

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **CE 403** (Socio Economic Aspects of Development Projects)

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) Briefly describe the different levels of community participation with the example of arsenic mitigation program for the rural areas of Bangladesh. (10)
 (b) Discuss the strategic issues to be considered for the success of WSS projects in Bangladesh. Explain how this can be achieved. (25)
2. (a) What are the major difficulties in conducting socio-economic assessments in developing countries? Explain with examples. (15)
 (b) Briefly discuss methodologies in practice to ensure community participation. (20)
3. (a) List the socio-economic issues that must be considered in a project concerning water quality management planning. (14)
 (b) What are the advantages and features of Social Impact Assessment (SIA) process? (14)
 (c) List four replicable urban development projects and three rural development projects in Bangladesh. (7)
4. (a) What are socio-economic impacts of development projects? Explain the various types of impacts that one may experience after a development project is implemented. Why socio-economic impacts of development projects are of great concern? (20)
 (b) "Economic development is much more than just economic growth" – Explain. What do you understand by "Human Development"? How does human development differ from economic development? (15)

SECTION – B

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

5. (a) Name 5 large infrastructure development projects that need significant land acquisition. List down major social and economic issues related to these projects. Why land acquisition and resettlement issue is one of the most sensitive issues in major development projects? (18)
 (b) What policy considerations should be taken into account in the early stages of project preparation regarding involuntary resettlement? (17)

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6. (a) How participation of involuntary resettlers and host population can lead to a successful resettlement for a development project requiring land acquisition? (18)
- (b) What important factors or information should be included in the socio-economic survey that will be used in developing a resettlement plan for a development project requiring land acquisition? (17)
7. (a) Write down the name of the Bangladesh law that constitutes the legal framework for land acquisition for development projects in Bangladesh. Prepare a list of important features of resettlement in the legal context of Bangladesh. (18)
- (b) Write down, in a tabular form, the differences between Bangladesh law, World Bank, and ADB's, policies on land acquisition and resettlement with respect to coverage, compensation, minimization of impacts, stakeholders' consultation, relocation assistance and livelihood restoration. (17)
8. (a) "Sustainable Development is about equity – intergenerational and intragenerational" – Explain. (8)
- (b) What are the strategic imperatives for sustainable development? (10)
- (c) Write down the main goals of Sustainable Development Goals (SDGs). (17)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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) Describe seven core concept of marketing. (15)
 (b) Briefly describe different states of demand. (20)
2. (a) Briefly describe the production concept, the product concept and the selling concept of marketing management philosophies. (10)
 (b) Briefly describe Integrative growth opportunities to fill the strategic planning gap. (5)
 (c) Write short notes on
 - (i) Manufacturer bands and Private bands (5)
 - (ii) Brand extension (4)
 - (iii) Strength and weakness analysis. (8)
 - (iv) Market penetration (3)
3. (a) Briefly describe Boston Consulting Group's Model. (23)
 (b) Show in a flow diagram the process of strategic planning, implementation and control. (12)
4. (a) Define career and career development. Briefly describe the value of effective Career development. What is meant by internal and external dimension of a career? (15)
 (b) Describe the different stages of a career. Show the links between the first two stages of a career with internal and external career dimensions. (20)

SECTION – B

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

5. (a) What are the main issues to consider during job search? Describe the things to consider for building your online brand. (15)
 (b) What is an internship and why is it needed. Briefly describe what is necessary for internship success. (20)

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6. (a) What do you mean by “Collective Bargaining Process? How the labor-management disputes are settled in an organization? What are the competitive tactics undertaken by the labor unions and management to force the outcome of a discussion. (25)
- (b) What is Maslow’s Hierarchy of Needs? Explain. (10)
7. (a) Explain the various factors that affect manpower planning. (10)
- (b) “Manpower Planning may be regarded as a multi-step process” – Explain. Briefly describe the various steps involved in manpower planning. (25)
8. (a) Define operations management. How is operation management different from production management? (5)
- (b) Briefly describe the concept of “Product Life Cycle”. Name the stages in a product life cycle and outline the important features of different stages in product life in a tabular form. (20)
- (c) How the strategic capacity planning is carried out for products and services? (10)
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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **CE 419** (Introduction to Finite Element Method)

Full Marks : 140

Time : 3 Hours

The figures in the margin indicate full marks.

The symbols and abbreviation have their usual meaning.

Assume reasonable values for missing data if any.

USE SEPARATE SCRIPTS FOR EACH SECTION

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

1. (a) Is FEM an exact method of analysis? Explain why? (5)
- (b) For the spring system shown in Fig. 1, find the global stiffness matrix. (12)
- (c) A shear wall is subjected to vertical and lateral loads as shown in Fig. 2. What constitutive law will you use for the problem? Will there be any strain in the z-direction? (6 1/3)

2. (a) What are the advantages of FEM over other matrix based methods of structural analysis? (4)
- (b) Determine the support reaction forces at the two ends of the bar shown in Fig. 3, given the following, (10)

$$P = 6.0 \times 10^4 \text{ N} \quad E = 2.0 \times 10^4 \text{ N/mm}^2$$

$$A = 250 \text{ mm}^2, \quad L = 150 \text{ mm}, \quad \Delta = 1.2 \text{ mm}$$
- (c) The beam shown in Fig. 4 is clamped at the two ends and acted upon by the distributed force p. Find the deflection and rotation at the center node. (9 1/3)

3. (a) What are the assumptions of linear static problems? (3)
- (b) For the spring system shown in Fig. 5, (12)

$$k_1 = 100 \text{ N/mm}, k_2 = 200 \text{ N/mm}, k_3 = 100 \text{ N/mm}$$

$$P = 500 \text{ N}, u_1 = u_3 = 0$$
 Find (i) the global stiffness matrix, (ii) displacement of node 2, (iii) the reaction forces at nodes 1 and 3 and (iv) the force in the spring 2.
- (c) Determine the rotation at the right most hinge of the beam shown in Fig. 6. (8 1/3)

4. (a) A two noded bar element shown in Fig. 7 is subjected to a triangularly varying axial load with intensity zero at the i-node and maximum intensity q at the j-node. Determine the nodal force vector. (8 1/3)
- (b) What do you understand by 'Transformation Matrix'? (3)
- (c) A simple plane truss is made of two bars and loaded as shown in Fig. 8. Find (i) displacement of node 2 and (ii) strain-energy in each bar. (12)

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SECTION – B

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

5. (a) Explain the situation when band solution becomes more expensive than frontal solution technique in terms of memory requirements and storage time. (7 1/3)
- (b) Name different types of symmetry considerations that an engineer may adopt in modeling a problem using finite element approach. (8)
- (c) In modeling a 2D space, a triangular element is often superior than a quadrilateral element while in modeling a 3D solid cube, tetrahedral elements are often better than brick elements. Explain. (8)
6. (a) Explain the isoparametric concept in finite element analysis. (9)
- (b) Determine shape functions for 4-noded rectangular elements. Use natural coordinate system. In this process show that shape function for i_{th} node can be written generally as: (14 1/3)

$$N_i = \frac{1}{4} (1 + \xi\xi_i)(1 + \eta\eta_i) \quad \text{for } i = 1, 2, 3 \text{ and } 4.$$

7. (a) Why Gauss quadrature formula is preferred in finite element analysis? Write down also the expression that the Gauss method uses to compute a function at predetermined sampling points. (10)
- (b) Write a short note on the effect of element aspect ratio on accuracy. (5 1/3)
- (c) Discuss convergence criteria for isoparametric elements. (8)
8. (a) "An inadequately defined displacement based finite element mesh may provide a lower bound solution" – Explain. (10 1/3)
- (b) Describe the sequence of the development of front in terms of letters used for nodes as the front creeps forward one element after another as shown in Figure 9. (13)

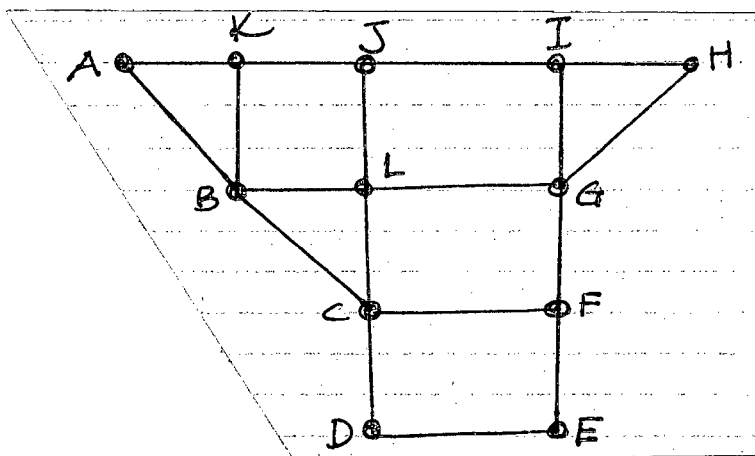


Fig. 9

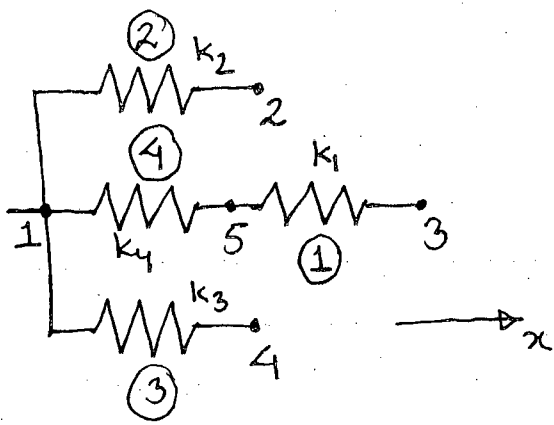


Fig. 1

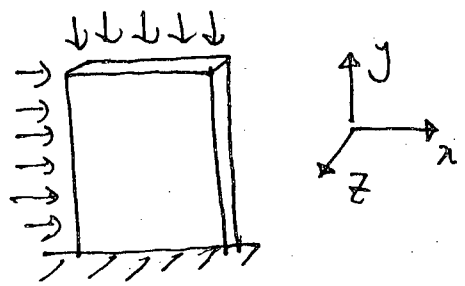


Fig. 2

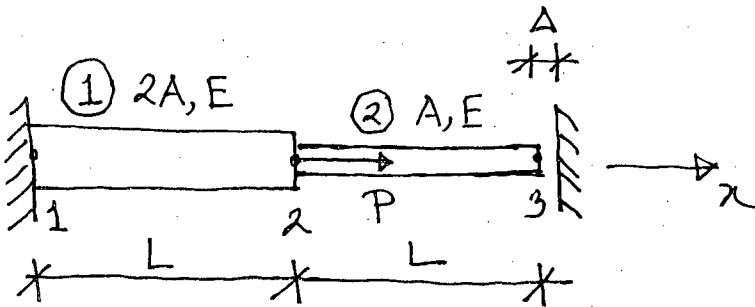


Fig. 3

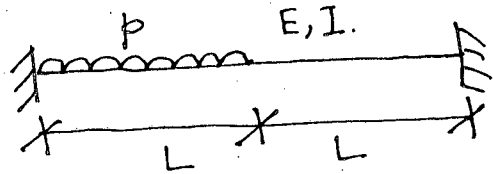


Fig. 4

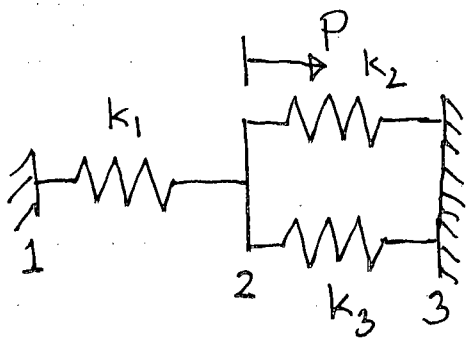


Fig. 5

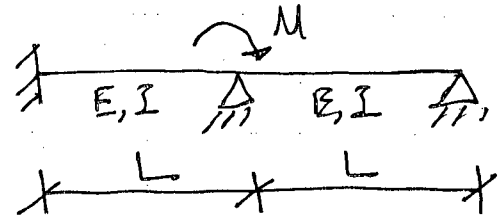


Fig. 6

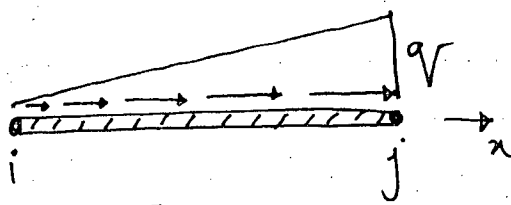


Fig. 7

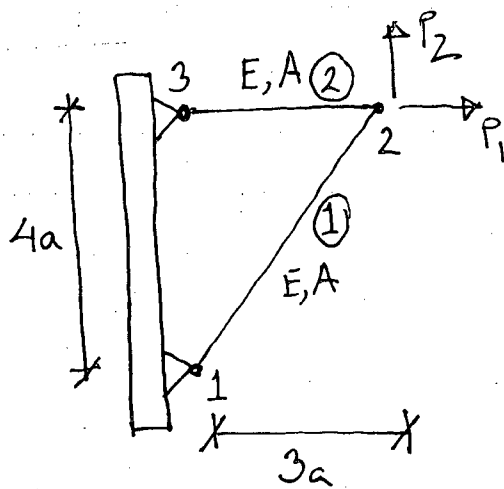


Fig. 8

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SECTION – A

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

Assume any reasonable value for missing data.

1. (a) Define and differentiate between traffic engineering and traffic management concepts and list the more common objectives of traffic management. Give an overview of the standard short-term traffic management schemes and measures that have been widely applied in tackling traffic problems in urban areas. What specific measures could be applied in order to be able to improve traffic problems along major traffic routes and what are the essential prerequisites? (13)
- (b) Explain the significance of walking and cycling as important modes of transportation in urban areas. Enumerate various pedestrian and bicycle facilities and their design principles and concepts. List some effective road and traffic engineering measures for the reduction of pedestrian-vehicular collisions at intersections. (10 $\frac{1}{3}$)
2. (a) Based on your understanding list some underlying factors that are contributing to severe traffic congestion in major cities of developing countries. Also list the economic consequences of traffic congestion. Enumerate some emerging transport challenges and important transport policy objectives that deserve urgent attention in Bangladesh. What is sustainable transport policy? (11 $\frac{1}{3}$)
- (b) State your understanding about the latest lessons learned in dealing with road traffic accidents. Give detailed classifications of accidents both by location and their severity-levels and explain the necessity and concepts of the "accident type" classification system. Explain "clustering" of accidents on the road network and its significance in mitigating road safety problems. (12)
3. (a) State the main functions of traffic control devices with detailed description of their specific purposes and objectives. Also state the reasons that are attributable to the failure of traffic control device to fulfil its function and the requirements of the applicability of traffic control devices. Give sketches for the following signs and markings: (13 $\frac{1}{3}$)
 - (i) advisory speed limit at curves,
 - (ii) merging traffic,
 - (iii) give way at tee intersection and
 - (iv) separation lines and barrier lines.
- (b) Explain the necessity of accident data collection and list the basic parameters and common core data items for accident investigation. Discuss (i) accident exposure and accident spot maps and (ii) principles for designing safer intersections and links (mid-blocks). (10)
4. (a) Explain Transport Demand Management (TDM) concepts and briefly discuss site-specific and area-wide TDM strategies and measures and in which ways Non-Motorised Transport (NMT) modes play a greater role in TDM. (8)

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Contd ... Q. No. 4

(b) Write notes with a special focus on traffic and safety management policy implications on: (i) City road and street function, classification and hierarchy and (ii) Road safety audit and investigation of Hazardous Road Locations (HRL) Programs.

(15 1/3)

SECTION – B

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

5. (a) Explain moving observer method of traffic data collection with relevant equations and variables. Having difficulties with the above method, discuss various schemes, tools and techniques for automated road traffic data collection. How most of these can be interfaced with Intelligent Transport System (ITS) setup?

(4+4+3)

(b) Assuming a linear speed density relationship, the mean free speed is observed to be 60 mph near zero density and the corresponding Jam density is 140 veh/mi. Assume the average length of vehicle as 20 ft.

(i) Determine speed-density and flow-density equations.

