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Stress Analysis of Bearing Housing Components of Boogies & Review on Bearings

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***Abstract**: This paper reviews a detailed study of bearings and its housing, a comprehensive stress analysis was carried out on bearing housing components in order to identify the stress concentration of the bearing housing with the aim of improving bearing life. Solid work software was employed to identify the causes of constant wear and bearing failures. The factors considered for the stress analysis of components of the boogies are 5000kg load, 250^{o} C sterilizing temperature and a pressure of 3 bar. The results of this review indicated that the frequent failure of the worn bearing housing components was however, as a result of the applied pressure that exceeded the yield strength. It was recommended that production of nano lubricants or incorporation of nano composite coatings could help increase bearing life and its housing.*

Keywords: Bearing Housing, Bearing, Stress, Plain Carbon Steel, Deformation, Loads, Fatigue, High Loads, temperature, Pressure, Plain carbon steel, Machineries, Boogies

INTRODUCTION

The role of bearings in terms of motion transmission in machineries can't be over emphasized; this bearings are used to reduce frictional force for machineries. The type of material used to produce bearings Babbitt metal, steel, cast iron, and bronze however, all bearing lubrication should be done constantly due to the fact that the bearing surface and the shaft journal ought to be protected from having a direct contact with each other while the shaft is rotating.

It is pertinent to note that the bearings are enclosed in the bearing housing component and also linked to a turning axle or shaft component for maximum delivery of motion. Ball, journal and roller bearing are more simple components with complex inner functions. Also, working condition of heavy loads, high speed, and temperature can negatively damage bearing life and bearing housing. Defects during bearing production, improper design, misalignment can cause excessive deflection, high frictional torque, and adhesive wear. The temperature of bearing housing have many significant parameters, such as the viscosity of the lubricant, load-carrying capacity and distribution as well as power loss. Gear and shaft vibrations produce bearing reaction forces which bears the responsibility for transferring displacement excitations of meshing gears to the housing. Knowing these forces of reaction will pave way for better handling and enhancement of bearing life and bearing housing. Bearing failures and its housing increases maintenance cost.

OBJECTIVES

(i) To improve bearing handling and bearing life
(ii) To determine the causes of worn bearing housing components and breakdown
(iii) To improve corrosion and wear resistance

MATERIALS AND METHODS

A plain carbon steel specimen with dimension 90x70 mm of boogies was used for the study. Solid works simulation was employed to conduct the stress analysis taking into account of factors such as loads 5000kg, Sterilizing Temperature 250^{o} C and pressure of 3 bar which are the factors encountered while transferring products to the sterilizer.

The worn bearing housing component and stress analysis are presented in Plates (1a),(1b),(1c).(1d),(1e) and (1f) respectively.

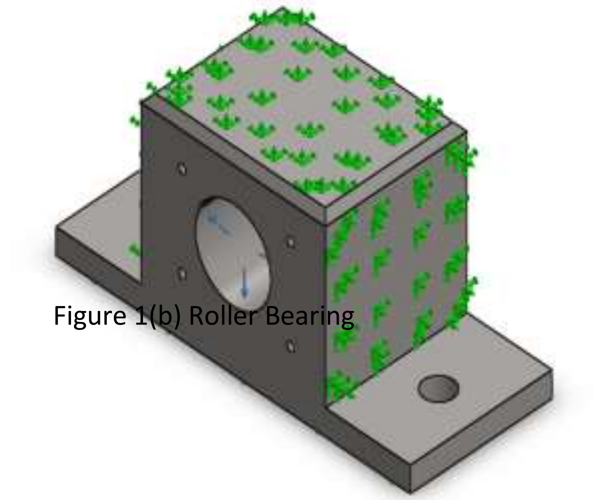
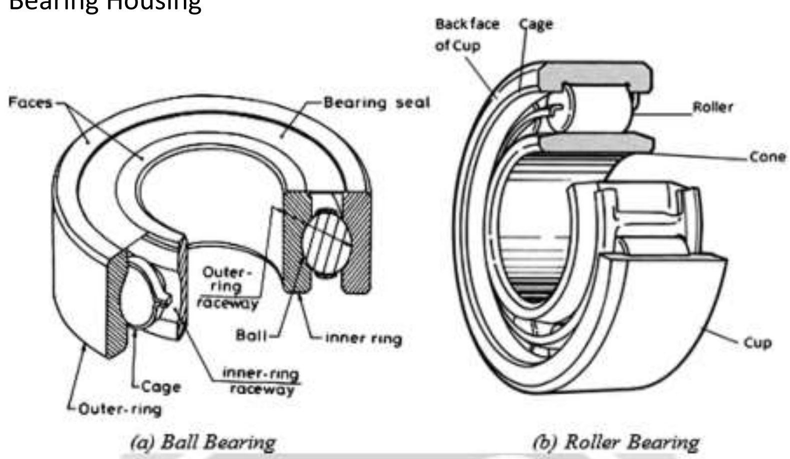


