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PERFORMANCE ANALYSIS OF THE BUSH BEARING USING FEM & REGRESSION ANALYSIS

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ABSTRACT

It is considered that one of the main culprit of the one third part of the energy resources of the world is Friction, and the vast majority of these type of losses are regarded as waste. Around 70 percent of mechanical component failures, for this tribology is responsible. This highlights the significance of tribological research in industrial environments, which finally leads to more profit generation by reduction of cost. As above mention the large amount of energy is lost in the form of friction thus it is highly recommended and essential to install bush bearings in rotating equipment such as generators, rolling mills, turbines, blowers, and other similar machinery in order to fulfill the role of bearings in these machines. Very large number of machines with vast majority are dependent on bush bearings, this are one of the very important part and make significant demands on load capacity as well as the dependability of the mechanical machine, therefore, bush bearing's operational capabilities are constantly being assessed for the purpose of further research & future development. The use of bush bearings may be traced back for a substantial amount of time and is used in an extraordinarily wide variety of different contexts today.

The mechanical system will make use of more than one bush bearings if it is consist of rotor and stator, which requires either low-friction torque or high-speed rotation, or requires either of these conditions. In addition, bearings enable a precise positioning of the axis of rotation and have the capacity to sustain very high loads. This research aims to investigate the impact that a bush-bearing surface has on a bearing's ability to operate well when subjected to dynamic load by using CATIA 5.1, ANSYS 2021R1, and MINITAB 19. Both a finite element and a regression analysis were carried out in this manner. MINITAB was utilized to construct a regression model for the purpose of forecasting the performance, and the findings of ANSYS were used as input into MINITAB. Both a finite element and a regression analysis were carried out in this manner. MINITAB was utilized to construct a regression model for the purpose of forecasting the performance, and the findings of ANSYS were used as input into MINITAB. It was discovered that the simulation of the complete Bush Bearing process takes too much time to be analyzed useful in the engineering work that is done on a daily basis. It is possible to successfully estimate Total Deformation, Equivalent Stress, Equivalent Elastic Strain, Directional Deformation, Force Reaction, and Pressure with simplified models.

Keywords: Bush Bearing; Simulation; Finite Element Analysis; CATIA; ANSYS; Regression Analysis; MINITAB.

I. INTRODUCTION

In the automotive industry, bush bearings which are also referred to as simple bearings, are commonly utilized, as they do not impede the free movement of the parts they support. The sleeve that guides the shaft is one of component that make up a bush bearing. The bush itself is the part of the bearing that is responsible for transmitting motion. Both the bush and bearing are made up of particular metal that has superior mechanical and thermal qualities. In order to send the transmission in a manner that is both efficient and effective, the friction that exists between two elements needs to be reduced. There is a very thin coating of lubricant that is placed between the two metal surfaces so that there is no direct contact and very less friction. When two metals come into direct touch with one another, it can cause the shaft or the sleeve to become damaged, which ultimately leads to the failure of the mechanism. There are two different kinds of loads that can be applied to the bush bearing. The purpose of project is to determine the amount of pressure present inside the bearing. This is true, that regardless of the type of application that uses a bush bearing. When there is no load on the bearing and sufficient lubricant is being supplied to it, the Bush shaft or sleeve will rotate concentrically within the bearing. A wedge-shaped oil film is formed when a load is applied, which causes the bush or sleeve to move into an eccentric position. This is the location where the load supporting pressure is generated. It is anticipated that the clearance will be on the order of one thousandth of the diameter of Bush.

II. LITERATURE REVIEW

In 2009, in the course of working on his project, Carl R. Wassgren did a study on the instability of roller bearings. A model with six degrees of freedom was constructed with the intention of mimicking the movement of each and every component that is contained within a cylindrical roller bearing. The instability of the cage was assessed with respect to the performance of roller racing wheels and roller cage wheels in conditions of low load and high speed. An inquiry was carried out with the purpose of determining the impact that factors such as varied size on one of the rolls, misalignment, asymmetry of cages, and variable speed on the internal rotation had. Jing Liu (2015) introduced a brand-new model that demonstrated the relationship between the vibration characteristics that are brought on by the stiffness of the contact between the deep grove ball bearing and the size of the defect as it grew over the course of its lifetime. This model was used to demonstrate the relationship between the vibration characteristics that are brought on by the stiffness of the contact between the deep grove ball bearing and the size of the defect. In this article, the vibrational characteristics of a deep groove ball bearing are broken down in greater detail.