(3)

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

(3)

(iii) compute speed and density corresponding to a flow of 1000 vph.

(2)

(iv) Compute the average headway, spacing, clearance and gap when the flow is maximum.

(3)

Also, assuming same jam density and optimum speed, develop a logarithmic speed-density model.

(1 1/3)

6. (a) Explain the parameters, equations and limitations of Davidson's and US Bureau of Public Roads' volume-density function. Draw a typical 4-leg roundabout junction showing all the critical geometric design elements as proposed by Kimber formula.

(6+5)

(b) A simple 4-leg intersection needs a peak and off-peak period fixed-time signal. The critical flows in the N-S and E-W directions are 900 and 750 vph & 600 and 400 vph during peak and off-peak periods respectively. Saturation flow is 1800 vph and the lost time per phase is observed to be 1.2 s. Assuming an amber period of 4s determine cycle length and distribution of green for the two periods. Also, explain the relationship of optimum cycle time and summation of critical flow ratios with diagram showing the criticality of the relation.

(5+5+2 1/3)

7. (a) Discuss various features of line markings as used for traffic control on roads. Explain the cases when drivers need to be served with warning signs on the roads.

(6+5)

(b) With neat sketches show various flow arrangements in the following interchanges.

(12 1/3)

(i) Trumpet; (ii) Diamond; (iii) Partial clover-leaf ; (iv) Full clover-leaf

8. (a) Explain Car following model (CFM) concept leading to generalised CFM with equations and definitions of parameters. Compare between lane based and mixed traffic non-lane based car following situation.

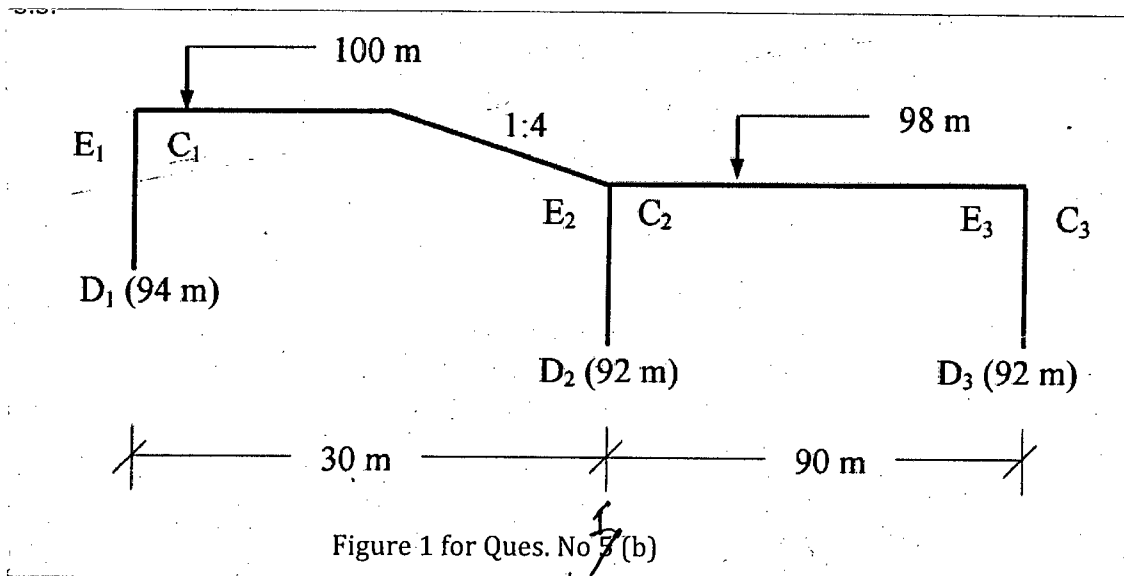
(7+4)

(b) Explain actuated and semi-actuated traffic signal operation with relevant diagrams. Also, explain schematic drawing of traffic signal and communication system in an intelligent signal system setup. Make short notes on SCAT and SCOOT system of traffic signal operation.

(4+4+4 1/3)

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Briefly outline the salient features of Khosla's Theory of seepage below a hydraulic structure. (6 1/3)
- (b) Calculate the percentage uplift pressure at the key points for the intermediate pile line using Khosla's theory for a barrage foundation profile shown in Figure 1 applying necessary corrections. Assume the thickness of the floor is 0.8 m. Also, determine exit gradient considering upstream pond level at 103 m. The correction factor for 1:4 slope is 3.3. (17)

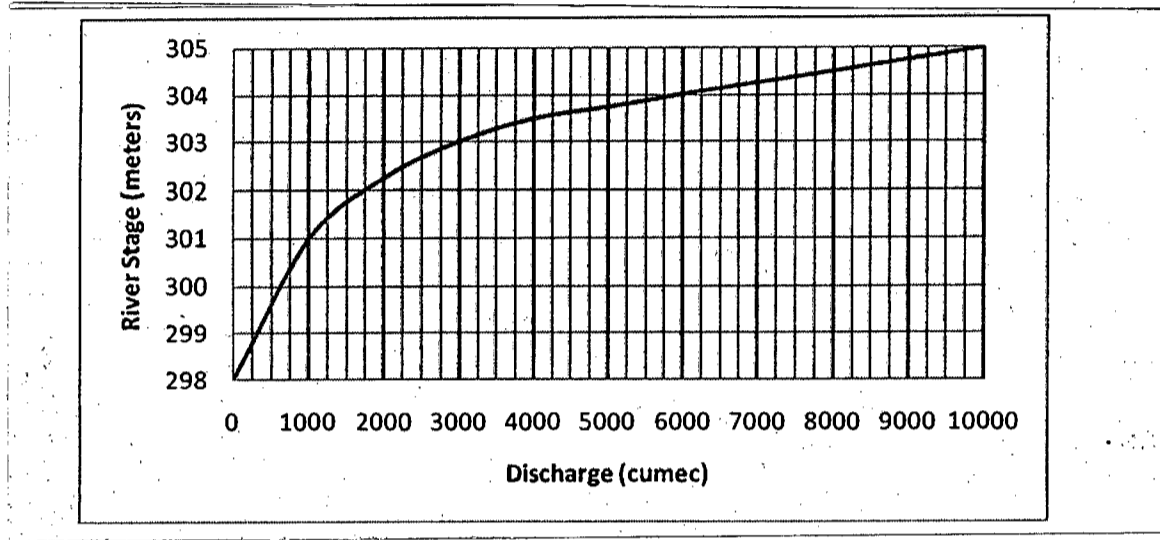


2. (a) Draw a typical layout of "Diversion Head-Work" and indicate various components of the system. Briefly describe the function of each component. (11 1/3)
- (b) Explain the surface flow considerations involved in the design of thickness of the sloping glacis and the downstream floor of a weir for different flow considerations. (12)
3. (a) What is meant by "piping" on foundation of a weir? Explain Bligh's Creep Theory for safe guarding the foundation against the ill effects of piping. (5 1/3)
- (b) A barrage is to be constructed on a river having a high flood discharge of approximately 10,000 cumec. The relevant data are as follows: (18)

WRE 41

Average bed level of river	299.50 m
High flood level (before construction of barrage)	305.00 m
Permissible Afflux	1.00 m
Pond level	303.00 m
Lacey's silt factor	1.0
Safe Exit Gradient for river bed material	1/6
Concentration	20%
Bed retrogression	0.50 m

Stage discharge curve of the river at barrage site is given below:



Fix the crest levels, waterway and undersluice portion for high flood condition considering concentration and retrogression.

4. (a) In what condition of drainage and canal crossing, syphon is provided? Draw a typical plan and cross-section of a canal syphon. (6 1/3)

(b) Design a suitable cross drainage work for the given data at the crossing of a canal and a drainage. (17)

- RL of bed of drainage = 520.00 m
- High Flood Level of drainage = 523.00 m
- High Flood Discharge in drainage = 300 cumec
- RL of ground = 525.00 m
- RL of bed of canal = 524.50 m
- Full Supply Discharge in canal = 30 cumec
- Full Supply level in canal = 526.2 m
- Bed Width of canal = 22.0 m
- Depth of water in canal = 1.70 m
- Trapezoidal Canal Section with 1.5 H: 1V

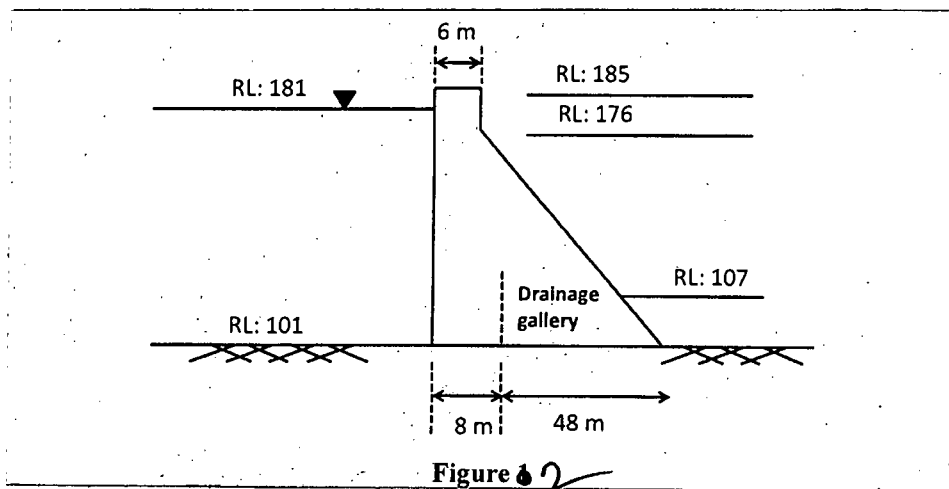
Determine (i) Drainage waterway (ii) Canal Waterway (iii) Head loss and levels at different sections.

WRE 411

SECTION – B

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

5. (a) Briefly discuss the classification of dams based on construction material. (8)
- (b) Write short note on (i) Vertical component of earthquake force on a gravity dam (ii) Structural stability criteria for a gravity dam. (3+4)
- (c) Briefly discuss, with neat sketches, different components of storage zone of a reservoir. (8 1/3)
6. (a) Write short note on (i) Function of retarding basin (ii) Advantages and disadvantages of detention basin. (3+3)
- (b) Design a suitable section for the overflow section of a concrete gravity dam having the d/s face sloping of 0.7 H : 1 V and vertical u/s face. The design discharge for the spillway is 6000 cumec. The height of the spillway above the river bed is 60 m. The effective length of spillway may be taken as 50 m. Also determine the crest length if there are 6 spans. Consider rounded nose piers and rounded abutments for calculation. (11 1/3)
- (c) Briefly discuss the effect of horizontal acceleration on a gravity dam. (6)
7. (a) Differentiate between chute spillway and side channel spillway. Also draw neat sketches of both types of spillways. (5)
- (b) A non-overflow section of a gravity dam made of concrete is shown in Figure 2. Considering the wave forces ($h_w = 0.85$ m) and neglecting the earthquake forces, calculate (i) major principle stress at the toe and (ii) the intensity of shear stress on a horizontal plane near the toe. Assume unit weight of concrete 24 kN/m^3 . (18 1/3)



8. (c) Discuss briefly the various types of energy of energy dissipators that are used for energy dissipation below overflow spillways, under different relative positions of Tail water curve and Jump height curve. (8)
- (b) Write detailed note on different types of spillway gates. (8)
- (c) Derive the equation of principle stress acting at the toe of a reservoir when the reservoir is full. (7 1/3)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations

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 – AThere are **FOUR** questions in this Section. Answer any **THREE**.

Assume reasonable values for parameters not given.

1. (a) What do you understand by “line source” of air pollution? Give two examples.
On a particular day, cars are traveling along an elevated expressway at an average speed of 70 km/hour, and average distance between cars is 10 m. The height of the elevated expressway is 10 m from ground surface. Each car on the expressway is emitting carbon monoxide (CO) at a rate of 4.9 g/km. If the wind speed is 2.4 m/sec perpendicular to the road, estimate ground level CO concentrations at 1.5 km downwind. Consider atmosphere to be “slightly stable”. [Table for calculation of dispersion coefficient provided] (10)
- (b) What do you understand by Short Lived Climate Pollutant (SLCP)? How does soot/black carbon affect regional/global climate? Explain. (5)
- (c) What do you understand by aerodynamic diameter of particulate matter (PM)? Why PMs of anthropogenic origin are considered more harmful compared to PMs of natural origin? Explain. (5 1/3)
- (d) What do you understand by primary and secondary pollutants? Give examples. The measured concentration of a criteria pollutant is 247 $\mu\text{g}/\text{m}^3$. If this corresponds to 0.13 ppm at 20°C and 1 atm pressure, identify the pollutant. (3)
2. (a) A power plant is emitting 120 g/sec of NO_2 from a stack that has an effective height of 60 m. The wind speed is 2.8 m/sec (at 10 m height), and the atmosphere is “slightly unstable”. Estimate: (10)
- (i) Ground-level concentration of NO_2 at 1.2 km downwind along the centerline of the plume; and
- (ii) NO_2 concentration on the top of a 20 m high building located 1.2 km downwind and 0.4 km off the centerline of the plume.
- [Given: $p = 0.20$; Table for calculation of dispersion coefficient provided]
- (b) What do you understand by stoichiometric ratio, lean mixture and rich mixture for a fuel-air mixture? Explain, with an appropriate figure, the effect of air-fuel ratio on automotive emissions of CO, HC and NO_x . How these emissions could be reduced by using “post-engine” control devices? Explain. (9 1/3)

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Contd ... Q. No. 2

(c) What do you understand by stable, unstable and neutral atmosphere? Explain. Determine the nature of atmospheric stability for each of the following situation of ambient atmosphere, and explain your answer. (4)

(i) $dT/dz = 1.5 \Gamma$; (ii) $dT/dz = 0$; (iii) $dT/dz = -1.25 \Gamma$

[Symbols have their usual meanings]

3. (a) On a particular day, ambient atmospheric temperature profile is given by the following equations: (9)

$$\begin{aligned} \Lambda (\text{°C}) &= 30 + 0.05 z \quad ; z \leq 175 \text{ m} \\ &= 38.75 - 0.005 z \quad ; z > 175 \text{ m} \end{aligned}$$

where, z = altitude in m.

Plumes are emitted at a temperature of 40°C from smoke stacks of two brick kilns. The stack height of one kiln is 10 m and that of the other is 100 m. Estimate how high the plumes would rise in each case. Also, calculate ventilation coefficients for these emissions, assuming an average wind speed of 2.5 m/sec, and comment on the effect of stack height on pollution.

Also draw the shapes of plumes emitted from the two stacks, showing maximum height up to which the plumes would rise.

(b) What is AQI? What are the purposes of AQI? Identify the important measures that have been taken in the past for improvement of air quality in Bangladesh. (9)

On a particular day, air quality data recorded at a CAMS in Chittagong are as follows:

$$PM_{2.5} (24\text{-hr}) = 160 \mu\text{g}/\text{m}^3$$

$$PM_{10} (24\text{-hr}) = 310 \mu\text{g}/\text{m}^3$$

$$O_3 (8\text{-hr}) = 30 \mu\text{g}/\text{m}^3$$

$$SO_3 (24\text{-hr}) = 25 \mu\text{g}/\text{m}^3$$

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

[Given: $T = 24^\circ\text{C}$; $P = 1 \text{ atm}$; Table for calculating AQI provided]

(c) What are “halocarbons”? Explain the “direct” and “indirect” radiative forcing of each individual halocarbon. (5 1/3)

4. (a) Identify the devices available for control of particulate contaminants from industrial sources.

Determine the dimensions of a “settling chamber” that could be used to remove all particles with size $\geq 30 \mu\text{m}$ at 100 % efficiency. The length to height ratio of the chamber should be 5, and a flow velocity of 0.32 m/sec should be maintained through the chamber.

