Vibration Analysis by Using Wheatstone Bridge Circuit

[1]Rahul S Jangam, [2]Vinode S. Mugle, [3]Parmeshwar G. Mote, [4]Vaibhav A. Nehete, [5]Prof. S.R.Kulkarni
Department of Mechanical Engineering, UCOER Pune. Maharashtra, India.

Abstract- *A visual graphical display of instantaneous mechanical vibration versus frequency over a selected frequency spectrum is presented to provide a vibration analyst with a prompt overall visual impression of the mechanical vibration characteristics of rotating device, which is under surveillance. In an alternative application, the visual display permits a rapid adjustment of an electrical band pass filter of an associated vibration analyser. The device employs several trains of diodes, which are arranged so that one or more diode in each train is illuminated at any one moment. The vibrational components over a frequency spectrum of interest developed by a machine are transformed into electrical signal by means of a transducer such as an accelerometer, and these electrical signal in turn are processed by means of a spectrum analyser to provide a power spectral density plot thereof. The peak amplitude of the signals in a pair of preselected frequency bands is then detected and the ratio between these two signals determined. This ratio is then compared against a value representing and acceptable ratio experimentally or theoretically derived to determine whether the majored ratio is within acceptable tolerance for the machine the bands utilised are preferably a first band within a high frequency vibrational range, and a second band lower in frequency than this first band with the signals in these bands being of medium amplitude relative to all of the signals developed in the spectrum analysis. A strain gauge based displacement transducer for measurement of the displacement in the range of 0 to 10 mm is reported. As compared to LVDT this transducer has short body length and is free from electromagnetic effect.*

Keywords- LVDT, Wheatstone Bridge Circuit, Mounting Strain Gages.

1. INTRODUCTION

In this system we are measure the vibration by using Wheatstone strain gauge meter bridge which is mounting on the system. The system is that of a cantilever beam of steel plate .We introducing a new concept to measure the vibration in the form of electrical signal. Mounting strain gages to load cell body is not a difficult task if the suggested procedure is followed. It is important to recognize that the strain gages are delicate and can easily be damaged if incorrectly handled or mounted most importantly, the solder pads will break off if strain relief is not provided. Strain gauges are sensors which are used in variety of physical measurements. They change resistance when they are stretched or compressed. Because of this property, strain gauges often are bonded to a solid surface and used for measuring acceleration, pressure, tension and force Vibration, in mechanics, is the to and fro motion of an object. Vibration can be exploited for useful tasks, such as the use of a vibrator to massage the body, to compact loose soil, to increase the workability of wet concrete and to shake sugar, pepper and salt from their containers. On the other hand, vibration can cause discomfort for people and problems for machines. Too much vibration can cause people to lose concentration and to fall sick. In machines, vibration causes wear and tear and can even cause the malfunctioning of the machine. So The vibration design aspect is even more important in micro machines such as electronic packaging, micro-robots, etc. Because of their enhanced sensitivities to vibration. Moderately thick plates are extensively used in modern structures. Analysis of these plates is of great importance for design engineers. The solution of the flexural vibration depends on the boundary conditions of the plate. Rectangular plates are commonly used as structural components in many branches of modern technology, namely, mechanical, aerospace, electronics, marine, optical, nuclear and structural engineering.

