

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 405** (Business and Career Development )

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) Define career. Explain the individual and organizational perspectives of career development. Briefly describe the value of effective career development. (18)  
 (b) Briefly describe the steps involved in preparing for job search. (17)
  
2. (a) What is meant by external and internal dimensions of an individual's career? Briefly describe the various stages of an individual's career. (18)  
 (b) Define internship. What are the skills gained from internship and why is it needed? Briefly describe the steps required to prepare for internship. (17)
  
3. (a) What are the characteristics of a good opportunity and what are the places to look for them? (18)  
 (b) Explain value map, customer profile and fit for designing value proposition. (17)
  
4. (a) Define marketing. What are the main marketing management tasks? Briefly describe how information is gathered from market research. (18)  
 (b) What is CRM and what does its success depend upon? Briefly describe the STP model and market segmentation criteria. (17)

**SECTION – B**

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

5. (a) Briefly describe four frame model for understanding and managing organizations. (10)  
 (b) State the assumptions, role of Manager, options for differentiation and integration of structural frame. (25)

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6. (a) What are the generic strategies and source of competitive advantage? Briefly explain. (10)  
(b) Explain the value net and identify the benefits of complementary mindset. (25)
7. (a) What is low end disruption and how it works? (10)  
(b) Briefly explain the interdependent and modular Architecture and Challenges of modularity. (25)
8. (a) What do you understand by good money and bad money? Explain. (10)  
(b) What are the five competitive forces that define the industry structure? Explain threat of new entrant. Identify sources of entry barrier. Explain the scenario where fear of expected retaliation is high. (25)
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**SECTION – A**

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

1. (a) Explain the demographic trends of Bangladesh in terms of gender balance, population growth, domestic migration and education. Explain the urban-rural disparities in sectors of water, sanitation and health coverage and development progress. (20)  
 (b) Which policy considerations should be taken into account for Involuntary resettlement as an integral part of project design, explain. (15)
  
2. (a) Explain the involvement of women in water and sanitation in rural part of Bangladesh. Explain what needs to be done in order to make the contribution of women in this sector more visible for national development. (20)  
 (b) List and explain some important factors that need to be considered in Resettlement Planning for a development project in Bangladesh context. (15)
  
3. (a) Explain the following terms with explanations in the context of a WSS project in Bangladesh: (5×4=20)  
 (i) Clientele groups (ii) Clientele need (iii) Clientele demand (iv) Absorptive Capacity.  
 (b) What important factors/information should be included in the socio-economic survey that will be used in developing a resettlement plan? (15)
  
4. (a) What is HDI? Which indicators does it contain? Explain how HDI is calculated. (20)  
 (b) What are the major social and economic issues in large infrastructure project? Why Resettlement Issue is one of the most sensitive issues in major development projects? (15)

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**SECTION – B**

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

5. (a) Briefly describe the different levels of community participation with the example of arsenic mitigation program for the rural areas of Bangladesh. (18)
  - (b) What is a Client Centered approach? Explain this as a strategic issue for the WSS policies of Bangladesh. (17)
  
  6. (a) What are the major difficulties in conducting socio economic assessments in developing countries? Explain with examples. (18)
  - (b) Briefly discuss methodologies in practice to ensure community participation. (17)
  
  7. (a) What are the advantages and features of Social Impact Assessment (SIA) process? (18)
  - (b) List the major socio-economic issues in water quality management planning. (17)
  
  8. (a) Define "Participation". What is the significance of peoples' participation in WSS projects? (18)
  - (b) What are the major difficulties in conducting socio-economic assessments in developing countries? (17)
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**SECTION – A**There are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Define:

(3)

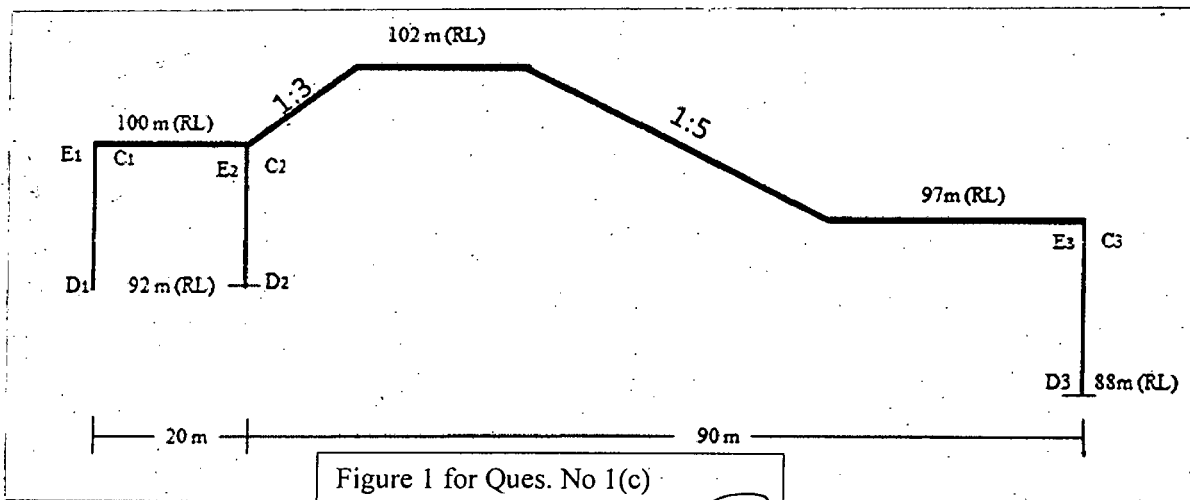
(i) Afflux (ii) Inverted filter (iii) Retrogression

(b) What are the main causes of failure of hydraulic structures constructed on permeable foundation and what remedial measures are taken to prevent them?

(5 1/3)

(c) Determine the percentage uplift pressures at  $C_1$ ,  $E_2$ ,  $C_2$ ,  $D_2$ ,  $E_3$ ,  $D_3$  for the structure shown in Fig. 1 using Khosla's formula and apply necessary corrections. The correction factors for 1:3 and 1:5 slopes are 4.5 and 2.8 respectively. Also compute the exit gradient for pond level of 105.0 m on upstream and no flow on downstream.

(15)



2. (a) List the considerations for selecting of a suitable type of cross drainage work.

(3 1/3)

(b) Draw a typical layout of diversion head works and indicate the various components of the system.

(5)

(c) A barrage is to be constructed on an alluvial river having a flood discharge of 8400 cumec. The relevant data are as follows:

(15)

Average river bed level = 202.0 m

HFL (before construction of barrage) = 207.3 m

Permissibility afflux = 1.0 m

Lacey silt factor = 0.75

Determine (i) the crest level of under-sluices and barrage bays (ii) the waterway to pass the flood discharge (iii) downstream floor level for under-sluices portion considering a retrogression of 0.5 m and 20% discharge concentration.

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3. (a) Compare Khosla's theory with Bligh's theory for seepage below a hydraulic structure. (4)  
 (b) Show that the critical exit gradient for most of the river sand is equal to unity. (4 1/3)  
 (c) Design a suitable cross-drainage work, given the following data at the crossing of a canal and a drainage. (15)

Canal:	Drain:
Discharge = 25 cumec	High flood discharge = 280 cumec
Bed width = 20 m	HFL = 247.5
Depth of water = 1.5 m	High flood depth = 2.5 m
FSL = 251.5 m	General ground level = 251.0 m

Assume reasonable values for data if missing.

Now determine (i) drainage waterway (ii) canal waterway including bed levels at different sections (iii) transitions.

4. (a) Elaborate on (with diagrams) the uplift pressures in jump through for no flow and with a certain flow conditions. (6)  
 (b) State the salient points of difference between: (9)  
 (i) Aqueduct and syphon aqueduct (ii) silt excluder and silt extractor (iii) Weir and Barrage  
 (c) The head regulator of a canal has 3 openings each 5.0 m wide. The water is flowing between the upper and lower gates. The vertical opening of the gate is 1.0 m. The head on the regulator is 0.5 m. If the upstream water level rises by 0.25 m, find how much the upper gates must be lowered to maintain the canal discharge unchanged. (8 1/3)

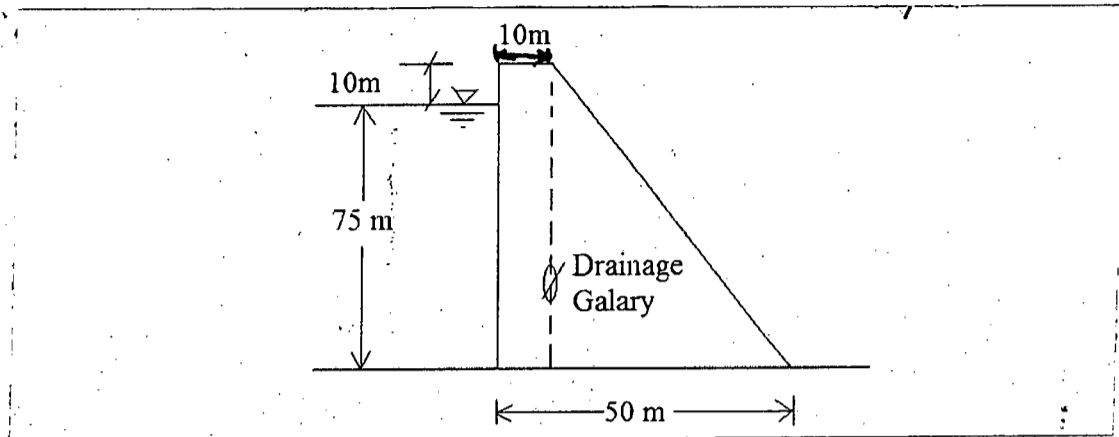
**SECTION – B**

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

5. (a) What is Dam? Discuss the problems of dam Construction. (2+6)  
 (b) Discuss the governing factors regarding the dam site selection. (8 1/3)  
 (c) Discuss various combinations of forces for the design of Gravity dam for reservoir full and reservoir empty case. (7)
6. (a) Draw a typical cross section of Syphon type and Shaft type Spillway. (5 1/3)  
 (b) Following figure shows the cross-section of a gravity dam. Neglecting Earthquake forces, calculate – (i) Maximum vertical stress at heel and Toe (ii) Major principle stresses at heel and toe. Assume any reasonable values if not given. Assume there is no tail water and the weight of concrete 24 kN/m<sup>3</sup>. (18)

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



7. (a) A contour survey of a reservoir site gives following data:

**(14 1/3)**

Contour values (m)	Area (hectars)
300	6
310	18.1
320	34

The capacity of the reservoir up to 300 m contour level was found to be 14.1 ha-m. Determine the equation of area-elevation and area capacity curve for the reservoir. Also find the storage capacity for 325 m elevation.

(b) Draw a typical longitudinal section of a dam reservoir and show various storage zones.

**(9)**

8. (a) What is gravity dam? Name different forces acting on a gravity dam.

**(5)**

(b) Design the downstream portion of a Ogee spillway for a dam having following characteristics. The u/s face is vertical and the downstream portion is having a slope of 0.7H : 1V. The design discharge is 9000 cumecs. The height of spillway crest is kept at RL 312 m. And the bed elevation is 200 m. Spillway length consists of 6 spans having clear width of 10 m each. Pier thickness is 2.5 m. Assume  $K_p = 0.01$ ,  $K_a = 0.1$ .

**(18 1/3)**

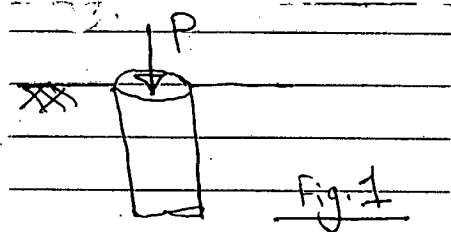
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**SECTION – A**

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

Symbols carry their usual meaning.

1. (a) What are the steps involved in Finite Element analysis? (4)
- (b) What is the definition of strain for beam elements? Derive the strain-displacement matrix of beam elements. (12)
- (c) What constitutive law will you use for an axially loaded pile as shown in Fig. 1. Will there be any normal stress in the tangential direction? (7 1/3)



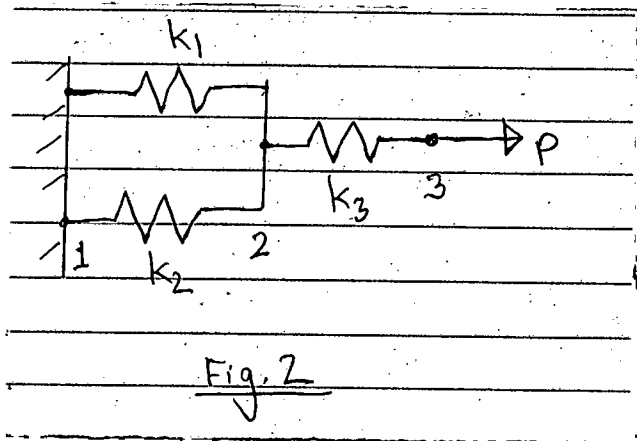
2. (a) Explain why the two noded bar element yields exact stiffness matrix. (5)
- (b) For the spring system shown in Fig. 2: (11)

$k_1 = 100 \text{ N/mm}, K_2 = 200 \text{ N/mm}, k_3 = 100 \text{ N/mm}$

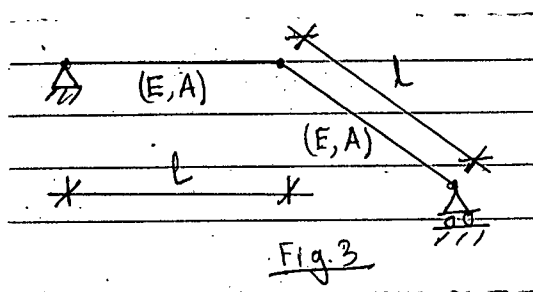
$P = 500 \text{ N}$  and  $u_1 = 0$

Find:

- (i) The global stiffness matrix
- (ii) Displacements of nodes 2 and 3
- (iii) The reaction force at node 1
- (iv) The force in spring 2



- (c) A simple plane truss is made of two identical bars as shown in Fig. 3. Find the global stiffness matrix. (7 1/3)



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3. (a) A propped cantilever beam is subjected to a distributed vertical load  $p$  as shown in Fig. 4. Show the work equivalent nodal loads. Ignoring nodal moment at the right end, find the deflection and rotation at node 3. (12)

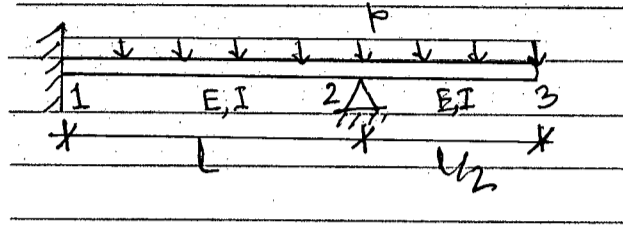


Fig. 4

- (b) Determine natural coordinates of the point P of the triangular element ABC shown in Fig. 5. (11 1/3)

