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Review: DESIGN OF PASSIVE COMPOSITE ISOLATION SYSTEM FOR MACHINE FOUNDAION

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Abstract — *The contribution of design has been essential to the more recent developments in new machine foundation isolation. To minimize vibration level, isolators are equipped for getting minimum transmissibility. The paper reviews the analyzing the dynamic response of foundations subjected to machine-type loadings. Following a brief outline of the historical developments in the field, the concepts associated with the definition, physical understanding and use of the dynamic impedance functions of foundations are elucidated and the available analytical as well as software methods for their evaluation are discussed for the sake of comparison it is again analyzed by making different experimentation . Care must be taken to ensure smooth running of machine by avoiding damaging vibrations in the base or if the foundation does not fixed on the ground, in the floor which supports it and may transmit vibrations to the structure or nearby machine Furthermore, through comparisons with published research work and rigorous boundary element solutions, the validity of the design formula has been established.*

Keywords- *vibration, isolation, passive, composite.*

I. INTRODUCTION

The machinery which having different forces by reciprocating, impacting, or rotating motion requires a support system that can resist dynamic forces and the resulting vibrations. When excessive, such vibrations may be detrimental to the machinery foundation, its support system. Many engineers with varying department are engaged in the analysis, design, construction, maintenance, and repair of machine foundations. Therefore, it is important that the operator, engineer and equipment supplier collaborate during the design process [9]. As the adverse and undesirable effects of these vibrations include reduction in tool life, improper surface finish, unwanted noise and excessive load on the machine tool.

A machine tool is expected to have high stiffness in order to avoid such effects. Hence the machines are to be made of strong structured materials through passive foundation damping technology to suppress the chatter vibrations and thereby increasing the production rates [3].

At a time of working condition of machine, the vibration creates dynamic forces, also it causes by the other affects also such as: nearest machine vibration pass by ground, operation of reciprocating machine and hammers [1]. And now a day because of the limitation of land much more time some small firms are assembled the machines at second, third floor also; and there vibration are harmful for the structure. For this case the seismic base isolation is a valuable resistant technique for structures.

As a result of isolation, the fundamental horizontal period of structure is increased to a value away from the dominant range of periods of ground vibration. Therefore, the energy transmitted to the structure by ground is decreased considerably. This is achieved by installing isolators which have low horizontal, but high vertical and bending stiffness beneath superstructure [5]. Vibration isolation is the action or treatment that eliminates the unwanted vibration or reduces it to an acceptable level [2]. Composite polymers have been used as isolators for their damping ability. This study aims to the damping characteristics of Hybrid polymer composite, which can be used in many applications, and in engineering structures. Polymer Glass and carbon fiber reinforced with epoxy matrix hybrid composite have to be prepare by hand-lay-up and vacuum-bag molding fabrication technique because it is light weight and have good damping effect as compare to single material[13].

The rubber and the steel reinforcing cords used in manufacturing the tire are the alternative materials of the proposed base isolation system. The steel reinforcing wire represent the steel plates used in conventional coated rubber bearings. These steel reinforcing cords shall prevent the lateral bulging of the rubber bearing, it also having effective under static condition[16].

The basic aimed in the design of a machine foundation is not to limit its motion to amplitudes which will endanger the satisfactory operation of the machine nor will they disturb the people working in the immediate vicinity. Thus, a key ingredient to a successful machine foundation design is the careful engineering analysis of the foundation response to the dynamic loads from the anticipated operation of the machine [15]..

II. VIBRATION CRITERIA

As the area of working is very critical, so as per that case design of machine foundation is very important, in which vibrations are taken into account, the following conditions should be satisfied by isolating pads [10]:

1 the vibration does not damage to the structure where the machine is housed and also to the surrounding structures.
2 prevent the machine itself from its vibration.
3 The working of machine or the adjacent machines is not impaired.
4 Extreme maintenance cost for the machines and structures is not generated.
5 The health of employees in the vicinity is not impaired.
6 The health and comfort of the people in the surrounding area is not adversely affected.

