L-3/T-1/WRE **Date : 15/07/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

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

Full Marks : 280 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable value if data is not given.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) Write the various uniform flow equations and find the relation between Manning's roughness value (n), friction factor (f) and Chezy's C. **(15)**

   (b) Deduce the expression of composite roughness of Horton. What are the underlying assumption in deriving the expression? **(15)**

   (c) A trapezoidal channel has side slopes z = 2, bottom width, b = 6 m and channel slope S = 0.0016. The channel is flowing with depth 1.5 m. The channel bed is composed of alluvial soil (n = 0.025) and sides is lined with cement masonry (n = 0.015), determine (i) the flow through channel. **($16\frac{2}{3}$)**

2. (a) Derive the expression for the tractive force ratio. Draw a typical diagram showing the allowable tractive forces along the bottom and sides of a trapezoidal channel section. **($5+6\frac{2}{3}$)**

   (b) Design a channel section which will be constructed in alluvial plain. Take D_{50} = 0.12 mm and Discharge Q = 100 m^3/s. Assume other values if not given. **(15)**

   (c) Write briefly about the following: **(20)**

   (i) Best hydraulic section

   (ii) Use of freeboard in channel design

   (iii) Permissible velocity method of channel design

   (iv) Assessment of longitudinal and side slope

3. (a) Using the Manning equation, deduce expression of the dynamic equation of gradually varied flow in terms of depth for wide rectangular channel. **(15)**

   (b) Determine the upstream profile of a backwater curve due to flow obstruction by a dam of height 4.0 m. Given that Q = 10 m^3/s, b = 3.5 m, S_0 = 0.0001, n = 0.025 and y_n = 2.65 m. Use at least 4 steps and use any method of computation. **(15)**

   (c) Sketch the possible flow profile (with types) in the following serial arrangement of the channels. The flow is from left to right. **($16\frac{2}{3}$)**

Contd P/2

WRE 301

Contd ... Q. No. 3(c)

(i) Steep-steeper-mild

(ii) Mild-Milder-steep

(iii) Critical-horizontal-steep

(iv) Mild-Steeper-milder steep

4. (a) What are the factors affecting the Manning's roughness value? Answer with sketches. **(15)**

(b) Deduce the expression of hydraulic exponent (N) for uniform flow using the Manning's equation. What will be the value of N for (i) narrow rectangular section and for (ii) equilateral triangular channel with vertex at the bottom? **(15)**

(c) A trapezoidal channel has side slopes z = 1, bottom width b = 5 m and channel slope S = 0.0002. If the channel carries discharge of 12 m^3/s, determine (i) the normal depth and (ii) critical slope for same discharge. **($16\frac{2}{3}$)**

SECTION – B

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

5. (a) Define: (i) Rigid boundary channel, (ii) Velocity distribution coefficients, and (iii) Wetted perimeter. **(9)**

(b) By using the trapezoidal rule of numerical integration, compute the discharge of the rectangular channel whose width is 80 cm. The following velocities were measured for the depth of flow 120.0 cm. **(12)**

z (cm)	0.0	3.0	10.0	20.0	40.0	60.0	80.0	100.0	120.0
u (cm/s)	0.0	11.25	12.75	20.20	25.55	32.75	37.75	43.90	44.25

(c) The velocity distribution in a wide rectangular channel may be expressed by **(12)**

$$u = 0.4 + 0.6\frac{z}{y} \text{ (m/s)}$$

Where u is the velocity at a distance z from the channel bottom, y is the depth of flow. Compute mean velocity of flow V and velocity distribution coefficients α and β for this channel when y = 1.0 m.

(d) Show that the total pressure head can be expressed as **(7)**

$$Total\ Pressure\ Head = y\left(1 \pm \frac{1}{g}\frac{V^2}{r}\right)$$

(e) Compute the geometric properties of a circular channel whose diameter is 2.0 m and the depth of flow is 1.2 m. **($6\frac{2}{3}$)**

Contd P/3

WRE 301

6. (a) What is a specific energy curve? A flow rate of 5.0 m^3/s is passing at a depth of 1.50 m through a rectangular channel of 2.50 m width. What is the specific energy of the flow? What is the value of the alternate depth to the existing depth? **(4+6)**

(b) Derive the general equation to compute the hydraulic exponent for critical flow computation in any channel. **($6\frac{2}{3}$)**

(c) Water is flowing at a velocity of 4.5 m/s and a depth of 1.0 m in a long rectangular channel 2.5 m wide. Compute (i) the height of a smooth upward step in the channel bed that will produce critical flow in the channel, and (ii) the depth and change in water level produced by (a) a smooth upward step of 0.35 m, (b) a smooth upward step of 0.75 m. In all cases, neglect energy losses and take $\alpha = 1.00$. **(20)**

(d) Write down the working principle and equation of a broad crested weir? Why the use of critical flow is very important in designing the flow measuring devices? **(6+4)**

7. (a) Show the depth-discharge curve for variable discharge in an open channel and establish the condition for maximum discharge. **(8)**

(b) If y_1 and y_2 are the alternate depths in a rectangular channel, show that **(10)**

$$y_c^3 = \frac{2y_1^2 y_2^2}{(y_1 + y_2)}$$

(c) A trapezoidal channel is given with b = 2.20 m, z = 2.0 and Q = 14 m^3/s. Calculate the critical depth and velocity by the Trial and Error method. Given $\alpha = 1.08$. **(12)**

(d) A highway bridge 150.0 m long has seven piers with semicircular noses and tails, each 2.5 m wide and equally spaced. At the peak of a flood the backwater was found to be 10.0 cm for the eight openings. The average depth of flow immediately downstream of the bridge is 3.0 m. Compute the flood discharge. **(10)**

(e) What do you mean by transition in open channel flow? Answer with neat sketches. **($6\frac{2}{3}$)**

8. (a) The values of initial depth and initial velocity in connection with a hydraulic jump in a horizontal rectangular channel are 0.25 m and 18.5 m/s respectively. Compute the values of y_2 (m), V_2 (m/s), Fr_1, Fr_2, q ($m^3/s/m$) and h_L. **(12)**

(b) Prove that for a hydraulic jump in a horizontal rectangular channel the energy loss of the jump can be computed by using the initial and sequent depth only. **(12)**

(c) Define: (i) Strong jump, (ii) Height of the jump, and (iii) Stilling basin. **(9)**

Contd P/4

WRE 301

Contd ... Q. No. 8(d)

(d) A rectangular channel is 1.0 m wide and inclined at an angle of 3° with the horizontal. Determine the type of jump when the discharge is 0.75 m^3/s, the initial depth of flow section (d_1) is 0.04 m and the tail water depth is 0.9 m. Also determine d_2 and y_2^*. **($13\frac{2}{3}$)**

L-3/T-1/WRE Date : 08/08/2017

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

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

Assume any reasonable value of missing data.

