L-4/T-1/CE **Date : 07/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : CE 411 (Structural Analysis and Design II)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Assume reasonable values for missing data, if any. The symbols carry their usual meaning.

1. Fig. 1 shows a loaded one-story bent with an inclined leg. The relative stiffness value for each member is given in the figure within parentheses. Analyze the structure using moment distribution method and find out end moments. **(35)**

2. (a) Analyze the beam shown in Fig. 2 using moment distribution method. Draw bending moment diagram. EI is constant. **(15)**

   (b) Calculate deformation of the unrestrained degrees of freedom of the plane frame shown in Fig. 3. Use stiffness method. Ignore axial deformation. Given, EI = 10,000 k-in^2. **(20)**

3. (a) Write down the stiffness equations in matrix form for the beam shown in Fig. 4. Given: E = 3,000 ksi, I_1 = 10,000 in^4, I_2 = 7,500 in^4. **(15)**

   (b) Determine bar forces of the truss shown in Fig. 5. Use stiffness method. Areas are given in parentheses. Given, E = 30,000 ksi. **(20)**

4. For the plane truss shown in Fig. 6, determine the nodal coordinate matrix, member connectivity matrix, member property matrix, combined load matrix, member stiffness matrix, global stiffness matrix and modified global stiffness matrix. Given, E = 30,000 ksi. **(35)**

Contd P/2

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SECTION – B

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

5. (a) Analyse the frame in Fig. 7 by the consistent deformation method and draw the bending moment diagram. (EI = Constant) **(29)**

   (b) Show two possible primary (released) structures and redundants for the structures in Fig. 8. **(6)**

6. (a) Find reactions due to a vertical settlement of 6 mm at the support A of the beam in Fig. 9. $E = 200 \times 10^6$ kN/m^2 and $I = 160 \times 10^{-6}$m^4 for the beam. **(25)**

   (b) For the frame in Fig. 10, draw the qualitative influence lines for (i) maximum +ve bending moment at P, (ii) maximum negative bending moment at B of the beam BC and (iii) maximum axial force in column BF. Show the corresponding loading pattern for uniformly distributed live load for each of them. **(10)**

7. (a) Compute the force in the tie rod (Fig. 11). Include the effect of both axial and bending (E is constant). **(27)**

   (b) Draw qualitative influence lines for bending moment at B and A, shear force at A and reaction at B of the continuous beam in Fig. 12. **(8)**

8. (a) Analyse the truss in Fig. 13 by the consistent deformation method (EA = Constant). **(30)**