7 Resonance should not take place, i.e. frequency at working condition of the machine should not match with the natural frequency of the foundation. The zone of resonance should be avoided; otherwise induced amplitudes may be very high

III. DIFFERENT ISOLATING SYSTEMS USED FOR FOUNDATION

Jyant Kumar has done work on, Dynamic response of footing and machine with spring mounting base (2006). In these work, the effect of spring mounting cushion type of isolator is inserted between the concrete block and machine base. It has been tested by experimentally for block vibration. For the experimentation the machine is in the vertically loaded and it has been checked by harmonic motion. By these research, for different footing block the frequency is different and for some of the case it excide the resonance level. By analyzing the different testing, proper block size is defined for experimental setup [1].

GyungJu Kang [2] investigates Dynamic analysis of fiber-reinforced elastomeric isolation structures (2009). This work is related with analysis of seismically isolated buildings using fiber-reinforced elastomeric structures that are subject to excitations caused by earthquakes. The steel-reinforced elastomeric isolator is composed of layers of rubber and steel plates. The plates protect from lateral bulging of the rubber layers yet allow the rubber layers to undergo shear deformation.

Mr.Ashirbad Swain [3] investigate, Analysis of machine tool structure using RSM approach. In these work Machine like lathe, milling, broaching, and grinding machines, etc. are subjected to regular vibrations. These machine vibrations or chatter are harmful to machining operations. It results in degraded quality on the machined parts, shorter tool life, and repulsive noise, hence are to be necessarily damped out. The important characteristics of the machine tool structures for metal cutting are high damping and static stiffness which ensure manufacture of work pieces of the required geometries with acceptable surface finish at the required rate of production in the most economical way. The unwanted vibrations must be arrested in order to ensure higher accuracy along with productivity [3]. In this isolation system the composite epoxy type of materials are use to isolate the vibration. These isolating pads are mounted in between the machine bed and object which is to be machined. As the vibration as traveled from machine rotating parts to tool, it has been restricted by the isolating member. This system is analyzed by the Digital Storage Oscilloscope to check the vibration level. And from this the effective isolating dimension pads are used to avoid chatter vibration.2011

Pedro Jorge [4] has investigate Cork Composition Damping Layer To Reduce Vibrations In this work, finite element (FE) models and experimental tests of a cork composition material used as a damping layer in the unconstrained and constrained damping treatments of steel plates are used to show the performance of the cork composition, used in the damping treatments, to reduce vibrations over a predefined frequency range of interest. To obtain the experimental FRF curves, the experimental setup with an impact hammer to apply to the panel the force effectively measured through a force transducer (input signal). The dynamical deformation propagates throughout the panel and, on the back side of the panel, an accelerometer measures the acceleration (output signal) are used. three different experimental test panels have been built and tested, They are: 1. The panel without treatment;
2. The panel subjected to a FLD treatment using cork composition material;
3. The panel subject to a CLD treatment using a cork composition material and a similar steel panel as the elastic constraining layer.
Result it reveals to be quite capable in reducing vibrations when used in the constrained damping treatment. This may opens up a new frontier for composition materials, which are known to be capable of supporting higher temperatures then most viscoelastic materials used in this type of treatments.2012

Now a days a new types has been introduced for the vibration isolation purpose, in that type scrap tire rubber pads (STRP) has been introduced for isolating seismic types of vibration. “Finite element analysis and experimental verification of the scrap tire rubber pad isolator”(2013), by HumaKanta Mishra et.al.[5] The conventional seismic design approach in recent practices is aimed to provide adequate strength and ductility in order to maintain the structural integrity and to absorb seismic energy. This method is based on the fact that the structural components have to be designed for the required seismic demand. This system is tested with the help of vertical and horizontal actuator load machine. With the help of the

machine calculation its strength has been calculated. As the static load is consider by a simple machine, the system goes in compression. And the load verses the compression graphs are plots to compare the composite system with ordinary system. As in the scrap tire the steel fibers are presented, it restrict the static load and the rubber helps in absorbing the vibration.