1. (a) Define simple, complex and compound truss with examples. **(9)**

   (b) Determine the forces in members GF, FC and CD of the bridge truss shown in Figure1. State if the members are in tension or compression. Assume all members are pin connected. **(21)**

   (c) The tied three-hinged arch is subjected to the loading shown in Figure 2. Determine the components of reaction at A and C and the tension in the cable. **($16\frac{2}{3}$)**

2. (a) The parabolic arch [$y = 2(x-x^2/100)$] shown in Figure 3 carries loads as shown in the figure. Calculate the values of normal force, shear force and bending moment at the point E which is located at a distance 30 ft from the left support. Determine also the maximum bending moment for the arch. **(24+8)**

   (b) Determine the axial forces in members "x" and "y" of the truss shown in Figure 4 assuming that the shear in each panel is divided equally between the diagonals. **($14\frac{2}{3}$)**

3. (a) Draw the shear force and bending moment diagrams for the building frame loaded as shown in Figure 5. **(24)**

   (b) Draw the shear force and bending moment diagram of the beams and columns for the building frame as shown in Figure 6. Use Portal method. **($22\frac{2}{3}$)**

4. Using Cantilever method, draw the axial force, shear force and bending moment diagrams of the beams and columns for the building as shown in Figure 7. Relative column cross-sectional areas are given beside the columns. **($46\frac{2}{3}$)**

Contd P/2

CE 321 (WRE)

SECTION – B

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

5. (a) Determine maximum positive shear force at section 'C' of a simple beam having a span of 45 feet due to the moving wheel loads as shown in Figure 8. **($24\frac{2}{3}$)**

   (b) For the suspension bridge (having a stiffening girder of self-weight = 2 kip/ft), as shown in Figure 9 below; Determine:
   (i) horizontal component of cable tension (H). (ii) maximum the cable tension ($T_{maximum}$), (iii) support reactions at 'A' & 'C' (iv) uniform load on the cable (w_o), (v) hanger tensile force (F), (vi) draw shear force and bending moment diagram for the right part "BC" of stiffening girder. **(22)**

6. (a) Determine absolute maximum bending moment for a simple beam having a span of 60 feet due to the moving wheel loads as shown in Figure 10. **($24\frac{2}{3}$)**

   (b) For the bridge truss as shown in Figure 11, check whether counter diagonal is needed or not for panel '5'. If needed, determine the force in counter diagonal. What will be the force in main diagonal? Given, truss self-weight = 0.5 kip/ft., vehicle load = 1 kip/ft, and roving concentrated load = 12 kip. **(22)**

7. (a) For the plate girder bridge as shown in Figure 12, draw influence lines for all floor beam reactions and hence draw influence lines for reactions at 'B', shear in panel 'DE' and moment at 'E' for the plate girder. **(22)**

   (b) For the plane truss as shown in Figure 13, determine horizontal deflection of joint 'B' due to -
   (i) external loads only
   (ii) external loads in addition support 'A' moves 0.001 inch left, 'CD' member made too long by amount 0.002 inch and temperature rises 20°F member 'BD'. Take modulus of elasticity (E) = 29000 ksi and co-efficient of thermal expansion (α) = $5.5 \times 10^{-6}/^{0}F$. Use method of virtual work. Cross-sectional areas of the members ($inch^2$) are shown in parentheses. **($24\frac{2}{3}$)**

8. (a) For the plane frame as shown in Figure 14, determine the rotation of the point 'C' due to external loads as applied on it. Consider bending deformation only and no need to consider axial and shear deformations. Take bending stiffness (EI) = 400×10^3 kip-ft^2. **($24\frac{2}{3}$)**

   (b) For the plane frame (see Figure 15, draw inlluence line for
   - vertical reactions at 'A' and 'F'
   - axial force and shear in member 'EF'
   - shear and moment at 'D'. **(22)**

