QUESTION BANK

STRUCTURAL ANALYSIS – I

Two marks Questions

1.

a. Differentiate between Dam & Retaining wall?

b. Give formula for calculating length of the cable `L' & increase in dip `dH'?

c. State any two assumptions of rankine's theory?

d. What are the various failures of masonry dams?

e. Differentiate between Active earth pressure & Passive earth pressure.

f. A truss is normally subjected to which type of forces?

g. State any two assumptions of rankine's theory.

h. State any four assumptions made in finding out the forces in a truss.

i. Give formula for calculating length of the cable `L' & increase in dip `dH'?

j. Define Influence Line Diagram. Give any two uses of Influence Line Diagram?

k. Define Muller Breslau's Principle?

l. Give the formula's for calculating span lengths (l1 & l2) and horizontal thrust `H' for arches having supports at different level?

m. Give the formula/equation for calculating radius `R' & vertical rise `y' for circular segmental arches ?

n. Give any two uses of influence line Diagrams ?

o. Where do you get absolute maximum bending moment in a simply supported beam when a series of loads cross it?

Four marks Questions

2. Explain the step by step procedure to draw force polygon?

3. A cord supported at its ends 40 m apart carries loads of 20 KN, 10 KN & 12 KN at distances 10 m, 20 m & 30 m from the left end. If the point on the cord where the 10 KN load is supported is 13 m below the level of the end supports, determine reactions at the supports & tensions in different parts of the cord.

4. For the girder shown in figure (a) draw influence line diagram for reactions Va and Vb.

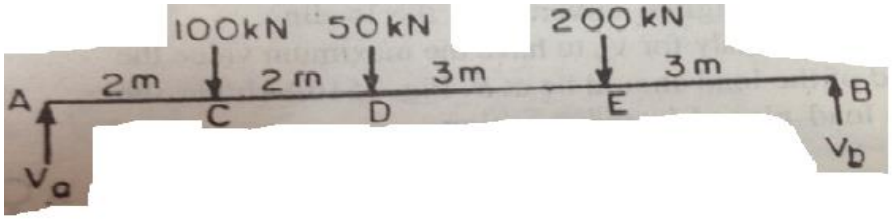


Fig (a)

5. Determine the maximum & minimum stresses at the base of an hollow circular chimney of height 20 m with external diameter 4 m & internal diameter 2 m. The chimney is subjected to a horizontal wind pressure of intensity 1 KN/m^2. The specific weight of the material of chimney is 22 KN/m^3.

6. A trapezoidal masonry dam is of 20 m height. The dam is having water upto a depth of 16 m on its vertical side. The top & bottom width of the dam are 3 m & 9 m respectively. The density of masonry is given as 19.62 KN/m^3. Determine max. & min. stress intensities at the base.

7. A three hinged arch of span "l" and rise "h" carries a uniformly distributed load of w per unit run over the whole span. Show that the horizontal thrust at each support is $wl^2/8h$.

8. Find the strain energy stored by the cantilever & calculate the deflection at the free end refer fig (a)?

9. Drive an expression for maximum slope & maximum deflection for a fig (b) given below using double integration method?

10. State the assumptions made in finding out the forces in a truss?

11. What are the various failure criteria of dams?

12. A concrete dam of rectangular section 15m high and 5m wide contains water upto a height of 13m. Find the total pressure on 1 m length of dam, point where resultant cuts the base and max. & min. pressure on the base of dam. Assume weight of concrete as 2530kg/m^2.

13. For the beam shown in figure (a) determine the shear force at section –X.

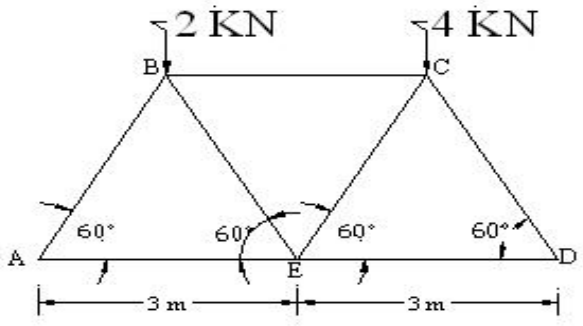
Eight Marks Question

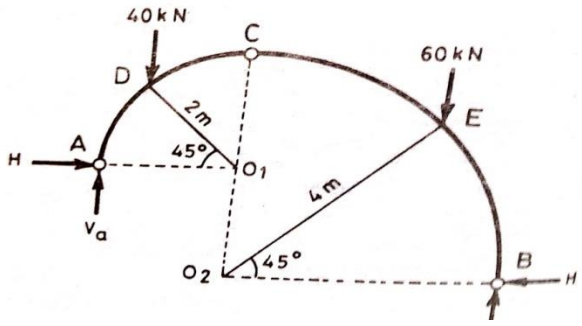
14. A simply supported beam 5 m span carries a u.d.l. of 12 KN/m on the whole span and in addition it carries a point load of 25 KN at the centre. Calculate the maximum slope and deflection by moment area method Take E= 2x 10^5 N/mm^2 and I = 5500 x 10^4 mm^4.

15. A horizontal girder of steel having a uniform section & a span of 14 m is applied by two point loads 120 KN & 80 KN at 3 m & 9.5 m from left support. Find Slope & deflection under the loads & slope at each end. EI = 3.36 X 10^{11} KN mm^2. (Use conjugate beam method)

16. A warren girder consisting of seven members each of 3 m length freely supported at its end points. The girder is loaded at B & C as shown in fig (a). Find the forces in all the members of the girder, indicating whether the force is compressive of tensile. (Use method of sections).

17. Figure (b) shows a three hinged arch consisting of two quadrantal parts AC and CB of radii 2 m and 4m respectively. For the load system acting on the arch, calculate the reactions at the supports and the bending moments under the loads.





18. The three hinged stiffening girder of a suspension bridge of span 120m is subjected to two point loads of 240 KN & 300 KN at distances 25 m & 80 m from the left end. Find the shear force & bending moment for the girder at a distance of 40 m from the left end. The supporting cable has a central dip of 12 m. Find also max. tension in the cable.

19. A distributed live load of 80 KN per metre run may occupy any position on a girder as shown in figure (b). Find the maximum positive and negative shear force at the section marked C.

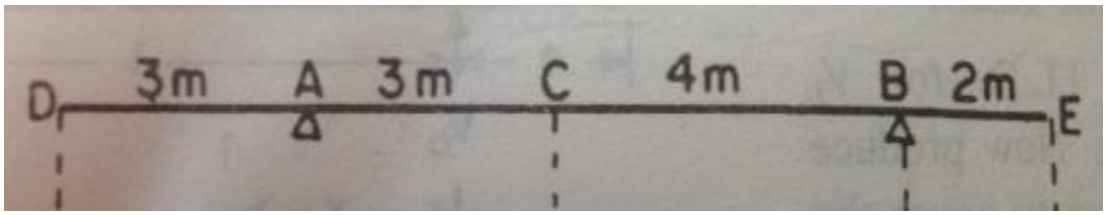


Fig (b)

20. The load system shown in figure (b) moves from left to right on a girder of span 10 metres. Find the absolute maximum bending moment for the girder.

21. A masonry retaining wall of trapezoidal secion 12 m high retains earth which is level upto the top. The width at the top is 3 m & at the bottom is 6 m. The exposed face is vertical. Find the maximum and minimum intensities of normal stress at the base. Take density of earth as 15.7 KN/m^3, density of masonry as 22.56 KN/m^3 & angle of repose is equal to 30^o.

TOPIC – DOUBLE INTEGRATION METHOD

A. Simply Supported Beam cases:-

1. A simply supported beam of span 3m is subjected to a central load of 10 KN. Find maximum slope and deflection. Take I = 12×10^6 mm^4 and E = 200 GPa.

   ANS.:- Y = 2.34 mm , θ = 0.002342 radians

2. A simply supported beam AB of span 5m is carrying a point load of 30 KN at a distance of 3.75m from the left end A. Calculate the slope at A & B and deflection under the load. Take EI = 26×10^9 KN-mm^2**.**

   ANS.:- θa = 0.00113 radians, θb = 0.00158 radians, Y = 1.69 mm

3. A simply supported beam of span 4m is carrying a UDL of 2 KN/m over the entire span. Find the maximum slope and deflection of the beam. Take EI = 80×10^9 N-mm^2.

   ANS.:- θa = 0.067 radians , Y = 83.3 mm

4. A simply supported beam of spam 4m is carrying a triangular load varying from zero at A to 5 KN/m at B. Determine the maximum deflection of beam. Take E = 1.25×10^9 KN-mm^2 .

   ANS.:- Y = 668 mm

B. Cantilever Beam cases :-

1. A cantilever beam of 160mm wide and 240mm depth is 1.75m long. What load can be placed at the free end of the cantilever, if its deflection under the load is not to exceed 4.5mm . take E = 180 GPa.

ANS. :- 35.26 KN

2. A cantilever beam of span 3m long carries a point load of 20 KN at the distance pf 2m from the fixed end. Determine the slope and deflection at the free end. Take EI = 8×10^9 KN-mm²

ANS.:- θb = 0.005 radians, Y = 11.7 mm

3. A cantilever beam of span 2m is subjected to UDL of 5 KN/m over its entire length. Find the slope and deflection at the free end of cantilever. Take EI = 2.5×10^9 KN-mm²

ANS.:- θb = 0.0027 radians, Y = 4.0 mm

4. A cantilever beam of span 2m carries a triangular load of zero intensity at free end and 100 KN/m at the fixed end. Determine slope and deflection at the free end. Take I = 100×10^6 mm⁴ and E = 200GPa.

