Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

A Comparative Analysis of Thermal Strain on SKF 6001ball Bearing of Stainless Steel &Ceramic Material

Murari Krishnapathak[1], Sheikh Irfan[2], Ankit Phanse[3]
[1]*Research Scholar, Sushila Devi Bansal college of Technology, Indore, M.P.*
[2]*Faculty of Mechanical Engineering Deptt, S.D.B.C.T, Indore, M.P.*
[3] *Faculty of Mechanical Engineering Deptt, S.D.B.C.T, Indore, M.P.*

Abstract: Ball bearings are subjected to variable loads at higher & lower temperature. it is necessary to predict the behavior of bearing under different operational parameters. the different loads on elevated temperature are applied on ball bearing in a simulated atmosphere by using fea package ansys & physical parameters like thermal strain,stress,deformation& heat flux are find out for different material and compared .
keywords-: thermal strain, heat flux, deformation, stress, ansys.

I. INTRODUCTION

Bearings are highly engineered, precision-made components that enable machinery to move at extremely high speeds and carry remarkable loads with ease and efficiency. Bearings must be able to offer high precision, reliability and durability, as well as the ability to rotate at high speeds with minimal noise and vibration. Bearings are found in applications ranging from automobiles, airplanes, computers, construction equipment, machine tools, DVD players, refrigerators and ceiling fans. If something twists, turns or moves, it probably has a bearing in it. In this paper (1) author concluded that using unique tapered roller bearing that boasts greater rigidity for machine tool main spindles, the authors have invented a novel bearing construction and a novel air-oil lubrication mechanism to address the issue of unsatisfactory high-speed performance, which is a drawback of conventional tapered roller bearings. This research (2) is aimed to develop the analytical fundamentals details of new model which is dedicated to the dynamic behavior of rotating ball bearings. Theoretical research will be detailed enough to provide a simple model that lends easily to programming, but powerful enough to incorporate the effect of a maximum of influential parameters on the vibration of bearings. These white paper (3) Machine Tool Precision bearings are very accurately engineered components and as such are very important to the successful performance of the machine tool. The way in which a bearing is handled and fitted to a machine tool does not only determine if the machine operates accurately but can also affect the life of the bearing in the spindle.

II. METHODOLOGY

The methodology followed for the analysis is given below in flowchart tagged as figure no 1.First of all 3D Modeling carried out by using modeling software. The steady state thermal analysis is carried out by using ansys 14.0.

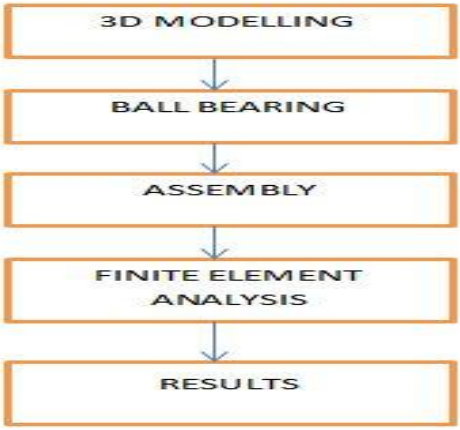

Figure 1

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

A. Factors included in this research paper are

1) By considering temperatures variations

2) By considering frictional torque

3) By considering overall torque.

Assumptions considered in this research work Material is considered as homogeneous. Clearances and tolerances are neglected. Frictional torque is considered constant. Temperature changes with time is neglected

B. Dimensions

The dimensions are taken from the SKF 6001 ball bearing manual and guide. (4)

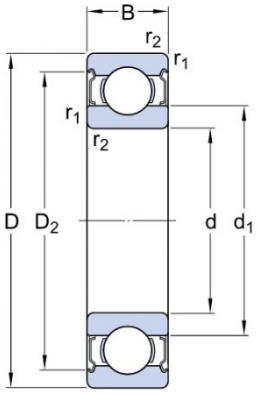

Figure 2:Dimensions of SKF 6001

The dimensions are given below shows the dimensions of SKF 6001 ball bearings. All dimensions are in centimeter