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Contd ... Q. No. 4(a)

Also derive the expression for fractional removal efficiency of particles in a settling chamber, and then estimate the removal efficiency of 10 μm particle in the designed settling chamber. [Given: $\mu = 2.1 \times 10^{-5}$ kg/m-sec; and Sp. Gr. of particle is 1.9]. (9)

(b) Describe the NO-NO₂-O₃ photochemical reaction sequence. Explain how hydrocarbon affects the reaction sequence. With appropriate equations show how O₃ production is promoted as a result of these reactions. (7)

(c) What do you understand by thermal NO_x and fuel NO_x. What are the principal adverse impacts of NO_x. (4)

(d) What do you understand by GHGs? Why do we see seasonal oscillations in the recorded atmospheric CO₂ concentration data? Explain. (3 1/3)

SECTION – B

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

5. (a) Define point and non-point sources of water pollution with examples? Which type of pollution is difficult to control and why? What are the main sources of pathogens in water? (6)

(b) What are the applications of BOD in environmental engineering? (3)

(c) A city of 200,000 people deposits 37 ft³/sec of sewage having a BOD₅ of 28 mg/L and 1.8 mg/L of DO into a river that has a flowrate of 250 ft³/sec and flow speed of 1.2 ft/sec. Just upstream of the release point, the river has a BOD₅ of 3.6 mg/L and a DO of 7.6 mg/L. The saturation value of DO is 8.5 mg/L. Deoxygenation coefficient, k_d is 0.61/day and the reaeration coefficient k_r is 0.76/day. Assuming complete and instantaneous mixing of the sewage and river water, find (14 1/3)

- (i) the initial oxygen deficit and ultimate BOD just downstream of the outfall.
- (ii) the time and distance to reach the minimum DO from the release point.
- (iii) the minimum DO.
- (iv) the DO that could be expected 10 miles downstream of the release point.

6. (a) Explain with diagrams the effect of temperature on the DO sag curve and its implications. What are the important sources and sinks of DO in rivers? (6)

(b) What are the sources and effects of thermal pollution? What are the factors that have contributed to the pollution of Buriganga river in Bangladesh? (6)

(c) A lake with a surface area of 8.5×10^7 m² is fed by a stream having an average flow rate of 6.5 m³/s and average total phosphorus concentration of 0.05 mg/l. The lake also receives phosphorus from two other sources: a wastewater treatment plant with a flow rate of 0.25 m³/s and a phosphorus concentration of 6.0 mg/l; and a domestic sewage outfall with a flow rate of 0.1.5 m³/s and phosphorus concentration of 3.5 mg/l. The phosphorus settling rate in the Lake is 11 m per year. (11 1/3)

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Contd ... Q. No. 6(c)

- (i) Estimate average phosphorus concentration in the Lake.
- (ii) If a treatment unit is installed at the wastewater treatment plant to remove 90% phosphorus from the wastewater, what would be the phosphorus concentration in the lake?
7. (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. **(10)**
- (b) Why is phosphorus typically the limiting nutrient in a lake environment? Suppose there are 0.1 mg of N and 0.04 mg of P available for algal production per liter of water. Assuming adequate amounts of other nutrients, which is the limiting nutrient? **(5)**
- (c) A municipal wastewater treatment plant discharges $1.10 \text{ m}^3/\text{s}$ of treated effluent having an ultimate BOD of 50.0 mg/L into a stream that has a flow of $8.70 \text{ m}^3/\text{s}$ and an ultimate BOD of 6.0 mg/L. The deoxygenation constant k_d is 0.20/day. **(8 $\frac{1}{3}$)**
- (i) Assuming complete and instantaneous mixing, estimate the ultimate BOD of the river just downstream of the outfall.
- (ii) If the stream has constant cross section so that it flows at a fixed speed equal to 0.30 m/s, estimate the BOD of the stream at a distance 30,000 m downstream of the outfall.
8. (a) Write short notes on: **(12)**
- (i) Cultural Eutrophication
- (ii) Bio-accumulation and Bio-magnification
- (iii) Nitrification and NBOD
- (iv) Hydrodynamic control of groundwater plume.
- (b) Consider a confined aquifer having thickness 30 m, hydraulic conductivity $2 \times 10^{-3} \text{ m/s}$, and a regional hydraulic gradient equal to 0.001. The aquifer has been contaminated and the plume can be considered rectangular with a width of 90 m. **(11 $\frac{1}{3}$)**
- (i) If the maximum pumping rate of an extraction well is $0.006 \text{ m}^3/\text{s}$ in this aquifer, determine the width of the capture zone at the location of the extraction well and at an infinite distance upgradient.
- (ii) How far from the plume should the extraction well be located so that it can totally remove the plume?
- (iii) If two optimally located wells are aligned along the leading edge of the plume, what minimum pumping rate should be maintained to assure complete plume capture? How far apart should the wells be?
-

Table for estimation of dispersion coefficients [for Questions 1(a) and 2(a)]

Stability	$x \leq 1 \text{ km}$				$x \geq 1 \text{ km}$		
	a	c	d	f	c	d	f
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

^a The computed values of σ will be in meters when x is given in kilometers.

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

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

Table for calculation of AQI [for Question No. 3(b)]

Breakpoints							AQI
O ₃ (ppm) 8-hr	O ₃ (ppm) 1-hr (i)	PM _{2.5} (µg/m ³) 24-hr	PM ₁₀ (µg/m ³) 24-hr	CO (ppm) 8-hr	SO ₂ (ppm) 24-hr	NO ₂ (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) NO₂ has no short-term air quality standard and can generate an AQI only above 200
- (iii) 8-hr O₃ values do not define higher AQI values (≥301). AQI values of 301 or higher are calculated with 1-hr O₃ concentrations

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

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

Full Marks : 140

Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

Assume reasonable values for missing data, if any.

1. (a) State the advantages of steel-concrete composite floor system over conventional RCC floor system? (5 1/2)
 - (b) Two typical bays of a composite floor system are illustrated in Figure 1.
 - (i) Calculate the effective slab width for the secondary beam SB2 and the main beam MB2. (3)
 - (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. (3)
 - (iii) Check whether the composite deck detailing shown in Figure 2, satisfies the requirements stipulated in AISC specifications. (6)
 2. (a) The secondary beam SB2 as shown in Figure 1 is simply supported with a span length of 36'. It is constructed using standard W 21 × 50 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 Figure 1. (14)
 - (b) Show the flexural stress distribution across the depth of the beam for precomposite and composite stages of construction. (3 1/2)
 3. (a) Why shear connectors are required in composite construction? Name three different types of shear connectors with sketches. (5 1/2)
 - (b) Calculate the vertical deflection of the secondary beam SB2 (as shown in Figure 1) at the precomposite and composite stages of construction. (12)
- Check these deflections with the code specified limits for vertical deflections. Assume, 50% composite action achieved through shear connectors.
- All sectional properties and loading data are provided in Figure 1.

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4. (a) Why stages of construction is very important for composite construction? (3 1/2)
- (b) Find the yield moment capacity of the composite beam section SB2 (Figure 1) in positive bending. Compare the yield capacity of the composite section with the yield capacity of the steel section only and provide your comments. (14)
5. (a) List two methods of reduce the vertical deflection of the composite beam at the precomposite stage without increasing the stiffness of the beam. (3 1/2)
- (b) (i) Find the ultimate moment capacity of the main beam MB2 (Figure 1). Assume, full composite action between deck slab and steel I beam. All properties and loading data are given in Figure 1. (8)
- (ii) Check whether the main beam MB2 is adequate to withstand the given loads. Use AISC-LRFD method. Assume, simply supported condition for MB2. (6)

SECTION – B

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

Assume reasonable values for missing data, if any.

6. (a) Discuss with neat sketches the different types of steel-concrete composite columns. (2 1/2)
- (b) A fully encased composite (FEC) column section is shown in Fig. 3. Check whether the provided section satisfies the code specified limits for (5)
- (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 $E_c = 3600$ ksi.
- (c) Check the adequacy of the section provided in Fig 3. to resist the given compressive load. Use the data provided in 6(b) as required. (10)
7. (a) Briefly discuss the advantages and disadvantages of FEC column sections. (4 1/2)
- (b) Determine the axial capacity of the given partially encased column (PEC column) with non-compact steel section in Fig. 4. Also check the given section with the code specified limits for material and geometric properties. (13)
- Given: $f_y = 350$ MPa, $f'_c = 30$ MPa, $E_s = 200$ GPa and $E_c = 24$ MPa.

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8. (a) State the advantages and disadvantages of CFT sections over other composite column sections. (4 1/2)

(b) For the CFT column section shown in Fig. 5, 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. (13)

Given: $f_y = 36$ ksi, $f'_c = 4$ ksi, $E_s = 29,000$ ksi and $E_c = 3600$ ksi and wall thickness = 0.5".

9. (a) State the assumptions of plastic stress distribution method for predicting the capacity of composite columns. (4 1/2)

(b) How much live load thrust (service load condition) can be supported by an A36 steel tube with 0.50 inch wall thickness and 10 inch outside diameter, if the effective length of the column is 15 ft and dead load thrust is 125 kip? Moments are negligible. (13)

Use the material properties in question 8(b).

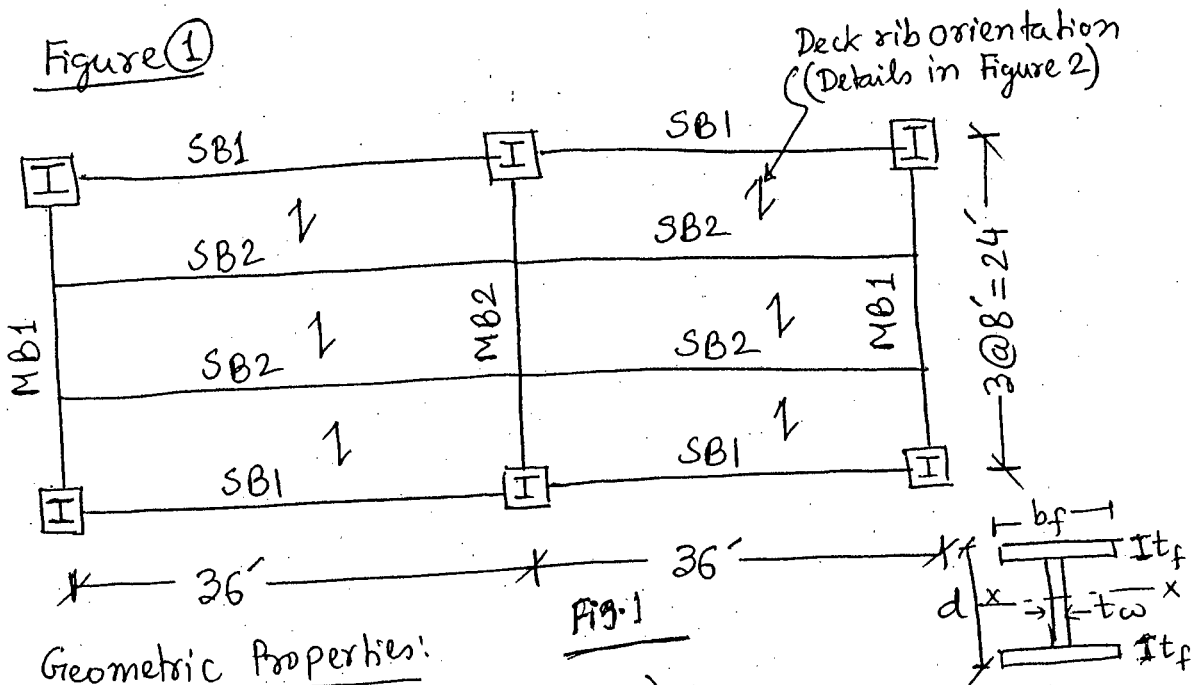
10. (a) Draw the idealized P-M diagram in plastic stress distribution method for FEC column section shown in Fig. 6 about its weak axis. (2 1/2)

(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. (10)

Given: $F_y = F_{yr} = 50$ ksi, $f'_c = 4$ ksi, $E_s = 29,000$ ksi and $E_c = 3600$ ksi. Effective length of the column = 12'.

Figure (1)



Geometric Properties:

Secondary Beam SB2 (W 21 x 50)

$$A_s = 14.7 \text{ in}^2, \quad b_f = 6.53", \quad t_f = 0.535"$$

$$I_{sx} = 984 \text{ in}^4, \quad d = 20.8", \quad t_w = 0.380"$$

Main Beam MB2 (W 24 x 76)

$$A_s = 22.4 \text{ in}^2, \quad b_f = 8.99", \quad t_f = 0.680"$$

$$I_{sx} = 2100 \text{ in}^4, \quad d = 23.9", \quad t_w = 0.440"$$

Material Properties:

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

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

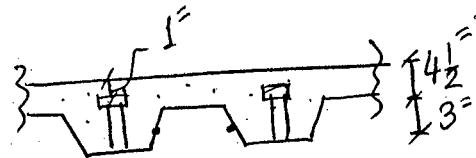


Figure (2) (Deck Details)

Loading Data:

Dead Loads:

- PreComposite: Slab & deck = 85 psf
- Self wt. → Beam = 5 psf.
- Composite: Partition wall = 40 psf.
- Floor finish = 30 psf.
- Miscellaneous = 10 psf.

Live Loads:

PreComposite: Construction = 25 psf.
LL.

Composite: Service LL = 100 psf.

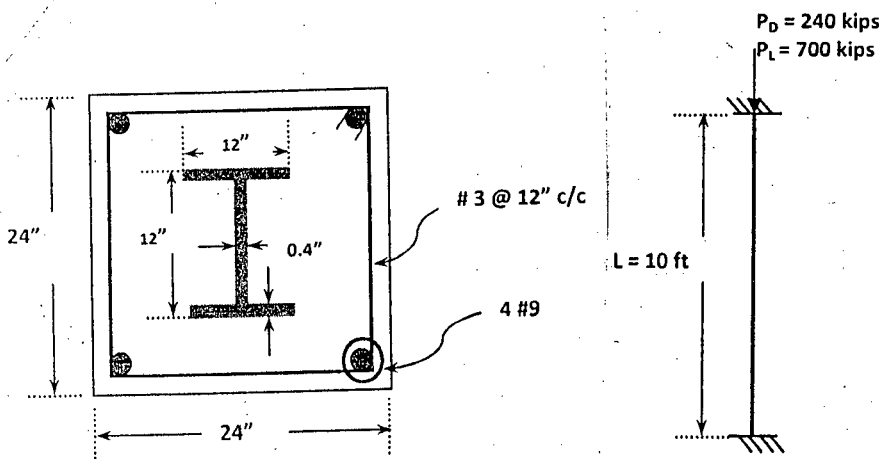


Figure 3 for Question 6(b) & 6(c)

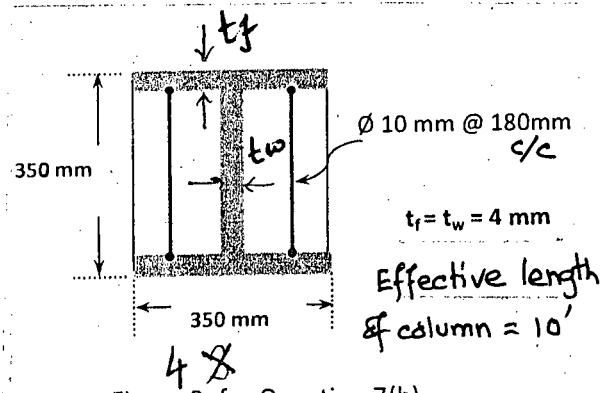
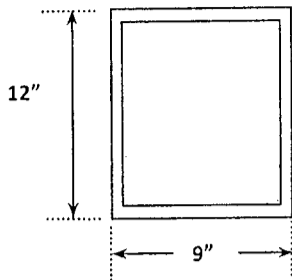


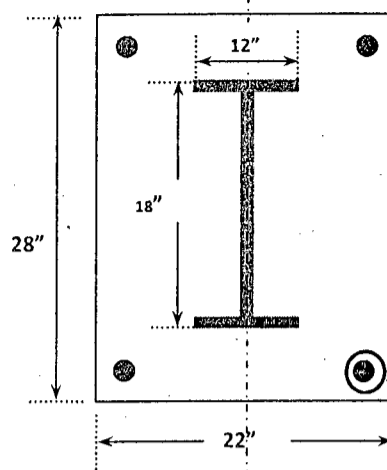
Figure 2 for Question 7(b)

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= 5 =



5X
Figure 3: for Question 8(b)



$t_f = t_w = 0.3"$

4 #9

C_1 of weak axis

6X
Figure 4: for Question 10

= ANNEXURE 1 =

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	λ_p Compact/ Noncompact	λ_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

λ , λ_p and λ_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

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

= ANNEXURE 2 =

where

(i) For rectangular filled sections

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

(ii) For round filled sections

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

$$EI_{eff} = E_s I_s + E_s I_{sr} + C_1 E_c I_c$$

$$C_1 = 0.6 + 2 \left(\frac{A_s}{A_c + A_s} \right) \leq 0.9$$

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

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

For FEC Columns:

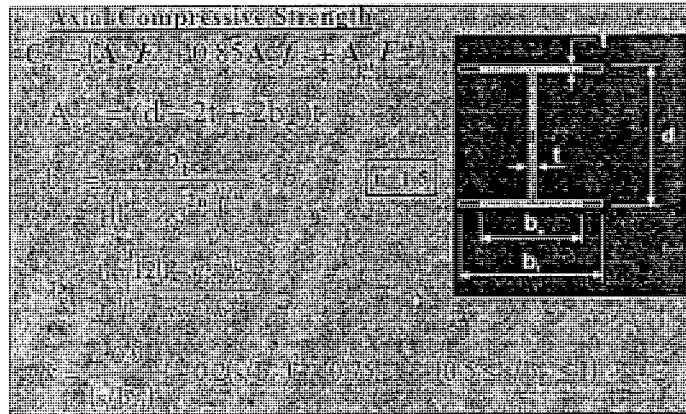
Nominal compressive strength: $P_o = A_s F_y + A_{sr} F_{yr} + 0.85 A_c f'_c$

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

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

Nominal Tensile Strength: $P_o = A_s F_y + A_{sr} F_{yr}$

For PEC Column with non-compact section :



SECTION – A

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

Assume reasonable missing value/values.