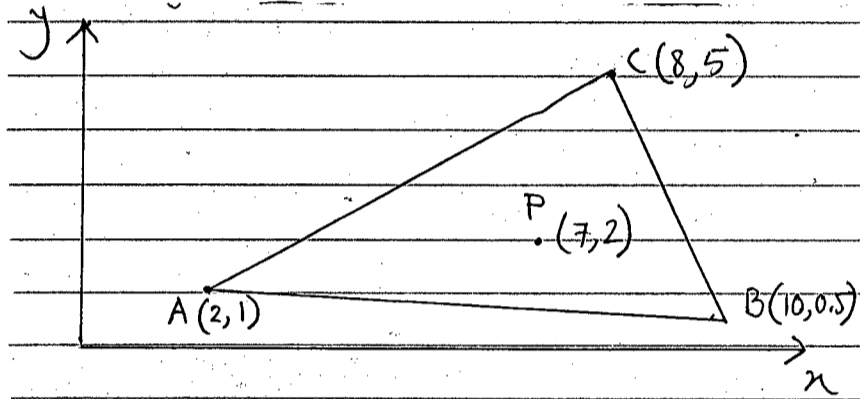


Fig. 5

4. (a) Determine nodal displacement at node 2 (Fig. 6) due to applied force  $P = 400$  kN and temperature rise  $30^\circ$  C. Given: (11 1/3)

Thickness,  $t = 20$  mm,  $E_{al} = 0.7 \times 10^5$  N/mm<sup>2</sup>,  
 $E_{st} = 2 \times 10^5$  N/mm<sup>2</sup>,  $\alpha_{al} = 22 \times 10^{-6}/^\circ$ C and  $\alpha_{st} = 12 \times 10^{-6}/^\circ$ C

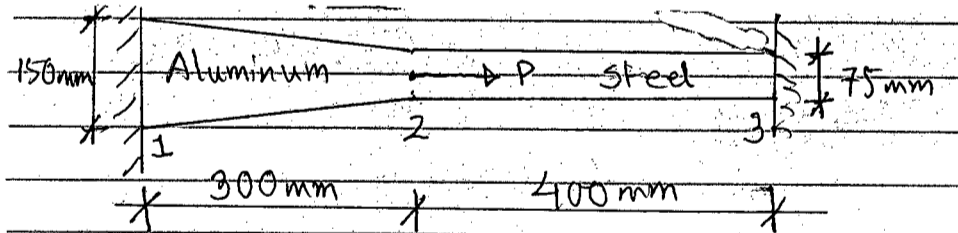
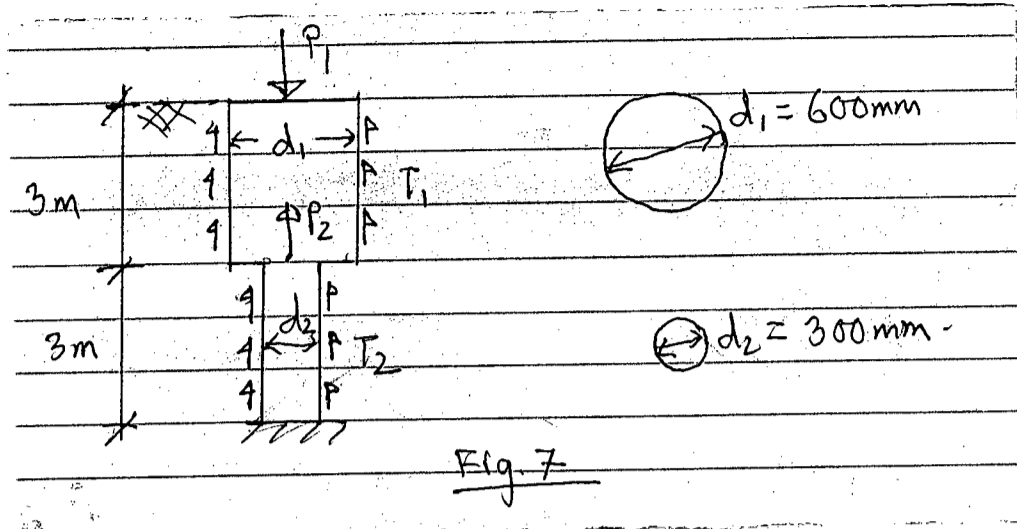


Fig. 6

- (b) A jet grout pile as shown in Fig. 7 is subjected to concentrated loads  $P_1$  and  $P_2$  at nodes 1 and 2 and surface tractions  $T_1$  and  $T_2$  in elements 1 and 2. Determine stresses in element 1 and 2. Given:  $E = 2.5 \times 10^5$  N/mm<sup>2</sup> and  $\rho = 16$  kg/m<sup>3</sup>,  $P_1 = 400$  kN,  $P_2 = 100$  kN,  $T_1 = 20$  N/mm<sup>2</sup> and  $T_2 = 80$  N/mm<sup>2</sup>. (12)

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**SECTION - B**

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

5. (a) Introduce and explain isoparametric concept in finite element analysis. (5)  
 (b) State three basic theorem on which isoparametric element is developed. (6)  
 (c) Discuss convergence criteria for isoparametric elements. (6 1/3)  
 (d) Explain the following terms: (6)  
 (i) Subparametric element  
 (ii) Superparametric element
  
6. (a) In Civil engineering problem derived global stiffness matrix is usually "banded" and "symmetric" – Explain the implications of these characteristics features in solving global FE equations by employing band solution technique. (11 1/3)  
 (b) Explain the solution when band solution becomes more expensive than frontal solution technique in terms of memory requirements and storage time. (12)
  
7. (a) Why Gauss quadrature formula is preferred in finite element analysis? Write down the expression that Gauss method used to compute a function at predetermined sampling points. (11 1/3)  
 (b) What is a numerical error? (5)  
 (c) Explain Skyline storage technique with an example. (7)
  
8. (a) List four major discontinuities that may exist in a real structure and the necessity of considering those in discretizing a structure. Draw necessary sketches. (16)  
 (b) Write down a short note on the effect of element aspect ratio on accuracy of a numerical solution. (7 1/3)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 433** (Solid and Hazardous Waste Management)

Full Marks : 140

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) Draw the flow chart showing the inter-relationship among the functional elements of the solid waste management system. (6)

(b) What are the factors to be considered in case of On-site Storage? How does processing of solid wastes at Site effect the management of the same? (7)

(c) Determine the round-trip break-even time for a solid waste collection system in which 30-yd<sup>3</sup> self-loading compactors used for collection are driven to the disposal site as compared to using a transfer and transport system. Assume that the following cost data are applicable: (10 1/3)

i	Density of wastes in self-loading compactor (in lb/yd <sup>3</sup> )	= 600
ii	Density of wastes in Tractor-trailer (in lb/yd <sup>3</sup> )	= 325
iii	Capacity of Tractor-trailer transport unit	= 120 yd <sup>3</sup>
iv	Operating cost of self-loading compactor	= \$20 per hr.
v	Operating cost for Tractor-trailer transport unit	= \$30 per hr.
vi	Transfer station operating cost including amortization	= \$2.10 per ton
vii	Cost for extra unloading time for Tractor-trailer transport unit as compared to the compactors	= \$ 0.40 per ton

2. (a) Draw and explain the graphs showing the impact of size reduction on the unseparated solid wastes at MRFs? (6)

(b) Draw the Solid Waste Management hierarchy and briefly explain the diagram. (7)

(c) Design a solid waste collection system to service a residential area with 1,000 single-family dwelling, including the number of trips required per week and number of collector-days per week. Assume that a two-person collection crew will be used and that the following data are applicable: (10 1/3)

(i) Average number of residents per service = 3.5

(ii) Solid waste generation rate per capita = 2.0 lb/capita/day

(iii) Density of solid waste (at containers) = 200 lb/yd<sup>3</sup>

(iv) Containers per service = two 32-gal containers

(v) Type of service = 50% rear-of-service, 50% alley

(vi) Collection frequency = once per week

(vii) Collection vehicle = rear-loaded compactor, compaction ratio =2

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**Contd ... Q. No. (c)**

- (viii) Round-trip haul distance = 15 miles
- (ix) Length of work day = 8 hours
- (x) Trips per day = 2
- (xi) Off-route factor = 0.15
- (xii) Haul-time constants  $a = 0.016$  hr/trip and  $b = 0.01$  miles/hr
- (xiii) Assume at-site time per trip = 0.10 hr/trip

3. (a) List the factors governing the solid waste generation rate. Provide examples for each. **(6)**
- (b) List the guidelines for laying out the collection routes. **(7)**
- (c) Draw the definition sketch for allocation of solid waste from five transfer stations to three disposal sites. Write the mathematical expressions for minimization of haul cost for the above. Also, enumerate the appropriate assumptions and constraints with the corresponding mathematical expressions. **(10 1/3)**

4. (a) Draw the typical (i) hourly and (ii) daily waste discharge rates in high-rise apartments in residential areas of Dhaka City. Briefly explain the nature of the curves. **(6)**
- (b) Draw the schematic diagram showing the operational sequences of conventional HCS and SCS. Write the definitions with mathematical expressions of the Terms for each of these systems. **(7)**
- (c) The following average speeds ( $y$ ) were obtained for various round-trip distances ( $x$ ) to a disposal site. Using the graphical method to find the haul speed constants  $a$  and  $b$  for the haul speed equation represented by a rectangular hyperbola;

$$y = \frac{x}{a + bx}$$

Also, find the round-trip haul time for a site that is located 21 km away. **(10 1/3)**

Round-trip Distance $x$ (km)	Average Haul Speed $y$ (kph)
3.2	27.4
8.0	45.1
12.9	51.5
19.3	57.9
25.7	64.4
32.2	67.6
40.2	72.4

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**SECTION – B**

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

5. (a) Define “Solid Waste”. List the problems created by indiscriminate dumping of solid wastes in and around cities. (6)
- (b) Tabulate the main features of different development levels of landfills in developing countries. (6)
- (c) What is sanitary landfill? Describe the “Trench Method” of landfilling. (6 1/3)
- (d) Calculate the required landfill capacity for a town for the year 2020 from the following data: (5)
- Projected population for the year 2020 = 15,00,000
- Per capita waste generation rate = 5.8 lb/cap/d
- Diversion fraction = 0.20
- Compacted waste density = 42.4 lb/ft<sup>3</sup>
- Assume a daily soil cover is used that accounts for 15% of the landfill volume.
6. (a) List the area exclusion criteria for siting a sanitary landfill. (8)
- (b) Define “Leachate”. Draw typical concentration profile of leachate constituents and explain it. (4 1/3)
- (c) Derive an expression for the spacing of laterals of a leachate collection system. (5)
- (d) Design the spacing of laterals for an uncapped landfill for a required maximum leachate head of 40 cm, if the top surface of the laterals is 12 cm above the bottom liner. Assume that the hydraulic conductivity of the drainage layer is 110 m/d and overall vertical hydraulic conductivity through the waste is  $1.2 \times 10^{-3}$  cm/s. Also, determine the flow rate through each lateral. (6)
7. (a) What are the important factors in the design of a leachate treatment system? Summarize the leachate treatment options. (7)
- (b) State the potential environmental impacts of landfill gases. (7)
- (c) Draw a neat sketch of idealistic development of landfill gases. (4 1/3)
- (d) Estimate the theoretical volume of methane and carbon dioxide gases that would be expected from the anaerobic digestion of 100 ton of wastes having the composition C<sub>45</sub>H<sub>90</sub>O<sub>35</sub>N<sub>2</sub>. Comment on the results. (5)
- Given: Density of methane gas at STP = 0.7167 kg/m<sup>3</sup>
- Density of carbon dioxide gas at STP = 1.9783 kg/m<sup>3</sup>

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8. (a) Show the main pathways of human exposure to hazardous wastes. (4)
- (b) List the treatment processes suitable for different types of hazardous wastes mentioning the functions performed in each process. (9 1/3)
- (c) Draw a double-lined landfill for hazardous wastes after closure. (3)
- (d) Give a detail classification of hospital wastes. (4)
- (e) How will you collect and store hospital wastes? (3)
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Sub : **CE 455** (Transportation Engineering IV: Pavement Management,  
Drainage and Airport)

Full Marks: 140

Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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

1. (a) Show with diagrams the length, wingspan, maximum height, wheelbase and wheel track of an aircraft and also a dual tandem landing gear configuration. (8)
- (b) Expand the following abbreviations: (5)
  - (i) OEW (ii) ZFW (iii) MRW (iv) MGTOW (v) MSTOW (vi) MSLW (vii) LD (viii) NOTAM (ix) FAA (x) ICAO.
- (c) Explain with a labelled diagram the declared distance for normal take-off case. (10 1/3)
2. (a) Write the names of the international and domestic airports of Bangladesh. (5)
- (b) Show with a diagram the components of an airport system for a large airport. (9)
- (c) Discuss the trend of air travel demand in Bangladesh with qualitative diagrams. (9 1/3)
3. (a) Explain with diagrams the different elements of a runway system. (11 1/3)
- (b) Explain the concept of cumulative damage failure method of airfield pavement design. (12)
4. (a) Explain the airport reference code based on aircraft approach speed and wingspan according to FAA. (11 1/3)
- (b) Explain the concept of layered elastic design method for flexible airfield pavement design. (12)

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

Assume reasonable values for missing data (if any).

5. (a) Define "Pavement Management". What are the principal components of a pavement management system? (5)
- (b) List four characteristics of pavement condition used in evaluating pavement rehabilitation needs. Differentiate between PSI and PSR. (6)

**CE 455**

**Contd... Q. No. 5**

(c) A government agency is responsible for maintaining a road network of 500 kilometers. The results of the annual survey in a given year showed that the pavement condition (PCR) of 60% of the roads in this network is between 80 and 89, while the remaining 40% has a PCR between 70 and 79. Using the Markovian transition matrix (Figure 1), determine the condition of the road network (i) One year later and (ii) Two years later.

(12 1/3)

6. (a) Differentiate between corrective and preventive rehabilitation techniques. Cite three examples of surface treatments in each category.

(7)

(b) Briefly discuss the use of condition and priority assessment models in developing pavement improvement programs.

(4)

(c) The traffic volume of a 2-mile pavement section is 10,000 veh/day. The deterioration relationship for sections in this family group is  $PQI = 10 - 0.50(\text{age})$  where,

(12 1/3)

PQI = pavement quality index with values between 0 and 10

Age = pavement age in years.

The highway agency which holds a policy of maintaining pavement sections with  $PQI < 5$  is analyzing the effectiveness of two treatment alternatives – A and B. Resurfacing the pavement section after 12 years of construction with treatment alternative A will increase the PQI to a value of 9; however, after resurfacing, the section is expected to deteriorate at a rate of 1.25 PQI points per year. On the other hand, pavement resurfacing after 13 years of construction with treatment alternative B will increase the PQI to a value of 8.5; while subsequent deterioration will occur at a rate of 0.75 PQI points per year. Calculate the effectiveness of both of the alternatives and hence determine their cost effectiveness. Given, costs of treatment alternatives A and B are BDT 50,00,000 and BDT 80,00,000 respectively.

7. (a) Identify the major problems related with inadequate drainage of highways. Schematically show the principal components of a surface drainage system.

(7)

(b) Name the special precautionary techniques commonly adopted to control erosion and sediment accumulation during highway construction. What are the main disadvantages of using turf cover on unpaved shoulders?

(6)

(c) Determine whether 3/8 inch Fiberglass Mat lining (Figure 2) is suitable for a trapezoidal channel having 2:1 side slope and 5 ft bottom width to carry an estimated runoff of 150 ft<sup>3</sup>/sec, if the slope of the channel is 1% and Manning's roughness coefficient, n, is 0.030. Assume erosion-resistant soil. Flow velocity for channels lined with 3/8 inch Fiberglass Mat is expressed by the equation:  $V = 73.53 R^{1.330} S_0^{0.512}$ , (R = hydraulic radius, S<sub>0</sub> = channel slope).

