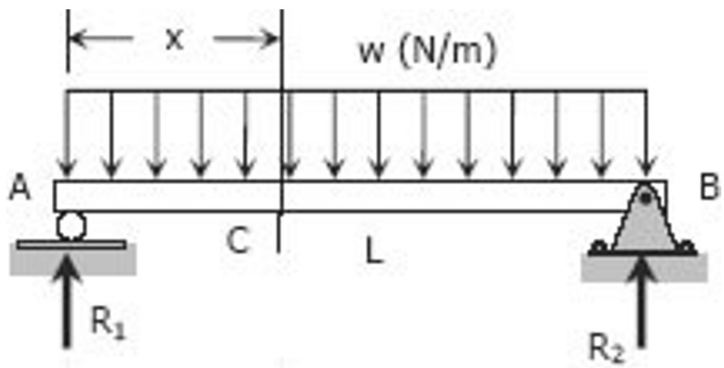
1. Inflection point – if BMD passes through zero bending moment then this point is called POI.
2. Dangerous point/Section – A point/section where the shear passes through zero is called dangerous section.
3. SFD – The algebraic sum of all vertical forces of one side at any section
4. BMD – The algebraic sum of all moments of the external forces to one side of any section
5. bending stresses, or flexure stresses - The stresses caused by the bending moment are known as
6. Yield strength = At stress-strain diagram at in which point strain increased but stress doesn't increase
7. Ultimate strength – It is the maximum stress that a material can withstand before it breaks or weakens.
8. Necking – At failure time, the narrowing of steel specimen
9. Hardness – the resistance of material to scratching or abrasion or penetration
10. Thermal strain - Thermal strains are strains that develop. when a material is heated or cooled
11. Modulus of rigidity - ratio of shear stress to shear strain
12. Poisson's ratio – it is the amount of transversal elongation divided by the amount of axial compression.
13. Ductility - the ability of a material to have its shape changed without losing strength or breaking
14. Lap joint - When two plates are folded under or above each other, this type of joint is called a lap joint.
15. Butt joint - both plates are combined by placing the plates on each other or on each other.
16. Efficiency of riveted joint - The ratio of the strength of the joint to the strength of the solid plate
17. Hoops stress - Hoop stress is the stress that occurs along the pipe's circumference when pressure is applied
18. Longitudinal stress - Longitudinal stress is defined as the stress produced when a pipe is subjected to internal pressure.
19. Hooks law - the strain of an elastic object or material is proportional to the stress in proportional limit.
20. Pitch – It is the distance from the center of one rivet to the center of the next rivet measured parallel to the seam.
21. shear center - Shear center is a point on the beam-section where the application of loads does not cause its twisting
22. Side fillet – when the weld is parallel to the direction of load then it is known as side fillet.
23. Stiffness - the property of material for which the element is able to resist deformation or deflection under the action of an applied force.
24. Transvers filet – when the weld is perpendicular to the direction of load
25. Butt fillet - Butt fillet is taken from the thicker end of the beef tenderloin. Butt fillets are very tender and taste fantastic roasted, grilled or fried.
26. REPEATING SECTIOIN – pitch
27.

Derivattion

1. Sfd bmd
2. Thin wall
3. Maximum shearing stress of rectabgular beam is 50 % more than average stress
4. Derive formula for horizontal shearing stress
5. Bending stress, shear stress

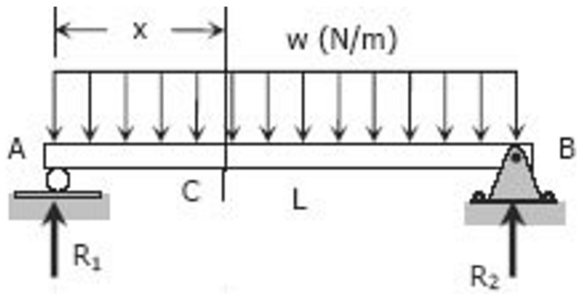
Relation among Load Shear and Moment

Consider a simple beam shown of length L that carries a uniform load of w (N/m) throughout its length and is held in equilibrium by reactions R_1 and R_2.



$R_1 = R_2 = wL/2$

- $V_x = R_1 - wx = wL/2 - wx$
- $M_x = R_1 * x - w * x^2/2$
- $M_x = wLx/2 - w * x^2/2$



- Differentiate M with respect to x

$$\frac{dM}{dx} = \frac{wL}{2}\frac{dx}{dx} - \frac{w}{2}2x\frac{dx}{dx} \qquad \Rightarrow \frac{dM}{dx} = \frac{wL}{2} - wx$$

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

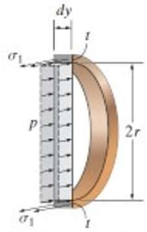
- Thus, the rate of change of the bending moment with respect to x is equal to the shearing force, or **the slope of the moment diagram at the given point is the shear at that point.**

- Differentiating V with respect to x

$$\frac{dV}{dx} = -w = Load$$

Thus, the rate of change of the shearing force with respect to x is equal to the load o**the slope of the shear diagram at a given point equals the load at that point.**

For circumferential direction



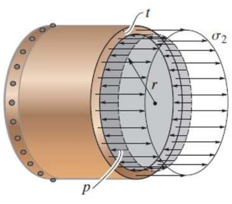
(b)

$$\Sigma F_x = 0; \qquad 2[\sigma_1(t\,dy)] - p(2r\,dy) = 0$$

$$\sigma_1 = \frac{pr}{t}$$

Cylindrical pressure vessels, such as this gas tank, have semi-spherical end caps rather than flat ones in order to reduce the stress in the tank.

For longitudinal direction

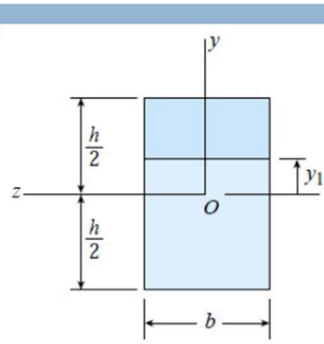


(c)

$$\Sigma F_y = 0; \qquad \sigma_2(2\pi rt) - p(\pi r^2) = 0$$

$$\sigma_2 = \frac{pr}{2t}$$

Distribution of Shear Stresses in a Rectangular Beam

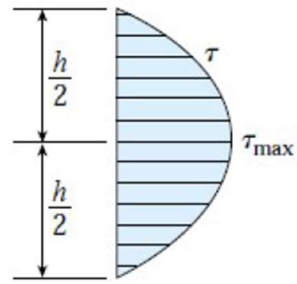


- The first moment Q *of the* shaded part of the cross-sectional area is obtained by multiplying the area by the distance from its own centroid to the neutral axis

$$Q = b\left(\frac{h}{2} - y_1\right)\left(y_1 + \frac{h/2 - y_1}{2}\right) = \frac{b}{2}\left(\frac{h^2}{4} - y_1^2\right)$$

Same result can be obtained by integration

$$Q = \int y \, dA = \int_{y_1}^{h/2} yb \, dy = \frac{b}{2}\left(\frac{h^2}{4} - y_1^2\right)$$



$$\tau = \frac{V}{2I}\left(\frac{h^2}{4} - y_1^2\right)$$

This equation shows that the shear stresses in a rectangular beam vary quadratically with the distance y_1 *from the neutral axis.*

$$\tau_{max} = \frac{Vh^2}{8I} = \frac{3V}{2A}$$

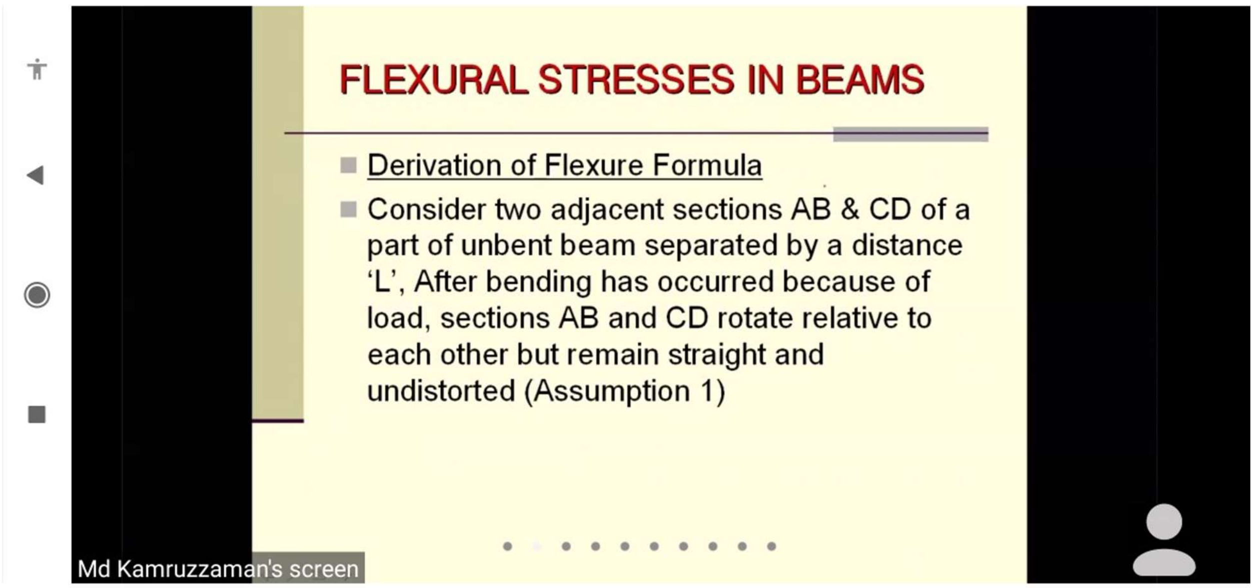
A = bh is the cross-sectional area.

