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# EXPERIMENTAL ANALYSIS AND SIMULATION OF ROTOR SUPPORTED ON A SHAFT

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**ABSTRACT** - Bearings and rotors are employed extensively across all engineering specialties. Rotor rotation is primarily influenced by the system's dynamic properties.The force and stiffness are essentially these dynamic properties.Torsional stiffness, which is present while the rotor is rotating, is taken into account.The ansys was used to get the results.Essentially, the model compr ises of a rotor mounted on a shaft and supported by bearings.Software called SOLID WOKS was used to create the CAD model.The model consisted of a rotor supported by bearing at a uniform distance from the shaft, and the mass of the rotor was likewise uniform, ensuring that efficiency is the same at both shaft ends.The task at hand is to research the dynamic properties.Ansys softw are was used for this study.

**Keywords : -**Rotor, dynamic characteristics, journal bearing, shaft rotation, etc .

## 1. INTRODUCTION

Pumps, jet engines, turbochargers, and other rotating machines are all prone to vibrations.Rotor whrilling results in two different forms of vibrations: synchronous and nonsynchronous.[1]Rotor critical speed, system stability, and imbalance response are the main areas of concern.The shaft, rotor with disc, and bearing with seals are the three major parts of a rotor-dynamic system.
Turbo machinery vibration has an impact on how industrial operations operate.High levels of vibration decrease a system's output and efficiency.The turbo machine is basically just a rotor supported by bearings.Torsional, lateral, and axial vibrations are the three types of vibration.
The angular/rotational motion of an object is described by torsional vibration. the shaft. Lateral vibration as name species the vibration of rotor in lateral direction. Axial vibration specifies dynamics of rotor in axial direction. Rotating shaft are used in industrial machines such as turbo-generators, combustion engine, turbine for power transmission. On demand of such system in industries , the rotors of these machine are made flexible, which leads to detail study of vibration and dynamic characteristics of the system. These machines are subjected to torsional and bending vibrations. .

### 1.1 Operating principle.

To comprehend the operation of the power transmitted through the rotor, consider a three-phase induction motor.[4]The stator and rotor systems, which are supported by the bearings on the end frames/shields, are the two main components of a three-phase induction motor.

The stator has a uniformly distributed load and is the stationary component of the system while the rotor rotates. windings in the form of coils across the slots in the stator. The magnetic field is created in the stator, the rotor on the other hand has a squirrel cage construction comprising of slots which are usually filled with brass or aluminum damper bars with end rings short circuiting creating close loop internally.

When the electric power (alternating current) that is supplied to the stator windings. This energizes the stator to create the magnetic flux in the system. This flux generated in the stator links across the rotor through the air gap between rotor and stator which in turn leads to induce the voltage and hence further produces current through the rotor bars. The output of the rotating flux and current produces force that generates torque to start the system.

Due to the relative speed between the rotating flux & stationary conductors, an emf is induced in the rotor, the emf induced is the same as that of the supply frequency. Its magnitude is proportional to the relative velocity between the flux & the conductors. Since the rotor bars form a closed circuit (squirrel cage construction), the rotor current direction is such as to the cause producing it (Lenz's law).

## II. PRINCIPLE USED IN DESIGNING MODEL

Primarily the model used incorporates the assembly with a unit comprising of a simply support structure with 2 bearings, the rotor mass is a single unit. But the modified model intends to uniformly distribute mass in 2 sections. Supported by 3 bearings yielding a very efficient & balanced unit optimizing the unit.The shaft defection in the earlier model is a unit with mass concentrated at a particular location, usually compensated by a higher shaft diameter & bearing sizes leading to higher costs of the unit.The proposed unit due to the intermediate support bearing will no doubt give a better support reducing the defection & also uniformly distribute the mass & optimize the entire the assembly.

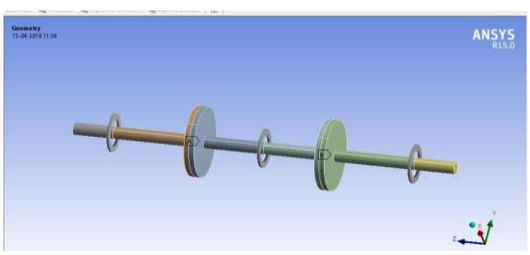


**Fig-1** Rotor supported by bearing.

**Table-1:** Set up of the design showing details

| **Resources used details** | **Value** |
|---|---|
| Diameter of the rotor | 70mm |
| Mass of the rotor | 20kg and 30kg |
| Thickness of the rotor | 10mm |
| Speed of the rotor | Upto 30,000 rpm |
| Length of the shaft | 1200mm |
| Force | 280N |
| Stiffness | $10^6$N/mm |

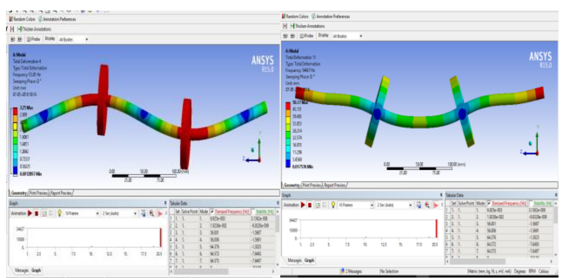


**Fig 2 :** mode Shapes at different rpm values.

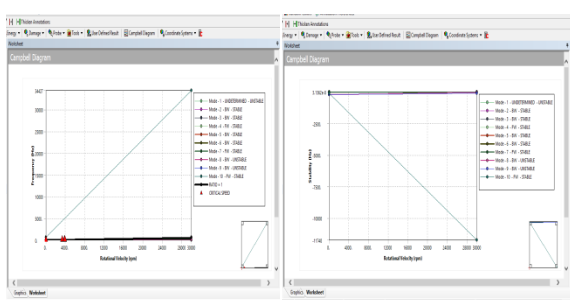


Fig 3: Results obtained showing the stability and critical speed of the system for 20kg

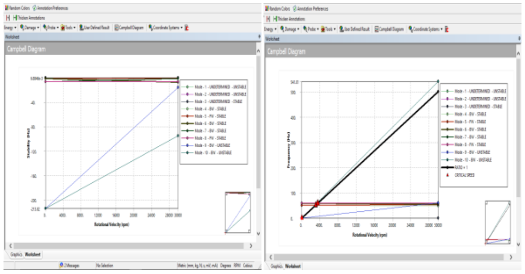

Fig 4 . Shows graph for stability at rpm which also shows the critical speed

## III. RESULTS

It is evident from the preceding graph that the system's stability is linear, meaning that the gap changes linearly as system speed rises from 0 to 4000 rpm.As speed rises, the value of the syste m's stability rises as well.When a rotor has a mass of 20 kg, the critical speed is 3800 rpm; when it has a mass of 30 kg, it is 3400 rpm. The critical speed is the point at where stability and speed intersect.We can observe from the graph above that the system's logarithmic decline is linear.

## IV. CONCLUSION

We may check the stability of the system based on the results mentioned above.According to the literature review, a rotor's stability is influenced by its mass and speed.Therefore, the work was carried out by changing the mass of the rotor, and it was discovered that as loads and mass on the rotor varied, so did the stability of the system.At various rpms, dynamic properties including for ce and stiffness are examined.

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