1. (a) List examples of structures for which the foundations are to be designed with considerations of lateral loads. (5 ⅓)
 - (b) Determine the factor of safety against bearing capacity failure for the retaining wall shown in Fig. 1. Calculated loads on the base per meter of wall are: Vertical-450 kN, Horizontal-250 kN. Use Hansen's method. (10)
- $$N_c = (N_q - 1) \cot \phi; \quad N_q = e^{x \tan \phi} \tan^2 \left(45 + \frac{\phi}{2} \right); \quad N_\gamma = 1.5 (N_q - 1) \tan \phi$$
- (Table containing Hansen's bearing capacity factors is provided).
- (c) A concrete caisson foundation is to be constructed for a bridge pier (Fig. 2). Analyze to determine the wall thickness for the caisson to be self sinking. (8)
2. (a) Mention the advantages and disadvantages of different types of caissons. (8)
 - (b) State situations for which analysis for deep stability of a retaining wall is required. Also briefly state the procedure for such analysis. (5 ⅓)
 - (c) A braced excavation, 18 m × 21 m in plan and 10 m in depth, is planned to be made in a soft to medium stiff clay ($q_u = 60$ kPa) for construction of a basement. It is considered that the bracing system will consist of steel sheet piles along with I-sections as wales and struts. The struts will be placed at three levels from the ground surface (at 2m, 5m and 8m depths) and will be horizontally 3m apart from each other. Analyze and comment on the possibility for failure by bottom heaving. (10)
3. (a) Discuss, with sketches, different types of braced cofferdams considering the arrangement of components. (8 ⅓)
 - (b) Analyze the retaining wall shown in Fig. 3 and comment on its stability against failure by sliding. (10)
 - (c) Discuss the considerations for selecting soil parameters in the design of braced excavation in stiff fissured clays. (5)

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4. (a) Discuss the different types of loads that are to be considered in the design of caissons. (6)
(b) Discuss factors that govern the magnitude of lateral earth pressure on a rigid retaining wall. (8)
(c) A long trench, 7 m deep and 5 m wide, is to be made in sand for construction of a tunnel segment. If struts are placed as shown in Fig. 4, determine the force on strut B. Consider 2 m center to center spacing of the struts in plan. (9 1/3)

SECTION – B

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

5. (a) What are the benefits of construction dewatering? What techniques are available? Point out how soil permeability affects the selection of method. (9)
(b) Discuss the desirable properties and role of slurry in slurry trench wall construction. Comment on the loss of slurry during construction. (9)
(c) Show pressure diagrams for designing braced excavations in sand and clay. (5 1/3)
6. (a) Briefly compare the different methods available for the analysis of laterally loaded piles. Comment on the suitability of these methods. (8 1/3)
(b) List advantages of steel sheet piles. Comment on the use of different sections of such piles. (9)
(c) Write short notes on: (3×2=6)
(i) Use of factor of safety in sheet pile design
(ii) Effect of wall movement on lateral earth pressure.
7. (a) Determine the required length of cantilever sheet pile in cohesive soil (Fig. 5) retaining cohesive backfill. Consider short term loading. (15)

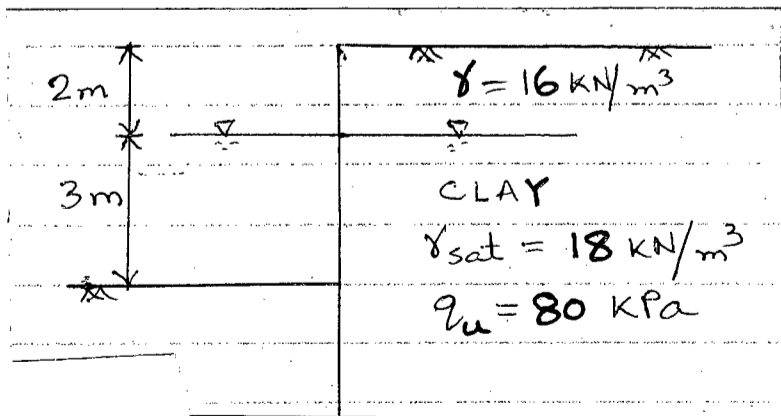


Fig. 5

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Contd ... Q. No. ~~3(c)~~ ⁷

(b) Using Broms' method, determine the factor of safety against bearing failure for a 24 inch dia 30 ft. long free standing pile subjected to a horizontal load of 10 kips, 2 ft. above ground level. Also determine the horizontal deflection of the pile. Consider the ground water table to be at G.L. Soil properties are : Unit weight = 112 pcf, Angle of internal friction = 30° , $n_h = 12 \text{ ton/ft}^3$. Pile properties are : Yield Moment = 300 kip-ft, $E = 3.2 \times 10^6 \text{ psi}$.

(8 1/3)

8. (a) Determine the required length of anchored sheet pile shown in Fig. 6, embedded in sandy soil. Determine the force in tie-rod. Note that the back fill supports a surcharge load of 15 kPa to a large distance.

(18)

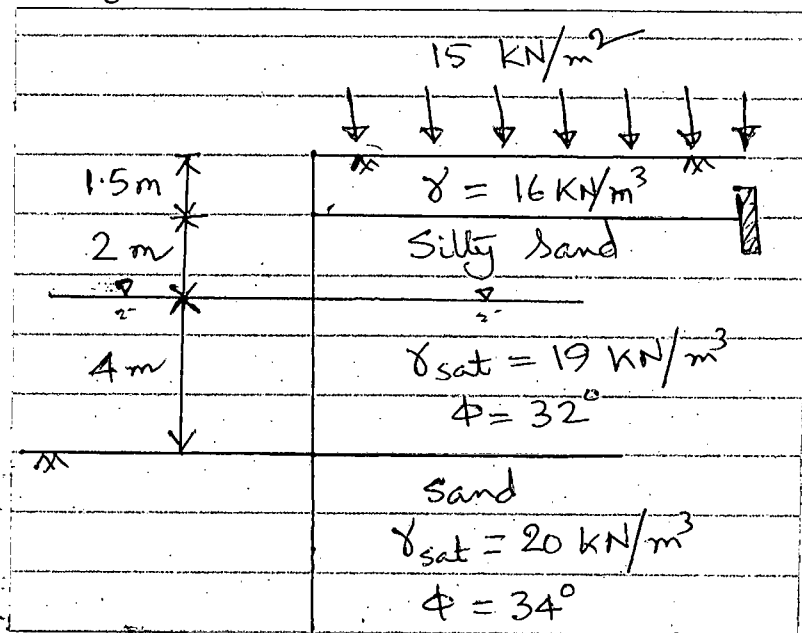
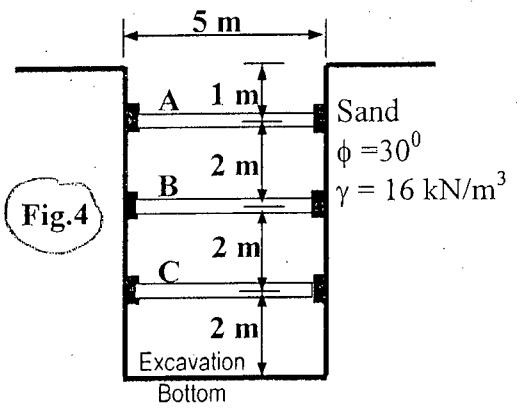
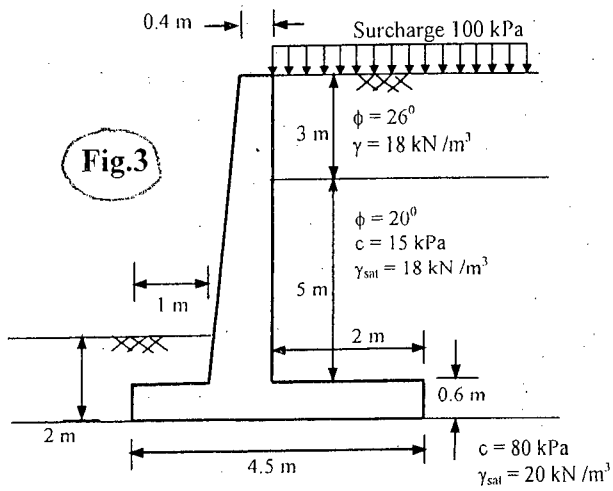
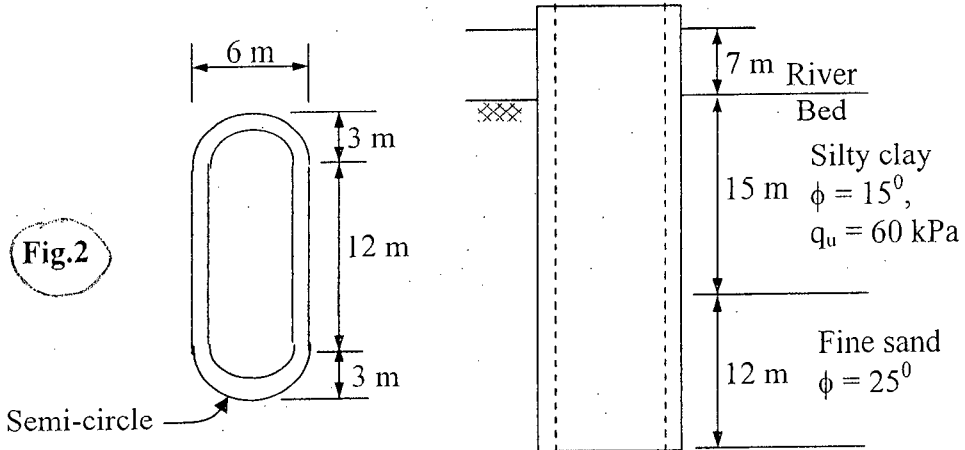
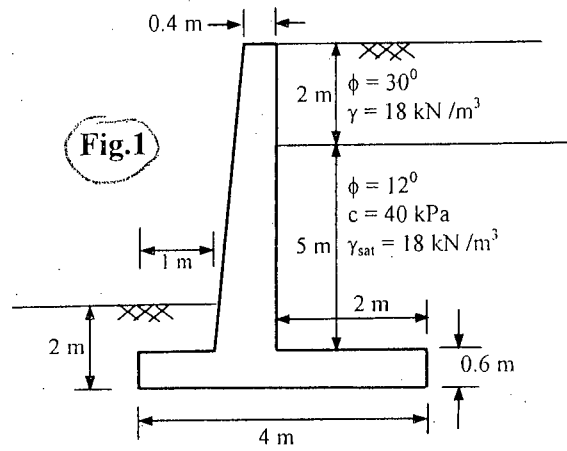


Fig. 6

(b) If the water table in front of the wall (Fig. 6) drops by 2 m, while that in the backfill material remains unchanged, what will be the effect on the problem? Elaborate the procedure how you will consider this in your analysis.

(5 1/3)



Shape, depth, inclination, ground and base factors for use in either the Hansen (1970) or Vesic (1973) bearing-capacity equations.
Factors apply to either method unless subscripted with (H) or (V). Use primed factors when $\phi = 0$

Shape factors	Depth factors	Inclination factors	Ground factors (base on slope)
$s'_c = 0.2 \cdot \frac{B}{L}$ $s_c = 1 + \frac{N_q}{N_c} \cdot \frac{B}{L}$ $s_c = 1$ for strip	$d'_c = 0.4k$ $d_c = 1 + 0.4k$	$i'_{c(H)} = 0.5 - 0.5 \sqrt{1 - \frac{H}{A_f c_a}}$ $i'_{c(V)} = 1 - \frac{mH}{A_f c_a N_c}$ $i_c = i_q - \frac{1 - i_q}{N_q - 1}$ (Hansen and Vesic)	$g'_c = \frac{\beta^\circ}{147^\circ}$ for Vesic use $N_y = -2 \sin \beta$ for $\phi = 0$ $g_c = 1 - \frac{\beta^\circ}{147^\circ}$
$s_q = 1 + \frac{B}{L} \tan \phi$	$d_q = 1 + 2 \tan \phi (1 - \sin \phi) k$	$i_{q(H)} = \left(1 - \frac{0.5H}{V + A_f c_a \cot \phi}\right)^5$ $i_{q(V)} = \left(1 - \frac{H}{V + A_f c_a \cot \phi}\right)^m$	$g_{q(H)} = g_{y(H)} = (1 - 0.5 \tan \beta)^5$ $g_{q(V)} = g_{y(V)} = (1 - \tan \beta)^2$
$s_y = 1 - 0.4 \cdot \frac{B}{L}$	$d_y = 1.00$ for all ϕ $k = \frac{D}{B}$ for $\frac{D}{B} \leq 1$ $k = \tan^{-1} \frac{D}{B}$ for $\frac{D}{B} > 1$ (rad)		Base factors (tilted base) $b'_c = \frac{\eta^\circ}{147^\circ}$ $b_c = 1 - \frac{\eta^\circ}{147^\circ}$
Where A_f = effective footing area $B' \times L'$ (see Fig. 4-4) c_a = adhesion to base = cohesion or a reduced value D = depth of footing in ground (used with B and not B') e_y, e_x = eccentricity of load with respect to center of footing area H = horizontal component of footing load with $H \leq V \tan \delta + c_a A_f$ V = total vertical load on footing β = slope of ground away from base with downward = (+) δ = friction angle between base and soil—usually $\delta = \phi$ for concrete on soil η = tilt angle of base from horizontal with (+) upward as usual case		$i_{y(H)} = \left(1 - \frac{0.7H}{V + A_f c_a \cot \phi}\right)^5 \quad (\eta = 0)$ $i_{y(H)} = \left(1 - \frac{(0.7 - \eta^\circ/450)H}{V + A_f c_a \cot \phi}\right)^5 \quad (\eta > 0)$ $i_{y(V)} = \left(1 - \frac{H}{V + A_f c_a \cot \phi}\right)^{m+1}$	$b_{q(H)} = \exp(-2\eta \tan \phi)$ $b_{y(H)} = \exp(-2.7\eta \tan \phi)$ $b_{q(V)} = b_{y(V)} = (1 - \eta \tan \phi)^2$ Notes: $\beta + \eta \leq 90^\circ$ $\beta \leq \phi$
General: 1. Do not use s_i in combination with i_i . 2. Can use s_i in combination with $d_i, g_i,$ and b_i . 3. For $L/B \leq 2$ use ϕ_{ir} For $L/B > 2$ use $\phi_{ps} = 1.5\phi_{ir} - 17$ For $\phi \leq 34^\circ$ use $\phi_{ps} = \phi_{ir}$		$m = m_B = \frac{2 + B/L}{1 + B/L}$ H parallel to B $m = m_L = \frac{2 + L/B}{1 + L/B}$ H parallel to L	
		Note: $i_q, i_y > 0$	