Mustapha Assarar et.al.(2013) has introduced, Analysis of the Damping of Sandwich Materials and Effect of the Characteristics of the Constituents [6] In much of the system the epoxy composite isolating pads are used which are tested with the help of numerical governing equation or making as a beam by the epoxy material, and same beam has been checked for the vibration testing by using hammer and sensor of the vibro-meter .

Structural composite materials tailored for damping introduces by D.D.L. Chung [7]. This paper reviews the tailoring of structural composite materials for damping. By the use of the laminating interfaces and viscoelasticity provided by appropriate components in a composite material, the damping capacity can be increased with negligible decrease, if any, of the stiffness. In this study the polymer matrix and cement –matrix for viscoelastic material are introduced. This is useful for the noise and vibration isolation.

The fundamental equations of motion are derived for base isolated structures, and the hysteretic and nonlinear-elastic characteristics are included in the numerical calculations. For experimental investigating the system, it is tested in vertical load machine. And its loading to deformation has been tested. In this work two types of system are taken in account and for both of the system same experimentation has been carried out. These types of system are known as passive type of isolation system.

For heavy static loading condition different isolating systems are made with the steel and rubber. These systems is analyzed by using the experimental as well as numerical by using governing equation and for the sake of checking experimentation has been carried out on vertical loading machine. By which the load and deformation has check for the static loading.

Mustapha Assarar et.al. has done work in Analysis of the Damping of Sandwich Materials and Effect of the Characteristics of the Constituents, In the work modeling of the damping properties of sandwich materials that was implemented considering the theory of sandwich plates and using a finite element analysis. The analysis derives the strain energies stored in the material directions of the foam core and in the material directions of the layers of the skins. Further, the energy dissipated by damping in the structure can be obtained as a function of the strain energies and the damping coefficients associated to the different energies stored in the material directions of the core and the layers of the skins [3].

Stress levelon sustainable vibration isolator using numerical method by M.A. Salim 2015 [12] This paper represents the stress distributions study on sustainable vibration isolator using numerical method. In these research work, Rubber materials were used and modeled because it is a hyper elastic material and it. Behavior. Mooney-Rivlin model were used to investigate the stress and strain indicator. The numerical base tool has used for the finding the isolation. vibration isolator due to stress distributions. According to the analysis, by increase the number of metal plate, it was found that the deformation is reduced; however the stress distributions become higher. To find the isolation two types are there, They are frictional type sliding isolator and laminated rubber bearing isolators with and without lead-core. In this research the laminated isolator has use and has been laminated by the rubber and steel plate. By using the different later of steel plate the isolation factor has tested by numerically, and from that the result has been found that, increasing the number of metal plate has increase the stiffness of isolator.

IV. CONCLUSION

The above works stated the different isolation materials and their effect, by different types of experimentation. It has been see that, numbers of isolating materials are used for different working condition. for some of the experimentation, single material is used and in some cases composite material are used. The composite materials are also of polymer or epoxy type. Much more researcher was using same material with different design.

By the above research work, rubber, cork, concrete, polymer, ceramics and epoxy materials are used for isolation. For these isolation calculation different methods are used as; digital vibro-meter, numerical governing equation for the work.

In all these research area, the composition has used only of two materials. Now it has necessary to use the composite passive isolation type, with the cork, rubber and mild steel. These are for stiffness, damping and static loading condition. These three materials have different property of damping, so there position in isolation pad is also makes an important role so, now the pads are made with different composition at different position. And it is check for the different machine foundation for experimentation by using the F.F.T. Analyzer. For the sake of comparison, isolating pads are analyzed by the ANSYS for calculating its natural frequency and deformation under dynamic loading, because machine work on varying load. To find the rigidity and damping ability, it has to test on vibration exciter machine.

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