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Transient analysis of double raw deep groove ball bearing used for clutch release

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Abstract : Double raw deep groove ball bearing is an essential and critical component for clutch assembly of any automobile. This paper is devoted to find out natural frequency, von misses stresses, Maximum shear stresses and maximum deformation under the loading condition. We have analyzed Natural frequency; Von misses stresses, Maximum shear stresses and maximum deformation which are useful in vibration analysis of bearing.

Key words: Clutch release bearing, CRB-06

1. INTRODUCTION:

The term bearing is derived from the verb "to bear"; a bearing being a machine element that allows one part to bear another. A bearing is a machine element which supports another moving machine element and permits a relative motion between the machine members, while carrying the axial or radial load with minimum friction. The functions of bearing are as follows:

a) The bearing ensures free rotation of the shaft or the axle with minimum friction.
b) The bearing supports the shaft or the axle and holds it in the correct position.
c) The bearing takes up the forces that act on the shaft or the axle and transmits them to frame or the foundation.

1.1 Classification of bearing:

Bearings are classified in following way:

- **Depending upon the direction of load acting**
  1) Radial bearing
  2) Thrust bearing
- **Depending upon the nature of contact**
  1) Sliding contact bearing
  2) Rolling contact bearing

1.2 Function of clutch:

A clutch is a mechanical device used in the power transmission system of automobile to engage and disengage to the engine to the transmission system.

The most common parts in a hydraulic clutch system are:

1) Clutch master cylinder
2) Clutch pedal
3) Clutch slave cylinder
4) Clutch fork (in some models)
5) Clutch release bearing
6) Clutch pressure plate
7) Clutch disc
8) Flywheel
9) Pilot bearing or pilot bushing depending on the manufacturer.

1.3 Clutch release bearing:

Clutch release bearing is used in power transmission system to release clutch in automobile Car. Clutch release bearing is a radial contact double raw deep groove ball bearing which carry radial and axial load. Clutch release bearing helps releasing pressure which allows the engine and the gearbox to be move and declutch. The Clutch release bearing is a bearing fixed on the shaft going into the gearbox, it is movable along it. It is operated when you push clutch pedal to floor and cause the clutch mechanism to operate, thus stopping driving force from engine being carried through to gears.

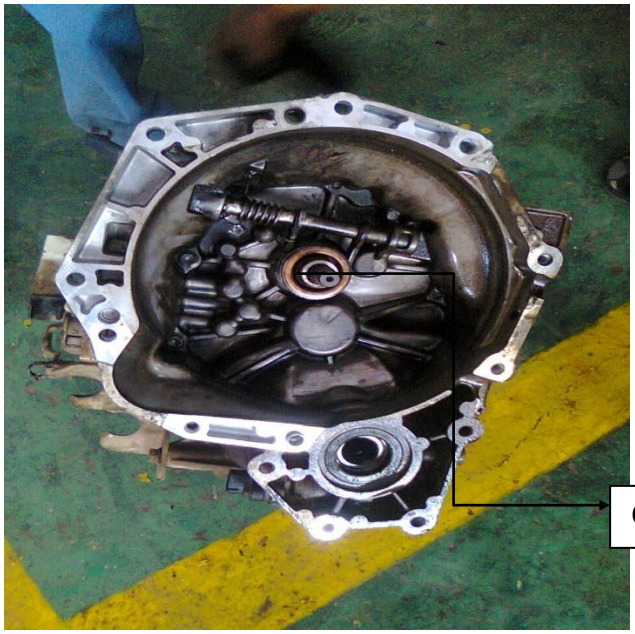

Fig.3.1 bearing location in car engine

Clutch Release Bearing Failure Causes:

1) Incorrect release Bearing adjustment or inadequate clearance
2) Riding a clutch pedal
3) Waiting in traffic with the vehicle in Gear and Clutch

2. GEOMETRIC DATA AND LOADS FOR CLUTCH RELEASE BEARING (CRB-06)

2.1 Geometric data:

Table 3.1Geometric data for clutch release bearing

Sr. no.	Parts	Materials	Outer diameter	Inner diameter	width
1	Outer race	ST 52	47mm	42mm	18mm
2	Inner race	ST 52	37mm	30mm	18mm
3	Ball	Forged Steel	5.1mm	-	-
4	Cage	AISI 1008	40mm	37mm	3.550mm
5	Seal	Polyurethane	43mm	35mm	0.9mm