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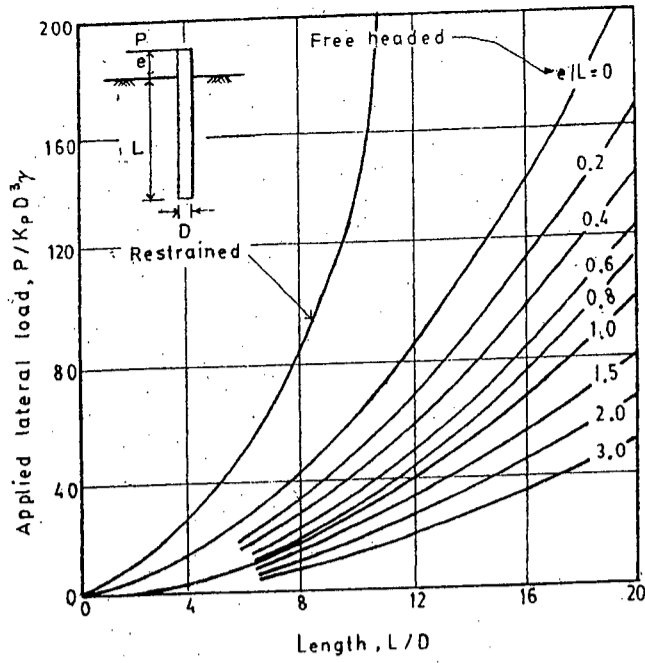


Chart 1

Ultimate lateral resistance for cohesionless soils related to embedment length. After Bengt B. Brams

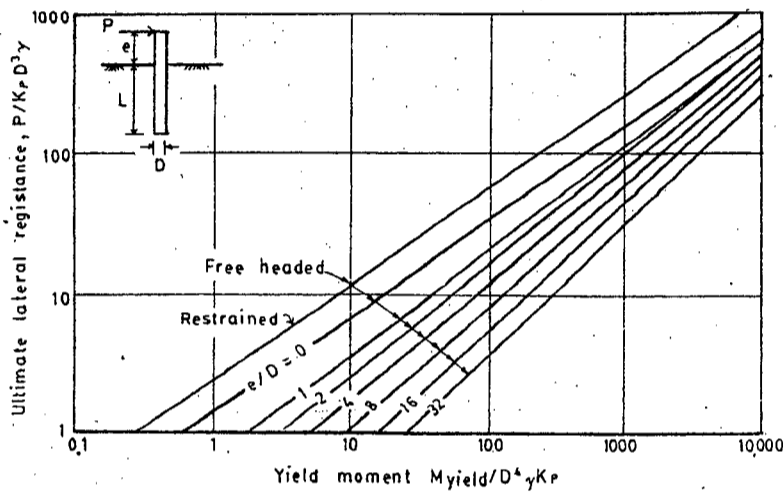


Chart 2

Ultimate lateral resistance for cohesionless soils related to yield moment. After Bengt B. Brams

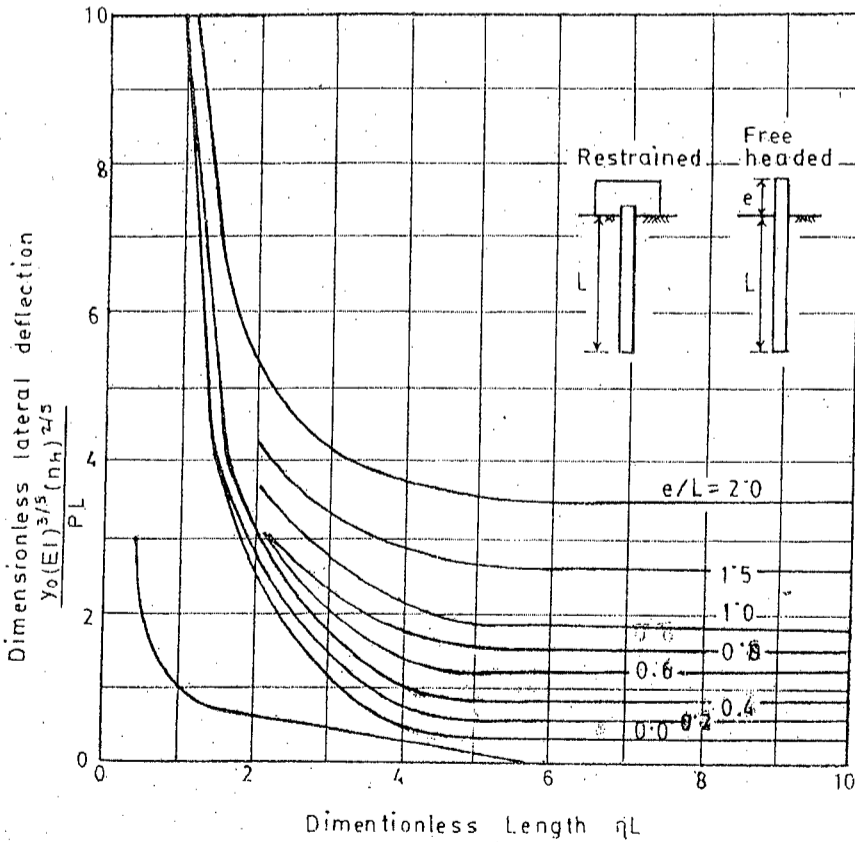


Fig. 6 Lateral deflections at ground surface for cohesionless soils. After Bengt B. Brams

$$\eta = \sqrt[5]{\frac{n_h}{EI}}$$

= 6 =

The figures in the margin indicate full marks.

Assume reasonable value for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. Design a symmetrical I-shape section with $h = 1000$ mm for a simply supported beam (Fig. 1) carrying the following service loads: (a) Self weight, w_g , Super imposed Dead load, $w_D = 12$ kN/m and Live Load, $w_L = 5$ kN/m. Assume normal weight concrete with $f'_c = 42$ MPa, $f'_{ci} = 32$ MPa, and 12.7 mm diameter 1860 MPa Grade strands; $A_{ps} = 100$ mm²/strand, $f_{pu} = 1860$ MPa and transfer stress of $0.7 f_{pu}$. Loss = 20%. Use two stage prestressing if a lighter section results and consider no tension to be allowed in concrete. Second stage post-tensioned strands to be grouted for perfect bond. (23 $\frac{1}{3}$)

2. (a) What are the different sources of prestress loss? Discuss briefly with an estimate of possible losses due to each source for pretensioned and post-tensioned prestressed concrete. (10 $\frac{1}{3}$)
 (b) A simple beam with cable layout is shown in Fig. 2. Compute the percentage loss of prestress due to friction at midspan if it is tensioned from both ends. (13)
 Solve using (i) simple approximate method and
 (ii) segment wise exact friction formula.
 Given : $K = 0.0033$ per metre, friction co-efficient, $\mu = 0.36$.

3. A prestress concrete beam of Fig. 3 is post-tensioned with 1800 mm² of high tensile steel to an initial prestress of 1060 MPa at transfer. Compute the initial deflection at midspan. Assume $E_{ci} = 27 \times 10^3$ MPa and $\gamma_{conc.} = 24$ kN/m³.
 Also, estimate the deflection at midspan after 3 months when superimposed uniform dead load of 3 kN/m and a centre point concentrated load of 50 kN acts.
 Given: $C_c = 2.1$ and $E_c = 32 \times 10^3$ MPa at that stage. (23 $\frac{1}{3}$)

4. (a) What is partial prestressing? How (different measures) this can be achieved? (8 $\frac{1}{3}$)
 (b) The midsection of a composite beam is shown in Fig. 4. It is post-tensioned with a initial prestress of 2900 kN which reduces by 14% to reach the effective prestress. After erection of the precast box section, the 150 mm thick slab is cast in place. Compute the stresses in the precast and composite section (as appropriate) at various stages of loading. Also, find the span, L of the beam. Given Moments: (15)

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Contd ... Q. No. 4(b)

- (i) Due to weight of precast section = 400 kN-m
- (ii) Due to top slab = 180 kN-m
- (iii) Due to Live Load (W_L) = 650 kN-m

SECTION – B

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

5. (a) Describe briefly the different concepts which may be applied to explain and analyze the basic behavior of prestressed concrete. (10)

(b) Compute the value of the concentrated load “P” that the cantilever beam of Fig. 5 can carry (i) without producing tension at section 1-1 and (ii) Producing first crack at the support section at a modulus of rupture of 4.0 MPa, and assuming concrete to take tension upto that value. (13 1/3)

6. (a) Describe briefly the different stages of loadings to which a prestressed concrete member is often subjected. (7)

(b) Write short note on transverse tension at End Block of a prestressed concrete beam. (5)

(c) Determine the Ultimate moment capacity of the section (Fig. 6) of a prestressed and reinforced concrete combination system. Use $f'_c = 40$ MPa, $E_p = 2 \times 10^5$ MPa, $E_c = 3 \times 10^4$ MPa, $f_{pu} = 1860$ MPa, $f_y = 415$ MPa, $\epsilon_{cu} = 0.003$ and effective prestress $f_{se} = 1100$ MPa. Follow any method for your Calculation. (11 1/3)

7. (a) Explain the importance of prestress transfer bond in a prestressed concrete member. Also, 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 consists of 14-12.7 mm dia. 7-wire strands anchored at the end of a beam as shown in Fig. 7. At the time of post tensioning assume that $f'_{ci} = 35$ MPa and at service load after all losses $f'_c = 45$ MPa. The tendon force for design is 2100 kN due to maximum jacking force and 1500 kN at service load. Allowable bearing stress on concrete as per Post-Tensioning Institute (PTI) are: (13 1/3)

At service load : $f_{cp} = 0.6 f'_c \sqrt{A'_b / A_b} \nlessgtr f'_c$

At transfer load : $f_{cp} = 0.8 f'_{ci} \sqrt{\frac{A'_b}{A_b} - 0.2} \nlessgtr 1.25 f'_{ci}$

The symbols carry the usual meaning.

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8. (a) Describe the procedure for the evaluation of web shear cracking stress (v_{ew}) and inclined flexural cracking stress (v_{ei}) for a prestressed concrete beam subjected to uniformly distributed load (UDL). (10)

(b) Check shear strength for the beam shown in Fig. 8 at section 1-1 and 2-2 respectively. Given that this section is adequate for $w_u = 60 \text{ kN/m}$ on the basis of its flexural strength. Given: Effective prestress = 1100 MPa, Initial prestress = 1400 MPa, $f'_c = 40 \text{ MPa}$ and USD method of design. (13 1/3)

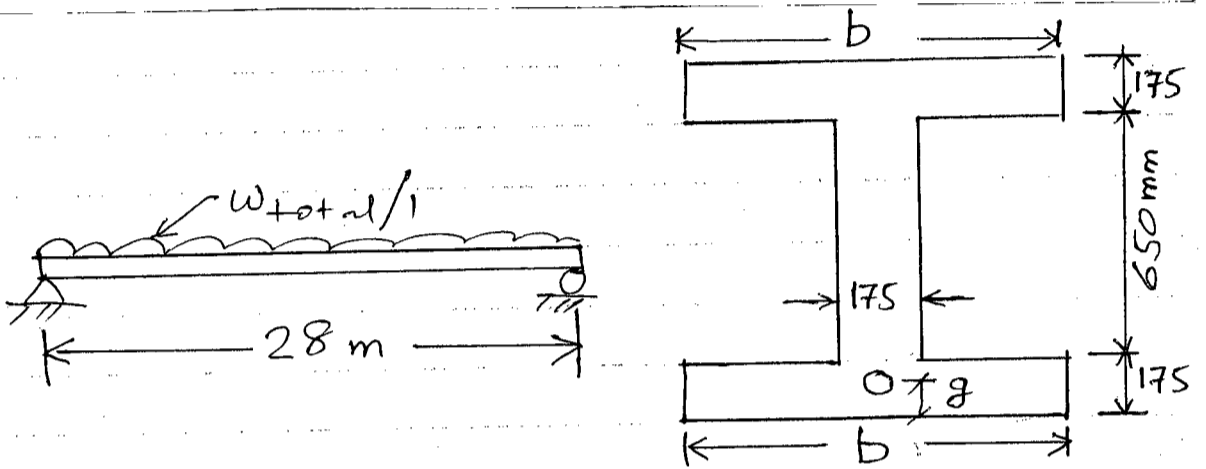


Fig. 1

X-section.

