Volume: 3 Issue: IV Month of publication: April 2015

DOI:

www.ijraset.com Volume 3 Issue IV, April 2015
IC Value: 13.98 ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Vibration Monitoring Of Fixed Bearing

T.Karthick[1], N. Sangeetha[2], V.R. Muruganantham[3], A.Bala Kumaran[4]
[1,4]*P.G student, Department of Mechanical engineering,* [2,3] *Faculty of Mechanical Engineering,*
[1,2,3,4]*Kumaraguru College Of Technology, Coimbatore, India*

***Abstract*— On Bearing Vibration (OBV) together with the contact type accelerometer has been used for the Vibration Based Condition Monitoring (VCM) and the method has been applied to a small experimental rig. The observation made on the measured (OBV) data during the rig run-up operation, in exacting the identification of the rig critical speeds from the (OBV) run-up data and varying the differences between the analytical and experimental values are presented in the paper.**
Keywords— ***Fixed Bearing, FFT, Accelerometer, Spectrum Analysis, Critical Speed.***

I. INTRODUCTION

Vibration- based condition monitoring (VCM) and diagnosis is a well know tool for the fault diagnosis of rotating machines. The vibration based techniques for identifying different fault in the rotating machine. Fault capability identification in the condition monitoring may be well appreciated by any industry. Hence, an innovative measurement scheme i.e., on-bearing vibration (above). This concept is expected to reduce the amount of shaft damage under different speeds. In this paper, we use the contact type accelerometer sensor mounted directly on the bearing casing. The rotor is fixed between the two bearing support and it was used as experimental rig and then a few vibrations measurements were carried out at different shaft speeds. In this paper, the OBV method has again been used on a small experimental rig. The experiments were conducted during the rig run -up and both OBV and vibration measurement using accelerometer at the bearing pedestals in the radial direction are collected, analyzed and compared. The observation made on the measured vibration response directly from the accelerometer mounted on the bearing, particularly related to the identification of the rig critical speed, during the rig run- up has been discussed here.

II. EXPERIMENTAL SET UP

A. Test Rig

The picture of the rig shown in figure 1. The rig consists of a 0.47cm diameter and length 92cm the shaft with supported on the relatively rigid foundation through ball bearings.

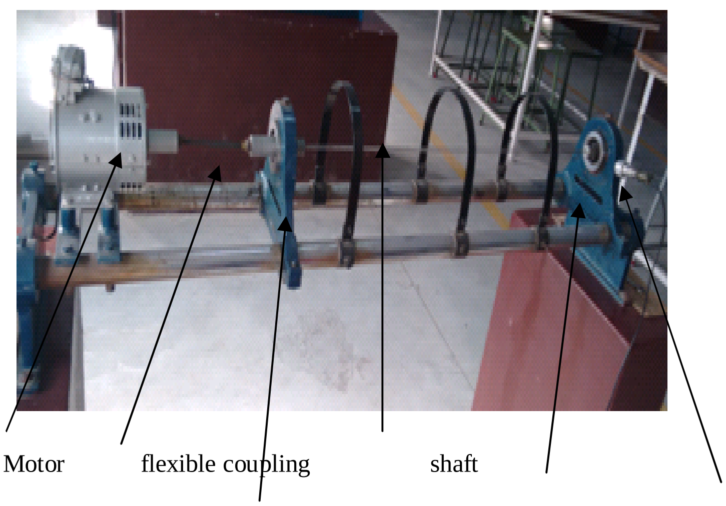

Fig.1 Equipment Setup

A motor is also connected to the shaft through a flexible coupling to drive the shaft at different speeds. The proposed vibration

Volume 3 Issue IV, April 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

measurement scheme adopted in the present study. A contact type accelerometer is fixed in the two bearings mounting.The accelerometer sensor type AB-1021A has a range of 20.0m/sec^2 and sensitivity of about 97.5mV/g. The accelerometer for transmission of vibration signals measured by the FFT COCO 80 analyser. The data signals are collected in the FFT COCO 80 and the collected are transferred to The Engineering Data Management [EDM] software through USB.

B. Design of Shaft

There are three major methods to design the shaft such as

1) Based on material strength.

2) Based on rigidity.

3) Based on critical speed.

In this paper which discussed about the critical speed of the shaft. When the speed shaft is under the critical speed condition it attains more vibration by evaluating the vibration measurement the critical speed is to be observed clearly of the shaft. The critical speed is to be varied by the shaft support. Here we concentrate about the fixed supporting conditions for analyzing the critical speed of the shaft.

