L-4/T-1/WRE **Date : 20/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **WRE 417** (Groundwater Engineering)

Full Marks : 140 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

1. (a) List the various components of the hydrologic cycle. Sketch a layered aquifer system and show its various features. **(6⅓)**

   (b) Name the different environmental factors that affect ground water level. Describe how the urbanization affect the groundwater level changes. **(6)**

   (c) Describe the significance of 'hyporheic zone'. **(3)**

   (d) Explain how the differential physical, chemical and biological tests determine the quality of groundwater? **(8)**

2. (a) Name some of the in-situ and ex-situ groundwater treatment processes and describe how they work. **(6⅓)**

   (b) Draw a neat sketch showing sub-surface water distribution in a vertical soil profile and describe them. **(6)**

   (c) Explain why groundwater treatment system is necessary. **(3)**

   (d) Identify the various scopes or opportunities for groundwater management. **(8)**

3. (a) What are the advantages and disadvantages of conjugative use of surface water and groundwater? **(6⅓)**

   (b) Why do we use groundwater modeling? List the parameters used in the groundwater modeling? **(6)**

   (c) Illustrate how the artificial recharge will help in improving the status of groundwater. **(3)**

   (d) Briefly explain the phenomenon of saline water intrusion and prove that the height of saline water below the ground level is 40 times the height of fresh water above the sea level. **(8)**

4. (a) Describe with figures the various systems of controlling saline water intrusion. **(6⅓)**

   (b) Write short notes on (i) Perched water table and (ii) Spring **(6)**

   (c) Compare the Glover relationship with Ghyben-Herzberg relationship between fresh water and saline water. **(3)**

   (d) The steady fresh water discharge from an unconfined coastal aquifer into the sea is about 1.6 $m^3$/day/m along the shoreline. The hydraulic conductivity of aquifer is 8.6 m/day and the horizontal impervious stratum is located 57 m below sea level. Determine the shape of the fresh-saline interface and the location of the toe of the interface from the shoreline. **(8)**

Contd ..... P/2

**WRE 417**

## SECTION – B

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

5. (a) River A and B located 1200 m apart fully penetrate an aquifer with a hydraulic conductivity of 0.5 m/day. The region receives an average rainfall of 22 cm/yr and evaporation is about 10 cm/yr. Assume that the water elevation in River A is 21 m and the water elevation in River B is 19 m. Determine the following: **(12)**

(i) The location and height of the water divide

(ii) Daily discharge per meter width into each river.

(b) A sanitary landfill is located on a dense clay deposit that is 6 m thick overlying an aquifer that provides drinking water to a town. A zone of leachate-contaminated groundwater has accumulated at the base of the landfill. Observations in the aquifer indicate a steady piezometric level of 250.5 m above datum. The surface of the water table at the landfill is at 251 m. How long will it take for contaminants to move through the clay into the aquifer with $k = 2\times10^{-11}$ m/s and porosity 20%? **(6)**

(c) A falling head permeameter containing a silty fine sand has a falling head tube diameter of 2.0 cm, a sample diameter of 10.0 cm, and a flow length of 15 cm. The initial head is 5.0 cm. It falls to 0.75 cm over a period of 450 minutes. Find the hydraulic conductivity. **(5⅓)**

6. (a) Derive the Laplace equation for unsteady flow. **(10)**

(b) Consider a confined aquifer that is recharged from an unconfined aquifer through an aquitard (Figure 1). The recharge rate is 0.4 m/yr. The water table is at H=50 m above the datum. The aquitard is 10 m thick and its vertical hydraulic conductivity $K' = 10^{-3}$ m/d. **(7)**

The unconfined aquifer is 25 m thick and has a hydraulic conductivity $K=10^{-1}$ m/d. Find the piezometric head h′ at the bottom of the unconfined aquifer and the distance between the water table and the piezometric surface.

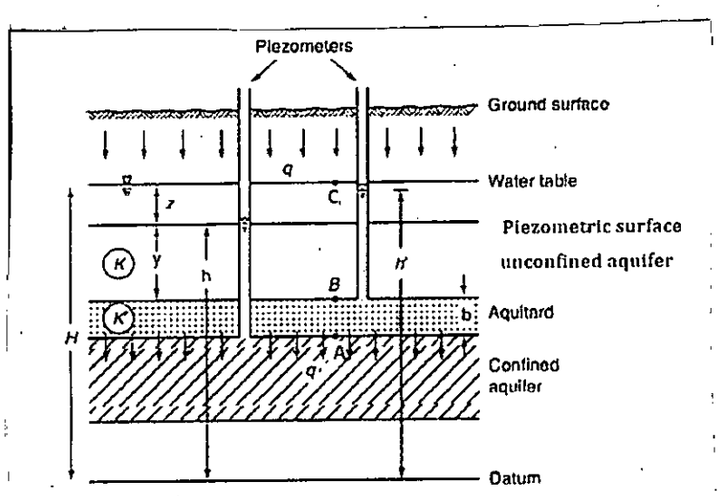


Figure 1 for Question 6 (b)

**WRE 417**

Contd...Q. No. 6

(c) An unconfined aquifer with a storativity of 0.13 has an area of 520 $km^2$. The water table drops 1.5 m during a drought. How much water was lost from storage? **(3)**

(d) Write down the assumptions of Dupuit Equation. **(3⅓)**

7. (a) A well pumping at 70,000 $ft^3$/day has observation wells located 10, 50, 200, 300 and 400 ft away in a confined aquifer. After 5 hours of pumping, the following drawdowns were observed:

| Distance (ft) | 10 | 50 | 200 | 300 | 400 |
|---|---|---|---|---|---|
| Drawdown (ft) | 15.0 | 8.6 | 3.0 | 1.4 | 0.2 |

Find the storage coefficient of the aquifer. Use Cooper-Jacob method. **(9)**

(b) A well fully-penetrates a 30-m thick confined aquifer. After a long period of pumping at a constant rate of 0.05 $m^3$/s. the drawdown at distance of 50 m and 150m from the well were observed to be 3 and 1.5 m, respectively. Determine the hydraulic conductivity and transmissivity. **(6)**

(c) A well of radius 0.25 m produces 700 $m^3$/day from an unconfined aquifer with K=10 m/day. The well is located 200 m from a river and the saturated thickness at the river is 25m. What is the drawdown at the well? **(5)**

(d) Write short notes on the factors affecting soil porosity. **(3⅓)**

8. (a) Describe the advantages and disadvantages of rotary direct method. **(4)**

(b) Write a short note on well rehabilitation procedure. **(4)**

(c) Design the following components of a groundwater well assembly penetrated in a heterogeneous aquifer (sand layer) of 50 m thickness. **(15⅓)**

(i) Upper casing length (ii) Lower casing diameter (iii) Screen length (iv) Screen slot size (v) Gravel and filter packs

The grain size distribution curve of the sand layer is given in Figure 2. The hydraulic conductivity is $3.2\times10^{-4}$ m/sec and the expected discharge of the well is 2000 liter/min. Assume, static water level below ground level = 15 m, anticipated drawdown = 5.0 m, pump submergence requirement = 5 m, screen entrance velocity = 0.01 m/s and % of open area = 10%. Assume reasonable values if any data is missing.

