Petroleum University of Technology

In the name of GOD

Critical distance test shafts

Report from a laboratory experiment conducted on?? 17-MAY-17

As part of vibration lab

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Abstract:

Get away under the load has been crisis-driven. We know that the beams continuous or continuous systems (continuous). Therefore a transverse vibrations, and because they are infinite degrees of freedom, can have extremely natural frequency. If the beams are under the rotational speed, the rotational speed where the frequency is equal to one of the natural frequencies of the beam, the beam mode resonance to occur.

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1. Introduction and Background

As you know, in a shaft, because of weight, there is a rise in bar (static). In the case where the shaft is in addition to the weight, as well as a rotational movement, the rich can be increased or reduced. One of the reasons that caused the deformation of the force of the weights and the other eccentric shaft is the center of mass of the initial order.

2. Theory

The vibrations, for convenience of analysis for the various components, hard flexibility to define different. We use the relationship to a shaft deflection beams for each mode of loading, by dividing the force on beam to beam deflection, it is difficult to obtain. For example, a simple shaft on two bearings located on one side and the other side within a distance b to the case are:

$$S = \frac{F \cdot a^2 \cdot b^2}{3E \cdot I \cdot L} \Rightarrow K = \frac{F}{S} = \frac{3EIL}{a^2 b^2}$$

The other can be the shaft for a mass-spring system that have been considered. The natural frequency in this case, the relationship is obtained: $\omega_n = \sqrt{\frac{K}{m}} = \sqrt{\frac{3EIL}{a^2 b^2 .m}}$

3. List of Equipment Used

A brass shaft that is located on two bearings. The shaft on the one hand is connected to a motor which provides rotational force of the shaft. Electric motors provide power from a DC source. This source has a voltage volume by which it can be determined that the rotational speed of the rotation axis. The source screen to display rotating shaft rotational speed there.

4. Procedure

On the shaft there are two weights 0.5 kg. We consider that the axis of the shaft itself has a weight in the middle. The high hardness of the relationships and the natural frequency of the system is then calculated:

$$\left.\begin{aligned} S &= \frac{FL^3}{48EI} \\ I &= \frac{\pi d^4}{64} \end{aligned}\right\} \Rightarrow \boxed{K_b = \frac{3E \cdot \pi d^4}{4L^3}}$$

$$\omega_n = \sqrt{\frac{K}{m}} = \sqrt{\frac{3E \cdot \pi \cdot d^4}{4mL^3}}$$

The natural frequency of the system is calculated as:

$$\omega_n = \sqrt{\frac{3(106\times10^9)\cdot\pi\cdot(6\times10^{-3})^4}{4(1)\left[(45-7.5)\times10^{-2}\right]^3}} = 78.346(rad/\sec) = 748.144(rpm)$$

5. Data

L1=48.5CM far way=948

L2=83CM   far way=667

Two weights placed in the middle of the shaft by the DC motor to motor, we establish the flow and volume by varying the potential difference, we will slowly away. As the round, shake for a crime occurs. After passing through a certain distance, vibration reaches its maximum mass crimes. This represents the rate is (when ω too close to the critical frequency) and after dose increases, we continue to move the constantly increasing energy stored in the system and to increase their scope indicated a When this time round, we have reached the natural frequency of the system. The natural frequency of the shaft system and the mass was in the middle as follows:

$$\boxed{\omega = 840(rpm)}$$

We calculate the amount of error theory and practice modes:

$$= \frac{|\omega_{teoric} - \omega|}{\omega_{teoric}} \times 100 = 10.93\%$$

6. Discussion of Results

Do the same experiment with the difference that the two weights are put side bearings and in this case, the critical rotational speed (natural frequency) obtains. The remarkable thing in this case is that in the latter case, our system is a system of two degrees of freedom, while in case before the system was a degree of freedom. As a result, two critical frequency (natural frequency) for the shaft that must obtain Aha. In this case, we in Three Springs, defined. But in this case given that it is a complex value, the methods we use to use the superposition principle is applicable. In that case, the natural frequency of the system is critical for individual weight gain and combine them together.

7. Conclusions

The main result of this experiment is that the distance is less than bearings, which is smaller than the critical distance relationship starts later and have higher stability. In fact, the crisis has come at a higher frequency than is desirable.

8. References

Book
http://jaafarali.info/files/mech_vibration_lab.pdf
http://www.mechanism.ir/index.php/design/vibration/1497-critical-speed