Bearing Life Optimization of Taper Roller Bearing

Prachi Prajapati[1] Digvijay Jadeja[2]
[1]P.G.student [2]Assistant Professor
[1,2]Kalol institute of technology & research centre

Abstract— The life of the Taper Roller Bearing is most important factor with the optimum dimension, life and the geometry both of these are important to stay in the market. These parameters are determined the cost and quality of the bearing. To increase the life of bearings, the dimension of the bearing should be optimum to get the reliability and function of the bearing. In this project the geometry of the bearing component is trying to optimize with the desired life. By optimize the dimension of the Pocket corner radious of bearing component, the total mass of the bearing component. By reducing the weight of the bearing component ultimately total efficiency as well as total cost of the bearing is also reduced. The mass of bearing is reduced by changing the geometry of the dimension of the bearing component. The optimization has been carried out by keeping the results of the existing bearing constant.

Key words: Gear box, tapered roller bearing design, ANSIS Analysis, life Optimization

I. INTRODUCTION

Bearing is a device which locates two machine components relative to each other and permits relative motion between them. A bearing is a machine element which supports another moving machine element (known as journal). It permits a relative motion between the contact surfaces of the members, while carrying the load.

Tapered roller bearings provide several important and unique performance characteristics to meet a wide range of application requirements. Tapered roller bearings have a spherical surface ground on the large ends of the rollers. The radius of this surface is slightly less than the apex length (distance from the roller large end to the apex). The roller large end makes point contact with the cone large rib when under light load. Under heavier load, this contact area becomes elliptical. The roller rib interface geometry promotes hydrodynamic lubrication in the contact area. The seating force of the roller against the rib is normally small and therefore contact stresses are relatively low. This is true whether pure radial load or pure thrust load is involved.

II. PROBLEM DEFINITION

During the industrial visit of "Vijay Enterprise" located at Bapunagar Ahmadabad.

They used the Spur Gear Box as a speed reducer. They frequently face the problem of bearing used in this gear box during the application of the Spur Gear Box. The bearing is used in the pinion shaft of the spur gear box. The driver shaft rotates at the 1050 RPM.

The application for the system arrangement is as under. The two ends of the shafts are carrying the load equal to the load generated during the running the system

III. MODEL OF TAPER ROLLER BEARING

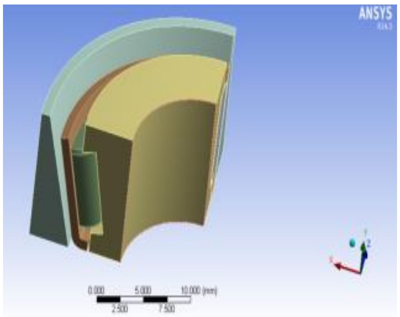


Fig. 1: Model of Taper roller Bearing

IV. MESHING OF TAPER ROLLER BEARING

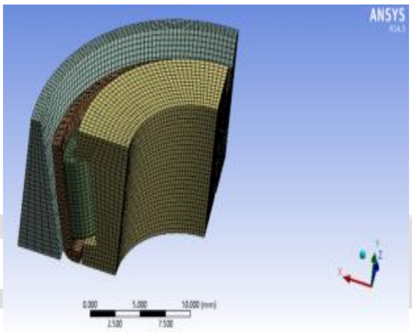
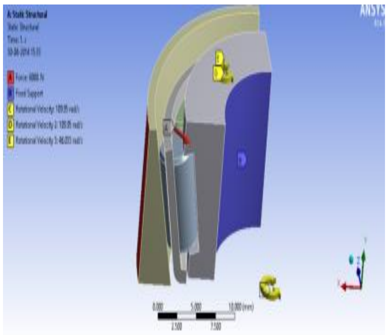
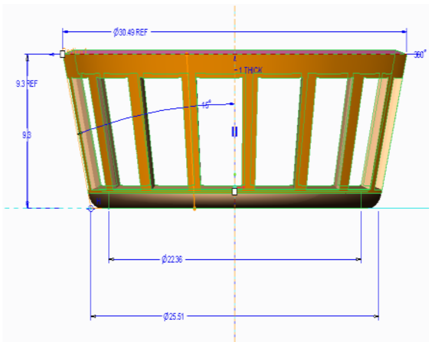


