L-3/T-1/WRE **Date: 01/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **WRE 301** (Open Channel Flow)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Define Prismatic, Non-prismatic, Natural and Artificial channels. **(6)**

(b) Why velocity distribution coefficients are used in open channel flow problems? **(4⅔)**

(c) Show that for a channel with large slope the pressure distribution is less than the hydrostatic pressure. **(6)**

(d) The velocity distribution in a rectangular channel of width B and depth of flow y_0 was approximated as $v = k_1\sqrt{y}$, where $k_1 =$ a constant. Calculate the average velocity for the cross section and α and β. **(15)**

(e) The following data were obtained in a stream gauging operation. A current meter with a calibration equation, v = (0.3 N + 0.03) m/s where N = revolutions per second, was used to measure the velocity at 0.6 depth. **(15)**

Calculate the discharge.

Distance, m	0	2	4	6	9	12	15	18	20	22	23	24
Depth, m	0	0.5	1.2	1.9	2.3	1.8	1.7	1.6	1.5	1.2	0.8	0
No. of revolution	0	75	80	125	140	120	110	105	90	85	70	0
Time, s	0	150	120	120	120	120	120	120	120	120	150	0

2. (a) Define Conveyance and Section factor for uniform flow. **(6)**

(b) Uniform flow of an ideal fluid on a sloping channel is impossible. Why? **(4⅔)**

(c) Derive Chezy's formula. **(6)**

(d) A rectangular channel 2.0 m wide carries water at 20°C at a depth of 0.5 m. The channel is laid on a slope of 0.004. Find the hydrodynamic nature of the surface if the channel is made of (i) very smooth concrete (k_s = 0.25 mm) and (ii) rough concrete (k_s = 3.5 mm). **(15)**

(e) A channel consists of a main section and two side sections as shown in Figure 1. Compute the total discharge, the mean velocity of flow and the Manning's n for the entire section when n = 0.025 for the main channel and n = 0.045 for the side channels and S_0 = 0.0002. Also compute α and β for the entire section assuming that $\alpha = \beta = 1$ for the main and the side sections. **(15)**

Contd P/2

3. (a) State momentum principle. Why the momentum principle is used in hydraulic jump analysis? (6)

   (b) How the channel irregularity and alignment effect the Manning's roughness n. **(4⅔)**

   (c) Derive the equation of head loss, h_L for hydraulic jump in a horizontal rectangular channel. **(6)**

   (d) Water flows at a velocity of 1 m/s in an open channel under uniform flow condition. The longitudinal slope of the channel is 0.0016 and n = 0.02. Compute the depth of the flow when the channel is parabolic whose profile is $y^2 = 4z$. **(15)**

   (e) An earthen trapezoidal channel (n = 0.025) has B = 5.0 m, y_0 = 1.1 m and side slope 1.5H : 1V. In an economic study to remedy excessive seepage from the canal two proposals, (i) to line the sides only and (ii) to line the bed only are considered. If the lining is of smooth concrete (n = 0.012), determine the equivalent roughness in the above two cases. **(15)**

4. (a) What is stilling basin? What are the purposes of providing stilling basin? Write down the various appurtenances of stilling basin. **(2+2+2=6)**

   (b) Describe the different types of hydraulic jumps that occur in horizontal sloping channel with neat sketches. **(4⅔)**

   (c) Write down the working principles of four types of stilling basins. **(6)**

   (d) The values of variables in connection with one hydraulic jump in horizontal rectangular channel are given in the following table. Compute the values of the other variables in the table. **(15)**

	Y_1(m)	V_1(m/s)	Y_2(m)	V_2(m/s)	q(m^2/s)	F_{r1}	F_{r2}	h_L	L_j
Jump 1	0.3		2.8						

   (e) Water flows at a depth of 1 m in a horizontal triangular channel having side slope 2H : 1V and carries a discharge of 20 m^3/s. Compute the downstream depth that will form a hydraulic jump. **(15)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
Assume any reasonable value if data is not given.

5. (a) Define gradually varied flow, rapidly varied flow and spatially varied flow. Sketch and show gradually varied and rapidly varied flow zone in a single setup. **(10)**

   (b) Derive Euler equation of motion for steady uniform flow. **(10)**

   (c) Describe characteristics of specific energy curve with sketch. A rectangular channel has a bottom width of 6 m. Construct a specific energy curve for Q = 15 m^3/s and determine the critical depth and minimum value of specific energy from the curve. **(26⅔)**

Contd P/3

6. (a) Derive an expression of hydraulic exponent for critical flow computation and use it to determine the value of hydraulic exponent for trapezoidal channel. **(11)**

(b) Water is flowing at velocity of 2 m/s and a depth of 2.5 m in a long rectangular channel of 6 m wide. Compute (a) the contraction in width of the channel for producing critical flow, and (b) the depth and change in water level produced by (i) a smooth contraction in width to 5 m, (ii) a smooth contraction in width to 3 m. In all cases neglect energy losses and take $\alpha = 1$. **($19\frac{2}{3}$)**

(c) For trapezoidal channel with $b = 6$ m and $z = 2$, compute the critical depth by Newton-Raphson Method if $Q = 14$ m^3/s and $\alpha = 1$. **(16)**

7. (a) Define tractive force and tractive force ratio. Derive the expression of tractive force ratio. **(10)**

(b) The cross sectional area of a channel is 40 m^2. Calculate wetted perimeter and the hydraulic radius using best hydraulic section for following channel sections (i) rectangular (ii) triangular (iii) trapezoidal. Also determine which cross section can be considered as best from above three and why? **(18)**

(c) What are the assumptions of Lacey's Regime Theory? Using Lacey's method, design a stable alluvial channel when $d_{50} = 1.5$ mm and discharge 25 m^3/s. **($18\frac{2}{3}$)**

8. (a) Discuss the behavior of flow profiles in different regions of adverse channel with sketches. **(10)**

(b) Sketch the possible flow profile (with types) in the following serial arrangement of the channels. The flow is from left to right. **(15)**

   (i) mild-steep-mild
   (ii) upstream of an overflow weir in a mild sloping channel
   (iii) free overfall at the end of mild slope channel.

(c) A trapezoidal channel having $b = 6.09$ m, $z = 2$, $S_0 = 0.0016$ and $n = 0.025$ carries a discharge of 11.3 m^3/s. Compute the backwater profile created by the dam which backs up the water to a depth of 1.52 m immediately behind the dam by direct step method. The upstream end of the profile is assumed at a depth equal to 1% of greater than normal depth (1.02 m) of the channel. Given $y_c = 0.68$ m and $\alpha = 1.10$. **($21\frac{2}{3}$)**

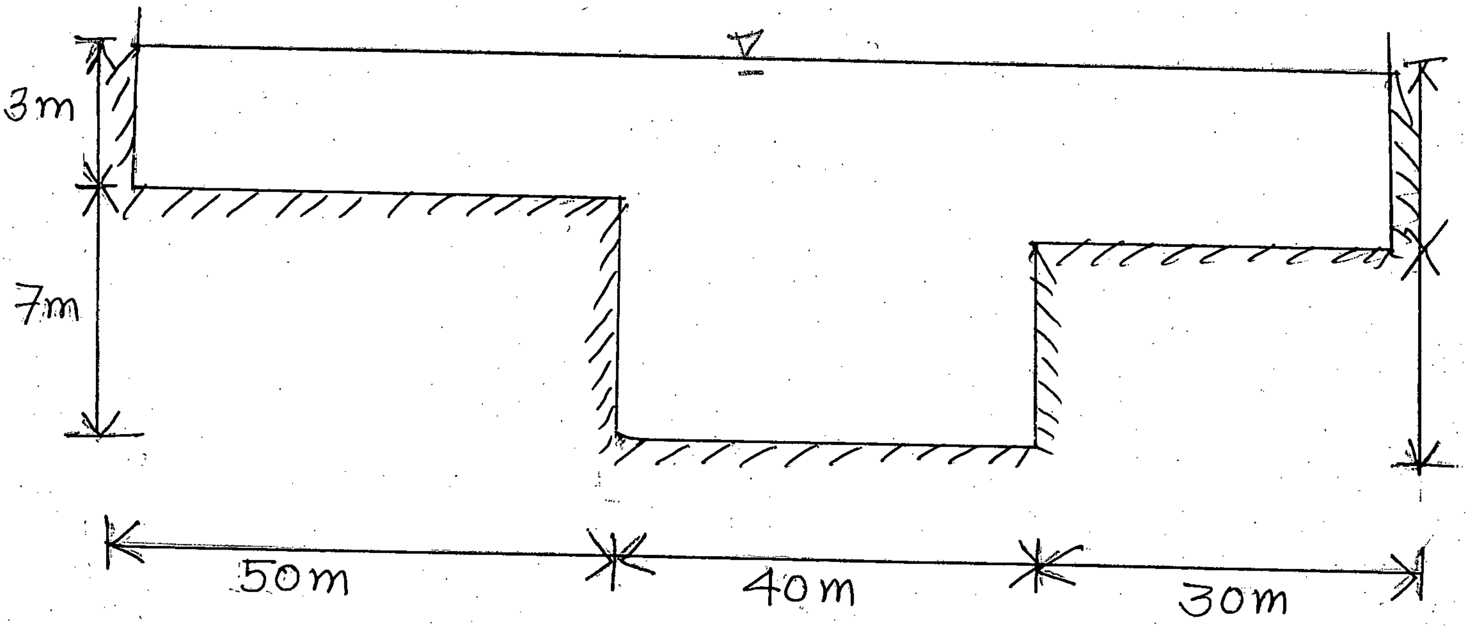


Figure 1 for the Ques 2(e)

L-3/T-1/WRE **Date: 11/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B.Sc. Engineering Examinations 2017-2018

Sub : **CE 381** (Principles of Soil Mechanics)

Full Marks: 280 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

Assume any reasonable value of missing data.