ANS.:- θb = 0.00167 radians , Y = 2.67 mm

5. A 2m long cantilever beam which is 75mm wide and 200mm deep is partially UDL of 20 KN/m over span of 1m from its free end. Find slope and deflection of cantilever beam. Take E = 200 GPa.

ANS.:- θb = 0.00234 radians , Y = 3.42 mm

TOPIC – MOMENT AREA METHOD

1. Calculate slope and deflection at the free end of the cantilever beam carrying a point load of 10 kN at the free end and a UDL of 20 kN/m for 3 m from the fixed end. The length of the beam is 4 m.

   Take $E = 2 \times 10^5$ N/mm² and $I = 250 \times 10^6$ mm^4.

   [ANS: $\theta = 0.0034$ radians , $Y = 10.12$ mm]

2. A steel tube cantilever 4m long has outer diameter 120mmm and thickness 10mm. It carries a UDL of w kN/m for 3m from the fixed end. Find "w", if the maximum stress due to bending is 7×10^4 kN/m². Take $E = 2.1 \times 10^8$ kN/m².

   [ANS: w = 1.36 kN/m]

3. A simply supported beam of span 5 m is carrying a point load of 25 kN at its midpoint and a UDL of 12 kN over the entire span. Calculate slope at the ends and deflection at its mid point.

   Take $E = 2 \times 10^5$ N/mm² and $I = 5500 \times 10^4$ mm^4.

4. A simply supported beam 5m long carries concentrated loads 10 kN each at points 1m from the ends.

   Calculate:- (a) maximum slope and deflection of the beam ;

   (b) slope and deflection under each load. Take $EI = 1.2 \times 10^4$ kNm²

   [ANS: $\theta_{max} = 0.001666$ radians $Y_{max} = 2.465$mm $\theta C = \theta D = 0.001249$ radians $YC = YD = 1.526$mm]

TOPIC – CONJUGATE BEAM METHOD

1. A beam ABCD 9m long is simply supported at the ends A and D and carries a concentrated load of 18 KN at C. The parts AB , BC and CD are each 3m long. The moment of inertia of the section for the parts AB, BC and CD are respectively 3I , 2I and I. Take E = 200kN/mm^2 and I = 4.15x10^7 mm^4. Find :- (a). Slope at A, B, C and D; (b). Deflections at B and C.

2. A beam ABCD is simply supported at its end A and D over a span of 30 metres. It is made up of three portions AB , BC and CD each 10 m in length. The moments of inertia of the section of these portions are I , 3I and 2I respectively , where I = 2x10^{10} mm^4. The beam carries a point load 150 kN at B and a point load of 300 kN at C. Neglecting the weight of beam, calculate the slopes and deflections at A, B , C and D. Take E = 200 kn/mm^2.

3. A cantilever of length 6 metres carries a uniformly distributed load of 10 kN/m over the whole length. If E = 200x10^6 kN/m^2 and I = 30x10^{-5} m^4. Determine the following using conjugate beam method :- (a). Slope at the free end ;

(b). Deflection at the free end.

[ANS. :- Slope = 0.006 radians

Deflection = 27 mm]

TOPIC – ANALYSIS OF DAMS, CHIMNEYS AND RETAINING WALLS

Question-1 A masonry dam of rectangular section is 2 metres wide. Calculate the height of dam when the resultant thrust hits the base at the middle third point. The water is level with the top of the well. The specific weights of water and masonry are 9.8 kN/m³ and 24 kN/m³ respectively.

Question-2 A masonry dam of trapezoidal section is 16 metres high and impounds water to a depth of 15 metres. It has a vertical water face. Determine the top and bottom widths for the section, if the normal stress intensity varies from 120 kN/m² at one end to 480 kN/² at the other, both compressive. The specific weights of masonry and water are 24 kN/m³ and 9.8 kN/m³, respectively.

Question-3 A masonry dam is 1 metre wide at the top, 4 metres wide at the base and 6 metres high. The face of the wall exposed to water is vertical and water is likely to rise to the top of the wall. Find the maximum and minimum normal stress intensities at the base, if the specific weight of masonry is 22 kN/m³ and that of water 9.8 kN/m³ . Calculate also the normal stress intensities when the reservoir is empty.

Question-4 A masonry dam, 1.5 metres wide at the top, 5 metres wide at the base is 7.5 metres high with a vertical water face and retains water to a depth of 7.2 metres. Find the maximum and minimum normal stress intensities at the base, if the specific weights of masonry and water are 22 kN/m³ and 9.8 kN/m³ respectively.

Question-5 Calculate the minimum bottom width required for a dam of height 7 metres. Maximum depth of water be impounded is 6 metres. Top width of section is to be 1.25 m. The specific weight of masonary is 22.50 kN/m³; coefficient of friction between masonry and masonry 0.6. Assume weight weight of water 10 kN/m³ .

Question-6 A masonary dam of trapezoidal section is 20 metres high, with a vertical water face. It impounds water to a depth of 18 metres. Determine the width at the top and bottom of the section if the normal stress intensity at the base varies uniformly from 100 kN/m² at one and to 500 kN/m² at the other. Take the specific weight of water and masonry as 10.0 and 240 kN/m³.

Question-7 A masonry dam 12 metres high, trapezoidal in section, has a top width of 2 m and bottom width 8 m. The face exposed to water has a batter of 1 in 12. Water is likely to rise to the top of the wall. Calculate the maximum and minimum normal stress intensities at the base, given that the specific weight of masonary is 24 kN/m³ and that of water, 10 kN/m³.

Question-8 A masonry dam, 12metres high, is trapezoidal in section. The top width is 2 metres and the face exposed to water is inclined at 8˚30’ to the vertical. Water is likely to rise to the top of the wall. Calculate the minimum bottom width necessary so that no tension is induced at the base. Specific weight of masonry 22.4 kN/m³. Specific weight of water is 10 kN/m³ .

Question-9 The profile of a masonry dam is basically triangular, with a vertical water face 27 m high. The base width is designed to be a minimum for no tension to be developed in the masonry with 27 m depth of water. Before completion, it is decided that provision must be made for a depth of 28.8 m and

the top of the dam is therefore rectangular and 4.5 m wide at the top as shown in fig. What must be new height of the dam if no tension is be developed anywhere?

Specfic Weight of masonry = 2.25 x specific weight of water.

Question-10 A masonry dam 8 m high is 1.5 m wide at the top and 5 m wide at the base. It retains water to a depth of 7.5 m. The water face of the dam is vertical. Find the maximum and minimum stresses at the base. The weight of the masonry is 22.4 kN/m³. Find the factor of safety against (a) sliding and (b) overturning for the dam section (Coefficient of friction between soil and dam base is 0.6).

Question-11 Design the section of a trapezoidal masonry dam (with water face vertical) to impound water up to 29 m depth on the upstream side, with a free-board of 1 m. The maximum allowable pressure on base is 900 kN/m². Assume no tension in masonry (weight of masonry = 23 kN/m³).

Question-12 A masonry retaining wall of trapezoidal section retains level earth 6 meters high. The retaining wall is 1 m wide at the top, determine the bottom width so that no tension is induced in the base. The unit weight of masonry is 23 kN/m³ and of soil 15 kN/m³. The angle of repose of the soil is 30˚ and the back face of the wall is vertical.

Question-13 A masonry retaining wall, trapezoidal in section, is 5 metres high, 0.60 m wide at the top and 2.5 m wide at the base, with a vertical face retaining earth level with the top of the wall. If the specific weights of masonry and earth are 24 and 20 kN/m³, respectively, calculate the maximum and minimum normal stress intensities at the base, the coefficient of active earth pressure being 0.27.

Question-14 A retaining wall, 6 metres high, 1 metre wide at the top and 3 metres wide at the base has a batter of 1 in 10 on its earth-face. It retains earth level with the top of the wall. If specific weights of masonry and earth are respectively 24 and 20 kN/m³ and the angle of repose of the material is 40˚, find the distribution of normal stress intensity across the base.

Question-15 A masonry abutment resting on a concrete foundation 750 mm thick is shown in fig. Calculate the intensity of shear stress across the piece at the section 00. Specific weights of masonry, concrete and the retained material, are 24, 22.4 and 17.6 kN/m² respectively. The angle of repose of the retained material is 35˚.

Question-16 A masonry retaining wall of trapezoidal section, 1 metre wide at the top, 3 metres wide at the base and 6 metres high, has a vertical earth face and retains earth level with the top of the well. In the top 3 metres, the weight of retained material is 18 kN/m³, while below this level it is 21 kN/m³. The angle of repose of the material is 30˚. Taking the weight of masonry as 24 kN/m³, calculate the maximum and minimum normal stress intensities at the base.

Question-17 A concrete dam of rectangular section 15m high and 5m wide contains water upto a height of 13m. Find the total pressure on 1m length of dam, point where resultant cuts the base and maximum and minimum pressure on the base of dam. Assume weight of concrete as 2530kg/m².

Note : For figures refer recommended books (Ramamurtham, Brinder Singh, RS Khurmi)

TOPIC – CABLE AND SUSPENSION BRIDGE

Question-1 A suspension cable supported at the same level has max. dip of 3m and loaded with a udl of intensity 1 kN/m throughout upon its horizontal span of 30 m. Find maximum tension in cable and find its inclination with horizontal.

Question-2 A cable is used to support six equal and equidistance loads over a span 14 m. The cable has central dip o 1.6 m. Find the length of the cable and sectional area required if safe tensile stress in cable material is 1.5 kN/cm².

