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Design and Manufacturing of Pneumatic Based Vibration Exciter

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ABSTRACT

The test component or part under study is subjected to the mechanical vibratory motion. This motion is generated by the vibration exciter. Designing of such exciter machine along with its construction and performance testing is focused in this study. This machine has unbalanced mass which generates uniaxial vibrations. Specified range of harmonic or time dependent excitation force is generated by the exciter. Also, time dependent displacement through a specified frequency is achieved. The vibrations are generated due to centrifugal force of eccentric mass which rotates. The vibrations produced lie in the low frequency range. The construction of working device and its important parts are described here. This exciter is used for testing of welded parts, small mechanical part. The obtained experimental results are in line with theoretical results. In this project we used pneumatic cylinder for provides vibration to fixer plate and pneumatic cylinder will actuate with help of solenoid valve and microcontroller. testing specimen will be mounting on fixer platform Model analysis will be require find out natural frequency of test specimen and validates with the help of FFT analyser impact hammer test.

Keywords : Microcontroller, FFT Analyser, Hammer Test

I. INTRODUCTION

A vibration exciter is a machine which produces mechanical vibratory motion to test object. The exciters are designed to produce a given range of harmonic or time dependent excitation force and displacement through a given range of frequencies. These machines can be mechanical, electrohydraulic or electro-dynamic in nature. The vibration exciters available in market were too costly for small scale applications so there was a need of for relatively low-cost exciter which can be used for low frequency range. This can be used for experimentation purpose and testing product at different frequencies. Certain machines and structures that develop excessive vibrations during their life and it may be required to make a diagnostic vibration analysis to prevent an impending failure of some of components. Such components can be tested using vibration exciters. Different types of vibration exciters are used for development, simulation, production, studying the effects of vibration and for evaluating physical properties of materials or structures. This paper also provides a brief description about different types of vibration exciters, its advantages and disadvantages

over mechanical vibration exciter. It includes theory on forced vibration exciters.

II. LITERATURE REVIEW

Pramod Rao et al. [1] A vibration exciter is a machine which produces mechanical vibratory motion to which the test object is subjected. This article presents design, construction, performance and testing of mechanical vibrations exciter, which have unbalanced mass to generate uniaxial vibrations. The exciter is designed to produce a given range of harmonic or time dependent excitation force and displacement through a given range of frequencies. The mechanical vibration exciter produces vibrations due to centrifugal force of rotating eccentric mass. The vibrations produced lie in the low frequency range. The construction of working device and its important parts are described here. The most important part of exciter is unbalanced mass attached with rotating disc of motor. Exciter has unbalanced mass at one end of disc, base frame, top plate as platform, springs and motor. This exciter is used for testing of welded parts, consolidation of concrete, concrete filling in mould. The obtained experimental results are in line with theoretical results.

Zhen liang Huang et al. [2] According to the functional requirements of mechanical auto parts road simulation vibration test platform, mechanical auto parts road simulation vibration test platform structure is studied and designed, and a vibration simulation test platform entity is developed which can simulate auto parts vibration test on the actual road. The vibration simulation test platform design features is verified by experiments. New mechanical auto parts road simulation vibration test platform is a mechatronic vibration test platform. Through the integrated use of a variety of mechanical and electrical control technology it has been achieved that the mechanical exciter amplitude adjusts continuously and a combination of multiple vibration frequencies output. It improves vibration performance and meets the different needs of the excitation amplitude and frequency. It is a new kind of auto parts road simulation vibration test platform, compared with electromagnetic and electro-hydraulic exciter vibration simulation test platform, low cost, easy to use, has good application prospects. Prasad R. Bhokareet al. [3]A vibration exciter is a machine which produces mechanical vibratory motion. Vibration gives a significant effect in many aspects of our life. The vibration exciters or shakers can be used in several applications such as determination of the dynamic characteristics of machines and structures and fatigue testing of materials. Article presents design, development and testing of Electromagnetic vibration exciter which uses flexural bearings for frictionless vibration generation. Modeling of flexure bearing is done by using software's like CATIA/PROE and FEM analysis of flexural bearing is done by using Ansys software. Initial experiments are conducted on vibration exciter and identification is carried out. System identification reveals the force deflection characteristics, damping property and frequency response. It is observed that experimental results are in close match with theory results with accuracy of less than 5%. For flexure bearing having angle 360° and thickness 1 mm with spiral slot dimension 1.5 mm is suitable for our work. MATLAB Simulink code was developed for real time frequency response estimation. With amplitude of 0.08 volts, a frequency (1 Hz to70 Hz) response curve for the system is generated to analyse the natural frequency of the system and the phase change behaviour. It is observed that peak frequency is 24.51rad/s. The damped Natural frequency is 3.8625 Hz. The Force-Deflection curve is linear in nature and has fixed slope. Peng Junet al. [4] in this paper, we study the high-temperature effects on the reflection of shock waves in hypersonic flows by using analytical and computational approaches. First, a theoretical approach is established to solve the shock relations which are further applied to develop the shock polar analytical method for high-temperature air. Then a

