SHEKHAWATI INSTITUTE OF ENGINEERING & TECHNOLOGY

SIKAR , RAJASTHAN

1st-MID TERM EXAMINATION 2018 (6th Semester -ME)

Subject Code & Name: 6ME1A (MD-2.)

MM: 20 Time: 1 :30H

Student Instruction

1. Use pencil for diagrams.
2. Answer should mark proper S No.
3. **Attempt ~~any~~ five question** all

1A helical spring is made from a wire of 6mm dia. And has outside Diameter of 75mm.if the permissible shear stress is 350Mpa and modulus of rigidity 84KN/mm^2 ,fine the axial load which the spring can carry and the deflection per active coil?

2Explain the different type of anti friction bearing ?

3Derive the expression for bending strength of the gear?

4derive the expression for helical spring under axial compressive load and friction coefficient for journal bearing?

5A single row angular contact ball bearing number 310 is used for an axial load . the bearing is to carry a radial load of 2500N and thrust load of 1500N .assuming light shock load ,determine the rating life of the bearing?

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Model Answer Paper

Q.1 A helical spring is made from a wire of 6mm diameter and has outside diameter of 75mm. if the permissible shear stress is 350mpa and modulus of rigidity 84 kN/mm². find the axial load which can carry and the deflection per active turn.

Sol.ⁿ → Given $d = 6mm$, $D_0 = 75mm$, $\tau = 350mpa$

$\tau = 350 N/mm^2$, $G = 84 kN/mm^2 = 84\times10^3 N/mm^2$

we know that mean diameter of the spring

$$D = D_0 - d = 75 - 6 = 69mm$$

∴ Spring index, $C = \frac{D}{d} = \frac{69}{6} = 11.5$

let, W = Axial load

δ/n = Deflection per active turn,

i) Neglecting the effect of curvature.

we know that shear stress.

$$K_s = 1 + \frac{1}{2C} = 1 + \frac{1}{2\times11.5} = 1.043$$

maximum shear stress induced in the wire (2)

$$350 = K_s \times \frac{8WD}{\pi d^3} = 1.043 \times \frac{8W\times69}{\pi d^3} = 0.848W$$

$$W = 350/0.848 = 412.7N$$ Ans

We know that the deflection of the spring.

$$\delta = \frac{8 \cdot W \cdot D^3 n}{G \cdot d^4}$$

∴ Deflection per active turn.

$$\frac{\delta}{n} = \frac{8 \cdot W \cdot D^3}{G \cdot d^4} = \frac{8 \times 412.7 (69)^3}{84 \times 10^3 \times 6^4}$$

$$\boxed{\frac{\delta}{n} = 9.96 \text{ mm}}$$ Ans

2) Considering the effect of curvature.

we know that Wahl's Stress factor.

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

$$K = \frac{4 \times 11.5 - 1}{4 \times 11.5 - 4} + \frac{0.615}{11.5}$$

$$\boxed{K = 1.123}$$

maximum shear stress induced in the wire (τ)

$$350 = K \times \frac{8 \cdot W \cdot C}{\pi d^3} = 1.123 \times \frac{8 \times W \times 11.5}{\pi \times 6^2} = 0.913 W$$

$$W = 350 / 0.913$$

$$\boxed{W = 383.4 \text{ N}}$$ Ans

Deflection of the spring

$$\delta = \frac{8 \cdot W D^3 n}{G d^4}$$

∴ Deflection per active turn.

$$\frac{\delta}{n} = \frac{8 \cdot W \cdot D^3}{G \cdot d^4} = \frac{8 \times 383.4 (69)^3}{84 \times 10^3 \times 6^4} = 9.26 \text{ mm}$$ Ans

Q.2 Explain the different type of anti friction bearing?

Ans:- There are two Types of anti friction bearing.

a) Ball Bearing.

b) Raller Bearing.

Types of Ball Bearing!

1) Deep groov. B.B

i) fr/fa > 1

ii) Construction simple

iii) Cost (min)

iv) mostly used.

