Problems of Practices
Of
Mechanics of Solids
5- Concept of Shear Force and Bending Moment in Beams

Prepared By

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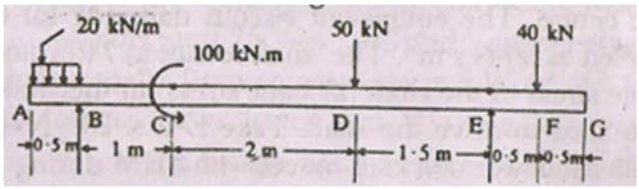
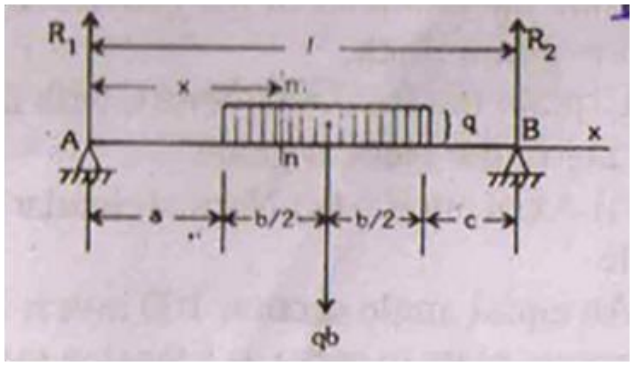
Please welcome for any correction or misprint in the entire manuscript and your valuable suggestions kindly mail us brijrbedu@gmail.com.

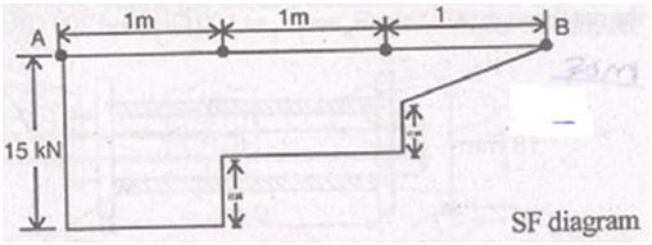
1. Construct the bending moment and shearing force diagrams for the beam shown in Fig.1.



2. In fig.1 a uniform load q covers only a part of the span. Calculate the reactions R_1 and R_2 and draw the shear force and bending moment diagrams.

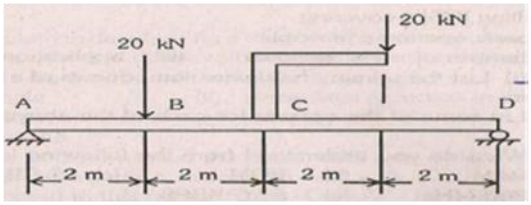


3. The Shear Force diagram for rectangular cross-section beam *AB* is shown in the figure given below. Width of the beam is 100 mm and depth is 250 mm determine the maximum bending stress in the beam.

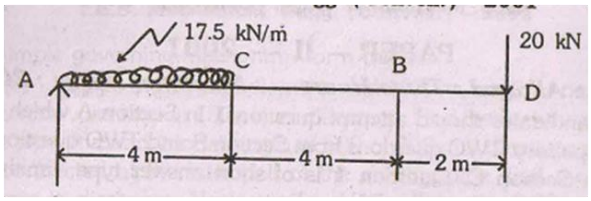


4. A uniform beam of length *L* is carrying a uniformly distributed load *w* per unit length and is simply supported at its ends. What would be the maximum bending moment and where does it occur?

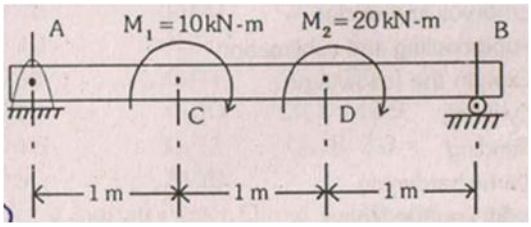
5. A beam *ABCD*, 8 m long, hanged at end *A* and roller sup-ported at end *D* carries the transverse loads as shown in the above figure. Determine the support reactions and draw the BM diagram for the beam.



