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EXPERIMENTAL ANALYSIS OF HYDRODYNAMIC SIMPLE JOURNAL BEARING

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ABSTRACT:

The new machine design applications require high operating speed, higher power density, small size, high load carrying capacity and to full fill this requirement it is necessary to consider transmission section. So one of the most important element to be considered for design is bearing. Bearing not only support rotor weight and operating speed but also influence on rotor dynamic behaviour This constant trend towards higher power densities in rotating machinery calls for better mechanical components capable of carrying higher loads while being the same or smaller in size without sacrificing machine safety. For hydrodynamic bearings it is important that minimum film thickness never drops below a safety limit. An oil film becomes thinner if load increases. This also results in elevated temperatures, which reduce oil viscosity and further decrease oil film thickness. When the fluid-film bearings operate under high speed, heat is generated within the oil film due to shearing of the lubricant and temperature rise of the lubricant fluid film and the bearing surface takes place

INTRODUCTION:

Hydrodynamic journal bearing is defined as a mechanical element which supports high load due to wedge shape geometry formed during the relative motion between journal and bearing surface. Hydrodynamic journal bearing is widely used due to its high load carrying capacity and good damping properties [1]. The major problem with hydrodynamic bearing is failure of fluid film during the operation. This may cause metal to metal contact between journal and bearing surface. This leads to wear and friction which overheats the surfaces [6]. Hence the power loss increases. In this paper Experimental analysis of hydrodynamic simple bearing of aluminium material. Three dimensional studies have been done to predict pressure distribution along journal surface [3]. The FSI technique can give accurate pressure distribution. The fluent and static structural modules are coupled to generate actual load on shaft and baring inner surface [4].

OPERATING CONDITIONS:

The fig.1 shows the fluid film of bearing and oil inlet at upper side of fluid film. The material used for bearing is Aluminium.

Table I
Operating Conditions

Bearing Diameter	75mm
Bearing Length	68.5mm
Journal Diameter	46mm
Radial Clearance	0.4μm
Rotation Speed	4000 rpm
Lubricant viscosity	0.0277 Pa. s
Lubricant density	860 Kg/m^3

MODEL OF SIMPLE BEARING:

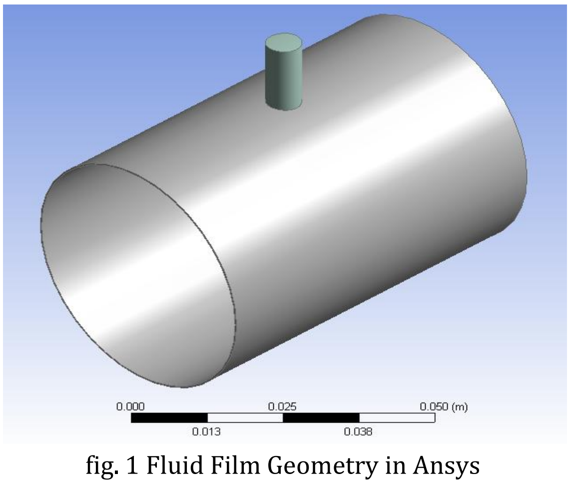

fig. 1 Fluid Film Geometry in Ansys

The journal has given random offset origin while modelling the geometry. The origin of journal is considered as parameter(X and Y position of origin). The eccentricity and attitude angles also added in parameter set as input with random values. A relation between journal origin, eccentricity and attitude angle is made so that at end of solution we can get value of eccentricity and attitude angle. The meshing of fluid film is done in fluent meshing.

EXPRIMENTAL RESULTS OF SIMPLE BEARING:

First of all switch on all the displays and power supplies. Then all pressure sensors are checked for presence of negative pressure. Following is the step-by-step procedure that is incorporated for the experimentation Apply load on bearing by using load cell and belt. Start oil supply to bearing so that the oil can flow through sensor and check all the sensors connections for leakages. Check supply pressure of oil and set it to required inlet pressure.

Start VFD and check output frequency of VFD. Then increase the output of VFD to reach required speed of motor. The pressure reading is to be taken after 15 to 20 minutes after supply of oil at required rpm because that much time is required to stabilize the pressure over the bearing. . Take the reading of pressure for all sensors.

Now follow same procedure for different speed and load conditions

Table II
Experimental Readings for Simple bearing at different sensor

At 600 N Load									
Speed(rpm)	1	2	3	4	5	6	7	8	9
1500	0.19	0.22	0.3	0.4	1.5	0.5	0.3	0.18	0.09
2500	0.3	0.36	0.56	0.6	2.5	0.8	0.6	0.4	0.35
3500	0.35	0.35	0.51	0.5	2.8	0.8	0.5	0.32	0.2
4500	0.44	0.22	0.51	0.5	3.85	0.6	0.3	0.25	0.09

