L-4/T-1/CE **Date : 30/06/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **CE 411** (Structural Analysis and Design III)

Full Marks: 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

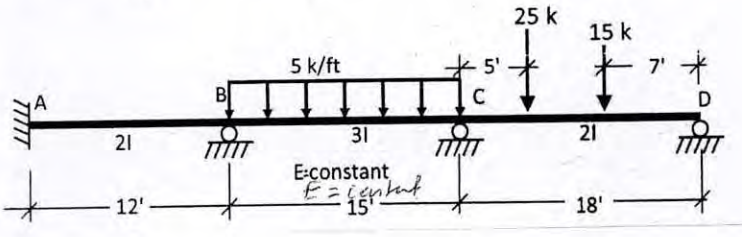
The figures in the margin indicate full marks.

SECTION – A

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

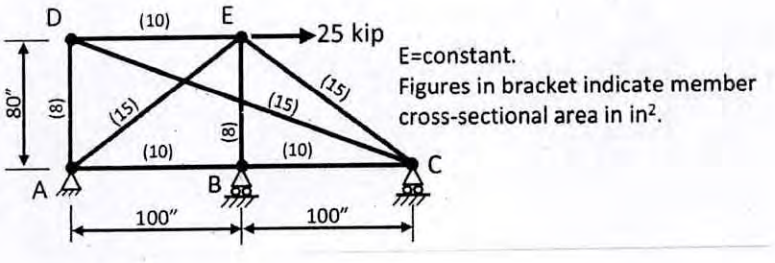
1. For the three span continuous beam shown in Fig. 1, analyze it using moment distribution method and draw the shear force and bending moment diagrams. Also draw the qualitative deflected shape. **(21)**

Fig.1



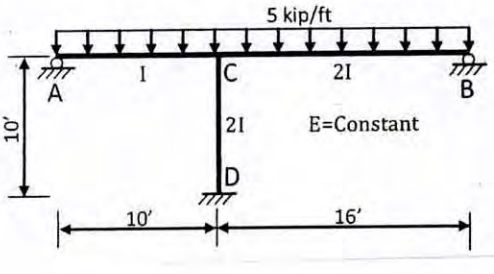
2. Analyze the indeterminate plane truss shown in Fig. 2 using flexibility method and determine the support reactions and bar forces. **(21)**

Fig.2



3. Analyze the plane frame of Fig. 3 using moment-distribution method and draw the shear force and bending moment diagrams. **(21)**

Fig.3



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4. Analyze the plane frame of Fig. 4 using flexibility method and determine the forces and moments at support A. **(21)**

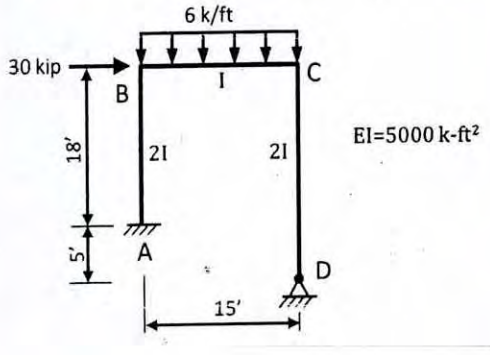

Fig.4

5. Analyze the plane frame of Fig. 5 using moment distribution method and determine the reaction at support D. **(21)**

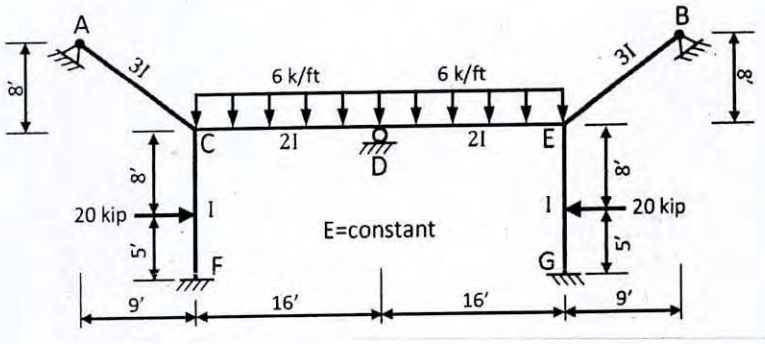

Fig.5

6. In addition to the load acting on the beam as shown in Fig. 6, support at A rotates 0.04 radian clockwise while the support at C moves up by 0.3 ft. Analyze the problem using flexibility method and draw the shear force and bending moment diagrams. Take EI = 5000 k-ft^2 for this beam. **(21)**

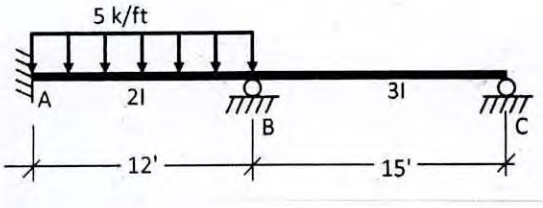

Fig.6

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7. In addition to the load acting on the frame as shown in Fig. 7, support at B rotates 0.03 radian clockwise while the support at D moves right by 0.4 ft. Analyze the problem using moment distribution method and determine all support reactions (forces and moments). Take $EI = 3000$ k-ft^2 for this frame. **(21)**

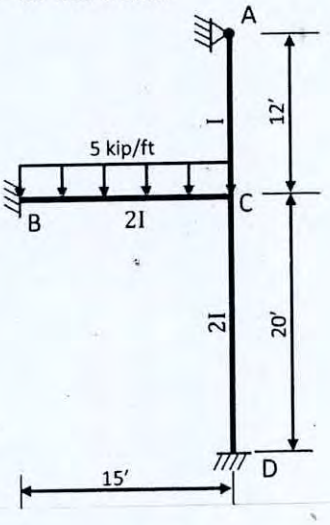

Fig.7

SECTION – B

There are **SEVEN** questions in this section. Answer any **FIVE**.
Symbols carry their usual meaning. Assume any data not available.

8. Determine the stiffness equation in matrix form for the beam shown in Fig. 8. **(21)**

9. Determine the stiffness equation in matrix form for the frame shown in Fig. 9. Consider axial deformation. Assume that the members have same flexural and axial rigidity. **(21)**

10. Determine the stiffness equation in matrix form for the truss shown in Fig. 10. Assume that the members have same axial rigidity. **(21)**

11. Determine the stiffness equation in matrix form for the plane grid shown in Fig. 11. Consider torsion. Assume: E, I, J, G as constant. The members have circular cross-section. **(21)**

12. Determine the modified stiffness equation imposing support conditions of the beam shown in Fig. 12. **(21)**

13. Determine the coordinate matrix, connectivity matrix, member property matrix, member stiffness matrices and global stiffness matrix of the truss shown in Fig. 13. Member areas are given in parentheses. Given: E = 30000 ksi. **(21)**

14. Derive the equation of influence line of R_B of the beam shown in Fig. 14. Given: EI is constant. **(21)**

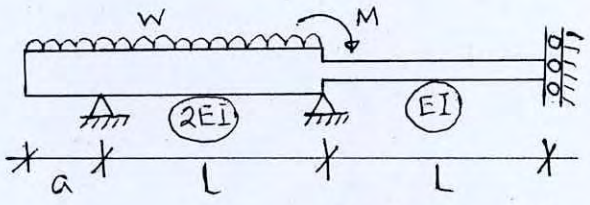

Fig. 8 (for Q.no.8)

