Mahavir Swami College of Engineering and Technology, Surat

(Bhagwan Mahavir Education Foundation, Surat)

CIVIL ENGINEERING DEPARTMENT

Question Bank

4th semester – Structural Analysis-I (2140603)

Each following definition carries 1 mark.

1. Define Conjugate beam Theorems.
2. Which points should be take care while using Macaulay's Method.
3. A simply supported beam is subjected to a central point load. If the slope is 0.8^0 at support due to the effect of loading, calculate deflection at center. Length of the beam is 3m.
4. Find Structural indeterminacy of the structure shown in **figure 1(a)** & **1(b).**
5. Find Kinematic indeterminacy of the structure shown in **figure 1(a)** & **1(b).**

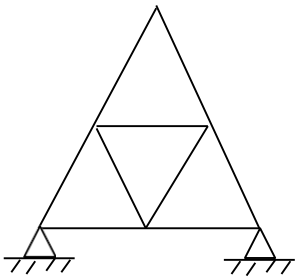


Fig. 1(a)

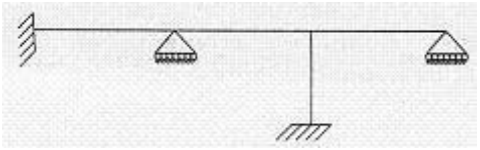


Fig. 1 (b)

6. Give advantages of fixed beam over a simply supported beam.
7. Differentiate between column and strut
8. Determine Structural indeterminacy of the structures shown in **figure 1(a).**
9. Determine Structural indeterminacy of the structures shown in **figure 1(b).**
10. Determine Kinematic indeterminacy of the structures shown in **figure 1(a).**
11. Determine Kinematic indeterminacy of the structures shown in **figure 1(b).**

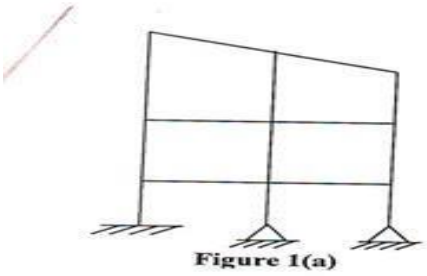


Figure 1(a)

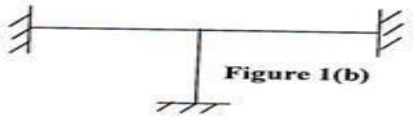
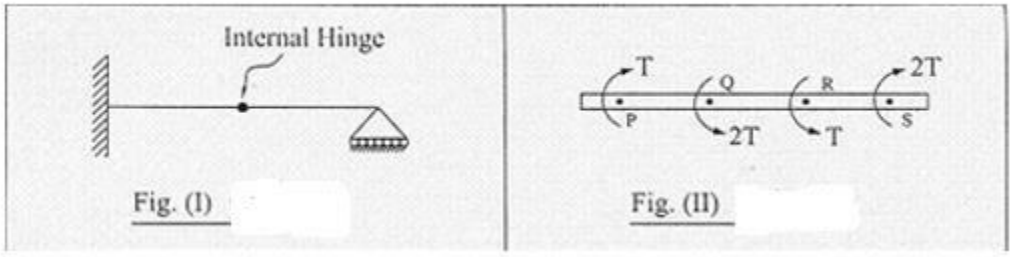


Figure 1(b)

12. Define Principle of superposition.
13. Define Maxwell's reciprocal theorem.
14. Define Crippling load.
15. Define Crushing load.
16. Define strain energy.
17. Define Structural indeterminacy
18. Define Kinematic indeterminacy
19. Define Proof Resilience
20. Define Column
21. Define strut
22. Define the terms: (i) slenderness ratio. (ii) proof resilience.
23. Which points should be taken care while using Macaulay's method?
24. Differentiate between the terms flexural rigidity and torsional rigidity
25. Draw the conjugate beam diagram corresponding to real beam shown in **fig.(I).**
26. A shaft PQRS is subjected to a torque at P, Q, R and S as shown in **fig.(II).** In which section the maximum torque will occur?

