UNIT- I

STRESS STRAIN DEFORMATION OF SOLIDS

1. Define stress.

When an external force acts on a body, it undergoes deformation. At the same time the body resists deformation. The magnitude of the resisting force is numerically equal to the applied force. This internal resisting force per unit area is called stress. Stress σ= Force/Area, P/A Unit N/mm2

2. Define strain

When a body is subjected to an external force, there is some change of dimension in the body. Numerically the strain is equal to the ratio of change in length to the original length of the body Strain = Change in length/Original length

e = ∂L/L

3. State Hooke's law.

It states that when a material is loaded, within its elastic limit, the stress is directly proportional to the strain.

E=σ/e

E= Stress / Strain, unit is N/mm2

Where,

E - Young‟s modulus

σ - Stress e - Strain

4. Define shear stress and shear strain.

The two equal and opposite force act tangentially on any cross sectional plane of the body tending to slide one part of the body over the other part. The stress induced is called shear stress and the corresponding strain is known as shear strain.

5. Define Poisson's ratio.

When a body is stressed, within its elastic limit, the ratio of lateral strain to the longitudinal strain is constant for a given material. Poisson‟ ratio (μ or 1/m) = Lateral strain /Longitudinal strain

6. State the relationship between Young's Modulus and Modulus of Rigidity.

$E = 2G (1+1/m)$

Where, E – Young's Modulus, K - Bulk Modulus, 1/m – Poisson's ratio

7. Define strain energy

Whenever a body is strained, some amount of energy is absorbed in the body. The energy which is absorbed in the body due to straining effect is known as strain energy.

8. Give the relationship between Bulk Modulus and Young's Modulus.

$E = 3K (1-2\nu)$

Where, E – Young's Modulus, K - Bulk Modulus, ν – Poisson's ratio

9. What is compound bar?

A composite bar composed of two or more different materials joined together such that system is elongated or compressed in a single unit.

10. Define- elastic limit

Some external force is acting on the body, the body tends to deformation. If the force is released from the body its regain to the original position. This is called elastic limit

11. Define – Young's modulus

The ratio of stress and strain is constant with in the elastic limit.

E = Stress/Strain

12. Define Bulk-modulus

The ratio of direct stress to volumetric strain**.**

K = Direct stress/Volumetric strain

13. Define- lateral strain

The strain right angle to the direction of the applied load is called lateral strain.

13. Define- longitudinal strain

When a body is subjected to axial load P, The length of the body is

increased. The axial deformation of the length of the body is called longitudinal strain.

14. What is principle of super position?

The resultant deformation of the body is equal to the algebraic sum of the deformation of the individual section. Such principle is called as principle of super position

15. Define- Rigidity modulus

The shear stress is directly proportional to shear strain.

N = Shear stress/Shear strain

UNIT II

BEAMS - LOADS AND STRESSES

1. Define beam?

BEAM is a structural member which is supported along the length and subjected To external loads acting transversely (i.e) perpendicular to the center line of the beam.

2. What is mean by transverse loading on beam?

If a load is acting on the beam which perpendicular to the central line of it then it is called transverse loading.

3. What is Cantilever beam?

A beam one end free and the other end is fixed is called cantilever beam.

4. What is simply supported beam?

A beam supported or resting free on the support at its both ends.

5. What is mean by over hanging beam?

If one or both of the end portions are extended beyond the support then it is called over hanging beam.

6. What is mean by concentrated loads?

A load which is acting at a point is called point load.

7. What is uniformly distributed load.

If a load which is spread over a beam in such a manner that rate of loading „w" is uniform throughout the length then it is called as udl.

8. Define point of contra flexure? In which beam it occurs?

Point at which BM changes to zero is point of contra flexure. It occurs in overhanging beam.

9. What is mean by positive or sagging BM?

BM is said to positive if moment on left side of beam is clockwise or right side of the beam is counter clockwise.

10. What is mean by negative or hogging BM?

BM is said to negative if moment on left side of beam is counterclockwise or right side of the beam is clockwise.