Table 1

Outer Diameter D	32
Inner Diameter d	15
B Width	9
d(1)	20.5
D2	28.2

III. 3D MODELING

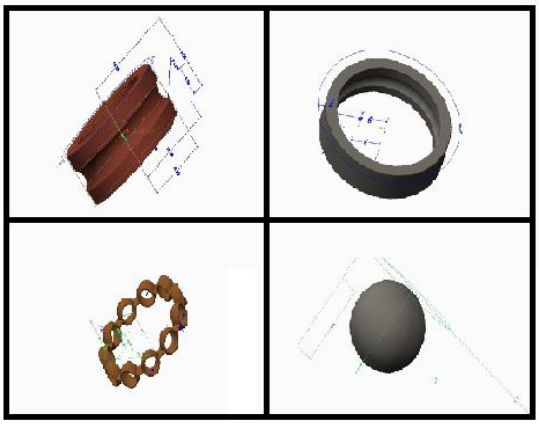

Figure 3:3D model of outer,inner,ball & cage

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

The 3d model is made by using modeling software creo 2.0 and finally assembles in such way that the outer race and ball are rotating with respact to the inner race.

Figure 4:Assemblage of SKF 6001 ball bearings.

A. FEA of SKF 6001 ball bearings

Meshing of the 3D model is done by using ansys .The meshing element “Triangular 3 nodded” is used for meshing with the coarse mesh by taking element size of10mm.The meshed element is shown in fig no 5.

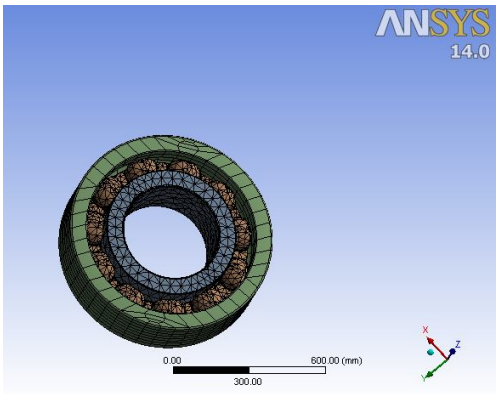

Figure 5:Meshed Model of Ball Bearing

The thermal strain ,heat flux, total deformation and deformation are find out by **ansys** are given below in figures in 6,7,and 8.It is not possible to conduct the practical on experimental set up so it is find out in simulated environment of ANSYS 14.0.