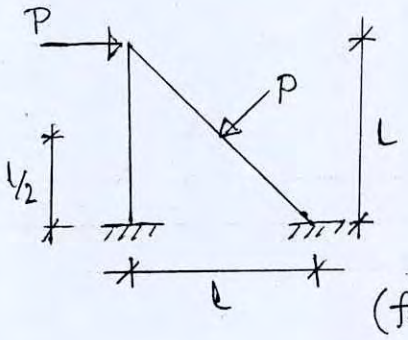

Fig. 9
(for Q.no.9)

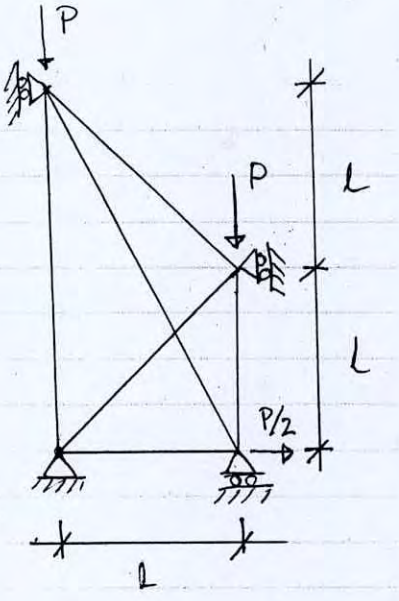

Fig. 10 (for Q. no.10)

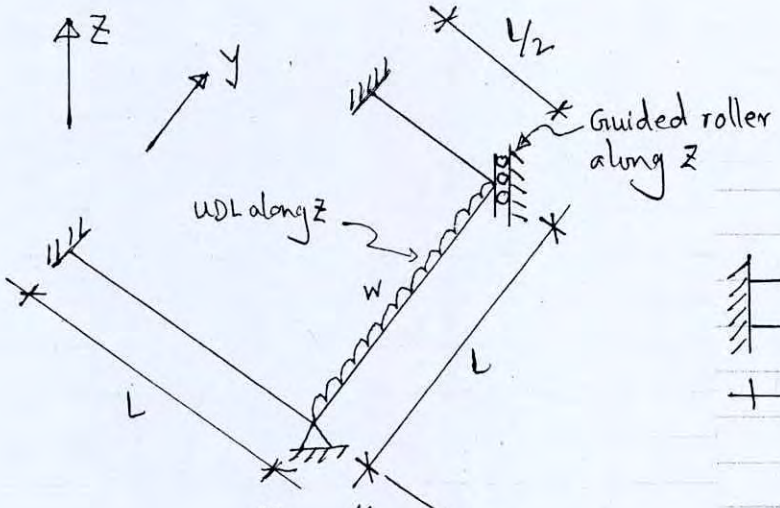

Fig. 11
(For Q. no. 11)

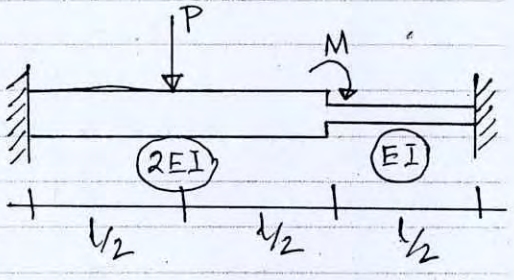

Fig. 12
(for Q. no. 12)

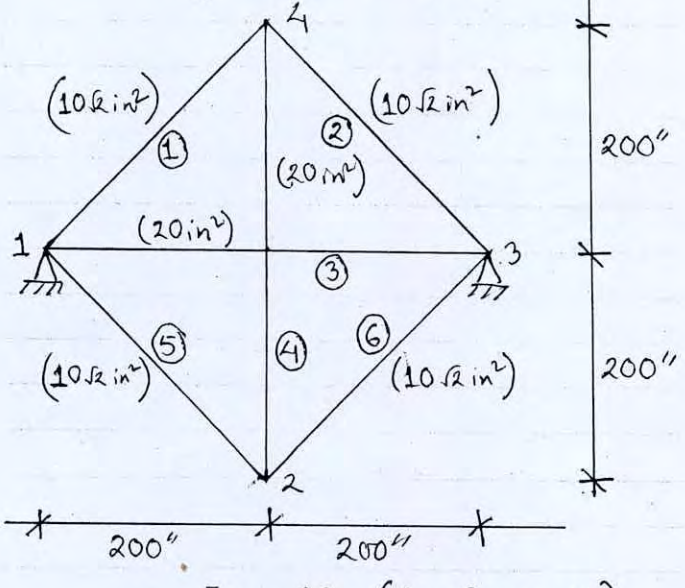

Fig. 13 (for Q. no. 13)

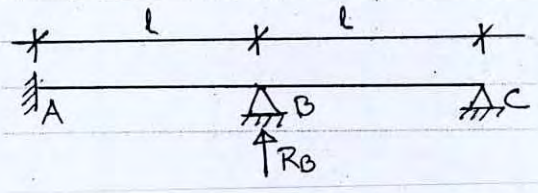

Fig. 14. (for Q.no. 14)

L-4/T-1/CE **Date : 07/07/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

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

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 FOUR from the rest.

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

   (a) "Quality control ensures that the work proceeds in accordance with the specifications and inspection are the tool through which quality control is exercised" – Explain the statement.

   (b) State the steps in Time-Cost optimization.

   (c) State the safety measures that should be taken for hot bituminous works.

   (d) List the Functions of the following equipment (i) Cold Milling Machine (ii) Road Roller (iii) Crane.

   (e) State Responsibility of different agencies during different project stages.

   (f) Explain the tendering process with a flow diagram.

   (g) Explain the steps in project planning and controlling.

2. (a) The network of a construction project is shown in Figure-1, along with the duration of each activity. Compute event time, activity time and total float of each activity. Locate the critical path on the network. **(25)**

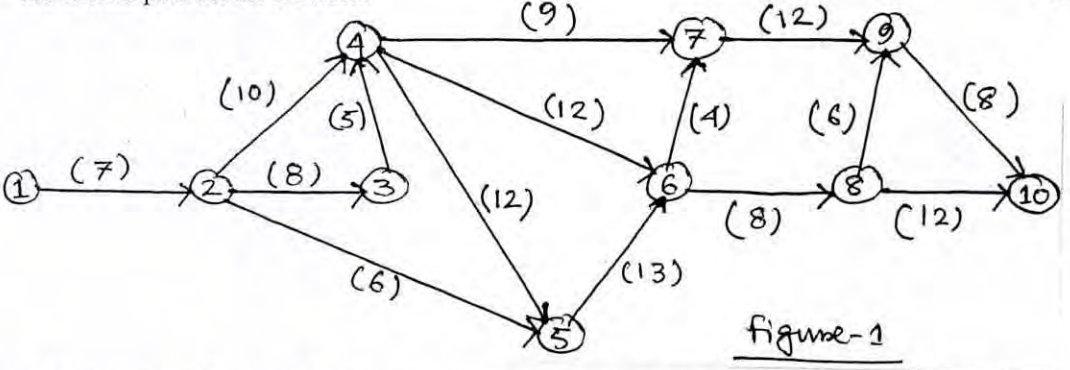

Figure-1

3. A Construction Company has an opportunity to submit a bid for the construction of a new apartment building. From the specification provided by the developer, the PERT network along with three time estimate (in week) for each activity are shown in Figure – 2. **(25)**