Figure 1(a) Ball Bearing Figure 1(b) Roller Bearing

Plate: (1b) Support Structure

Plate: (1a) Worn Bearing Housing



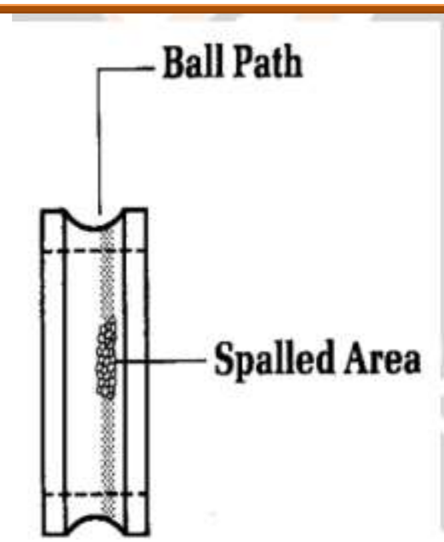


Figure 1(c) Fatigue Failure showing spalled growth

RESULTS

Insufficient lubrication can lead to excessive wear of balls. rings, cages and top surfaces of bearings and bearing housing. Followed by over heating and subsequently, catastrophic failure which could begin due to restricted flow of lubricant or temperatures that are excessive which can reduce the properties of the lubricant. As can be seen in plates 1(a) the wear began from the hollow internal surface of the material but grew worse gradually due to more loads and operations which caused material and property deformation, see plate 1(e). However, the worn bearing housing was caused by fatigue failure since it has to deal with wear from these factors likened to spalling. Fatigue failure caused by fracture of small particle removal and surfaces usually occur on raceway and grows worst once it begins, see Figure 1(c) appendix. As can be seen in Plate 1(a), the wear started gradually and increased rapidly due to the fact that the applied pressure and the tensile strength is greater than the yield strength. Also, presented in plate 1(d) namely materials properties and load fixtures. The surface fatigue was due to re-occurring alternating hydraulic and mechanical loads that led to surface cracks on the component that is already loaded, as seen in Plate 1(c) in the appendix, the minimum stress was 5.66466N/M^2 while the maximum stress was 45129.9H/M^2, other factors are loads, temperature and pressure. Further investigations revealed that damaged layers were due to sharp edged particles between interacting surfaces resulting in adhesive and abrasive wear on the bearing housing components of the boogies.

CONCLUSION

Deformation of bearings occur at high temperature that exceeds 150°C, usually caused by over heating of components. Ironically, rolling element, bearing raceway and its housing are deformed in this mishandling process. Extreme temperature can also cause degradation of lubricant and it can also rise with factors like speed and pressure. Other factors that can cause bearing housing failure are dirts, miss-assembly and misalignment, poor lubricants, corrosion and heavy loads therefore, reducing or avoiding overload and maintaining of cooling practice are effective remedy to deformation of mechanisms and bearing problems. In event of spalling conditions, it is advisable for total replacement of bearings and its housing. It is also preferable that models are designed with fatigue loads so that it can endure operational loads during its active lifetime. Another solution is to implore novel nano lubricants or incorporation of nano composite coatings on the surfaces of bearing housing components. As a means of improvement of their micro-structural layers which will help to reduce the effect of wear and corrosion problems in bearings and its housing.