Question-3 A flexible rope weighing 1 N per metre span between two points 40 m apart at the same level and 12 m above the ground. It is to carry concentrated load of 300 N at a point *P* on the rope which is to be at a horizontal distance of 10 m from the left hand support. What is the maximum height of the point *P* above the ground if the maximum tension in the rope is not to exceed 1000 N? Assume that the distance measured along the rope is equal to their horizontal projection.

Question-4 A suspension cable o span 160 m and 16 m central dip carries a load of 1/2 kN/ meter. Calculate the maximum and minimum tension in the cable. Find horizontal and vertical forces in each pier under the following alternative conditions:

(a) If the cable passes over frictionless rollers on the top of the piers.

(b) If the cable is firmly clamped to saddles carried on frictionless roller on the top of the piers.

In each case the back stay is inclined at 30˚ to the horizontal.

Question-5 A cable of span 100 m has its ends at heights 8 m and 15 m above the lowest point of the cable. It carries a uniformly distributed load of 10 kN/m per unit horizontal run of the span. Determine the horizontal and vertical reactions at the support. What is the length is the cable?

Question-6 If the central dip of a cable of a steel wire is limited to 1/12 span find the maximum horizontal span of the steel wire of uniform cross section with the stress not exceeding 120 N/mm². Take unit weight of steel as 78 kN/m³.

Question-7 A three hinged stiffening grider of a suspension bridge of span 100m is subjected to two point loads of 200 kN and 300 kN at the distances of 25m and 50m from the left end. Find the shear force and bending moment for the girder at a distance 30m from the left end. The supporting cable has a central dip of 10m. Find also the maximum tension and its slope in the cable.

Question-8 A suspension bridge of 120 span has two three hinged stiffening girders supported by two cables having a central drip of 12m. The roadway has a width of 6m. The dead load on the bridge is 5kN/m² while the live load is 10 kN/m² which acts on the left half of the span. Determine the shear force

and bending moment in the girder at 30 m from the left end. Also find the maximum tension in the cable for this position of live load.

Question-9 A three hinged stiffening grider of span 250 m, has two nos. of grider. Dip of cable is 25 m, the grider is subjected to 4 point loads, 300 kN each placed at centerline of road way at 20, 30, 40 and 50 m from left hinge. Find *SF* and *BM* in each grider at 62.5 m from each end. Also find T-max in cable.

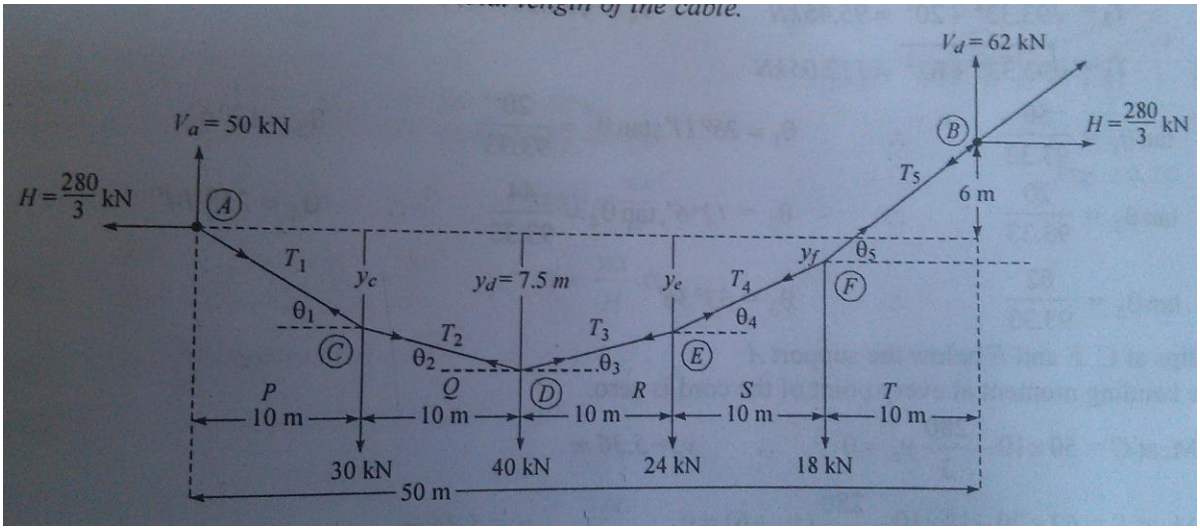
Question-10 A suspension bridge of 100 m span has two three hinged stiffening girder supported by two cables having central dip of 10 m. The dead load on bridge is 5 kN/m², and L.L. is 10 kN/m² which covers left half of span only. Find *SF* and *BM* at 24 m from left end if road way is 6 m wide.

Question-11 A suspension bridge of span 80m, and width 6m, is having two cables stiffened to the two hinged girders. The central dip of cable is 8m, the dead load on the bridge is 5kN/m² and live load is 10 kN/m which covers the left half of span only. Find SF and BM at 20 m from the left end. Also find max. tension in cable.

Question-12 A suspension bridge of span 100 m has two three hinged stiffening girder supported by two cables with a central dip of 18m. If four point loads of 200 kN each are placed along the central line of roadway at 30 m, 33 m, 36 m and 39 m from left hinge. Find SF, BM in girder at a section 45m from left and also calculate max. tension in cable. Using influence line diagrams.

Question-13 A suspension cable of span 40 m and dip 4 m, is stiffened by a three-hinged girder. The dead load is 10 kN/m. Find max. tension in cable and max B.M. in girder if a concentrated load of 100 kN crosses the girder from left to right.

Question-14 Fig. shows a loaded chord ACDEFB of span 50m. The dip of the chord at D is 7.5 m below the left support A. The right support B is 6m higher than the support A. Find the reactions at the support s , the tensions in the various parts of cable, the inclination of the various parts of the cable and the total length of the cable.



Question-15 Find the maximum possible span for a cable supported on the ends at the same level allowing a central dip of 1/10 the span and a permissible stress of 150 N/mm². Steel weights 78000 N per cum. Assume that the cable takes a parabolic profile.

[ANS. l = 1387.5m**]**

Question-16 A cable of span 150m dip 15m carries a load of 6kN per metre run of horizontal span. Find max. tension for cable and the inclination of the cable at the support. Find the forces transmitted to the supporting pier.

(a). if the cable is passed over the smooth rollers on the top of the pier , and

(b). if the cable is clamped to a saddle with smooth rollers resting on the top of the pier.

For each of the above cases the anchor cable is at 30degress to the horizontal. If the supporting pier is 20m high find the max bending moment for the pier for case (a).

Question-17 A cable having span of 100m and the dip of 10 m is subjected to a rise of temp. of 10degrees. The cable supports a total load of 25 kN/m run of the horizontal span. Find the change in tension due to rise of temp.

[ANS. Decrease in tension = -7.03kN**]**

Question-18 The three hinged stiffening girder of a suspension bridge of span 120m is subjected to two point loads of 240KN and 300KN at distances 25m and 80m from left end .Find shear force and bending moment for girder at a distance of 40m from the left end. The supporting cable has a central dip of 12m. Find also the maximum tension in the cable, and draw the B.M diagram for the girder.

Question-19 The two hinged girders of a suspension bridge have a span of 100m, the dip of supporting cable being 10m.If the girder is subjected to two point loads 200KN and 400KN at distances of20m and 80m from the left end, find the S.F and B.M for the girder at25m from the left end. Find also maximum tension in the cable.

Note : For figures refer recommended books (Ramamurtham, Brinder Singh, RS Khurmi)

TOPIC – ROLLING LOADS AND INFLUENCE LINE DIAGRAMS

Question-1 A udl of 15 kN/m covering a length of 3 m crosses a girder of span 10 m. Find max. S.F. and B.M. at a section 4m from L.H. support.

Question-2 Draw the diagram of max. B.M. and S.F. if a single concentrated load of 15 kN moves from left to right over a simply supported girder of span 15 m.

Question-3 Two loads of magnitude 6 kN and 12 kN are spaced 4 m apart. They are made to made over a span of simply supported girder of 25 m with 6 kN load leading. Draw the diagram for max. S.F and B.M. for the girder.

Question-4 A train of wheel load consist of six wheels movers from right to left on a girder of 20 m span. Find the max. S.F. and B.M. at a section 7.5 m from left support. Also find absolute max. value of S.F. and B.M. that may occur anywhere in the span.

Question-5 Draw influence line diagrams for SF and BM for the following beam at point '*C'.*

Question-6 The frame is used to support a crane of material handling in a work shop. The load of dolly of crane is 3 kN and the beam *CB* has a mass 24 kg/m. Assume the dolly has negligible size and can travel the entire span, *CB.* The joint '*A'* is a pin and B is a roller support. Determine the max. vertical support reaction at *A* and *B* and the max. moment at 'D'.

Question-7 Two wheel loads 400 kN, and 200 kN, spaced at 3 m apart move from left to right on a simply supported girder of span 9 m. Find max. +ve SF and –ve SF and Max. B.M. at a section 4m from left support assume that 200 kN load is the leading load.

Question-8 Draw influence lines for both reaction, shear and moment at section 1-1 in a simply supported beam *AB*. Hence determine the maximum moment and shear at the section due to the following moving loads:

(a) A point load of 10 kN

(b) A truck moving from feft to right having 50 kN load on the front wheels and 200 kN on the rear wheels with a wheel base of 3 m.

Question-9 Draw influence lines for shear and moment at section *C* and *B* in the cantilever beam *AB*.

Question-10 A simply supported bridge girder has a span of 16.5 m. Determine the maximum shear force, absolute maximum bending moment and maximum bending moment at 4 m from one end when a highway class B loading) crosses the girder.