B. Shaft with Fixed Bearing Support Condition

In this condition the shaft is subject to the supported by the two fixed bearings ,

(SKF 6205) single row – 9 balls. 25mm x 52mm x 15 mm

C. Analytical Calculations

The formulae used:

$$f = k \times \sqrt{\frac{E.I.g}{W.L4}} \quad \text{RPS} \qquad (1)$$

Where

L -Length of the shaft = 92 cm

E – Young's modulus in kg/cm^2 = 2.06 kg/cm^2

I – Second moment of inertia of the shaft in cm^4

W – Weight of the shaft per unit length in kg/cm

g – Acceleration due to gravity = 9.81 cm/sec^2

K – Stiffness value in mode 1

For Two End Fixed Support Bearings = 3.56

By using the above formulae we have found the theoretical speed of the shaft

For Two End Fixed Support Bearings = 1015.77 rpm = 16.92 Hz

III. RUN UP EXPERIMENT

The shaft of 0.47cm diameter is mounted with bearing for two ends fixed bearing support condition. The shaft is allowed to rotate and the critical speeds are noted in first mode shape. The above steps are repeated for different end condition by changing the support bearings. By using FFT COCO 80 Analyzer and Engineering Data Management software is used for vibration analysis for bearings and identifies the critical speed of the shaft.

Fig. 2: Test Rig with Two End Fixed Support Bearings

A. Data Analysis and Observation

The amplitude amplification at different speeds during the run-up definitely indicates the excitation of machine critical speeds. To understand this, the Fast Fourier Transformation (FFT) analysis was carried out initially for measuring acceleration response at the bearing pedestal in the radial direction.

Typical EDM software the spectrum curve analysis of the horizontal and vertical direction are shown in figure 4. The EDM clearly shows the presence the frequency peaks related to the shaft RPM. However the distinct amplitude spots corresponding to 27.50 Hz in the radial directions are also observed when the shaft passes through the critical speed 1650.22 RPM in radial direction.

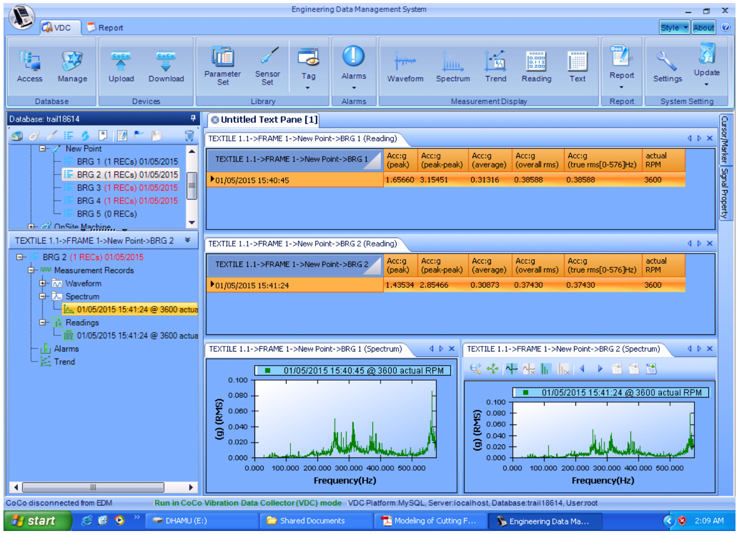

Fig. 3. Spectrum Curve Analysis For The Horizontal And Vertical Direction

Typical spectrum in the radial direction is also shown in figure 5 under the two ends fixed support bearings, it is shown in the figure 6

TABULATION 1
Value of the Shaft

Sl. No	End condition	Shaft diameter (In cm)	Theatrical speed Mode 1 (rpm)	Experimental speed mode 1 (rpm)
1	Two End Fix	0.47	1475.97	1650.22

B. Critical Speeds Prediction

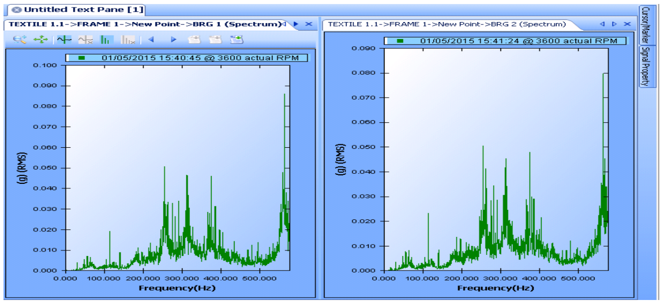

Fig. 4. The Amplitude Peaks are observed for On- Bearing Vibration

Instead of showing a single peak when the rotor passes an integer of a critical speed. The amplitude peaks are observed in figure 5 for on- bearing vibration. Hence the vibration spectra at the shaft speeds of 1650.22 RPM (27.50 Hz) and 650.92 RPM (10.84 Hz).

