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Department of Civil Engineering

Question Bank

Subject - BTCVC403_Structural Mechanics

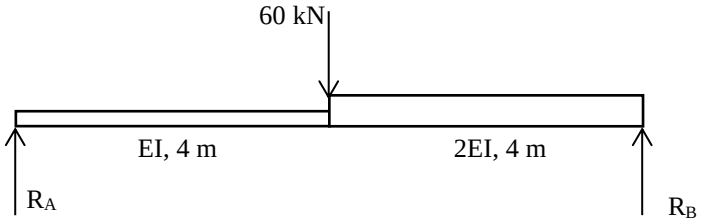
Module 1

1. Define the terms:
   a) Slope
   b) Deflection
   c) Displacement
   d) Elastic curve
   e) Radius of curvature
2. List out the different methods to find slope and deflection and explain them in detail?
3. Derive relation between slope, deflection and radius of curvature?
4. Derive an expression for slope and deflection for simply supported beam with a UDL throughout span using double integration method?
5. A simply supported beam of span 3 m is subjected to a central load of 10 kN Find the maximum slope and deflection of the beam. Take I = 12 x 10^6 mm^4 and E = 200 GPa
6. A wooden beam 140 mm wide and 240 mm deep has a span of 4 m. Determine the load, that can be placed at its centre to cause a deflection of 10 mm. Take E as 6 GPa
7. A steel joist, simply supported over a span of 6 m carries a point load of 50 kN at 1.2 m from the left-hand support. Find the position and magnitude of the maximum deflection. Take EI = 14 x 10^{12} N-mm^2.
8. A timber beam of rectangular section has a span of 4.8 m and is simply supported at its ends. It is required to carry a total load of 45 kN uniformly distributed over the whole span. Find the values of the breadth (b) and depth (d) of the beam, if maximum bending stress is not to exceed 7 MPa and maximum deflection is limited to 9.5 mm. Take E for timber as 10.5 GPa.
9. A simply supported beam AB of span 4 m is carrying a triangular load varying from zero at A to 5 kN/m at B. Determine the maximum deflection of the beam. Take rigidity of the beam as 1.25 x 10^{12} N-mm^2
10. A horizontal beam AB is freely supported at A and B, 8 m apart and carries a UDL of 15 kN/m run (including its own weight). A clockwise moment of 160 kN-m is applied to the beam at a point C, 3 m from the left hand support A. Calculate the slope of the beam at C, if EI = 40 x 10^3 kN-m^2.
11. Prove that first moment area theorem and second moment area theorem?
12. A cantilever of length 2a is carrying a load of W at the free end and another load of W at its centre. Determine the slope and deflection of the cantilever at the free end.
13. A cantilever beam AB of span L is carrying a point load W at B. The moment of inertia for the left half is 2I, whereas that for the right half is I, Find the slope and deflection at B in terms of EI, W and L.
14. A simply supported beam AB of span 4 m, carrying a load of 100 kN at its mid span C has cross-sectional moment of inertia 24 x 10^6 mm^4 over the left half of the span and 48 x 10^6 mm^4 over the right half. Find the slopes at the two supports and the deflection under the load. Take E = 200 GPa.
15. How will you find out the slope and deflection by conjugate method of a cantilever carrying a UDL?

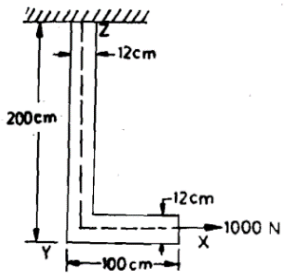
Module 2

1. Define the concept of Strain Energy and Complementary energy?
2. Derive an expression for strain energy due to bending?

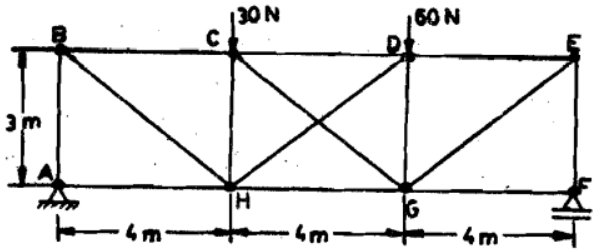
3. Using strain energy method determine the deflection at free end of cantilever of length L subjected to a concentrated load 'P' at the free end.
4. Determine the deflection under the 60 kN load in the beam as shown below figure