2.2 Loan on bearing

- Radial load, Fr=340N
- Axial load, Fa=265N

2.3 Static load and Dynamic load rating

- Basic static load rating for bearing, C_{or} =113900N
- Basic Dynamic load rating for bearing, C_r =13500N
- Equivalent static load for bearing, P_{or} =336.5N
- Equivalent dynamic load for bearing, P_r =709.80N

3. MODELING OF CLUTCH RELEASE BEARING:

The modeling of clutch release bearing is prepared in solid works 2009. To prepare a complete model of clutch release bearing following steps are adopted.

- Modeling of outer race
- Modeling of inner race
- Modeling of ball
- Modeling of cage

- Modeling of seal
- Assembly of all components

3.1 Model of clutch release bearing:

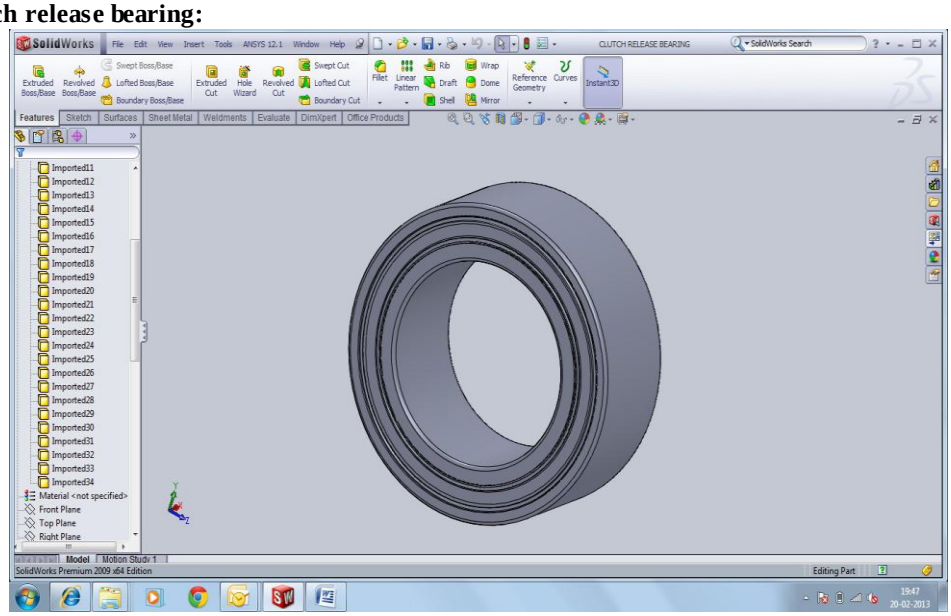

Figure 3.1 3D model of clutch release bearing

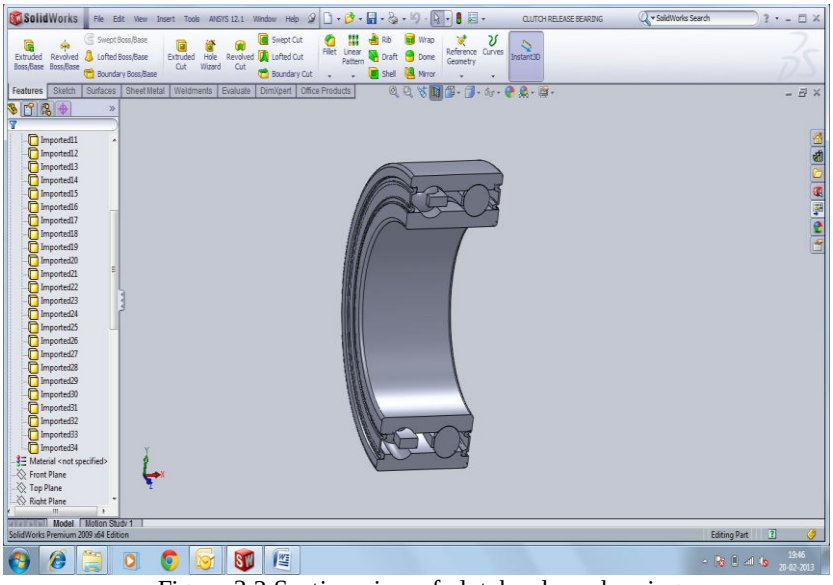

Figure 3.2 Section view of clutch release bearing