Fig. 2: Meshing of Taper roller Bearing

V. BOUNDARY CONDITION



VI. CAGE MODEL WITH THE POCKET CORNER RADIUS



VII. ANALYSIS OF BEARING WITH 1.00MM THICK BEARING CAGE WITH 0.10MM CORNER RADIUS

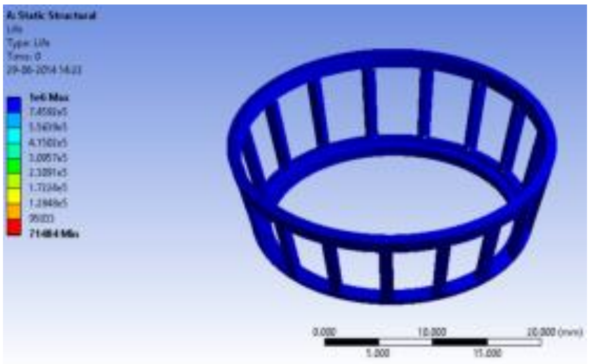


Fig. 5: Von-misses stress generated on the bearing

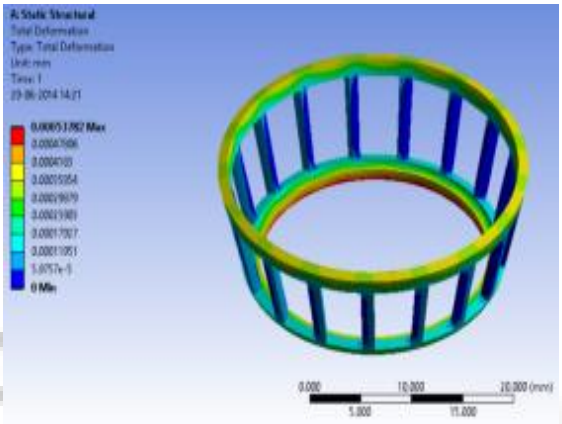


Fig. 6: Total deformation generated on the bearing

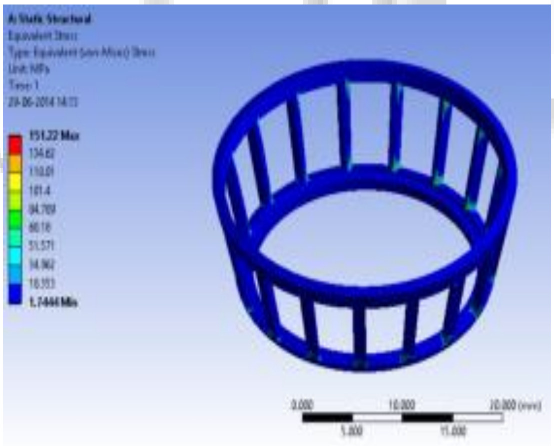


Fig. 7: Life estimated for the cage

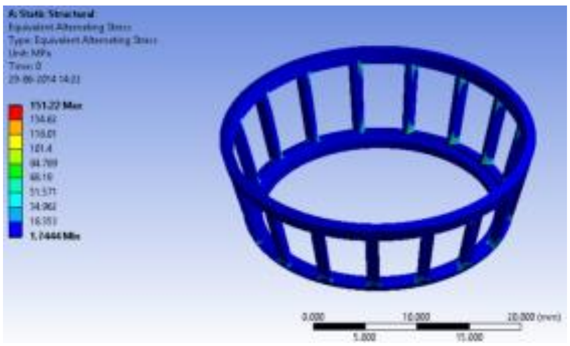


Fig. 8: Equivalent alternating stress generated on the cage

VIII. ANALYSIS OF BEARING WITH 1.00MM THICK BEARING CAGE WITH 0.15MM CORNER RADIUS

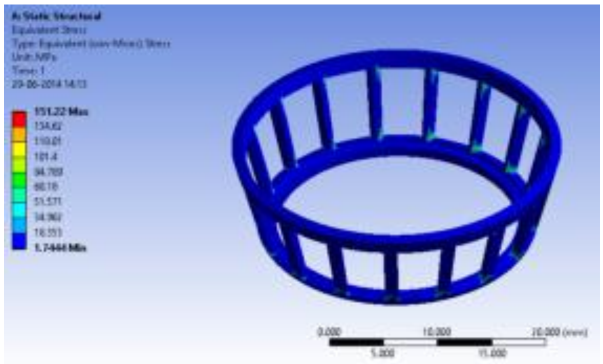


Fig. 9: Von-misses stress generated on the bearing

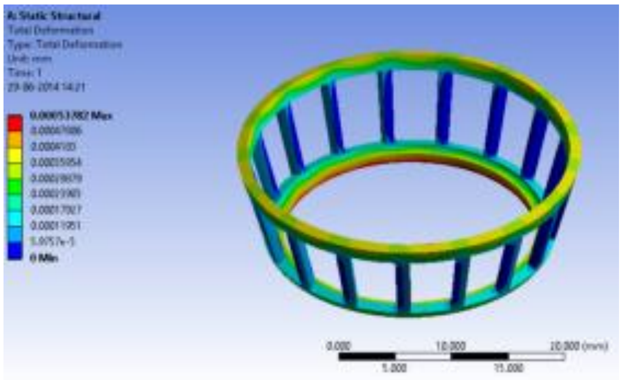


Fig. 10: Total deformation generated on the bearing

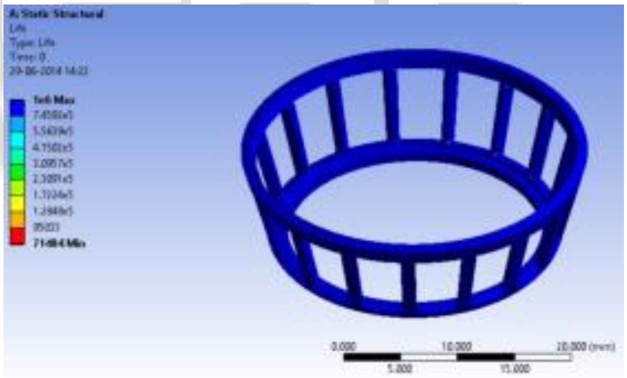


Fig. 11: Life estimated for the cage

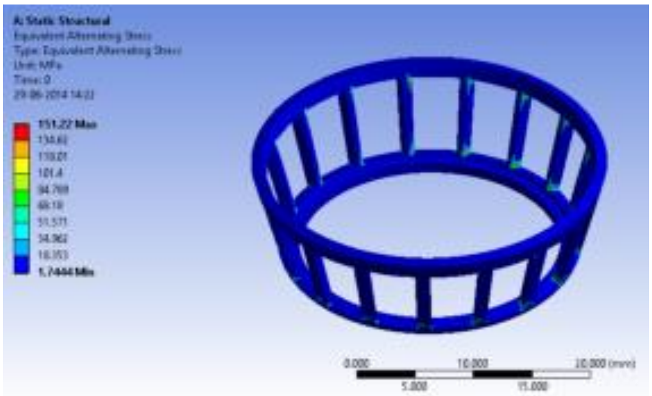


Fig. 12: Equivalent alternating stress generated on the cage

IX. Analysis Of Bearing With 1.00mm Thick Bearing Cage With 0.20mm Corner Radious.

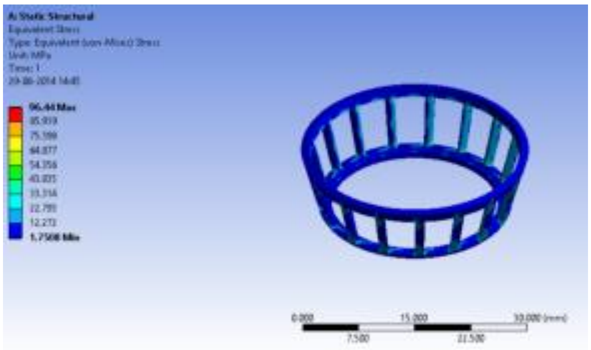