An essay written by Ankur Ashtekar (2012) with the title "A Novel Approach to Taking Into Consideration the Flexibility of Cages in Dynamic Bearing Models" was presented at the conference. It was about developing a novel method for dynamic bearing models to take into account the degree to which cages are flexible. The invention of a novel approach was the primary focus of this work. In order to investigate the motions of bearing cages, Lars Holland (2016) conducted research on a number of methods for the acquisition of photographs and the processing of images. This article presents an analysis of the movement of ball bearings in relation to the stable and unstable behavior of the movement in the cage. The analysis is broken down into three parts. This kind of research is often carried out by means of simulation, and it typically entails looking at the swirl of a cage in order to gather data. A variety of distinct studies are currently being carried out, each of which involves the cage being modified in some way in order to monitor its motion by utilizing various sensors. This makes it possible to study the movement of the angular contact ball bearing while it is operating normally in its natural surroundings.

In the publication, Tomoya Sakaguchi's (2006) article, which was devoted to the dynamic study of cage behavior in a conical roller bearing was examined. Sakaguchi's presentation was included in the publication. The three-dimensional dynamic simulation study that was crafted with the use of commercial software takes up the bulk of this piece of writing as its principal focus. Six degrees of freedom were utilized in order to conduct an analysis of the dynamic movement of both the cage and the rollers. JV Popawski presented a document in 2015 concerning sliding forces and a cage in a high-speed roller bearing. The purpose of this article is to present a model for roller bearings that takes into account the effect of total film lubrication on race contacts. This model is used to estimate the slip of the cage, roll slip, the thickness of the film, and cage forces for a given bearing geometry and set of operating conditions. This model takes into account a number of factors, including the loss of whipping, friction on the surface of the cage pilot, friction in the roller recess, cage unbalance, and resistance induced by unloaded rolling parts.

III. ANALYSIS IN ANSYS

After the design of a bush bearing has been done, but before the actual manufacture of the bodies, it is essential to understand the typical behavior of the component parts when they are subjected to simulated operating conditions. This knowledge is required before the bodies can be manufactured. An investigation that makes use of static finite elements has the potential to identify possible design flaws, such as stress concentrations, validate the component stiffness, and provide information that will assist in the validation of calibration results. These objectives can be accomplished through the gathering of the aforementioned information. We can create predictions about the performance by carefully picking the appropriate boundary conditions and then determining whether or not those projections fit within the acceptable range for the hardware that is now available. Within the scope of this article, we will talk about the dynamic finite element analyses that were

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performed using ANSYS 2021 R1. After doing an analysis of the convergence of the mesh in an effort to obtain the most accurate results possible, we discuss the findings.

