Published on *Mechanical Engg Simple Notes ,Solved problems and Videos* (https://mechdiploma.com)

A shaft has number of collars integral with it...........

Question:

A shaft has number of collars integral with it. The external diameter of the collars is 400 mm and the shaft diameter is 250 mm. If the uniform intensity of pressure is 0.35 N/mm2 and its co-efficient of friction is 0.05; find (i) power absorbed in overcoming friction when shaft rotates at 105 rpm and carries a load of 150 kN, and (ii) number of collars required.

Answer:

Given : d_1 = 400 mm or r_1 = 200 mm ; d_2 = 250 mm or r_2 = 125 mm ; p = 0.35 N/mm^2 ; μ = 0.05 ; N = 105 r.p.m or $\omega = 2\pi \times 105/60 = 11$ rad/s ; W = 150 kN = 150×10^3 N

1. *Power absorbed*

We know that for uniform pressure, total frictional torque transmitted,

$$T = \frac{2}{3} \times \mu . W \left[\frac{(r_1)^3 - (r_2)^3}{(r_1)^2 - (r_2)^2} \right] = \frac{2}{3} \times 0.05 \times 150 \times 10^3 \left[\frac{(200)^3 - (125)^3}{(200)^2 - (125)^2} \right] \text{N-mm}$$

$$= 5000 \times 248 = 1240 \times 10^3 \text{ N-mm} = 1240 \text{ N-m}$$

$\therefore$ Power absorbed,

$$P = T.\omega = 1240 \times 11 = 13640 \text{ W} = 13.64 \text{ kW} \textbf{ Ans.}$$

2. *Number of collars required*

Let n = Number of collars required.

We know that the intensity of uniform pressure (p),

$$0.35 = \frac{W}{n.\pi[(r_1)^2 - (r_2)^2]} = \frac{150 \times 10^3}{n.\pi[(200)^2 - (125)^2]} = \frac{1.96}{n}$$

$\therefore$ $n = 1.96/0.35 = 5.6$ say 6 **Ans.**