following causes: **(6)**

      (i) When the slope is dry.

      (ii) When seepage occurs at and parallel to the slope (i.e., water table is at slope surface).

6.   (a) What are the major causes of soil sample disturbance. Draw the qualitative curves showing the effect of sampler characteristics on degree of disturbance. Also mention the effects of tube sampling disturbance on soil properties. **(12)**

    (b) Describe briefly with neat sketches the procedure of in-site freezing technique for undisturbed sampling of saturated sands. **(9)**

    (c) Show with neat sketches the various modes of slope failures. With neat figure deduce an expression for the factor of safety against sliding of a slip circle in a C-ϕ soil using Fellenius Method of slices. **(9)**

    (d) A cut slope was excavated in a saturated clay at an angle of 40° with the horizontal. Slope failure occurred when the cut reached a depth of 6.1 m. Previous soil explorations showed that a rock layer was located at a depth of 9.15 m below the ground surface. Assuming an undrained condition and that γ_{sat} = 17.5 KN/m^3, **(5)**

      (i) Determine the undrained cohesion of the clay

      (ii) What is the nature of the critical circle?

7.   (a) List the information that are usually obtained from a bore log. **(5)**

    (b) Mention the relative advantages and disadvantages of Cone Penetration Test (CPT). **(5)**

    (c) Draw neatly a schematic arrangement of dynamic probing. What are the four recommended types of dynamic probing? **(6)**

    (d) The upstream slope of an earth dam of height 6 m was constructed at angle of 70°. The values of saturated unit weight, cohesion and angle of internal friction of the embankment soil are 20 KN/m^3, 25 KN/m^2, and 10° respectively. using Taylor's Method, determine the factor of safety of the slope when the reservoir is full to the top level of the slope and when a sudden drawdown occurs. **(8)**

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(e) A dry cohesive deposit of clay of height 3 m exists in an infinite slope. The slope angle is 60°. The values of effective cohesion (C′) and effective angle of internal friction (ϕ') of the clay are 25 KN/m^2 and 20°, respecrively. Dry unit weight of the clay is 16 KN/m^3, Find the following: **(11)**

      (i) Factor a safety of the slope with respect to cohesion assuming friction has been fully mobilized.

      (ii) Factor of safety of the slope with respected to sliding.

      (iii) Critical height of the slope.

8.   (a) Define negative skin friction in a pile. What are the causes of negative skin friction and how it can be mitigated? **(6)**

    (b) Why pile load tests are performed? Described at least three methods of estimating allowable load from pile load test. **(7)**

    (c) What are the advantages of using drilled (bored) piles? Also mention disadvantages of bored piles. **(5)**

    (d) Why a larger magnitude of settlement is allowed for the design of raft foundation? **(5)**

    (e) A concrete raft foundation of 40 ft by 60 ft is shown Fig. 2 with mat thickness of 4 ft. The raft is resting on clay having an unconfined compressive strength (qu) of 1.5 tsf. The load coming from the super-structure (DL + LL) is 3000 ton. Estimate the depth of the bottom of the raft for a fully compensated foundation. **(12)**
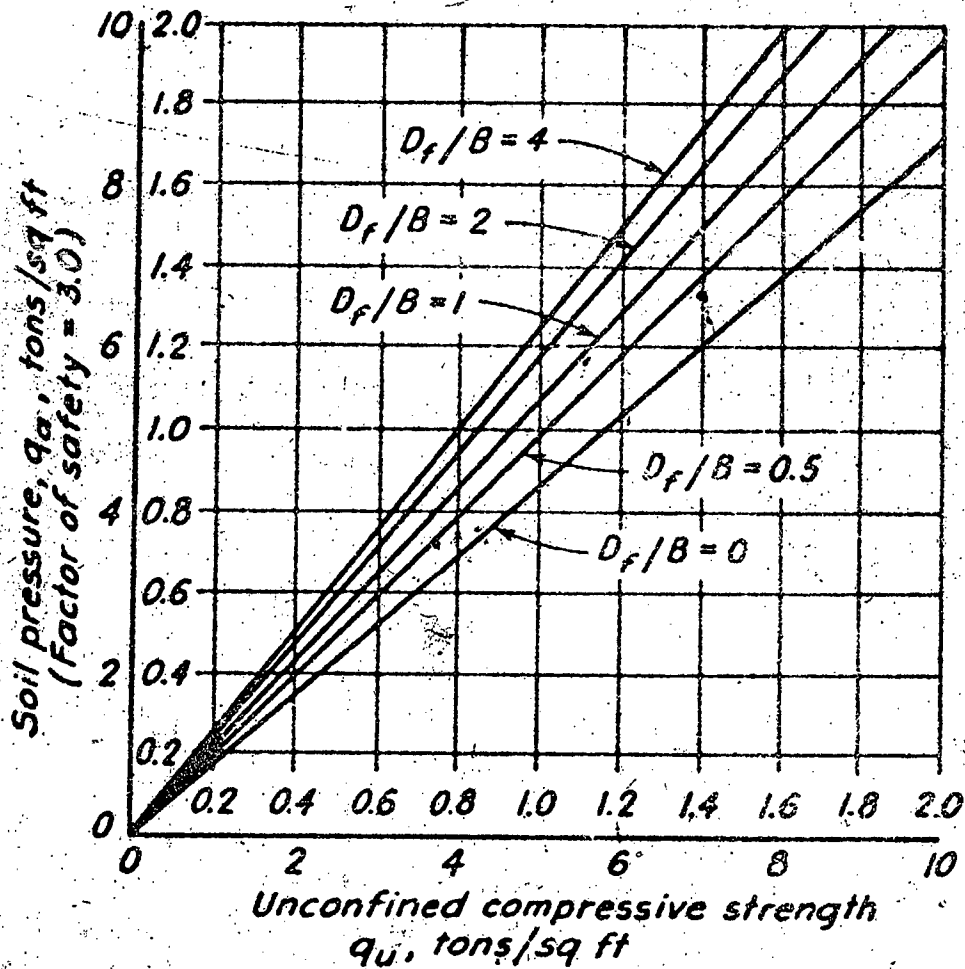