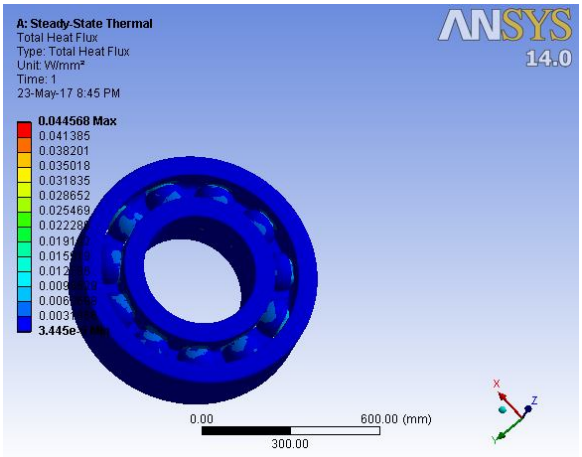

Figure 6:Heat Flux generated in ball bearing

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

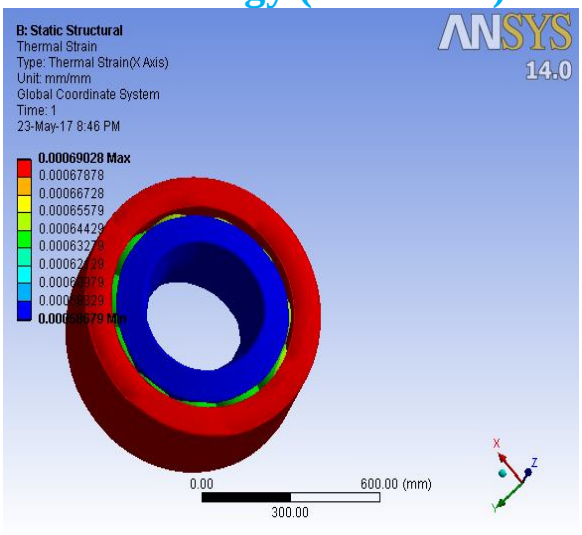

Figure 7:Thermal strain in SKF ball bearing 6001

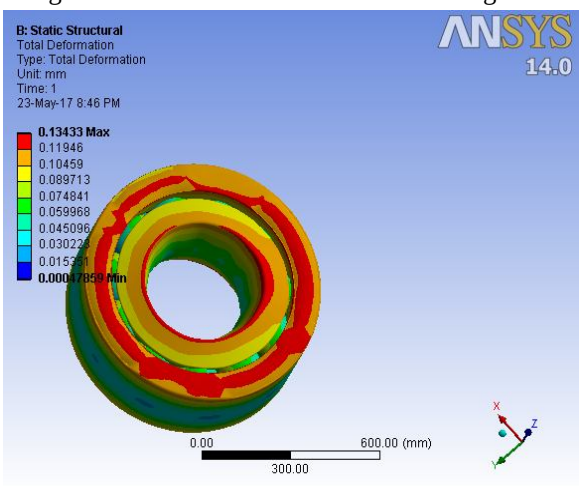

Figure 8:Total deformation in ball bearing at elevated temperature.

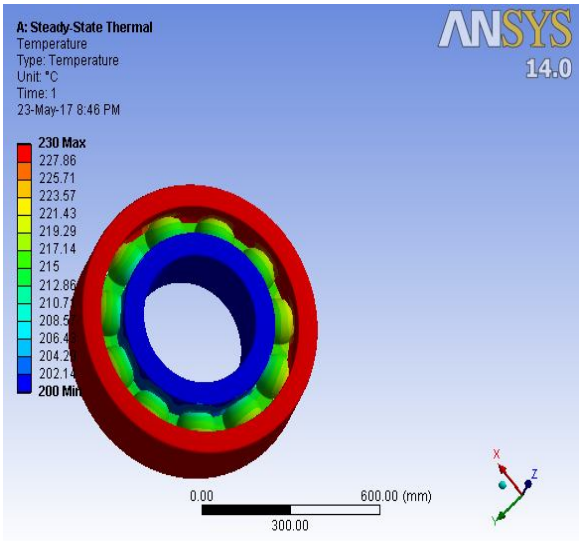

Figure 9:Tempreture range between 230 to 200 degrees centigrade.

Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

IV. RESULTS

The figure 10 shows the comparison of thermal strain of ball bearing made up stainless steel and ceramic material. The thermal strain is find out considering the overall torque and frictional torque .The figure 10 is the comparison thermal strain of stainless steel and ceramic material under the frictional torque.

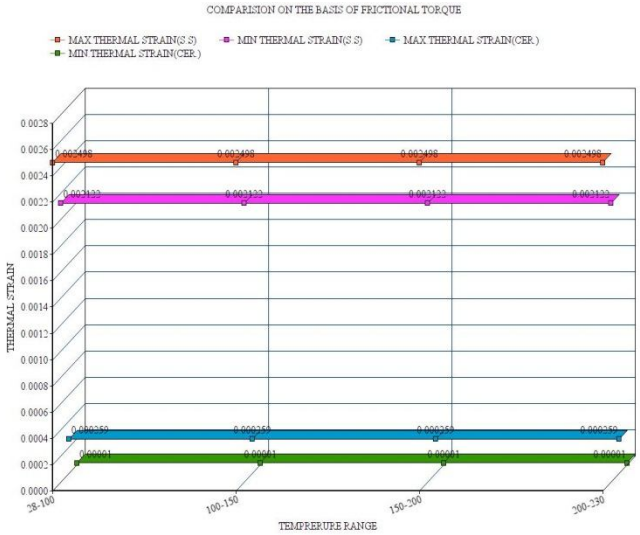

Figure 10:Comparision of Thermal strain of stainless and ceramic material.

