Problem

1) A torsion bar suspension is to be designed to support a maximum static load of 3433.5 N at the end of a lever arm 250mm long. The deflection of the lever above the horizontal is to be 30° with a total angle of deflection of 90°. Assuming a safe allowable stress of 784800 kPa. Calculate (a) diameter of torsion bar (b) The effective length (c) The load rate

Given data:

Static load = 3433.5 N

Dynamic load = 2 x static load.

= 2 x 3433.5

= 6867 N

$l = 250mm$

$\theta = 90^\circ$

$\alpha = 30^\circ$

$f_s = 784800 kPa$

$= 784.8 MPa$

$= 784.8 N/mm^2$

C (or) G = 73575 $\times 10^6$ Pa (considering)

= 73575 N/mm^2

To find:

(i) d

(ii) L

(iii) γ

Solution

$$d = \sqrt[3]{\frac{16\, T_{max}}{\pi\, f_{s\,max}}}$$

$T = W \times y$

$y = l \cos\alpha$

$= 250 \cos 30$

$\boxed{y = 216.5 mm}$

$T = 6867 \times 216.5$

$\boxed{T = 1.487 \times 10^6 \ N \cdot mm}$

$$d = \sqrt[3]{\frac{16\, T_{max}}{\pi\, f_{s\,max}}}$$

$$d = \sqrt[3]{\frac{16 \times 1.487 \times 10^6}{\pi \times 784.8}}$$

$$\boxed{d = 21.2 \text{ mm}}$$

(ii) $$L = \frac{G\theta_{max} d}{2 f_{s\,max}}$$

$$= \frac{73575 \times 90 \times 21.2}{2 \times 784.8}$$

$\theta_{max} = 90^\circ$

$\theta_{max} = \frac{\pi}{180} \times 90$

$= \frac{\pi}{2}$ radians

$$= \frac{73575 \times \frac{\pi}{2} \times 21.2}{2 \times 784.8}$$

$$\boxed{L = 1561 \text{ mm}}$$

(iii) $$Y = \frac{\pi d^4 G + 32 L W x}{32 L (l^2 - x^2)}$$

$x = l \sin\alpha$

$= 250 \times \sin 30$

$$\boxed{x = 125 \text{ mm}}$$

$$\gamma = \frac{\left(\pi d (21.2)^4 \times 73575\right) + \left(32 \times 1561 \times 6867 \times 125\right)}{32 \times 1561 \left(950^2 - 125^2\right)}$$

$$\gamma = 38.25 \text{ N/mm}$$

(or)

$$\gamma = 38250 \text{ N/m}$$

Result:

$d = 21.2 \text{ mm}$ (or) $d = 0.021 \text{ m}$

$L = 1561 \text{ mm}$ (or) $L = 1.56 \text{ m}$

$\gamma = 38.25 \text{ N/mm}$ (or) $\gamma = 38250 \text{ N/m}$