

# Fabrication and testing of energy regenerative suspension

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**ABSTRACT** - The research and development of the energy alternative for automotive industry is important as the world is demanding on the energy efficient vehicle (EEV). The use of hybrid vehicle and electric vehicle is one of the steps to the EEV vehicle which using alternative way other than using fuels to propel the vehicle. This research emphasizes the development of energy regenerative suspension system (EReSS) as the energy harvesting system for wasted energy on the vertical vibration in the suspension system of a vehicle. The EReSS is fabricated and tested on the laboratory experimentation.

## 1. INTRODUCTION

The energy loss on the suspension system of a vehicle is neglect on past research. The loss that is neglect is the energy dissipated in the suspension vertical vibration. The function of the suspension is to support the body, road disturbance and give response to the wheel to hold the road surface. The energy efficient vehicle (EEV) is popular this time and several researches have been done for better EEV vehicle in the future. Electromagnetic regenerative suspension transforms the vertical vibration to electric energy that can be stored and reuse [1]. The vehicle dissipation of the suspension system is different at different road surface, vehicle velocity and stiffness of damper. It indicates that the velocity and the tire pressure is directly proportional and affects the power dissipation. Other research states that the energy dissipation is taking the rider comforts and road handling into account [2]. Schematic analysis of the road surface, dynamics, ride and power at the same time is currently not available [3]. The usage of energy regenerative suspension reduces the electrical demand on the vehicle alternator at the same time reduces the engine work load. The system of regenerative will improve the fuel efficiency of the vehicle by designing the appropriate system to harvest the energy from the vehicle vibration.

## 2. METHODOLOGY

The design of the energy regenerative suspension (EReSS) is drawn in the computer-aided-drafting (CAD) software. This is to ensure the dimension of the fabrication product parts fit to each other. The drawing is illustrates in Figure 1.

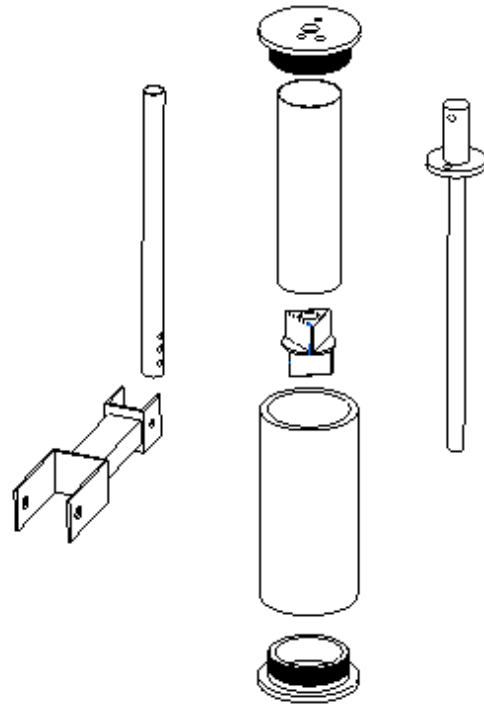


Figure 1 CAD drawing of EReSS

The fabrication process is done part by part. The material use for the EReSS is different for each of the part. The EReSS system will be tested on a test rig on the laboratory. On the test rig, the EReSS is operated such that the system is on the vehicle suspension system by moving it upwards and downwards. The different of the testing on the test rig is that the frequency can be set and constant whereas if the test is done on the car suspension, the frequency cannot be set because of the road irregularity.

## 3. RESULTS AND DISCUSSION

The EReSS is fabricated by referring the CAD data and the product is shown in Figure 2. The design of the EReSS is retrofit which is not disturbing the original suspension system of the vehicle. This EReSS can function automatically by following the suspension movement. The EReSS is then tested in laboratory to record the voltage produces by the system. The experiment is done on a test rig in the laboratory and the data of the experiment is shown in Table 1. The

frequency of the experiment is different which is set from 10Hz to 50Hz. The coil diameter used for the testing is 0.29mm and standard magnet magnetic flux density of 0.2T. The number of loop that is used in the system is different to record the different value of voltage produces by each set of coil loop. From the result of experiment, the number of loop used in the system affected the voltage produces by the EReSS. The greater the number of loop, the greater the voltage produces by the system. The highest voltage reading is occurs at 40Hz frequency with the voltage value of 3.03V. The use of EReSS reduces the load for the engine as it reduces the use of the alternator. Thus, the fuel efficiency of the vehicle increases. Other than that, the stored energy by the EReSS can be use for the electrical system of the vehicle and reduce the usage of the battery.



Figure 2: Fabricated EReSS system.

Table 1: Voltage reading of EReSS experiment.

Loop (N)/ Frequency (Hz)	Voltage (V)		
	400	250	100
10	0.82	0.43	0.27
20	2.06	1.98	1.25
30	1.64	2.01	1.56
40	3.03	2.24	1.98
50	1.40	1.15	0.73

#### 4. CONCLUSIONS

The EReSS system can harvest wasted energy and convert the vibration energy to voltage charge. This system can be use in EEV vehicle that will increase the fuel efficiency of vehicle and reduces the usage of alternator. Besides, this system is an alternative source of energy that can be reuse and stored from the harvested wasted energy on the vehicle suspension system. The EReSS is an important system that is suitable to be use on hybrid or electric car in the future. This system has potential to fulfill the world demand on reducing the fuel consumption of vehicle in automotive industry.

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