(10 1/3)

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8. (a) What are the basic principles used in determining the most appropriate location of culverts? Briefly describe the different types of culvert flows under inlet control condition. (5)

(b) Subsurface drainage system is to be designed for a new two-lane flexible pavement constructed in a cut section. The net amount of water to be discharged consists of water due to infiltration and ground water seepage due to gravity. Determine the net inflow rate ( $q_n$ ) for the following data: (11)

Lane width = 12 ft

Shoulder width = 8 ft

Length of contributing transverse cracks ( $W_c$ ) = 20 ft

Rate of infiltration ( $K_p$ ) = 0.05 ft<sup>3</sup>/day/ft<sup>2</sup>

Spacing of transverse cracks ( $C_s$ ) = 30 ft

Thickness of subgrade below drainage pipe = 12 ft

Coefficient of permeability of native soil = 0.35 ft/day

Height of water table above impervious layer = 21 ft

Slope of drainage layer = 2%

See Figure 3 for necessary charts and formulae.

(c) using Figure 4, determine the thickness of a suitable drainage layer required to transmit the net inflow ( $q_n$ ) as determined in the previous question to a suitable outlet, if the permeability of drainage material is 2,000 ft/day and the length of the flow path is 44 ft. (7 1/3)

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=4=

To PCR State

		9 100 to 90	8 89 to 80	7 79 to 70	6 69 to 60	5 59 to 50	4 49 to 40	3 39 to 30	2 29 to 20	1 19 to 10	P
From PCR State	9 100 to 90	0.90	0.10								1.0
	8 89 to 80		0.70	0.30							1.0
	7 79 to 70			0.60	0.30	0.10					1.0
	6 69 to 60				0.50	0.30	0.15	0.05			1.0
	5 59 to 50					0.30	0.40	0.30			1.0
	4 49 to 40						0.30	0.70			1.0
	3 39 to 30							0.60	0.35	0.05	1.0
	2 29 to 20								0.20	0.80	1.0
	1 19 to 10									1.0	1.0

Figure 1 for Question 5(c): Probabilities of Pavement Condition Changes

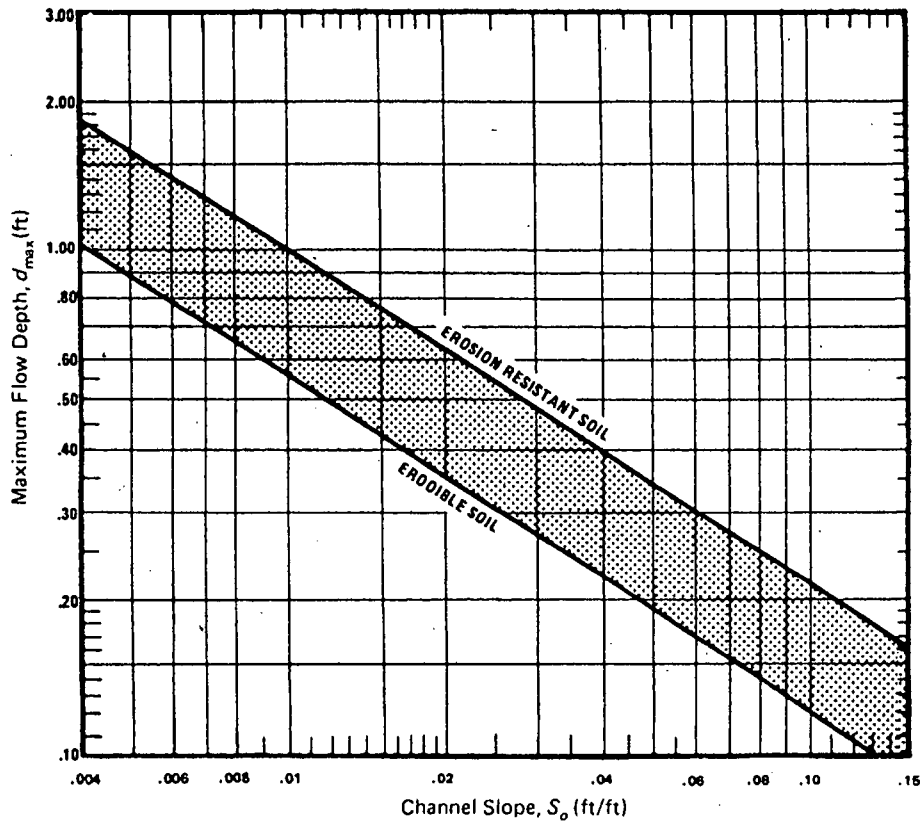


Figure 2 for Question 7(c): Maximum Permissible Depth of Flow,  $d_{max}$ , for Channels Lined with 3/8 in. Fiberglass Mat

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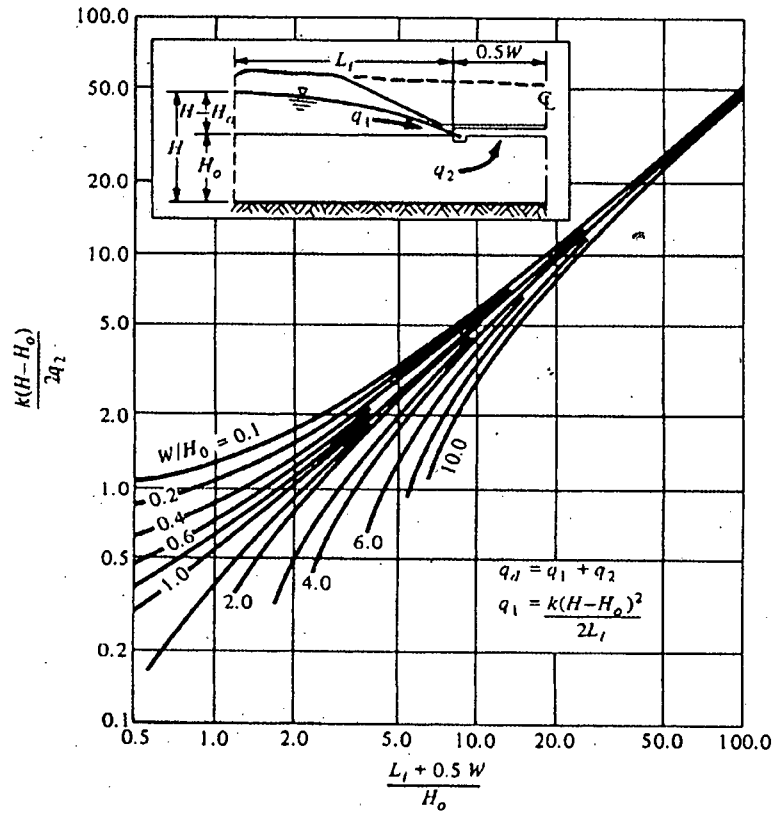


Figure 3 for Question 8(b): Chart for Determining Flow Rate in Horizontal Drainage Blanket

$$q_1 = I_c \left( \frac{N_c}{W} + \frac{W_c}{WC_s} \right) + K_p; L_i = 3.8(H - H_o); q_g = \frac{q_2}{0.5W}$$

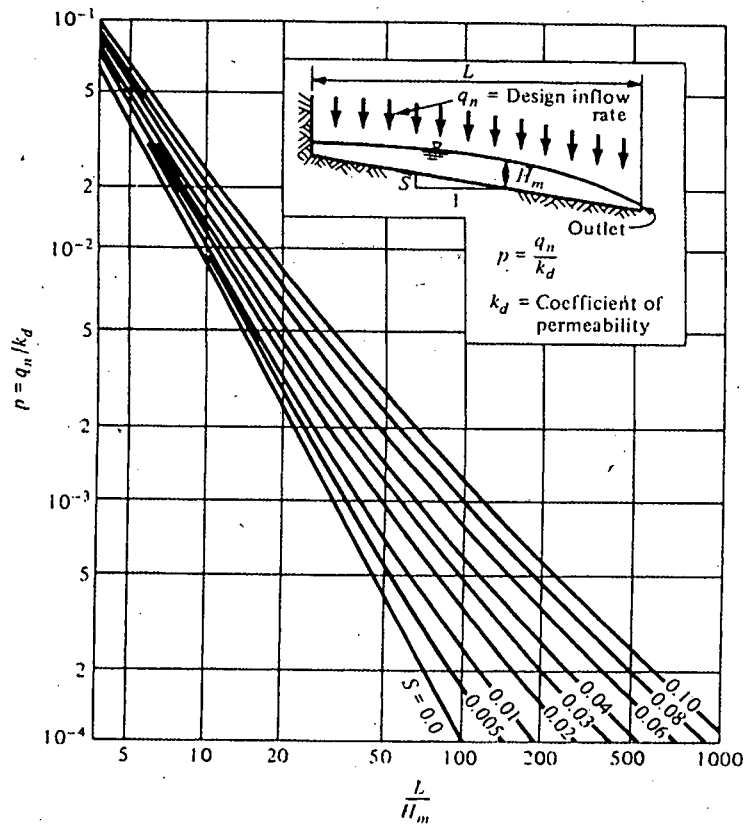


Figure 4 for Question 8(c): Chart for Estimating Maximum Depth of Flow Caused by Steady Inflow

**SECTION – A**

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

1. (a) Describe the procedure for the evaluation of web shear cracking stress ( $V_{cw}$ ) and inclined flexural cracking stress ( $V_{ci}$ ) for a prestressed concrete beam subjected to uniformly distributed load (UDL) (8)
- (b) Check shear strength for the beam shown in Fig. 1 at section 1-1 and 2-2 respectively. Given that this section is adequate for  $w_u = 70$  kN/m on the basis of its flexural strength. Given : Effective prestress = 1050 MPa, Initial prestress = 1300 MPa,  $f'_c = 42$  MPa and USD method of design. The tendon is parabolic with  $e = 0$  at the ends. (15  $\frac{1}{3}$ )
2. (a) Explain the importance of prestress transfer bond in a pretensioned prestressed concrete member. Mention the factors which affect the transfer length of prestressing steel of such beam. (10)
- (b) Determine the bearing plate area required for a tendon that consists of 15-12.7 mm dia 7-wire strands anchored at the end of a beam as shown in Fig. 2. At the time of posttensioning assume that  $f_{ci} = 30$  MPa and at service load after all losses (20%)  $f'_c = 42$  MPa. The tendon force for design is 2000 kN due to maximum jacking force and 1500 kN at service load. Follow the average bearing stress on concrete as per post-tensioning Institute (PTI) and the 1977 ACI Commentary,  $f_{cp}$ . (13  $\frac{1}{3}$ )
- At service load :  $f_{cp} = 0.6 f'_c \sqrt{A'_b / A_b} \not\geq f'_c$
- At transfer load :  $f_{cp} = 0.8 f'_{ci} \sqrt{A'_b / A_b} - 0.2 \not\geq 1.25 f'_{ci}$
- All symbols carry their usual meanings.
3. (a) Briefly describe the transverse tension at End Block of a posttensioned prestressed concrete member. (6)
- (b) The top flange of a composite section is given as slab 125 mm thick and 1600 mm wide cast-in-place. Design a precast section with a total depth of 1000 mm (including the slab thickness) to carry the following moments:  $M_T = 450$  kN-m,  $M_G = 60$  kN-m, the moment acting on composite section,  $M_C = 310$  kN-m. (17  $\frac{1}{3}$ )

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

Allowable stresses are:  $f_t = 12.0$  MPa (comp.),  $f_b = 13.5$  MPa (comp.),  $f'_t = 2.0$  MPa (ten.) and  $f'_b = 1.10$  MPa (ten.). Initial prestress: 1050 MPa and effective prestress = 850 MPa. You can assume the lever arm of 0.65 h for your preliminary design. All symbols convey the usual meaning.

4. (a) Describe the method applied to obtain the location of limiting zone for c.g.s of simply supported prestressed concrete beam with a concentrated load at midspan. Consider both no-tension and limited tension in concrete. (6)
- (b) Draw and explain the load deflection curve of a prestressed concrete beam under different stages of loading. (6)
- (c) Compute the initial deflection at midspan of a simply supported beam of width 400 mm and depth 800 mm due to prestress and uniformly distributed load of 40 kN/m (self wt. included). Estimate the deflection after six months assuming a creep coefficient,  $C_c = 2.5$ , Use  $f_o = 1200$  MPa,  $f_{se} = 1000$  MPa, span of beam = 12.0 m and  $A_{ps} = 820$  mm<sup>2</sup>. The c.g.s with constant eccentricity is at 100 mm from the bottom surface of the beam. All symbols carry the usual meaning. (11 1/3)

**SECTION – B**

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

5. A post tensioned beam has a midspan section with a duct hole of 50 mm by 80 mm to house the tendons (see Fig. 3). It is prestressed with 840 mm<sup>2</sup> of steel to an initial stress of 1020 MPa. At transfer the stress is reduced by 6% due to elastic shortening and anchorage take up. Compute the stresses in concrete soon after transfer considering
- (i) Gross concrete section
- (ii) Net concrete section (excluding hole)
- Compare the difference in concrete stress obtained by the two methods and comment on your findings. (23 1/3)
6. (a) Make a preliminary design for section of a prestressed concrete beam to resist a total moment of 580 kN-m which includes a girder self weight moment of 85 kN-m. Given: Effective prestress in steel,  $f_{se} = 920$  MPa and  $f_c = 12$  MPa. Start with a trial depth of about  $42 \sqrt{M_T}$  in mm for  $M_T$  in kN-m. (8 1/3)
- (b) Make a final design for the preliminary section obtained above for the following prescribed material properties and allowing no tension in the beam at any stage:
- $f_b = -14$  MPa,  $f_t = -12$  MPa,  $f_{so} = 1040$  MPa. (15)

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7. (a) What are the different types of steel used for prestressing? Discuss. (6 1/3)

(b) The mid-section of a composite beam is shown in Fig. 4. It is post-tensioned with an initial force of 3300 kN which eventually reduces by 15% to get down to effective value. After erection of the precast box section, the 180 mm thick slab is cast in place. Compute stresses in the precast and composite section (as appropriate) at various stage of loading.