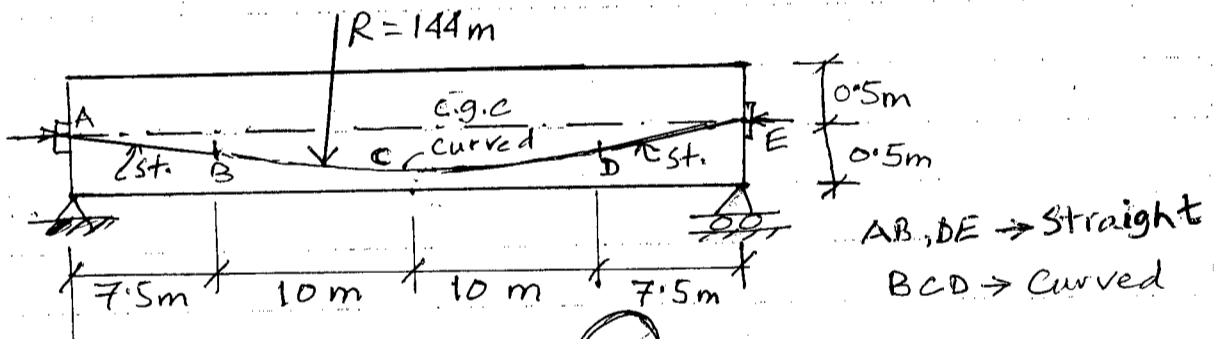


Fig. 2

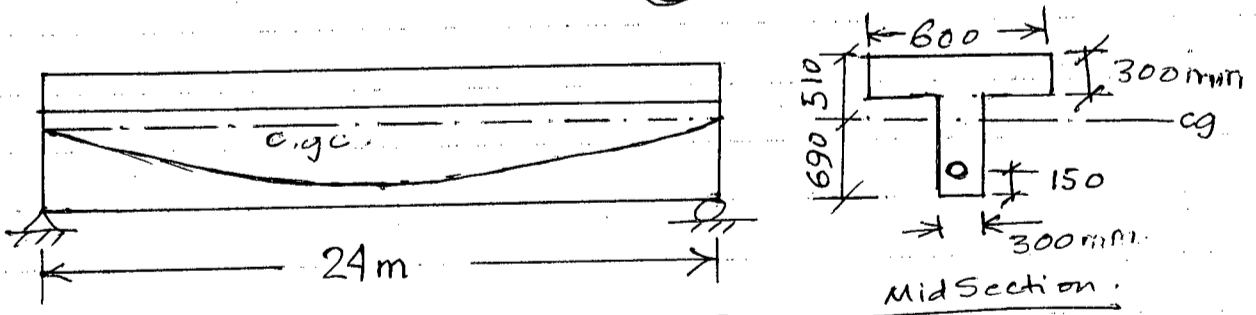


Fig. 3

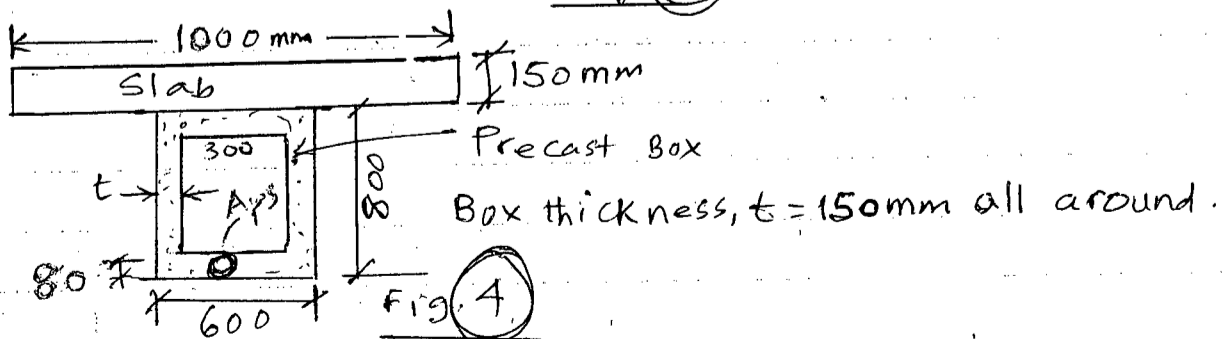


Fig. 4

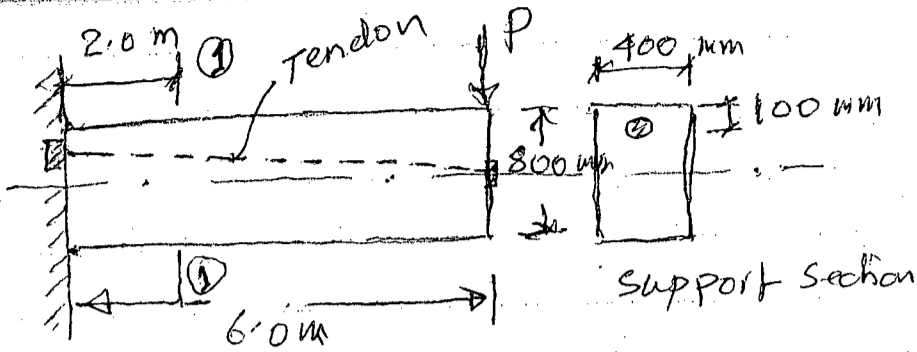


Fig. # 5

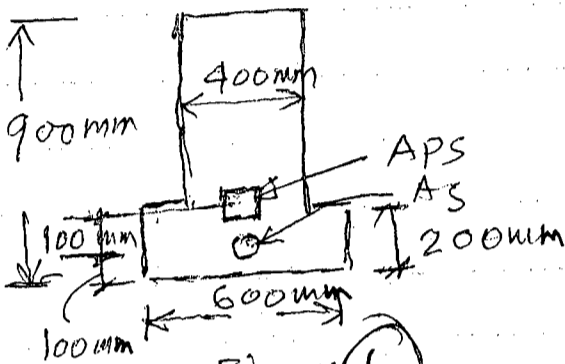


Fig. # 6

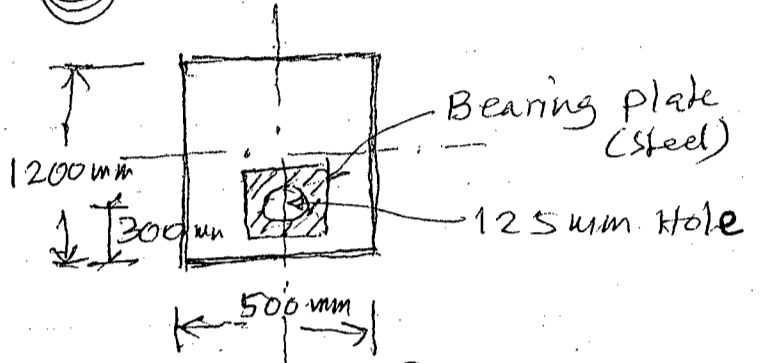


Fig. # 7

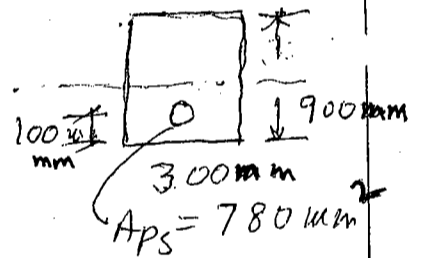
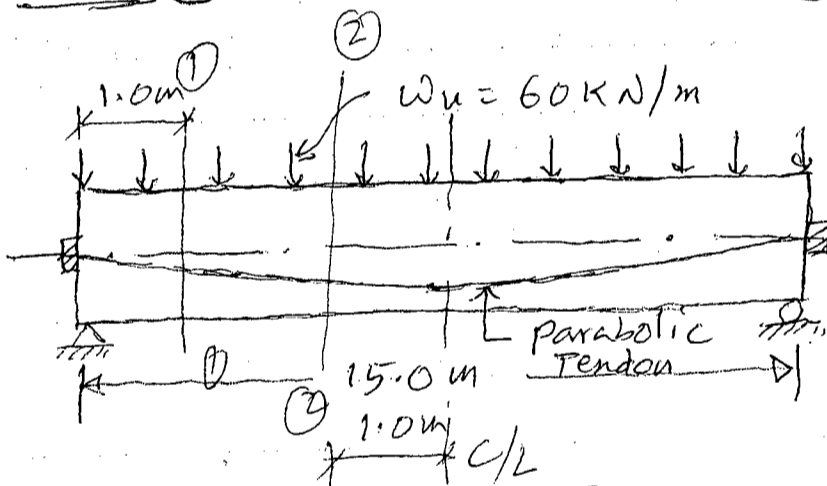


Fig. # 8

USE SEPARATE SCRIPTS FOR EACH SECTION**SECTION – A**

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

Use attached Table and Chart where necessary.

1. (a) Derive Laplace's equation in two dimensions. Also show that both the potential function and stream function satisfy Laplace's equation. (8)
- (b) With neat plots define permeability parameters (n and C) and permeability change index (C_k). (5)
- (c) Mention the assumptions for determining permeability of soils by pumping test. With neat diagrams briefly describe the variable head borehole permeability tests for the following cases. (10 1/3)
 - (i) Cased hole with soil flush with bottom of hole
 - (ii) Cased hole with column of soil inside the casing to certain height
 - (iii) Cased hole with uncased or perforated extension to certain length.
2. (a) Derive Kozeny-Carman equation for coefficient of permeability of soil. (7 1/3)
- (b) A test well, 0.5 m in diameter, has been drilled through an aquifer of 8 m thick up to the underlying impermeable stratum. The original water table is at the ground surface. At the steady state, the discharge from the well is $5 \times 10^{-2} \text{ m}^3/\text{sec}$ at a drawdown of 3 m. Determine the coefficient of permeability of soil in place if the observed radius of influence is 125 m. (4)
- (c) What are the basic requirements to be fulfilled for construction of flow net in an earth dam? Also mention the boundary conditions for drawing flow net in an earth dam. (6)
- (d) Show with a neat figure the various components of a revetment on river bank. Also list the different types and groups of revetment. (6)
3. (a) A homogeneous earth embankment of height 10 m was built on an impervious foundation with side slopes 0.25 : 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 using A. Casagrande's method. (Use plain graph paper for plotting) (9 1/3)

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Contd ... Q. No. 3

- (b) A homogeneous earth embankment of height 12 m was built on an impervious foundation with side slopes 3 : 1 (horizontal : vertical). The embankment retains water to a height of 10 m. The crest width of the embankment is 3 m. The coefficient of permeability of embankment soil is 4×10^{-5} m/sec. Calculate the rate of seepage through the embankment using Schaffernak and Van Iterson's method. (4)
- (c) With neat sketch briefly describe the procedure of determining coefficient of permeability in the laboratory by horizontal capillarity test. (6)
- (d) What general criteria should be considered during design of a revetment structure? (4)
4. (a) Briefly describe a direct method of determining soil suction. (4 1/3)
- (b) 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. (8)
- (c) The following data have been obtained for the design of bank revetment using CC blocks for a site on Meghna river. (11)
- Average flow velocity = 3 m/sec
Specific gravity of CC block = 2.4
Mass density of CC block = 2400 kg/m³
Angle of repose of CC block = 40°
Ratio of water depth and revetment size = 5
Slope of bank = 2 : 1 (horizontal : vertical)
Shield's constant = 0.035
Strength coefficient = 5
Damage coefficient = 7
Wind speed = 30 m/sec
Wind duration = 0.75 hour
Fetch length = 5 km
- Characteristics of waves are shown in Table 1. Determine the thickness of CC blocks capable of withstanding the actions of currents and waves.

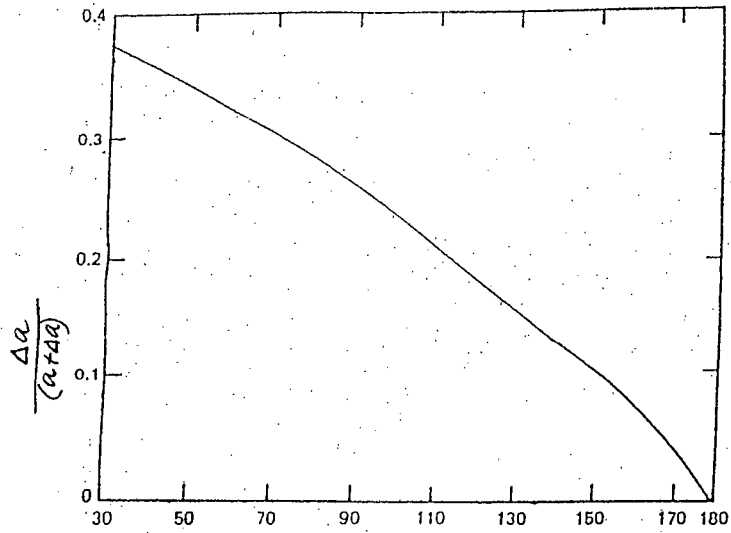
SECTION – B

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

5. (a) Discuss the influence of water on the design of different geotechnical problems. (6 1/3)
- (b) State the desirable characteristics of drain and filter. (5)
- (c) Discuss the initial states and properties of a hydraulic fill made with- (12)
- (i) clean sand (ii) silty or clayey sand (iii) soft cohesive soil

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6. (a) Distinguish between 'grab' and 'wide-width' tensile strength of geotextiles. (4)
- (b) Discuss the two design criteria, which must be satisfied, in the design of granular filters for different types of soils including medium and high plastic clays. (6)
- (c) Discuss factors that are important for the design and performance of hydraulic fills. (8 1/3)
- (d) Discuss the means of controlling ground water and seepage problems? (5)
7. (a) State the considerations required to select the appropriate ground improvement method for a hydraulic fill. (5 1/3)
- (b) Briefly discuss the suitability of improvement of hydraulic fills by (i) deep densification by vibration (ii) dynamic compaction. (6)
- (c) Show, with sketches, the use of filters and drains for: (12)
- (i) Foundations of structure
 - (ii) Embankments
 - (iii) Retaining walls
 - (iv) Road work
8. (a) Define the following properties of geotextiles: (9)
- (i) AOS
 - (ii) Permittivity
 - (iii) Transmissivity
- (b) Define 'piping ratio' which is relevant to granular filters? (3)
- (c) A revetment structure is to be constructed on a river bank slope of 1(V) : 4(H). The in-situ soil is fine sand with grain size distribution as shown in **Fig. 1**, relative density of 75% and void ratio of 1.7. It is observed that it takes 2 hours for the water to recede from HWL to LWL resulting in a drawdown of the water surface in the bank soil as shown in the **Fig. 1**. Analyze and comment on the adequacy of a candidate geotextile as filter. (Table for partial factor of safety are also provided in **Fig. 1**). (11 1/3)
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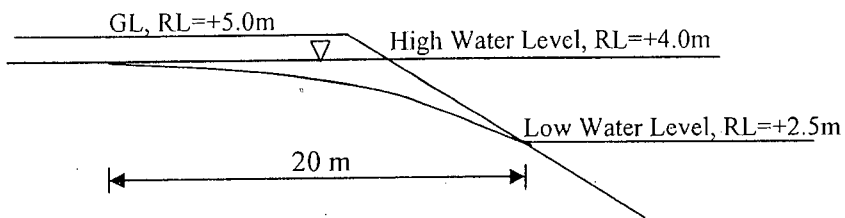


Downstream slope angle, β

Chart 1

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



Partial safety factors-
 Soil clogging and blinding: 10
 Creep reduction of voids: 1.5
 Intrusion into voids: 1.5
 Chemical clogging: 1.1
 Biological clogging: 4.0

US sieve size (No.)	Opening (mm)	US sieve size (No.)	Opening (mm)
4	4.750	60	0.250
6	3.350	70	0.210
8	2.360	80	0.180
10	2.000	100	0.149
16	1.180	140	0.106
20	0.850	170	0.088
30	0.600	200	0.075
40	0.425	270	0.053
50	0.300	400	0.037

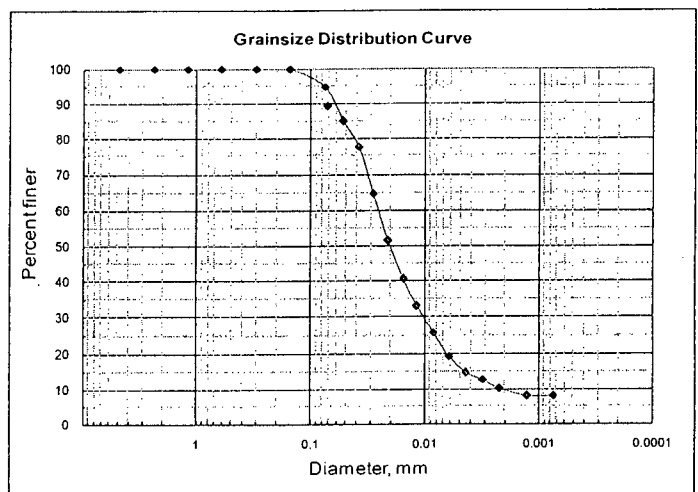


Fig.1

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=4=

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) State the general requirements of data for the design of machine foundations. (4)
- (b) Give a pictorial Description of a system of two-degrees of freedom for 'vibration absorber' using two masses and two springs in the system. Also draw the free body diagram for the system, write the corresponding differential equations of motion, and hence derive an expression for solving the natural frequencies of the system. (2+2+2+8 1/3 +5)

2. (a) Describe various methods of vibration isolation in machine foundations. (10 1/3)
- (b) Define over-tuned and under-tuned foundations. Which foundation system is more vulnerable to the vibration even if operating frequency is far away from natural frequency of vibrating system which can be considered safe in dynamic analysis? How is this vulnerability minimized? (7)
- (c) What is logarithmic decrement? Show that logarithmic decrement can be estimated with reasonable accuracy by $2\mu D$. D is the damping ratio of the vibrating system. (6)

3. (a) Show that, in frequency dependent excitations, the damping factor D (defined as by c/c_c) is given by the following expression: (8)

$$D = \frac{1}{2} \left(\frac{f_1 - f_2}{f_n} \right), \text{ where } f_2 \text{ and } f_1 \text{ are frequencies at which the amplitude is } \frac{1}{\sqrt{2}} \text{ times the peak amplitude.}$$

(b) Define transmissibility and hence deduce the following: $T_r = \frac{\sqrt{1 + (2Dr)^2}}{\sqrt{(1 - r^2)^2 + (2Dr)^2}}$

How do you use the concept of transmissibility in designing a vibration control system? (10+2+3 1/3)

4. (a) State general requirements of machine foundations. State and describe briefly the factors to be considered in the planning stage to avoid excessive vibration due to the working of a machine. (8+4 1/3)

- (b) For the system represented by the following equation: (11)

$$m \frac{d^2 z}{dt^2} + c \frac{dz}{dt} + kz = m_e \omega^2 \sin \omega t$$

Deduce the magnification factor M defined by $Z_0 / \left(\frac{em_e}{m} \right)$ as given below:

$$M = \frac{1}{\sqrt{\left(1 - \frac{\omega}{\omega_n}\right)^2 + \left(2D \frac{\omega}{\omega_n}\right)^2}}$$

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Using the above expression, show that resonance occurs at a frequency ratio slightly

larger than one, which can be given by: $f_{mr} = \frac{f_n}{\sqrt{1 - 2D^2}}$

Also derive the expression for maximum amplitude in terms of $\left(Z_0 / m_e e / m \right)_{max}$

SECTION – B

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

5. (a) Describe vibro compaction method with neat sketches and a case study. (10)

(b) There are two zones in and around a particular site. Estimate SDE and SSE earthquake on the basis of cumulative intensity-frequency relation. (13 1/3)

Zone	a	b	I _{max}	ΔI
1	0.40	0.51	X	2.0
2	0.75	0.60	IX	1.5

6. (a) Explain different types of waves with neat sketches. (13 1/3)