1. (a) The current σ'_z at a certain point in a saturated clay is 181 kPa. This soil is to be covered with a 2.5 m thick fill that will have a unit weight of 19.3 kN/m^3. What will be the value of σ'_z at this point immediately after the fill is placed (i.e., before any consolidation has occurred)? What will it be after the consolidation settlement is completed? **$(16\frac{2}{3})$**

Also, show graphically (i) variation of U_z(%) with T_v and z/H_{dr} and (ii) average degree of consolidation, U (%) with T_v.

(b) Deduce: $S_c = \frac{c_c H}{1+e_0} \log_{10} \frac{\Delta\sigma + \sigma'_0}{\sigma'_0}$ for normally consolidated clay. Start with the laboratory e~logσ' plot and use phase diagram of soil element. **(15)**

(c) Following are the results of a laboratory consolidation test on a soil specimen: dry mass of the specimen = 128 gm and specific gravity of soil solids = 2.75. What is initial void ratio of the sample? **(15)**

State the procedure to determine the pre-consolidation pressure σ'_c from the laboratory e~logσ' plot.

2. (a) Using basic definition (don't use phase diagram), derive the following equation for a soil element: **$(16\frac{2}{3})$**

$$\gamma_{sat} = \frac{(e+G_s)\gamma_w}{1+e_0}$$

Also, write short notes on: Dynamic compaction technique and depth of influence zone of compaction.

(b) A field density test has been conducted in a compacted fill that is currently under construction. The test results indicate a relative compaction of 101-103%, which made the construction manager believe the test must be incorrect. He believes it is impossible for the dry unit weight in the field to be greater than the maximum dry unit weight from the Proctor compaction test. Do you think the construction manager's concern is correct? Justify your answer. **(10)**

(c) Explain: **(20)**

(i) The unit, in which the compaction is measured,
(ii) 95 percent of proctor density;
(iii) Zero air-voids line, and
(iv) Effect of compaction on the shear strength of soil.

Contd P/2

3. (a) What are the types of rollers used for compacting different types of soils in the field? Write down the properties (test specifications) of Modified Proctor test. How do you use the information of laboratory compaction test result of a clay in the field in quality control scheme? **($16\frac{2}{3}$)**

(b) Describe the field density determination test conducted by sand cone method. Write short notes on 'Suitability index". **(15)**

(c) A proposed embankment fill requires 5000 m^3 of compacted fill. The void ratio of the compacted fill is specified as 0.7. Four borrow pits (namely: A, B, C and D) are available as described in the following table, which lists the respective void ratios of the soil and the cost per cubic meter for moving the soil to the proposed construction site. Make necessary calculations to select the pit from which the soil should be brought to minimize the cost. Assume G_s to be the same at all the pits. **(15)**

Borrow pit	Void ratio	Cost (Tk/m^3)
A	0.85	720
B	1.2	480
C	0.95	560
D	0.75	800

4. (a) State the lateral earth pressure conditions for the following cases with brief reasoning: **(10)**

(i) Design of a basement wall
(ii) Design of a free-standing cantilever wall

(b) A wall with a smooth vertical back 3 m high retains a mass of dry cohesionless sand that has a horizontal surface. The sand weights 18 kN/m^3 and has an angle of internal friction of 36°. What is the approximate resultant against the wall, if the wall is prevented from yielding? Will the wall yield far enough to satisfy the deformation condition for the active Rankine state? **(20)**

(c) State the assumption of Rankine's theory of lateral pressure for cohesionless soil. Also, derive $K_p = tan^2(45^\circ + \phi/2)$ for passive lateral earth pressure condition in granular soil. **($16\frac{2}{3}$)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE** questions.
Use attached charts where necessary .

5. (a) Write the salient features of drained and undarined conditions. **($10\frac{2}{3}$)**

Contd P/3

Contd... Q. No. 5

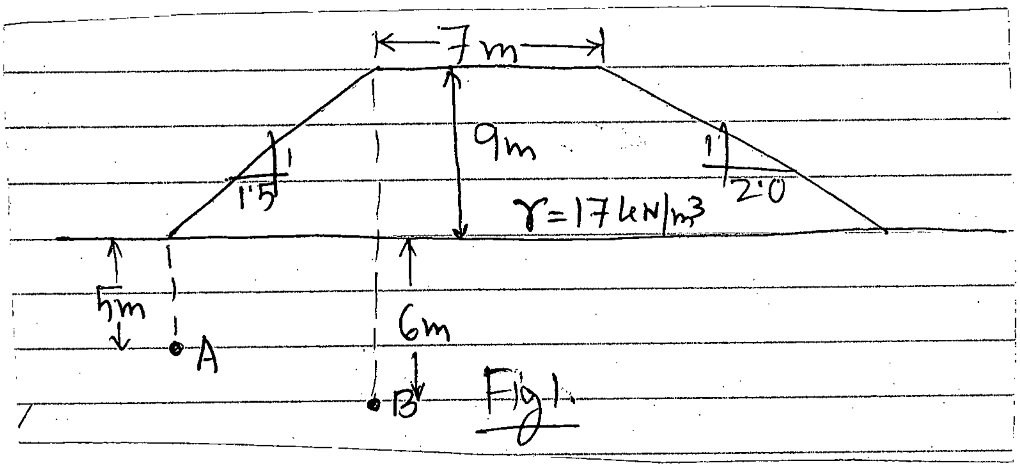
(b) Discuss and explain the following soil models **(18)**

(i) Friction model

(ii) Extended friction model

(iii) Mohr-Coulomb model

(c) An embankment is shown in Figure 1. Determine the stress increase under the embankment at points A and B. **(18)**



6. (a) Describe the method to obtain increase in vertical stress due to uniformly loaded area of any shape. **(10)**

(b) Derive ϕ'_{cs} and θ for Mohr-Coulomb Model. **(10)**

(c) Draw neatly the plasticity chart according to USCS system showing the classification of different soil deposits. **($8\frac{2}{3}$)**

(d) A rectangular foundation 7m × 3m carries a uniform pressure of 250 KPa near the surface of soil mass. Determine the vertical stress at a depth of 3.5 m below a point on the center line and 1.5 m outside a long edge of the foundation. **(18)**

7. (a) Write Bernoulli's equation and explain the different terms used. **($6\frac{2}{3}$)**

(b) Derive the following two equations **(12)**

(i) Seepage velocity $(v_s) = \dfrac{\text{discharge velocity}(v)}{\text{posrosity(n)}}$

(ii) $K_{20^\circ C} = \dfrac{\eta_{T^\circ C}}{\eta_{20^\circ C}} K_{T^\circ C}$

where K= hydraulic conductivity

η = viscosity of water

(c) Derive an expression for seepage from a flow net, through a neat sketch. **(10)**

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Contd... Q. No. 7

(d) Figure 2 shows a weir, the base of which is 2m below the ground surface. Estimate the uplift force below the weir. **(18)**

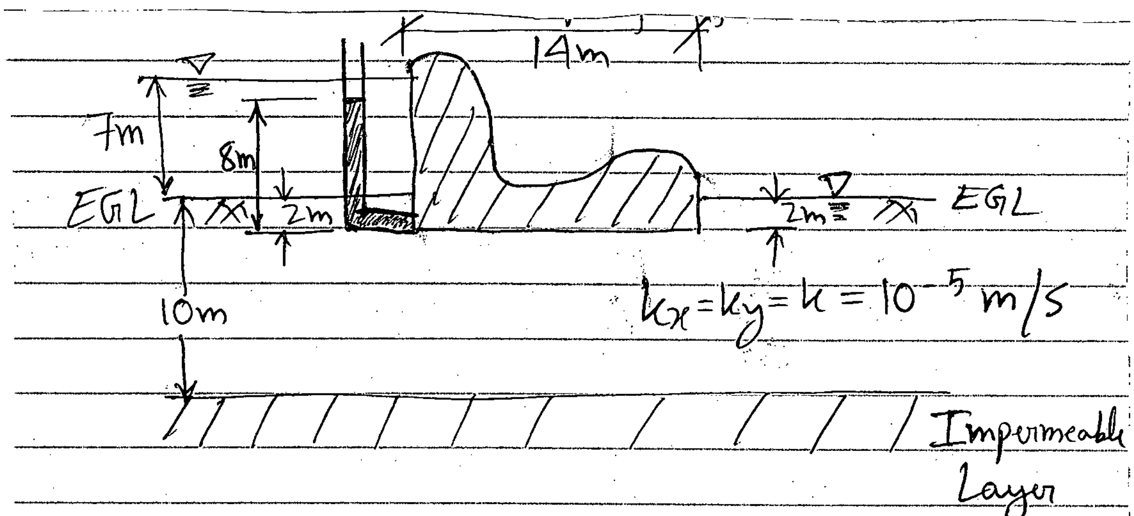

Fig 2.

8. (a) Explain the following with necessary mathematical expressions: **(15)**

   (i) Surface Tension

   (ii) Critical Hydraulic Gradient

   (iii) Sensitivity

   (b) Explain the structures and other features of the following clay minerals with neat sketches: **(18)**

   (i) Kaolimite, (ii) Montmorillonite, (iii) Illite

   (c) The natural soils along a proposed highway alignment have the following grain size distributions: **($13\frac{2}{3}$)**

Passing # 4 sieve = 94%

Passing # 10 sieve = 76%

Passing # 40 sieve = 29%

Passing # 100 sieve = 16%

Passing # 200 sieve = 9%

The soil has liquid limit of 33 and a plastic limit of 26. Determine the AASHTO soil classification and rate its suitability for pavement support.

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General Classification	Granular Material (35% or less passing No. 200 sieve)							Silt Clay Materials (More than 35% passing No. 200 Sieve)			
Group Classification	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6
Sieve Analysis; Percent Passing											
No. 10	50 max	—	—	—	—	—	—	—	—	—	—
No. 40	30 max	50 max	51 min	—	—	—	—	—	—	—	—
No. 200	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min	36 min
Characteristics of fraction passing No. 40											
Liquid Limit	—		—	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min*
Plasticity Index	6 max		N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min*
Usual types of significant constituent materials	Stone Fragments; gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils	
General Rating as Subgrade	Excellent to good							Fair to poor			

- Plasticity index of A-7-5 subgroup is equal to or less than L.L. minus 30.
- Plasticity Index of A-7-6 subgroup is greater than L.L. minus 30.