Given Moments are: (17)

- (i) Due to Wt. of precast section = 276 kN-m
- (ii) Due to top slab = 166 kN-m
- (iii) Due to live load = 500 kN-m

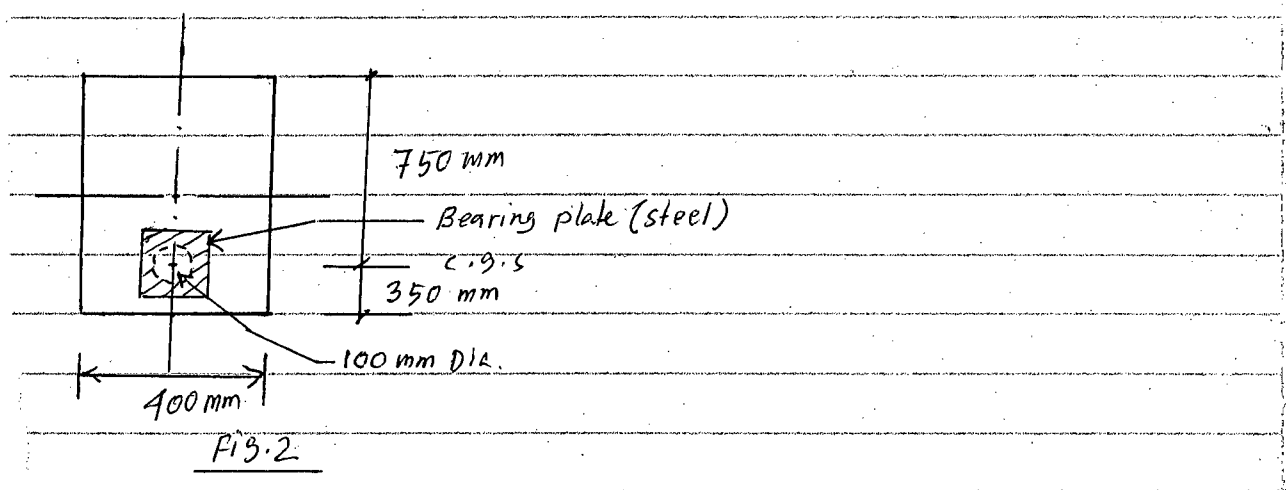
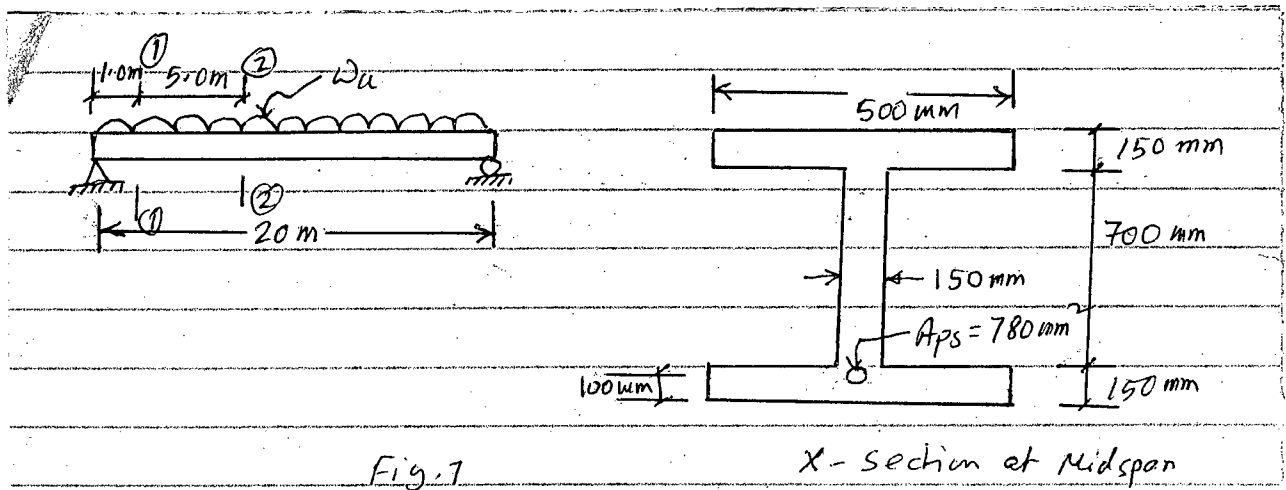
Estimate the beam span if  $\gamma_{con} = 24 \text{ kN/m}^3$ .

8. (a) Compare prestressed concrete with reinforced concrete in respect of safety, serviceability and economy. (8)

(b) Determine the ultimate moment capacity of prestressed concrete beam section of Fig. 5. It contains mild steel rebars in addition to prestressing steel. Follow any method for your calculation. Use

$f'_c = 40 \text{ MPa}$ ; and  $E_p = E_s = 195 \text{ GPa}$ ,  $E_c = 35000 \text{ MPa}$ ,  $f_{pu} = 1860 \text{ MPa}$ ,  $f_y = 415 \text{ MPa}$

$\epsilon_{cu} = 0.003$  and  $f_{se} = 1100 \text{ MPa}$ . (15 1/3)



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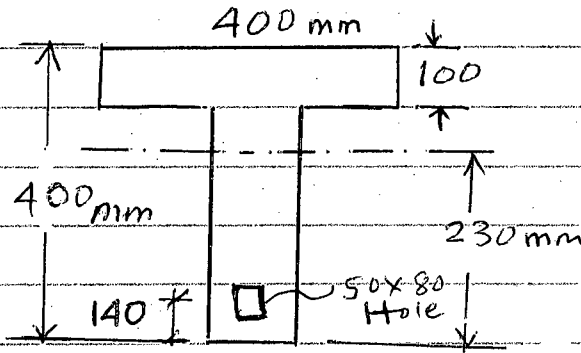


Fig. # 3

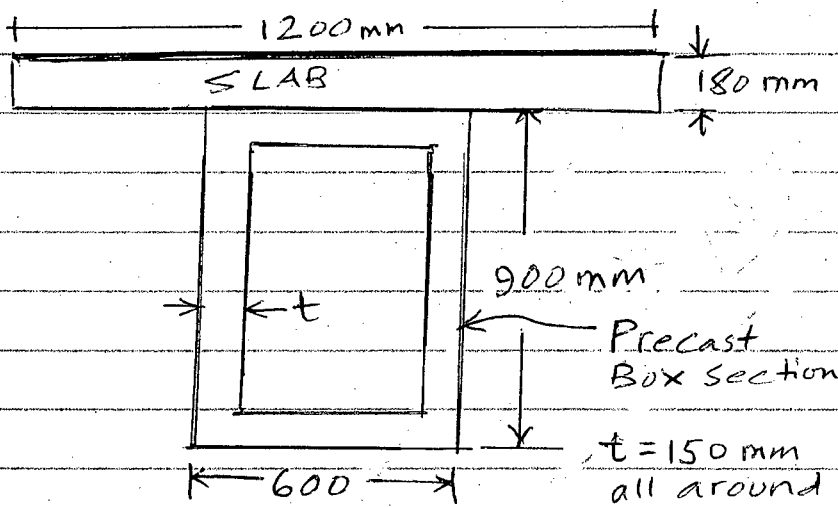


Fig. # 4

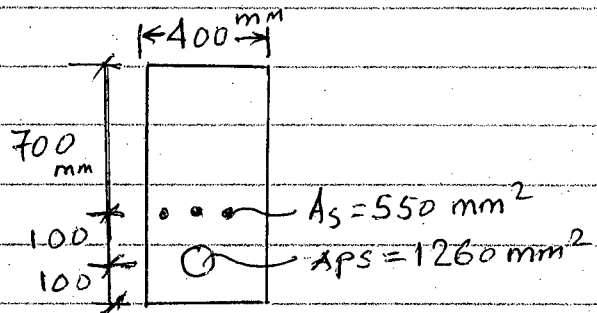


Fig. # 5

**SECTION – A**

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

1. (a) Classify with sketches the different plan form patterns of river. (8)  
 (b) Name three meandering rivers in Bangladesh. Explain “Helicoidal Flow” in a river bend. (2+8=10)  
 (c) A meandering river channel of radius of curvature 3 km has a bankfull flow area of 1000 m<sup>2</sup> and longitudinal slope is 1 in 3 km. Calculate the channel forming discharge. (5 ½)
  
2. (a) What are the causes of “Cutoff formation” in a meandering river? Explain with sketches. (8)  
 (b) A meandering river is flowing with a discharge of 40000 m<sup>3</sup>/s. Calculate: (6)  
 (i) Meander width  
 (ii) Meander length  
 (iii) Meander ratio  
 (c) Compare salient characteristics between confluence and bifurcations. Give examples in case of rivers of Bangladesh. (6)  
 (d) Define: (i) Bankfull discharge (3 ½)  
 (ii) Specified recurrence interval discharge  
 (iii) Effective discharge
  
3. (a) Bankfull discharge of the river Jamuna is 48,000 m<sup>3</sup>/s. Calculate the hydraulic geometry and average velocity of the river. Assume reasonable data for Jamuna. (10)  
 (b) Distinguish between “Clear water scour” and “Live bed scour”. A river has a bankfull width 200 m, flowing with a discharge 2000 m<sup>3</sup>/s. Two river crossings towers (5 m dia each) are to be constructed across the river. Calculate the general scour. Take  $d_{50} = 0.13$  mm. (3+7=10)  
 (c) What are the causes of long term general scour? (3 ½)
  
4. (a) Explain the impact of bed aggradation on the erosion of river banks in Bangladesh. (5)  
 (b) Draw a figure showing different types of bridge scour. (3 ½)

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(c) A bridge is to be constructed across a river with a moderate bend. Given the following data: (15)

Discharge = 12000 m<sup>3</sup>/s

Depth of flow = 25 m

Width of the river = 900 m

Width of pier = 4 m

Size of bed material = 0.10 mm

Protrusion of vertical wall abutment = 15 m

Calculate total scour. Compare the result with Laursen's formula.

**SECTION – B**

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

5. (a) Give a typical sketch of river network system. (5)

(b) Give short notes on:

(i) Falling apron (ii) Mattresses (iii) Riprap (iv) Threshold condition of sediment transport (8)

(c) Sketch a typical Shield's diagram and mention its salient features. Calculate the depth of flow at which the bed particle of size 0.20 mm just starts to move for a wide channel with longitudinal gradient 0.3 m per 3 km. Assume reasonable value if not given. (10 1/3)

6. (a) Describe different types of groynes with neat sketches. (8 1/3)

(b) For the river Ganges, following hydraulic data pertains to a bridge site. (15)

Maximum discharge = 44,000 cumec

Highest Flood level = 10.2 m PWD

Average Water level = 5.5 m PWD

Low water level = 2.5 m PWD

Bed material size = 0.15 mm

Design and sketch a guide bank including the launching apron to train the river.

7. (a) According to BIWTA, classify IWT routes and suggest the required navigational clearances.

(b) Explain why seepage analysis is important in designing earthen dams/levees.

(c) What are the general design considerations of designing an earthen levee? Describe the main causes of failure of an earthen dam/levee with neat sketches.

**WRE 409(CE)**

8. (a) List down five hard points in Bangladesh. **(3 1/3)**
- (b) Name the various types river training and bank protection techniques. What types of protection techniques are commonly used in Bangladesh? Answer with sketches. **(10)**
- (c) What are limitations of using reservoir as a flood mitigation measures. Estimate the design dredging depth of a navigation channel for a 1000 tonnage Cargo ship. **(10)**
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 413** (Introduction to Steel Concrete Composite Structures)

Full Marks : 140

Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data, if any.

USE SEPARATE SCRIPTS FOR EACH SECTION

**SECTION – A**There are **FIVE** questions in this Section. Answer any **FOUR**.

One page with figures.

1. (a) What are the components of a steel-concrete composite floor system? Show them in a neat sketch. (3 ½)
- (b) Two typical bays of a composite floor system are illustrated in Fig. 1
  - (i) Calculate the effective slab width for the secondary beam SB2 and main beam MB2 (Fig. 1) (4)
  - (ii) Draw transverse section of the composite floor system across beam SB2 and MB2. Clearly show the deck rib orientation and effective slab width for each case. (4)
- (c) Check whether the composite deck detailing including the shear connectors shown in Fig. 2, satisfies the requirements of AISC specifications. (6)
  
2. (a) The secondary beam SB2 as shown in Figure 1, is simply supported with a span length of 30'. It is constructed with W18 × 65 section. Calculate the service load flexural stress in concrete and steel of the composite section for unshored construction. Assume, full interaction between steel and concrete. The geometric, material properties and loading data are given in Fig. 1. (14)
- (b) Show that flexural stress distribution across the depth of the beam for precomposite and composite stages of construction. (3 ½)
  
3. (a) State the design considerations for serviceability limit state of steel-concrete composite floor system. (3 ½)
- (b) For the secondary beam SB2 (Fig. 1)  $\frac{3}{4}$ " shear connectors with a height of 3" are provided at a spacing of 6" along the span of the beam. (14)
  - (i) Calculate the percent (%) of composite action achieved through the provided number of shear connectors.  
Assume:  $R_p = 0.75$ ,  $R_g = 1.0$ , and for shear connectors  $F_u = 65$  ksi.
  - (ii) Calculate the maximum vertical deflection of the beam SB2 at the precomposite and composite stages of construction. All sectional properties and loading data are given in Fig. 1.

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4. For the composite beam section shown in Fig. (3):
- (a) Calculate the section properties of the composite section. Transform the section into equivalent steel section. Given:  $f'_c = 4$  ksi; and  $E_c = 3.6 \times 10^3$  ksi.  $f_y = 50$  ksi,  $E_s = 29 \times 10^3$  ksi. (7 ½)
  - (b) Find the yield moment capacity of the composite beam (Fig. 3) in positive as well as in negative bending. (5+5)
5. (a) State the assumptions for the design of composite beams for ultimate limit state in flexure. (3 ½)
- (b) Determine the ultimate moment capacity of composite section shown in Fig. (3).  
Given:  $f'_c = 4$  ksi; and  $E_c = 3.6 \times 10^3$  ksi.  $F_y = 50$  ksi,  $E_s = 29 \times 10^3$  ksi. (14)

**SECTION – B**

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

6. (a) State the advantages and disadvantages of CFT sections over other composite column sections. (4)
- (b) A fully encased composite (FEC) column section shown in Fig. 4. Check whether the provided section satisfies the code specified limits for (2 ½)
- (i) Concrete strength
  - (ii) Specified minimum yield stress of structural and reinforcing steel
  - (iii) Structural steel ratio
  - (iv) Maximum and minimum longitudinal reinforcement ratio
  - (v) Transverse Steel
- Given :  $F_y = F_{yr} = 50$  ksi,  $f'_c = 4$  ksi;  $E_s = 29,000$  ksi. and  $E_c = 3900$  ksi.
- (c) Check the adequacy of the section provided in Fig. 4 to resist the given compressive load. Use the data provided in 6(b) as required. (11)
7. (a) Briefly discuss the advantages and disadvantages of fully encased composite columns. (4)
- (b) How much live load thrust (service condition) can be supported by an A36 steel tube if the effective length of the column is 12 ft and dead load thrust is 120 kip? The column has a cross section with a 0.50 inch wall thickness and 10 inch outside diameter. Moments are negligible. (13 ½)
- Given :  $f_y = 36$  ksi,  $f'_c = 4$  ksi;  $E_s = 29,000$  ksi. and  $E_c = 3600$  ksi.

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8. (a) State six advantages of steel-concrete composite construction over RCC and steel only construction. (4)

(b) Check the material and geometric properties of the given partially encased column (PEC column) in Fig. 5 with the code specified limits. Also determine the axial capacity of the column. (13 ½)

Given :  $f_y = 350$  MPa,  $f'_c = 30$  MPa,  $E_s = 200$  GPa. and  $E_c = 24$  MPa.

9. (a) State the assumptions of plastic stress distribution method for predicting the capacity of composite columns. (4)

(b) For the CFT column section shown in Fig. 6, calculate the axial force and bending moment for balanced failure condition. Use, plastic stress distribution method. The length of the column is 10 feet and the column is pin-fixed connected in both axes.