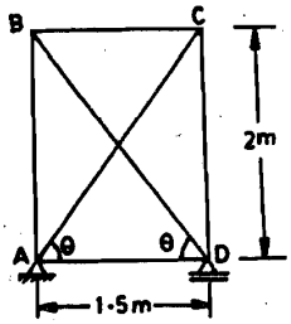
5. Determine the total strain energy of the L – shaped member which is subjected to 1000 N load as shown. The cross-sectional area of the member is 6 cm x 12 cm. Assume E = 2 x 10^7 N/cm^2 and G = 0.8 x 10^7 N/cm^2



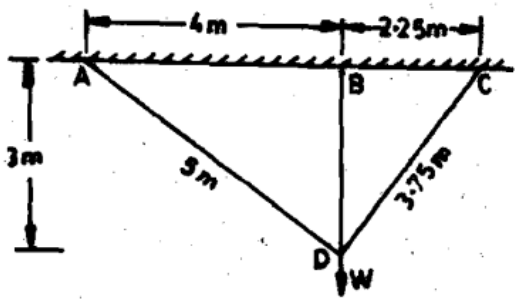
6. Find the reaction of propped cantilever beam subjected UDL of '**w**' kN/m throughout its span '**L**' by using strain energy principles.
7. Find the reaction of two span continuous beam having each span of length '**L/2**' subjected UDL of '**w**' kN/m throughout its span by principle of least work.
8. A simply supported beam of span L, carries a concentrated load P at a distance **'a'** left hand side support and at a distance of 'b' from right hand support. Using Castigliano's theorem determine the deflection under the load. Assume uniform flexural rigidity.
9. State and explain in detail Maxwell theorem of reciprocal deflections?
10. Determine the forces in the members of truss loaded as shown in the figure below. The sectional area of the vertical member = 3000 mm^2; horizontal member = 4000 mm^2 and diagonal members = 5000 mm^2 each. The members are of same material.



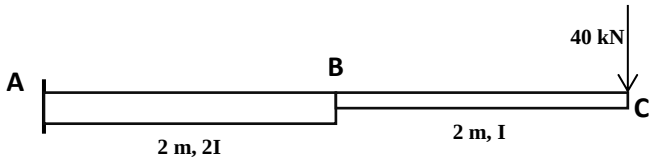
11. Determine the forces in all the members of the pin jointed frame as shown below if the member AC is 1 mm short of the required length and the last member to be fitted. Assume area of each diagonal members = 1000 mm^2, area of each remaining members = 2000 mm^2 and E = 200 kN/mm^2



12. Find the tensions in the wires AD, BD and CD having the same cross-sectional area and of the same material supporting a load **W** at D as shown in the figure below. Prove that the horizontal displacement of D is equal to **1/7th** of extension of BD.



13. Using strain energy method, determine the vertical displacement at the free end of cantilever beam as shown in below. Given E=200 kN/mm^2 & I = 20 x 10^6 mm^4



14. Using unit load method, analyze above Q. No. 13 and determine the displacement at B and C.
15. State and explain Generalized reciprocal theorem and Betti's theorem?

Module 3

1. Define indeterminacy of structures. Explain in detail with examples?
2. Determine static and kinematic indeterminacy of the structure as shown below.

