Problems

1) A typical coil Spring Suspension has 10 effective coil of a mean diameter 125 mm & made out of wires of diameter 15 mm. The Spring is designed to carry a max Static load of 3531.6 N. Calculate Shear Stress and deflection under above loading condition. If the maximum Stress of 637650 KPa is allowed in the material, What is the possible clearance?

Given data:

(i) $n = 10$

$D = 125\,mm = 0.125\,m$

$d = 15\,mm = 0.015\,m$

$P = 3531.6\,N$

$\tau = 637650\,KPa = 637650 \times 10^3\,Pa$

$= 637.65 \times 10^6\,Pa$

$= 637.65\,N/mm^2$

$G = 73575 \times 10^6\,Pa$

$= 73575\,N/mm^2$

To find:

(i) δ, f_s

(ii) δ, clearance

Solution:

$$\delta = \frac{8nPD^3}{Gd^4}$$

$$= \frac{8 \times 10 \times 3531.6 \times 0.125^3}{73575 \times 0.015^4}$$

$$\boxed{\delta = 148.1 \text{ mm}}$$

$$\tau = k \times \frac{8PD}{\pi d^3}$$

$$C = \frac{D}{d} = \frac{125}{15}$$

$$\boxed{C = 8.33}$$

$$k = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

$$= \frac{4(8.33)-1}{4(8.33)-4} + \frac{0.615}{8.33}$$

$$\boxed{k = 1.177}$$

$$\tau = 1.177 \times \frac{8 \times 3531.6 \times 125}{\pi \times 15^3}$$

$$\boxed{\tau = 391.9 \text{ N/mm}^2}$$

(ii) $\tau = K \times \frac{8PD}{\pi d^3}$

$$\tau = \frac{G d \delta}{\pi D^2 N}$$

$$637.65 = \frac{73575 \times 15 \times \delta}{\pi \times 125^2 \times 10}$$

$$\boxed{\delta_2 = 283.6 \text{ mm}}$$

Clearance $= \delta_2 - \delta_1$

$= 283.6 - 148.1$

$$\boxed{\text{Clearance} = 135.6 \text{ mm}}$$

Result:

(i) $\delta = 0.148 \text{ m}$ (or) 148.1 mm

& f_s (or) $\tau = 391.9 \text{ N/mm}^2$

(ii) Clearance $= 135.6 \text{ mm}$.

2. A compression coil helical Spring made of an alloy Steel is having the following Specifications

mean diameter of coil = 50 mm

Wire diameter = 5 mm

number of active coil = 20

If this Spring is Subjected to an axial load of 500 N. Calculate the maximum Stress [neglect the curvature effect] to which the Spring material is Subjected.

Given data:

$D = 50$ mm

$d = 5$ mm

$n = 20$

$P = 500$ N

Given that the curvature effect is neglected

To find:

τ

Solution: For the condition, "curvature effect is neglected"

$$K = 1 + \frac{1}{2C}$$

$$C = \frac{D}{d} = \frac{50}{5}$$

$$\boxed{C = 10}$$

$$K = 1 + \frac{1}{2C}$$

$$\boxed{K = 1.05}$$

$$\tau = K \times \frac{8PD}{\pi d^3}$$

$$= \frac{1.05 \times 8 \times 500 \times 50}{\pi \times 5^3}$$

$$\boxed{\tau = 534.76\ N/mm^2}$$

Result:

$$\tau = 534.76\ N/mm^2$$

3) A helical spring is made from a wire of 6mm diameter and has outside diameter of 75mm. If the permissible shear stress is 350MPa & Modulus of Rigidity is 84KN/mm^2. Find the axial load which can carry and the deflection per active turn.

Given data:

Outer dia = 75mm

$d = 6$mm

$\tau = 350$ MPa $= 350\ N/mm^2$

$$G = 84\ kN/mm^2$$

$$= 84 \times 10^3\ N/mm^2$$

To find:

(i) P, δ/n

Solution:

$$D = d_o - d$$

$$= 75 - 6$$

$$\boxed{D = 69\ mm}$$

$$C = \frac{D}{d} = \frac{69}{6} = 11.5$$

$$\boxed{C = 11.5}$$

$$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

$$= \frac{4(11.5)-1}{4(11.5)-4} + \frac{0.615}{11.5}$$

$$\boxed{K = 1.125}$$

$$\tau = K \times \frac{8PD}{\pi d^3}$$

$$350 = \frac{1.125 \times 8 \times P \times 69}{\pi \times 6^3}$$

$$\boxed{P = 382.45\ N}$$

$$\delta/n = \frac{\frac{8PD^3}{Gd^4}}{D} \Rightarrow \frac{8PD^3}{Gd^4}$$

$$= \frac{8 \times 382.45 \times 69^3}{84 \times 10^3 \times 6^4}$$

$$\boxed{\delta/n = 9.23\ mm}$$

Result:

$P = 382.45\ N$

$\delta/n = 9.23\ mm$

4. Design a compression helical Spring to carry a load of 500N with a deflection of 25 mm. The Spring Index may be taken as 8. Assume the following values for Spring material, permissible Shear Stress is 350 MPa, $G = 84\ KN/mm^2$, Wahl's factor

$$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

Given data;

$P = 500\ N$

$\delta = 25mm$

$C = 8$

$\tau = 350\ MPa = 350\ N/mm^2$

$G = 84\ kN/mm^2 = 84 \times 10^3\ N/mm^2$

$$K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

To find:

K, D, d, n

Solution:

$$k = \frac{4C-1}{4C-4} + \frac{0.615}{C}$$

$$= \frac{4(8)-1}{4(8)-4} + \frac{0.615}{8}$$

$$\boxed{K = 1.184}$$

$$\tau = K \times \frac{8PD}{\pi d^3}$$

$$350 = \frac{1.184 \times 8 \times 500 \times D}{\pi d^3}$$

$$C = \frac{D}{d} \Rightarrow 8 = \frac{D}{d}$$

$$\boxed{D = 8d}$$

$$350 = \frac{1.184 \times 8 \times 500 \times 8d}{\pi d^2}$$

$$\boxed{d = 5.87\,mm}$$

$$D = 8 \times 5.87$$

$$\boxed{D = 46.96\,mm}$$

$$\delta = \frac{8nPD^3}{Gd^4}$$

$$25 = \frac{8 \times n \times 500 \times 46.96^3}{84 \times 10^3 \times (5.87)^4}$$

$$\boxed{n = 6}$$

Result:

$D = 46.96\,mm$

$d = 5.87\,mm$

$n = 6$ coil