6. What is meant by point of contraflexure or point of inflexion in a beam? Show the same for the beam given below

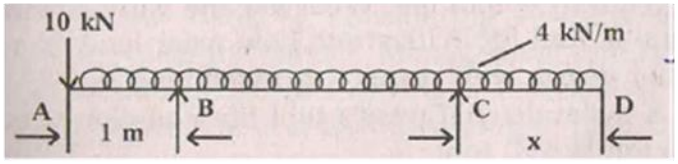


7. Draw Shear Force and Bending Moment diagrams for the beam *ACDB* shown in figure where two couples are acting.



Find the ratio of deflections in the beam at locations *C* and *D* where the couples are acting.

8. A beam *ABCD*, 10 m long is supported at *B*, 1 m from end *A* and at *C*, *x* m from end *D*. The beam carries a point load of 10 kN at end *A* and a uniformly distributed load of 4 kN per meter run throughout its length. Determine the value of *x* if the centre of the beam is the point of contraflexure. Draw the bending moment diagram.

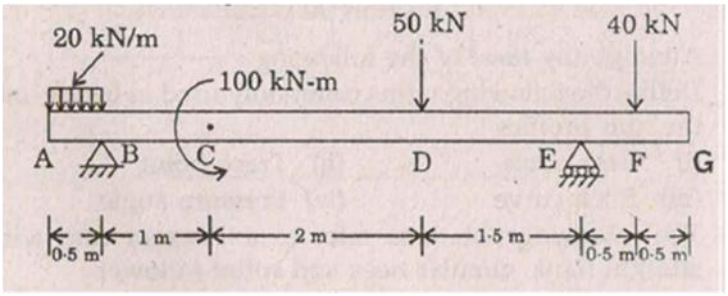


9. A simply supported beam of span 6 m carries a uniformly varying load whose intensity varies from zero at the left support *A* to 12 kN/m run at right support *B*.

Obtain shearing force and bending moment at sections 1.5 m and 4.5 m from the end *A*.

10. A simply supported beam of length 10 m carries a uniformly varying load whose intensity varies from a maximum value of 5 kN/m at both ends to zero at the centre of the beam.
It is desired to replace the beam with another simply supported beam which will be subjected to the same maximum 'Bending Moment' and 'Shear Force' as in the case of the previous one. Determine the length and rate of loading for the second beam, if it is subjected to a uniformly distributed load over its whole length. Draw the variations of 'SF' and 'BM' in both the cases.

11. Construct the bending moment and shearing force diagram for the beam as shown in the figure given below:



12. A beam 5 m long, hinged at both ends is subjected to an anticlockwise moment *M* equal to 60 kNm at a point 3 m away from one end. Draw the S.F. and B.M. diagrams.

13. Two beams of equal lengths *l*, one as a simply supported and the other as a cantilever, are loaded at the centre with a concentrated load of *W*. Draw the shear force, B.M. and deflection diagrams, indicating the maximum values.

14. A beam, 15 meter long, rests on supports 12 meter apart with an overhang of 3 meter at the right hand end. The beam weighs 600 Newton per meter run and carries a concentrated load of 15 kN at the middle of its supported length. Calculate the maximum moment and position of the point of contra-fleaxture.

15. A beam *ABCD*, 6 m long, hinged at both ends *A* and *D*, is subjected to moments 6 kN-m (cw) at *B* and 3 kN-m (ccw) at *C* as shown in Fig. 3. Sketch the bending moment diagram of the beam. How many points of contraflexure are there in the beam?

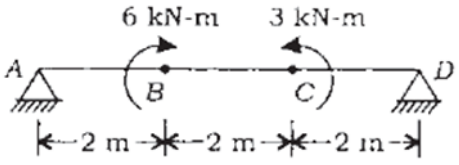


Fig. 3

16. Construct Shear Force and Bending Moment diagrams for a beam as shown in Figure 1. The loading is shown in the diagram.

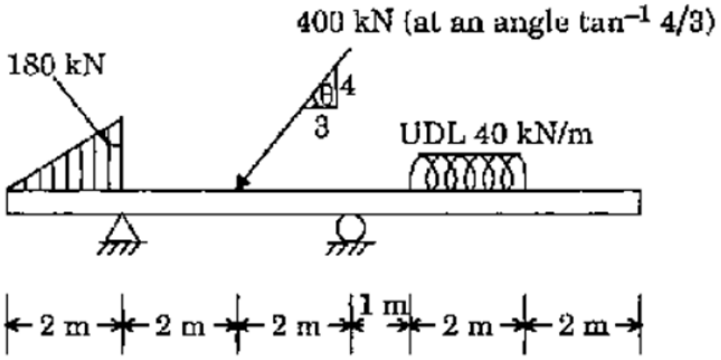


Figure 1 (not to scale)

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17. Draw the Bending Moment and Shear Force Diagrams for a simply supported beam of span l and a uniformly distributed load of intensity w/unit length acting over the entire length of the span of the beam.

