



Fluid flow modeling and experimental investigation on automobile damper



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HIGHLIGHTS

- Methodology used to minimizing suspension of a vehicle for different velocities.
- Investigate effect of orifices on the damping force at different velocities.
- Three different orifices opening to conduct experiment analysis.
- Auto mobile damper results of two, six, and ten-orifice opening are compared.

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ABSTRACT

The liquid flow through orifices produces larger damping, whereas the cushioning effect comes from the fluid's compressibility. The hydraulic damper design is subjected to constant high pressure necessary to achieve the required forces, which drastically increases during the dynamic operation. Damper has different orifices or piston valves that lead to different flow losses. The main objective behind this work is to investigate the effect of number of orifices on the damping force at different velocities for rear side two-wheeler automobile mono tube damper. Three different orifice opening cases are considered for simulations and experiments such as two-orifice opening, six-orifice opening and ten-orifice opening.

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1. Introduction

Shock absorber or damper is a power dissipating device, no matter if an existing, dry friction one or a recently created Magnetorheological damper which utilizes Magnetically Responsive fluid, all transforms the kinetic energy of actions into thermal energy [1]. Damping powers might be exceptionally difficult. There is kinetic friction, which has a tendency to be autonomous of velocity. The free vibrations once set vibrating; the framework would bear on oscillating forever the power put into the framework by the introductory aggravation can't escape out of the framework. The damper was employed to investigate the oscillation of a piston. Different sorts of damper utilized within a damping method, the dampers are Fluid damper, automobile damper, twin-tube, mono

tube damper and Magnetorheological damper. In this exposition work has been carried out on mono tube damper. Fluid dampers are utilized within the automobile shock absorber comprise of a piston with a number of openings. The primary capacity of the dampers is to control the transient conduct of the sprung and unsprung masses of the vehicle. The fluid flow through openings produces bigger damping where as the cushioning effect originates from the fluid's compressibility. Isolation from forces transmitted by outer excitation is the essential errand of any suspension framework monotube MR fluid based damper has been popularized for employing in a semi-active seat suspension framework for substantial on- and off-highway vehicles in this application the MR damper enables to empowering innovation for an assortment of semi-active control plans [2]. An automotive shock absorber, not at all like a linear dashpot model, creates a power which is not basically a function of the velocity of its finishes. The enhancement and breakdown of either a gas or vapor stage in the hydraulic fluid

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[3]. Tuned liquid column damper (TLCD) was connected for the most part to tall structures or lean structures to lessen horizontal movement. Tuned fluid segment damper is such a sort of vibration control gadget which depends on the movement of a fluid mass in a tube-like holder to check the outside energy while a hole in it incites damping compels that disseminates energy [4]. For more application Magnetorheological damper was important to make a scientific model of the damper. A huge set of information with immense interims of frequencies and inciting ebbs and flows was measured [5]. The free-piston term is most normally utilized within a direct motor from a turning crankshaft motor. The piston is “free” in light of the fact that its movement is not confined by the position of a turning crankshaft, as known from tried and true motors [6]. The piston is one of the key segments in an engine and it nearly identifies with the machine execution, carbon outflows and the economy. With the motor higher speed and fortify creating, its higher pressure degree and higher power enhance simultaneously [7]. An orifice plate is a gadget utilized for measuring the volumetric strain rate. It utilizes the Bernoulli’s standard, which states that there is a relationship between the pressure of a liquid and the velocity of that liquid. At the point when the velocity expands, the pressure declines and the other way around [8]. Orifices are dispersed on the piston consistency for single piston orifice with measurement do and length L_o , its category might be chosen by the degree L_o/d_o . Because of this, orifice type, piston orifice could be viewed as an orifice. By utilizing CATIA (Computer Aided Three-dimensional Interactive Application) V5 R20 programming software demonstrating every segment of the shock absorber on the premise of outline estimation and real measurement information gathering of the damper. In above discourse the each one set of orifice velocity is distinctive and manufacture the orifice is troublesome in every upcoming progression. The oscillation is maximum in piston; reduce the oscillation using CFD software in a request to increase bits of knowledge into these methods, Computational Fluid Dynamics (CFD) system is presently generally employed. Signifying inner combustion motor indicates to a standout amongst the most difficult fluid mechanics issues because of the compressed nature of the stream with vast density variations [9]. The principle apprehension of planners and building structures producers is to have the capacity to give an abnormal state of well being for their work regarding seismic activity CFD examination of the fluid damper framework concentrated on the conduct of the friction viscous device (FVD), amid the competent administration [10]. The CFD models connected consider different air motion facilitating strengths following up on the particles and additionally particle–divider communications [11]. Computational Fluid Dynamics is an option approach, which is quicker and less lavish gave it is connected prudently. The diffuser with consolidated horizontal and vertical counterbalances with utilizing a business CFD code; FLUENT and indicated as the stream consistency diminishes with expansion in the vertical balance [12]. CFD model is created by the convective heat transfer in a twofold coated window with a between-sheets creased material cloth blind. One-dimensional representation is displayed for computing the U-estimation of this complex fenestration. The one-dimensional model is suitable for utilization in window plan programming and for building energy simulation [13]. The response to a stream issue (velocity, pressure, temperature and so on.) is characterized at hubs, within every cell. The amount of cells in the networks represents the exactness of a CFD result. Both the precision of a response and its cost as far as vital computer hardware and estimation time are reliant on the fineness of the matrix. A recreation model of the suppressor was made in the cylindrical coordination framework, utilizing hub symmetry, which decreased the case to a two-dimensional one. The POENICS CFD system is focused around the Finite Volume Method, which is an extraordinary plan of FDM

