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Simulation of Structural Vibration Controlled System Using Semi Actively Controlled MR Dampers

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Abstract - *Semi-dynamic disconnection framework have gotten consideration over the dynamic and uninvolved separation framework for vibration, alleviation of vibration in modern application is the basic improvement. Magneto rheological damper speedy reaction to unexpected moves with less power utilization prompts many research and structure of MR damper for various plan parameters and variable flow contribution, in this present work planned a MR damper with all the essential structure parameter data assembled from before work., number of loops required to create the compelling attractive transition field has been determined to plan the magneto rheological damper and to arrive most extreme attractive motion thickness versus dc ebb and flow with legitimate extent level of ferrite particles in MR liquid which further prompts ascertain shear pressure and damper power can deliver by the planned MR damper at variable ebb and flow input.*

Key Words: *MR damper, MR fluid, damping force*

1. INTRODUCTION

Recently rising semi-dynamic control device, magneto rheological (MR) damper, indicates great promises for stun assimilation in the fields, for example, structural designing, aeronautic design, car building, etc. Some issue ought to be completely concentrated to make MR dampers use broadly in engineering, for example, plan of MR dampers, execution tests and numerical model for MR dampers.

The customary strategies utilized for the ideal structure of MR damper are done through streamlining the geometric and parameters of the electromagnetic circuit [1].In a MR gadget, magnet get together assumes a significant job in gadget in general attributes. Electromagnet configuration influences both liquid stream and magnetics. Since the hole is likewise part attractive circuit, it influences the attractive execution parameters, for example, motion thickness and time response.so following are the goals of magnet get together plan for MR gadget

Design a low hesitance attractive circuit that manages the attractive transition lines into a locale where MR liquid should be stimulated (for the most part an annular gap in the scope of 0.5– 2 mm). • Minimize weight and cost of the electromagnet by utilizing least center material and selecting simple to assemble parts.

• Select loop parameters, e.g., the quantity of turns and wire check, to furnish the required magneto-thought process power with least ohmic resistance. An imperative is the all out space available to oblige the loop.

Gavin et al. [3] has talked about the two noteworthy structure objectives for them gadgets. To start with, the dampers must have low electrical power usage. Second, the power in the gadget must reaction quickly to changes on the electrical direction flag. Aydar et al. [4] has planned and created a little MR damper, which can be possibly connected to a level pivot, front-stacking clothes washer. Lee et al. [5] has considered the coordinated structure strategy for an extensive scale MR damper and electromagnetic enlistment framework and has also considered a brilliant aloof control framework for lessening remain link reactions in this investigation. Taking into thought that most MR dampers have annular attractively dynamic region, Chooi et al. [6] has designed and created a twofold tuber damper dependent on the annular arrangement and on the compressibility of MR fluid inside the chambers. Jorge et al. [7] has proposed a way to deal with discover the preparation inputs for detection of a MR damper, which has the attributes of decrease of abuse of the damper, number of examinations and arrangements of preparing inputs. A later report by Ding et al. [8] has also planned and manufactured two MR dampers with full-length compelling damping way and an arrangement of tests have been performed to acquire the force– dislodging bends and the force– speed bends of the damper.

In this paper considering all parameters established by earlier work considered to deign low force MR damper and analysis is carried out for variable current from 0.1A to 1.0A for maximum magnetic flux density. Based on resulted Maximum flux density shear stress computed and also computed the damping force generated by the designed model

1.1 MAGNETO RHEOLOGICAL DAMPER DESIGN PROCESS

The MR damper plan process comprises of material determination, geometry structure and attractive circuit design. One of the objectives for materials choice is to pick a sort of MR liquid that has low apparent viscosity and proper attractive immersion yield quality. Another objective for materials determination is to choose the materials of the barrel and cylinder, in which the immersion enlistment thickness ought to be higher than the attractive field force when MR liquid accomplishes attractive immersion yield strength, so that the MR liquid can be utilized completely. The errand of geometry configuration is to pick a fitting hole, significant cross-segment zone of cylinder head and a functioning post length to fulfill the design requirements. The target of attractive circuit design is to decide the quantity of the loops, with the goal that the attractive acceptance thickness in the annular flow path produced by attractive circuit is more than the attractive field force when MR liquid achieves magnetic immersion yield quality.