Given :  $f_y = 36$  ksi,  $f'_c = 3.5$  ksi;  $E_s = 29,000$  ksi. and  $E_c = 3600$  ksi and wall thickness = 0.5" (13 ½)

10. (a) Draw the idealized P-M diagram in plastic stress distribution method for FEC column section shown in Fig. 7 about its weak axis. (2 ½)

(b) For the five points in the P-M diagram, show the stress-distribution across the depth of the section in neat sketches. (5)

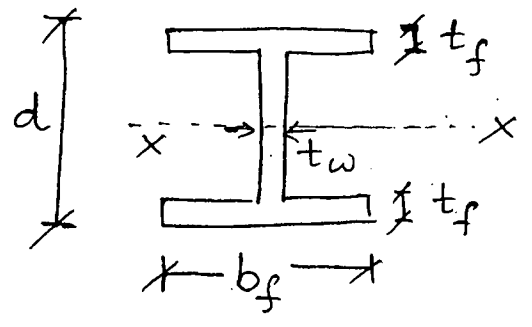
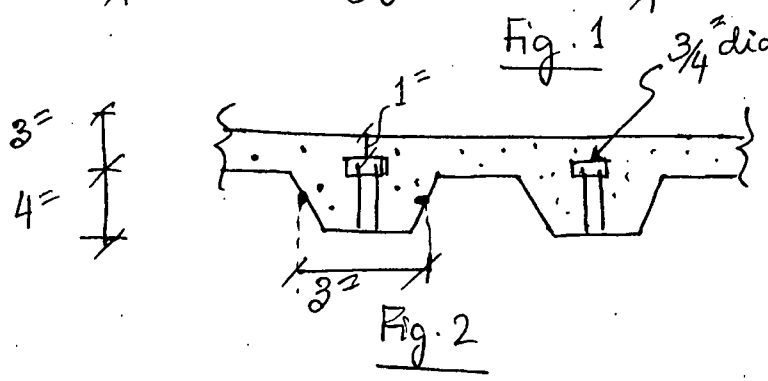
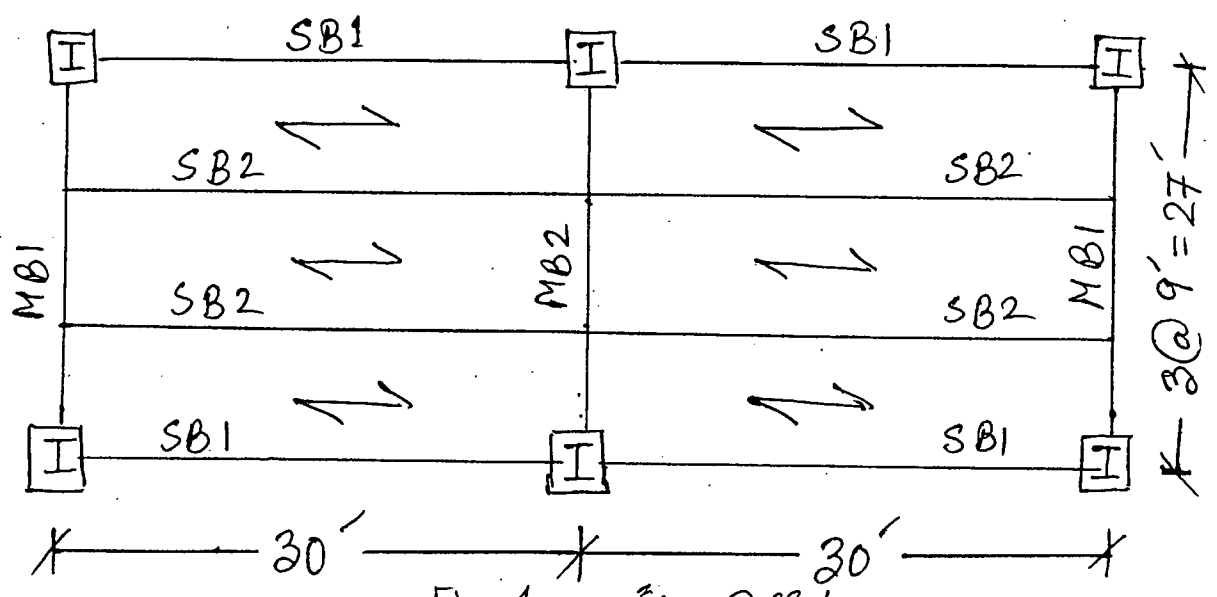
(c) Calculate the axial load (P) and bending moment (M) for the five points in the P-M diagram about the weak axis and the column is pin ended about either principal axes. (10)

Given :  $F_y = F_{yr} = 50$  ksi,  $f'_c = 3$  ksi;  $E_s = 29,000$  ksi. and  $E_c = 3600$  ksi Effective length of the column = 10'.

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Figure ①



Geometric properties:

Secondary beam SB2

W18x65, self wt = 65#/-  
 $A_s = 19.1 \text{ in}^2$ ,  $b_f = 7.59$ ,  $t_f = 0.75$   
 $I_{sx} = 1070 \text{ in}^4$ ,  $d = 18.4$ ,  $t_w = 0.45$

Main beam MB2

W 21 x 93, self wt. = 93#/-  
 $A_s = 27.3 \text{ in}^2$ ,  $b_f = 8.42$ ,  $t_f = 0.93$   
 $I_{sx} = 2070 \text{ in}^4$ ,  $d = 21.6$ ,  $t_w = 0.58$

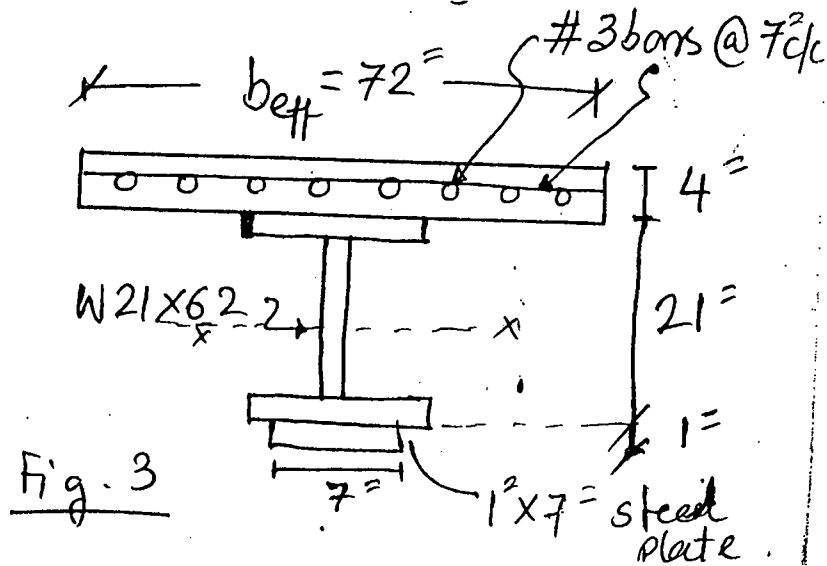
Material Properties:

$f_c' = 4 \text{ ksi}$ ,  $E_c = 3.6 \times 10^3 \text{ ksi}$   
 $f_s = 50 \text{ ksi}$ ,  $E_s = 29 \times 10^3 \text{ ksi}$

Loading Data:

Superimposed dead load: Partition wall = 80 psf.  
 Floor finish = 30 psf.  
 Construction live load = 20 psf.  
 Service live load = 60 psf.

$$= 5 =$$



Given:

$$f_c' = 4 \text{ ksi}, \quad E_c = 3.6 \times 10^3 \text{ ksi}$$

$$f_s = 50 \text{ ksi}, \quad E_s = 29 \times 10^3 \text{ ksi}$$

For, W 21x62,  $A_s = 18.3 \text{ in}^2$ ,  $b_f = 8.24''$ ,  $t_f = 0.615''$   
 $I_{xs} = 1330 \text{ in}^4$ ,  $d = 21''$ ,  $t_w = 0.40''$

= 6 =

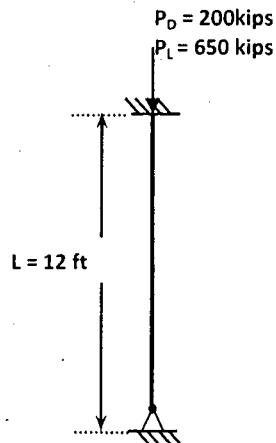
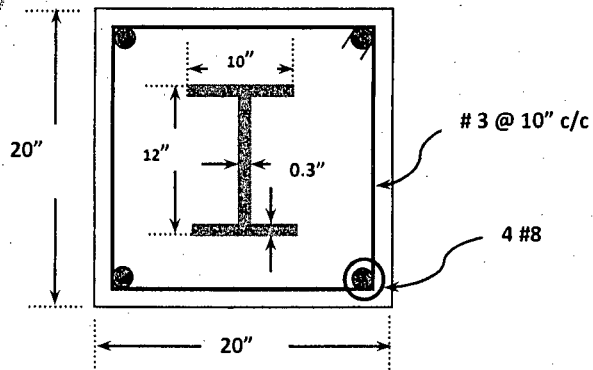


Figure 1: for Question 6(b) & 6(c)

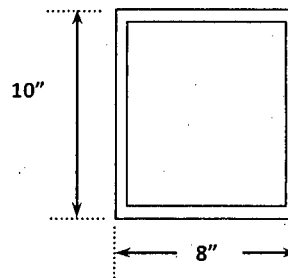
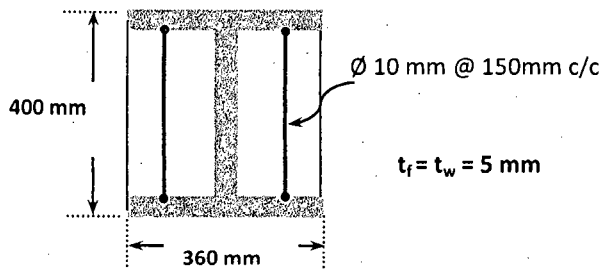


Figure 2: for Question 7(b)

Figure 3: for Question 8(b)

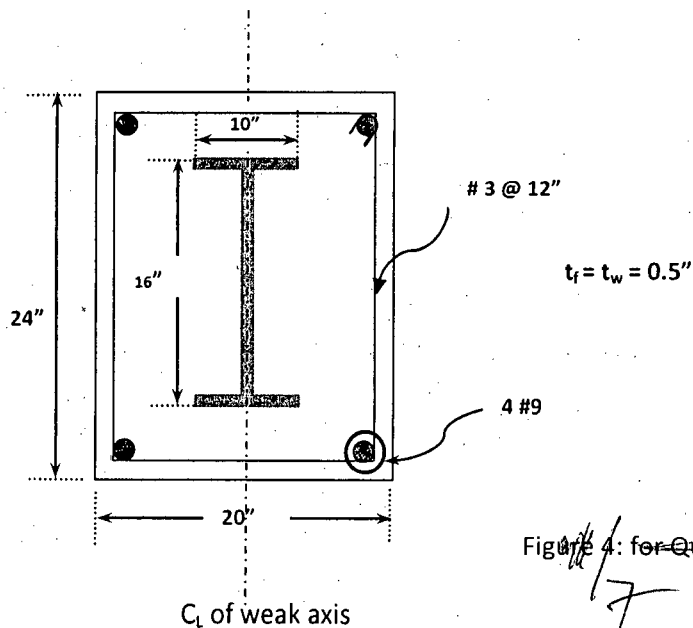


Figure 4: for Question 10

TABLE I1.1A Limiting Width-to-Thickness Ratios for Compression Steel Elements in Composite Members Subject to Axial Compression For Use with Section I2.2				
Description of Element	Width-to-Thickness Ratio	$\lambda_p$ Compact/ Noncompact	$\lambda_r$ Noncompact/ Slender	Maximum Permitted
Walls of Rectangular HSS and Boxes of Uniform Thickness	$b/t$	$2.26 \sqrt{\frac{E}{F_y}}$	$3.00 \sqrt{\frac{E}{F_y}}$	$5.00 \sqrt{\frac{E}{F_y}}$
Round HSS	$D/t$	$\frac{0.15E}{F_y}$	$\frac{0.19E}{F_y}$	$\frac{0.31E}{F_y}$

(a) For compact sections

$$P_{no} = P_p$$

where

$$P_p = F_y A_s + C_2 f'_c \left( A_c + A_{sr} \frac{E_s}{E_c} \right)$$

$C_2 = 0.85$  for rectangular sections and  $0.95$  for round sections

(b) For noncompact sections

$$P_{no} = P_p - \frac{P_p - P_y}{(\lambda_r - \lambda_p)^2} (\lambda - \lambda_p)^2$$

where

$\lambda$ ,  $\lambda_p$  and  $\lambda_r$  are slenderness ratios determined from Table I1.1a

$P_p$  is determined from Equation I2-9b

$$P_y = F_y A_s + 0.7 f'_c \left( A_c + A_{sr} \frac{E_s}{E_c} \right)$$

(c) For slender sections

$$P_{no} = F_{cr} A_s + 0.7 f'_c \left( A_c + A_{sr} \frac{E_s}{E_c} \right)$$

where

(i) For rectangular filled sections

$$F_{cr} = \frac{9E_s}{\left(\frac{b}{t}\right)^2}$$

(ii) For round filled sections

$$F_{cr} = \frac{0.72F_y}{\left(\left(\frac{D}{t}\right) \frac{F_y}{E_s}\right)^{0.2}}$$

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= ANNEXURE Q1 =

$$EI_{eff} = E_s I_s + E_s I_{sr} + C_3 E_c I_c$$

$$C_3 = 0.6 + 2 \left( \frac{A_s}{A_c + A_s} \right) \leq 0.9$$

$$\text{If } \dots \frac{P_{no}}{P_e} \leq 2.25 \quad P_n = P_{no} \left[ 0.658 \left( \frac{P_{no}}{P_e} \right) \right]$$

$$\text{Else } \dots \frac{P_{no}}{P_e} > 2.25 \quad P_n = 0.877 P_e$$

**For FEC columns:**

nominal compressive strength,  $P_o = A_s F_y + A_{sr} F_{yr} + 0.85 A_c f'_c$

$$EI_{eff} = E_s I_{sy} + 0.5 E_s I_{sry} + C_1 E_c I_{cy}$$

$$C_1 = 0.1 + 2 \left( \frac{A_s}{A_c + A_s} \right) \leq 0.3$$

nominal tensile strength,  $P_o = A_s F_y + A_{sr} F_{yr}$

**For PEC Columns:**

### Axial Compressive Strength

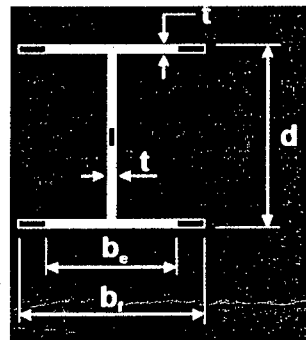
$$C_r = (A_{se} F_y + 0.85 A_c f_{cu} + A_{sr} F_{yr})$$

$$A_{se} = (d - 2t + 2b_e) t$$

$$b_e = \frac{b_f}{(1 + \lambda_p^{2n})^{1/n}} \leq b_f \quad \boxed{n=1.5}$$

$$\lambda_p = \frac{b}{t} \sqrt{\frac{12(1 - \nu_s^2) F_y}{\pi^2 E_s k}}$$

$$k = \frac{0.9}{(s/b_f)^2} + 0.2(s/b_f)^2 + 0.75, \quad (0.5 \leq s/b_f \leq 1)$$



**SECTION – A**

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

1. (a) Define environmental policy. What are the objectives of Bangladesh Environmental Policy 1992? What legal framework was proposed and institutional arrangements were considered under the environmental policy? What were the specific policy statements under the following sectors: (i) Industry, (ii) Fisheries and livestock (iii) Housing and urbanization. (17)
- (b) "What are the differences in the information required and procedures for environmental clearance between "Orange A" and "Red" category projects according to ECR 1997? (6 1/3)
  
2. (a) What are the salient features of the Environment Court Act 2000? (7 1/3)
- (b) In the Jamuna Multipurpose Bridge Project, what were the positive and negative impacts due to the closure of the northern intake of Dhaleswari river? (16)
- Summarize the mitigation measures suggested for the following environmental impacts for the implementation of the Jamuna Multipurpose Bridge Project:
  - (i) Disruption of river navigation
  - (ii) Deterioration of surface water quality
  - (iii) Disruption of irrigation
  - (iv) Transmission of diseases among workers
  - (v) Contamination of drinking water.
  