Question-11 (i) Load moves along the top chord of the N truss (a) Draw influence lines for members $L_2 L_3$, $U_2 L_3$, $U_2 L_3$, $U_3 L_3$ and $U_2 L_2$.

(ii) Redraw the influence line for member $U_2 L_2$ and $U_3 L_3$ if the load moves on the bottom chord.

Question-12 (i) Draw influence lines for members L_1L_2, $L_1 U_2$ and U_2L_3 of the Warren truss (a) when the load moves on the bottom chord.

(ii) Hence, determine the maximum forces in these members when a uniform load of 15 kN/m intensity and 36 m long crosses the span on the bottom chord.

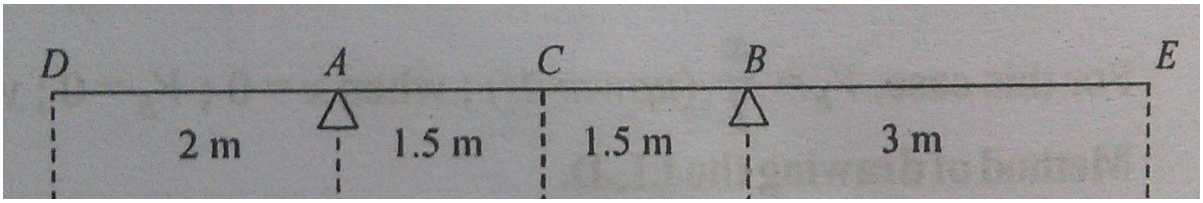
Question-13 A ULD of 2t/m and 20 m long crosses a girder of span 16m . Calculate the maximum S.F. and B.M. at 0, 4, 8, 12, and 16 m from left end support.

Question-14 A UDL of 5t/m of 6m long span crosses a girder of span 40m from left to right. With the help of influence line determine the values of S.F. and B.M. at a point 12m from left end when the head of load is 16m from left end.

Question-15 A uniformly distributed live load of 60 kN per metre run of length 5 metres moves on a girder of span 16 metres. Find the maximum positive and negative shear force at a section 6 metres from left end.

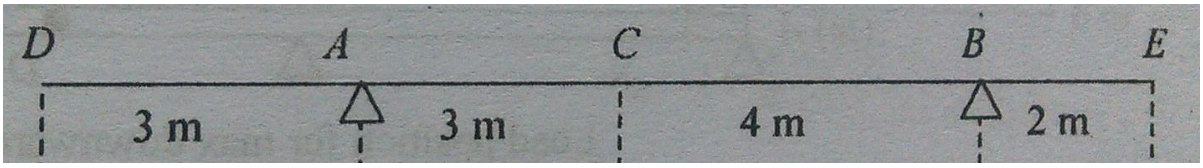
[ANS: Max. +ve = 140.625 kN; Max. –ve = 65.625 kN **]**

Question-16 Two wheel loads 200 kN and 80 kN spaced 0.8 m apart on the girder shown in fig. Find the maximum positive and negative shear force at the section C.



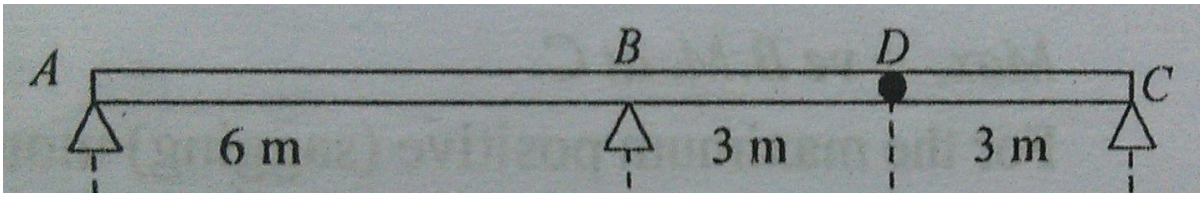
[ANS: Max. +ve S.F. = 165.33 kn , Max. –ve S.F. = 258.6 kN **]**

Question-17 Two wheel loads 200 kN and 80 kN spaced 0.8 m apart roll on the girder shown in fig. Find the maximum positive and negative bending moments that can occur at the section C.



[ANS:- Max. +veB.M. = 473.26 kNm , Max. –ve B.M. = 443.66 kNm **]**

Question-18 Draw the influence lines for reactions at the supports A, B, C and bending moment at the support B for the beam shown in fig. There is a hinge provided at D. Find their maximum values when a travelling load of 60 kN per metre run may cover any part of the span.

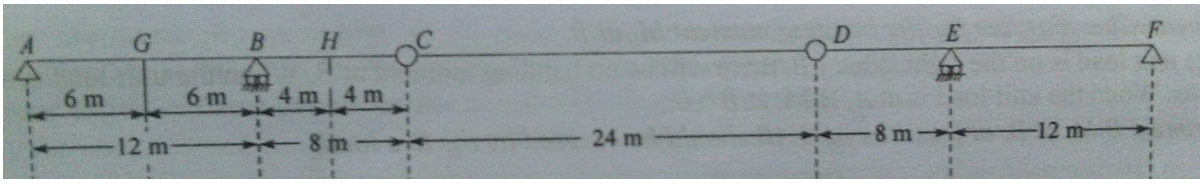


[ANS.:- Max. +ve V_a = 180 kN , Max. –ve V_a = 90 kN ,

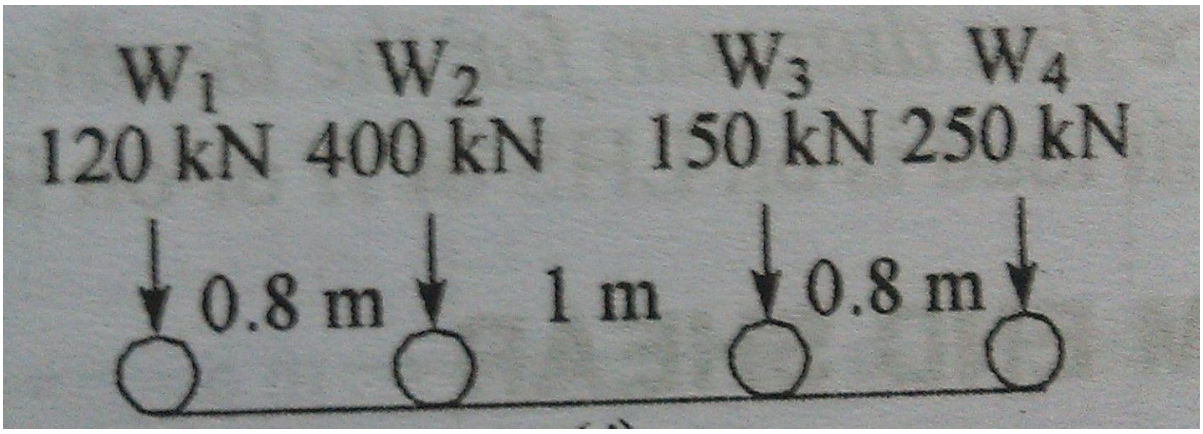
Max. +ve reaction at B = 540 kN , Max. +ve reaction at C = 90 kN ,

Max. –ve B.M. at B = 540 kNm **]**

Question-19 For the balanced cantilever beam shown in fig. draw the ILD for reactions at the supports A and B and the bending moment at G and shear force and bending moment at H.

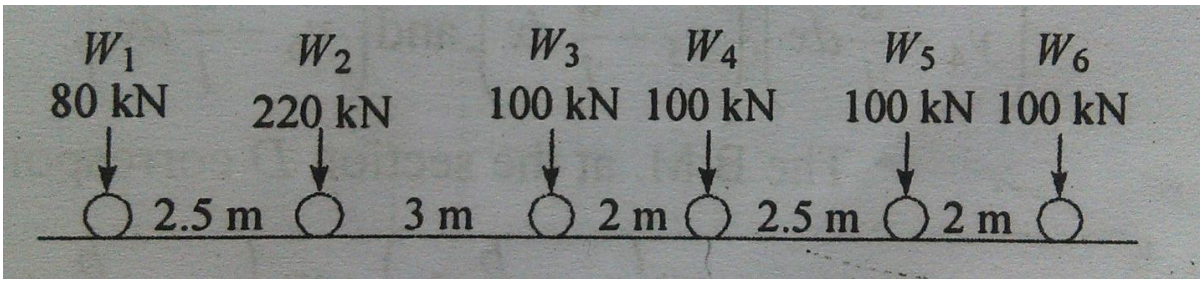


Question-20 The wheel load system shown in fig. can move on a girder of span 5m. Find the maximum positive and negative end shear force for the girder.



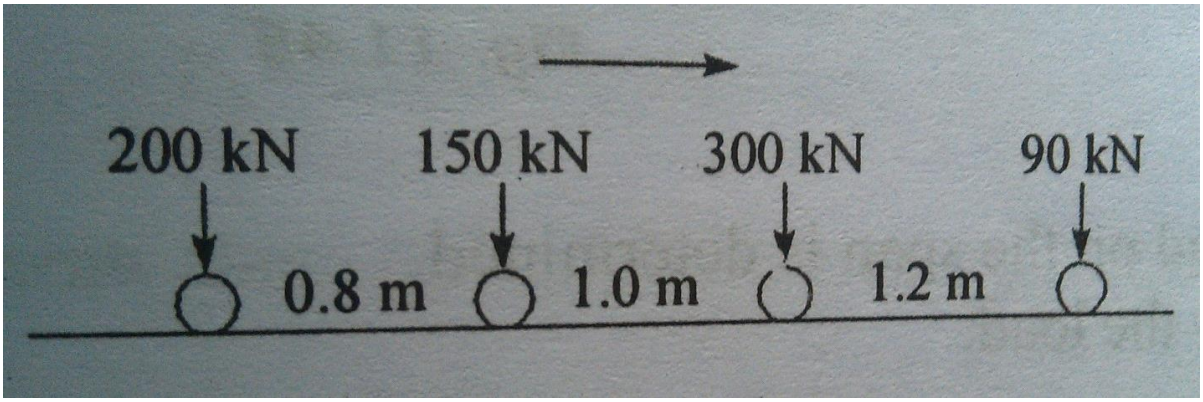
[ANS.:- Max. +ve S.F. = 680 kN; Max. –ve S.F. = 689.6 kN **]**

Question-21 The load system shown in fig. moves from left to right on a girder of span 20 metres. Find the maximum shear force at a section 7.5 m from the left end.



