Solid Mechanics - II

Code: CE 604

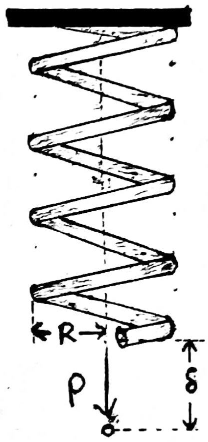
Case Study

Answer to the Question No- 02

Solution: Given, $n = 20$ turns $\quad P = 500\,lb$

$d = 1.0\,in \quad R = 4\,in$

$G = 6\times10^6\,psi \quad m = \frac{2R}{d} = \frac{2\times4}{1} = 8$



$$\tau_{max} = \frac{16PR}{\pi d^3}\left(\frac{4m-1}{4m-4} + \frac{0.615}{m}\right)$$

$$= \frac{16\times500\times4}{\pi\times1^3}\left(\frac{4\times8-1}{4\times8-4} + \frac{0.615}{8}\right)$$

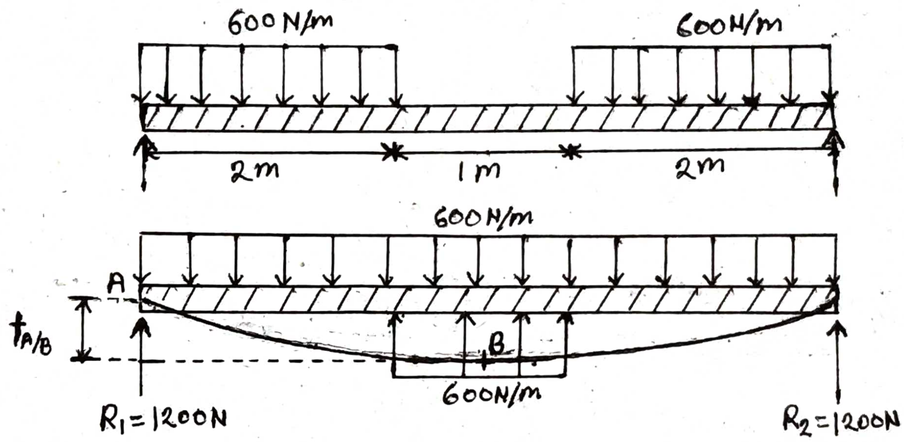
$$= 12060.31\ psi \quad \text{(Answer)}$$

Elongation $$\delta = \frac{64PR^3n}{Gd^4} = \frac{64\times500\times4^3\times20}{6\times10^6\times1^4}$$

$$= 6.827\ in \quad \text{(Answer)}$$

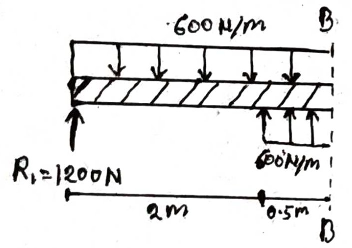
Answer to the Question No-02

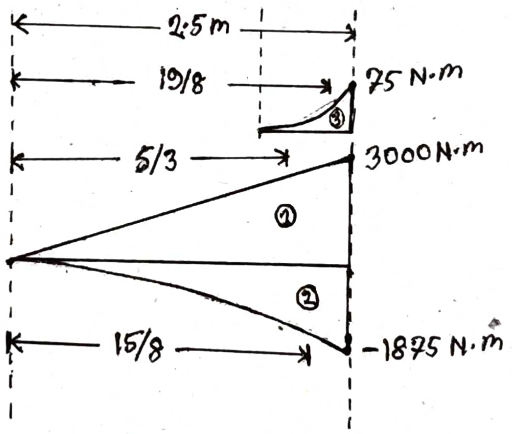
Solution: Compute the midspan value of EIδ for the beam shown below:



By Symmetry:

$$R_1 = R_2 = \frac{600 \times 4}{2} = 1200N$$





$$t_{A/B} = \frac{1}{EI}\left(A_1\bar{x}_1 + A_2\bar{x}_2 + A_3\bar{x}_3\right)$$

$$= \frac{1}{EI}\left(\frac{1}{2}\times 2.5\times 3000\times\left(\frac{5}{3}\right) + \frac{1}{3}\times 2.5\times(-1875)\times\left(\frac{15}{8}\right) + \frac{1}{3}\times 0.5\times 75\times\frac{19}{8}\right)$$

$$\therefore t_{A/B} = \frac{1}{EI}(3350) = \frac{3350}{EI}$$

From the figure,

$$\delta_{midspan} = t_{A/B}$$

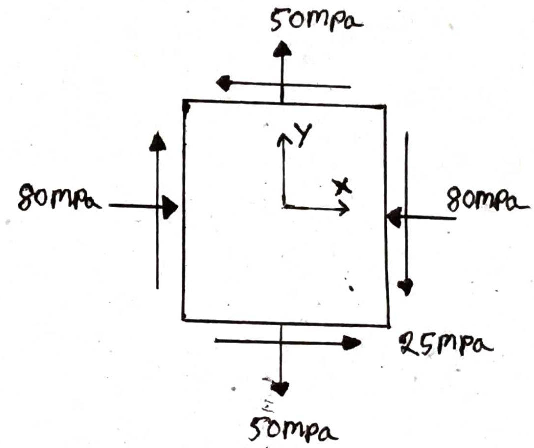
Thus,

$$EI\,\delta_{midspan} = 3350 \text{ N.m}^3 \text{ (Answer)}$$

Answer to the Question NO-03

Solution: Finding the stresses on an element inclined at 30° clockwise:

Define the stresses in terms of the established sign convention:



$\sigma_x = -80$ mpa $\quad \sigma_y = 50$ mpa

$\tau_{xy} = -25$ mpa $\quad \theta = -30^\circ$ (cw)

Now,

$$\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$= \frac{-80+50}{2} + \frac{-80-50}{2} \cos 2(-30) + (-25) \sin 2(-30) = -25.85 \text{ mpa}$$

(Ans)

$$\sigma_{y'} = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$$

$$= \frac{-80+50}{2} - \frac{-80-50}{2} \cos 2(-30) - (-25) \sin 2(-30) = -4.15 \text{ mpa}$$ (Ans)

$$\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$$

$$= -\frac{-80-50}{2} \sin 2(-30) + (-25) \cos 2(-30) = -68.79 \text{ mpa}$$ (Ans)