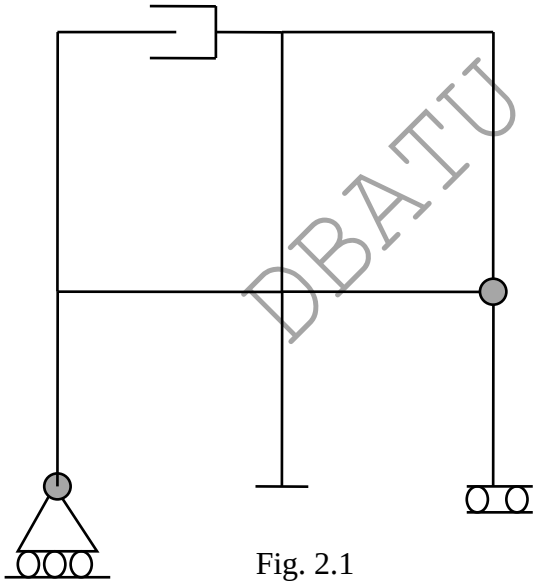


Fig. 2.1

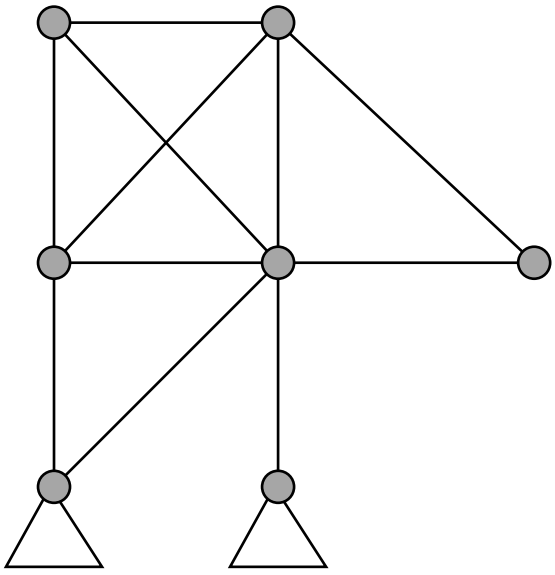


Fig. 2.2

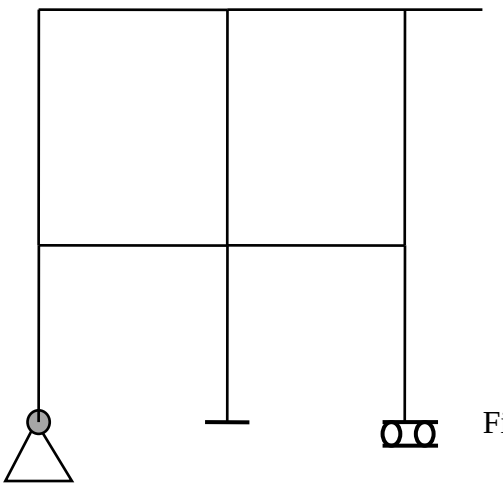


Fig. 2.3

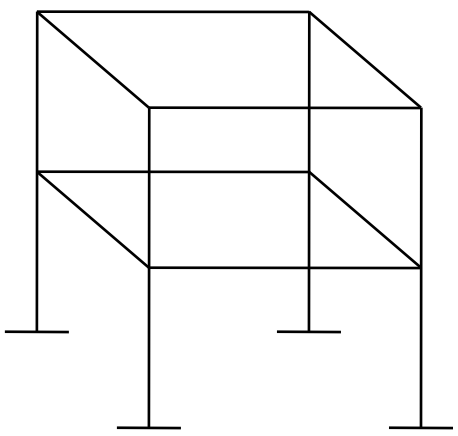
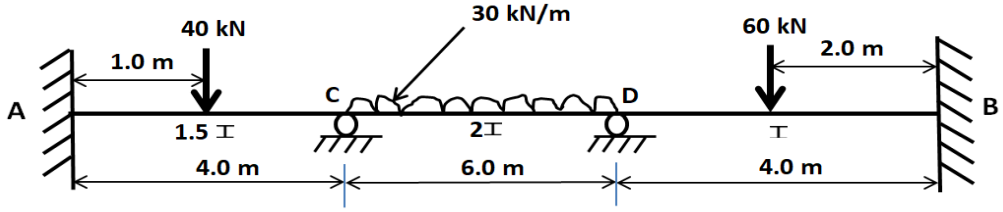


