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DEVELPOMENT AND ANALYSIS OF FREQUENCY RESPONSE SETUP FOR POLE SHOE FERROUS MATERIAL CARBON STEEL 1010

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Abstract - *Basically Destructive and Non-destructive techniques are used for testing the components and check the defects. Testing is carried for all the materials like ferrous, non ferrous, ceramics, composites etc. The quality department and inspection department mainly focus on the testing final product. This work aims to catch the failure product as soon as possible to prevent excessive scrap. In such a way the faulty product can be removed so no further time and labor will be wasted. The objective of inspection of in-service pole shoe material is to make sure that the component or part in service will further satisfactorily perform its intended purpose. In this project several non-destructive techniques used for the inspection are discussed. It is important for the NDT inspector to be able to locate the source of the problem. The nature and type of discontinuities which can be expected in the material at each stage are understood.*

Key Words: Non destructive testing machine, Vibrometer, Impact, Pole shoe.

1. INTRODUCTION

Testing and evaluation of materials plays very important role in industry. The parts produced should meet the specified dimensions given by the customer. Non-destructive testing and evaluation (NDT&E) is a quality control tool that permits the industries to produce better quality products. The quality control department and inspection department should work in hand in hand together to reduce the scrap. It means that the inspection department should catch the fault in the product at early stage so that excessive scrap produced will be reduced. In this manner the faulty specimen or the product will be identified with no further labour or time to be wasted. The quality control department can make necessary changes before too many products are produced.

The objective of NDT is to make sure that the specimen in service will perform at full extent without hampering the operation. Also the detection of any flaw or defect without damaging the component fulfills both objective of finding the faulty piece and not wasting the material. 100% accuracy in part production is required by the company and also the need of customer. The specimen may serve as a part of any assembly with certain reliability. The interpretation of the data obtained by non destructive testing during inspection is performed to large extent by fracture mechanics concept. According to this concept, defects like any type of crack present in the material grow under vibration or stress during service and leads to failure of the specimen by growing upto extended limit. Also the fracture mechanics permit the remaining life of specimen and also allow to calculate critical size of flaw. Non destructive testing is used for finding size and defect location whereas Non destructive evaluation characterizes defect. The selection of NDT and NDE helps in clear understanding of problem to be sort.

2. Literature review

Ali Vaziri and M. J. Patil (2013): - studied the vibration analysis of a cracked shaft to determine catastrophic failure of the rotor. Defects in a structural member introduce a local flexibility which is a function of the crack depth. The detection of cracks in shaft by measuring the changes in an adequate number of the natural frequencies has been considered in this paper. 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. In this study variations in RMS value with respect to crack size are studied. From the study it has been concluded that the RMS value goes on increasing with respect to increase in crack size and increase in frequency. For constant frequency, RMS value is only function of variation in crack size. The frequency of the cracked shaft increases with increase in the crack depth for the all modes of vibration. [1]

Seth S. Kessler et al. (2002):- presents experimental and analytical survey of methods for the detection of damage in composite materials. To figure out the natural frequencies and mode shapes of the specimens, a scanning laser vibrometer system was used. It has been seen that the clamping condition is most sensitive factor in carrying out experiment. It was experimentally found that by slightly loosening the clamp, the lowest natural frequencies in the control specimen could drop up to 10%. Thus it can be concluded that clamping of specimen plays an important role in frequency response analysis. [2]

Ion Crastiu et al. (2017):- studied the development and validation of a vibroacustic technique to welding defects detection. They used condenser microphone in the frequency range of 20 – 20.000 Hz for experimental measurement of the vibroacustic response .The vibration

responses of the welded specimens, in free-free conditions, was carried out using algorithms based on Fast Fourier Transform (FFT), and Prony's series. The results obtained from this work shows that the signals and data analysis method for free vibration of the specimen can be considered as non-destructive method that can be used to determine the quality of the welding joint. Prony's Series Method and Fast Fourier Transform Method were compared with numerical method (FEM). FFT Indicator method gives the best stability for high resonance frequencies of the modes. [3]

Missoum Lakhdar et al. (2013):- stated the basic components of a composite material made him very sensitive to damage, which requires techniques for detecting damage reliable and efficient. It focuses on detection of damage by vibration analysis. The predicted results are compared with experimental results to confirm the approach usefulness. The area of fault detection by vibration method relies on very different work. Some models require, others are choosing to work without a priori information. [4]

Franz Pernkopf and Paul O'Leary (2003):- this paper provided an overview of three different image acquisition approaches for automatic visual inspection of metallic surfaces. The first method is concerned with gray-level intensity imaging, whereby the most commonly employed lighting techniques are surveyed. Subsequently, two range imaging techniques are introduced which may succeed in contrast to intensity imaging if the reflection property across the intact surface changes. However, range imaging for surface inspection is restricted to surface defects with three-dimensional characteristics, e.g. cavities. [5]

3. Various NDT methods

Visual inspection is the primary non destructive testing method. In this method only surface related discontinuities and surface cracks can be detected. Large numbers of products are produced per day in a factory. Just to sort the product with poor surface finish or surface defect product is easy job for the worker and no extra time or money to be wasted is required. The second most important NDT test is ultrasonic testing in which internal cracks or defects can be identified by the change in frequency of the waves. The change in frequency is shown in wave form and defect size can be identified. Liquid penetrating testing is done on the surface of the material. Large pipe lines carrying gas or petroleum are checked with by liquid penetrant test regularly to identify surface cracks and reduce the defect. X-Ray technique is also one of the useful non destructive techniques to identify the defects in materials. The greater penetration power allows the rays to pass through material and identify defects by filming the ray intensity

4. Problem identification

Pole shoe find wide range of application in industry in dc motor construction. Pole shoe after manufacturing are used directly in dc motor. The manufacturing includes many processes staring from forging to drilling and finally sand blasting. These materials are passed through many processes in which there are chances of internal defects that may reduce the reliability of the component and may cause premature failure of the component. Conventional methods like ultra-sound, X-ray etc can be used but they are not reliable for better results and also not economical. For every part to be mounted, then carrying test, un-mounting is time consuming. Hence a new method of non-destructive testing and maturity determination need to be created where in the process can be economical, reliable and repetable.