4. MODAL ANALYSIS OF CLUTCH RELEASE BEARING

Dynamic analysis is the testing and evaluation of a machine component during runtime. Modal analysis allows the design to avoid resonant vibrations or to vibrate at a specified frequency and Gives engineers an idea of how the design will respond to different types of dynamic loads and also Helps in calculating solution controls (time steps, etc.) for other dynamic analyses.

4.1 Modal analysis result

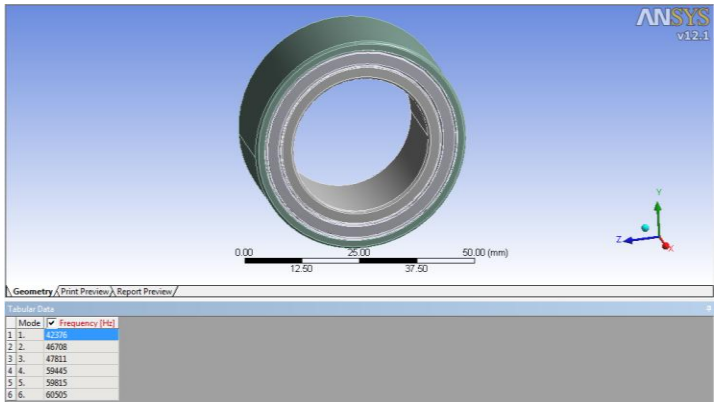

Figure 4.1 Natural frequency of clutch release bearing

Table 5.2 Natural Frequency at different node

No. of Modes	Natural Frequency(Hz)
1	42376
2	46708
3	47811
4	59445
5	59815
6	60505

5. TRANSIENT ANALYSIS RESULT:

Transient structural analysis provides users with the ability to determine the dynamic response of the system under any type of time-varying loads.