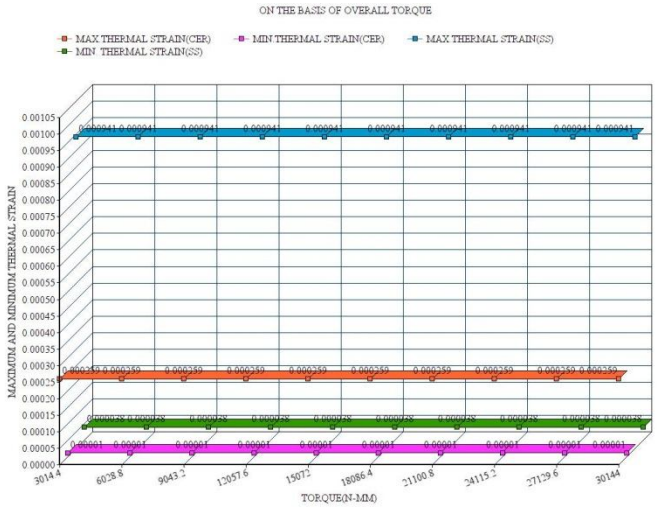

Figure 11:Comparision of thermal strain by considering overall torque.

V. CONCLUSION

The thermal strain, at fixed frictional torque, in ceramic material is much lower then stainless steelat all temperature range.so it can be replace by ball bearing of ceramic material silicon nitried. The thermal strain, at overall torque, in ceramic material is much lower than stainless steel at all temperature range.so it can be replace by ball bearing of ceramic material silicon nitride.

REFERENCES

[1] Michael M. Khonsari, E. Richard Booser, “Applied Tribology Bearing Design and Lubrication”, John Wiley and Sons Ltd , England 2008.
[2] Pandiyarajan. R, Starvin.M.S, Ganesh.K.C, “Contact Stress Distribution of Large Diameter Ball Bearing Using Hertzian Elliptical Contact Theory” Procedia Engineering 38 (2012) 264-269.
[3] Prabhat Singh, Prof. Upendra Kumar Joshi, “Fatigue Life Analysis of Thrust Ball Bearing Using Ansys”, International Journal of Engineering Sciences and Research Technology, 2277-9655 January 2014.
[4] TEDRIC A. HARRIS, “Rolling Bearing Analysis”, 4th edition , John Wiley and Sons Inc., New York, 2001. Bernard J. Hamrock, William J. Anderson,

Volume 5 Issue VI, June 2017
ISSN: 2321-9653

"Rolling Element Bearings", Lewis Research Centre, NSA Reference Publication, June 1983
[5] Avraham Harnoy, "Bearing Design in Machinery", 2003 by Marcel Dekker, Inc
[6] DYNAROLL Corporation, 12840 Bradley Avenue Sylmar, CA 91342
[7] Yongming Liu, Brant Stratman, and Sankaran Mahadevan, "Fatigue crack initiation life prediction of railroad wheels", International Journal of Fatigue 28, 2006, p 747-756.
[8] Tatjana Lazovic, Mileta Ristivojevic, Radivoje Mitrovic, "Mathematical Model of Load Distribution in Rolling Bearing". FME Transactions (2008) 36, 189-196
[9] V B Bhandari, "Design of Machine Elements", 2nd edition Tata McGraw Hill Publication, chapter 1
[10] ANSY
[11] Creo
[12] High-Speed Tapered Roller Bearing for Machine Tool Main Spindles, TN Paper review 2014