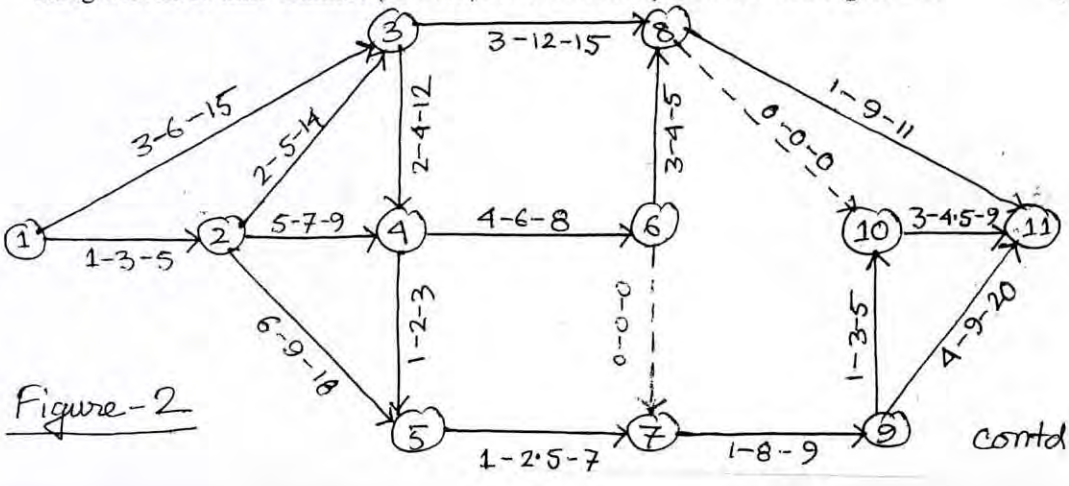

Figure-2

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CE 401

Contd ... Q. No. 3

Determine :

(i) Critical path and its standard deviation.

(ii) Probability of completing the work in 38 days..

(iii) Completion time duration for which the Company should bid to provide 95% probability of completing the project in time.

4. (a) A school is preparing a trip for 400 students. The Company who is providing the transportation has 10 Buses of 50 seats each and 8 Buses of 40 seats, but only has 9 drivers available. The rent Cost for a large bus is Tk. 8000 and Tk. 6000 for the small bus. Calculate how many (Graphical method) Buses of each type should be used for the trip for least possible cost using LP model. **(15)**

(b) Explain the basic ingredients in project management with diagram. Explain the ability to influence Construction Cost over time. **(10)**

5. (a) Draw the bar chart for "Finalization of designs and work order" for a Bridge Construction project. Assume appropriate activity and their relationship. Total activity 7 and duration of the project 25 weeks. **(12)**

(b) Compare CPM and PERT method of network analysis. State causes of total accidents in the construction industry. Why have accidents increased in construction works in recent time? **(13)**

6. (a) Draw a network diagram for the project having 9 activities, with the following inter-relationships: **(10)**

⇒ A and B start at the same time

⇒ C follows B but precedes H

⇒ C follows D but precedes F

⇒ G follows F abut precedes I

⇒ E follows A but precedes J

⇒ D follows A

⇒ H and I terminate at the same time

(b) Explain the "Tendering Period" phase of tendering process. List the good practices that should be followed during tender's evaluation process. What are the typical evaluation criteria of tender evaluation? **(15)**

7. (a) From the following information draw the "Variation of direct Cost with time". Curve.

Shift System	Time to complete (days)	Shift arrangement
Single shift	10 days	10 single shift
Double shift	6 days	6 single shift, 4 double shift
Three shift	4 days	4 single shift 4 double shift and 2 three shift.

The labor charges are at the rates of Tk. 500, 800 and 1200 for single shift, double shift and three shifts, respectively. **(10)**

Contd P/3

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(b) What do you understand by a "Dummy"? What are its uses? What are the short comings of bar charts? How are these removed? Define Event and Activity. **(15)**

SECTION-B

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

5. (a) What are the four important topics which need to be fostered in management education for Civil Engineering? Explain the significance and emerging role of management knowledge and leadership functions in Civil Engineering practices. Define EIA. State some important personality characteristics of a manager. **(24)**

(b) Briefly discuss the various tests for evaluating investments. Define discount rate, internal rate of return and present worth. State the different components of a feasibility report.

A cement plant will produce Tk. 1,250,000 worth of cement in its first full year of operation in 2020 (the fifth year of the project). Discounted at 14%, what is the present worth of that output on December 31, 2015? $(22\frac{2}{3})$

6. (a) Define construction management. Write down the objectives and functions of construction management. Briefly discuss the classification of management theory. Discuss the role of human resource management. State advantages and disadvantages of inventory control. **(24)**

(b) Define management organization. Discuss the element and principles of organization. State different components of a project cycle. What additional factors are to be considered if we incorporate environmental parameters in a regular project cycle? $(22\frac{2}{3})$

7. (a) Classify human needs. Explain with example the fundamental difference between economic and financial analysis of a project. Write the usual patterns for departmentation with examples. Briefly discuss the following:

   (i) Matching jobs and individuals

   (ii) Controlling conflicts in management. $(23\frac{2}{3})$

(b) Define and discuss the framework, various approaches and theories of motivation. Explain the concept and importance of morale in the context of motivation. Write down the dimensions and elements of planning. **(23)**

8. (a) State the conditions that foster voluntary cooperation in the organization. What are the issues in collective bargaining? What problems might arise in using staff? Make a list of positive and negative outcomes of conflict. What are the techniques in conducting effective meeting? **(22)**

(b) Justify that "management is a meta process". What is sinking fund? What do you mean by "Golden Hour"? Discuss in brief the benefits of organization. Write down the key factors in delegation and departmentation. What are the functions of management? $(24\frac{2}{3})$

L-4/T-1/CE **Date : 01/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

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

1. (a) Define flexible, semi-rigid and rigid pavements. Write down six important advantages of rigid pavement. In your opinion which type of pavement is suitable for Bangladesh and why? Draw typical sections for flexible and rigid pavements and also show load distribution mechanisms for them. **(3+3+5+11=22)**

   (b) Classify flexible pavement. What are the technological advancements that made perpetual pavement possible? Joint-wise classify rigid pavement. Write down two important benefits of continuously reinforced rigid pavement (CRCP)? **(4+4+3+2=13)**

   (c) An existing 4-lane national highway constructed on embankment requires full reconstruction. A number of trial pits were undertaken and the CBR of the sub-grade beneath the existing road was found to be 4%. A 24 hour classified traffic count was carried out on a typical weekday and shown only heavy vehicles as follows. Determine the pavement layer thicknesses by using RHD flexible pavement design guide method. Consider annual traffic growth rate 10% and design period 20 years. Use Base type II. Necessary Tables are given at the end of the question paper. Assume reasonable values for missing data, if any. **(11⅔)**

Vehicle Categories	Base year Two-way Flow/day
Heavy truck	40
Medium truck	300
Light truck	100
Large bus	200

2. (a) Write down the common modes of distresses of flexible and rigid pavements. Why joints are used in rigid pavement? Schematically show the layout arrangement of different types of reinforcement that are used in the concrete pavement. **(8+3+4⅔=15⅔)**

   (b) Why and where twin-track rigid pavement is usually constructed? Write down the sequences of pavement failure under submerged condition in Bangladesh. Why ditto copy of AASHTO method of pavement design is not appropriate for Bangladesh. **(4+4+4=12)**

Contd P/2

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Contd... Q. No. 2

(c) Determine ESAL for the following data: **(19)**

Highway type =	4-lane rural highway
Design Period =	20 yr
Uniform growth rate =	7.5 %
Total No. of trucks weighed =	1200 (one day & both directions)
Terminal Serviceability, Pt =	2.5 (Default Po = 4.6)

Give only one trial with SN = 6.0 and put your comments for the next trial (if needed).