Fig. 2
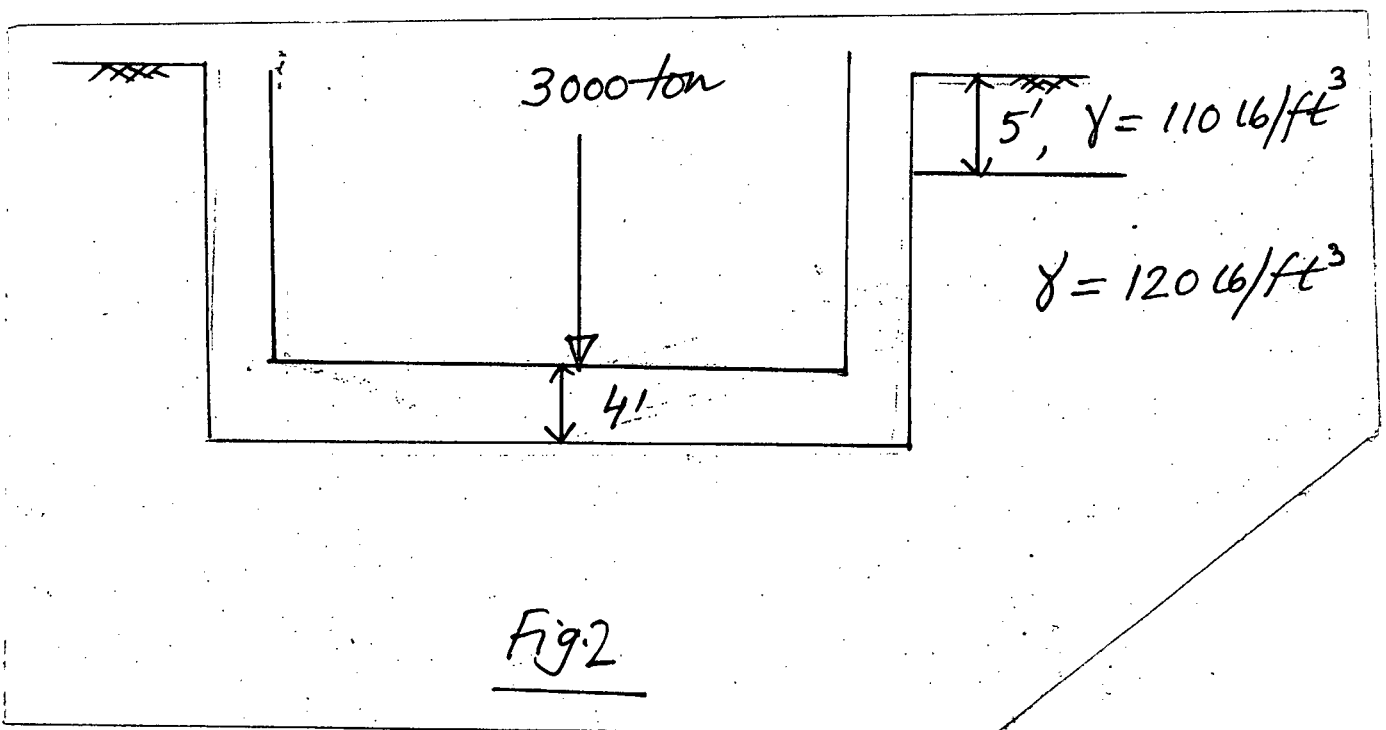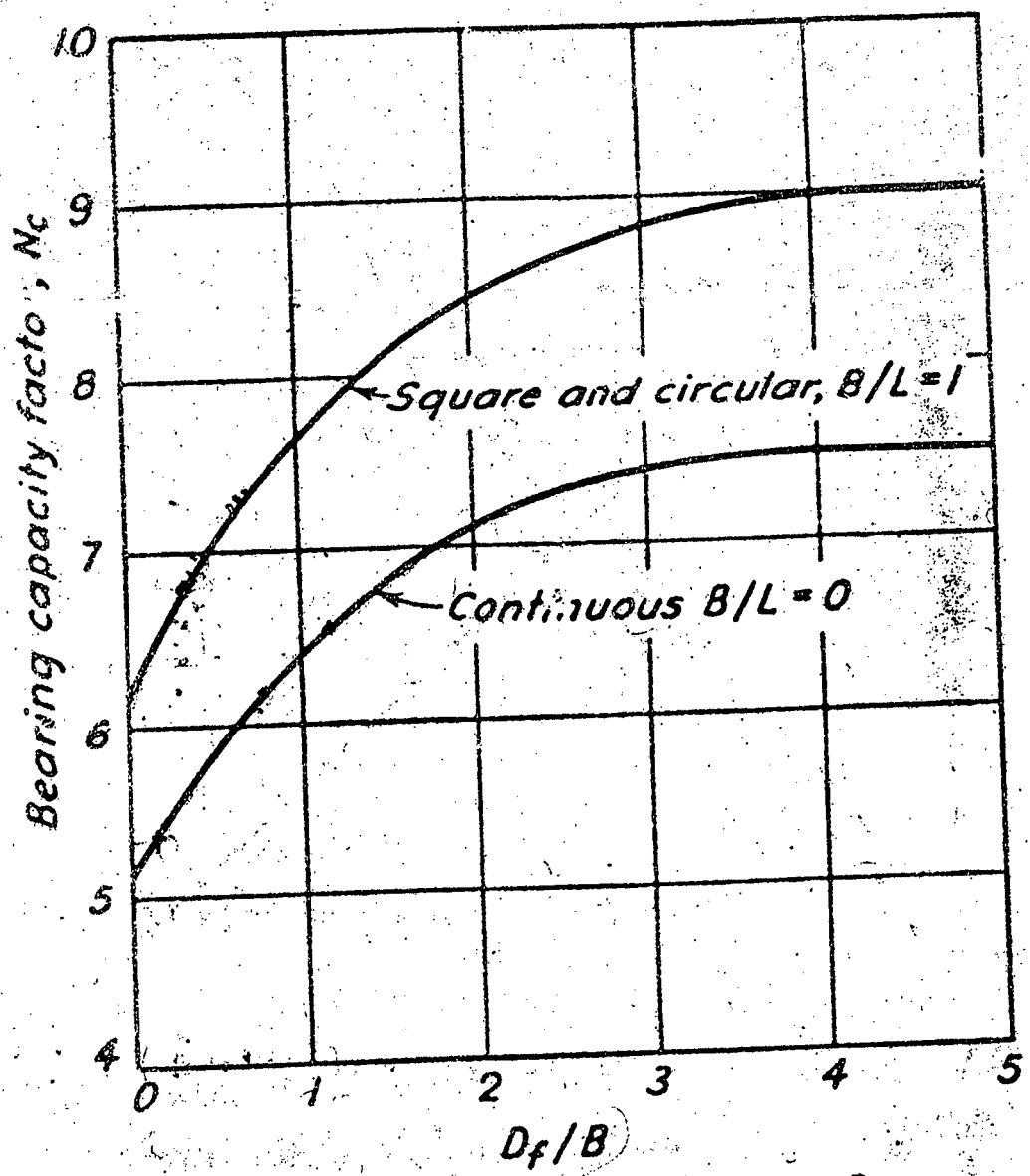
Appendix -I

Bearing capacity factors for foundations on clay under $\phi = 0$ conditions (after Skempton, 1951). Chart 1

Appendix -I

Y-axis: Soil pressure, q_a, tons/sq ft (Factor of safety = 3.0)