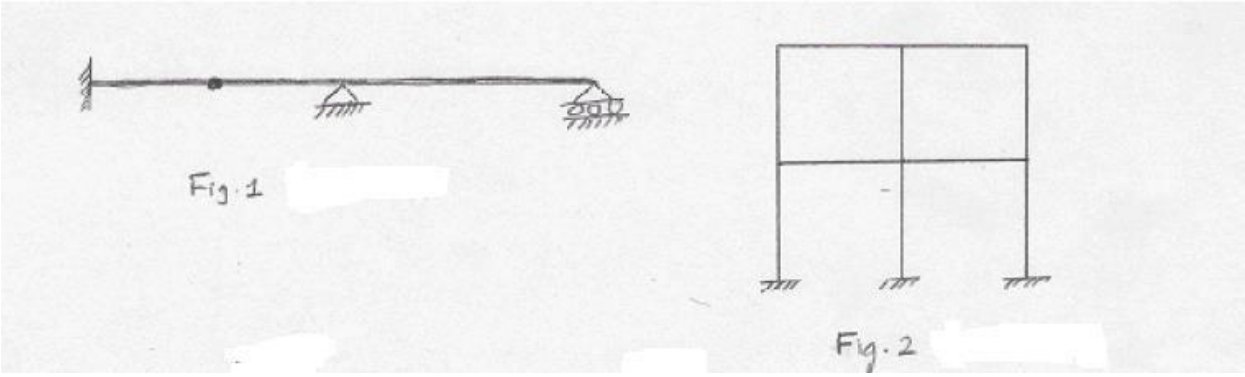


27. A three hinged parabolic arch with central hinge at the crown is subjected to a uniformly distributed load of w kN/m over the entire span. The bending moment at the quarter span is_____.
28. Define : Resilience, Modulus of resilience
29. Write down any four assumptions made for derivation of Euler's crippling load formula.
30. Sketch kern of rectangular section 600 x 900 mm.

Each following question carries 3-4 marks.

1. Derive the equation for fixed end moment developed if one of the supports of a Fixed beam settles by amount 'δ'.
2. A cylinder vessel closed with plane ends is made of a 5 mm thick steel plate. Its diameter is 250 mm and length is 1000 mm. it is subjected to an internal fluid pressure of 3.0 N/mm^2. Calculate the longitudinal and hoop stresses in the shell plate. Also calculate change in volume of the cylinder.
   Take E= 210 $GN/m^{2,}$ μ=0.3.
3. Derive the expression of increase in volume for thin spherical cell subjected To internal fluid pressure.
4. Explain the condition to avoid tensile stresses at the base of a masonry dam When subjected to hydrostatic pressure.
5. Differentiate Plane frame and Grid
6. Differentiate Conjugate beam and real beam
7. Derive an equation to determine deflection at center for the simply Supported beam subjected to uniformly distributed load over an entire Span.
8. State the theorems of moment area method.
9. Show that for a three hinged parabolic arch carrying a uniformly Distributed load over the whole span, the Bending moment at any section is Zero.
10. Calculate fixed end moments if left support of fixed beam is rotates Clockwise by an amount 'θ '.
11. Derive Euler's crippling load formula for the long column Fixed at Both ends.
12. Derive the equation of the strain energy stored in a member due to Torsion.
13. An unknown weight falls through 100 mm on a collar rigidly attached to the lower end of a vertical bar, 3 m long and 3 cm in diameter. If the maximum instantaneous extension is known to be 3.5 mm, what is the corresponding stress and the value of unknown weight?Take E= 2×10^5 N/mm^2.
14. Define and Explain core and Kernel of a section with suitable example
15. A cylindrical vessel 2.5 m long and 400 mm in diameter with 8 mm thick plate subjected to an internal pressure of 2.5 MPa. Calculate the change in length, change in diameter and change in volume of the vessel. Take E = 200 GPa and Poisson's ratio = 0.3 for the vessel material.
16. write advantages of Three Hinge parabolic arch over a Simply supported beam.
17. The cables of a suspension bridge of 100m span are suspended from piers which are 12m and 6m respectively above the Lowes point of the cable. The load carried by each cable is 1 KN/m of span. Find:
    (i) horizontal pull in the cable at the pier
    (ii) Maximum Tension in the cable at the pier.