11. Define shear force and bending moment?

SF at any cross section is defined as algebraic sum of all the forces acting either side of beam. BM at any cross section is defined as algebraic sum of the moments of all the forces which are placed either side from that point.

12. When will bending moment is maximum?

BM will be maximum when shear force change its sign.

13. What is maximum bending moment in a simply supported beam of span 'L' subjected to UDL of 'w' over entire span?

Max BM =wL2 /8

14. In a simply supported beam how will you locate point of maximum bending moment?

The bending moment is max. When SF is zero. Write SF equation at that point and equating to zero we can find out the distances „x" from one end .then find maximum bending moment at that point by taking all moment on right or left hand side of beam.

15. What is shear force?

The algebraic sum of the vertical forces at any section of the beam to the left or right of the section is called shear force.

16. What is shear force and bending moment diagram?

It shows the variation of the shear force and bending moment along the length of the beam.

17. What are the types of beams?

1. Cantilever beam

2. Simply supported beam

3. Fixed beam

4. Continuous beam

5. over hanging beam

18. What are the types of loads?

1. Concentrated load or point load

2. Uniform distributed load

3. Uniform varying load

19. In which point the bending moment is maximum?

When the shear force change of sign or the shear force is zero

20. Write the assumption in the theory of simple bending?

1. The material of the beam is homogeneous and isotropic.

2. The beam material is stressed within the elastic limit and thus obey

Hooke's law.

3. The transverse section which was plane before bending remains plains after bending also.

4. Each layer of the beam is free to expand or contract independently

about the layer, above or below.

5. The value of E is the same in both compression and tension.

21. Write the theory of simple bending equation?

M/ I = F/Y = E/R

M - Maximum bending moment

I - Moment of inertia

F - Maximum stress induced

Y - Distance from the neutral axis

E – Young's modulus R – Radius of curvature

UNIT – III TORSION

1. Define Torsion

When a pair of forces of equal magnitude but opposite directions acting on body, it tends to twist the body. It is known as twisting moment or torsion moment or simply as torque. Torque is equal to the product of the force applied and the distance between the point of application of the force and the axis of the shaft.

2. What are the assumptions made in Torsion equation

The material of the shaft is homogeneous, perfectly elastic and obeys Hooke's Law. Twist is uniform along the length of the shaft The stress does not exceed the limit of proportionality The shaft circular in section remains circular after loading Strain and deformations are small.

3. Define polar modulus

It is the ratio between polar moment of inertia and radius of the shaft. =

J/R polar moment of inertia = J Radius R

4. Write the polar modulus for solid shaft and circular shaft.

polar moment of inertia = J Radius R

J = D4 / 32

5. Why hollow circular shafts are preferred when compared to solid circular shafts?

The torque transmitted by the hollow shaft is greater than the solid shaft. For same material, length and given torque, the weight of the hollow shaft will be less compared to solid shaft.

6. Write torsion equation

$T/J=C\theta/L=q/R$

T-Torque, θ-angle of twist in radians

J- Polar moment of inertia

C-Modulus of rigidity

L- Length

q- Shear stress R- Radius

7. Write down the expression for power transmitted by a shaft

$P=2NT/60$

N-speed in rpm

T-torque

8. Write down the expression for torque transmitted by hollow shaft

T= (/16) (D4-d4)/d4

T-torque

q- Shear stress

D-outer diameter d- Inner diameter

9. Write down the equation for maximum shear stress of a solid circular section

in diameter 'D' when subjected to torque 'T' in a solid shaft.

T=/16 D3 Where T-torque, q-Shear stress and D-diameter

10. Define tensional rigidity

Product of rigidity modulus and polar moment of inertia is called torsional rigidity

11. What is composite shaft?

Sometimes a shaft is made up of composite section i.e. one type of shaft is sleeved over other types of shaft. At the time of sleeving, the two shafts are joined together, that the composite shaft behaves like a single shaft.