(b) Estimate probability of earthquake hazard for bridges for a return period of 100,475 and 950 years. (10)

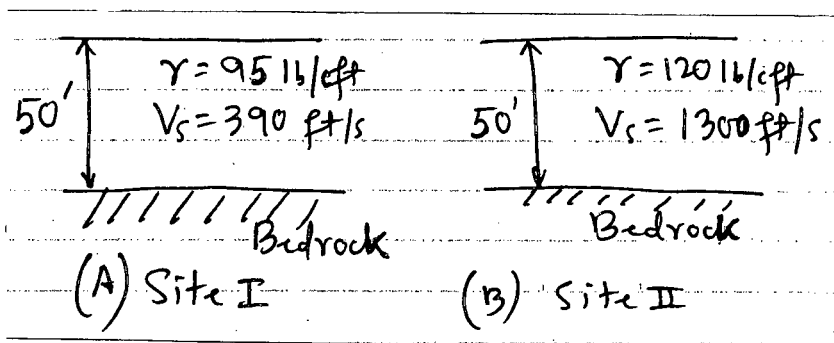
7. (a) Explain Simplified Procedures for estimating soil liquefaction on sandy soil. (10)

(b) Estimate liquefaction potential at 4.5 m depth of a proposed construction site for a 7.5 magnitude earthquake producing a PGA of 0.23g. Consider the watertable at 1.2 m depth below the GL. Take $\gamma_{sat} = 19 \text{ kN/m}^3$. (13 1/3)

Depth (m)	1.5	3.0	4.5
N	2	4	3
D ₅₀ (mm)	0.73	0.91	1.10

8. (a) Explain and differentiate Seismic Zonation and Microzonation with neat sketches. (13 1/3)

(b) Two soil deposits with necessary parameters are shown below. Explain Amplification for the two sites (I) and (II) (10)



SECTION – A

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

1. (a) What are the main objectives of Bangladesh Environmental Policy 1992? What legal framework was proposed and institutional arrangement were considered to implement Bangladesh Environmental Policy? What were the policy statements in the following sectors? (12 $\frac{1}{3}$)
- (i) Industry
- (ii) Water development, flood control and Irrigation
- (iii) Science, technology and research.
- (b) Write down the differences between the documents required and environmental clearance formalities for the following categories of projects as per ECR 1997 (a) "Green" (b) "Orange A" and (c) "Red". (8)
- (c) Who can file a Public Interest Litigation (PIL)? What kind of issues can a PIL deal with? (3)
2. (a) Write down the names of 4 legal instruments in Bangladesh pertaining to workplace health and safety. What are the different safety provisions for the protection of public health in the Bangladesh National Building Code? (7 $\frac{1}{3}$)
- (b) Summarize the mitigation measures suggested for the following environmental issues for the implementation of the Jamuna Multipurpose Bridge Project: (10)
- (i) Air pollution
- (ii) Safety of workers
- (iii) Dredged Spoils Disposal
- (iv) Social disruption among workers and villagers
- (v) Disruption of navigation.
- (c) Describe the sources and/or activities that may have posed health hazard among workers and social disruption among workers and villagers during the implementation of the Jamuna Multipurpose Bridge Project. (6)

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3. (a) Draw the schematic diagram showing the Environmental Impact Chain approach, with corresponding standards. What are the main benefits and drawbacks of an impact-oriented approach in setting environmental standards? (11)
- (b) Write down the answers to the following questions regarding the trial process as per Bangladesh Environment Court Act: (5)
- (i) What is the rank of the judge?
 - (ii) What is the rank of the Public Prosecutor?
 - (iii) Who can enter any place for inspection, search and seizure?
 - (iv) Who can carry out investigation?
 - (v) What are the guiding legislations for trial and disposal of cases related to compensation and offences?
- (c) What is the purpose of Environmental monitoring in EMP? What are the limitations of environmental quality standards in ECR 1997? (7 1/3)
4. (a) How would you identify the stakeholders for a public consultation process during an EIA study? What are the practical considerations for an effective public consultation process? (8 1/3)
- (b) Define "Public Goods" and "External Benefits" in the context of environmental economics. How does "External Benefits" affect the socially efficient rate of output? 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. (8)
- (c) From the data given below determine how much emission each plant has to reduce, if the total emission reduction of 10 tonnes/week is to be achieved at the minimum possible total cost. (7)

Emission (tonnes/week)	Marginal Abatement Cost (lakh BDT/week)		
	Plant A	Plant B	Plant C
10	0	0	0
9	1	2	3
8	2	3	4
7	3	4	5
6	4	6	6
5	5	10	10
4	6	12	12
3	10	25	25
2	12	40	45
1	25	90	100
0	50	200	225

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SECTION – B

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

5. (a) State the objectives of Sustainable Development Goals (SDGs). Make a comparison between MDGs and SDGs. What are the challenges for Bangladesh to achieve SDGs? Describe. (3+6+6 $\frac{1}{3}$ = 15 $\frac{1}{3}$)
- (b) Why the concept of 'Carrying Capacity' of Environment can not be applied to estimate the 'Carrying Capacity' for human populations reliably? Explain with examples. (8)
6. (a) State the global efforts to reduce the effects of Global Warming. How is Bangladesh preparing to face the impacts of Climate Change? Describe. (11 $\frac{1}{3}$)
- (b) Define the following terms: (3×4=12)
- (i) SMOG
 - (ii) Acid Rain
 - (iii) EIV
 - (iv) Ozone Layer Depletion
7. (a) How does development in Agricultural Sector affect Water Quality, Water Quantity, Green-house Gas Emissions and Biodiversity? Explain. How can you minimize those effects? (12 $\frac{1}{3}$)
- (b) Describe the environmental implications of Energy Sector Development for using non-renewable materials as an energy source. Why is 'Rampal Power Plant' project a serious concern to the Environmentalists? What measures are recommended by the authority to mitigate the negative impacts? Write down your opinion on this issue. (11)
8. (a) Define Environmental Management. Why is it necessary? Name at least three tools of Environmental Management. (10)
- (b) A Paper Industry is proposed to be set up in a peri-urban area and the effluent will be discharged in an adjacent river. There are few other industries already existing in that area. Identify and assess the impacts on different environmental components due to this industry. Make suggestions to mitigate adverse impacts and enhance positive impacts. (13 $\frac{1}{3}$)
-

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. Also, briefly explain the inter-relationship among the functional elements. (9)

(b) A small township has plans to set up a Waste to Energy facility to generate their own power from the daily waste collected by the city corporation. Waste generation rate was found to be 3.5 kg/capita/day. The percentage distribution of the different components and the corresponding energy value for each component are provided in the following Table. Dry Ash and Metal free wastes may only be used in the proposed Energy Recovery Plant. If this plant is designed to generate at least 10000 Giga-Joules per day, how many households (with average family size of 8 persons) must participate in the Waste to Energy program to make it successful? (14 $\frac{1}{3}$)

Component	% Dry Mass	Typical Energy Value (kJ/kg)
Food Waste	70	4700
Paper	10	16700
Cardboard	2	16000
Plastics	10	32600
Rubber	5	23300
Tin Cans	1	700
Ash	2	7000

2. (a) What are the primary properties of the MSW to be known for using it as fuel? List the tests required to assess these primary properties. (9)

(b) A cannery receives on a given day 15 tons of raw produce, 5 tons of cans, 0.5 tons of cartons, and 0.3 tons of miscellaneous materials. Of the 15 tons of raw produce, 12 tons become processed product, 2.2 tons end up as produce waste, which is fed to cattle, and the remainder is discharged with the wastewater from the plant. Four tons of cans are stored internally for future use, and the remainder is used to package the product. About 5 percent of cans used are damaged. Stored separately, the damaged cans are recycled. The cartons are used for packaging the canned product, except for 5 percent that are damaged and subsequently separated for recycling. Of the miscellaneous materials, 25 percent is stored internally for future use; 50 percent becomes waste paper, of which 35 percent is separated for recycling with the remainder being discharged as mixed waste; and 25 percent becomes a mixer of solid waste materials. Assume the materials separated for recycling and disposal are collected daily. Prepare a materials balance for the cannery for this day and a materials flow diagram accounting for all of the materials. Also determine the amount of waste per ton of product. (14 $\frac{1}{3}$)

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3. (a) "Use of volatile matters in expressing the Biodegradability of solid waste is not an appropriate approach" – Explain citing of the mathematical expression for biodegradability. (9)
- (b) Determine, based on operating cost, the break-even points for a hauled and stationary system as compared with a system using transfer and transport operations for transporting wastes collected from Dhaka metropolitan area to a landfill site. Assume that the following cost data are applicable: (14 1/3)

Operating costs:

HCS carrying compacted solid waste in 6 m³ container = Tk. 1875/-

SCS using 15 m³ compactor = Tk. 3000/-

Tractor semitrailer transport unit with a capacity of 80 m³ = Tk. 3500/-

Other costs:

Transfer station operating costs, including amortization = Tk. 30/m³

Extra cost for unloading facilities for Tractor semitrailer transport unit = Tk 4/m³

Other data:

Specific weight of wastes in HCS container (in kg/m³) = 225

Specific weight of wastes in SCS (in kg/m³) = 325

Specific weight of wastes in Transport unit (in kg/m³) = 150

4. (a)

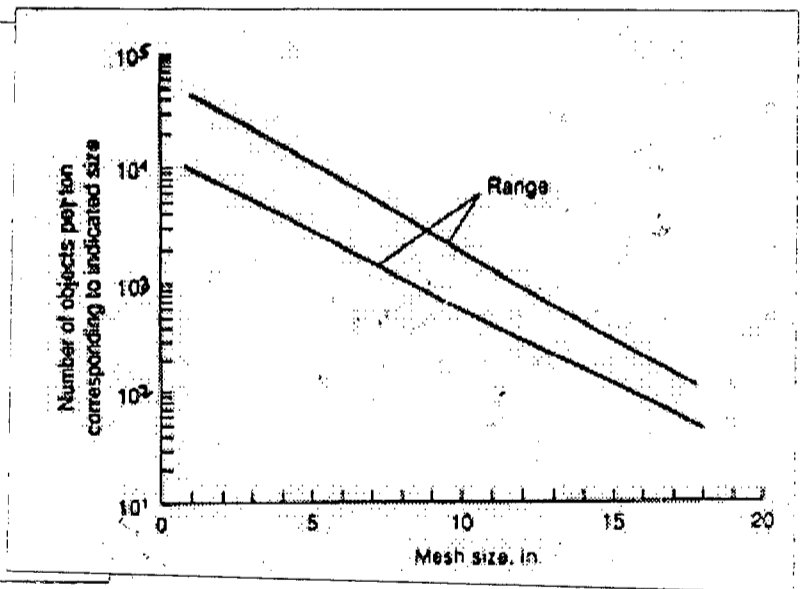
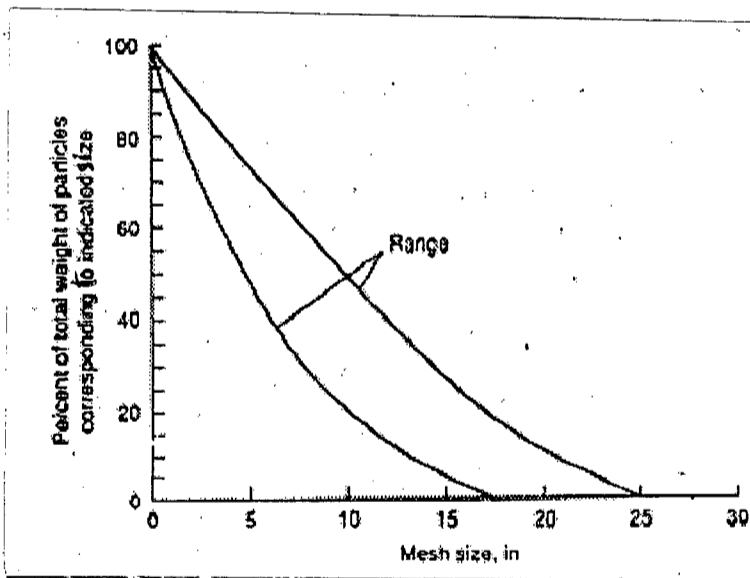


Fig: Typical sizes of individual components comprising residential and commercial MSW [4,12]

Fig: Percentage of total mass of residential and commercial MSW as a function of mesh size [4,12]

Briefly describe the information that can be extracted from the two set of graphs shown above. Also, explain the use of the extracted information in the solid waste management system.

(9)

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Contd ... Q. No. 4

(b) Because of a difference of opinion among city staff members, you have been retained as an outside consultant to evaluate the collection operations of Dhaka North City Corporation. The basic question centers around the amount of time spent on off-route activities by the collectors. The collectors say that they spend less than 10% of each 8-hr workday on off-route activities; management claims that the amount of time spent is more than 10%. You are given the following information that has been verified by both the collectors and the management:

(14 1/3)

- (i) An HCS, without container exchange system, is used.
- (ii) The average time spent driving from yard to the first container is 15 min, and no off-route activities occur.
- (iii) The average pick up time per container is 4 min.
- (iv) The average time to drive between containers is 4 min.
- (v) The average time required to empty the container at the disposal site is 6 min.
- (vi) The average round-trip distance to the disposal site is 12 miles/trip, and the haul equation $(a + bx)$ constants are $a = 0.004$ h/trip and $b = 0.015$ hr/mile.
- (vii) The time required to redeposit a container after it has been emptied is 6 min.
- (viii) The average time spent driving from the last container to the corporation yard is 20 min, and no off-route activities occur.
- (ix) The number of containers emptied per day is 12.

From this information, determine whether the truth is on the side of the collectors or the management. Also, determine the length of the workday.

SECTION – B

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

- 5. (a) State briefly the solid waste disposal practices in low-income countries.
- (b) What are the advantages and disadvantages of a sanitary landfill?
- (c) Discuss the important considerations in the planning of a sanitary landfill.
- (d) A solid waste has the following components and bulk densities:

(7 1/3)

(6)

(5)

(5)

Component	% by weight	Loose bulk density (lb/ft ³)
Garden Waste	38	4.63
Glass	21	18.57
Paper	26	3.83
Food Waste	15	9.36

The compacted waste density in the landfill is 43.5 lb/ft³. Estimate the % volume reduction achieved during compaction of the waste. Estimate the overall uncompacted bulk density if the food waste is removed for biogas generation.

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6. (a) Describe briefly the different stages of solid waste decomposition in landfills. (6 1/3)
- (b) How will you control leachate in a landfill? (4)
- (c) Summarize leachate treatment options. (7)
- (d) The following four soil layers are lying between the base of a landfill and the underlying aquifer. How long will it take for leachate to migrate to the aquifer? Also, calculate the amount of leachate flowing down if the landfill area is 75 hectare. (6)

Soil layer	Depth (m)	Porosity (%)	Permeability (m/s)
Soil A	1.5	43	5.8×10^{-7}
Soil B	2.0	42	3.7×10^{-9}
Soil C	2.5	41	3.2×10^{-9}
Soil D	3.0	44	2.1×10^{-8}

7. (a) What are the potential environmental impacts of landfill gases? Explain. (7 1/3)
- (b) State briefly the different gas venting methods of sanitary landfills with neat sketches. (6)
- (c) Show the pathways of human exposure to hazardous waste. (5)
- (d) Estimate the percolation of leachate through a landfill 15 m deep, with a 0.5 m cover of silty clay for the following data: (5)
- Precipitation = 2375 mm/year
- Runoff coefficient = 0.32
- Evapotranspiration = 765 mm/year
- Silty clay field capacity = 370 mm/m
- Waste field capacity = 275 mm/m

Assume that the moisture content of the soil cover is 300 mm/m when applied and that of the incoming waste is 160 mm/m.