   (b) State the Müller-Breslau Principle. **(5)**

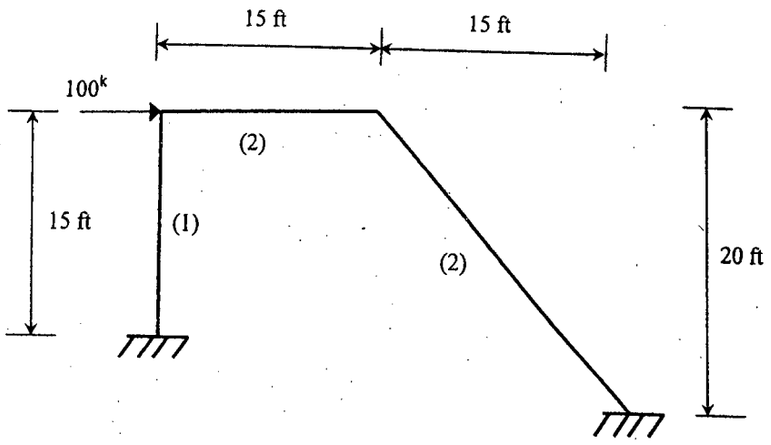

Fig. 1

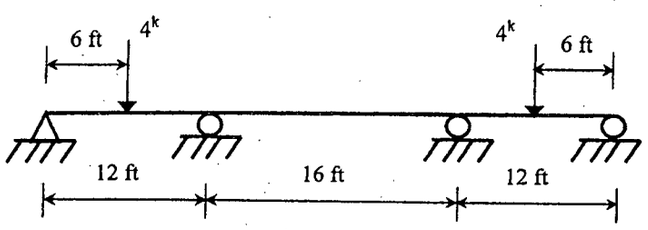

Fig. 2

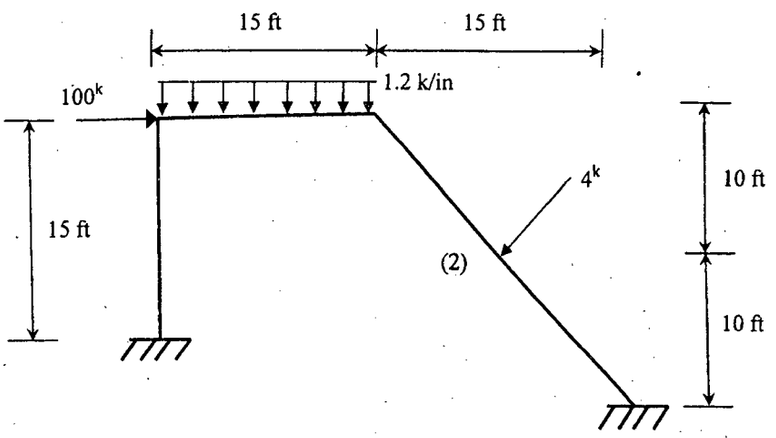

Fig. 3

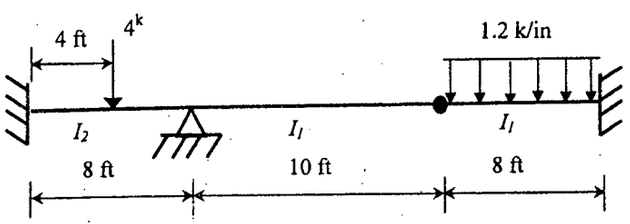

Fig. 4

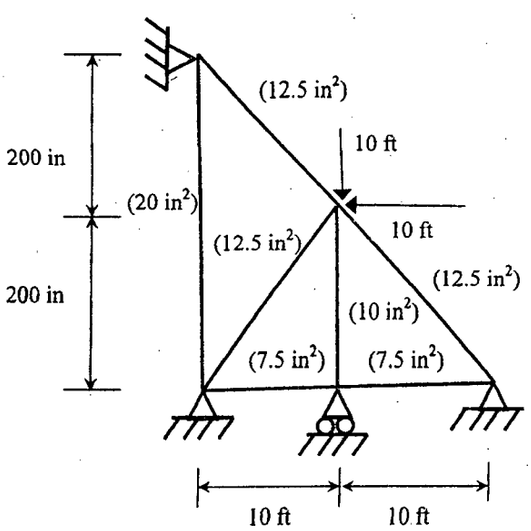

Fig. 5

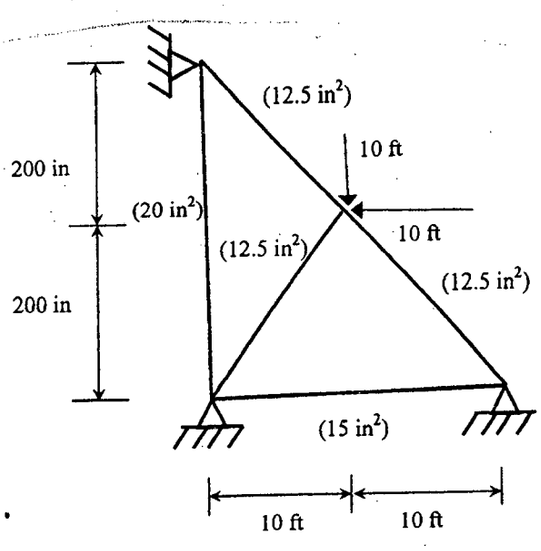

Fig. 6

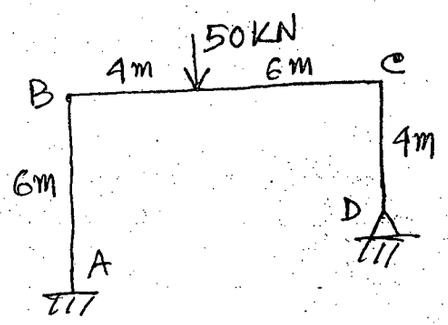

Fig. 1 7

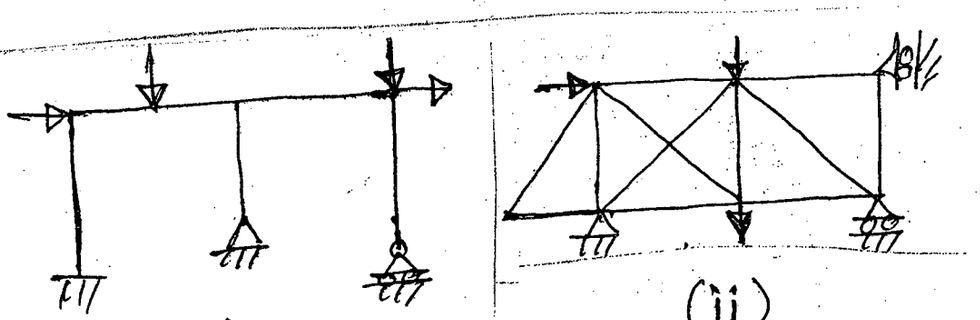

Fig. 2 8

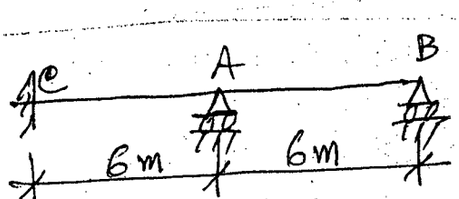

Fig. 3 9

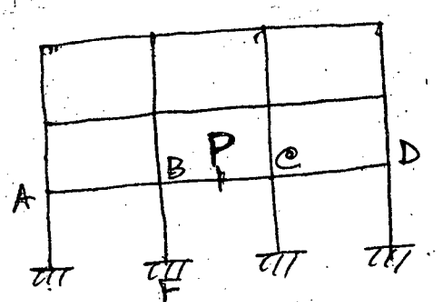

Fig. 4 10

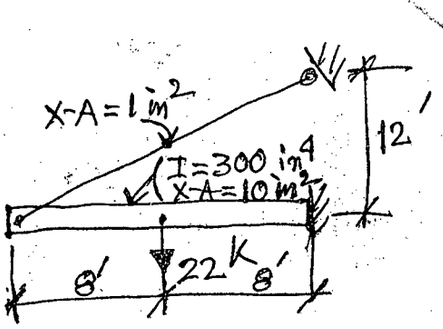

Fig 5 11

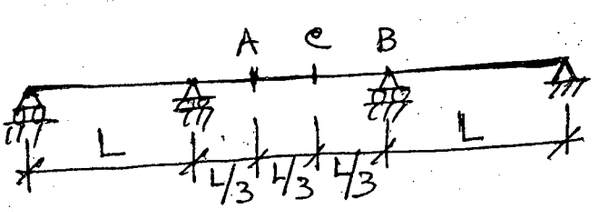

Fig. 6 12

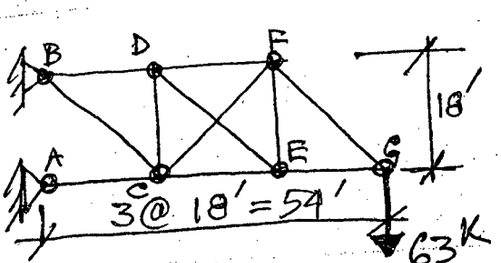

Fig. 7 13

L-4/T-1/CE **Date : 13/12/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 401** (Project Planning and Construction Management)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. Answer any five of the following: **(5×8=40)**

   (a) Differentiate between "Forward Planning", "Backward Planning" and "Combined Planning".

   (b) Define "Optimistic time estimate", "Pessimistic time estimate" and "Most likely time estimate".

   (c) Explain "Expression of Interest (EOI)". What are the advantages and limitations of EOI?

   (d) "Equipment make it possible" — Explain the statement and state the importance of equipment in construction.

   (e) Explain "project management cycle".

   (f) List the Functions of the following equipment:

   (i) Excavator (ii) Asphalt pavers (iii) Road Roller.

   (g) What do you understand by "Cost-Slope"? How do you determine it?

2. Figure-1 shows the network for a construction project, with the three time estimates of each activity marked. Determine **(20)**

   (i) Critical path and its standard deviation.

   (ii) Probability of completion of project in 38 days.

   (iii) Time duration that will provide 95% probability of its completion time.

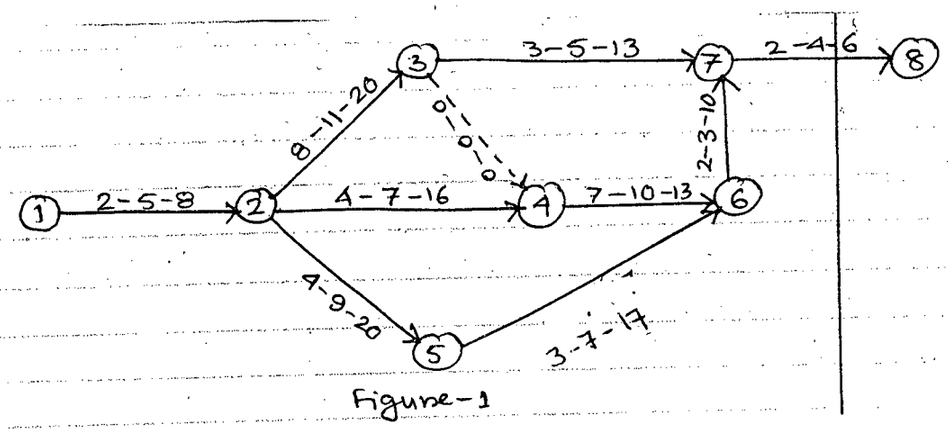

Figure-1

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3. (a) Explain the tendering process with a flow diagram. Differentiate between "single" and "two stage" tendering. **(10)**

   (b) What are the steps to follow to make a construction site safe? Give some examples of personal protective equipments in construction site. **(10)**

4. The network of a construction project is shown in Figure-2, along with the duration of each activity. Compute activity time and total Float of each activity. Locate the critical path on the network. **(20)**

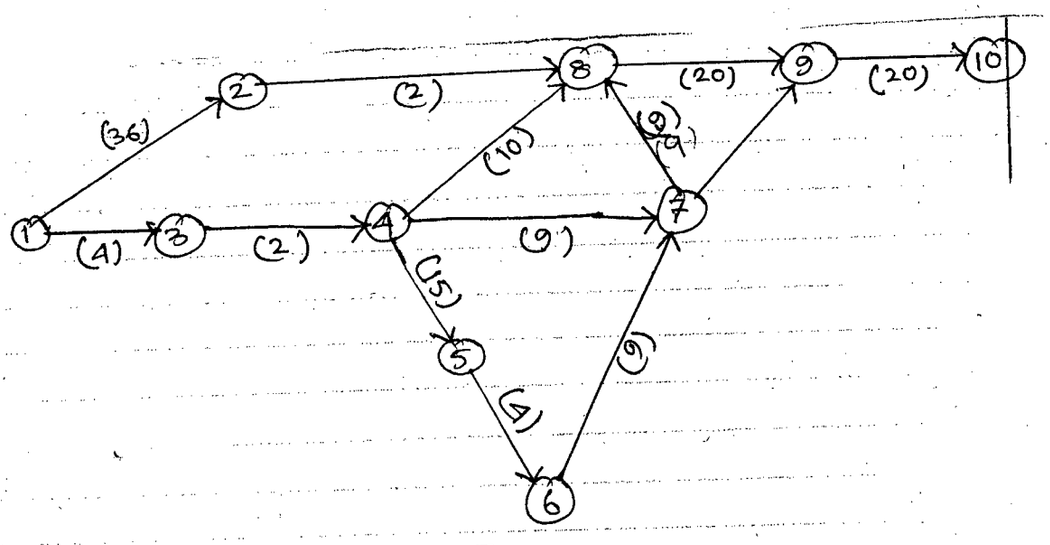

Figure-2

5. (a) A construction project consists of 12 activities. The predecessor relationships are identified by their node numbers as indicated below: **(10)**

Activity	Identification	Activity	Identification
A	(1, 2)	G	(4, 6)
B	(2, 4)	H	(5, 6)
C	(2, 3)	I	(5, 7)
D	(2, 7)	J	(7, 8)
E	(3, 4)	K	(6, 8)
F	(3, 5)	L	(8, 9)

Draw the network diagram.