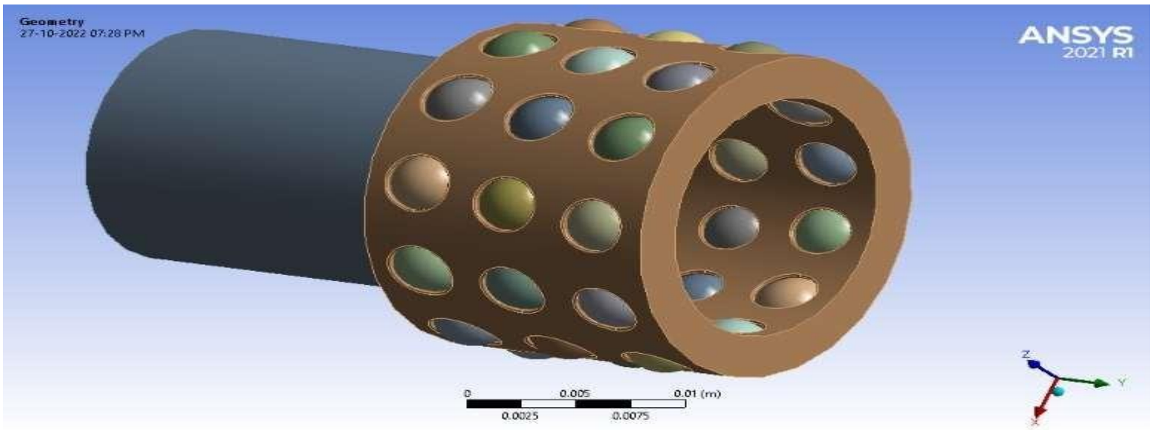

Fig.1 Bush Bearing model generated in the CATIA software

IV. MESH GENERATION

In order to produce the mesh for the finite elements, parabolic tetrahedral elements are used. The von Misses stress is examined to see whether or not it converges. In this study, the mesh that is being used is generated through the use of an automatic approach.

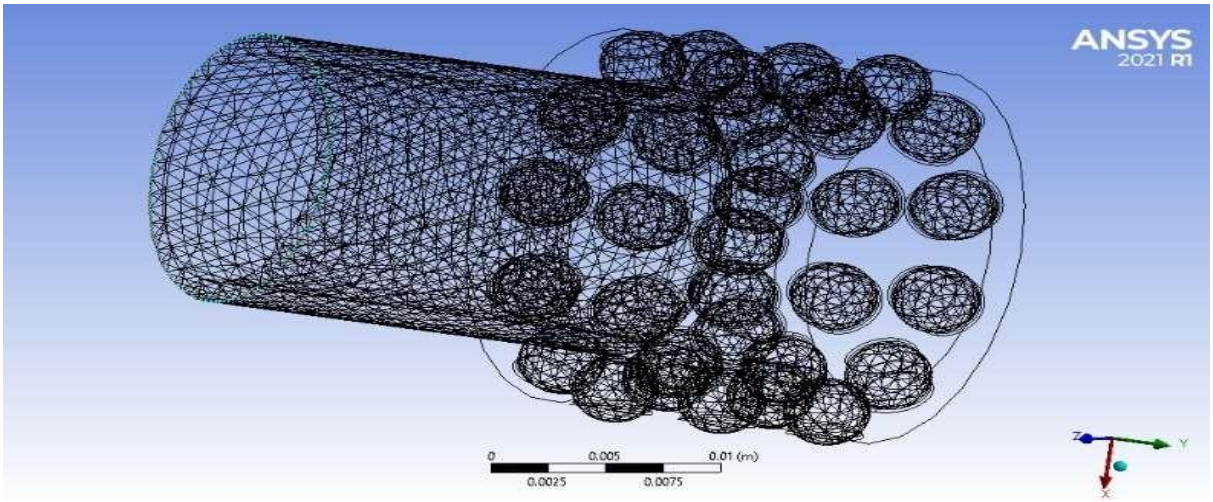

Fig.2 After modelling in CATIA software, triangular type of meshing for Bush Bearing is done in ANSYS software