Axle Load Distribution

Axle Load Groups (kip)	Number of Axles, N	Axle Load Groups (kip)	Number of Axles, N
Single Axles		Tandem Axle	
0 - 3	0	0 - 6	0
3 - 7	10	6 - 12	28
7 - 8	480	12 - 18	200
8 -12	1440	18 - 24	480
12 -15	510	24 - 30	344
26 - 30	450	30 - 32	540
-	-	32 - 34	552
-	-	34 - 36	544

3. (a) State the widths of different railway gauges that are available in Bangladesh. What are the difficulties with non-uniformity in gauges? **(10⅔)**

(b) List the requirements of an ideal fastening. What are fish plates? **(16)**

(c) Calculate the maximum permissible train load that can be pulled by a locomotive having four pairs of driving wheels having an axle load of 28.42 tones latch on a B.G. track with a rising gradient of 1 in 200 and maximum curvature of 3 degrees at a speed of 48.3 kmph. Take coefficient of friction as 0.2. **(20)**

4. (a) What are the advantages of concrete sleepers? What is sleeper density? **(10⅔)**

(b) Explain classification of railway stations as per operational and functional considerations. **(16)**

(c) What is the function of points and crossings? Draw a complete labeled diagram for a right hand turnout. **(20)**

Contd P/3

CE 451/CE

SECTION – B

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

5. (a) Make a comparative statement of low cost gravel and clay brick surfaces in Bangladesh situation. Also, compare between Penetration Macadam surface and Double Bituminous Surface Treatment (DBST). Make a list of equipment with their specific uses in bituminous pavement construction. **(20)**

(b) Discuss different kinds of excavations as required for highway embankment construction. Discuss the quality control tests and their typical frequencies for granular road base construction. Also, explain the uses of typical tools and devices for traffic control in road work zone. **(20)**

(c) Discuss preparation of road application surface before placing of bituminous mixes and write down subsequent standard rolling procedure for mix compaction. **(6⅔)**

6. (a) What are the critical elements before start of cement concrete paving operation? What are the defects in dowel bar alignment and what points must be considered while doing dowel bar installation. Discuss important issues related to concrete curing. **(20)**

(b) Write short notes on the following: **(5×4=20)**

(i) Scheme of bituminous pavement crack repair.
(ii) Pavement life cycle diagram and maintenance management system.
(iii) Rutting and channel repair in bituminous pavement.
(iv) Joint maintenance and curling crack repair in rigid pavement.
(v) Bituminous pavement recycling.

(c) Explain the use of Gantt. Chart, CPM and PERT in highway construction project. **(6⅔)**

7. (a) What are the requirements/objectives of asphaltic concrete mix design? What are the methods and general steps for determining optimum asphalt content? **(20)**

(b) How is C.K.E. Determined? What are the test schedule, tests, and steps for determining design asphalt content in Hveem method? **(20)**

(c) An asphaltic concrete sample cut from the top layer of runway overlay weighs 3537 gm in air and 2037 gm in water. The mix when tested in the lab resulted G_{mb} = 2.356 and G_{mm} = 2.466. Find the percent air voids and percent compaction achieved in the field. **(6⅔)**

8. (a) What are the properties and classification of aggregates? How do you get aggregates in a specified gradation for a particular project? What are the tests included for aggregates in the specification for pavement overlay project? **(20)**

(b) Briefly state the steps for obtaining different varieties of asphalt from crude petroleum. What are the present grades of asphalt cement based on standard capillary viscometer test? **(20)**

(c) What are the types and grades of emulsified asphalts? **(6⅔)**

For Q 1(c)

Table 1: Improved Sub-grade Requirements

CBR Required	Compacted thickness of additional layer to provide required CBR				
	CBR of underlying layer				
	<2%	2%	3%	4%	5%
5%	Sub-grade material should be removed	450mm	300mm	250mm	200mm

Table 2: Thickness Design Table for Flexible Pavements (RHD design guide method)

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

For Q 2(c)

Table 3: Lane distribution factors

Number of lanes in both directions	Percent of 18-kip ESAL traffic in design lane
1	100
2	80 - 100
3	60 - 80
4 or more	50 - 75

Table 4: Axle Load Equivalency Factors for Flexible Pavements Single Axles (Pt = 2.5)

Axle Load (kips)	Pavement Structural Number (SN)					
	1	2	3	4	5	6
2	0.0004	0.0004	0.0003	0.0002	0.0002	0.0002
4	0.003	0.004	0.004	0.003	0.002	0.002
6	0.011	0.017	0.017	0.013	0.01	0.009
8	0.032	0.047	0.051	0.041	0.034	0.031
10	0.078	0.102	0.118	0.102	0.088	0.08
12	0.168	0.198	0.229	0.213	0.189	0.175
14	0.328	0.358	0.399	0.388	0.36	0.342
16	0.591	0.613	0.656	0.645	0.623	0.606
18	1	1	1	1	1	1
20	1.61	1.57	1.49	1.47	1.51	1.55
22	2.48	2.38	2.17	2.09	2.18	2.3
24	3.69	3.49	3.09	2.89	3.03	3.27
26	5.33	4.99	4.31	3.91	4.09	4.48
28	7.49	6.98	5.9	5.21	5.39	5.98
30	10.3	9.5	7.9	6.8	7	7.8
32	13.9	12.8	10.5	8.8	8.9	10
34	18.4	16.9	13.7	11.3	11.2	12.5
36	24	22	17.7	14.4	13.9	15.5

