

What Are Shear Force and Bending Moment?

Worksheet

Shear force (V) is the internal force acting perpendicular to a beam's axis, while bending moment (M) is the internal moment that bends the beam; both are found from static equilibrium and vary along the beam's length depending on the loading.

$$\frac{dM}{dx} = V$$

Questions

1. For a simply supported beam with a central point load P over span L , what is M_{\max} ?
A) PL
B) $PL/2$
C) $PL/4$
D) $PL/8$
2. Shear force acts...
A) Parallel to the beam's axis
B) Perpendicular to the beam's axis
C) Only at the supports
D) Only at the free end
3. What is the relationship between shear force V and bending moment M ?
A) $V = dM/dx$
B) $M = dV/dx$
C) $V = M$
D) No relationship
4. For a cantilever beam with a point load P at the free end (length L), where is the bending moment maximum?
A) At the free end
B) At the midspan
C) At the fixed support
D) It's constant everywhere
5. A simply supported beam spans 8 m with a 10,000 N point load at midspan. Find the maximum bending moment.
6. For the same beam, find the maximum shear force.
7. A cantilever beam of length 3 m has a 2,000 N point load at its free end. Find the maximum bending moment (at the fixed support).
8. Define: What is shear force?
9. Define: What is bending moment?
10. Define: Where is bending moment maximum in a simply supported beam with a central load?

Answer Key

1. C) $PL/4$ - $M_{\max} = PL/4$ occurs at midspan for this loading case.
2. B) Perpendicular to the beam's axis - Shear force is the internal force perpendicular (transverse) to the beam's longitudinal axis.
3. A) $V = dM/dx$ - Shear force is the derivative of bending moment with respect to position: $V = dM/dx$.
4. C) At the fixed support - The moment builds up along the beam and is maximum at the fixed support: $M_{\max} = PL$.
5. $M_{\max} = PL / 4$ $M_{\max} = 10,000 \text{ N} \cdot 8 \text{ m} / 4 = 20,000 \text{ Nm} = 20 \text{ kNm}$
6. By symmetry, each support carries half the load: $V_{\max} = P / 2$ $V_{\max} = 10,000 \text{ N} / 2 = 5,000 \text{ N} = 5 \text{ kN}$
7. For a cantilever with an end load: $M_{\max} = P L$ $M_{\max} = 2,000 \text{ N} \cdot 3 \text{ m} = 6,000 \text{ Nm} = 6 \text{ kNm}$
8. The internal force acting perpendicular (transverse) to a beam's axis, resisting sliding between cross-sections.
9. The internal moment that resists bending of the beam, causing tension on one face and compression on the other.
10. At the midspan, where $M_{\max} = PL/4$.

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