ABSTRACT
We know a shaft crack is a detection of such shaft crack is a very serious matter. A crack could lead to a catastrophic failure of the rotor if not detected in a timely manner. When the system has working crack in shaft could be make failures. Vibration analysis is widely used to monitor the health of the rotating machinery. However vibration signature of a cracked shaft is not clear because the presences of cracks change the physical characteristics of a structure, although a considerable literature is vibration analysis of rotor cracks. In this project experimental process is done and the results obtained are compared with The results obtained cracked shaft. In this stage of the project, particular piezoelectric element, accelerometer is used along with a device called as Fast Fourier Transform Analyzer. The cracked shaft will be vibrated using actuator and then the vibratory motion in the shaft is sensed by accelerometer. The accelerometer will send the sensed vibration data to F.F.T Analyzer which can change the sensed data by accelerometer to meaningful data shown in the PC, such as; frequency, Amplitude, displacement and so on.


INTRODUCTION-
A crack on a structural member introduces a local flexibility which is a function of the crack depth. Major characteristics of structures, which undergo change due to presence of crack, are:
1) The natural frequency.
2) The amplitude response due to vibration
3) Mode shape
4) Type of material component.

An important part of dynamic finite element analysis is model analysis. Computer modeling alone can not determine completely the dynamic behavior of structures, because certain structure properties such as damping and non rarity do not conform to traditional modeling treatment. There are also boundary condition uncertainties which modeling needs additional help to work.

Substantial advances in experimental techniques have complemented modeling with the experimental determination of structural properties. A milestone of this endeavor is the advent of digital Fourier Transform analyzers. The experimental techniques are nurtured by the theory of modal analysis.

5.1. Comparison of Speed and R.M.S. Acceleration
In this section, the overall R.M.S. acceleration values are compared with speed for different crack’s depth for all shafts for both A and B bearing. The R.M.S. values obtained in difference speed in both A and B bearing are shown in table 5.1, whereas the graph of R.M.S. values versus Speed are shown in below Figs respectively. Table above shown R.M.S acceleration values for 0 mm and 2 mm and 4 mm crack’s depth for different speeds in bearing A.

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It can be seen that for the same amount of speed if rotating speed is increased there is increase in overall R.M.S. Value of vibration acceleration both in 0 mm and 2 mm and 4 mm crack’s depth of cracked shaft. We can see that is in below Fig.

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Fig 1. Experimental set up components

Experimental setup and instrumentation
The accelerometer was connected to F.F.T Analyzer. The test rig consists of a shaft of 16 mm diameter 640 mm overall length and supported in two bush bearings. A rotor disc of diameter 100 mm and thickness 10 mm is fixed at the midspan of the rotor shaft. A D.C. shunt motor of 0.37 kw coupled by flexible coupling drives the shaft.

The setup is run for few minutes to settle down all minor vibrations. Accelerometer along with FFT analyzer is used to acquire the vibration signals. The accelerometer is connected to channel no.1 of FFT analyzer. The vibration signals are measured at five different speeds namely 300, 600, 900, 1200, 1500 rpm. The speed is measured with digital tachometer.

The figures below, can illustrate the experimental set up which is going to be used in the current project for obtaining the experimental data. The test rig manufactured consists of motor, coupling, shaft, bearings, disc, D.C.drive.

Fig 2. Cracked shaft

5.1. Comparison of Speed and R.M.S. Acceleration

<table>
<thead>
<tr>
<th>FREQUENCY (RPM)</th>
<th>Crack size mm</th>
<th>Crack loc(cm)</th>
<th>Bearing loc</th>
<th>RMS for 0mm</th>
<th>RMS for 2mm</th>
<th>RMS for 4mm</th>
<th>DC loc</th>
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<td>A</td>
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<td>A</td>
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</table>

In this section, the overall R.M.S. acceleration values are compared with speed for different crack’s depth for all shafts for both A and B bearing. The R.M.S. values obtained in difference speed in both A and B bearing are shown in table 5.1, whereas the graph of R.M.S. values versus Speed are shown in below Figs respectively. Table above shown R.M.S acceleration values for 0 mm and 2 mm and 4 mm crack’s depth for different speeds in bearing A.
CONCLUSIONS

The detection of cracks in shafts by measuring the change in an adequate number of the natural frequencies has been considered in this paper. A crack is known to introduce local flexibility in the shaft. The local flexibility due to a crack in the presence of bending moment and shear loads is modeled by using fracture mechanics concepts.

Cracks are then predicted by measuring an adequate number of shaft natural frequencies. The adequate number of natural frequencies that needs to be measured depends on the number of cracks present. The first five natural frequencies need to be measured for a single crack, and each additional crack requires the measurement of two more higher natural frequencies. This may limit the application of this method to shafts with not more than three or four cracks and with no closely coupled modes. The technique presented is most suited as a preventive maintenance tool from the initial installation of the shaft through a programmed maintenance schedule to record the history of the cracks as they grow, at appropriate time intervals.

- For the same amount of speed if rotating speed is increased there is increase in overall R.M.S. value of vibration acceleration both in 0 mm and 2 mm and 4 mm crack’s depth of cracked shaft.
- The comparison of overall R.M.S. value of vibration acceleration in difference bearing and crack’s depth and difference speed shows that the amplitudes of R.M.S. value of vibration acceleration are higher in bearing A than in bearing B.
- The natural frequency changes substantially due to the presence of cracks. The changes depending upon the location and size of cracks.
- The position of the cracks can be predicted from the deviation of the fundamental modes between the cracked and uncracked shaft.
- The frequency of the cracked shaft increases with increase in the crack depth for the all modes of vibration.
- The structural crack detection is challenging because actual rotor system dynamic responses are always contaminated by unknown external loads as well as other harmless conditions, such as material composition uncertainty, geometric variation, sensor noise, and so on.

REFERENCES