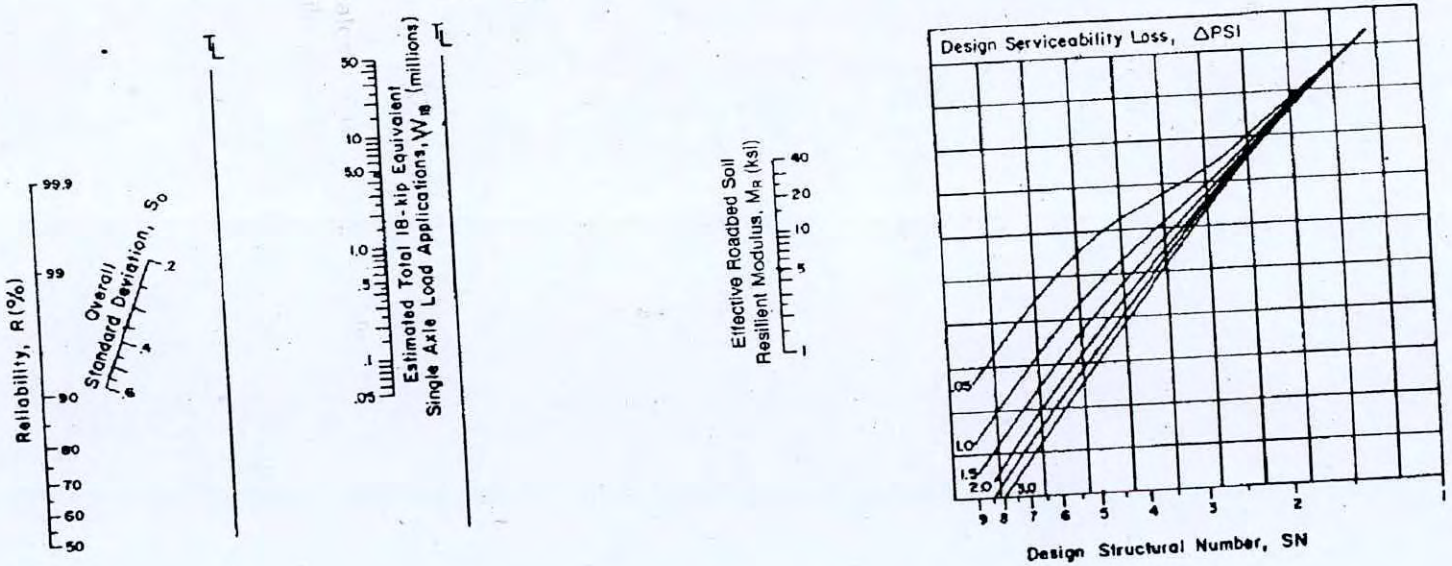
Table 5: Axle Load Equivalency Factors for Flexible Pavements Tandem Axles (Pt = 2.5)

Axle Load (kips)	Pavement Structural Number (SN)					
	1	2	3	4	5	6
2	0.0001	0.0001	0.0001	0	0	0
4	0.0005	0.0005	0.0004	0.0003	0.0003	0.002
6	0.002	0.002	0.002	0.001	0.001	0.001
8	0.004	0.006	0.005	0.004	0.003	0.003
10	0.008	0.013	0.011	0.009	0.007	0.006
12	0.015	0.024	0.023	0.018	0.014	0.013
14	0.026	0.041	0.042	0.033	0.027	0.024
16	0.044	0.065	0.08	0.057	0.017	0.043
18	0.07	0.097	0.109	0.092	0.077	0.07
20	0.107	0.141	0.162	0.141	0.121	0.11
22	0.16	0.198	0.669	0.207	0.18	0.166
24	0.231	0.273	0.315	0.282	0.26	0.242
26	0.327	0.37	0.42	0.401	0.364	0.342
28	0.451	0.493	0.548	0.534	0.495	0.48
30	0.611	0.648	0.703	0.695	0.658	0.633
32	0.813	0.843	0.889	0.887	0.857	0.834
34	1.06	1.08	1.11	1.11	1.09	1.08
36	1.38	1.38	1.38	1.38	1.38	1.38

AASHTO Design Nomograph for Flexible Pavement

NOMOGRAPH SOLVES:

$$\log_{10} W_{18} = Z_R * S_o + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2 - 1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$



L-4/T-1/CE **Date : 05/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

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

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) The following are the ordinates of the Flood Hydrograph from a catchment area of 489 km^2 due to a 4-h rainfall. Derive the ordinates of a 4-h unit hydrograph. (15)

Time (h)	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56
Discharge (m^3/s)	20	30	50	80	110	150	130	110	80	60	50	40	30	20	20

(b) The ordinates of a 6-h unit hydrograph of a catchment is given below. (15)

Time (h)	0	6	12	18	24	30	36	42	48	54
UH ordinates (m^3/s)	0	50	125	170	150	100	60	40	15	0

The average storm rainfall values over that catchment in three successive 6-h intervals are known to be 5.2, 4.2 and 2.7 cm. The ϕ-index for the catchment is estimated to be 0.2 cm/h. The base flow can be assumed to be 10 m^3/s at the beginning of storm and increases by 2 m^3/s every 18 h. Estimate the resulting flood hydrograph.

(c) Explain why the boundaries of the polygons are formed by the perpendicular bisectors of the lines joining adjacent gages in thiessen Polygon method. (5)

2. (a) To estimate the magnitude of peak runoff by Rational method, explain why a rainfall of very long duration occurring over a basin is considered. (5)

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

(c) The amount of precipitable water in a saturated air column in the first 2 km from the ground is 500 kg corresponding to a ground area of 10m^2. Assume linear variation of air density and specific humidity in the column. The average air density in the column is 1 kg/m^3 and specific humidity at ground surface is 50% higher than the same at an elevation of 2 km. Find out the specific humidity at ground surface and at 2 km elevation. (10)

(d) 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)

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3. (a) Classify and explain streams according to annual Hydrograph. (5)

(b) The relative humidity and saturation vapor pressure are computed to be 70% and 2400 Pa respectively. Assume standard air pressure, find out the following: (i) air temperature, (ii) actual vapor pressure at air temperature, (iii) dew point temperature, (iv) specific humidity, (v) gas constant for moist air, and (vi) density of moist air. (15)

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

Rain gage location	Rainfall (mm)
(2, 9)	18
(7, 11)	25
(12, 10)	35
(6, 2)	42

All coordinates are expressed in kilometers. Compute the average rainfall in the area by Isohyetal Method (use isohyets of 20, 30 and 40 mm). Use plain graph paper.

4. (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 m^2	Area = 3 km^2

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 Fig. 1.

(b) Briefly explain the three mechanisms of air mass lifting. (5)

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

(d) Define : (i) Biological water and (ii) Percolation. (5)

(e) Define : (i) Exceedence Probability and (ii) Return period. (5)

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SECTION-B

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

5. (a) What do you understand by irrigation? Write down its necessity in the context of Bangladesh. (5)

   (b) Define irrigation engineering and write short note on water right and return flow. (10)

   (c) Rabi season is the main irrigation season of Bangladesh and favorable for high yield, Why? (5)

   (d) What is national water policy? Write down its main elements in the government policy? (7)

   (e) What do understand by soil moisture tension? Write down the physical properties of soil. (8)

6. (a) Define field capacity, permanent wilting point and infiltration rate. (6)

   (b) Briefly describe different methods for the measurement of soil moisture. (8)

   (c) Write down the guidelines (special considerations) for using poor quality irrigation water. (5)

   (d) A stream of 130 lps was diverted from a canal and 100 lps were delivered to the field. An area of 1.6 hectares was irrigated in 8 hours. The effective depth of root zone was 1.7 m. The runoff loss in the fields was 420 m^3. The depth of water penetration varied linearly from 1.7 m at the head end of the field to 1.1 m at the tail end. Available moisture holding capacity of the soil is 20 cm per meter depth of soil. it is required to determine the (a) water conveyance efficiency, (b) water application efficiency, (c) water storage efficiency and (d) water distribution efficiency. Irrigation was started at a moisture extraction level of 50% of the available moisture. (16)