From figure 5 & 6 shows the peak amplitude values which are close to the analytical calculated values. Hence the experimentally identified critical speeds are also close to the theoretical predictions. This behavior of the on bearing vibration measurement clearly indicates the machine critical speeds get amplitude modulated with the shaft speed and appear as the frequencies $_{RPM}$) instead of a single peak frequency itself, where and $_{RPM}$ are the *not* critical speed and the shaft rotational speed in Hz respectively. Such amplitude modulation of the serious speed in the vibration response is probably due to on-shaft vibration measurement using accelerometer. Hence this approach should be used to identify the critical speeds.

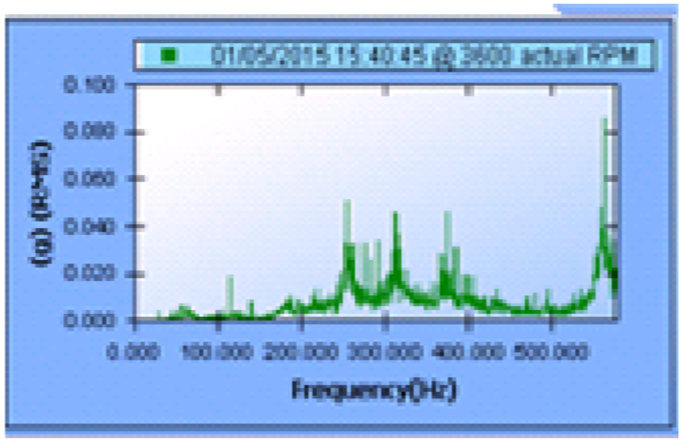

Fig. 5. Typical spectra of on-bearing measure acceleration response at the shaft speed (a) 1650.22 rpm (27.50 Hz) .

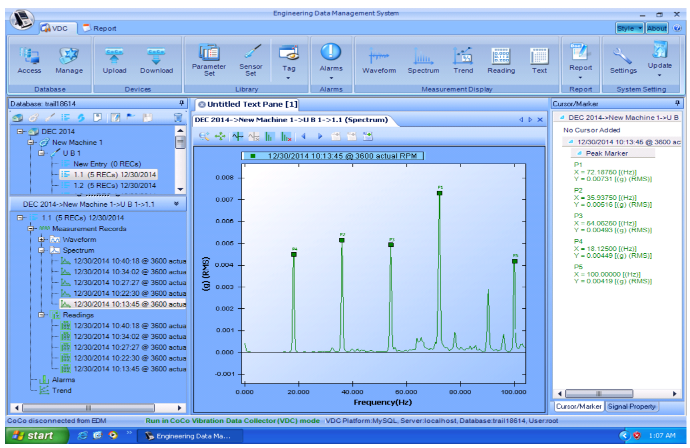

Fig.6. FFT of on-Bearing acceleration response highlighting modulated peaks, critical speeds of two end condtions

IV. CONCLUSIONS

On- bearing vibration measurement method using FFT transmission of the vibration signals has been proposed as a concept for the future condition monitoring system. The proposed method has been applied to a small experimental rig with a flexible rotor and the experiment has been conducted during the machine run-up. OBV data have been compared analytical calculation of critical speed determination. Hence the identification of various critical speeds values using the OBV data has been suggested based on the observation.

REFERENCES

[1] **M** E Elnady , Jyoti K Sinha and S O Oyadiji "Identification of Critical Speeds of Rotating Machines Using On-Shaft Wireless Vibration Measurement, the university of Manchester, Manchester m13 9pl, UK, April 2012.

[2] DR..zahari taha1,nguyen trung dung, Rolling Element Fault Detection with a Single Point Defect on the Outer Raceway Using Finite Element Analysis", Universiti Malaysia Pahang, 26300*A*, July 2010.

[3 Feiyun Cong, Jin Chen, et al.l., "Vibration model of rolling element bearings in a rotor-bearing system for fault diagnosis" Institute of Thermal Science and Power, China, July 2012.

[4] N.Jamaludin,D.Mba, "Monitoring extremely slow rolling element bearings" Department of Mechanical Engineering, faculty of Mechanical, Selangor, Malaysia.

[5] J.S.Rao et al "Condition Monitoring of Rolling Element Bearing"

[6] Mostafa A. Abu-Zeid, S.M. Abdel-Rahman, "Bearing problems' effects on the dynamic performance of pumping stations." Mechanical & Electrical Department, Ministry of Water Resources & Irrigation, Egypt B Mechanical & Electrical Research Institute, National Water Research Center, Ministry of Water Resources & Irrigation,Delta Barrage, Egypt. *February 2013.*