[ANS.:- Max. S.F. = 24.5 kN **]**

Question-22 The wheel loads shown in fig. roll along a beam of span 10 metres. Find the maximum bending moment which can occur at a section 4 metres from the left end.



[ANS:- Max. B.M. = 1420kNm **]**

Question-23 A live load of 50 kN per metre 8 metres long moves on a simply supported girder of a span 10 m. Find the maximum bending moment which can occur at a section 4 metres from the left end.

[ANS:- Max. B.M. = 576kNm **]**

Note : For figures refer recommended books (Ramamurtham, Brinder Singh, RS Khurmi)

TOPIC – ARCH

Question-1 Find horizontal thrust and axial thrust at support, B.M. at a point 6 m from left springing point and max. – ve and +ve BM in a circular arch.

Question-2 A three hinged circular arch consist of two quadrants of radii 3m and 5 m carries a point load of 10 kN find max. B.M. in arch.

Question-3 Find reaction at support and maximum bending moment that may occurs at a section in the following semi-circular arch.

Question-4 A three hinged parabolic arch of span 24m and central rise of 4 m carries a concentrated load of 50 kN at 18 m from left support and a uniformaly distributed load of 30 kN/m over the left half portion. Determine the moment, thrust, radial shear at a section 6 m from the left support.

Question-5 Find bending moment at a point '*P*' along the arch rib in the following arch. Note that the end supports are at different level.

Question-6 The equation of a three hinged parabolic arch with origin at its left hand support is $y = x - x^2/40$. The horizontal span of arch is 40 m. Find normal thrust, radial shear and B.M. at a section 5 m from left hand if the arch is loaded with a udl of 30 kN/m upon its half of span.

Question-7 A three hinged parabolic arch of span 30 m and rise 4 m carriers a load whose intensity varies 20 kN/m at crown at 40 kN/m at the ends. Find BM, N.T. and R.S. at a section '*D*', 7.5 metres from left end.

Question-8 A three hinged arch of span 20m and rise 4m carries a UDL of 25kN/m. Find the horizontal thrust for the arch. If now the arch is subjected to a rise in temp. of 40degree Celsius. Find what change in the horizontal thrust will occur. Take co-efficient of linear expansion of material = 12^x10^{-6} per degree Celsius.

[ANS. Change= 1.0875kN**]**

Question-9 A three hinged arch has a span of 30m and a rise of 10m.The arch carries a uniformly distributed load of 60 KN per metre on the left half of its span. It also carries two concentrated load of 160KN and 100KN at 5m and 10m from the right end. Determine the horizontal thrust, at each support.

[ANS. H= 427.5kN**]**

Question-10 A three hinged arch ABC consisting of quadrantal parts AC and BC of radii 4m and 6m respectively carries two point loads of 100KN each as shown in fig. Find the reactions at the support A and B ,and B.M at E and F.

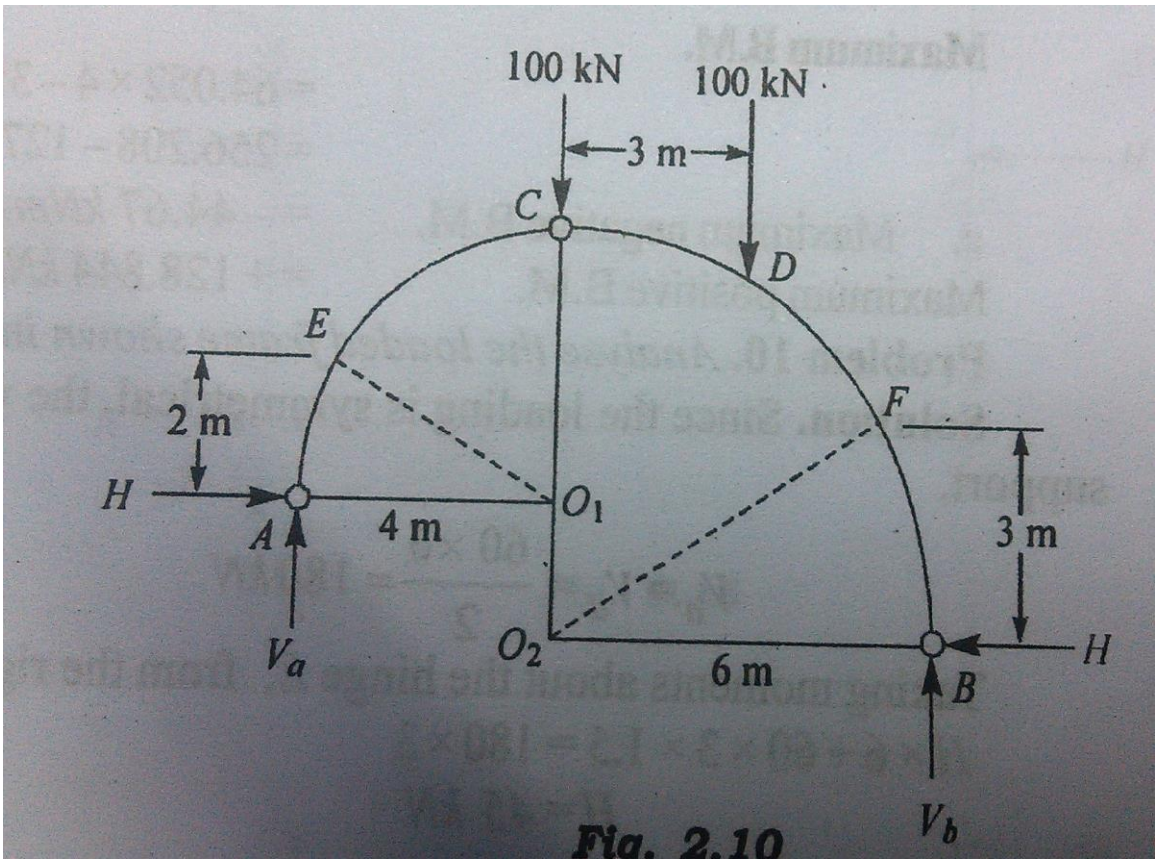


Fig. 2.10

[ANS. Va= 75kN ; Vb= 125kN; Me= -109.81kNm ; Mf= -124.52kNm**]**

Question-11 A three hinged parabolic arch ACB of span 30m has its supports depths 4m and 16m below the crown hinge C. The arch carries a point load of 60kN at a distance of 5m from C and a point load of 120 kN at a distance of 10m from C as shown in fig. Find the reactions at the supports and the bending moments under the loads.

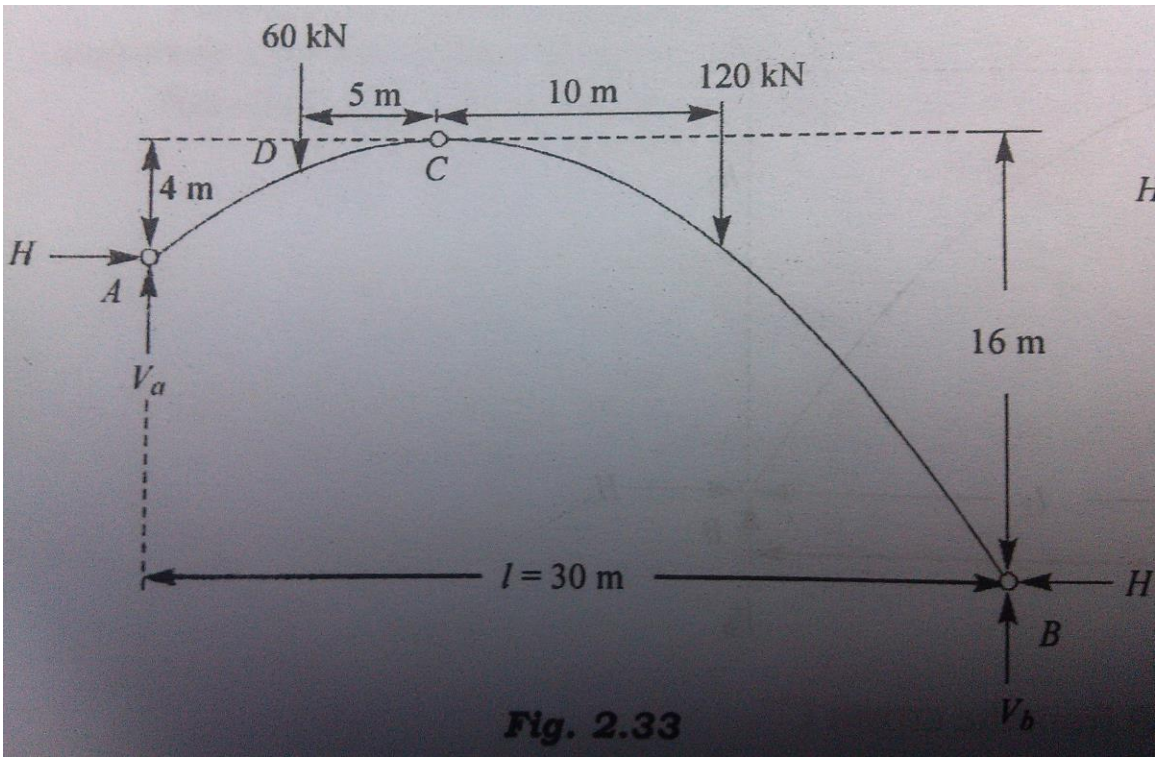
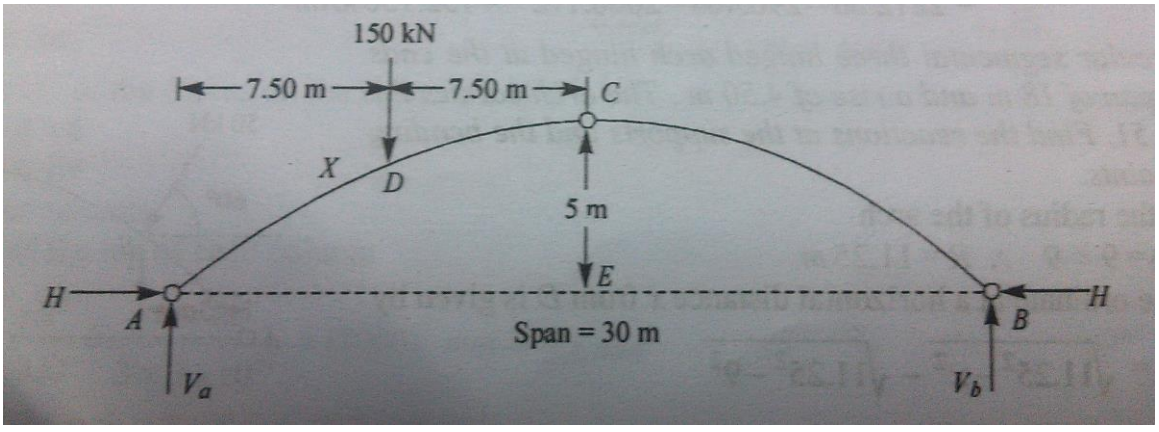