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

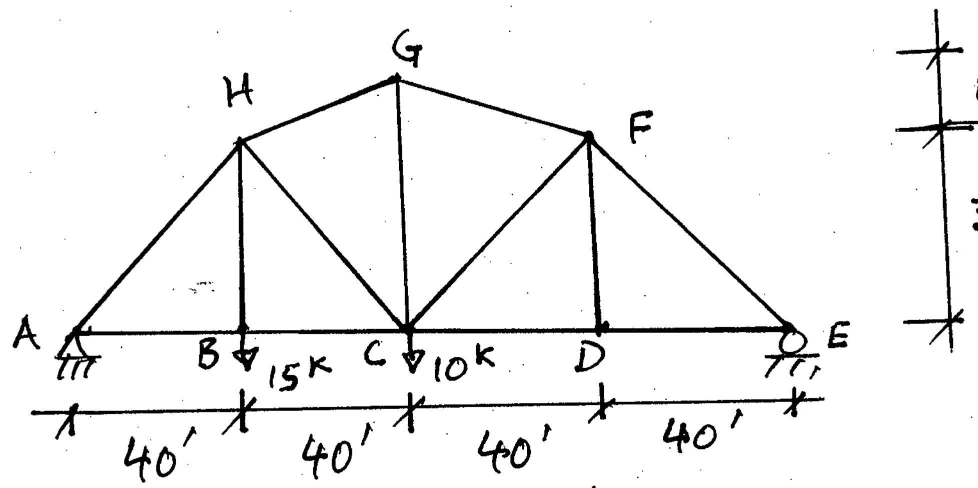


Figure 1

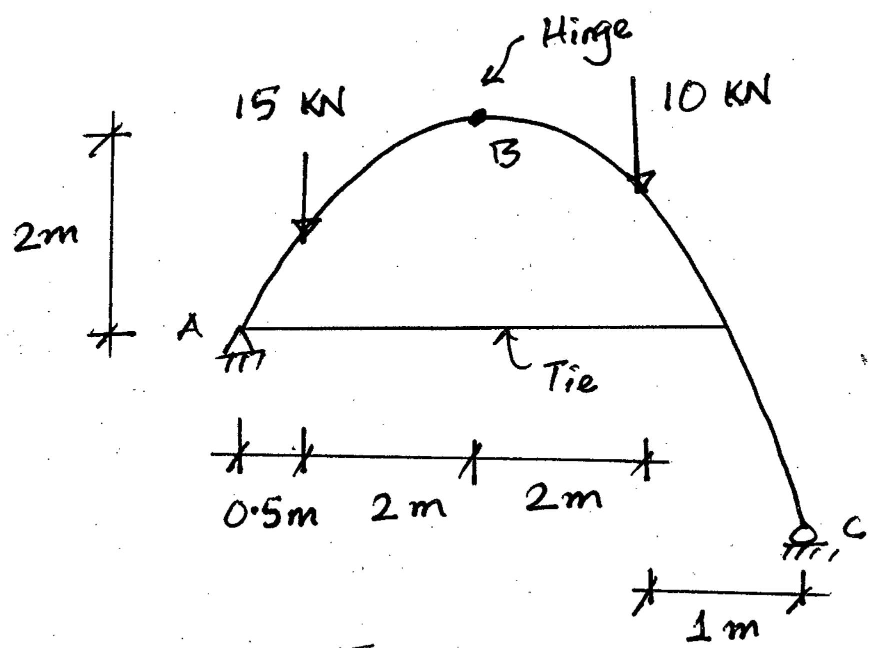


Fig. 2

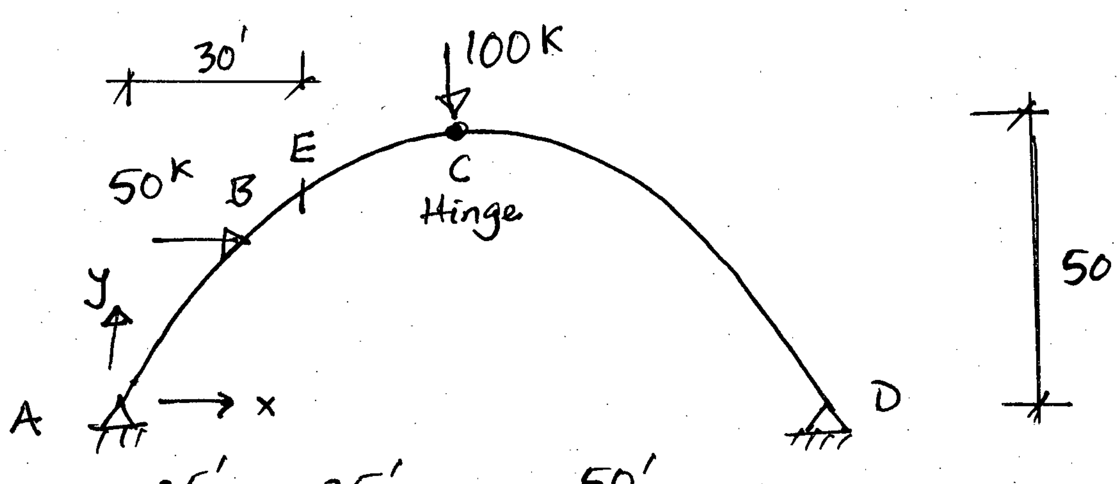


Figure 3

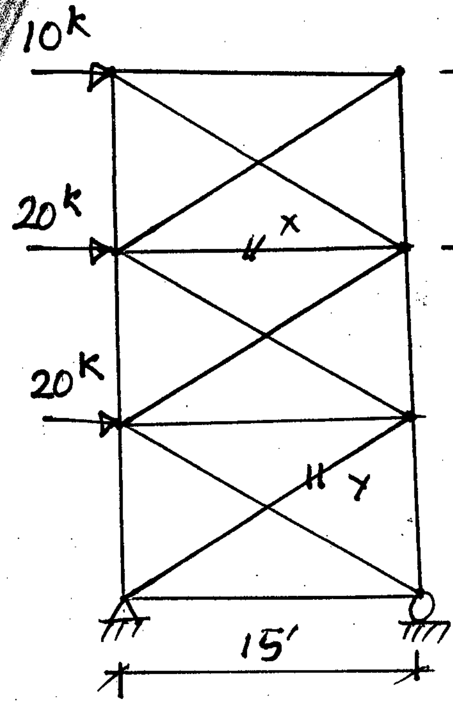


Figure 4

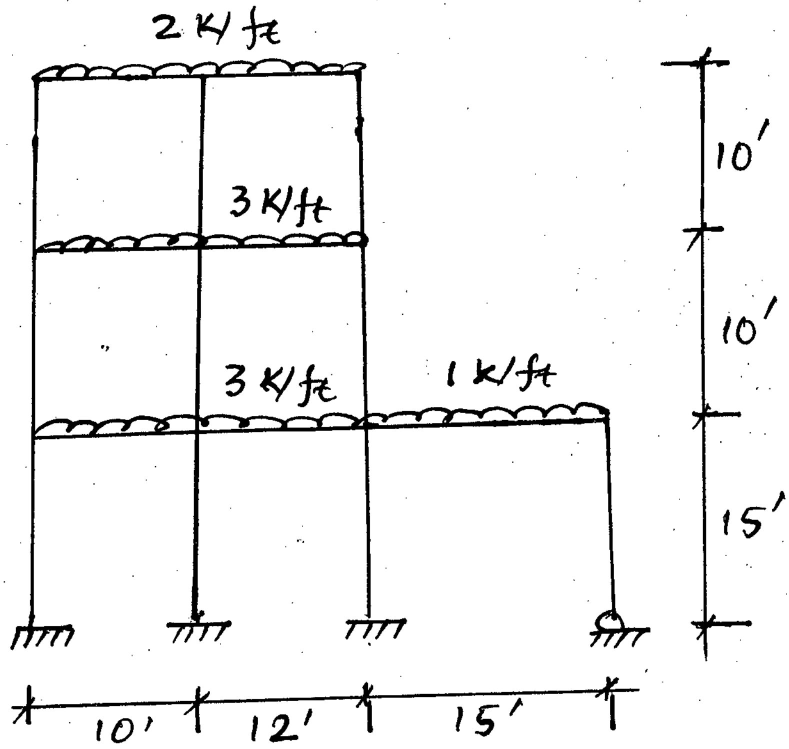


Figure 5

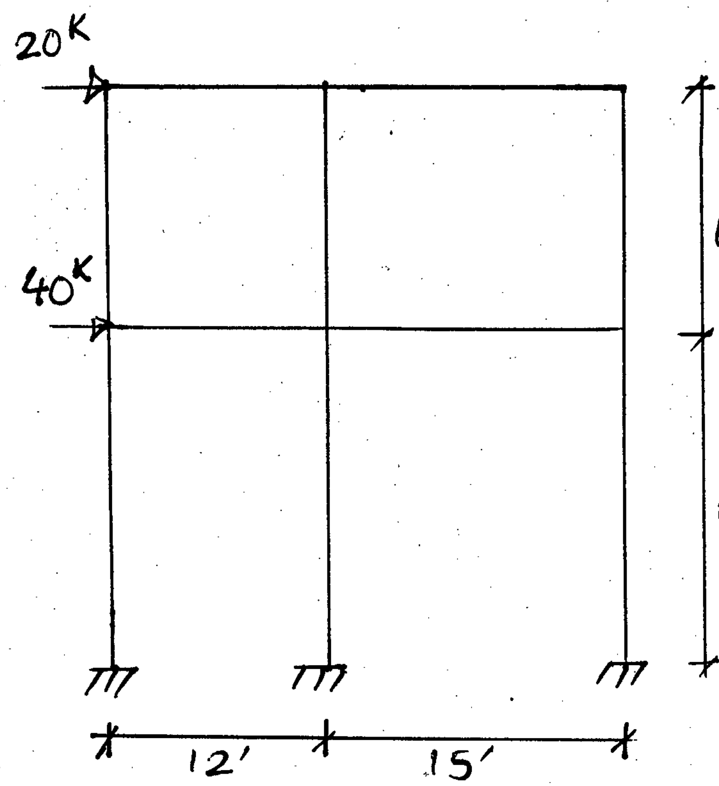


Figure 6

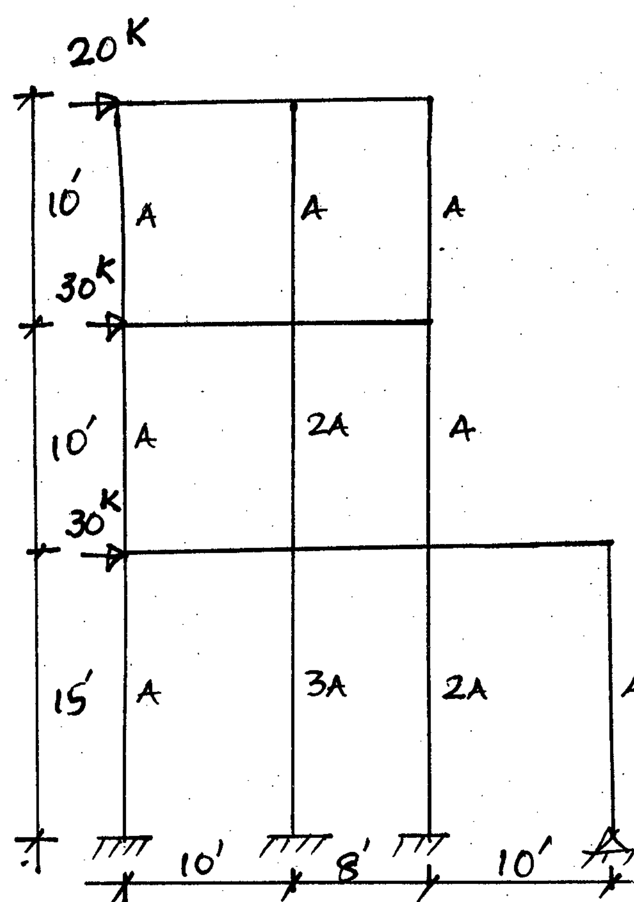


Figure 7

=5=

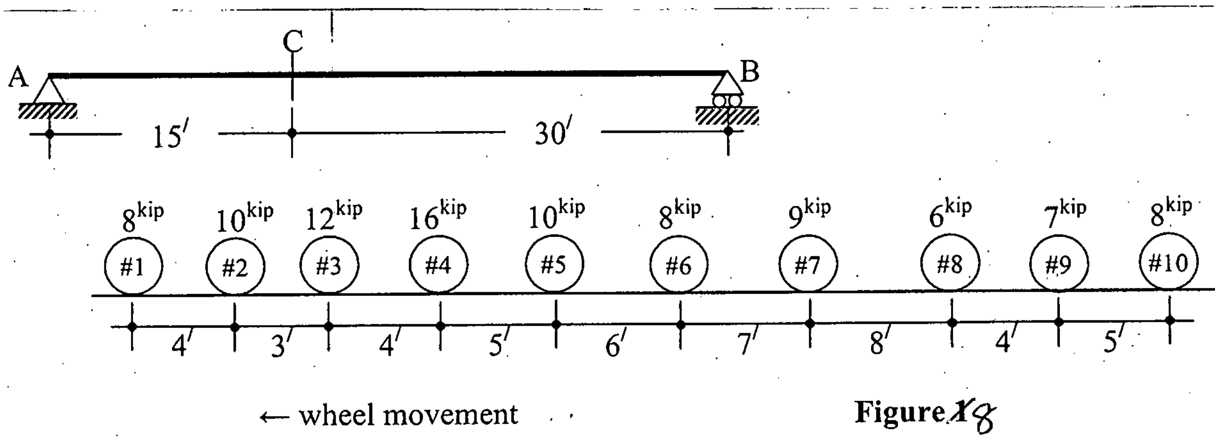


Figure 8

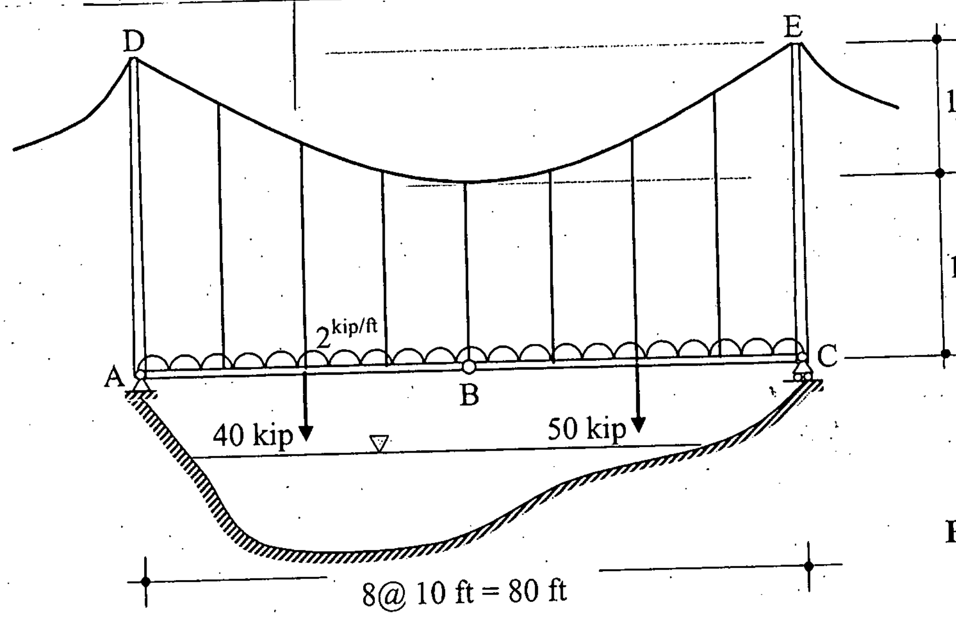


Figure 9