3. (a) Write short notes on (i) the Water Act 2013; (ii) Public Interest Litigation; (iii) Ecologically Critical Area. (6)
- (b) Describe the traditional project cycle. How is environmental assessment now incorporated in the project cycle? What is the difference between IEE and EIA? (10)
- (c) What is the purpose of environmental monitoring? What are the typical contents of an EMP report? (7 1/3)

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4. (a) draw a schematic diagram showing the interaction of economic activities (production and consumption) with the natural environment. How can the residuals from production and consumption process be minimized? What are external benefits and how does it affect the socially efficient rate of output? (9)
- (b) Explain 'efficient level of emissions' using Marginal Damage (MD) and Marginal Abatement Cost (MAC) curves. Show graphically what would be the effect on the 'efficient level of emissions' if there is (i) an increase in population and (ii) adoption of improved technology in reducing emissions. (7)
- (c) Write down the answers to the following questions regarding various provisions of the Environment Court Act 2000 and Environment Conservation Act 1995: (7 1/3)
- (i) What is the rank of the judge and Public Prosecutor?
  - (ii) Who has the power to make Rules?
  - (iii) Who can carry out investigation and conduct search/examination?
  - (iv) What are the guiding legislations for trial and disposal of cases related to compensation and offence?
  - (v) What is meant by 'actions taken in good faith'?

**SECTION-B**

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

5. (a) What do you mean by 'Environmental Management'? (3+3+4)  
What is the difference between 'Development' and 'Sustainable Development'?  
'Applying Environmental Management, development projects can be made sustainable'  
— Explain with examples.
- (b) State at least three goals in each of the following sectors that should be achieved for Sustainable Development (6+3+4 1/3)
- (i) Economic
  - (ii) Environmental
  - (iii) Social
- What are the features that are new in SDG 2030? Mention those.  
What are the challenges and opportunities for Bangladesh to achieve SDGs? Describe.
6. (a) State the measures those can be adopted to control air pollution at (i) National level, and (ii) Individual level. (6)

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**Contd... Q. No. 6**

(b) Name the renewable energy sources. What are the environmental implications of energy sector development using renewable energy sources? Briefly discuss. **(10+3+4 1/3)**

State the causes of failure of wind operated Power Plant in Bangladesh.

What challenges are there for Nuclear Power Plant in Bangladesh with respect to climate change? Describe briefly.

7. (a) Why do you need EIA methodologies? Name some commonly used EIA methodologies. What are the limitations of Check List and Matrix methods? **(12)**

(b) An embankment is proposed to be constructed in a village in coastal area for flood protection. Identify the potential impacts in social, ecological and physico-chemical components of environment. **(11 1/3)**

8. (a) Identify the different activities in transportation sector which have environmental implications. **(11)**

What are the impacts of these activities? Describe.

(b) In your opinion, what environmental issue should be given the most priority in context of Bangladesh? Write a short note on this issue. **(12 1/3)**

Define the following ecosystem with examples:

- (i) Aquatic (ii) Wetland (iii) Terrestrial
-

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 435** (Environmental Pollution Management)

Full Marks: 140

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) Write down the assumptions of the "point source Gaussian plume model". On a particular highway, cars are travelling at a speed of 60 km/hr along a road, and average distance between cars is 8 m. Each car, on an average, is emitting 5.1 g/km of Carbon Monoxide (CO). Wind speed is 2.5 m/sec perpendicular to the road, and the atmosphere is "adiabatic". Estimate the concentration of CO at 1.25 km downwind and at a height of 20 m. [Table for calculation of dispersion coefficient provided.] (10)
- (b) What is "black carbon"? What are the major sources of black carbon? Discuss the health and climate effects of black carbon. (8 1/3)
- (c) What are "halocarbons"? "Halocarbons induce both positive and negative radiative forcing" — explain this statement. (5)
2. (a) A power plant burns 6.5 metric tons of coal per hour and discharges the combustion product through a stack which has an effective height of 50 m. The coal has a sulfur content of 4.5% and 20% of this sulfur is emitted as SO<sub>2</sub>. Wind speed at instrument height (10 m) is 2.8 m/sec, and the atmosphere is characterized as "slightly stable". Compute concentration of SO<sub>2</sub> concentration at a distance 1.5 km downwind, 50 m off the center-line of the plume, and at a height of 25 m. (10)
- [Given:  $p = 0.20$ ; Table for calculation of dispersion coefficient provided]
- (b) If 11 moles of O<sub>2</sub> are required for complete combustion of the fuel n-heptane (C<sub>7</sub>H<sub>16</sub>), calculate the stoichiometric ratio for the fuel. Explain, with an appropriate figure, the effect of air-fuel ratio on automotive emission of CO, HC and NO<sub>x</sub>. (8 1/3)
- (c) Describe NO-NO<sub>2</sub>-O<sub>3</sub> photochemical reaction sequence. Explain how hydrocarbon affects the reaction sequence and thus promotes formation of ozone. (5)
3. (a) Define "meteorology" and "aeronomy". What do you understand by stable, unstable and neutral atmosphere? Explain. On a particular day, ambient atmospheric temperature profile is given by the following equations: (9)
- $$\Lambda = 29.0 + 0.07 z \quad ; z \leq 150 \text{ m}$$
- $$39.5 - 0.10 (z - 150) \quad ; z > 150 \text{ m; where, } z = \text{altitude in m.}$$

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**Contd... Q. No. 3(a)**

Plumes are being emitted at a temperature of 40°C from the top of a smokestack which is 35 m in height. Estimate the height up to which the plume would rise under the existing condition.

(b) Flow rate of exhaust gas from a 300 MW combined cycle power plant is 580 kg/sec. The estimated maximum concentration of SO<sub>2</sub> in the exhaust gas is 15.5 ppmv. Estimate SO<sub>2</sub> emission rate in "g SO<sub>2</sub>/sec". [Given: MW of exhaust gas = 28.0 g/mole; assume reasonable values for parameters not given] (5)

(c) From the viewpoint of deposition of particulate matter (PM), what are the three "regions" of the human respiratory system? What are the important mechanisms for deposition of PM in the respiratory system? Show with appropriate figures. (6)

(d) Radiative forcing (since pre-industrial time) of "tropospheric ozone" is considered to be positive, while that of "stratospheric ozone" is considered to be negative. Briefly explain why. (3 1/3)

4. (a) Identify the major processes that lead to the emission of pollutants into the atmosphere. Why an "averaging period" is associated with air quality standards of pollutants? Explain. (10)

On a particular day during a dry season, air quality data recorded at the CAMS in Narayanganj are as follows:

$$PM_{2.5} (24\text{-hr}) = 320 \mu\text{g}/\text{m}^3$$

$$PM_{10} (24\text{-hr}) = 435 \mu\text{g}/\text{m}^3$$

$$O_3 (8\text{-hr}) = 35 \mu\text{g}/\text{m}^3$$

$$SO_2 (24\text{-hr}) = 145 \mu\text{g}/\text{m}^3$$

Determine AQI for each parameter and report AQI for that particular day.

[Given: T = 20°C; P = 1 atm; Table for calculating AQI provided]

(b) Identify the natural atmospheric cleansing processes. Derive the expression for estimation of minimum diameter of a particle (PM) that would be collected/removed with 100% theoretical efficiency in a gravitational settling chamber of length L and height H. (7)

(c) Among the fuels commonly used in Bangladesh, which ones typically contain higher quantities of sulfur (S). Starting from the burning of S-containing fuel, explain the process of formation of sulfate particles in the atmosphere. (6 1/3)

Why SO<sub>x</sub> is particularly harmful in dusty atmosphere? Explain.

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**SECTION-B**

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

Assume reasonable values of missing data, if any.

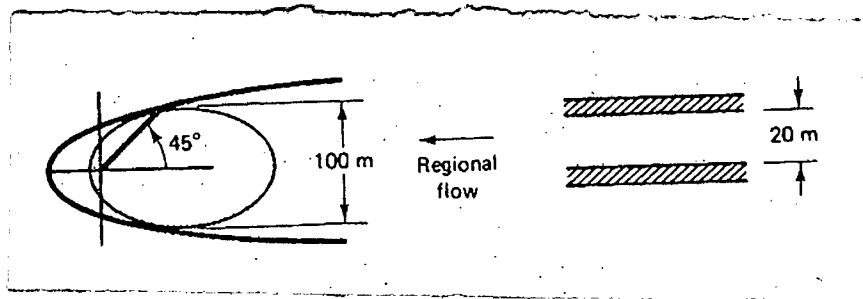
5. (a) Describe the factors affecting BOD rate constant. Explain with diagram the biogeochemical cycle of nitrogen. (10)

(b) The ultimate BOD of a river just below a sewage outfall (after mixing) is 50 mg/L and the DO is at a the saturation value of 10 mg/L. The deoxygenation rate coefficient  $k_d$  is 0.3/day and the reaeration rate coefficient  $k_r$  is 0.9/day. The river is flowing at a speed of 48 miles/day. The only source of BOD on this river is this single outfall. (13 1/3)

- (i) Find the critical distance downstream at which DO is a minimum
- (ii) Find the minimum DO
- (iii) If a wastewater treatment plant is to be built, what fraction of the BOD would have to be removed from the sewage to assure a minimum DO of 5 mg/L everywhere downstream?

6. (a) How does thermal stratification affect the water quality in lakes both in summer and winter? What happens during spring and fall overturn? Explain with diagrams. What are the characteristic differences between an eutrophic and oligotrophic lake. (15)

(b) A single well is to be used to remove a symmetrical oblong plume of contaminated groundwater in an aquifer 20 m thick with porosity 0.30, hydraulic conductivity  $1 \times 10^{-4}$  m/s, and hydraulic gradient 0.0015. With the plume and capture zone curve superimposed as shown in the following figure, the angle from the well to the point where the two just touch is  $45^\circ$ , and the width of the plume is 100 m. What pumping rate would create these conditions? (8 1/3)



7. (a) What is the difference between NBOD and CBOD? What are the harmful effects of an algal bloom in the aquatic environment? (8)

(b) What is NAPL? Why is DNAPL extremely difficult to remove? What are the factors affecting residual saturation of NAPL plumes? (7)

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**Contd... Q. No. 7**

(c) A municipal wastewater treatment plant discharges  $1.10 \text{ m}^3/\text{s}$  of treated effluent having an ultimate BOD of  $50.0 \text{ mg/L}$  into a stream that has a flow of  $8.70 \text{ m}^3/\text{s}$  and a BOD of its own equal to  $6.0 \text{ mg/L}$ . The deoxygenation constant  $k_d$  is  $0.20/\text{day}$ .

**(8 1/3)**

- (i) Assuming complete and instantaneous mixing, estimate the ultimate BOD of the river just downstream from the outfall.
- (ii) If the stream has constant cross section so that it flows at a fixed speed equal to  $0.30 \text{ m/s}$ , estimate the BOD of the stream at a distance  $30,000 \text{ m}$  downstream.

8. (a) Write short notes on:

**(12)**

- (i) Bioaccumulation of DDT
- (ii) The 'Great Stink' in London
- (iii) Hydrodynamic control of groundwater plume
- (iv) Retardation of groundwater plume

(b) Estimate the retardation factor for the transport of dissolved chloroform under the following conditions:

**(5 1/3)**

porosity of the aquifer materials =  $0.3$

$f_{oc} = 1\%$

soil bulk density =  $2.1 \text{ g/cm}^3$

$\log K_{ow}$  for chloroform =  $1.97$

$K_{oc}$  of chloroform can be estimated using the relationship:

$$\log K_{oc} = 0.544 \log K_{ow} + 1.377$$

(c) A  $0.1 \mu\text{g}$  pulse of a chemical is injected at a rate of  $1 \text{ m/hr}$  into one end of a packed chromatographic column of length  $220 \text{ cm}$  and inside area of  $0.06 \text{ cm}^2$ . The packing medium particles have a diameter of  $0.02 \text{ mm}$  and a porosity of  $0.3$ . What is the maximum concentration of the chemical after its center of mass has traveled  $2 \text{ m}$ ? Assume the only mixing process is mechanical dispersion.

**(6)**

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= 5 =

Table for calculation of AQI [for Question No. 2(a)]

Breakpoints							AQI
O <sub>3</sub> (ppm) 8-hr	O <sub>3</sub> (ppm) 1-hr (i)	PM <sub>2.5</sub> (µg/m <sup>3</sup> ) 24-hr	PM <sub>10</sub> (µg/m <sup>3</sup> ) 24-hr	CO (ppm) 8-hr	SO <sub>2</sub> (ppm) 24-hr	NO <sub>2</sub> (ppm) Annual	
0.000-0.064	--	0.0-15.4	0-54	0.0-4.4	0.000-0.034	(ii)	0-50
0.065-0.084	--	15.5-40.4	55-154	4.5-9.4	0.035-0.144	(ii)	51-100
0.085-0.104	0.125-0.164	40.5-65.4	155-254	9.5-12.4	0.145-0.224	(ii)	101-150
0.105-0.124	0.165-0.204	65.5-150.4	255-354	12.5-15.4	0.225-0.304	(ii)	151-200
0.125-0.374	0.205-0.404	150.5-250.4	355-424	15.5-30.4	0.305-0.604	0.65-1.24	201-300
(iii)	0.405-0.504	250.5-350.4	425-504	30.5-40.4	0.605-0.804	1.25-1.64	301-400
(iii)	0.505-0.604	350.5-500.4	505-604	40.5-50.4	0.805-1.004	1.65-2.04	401-500

- (i) In some cases, in addition to calculating the 8-hr ozone index, the 1-hr ozone index may be calculated, and the maximum of the two values reported
- (ii) NO<sub>2</sub> has no short-term air quality standard and can generate an AQI only above 200
- (iii) 8-hr O<sub>3</sub> values do not define higher AQI values (≥301). AQI values of 301 or higher are calculated with 1-hr O<sub>3</sub> concentrations

Table for estimation of dispersion coefficients [for Questions 3(a) and 4(a)]

Stability	$x \leq 1$ km				$x \geq 1$ km		
	<i>a</i>	<i>c</i>	<i>d</i>	<i>f</i>	<i>c</i>	<i>d</i>	<i>f</i>
A	213	440.8	1.941	9.27	459.7	2.094	-9.6
B	156	106.6	1.149	3.3	108.2	1.098	2.0
C	104	61.0	0.911	0	61.0	0.911	0
D	68	33.2	0.725	-1.7	44.5	0.516	-13.0
E	50.5	22.8	0.678	-1.3	55.4	0.305	-34.0
F	34	14.35	0.740	-0.35	62.6	0.180	-48.6

\* The computed values of  $\sigma$  will be in meters when  $x$  is given in kilometers.

$$\sigma_y = a \cdot x^{0.894}$$

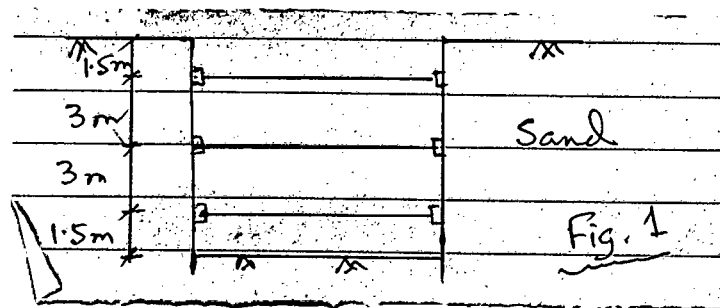
$$\sigma_z = c \cdot x^d + f$$

**SECTION – A**

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

Assuming reasonable value of missing data, only if necessary.

