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Vibration Control Devices: A Review

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***Abstract*: Vibration control is the mitigation of seismic impact on structures. Vibrations occurs due to various natural as well as manmade causes. So it is necessary to protect the structures against vibrations by using devices such as isolators, dampers, piezoelectric devices, vibrating barriers etc.**

The aim of this review paper is to present general overview of vibration control by various techniques so as to get idea about its effectiveness safety and economy.

***Keywords*: Vibration, Passive vibration control, Active vibration control, Dynamic modeling, AVC, PZT, Dampers.**

1. Introduction

Vibration is a mechanical phenomenon i.e. oscillation about an equilibrium point. Vibrations are occurring due to both natural and manmade causes. The unwanted vibration may cause damage to structure or degradation of the system. Over the past few decades world had experienced number of disasters due to earthquake which resulted in structural damages collapse of buildings and loss of human life. Hence it is necessary to control the vibrations to reduce its impact on the structures and mitigate further disaster. So basically vibration control system is modern technique which prevents or diverts the major portion of vibrating energy from entering into the main system.

Three types of vibration control systems are passive vibration control system which do not require any additional source to operate and activated by vibrating motion only e.g. base isolator. Active vibration control system which imposes force on the structure which counterbalances the vibrations induced, by using energy sources and computer controlling operations e.g. active mass dampers. Hybrid vibration control is the combination of passive and active vibration control system.

2. Literature Review

Vibration Control by Piezoelectric Materials- A Review

This paper gives idea about vibration control by using PZT (Lead Zicronate Titanate). It transfers energy between the mechanical and electrical domain of materials. In this paper the behavior of the beam is observed after using magnetically mounted PZT elements for same mass and natural frequencies which influenced by vertical and tangential contact stiffness's between control mount and beam. It is observed that for low contact stiffness there is a minimum influence on the bending natural frequency but for higher stiffness, frequencies asymptotically approaches with perfectly bonded control mount beam. Magnetic PZT control devices reduces vibration even without perfect bond but it is dependent upon magnetic bond between beam and control device i.e. stiffness and thickness of magnetic layer. It can be used for simple structures e.g. beam and plates. It is not suitable for complex system because it is difficult to understand the environmental effect which influences the system. Also use of epoxy makes it costlier and difficult for configuration.

Application of Dampers for Vibration Control of Structures - An Overview

It gives us idea about different types of vibration control techniques and its uses e.g. visco-elastic dampers it consists of steel plates with viscous materials, metallic dampers it dissipates the energy through the inelastic deformation of metal, viscous dampers it works on the principle of fluid flow through orifice. Shape memory alloys these types of alloy can regain their original shapes when heated at certain temperature. Elasto-plastic material which may be in X or V shape X shape is more effective during earthquake .it can absorb more energy so the intensity can be reduced.

Review of Active Vibration Control

It gives basic information about Active vibration control (AVC). AVC is based on principle of superposition and destructive interference. Basic three types of vibration control approaches are, feed forward and feed backward approach, Feed forward corrects the error before it happens and feed backward corrects the error after it happens. Analogue and digital approach, analogue approach is simple hence used for local applications, digital approach is used when type of vibration or noise is exactly known. Adaptive or non-adaptive approach, adaptive method can be used for many applications but it has problem with speed and sustainability on the other hand the methods which are non- adaptive due to their simplicity has more acceptances.

A Review On Recent Active Vibration Control Techniques

It gives idea about new AVC techniques e.g. Integral based controllers. These are based on proportional integral method and used in closed loop form. Sliding mode control and nonlinear method can be used in cantilever beams. Positive position feedback (PPF) is used in space structures. It has piezoelectric sensors. Micro-Electric-Mechanical (MEM) system is extensively applicable in micro mass measurement e.g. micro gyroscope.

Dynamic Modeling and AVC of Flexible Beam

It gives knowledge about AVC of flexible beam using smart materials. Dynamic modelling is carried out and FEM is used for numerically solving the equations. The behavior of beam is observed by displacement of element and material law. It gives idea about designing the controllers. Conventional controller is simple but adaptive controller is better when parameters are unknown and uncertain.

Vibration Control of Structure Through Structure-Soil-Structure Interaction

Introduction of control devices in existing structure is difficult and costly process. Especially in historical building it is strictly prohibited. So the alternative option is to introduce some structure in soil away from the structure e.g. pile or wall which can absorb or divert the energy. This phenomenon is based on soil-structure-soil interaction. It can reduce the intensity upto 44%. It is efficient and gives better result when pile diameter is small with respect to the wavelength. In this paper the analytical expression is given and reduction factor is calculated by different spacing between barrier and structure. If spacing is less, then the reduction factor is more that means efficiency is less. This method is efficient up to 10-meter spacing.

3. Conclusion

This paper presented a literature review about vibration control. Objective of this paper is to summaries the types of vibration control devices and attract the engineers or researchers for further study about this subject. Key point in designing any successful vibration control device is first to understand the problem very well. After that choosing best option which can reduce structural and non-structural damages also increase safety and serviceability. It is highly impossible to stop the vibrations but it can be reduced or controlled by three ways, addition and alteration in existing structure wherever possible e.g. tuned mass dampers, by constructing the safeguard around the structure e.g. shear wall. If these two ways are not practicable in such cases structure-soil-structure interaction can be used e.g. pile.

References

[1] Vibration control by piezoelectric materials- a review
[2] Application of dampers for vibration control of structures – An overview
[3] Review of Active Vibration Control
[4] A Reviews on recent active vibration control techniques.
[5] Dynamic modeling and AVC of flexible beam
[6] Vibration control of structure through structure-soil-structure interaction