18. A cantilever *AB*, 5 m long is fixed at end *A*. At end *B*, an upward load of 2 kN is applied. At point *C*, 2 m from end *B*, a downward load of 2 kN is applied. Draw the bending moment diagram of the cantilever.

19. On a simply supported beam (10 m span) a concentrated load (10 kN) and a moment of 40 kN act at a section 7 m from one of the ends. Draw the shear force and bending moment diagrams. Indicate the points of contraflexure if any.

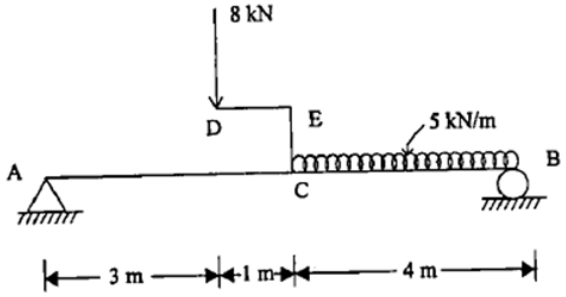
20. A beam *AD*, 8 m long hinged at end A and roller supported at end *B* carries a point load of 8 kN at crank *ED* = 1 m, and a uniformly distributed load of 5 kN/m over *CB* = 4m.

Determine:

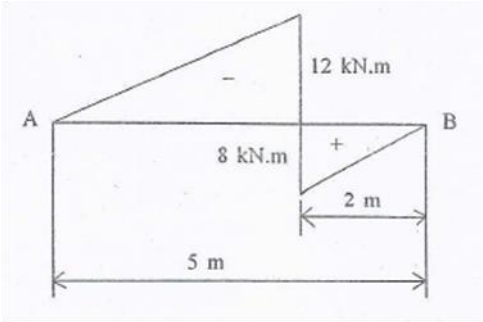
(i) reactions at ends.

(ii) bending moment at section where SF is zero.

(iii) Draw BM diagram only.



21. The bending moment diagram for a simply supported beam *AB* is shown in Fig. below. Sketch the loading diagram and S.F. diagram of the beam.



22. A horizontal simply supported beam *AB*, 8 m long, carries a total uniformly distributed load of 300 kN. The beam is supported at *A* and at a point *C*, between *A* and *B*, where overhang *BC* is *x*. Determine the value of *x*, if the midpoint of the beam *AB* is to be a point of inflexion.

23. For the beam shown in Figure 2(b), write the equations for the shear force and bending moment at any point. Also draw the shear force and bending moment diagrams.

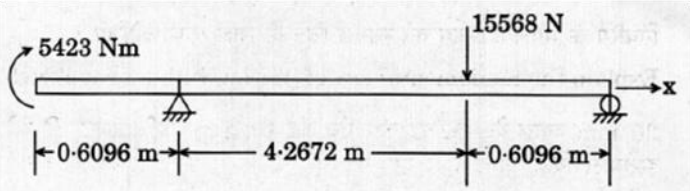
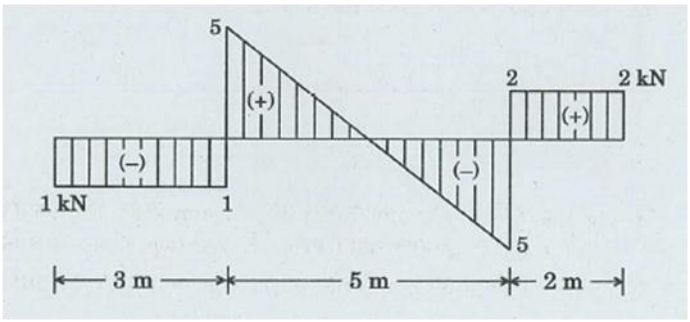
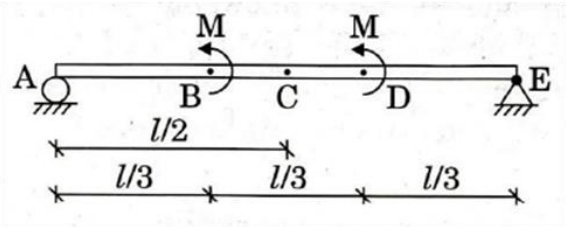


Figure 2(b) /चित्र 2(b)

24. The S.F. diagram of a beam with overhangs is shown in the figure. Determine the loading on the beam and draw the B.M. diagram.



