

## Design and Development of Road Power Generation System

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### Abstract:

Nowadays energy and power are the one of the basic necessities regarding this modern world. As the demand of energy is increasing day by day, so the ultimate solution to deal with these sorts of problems is just to implement the renewable sources of energy. But these renewable energy sources must have to be adopted in practical manner by keeping an eye on all aspects regarding the research work. So then these techniques should be applied in order to get the desired output. The objective of this work is power generation through vehicle motion over road as a source of renewable energy that we can obtained while walking on to the certain arrangements like footpaths, stairs, plate forms and these systems can be install elsewhere specially in the dense populated areas. In this project we are generating electrical power as non-conventional method by simply walking on the foot step. Non-conventional energy using vehicles on road needs no fuel input power to generate the output of the electrical power. This project using simple drive mechanism such as rack and pinion assemble. For this project the conversion of the force energy in to electrical energy. The control mechanism carries the rack & pinion, D.C generator. We have discussed the various applications and further extension also.

### Keywords:

Road power generation, rack and pinion, DC motor etc.

### INTRODUCTION:

Man has needed and used energy at an increasing rate for his sustenance and wellbeing ever since he came on The earth a few million years ago. Primitive man required energy primarily in the form of food. He derived this by eating plants or animals, which he hunted. Subsequently he discovered fire and his energy needs increased as he started to make use of wood and other bio mass to supply the energy needs for cooking as well as for keeping himself warm. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels.

Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable sources of energy. The utilization of energy is an indication of the growth of a nation. For example, the per capita energy consumption in USA is 9000 KWh (Kilo Watt hour) per year, whereas the consumption in India is 1200 KWh (Kilo Watt hour). We can say that to be materially rich and prosperous, a human being needs to consume more and more energy. A recent survey on the energy consumption in India had published a pathetic report that 85,000 villages in India do not still have electricity. Supply of power in most part of the country is poor.

Hence more research and development and commercialization of technologies are needed in this field. In India, unlike the developed countries we do not have elevators or lifts in the buildings of rural area. There are still conventional steps are used for road, speed breakers, steps on the floor. From our point, the energy can be utilized by just placing a unit road Power Generation system". By placing this system in a rural building or in places like railway stations, so much of energy can be tapped.

## II. LITERATUREREVIEW:

Every speed breaker is now a source of power [1]

aswathaman.v, priyadharshini.m

This paper attempts to show how man has been utilizing energy and to explore prospects of optimizing the same. Researches show that the world has already had its enough shares of its energy resources. Fossil fuels pollute the environment. Nuclear energy requires careful handling of both raw as well as waste material. The focus now is shifting more and more towards the renewable sources of energy, which are essentially, nonpolluting. The experimental investigation is performed by placing the speed breaker arrangement in a pit with a depth of 75 Cm.

Electricity Generation by Speed Breaker [2]

G.RamakrishnaPrabu, G.Ethiraj

Energy is the primary need for survival of all organisms in the universe. Everything what happens in the surrounding is the expression of flow of energy in one of the forms. But in this fast moving world, population is increasing day by day and the conventional energy sources are lessening. The extensive usage of energy has resulted in an energy crisis over the few years. Therefore to overcome this problem we need to implement the techniques of optimal utilization of conventional sources for conservation of energy. This project includes how to utilize the energy which is wasted when the vehicles passes over a speed breaker.

Electricity Generation through Road Ribs using law of Electromagnetic Induction [3]

ParulBisht, RajniRawat

Recognizing the importance of developing renewable energy resources, the Highways Agency commissioned a preliminary scoping study in 2001 to explore available methods and assess the possibility of renewable energy generation being exploited within the highway network. The road rib can be designed so that any vehicle, from bicycle to HGV, pass across it and it generate electricity which is then stored at the road side in a battery then used to power any electrical roadside device.

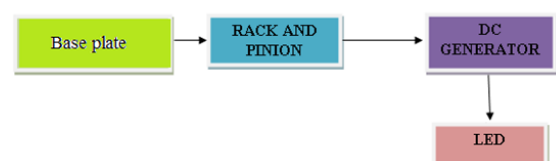
Design of Rack and Pinion Mechanism for Power Generation at Speed Breakers [10]

M.Sailaja\*1, M. Raja Roy2, S. Phani Kumar3

Need is the mother of all inventions and innovations. Man has improved the standards of everything around him to his comfort, need and desire. In the long run of science, since the time that science has taken a rigid form, man has stated, restated, invented, modified, discovered and re-discovered many facts, concepts and methods. In such a venture, a country's growth in the world economy largely bases upon its power generation rate, per-capita consumption rate and most importantly, efficiency of the both.

