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CHAPTER

Shear Stresses in Beams

Q.1 The ratio of the maximum shear stress to the average shear stress in a beam with square cross-section is

(a) 1 (b) $\frac{3}{2}$

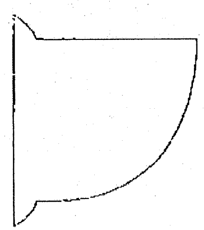
(c) $\frac{5}{4}$ (d) 2

Q.2 Assertion (A): In an I-section beam subjected to concentrated loads, the shear force at any section of the beam is resisted mainly by the web portion.

Reason (R): Average value of the shear stress in the web is equal to the value of shear stress in the flange

(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.3 The shear stress distribution over a beam cross-section is shown in the figure. The beam is of



(a) Equal flange I-section
(b) Unequal flange I-section
(c) Circular cross-section
(d) *T*-section

Q.4 Consider the following statements:

Two beams of identical cross-section but of different material carry same bending moment at a particular section, then

1. The maximum bending stress at that section in the two beams will be the same.
2. The maximum shear stress at that section in two beams will be the same.
3. Maximum bending stress at that section will depend on the elastic moduli of beam materials.
4. Larger the beam curvature larger is the value of E.

Which of the above statement(s) is(are) correct?

(a) 1 and 2 (b) 1, 3 and 4
(c) 1, 2 and 3 (d) 2, 3 and 4

Q.5 Maximum shear stress in a circular cross-section is

(a) $\frac{9}{8}q_{av}$ (b) $\frac{4}{3}q_{av}$

(c) $\frac{3}{2}q_{av}$ (d) $\frac{8}{3}q_{av}$

Q.6 If *S* is the shear force at a section of an I-joist, having web depth '*d*' and moment of inertia I about its neutral axis, then the difference between the maximum and mean shear stresses in the web is,

(a) $\frac{Sd^2}{8I}$ (b) $\frac{Sd^2}{12I}$

(c) $\frac{Sd^2}{16I}$ (d) $\frac{Sd^2}{24I}$

Q.7 Shear stress is caused by

(a) pure shear force only
(b) pure bending moment also
(c) torsional force only
(d) transverse shear and torsional moment

Q.8 The variation of the shear stress on the transverse plane of a normal beam section caused by a transverse shear force is usually

(a) linear (b) parabolic
(c) non-linear (d) linear or non-linear

Q.9 Consider the following statements:

The shear stress over a beam section of any shape for a given loading does not vary with

1. shear force at the section
2. area of the section
3. moment of inertia of the section

Which of these statements are correct?

(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

Q.10 A timber beam is simply supported at the ends and carries a concentrated load at mid-span. The maximum longitudinal stress '*f*' is 12 N/mm² and the maximum shear stress '*q*' is 1.2 N/mm². The ratio of span to depth of beam would be

(a) 10 (b) 6
(c) 5 (d) 4

Answers Shear Stress In Beams

1. (b) 2. (c) 3. (b) 4. (a) 5. (b) 6. (d) 7. (d) 8. (c) 9. (a) 10. (c)

Explanations Shear Stress In Beams

2. (c)

In practice, it is found that most of shearing force (about 95%) is carried by the web and the shear force is negligible.

Arrange value of shear stress in web is much larger them average value of shear stress in flange.

4. (a)

Bending stress, $\sigma = \frac{My}{I}$

Shear stress, $\tau = \frac{VA\bar{y}}{Ib}$

i.e., both σ and τ does not depend on material of beam.

5. (b)

$q_{max} = \frac{4}{3}q_{avg}$ (circular section) at NA

$q_{max} = \frac{3}{2}q_{avg}$ (Rectangular at NA section

$q_{max} = \frac{3}{2}q_{avg}$ (Triangular section) at mid depth

$q_{max} = \frac{9}{8}q_{avg}$ (diamond section)

at $\frac{3}{8}h$ from top and bottom

8. (c)

Shear stress distribution in a transverse plane is parabolic for rectangular, triangular and circular sections while in case of *I*-section, diamond section etc. it is non parabolic, hence in general shear stress is non linear. It may be noted that shear stress is not linear.

9. (a)

Shear stress, $\tau = \frac{VQ}{Ib}$

At a given section the shear force will remain same for any shape. Secondly the stress does not vary with area of the section. It varies with distribution of area i.e. moment of inertia of the section.

10. (c)

$f = \frac{M}{I}y = 12$

$$q_{max} = \frac{3}{2}\frac{R}{A} = 1.2$$

For simply supported beam with a concentrated load 'W' at mid-span

$$M = \frac{WL}{4}$$

$$\therefore \quad f = \frac{6WL}{4bd^2} = 12$$

$$\Rightarrow \quad \frac{3WL}{2bd^2} = 12 \qquad \text{...(i)}$$

and $\quad R = \frac{W}{2}$

$$\therefore \quad \frac{3}{2}\frac{W}{2bd} = 1.2$$

$$\Rightarrow \quad q_{max} = \frac{3W}{4bd} = 1.2 \qquad \text{...(ii)}$$

$$\therefore \quad \frac{3WL}{2bd^2} \times \frac{4bd}{3W} = \frac{12}{1.2}$$

From eq. (i) and (ii)

$$\Rightarrow \quad \frac{2L}{d} = 10$$

$$\Rightarrow \quad \frac{L}{d} = 5$$

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