X-axis: Unconfined compressive strength q_u, tons/sq ft

Curves: $D_f/B = 4$, $D_f/B = 2$, $D_f/B = 1$, $D_f/B = 0.5$, $D_f/B = 0$

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.
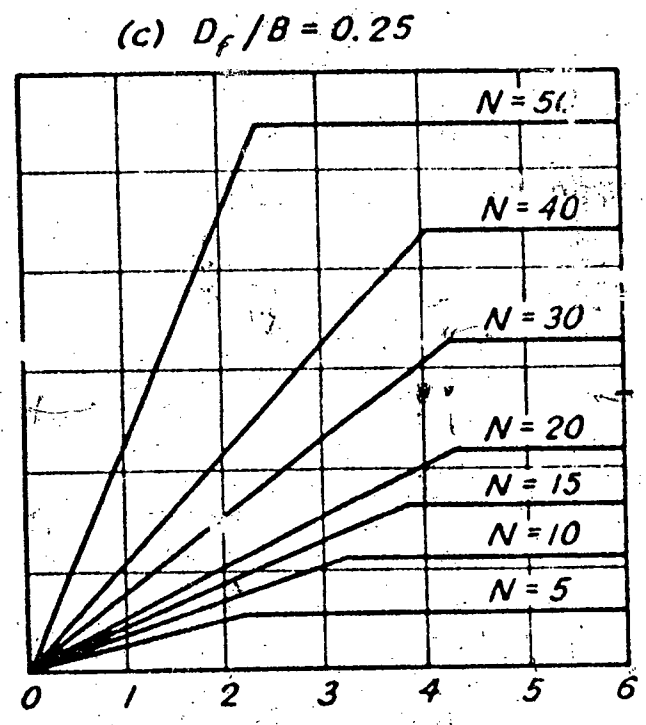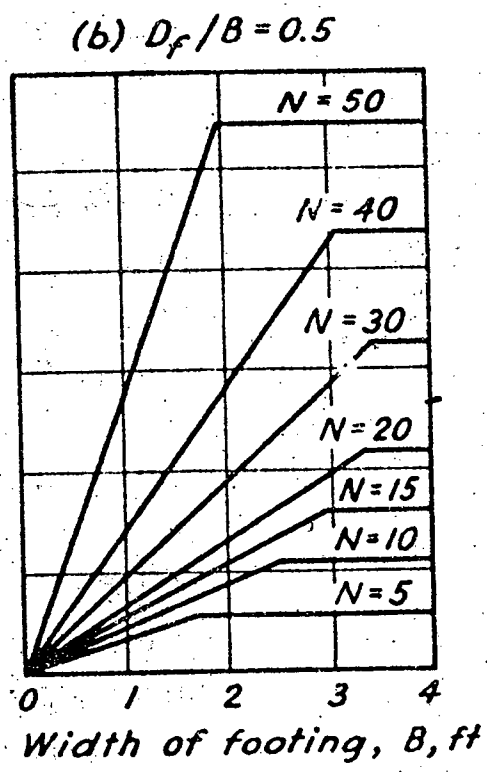
Chart 2

(a) $D_f/B = 1$ (b) $D_f/B = 0.5$ (c) $D_f/B = 0.25$

Soil pressure, tons/sq ft

N = 50
N = 40
N = 30
N = 20
N = 15
N = 10
N = 5

Width of footing, B, ft
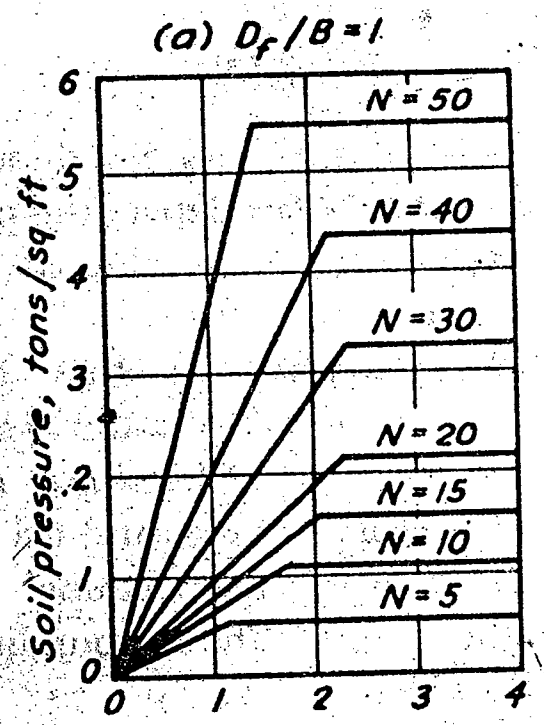
Chart 3

Design chart for proportioning shallow footings on sand.