Table . Recommended Diameter of casing pipe and well screen

| Discharge (l/min) | Casing pipe / screen diameter, cm | |
|---|---|---|
| | Minimum | Recommended |
| 475 | 10 | 10 |
| 475 - 1125 | 15 | 15 |
| 1125 - 3000 | 20 | 25 |
| 3000 - 5250 | 25 | 30 |

TABLE: Minimum Screen Lengths for Different Types of Screens and Pump Discharges

| Diameter (m) | Open Area (%) | Open Area ($m^2/m$) | Minimum Screen Length (m) $Q$ = 100 $m^3/h$ | $Q$ = 200 $m^3/h$ | $Q$ = 300 $m^3/h$ |
|---|---|---|---|---|---|
| 0.15 | 10 | 0.024 | 77 | 154 | 231 |
| 0.15 | 20 | 0.047 | 39 | 79 | 118 |
| 0.15 | 40 | 0.094 | 20 | 39 | 59 |
| 0.20 | 10 | 0.031 | 60 | 119 | 179 |
| 0.20 | 20 | 0.063 | 29 | 59 | 88 |
| 0.20 | 40 | 0.126 | 15 | 29 | 44 |
| 0.25 | 10 | 0.039 | 47 | 95 | 142 |
| 0.25 | 20 | 0.079 | 23 | 47 | 70 |
| 0.25 | 40 | 0.157 | 12 | 24 | 35 |

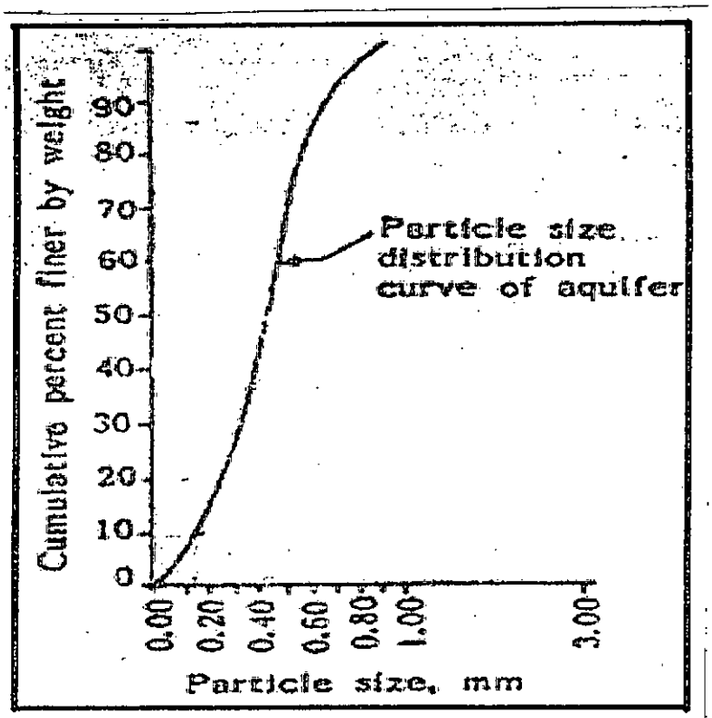


Figure2: Grain size distribution for Q 8(c)

L-4/T-1/WRE **Date : 01/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **WRE 419** (Irrigation and Drainage Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

There are **FOUR** questions in this section. Answer Q. No. **4** and any **TWO** from the rest.

1. (a) Duty of irrigation water varies from place to place and it decreases as water moves downstream from the head of the main canal – Explain the statement with proper reason. **(6)**

   (b) AWD irrigation practice can play an important role for reducing water losses and save cost of irrigation for crop production. Explain AWD irrigation practice system and justify the above statement. **(6)**

   (c) Explain how the capacity (size) of tile drain is determined? **(6)**

   (d) State the working principle, advantages and disadvantages of centrifugal pump. **(6)**

   (e) The gross command area of a distributary is 197,500 ha, 72% of which is cultivable. The intensity of irrigation for Rabi season is 55% and Kharif season is 36%. The average duty at the head of the distributary is 2255 ha/cumec for Rabi season and 665 ha/cumec for Kharif season. The kor (peak) depth and period for Rabi crops are 28 cm and 3 weeks respectively and for Kharif crop are 36 cm and 2 weeks respectively. Assuming a time factor of 0.82, determine the design discharge at the canal outlet. **(11)**

2. (a) Explain the soil-plant-water relationship with respect to moisture content of the soil. **(6)**

   (b) With neat sketches show (i) borrow pit with appropriate dimensions (ii) section of a turbine pump. **(6)**

   (c) Write down the objective of National Water Policy of Bangladesh. **(6)**

   (d) Write down the considerations during fixing the full supply level on the L-section of an irrigation canal. **(6)**

   (e) Two branch canals offtake from a main canal of an irrigation project. The left branch canal carrying a discharge of 26 $m^3/s$ has culturable command area of 32,500 hectares. The intensity of Rabi crop is 76% and the base period is 115 days. The right branch canal carrying discharge of 7.5 $m^3/s$ has culturable command area of 16,400 hectares, intensity of irrigation of Rabi crop is 47% and the base period is 110 days. Determine which canal is more efficient. **(11)**

Contd ..... P/2

## WRE 419

3. (a) Describe the main features of Teesta Barrage Irrigation Project. **(6)**

(b) You are asked to design an irrigation canal for a command area beside Dharla river at Kurigram district. The topographic survey of the command area shows slightly undulation in the land elevations. You are suggested to divert the river water to the main irrigation canal using a barrage. Sketch a qualitative canal network for this command area using the given information as stated above. **(6)**

(c) Write down the factors on which irrigation canal seepage loss depends. **(6)**

(d) Explain the Christiansen formula of measuring pan evaporation to be used in estimating consumptive use. **(6)**

(e) A 52 KW capacity irrigation pump has to be installed with water discharge 68*l*/s through a pipe 24 cm diameter and Darcy-Weisbach friction factor for the pipe material is 0.062. The suction head is 11.50 m. If delivery efficiency of the shaft is 82%, motor efficiency is 88%, pump efficiency is 78%, calculate the delivery head of the pump. **(11)**

4. (a) Differentiate between the concept of true regime channel and final regime channel based of Lacey's arguments and with necessary sketches. **(5)**

(b) In a surface water irrigation project at Thakurgaon, a minor irrigation canal takes off from a distributary canal having its bed elevation 68.00 m and full supply elevation 71.25 m. The culturable command area at the head of the distributary is 134,000 ha and after each km it is reduced by 13,000 ha. The intensity of irrigation for Rabi and Kharif seasons are 36% and 44% respectively. Assume the following data: **(30)**

*Length of minor canal = 7 km*

*Channel losses occur at the rate of 0.65 cumec per km length of the minor canal.*

*Chezy's C = 52 $m^{1/2}/s$.*

*Critical velocity ratio for the soil = 0.85*

*Silt factor = 1.05*

*Peak water demand period for Rabi and Kharif crops are 2 weeks and 3 weeks respectively.*

*Peak water demand for Rabi and Kharif crops are 12 cm and 32 cm respecvtively*

*Ground elevation at the head of the minor canal is 69.25 m and land slope (down) along the proposed alignment is 0.4 m/km.*

*Freedboard = 0.45 m, bank width = 4 m.*

*Assume the reasonable value of any other data if needed.*

Design the canal section for first 2 km length of the minor canal from its head and sketch

(i) one canal cross-section including bank for each km long minor canal (for first 2 km length of minor canal from its head).