18. Find static indeterminacy and kinematic indeterminacy of structures given in **Fig.1** and **Fig.2**



19. An object of weight 100 N falls by gravity a vertical distance of 5 m when it is suddenly stopped by a collar at the end of a vertical rod of length 10 metres and diameter 20 mm. The top of the bar is rigidly fixed to a support. Calculate the maximum stress and strain induced in the bar due to the impact. Take E = 200 GPa.
20. Draw neat sketch of kernel of the following cross-sections
    a. Rectangular block 200 mm x 300 mm
    b. Circular section of 300 mm diameter
21. Differentiate between curved beam and arches.
22. What are the different types of the strain energies stored in the structure?Why is it important for the analysis of the structure?
23. What is the difference between mode of failures of long and short column?For a mild steel having modulus of elasticity as 200 GPa and yield stress of 250 N/mm^2, calculate the critical slenderness ratio that separates short and long column.
24. A thin cylinder is filled with fluid which exerts pressure $2kN/m^2$ on the wall.If the diameter of cylinder is 1m, length of 3m and shell thickness of 15mm. Calculate the change in the volume of the cylinder. Assume E= $2x10^5 N/mm^2$ and Poisson's ratio as 0.22.
25. State the assumptions made in the Euler's theory for long column.
26. Derive the Euler's buckling load for the column when both ends are Hinged.
27. State and Explain Principle of Superposition.
28. Derive an expression of slope at supports for the simply supported beam subjected to point load at the centre of the beam.
29. Calculate value of maximum limit of eccentricity for circular section.
30. Indeterminate structures are always better than determinate structures". Comment on the statement.
31. State the theorems of moment area method.
32. A load 'P' is acting on the diagonal of the square column of size 'D'. For no tension to develop what would be the maximum distance of the load from centre? What would be the shape of the 'core' or 'kernal' of the section?
33. For the portal shown in the fig. find out moment at B ,shear and axial force in member AB.

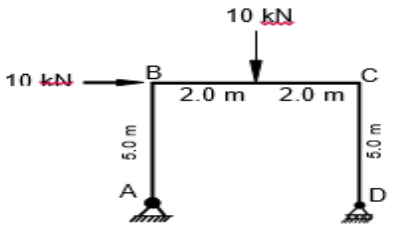


fig.2

34. Write the expressions for strain energy stored due to bending, shear And torsion. Write meaning of each term.
35. Derive the expression for the determination of horizontal thrust for a Parabolic arch loaded by uniformly distributed load.
36. Differentiate between stable and unstable structure
37. A suspension cable having supports at the same level, has a span of 30m And a maximum dip of 3m. The cable is loaded with a uniformly distributed load of 10 kN/m throughout its length. Find the maximum tension in the cable.

Each following question carries 7 marks.

1. A column of size 250mm (b) x 350mm (d), 4.2 m in length with its both ends are fixed. Find load carrying capacity of the column by 1) Euler's formula 2) Rankine's formula. Take f_c=320 N/mm^2, E = 2.1 x 10^5 N/mm^2, α= 1/6400.
2. Analyze the plane frame as shown in **figure**. Draw shear force diagram, Bending moment diagram, and axial force diagram.

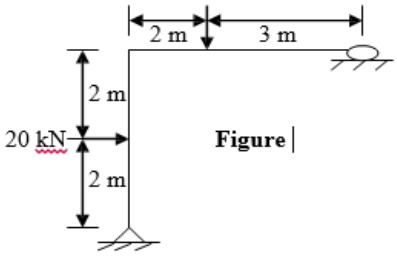
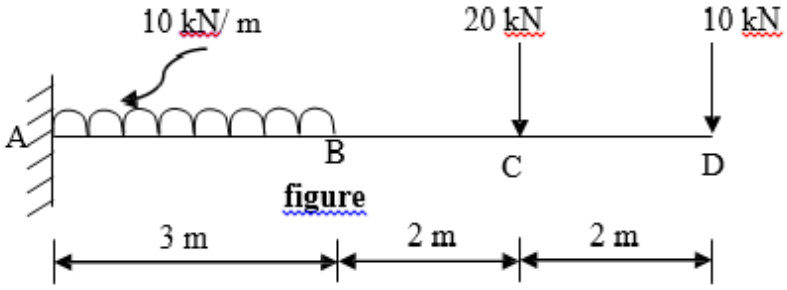


