Electricity generation by using of regenerative suspension system

[1]Nirmala H Bhingare,[2]Anand Ralegankar,[3]Piyush Tale, [4]Sumit Mehare

[1]Assistant professor, [2]Student BE Mechanical, [3]Student BE Mechanical, [4]Student BE Mechanical
[1]Deapartment of Mechanical Engineering ,
[1]D Y Patil College of Engineering, Akurdi, Pune,India

Abstract : The regenerative suspension system (RSS) is a device that converts the kinetic energy of an oscillating object into electric energy. Normally, this kinetic energy is dumped in a form of thermal energy in a conventional of mechanical shock absorber The suspension systems in modern vehicles better work of dissipating energy. The onward energy in a vehicle to be changed into vertical energy can be form at any bump in the road or terrain. The energy existence that is wasted from the modern vehicle suspensions systems can be harvested and converted into a form that can be used in a different part in the vehicle. More purposely, this energy can be transformed into electrical energy that can be used to charge a car battery. This could possibly balance in small or more of the work done by the alternator, resulting in rose up of fuel efficiency. If this system is carried out in electric vehicles, energy regenerated could recharge the battery and will longer the distance of these vehicles to travel. The method used for this project is to conduct the experiments on the electricity generated from piezoelectric cells that are attached to the suspension system and its conversion. The main target of this project is to design and operation of the RSS.

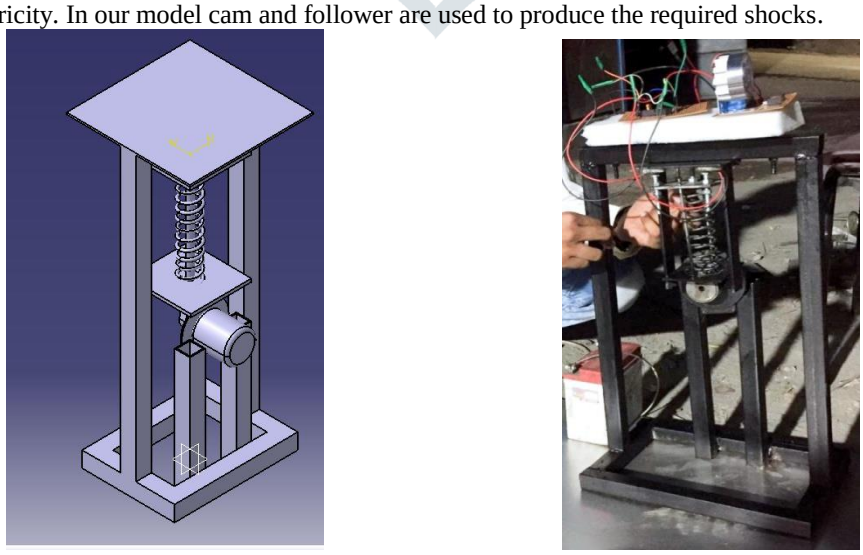
***IndexTerms* –RSS(Regenerative suspension system), piezoelectric cells, electricity, kinetic energy of vibration.**

I. INTRODUCTION

A source of mechanical energy is harvest by the vibration excited by road unevenness [3]. It is converted into electrical energy to compensate for the energy consumption by the active suspension which is call as "Regenerative Suspension System" (RSS) [5, 14].Shocks absorbers are used to decrease oscillation by absorbing the energy stored in the springs when the wheels of an automobile reciprocates [8]. The shock absorbers turn the KE of suspension movement into thermal energy or heat energy to be dissipated within the hydraulic fluid. Still, this kind of kinetic energy can be converted into electric energy which in chance can be stored in a battery [6]. It is possible if RSS is used. One advantage of the regenerative energy based suspension is that they could offer potential fuel savings up to 3%, or estimated by 0.3–0.5L per 100 km[15]. This is particularly essential if an electric vehicle is considered. The overall efficiency of the electric drive is getting higher by converting the oscillation energy and storing it in the battery. , automobile energy harvesting technologies have attracted more attention in which a harvested average power of 350W could be achieved for a medium-size sedan (four energy-harvesting dampers). For heavy-duty and off-road vehicles, the regenerative suspension can effectively provide a wide range of the harvestable power over 1kW which is worthy of being recovered regarding improvements in fuel efficiency. [1]
This paper focus on reliability of the regenerative suspension system which the experimental will be conduct to identify how much the source power will it produce and does it is useable to use for the vehicle. Another objective for this project is to design and fabricate the regenerative suspension system.