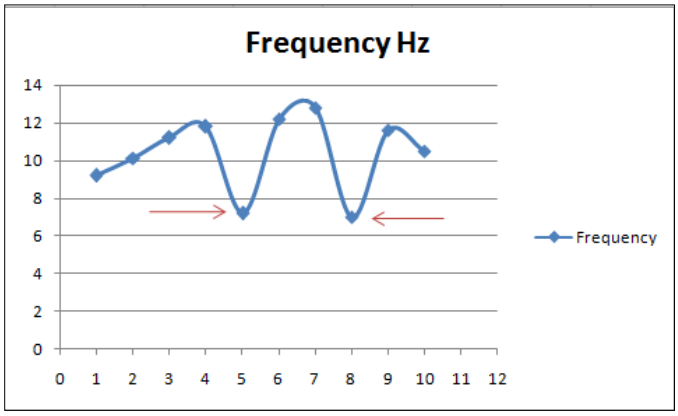
4.1 EXPERIMENTATION

Performance of NDT on pole shoe is done by using frequency response setup. Development and analysis of setup is done by using Ansys 15. Frequency, displacement and Acceleration readings are taken by using vibrometer. The setup consists of 12V dc motor, helical spring, fixed and movable jaw, pole shoe components, brass tong and electrical 2 way switch. The pole shoe is held between movable and fixed jaw. Then the pole shoe is placed on nylon pad for vibrations to pass.

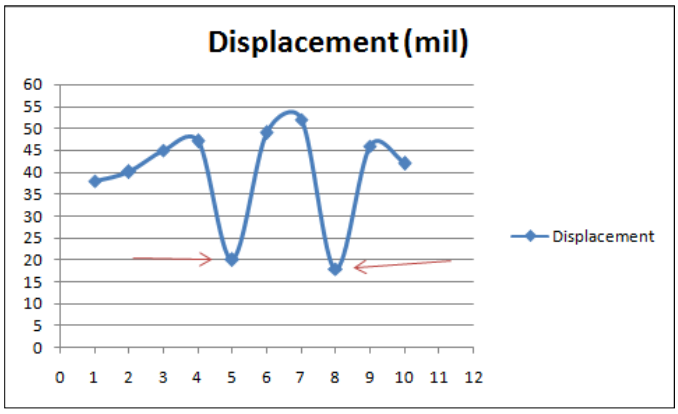
Table -1: Observation table

Sr. No	Samples	Freq Hz	Displacement mil	Acceleration mm/s^2
01	Pole shoe 1	9.2	38	602
02	Pole shoe 2	10.1	40	620
03	Pole shoe 3	11.2	45	652
04	Pole shoe 4	11.8	47	666
05	Pole shoe 5	7.2	20	502
06	Pole shoe 6	12.2	49	680
07	Pole shoe 7	12.8	52	702
08	Pole shoe 8	7.0	18	492
09	Pole shoe 9	11.6	46	658
10	Pole shoe 10	10.5	42	630

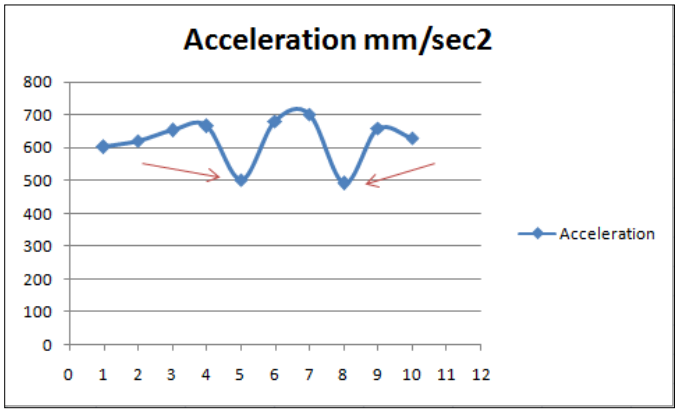
The brass tong is raised and hammered on the pole shoe, vibrometer connected records the reading for frequency, displacement and acceleration. Numbers of components are selected and graph for each i.e frequency, displacement and acceleration is plotted.



Graph -1: Specimen v/s Frequency



Graph -2: Specimen v/s Displacement



Graph 3: Specimen v/s Acceleration

The graphs are plotted as per the ten pole shoe samples. The vibrometer measures the values for frequency, displacement and acceleration. The range for healthy specimens is decided by taking the average of defect free readings. And the specimens showing the values below the certain level are defective specimens.

Fig -1: Pole shoe held in jaws

Fig -2: Specimens 1 to 5

Fig -1: Specimens 6 to 10

3. CONCLUSIONS

From the above observation table and graphs we can obtain the results. The specimens show the specific range of frequency (09 to 13.00 Hz.), displacement (37 to 54 mil.) and acceleration (600 to 720 mm/sec ^{2}) from which we can say that the specimens shows no defects in this range. The specimens with defect show frequency range of

7 to 8 Hz, displacement 18 to 20 mil., and acceleration 490 to 510 mm/sec^2. Specimens found doubtful have been proven defective by all the above three tests. By using frequency response method we can determine the acceptance zone and rejectance zone of specimens, presence of defects at very low cost of steel.

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