Figure |

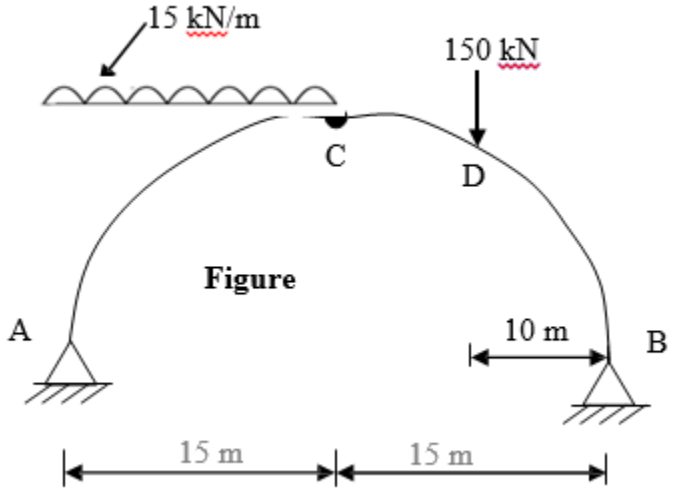
3. A cylindrical chimney 25m high of uniform circular section is 6m external dia. & 2.5m internal dia. It is subjected to a horizontal wind pressure of1500N/mm^2. If the coefficient of wind pressure is 0.7 & unit weight of masonry is 20 kN/ m^3. Find the maximum & minimum stresses at the base of the section.

4. Determine deflection at B, C and D for the cantilever beam loaded as shown in **figure** using Macaulay's method**.** Take E=2 x 10^5 N/mm^2 & I = 2 x 10^8 mm^4.



figure

5. Calculate reaction at supports and draw bending moment diagram for the three- hinge arch as shown in **figure.**



Figure

6. Find slope and deflection at point C for the beam shown in **figure** using Conjugate beam method. Take EI = 20000 KN/m^2.

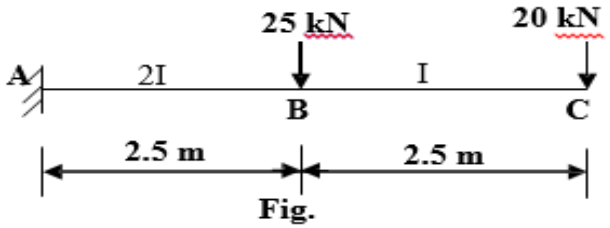
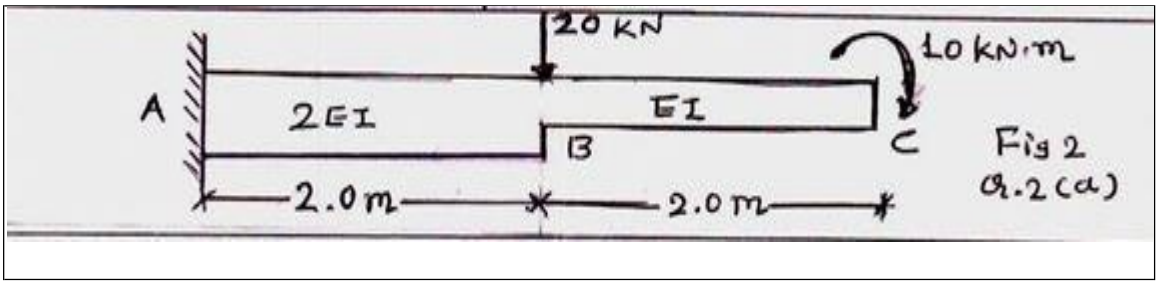


Fig.