[14]. An auto suspension framework is intended to give wellbeing and solace to the tenants. The shock absorber is a vital piece of automotive suspension framework which has an impact on ride attributes, for example, rides solace and driving security [15]. Computational Fluid Dynamics (CFD) has picked up prevalence as a proficient and valuable instrument in the outline and investigation of indoor environment and building security. The applications of CFD in indoor environment and building wellbeing are extensive [16].

2. Literature review

In 2014 Hejazi et al. [17] have proposed the elastic damper in the center part and two plastic hinges at both the ends of the component which are upright with the constitutive model to fortify concrete structures and was fit to identify failure and harm in viscous damper gadget associations amid earthquake excitation. The limited component model comprises of strengthened concrete edge component and viscous damper component was created and unique finite element algorithm employing Newmark’s abrupt regulated combination was produced for in elastic element examination of structure with supplementary elastic plastic thick damper component. So focused around all the created segments a particular limited machine program has been classified for “Non-linear Analysis of Reinforced Concrete Buildings with Earthquake Energy Dissipation System”. The assessment of seismic reaction of structure and harm identification in structural parts and damper gadget was completed by 3D modeling, of 3 story fortified concrete casing building under earthquake multi-support excitation.

In 2014 Guan Changbin et al. [18] have proposed the single-piston model exhaustively deliberates fluid compressibility, opening confinement impact, and fluid resistance in the capillary tube, and the spillage stream. In view of the single-piston model, a multi-piston pump model has been secured as per the direct hydraulic driven circuit. The created multi-piston pump model has been accepted by being contrasted and the statistical analysis about by computational fluid dynamic (CFD). The impacts of the pre-pressurization fluid method on the stream undulate and the immediate pressure in the piston chamber have been contemplated and upgraded outline suggestions for the aviation pivotal piston pump. Through the analysis the configuration of the pre-pressurization fluid way is to diminish the pressure distinction.

In 2013 Nitin Satpute et al. [19] have mentioned about numerical demonstrating of the fluid damper which employs number of shim controlled openings. Finite element analyst was carried out to compute solidness of the shims utilized with the openings. Mat lab programmed compute pressure difference and restraining forces over the piston utilizing fluid flow continuity evaluations. At last single degree of freedom Matlab Simulink of the damper is utilized to discover displacement transmissibility for range of frequencies.

In Engin Gedik 2012 et al. [20] a two-dimensional Computational Fluid Dynamics (CFDs) simulation for the constant, laminar stream of an incompressible magneto rheological (MR) fluid among two fixed parallel plates in the reputation of a uniform magnetic field. A uniform transverse external magnetic field was employed perpendicular to the flow direction. The external applied magnetic field, B_0 , takes values somewhere around 0 and 1.5 T with 0.5 T step size, was employed to ascertain B_0 impacts on fluid flow. The numerical results for velocity and pressure conveyances were acquired for distinctive magnetic fields. Through the solution of this evaluation, different plots were acquired and exhibited in the diagrams looking into off low velocity and pressure appropriations.

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