Fig. 2.33

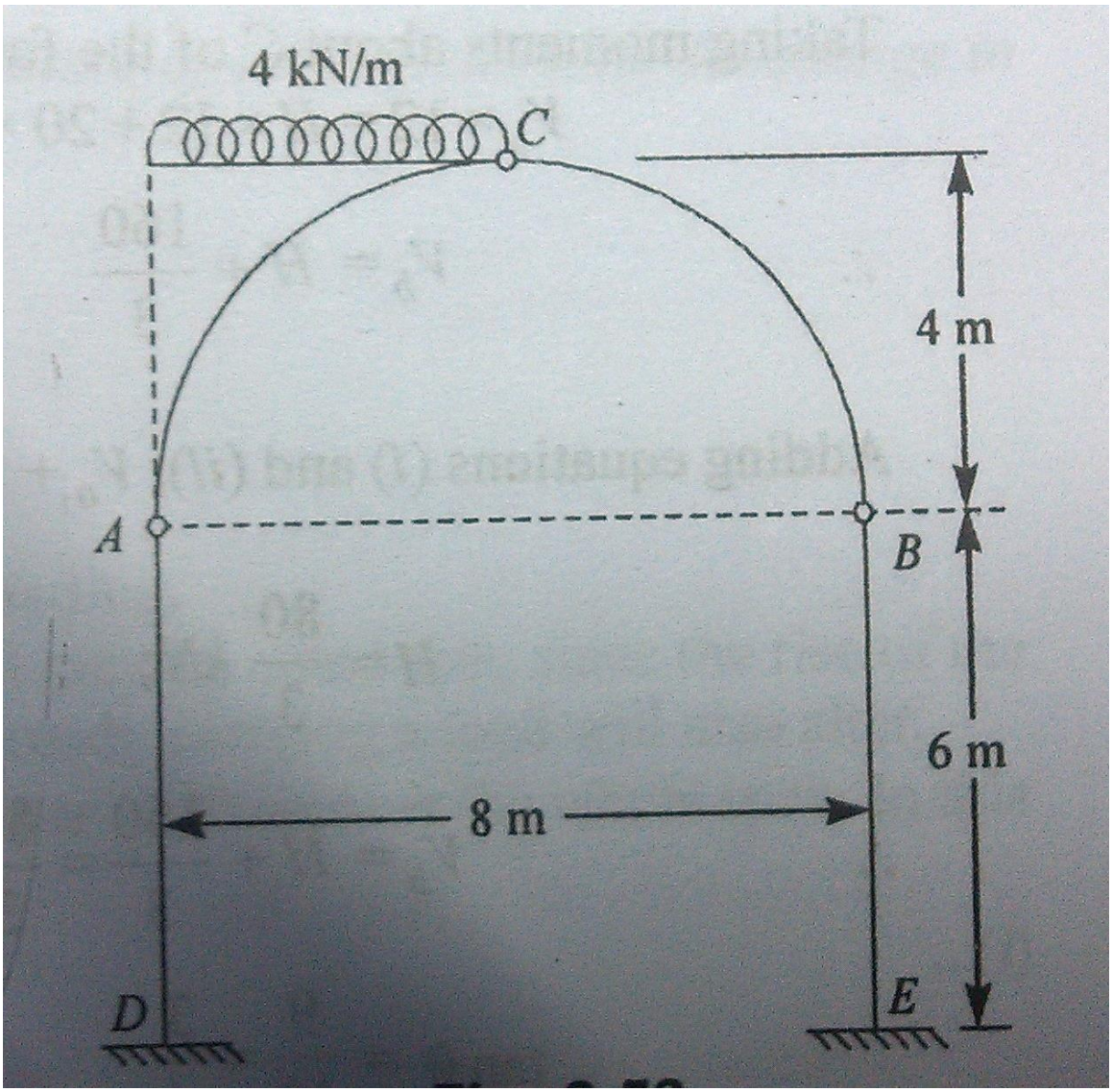
[ANS. Va= 60kN ; Vb= 120kN ; Md= 75kNm ; Me= 300kNm**]**

Question-12 A three hinged segment arch ACB has a span of 30m and a rise of 5m. It supports a concentrated load of 150 kN at a section 7.5 from the left support as shown in fig. Find the reactions at the supports and the maximum positive and negative bending moments.



[ANS. Va= 112.5kN ; Vb= 37.5kN ; M(max) = -152.136kNm **]**

Question-13 A three hinged arch ACB is supported on two columns DA and EB as shown in fig. The arch carries a UDL of 4kN/m on the left half of the span. If the lower ends of the columns are fixed. Find the increase in the span of the arch. Take EI= $30^{x}10^{9}$ kNmm².



[ANS. Increase in span = 19.2mm**]**

Note : For figures refer recommended books (Ramamurtham, Brinder Singh, RS Khurmi)

TOPIC – ANALYSIS OF TRUSS

Question-1 Analyse the truss shown below and find member forces by method of joints.

Question-2 Analyse the following roof truss by method of joints.

Question-3 Find members force in the truss by method of joints.

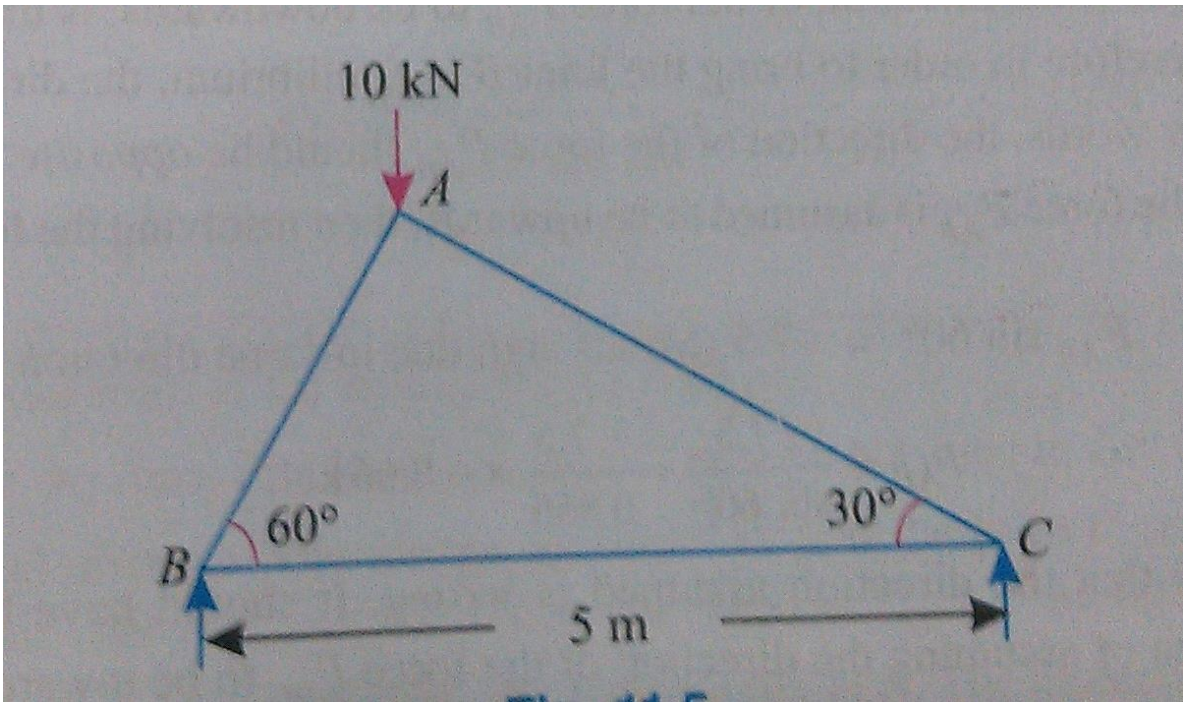
Question-4 Analyse the following truss for the member forces by method of section.