Chart 1 AASHTO soil classification system (after Atkins, 1997)

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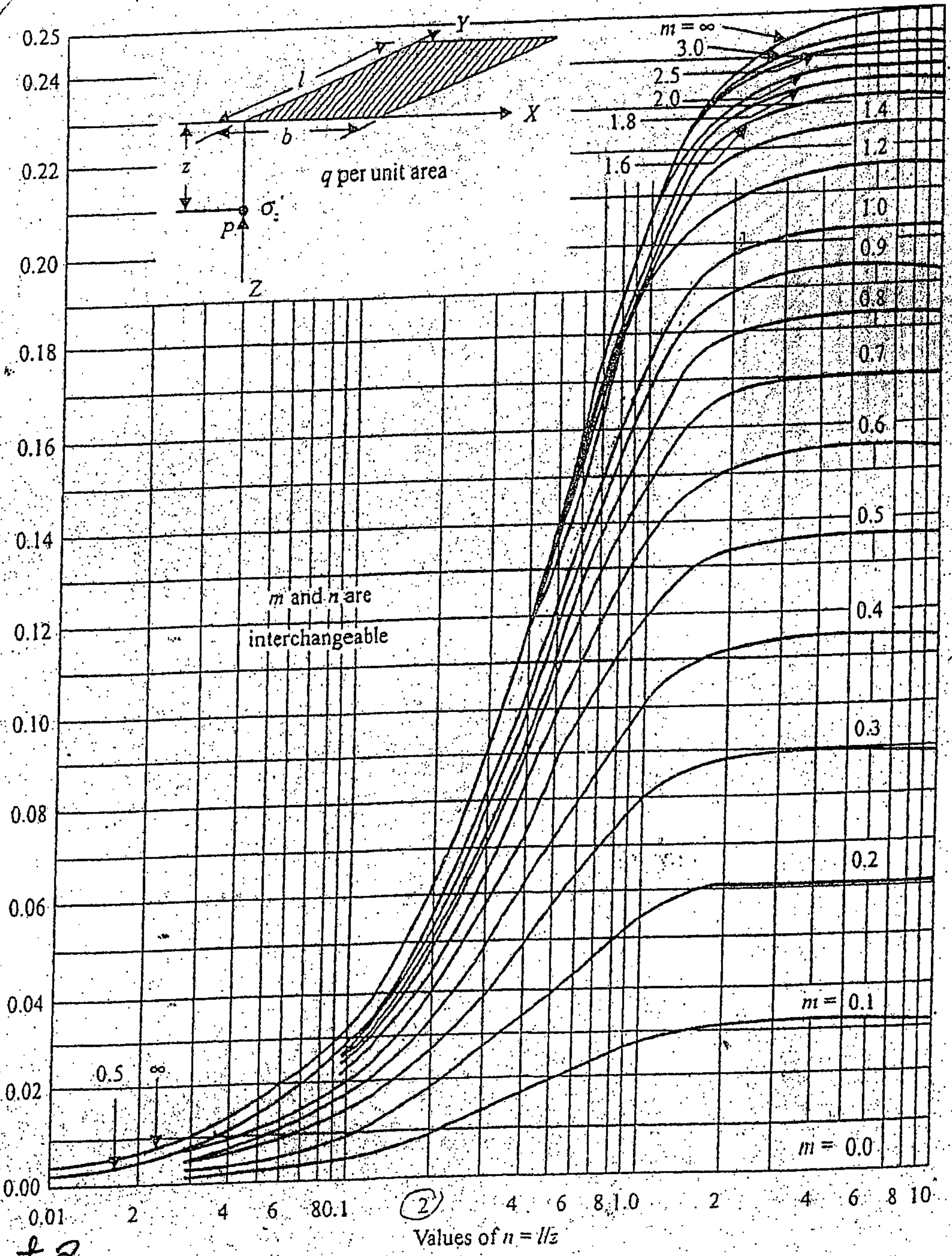

Chart 2

Fadum's chart for obtaining Newmark's influence coefficient, I in terms of m and n.

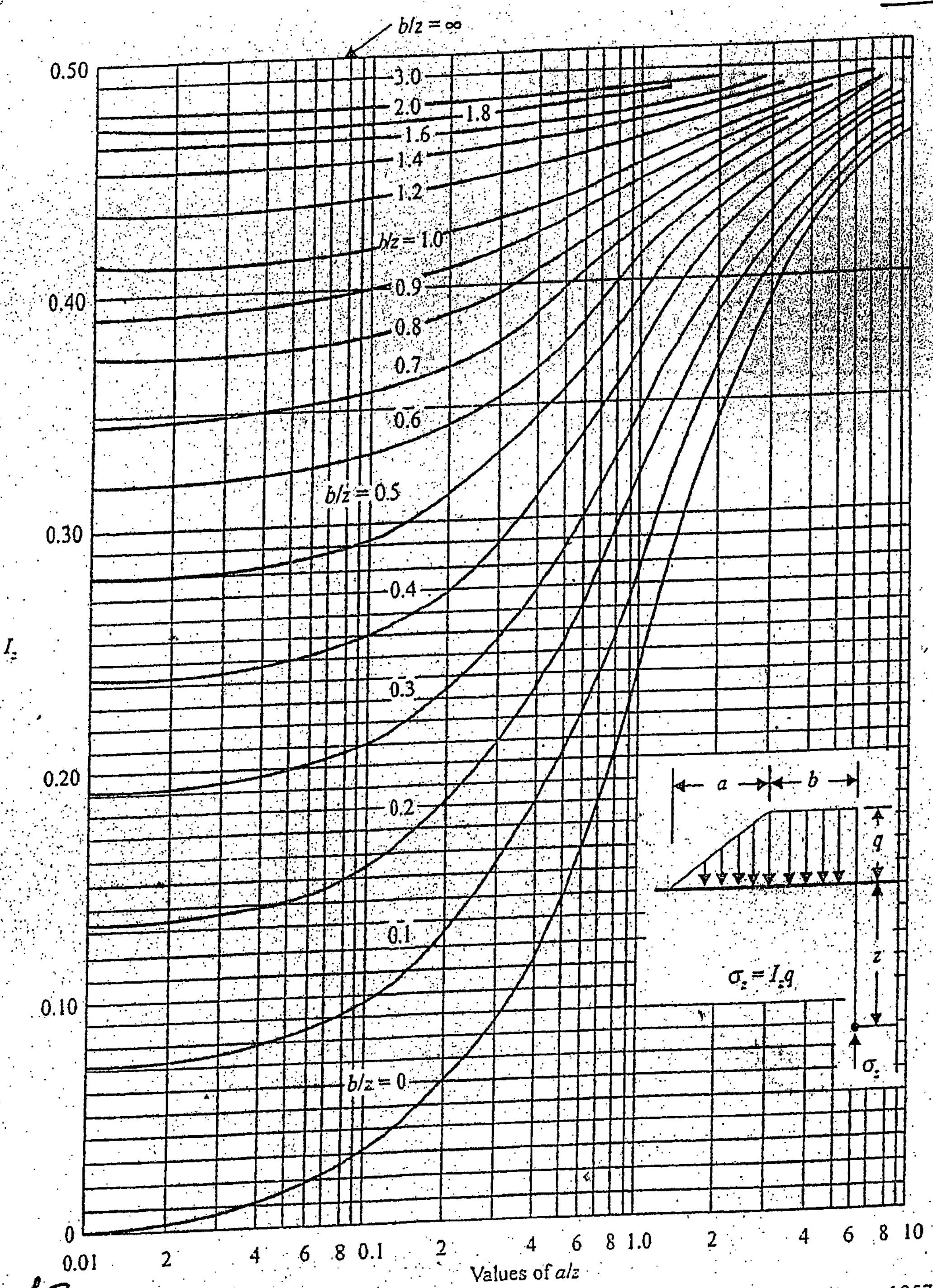

Chart 3

3 Influence coefficient for vertical stress under a long embankment (after Osterberg, 1957).

L-3/T-1/WRE **Date: 17/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **CE 323** (Design of Concrete Structures I)

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) Why do we provide temperature and shrinkage reinforcement in slab? **(5)**

(b) Design the one way slab panel "S1" as shown in Fig. 1. The slab carries a uniform live load of 40 psf and dead load of 35 psf in addition to its self-weight. Draw the reinforcement details also. Use Fig. 2 for calculation. **(18)**

Given, $f_c' = 3$ ksi, $f_y = 60$ ksi.

(c) Design the beam "B1" as shown in Fig. 1, supporting the slab system with loading as described in problem 1(b). **(12)**

Given, $f_c' = 4$ ksi, $f_y = 60$ ksi.

2. (a) For a slab with longer to shorter span ratio greater than 2, it acts as a one way slab. Why? **(5)**

(b) Design the two way slabs panel "S1" as shown in Fig. 3. The slab carries a uniform live load of 60 psf and a super-imposed dead load (floor finish and partition wall) of 50 psf in addition to its self-weight. Draw the reinforcement details also. Use Table 1, 2, and 3 for calculation. **(22)**

Given, $f_c' = 4$ ksi, $f_y = 60$ ksi.