comparative investigation using ideal gas model and real gas model considering vibration excitation indicates that the high-temperature effects cause an obvious change to the overall profile of the shock polar. The post-shock pressure increases within the strong branch of the shock polar while decreases within the weak branch due to vibration excitation of air molecules. A more notable phenomenon is the increase in the maximum deflection angle of the shock polar which can significantly influence the detachment criterion of shock reflection transition in high-temperature air flows. A further investigation about the effect of vibration excitation on the transition of shock reflection indicates that vibration excitation makes the detached angle increase significantly while influences the von Neumann angle slightly.

III. PROBLEM STATEMENT

Mechanical vibration exciters can accommodate only a single type of output like SHM. These conventional cam profiles can not provide shocks and sudden jerks. But vibration exciter has operating on pneumatic cylinder are easy to operate So it was planned to fabricate a vibration exciter with multiple output using Adriano and solenoid valve .

IV. OBJECTIVES

•To design and manufacture experimental test rig for pneumatic vibration exciter.

- CAD model of pneumatic vibration exciter.
- To perform model analysis of pneumatic vibration exciter model.
- Selection of solenoid valve and microcontroller, its program
- Experimental vibration testing setup with the help of FFT analyzer and impact hammer.

V. METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about solar tracking system.
Step2: - After that the components which are required for my project are decided.
Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of software.
Step 4: - The components will be manufactured and then assembled together.
Step 5: -The testing will be carried out and then the result and conclusion will be drawn.