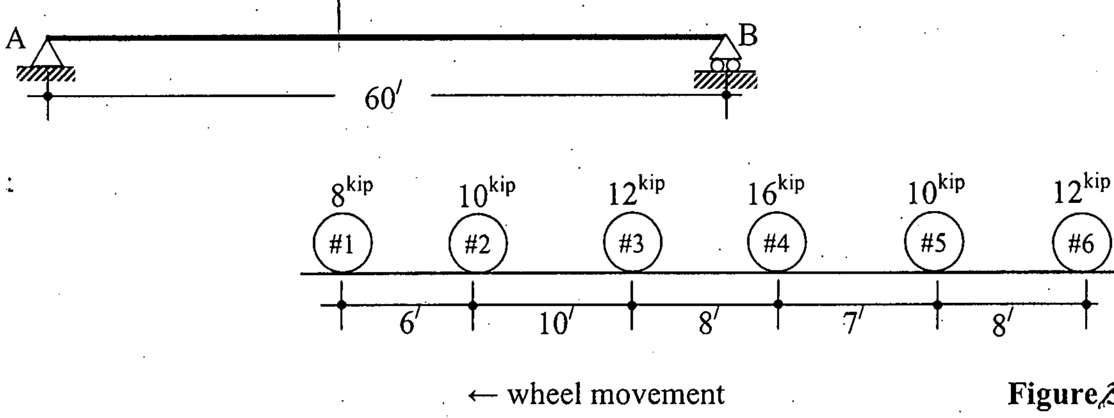


Figure 10

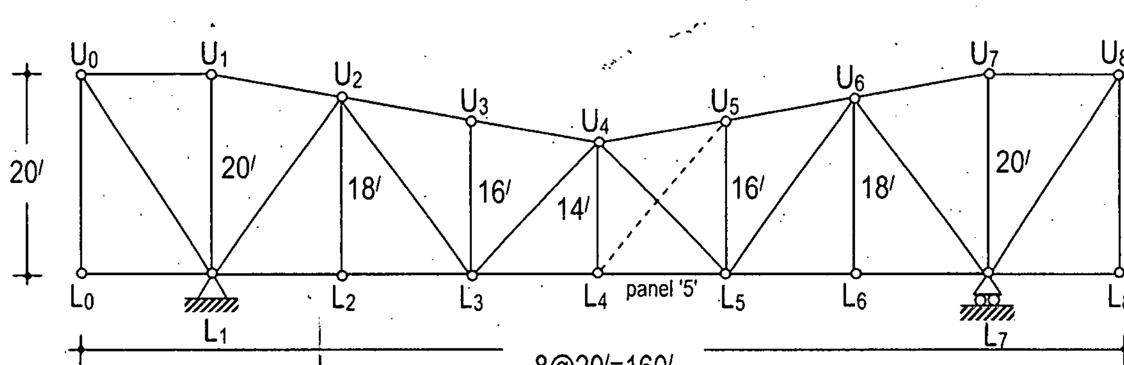


Figure 11

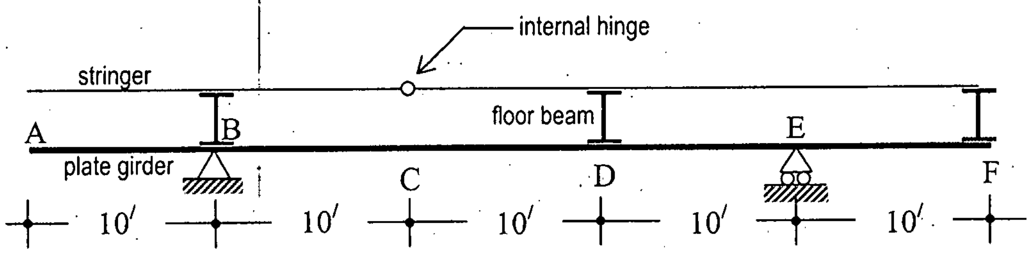


Figure ~~5~~ 12

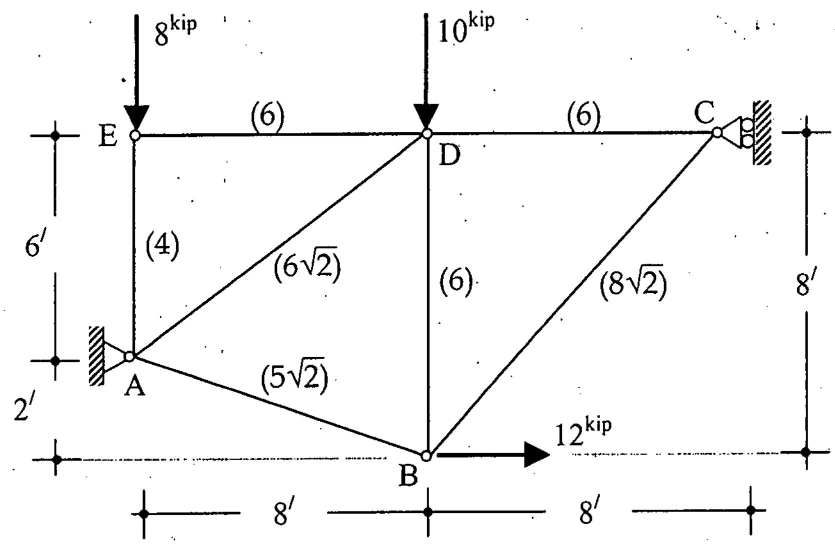


Figure ~~6~~ 13

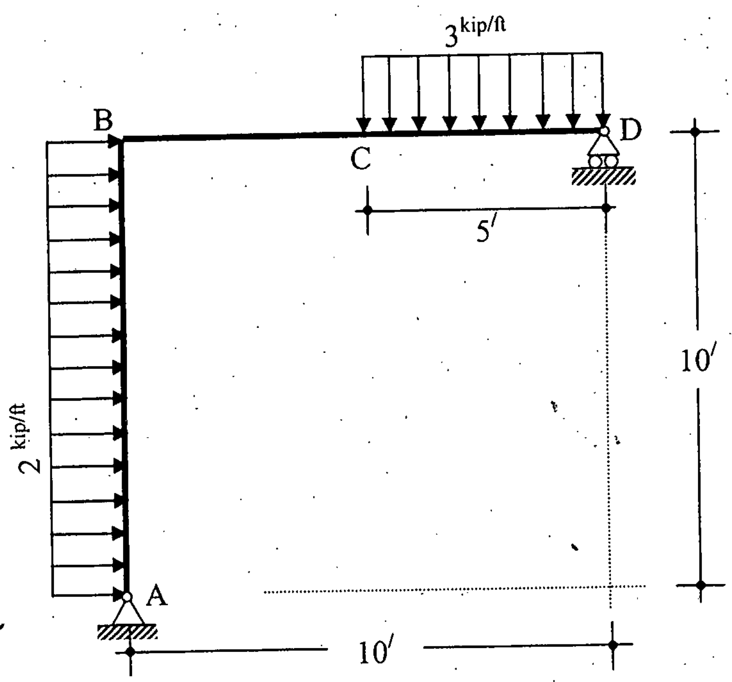


Figure ~~7~~ 14

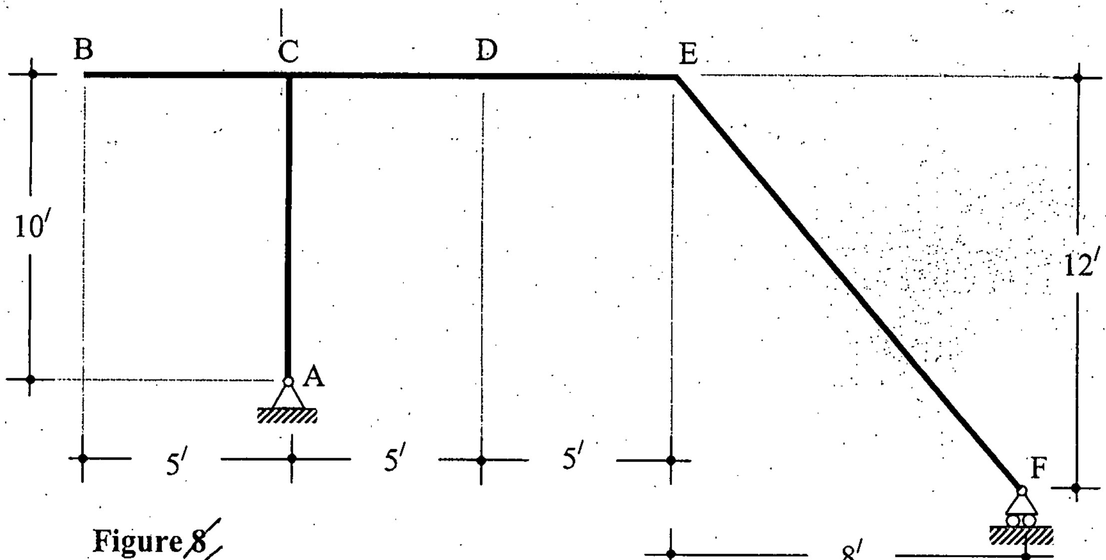


Figure ~~8~~ 15

L-3/T-1/WRE **Date : 02/08/2017**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-3/T-1 B. Sc. Engineering Examinations 2016-2017

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) What are the advantages of reinforced concrete? **(7)**

(b) Why are temperature and shrinkage reinforcements required in one-way slab? What are the recommended ratios for such steel? **(11)**

(c) What is the minimum length of lap for column splices as per ACI/BNBC code? **(7)**

(d) Calculate the development length of 20 mm and 25 mm uncoated top bars in USD, Repeat the calculation for bottom bars also. Use $f_c' = 3$ ksi; and $f_y = 60$ ksi. and assume appropriate value for any missing data. **(10)**

2. (a) Show with a sketch the crack pattern of a beam under two point loading. **(4)**

(b) How does web reinforcement augment shear resistance after development of diagonal cracks? **(8)**

(c) A beam supported on two other beams, as shown in Fig. 1, is 16″ wide and have an effective depth of 22 in. The beam carries a total factored load of 8 kips/ft on a 20 ft clear span. It is reinforced with 7.62 in^2. of tensile steel. Using vertical U stirrups with $f_{yt} = 60000$ psi, design the web reinforcement for the beam. $f_c' = 4000$ ksi. **(23)**