Fig. 2.4

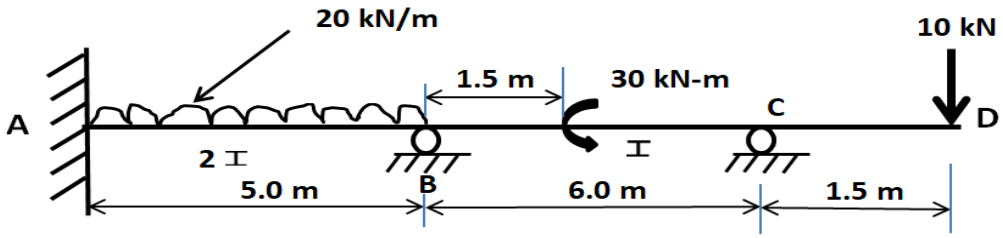
3. Draw the BMD for propped cantilever of span '**L**' subjected to concentrated load '**W**' at its mid span. The end supports (i. e. Fixed & Prop support) remain at the same level after the load.
4. Find the support moment for propped cantilever of span '**4 m**' subjected to concentrated load '**100 kN**' at its mid span, if fixed support rotates clockwise by 0.002 radian; EI = 1 x 10^6 N-m^2
5. Find the support moment for propped cantilever of span '**L**' subjected to clockwise moment '**M'** at the prop end. Draw BMD?
6. Draw the BMD for propped cantilever of span '**L**' with overhang span of length '**L/4'** subjected to concentrated load '**W**' at free end of overhang.
7. A propped cantilever of span '**L**' with overhang span of length '**a**' subjected to UDL of 'w' per unit length thought the span of beam. Find the overhang length so that the deflection at free end is zero.
8. In above problem no. 7 find the length of overhang if slope at prop is zero.
9. Using the consistent deformation method, find the fixed end moments developed in the fixed beam of span 'L' subjected to UDL w per unit length. Draw SFD and BMD.
10. A fixed beam of span '**L**' subjected to concentrated load at a distance '**a**' from one of its fixed supports and at a distance '**b**' from other end fixed support. Determine the end moments developed.
11. A fixed beam of span '**L**' subjected to an external clockwise moment '**M**' at a distance '**a**' from one of its fixed supports and at a distance '**b**' from other end fixed support. Determine the end moments developed.
12. Determine the fixed end moments developed in a fixed beam of span '**L**' and flexural rigidity EI when the right hand support settles down by distance Δ.

Module 4

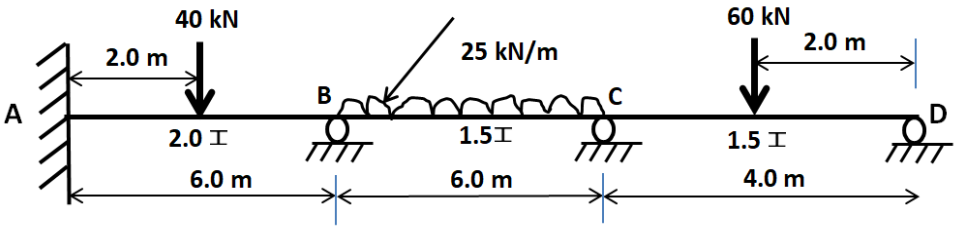
1. Define the following terms:
   a) Carry over factor,
   b) Distribution factor,
   c) Carry over moment and
   d) Relative stiffness.
2. A Continuous Beam ABC is Supported at A, B, C. span AB= 6m, span BC = 5m. span AB carries a UDL of 30 kN/m and span BC Carries a UDL of 25 kN/m. calculate the support moments and draw SFD, BMD by Hardy Cross Method.
3. Analyze the continuous beam as shown below and draw BMD using moment distribution method.



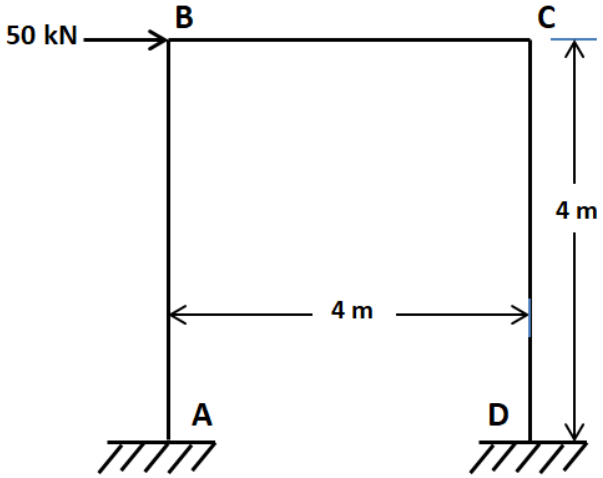
4. Analyze the continuous beam as shown below and draw BMD using moment distribution method.



5. Analyze the continuous beam as shown below and draw BMD using moment distribution method.

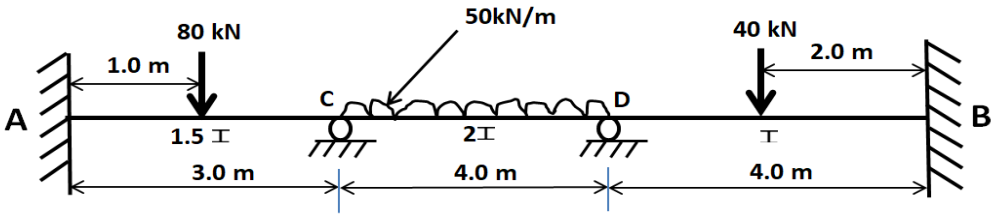


6. Analyze the frame shown below for moments at the ends of members. Draw BMD. EI is same for all the members. Use Moment distribution method.