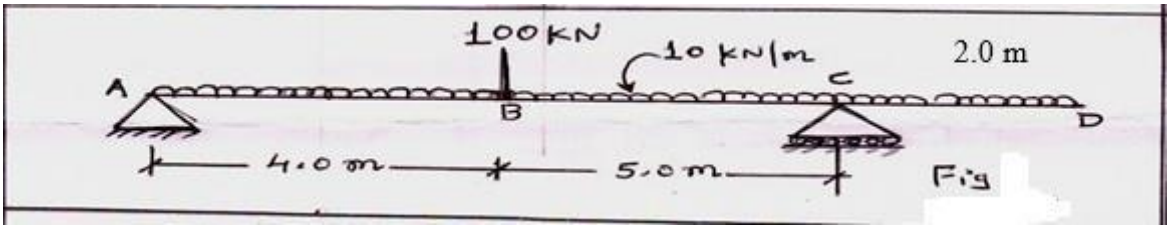
7. A simply supported beam AB of span 6m carries a uniformly distributed load of 15 kN/m over its entire span. Determine the strain energy stored in the beam. Take E = 2 x 10^5 N/mm^2 and I = 10 x 10^7 mm^4.
8. A masonry dam 5 m high, 1 m wide at the top and 3 m wide at the base retains water to the full height. The water face of the dam is vertical. Determine the extreme pressure intensities at the base. Water and masonry weigh 10 kN/ $m^3$and 22 kN/ m^3 respectively.
9. A 1.5m long wire of 30 mm^2 cross sectional area is hanged vertically. It receives a sliding collar of 200 N weight and stopper at the bottom end. The collar is allowed to fall on stopper through 250 mm height. Determine the instantaneous stress induced in the wire, corresponding elongation and the strain energy stored in the wire. Take modulus of elasticity of wire 2x10^5N/mm^2.
10. A beam AB of span 5 meter fixed at both ends carries a uniformly distributed load of 20 kN/m over the whole span. The left end 'A' rotates clockwise by 0.8^0 and right end 'B' sinks by 10 mm. Determine the fixed end moments and the reactions at the supports. Draw also shear force and bending moment diagrams. Take E = 200 kN /$mm^2$and I = 10 x10^7 mm^4.
11. A solid cast iron circular column of 5.0 m height is to be erected such that its both ends are hinged. Find the size of the section, if column has to carry a safe axial load of 500 kN. Take Factor of safety of 5.

Take f_c =500 N/mm^2, Rankine's constant α = 1/1500.

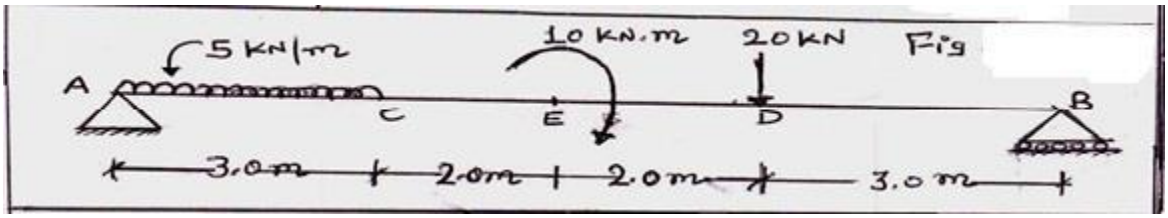
12. Find slope and deflection of point B and C for the beam as shown in fig. Take EI=5000 kN.m^2.



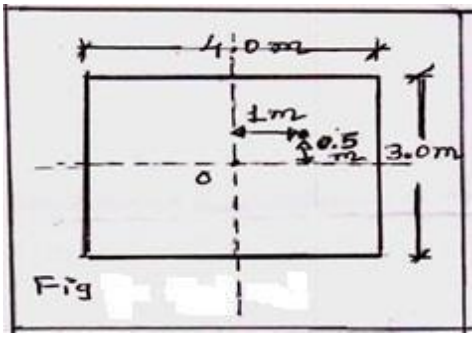
13. For a beam as shown in fig. calculate the slope at support C and deflection under point load. Take E= 2 x 10^5 N/mm^2, I= 5 x 10^8 mm^4.



