3D CAD MODELLING AND COMPUTATIONAL FLUID ANALYSIS OF PISTON VALVE OF TWIN TUBE SHOCK ABSORBERS

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Abstract

This study aims to generate a 3D CAD model of the piston valve and conduct CFD analysis of the same. The piston valve of the shock absorber is one of the more critical parts of the mechanism assembly as the motion of the piston through the fluid in the working chamber of the damper is the primary source of damping force in suspension systems. The design of the piston valve is reverse engineered from existing designs and modelling is done in CREO 2.0 using cloud point data generated using Coordinate Measuring Machine. Computational fluid analysis is done using FLUENT integrated into ANSYS15.0 Workbench.

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1. Introduction

The concept of hydraulic damping was introduced early in the 20\textsuperscript{th} century but did not catch on until much later. Production of hydraulic dampers started after patents were awarded to Houdaille [1-2] for his damping apparatus in 1908-09. The 1912 Olympia Motor Show saw the first production shock absorber in the Telesco Shock Absorber exhibited there. Designs of dampers have come a long way since then.

Modern damper designs utilize the movement if a piston with orifices through a viscous fluid as the primary source of damping force. The energy absorbed is dissipated in the form of heat. Czop et al. [3] have investigated the
fluid flow inside the twin tube shock absorber. Their study however revolves around the noise generated by the system and on the reduction of the same.

The base valve assembly was reverse engineered and modeled using commercially available parametric modeling program PTC Creo 2.0 using cloud point data generated using a Coordinate Measuring Machine. The flow analysis of the system was done using commercially available CFD code FLUENT, integrated into ANSYS Workbench 15.0

2. The Shock Absorber System

Modern twin tube shock absorber designs utilize two interconnected chambers and a piston that moves inside the fluid filled cylinder [4]. The pressure difference built across the piston forces the fluid to flow through the valves in the piston as well as the base assembly. The viscous force generated damps the forces exerted on the system.

![Figure 1. Twin Tube Shock Absorber[5]](image)

Figure 1 shows the cut section of a commercially available twin tube shock absorber.

The movement of damping fluid from the compensation chamber to the working chamber happens through the base valve assembly. However the primary damping force is provided by the piston valve moving through the damping fluid in the working chamber.

3. Reverse Engineering and 3D CAD Model Generation

3.1. Coordinate acquisition

Poniatowska [6] observed that the most technologically advanced and universal tools commonly used to perform all kinds of precision measurements available at present are Coordinate Measuring Machines (CMMs). As reported by Puertas et al. [7], Coordinate Measuring Machines (CMMs) represent one of the most accurate and flexible measuring instruments used in metrology. They are also widely used to examine the conformity of parts produced to the designers’ intent [8].

In this study, Coordinate Measuring Machine (CMM) was used for coordinate acquisition of the components of the piston valve assembly. Fig.2 illustrates CMM.
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