8. (a) List the problems in hazardous wastes treatment and disposal in developing countries. (5)
- (b) What are the advantages, disadvantages and limitations of chemical and thermal treatment processes of hazardous wastes? (5 1/3)
- (c) What are the problems of land disposal option for hazardous wastes? (5)
- (d) List the main sources of contaminated wastes in hospitals. (3)
- (e) Draw a flow diagram of hospital waste management. (5)

SECTION – A

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

Assume missing values/data (if any)

1. (a) Explain ICAO- Airport classification. Why are aircraft characteristics essential for the planning and design of airports? (8)
- (b) What are the components of Airport system? Explain each component in brief. (8 1/3)
- (c) Show the distribution of the aircraft movements on the Runway. What are the functions of blast pad? (7)
2. (a) Explain the functions of Taxiway and Aprons. Show the Air Traffic Transformation from year 2007 to 2025. (9 1/3)
- (b) List the factors considered in Airport Site Selection. What are the purposes of Airport Master Planning? (9)
- (c) Define passenger load Factor (PLF). From the following data Calculate PLF. (5)

Passenger Capacity of aircraft = 100
Average passenger carrying = 70
Average number of flight = 6
Average distance flying = 750 km
3. (a) Explain the importance of an Airport in city/Country. What are the factors influencing Air Travel demand? (7)
- (b) What are the functions of Airport lighting and signing? Show in tabular form “the international standard Traffic Signal light patterns for Airport”. (10 1/3)
- (c) Why are Runway and Taxiway markings important? (6)
4. (a) Discuss the design Considerations of Terminal area. List the steps to determine terminal facility space requirements. (10)
- (b) Explain Taxiway Edge lighting and Taxiway Centreline lighting. (7 1/3)
- (c) Explain the procedure of Runway Numbering. (6)

SECTION – B

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

5. (a) What are the principles of good drainage? What are the mechanisms of damage to highways due to faulty drainage? (13 1/3)
- (b) Briefly state the procedure for drainage in an urban intersection. (10)

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6. (a) What are the principles of culvert location? What are the general procedure for hydraulic design of culverts? (10)
- (b) What are the purposes of installing subdrains in highways? Show the placement of subdrains for various purposes. (13 1/3)
7. (a) Briefly state the relevant aircraft characteristics for taxiway and runway pavement design. (10)
- (b) Briefly state various steps for the evaluation and design of overlays using layered elastic theory. (10)
- (c) What are the functions of airport drainage? (3 1/3)
8. (a) What are the functions of subbase and benefits of stabilized subbase for rigid airport pavements? Briefly state different types of joints in rigid pavement. (13 1/3)
- (b) A taxiway pavement is to be designed for a DC 10-10 airplane by using the relationship shown in Fig. 1. The design CBR-values for different layers are as follows: (10)

Material	Design CBR
Compacted subgrade soil	6
Subbase material -1	20
Subbase material-2	30
Crushed stone base-	80

The minimum thickness of asphaltic concrete surface course is recommended to be 6 inches. Find the thickness of different layers of pavement and show the sections. Use Fig. 1 and reasonable values for missing data, if any.

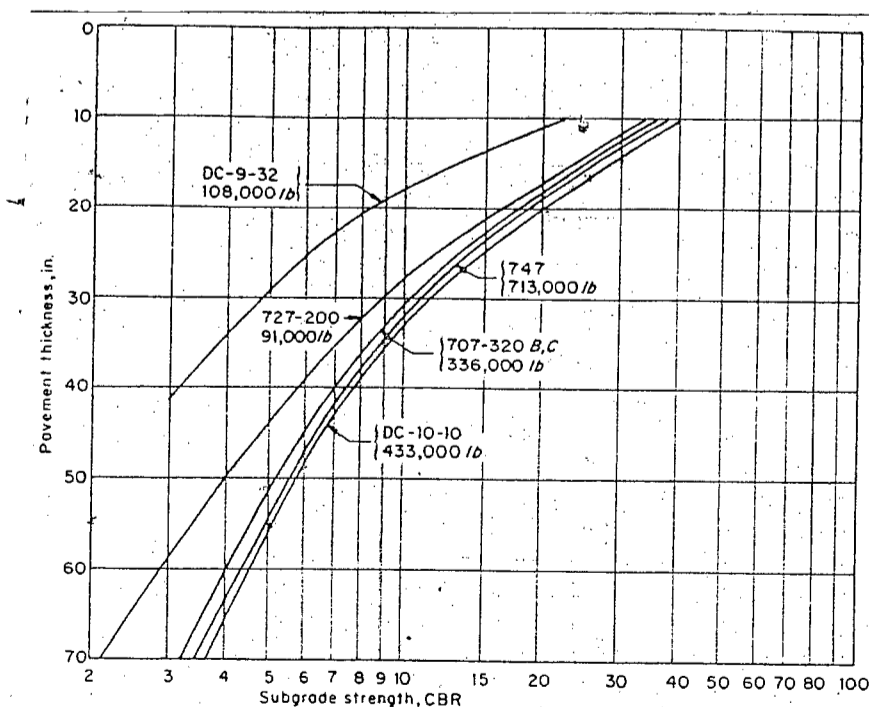


Figure 1: Flexible-pavement thickness—Corps of Engineers design method. Weights represent maximum ramp weights with the main landing gears loaded to their maximum.

SECTION – A

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

1. (a) Classify different types of river training works based on objective and purposes. (8 1/3)
 (b) What is the regime channel concept? Based on the regime concept, explain how a river will response if bed level is increased or decreased. (8)
 (c) Explain the causes of braiding of a river with sketches. (7)

2. (a) Describe different components of river training for guiding the flow with sketches. (7 1/3)
 (b) Explain how channel improvement and flow diversion can help to deduce flood. (7)
 (c) Calculate the total volume of stone required in per unit width for the shank and nose portions of a revetment for the following given data. Maximum discharge of the river is 8000 cumecs and the corresponding water depth is 5.0 m. Mean diameter of sediment particle is 15 mm. Assume any other data if needed. (9)

3. (a) Describe different types of temporary measures for river bed control. (7 1/3)
 (b) Describe different types of measures for sediment control in a watershed. (7 1/3)
 (c) Describe the following terms in brief with neat sketches, if necessary. (3×3)=9
 (i) Matresses
 (ii) Bankfull discharge
 (iii) Riprap

4. (a) Classify different types of bed forms according to their flow regime and describe them with neat sketches. (8 1/3)
 (b) Explain with graphs how bed forms affect bed roughness and water surface elevation in a river. (7)
 (c) Calculate bed sediment load using Duboy's bed load formula for the following given data. The channel depth is 4 m and the channel slope is 5.5×10^{-4} . Mean diameter of sediment particle is 15 mm. Assume any other data if needed. (8)

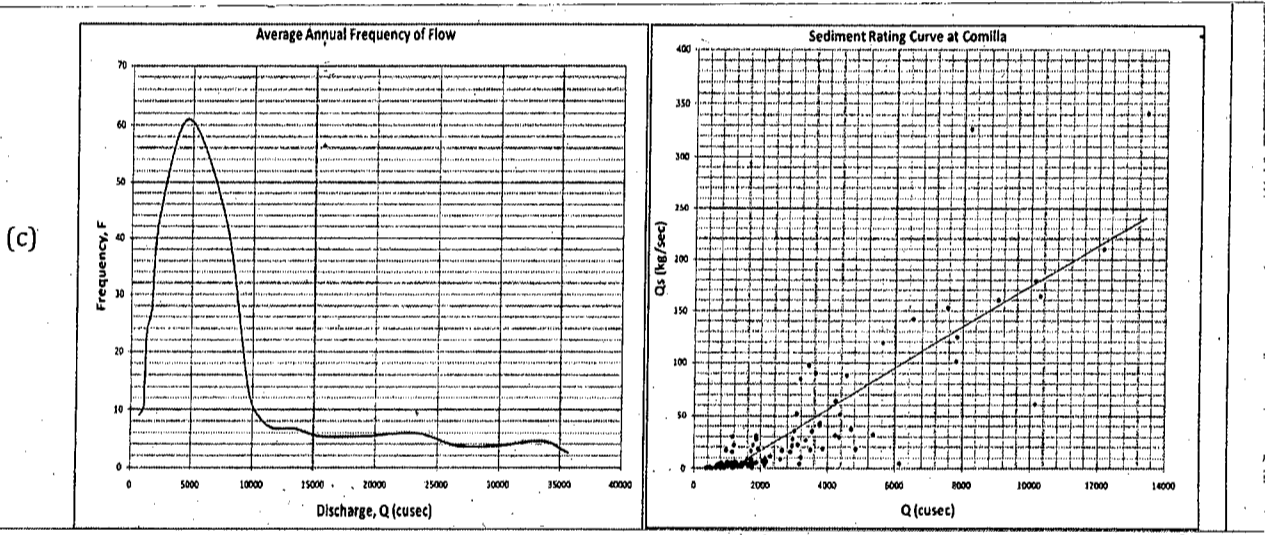
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SECTION – B

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

Assume any reasonable value where necessary.

5. (a) Describe various stages through which River passes as it flows from its origin in a mountain to a sea. (9)
- (b) Write down the classification of Meanders. Write short notes on the general features of Meandering. (4+6 1/3)
- (c) Define (i) Khadirs, (ii) Crossings, (iii) Sinuosity and (iv) Tortuosity. (4)
6. (a) Define Dominant Discharge. Classify river based on hydrograph. (5 1/3)
- (b) Explain how secondary motion is related to meander development. (7)
- (c) Estimate the dominant discharge of the *Gumti* River showing all steps clearly with neat sketches. Use the following data of the *Gumti* River at Comilla station. (11)



7. (a) What is aggradations? Briefly describe the occurrence of aggradations. (6 1/3)
- (b) Write down the causes and impacts of degradation. How it can be controlled? (8)
- (c) Sketch the plan view and typical cross section (at bend) showing estimated diameters for the *Kalni* River with a discharge of 3500 cumec. Also calculate the rise of water level at outer bank of this section. (2+3+4)
8. (a) Derive the relationship between Shield's Entrainment Function and Particle Reynold Number. (9 1/3)
- (b) A bridge is going to be built over the *Kushiyara* River where the section is 350 m wide. Here the maximum discharge is 6789 cumec and corresponding upstream water depth is 5 m. There will be 12 circular cylindrical piers of 10 m length and 2 m diameter each, and the vertical-wall abutments will protrude 20 m into the river. (4+5+5)
- (i) Calculate abutment scour,
- (ii) Select design scour depth for bridge pier using at least four different formulas, and
- (iii) Show the variation of pier scour for increasing angle of attack for this given data.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2013-2014

Sub : **CE 457** (Transportation Engineering V)

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) “Many dimensions to the urban transport challenge are linked with the dominance of the automobile” – Explain elaborately. (11)
 (b) List the most notable urban transport problems. In automobile dependent cities, what measures can help alleviate congestion to some extent? (6+6 1/3)

2. (a) Draw a flow-chart showing the factors affecting the choice of form of public Transport. Also, describe the following terms related to transit capacity: (i) Maximum Load Point; (ii) Productive Capacity; (iii) Crush Capacity; and (iv) Dwell and Clearance Time. (7+6)
 (b) A bus system needs to be set up between the Bangladesh University of Engineering and Technology Campus and the North-South University Campus, distance of 9.5 miles. The operating time is 30 minutes. It has been estimated that the peak hour demand is 450 passengers/hour and 45-seater buses are available, which can safely accommodate 20 standees. Design the basic system and determine the fleet size assuming that the minimum terminal time is 7.5 minute, which may be revised if necessary. (10 1/3)

3. (a) Why transportation planners and traffic engineers in many cases are not aware about urban goods movement (UGM)? Write down the views of different parties involved in UGM. (5+6)
 (b) Differentiate between truck Terminals and Stops with respect to their operation. Briefly discuss the commonly encountered issues involving truck loading/unloading in a CBD and Non-CBD location. (4+8 1/3)

4. (a) What are the most difficult challenges that urban transit faced in the developed countries? (11)
 (b) The department of traffic is considering three improvement plans for a heavily traveled intersection within the city. The improvement is expected to achieve three objectives: improve travel speeds, increase safety, and reduce operating expenses for drivers. The annual dollar value of savings compared with existing conditions for each criterion as well as additional construction and maintenance costs is shown in as follows.

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Contd ... Q. No. 4(b)

If the economic life of the road is considered to be 50 years and the discount (interest) rate is 3%, which alternative should be selected? Assume reasonable values for missing data, if any.

(12 1/3)

Alternative	Construction Cost (\$)	Annual Savings in Accidents (\$)	Annual Travel Time Benefits (\$)	Annual Operating Savings (\$)	Annual Additional Maintenance Cost (\$)
1	185,000	5000	3000	500	1500
2	230,000	5000	6500	500	2500
3	310,000	7000	6000	2800	3000

SECTION – B

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

Assume missing value/data (if any).

5. (a) Explain system approach of transportation planning. Define costs of highway transportation with examples.

(10 1/3)

(b) A two lane road of 30 km long is to be widened to four lanes at a cost of Tk. 250 lac/km including all improvements. The VOC (Vehicle Operating Cost) on the existing two lanes is Tk. 25/veh-km, while it is Tk. 18.5/veh-km on the improved facility. The AADT may be assumed 5500 vehicle over a design period of 20 years. The interest rate is 10% per year. The maintenance cost is Tk. 250,000 (Total) on existing road and Tk. 5,00,000 (Total) on improved road. Is the investment in the improvement scheme worthwhile?

(8)

(c) State advantages and limitations of "Saturation System".

(5)

6. (a) The following information Comes from trip generation:

(13 1/3)

Travel times

Zone	P	A
1	550	450
2	600	650
3	400	475

Zone	1	2	3
1	2	5	10
2	6	4	11
3	13	12	5

Distribute the trips using the Gravity model.

Friction Factors			
Zone	1	2	3
1	0.875	1.515	0.75
2	1.515	0.875	0.75
3	0.75	0.75	0.875

K Factors			
Zone	1	2	3
1	1.04	1.15	0.65
2	1.05	0.78	1.12
3	0.75	0.95	1.15

(b) Explain the different types of Road patterns used for highway planning with their advantages and disadvantages.

(7)

(c) Define Home bound trip and Non Home bound trip.

(3)

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7. (a) Given the utility expression as follows :

(7 1/3)

$$U_k = A_k - 0.055 T_a - 0.042 T_w - 0.025 T_r - 0.015C$$

Where, T_a = Access Time (min)

T_w = Waiting Time (min)

T_r = Riding Time (min)

C = Out of Pocket Cost (Tk)

Apply the Logit model to calculate the proportion of usage among the C_{ar} ($A_k = -0.0051$), Taxi ($A_k = -0.055$) and bus ($A_k = -0.045$).

Mode	T_a	T_w	T_r	C
Car	5	0	30	120
Taxi	10	8	35	100
Bus	12	15	40	40

If Total number of trip is 3500, distribute these trips among different modes.

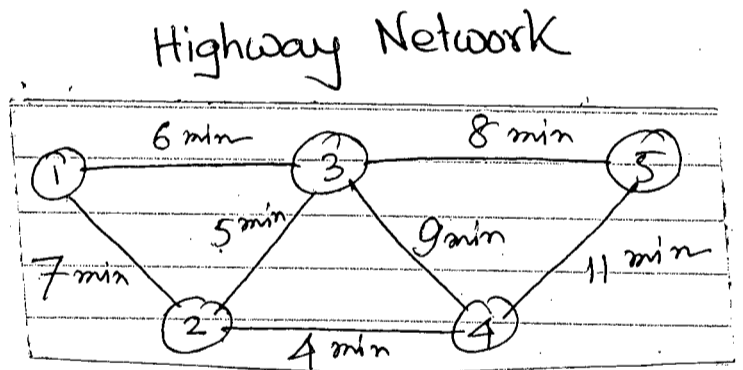
(b) Assign the vehicle trips shown in the following 0-D trip table to the network, using the all – or – nothing assignment technique.

(10)

0-D Trip Table

Trips between Zones

From/to	1	2	3	4	5
1	-	150	150	250	200
2	350	-	250	150	400
3	250	150	-	200	200
4	300	200	400	-	500
5	300	200	150	400	-



(c) Explain the Relationship among Land-Use and Transportation Demand.

(5)

8. (a) State the objectives of Transportation Demand Management (TDM). List various TDM strategies.

(6 1/3)

(b) Discuss Transportation System Management Strategies on the Supply side. List the factors influencing Trip distribution and mode choice.

(10)

(c) "Good highway planning should be Long range, Comprehensive and Co-ordinated"- Explain.

(7)