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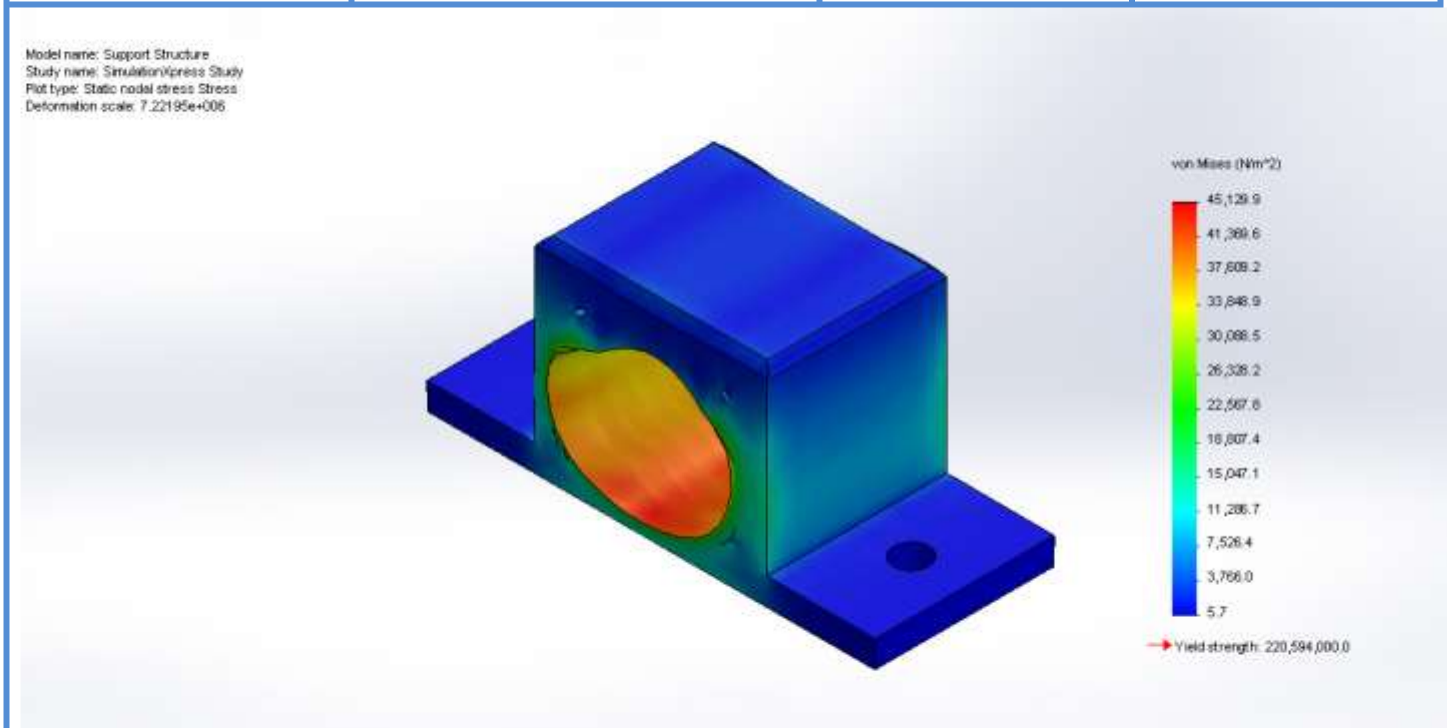
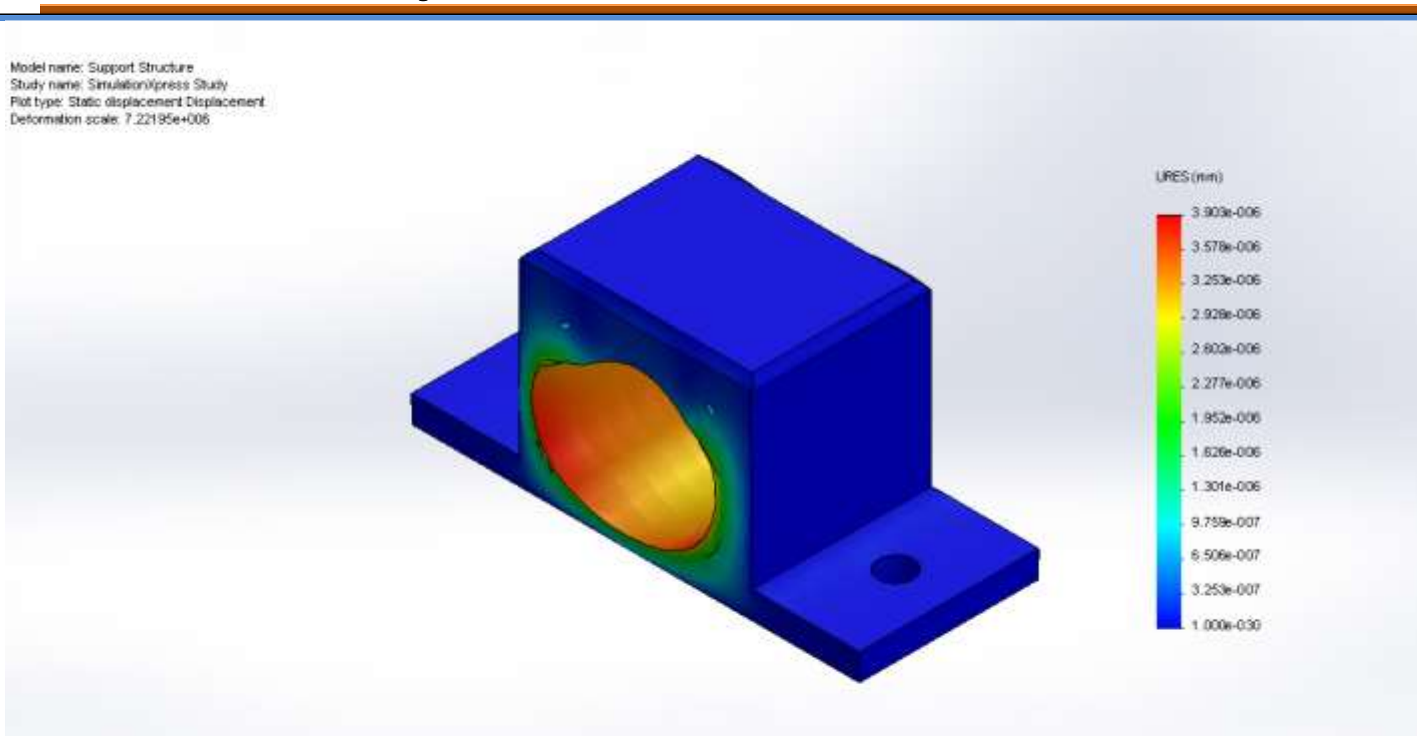
Name	**Type**	**Min**	**Max**
Stress	VON: von Mises Stress	5.66466 N/m^2 Node: 12687	45129.9 N/m^2 Node: 16306