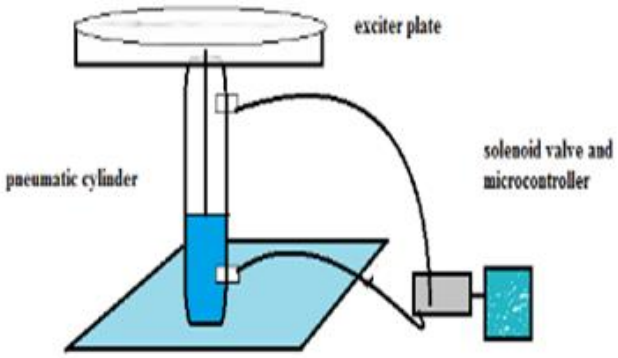

Figure: - Basic 2d Model

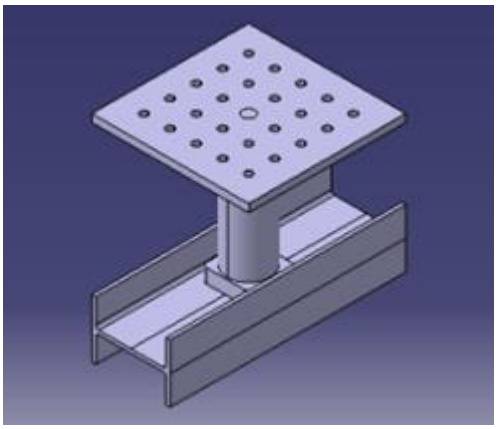

Figure 1 : -3D model of Pneumatic based Vibration Exciter

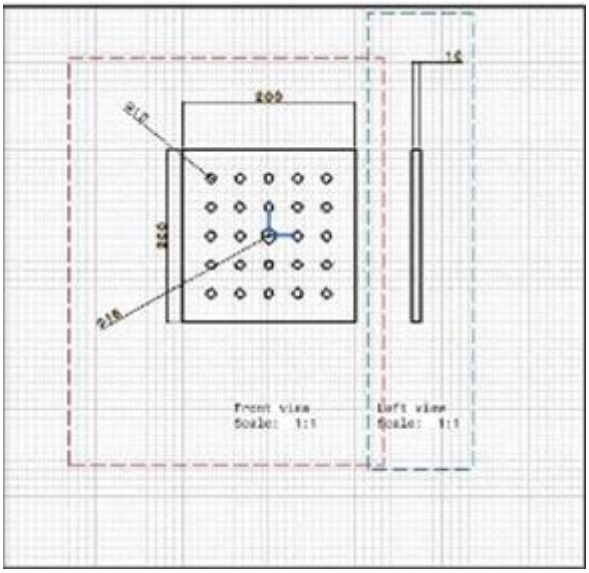

Figure 3 : Drafting of Pneumatic Based Vibration Exciter

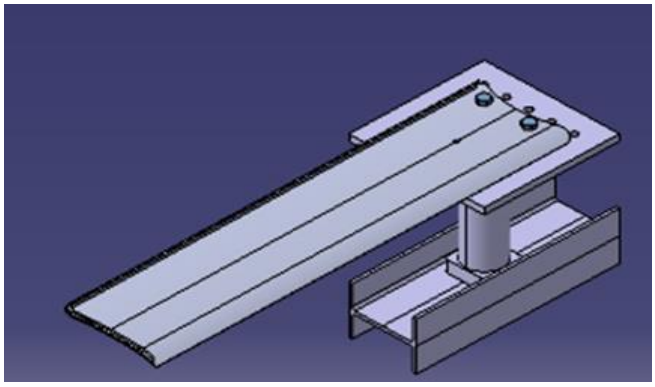

Figure 3 : 3D Model of Pneumatic based Vibration Exciter with Fan blade

VI. MODAL ANALYSIS

Properties of Outline Row 3: Structural Steel

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	7850	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
5	Coefficient of Thermal Expansion	1.2E-05	C^-1
6	Isotropic Elasticity		
7	Derive from	Young's Modulu...	
8	Young's Modulus	2E+11	Pa
9	Poisson's Ratio	0.3	
10	Bulk Modulus	1.6667E+11	Pa
11	Shear Modulus	7.6923E+10	Pa

2. Finite Element Analysis:

Design of existing pneumatic based vibration exciter is done by using CAD package CATIA V5 as per following;

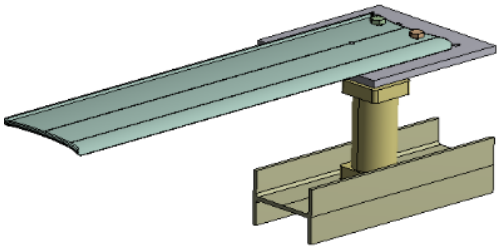

Figure 4 : 3D Model of vibration exciter

3. Mesh

ANSYS Meshing is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient Multiphysics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model. Full controls over the options used to generate the mesh are available for the expert user who wants to fine-tune it. The power of parallel processing is automatically used to reduce the time you have sto wait for mesh generation.

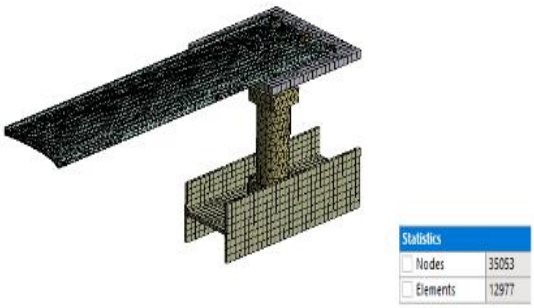

Figure 5 : Meshing of pneumatic based vibration exciter with Fan blade

VII. RESULTS

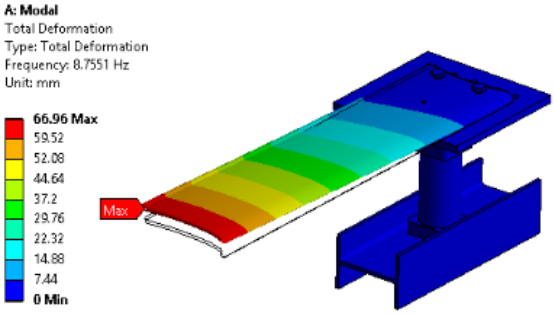

Figure 6 : Natural frequency of pneumatic based vibration exciter with Fan blade at mode 1

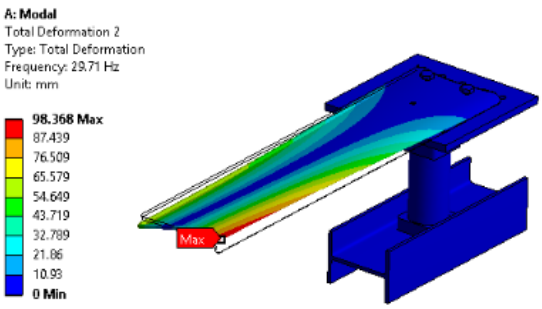

Figure 7 : Natural frequency of pneumatic based vibration exciter with Fan blade at mode 2

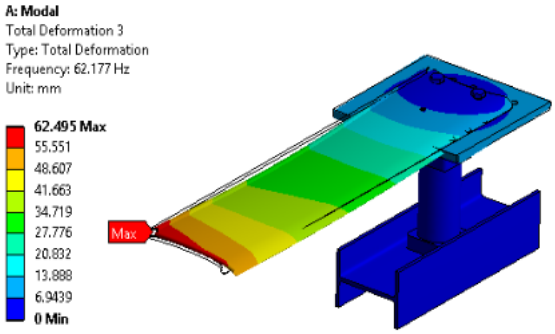

Figure 8 : Natural frequency of pneumatic based vibration exciter with Fan blade at mode 3