(c) Why hooks are provided in the reinforcing bars? Draw neat sketch showing the standard bar hooks dimensions according to ACI code. **(8)**

3. (a) What do you mean by development length of a reinforcing bar? What are the factors that influence the development length? **(5)**

(b) For the beam cross section shown in Fig. 4, what are the development lengths of the top #6 bars and bottom #9 bars for #4 (No. 13) stirrups with $1\frac{1}{2}$ inch clear side cover spaced at 6 inch? Use the simplified development length equations. Given, normal weight concrete, $f_c' = 4000$ psi. **(15)**

(c) In reference to Fig. 5, four #10 column bars from the floor below are to be lap-spliced with four #9 column bars from above, and the splice is to be made just above a construction joint at floor level. The column, measuring 12 × 22 inch in cross section, will be subject to compression only for a load combinations. Transverse reinforcement consists of #4 ties at 12 inch spacing. All vertical bars may be assumed to be fully stressed. Calculate the required splice length. Material strengths are $f_y = 60$ ksi and $f_c' = 4$ ksi. **(15)**

Contd P/2

4. (a) What do you mean by one way slab and two way slab? **(3)**

(b) Describe briefly the primary torsion and secondary torsion with neat sketches. **(7)**

(c) The 25 ft span beam shown in Fig. 6 carries a monolithic slab cantilevering 6 ft past the beam centerline. The resulting L beam supports a live load of 950 lb/ft along the beam centerline plus 50 psf uniformly distributed live load over the upper slab surface. The effective depth to the flexural steel centroid is 21.5 in., and the distance from the beam surfaces to the centroid of stirrup steel is $1\frac{3}{4}$ inch. Material strengths are $f'_c = 4000$ psi and $f_y = 60{,}000$ psi. **(25)**

(i) Check whether torsional reinforcement is required or not.

(ii) Check whether the beam section is adequate to satisfy the limiting criteria for combined shear and torsional stresses as per ACI code?

(iii) Calculate the required spacing of the #4 stirrups for the torsion and shear values at a distance **d** from the column face.

(iv) Also calculate the longitudinal reinforcement for torsion at a distance **d** from the column face.

SECTION – B

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

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

5. (a) What do you mean by concrete cylinder strength, f'_c, and yield strength of steel f_y? **(5)**

(b) An 8 ft span cantilever beam has a rectangular section (b = 8", h = 18", and $d = 15\frac{1}{2}$). It is reinforced with 3#7 bars at the top. The beam carries a dead load, including its own weight, of 1.5 k/ft and a live load of 0.9 k/ft. Using $f'_c = 4$ ksi, $f_y = 60$ ksi, check if the beam is safe to carry the above loads. **(12)**

(c) A rectangular beam (b = 12", h = 28", and d = 26") is reinforced with 3#9 bars at the bottom. Determine the stresses caused by a bending moment, M = 160 k-ft. Given, $f'_c = 4$ ksi, $f_y = 60$ ksi, and f_r (modulus of rupture) = 475 psi. **(18)**

6. (a) A floor system consists of a 4-inch concrete slab supported by continuous T-beams of 24-ft span, 48 inch on centers. Web dimensions are $b_w = 12$ inch, and d = 20 inch. What tensile steel area is required at midspan to resist a factored moment of 8200 kip-inch? Given, $f'_c = 3$ ksi, $f_y = 60$ ksi. **(15)**

(b) Determine the required depth of the beam as shown in Fig. 7 and hence determine the flexural requirements at maximum positive moment and maximum negative moment sections. The beam carries a uniform live load of 3 k/ft. consider self-weight of the beam in addition to the live load. Draw the beam sections with reinforcement details. Given: $f'_c = 3$ ksi, $f_y = 60$ ksi. **(20)**

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7. (a) A rectangular concrete beam measures 12 inch wide and has an effective depth of 18 inch. Compression steel consisting of 2#8 bars is located 2 ½ " from the compression face of the beam. Tension steel consist of 6#9 bars in two layers. What is the design capacity of the beam? Given: $f_c' = 4$ ksi, $f_y = 60$ ksi. **(15)**

(b) Design the shear reinforcement of the beam as shown in Fig. 8. The beam carries a factored uniformly distributed load of 5 k/ft and a factored concentrated load of 20.5 kip at mid-span of the beam. Given: $f_c' = 4$ ksi, $f_y = 60$ ksi. **(20)**

8. (a) It is good practice to design the beam such that the failure would be initiated by yielding of steel rather than by crushing of concrete. Why? **(3)**

(b) What do you mean by balanced strain condition? Derive the expression for balanced reinforcement ratio, ρ_b. **(7)**

(c) Describe diagonal tension in a RC beam. **(5)**

(d) A rectangular beam of width b = 24 inch is limited by architectural considerations to a maximum total depth h = 16 inch. It must carry a total factored load moment, M_u = 400 kip-ft. Design the flexural reinforcement for this member, using compression steel, if necessary. Allow 3 inch to the center of the bars from the compression or tension face of the beam. Show a sketch of your final design. Given, $f_c' = 4$ ksi, $f_y = 60$ psi. **(20)**

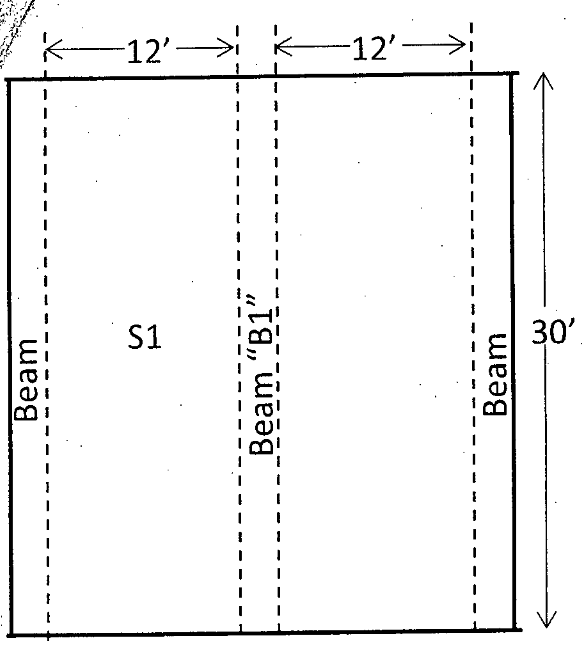


Fig. 1

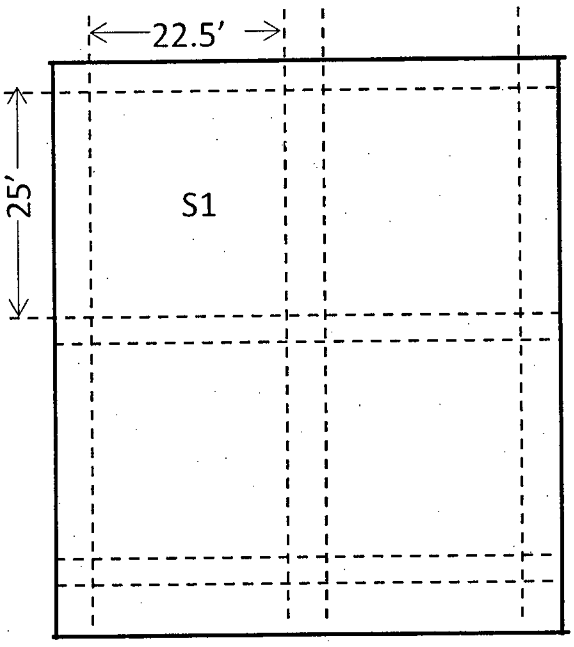
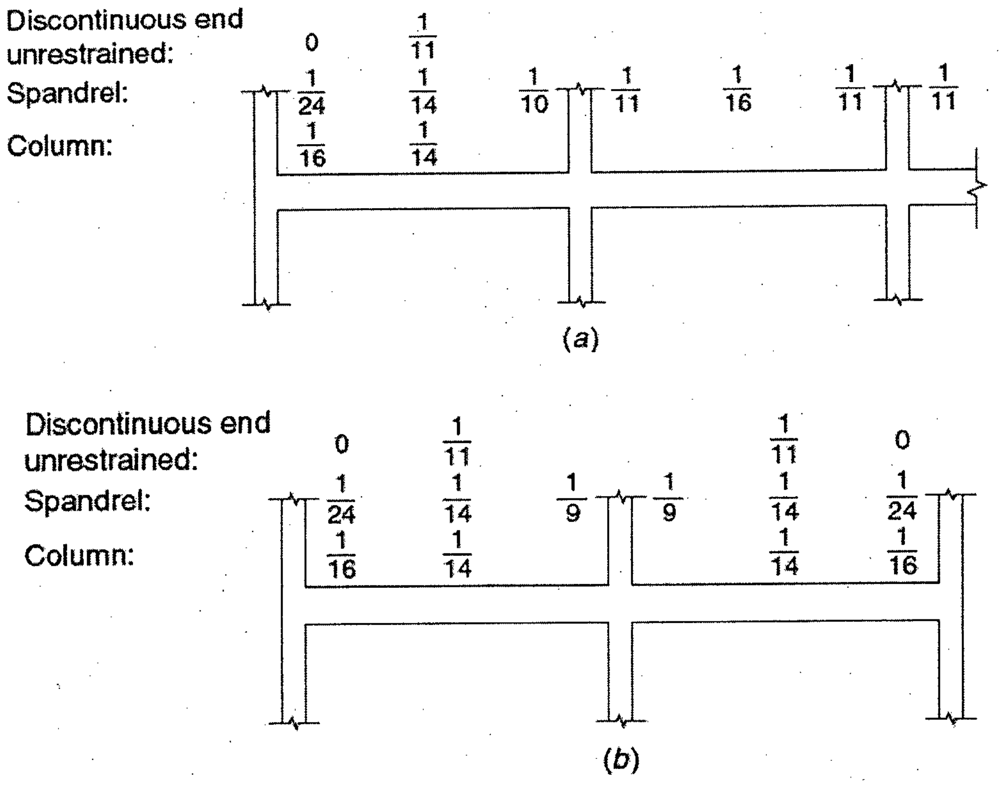


Fig. 3



Summary of ACI moment coefficients: (*a*) beams with more than two spans; (*b*) beams with two spans only;