2. CONCEPT OF SHOCK AND VIBRATION

The terms shock and vibration are generally used to refer to the dynamic mechanical excitation that may cause a dynamic response of a physical system, usually a mechanical structure that is exposed to that excitation. To be more specific, a shock is a dynamic excitation with a relatively short duration and a vibration is a dynamic excitation with a relatively long duration as compared to the time required for a physical system exposed to that excitation to fully respond. Both shock and vibration excitations can appear either as an input motion or force at the mounting points or as a pressure field over the exterior surface of the physical system of interest. In either case the basic description of a shock or vibration is given by the instantaneous magnitude of the excitation as a function of time, which is called a time history. Shock and vibration excitations can be broadly classified as being either deterministic or random (also called stochastic).A deterministic excitation is one where, using analytical calculations based upon fundamental physics or repeated observations of the excitation produced under identical circumstances, the exact time his- tory of the excitation in the future can be predicted with only minor errors. For example, a step input with a fixed magnitude at the mounting points of an equipment item would constitute a deterministic shock, while the excitation produced by an unbalanced shaft rotating at constant speed would produce a deterministic vibration. On the other hand, a random excitation is one where neither analytical calculations nor previous observations of the excitation produced under identical circumstances will allow the prediction of the exact time history of the excitation in the future. For example, a chemical explosion produces a pressure time history with detailed characteristics that are unique to that particular explosion, while the vibration of a pipe produced by the turbulence in the boundary layer between the pipe and the high- velocity flow of a fluid through the pipe will also be random in character. The simplest model for a physical system that will respond to a shock or vibration excitation is given by a rigid mass supported by a linear spring, commonly referred to as a single-degree-of-freedom-system. The vibration of such a model, or system, may be "free "or "forced. "In free vibration, there is no energy added to the system but rather the vibration is the continuing result of an initial disturbance. An ideal system may be considered undammed for mathematical purposes; in such a system the free vibration is assumed to continue indefinitely.

3. METHODOLOGY

3.1 Selection Criteria of Adhesive.

Adhesive selection involves the following considerations:

- Substrates: What are you trying to bond? Are the surfaces the same or dissimilar, porous or smooth? Are you covering a large area? Do you have heat or solvent sensitive surfaces?
- Application restrictions: How do you intend to apply the adhesive-examples: spray, roll, heat gun, cartridge, squeeze bottle?
- Use Requirements: How does the bonded piece get used? How much strength is required.

3.2. Number of Adhesive Available

- Araldite AW 106 Resin HV 953U Epoxy.
- Araldite clear fast & clear epoxy adhesive.
- Epoxy Resign LY556.

3.3. Number of Adhered Available

1.Aluminum.
2.Carbon Fiber.
3.Fiber Reinforced Plastic (FRP).
4.Glass fiber.

Sr. No	Properties	Value
1	Shear Strength	186.16*10^5 N/m^2
2	Peel Strength	1.999*10^5 N/m^2
3	Tensile Strength	330.94*10^5 N/m^2
4	Young's Modulus	1.9*10^9 N/m^2
5	Density	1050 kg/m^3

Table 1: Properties of Adhesive

3.4.Wheatstone Bridge Circuit

Wheatstone's Original Design Charles Wheatstone's 1843 Bakerian lecture5 to the Reyal Society in London, "An account of several new Instruments and Processes for determining the Constants of a Voltaic Circuit," is a surprisingly modern paper on electrical measurements. In it he discusses the idea of resistivity, applies Ohm's law in a number of ways, and calculates the resistance of circuit elements in series and parallel. With a little bit of translation into modern nomenclature, this paper could be given to present-day students as a guide to making electrical measurements.

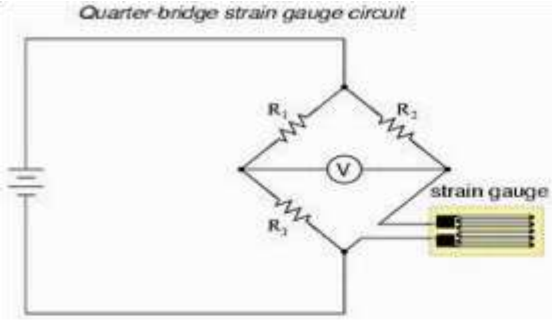

Fig.1: Wheatstone Bridge Circuit

3.5 Mounting Strain Gages

The correct positioning and orientation of the strain gages is important. Figure 2 shows the orientation and positioning for 1, 2 or 4 gage (full bridge) configuration. The arrows represent the gage grid line orientation. (Note that for the 4 gage configuration, the 2 transverse gages may be mounted at any convenient location on the load cell body, but must be oriented transversely). One gage (longitudinal) Two gages (2 longitudinal) four gages (2 longitudinal, 2 transverse)

