Section-4

Q. 1
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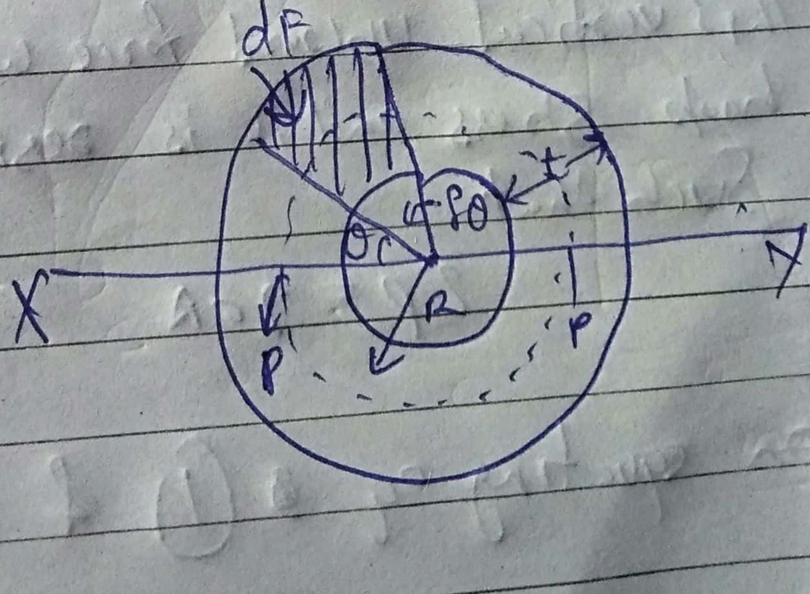
Let
D = mean Diameter of rim
R = mean radius of rim
A = cross-section area of rim
ρ = Density of rim material
N = speed of flywheel
ω = Angular velocity of flywheel.
σ = Tensile (or hoop) stress due to centrifugal force
v = Linear velocity at the mean Radius

$$V = R\omega = \frac{\pi D N}{60}$$



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2 Consider a small element of rim which subtends an angle $\delta\theta$ at the centre of flywheel.

3. Volume of the small element $= AR\delta\theta$
and mass of the small element

$$dm = \text{Density} \times \text{Volume}$$
$$= \rho AR\delta\theta$$

4. Centrifugal force that acts radially outward
$$dF = dm\,\omega^2 R$$
$$= \rho AR^2\omega^2\delta\theta$$

5. Vertical component of $dF = dF\sin\theta$
$$= \rho AR^2\omega^2\delta\theta\sin\theta$$

6. total vertical upward force tending to burst the rim across the diameter XY

$$F = \rho AR^2\omega^2\int_0^{\pi}\sin\theta\,d\theta = 2\rho AR^2\omega^2 \quad \text{--- (1)}$$

7 This vertical upward force will produce hoop stress and it is resisted by 2P such that

$$2P = 2\sigma A \quad \text{--- (2)}$$

8 On equating eq (1) & eq (2)

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$$2\sigma A = 2\rho A R^2 \omega^2$$

$$\sigma = \rho R^2 \omega^2 \qquad [\because V = R\omega]$$

$$\sigma = \rho V^2$$

$$V = \sqrt{\frac{\sigma}{\rho}} \qquad \text{--- (3)}$$

(9) The mass of Rim M = Volume X Density

$$m = \pi D A \rho$$

$$A = \frac{m}{\pi D \rho} \qquad \text{--- (4)}$$

(10) Using eq (3) & eq (4) we can find the value of the mean radius and cross-sectional area of the rim.

(11) If the cross-sectional area of the rim is rectangular than

$$A = bt$$

Where b = width of the rim

t = thickness of the rim