(ii) the L-section of this 2 km length of minor canal showing bed and water level elevation.

Contd ..... P/3

**WRE 419**

## SECTION – B

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

5. (a) Discuss critically the quality standard required for irrigation water. **(10)**

   (b) What is meant by 'Border flooding' and how does it differ from 'Check flooding' and 'free flooding'? **(10)**

   (c) Discuss why and when irrigation is necessary and what are the merits and demerits of irrigation. **(8)**

   (d) Determine the time required to irrigate a strip of land of 0.04 hectare from a tube well with a discharge of 0.02 cumec. The infiltration capacity of the soil may be taken as 5 cm/hour and the average depth of the flow on the field as 10 cm. Also determine the maximum area that can be irrigated from this tube well. **(7)**

6. (a) What are the principal causes and effects of water logging in an irrigated land? **(10)**

   (b) In a tile drainage system, the drains are laid with their centres 1.5 m below the ground level. The impervious layer is 9.0 m below the ground level and the average annual rainfall in the area is 80 cm. If 1% of the annual rainfall is to be drained in 24 hours to keep the highest position of the water table 1 m below the ground level, determine the spacing of the drain pipes. Coefficient of permeability may be taken as 0.001 cm/sec. **(10)**

   (c) What are the advantages of using groundwater for irrigation over surface water? What is efflorescence? How saline soils effect the osmotic activity of the plants. **(3+2+3=8)**

   (d) What is Leaching requirement? Derive the expression for 'Leching requirement' in terms of depth of irrigation water and depth of consumptive use. **(7)**

7. (a) Write down the functions of 'under sluices', 'divide wall' and 'fish ladder'. **(10)**

   (b) What are the main functions of head regulator and cross regulator? Write down the function of energy dissipater and explain how it works. **(5+5=10)**

   (c) What are the different types of cross drainage works and explain differences between Syphon Aqueduct and Syphon. **(8)**

   (d) What are the benefits that can be accrued from irrigation projects? **(7)**

8. (a) What is meant by 'saline' and 'alkaline' soils? If you irrigate the land with the saline water, what problems will arise and what precautions you can take? **(10)**

   (b) A surface drainage channel has to be designed for an area of 1000 ha. If the drainage coefficient is 3 cm/day, determine the capacity of the channel and a suitable section of the channel for the given capacity. Take the side slope as 1: 1. Use the Lacey formula with a silt factor, f = 1.0; What will be the Lacey's regime slope? **(10)**

   (c) What are 'tile drains' and how do they help in preventing water logging? How will you decide the depth and spacing of the tile drain? **(8)**

   (d) Draw a typical layout of different tile drainage system and explain each of these. **(7)**

L-4/T-1/WRE **Date : 26/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **WRE 423** (River Engineering and Basin Management)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

Assume reasonable data if not given. Sketch wherever necessary.

1. (a) Illustrate the flow diagram showing conceptual model for river morphology. **(7)**

   (b) Explain the following terms used in river engineering:- **(16)**

   (i) Total sediment load

   (ii) Lane balance

   (iii) River Management

   (iv) Total scour depth

   (c) A river is flowing with bankful discharge 40000 $m^3/s$. Compute the transverse gradient of water surface in a bend of this river having radius of curvature 3 km. Assume reasonable values if not given. **(12)**

2. (a) Illustrate the dependent and independent variable that govern the fluvial system. **(12)**

   (b) Write down the various factors affecting the riverbank erosion. **(8)**

   (c) Explain (i) at-a station hydraulic geometry and (ii) downstream hydraulic geometry of alluvial river. Also compute the hydraulic geometry and average velocity of the river Jumuna for bankfull discharge 50,000 $m^3/s$. Assume reasonable values if not given. **(15)**

3. (a) Explain, how you will carry out the morphological analyses of an alluvial river? **(8)**

   (b) Following data are available for the construction of a circular bridge pier: **(15)**

   - Discharge = 2000 $m^3/s$
   - Average width = 250 m
   - Approaching flow depth=3.5 m
   - Pier diameter =2.0 m
   - Dimensionless critical shear stress = 0.045
   - Median Size of bed particles= 0.20 mm

   Estimate the local scour depth around the pier. Assume reasonable data if not given.

   (c) What do you mean by river restoration? Describe briefly, how you will carry out the river restoration works of rivers in Bangladesh? Answer with an example of rivers around Dhaka city. **(12)**

Contd ..... P/2

**WRE 423**

4. (a) An alluvial river reach AB is 200 m long. At section A, the average flow velocity is 1.45 m/s and sediment discharge is 0.0235 $m^3/s/m$. If the average flow velocity at section B is deceased by 10% of that at section A, compute the bed level changes at section B. Use reasonable values if missing. **(15)**

   (b) Illustrate, how you will assess the dimension (depth and width) of a dredged channel for the navigation of inland vessel? **(8)**

   (c) "Dredge material disposal and management is crucial for a dredging project in Bangladesh". – Justify the statement. Also mention the beneficial uses of dredged materials. **(12)**

## SECTION – B

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

5. (a) Describe the main causes of failure of an earthen dam/levee with neat sketches? What are the general design criteria in designing earthen dams/levees? **(11)**

   (b) Elaborate different types of flood diversion and flood proofing methods to reduce flood damages. **(12)**

   (c) Drainage congestion in the Southern West part of our country is a major hazard. What are the main reasons of such drainage congestion in that part of the country? What remedial measures can be taken to reduce such drainage congestion? **(12)**

6. (a) What does it mean by "Living with Flood? What are the major concepts to estimate flood resilience of a community? **(11)**

   (b) Distinguish between "Risk" and "Vulnerability". What are the significances of flood risk mapping in terms of flood mitigation measures? **(12)**

   (c) Flood is an integral part of the Haor areas. However, and early flash flood can be disastrous in Haor area. What kind of measures or combination of measures would you suggest in reducing the damages in Haor areas from such an early flash flood? **(12)**

7. (a) Distinguish between River Basin Management and Integrated Water Resource Management. Describe major issues in any river basin. **(11)**

   (b) Describe major bio-indicators of an ecosystem. Explain the importance of wetlands of Bangladesh in the context of River Basin Management. **(12)**