2) Angular Contact Ball Bearing

i) fr/fa < 1

ii) Construction is difficult

iii) Cost high.

iv) Pree loaded/ Bearing is required

3) Self Aligment Ball Bearing

i) permit miss Aligment b/w shaft and bearing house

ii) fa and fr both angular be used

4) Thrust Ball Bearing

i) fa (only)

ii) only for vertical shaft

iii) fr = 0

Types of Raller Bearing :

1) Spherical Raller Bearing

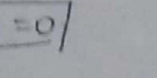
i) permit miss Aligment

2) Two Row of Raller Bearing

iii) fr and fa Both.

2) Critical Raller Bearing

i) fr



ii) Fa = 0

iii) Prefered for horizontal shaft.

iv) maximum Radial load capacity

3) Tapper Raller Bearing

i)

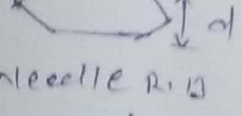
fr/fa > 1

ii) maximum load Bearing.

iii) Construction is difficult.

4) Needle Roller Bearing

i)

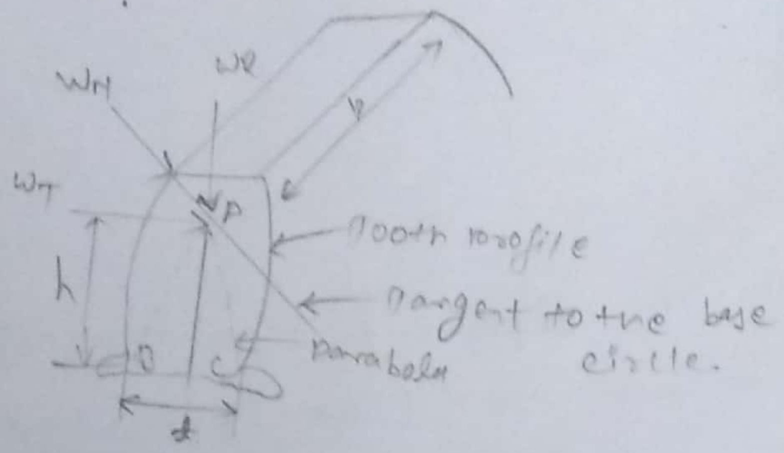


ii) Needle R.B are used when Radial space Constrained.

iii) used at frequency fr or fa

Q.3 Drive the expression for bending strength of the gear?

Ans;



$\sigma w = M \cdot y / I$

M = maximum bending moment.

W_T = Tangential load acting.

h = length of the tooth.

y = Half the thickness.

I = moment of interia.

b = width of the gear.

$$\sigma w = \frac{(W_T \times h)\, t/2}{b t^3/12} = \frac{(W_T \times h) \times 6}{b t^2}.$$