Appendix -I
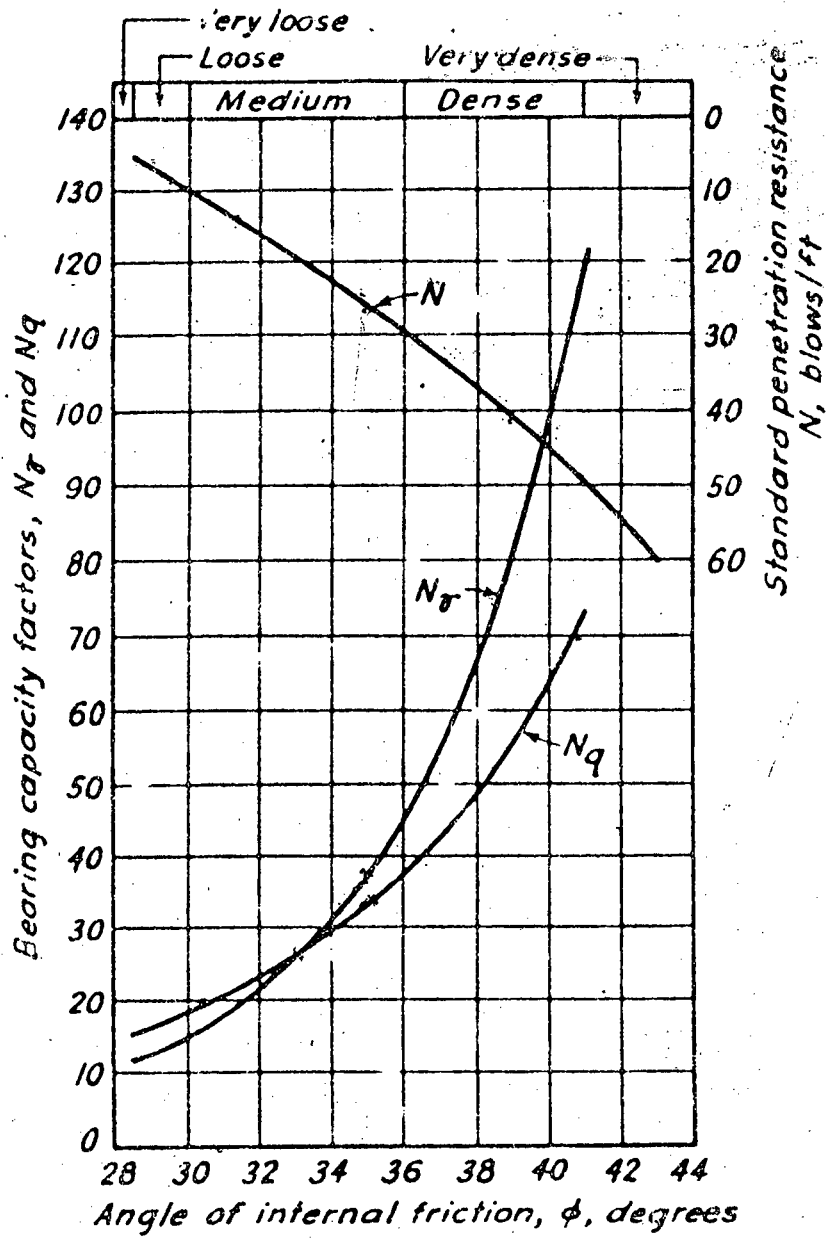
Curves showing the relationship between bearing-capacity factors and ϕ, as determined by theory, and rough empirical relationship between bearing capacity factors or ϕ and values of standard penetration resistance N.   Chart 4
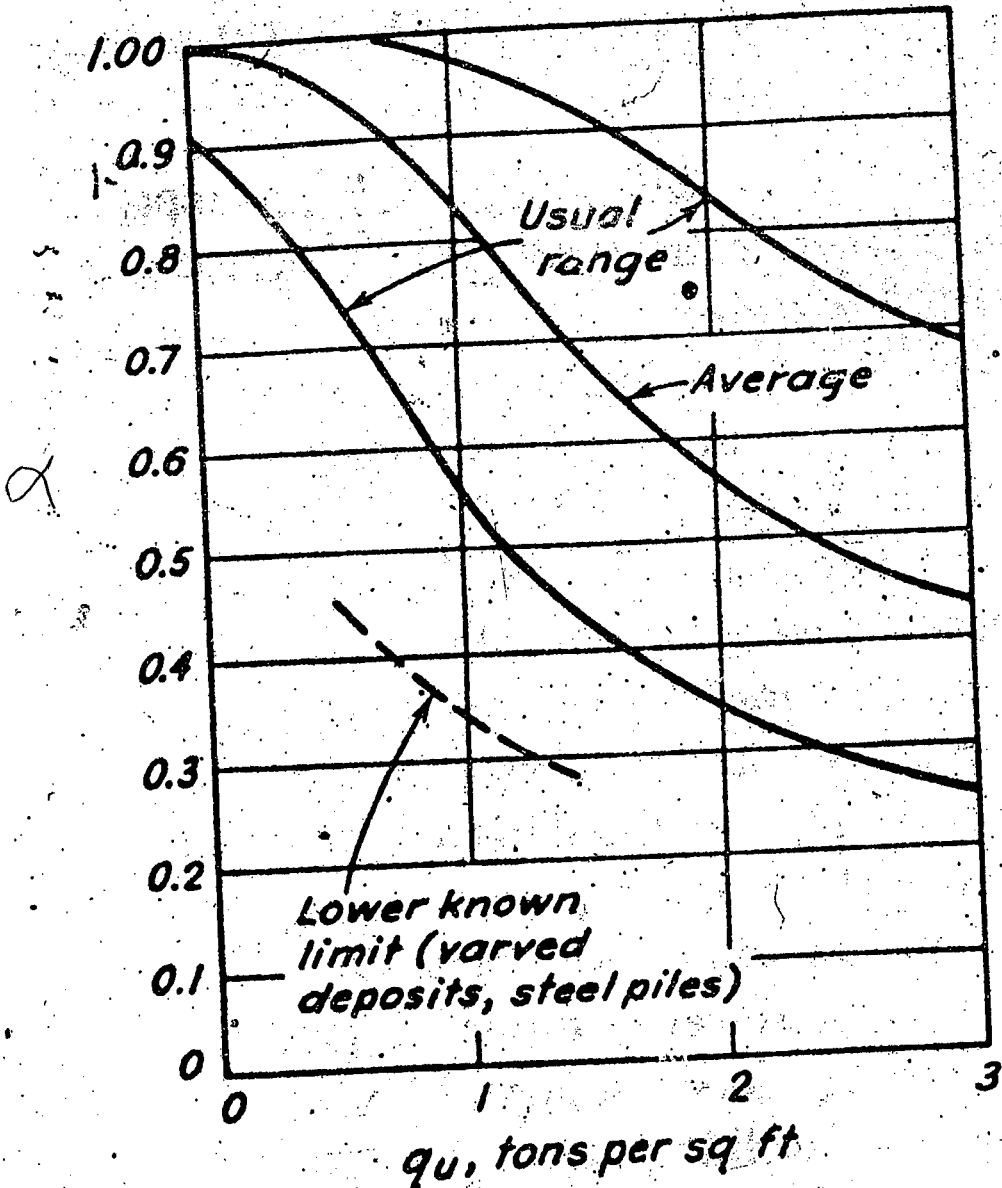
Values of reduction factor α_2 for calculation of static capacity of friction piles in clays of different unconfined compressive strengths q_u. Chart 5

(b) Berezantsev's Bearing Capacity Factor, N_q

Bearing capacity factors by various investigators for deep foundations.

chart 6

Table 1   Approximate Corrections to Measured N-Values

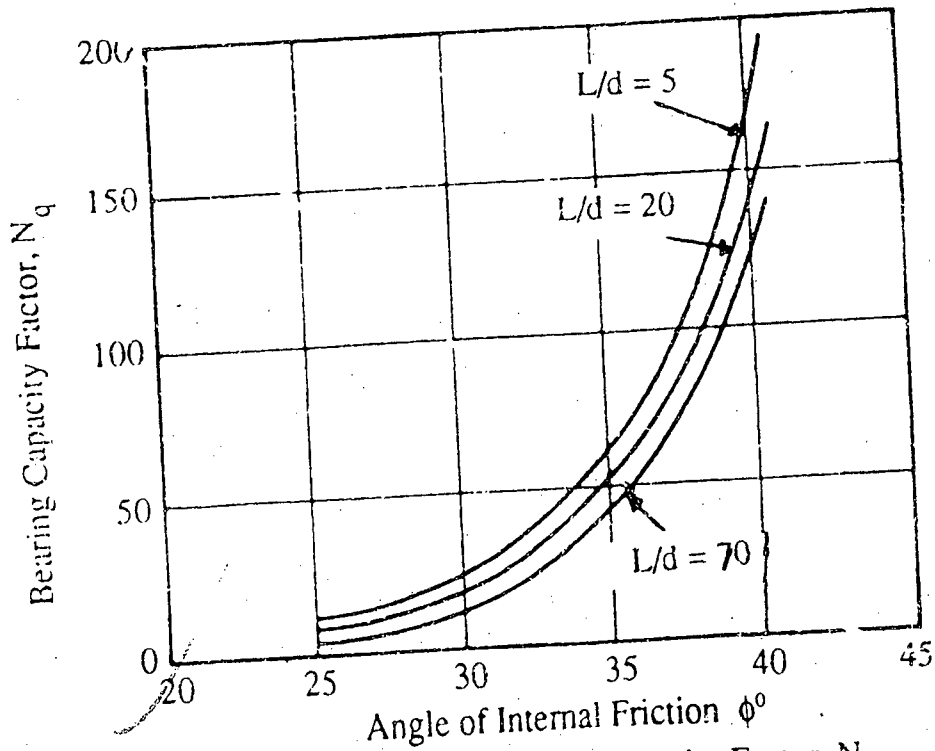| Rod length: > 10 m	1.00
6-10 m	0.95
4-6 m	0.85
3-4 m	0.75
Standard sampler	1.00
U.S. sampler without liners	1.20
Borehole diameter : 65-115 mm	1.00
150 mm	1.05
200 mm	1.15