Fig. 13: Von-misses stress generated on the bearing

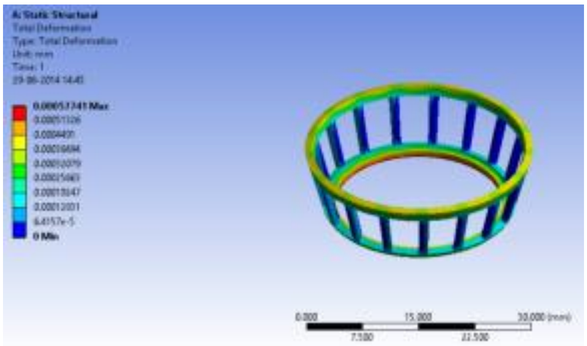


Fig. 14: Total deformation generated on the bearing

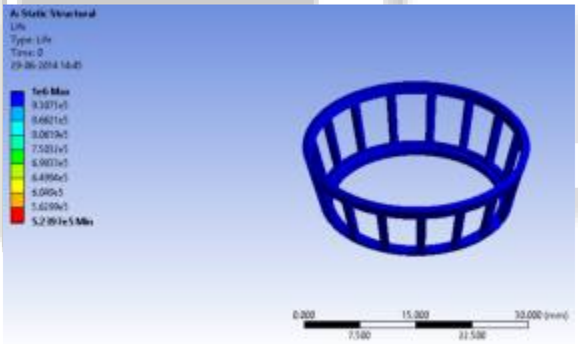


Fig. 15: Life estimated for the cage

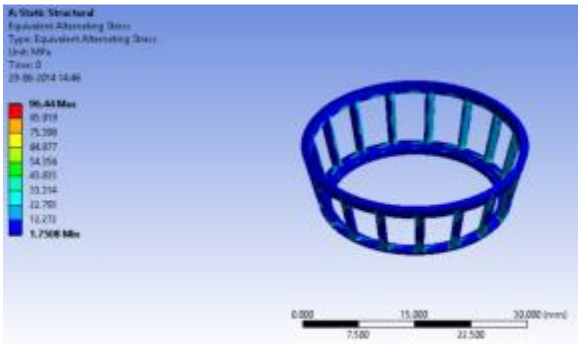


Fig. 16: Equivalent alternating stress generated on the cage

X. Result & Discussion

Initially the stress generated in the cage has been reduced by changing the corner radius of the pocket and the result of the cage are as under.

Sr. No.	Corner Radius (mm)	Von-misses stress cage (N/mm2)	Deformation cage (mm)	Life (Cycle)
1	0.05	175.61	0.0017596	41306
2	0.10	151.22	0.00053782	71484
3	0.15	110.30	0.00056197	2.418×10^5
4	0.20	96.44	0.00054417	5.2397×10^5

As shown in the above table, the cage pocket corner radius of the cage as increasing from the 0.05mm up to the 0.20mm. As the radius of the cage increasing the stress value is reduces from 175.61 N/mm2 to the 96.44 N/mm2 and life increasing from 41306 cycles to the 5.2397 x 10^5 cycles.

Reference

Paper:

[1] Zhang Yongqi, Tan Qingchang, Zhang Kuo1,Li Jiangang, " Analysis of Stress and Strain of the Rolling Bearing by FEA method", 2012 international conference on applied physics and industrial engineering. Physics procedia 24(2012) Page: 19-24.