   (c) What is an Instream Flow Requirement of a river? Describe different methods to estimate Instream Flow Requirement for a river. **(12)**

8. (a) Write down different components of any water related institutions. **(11)**

   (b) Write down the policy principles of first order and second order in relation to water policy. **(12)**

   (c) Describe the procedures/steps to mitigate water conflicts and water disputes between two nations. **(12)**

L-4/T-1/WRE **Date : 16/10/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **CE 325** (Design of Concrete Structure II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Symbols carry their usual meaning. Assume reasonable values for any missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

1. (a) A circular spirally reinforced column carries unfactored working loads: DL = 800 kip and LL = 500 kip. Design the column with about 2.5% reinforcement. Also design the ACI spiral. Given: $f_c' = 4.0$ ksi and $f_y = 60$ ksi. **(17)**

   (b) Why performance of spiral column is better than tie column? **(8)**

   (c) Show seismic detailing of a tie column which is a part of IMRF system according to BNBC. **(10)**

2. (a) A ground floor column of a 6-storied building is to be designed for the following load combinations (axial force and uniaxial bending)-

   Gravity load combination $P_u = 1200$ kip, $M_u = 200$ kip-ft

   Lateral load combination $P_u = 800$ kip, $M_u = 700$ kip-ft

   Architectural considerations require that a 25in. x 25in. square tied column is to be used. Material strengths are $f_c' = 4.0$ ksi and $f_y = 60$ ksi. Find the required column reinforcement and show in sketch. Use supplied column strength interaction design chart assuming reinforcement distributed along the perimeter and $\gamma$=0.8. **(20)**

   (b) Explain the Seismic Design Philosophy with allowed damage levels under different levels of earthquakes. **(8)**

   (c) Show seismic detailing of a RC beam which is a part of IMRF system according to BNBC. **(7)**

3. (a) A 18 x 24 inch column is reinforced with 8 # 9 bars as shown in Fig. 1. Construct the nominal strength interaction diagram for the column with three points corresponding to pure axial load, pure bending, balanced condition. Also find corresponding $\varphi$ for the above points. Assume bending about Y-Y axis. Given: $f_c' = 4.0$ ksi and $f_y = 60$ ksi. **(18)**

   (b) A flat plate slab without edge beam layout plan of a commercial building is given in Fig. 2. The flat plate has to carry 70 psf dead load and 100 psf live load in addition to its self-weight. Given: $f_c' = 4.0$ ksi and $f_y = 60$ ksi. Determine a uniform thickness for the slab for adequacy against punching shear failure, when no shear reinforcement is used. **(17)**

Contd ..... P/2

## CE 325(WRE)

4. (a) Design only the flexural reinforcement of a typical interior panel of the flat plate slab of Q. 3(b). Use Table 1 to determine the slab thickness. Loads and material strength are same as Q. 3. Show the reinforcements detailing with neat sketches. **(25)**

   (b) What are the different options of providing shear reinforcement in a flat plate? Discuss with neat sketches. **(10)**

### SECTION – B

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

5. (a) A three storied reinforced concrete wall is subjected to factored lateral loads as shown in Fig. 3. The wall is 15 ft long and 10" thick. Design reinforcement for the wall at the first level between the base and the first floor. Given: $f_c' = 4000$ psi and $f_y = 60000$ psi. **(19)**

$$A_w \geq [0.0025 + 0.5\left(2.5 - \frac{h_w}{l_w}\right)\left(\frac{A_u h}{S_2 h} - 0.0025\right)S_1 h$$

$$A_w \geq 0.0025 S_1 h$$

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

$$\frac{z}{l_w} = \frac{1}{2 + \frac{0.85\beta_1 l_w h f_c'}{A_{st} f_y}}; \ \beta_1 = 0.85.$$

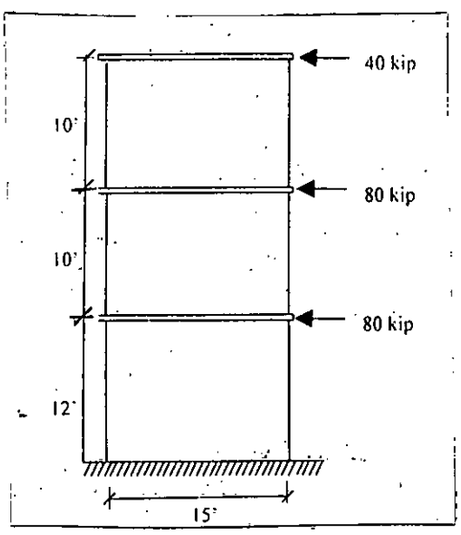


Fig. 3

(b) Design a square footing for an interior column that carries total working DL = 600 kip and LL =400 kip. The column is 25"X25" in cross section. Allowable bearing capacity of soil is 4200 psf. The bottom of the footing is 6 ft below the grade. Show the reinforcement in plan and section with neat sketch. Given: $f_c' = 3000$ psi and $f_y = 60000$ psi. **(16)**

6. (a) Differentiate between: **(12)**

   (i) Stand and cable

   (ii) Pre-tensioning and Post-tensioning

   (iii) Bonded and Unbonded tendons

Contd ..... P/3

**CE 325(WRE)**

Contd...Q. No. 6

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

(c) A post-tensioned bonded concrete beam as shown in Fig. 4 has a prestress of 355 kip in the steel immediately after prestressing and reduces to 308 kip due to losses. In addition to self-weight of 300 lb/ft, there is a live load of 700 lb/ft. Compute the extreme fiber stresses at midspan, **(16)**

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

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

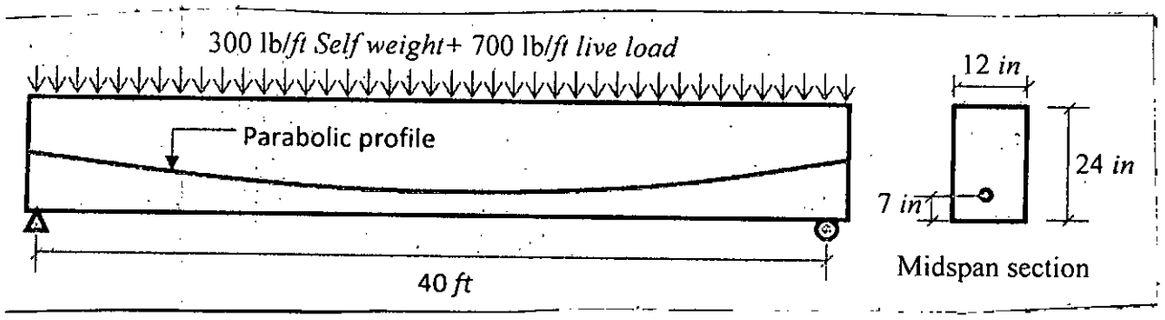


Fig. 4

7. (a) A 15" concrete wall supports a dead load, DL = 16 kip/ft and a live load, LL = 12 kip/ft. The allowable bearing capacity of soil is 4000 psf at the bottom level of footing which is 5ft below grade. Design the footing of the concrete wall with $f_c'$ = 3000 psi and $f_y$= 40000 psi. Check development length. **(21)**