Fig. 2

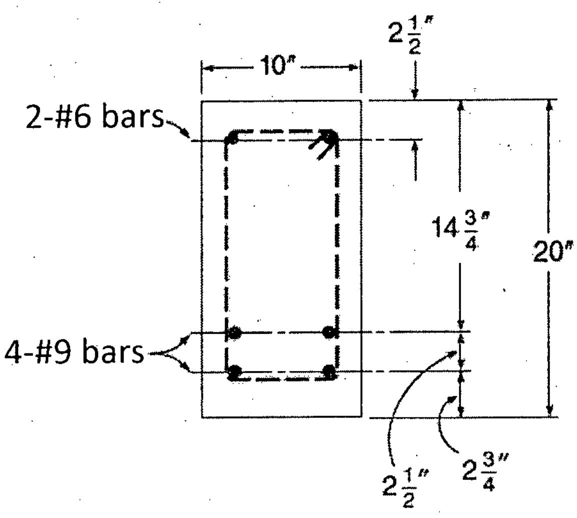


Fig. 4

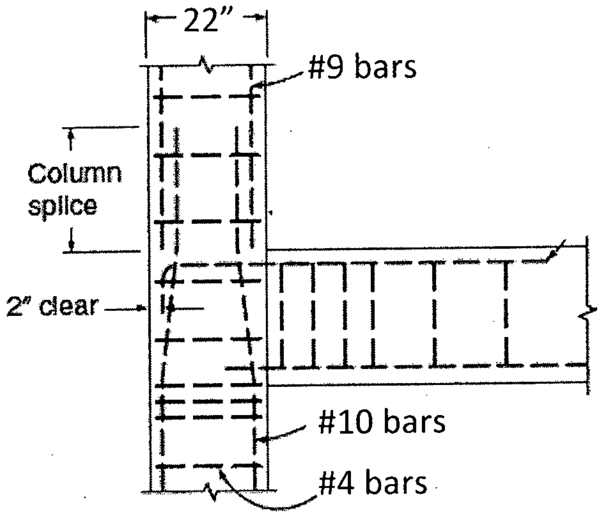


Fig. 5

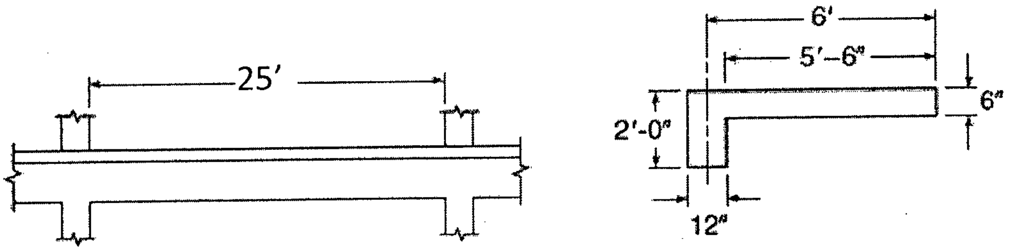


Fig. 6

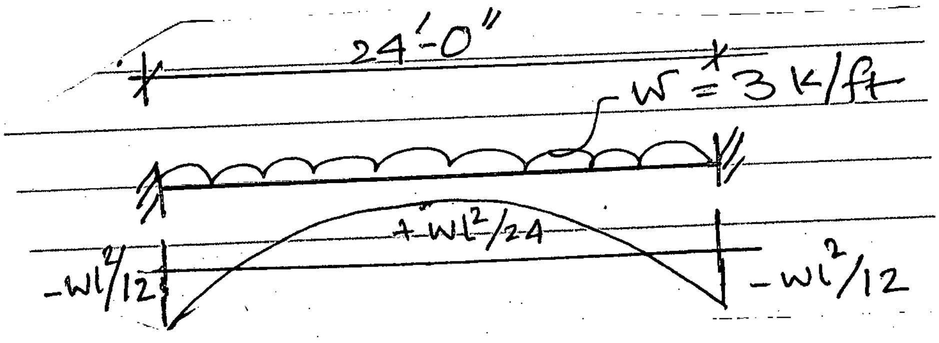


Fig. 7

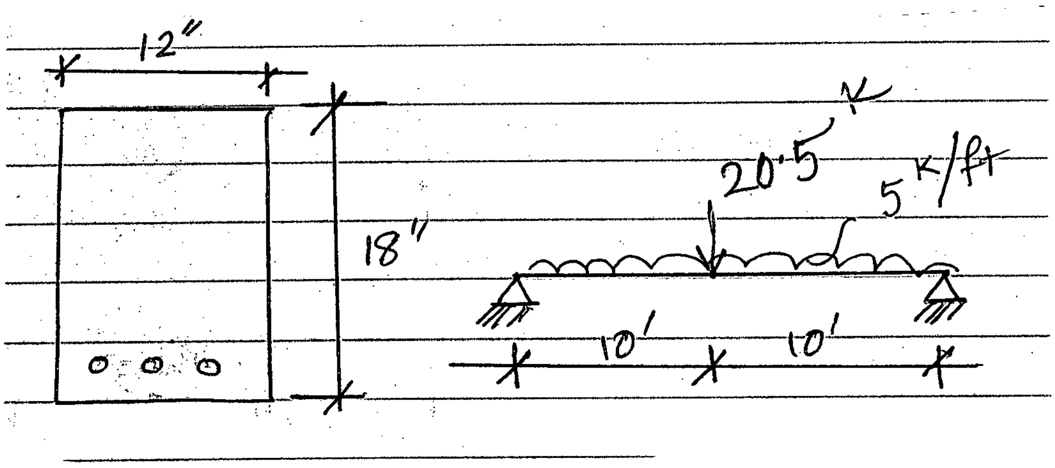


Fig. 8

Table: 1

Table Coefficients for negative moments in slabs*

$$\left.\begin{aligned} M_{A\,neg} &= C_{A\,neg} \times w \times A^2 \\ M_{B\,neg} &= C_{B\,neg} \times w \times B^2 \end{aligned}\right\}$$ where w = total uniform dead plus live load

Ratio $m = \frac{A}{B}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{A\,neg}$		0.045		0.050	0.075	0.071		0.033	0.061
	$C_{B\,neg}$		0.045	0.076	0.050			0.071	0.061	0.033
0.95	$C_{A\,neg}$		0.050		0.055	0.079	0.075		0.038	0.065
	$C_{B\,neg}$		0.041	0.072	0.045			0.067	0.056	0.029
0.90	$C_{A\,neg}$		0.055		0.060	0.080	0.079		0.043	0.068
	$C_{B\,neg}$		0.037	0.070	0.040			0.062	0.052	0.025
0.85	$C_{A\,neg}$		0.060		0.066	0.082	0.083		0.049	0.072
	$C_{B\,neg}$		0.031	0.065	0.034			0.057	0.046	0.021
0.80	$C_{A\,neg}$		0.065		0.071	0.083	0.086		0.055	0.075
	$C_{B\,neg}$		0.027	0.061	0.029			0.051	0.041	0.017
0.75	$C_{A\,neg}$		0.069		0.076	0.085	0.088		0.061	0.078
	$C_{B\,neg}$		0.022	0.056	0.024			0.044	0.036	0.014
0.70	$C_{A\,neg}$		0.074		0.081	0.086	0.091		0.068	0.081
	$C_{B\,neg}$		0.017	0.050	0.019			0.038	0.029	0.011
0.65	$C_{A\,neg}$		0.077		0.085	0.087	0.093		0.074	0.083
	$C_{B\,neg}$		0.014	0.043	0.015			0.031	0.024	0.008
0.60	$C_{A\,neg}$		0.081		0.089	0.088	0.095		0.080	0.085
	$C_{B\,neg}$		0.010	0.035	0.011			0.024	0.018	0.006
0.55	$C_{A\,neg}$		0.084		0.092	0.089	0.096		0.085	0.086
	$C_{B\,neg}$		0.007	0.028	0.008			0.019	0.014	0.005
0.50	$C_{A\,neg}$		0.086		0.094	0.090	0.097		0.089	0.088
	$C_{B\,neg}$		0.006	0.022	0.006			0.014	0.010	0.003

*A cross-hatched edge indicates that the slab continues across or is fixed at the support; an unmarked edge indicates a support at which torsional resistance is negligible.

Table: 2

Table Coefficients for dead-load positive moments in slabs*

$$\left.\begin{aligned} M_{A\,pos\,DL} &= C_{A\,DL} \times w \times A^2 \\ M_{B\,pos\,DL} &= C_{B\,DL} \times w \times B^2 \end{aligned}\right\}$$ where w = total uniform dead load

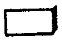
Ratio $m = \frac{A}{B}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
1.00	$C_{A\,DL}$	0.036	0.018	0.018	0.027	0.027	0.033	0.027	0.020	0.023
	$C_{B\,DL}$	0.036	0.018	0.027	0.027	0.018	0.027	0.033	0.023	0.020
0.95	$C_{A\,DL}$	0.040	0.020	0.021	0.030	0.028	0.036	0.031	0.022	0.024
	$C_{B\,DL}$	0.033	0.016	0.025	0.024	0.015	0.024	0.031	0.021	0.017
0.90	$C_{A\,DL}$	0.045	0.022	0.025	0.033	0.029	0.039	0.035	0.025	0.026
	$C_{B\,DL}$	0.029	0.014	0.024	0.022	0.013	0.021	0.028	0.019	0.015
0.85	$C_{A\,DL}$	0.050	0.024	0.029	0.036	0.031	0.042	0.040	0.029	0.028
	$C_{B\,DL}$	0.026	0.012	0.022	0.019	0.011	0.017	0.025	0.017	0.013
0.80	$C_{A\,DL}$	0.056	0.026	0.034	0.039	0.032	0.045	0.045	0.032	0.029
	$C_{B\,DL}$	0.023	0.011	0.020	0.016	0.009	0.015	0.022	0.015	0.010
0.75	$C_{A\,DL}$	0.061	0.028	0.040	0.043	0.033	0.048	0.051	0.036	0.031
	$C_{B\,DL}$	0.019	0.009	0.018	0.013	0.007	0.012	0.020	0.013	0.007
0.70	$C_{A\,DL}$	0.068	0.030	0.046	0.046	0.035	0.051	0.058	0.040	0.033
	$C_{B\,DL}$	0.016	0.007	0.016	0.011	0.005	0.009	0.017	0.011	0.006
0.65	$C_{A\,DL}$	0.074	0.032	0.054	0.050	0.036	0.054	0.065	0.044	0.034
	$C_{B\,DL}$	0.013	0.006	0.014	0.009	0.004	0.007	0.014	0.009	0.005
0.60	$C_{A\,DL}$	0.081	0.034	0.062	0.053	0.037	0.056	0.073	0.048	0.036
	$C_{B\,DL}$	0.010	0.004	0.011	0.007	0.003	0.006	0.012	0.007	0.004
0.55	$C_{A\,DL}$	0.088	0.035	0.071	0.056	0.038	0.058	0.081	0.052	0.037
	$C_{B\,DL}$	0.008	0.003	0.009	0.005	0.002	0.004	0.009	0.005	0.003
0.50	$C_{A\,DL}$	0.095	0.037	0.080	0.059	0.039	0.061	0.089	0.056	0.038
	$C_{B\,DL}$	0.006	0.002	0.007	0.004	0.001	0.003	0.007	0.004	0.002

*A cross-hatched edge indicates that the slab continues across or is fixed at the support; an unmarked edge indicates a support at which torsional resistance is negligible.