25. Draw the shear force and bending moment diagram for the given simply supported beam with moment loads as shown in the figure. Show the magnitude of shear force and bending moments at the respective points of the beam, i.e., at *A*, *B*, *C*, *D* and *E*.



26. Write down the equations for shear force and bending moment for various sections of the simply supported beam as shown in the figure. Also draw SFD and BMD.

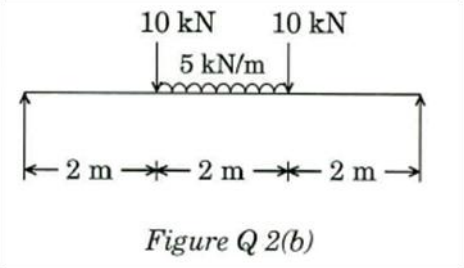


Figure Q 2(b)

27. Draw and show the bending moment diagram and shear force diagram of a beam of length *L* subjected to a uniformly distributed loading for the following boundary conditions:

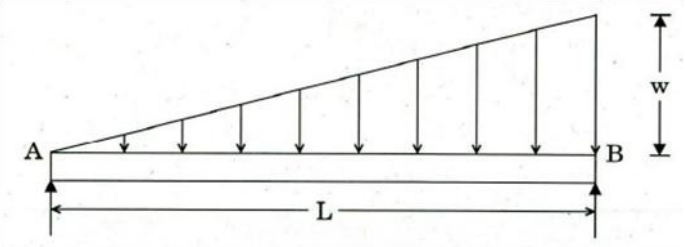
(i) Cantilever beam,

(ii) Simply supported beam,

(iii) Beam with both ends fixed,

(iv) Beam with one end simply supported and a propped support at 1/4th L from the other end.

28. Draw the Shear Force Diagram and Bending Moment Diagram of a simply supported beam carrying a uniformly varying load from zero at one end to 'w' per unit length at the other end. Compute the maximum B.M and its location.



29. For the single overhanging beam as shown in Figure 2(a), draw the Shearing Force and Bending Moment diagram, if $q \times 2L = 3P$. Also find the maximum Bending Moment and its location. Also locate the point of contraflexure.

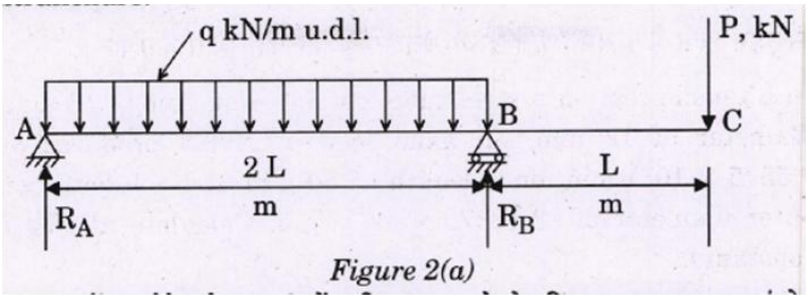
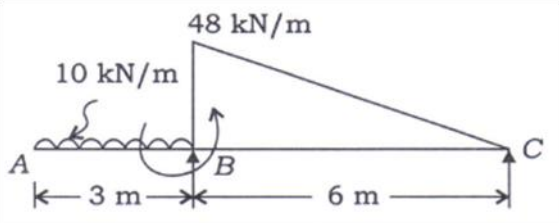


Figure 2(a)

30. A beam ABC is 9 m long and supported at B and C, 6 m apart as shown in the figure below. The beam carries a triangular distribution of load over the portion BC together with an applied counterclockwise couple of moment 80 kN-m at B and a uniformly distributed load of 10 kN/m over AB. Draw the shear force and bending moment diagrams for the beam:



31. Draw the shear force and bending moment diagram for the cantilever beam as shown in the figure given below: