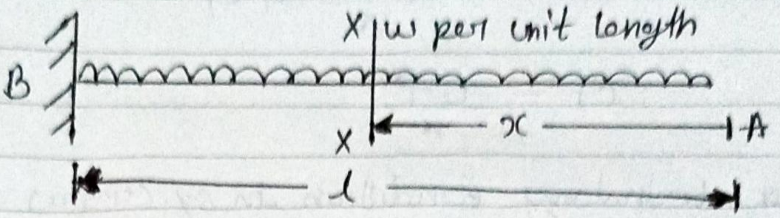
SECTION – 4

Q1 Given : Cantilever beam with uniformly distributed load.



4.41

1. Let us consider a beam AB length l carrying uniformly distributed load w per length. Take section XX at a distance x from the free end A.
2. Moment at XX section,

$$M_x = -wx\frac{x}{2} = \frac{wx^3}{2} \qquad \text{— 4.41}$$

3. We know that, $M_x = EI\frac{d^2y}{dx^2}$ — 4.42

4. Eq. (4.41) and (4.4.2) both are equal.

$$EI\frac{d^2y}{dx^2} = -\frac{wx^2}{2}$$

5. Integrate the equation,

$$EI\frac{dy}{dx} = (-\frac{wx^3}{6} + C_1 \qquad \text{— 4.43}$$

6. Again integrate $EIy = \frac{wx^4}{24} + C_1x + C_2$ — 4.44

7. Boundary Conditions,
when.

8. So from eq. (4.43), apply boundary condition

$$EI \times 0 = -\frac{wl^3}{6} + C_1$$

$$C_1 = \frac{wl^3}{6}$$

9. Applying boundary condition in eq. (4.4.4) after putting the value of C_1,
we get.

$$EI \times 0 = -\frac{wl^4}{24} + \frac{wl^3}{6} \times l + C_2$$

$$C_2 = \frac{wl^4}{8}$$

10. Put the value of C_1 and C_2 in eq. (4.44)

$$EIy = -\frac{wx^4}{24} + \frac{wl^3}{6}x - \frac{wl^4}{8}$$

This is deflection equation.

11. Deflection at free end $(x=0)$, $y = -\frac{wl^4}{8EI}$

Strain Energy DUE TO SELF-WEIGHT,,

A bar of uniform cross section A and of length l in a vertically hung position is considered (fig 3.4). Further, a strip of dx at a distance x from the lower end is also considered.

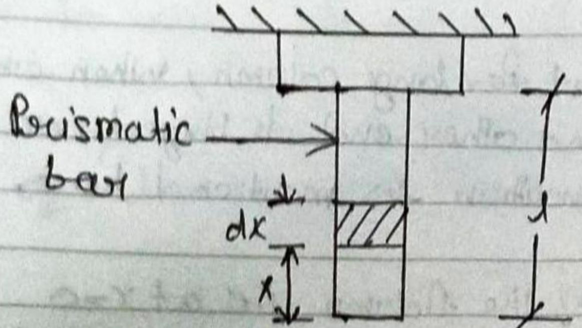


Fig. 3.4 Bar of uniform cross section.

The strip is acted upon by the weight of the bar of length, x.

Let ρ be the density of the material of the bar.

Weight acting on the strip $= (A \times x) \times \rho = \rho A x$

Strain in the strip of thickness, dx $\dfrac{\text{Elongation in } dx}{dx}$

Where Δx_5 is the elongation in dx

Stress in the strip...