Table°3

Table ✓ **Coefficients for live-load positive moments in slabs***

$$\left.\begin{aligned} M_{A\,pos\,LL} &= C_{A\,LL} \times w \times A^2 \\ M_{B\,pos\,LL} &= C_{B\,LL} \times w \times B^2 \end{aligned}\right\} \text{ where } w = \text{total uniform live load}$$

Ratio $m = \frac{A}{B}$		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8	Case 9
										
1.00	$C_{A\,LL}$	0.036	0.027	0.027	0.032	0.032	0.035	0.032	0.028	0.030
	$C_{B\,LL}$	0.036	0.027	0.032	0.032	0.027	0.032	0.035	0.030	0.028
0.95	$C_{A\,LL}$	0.040	0.030	0.031	0.035	0.034	0.038	0.036	0.031	0.032
	$C_{B\,LL}$	0.033	0.025	0.029	0.029	0.024	0.029	0.032	0.027	0.025
0.90	$C_{A\,LL}$	0.045	0.034	0.035	0.039	0.037	0.042	0.040	0.035	0.036
	$C_{B\,LL}$	0.029	0.022	0.027	0.026	0.021	0.025	0.029	0.024	0.022
0.85	$C_{A\,LL}$	0.050	0.037	0.040	0.043	0.041	0.046	0.045	0.040	0.039
	$C_{B\,LL}$	0.026	0.019	0.024	0.023	0.019	0.022	0.026	0.022	0.020
0.80	$C_{A\,LL}$	0.056	0.041	0.045	0.048	0.044	0.051	0.051	0.044	0.042
	$C_{B\,LL}$	0.023	0.017	0.022	0.020	0.016	0.019	0.023	0.019	0.017
0.75	$C_{A\,LL}$	0.061	0.045	0.051	0.052	0.047	0.055	0.056	0.049	0.046
	$C_{B\,LL}$	0.019	0.014	0.019	0.016	0.013	0.016	0.020	0.016	0.013
0.70	$C_{A\,LL}$	0.068	0.049	0.057	0.057	0.051	0.060	0.063	0.054	0.050
	$C_{B\,LL}$	0.016	0.012	0.016	0.014	0.011	0.013	0.017	0.014	0.011
0.65	$C_{A\,LL}$	0.074	0.053	0.064	0.062	0.055	0.064	0.070	0.059	0.054
	$C_{B\,LL}$	0.013	0.010	0.014	0.011	0.009	0.010	0.014	0.011	0.009
0.60	$C_{A\,LL}$	0.081	0.058	0.071	0.067	0.059	0.068	0.077	0.065	0.059
	$C_{B\,LL}$	0.010	0.007	0.011	0.009	0.007	0.008	0.011	0.009	0.007
0.55	$C_{A\,LL}$	0.088	0.062	0.080	0.072	0.063	0.073	0.085	0.070	0.063
	$C_{B\,LL}$	0.008	0.006	0.009	0.007	0.005	0.006	0.009	0.007	0.006
0.50	$C_{A\,LL}$	0.095	0.066	0.088	0.077	0.067	0.078	0.092	0.076	0.067
	$C_{B\,LL}$	0.006	0.004	0.007	0.005	0.004	0.005	0.007	0.005	0.004

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*A cross-hatched edge indicates that the slab continues across or is fixed at the support; an unmarked edge indicates a support at which torsional resistance is negligible.

L-3/T-1/WRE **Date: 23/09/2018**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2017-2018

Sub: **CE 321** (Structural Analysis and Design-I)

Full Marks: 280 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. For the plate girder bridge as shown in Figure 1, draw influence lines for all floor beam reactions (FBR_B, FBR_C, FBR_E and FBR_F), main girder reactions (R_B and R_G), shear in panel 'CE' (V_{CE}) and moment at 'E' (M_E) for the plate girder. Unit load moves over the stringer from 'A' to 'F'. **(28)**

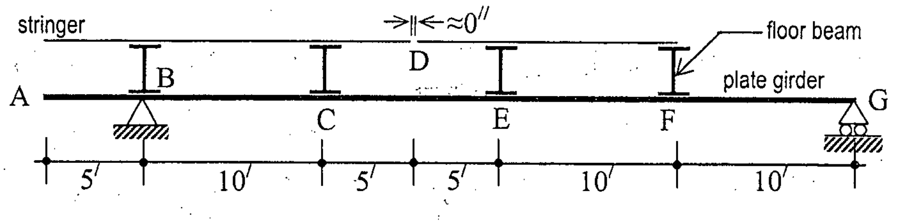

Figure 1

2. For the suspension bridge (having a stiffening girder of self-weight = 1 kip/ft), as shown in Figure 2; Determine the followings- **(28)**

(i) horizontal component of cable tension (H), (ii) maximum cable tension ($T_{maximum}$), (iii) support reactions at 'L' & 'R', (iv) uniform load on the cable (w_o), (v) hanger tensile force (F), and (vi) draw shear force and bending moment diagram for the left portion 'LI' of stiffening girder.

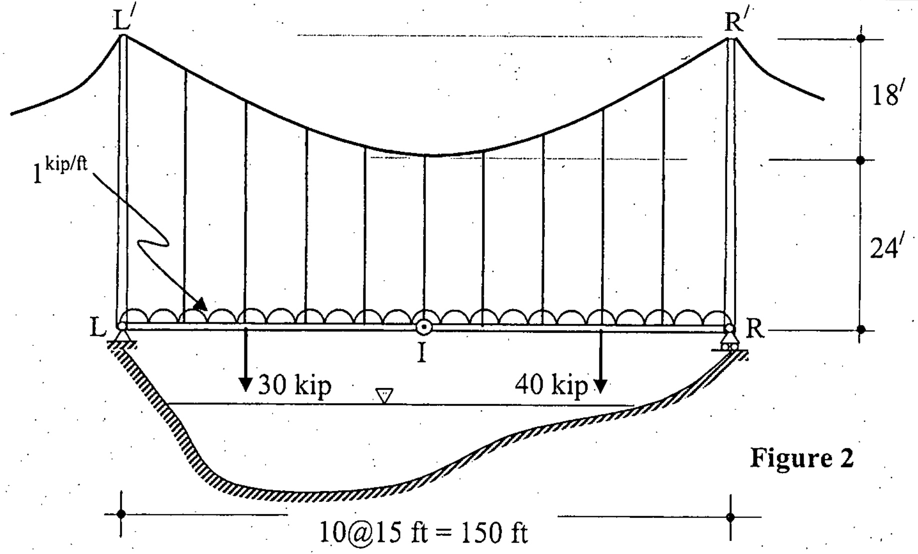

Figure 2

Contd P/2

3. (a) A 5-storied RC residential building (see Figure 3) has a plan dimension of 50 ft × 55 ft and typical floor-to-floor height of the building is 10 feet except the ground floor. The height of the ground floor is 12 feet and column bases are located 8' below ground level. The building is a special moment resisting frame (SMRF) located in Sylhet city. Determine the lateral force distribution along the height of the building on frame C-1-2-3-4-5 for Earthquake resistant design following equivalent static force method as per BNBC 1993. Given, slab thickness = 8 inch, floor finish = 30 psf, partition wall load = 80 psf, service live load = 40 psf. Neglect beam, column, stair, water tank and other element's self-weight. $R = 12$, $I = 1.00$, $S = 1.20$, $Z = 0.25$, $C < 2.75$ and $C/R > 0.075$. **(28)**

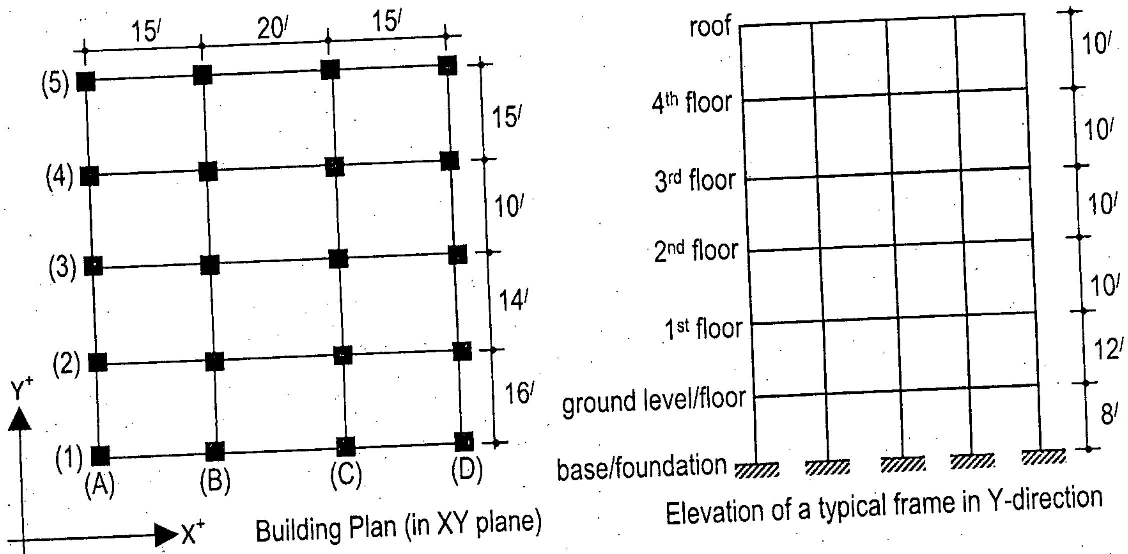

Figure 3

4. For the braced truss loaded as shown in Figure 4, determine – **(28)**
   - (i) Member force in diagonals CF & DE (mid-panel) assuming that diagonals can carry tensile force only.
   - (ii) Member forces in diagonals EH & GF (top-panel) assuming that both diagonals can carry tension as well as compression.