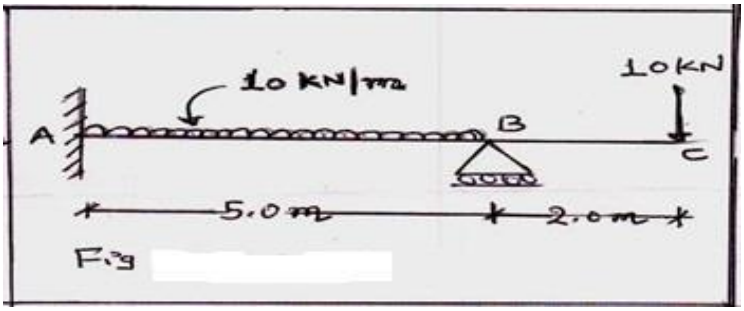
14. For a beam as shown in fig. calculate slope and deflection under point load.Take E= 2 x 10^5 N/mm^2, I= 5 x 10^{8}mm^4.



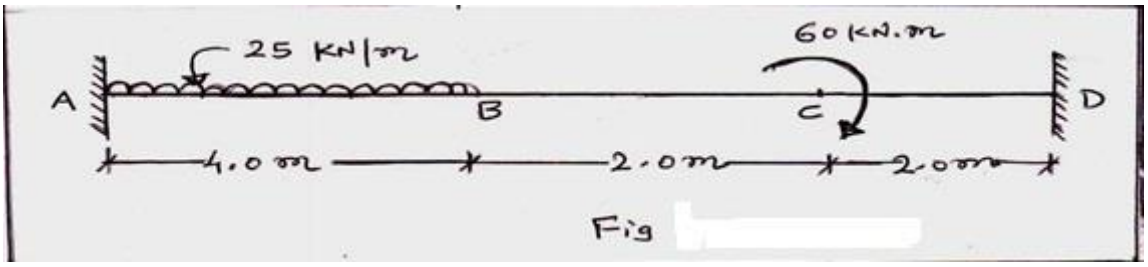
15. A masonry pier of 3 x 4 m supports a vertical load of 100 kN as shown in fig. Find the stress developed at each corner of the pier. What additional load should be placed at the Centre of the pier so that there is no tension?



16. A masonry Retaining wall with vertical face is 6.0 m high. Its width at top is 1m and at base the width is 3.0 m. Weight of masonry is 24 kN/m^3. Up to what height a soil weighing 15 kN/m^3 can be retained by this wall, so that maximum pressure at the base is 1.2 times the minimum pressure at the base? Angle of repose of the soil is 30^0.
17. A symmetrical three hinged circular arch has a span 20 m and central rise 5 m.It carries a point load of 20 kN at 5 m from left support. Calculate value of thrust at springing. Also calculate maximum positive Bending Moment and Bending Moment at 6.0 m from left support.
18. Analyze Propped cantilever as shown in fig. Draw Shear Force diagram

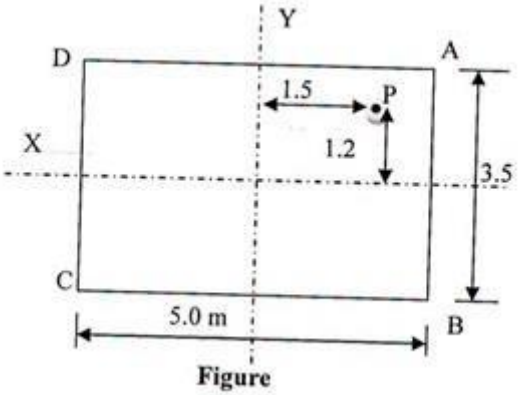


19. A cable of horizontal span of 28 m is to be used to support six equal loads of 50kN each at 4 m spacing. The central dip of the cable is limited to 2.0 m. Find the length of the cable required and its sectional area if the safe tensile stress is 750 N/mm^2.
20. Analyse a fixed beam as shown in fig.. Draw bending moment diagram.