(b) Select the length and width of the combined footing supporting two columns as shown in Fig. 5. The bottom of the footing is 6 ft below grade where allowable bearing capacity is 5000 psf. The outer end of the combined footing cannot protrude beyond the outer face of exterior column which coincides with property line. **(14)**

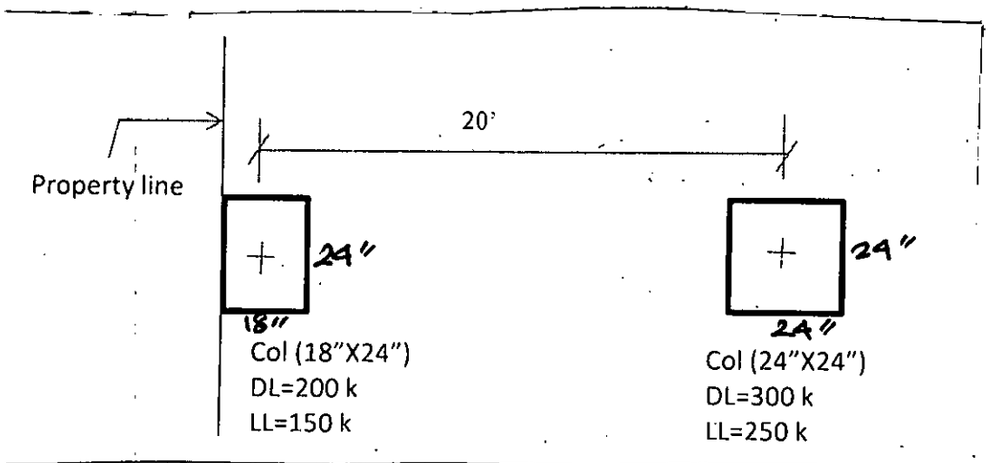


Fig. 5

8. (a) A posttensioned simple beam as shown in Fig. 6 has an initial prestress of 145000 *psi*, reducing to 126000 *psi* after deducting all losses and assuming no bending of the beam. The parabolic cable has an area of 2.8 sq in., n=6. The beam carries superimposed dead load of 800 *plf* in addition to its own weight of 375 *plf*. Compute the stresses in the steel at mispan, assuming: **(18)**

Contd ..... P/4

**CE 325(WRE)**

Contd...Q. No. 8(a)

(i) the steel is bonded by grouting

(ii) the steel is unbonded and free to slip.

(b) For the beam shown in Fig. 6 compute the total dead and live uniform load hat can be carried by the beam. **(17)**

(i) For zero tensile stress at bottom fiber

(ii) For cracking at the bottom fiber at a modulus of rupture of 600 *psi.*

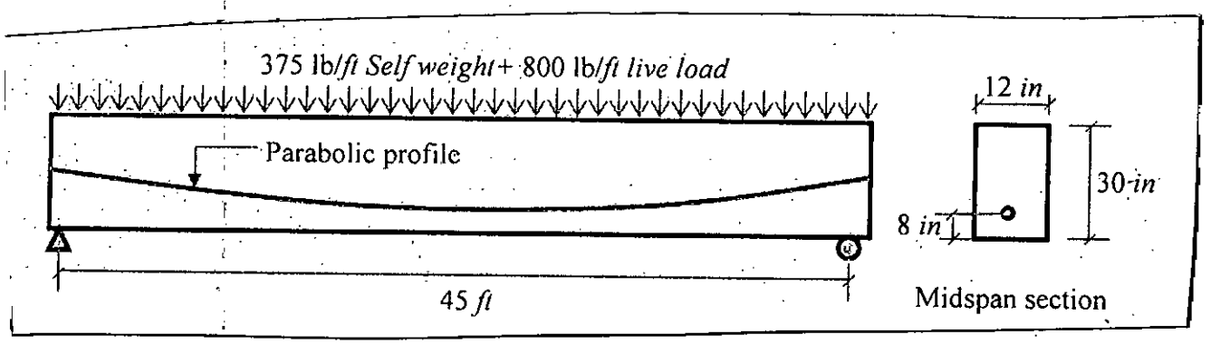


Fig. 6

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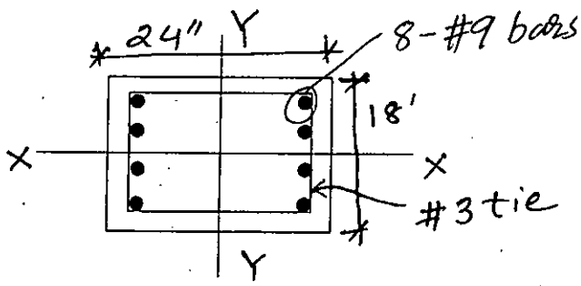
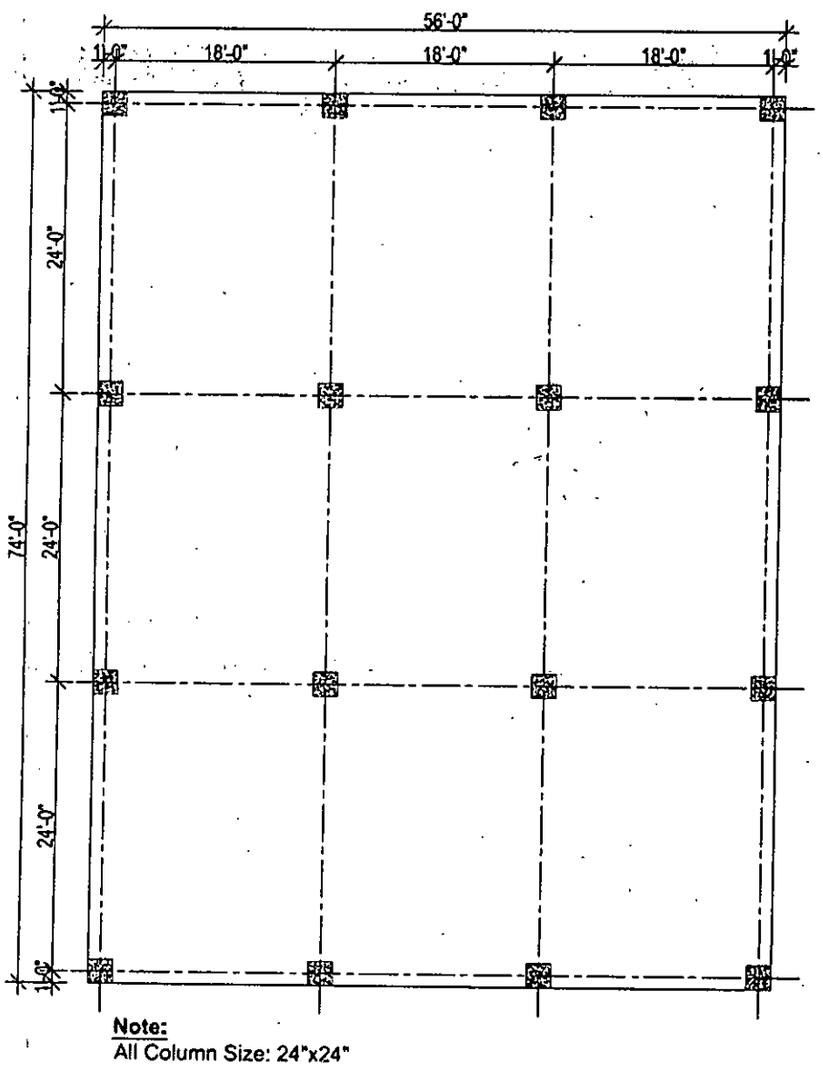