Support Structure-SimulationXpress Study-Stress-Stress

Name	**Type**	**Min**	**Max**
Displacement	URES: Resultant Displacement	0 mm Node: 129	3.90349e-006 mm Node: 10813

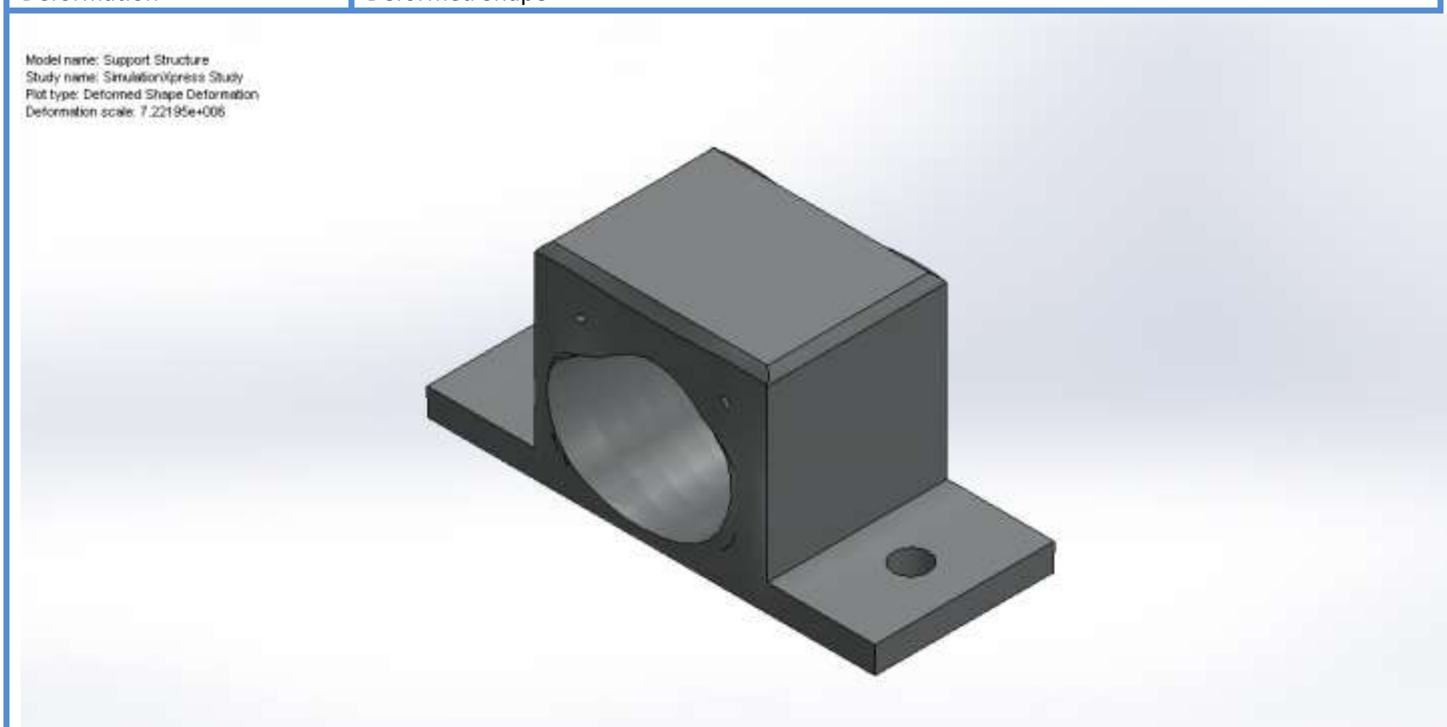
Plate 1: (c) Stress Study Displacement



Support Structure-SimulationXpress Study-Displacement-Displacement

Plate 1: (d) Support Structure Static Displacement