5.1 Von misses stress results in transient structural analysis

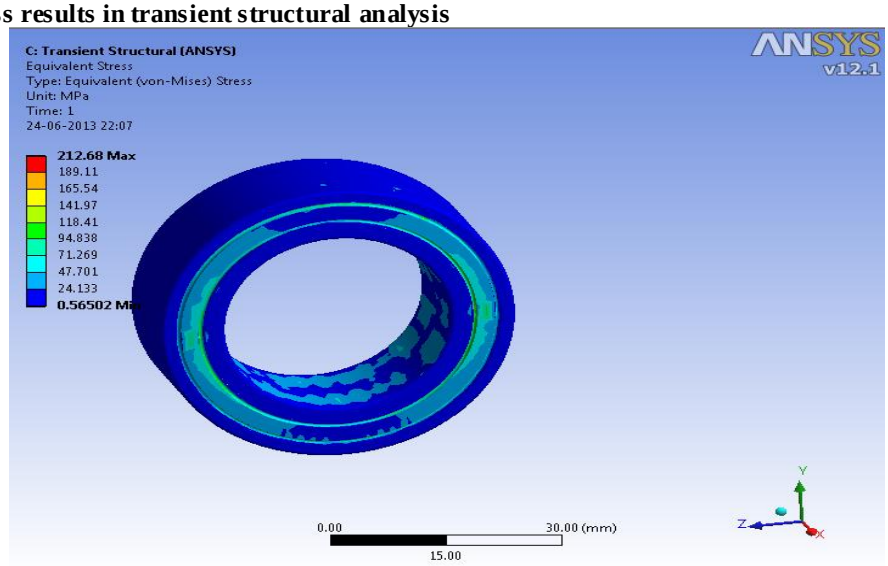

Figure 5.16Von Misses Stresses in transient analysis

5.2 Maximum Shear Stresses results in transient structural analysis

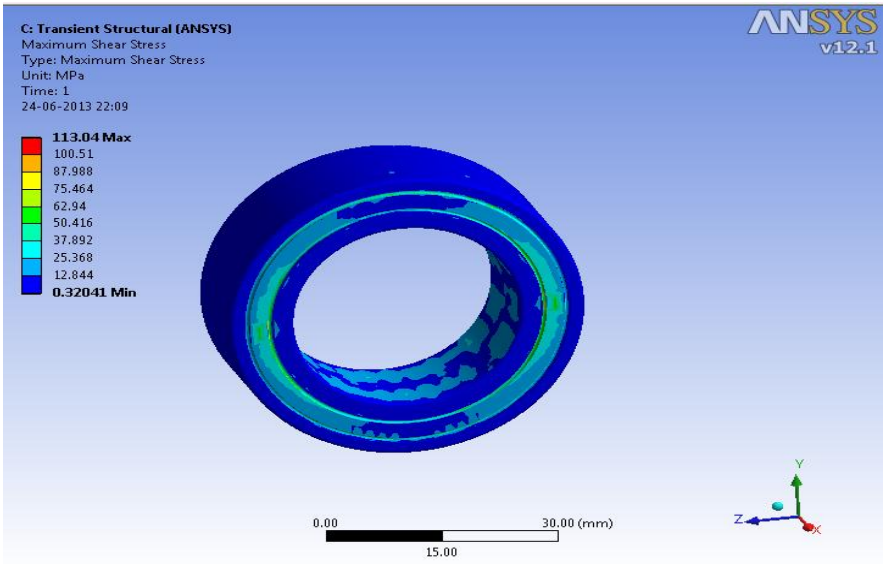

Figure 5.17 Maximum Shear Stresses in transient structural analysis

5.2 Maximum deformation in transient structural analysis

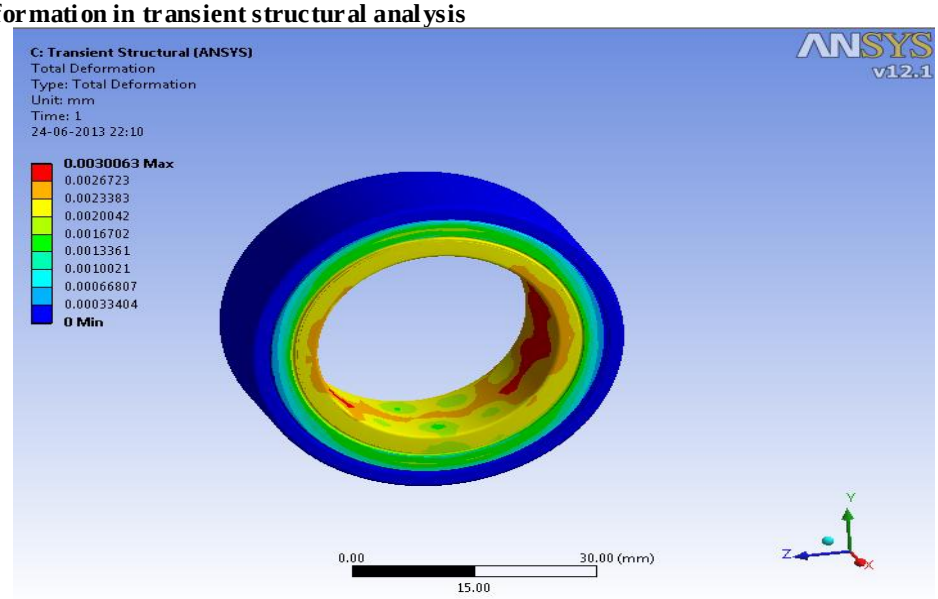

Figure 5.18Total deformations in transient structural analysis

6. CONCLUSIONS

In this paper Double raw radial contact deep groove ball bearing is selected for Modal analysis and Transient structural analysis, which is used in power transmission system of automobile. From this study we have analyze Natural frequency, Von misses stresses, Maximum shear stresses and maximum deformation which are useful in vibration analysis of bearing.

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