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Chapter-10
Selection of Bearing
Bearing Calculation-

Question-1 A radial ball bearing has a basic load rating of 50kN. If the desired rating life of the bearing is 6000 hours, what equivalent radial load can be bearing carry at 500 rpm.

Given- $C = 50\,kN$, $L = 6000\,Hrs.$, $n = 500\,rpm$

From page No.- 1144 using equation (16.10) -

$$L = \left(\frac{C}{P_c}\right)^3 \text{ million revolutions.}$$

$$\boxed{L = \frac{10^6}{60n}\left(\frac{C}{P_c}\right)^3}$$

$$\left(\frac{C}{P_c}\right)^3 = \frac{6000 \times 60 \times 500}{10^6} = 180$$

$$P_c = \frac{C}{(180)^{1/3}} = \frac{50}{5.65} = 8.85\,kN$$

$$\boxed{P_c = 8.85\,kN}$$

Question-2 A radial Ball Bearing, the desired rated life is 10000 hrs for a speed of 600 rpm and radial load of 5kN. Find the basic load rating for the bearing.

From page No.- 1144 using equation- (16.10)

$$\boxed{L = \frac{10^6}{60n}\left(\frac{C}{P_c}\right)^3}$$

Given- $n = 600\,rpm$, $L = 10,000\,Hours$, $P = 5\,kN$

$$\left(\frac{C}{P_c}\right)^3 = \frac{10000 \times 60 \times 600}{10^6}$$

$$\left(\frac{C}{P_c}\right)^3 = 360$$

$$C = P_c \cdot (360)^{1/3} = 5 \times 7.12 = 35.60\,kN$$

$$\boxed{C = 35.60\,kN}$$

Q.3 Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load.

Solution:- Given $F_R = 4000$ N, $F_a = 5000$ N, $N = 1600$ rpm

Average Life $= 5 \times 300 \times 10 = 15000$ Hours.

(Assuming 300 working days ~~per year~~)

Life of the bearing in revolution

$L = 60 N \times L_H = 60 \times 1600 \times 5000 = 1440 \times 10^6$ rev

Dynamic equivalent radial load

$P_e = S(XVF_R + YF_a)$ From 16.9 page 144

$S = 1.0$ constant or steady from table no. 16.4 page 145.

$P_e = XVF_R + YF_a$

$= 0.56 \times 1 \times 4000 + 1 \times 5000$

$= 7240$ N

$C = W\left(\frac{L}{10^6}\right)^{1/k}$

$= 7240\left(\frac{1440 \times 10^6}{10^6}\right)^{1/3}$

$C = 81760$ N

$\boxed{C = 81.76 \text{ kN}}$

Convert this N into kg and than from table 16.5 page 146 ~~table~~ column 6 Dynamic C table select the bearing no. from Column 1

Question4 A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500N and an axial or thrust load of 1500N. Assuming light shock load, determine the rating life of the bearing.

Solution. Given $F_r = 2500N$. $F_a = 1500N$

$X = 1$ and $Y = 0$

$P_e = S(XVF_r + YF_a)$

$S = 1$ from table 16.4 page 145.

$P_e = 1 \times 1 \times 2500 + 0 \times 1500$ [From 16.3 page 145]

$= 2500N$.

$W = 2500 \times 1.5 = 3750N$

$C = 53kN = 53000N$

$L = \left(\frac{C}{W}\right)^k \times 10^6$

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

$= 2823 \times 10^6$ rev.

Question-5 Design a self aligning ball bearing for a radial load of 7000N and a thrust load of 2100N. The desired life of the bearing is 160 millions of revolutions at 300rpm. Assume uniform and steady load.

Solution- $F_r = 7000N$. $F_a = 2100N$, $L = 160 \times 10^6$ rev.

$N = 300rpm$

taking $X = 0.65$ and $Y = 3.5$ [From 16.3 page 145 or related table as in book]

$W = XVF_r + YF_a$

$= 0.65 \times 1 \times 7000 + 3.5 \times 2100$

$= 11900N$.

$C = W\left(L/10^6\right)^{1/k} = 11900\left(\frac{160 \times 10^6}{106}\right)^{1/3} = 64600N$

$C = 64.6kN$

Select the bearing from table.