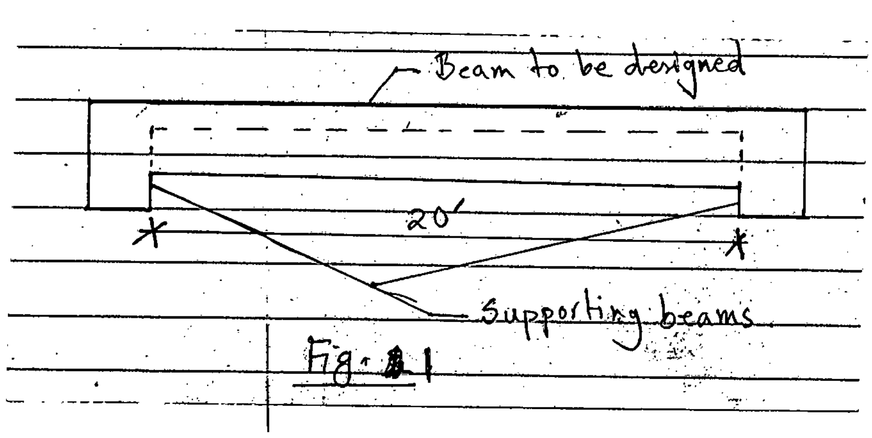


Fig. 1

3. (a) Explain primary torsion and secondary torsion with examples. **(8)**

(b) What is cracking torque? Give an estimate of cracking torque of a rectangular section. **(14)**

(c) Derive an expression for longitudinal reinforcement required to take beam torsion. **(13)**

Contd P/2

CE 323(WRE)

4. (a) A one-way slab between two beams behaves like a beam. Show the deflected shape of a one-way slab and show the direction of main reinforcement. **(4)**

(b) What sizes of reinforcement are usually used for slabs? How much should be the clear cover for slabs for interior exposure? **(6)**

(c) A 6″ thick one-way simply supported slab of 15 ft clear span supports a live load of 80 psf, Given: $f_c' = 4000$ psi; and $f_y = 60000$ psi. Design reinforcement of the slab. **(25)**

SECTION – B

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

5. (a) What are the sources of uncertainties in analysis, design and construction of RC structure? Discuss how safety is ensured against these uncertainties in USD method. **(7)**

(b) Discuss the behavior of RC rectangular bean in flexure under increasing load by drawing neat sketches for strain and stress distribution of uncracked, cracked and ultimate conditions. **(8)**

(c) A singly reinforced RC beam section, as shown in Fig. 2 has a width of 14 in., effective depth of 25 in. and total depth of 28 in. The tension reinforcement consists of three No. 10 bars in one row.

Given: $f_c' = 4$ ksi; and $f_y = 60$ ksi. $f_s = 24$ ksi, $f_r = 7.5\sqrt{fc'}$ psi, n = 8.

Find:

(i) Cracking moment **(10)**

(ii) Stresses in concrete and steel caused by a bending moment M = 120 kip/ft. **(10)**

6. (a) What is the purpose of providing minimum amount of flexural steel in beam? Write ACI/BNBC code provisions for minimum reinforcement ratios. **(5)**

(b) Discuss how a minimum tensile strain ($\varepsilon_t = 0.004$) at failure is ensured by not exceeding maximum reinforcement ratio. Also discuss the variation of φ with ε_t as given in ACI/BNBC code. **(10)**

(c) A beam section is limited to width b = 12 in. and total depth h = 25 in. Calculate the required reinforcement if the beam has to resist a factored moment $M_u = 475$ kip-ft. Assume two layer tensile reinforcement with d = 21 in. and $d_t = 22.5$ in. Also, assume d′ = 2.5 in. if compression steel is required. Given: $f_c' = 4$ ksi; $f_y = 60$ ksi. **(20)**

CE 323(WRE)

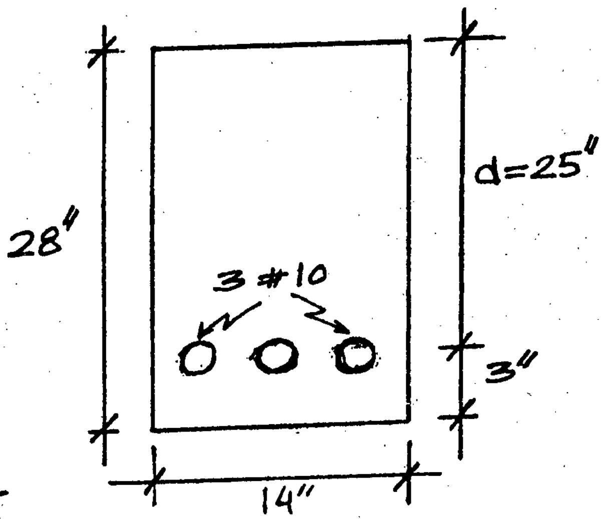
7. (a) A floor system consist of a 3 in. concrete slab supported by continuous T beams with a 24 ft span, 48 in. on centres as shown in Fig. 3. Web dimensions are b_w = 12 in. and d = 20 in. Tensile steel consists of 6 No. 9 bars. What is the nominal and design positive moment capacity of the section? Given: $f_c' = 4$ ksi; $f_y = 60$ ksi. **(17)**

(b) A rectangular RC beam as shown in Fig. 4 measures 12 in. wide and has an effective depth of 27 in. Tension steel consists of six No. 9 bars in two layers (d = 27 in., d_t = 28.5 in.) and compression steel consists of three No. 9 bars is located 2.5 in. from the BNBC code? Check for yielding of compression steel and ε_t. Given: $f_c' = 3.5$ ksi; $f_y = 60$ ksi. **(18)**

8. (a) A rectangular beam carries a service live load (unfactored) of 1.75 kip/ft and an unfactored superimposed dead load of 1.0 kip/ft (in addition to self-weight of beam) on a 20 ft simple span as shown in Fig. 5. The beam will have a cross-section of 12″ × 24″ for architectural reason. Design the beam for flexure using USD method. **(15)**
Given: $f_c' = 3.0$ ksi; $f_y = 60$ ksi.

(b) A rectangular beam has width 14 in. and effective depth 24 in. as shown in Fig. 6. It is reinforced with eight No. 9 bars in two rows (d = 24″, d_t = 25.5″). What is the nominal flexural strength M_n and what is the maximum moment φM_n that can be utilized in the design? **(15)**
Given: $f_c' = 5.0$ ksi; $f_y = 60$ ksi.