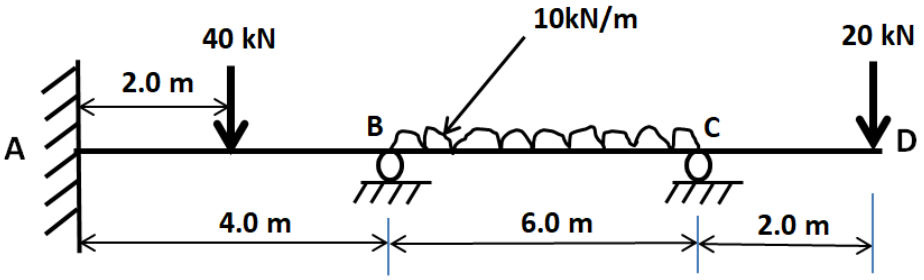


Module 5

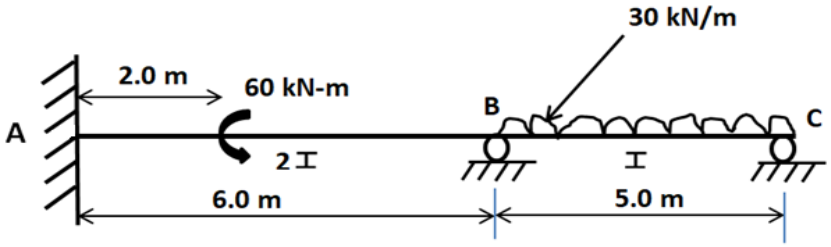
1. Determine the support moments for the continuous beam shown below. Draw BMD. Use slope deflection method.



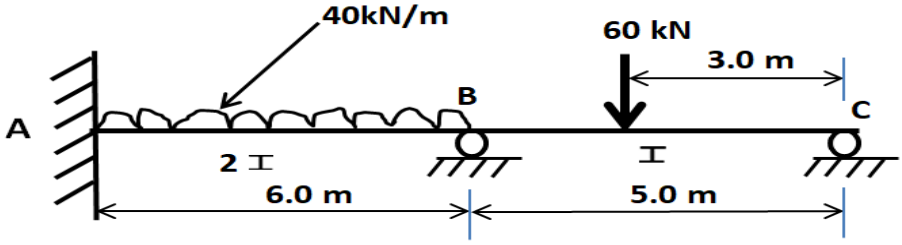
2. Determine the support moments for the continuous beam shown below if the support '**B**' sink by 10 mm. Take **EI=6000 kN-m^2**. Draw BMD. Use slope deflection method.



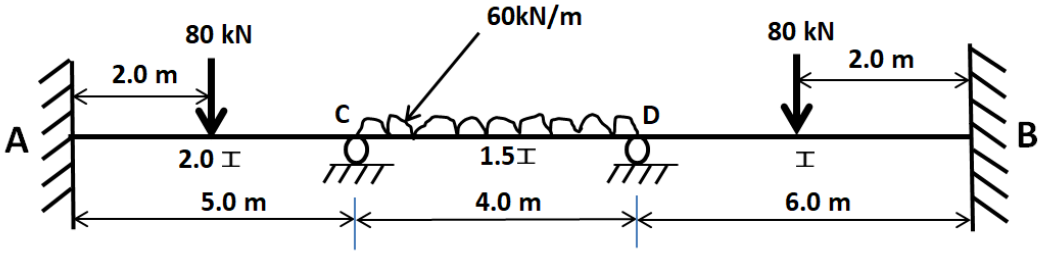
3. Determine the support moments for the continuous beam shown below. Draw BMD. Use slope deflection method.



4. Determine the support moments for the continuous beam shown below if Support 'B' sinks by 7mm.Take EI=7000 kN-m^2Draw BMD. Use slope deflection method.



5. Determine the support moments for the continuous beam shown below if the support '**D**' sink by 9 mm. Take E=200 kN/mm^2 and I= 3.0 X $10^7 mm^4$.Draw BMD. Use slope deflection method.



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