Question-5 Find member forces in the following truss:

Question-6 Using the method of tension coefficients analyse the cantilever truss.

A. Method Of Joints:-

Question-7 A truss ABC shown in figure below has a span of 5 metres. It is carrying a load of 10 kN at its apex. Find the forces in the members AB, AC and BC.

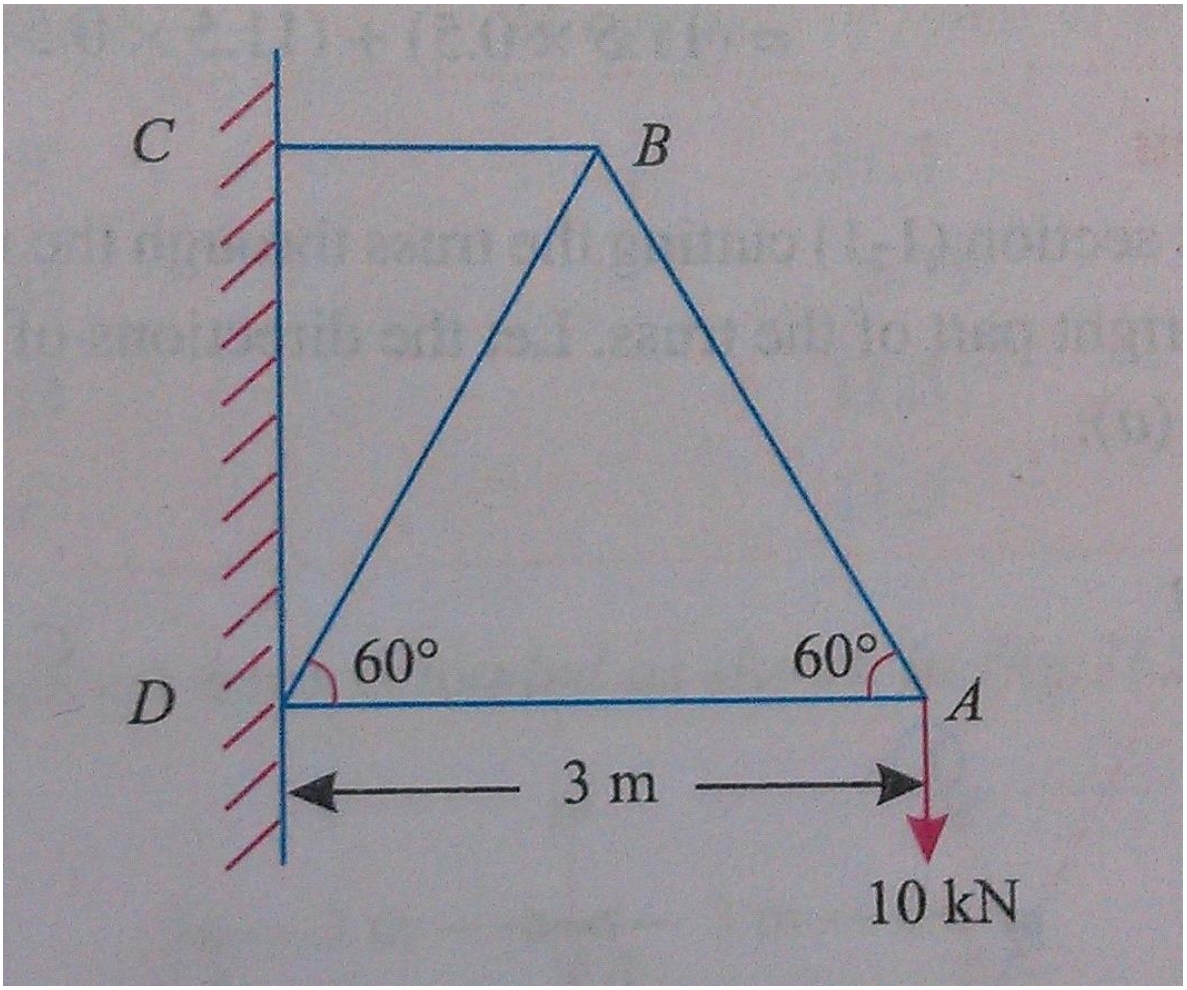


[ANS.:- Force in AB=8.66kN (compression)

Force in BC=4.33kN (tension)

Force in AC=5kN (compression)**]**

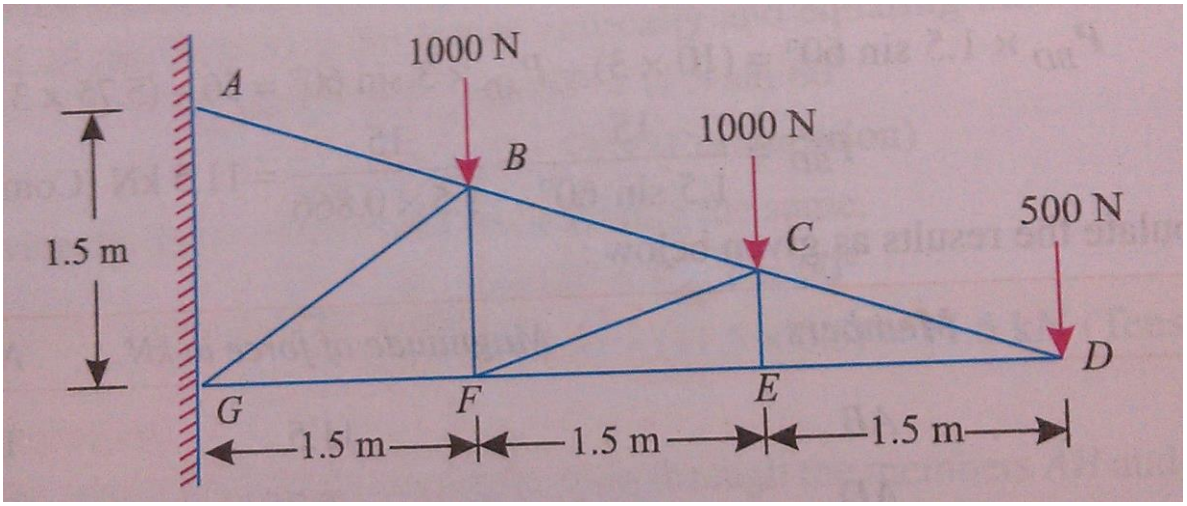
Question-8 A cantilever truss of 3m span is loaded as shown in figure. Find the forces in the various members of the framed truss and tabulate the results.



[ANS.:- AB=11.5kN (T), AD=5.75kN (C)

BD=11.5kN (C), BC=11.5kN (T)**]**

Question-9 Figure below shows a cantilever truss having a span of 4.5 metres. It is hinged at two joints to a wall and is loaded as shown. Find the forces in all the members of the truss.



[ANS.:- AB=4753 N (T) FE=1503 (C)

FC=1584 (C) BC=3168 (T)

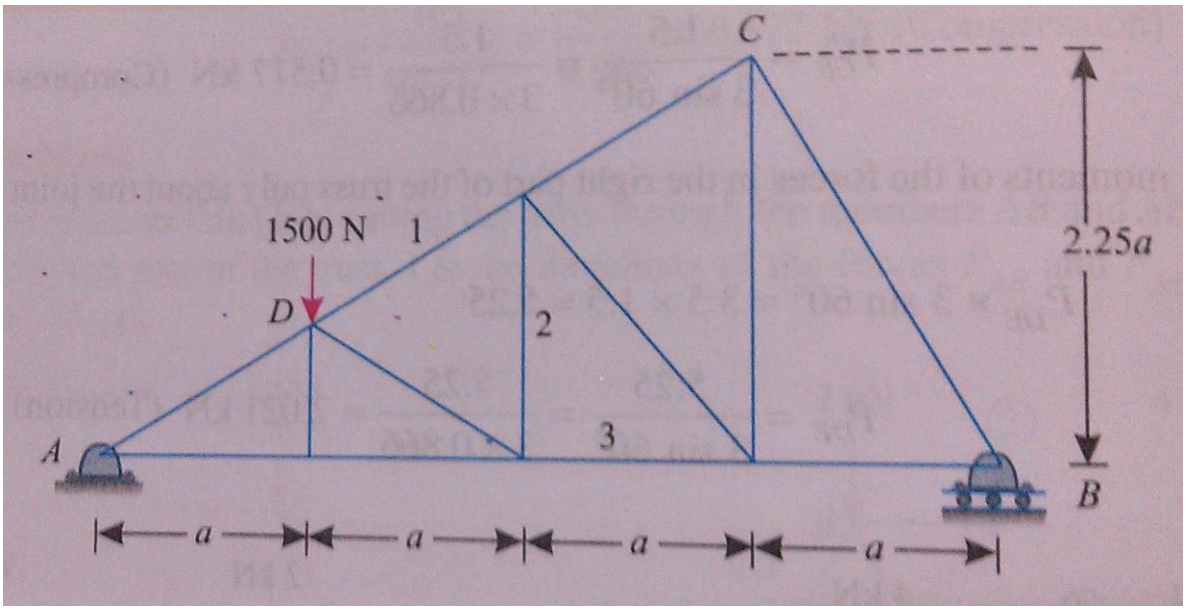
BF=500 (T) CD=1584 (T)

GF=3087 (C) DE=1503 (C)

BG=1801 (C) CE=0 **]**

B. Method Of Section:-

Question-10 A plane is loaded and supported as shown in figure below. Determine the nature and magnitude of forces in the members 1,2and 3.