[2] K. Gurumoorthy, Arindam Ghosh, "Failure investigation of a taper roller bearing: A case study", 1(2013) page: 110-114.

[3] Catalin C. Danaila, Cristina A. Bozan, " Machinery data input optimization in bearings rating life", TMT ,Mediterranean cruise, (2010) Page: 11-18.

[4] Rodríguez R a, Calvo S, Nadal I and Santo Domingo S," Influence of geometric imperfections on tapered roller bearings life and performance" R&D Department, FERSA Bearings S.A, 18 Bari, 50197 Zaragoza, Spain.

[5] Kazuyoshi Harada, Tomoya Sakaguchi," Dynamic Analysis of a High-Load Capacity Tapered Roller Bearing, NTN BEARINGS TECHNICAL REVIEW No.73.

[6] Daisuke Yonekura, Richard J. Chittenden, "Wear mechanisms of steel roller bearing protected by thin, hard and low friction coatings" wear 259 (2005)

Books:

[1] Tapered roller bearing design Catalogue – TIMKEN, Page No. 16 and 17.

[2] Bearing Life Calculation/Selection – TIMKEN, Page No. 3 and 4.

[3] Shigley, Mechanical Component Design, Chapter : Mechanical Component Design

[4] Machine design By R.S.Khurmi, & V.B.Bhandary. Page: 779-788.