12. What is a spring?

A spring is an elastic member, which deflects, or distorts under the action of load and regains its original shape after the load is removed.

13. State any two functions of springs.

1. To measure forces in spring balance, meters and engine indicators.

2. To store energy.

14. What are the various types of springs?

i. Helical springs

ii. Spiral springs iii. Leaf springs

iv. Disc spring or Belleville springs

15. Classify the helical springs.

1. Close – coiled or tension helical spring.

2. Open –coiled or compression helical spring.

16. What is spring index (C)?

The ratio of mean or pitch diameter to the diameter of wire for the spring

is called the spring index.

17. What is solid length?

The length of a spring under the maximum compression is called its

solid length. It is the product of total number of coils and the diameter of wire.

$Ls = nt \times d$ Where, nt = total number of coils.

18. Define spring rate (stiffness).

The spring stiffness or spring constant is defined as the load required per

unit deflection of the spring. K= W/y

Where W –load and y – Deflection

19. Define pitch.

Pitch of the spring is defined as the axial distance between the adjacent coils in uncompressed state. Mathematically

Pitch=free length/ n-1

20. Define helical springs.

The helical springs are made up of a wire coiled in the form of a helix

and are primarily intended for compressive or tensile load.

21. **What are the differences between closed coil & open coil helical springs?**

The spring wires are coiled very closely, each turn is nearly at right angles to the axis of helix The wires are coiled such that there is a gap between the two consecutive turns. Helix angle is less than 10o Helix angle is large (>10o)

UNIT-IV BEAMDEFLECTION

1. What are the methods for finding out the slope and deflection at a section?

The important methods used for finding out the slope and deflection at a section

in a loaded beam are

1. Double integration method

2. Moment area method

3. Macaulay‟s method

The first two methods are suitable for a single load, where as the last one is suitable for several loads.

2. Why moment area method is more useful, when compared with double integration?

Moment area method is more useful, as compared with double integration method because many problems which do not have a simple mathematical solution can be simplified by the ending moment area method.

3. Explain the Theorem for conjugate beam method?

Theorem I :"The slope at any section of a loaded beam, relative to the original axis of the beam is equal to the shear in the conjugate beam at the corresponding section"

Theorem II: "The deflection at any given section of a loaded beam, relative to the original position is equal to the Bending moment at the corresponding section of the conjugate beam"

4. Define method of Singularity functions?

In Macaulay's method a single equation is formed for all loading on a beam, the equation is constructed in such a way that the constant of Integration apply to all portions of the beam. This method is also called method of singularity functions.

5. What are the points to be worth for conjugate beam method?

1. This method can be directly used for simply supported Beam

2. In this method for cantilevers and fixed beams, artificial constraints need to be supplied to the conjugate beam so that it is supported in a manner consistent with the constraints of the real beam.

6. What are the different sections in which the shear stress distribution is to be obtained?

Rectangular section

Circular section

I- section

T- section

Miscellaneous section

7. What do you mean by shear stress in beams?

The stress produced in a beam, which is subjected to shear forces is known as stresses.

8. What is the formula to find a shear stress at a fiber in a section of a beam?

The shear stress at a fiber in a section of a beam is given by

F = shear force acting at a section

A = Area of the section above the fiber

Y = Distance of C G of the Area A from Neutral axis

I = Moment of Inertia of whole section about N A

b = Actual width at the fiber

9. **What is the shear stress distribution rectangular section?**

The shear stress distribution rectangular section is parabolic and is given by

$q = F/2I [d2 /4 – y2]$

d = Depth of the beam

y = Distance of the fiber from NA

10. What is the shear stress distribution Circular section?

$q = F/3I [R2-y2]$

11. State the main assumptions while deriving the general formula for shear stresses.

The material is homogeneous, isotropic and elastic the modulus of elasticity in tension and compression are same. The shear stress is constant along the beam width The presence of shear stress does not affect the distribution of bending stress.

12. Define: Shear stress distribution

The variation of shear stress along the depth of the beam is called shear stress distribution

13. What is the ratio of maximum shear stress to the average shear stress for the rectangular section?

Qmax is 1.5 times the Qavg.