Standard Rod Energy Ratio = 60%

Table 2   Summary of Rod Energy Ratios

Country	Hammer	Release	$ER_r\%$	$ER_r/60$
Japan	Donut	Tombi	78	1.3
	Donut	2 turns of rope	65	1.1
China	Pilcon type	Trip	60	1.0
	Donut	Manual	55	0.9
USA	Safety	2 turns of rope	55	0.9
	Donut	2 turns of rope	45	0.75
U.K.	Pilcon, Dando	Trip	60	1.0
	Old Standard	2 turns of rope	50	0.8

For β>53°, critical circles are **toe circles,**

For β<53°, critical circle may be a **toe circle, slope circle or midpoint circle.**

Max^m, m = 0.181

β=53°

$D = \infty$

For β < 53°:
Toe circle
Midpoint circle
Slope circle

4.0

1.0 1.2 1.5 2.0

Firm base   (a)

Stability number, m

Slope angle, β (deg)

Chart 7⊥

D = depth factor

H

β

DH

Hard stratum

$D = \infty$

$\phi = 0°$

5°

10°

15°

20°

25°

30°

35°

40°

D=4
D=3
D=2
D=1.5
D=1.2
D=1
D=1

Stability number, S_n

Slope angle, β
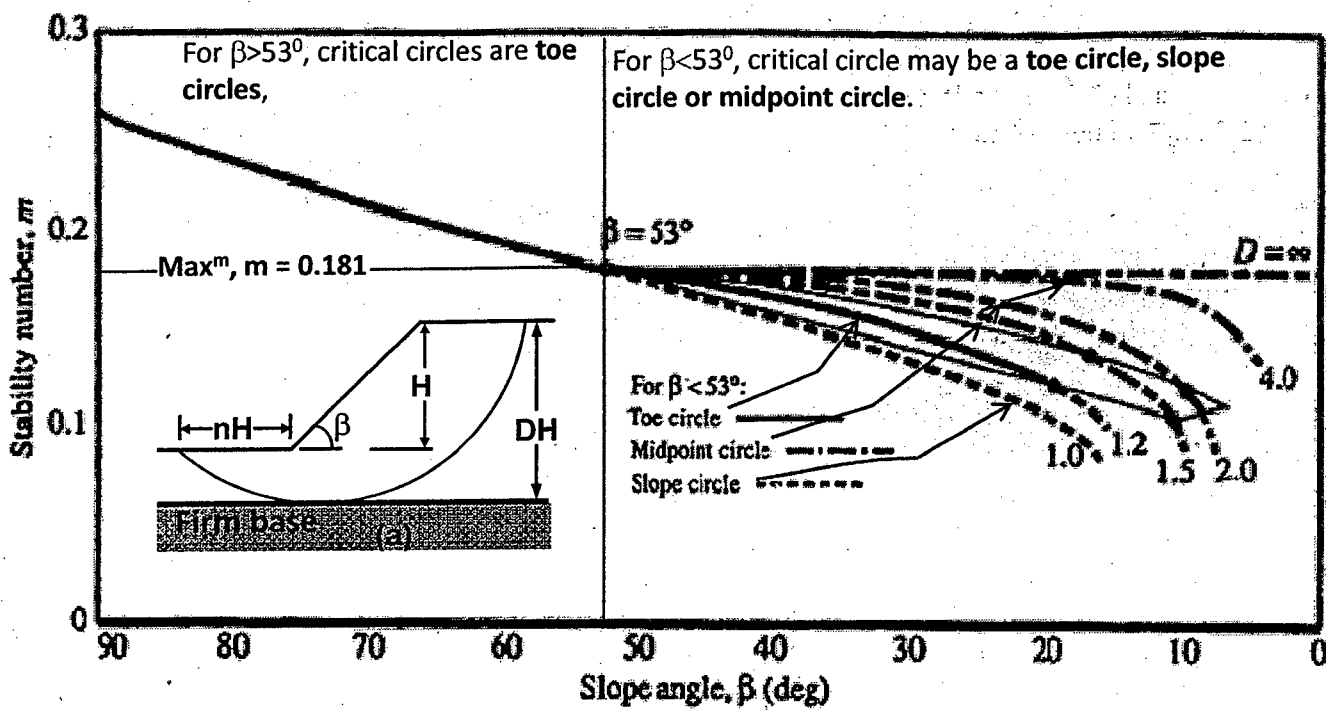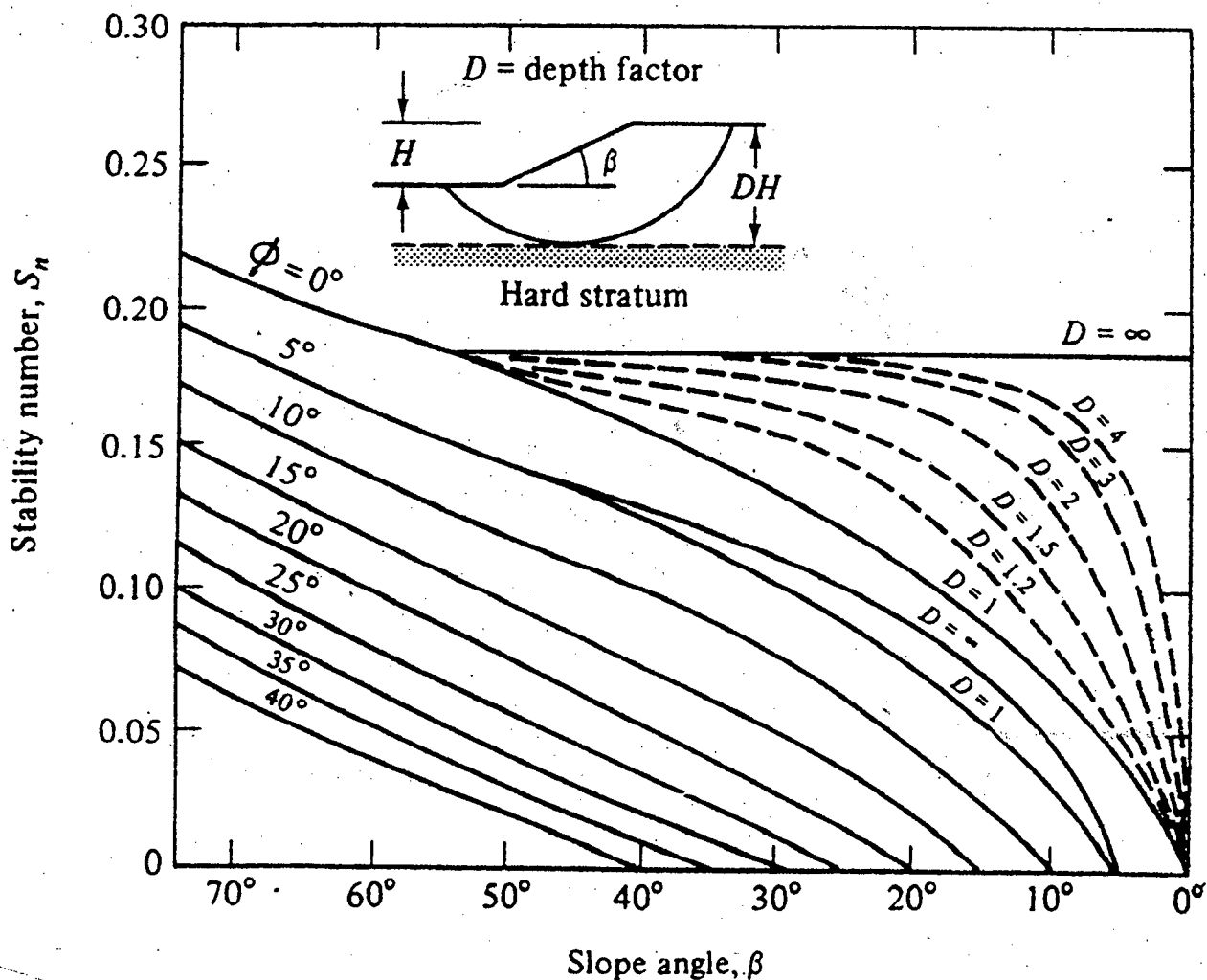
Chart 8