(b) Explain needs for Inspection and Quality Control in construction project. Show the application of Quality Control Cycle to public works projects. **(10)**

Contd P/3

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6. Table-1 gives the information about various activities of network shown in Figure-3. **(20)**

Table-1

Activity	Normal duration (days)	Normal cost (Tk.)	Crash duration (days)	Crash cost (Tk.)
1–2	9	80,000	6	95,000
2–3	5	50,000	3	55,000

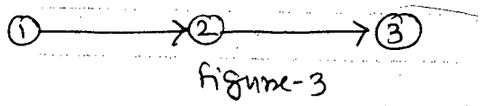

figure-3

The project overhead costs are @ 3,000 Tk./day. Determine (i) direct cost - duration relationship (ii) total cost - duration relationship and optimum duration and minimum cost.

7. (a) A manufacturer produces two products, X and Y with two machines, A and B. The cost of producing each unit of X is for machine A : 50 minutes and for machine B : 30 minutes. The cost of producing each unit of Y is for machine A : 24 minutes and for machine B : 33 minutes. Working plan for a particular week are: 40 hrs of work on machine A and 35 hours of work on machine B. The week starts with a stock of 30 units of X and 90 units of Y, and a demand of 75 units of X and 95 units of Y. How do you plan the production in order to end the week with the maximum stock? Use linear programming (LP). **(10)**

(b) What are the assumptions made to formulate and solve linear programming model? Differentiate between PERT network and CPM network with diagram **(10)**

8. (a) The network for a certain project is shown in Figure-4. Determine the expected time for each path. Which path is critical? **(10)**

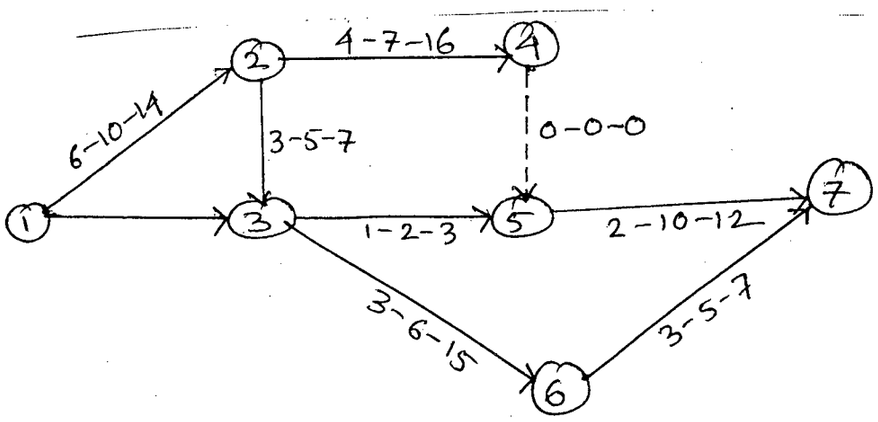

Figure-4

(b) What is a milestone chart? How does it differ from a bar chart? Why safety in construction site is utmost important? **(10)**

Contd P/4

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SECTION – B

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

9. (a) Define comprehensively the terms "management", "delegation" and "power" and briefly explain the different schools of thought in management. List the factors in (i) departmentation and (ii) decentralization. **(24)**

(b) Briefly explain the philosophy underlying the selection of appropriate discount rate and the length of project period of economic analysis. **(22⅔)**

What is the yield for a project where $200,000 is invested to produce cash flows of $50,000; $50,000; $60,000; $60,000; and $44,000 during year 1, 2, 3, 4 and 5 respectively? The project has a salvage value of $10,000.

10. State you understanding and classifications of human needs in the context of motivation. Discuss the factors in influencing and the guides and methods of disciplining. State the conditions that foster voluntary co-operation in the organisation and some desirable important personality characteristics of a manager. **(24)**

(b) Briefly explain the principal differences between the Capital Recovery Factor and the Annuity Factor. Explain clearly the meaning and implications of Internal Rate of Return (IRR) of the projects. A piece of new construction equipment will cost $60,000 and will have an expected life of 6 years, with no salvage value at the end of its life. The annual disbursements for operation, maintenance, fuel etc are estimated to be $12,000. What is the equivalent uniform annual cost of this piece of equipment if the rate of interest is 12%? What is the present worth of the disbursements at 12%? **(22⅔)**

11. (a) (i) Define clearly the term "motivation" and explain the importance of the role of Civil Engineering Leadership in the government sector. **(11)**

(i) Explain clearly why do we need a Feasibility Report of a project. Also explain "Project Life Cycle" and the chief distinctions between Economic analysis and Financial analysis of a project. **(12)**

(b) (i) What are the conflict response alternatives? Narrate advantages and disadvantages of each conflict resolving styles. **(11)**

(ii) What is the definition of Economic Order Quantity and Inventory Turnover Ratio? Define safety stock and lead time. **(12⅔)**

12. (a) What do you mean by "Golden Hour"? What are the benefits of it and how can you apply it in "HRM"? Explain "clean break" and "clean focus" with examples in your life. **(21⅔)**

(b) Explain the work types ABCDE with examples in practical life. What are the HRM functional components and which one is more important? What are the techniques of conducting effective meeting? **(25)**

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Table 2 Standard Normal Distribution Function Q.2

Z (+)	*Probability* (P_r)(%)	Z (−)	*Probability* (P_r) (%)
0	50·0	0	50·0
+0·1	53·98	−0·1	46·02
+0·2	57·93	−0·2	42·07
+0·3	61·79	−0·3	38·21
+0·4	65·54	−0·4	34·46
+0·5	69·15	−0·5	30·85
+0·6	72·57	−0·6	27·43
+0·7	75·80	−0·7	24·20
+0·8	78·81	−0·8	21·19
+0·9	81·59	−0·9	18·41
+1·0	84·13	−1·0	15·87
+1·1	86·43	−1·1	13·57
+1·2	88·49	−1·2	11·51
+1·3	90·32	−1·3	9·68
+1·4	91·92	−1·4	8·08
+1·5	93·32	−1·5	6·68
+1·6	94·52	−1·6	5·48
+1·7	95·54	−1·7	4·46
+1·8	96·41	−1·8	3·59
+1·9	97·13	−1·9	2·87
+2·0	97·72	−2·0	2·28
+2·1	98·21	−2·1	1·79
+2·2	98·61	−2·2	1·39
+2·3	98·93	−2·3	1·07
+2·4	99·18	−2·4	0·82
+2·5	99·38	−2·5	0·62
+2·6	99·53	−2·6	0·47
+2·7	99·65	−2·7	0·35
+2·8	99·74	−2·8	0·26
+2·9	99·81	−2·9	0·19
+3·0	99·87	−3·0	0·13

L-4/T-1/CE **Date : 05/01/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 441** (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 **SEVEN** questions in this section. Answer Q. No. 1 and any **FIVE** fro the rest.

QUESTION NO. 1 is COMPULSORY.

1. COMPULSOERY QUESTION: Answer any SEVEN of the TEN short questions furnished below. Answer should be brief and to the point. **(7×5=35)**

   (a) What information are required to be obtained from a subsurface investigation? What are the uses of these information?

   (b) Describe briefly the main considerations in carrying out a subsurface investigation programme.

   (c) List the common types of boring that are usually used in direct method of subsoil exploration. State the salient features of these methods each in three sentences.

   (d) Classify soil samples and define each of them. How would classify soil samples?

   (e) How do the soil samples get disturbed? How the "during sampling" disturbance of soil is estimated?

   (f) What are the functions of pile foundation? Give a classification chart for pile based on various criteria.

   (g) Describe briefly the construction methodology for a bored pile having a diameter of 1000 mm and length of 25 m, to be constructed in Dhaka city. Write a short specification for the concrete to be used in this construction.

   (h) Briefly describe the s-method of estimating skin friction of a pile.