14. What is the ratio of maximum shear stress to the average shear stress in the case of solid circular section?

Qmax is 4/3 times the Qave.

15. What is the shear stress distribution value of Flange portion of the I-section?

q= f/2I * (D2/4 - y)

D-depth

`y- Distance from neutral axis

16. What is the value of maximum of minimum shear stress in a rectangular cross section?

`Qmax=3/2 * F/ (bd)

17. What is the shear stress distribution for I-section?

The shear stress distribution I-section is parabolic, but at the junction of

web and flange, t**a**he shear stress changes abruptly. It changes from F/8I [D2 –d2] to B/b x F/8I [D2 –d2] where D = over all depth of the section

d = Depth of the web

b = Thickness of web

B = Over all width of the section.

18. How will you obtained shear stress distribution for unsymmetrical section?

The shear stress distribution for Unsymmetrical sections is obtained after calculating the position of N A.

19 Where the shear stress is max for Triangular section?

In the case of triangular section, the shear stress is not max at N A. The shear stress is max at a height of h/2

20. Where shear stress distribution diagram draw for composite section?

The shear stress distribution diagram for a composite section, should be drawn by calculating the shear stress at important points.

UNIT V

THIN AND THICK CYLINDERS

1. State principle plane.

The planes, which have no shear stress, are known as principal planes. These planes carry only normal stresses.

2. Define principle stresses and principle plane.

Principle stress: The magnitude of normal stress, acting on a principal plane is known as principal stresses. Principle plane: The planes which have no shear stress are known as principal planes.

3. What is the radius of Mohr's circle?

Radius of Mohr‟s circle is equal to the maximum shear stress.

4. What is the use of Mohr's circle?

To find out the normal, resultant stresses and principle stress and their planes.

5. List the methods to find the stresses in oblique plane?

1. Analytical method

2. Graphical method

6. Define thin cylinder?

If the thickness of the wall of the cylinder vessel is less than 1/15 to 1/20 of its internal diameter, the cylinder vessel is known as thin cylinder.

7. What are types of stress in a thin cylindrical vessel subjected to internal pressure?

These stresses are tensile and are know as Circumferential stress (or hoop stress) and Longitudinal stress.

8. **What is mean by Circumferential stress (or hoop stress) and Longitudinal stress?**

The stress acting along the circumference of the cylinder is called circumferential stress (or hoop stress) whereas the stress acting along the length of the cylinder is known as longitudinal stress.

17. What are the formula for finding circumferential stress and longitudinal stress?

Circumferential stress (f1) is given by as f1 = p x d / 2t x η1 and the

longitudinal stress (f2) is given by f2 = p x d / 2t x ηc

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18. What are maximum shear stresses at any point in a cylinder?

Maximum shear stresses at any point in a cylinder, subjected to internal fluid pressure is given by f1 –f2 / 2 = pd / 8t

19. What are the formula for finding circumferential strain and longitudinal strain?

The circumferential strain (e1) and longitudinal strain (e2) are given by

e1 = pd / 2tE (1- 1/2m), e2 = pd / 2tE (1/2 – 1/m).

20. What are the formula for finding change in diameter, change in length and change volume of a cylindrical shell subjected to internal fluid pressure p?

d = pd2 /2tE (1 – 1/2m),

L = pdL /2tE (1/2 – 1/m),

V = pd /2tE (5/2 – 2/m) x volume,

21. What are the formula for finding principal stresses of a thin cylindrical shell Subjected to internal fluid pressure p and a torque?

Major Principal Stress = f1 + f2 / 2+ {(f1 - f2 /2)2 + fs2}

Minor Principal Stress = f1 + f2 / 2 + {(f1 - f2 /2)2 + fs2}

Maximum shear stress = ½ [Major Principal Stress - Minor Principal

Stress]

Where f1 = Circumferential stress, f2 =Longitudinal stress,

fs =shear stress due to torque.