7. (a) Define surface and subsurface irrigation. Discuss briefly the various techniques used for distributing water in the firm. (15)

   (b) Determine the time required to irrigate a strip of land of 0.04 hectares in area from a tube-well with a discharge of 0.02 cumec. The infiltration capacity of the soil may be taken as 5 cm/h and the average depth of flow on the field as 10 cm. Also determine the maximum area that can be irrigated from this tube well. (10)

   (c) Determine the consumptive use and net irrigation requirement for paddy from the given data: (10)

Dates and periods of growth	Pan evaporation, Ep	Consumptive use coefficient	Effective precipitation in cm
Oct. 16-31	8.49	0.44	3.42
Nov. 1-30	15.57	0.54	2.19
Dec. 1-31	16.59	0.94	0.54
Jan. 1-31	19.10	0.99	0.15
Feb. 1-2	1.54	0.73	0.02

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8. (a) What do you understand by flood? What are the options for flood damage mitigation? (6)

(b) Mention the main reasons for the failure of any flood management policy and enlist the possible impacts on water resources system of Bangladesh. (12)

(c) Define (i) Available water (ii) Management allowable depletion (iii) Reference crop evapotranspiration (iv) Crop co-efficient and (v) Leaching (10)

(d) Write down the reclamation measures of water quality problems (7)

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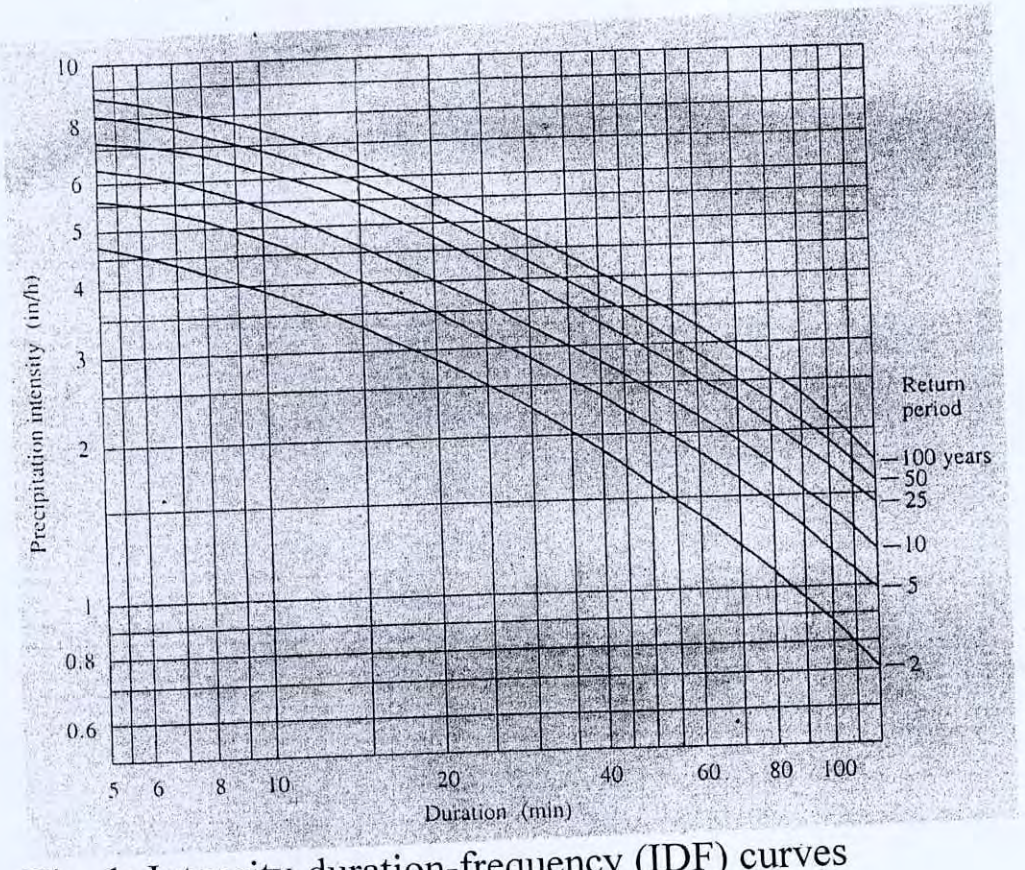

Fig. 1: Intensity-duration-frequency (IDF) curves

for Q. No. 4(a)

L-4/T-1/CE **Date : 09/08/2015**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2013-2014

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

1. Calculate the factor of safety and settlement at corner and at centre for the Raft Foundation. Given: (35)

   Foundation: raft size 80′×120′, D_f = 20′

   Soil: Upto 40 ft from ground level pre-loaded clay, γ = 120 pcf, q_u = 1 ksf, C_r = 0.05, C_c = 0.20, past maximum over burden pressure 5 ksf.

   Load: gross contact pressure 3 ksf. Ground water table at 30 ft depth. Below 40 ft very dense sand. Divide the clay soil into two layers for settlement calculation and draw neat sketches for the stated condition.

2. (a) Draw and discuss soil pressure vs. settlement curve for a narrow, intermediate and wide footing resting on sand. (8)

   (b) Draw and discuss soil pressure vs. footing width curve for a footing resting on sand. (8)

   (c) Describe a method to calculate the capacity of a raft foundation resting on sand at 20ft depth. Water table at 30 ft depth. (11)

   (d) Describe quality control tests on a bored pile. (8)

3. (a) Calculate the allowable capacity for a driven pile and drilled pier with factor of safety 2.5. Assume unit wt. of soil 125 pcf. Water table at 20 ft depth. (30)

   Given :

   Soil : 0′- 20 ft sand, N = 10, tanδ = 0.3, k = 1.0

   20′ - 80 ft sand, N = 30, tanδ = 0.5, k = 2.0, N_q = 80.

   Pile : Cross-section 15″× 15″

   Length 40ft.

   Top level at 5ft depth from EGL.

   Critical depth 20 ft.

   Drilled Pier: Cross-section 30″ diameter

   Length 40 ft.

   Top level at 5 ft depth from EGL.

   Use AASHTO method.

   (b) Describe the concreting procedure for a bored pile. (5)

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4. (a) Calculate pressure at four corners and at centre for an eccentrically loaded footing using Conventional Method and Meyerhof's Effective Width Method. (20)

Given:

Footing size 12′ × 16′

Vertical load 200 kip

Eccentricity in long direction 2 ft.

Eccentricity in short direction 1 ft.

Draw neat sketches for the stated conditions.

(b) Calculate load on four corner piles for an eccentrically loaded pile foundation. (10)

Given:

Pile group - 12 nos @ 5 ft

Vertical load 1000 K

Eccentricity in long direction 3 ft.

Eccentricity in short direction 2 ft.

Draw neat sketches for stated conditions.

(c) Discuss Engineering News formula for estimating the capacity of a pile from driving records. (5)

SECTION-B

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

5. (a) Discuss the considerations required for deciding upon the number, depth and layout of exploratory borings for sub-soil investigation. (8)

(b) Differentiate between 'disturbed' and 'undisturbed' soil samples and state their uses. (7)

(c) State the causes of variation of SPT-N values obtained by different drillers or equipments. (8)

(d) For an infinite slope of a c-φ soil that makes an angle β with the horizontal, show that the depth of the plane along which critical equilibrium occurs is given by:

$$H_{cr} = \frac{c}{\gamma} \cdot \frac{1}{Cos^2\beta(\tan\beta - \tan\varphi)}$$

γ = unit weight of soil.