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-2   B. Sc. Engineering Examinations 2016-2017

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

Full Marks: 280   Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1.   (a) What are the main objectives at water supply for drinking purpose? Show the essential elements of water supply system in a neat sketch. Explain with examples the relevance of Environmental Engineering in your professional field.   (23)

(b) Describe the factors affecting per capita demand of water. The population of a small town was 25,000 in 1970, 29,000 in 1980, 38,000 in 1990, 55,000 in 2000 and 80,000 in 2010. Estimate the probable population of the town in 2020 and 2030 by least square parabola method.   ($23\frac{2}{3}$)

2.   (a) Why is hydrologic cycle important? Explain with diagram. What are the main considerations for selection of a water supply source? What are the different factors that govern the location of an intake?   ($23\frac{2}{3}$)

(b) A 300 mm diameter well in a water table aquifer is being pumped at a rate of 2,000 litre/min with a drawdown of 10 m. The static depth of water in the well is 50 m. During pumping, the depth of water in a similar well, not being pumped situated at a distance of 7.5 m, is 47 m. At what rate could water be pumped from two wells, if both the wells are being pumped together with a drawdown of 9 m?   (23)

3.   (a) What are the different unit processes that commonly used to treat water for domestic or industrial water supply? What are the major problems of water supply in Bangladesh? Briefly explain the types and purpose of settling.   ($23\frac{2}{3}$)

(b) Considering the settling of discrete particles, derive stokes law.   (23)

4.   (a) What are the different steps in EIA process? State the DOE protocols for obtaining environmental clearance of projects/ industries? What are the main environmental issues in Bangladesh?   ($23\frac{2}{3}$)

(b) What are the main elements of an Environmental Management Plan (EMP)? With a mathematical deduction, show that the efficiency of a settling tank is independent of the depth of the tank, rather it depends on the surface area of the tank.   (23)

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SECTION-B

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

5. (a) Discuss the role of Fungi in sewage Treatment. **(10)**

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

   (c) Draw the anaerobic decomposition cycle of sewage. $(9\frac{2}{3})$

   (d) Show that the ratio of the $2\frac{1}{2}$-day BOD at 35°C to 5-day BOD at 20°C is approximately unity (Assume $\theta = 1.05$). **(12)**

6. (a) Briefly discuss a conventional simple pit latrine with merits and demerits. $(16\frac{2}{3})$

   (b) Differentiate between 'sedimentation tank' and 'Imhoff tank'. **(10)**

   (c) Design a septic tank for 50 users. The waste water generation rate is 200 lpcd. Desludging frequency of the septic tank is 10 years. (Assume any data missing). **(20)**

7. (a) State and prove Marais Theorem. $(16\frac{2}{3})$

   (b) How odour of an Anaerobic pond is controlled? **(6)**

   (c) Discuss briefly the volumetric loading and surface loading in waste stabilization ponds system. **(10)**

   (d) Why removal of Fecal Coliform is more in waste stabilization ponds system than any other waste treatment process? **(6)**

   (e) Discuss briefly the symbiosis between 'Algae' and 'Bacteria' in a facultative pond. **(8)**

8. (a) Draw flow diagram for the following treatment process. $(16\frac{2}{3})$

      (i) Waste stabilization ponds system.
      (ii) Activated sludge process.
      (iii) Aerated Lagoon.
      (iv) Two-stage trickling Filter.

   (b) Draw a flow diagram showing Functional elements of a complete solid waste management system. **(15)**

   (c) Draw schematic diagrams of hauled and stationary container systems of solid waste collection. **(15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
L-3/T-2   B. Sc. Engineering Examinations 2016-2017
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.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.
Assume reasonable values for missing data (if any).