(c) What is the difference between under-reinforced and over-reinforced beam? Which one is preferable and why? **(5)**



Given: $f_c' = 4\ ksi$

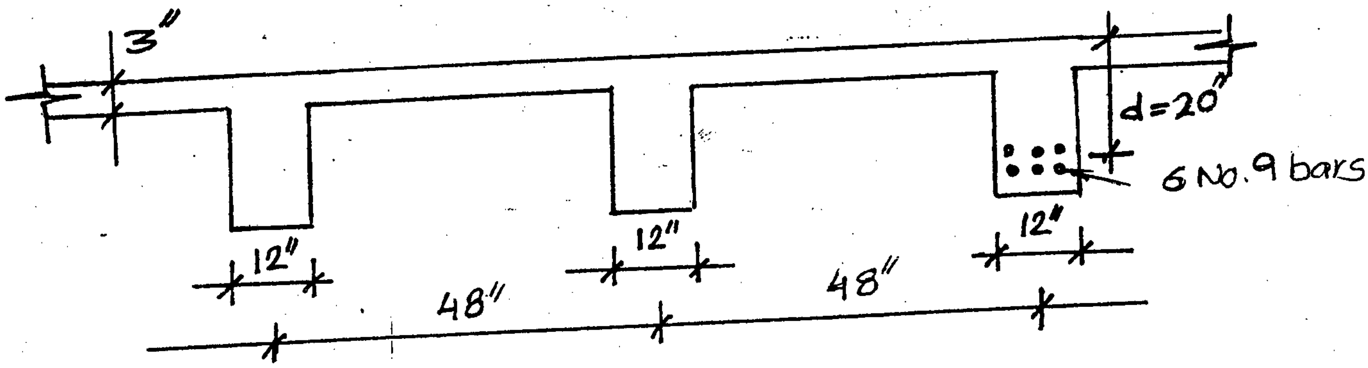
$f_y = 60\ ksi$

$f_s = 24\ ksi$

$f_r = 7.5\sqrt{f_c'}\ psi$

$n = 8$

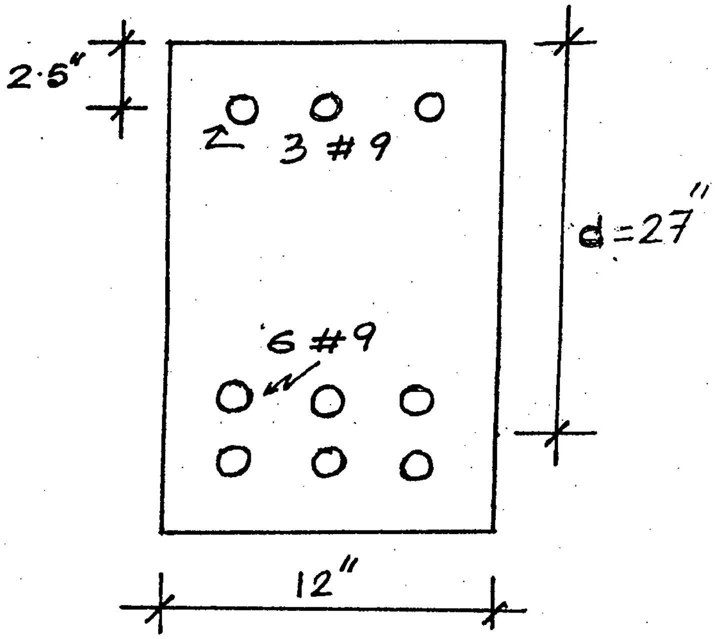
Fig. 2



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

Beam span = 24 ft

Fig. 3



Given:

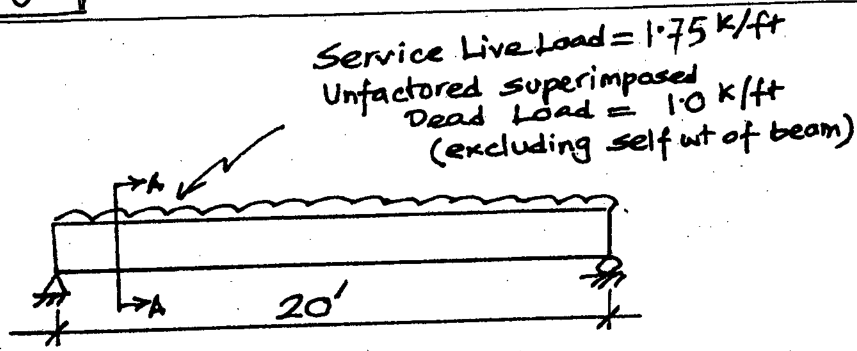
$f_y = 60$ ksi

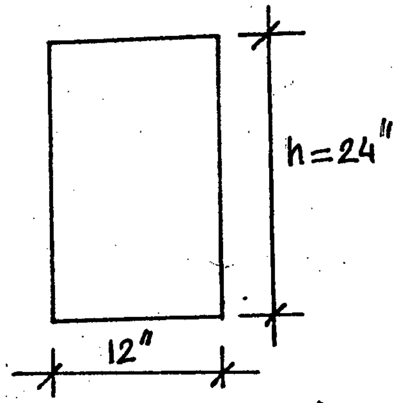
$f_c' = 3.5$ ksi

$d = 27''$

$d_t = 28.5''$

Fig. 4





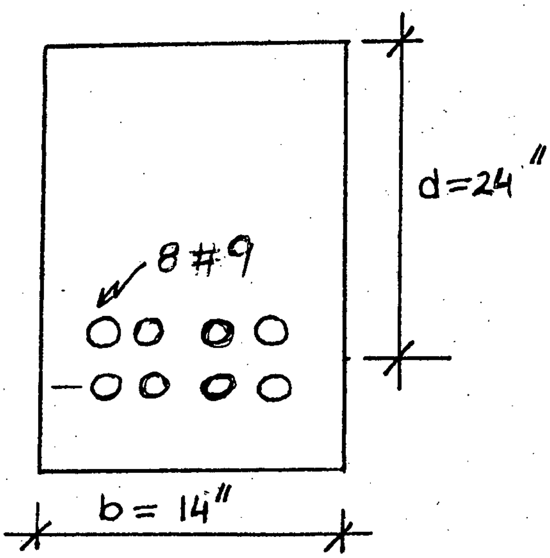
Section A-A

Given:

$f_c' = 3$ ksi

$f_y = 60$ ksi

Fig. 5



Given:

$f_c' = 5{,}000$ psi

$f_y = 60{,}000$ psi

$d = 24''$

$d_t = 25.5''$

Fig. 6