

CHAPTER-1

Solution:-

- ① For most of the brittle material the ultimate strength in compression is much larger than the ultimate strength in tension. This is mainly due to

- (a) Presence of flaws and microscopic cracks and cavities.
- (b) Necking and tension.
- (c) Severity of tensile stress as compared to compressive stress.
- (d) Non-linearity of stress-strain diagram.

Ans - a

- [illegible]

A Steel rod 10 mm in diameter and 1 m long is heated from 20°C to 120°C , $E = 200 \text{ GPa}$ and $\alpha = 12 \times 10^{-6} \text{ per } ^{\circ}\text{C}$. If the rod is free to expand, the thermal stress developed is.

→ Thermal Stress = $\alpha E \Delta t$

$$\alpha = 10 \times 10^{-6}$$

$$E = 200 \times 10^3$$

$$\Delta t = 120 - 20 = 100$$

$$= \alpha E \Delta T$$

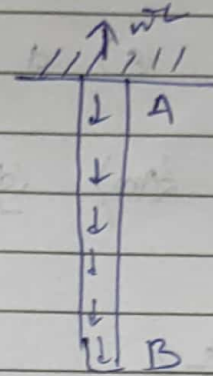
$$= (12 \times 10^{-6}) \times (200 \times 10^3) \times (100)$$

$$= 240 \text{ MPa}$$

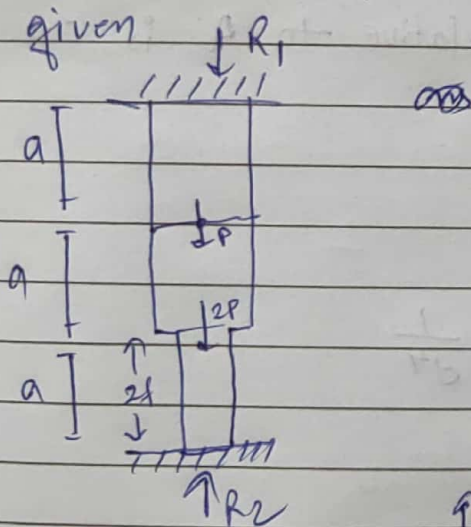
CHAPTER-2

- ① Determine the deflection of free end B of a elastic bar OB caused by its own weight w lb/in the constant cross section area A. Assume E is given

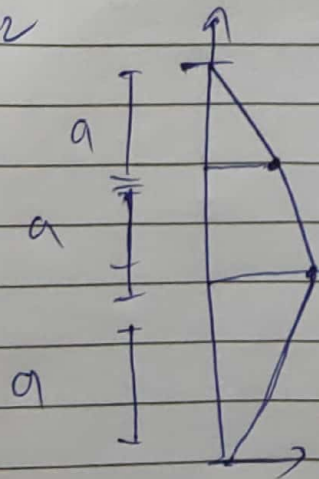
$$\begin{aligned} \Delta(m) &= \int_0^L \frac{P(x) dx}{AE} \\ &= \frac{1}{AE} \int_0^L w(L-x) dx \\ &= \frac{w}{AE} \left(Lx - \frac{x^2}{2} \right) \end{aligned}$$



- ② Draw the displacement graph (nature) of bar.



(ms)



Chapter -3

Question-1

give the stress in direction 3 (σ_3) when $\epsilon_3 = 0$ (Plane Strain Condition)

Ans \Rightarrow $\sigma_3 = \nu [\sigma_1 + \sigma_2]$

$\epsilon_3 = \frac{1}{E} [\sigma_3 - \nu (\sigma_1 + \sigma_2)] = 0$

$\sigma_3 = \nu [\sigma_1 + \sigma_2]$

Question 2

Consider a plate under uniaxial tension that is prevented from contracting in the transverse direction. Find effective modulus along the loading direction under this condition of plane strain.

Poisson's ratio = 0.33.

Ans \Rightarrow ν = Poisson's ratio = 0.33

E = Young's Modulus

$\sigma_3 = 0$ No stress

$\epsilon_2 = \frac{1}{E} (\sigma_2 - \nu \sigma_1)$ (in term of Hooke's law)

$\sigma_2 = \nu \sigma_1$ dir = 2

Direction -1

$\epsilon_1 = \frac{1}{E} (\sigma_1 - \nu \sigma_2) = \frac{1}{E} [\sigma_1 - \nu^2 \sigma_1]$

$\epsilon_1 = \frac{\sigma_1}{E} (1 - \nu^2)$

$E = \frac{\sigma_1}{\epsilon_1} = \frac{E}{1 - \nu^2}$ ($\nu = 0.33$)

$E' = 1.12 E$

Ans

Chapter - 4

Question-1

angle of twist of a shaft of diameter 'd' is inversely proportional with.

- (a) d (b) d^2 (c) d^3 (d) d^4

(Ans) (d)

Question:-2

A circular shaft fixed at A of diameter D for a half of its length and diameter $D/2$ over the other half. What is the rotation of C relative of B if the rotation of B relative to A is 0.1 radians?

$$\Rightarrow \frac{\tau}{J} = \frac{G\theta}{L}$$

$$\Rightarrow \theta \propto \frac{1}{J} \quad \text{or} \quad \theta \propto \frac{1}{d^4}$$

$$\Rightarrow J = \frac{\pi d^4}{32}$$

$$\frac{\theta}{0.1} = \frac{d^4}{(d/2)^4}$$

$$\Rightarrow \theta_2 = 0.1 \times 16$$

$$= \boxed{\theta_2 = 1.6 \text{ radians}}$$

ans