6. (a) An excavation is made in a saturated clay deposit for which c_u = 20 kN/m^2 and γ_{sat}= 17 kN/m^3. The cut slope makes an angle of 60° with the horizontal. Assuming undrained condition and using the charts (Fig. 3 & Fig. 4) given by Fellenious (10)

(i) Determine the critical height of excavation

(ii) Comment on the nature of the critical circle

(iii) Determine the horizontal distance between the toe (at critical height) and the point of intersection of the critical circle with the ground surface.

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(b) Mention the advantages and limitations of CPT and SPT. (8)

(c) What should be the contents of a good soil exploration report? – Discuss (9)

(d) Compare 'wash boring' and 'percussion drilling' methods. (8)

7. (a) For a given slope: γ = 105 pcf, φ= 20°, c = 400 psf, r_u = 0.4 and β = 20°. Determine the factor of safety using Spencer's solution. Charts for Spencer's method are given in Fig. 5. (12)

(b) What is the basic difference between Bishop's simplified method of slices and Spencer's solution for analysis of slope stability. (5)

(c) Explain 'area ratio' and 'inside clearance ratio' that are used to indicate the degree of sampling disturbance of tube samples. (6)

(d) Write down Terzaghi's Bearing Capacity Equation for net ultimate bearing capacity for c – φ soil. Discuss all the terms of the equation. (12)

8. Calculate the allowable capacity of the foundation with factor of safety 2.5. Calculate the settlement of the footing if the load on footing is 250 kip. (35)

Given :

Footing size : 8′× 10′, t = 30″, D_f = 8 ft.

Soil : Average unconfined compressive strength of deep deposit of clay = 2 ksf

γ =125 pcf, C_c = 0.15, C_r = 0.04, σ_{vmax} =8000 psf

Water table at 10ft depth

Draw necessary sketches.

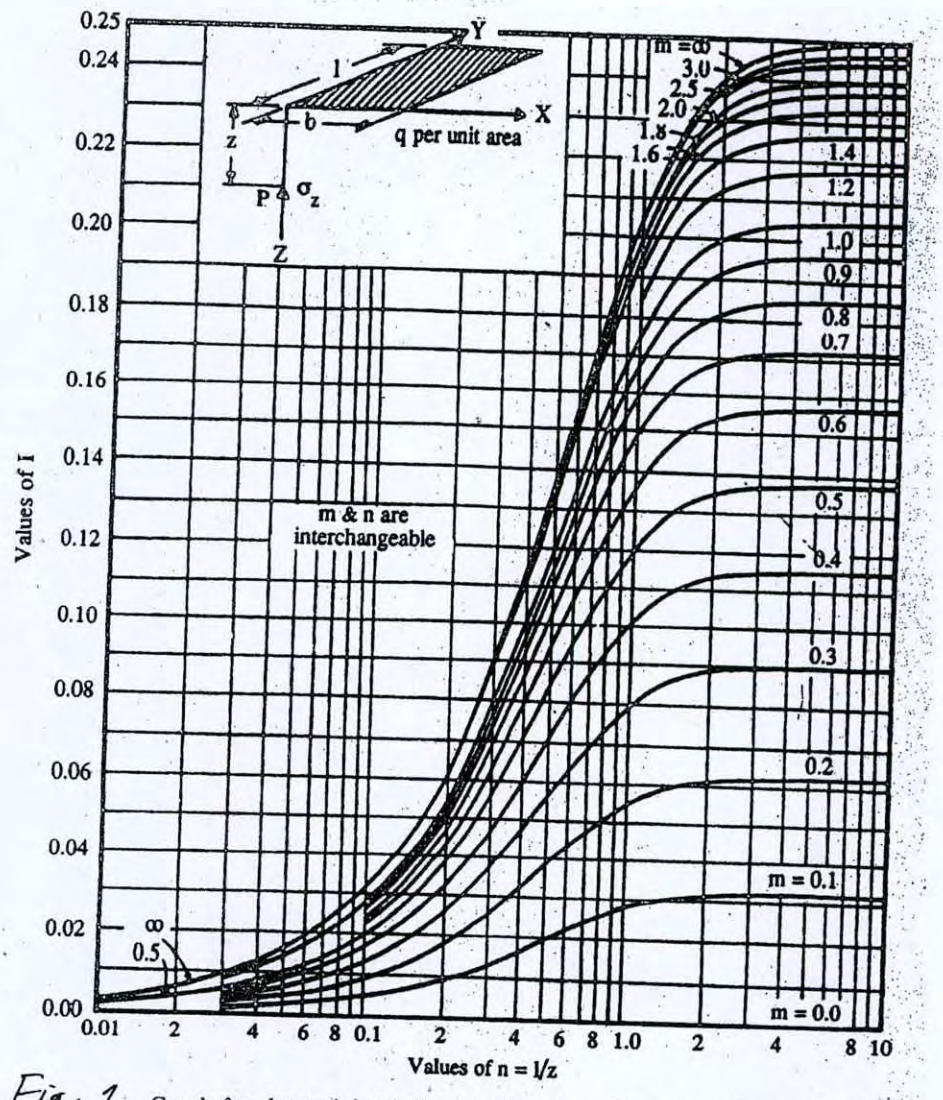

Fig. 1. Graph for determining influence value for vertical normal stress σ_z at point P located beneath one corner of a uniformely loaded rectangular area. (After Fadum)