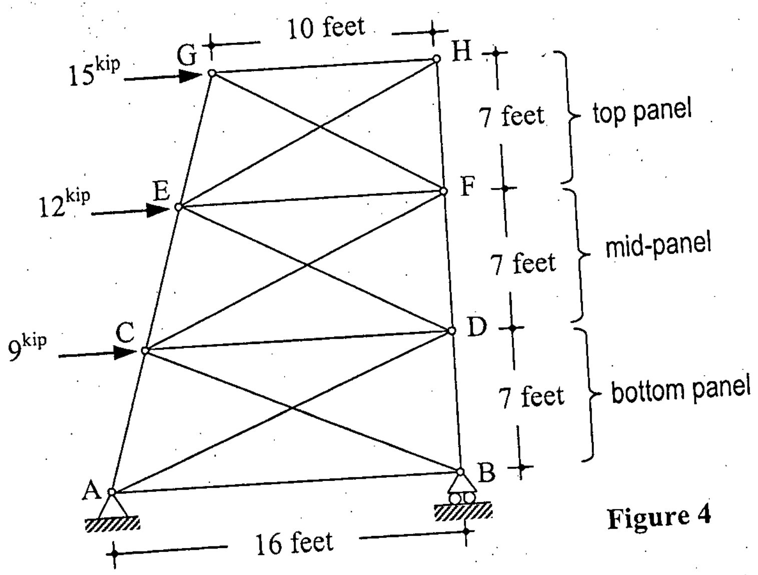

Figure 4

Contd P/3

5. For the bridge truss as shown in Figure 5, draw influence lines for axial force in truss members 'L_3U_3', 'L_3L_4', 'L_4U_3' and 'U_3U_4'. Also, determine axial force (both in tension and compression) in diagonal member 'L_4U_3' due to a traffic load = 2 kip/ft. Neglect self-weight (dead load) of the truss and unit load moves over the bottom chord. **(28)**

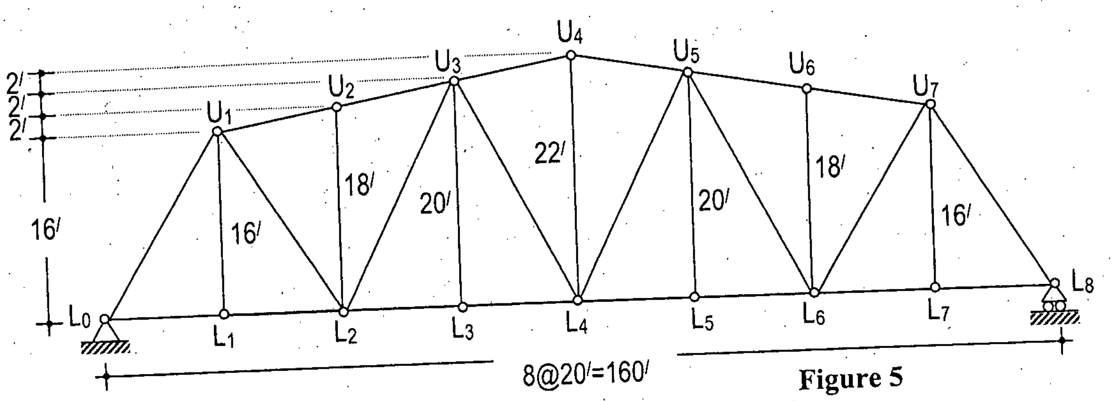

Figure 5

6. For the plane frame as shown in Figure 6, draw influence lines for **(28)**

   - vertical reactions at 'F' and 'G'
   - axial force in member 'BF'
   - shear and moment at 'C'.
   - shear just right of 'D' (at the end of 'DE' member).
   - moment just left of 'B' (at the end of 'AB' member).

   Unit load moves over the horizontal member 'ABCDE' (i.e., from 'A' to 'E')

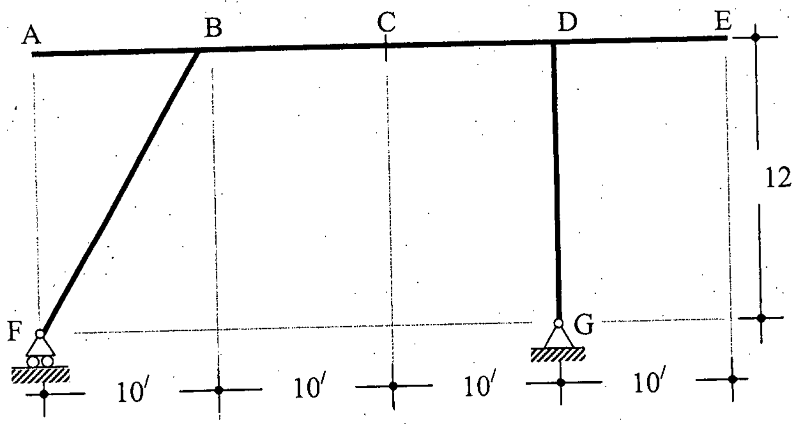

Figure 6

7. A three-hinged parabolic arch having supports at same elevation carries a uniformly distributed load of 2 kip/horizontal ft on it's right segment 'CB' as shown in Figure 7. Determine the following: **(28)**

   (i) horizontal thrust (H) at supports, (ii) vertical support reactions at 'A' & 'B', (iii) Draw bending moment diagram of the arch and (iv) maximum bending moment and it's location.

Contd... Q. No. 7

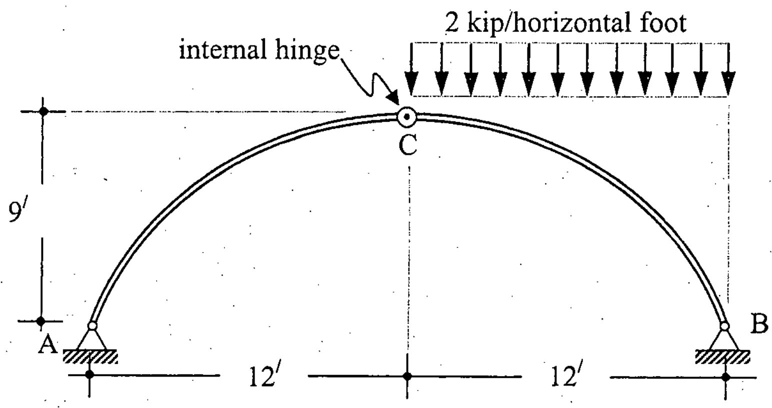

Figure 7

SECTION – B

There are **SEVEN** questions in this section. Answer any **FIVE**.
Symbols carry their usual meaning.

8. For the3 bridge truss as shown in Figure-8, check whether counter diagonal is needed or not for panel '3'. If needed, determine the force in counter diagonal. What will be the force in main diagonal? Given, truss self-weight is 0.5 kip/ft, vehicle load is 1 kip/ft and roving concentrated load is 15 kip. **(28)**

9. Determine the slope at A. Take E = 29×10^3 ksi. The moment of inertia of each segment of the frame is indicated in the Figure-9. Use the method of virtual work. **(28)**

10. Compute maximum moment at one-third point of a simply supported beam of 90 ft for the load shown in Figure-10. **(28)**

11. Compute Absolute maximum bending moment for a simply supported beam having a span of 100 ft due the moving load as shown in Figure-10. **(28)**

12. Draw the shear force and bending moment diagrams for the building frame loaded as shown in Figure-11. **(28)**

13. Draw the shear force and bending moment diagram of the beams and columns for the building as shown in Figure-12. Use Portal Method. **(28)**

14. Using Cantilever Method, draw bending moment diagrams of the beams and columns for the building as shown in Figure-13. Relative column cross-sectional area are given beside the column. **(28)**