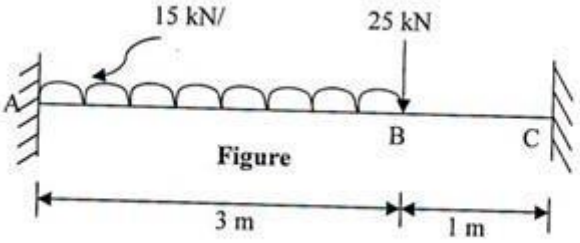
21. A steel bar of 100 cm long and rectangular in section 50 mm x 100 mm is subjected to an axial load of 1.5 kN. Find the maximum stress if ,
    (a) the load is applied gradually.
    (b) the load is applied suddenly
    (c)the load is applied after falling through a height of 10 cm.
    What are the strain energies in each of the above case? Take E= 2 x 10^5 N/mm^2.
22. Derive the equation for strain energy stored in an element due to Torsion.
23. A vertical steel rod of 1.25 m long is rigidly secured at its upper end and a weight of 1000 N is allowed to slide freely on the rod through a distance of 50mm on the stop at the lower end. The upper 750 mm length of the rod has a diameter of 28 mm while the lower 500 mm length is 15 mm diameter. Calculate the maximum instantaneous stress and elongation of the rod and strain energy at maximum elongation. E= 200 GN/mm^2.
24. Define Resilience, Proof Resilience, and Modulus of Resilience. Derive the equation for strain energy stored in an element due to Bending.

25. A Raft footing is supporting a vertical load of 150 kN as shown in **figure**.Compute the stresses at each corner of the pier. Draw stress distribution diagram also.



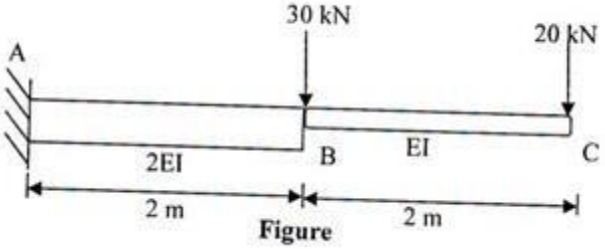
Figure

26. Analyses the fixed beam as shown in **figure** and draw the shear force diagram, Bending moment diagram.



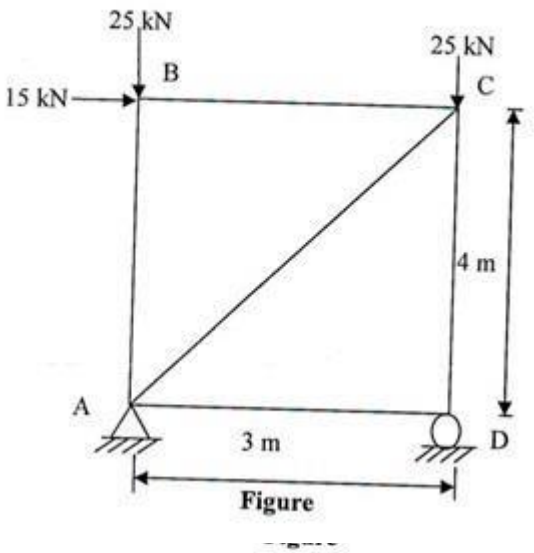
Figure

27. Calculate slope and deflection at point C for the beam as shown in **figure** using conjugate beam method. Take EI = 32000 kN.m^2.



Figure

28. Determine the strain energy stored in a truss loaded as shown in **figure.**Take E = 200 GPa and area of all members of truss is 400 mm^2.



Figure

29. Determine the ratio of strain energy stored in the simply supported beam AB of span 5m carries a 25 kN load at a central point and the same load uniformly distributed over its entire span.
30. A cast iron column of solid section has to transmit load of 450 kN. Calculate the diameter if the column is 5 meters long, both ends fixed. Use Rankine's formula. Taking f_c = 350 N/mm^2, Rankine's constant α = 1/2000 and factor of safety is 3.
31. A cylindrical chimney 60 m high of varying circular section is 6 m external diameter at Bottom and 3 m diameter at top. The internal diameter of chimney is 2.5m. It is subjected to a horizontal wind pressure of 1400N/mm^2. If the coefficient of wind pressure is 0.7. The self-weight of Chimney 16000 kN. Find the maximum & minimum stresses at the base of the section