1. (a) With neat sketches briefly describe different techniques available for construction dewatering. Indicate suitability of each method. (13)
- (b) Briefly describe the construction procedure for constructing diaphragm wall using slurry trench method and tremie concreting. Discuss slurry circulation and cleaning techniques. Present neat diagrams. (10 1/3)
  
2. (a) Write short notes on the following: (3×3=9)
  - (i) Filter skin
  - (ii) Factor of safety in sheet pile design
  - (iii) Stability number
- (b) Distinguish between computational p – y curve method and finite element method for laterally loaded piles. (5 1/3)
- (c) Draw the earth pressure envelope and determine the strut loads for the braced excavation in sandy soil. Assume :  $\gamma = 15 \text{ kN/m}^3$ ,  $\phi = 30^\circ$ , strut spacing = 4 m. Also determine the maximum moment developed in the wales. (6)



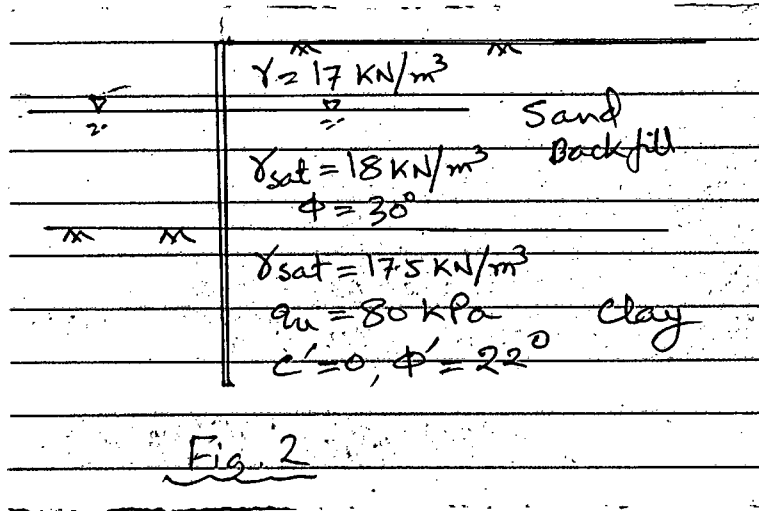
- (d) List advantages of steel sheet piles. (3)

**CE 443**

3. A cantilever sheet pile needs to retain 4.5 m of sandy backfill material. It is embedded in clay soil as shown in Fig. 2

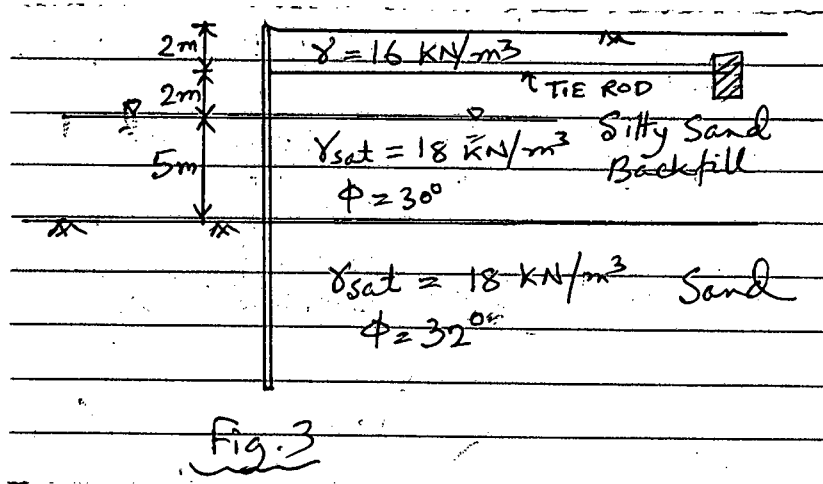
(15+8 1/3=23 1/3)

- (i) Determine the required depth of penetration of the sheet pile for short term loading condition.
- (ii) What will be the depth of penetration if drained condition is considered? Why do you need to consider drained condition?



4. (a) Determine the required length of anchored sheet pile shown in Fig. 3 embedded in sandy soil. Determine the size of mild steel tie rod and its spacing assuming  $f_y = 400$  MPa.

(19)



(b) Why do you need to place the anchor block at a minimum distance from the anchored sheet pile? Show the minimum distance required in a 2 layer soil.

(4 1/3)

**SECTION – B**

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

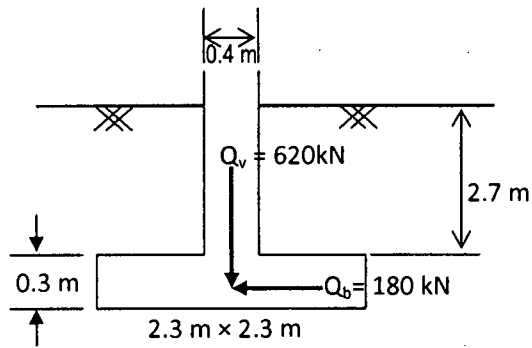
- 5. (a) List the internally stabilized earth retaining systems. Show in neat sketches the overturning and deep-seated stability problems of mechanically stabilized retaining wall. (3+3=6)
- (b) Compare between counterfort retaining wall and buttressed retaining wall. Show the common proportions of counterfeited retaining wall in schematic diagram. (3+2=5)

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**Contd... Q. No. 5**

- (c) Check the stability against sliding and bearing failure for the square footing (2.3 m × 2.3 m) shown in the Fig. 4 . If the factor of safety against sliding is not sufficient what can be done? What will you do if the unit weight of the soil is not constant? (Use bearing capacity factors presented in **Table 1**). **(12 1/3)**
6. (a) Why coarse-grained soils are chosen as backfill? List the common types of retaining wall drainage. **(3+2=5)**
- (b) Briefly describe the general construction procedure of caissons. **(4)**
- (c) Determine the factor of safety against overturning and sliding failure for the retaining wall shown in Fig. 5. Unit weight of concrete,  $\gamma_{\text{conc}} = 22.5 \text{ kN/m}^3$ . Consider the passive resistance in front of the wall. Comment on the safety of the retaining wall against overturning and sliding. **(14 1/3)**
7. (a) List the principal components of a braced cofferdam. Draw qualitative earth pressure diagrams for design of braced cofferdams in sand and clay (show the controlling ordinates). **(2+3=5)**
- (b) Discuss briefly the phenomenon of 'earth pressure on braced cofferdams in stiff clays'. **(4)**
- (c) A bracing system for a 5 m wide open cut is shown in Fig. 6. Determine the forces in the struts A, B and C. The struts are spaced at 3 m center to center horizontally. **(14 1/3)**
8. (a) List the uses of caissons. Compare between the Pneumatic caissons and Box caissons. **(2+3=5)**
- (b) Describe briefly the permanent design loads for designing caissons. Draw schematic diagrams of cutting edge for (i) hard stratum and (ii) soft soil. **(3+2=5)**
- (c) A circular caisson is shown in Fig. 7. Is the caisson self sinking? If not determine: (i) the required amount of ballast and (ii) the thickness for self sinking. Unit weight of concrete,  $\gamma_{\text{conc}} = 22.5 \text{ kN/m}^3$ . Assume reasonable value if necessary. **(13 1/3)**
-

=4=



Uniform soil layer  
 $\gamma = 17.0 \text{ kN/m}^3$   
 $\phi = 27^\circ$   
 $c = 20 \text{ kPa}$

Fig. 5 for Q. 4(c)

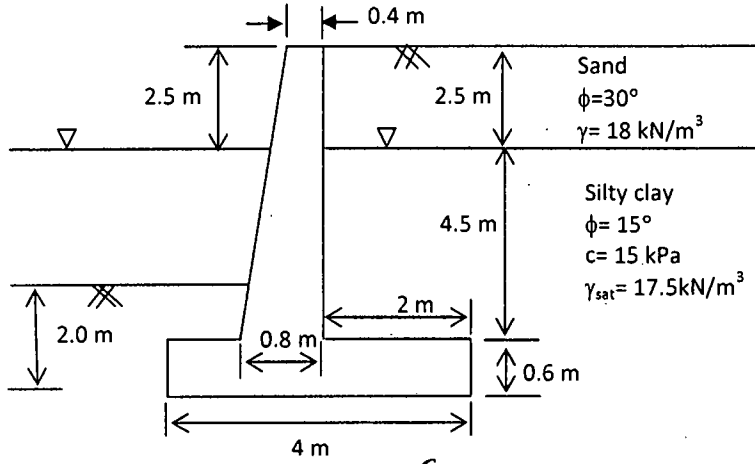


Fig. 5 for Q. 6(c)

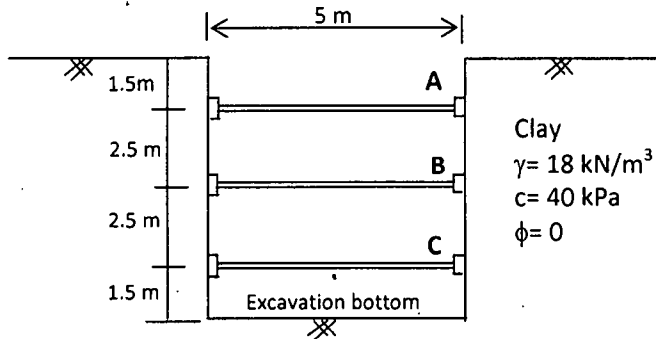
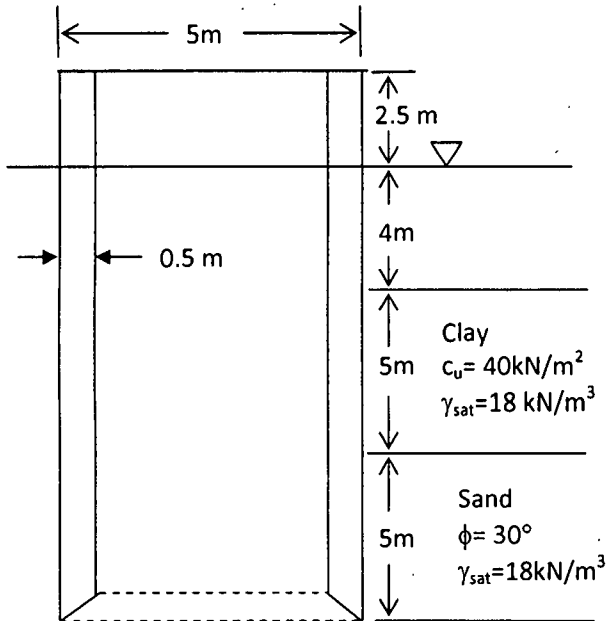


Fig. 6 for Q. 7(c)



Sand  $\phi = 32^\circ$ ,  $\gamma_{\text{sat}} = 19 \text{ kN/m}^3$

Fig. 7 for Q. 8(c)

= 5 =

Table 1

**Bearing-capacity factors for the Terzaghi equations**

Values of  $N_y$  for  $\phi$  of 34 and 48° are original Terzaghi values and used to back-compute  $K_{pv}$

$\phi$ , deg	$N_c$	$N_q$	$N_y$	$K_{pv}$
0	5.7†	1.0	0.0	10.8
5	7.3	1.6	0.5	12.2
10	9.6	2.7	1.2	14.7
15	12.9	4.4	2.5	18.6
20	17.7	7.4	5.0	25.0
25	25.1	12.7	9.7	35.0
30	37.2	22.5	19.7	52.0
34	52.6	36.5	36.0	
35	57.8	41.4	42.4	82.0
40	95.7	81.3	100.4	141.0
45	172.3	173.3	297.5	298.0
48	258.3	287.9	780.1	
50	347.5	415.1	1153.2	800.0

† =  $1.5\pi + 1$ .

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 457** (Transportation Engineering V: Urban Transportation  
Planning and Management)

Full Marks : 140

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) Explain five factors influencing urban transport pattern. Discuss, five globally acknowledged urban transport problem and write down eight urban transport problems specific to developing cities. (11 1/3)  
 (b) What is meant by Rapid Transit System (RTS)? Explain its key features. How do you determine a good route set for a RTS? Explain with the relevant optimisation model formulation along with illustration of variables and constraints. (12)
2. (a) For a particular of a transit system explain how number of stops vary with varying demand and stopping strategy with the help of graph. Explain eight factors depicting transit users' attitude. (11 1/3)  
 (b) Explain properties of good schedule for transit system. Also, discuss the variables, and constraints for mathematical modeling of transit schedule optimisation. (12)
3. (a) Explain four transit management and four restraint measure options for urban congestion management. Explain how information technology (IT) can be used for travel demand management. (11 1/3)  
 (b) Suggest public transport development policy and strategy for a developing metropolis. Discuss ten main problems of Dhaka city bus transport. And, suggest strategies for improving the informal buses to bus-lane based system. (12)
4. (a) What do you mean by Urban Road Safety Management System (URSMS)? Discuss URSMS scopes and general principles. Draw a typical stakeholders map for URSMS. (11 1/3)  
 (b) Explain components of URSMS with flow chart. Also, discuss the sub-tasks involved in Analysis and Strategy phases. Show objectives setting for URSMS in a typical section of urban road network. (12)

**CE 457**

**SECTION – B**

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

5. (a) What is 'Sustainable Transportation'? Write down its benefits. Which modes of transportation are said to be sustainable for Dhaka City and why? (2+4+4 1/3)
- (b) Why in many cases urban transportation planners and traffic engineers are not concerned and aware about urban goods movement problems? Write down the concerns of different parties involved in urban goods movement process. (6+7)
6. (a) Write down the basic requirements for urban transportation plans. Also, briefly discuss the three Cs (3C) of urban transport plan. (7+6)
- (b) Briefly discuss the commonly encountered issues involving truck loading/unloading in CBD and Non-CBD locations. (10 1/3)
7. (a) Write down the different approaches used for evaluating urban transportation alternatives. (8 1/3)
- (b) Given the benefits and costs schedule shown below for urban transportation projects A, B, and C, determine which project is best from an economic efficiency point of view. Conduct the assessment for discount rates of 8 percent, 10 percent, and 12 percent. How does the discount rate affect the choice of the "best" project? (15)

Year	Expected yearly cost (\$)			Expected yearly benefit (\$)		
	A	B	C	A	B	C
1	10	30	10	0	0	0
2	15	10	10	5	20	15
3	30	10	10	10	20	15
4	15	5	10	15	10	10
5	10	5	10	15	10	5
6	5	5	5	10	10	5
7	5	5	5	10	10	5
8	5	5	5	10	5	5
9	5	5	5	5	5	5
10	5	5	5	5	5	5

8. (a) What is the main difference between 'all-or-nothing' and 'capacity restraint' traffic assignment techniques? Which assignment technique would you use to assign trips into road network of Dhaka city? Why? (3+2+3)

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**Contd ... Q. No. 8**

(b) A calibration study resulted in the following utility equation:

**(15 1/3)**

$$U_k = a_k - 0.025X_1 - 0.032X_2 - 0.015X_3 - 0.002X_4$$

Where,  $X_1$  = access plus egress time, in min;  $X_2$  = waiting time, in min;  $X_3$  = line-haul time, in min;  $X_4$  = out-of-pocket cost, in BDT.