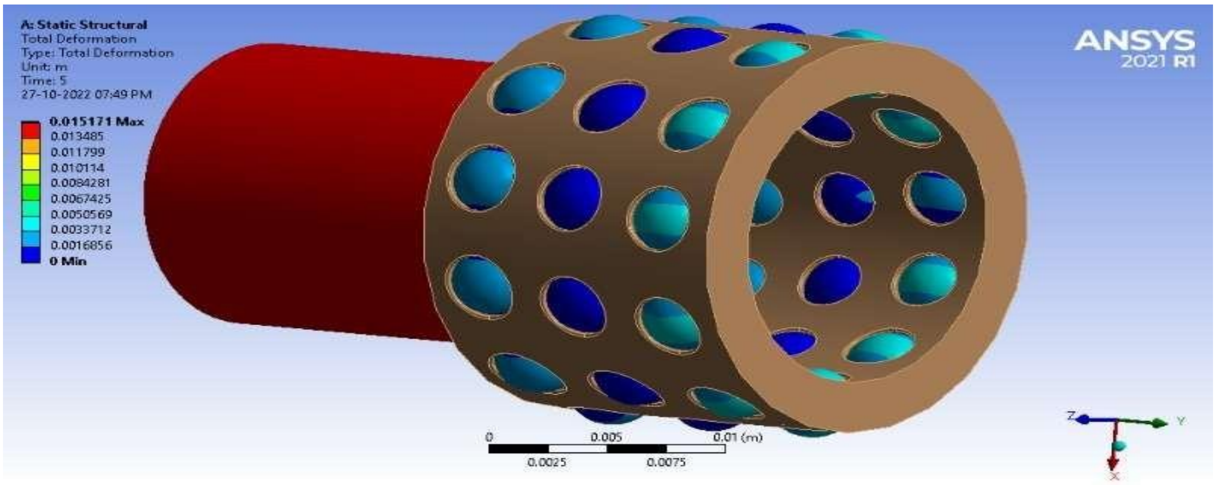

Fig.3. After Explicit Dynamic Performance Analysis in ANSYS Software, Total Deformation generated in the rollers of a Bush Bearing

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V. RESULT

Following are the value of some of the important mechanical properties, which are the findings of Finite element analysis is being carried out on bush bearing's CAD model.

1. Equivalent Stress maximum generated in Bush Bearing is 7.0733 × 10+8 Pa.
2. Equivalent Stress maximum generated in Bush Bearing Surface is 9.2288 ×108 Pa.
3. Equivalent Elastic Strain maximum generated in Bush Bearing is 5.0587 × 10-3 m/m.
4. Directional Deformation maximum generated in Bush Bearing is 1.517 × 10-2 m.
5. Directional Deformation maximum generated in the Rollers of the Bush Bearing is 3.7502 × 10-3 m.

Total Pressure maximum generated in Bush Bearing is 2.6265 ×109 Pa

VI. CONCLUSION

In this study, Bush Bearing has been analyzed by the Finite Element Method. A simplified and idealized finite element model by using symmetry assumption and a non-simplified finite element model of the process have been used in the analyses. Bush Bearing has been examined. The Total Deformation, Equivalent Stress, Equivalent Elastic Strain, Directional Deformation, Force Reaction, and Pressure exerted by the Bush Bearing during one complete revolution have been identified.

VII. REFERENCES

[1] Carl R. Wassgren & Farshid Sadeghi, "Cage Instabilities in Cylindrical Roller Bearings." ASME J. Tribol., Vol. 126, Oct-2009.

[2] Lars Holland, Eberhard Abele, Alexander Nehrbrass, "Image Acquisition and Image Processing Algorithms for movement Analysis of Bearing Cages." ASME J. Tribol., Vol.138, April-2016.

[3] Ankur Ashtekar, Farshid Sadeghi, "A New Approach for including Cage flexibility in Dynamic Bearing Models by using combined Explicit finite and Discrete Element Method." ASME J. Tribol., Vol. 134, Oct-2012.

[4] Jing Liu, Yimin Shao, W. D. Zhu, A New Model for the Relationship between Vibration Characteristics Caused by the Time-Varying Contact Stiffness of a Deep Groove Ball Bearing and Defect Sizes, ASME J. Tribol., Vol. 137, July-2015.

[5] Tomoya Sakaguchi, Kazuyoshi Harada, "Dynamic Analysis of Cage Stress in Tapered Roller Bearings using Component node Synthesis Method." ASME J. Tribol., Vol. 131, January-2009.

[6] J. V. Poplawski, "Slip and Cage forces in a high speed Roller Bearing." Journal of Lubrication Technology. ASME, April-1972, pp. 143-150.

[7] Kärkkäinen, A., Sopanen, J. & Mikkola, A. Dynamic simulation of a flexible rotor during drop on retainer bearings. Journal of Sound and Vibration, 2007. Vol. 306:3-5. pp. 601-617.

[8] Halminen, O., Kärkkäinen, A., Sopanen, J. & Mikkola, A. Active magnetic bearing-supported rotor with misaligned cageless backup bearings: A dropdown event simulation model. Mechanical Systems and Signal Processing, 2015. Vol. 50-51. pp. 692-705.