   (i) What is negative skin friction? What are the remedial measures for reducing negative skin friction in pile foundation?

   (j) Show in a neat sketch the various elements of pile head assembly for safe driving of a pile.

2. A 3 × 4 pile group consists of 12 piles of 300 mm diameter and 15 m length, spaced at 900 mm centre to centre. The top 6.0 m consists of soft clay with C_u = 30 kPa, followed by 6.0 m of medium shift clay with C_u = 65 kPa, which is underlain by stiff clay with C_u = 90 kPa. Estimate the allowable load carrying capacity of the pile group. Assume a global factor of safety of 2.50, and reasonable values of any other data if required. **(14)**

Contd P/2

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3. A pile group consists of 20 piles 400 mm square at a spacing of 1200 mm centre to centre. Draw a plan showing the arrangements of the piles. Computer the minimum and maximum pile reactions for the following data: **(14)**

   Total vertical load = 2000 kN

   Load Eccentricity in Long Direction, e_y = 600 mm

   Load Eccentricity in Short Direction, e_x = 400 mm

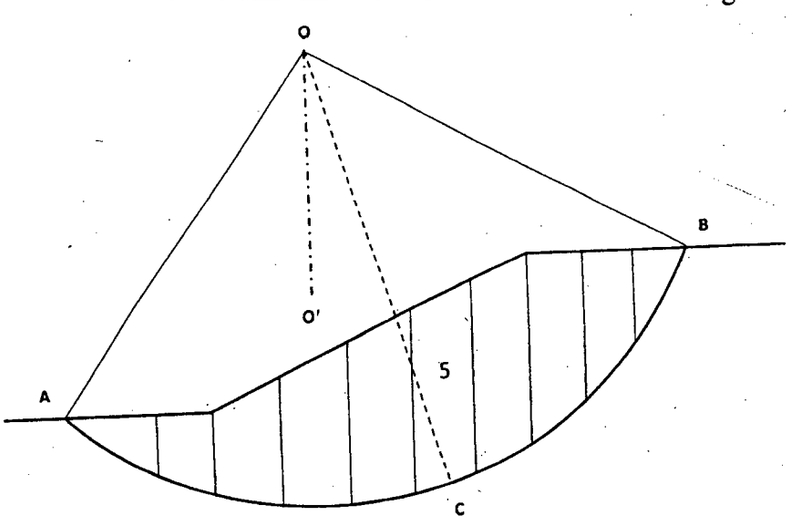
4. A 350 mm × 350 mm square pile is driven into a sand profile to a depth of 15 m. The underlying soil is clay. The SPT results are shown in the following Table. Estimate the allowable load carrying capacity of the pile. **(14)**

Depth (m)	1.5	3.0	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0	16.5
N-Value	22	18	25	20	22	23	25	27	28	30	15

5. The blow counts for an SPT test at a depth of 6 m in fine sand at every 150 mm are 8, 12 and 15. A donut hammer and a standard split spoon sampler were used in a borehole of 150 mm diameter. Estimate the corrected N-value. The water table is at a depth of 2.0 m from ground surface. The unit weight of above water table soil is 16.5 kN/m^3, whereas, below water table the saturated unit weight is 18 kN/m^3. Given that rod length correction factor, C_r = 0.95, sampler correction factor, C_s = 1.0, Borehole diameter correction factor, C_B = 1.05, Donut hammer efficiency, E = 45%. Assume reasonable values of any other data, if required. **(14)**

6. The soil profile at a site consists of 10 m of sand with ϕ' = 32° and γ = 18.0 kN/m^3, followed by a thick deposit of stiff clay layer with C_u = 120 kN/m^2. The water table lies 3 m below the ground level. It is required to design a driven pile foundation to carry a load of 350 kN. Propose a reasonable design. **(14)**

7. Calculate the factor of safety of slice 5 as shown in Fig. 1, using conventional method of slices. Assume uniform soil condition and water table at great depth. **(14)**



Unit weight of soil = 17 kN/m³;
Cohesion of soil = 30 kN/m²;
Angle of internal friction, ϕ=15°;
Rodius of slip circle = 20 m;

∠COO' = 15°
Average height of slice 5 = 6.1 m
Average width of slice 5 = 1.5 m
Base length (width) of slice 5 = 1.6 m

Fig. 1 Slip Circle for Method of Slices (for Question No. 7)

Contd P/3

CE 441

SECTION – B

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

8. (a) Draw a cross- section through long footing on clay, showing the basis for computation of ultimate bearing capacity. **(8)**

   (b) A footing is placed at 8 ft below the surrounding ground level. **(20)**

   Given c = 2000 psf, r = 125 pcf, ground water level below 40 ft. level.

   (i) Calculate the net ultimate bearing capacity for a footing 10′ × 15′.

   (ii) Calculate the net ultimate bearing capacity for a 6 ft wide footing.

   (c) Discuss the effect of ground water level for a foundation resting on clay and sand. **(7)**

9. A raft foundation 100 ft × 120 ft is placed at 20 ft below surrounding ground level in a deep deposit of clay. **(35)**

   Given: q_u = 3000 psf, r = 125 pcf, G.W.L. = – 30 ft for ground level, C_c = 0.12, C_r = 0.03, past maximum overburden pressure = 10,000 psf.

   (i) Draw a neat sketch of the stated condition.

   (ii) Calculate the maximum load that can be supported by the raft with F.S = 3.

   (iii) Calculate the settlement of the raft at centre and at corner if the gross contact pressure is 4000 psf.

10. (a) Describe dewatering system for construction of foundation in sand. **(10)**

    (b) Discuss the advantages of raft foundation in soft soils. **(10)**

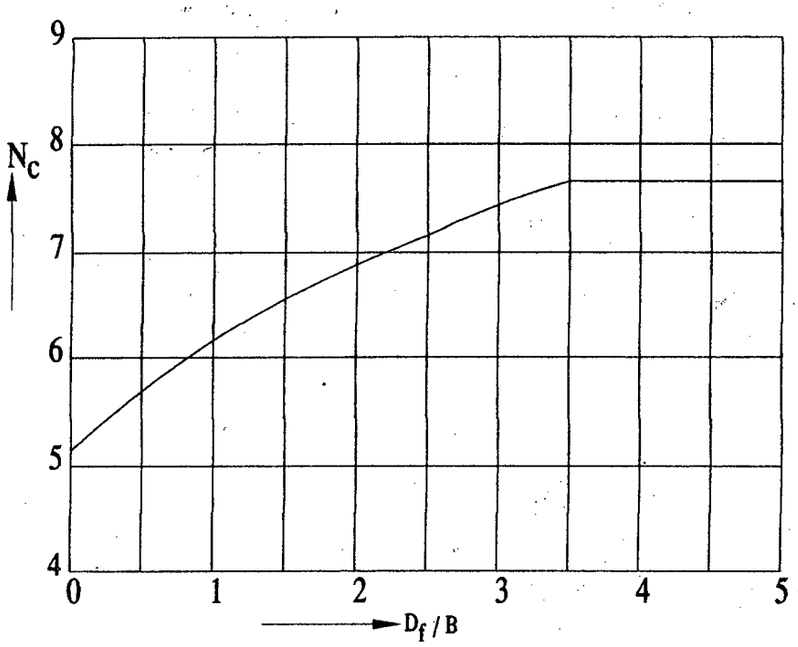
    (c) A footing 12 ft square and 30″ thick is supported by sand with an average N value of 30 blows/ft corrected for influence of overburden pressure. The surface of the ground is 6 ft above the top of footing and the water table is 8 ft below the ground surface. Compute the maximum load that can be supported by the footing if the settlement must not exceed 0.5 inch. **(15)**

11. (a) Describe the conventional method and effective width concept for an eccentrically loaded footing. **(9)**