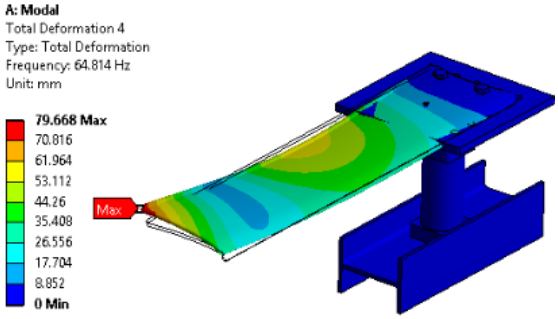

Figure 9 : Natural frequency of pneumatic based vibration exciter with Fan blade at mode 4

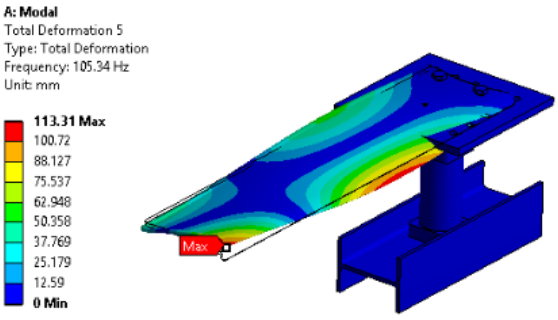

Figure 10 :Natural frequency of pneumatic based vibration exciter with Fan blade at mode 5

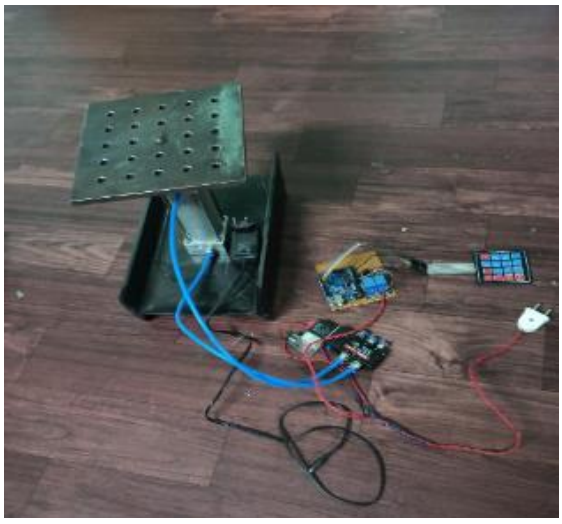

Figure 11 : Experimental setup of pneumatic based vibration exciter

The experimental validation operation is done by using FFT Operation testing (Fast Fourier Transform) analyzer. The FFT spectrum analyzer samples the input signal, computes the magnitude of its sine and cosine components, and displays the spectrum of these measured frequency components. The advantage of this technique is its speed. Because System operation FFT spectrum analyzers measure all frequency components at the same time, the technique offers the possibility of being hundreds of times faster than traditional analog spectrum analyzers. Fourier analysis of a periodic function refers to the extraction of the series of sines and cosines which when super imposed will reproduce the function. This analysis can be expressed as a Fourier series operation. The fast Fourier transform is a method of operation mathematical method for transforming a function of time into a function of frequency. Sometimes it is described as system transforming from the time domain to the frequency domain. It is very useful for all method analysis of time-dependent.

VIII. EXPERIMENTAL RESULTS

FFT analysis FFT is one main property in any sequence being used in general. To find this property of FFT for any given sequence, many

transforms are being used. The major issues to be noticed in finding this property are the time and memory management. Two different algorithms are written for calculating FFT and Autocorrelation of any given sequence. Comparison is done between the two algorithms with respect to the memory and time managements and the better one is pointed. Comparison is between the two algorithms written, considering the time and memory as the only main constraints. Time taken by the two transforms in finding the fundamental frequency is taken. At the same time the memory consumed while using the two algorithms is also checked. Based on these aspects it is decided which algorithm is to be used for betterresultsDEWE-43 Universal Data Acquisition Instrument When connected to the highspeed USB 2.0 interface of any computer the DEWE-43 becomes a powerful measurement instrument for analog, digital, counter and CAN-bus data capture. Eight simultaneous analog inputs sample data at up to204.8 kS/s and in combination with DEWETRON Modular Smart Interface modules (MSI) a wide range of sensors are supported Voltage Acceleration Pressure Force Temperature Sound Position RPM Torque Frequency Velocity And more The included DEWESoft application software adds powerful measurement and analysis capability, turning the DEWE-43into a dedicated recorder, scope or FFT analyzer.

IX. CONCLUSION

From modal analysis results it conclude that pneumatic based vibration exciter with Fan blade had maximum frequency at mode 5

Pneumatic based vibration exciter was simple manufacture setup, who can provide different output frequency for testing of mounted part.

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