The trip-distribution forecast for a particular interchange was a target-year volume of  $Q_{IJ} = 5000$  person-trips per day. During the target year trip-makers on this particular interchange will have a choice between the private automobile (A) and a local bus system (B). The target-year service attributes of the two competing modes have been estimated to be:

Attribute	$X_1$	$X_2$	$X_3$	$X_4$
Automobile	5	0	20	100
Local bus	10	15	40	50

Assuming that the calibrated mode-specific constants are 0.00 for the automobile mode (i.e., base mode) and -0.10 for the bus mode, apply the logit model to estimate the target-year market share of the two modes and the resulting fare-box revenue of the bus system.

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2014-2015

Sub : **CE 447** (Soil-Water Interaction)

Full Marks : 140

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**.

Used attached **Chart** and **Table** where necessary. Assume reasonable value of missing data, if any.

1. (a) Derive Kozeny-Carman equation for coefficient of permeability of soil. (7)
- (b) Mention the basic requirements to be fulfilled for drawing a flow net. What are the boundary conditions for drawing flow net in an earth dam? (6)
- (c) Draw neatly the entrance and exit requirements of the line of seepage (phreatic line) of an earth dam. (4)
- (d) Derive an expression for the factor of safety (F.S) of an infinite cohesive-frictional soil (C- $\phi$ ) with seepage parallel to the slope and occurring throughout the slope (i.e. water table is at slope surface). (6  $\frac{1}{3}$ )
  
2. (a) Mention the principal reasons of non-Darcy behaviour in soils. Also define permeability parameters  $n$  and  $C$ . (7)
- (b) What are the basic assumptions for determination of permeability of soils in field by pumping test? With neat figures describe the constant head borehole permeability test to estimate in-situ coefficient of permeability. Mention the possible sources of errors in this test. (8)
- (c) A homogeneous earth embankment of height 10 m was constructed on an impervious foundation side slopes 1.5:1 (horizontal: vertical). The embankment retains water to a height of 9 m. The crest width of the embankment is 2 m. Plot the line of seepage with necessary corrections using A. Casagrande's method (use plain graph paper for plotting) (8  $\frac{1}{3}$ )
  
3. (a) Derive equation of continuity and Laplace's equation in two dimensions. Also show that both potential function and stream function satisfy Laplace's equation while stream function satisfies equation of continuity. (8)
- (b) A homogeneous embankment of height 14 m was built on an impervious foundation with side slopes 3:1 (horizontal: Vertical). The embankment retains water to a height of 12 m. The crest width of the embankment is 3 m. The coefficient of permeability of embankment soil is  $3 \times 10^{-5}$  m/sec. Calculate the rate of seepage through the embankment using Schaffernak and Van Iterson's method. (4)

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**Contd ... Q. No. 3**

(c) Derive an expression for determining the rate of seepage through an earth dam resting on an impervious base using Leo Casagrande's method. Also state the procedure of plotting the line of seepage using this method. (7 1/3)

(d) List the general criteria to be considered for design of a revetment structure. (4)

4. (a) The upstream slope of an earth embankment of height 6 m was constructed at an angle of 70°. The values of saturated unit weight, cohesion and angle of internal friction of the embankment soil are 20 kN/m<sup>3</sup>, 25 kN/m<sup>2</sup> and 10°, respectively. Using Taylor's Method, compute 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. (6)

(b) With neat sketch briefly describe a direct method of determining soil suction. (4 1/3)

(c) A dry cohesive deposit of clay of height 3 m exists at 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<sup>2</sup> and 20°, respectively. Dry unit weight of the clay deposit is 16 kN/m<sup>3</sup>. Find the following: (5)

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

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

(iii) Critical height of the slope.

(d) The following data have been obtained for the design of bank revetment using CC blocks for the Bhairab Bazar, site on the Meghna river. (8)

- Average flow velocity = 3m/sec
- Specific gravity of CC block = 2.2
- Mass density of CC block = 2200 kg/m<sup>3</sup>
- Angle of repose of CC block = 25°
- Ratio of water depth to revetment size = 5
- Slope of bank = 2 : 1 (horizontal : vertical)
- Shield's constant = 0.03
- Strength coefficient = 4
- Damage coefficient = 5
- Wind speed = 30 m/sec
- Wind duration = 1.50 hour
- Fetch length = 10 km

Characteristics of waves are shown in Table 1. Determine the size (thickness) of CC blocks capable of withstanding the actions of currents and waves.

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**SECTION – B**

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

5. (a) Discuss factors that should be considered for the selection of methods for improvement of a hydraulic fill? (6)
- (b) Discuss, with examples, the adverse effects of water in the geotechnical field. (6)
- (c) State the criteria set by US Army Corps of Engineers for gradation of filter materials around holes and slots in embedded pipes. Also state the relevant criteria set by US Bureau of Reclamation for opening in pipe drains. (5 1/3)
- (d) In a laboratory test for determination of transmissivity, the length and width of the geotechnical specimen were 16.5 cm and 10 cm respectively. The thickness of the geotextile under 2 kPa pressure is 4.15 mm. Under a hydraulic head of 17 cm, volume of water flowed through the specimen was 100 cc. Calculate the transmissivity and the in-plane permeability of the geotextile. (6)
6. (a) Show, with sketches, the use of drain and filter for the following: (9)
- (i) retaining wall (ii) embankment (iii) road pavement
- (b) Discuss different physical and mechanical properties of geotextiles. (8 1/3)
- (c) What information should be collected for the design and construction of a hydraulic fill? (6)
7. (a) Discuss the principles, suitability, requirement of special equipments, advantages and limitations of different methods of densification of hydraulic fill during placement. (10)
- (b) A 3 m high retaining wall is going to be constructed with weep holes to release the water pressure behind the wall. Estimated flow through the wall is 0.025 m<sup>3</sup>/sec per m of wall. A geotextile sheet is to be placed on the back face of the wall to prevent soil erosion. The backfill soil is fine silty sand having an effective grain diameter of 0.05 mm, uniformity coefficient of 2.8 and permeability coefficient of  $2.5 \times 10^{-2}$  m/sec. Check the adequacy of a candidate geotextile whose thickness is 3 mm and cross-plane permeability is 3 m/sec. (8)
- (c) Discuss the two different approaches that are adopted to account for the differences between laboratory measured test value and the desired performance value of a geotextile. (5 1/3)
8. (a) Explain the difference between AOS and EOS of a geotextile. How are they determined? Mention the limitations of the test. (9)

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**Contd ... Q. No. 8**

(b) Discuss the initial state and properties of hydraulic fills using soft cohesive soil. (4 1/3)

(c) A revetment work is to be done on a river bank with cement concrete (CC) blocks. It is considered that a fine filter layer and a coarse aggregate layer will be needed beneath the CC blocks for protection of the in-situ soil. A two-stage filter with coarse sand as fine filter and brick aggregate as coarse filter is considered. Grain size analyses of samples of in-situ soil, coarse sand and brick aggregates were carried out and their gradation is presented in the following Table. Analyze and comment on the suitability of the coarse sand and brick aggregate for filter layer. (10)

Particle size, mm		0.08	0.15	0.25	0.30	0.42	0.60	0.84	1.18	2.00	2.36	4.75	12.00	19.00	25.00	37.00	51.00	67.00	75.00	100.00
% Finer	In-situ soil	5	60	88	94	100	100													
	Coarse Sand		5	8	12	20	34	62	87	98	100	100								
	Brick aggregate												4	8	40	87	98	100	100	100

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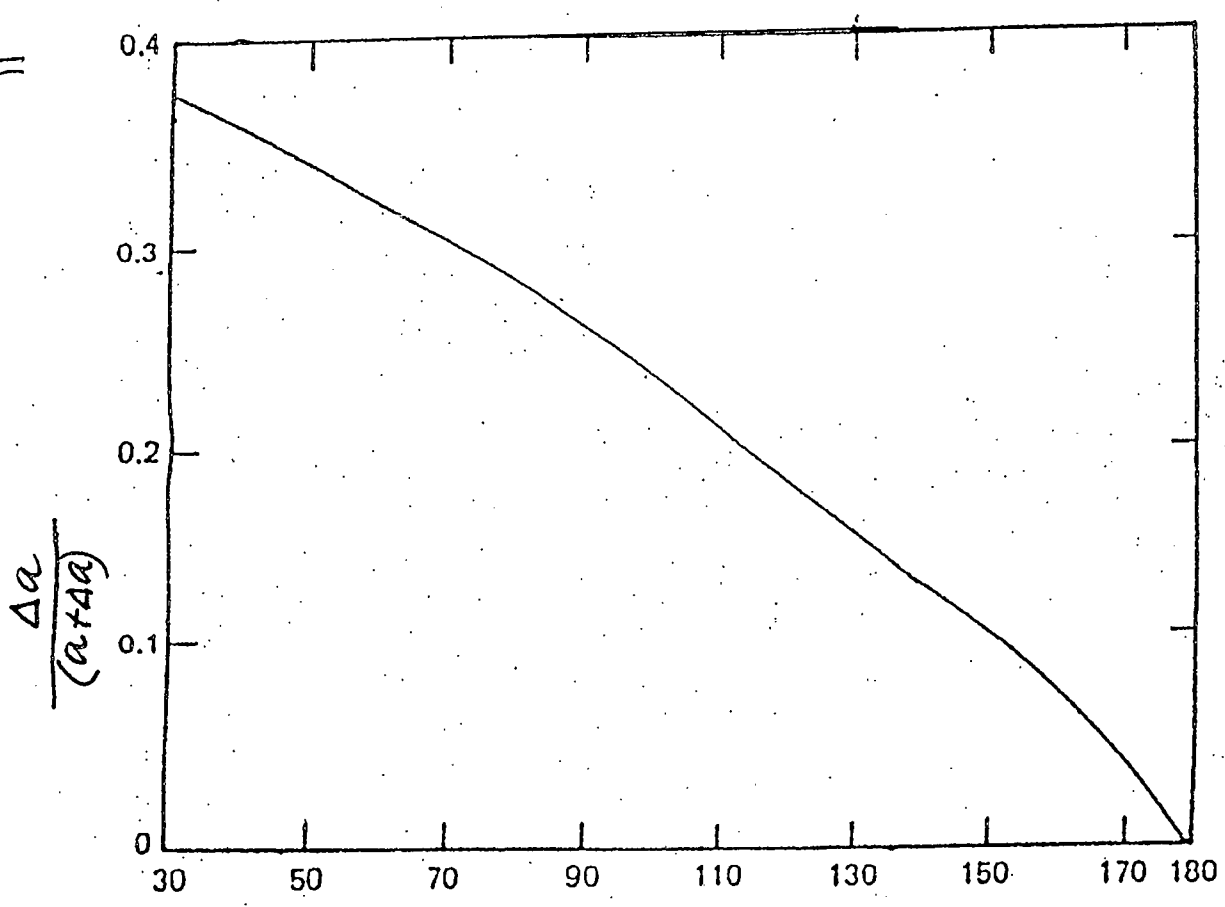


Chart 1

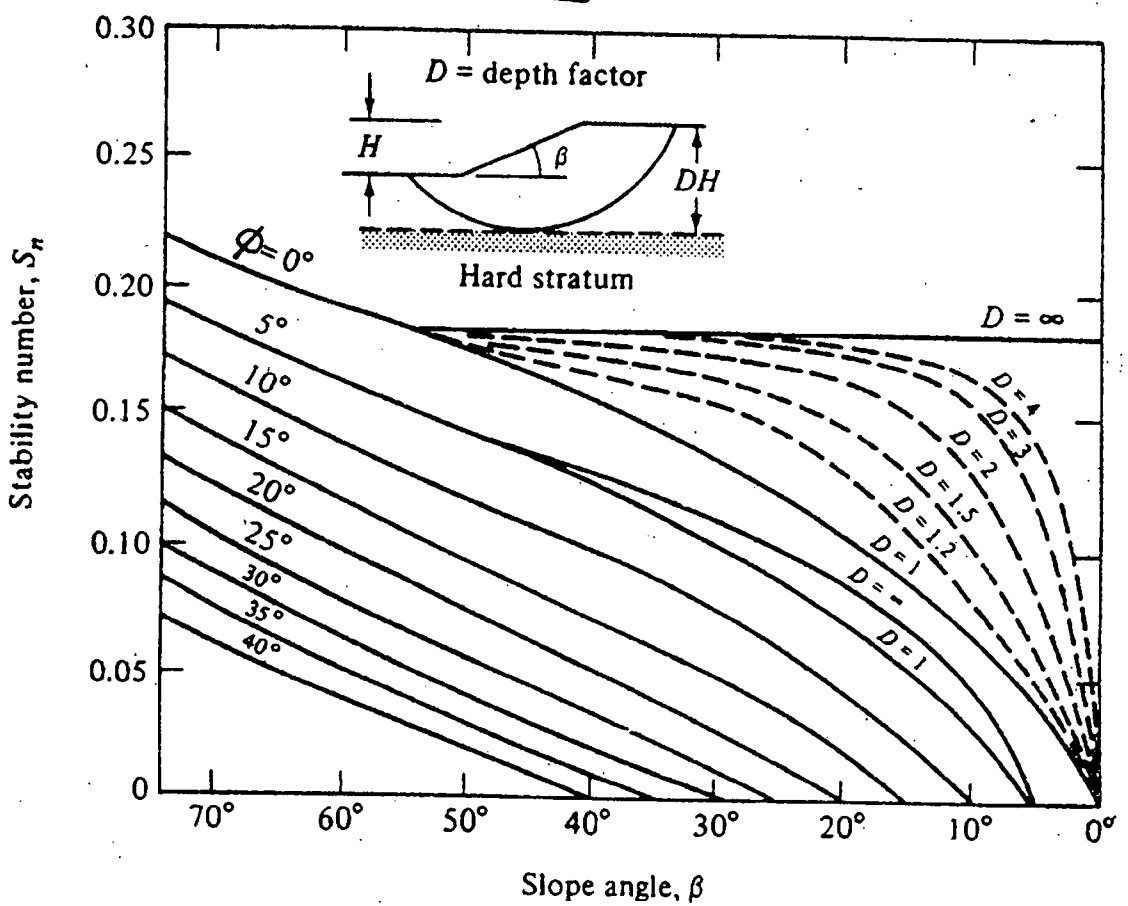


Chart 2

Table 1 Characteristics of Waves

Wind speed (m/sec)	Minimum duration of wind (hour)	Fetch length (km)	Wave height (m)	Wave period (sec)
15	1.00	5.0	0.7	2.8
	1.75	10.0	0.9	3.3
	2.25	15.0	1.2	3.8
30	0.75	5.0	1.3	3.5
	1.50	10.0	1.8	4.5
	2.00	15.0	2.0	5.0