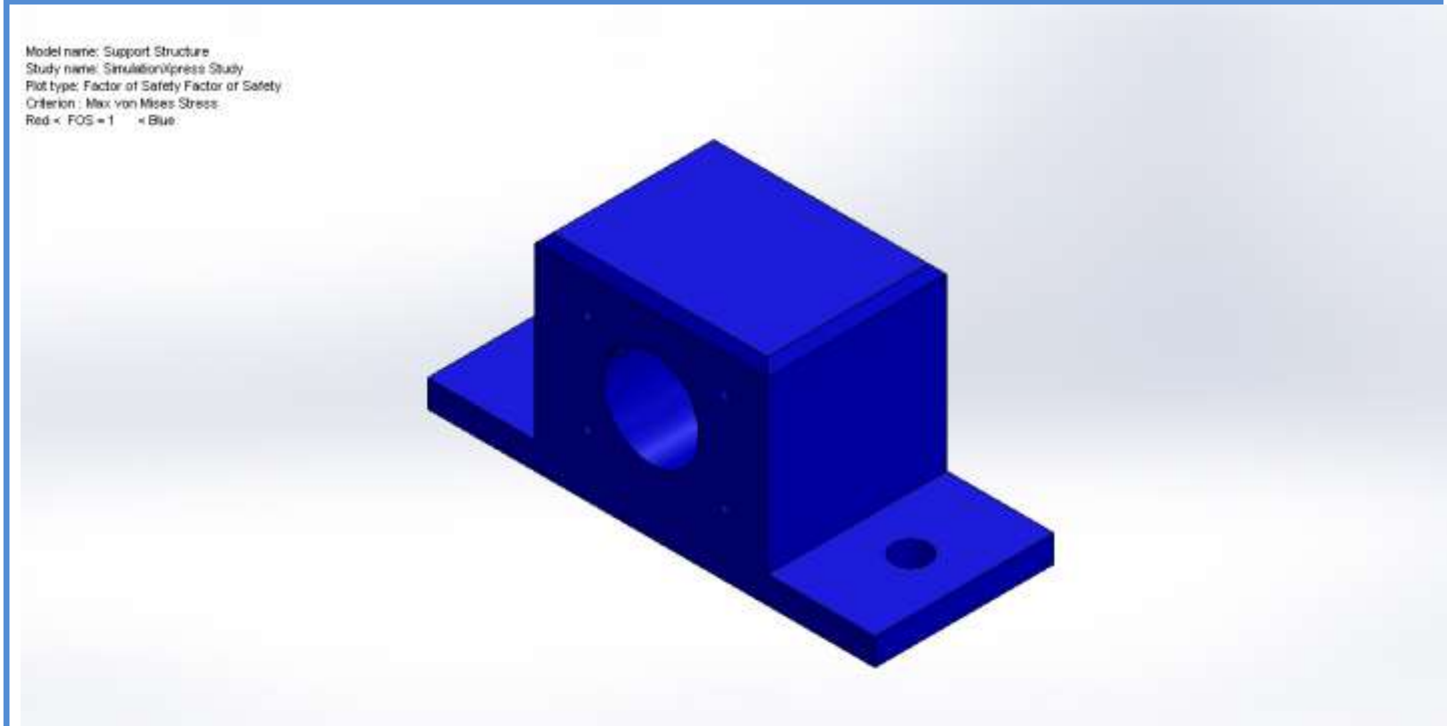
Name	Type
Deformation	Deformed Shape



Support Structure-SimulationXpress Study-Displacement-Deformation

Plate 1: (e) Study Displacement Deformation

Name	Type	Min	Max
Factor of Safety	Max von Mises Stress	4887.97 Node: 16306	3.89422e+007 Node: 12687



Support Structure-SimulationXpress Study-Factor of Safety-Factor of Safety

Plate: 1 (f) Factor of Safety