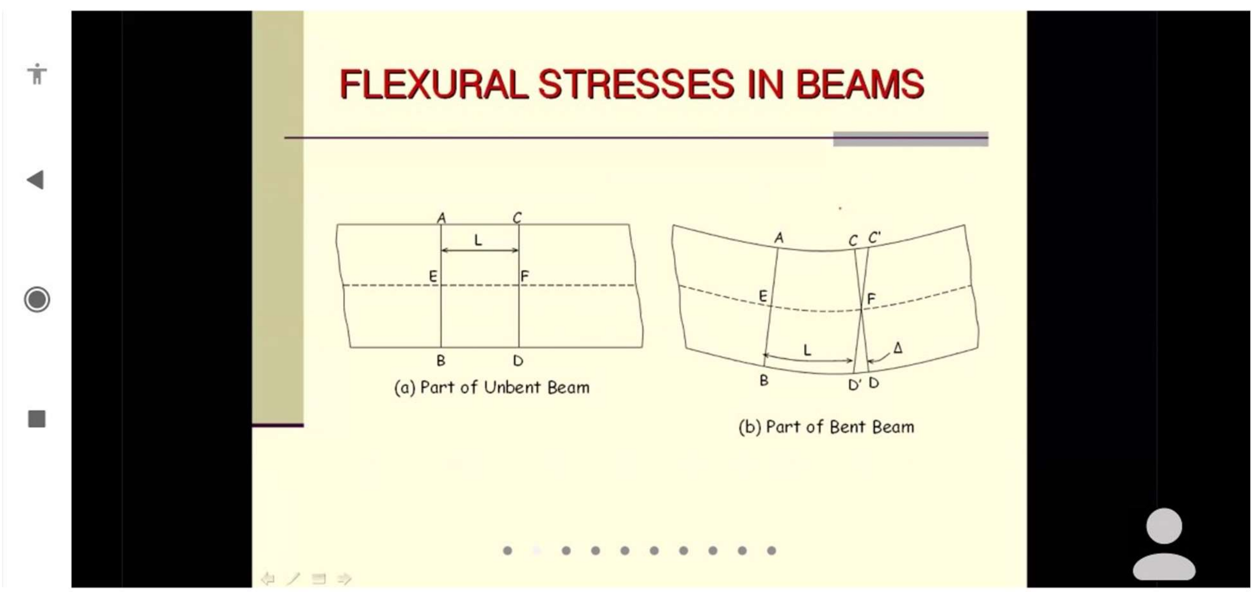
Thus, the maximum shear stress in a beam of rectangular cross section is 50% larger than the average shear stress *V/A.*

Pure bending can be for full beam or a particular section of beam, where shear force is 0 in every points.

Assumptions

- The material of the beam is homogeneous and isotropic.
- The value of the Young's modulus of elasticity is the same in tension and compression.
- The transverse section which were plane before bending remain plane after bending also.
- The beam is initially straight and all longitudinal filaments bend into circular arcs with a common center of curvature.
- The radius of curvature is so large compared with dimensions of the beam cross section.
- Each layer of the beam is free to expand or contract independently of the layer, above or below it.





FLEXURAL STRESSES IN BEAMS

- Fiber ‘AC’ at the top is shortened by an amount CC' and is in compression.
- Fiber ‘BD’ at the bottom is extended by an amount DD' and is in tension.
- Fiber ‘EF’ between Fiber AC and BD whose length is unchanged and is called neutral surface.

From distant C, Stress is S
From distant y, Stress is (Sy)/C

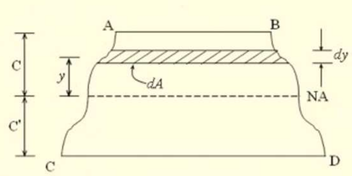


Fig. Cross Section of a Beam.

FLEXURAL STRESSES IN BEAMS

- Derivation of Formula:
  - Let ‘ABCD’ be any cross-section of a prismatic beam. The shaded strip dA ia an elementary part of the cross-section, its distance from N.A is ‘y’.
  - Let, ‘S’ be the stress in the top fiber and ‘C’ be the distance of these fibers from NA.
  - Hence, elementary stress on dA is, $= \frac{S \times y}{C}$
  - Hence, elementary force on dA is, $= S \times \frac{y}{C} \times dA$
  - Hence, elementary moment about NA is, $= \left(S \times \frac{y}{C} \times dA \right) \times y$

$$= \frac{S}{C} \times y^2 \times dA$$

FLEXURAL STRESSES IN BEAMS

$$\text{Resisting Moment, } M_R = \int_{-C}^{C} \frac{S}{C} \times y^2 dA = \frac{S}{C} \int_{-C}^{C} y^2 dA = \frac{S}{C} I$$

$$[\Theta \;\; I = \int y^2 \, dA = \text{Moment of Inertia} \,]$$

$$\text{Resisting Moment, } M_R = \text{Bending Moment, } M$$

$$\Rightarrow M = \frac{S}{C} \times I \qquad \boxed{\Rightarrow S = \frac{M \times C}{I}}$$

Here; S = Stress in top & bottom fiber of the beam in psi or ksi

M = Bending Moment in lb-in or k-in

C = Distance of NA from Top or Bottom fiber in

I = Moment of Inertia in in^4