

Dynamic Measurement System for Interchangeable Shock Absorber Test Rig

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ABSTRACT

An automotive suspension system is meant to provide safety and comfort for the occupants. Shock absorber is an important part of automotive suspension system which has an effect on ride characteristics such as ride comfort and driving safety. Basically, this project involves designing the test rig for testing and indicating the condition of shock absorber in automotive vehicle. The test rig is designed and built for testing shock absorber in the area of dynamic, vibration and displacement measurement. The system is capable for 850cc and 1600cc shock absorber interchangeable. Sensor technologies such as accelerometer, displacement sensor's wire and force sensor are applied in order to detect the signal and transfer to data acquisition. The data acquisition system is required to collect measure and analyze data from the test rig.

Keywords: vibration, sensor, dynamics and shock absorber

INTRODUCTION

Nowadays, people are looking for the car with the best performance. In order to archive this desire, one should consider the whole part of the car system. The automotive system includes the power plant, power train, steering system, breaking system, suspension system, and chassis. Out of many parts, the suspension system is very important because it influences the performance of the car and provides safety and comfort for the driver and occupants. Shock absorber is an important part of automotive suspension system which has an effect on ride characteristics. Shock absorbers are also critical for tire to road contact which reduces the tendency of a tire to lift off the road (Don Knowles 2003). This affects braking, steering, cornering and overall stability (Tim Gilles 2005). The removal of the shock absorber from suspension can cause the vehicle to bounce up and down. It is possible for the vehicle to be driven, but if the suspension drops from the driving over a severe bump, the rear spring can fall out (Thomas W. Birch 1999)

The shock absorber helps on ride comfort and driving safety. Shock absorbers also help influence ride quality, responsiveness and vehicle's handling balance. The main function of shock absorber is to dissipate the energy introduced in the vehicle by road irregularities and by driving situation. Shock absorber actually does not absorb shock because it is done by the spring. The goal of the shock absorber is to dampen spring oscillation by converting the kinetic energy from spring movement into heat energy (Tim Gilles 2005). In order to reduce spring oscillation, shock absorber absorbs energy. The shock absorber absorbs different amounts of energy depending on how fast the suspension is moving. In other word, shock absorber also could be call as the energy converter.

Usually, the shock absorbers must be replaced after driving exceeds certain distance. But this actually not should have been followed if there are no defective. To ensure there are no defective, the consideration to check the condition of the shock absorber is the best way. There are several methods to test the condition of the shock absorber. One of the tests is endurance test use frequency response method which applied to the suspension and tire. But this test is very complicated and costly because the machine is very expensive. The other method to check the shock absorber without removing from the vehicle is by using the bounce test (Newbold and Bonnick 2000). In the workshop, some mechanics will perform bounce test which is push down each corner of the car several times to check the condition of shock absorber. However, the result of this test is not very accurate to indicate the condition of shock absorbers.

Generally, the purpose of this final project is to design and develop Shock Absorber Test Rig for vibration measurement system. This product is actually developed to test and indicates the condition of shock absorber in automotive vehicle in term of vibration. So, this project involves designing the shock absorber test rig for testing, fabricate and analysis the shock absorber. This product can be used as a tool to verify the capability of shock absorber.

SHOCK ABSORBER REST RIG

The design of shock absorber test rig has been developed for vibration measurement system. This product is actually developed to test and indicates the condition of shock absorber in automotive vehicle. This product can also be used as a tool to verify the capability of shock absorber. The Figure 1 shows the complete of the design of shock absorber test rig.

This shock absorber test rig is a rigid structure with two main components connected vertical. The upper vertical is the shock absorber while the lower connection to the base structure is the pneumatic cylinder. The upper and lower component is divided by the middle plate. This middle plate is supported with two units of guide shaft for smooth movement. The shaft holder is placed at each end of the guide shaft for protecting and secures the guide shaft joints.

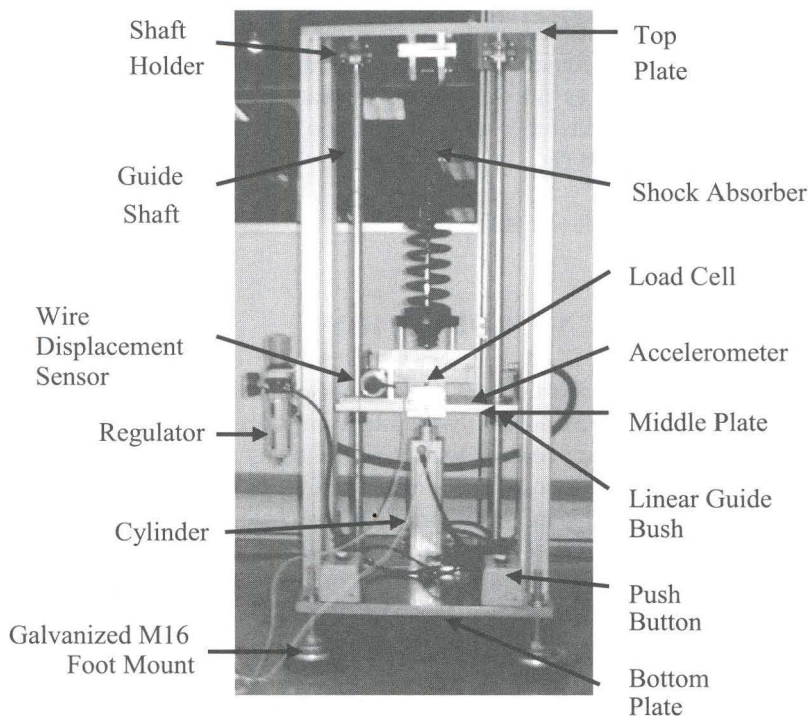


Figure 1: The design of shock absorber test rig

This test rig is designed for interchangeable shock absorber testing. Therefore, it can be used to test the shock absorber according to:

- a) Vehicle 800cc capacity
- b) Vehicle 1600cc capacity

In order to collect signals generated from the test rig components, there are the sensors positioned on the test rig. The unit of accelerometer is secured on the middle plate to record signal from the vibration caused from the cylinder when activated to compress the shock absorber. The accelerometer is low impedance, voltage mode designed for vibration measurement. The sensing element (accelerometer) actually is in contact with the process and gives an output which depends in some way on the variable to be measured. Then the element that take the output of accelerometer and convert it into more suitable for further processing is a signal conditioning elements. Therefore, it is suitably processed and modified in the signal conditioning element so as to obtain the output in desired form (Nakara and Chaudhry 2004). Figure 2 shows the picture of accelerometer.

As vibration can be expressed as a function of displacement, a unit of wire displacement sensor is installed at the middle plate. This wire is pulled and secured to the top plate. So, the compression of shock absorber from the activation of cylinder will show the displacement. The picture of wire displacement sensor is shown in Figure 3.