II. DESIGN AND WORKING PRINCIPLE

Design of a regenerative suspension system starts with selection of piezoelectric cells for maximum electricity output. Spring material also plays an important role in this design. Here an assumption of irregular terrain is made for the sake shocks required to produce electricity. In our model cam and follower are used to produce the required shocks.



a) b)

Fig 1. a) CATIA model of Regenerative suspension system b) Actual working model of Regenerative suspension system

MATERIAL SELECTION

From the variety of below materials which can be used we selected the optimum considering cost, life, weight, availability and application.

AISI 1018 Mild/Low Carbon Steel

Table 1. Elements of Low Carbon Steel and their contents

Element	Content
Carbon, C	0.14 - 0.20 %
Iron, Fe	98.81 - 99.26 % (as remainder)
Manganese, Mn	0.60 - 0.90 %
Phosphorous, P	≤ 0.040 %
Sulfur, S	≤ 0.050 %

WORKING

- Motor is used to produce the initial torque.
- Motor rotates the cam.
- The follower attached to the cam moves and displaces the spring attached to it.
- The rotary motion of the cam is converted into linear motion of spring.
- Another plate attached to the spring at its upper end moves upward.
- This plate hits the piezoelectric cells
- Property of piezoelectric material is such that it produces electricity after application of load
- Here the electricity produced is transferred to the battery through the bread board.
- The electricity stored in the battery is used for various purpose

III. METHEDOLOGY.

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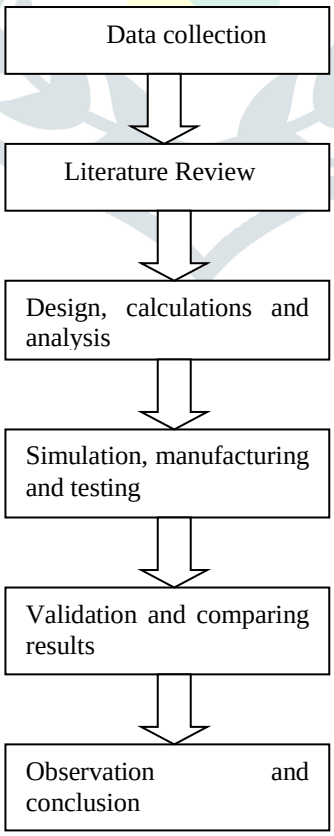
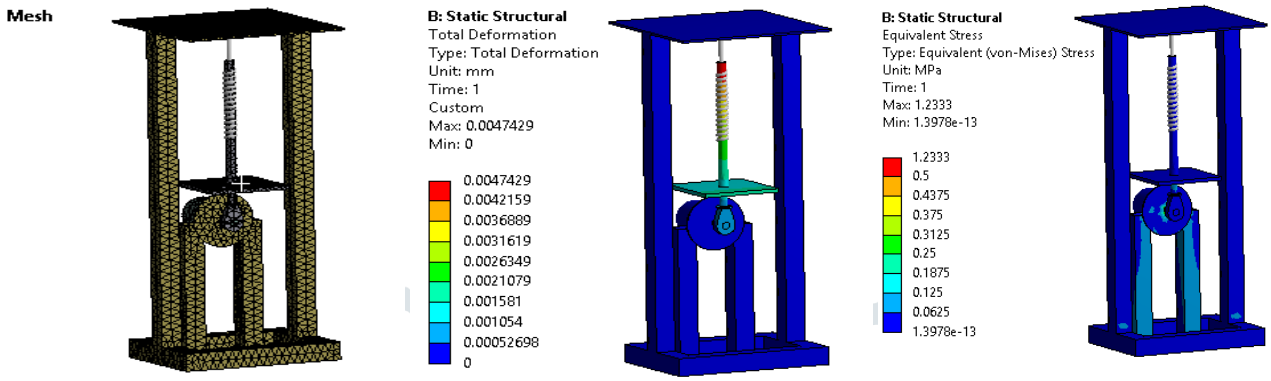


We wanted to work in energy generation domain, therefore we started our literature survey in the same direction. We got to know about the piezoelectric material available in the market and energy regenerative suspension systems from various research papers. Then we learned about various mechanisms to be used in our project required to simulate the suspension system in automobiles. We made a rough model and selected standard parameters and calculated the output based on standard properties of the material selected. Then we designed and analyzed the 3D model of our prototype in Catiav5 and Ansys16 respectively. Then we purchased the components from the market of selected materials. Manufactured and assembled the components and tested the actual model and got the results.