1.   (a) The sieve analysis results of three different types of aggregates are shown in the following Table. Blend these aggregates to get the desired specification as given. (for target value use midpoint value where required).   **(13)**

Materials Used	Specification	Aggregate-A	Aggregate-B	Aggregate-C
sieve size (in)		% Passing	% Passing	% Passing
$1\frac{1}{2}$	100	100	100	100
1	100	100	100	100
$\frac{3}{4}$	90-100	100	100	90
$\frac{1}{2}$	80-95	100	95	80
$\frac{3}{8}$	70-80	100	85	60
#4	50-60	80	60	40
#8	35-45	70	50	20
#200	5-8	15	10	0

(b) What are the desirable properties of stone aggregates? Why ten percent fines test is recommended for weak aggregates? "Stone aggregates is the king of construction materials"- Explain the statement.   **(13$\frac{2}{3}$)**

(c) Define low cost pavements. What are the different types of low cost pavements? Describe construction steps of earth roads.   **(10)**

(d) Why Highway maintenance is required? Describe different types of maintenance works.   **(10)**

2.   (a) Pavement design using staged construction, prove that, N_1 = 1.67 n_1 and N_2 =2.50 n_2 where N_1 = allowable numbers of ESALs for the initial thickness selected for stage 1,   **(10)**

n_1 = actual accumulated ESALs for stage 1
N_2 = adjusted design ESALs for stage 2
n_2 = design ESALs for stage 2.

(b) What are the desirable characteristics of pavement? Compare Rigid and Flexible pavements from following point of view: Design precision, life cycle cost, surface characteristics, traffic dislocation during construction.   **(7+8)**

Contd... Q. No. 2

(c) An 8-lane divided highway is to be constructed on a new alignment. Traffic volume forecasts indicate that the average annual daily traffic (AADT) in both directions during the first year of operation will be 12,000 with the following vehicle mix and axle loads. **(12$\frac{2}{3}$)**

Passengers Cars (1000 lb/axle) = 50%   [F_{Ei} = 0.00002]
2 axle single unit truck (6000 lb/axle) = 15% [F_{Ei} = 0.01043]
3 axle single unit truck (9000 lb/axle) = 12% [F_{Ei} = 0.0562]
3 axle single unit truck (12,000 lb/axle) = 13% [F_{Ei} = 0.189]
2 axle Tandem unit truck (12,000 lb/axle) = 10% [F_{Ei} = 0.0144]

The vehicle mix is expected to remain the same throughout the design life of the pavement. If the expected annual traffic growth rate is 5% for all vehicles, determine the design ESAL, given a design period of 20 years.

Assume, design lane factor f_d = 48%, Growth factor G_t = 33.06.

(d) List the basic Engineering properties of soils that are important in Connection of Pavement design. Discuss classification of sands according to source and size. **(9)**

3.   (a) What are the differences between "Fractional distillation" and "Destructive distillation" process. State the uses of Asphalt Cement, Asphalt Emulsion and Blown Asphalts. **(12)**

(b) What are the factors affecting design of Rigid Pavement? What are the factors considered in the AASHTO method of Rigid Pavement design? Explain the requirements of joints in Rigid Pavement. **(14)**

(c) Design a Rigid Pavement using the AASHTO method for the following design criteria. **(12)**

Effective modulus of suflgrade reaction k = 72 lb/in^3, Concrete elastic modulus, E_c = 5 × 10^6 lb/in^2, Mean Concrete modulus of rupture S'c = 650 lb/in^2, Load transfer coefficient J = 3.2, c_d = 1.0, present serviceability index P_i = 4.2, Final serviceability index P_t = 2.5, Reliability, R = 95%, overall standard deviation S_o = 0.29, ESAL = 6 ×10^6, Required design charts are given as attached.

(d) Differentiate between Tack Coat and Prime Coat. **(8$\frac{2}{3}$)**

4.   (a) Compare Railway with Roadway. What are the factors affecting the choice of a particular gauge? What are the advantages of flat footed rails? **(14)**

(b) What are the points to be kept in mind while selecting location for a railway station? Discuss the various resistances which a locomotive has to overcome before hauling a train. **(16$\frac{2}{3}$)**

(c) Write down the function of followings: **(16)**

   (i) Ballast (ii) Sleepers (iii) Rail (iv) Railway Signal.

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SECTION-B

There are **FOUR** questions in this section. Answer **QUESTION NO 5** and any **TWO** questions from the rest.

5. (a) With a neat sketches illustrate the traffic movement at an intersection having Partial Cloverleaf Interchange. **(10)**

(b) Derive the formula for calculating intergreen period in designing traffic signal for a 4- legged intersection with wider lanes having raised median at pedestrian crossings and high pedestrian movement. **(10)**

(c) Show with neat sketches the minimum passing sight distance for a two-lane two-way Highway for Right-Handed Traffic. **(10)**

(d) Illustrate the fundamental interconnection of transportation and land use. **(10)**

6. (a) With neat sketches demonstrate the conflict points at a 4-legged intersection. **(6)**

(b) A toll bridge can carry maximum of 7500 vehicle/day but it carries only two third of its capacity per day now. The current toll is BDT. 300. When the toll is decreased by BDT. 25, traffic volume increase by 500 vehicle/day. How much the government has to subsidize per day if they decide to decrease the toll by 50%, yet maintaining the current revenue. **(8)**

(c) Mention the locations where parking should be prohibited. Write down the types of parking facilities and method of parking. **(5+5=10)**

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

  (i) Design Speed

  (ii) Design Vehicle

  (iii) Level of Service

(e) The owner of a parking garage located in a CBD has observed that 20% of those wishing to park are turned back every day during the open hours of 8 a.m. to 6 p.m. because of lack of parking spaces. An analysis of data collected at the garage indicates that 60% of those who park are commuters, with an average parking duration of 9 hr, and the remaining are shoppers, whose average parking duration is 2 hr. If 20% of those who cannot park are commuters and the rest are shoppers, and a total of 200 vehicles currently park daily in the garage, determine the number of additional spaces required to meet the excess demand. Assume parking efficiency is 0.90. **(14)**

7. (a) Briefly state the main principles of Safer Road Environment. **(6)**

(b) A driver is driving at 65 mi/h when she observes that an accident has blocked the road ahead. Determine the distance the vehicle would move before the driver could activate the brakes. The vehicle will continue to move at 65 mi/h during the perception-reaction time. **(8)**

(c) Write down the basic concepts of Transportation System Modeling. **(10)**

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(d) How can you measure efficiency of transport system? Explain the performance measuring criteria with examples of various transportations modes. **(4+8=12)**

(e) We need to distribute work trip productions from zone 4 to zones 1, 2, 3, 4 and 5. The numbers of work trip productions and attractions were determined in the trip generation phase. Travel times and F_{ij} values are given. **(14)**

Zone	1	2	3	4	5	Total
Trip productions, P_i	0	102	602	715	397	1816
Trip attraction, A_j	1080	531	76	47	82	1816

Travel time (min)						Friction Factor, Fij					
i \ j	1	2	3	4	5	Travel time (min)	5	7	10	20	25
4	20	7	5	10	25	F_{ij}	45	29	18	6	4

8. (a) Explain diagrammatically the method of attaining super elevation considering pavement revolved about inside edge. **(6)**

(b) Determine the minimum yellow interval at an intersection whose width is 40 ft if the maximum allowable speed on the approach roads is 30 mi/h. Assume average length of vehicle is 20 ft. **(8)**

(c) Name the functional classification of traffic signs and give two examples for each. **(5+5=10)**