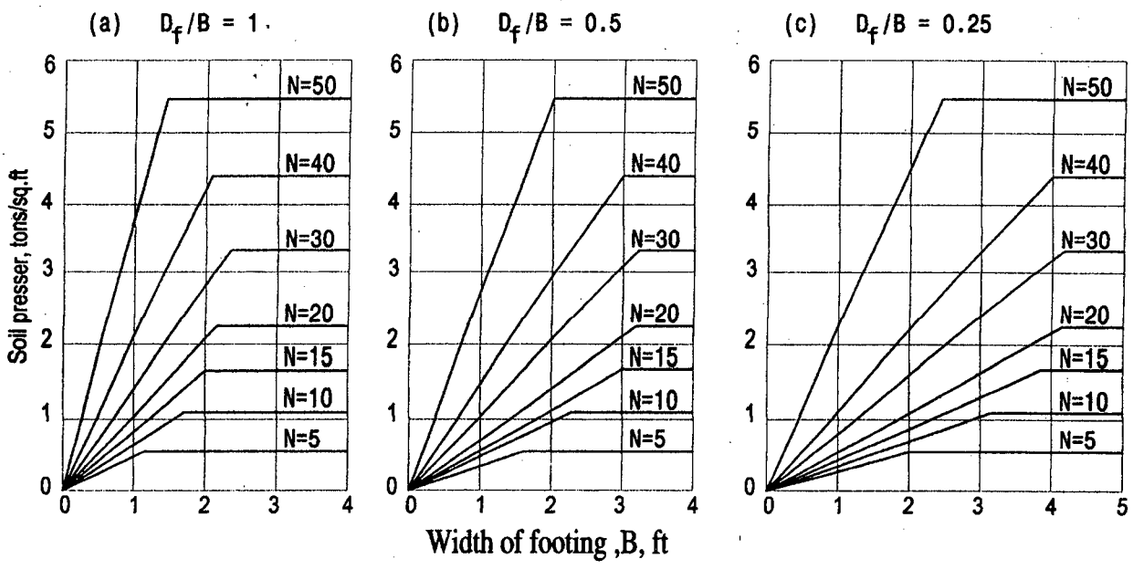
    (b) Describe the Quality Control tests for bored piles. **(9)**

    (c) What are the objectives of pile load test? **(8)**

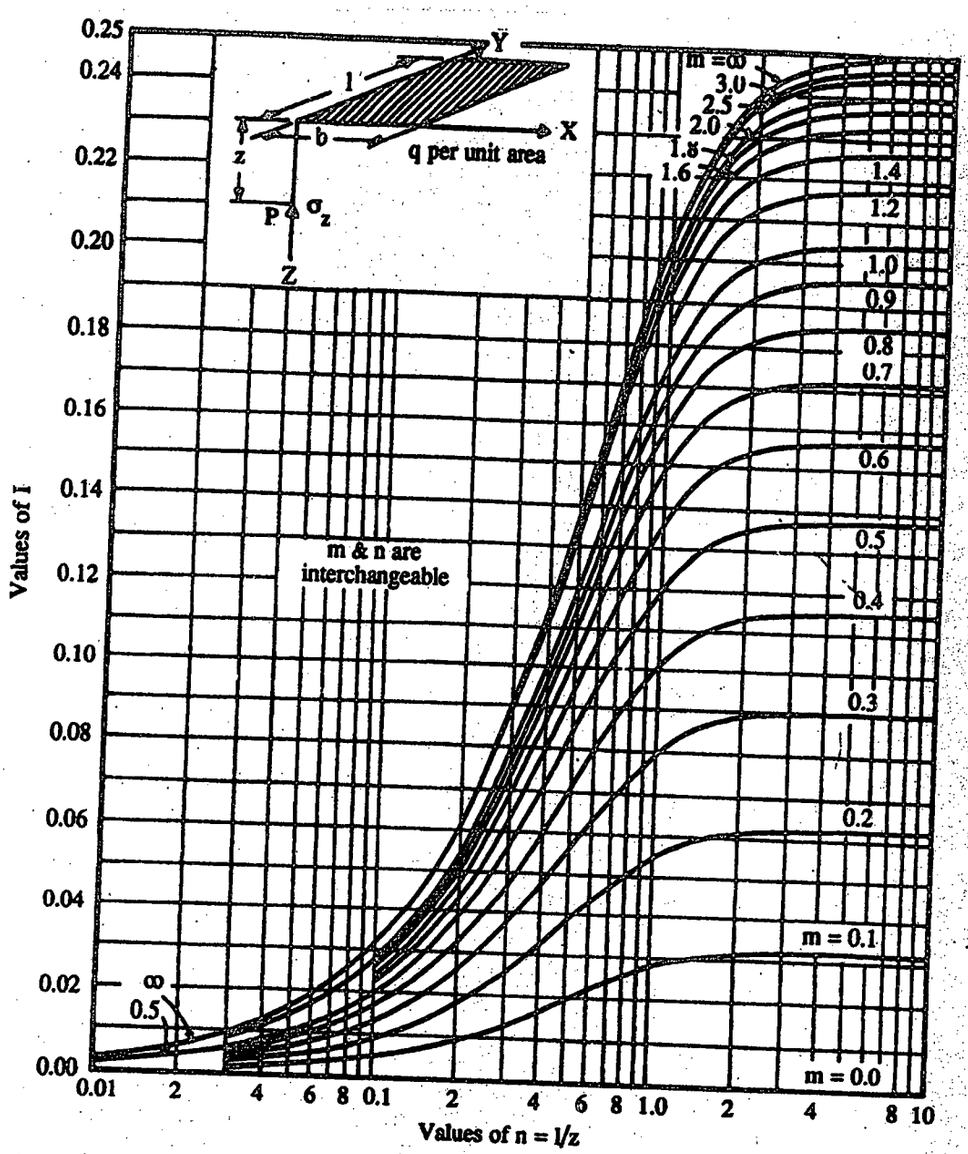
    (d) Discuss "Engineering News formula" for determining the capacity of a driven pile. **(9)**



Bearing Capacity Factor N_c
For Strip footing on clay



Design chart for proportioning shallow footings on sand



Graph for determining influence value for vertical normal stress σ_z at point P located beneath one corner of a uniformely loaded rectangular area.
(After Fadum)

L-4/T-1/CE Date : 10/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **CE 451** (Transportation Engineering II : Pavement Design and Railway 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**.

Assume reasonable values for missing data, if any.

1. (a) What are classification of aggregates based on source, size and weight? Why is aggregate grading and blending important for any aggregate construction in roads? **(15)**

   (b) What are the main differences between Marshall and Hveem method of mix design regarding compaction and testing of specimens? **(15)**

   (c) How do you find C.K.E. and surface capacity values in Hveem method of mix design? An asphaltic concrete sample cut from a completed pavement weighs 3540 gm in air and 1962 gm in water. The laboratory compacted specimen of the same mix has a bulk specific gravity G_{mb} of 2.384 and voids of 5.5 percent. Is the mix satisfactory? **(16⅔)**

2. (a) Briefly state the steps for refining crude petroleum in order to get different varieties of asphaltic materials. What are the grades of asphalt cement based on standard capillary viscometer test results? **(18⅔)**

   (b) Name the laboratory tests of bituminous materials used in road construction. Write down the specification requirement for asphalt used runway overlay mixes. **(16)**

   (c) What are the especial qualities required for bitumen to be used in road construction of Bangladesh? How are these qualities be achieved? **(12)**

3. (a) Define Perpetual Pavement? What are the technological advancements made Perpetual Pavement possible? Write down three main considerations of Perpetual Pavement. Compare between flexible pavement and rigid pavement. **(3+4+3+12=22)**

   (b) State the common modes of distresses of flexible pavement. What are the problems associated with pavement Fatigue Cracking and main causes of this distress? State the ways of removing 'Bleeding of bituminous pavement'? What were the purposes and outcomes of AASHO road test? **(7+6⅔+3+8=24⅔)**

4. (a) List different methods of pavement design. Write down the types of rigid pavement joints and functions of dowel bars. Draw a typical joint detail of rigid pavement showing sealant reservoir and backer rod. **(6+8+4⅔=18⅔)**

   (b) Design a concrete pavement by using PCA method for the conditions given below. Give one trial and put your comments on the trial thickness. Solution could be given in the worksheet provided at the end of question paper. **(28)**

Contd P/2

CE 451

General Data

Traffic (Average Daily Traffic, ADT):	450 veh/day (both directions)
Trucks:	15 percent of ADT
Annual growth:	3 percent
Modulus of Rupture, M_R:	550 psi
Modulus of Subgrade Reaction, k:	100 pci
Design life:	20 years

