

What are Beams and Loads?

Worksheet

A beam bends under transverse loads, developing internal shear force and bending moment; the resulting bending stress is $= Mc/I$, where M is the moment, c the distance to the extreme fiber, and I the moment of inertia.

$$M = F @ c \cdot d$$

Questions

1. The bending stress formula is

- A) $=F/A$
- B) $=Mc/I$
- C) $=Mv/A$
- D) $=PL/AE$

2. Max moment for a simply supported beam under UDL w over span L is

- A) wL
- B) $wL/8$
- C) $wL/2$
- D) $wL/4$

3. For a cantilever with end load P and length L , the maximum moment occurs

- A) at the free end
- B) at midspan
- C) at the fixed support
- D) nowhere

4. Increasing I (moment of inertia) for the same M and c

- A) increases bending stress
- B) decreases bending stress
- C) has no effect
- D) doubles stress

5. A beam has $M=8000$ Nm, distance to extreme fiber $c=150$ mm, and $I=4.510$ mm. Find the bending stress (convert M to Nmm).

6. A simply supported beam of span 8 m carries a uniform load $w=10$ kN/m. Find the maximum bending moment (at midspan).

7. A cantilever beam of length 3 m carries a 5 kN point load at the free end. Find the maximum shear force and moment at the fixed support.

8. Define: What is a beam?

9. Define: What is the bending stress formula?

10. Define: Where is bending moment maximum in a simply supported beam under UDL?

Answer Key

1. $\sigma = Mc/I$ - $\sigma = Mc/I$ relates moment, distance to extreme fiber and moment of inertia.
2. $wL/8$ - $M_{\max} = wL^2/8$ occurs at midspan for a UDL.
3. C) at the fixed support - Moment builds up along the length, maximum at the fixed support: $M=PL$.
4. B) decreases bending stress - $\sigma = Mc/I$ - I is in the denominator, so a bigger I means lower stress.
5. $M = 8000 \text{ Nm} = 8,000,000 \text{ Nmm} = \sigma = Mc/I = 8,000,000/150 / 45,000,000 = 1,200,000,000/45,000,000 = 26.67 \text{ MPa}$
6. $M_{\max} = wL^2/8 = 108/8 = 1064/8$ $M_{\max} = 80 \text{ kNm}$
7. Max shear $V = P = 5 \text{ kN}$ (constant along the beam) Max moment $M = PL = 53 = 15 \text{ kNm}$ (at the fixed end)
8. A structural member that resists transverse loads mainly through bending.
9. $\sigma = Mc/I$ - moment times distance to extreme fiber, divided by moment of inertia.
10. At midspan: $M_{\max} = wL^2/8$.

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