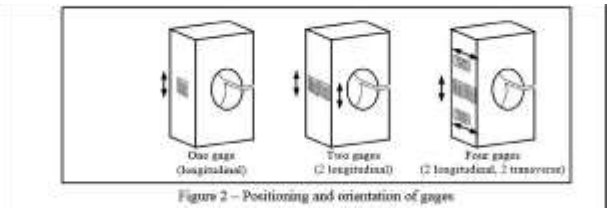

Fig. 2: Positioning and orientation of gages

3.6 Basic Setup Diagram

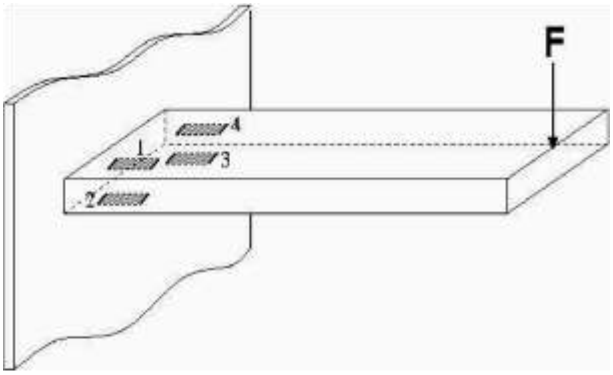

Fig.3: Basic setup Diagram

3.7.Output Signal on display

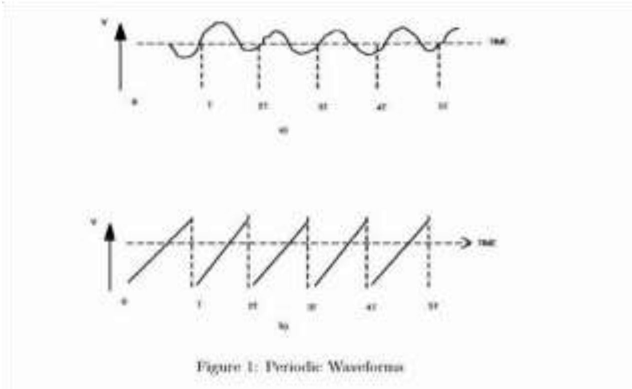

Fig.4: Dave Forms

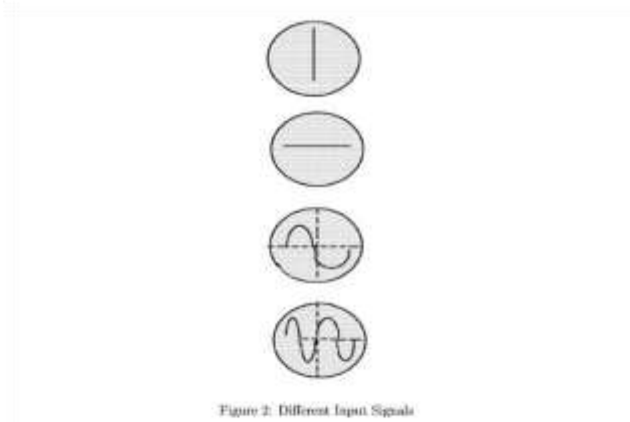

Fig.5: Different output Signals

4.WORKING

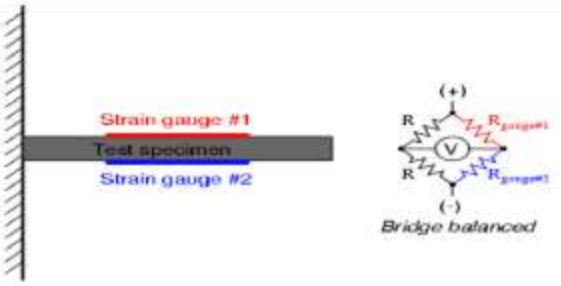

Fig.6.1.Working Diagram

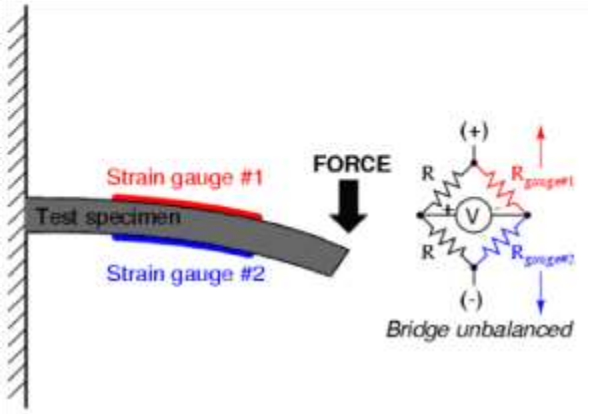

Fig.6.2.Working Diagram

5. DSO OUTPUT

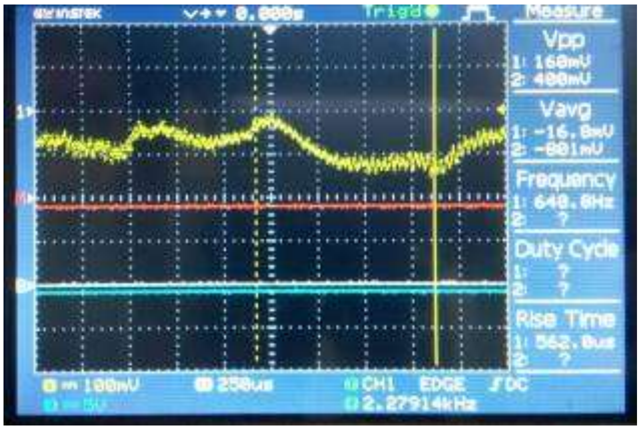

Fig.7.3.1.DSO Output

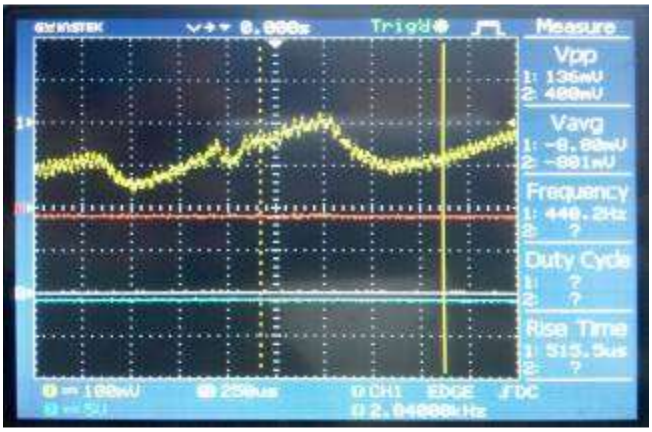

Fig.7.3.2.DSO Output

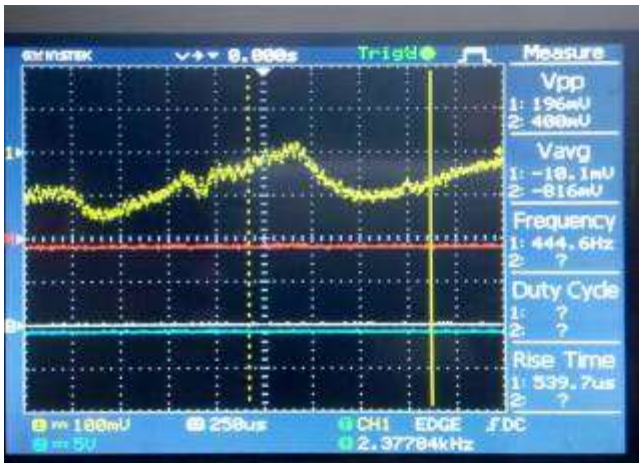

Fig.7.3.3.DSO Output

6. CONCLISION

By using this experimental setup result shows very good linearity with short body length on DRO display in the form of waves that means mechanical vibrations shows in the form of electrical signals. A strain gauge based transducer for displacement measurement of range 0–10 mm has been fabricated and tested. The experimental results show very good linearity with short body length as compared to the LVDT of same range. In this paper I have emphasized the importance of collecting and analysis of vibration data. Scheduled analysis of vibration data helps to maintain the health and thus improve the lifetime of the machine which saves the time and money.

REFERENSES

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