Figure: 1




**Note:**
All Column Size: 24"x24"

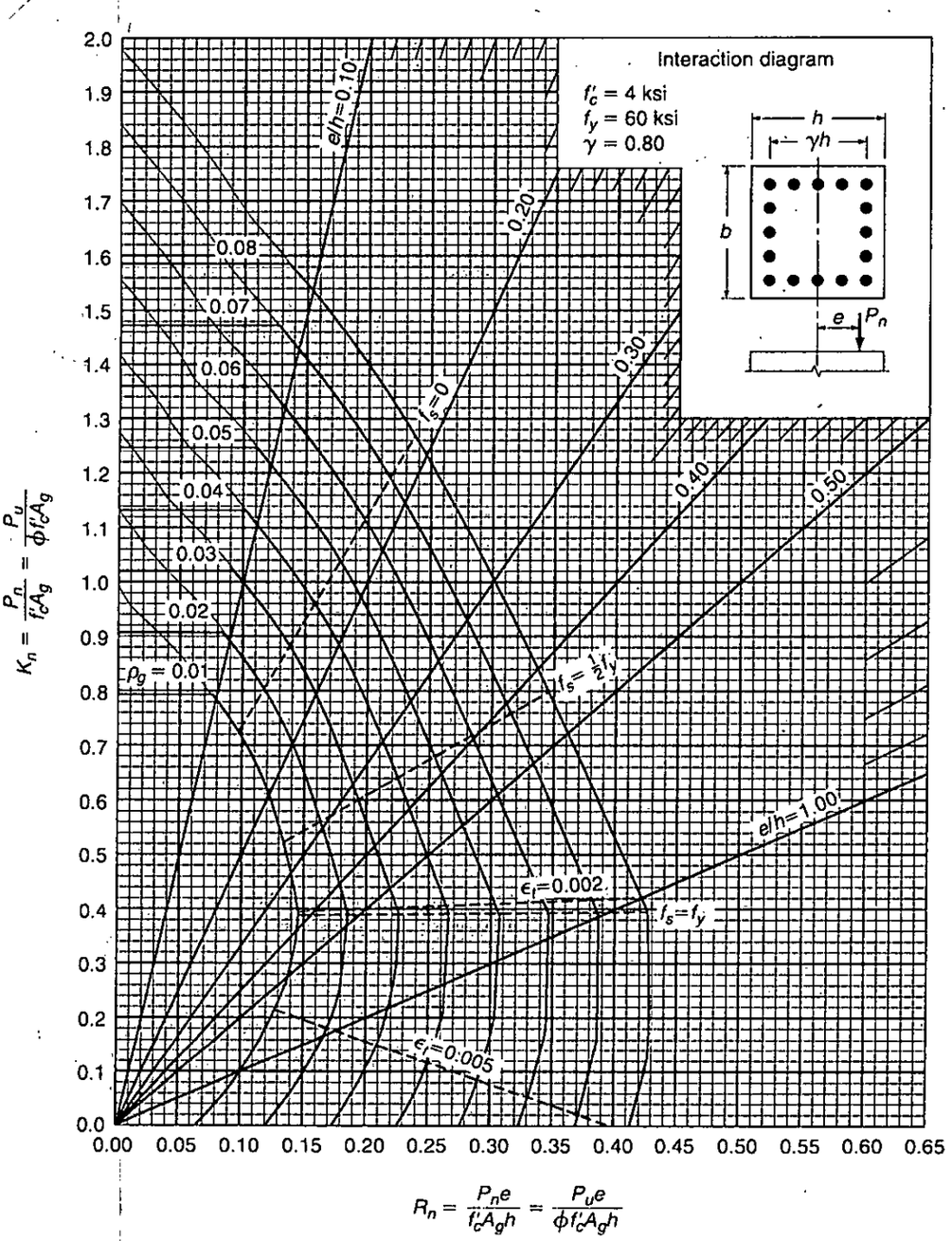
Figure: 2

Table: 1

**Minimum thickness of slabs without interior beams**

| Yield Stress $f_y$ psi | Without Drop Panels | | | With Drop Panels | | |
|---|---|---|---|---|---|---|
| | Exterior Panels | | Interior Panels | Exterior Panels | | Interior Panels |
| | Without Edge Beams | With Edge Beams[a] | | Without Edge Beams | With Edge Beams[a] | |
| 40,000 | $\ell_n/33$ | $\ell_n/36$ | $\ell_n/36$ | $\ell_n/36$ | $\ell_n/40$ | $\ell_n/40$ |
| 60,000 | $\ell_n/30$ | $\ell_n/33$ | $\ell_n/33$ | $\ell_n/33$ | $\ell_n/36$ | $\ell_n/36$ |
| 75,000 | $\ell_n/28$ | $\ell_n/31$ | $\ell_n/31$ | $\ell_n/31$ | $\ell_n/34$ | $\ell_n/34$ |

[a] Slabs with beams along exterior edges. The value of $\alpha_f$ for the edge beam shall not be less than 0.8.




**GRAPH A.7**
Column strength interaction diagram for rectangular section with bars on four faces and $\gamma = 0.80$.

L-4/T-1/WRE **Date : 25/09/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2020-2021

Sub : **CE 425** (Structural Analysis and Design II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data, If any. Neglect axial deformation of members unless otherwise stated. USE SEPARATE SCRIPTS FOR EACH SECTION

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## SECTION – A

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

1. In the beam shown in Figure 1, the support at C rotates 0.04 radian clockwise. Using flexibility method, determine vertical reaction at B and moment at C. **EI is constant**. Use attached table of **Product integral**. **(26¼)**

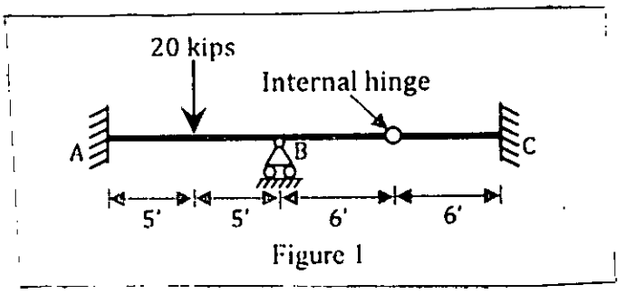

Figure 1

2. Analyze the pin connected steel structure shown in Figure 2 using the Stiffness Method and find the reaction forces at all supports. **AE is constant for all members**. **(26¼)**