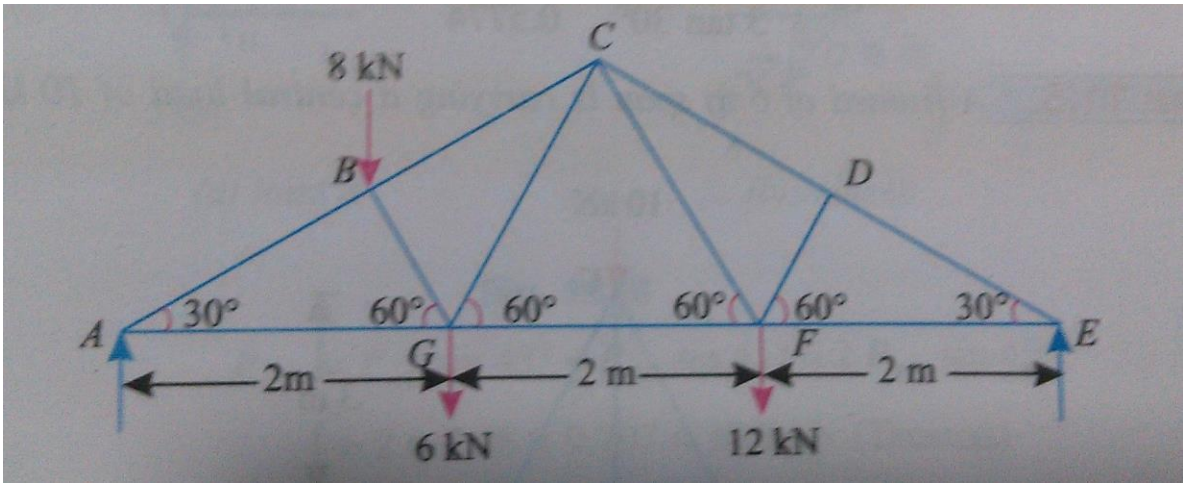


[ANS.:- Force in 1 = 625N (comp.)

Force in 2 = 750 N (tens.)

Force in 3 = 500 N (tens.) **]**

Question-11 An inclined truss shown in figure below is loaded as shown. Determine the nature and magnitude of forces in members BC, GC and GF of the truss.

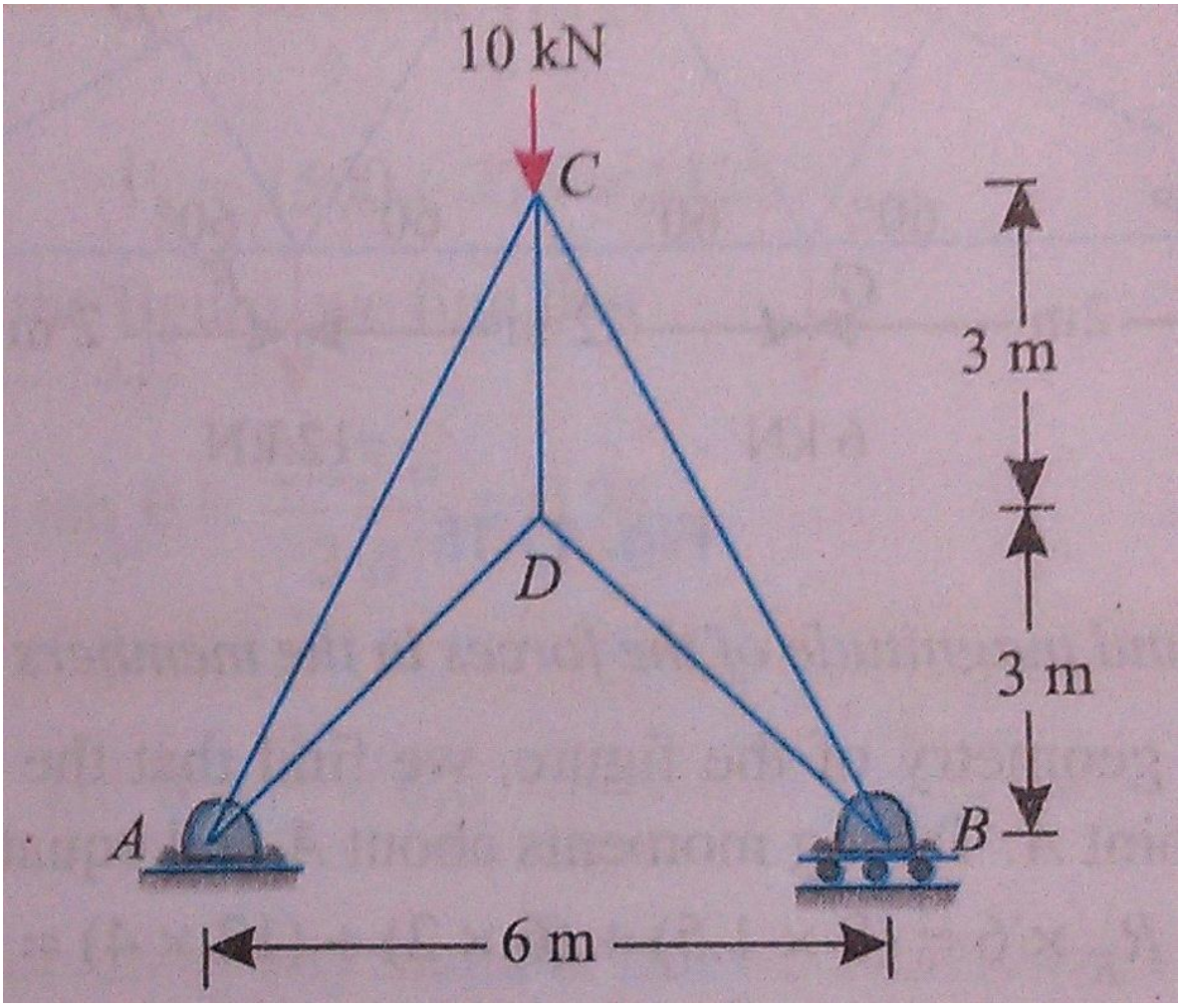


[ANS.:- Force in BC = 24 kN(comp)

Force in GC = 27.7 kN (comp.)

Force in GF = 20.8 kN (tens.)**]**

Question-12 A frame of span 6m is carrying a central load of 10 kN as shown in figure. Determine the nature and magnitude of forces in all the members of structure and tabulate the result.

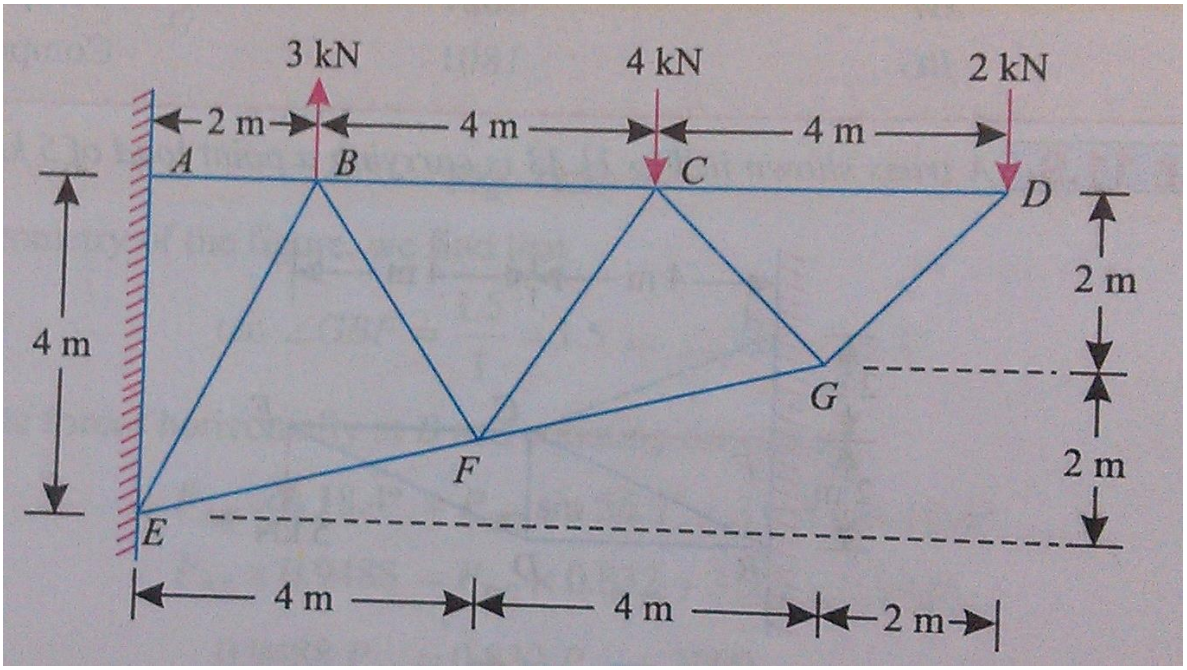


[ANS.:- Force in AD = 7.08 kN (tnsn)

Force in AC = 11.19 kN (comp)

Force in CD = 10kN (T)**]**

Question-13 A pin jointed cantilever frame is hinged to a vertical wall at A and E and is loaded as shown in figure. Determine the forces in all the members CD CG and FG.



[ANS.:- CD= 2kN(T)

CG=1:7kN (T)

FG=3:3kN(C)**]**

Note : For figures refer recommended books (Ramamurtham, Brinder Singh, RS Khurmi)