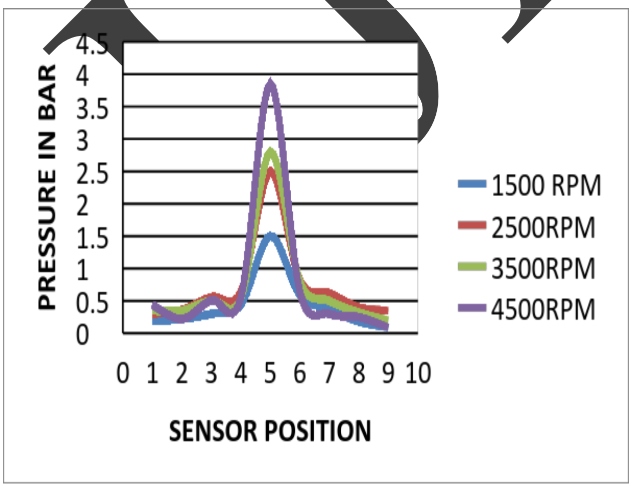

Fig.2 Graph of Pressure output at Load 600 N for simple bearing

Table III
Experimental Readings for Simple bearing at different sensor

At 600 N Load									
Speed (rpm)	1	2	3	4	5	6	7	8	9
1500	0.19	0.22	0.3	0.44	0.66	0.59	0.37	0.18	0.09
2500	0.3	0.36	0.56	0.64	1.12	0.82	0.62	0.4	0.35
3500	0.35	0.35	0.51	0.54	1.85	0.8	0.5	0.32	0.2
4500	0.44	0.22	0.51	0.55	2.5	0.64	0.3	0.25	0.09

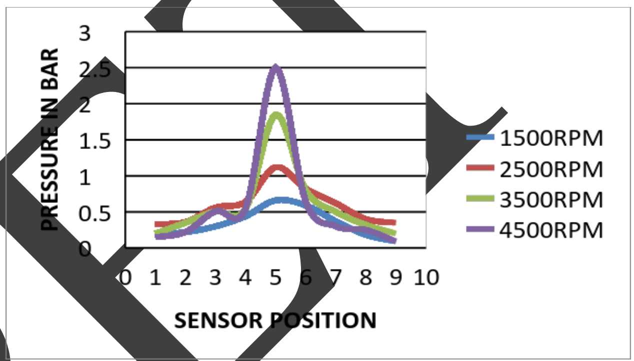

Fig.3 Graph of Pressure output at Load 300 N for simple bearing

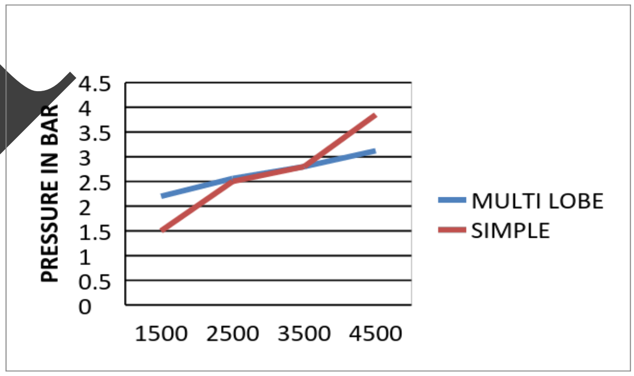

Fig.4 Graph of Pressure output at Load 600 N for simple bearing

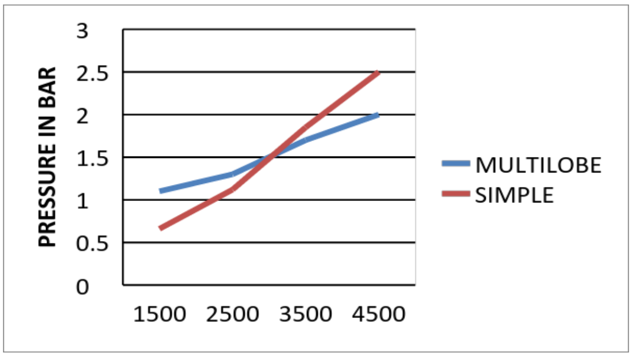

Fig.4 Graph of Pressure output at Load 300 N for simple bearing

CONCLUSION:

From the thorough study of the literature review, experimental performance analysis it was seen that the Speed and Load occurring at bearing highly affects the bearing fluid film. The pressure of fluid film gets increases with increase of load and speed. It was also seen that at higher rpm bearing gets stabilized. Due to higher load and speed the bearing shell gets deformed. This deformation leads to increase the flow of fluid film inside the clearance volume, which reduces pressure of fluid film. The higher pressure got from Fluent on fluid film was 3.22 Bar and experimental pressure value was 3.12 Bar. This validates the result of Minimum pressure of multi-lobe bearing as compare with simple bearing and maximum load carrying capacity of multi lobe than simple bearing at 4500 RPM The results of higher pressure of bearing with multi lobe bearing and simple bearing shows that with change of the pressure generated inside the bearing gets reduced. In multi-lobe bearing and simple bearing there is maximum pressure variation with respect to different speed, eccentricity and attitude angle. The load carrying capacity is also more in multi-lobe bearing. When we compare the results obtained from both CFD and Experimental we can say that, the bearing with lower outer diameter shows more deformation. Due to this the pressure of fluid film gets reduced. The load carrying capacity also increases. But due to more deformation bearing life may get reduced.

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