1.2 MATERIALS SELECTION

For the cylinder and the piston, the two parts are not only the part of magnetic circuit but also the main force delivery members of MR dampers. Therefore, Steel 1008less carbon content which have high magnetic permeability and high saturation induction density, are adopted for manufacturing the piston and the cylinder, respectively

2. CONCEPT DEVELOPEMENT

Magneto-rheological damper design requires knowledge of fluid dynamics, electromagnetic principles, and basic machine design. The purpose of this section is to describe the guidelines of designing and manufacturing MR dampers. As a Semi active control device, MR damper have paid more attention and applied in many areas to mitigate the vibration, so suppression of vibration will be carried out in three ways as explained below. The process of vibration suppression system is in different categories step by step Shows in fig. 1

MR dampers are categorized as " semi-active". This indicates that these dampers retain some of their damping properties even when there is no power supply, or even when the controller fails. In such cases the damper reverts to a passive state, working as a passive damper. This property is a significant advantage over similar systems which are not semi- active.

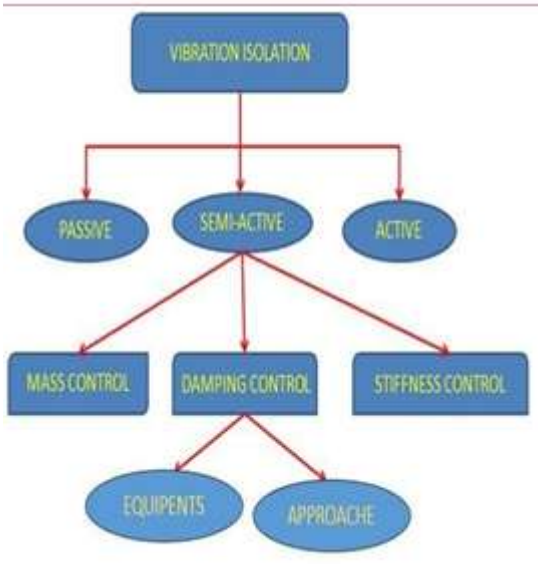

Fig.1 overview of Vibration Suppression

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3. GEOMTERY DESIGN

MR dampers have been created for different sizes, setups and burden prerequisites for explicit burden applications. Of the three methods of activity of MR liquid talked about above, MR damper works in valve mode and for specific applications in consolidated

(blended) method of valve and shear. In view of the development strategy, MR dampers are grouped into mono cylinder, twin cylinder and tri-tube gadgets. Mono cylinder is the generally utilized structure because of its straightforwardness for plan and manufacture. Twin cylinder structures are utilized for burden serious applications and tri-tube configuration is still in the lab look into. The sort of damper investigated in this exploration work is mono cylinder damper development. On a basic level, it is like a traditional mono cylinder damper with couple of adjustments. By and large, a high-weight gas chamber is available with a skimming cylinder isolating the gas chamber and working liquid. For fundamental undertaking investigations, the gas chamber configuration is avoided and constrained to the principle working liquid or spring can be utilized. A primary cylinder is available, isolating the working liquid into two chambers – pressure chamber and bounce back chamber. An annular is available in the middle of the cylinder and chamber. Scarcely any structures additionally join the annular hole in the cylinder get together itself. The figure 3 indicates one such structure.

The current in the loop creates an attractive transition. The attractive transition goes through the attractive circuit of which the cylinder, MR liquid hole, barrel divider are the fundamental segments. The cylinder and chamber are made of materials with high porousness. The attractive transition crosses over the MR liquid motion as spillage motion. The underlying structure stage for a MR damper includes the attractive circuit configuration joining the electromagnetic properties of the cylinder material, barrel material and MR liquid. This task work includes in the fundamental electromagnetic examination of a MR damper. Speaks to the attractive circuit of the dynamic working space of the magneto rheological damper. The specked line speaks to the progression of attractive transition lines. The motion lines structure a shut circle taking the most reduced hesitance way in the dynamic area district. The measure of damping power created from the damper depends up- on the enactment of the MR liquid in the annular hole locale through which MR liquid streams. The successfully of the damper relies on the dynamic volume of the MR liquid over which attractive motion is acting.

3.1 MAGNETIC CIRCUIT OF THE MR DAMPER

The magnetic circuit (loop) for the flux flow is shown in Fig. 2. The dotted line represents the flux flow direction. Dotted red line path shows the flow of magnetic flux when electromagnetic coils are active where outer cylinder and electromagnetic coil separated by fluid flow gap

3.2 GEOMETRIC PARAMETERS INVOLVED

The magnetic flux passes through various cross- sectional areas in the damper. The parameter for each of the flux area passage is found out and listed. The magneto rheological fluid flows in the annular orifice between the piston and cylinder, where the piston bobbin portion acts as a magnetic pole and the piston outer portion acts as the complementary magnetic pole. The fabricated MR damper is compared with LORD MR Damper 8040/1-0. The following dimensions are assumed for the fabricated MR damper.