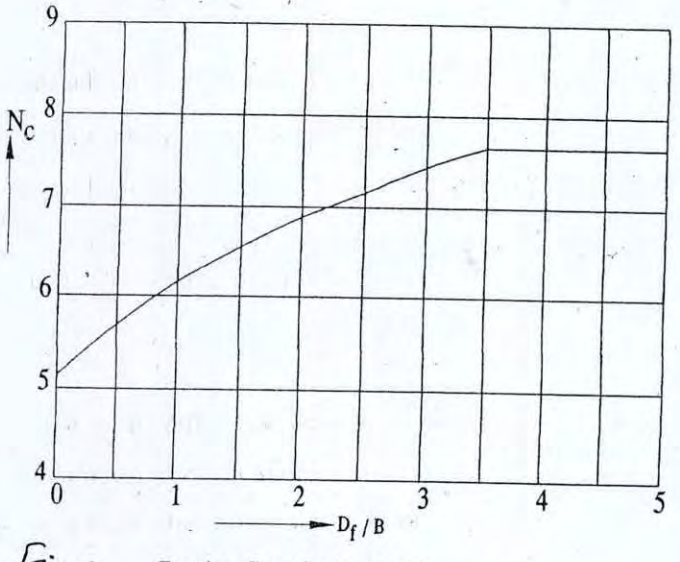

Fig. 2 Bearing Capacity Factor N_C For Strip footing on clay

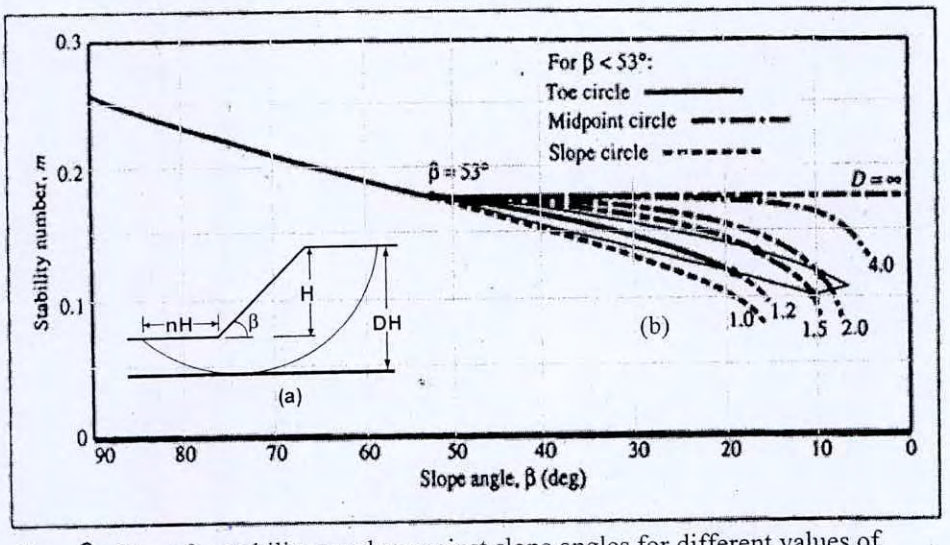

Fig. 3 Chart for stability number against slope angles for different values of depth factor D for slope stability analysis using Fellenious method.

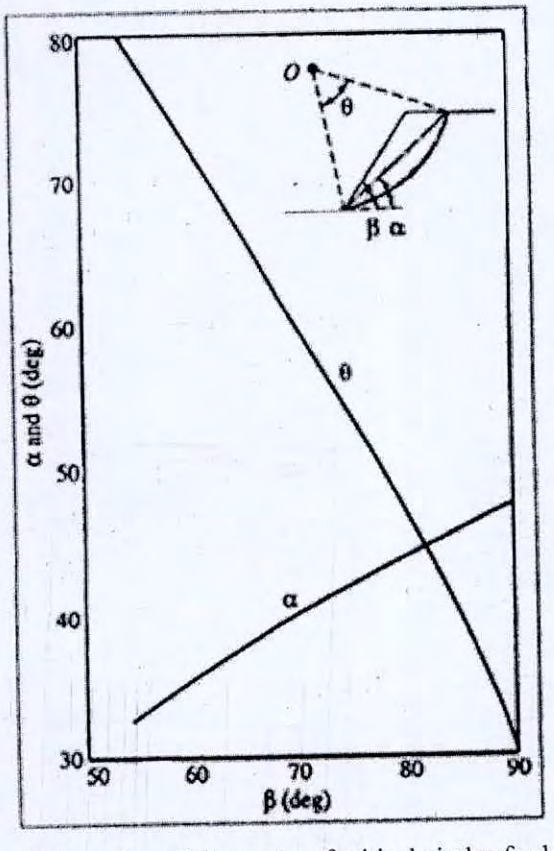

Fig. 4 Location of the center of critical circles for b>53^0

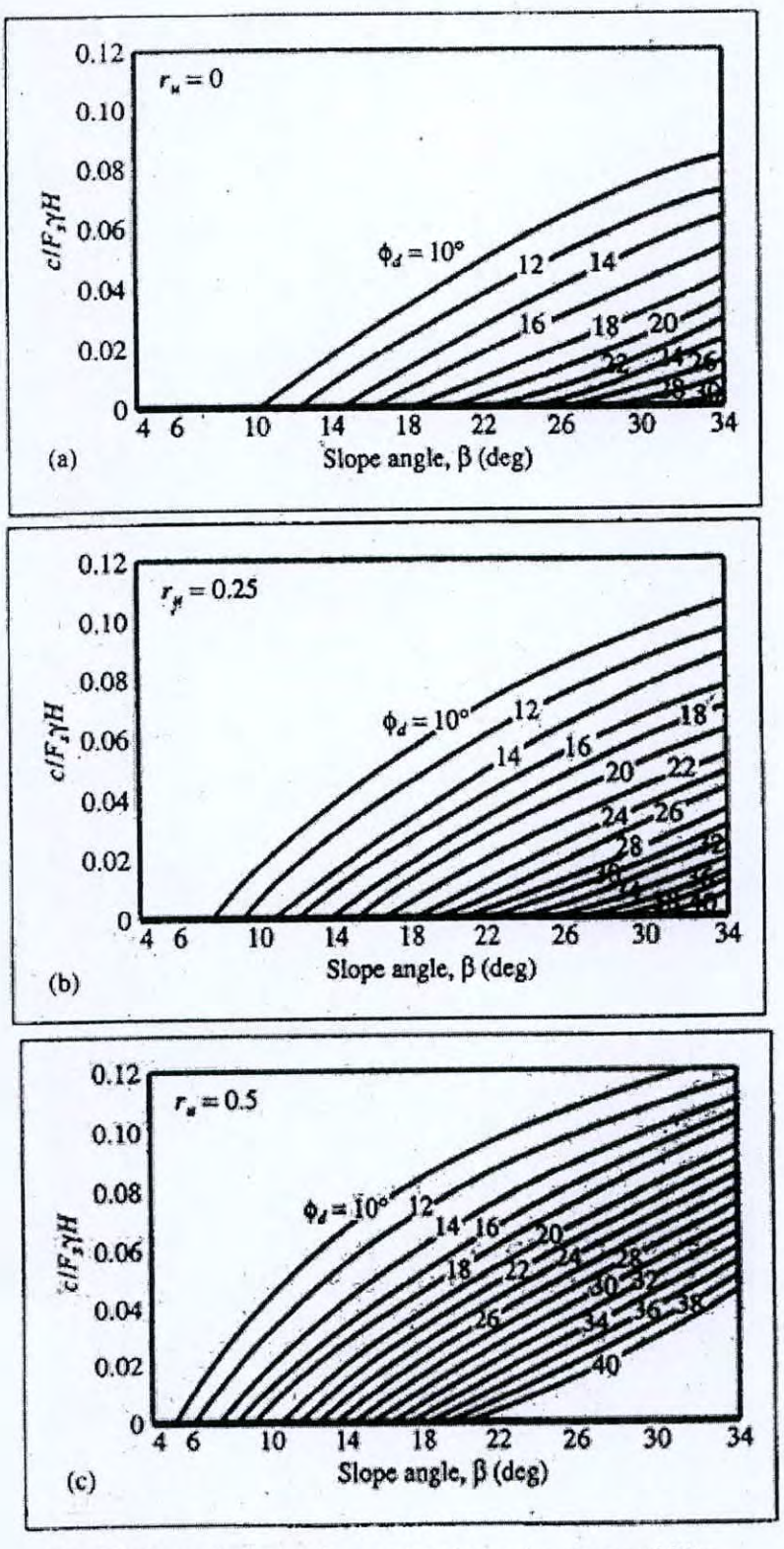

Fig. 5. Charts for using Spencer's solution for slope stability analysis.