IV. ANALYSIS



a) b) c)

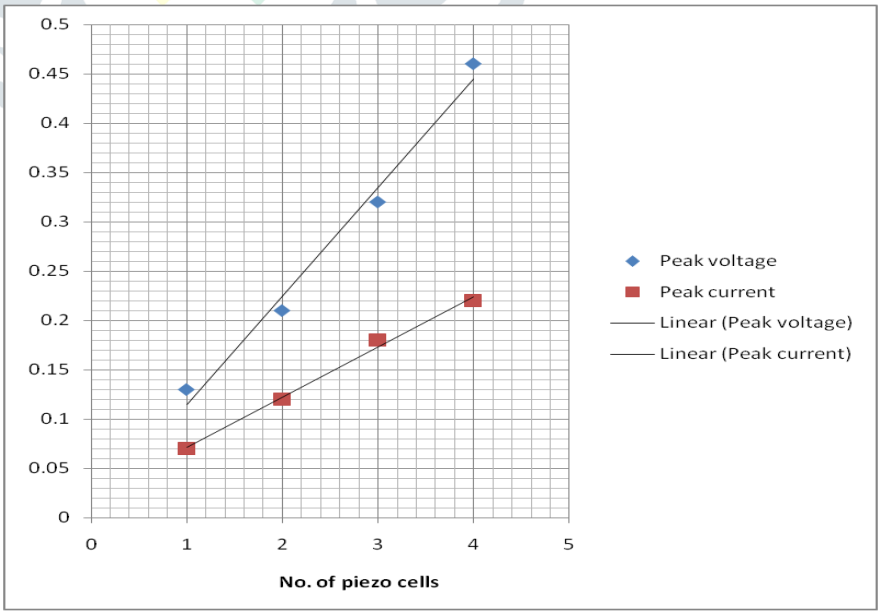
Fig2. a) Meshing of 3D model b) Deformation analysis of 3D model c) von-Mises stress analysis of 3D model

Regenerative suspension system using piezoelectric cells is based on the displacement of the spring and the load applied on the cells. The analysis above shows the meshing max displacement and max stress in the system .The maximum displacement here is used in designing process to decide the gap between the upper plate of spring and the piezoelectric cells mounted on the frame. In case if the distance between the upper plate and the piezoelectric cells is more than the max displacement it won't generate any voltage and hence no power generation, as the plate won't touch the cells and no load will be induced on the cells. If the distance is very less, then it may damage the piezoelectric cells or reduce its life, because of high load on the cells. Therefore the distance should be optimum.ie slightly less than the max displacement.

V. RESULTS

Final variation with different number of piezoelectric cells

No. of piezo cells	Peak voltage	Peak current
1	0.13	0.07
2	0.21	0.12
3	0.32	0.18
4	0.46	0.22



The quantity and quality of the piezoelectric cells is directly proportional to the electricity produced. The irregularities on the road surface and speed of the automobile also affects the electricity. More the irregularities more is the energy generation and more the speed more is the frequency of the suspension plate hitting the piezoelectric cells and more is the energy produced.

VI. CONCLUSION

Piezoelectric material is mostly used as sensors to sense load and frequency of loading. In this project used piezoelectric sensor to generate power to operate the indicating lights, indicators etc. in automobiles. This is possible when the piezoelectric cells are mounted over the suspension system in the automobiles. Due to the irregularities on the road the piezoelectric cells are frequently loaded which causes power generation. This electricity can be used to operates small units or to recharge battery.

Due to terrible road condition in India There is always kinetic energy in the suspension or continuous shocking and loading is experienced by the automobile suspension which is later dissipated as heat. This energy which is wasted can be utilized using piezoelectric cells and required circuits and arrangements. Though a sufficient amount of energy is not generated using the arrangements and circuits we used but in future this concept can be helpful for utilizing energy in various applications.

VII. REFERENCES

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