Other Data

Doweled joints:	Yes
Shoulder:	No
Subbase:	6 in untreated

Truck Axle Load Distributions

Axle Load Group (kips)	No. axles per 100 trucks on the road	
	Single Axles	Tandem Axles
12-14	8.0	
14-16	7.3	
16-18	6.1	
18-20	5.4	
20-22	3.2	
22-24		7.6
24-26		8.4
26-28		9.0
28-30		11.2
30-32		9.4
32-34		1.8
34-36		1.4
36-38		0.9
38-40		1.0

Effect of Untreated Subbase on *k* Values,

Subgrade value, pci	Subbase k value, pci			
	4 in.	6 in.	9 in.	12in.
50	65	75	85	110
100	130	140	160	190
200	220	230	270	320
300	320	330	370	430

Contd P/3

CE 451

SECTION – B

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

5. (a) Explain nature and values of various train resistance for a moving locomotive. **(10⅔)**

   (b) Explain factors affecting the choice of a railway gauge and mention examples of countries for different gauges. **(16)**

   (c) Write short notes on the following: **(20)**

   (i) Deficiency in super-elevation

   (ii) Working principals of compressed air and vacuum brakes

   (iii) Types of wear on rails

   (iv) Coning of wheels

   (v) Minimum depth of ballast cushion.

6. (a) Explain with neat sketches the construction and function of a semaphore signal. **(6⅔)**

   (b) Explain with neat sketches the classification of railway signals according to location. **(20)**

   (c) What is a "turnout"? Draw a complete labelled diagram for a left hand turnout. **(20)**

7. (a) Write down main strategies for customizing low cost road options. What do you mean by Engineered Earth road? Discuss construction of Dressed Stone road surface and Penetration Macadam road surface. Draw a neat section of Bangladeshi rural road with Herring Bone Bond (HBB) brick pavement and its construction and material specifications. **(6+4+10+10=30)**

   (b) Discuss following construction requirements of plant mixed hot bituminous pavement. **(16⅔)**

   (i) Quality control plan including testing frequency

   (ii) Preparation of asphalt concrete

   (iii) Preparation of application surface

   (iv) Compaction of asphaltic mix on road

8. (a) Write down names and uses of 10 highway construction equipments. Explain how Gantt Charts Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) are useful tool in highway construction management. **(10+10=20)**

   (b) Write down names of cement concrete uniformity testing prior to start of rigid pavement construction. Explain various curing means for rigid pavement. Discuss pumping distress phenomenon in rigid pavement. **(16⅔)**

   (c) Explain highway network management system framework with a schematic flow chart. **(10)**

For Q. No. 4(b)

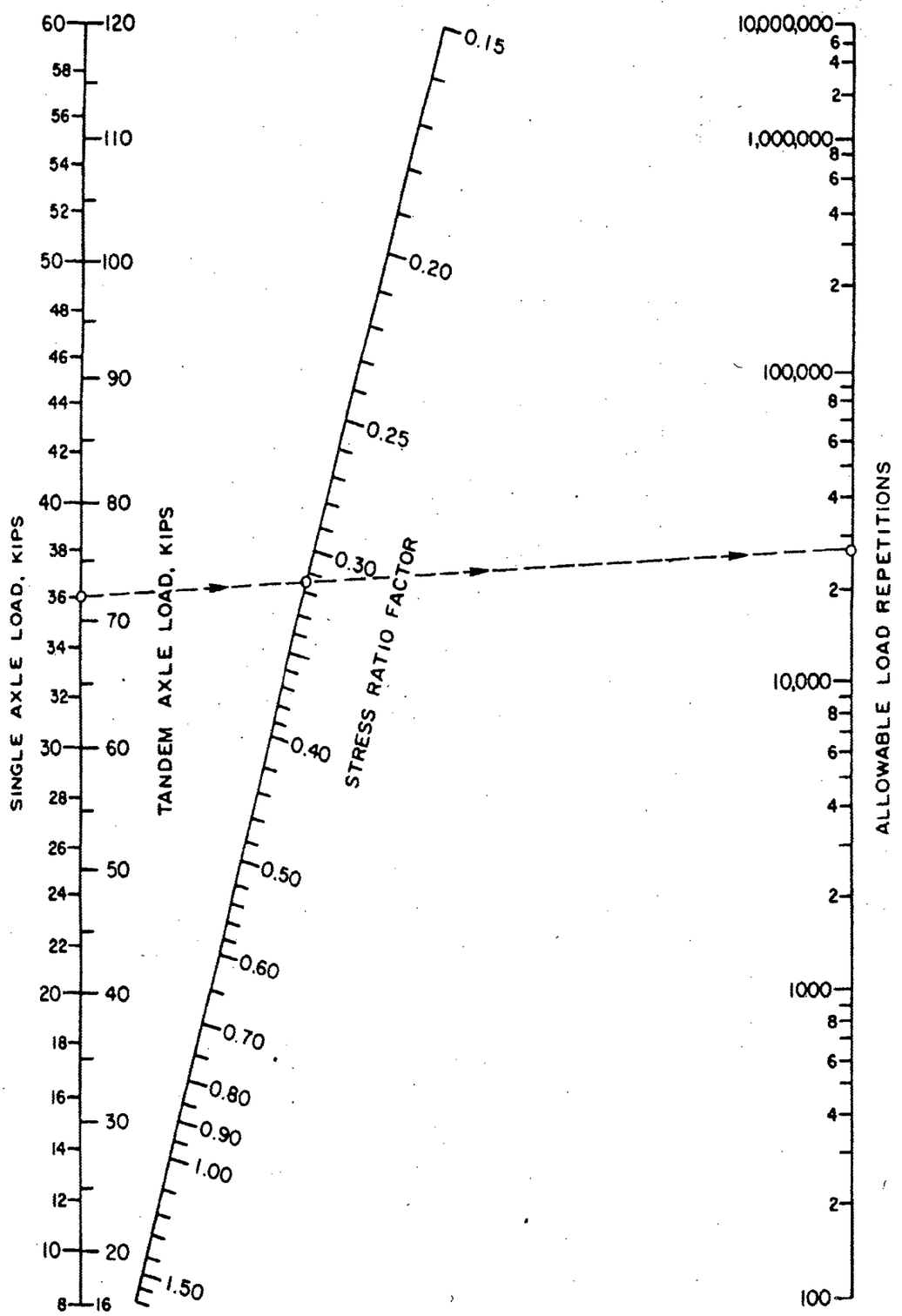
Equivalent Stress — No Concrete Shoulder (Single Axle/Tandem Axle)

Slab thickness, in.		*k* of subgrade-subbase, pci						
		50	100	150	200	300	500	700
4	4.5	825/679 699/586	726/585 616/500	671/542 571/460	634/516 540/435	584/486 498/406	523/457 448/378	484/443 417/363
5	5.5	602/516 526/461	531/436 464/387	493/399 431/353	467/376 409/331	432/349 379/305	390/321 343/278	363/307 320/264
6	6.5	465/416 417/380	411/348 367/317	382/316 341/286	362/296 324/267	336/271 300/244	304/246 273/220	285/232 256/207
7	7.5	375/349 340/323	331/290 300/268	307/262 279/241	292/244 265/224	271/222 246/203	246/199 224/181	231/186 210/169
8	8.5	311/300 285/281	274/249 252/232	255/223 234/208	242/208 222/193	225/188 206/174	205/167 188/154	192/155 177/143
9	9.5	264/264 245/248	232/218 215/205	216/195 200/183	205/181 190/170	190/163 176/153	174/144 161/134	163/133 151/124
10	10.5	228/235 213/222	200/193 187/183	186/173 174/164	177/160 165/151	164/144 153/136	150/126 140/119	141/117 132/110
11	11.5	200/211 188/201	175/174 165/165	163/155 153/148	154/143 145/136	144/129 135/122	131/113 123/107	123/104 116/98
12	12.5	177/192 168/183	155/158 147/151	144/141 136/135	137/130 129/124	127/116 120/111	116/102 109/97	109/93 103/89
13	13.5	159/176 152/168	139/144 132/138	129/129 122/123	122/119 116/114	113/106 107/102	103/93 98/89	97/85 92/81
14		144/162	125/133	116/118	110/109	102/98	93/85	88/78