(d) At what 'circumstances all-red period is considered in traffic signal design? List different types of signal controller and differentiate between pre-timed signal and vehicle-actuated signal controller. **(4+4+4=12)**
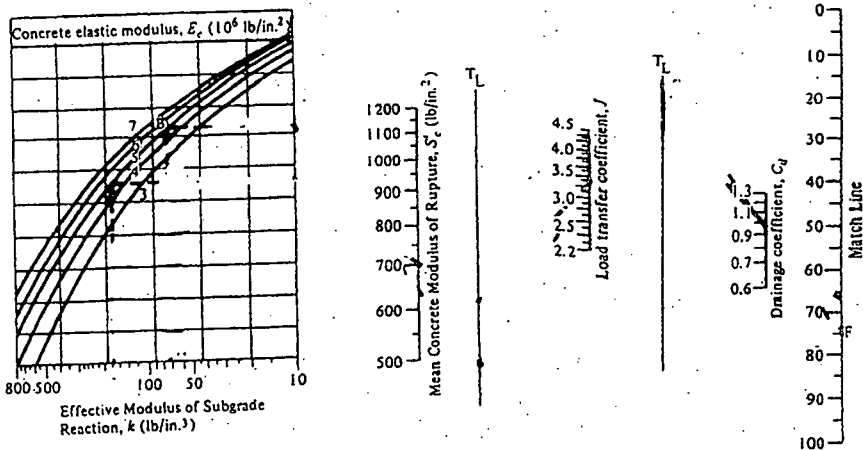
(e) Design a two-phase signal of an isolated cross-junction for the following data. **(14)**

Inter-green period, s	=	7	6
Initial and final lost time, s	=	3	2

		N	S	E	W
Flow, (pcu/hr)	=	730	480	850	650
Saturation Flow, (pcu/hr)	=	2100	1900	2200	2050

Draw the phase and cycle time bar diagram.

----

for Q 3(C)

Concrete elastic modulus, E_c (10^6 lb/in.²)

Effective Modulus of Subgrade Reaction, k (lb/in.³)

Mean Concrete Modulus of Rupture, S_c (lb/in.²)

Load transfer coefficient, J

Drainage coefficient, C_d

Match Line

Example:
$\overline{k} = 72$ lb/in.³
$E_c = 5 \times 10^6$ lb/in.²
$S'_c = 650$ lb/in.²
$J = 3.2$
$C_d = 1.0$

$S_o = 0.29$
$R = 95\% (Z_R = -1.645)$
$\Delta PSI = 4.2 - 2.5 = 1.7$
$W_{18} = 5.1 \times 10^6$ (18 kip ESAL)
Solution: $D = 10.0$ in. (nearest half-in., from segment 2)

Source: Redrawn from *AASHTO Guide for Design of Pavement Structures*, Washington, D.C.: The American Association of State Highway and Transportation Officials, copyright 1986. Used by permission.

Figure: **2.** Design Chart for Rigid Pavements Based on Using Mean Values for Each Input Variable (Segment 2)

for Q 3(C)

Design slab thickness, D (in.)

Match Line

Design Serviceability Loss, ΔPSI

Estimated total 18 kip equivalent single-axle load (ESAL) applications, W_{18} (millions)
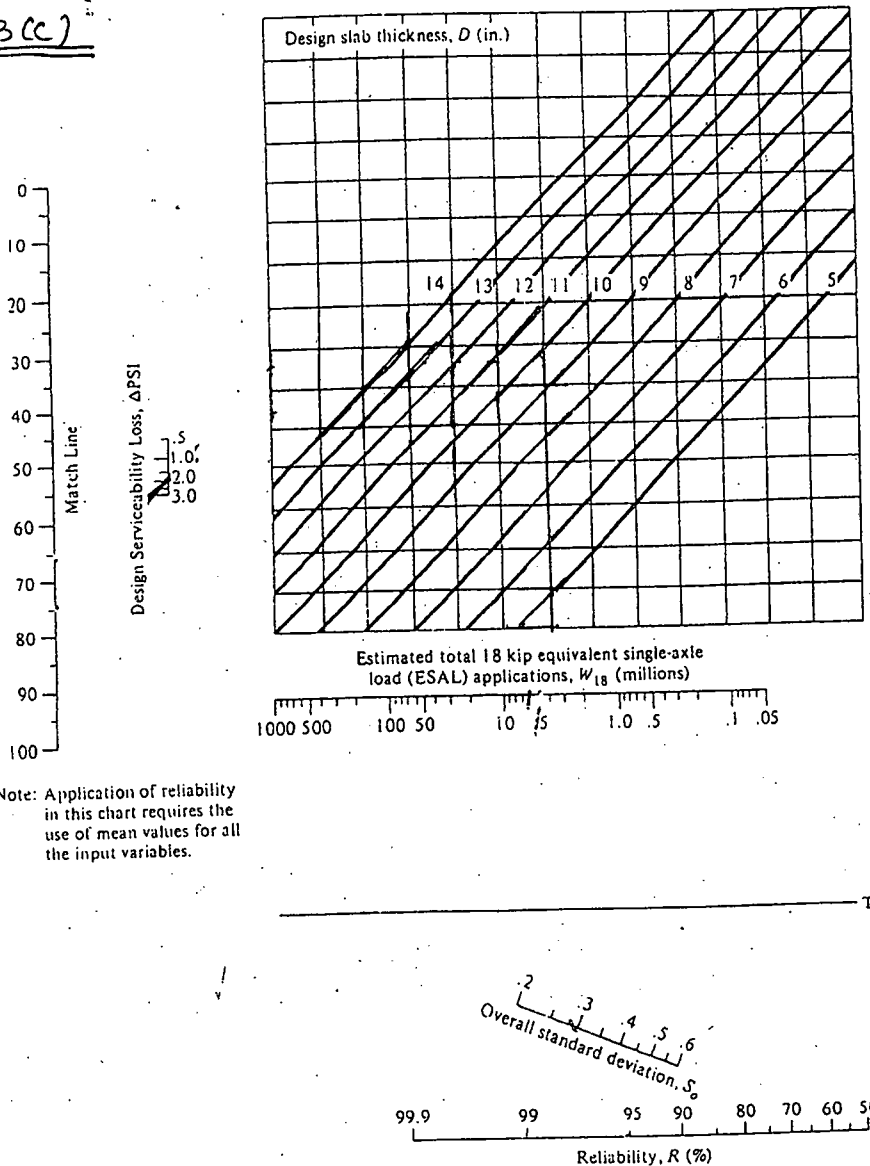
Note: Application of reliability in this chart requires the use of mean values for all the input variables.

Overall standard deviation, S_o

Reliability, R (%)

Source: Redrawn from *AASHTO Guide for Design of Pavement Structures*, Washington, D.C.: The American Association of State Highway and Transportation Officials, copyright 1986. Used by permission.