Table.1 GEOMETRICAL PARAMETERS

Flux path portion	Geometrical parameter
Piston middle portion	Piston diameter (Dp) Piston rod diameter (Dr) Coil portion height (hc)

Table.2 DIMENSIONS

Piston bobbin portion	Piston diameter (Dp) Width of MR fluid gap (Lp)
Piston outer portion	Piston diameter (Dp) MR fluid flow gap (g) Cylinder thickness (ct)
MR fluid gap	Piston diameter (Dp) Width of MR fluid gap (Lp)

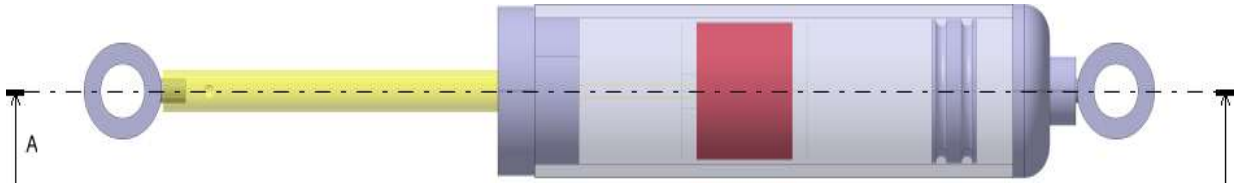

Fig.3 MR Damper (monotube MR damper with floating piston)

3.3 MRFLUID CHAMBER

An MRF consists of micron-sized, magnetically polarized particles Suspended in a carrier fluid, Such as Silicon or mineral oils. MRFs are capable of responding to a magnetic field in a few milliseconds. The material properties of an MRF can be changed rapidly by increasing or decreasing the intensity of the applied magnetic field. Silicon oil with suspended carbonyl iron powder of 30% of volume is used for the designed damper in this project. Components are all applied of magnetic steel to accommodate easier flow of MR fluid and effective activation when the current flow through the electric leads to the electromagnetic coil, electromagnetic coil induces magnetic field which passes through the ferromagnetic particles suspended in the MR fluid

4. CONCLUSION

In light of present work the plan of MR damper is finished and Analysis of damper at annular liquid stream hole attractive transition thickness for differing current gives the most extreme attractive motion thickness at fixed voltage, so acquired greatest motion density(B) prompts figuring of shear pressure and damping power of structured damper. In light of the accomplished plan measurements the MR damper made and tried for damping power..

REFERENCES

[1] T. M. Gurubasavaraju, Hemantha Kumar & M. Arun(2017), Evaluation of optimal parameters of MR damper fluids for damper application using particles swarm and response surface optimisation,volume 39,issue 9,pp:3683-3694.

[2] AlirezaFarjoud and EsmaeelA (2016) BagherpourElectromanet design for Magneto rehologicaldevices,volume 27(I)51-70.

[3] Gavin HP, Hoagg J, Dobossy M. Optimal design of MR dampers. Proc. U.S.-Japan Workshop on Smart Structures for Improved Seismic Performance in Urban Regions, 2001; 225–236.

[4] Aydar G, Evrensel CA, Gordaninejad F, Fuchs A. A low force magneto-rheological (MR) fluid damper: design, fabrication and characterization. Journal of Intelligent Material Systems and Structures 2007; 18:1155–1160.

[5] Lee HJ, Moon SJ, Jung HJ, Huh YC, Jang DD. Integrated design method of MR damper and electromagnetic induction system for structural control. Proceedings of SPIE 2008;

[6] Chooi WW, Oyadiji SO. Design, modeling and testing of magnetorheological (MR) dampers using analytical flow solutions. Computers and Structures 2008; 86:473–482.

[7] Jorge LS, Ruben MM, Ricardo RM. Design of experiments for MR damper modelling. Proceedings of the International Joint Conference on Neural Networks 2009; 1915–1922.

[8] Ding Y, Zhang L, Yao YF, Li ZX. Performance test and hysteresis model of MR dampers with full-length effective damping path. Journal of Vibration Engineering 2010; 23:31–36.

[9] Jolly MR, Bender JW, Carlson JD (1998) Properties and applicationsof commercial magnetorheological fluids. In: 5th annualinternational symposium on smart structures and materials, pp 262–275.

[10] Xu ZD, Sha LF, Zhang XC, Ye HH (2013) Design, performancetest and analysis on magnetorheological damper for earthquakemitigation. Struct Control Health Monit 20(6):956–970

[11] Lee HJ, Moon SJ, Jung HJ, Huh YC, Jang DD. Integrated design method of MR damper and electromagnetic inductionsystem for structural control. Proceedings of SPIE 2008; 6932:69320S.