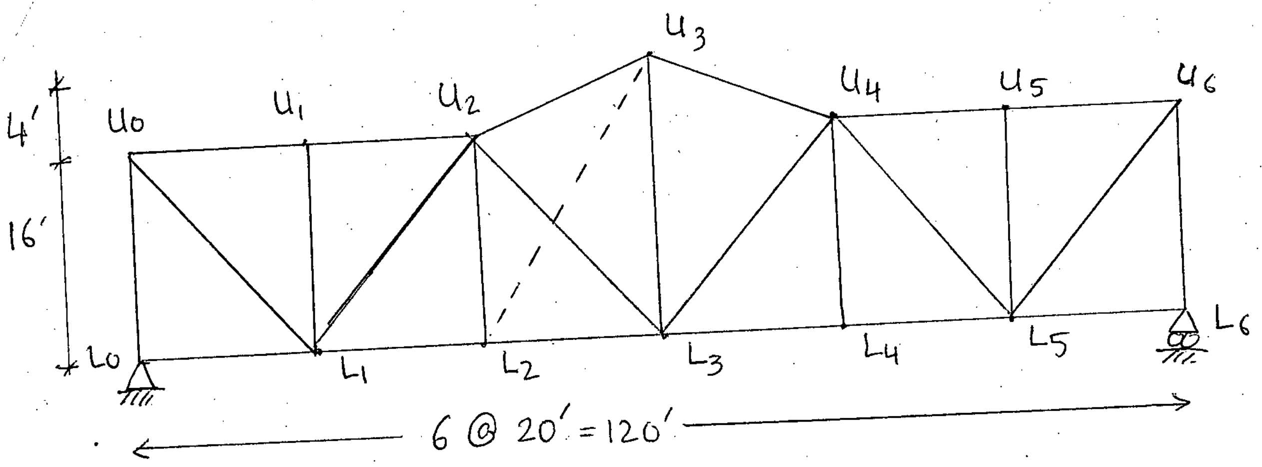

Figure-8

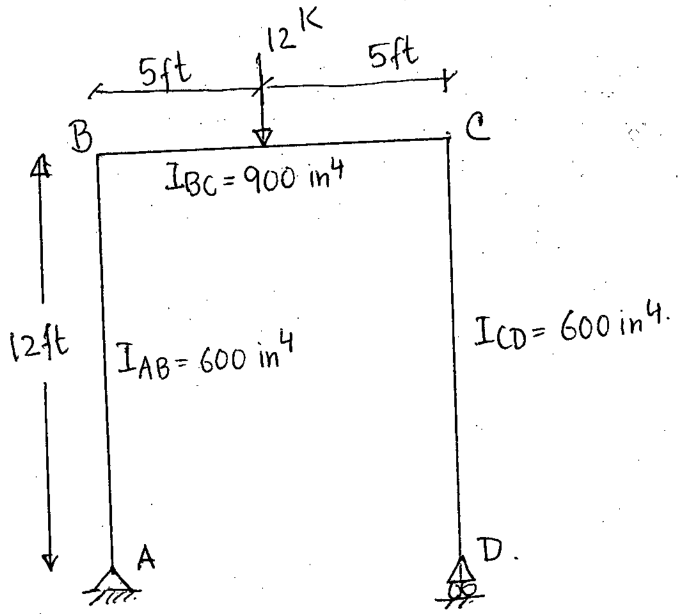

Figure-9

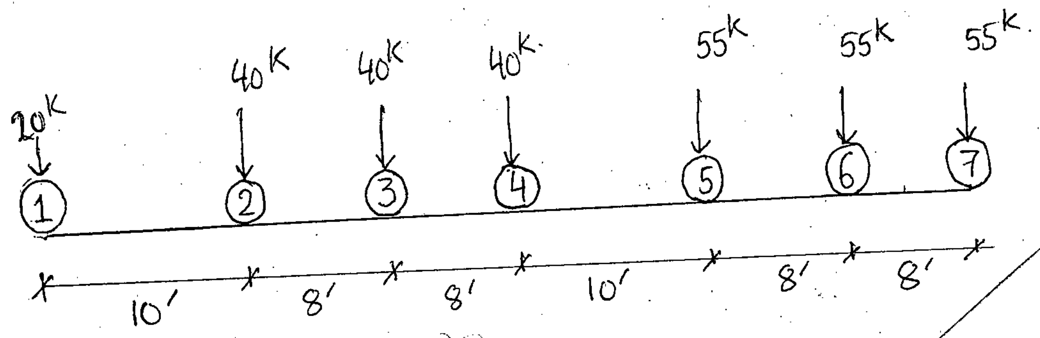

Figure-10

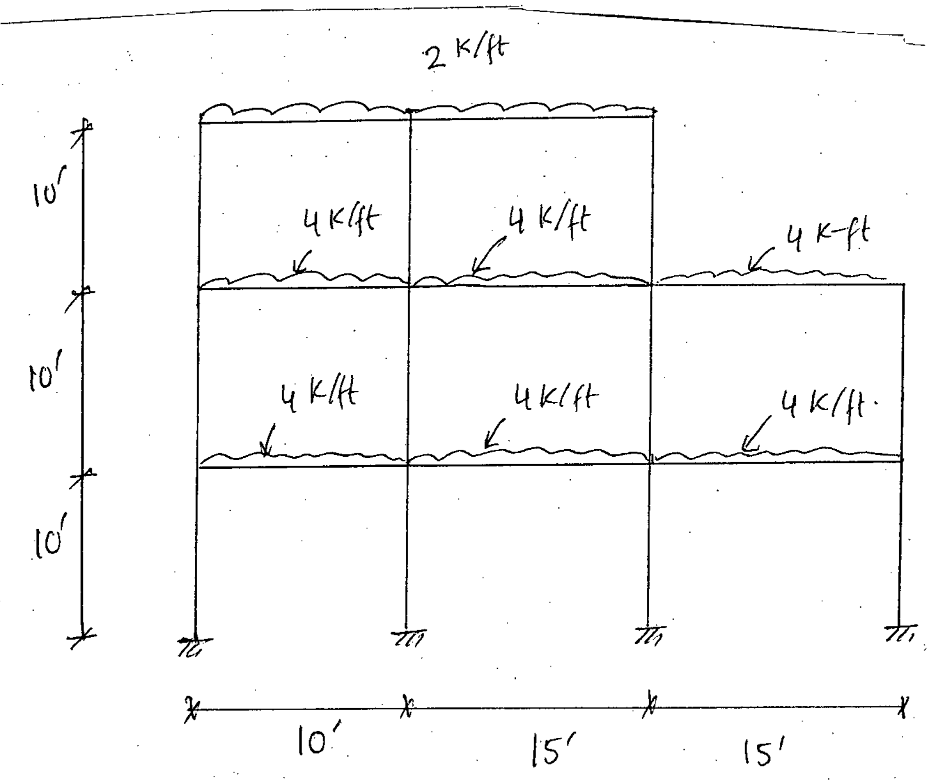

Figure - 11

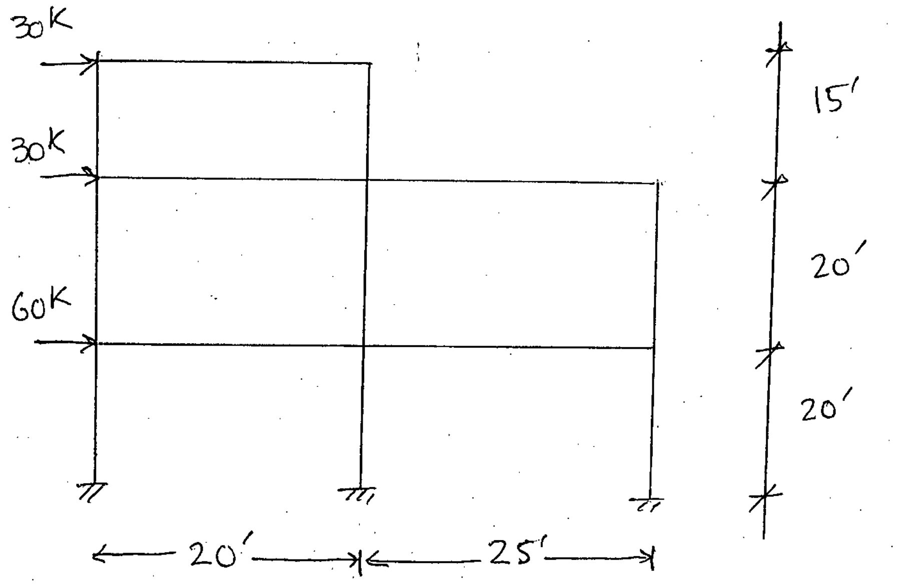

Figure 12

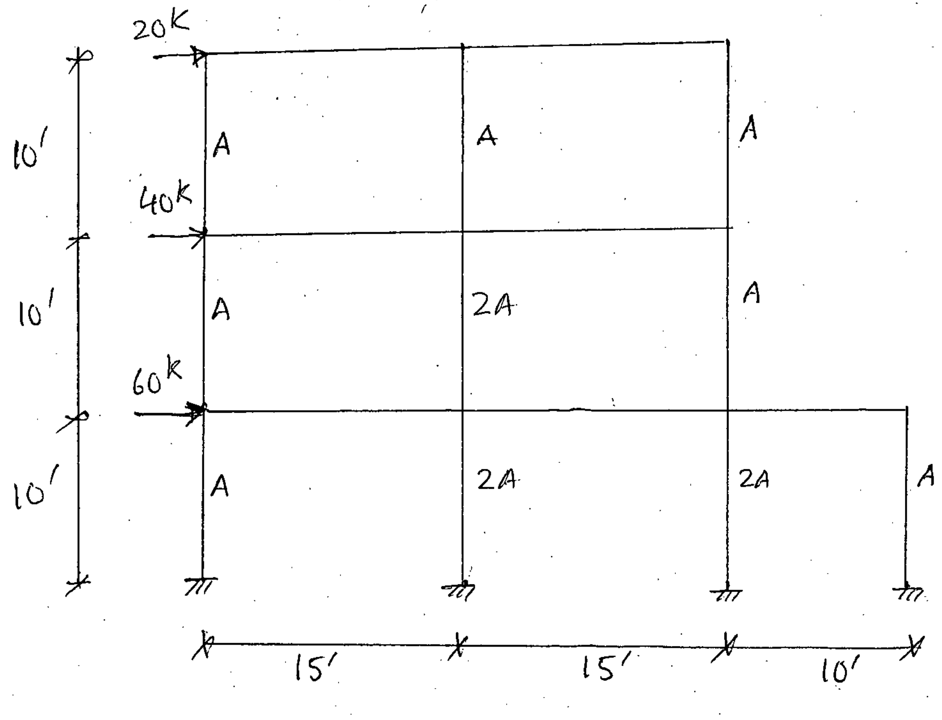

Figure - 13