Shaikh Sir's Diploma Classes

Sub:Strength of Material (22306)

UNIT 4. SFD/BMD and Bending/Shear stress in beams

4.1 Types of Beams (Simply supported without overhang. Cantilever . Types of loads(Point load, Uniformly Distributed load). Bending of beam,deflected shape.

4.2 Meaning of SF and BM. Relation between them. Sign convention.

4.3 SFD and BMD. Location of point of maximum BM. Deflected shape from

BMD. Location of Point of Contra-flexure

4.4 Theory of bending. Flexural formula. Neutral axis.

4.5 Moment of resistance. Section modulus.

4.6 Bending stress variation diagram across \depth for cantilever and simply supported beam for symmetrical and unsymmetrical sections.
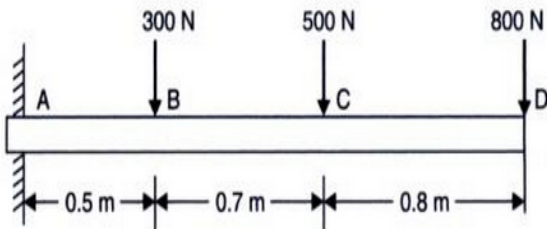
4.7 Transverse shear stress, average and maximum shear stress. Shear stress variation diagram.

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Websites : www.msbte.engg-info.website, www.mechdiploma.com,

Type 1. SFD & BMD for Cantilever Beam

Prob.1. Draw Shear force and Bending moment diagram for loading shown below.

Prob.2.Draw bending moment and shear force diagram of a cantilever beam having AB 4 meters long having its fixed end at A and loaded with a uniformly distributed load of 1 kN/m upto 2 meters from A and with a concentrated load of 2 kN at 1 m from B.

Prob.3.Draw bending moment and shear force diagram of a cantilever beam having AB 4 meters long having its fixed end at A and loaded with a uniformly distributed load of 1 kN/m upto 2 meters from A and with a concentrated load of 2 kN at 1 m from B.

Prob 4. A cantilever beam ABCD is fixed at A and free at D ,such that AB=1 m, BC= 2m, CD= 3.5 m. It carries an udl of 150 kN/m from B and D along with a point load of 500 kN at point C. Draw shear force and bending moment diagram for this beam.

Prob 5. A cantilever 2.4 m long carries point loads of 20 kN and 50 kN at free end and 1.68 m from free end respectively. It also carries uniformly distributed load of 30 kN/m starting from 0.24 m to 1.2 m from free end. Draw SFD and BMD.

Pr 6. Draw shear force and bending moment diagram for a cantilever beam AB of 4 m long having its fixed end at A and loaded with uniformly distributed load of 2 kN/m over entire span and point load of 3 kN acting upward at the free end of cantilever. Find point of contra-flexure if any.

Prob 7. Draw SFD and BMD locating all important features for a cantilever of 6m length and point loads of 15N at the center of the length of cantilever and 10N at the end of cantilever. There is udl of 5 KN/m. between the two point loads .

1.Draw SFD and BMD for diagram
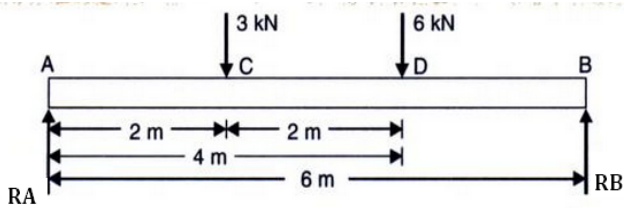
2.A simply supported beam of span 6 m carries two point loads of 30 kN each at 2 m and 4 m from left support. The beam also carries a U.D.L. of 20 kN/m between two point loads. Draw S.F.D. and B.M.D.

3. Draw S.F.D. and B.M.D. for a beam whose left support is hinge and right support is roller. The beam has following details :
**(i) Span = 8 m**
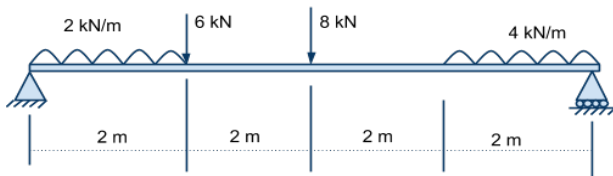**(ii) U.D.L. of 20 kN/m at 4 m from left support.**
(iii) A point load of 120 kN at a distance of 6 m from LHS.

4. A simply supported beam is having span of 6 m. It carries two point loads of 50 KN and 20KN at 1m and 4m from left hand support respectively. Draw bending moment diagram and hence draw the qualitative deflected shape of the beam .
5. Draw Shear force and bending moment diagram
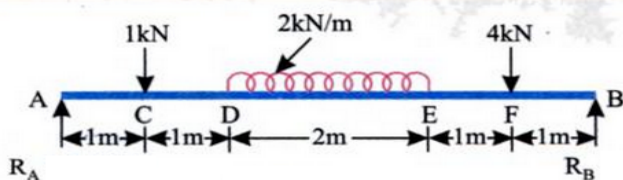
6. Draw Shear force and bending moment diagram.