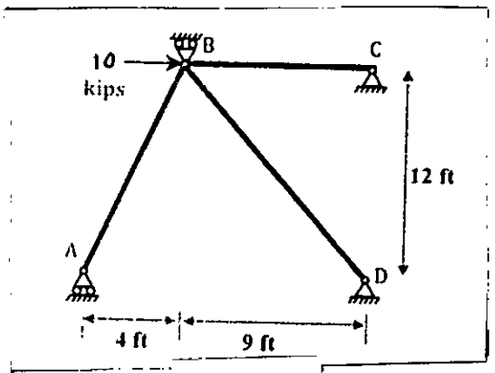

Figure 2

3. Analyze the following truss (Figure 3) using the flexibility method. Find all member forces if the top cord (45) experiences a temperature rise of 20°C and a misfit of amount $\frac{5\sqrt{2}}{AE}$ exists in cord (25) respectively. **$\alpha$ = 13 X $10^{-6}$/°C and E is constant for all members.** **(26¼)**

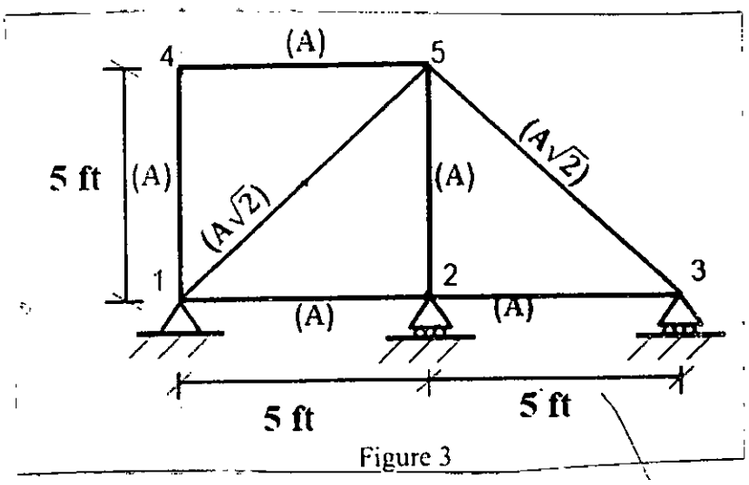

Figure 3

Contd ..... P/2

## CE 425(WRE)

4. (i) Draw qualitative Influence lines for $R_B$. $R_C$ $R_D$. $R_E$. $V_{C(Left)}$. $V_{C(Right)}$. $V_Q$. $M_P$. $M_R$ and $M_C$ of the the continueus beam shown in Figure 4. Here, P, Q and R are the middle pints of span BC, CD and DE respectively. Symbol R, V and M present reaction, shear and moment at different points.

(ii) Identify spans which should be loaded to get maximum effect for moment at P, R and C points. **(26¼)**

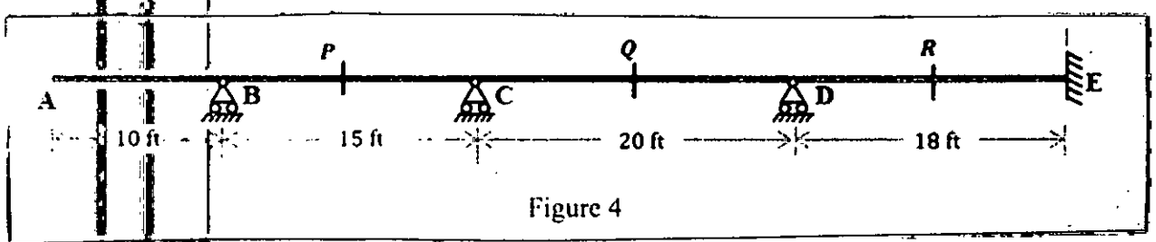


Figure 4

5. Analyze the beam shown in Figure 5 usng Stiffness Method and draw the shear force diagram and bending moment diagram. **(26¼)**

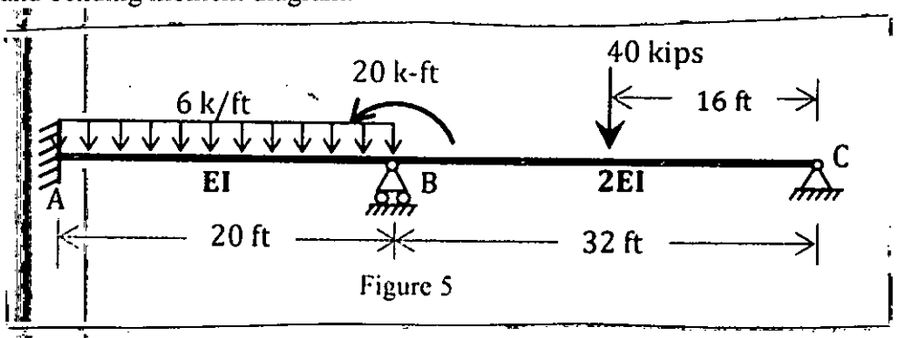


Figure 5

## SECTION – B

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

6. In the beam shown in Figure 6, the support at A settles down by 0.2 feet and the support at C rotates 0.05 radian clockwise. Analyze the beam using the Moment Distribution Method and draw the shear force diagram of the beam. **(26¼)**

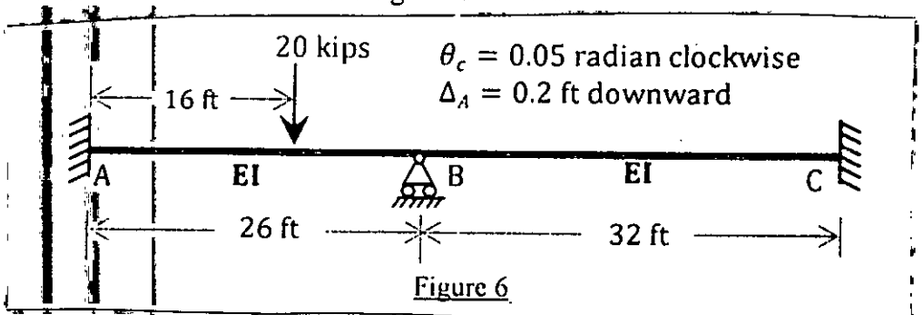


Figure 6

7. Analyze the frame shown in Figure 7 using the Moment Distribution Method, and find the moment and vertical reaction at A. **(26¼)**

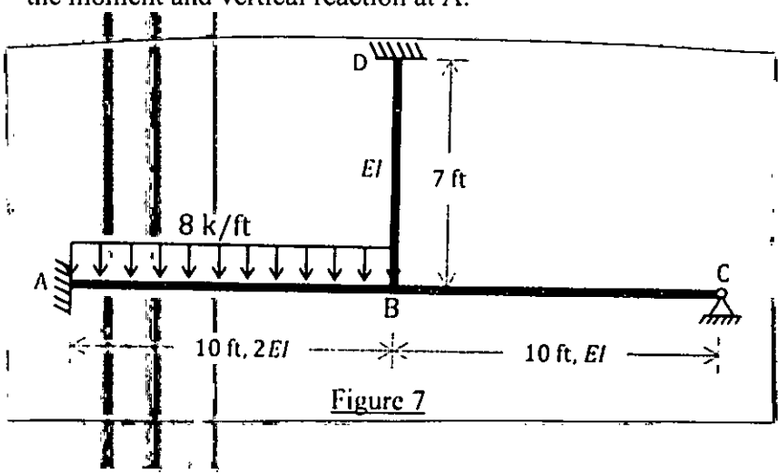


Figure 7

Contd ..... P/3

## CE 425(WRE)

8. Analyze the frame in Figure 8 using the moment distribution method and find the reactions at support A. **(26¼)**

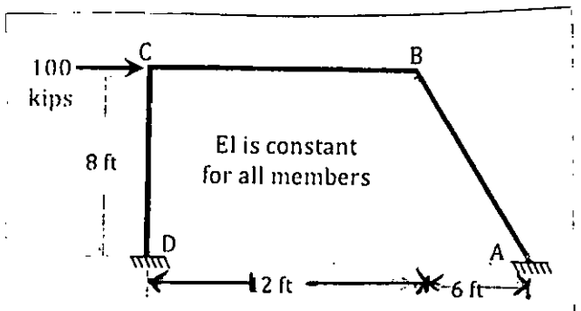


Figure 8

9. In the frame shown in Figure 9, the support at A settles down by 0.5 ft. Find the stiffness equations for this frame and show them in matrix form. Given, $EI$=5000 k-ft$^2$. **(26¼)**

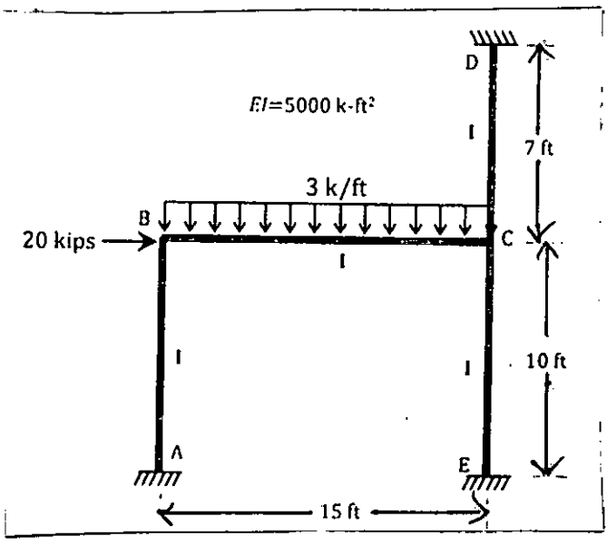


Figure 9

10. Analyze the plane grid shown in Figure 10 using the Stiffness Method, and find the bending moment and vertical reaction at support A. **(26¼)**

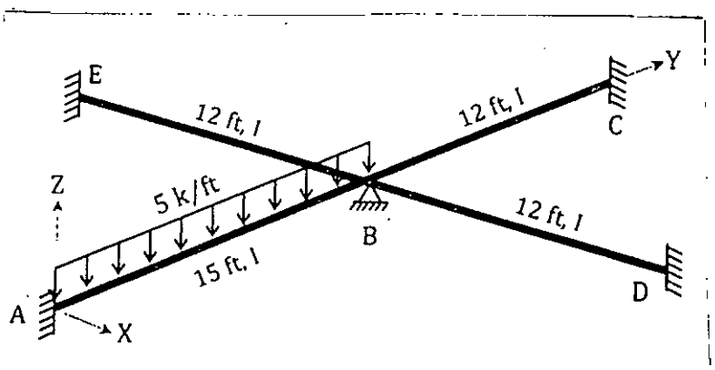


Figure 10

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Product Integral

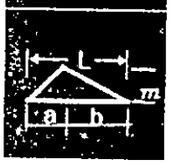
| $\int_0^L mm'dx$  |  |  |  |  |
|---|---|---|---|---|
|  | $mm'L$ | $\frac{1}{2}mm'L$ | $\frac{1}{2}m(m_1' + m_2')L$ | $\frac{2}{3}mm'L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{3}mm'L$ | $\frac{1}{6}m(m_1' + 2m_2')L$ | $\frac{5}{12}mm'L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{6}mm'L$ | $\frac{1}{6}m(2m_1' + m_2')L$ | $\frac{1}{4}mm'L$ |
|  | $\frac{1}{2}(m_1 + m_2)m'L$ | $\frac{1}{6}(m_1 + 2m_2)m'L$ | $\frac{1}{6}m_1(2m_1' + m_2')L + \frac{1}{6}m_2(m_1' + 2m_2')L$ | $\frac{1}{12}m'(3m_1 + 5m_2)L$ |
|  | $\frac{1}{2}mm'L$ | $\frac{1}{6}mm'(L + a)$ | $\frac{1}{6}m[m_1'(L + b) + m_2'(L + a)]$ | $\frac{1}{12}mm'\left(3 + \frac{3a}{L} - \frac{a^2}{L^2}\right)L$ |

Table 1: Table for Product Integral (Ques. 01)

Product Integral

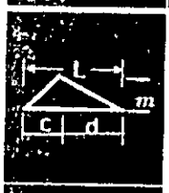
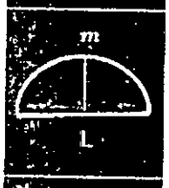
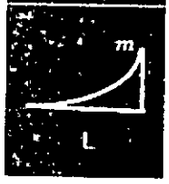
| $\int_0^L mm'dx$  |  |  |  |
|---|---|---|---|
|  | $\frac{1}{2}mm'L$ | $\frac{1}{6}mm'(L + a)$ | $\frac{1}{6}m[m_1'(L + b) + m_2'(L + a)]$ | For $c \le a$: $\left(\frac{1}{3} - \frac{(a-c)^2}{6ad}\right)mm'L$ |
|  | $\frac{2}{3}mm'L$ | $\frac{1}{3}mm'L$ | $\frac{1}{3}m(m_1' + m_2')L$ | $\frac{1}{3}mm'\left(L + \frac{ab}{L}\right)$ |
|  | $\frac{1}{3}mm'L$ | $\frac{1}{4}mm'L$ | $\frac{1}{12}m(m_1' + 3m_2')L$ | $\frac{1}{12}mm'\left(3a + \frac{a^2}{L^2}\right)$ |

Table 2: Table for Product Integral (Contd.) (Ques. 01)