$$\boxed{W_T = \sigma w \times b \times t^2/6h}$$

let $t = x \times P_c$ and $h = K \times P_c$ x and K are Constant

$$W_T = \sigma w \times b \times \frac{x^2 \cdot P_c^2}{6K \cdot P_c}$$

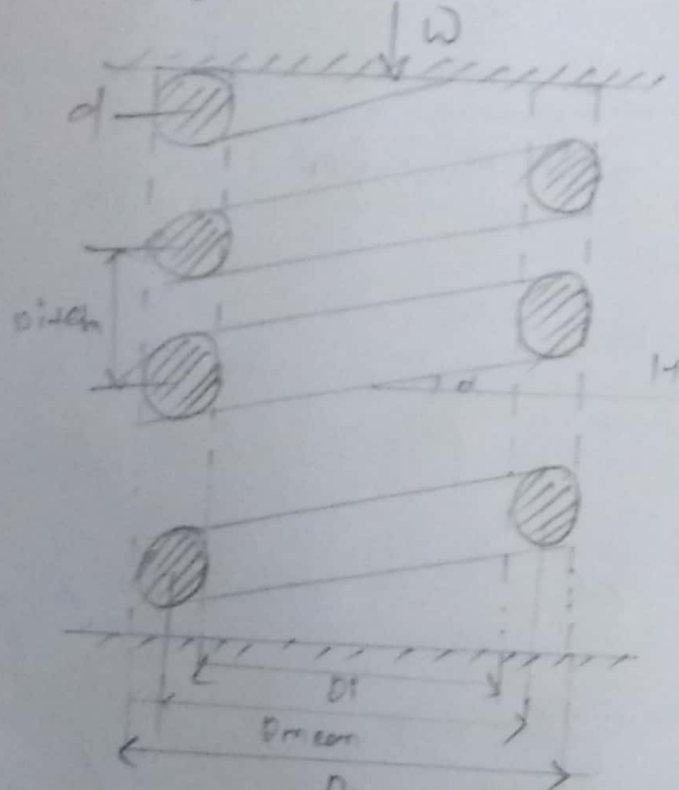
$$\boxed{W_T = \sigma w \times b \times P_c \times \frac{x^2}{6K}}$$

$$\boxed{W_T = \sigma w . b . P_c} \quad \boxed{y = \sigma w . b . \pi m . y}$$

$$\therefore y = \frac{x^2}{6K} = \frac{t^2}{(P_c)^2} \times \frac{P_c}{6h} = \frac{t^2}{6 \cdot h \cdot P_c}$$

Q.4 Derive the expression for helical spring under axial Compressive load and friction coefficient for journal bearing.?

Ans → Helical spring under axial Compressive load.



D = mean dia

D = Di + d = Do − d

C = spring index.

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

$$4 \leq C \leq 12$$

n = no. of active coils.

$$\tau_{dir} = \frac{P}{A} = \frac{W}{\pi/4 \, d^2}$$

$$\tau_{dir} = \frac{4W}{\pi d^2}$$

$$\tau = \frac{T r}{J}$$

$$\tau_{max} = \frac{TR}{J} = \frac{\frac{WD}{2} \times d/2}{\frac{\pi d^4}{32}}$$

$$\tau_{max} = \frac{8WD}{\pi d^3}$$

$\tau_{max} = \tau_{dire} + \tau_{twisting}$

$$\tau_{max} = \frac{4W}{\pi d^2} + \frac{8WD}{\pi d^3}$$

Inner point on maximum load.

outer point minimum load

$$W_{maxi} = \frac{\pi d^3}{8 D K_W} \times \tau_{per}$$

friction coefficent of Journal Bearing.

→ Journal bearing is a sliding contact radial load.

→ Journal bearing with generally operating with hydrodynamic lubrication.

$c_1 = R_1 - R_0$ = Radial clearance.

$c = D_1 - D_0$ = Diametrical clearance.

l = length of bearing

$$C = 2c_1$$

$2R_1 - 2R_0 = C$, $2(R_1 - R_0) = C$

$$2c_1 = C$$

Q.5 A single row angular contact ball bearing number 310 is used for an axial load. the bearing is to carry a radial load of 2500 N and thrust load of 1500 N. assuming light shock and determine the rating life of the bearing?

Soln ⟹ Given:

$W_R = 2500N$; $W_A = 1500N$

$W_A/W_R = 1500/2500 = 0.6$

$X = 1$ and $Y = 0$

The rating factor (V) for the most of the bearing.

$W = X.V.W_R + Y.W_A = 1 \times 1 \times 2500 + 0 \times 1500 = 2500N$

$W = 2500 N$

we find the for light shock.

$W = 2500 \times 1.5 = 3750 N$

for a single row angular contact ball bearing number 310.

$C = 53 kN = 53000 N$

We know that rating life of the bearing in revolution

$L = \left(\frac{C}{W}\right)^K \times 10^6 = \left(\frac{53000}{3750}\right)^3 \times 10^6$

$L = 2823 \times 10^6 rev$ Ans

$\because K = 3$