7. A simply supported beam ABC has 5m span,is supported between A and C. It carries uld of 20 kN/m over its entire span. It also carries a point load of 45 kN at a distance of 2m from left hand support. Draw SFD and BMD

8. A simply supported beam ABCD is of 5m span, such that AB=2m, BC=1 m and CD=2m. It is loaded with 5 kN/m over AB and 2 kN/m ovr CD. Draw shear force and bending moment diagrams for the beam..

Type 3: SFD & BMD of Overhanging Beam

1. A beam ABC is supported at A and B. It is loaded with u.d.l of 20kN/m on entire beam and a point load of 10 kn at C. Span Ab is 5m and overhang BC is 1m. Draw shear force and bending moment diagram..

2.A simply supported beam ABC which supported at A and B, 6 m apart with an overhang BC 2 m long, carries a udl of 15 kN/m over AB and a point load of 30 kN at C. Draw S.F. and B.M. diagrams.

3.An overhanging beam has two overhangs, each of 2m on both sides of supports. The distance between supports is 7m and the overall length of the beam is 11m . Two point loads each of 4KN are kept on free ends of the overhangs. Draw shear force and bending moment diagrams. Also find the value of maximum negative bending moment.

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Type 4: Problems on Bending Formula(flexural formula)

1. A Circular beam 500 mm dia is simply supported over span of 6m. It carries point load of 81 KN at center. Find bending stress induced.

(Ans f= 9.92 N/mm^2)

2. A simply supported beam of span 4m carries UDL of 2 Kn/m over the entire span.   if the bending stresses is not to exceed 165 N/mm2, find the value of section modulus for the beam and diameter of beam when it is circular.

(Ans d=   )

3. A rectangular beam 200 x 450 mm is fixed at one end as a cantilever beam of span 4m it carries udl of 100 N/m over entire span. Find bending stress

(Ans f= $0.119 \, N/mm^2$)

4. A rectangular beam 300 mm deep is simply supported over span of 4m. Find what udl beam can carry is bending stresses is limited to 120 MPa.

(Ans W = 90 N/mm)

5. A rectangular beam 60 mm wide and 150 mm deep is simply supported over a span of m. if the beam is subjected to audl of 4.5 KN/M and max. bending stress is limited to 40 MPa Find span of beam.

(Ans x= 4008 mm)

6. A rectangular beam 60 mm wide and 150 mm depth is simply supported over 6m. If beam has point load of 12KN at center. Find max. bending stress include.

(Ans F= $80.02 \, N/mm^2$)

7. A beam is rectangular section supports A load of 20 kn at center of beam span 3.6 m. If depth is twice width and stress is limited to 7 mpa find dimension of beam.

(Ans x = 156.82 mm)

8. A simply supported beam 150mm wide and 300mm deep carries an uniformly distributed load over a span of 4m If the safe stresses are 28 MPa in bending and 2MPa in shear find the maximum uniformly distributed load that can be safely supported by the beam

9. Calculate max stress induced in a CI pipe of ext. dia 40 mm and internal dia 25 mm length of pipe is 4 m and simply supported and carries pt load of 80 kN at center.

(Ans f =$15.02 \times 10^3 \, N/mm$)

10. A beam of rectangular c/s has depth 150 mm is supported at one end as cantilever is bending stress is limited to 30 mpa find max. udl it can carry   take I = $7.5 \times 10^6 mm^4$

(Ans W = 1.5 N/mm)

11. A cantilever beam 80 mm x 120 mm carried pt load of 6 kn at end, It bending stress is limited to 40 mpa find span.

(Ans L = 1280 mm)

12. A rectangular beam simply supported over span 4m, carries UDL of 50 Kn/m over span. It depth of section is 2:5 width find dimension of bending stress is limited to 60 mpa.

(Ans b = 117.02 mm, d = 292.55 mm)

Type 5: Problems on Average and Max shear stress

1. A rectangular section 230 mm wide and 400mm deep is subjected to shear force of 40 KN find max. shear stress across section.

*(**Ans** = $0.645 \, N \, / \, mm^2$)*

2. A circular has 50 mm diameter carries shear force of 120 KN find Average and max shear stress

*(**Ans** = $81.48 \, N \, / \, mm^2$)*

3. A circular beam has diameter 100 mm has max shear stress 2.122 N/mm^2 Find shear force acting on it.

*(**Ans** = f = $12.5 \times 10^3 N$)*

4. A rectangular beam 100 mm wide is subjected to shear force of 50 KN its max shear stress is 4 MPa find depth.

*(**Ans** = d = 187.5 mm)*

5. A simply supported beam of span 6m is having central point load of 100KN .If the maximum permissible shear stress for the timber materials is 8MPa design the suitable dimensions of the beam ,when the section is of i) Circular cross section ii) Square cross section .