Erosion Factors — Doweled Joints, No Concrete Shoulder (Single /Tandem Axle)

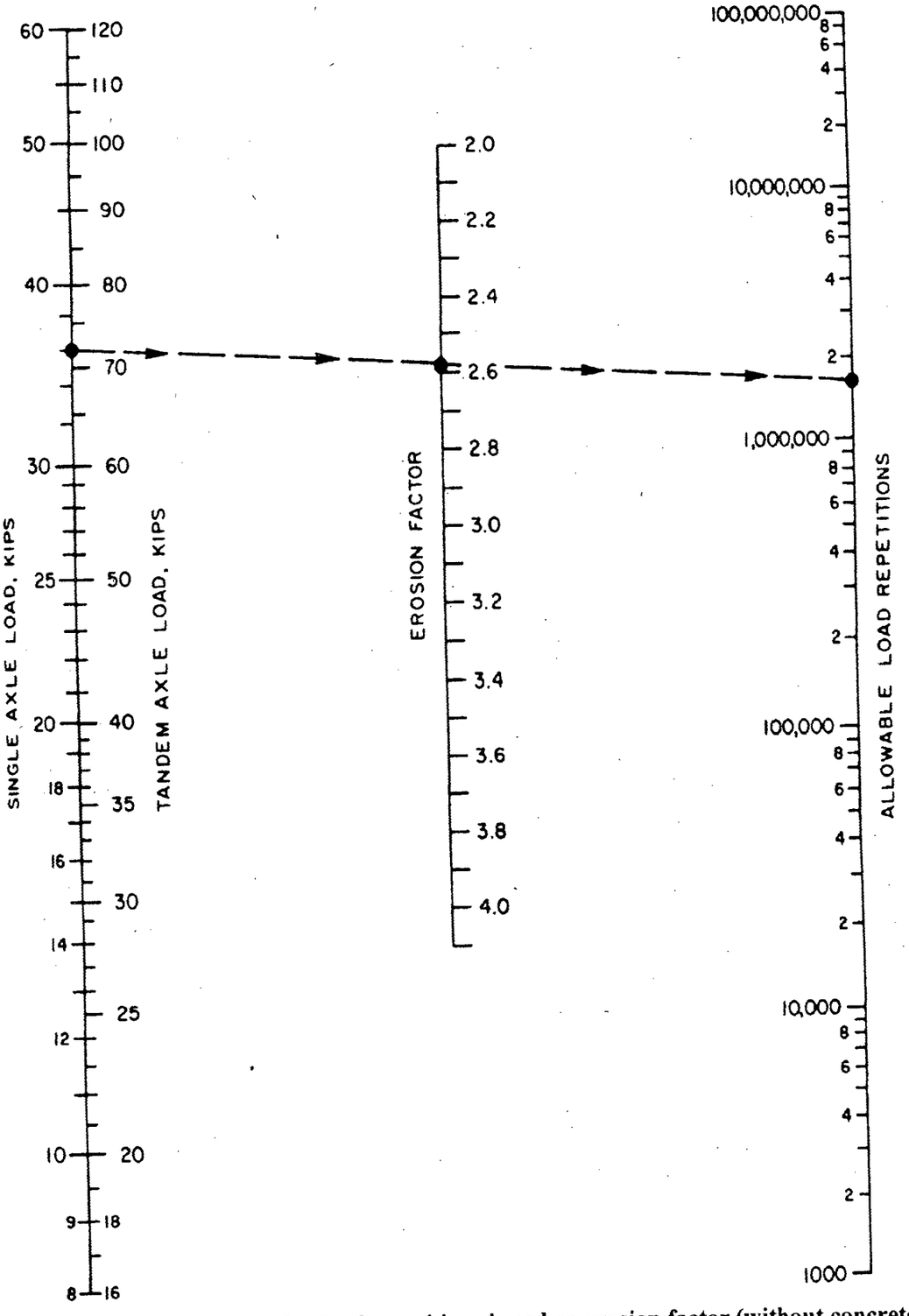
Slab thickness,		k of subgrade-subbase, pci					
		50	100	200	300	500	700
4	4.5	3.74/3.83 3.59/3.70	3.73/3.79 3.57/3.65	3.72/3.75 3.56/3.61	3.71/3.73 3.55/3.58	3.70/3.70 3.54/3.55	3.68/3.67 3.52/3.53
5	5.5	3.45/3.58 3.33/3.47	3.43/3.52 3.31/3.41	3.42/3.48 3.29/3.36	3.41/3.45 3.28/3.33	3.40/3.42 3.27/3.30	3.38/3.40 3.26/3.28
6	6.5	3.22/3.38 3.11/3.29	3.19/3.31 3.09/3.22	3.18/3.26 3.07/3.16	3.17/3.23 3.06/3.13	3.15/320 3.05/3.10	3.14/3.17 3.03/3.07
7	7.5	3.02/3.21 2.93/3.14	2.99/3.14 2.91/3.06	2.97/3.08 2.88/3.00	2.96/3.05 2.87/2.97	2.95/3.01 2.86/2.93	2.94/2.98 2.84/2.90
8	8.5	2.85/3.07 2.77/3.01	282/299 2.74/2.93	2.80/2.93 2.72/2.86	2.79/2.89 2.71/2.82	2.77/2.85 2.69/2.78	2.76/2.82 2.68/275
9	9.5	2.70/2.96 2.63/2.90	2.67/287 2.60/2.81	2.65/2.80 2.58/2.74	2.63/2.76 2.56/2.70	2.62/2 71 2.55/2.65	2.61/2.68 2.54/2.62
10	10.5	2.56/2.85 2.50/2.81	2.54/2.76 2.47/2.71	2.51/2.68 2.45/2.63	2.50/2.64 2.44/2.59	2.48/2.59 2.42/2.54	2.47/256 2.41/2.51
11	11.5	2.44/2.76 2.38/2 72	2.42/2.67 2.36/2.62	2.39/2.58 2.33/2.54	2.38/2.54 2.32/2.49	2.36/2.49 2.30/2.44	2.35/2.45 2.29/2.40
12	12.5	233/2.68 2.28/2.64	2.30/2 58 2.25/2.54	2.28/2.49 2.23/2.45	2.26/2.44 2.21/2.40	2.25/2.39 2.19/2.35	2.23/2.36 2.18/2.31
13	13.5	2.23/2.61 2.18/2.57	2.20/2.50 2.15/2.47	2.18/2.41 2.13/2.37	2.16/2.36 2.11/2.32	2.14/230 2.09/2.26	2.13/2 27 2.08/2 23
14		2.13/2.54	2.11/2.43	2.08/2.34	2.07/2.29	2.05/2.23	2.03/2.19

For Q. No. 4(b)



Fatigue analysis—allowable load repetitions based on stress ratio factor (with and without concrete shoulder).

For Q. No. 4(b)



Erosion analysis—allowable load repetitions based on erosion factor (without concrete shoulder).

For Q. No. 4(b)

Calculation of Pavement Thickness

Project _____

Trial thickness _____ in
Subbase-subgrade, k _____ pci
Modulus of Rupture, MR _____ psi
Load safety factor, LSF _____

Doweled joints yes ____ no ____
Concrete shoulder yes ____ no ____

Design Period _____ years

Axle Load, kips	Multiplied by LSF	Expected repetitions	Fatigue analysis		Erosion Analysis	
			Allowable repetitions	Fatigue Percent	Allowable repetitions	Damage Percent
1	2	3	4	5	6	7

8. Equivalent stress
9. Stress ratio factor _____
10. Erosion factor _____

Single Axles

11. Equivalent stress _____
12. Stress ratio factor _____
13. Erosion factor _____

Tandem Axles

			Total		Total	

L-4/T-1/CE **Date : 15/01/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2012-2013

Sub : **WRE 451** (Hydrology, Irrigation and Flood Management)

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**.

1. (a) Define residence time. Give a qualitative comparison between atmospheric moisture and groundwater in terms of residence time. **(5)**

(b) The rainfall values over a catchment in three successive 5-hr intervals are known to be 3, 1 and 7 cm. The ϕ-index for the catchment is estimated to be 0.2 cm/hr. Given below are the ordinates of a 5-hr unit hydrograph: **(15)**

Time(hr)	0	5	10	15	20	25	30	35	40	45	50
Ordinates of 5-hr UH (m^3/s)	0	50	125	185	160	110	60	36	25	12	0

Calculate the resulting storm hydrograph if the initial base flow is 10 m^3/s and increase by 2 m^3/s every 5 hours.

(c) Following are the ordinates of a storm hydrograph of a river draining a catchment area of 50 km^2 due to a 6-hr isolated storm. Derive the ordinates of a 6-hr unit hydrograph for the catchment. **(15)**

Time from start of storm (hr)	0	6	12	18	24	30	36	42	48	54
Discharge (m^3/s)	10	80	105	75	48	32	22	15	10	10

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

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

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

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

(e) In a 140-min storm, the following intensities of rainfall were observed in successive 20-min intervals: 3.3, 3.6, 9.0, 6.6, 0.6, 0.9 and 6.0 cm/hr. Assume the ϕ-index value to be 3.0 cm/hr, compute (i) total volume of runoff, (ii) total volume of infiltration, and (iii) time of rainfall excess. The catchment area is 2 km^2. **(15)**

Contd P/2

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3. (a) Briefly explain the three mechanisms of air mass lifting. **(5)**

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

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

(b) 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. Estimate the design return period (T). Also estimate the design precipitation volume (m^3) as well. Also find out the design peak discharge (m^3/s) using rational method for the catchment. The area of the catchment in 2 km^2 and runoff coefficient is 0.5. Use the IDF curves (Fig. 1) and Kirpich formula for your estimation. **(15)**

(c) 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)**

Raingage 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.

SECTION – B

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

5. (a) Define irrigation, and write down the advantages and disadvantages of irrigation. **(5)**

(b) Briefly explain the concept of multipurpose project and write down the consideration for developing any water resources project as a multipurpose project. **(10)**

Contd P/3

WRE 451/CE

Contd... Q. No. 5

(c) Classify irrigation development with respect to procurement process and coverage. **(5)**

(d) What is national water policy? Write down its main elements. **(7)**

(e) Briefly explain the social and environmental aspects of irrigation and FCD. **(8)**

6. (a) What do you understand by consumptive use of water? Write down the factors affecting CU or ET and the methods for direct measurement of ET. **(7)**

(b) What are the considerations for using surface water and groundwater for irrigation? **(7)**

(c) What is meant by C2-S2 water? Discuss its usefulness for irrigating fine textured soils. **(6)**

(d) Determine the volume of water required to be diverted from the head works to irrigate area of 5000 ha using the data given in the table below: Assume 80% as the effective precipitation to take care of the consumptive use of the crop. Also assume 50% efficiency of water in the field and 75% as the conveyance efficiency of canal. **(15)**

Month	Temp (°F)	% hrs of sunshine	Rainfall (mm)	Crop factor, k
June	70.8	9.9	75	0.80
July	74.4	10.2	108	0.85
August	72.8	9.6	130	0.85
September	71.6	8.4	115	0.85
October	69.3	7.86	105	0.65
November	55.2	7.25	25	0.65
December	47.1	6.42	0	0.60
January	48.8	8.62	0	0.60
February	53.9	9.95	0	0.65
March	60.0	8.84	0	0.70
April	62.5	8.86	0	0.70
May	67.4	9.84	0	0.75

Use Blaney-Criddle Formula.

7. (a) What is meant by surface and subsurface irrigation; and what are their types? Discuss briefly the various techniques used for distributing water in the firm. **(15)**

(b) Define and explain the following terms: (i) Available moisture (ii) Field capacity (iii) Crop factor. **(6)**

Contd P/4

WRE 451/CE

Contd... Q. No. 7

(c) Wheat is to be grown in a field having a field capacity equal to 27% and the permanent wilting point is 13%. Find the storage capacity in 80 cm depth of the soil, if the dry unit weight of the soil is 14.72 KN/m^3. If irrigation water is to be supplied when the average soil moisture falls to 18%. Find the water depth required to be supplied to the field if the field application efficiency is 80%. What is the amount of water needed at the canal outlet if the water lost in the water-courses and the field channels is 15% of the outlet discharge? **(8)**

(d) Write short note on Trickle irrigation. **(6)**

8. (a) Write down the causes and ill effects of flood. **(5)**

(b) What are the major types of flood in Bangladesh? Briefly explain the measures that can be taken for flood mitigation. **(7)**

(c) Mention the main reasons for the failure of any flood management policy and enlist the possible impacts on water resources system of Bangladesh. **(15)**

(d) What are the precautions for the use of saline water in irrigation? **(8)**

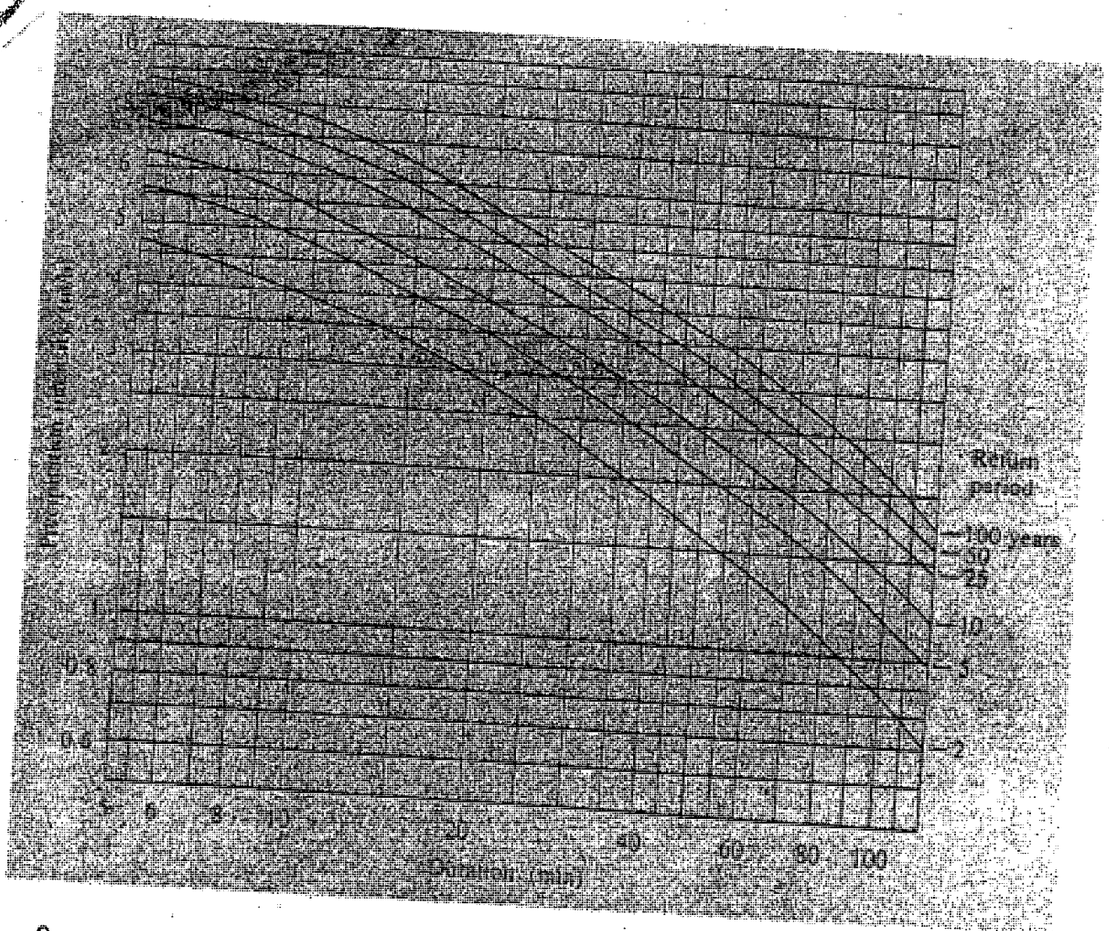

Fig. 1. IDF Curves [for Q. No. 4(b)]