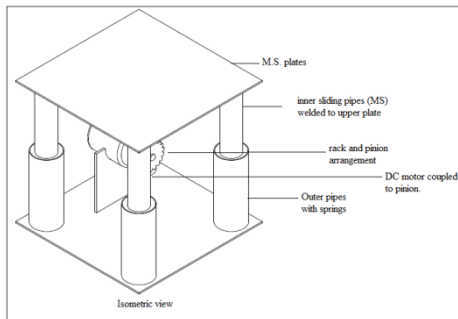
## III. SYSTEM ARCHITECTURE:

Rack and pinion system: A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar – the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel.



**Fig .block diagram of the system**

The complete diagram of the power generation using road power is given below. The rack & pinion, spring arrangement is fixed. Which is mounded bellow the L-shapes window. The spring is used to return the inclined L-shapes window in same position by releasing the load. The gear wheel is coupled to the smaller motor shaft. The generator is used here, is permanent magnet D.C generator. The generated voltage is 12Volt D.C. This D.C voltage is connected to LED which glows to show the generated electricity output.



**Fig. schematic diagram for single step**

#### IV. COMPONENTS AND SYSTEM DESIGN:

##### 1. MS PLATE :

The Mild steel plate is a square plate of size 1feet\*1 feet i.e. 300 mm\*300 mm. The thickness of the plate is 4mm. We are using two plates here one base plate and one upper plate to place foot.

##### Frame calculation:

$$M/I = \sigma/Y \dots\dots\dots (1)$$

M=force\*perpendicular distance  
 = (60\*9.81)\*150..... (Force=human weight considered)

$$M=88290 \text{ Nm}$$

$$Y=D/2=4/2=2 \text{ mm} \dots\dots\dots$$

(Thickness of frame=4mm)

$$\text{For } I = (bd^3)/12 = (300 \times 4^3)/12 = 1600 \text{ mm}^4$$

Therefore,

Using equation no.1

$$88290/1600 = \sigma/2$$

$$\sigma_b = 110.3625 \text{ N/mm}^2$$

$$\sigma_b \ll \sigma_{allow} \text{ i.e. } \sigma_{allow} = 210/1 = 210$$

So design is safe.

##### 2. RACK AND PINION:

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. The circular pinion engages teeth on a linear "gear" bar – the rack. Rotational motion applied to the pinion will cause the rack to move to the side, up to the limit of its travel. For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and pulls a train along a steep slope.

$$F_n = F_t \tan \theta \dots\dots\dots (1)$$

$F_t$  = tangential force (weight of human=60kg.....this is the standard value. Considered from net)

$$F_t = 60 \times 9.81$$

$$F_t = 588.6 \text{ N}$$

$$F_n = 588.6 \times \tan 200 = 214.23 \text{ N}$$

$$F_r = F_t / \cos \theta = 588.6 / \cos 20$$

$$F_r = 626.38 \text{ N}$$

$$\text{Power (P)} = \text{Work}/\text{time}$$

$$P = (\text{Force} \times \text{displacement})/\text{time}$$

$$P = (588.6 \times 0.050)/1$$

$$P = 29.43 \text{ watt}$$

$$P = 2\pi NT/60$$

$$T = (P \times 60)/(2 \times N)$$

$$T = (29.43 \times 60)/(2 \times 3.142 \times 30) = 9.3 \text{ N.m.}$$

$$T = F_t \times r$$

$$r = T/F_t = 9.3/588.6 = 0.015$$

$$r = 15 \text{ mm So } D = 30 \text{ mm}$$

##### 3. DC MOTOR:

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homo-polar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an

oscillating AC current from the DC source—so they are not purely DC machines in a strict sense.

#### 4. MS PIPES:

There two types of cylindrical Mild Steel pipes are used. One is for bottom plate of diameter 30 mm and thickness of 3 mm which contains spring placed into it, while other pipe is welded to upper plate of diameter 20 mm, and of thickness 3 mm. The length of both the pipes is 100 mm.

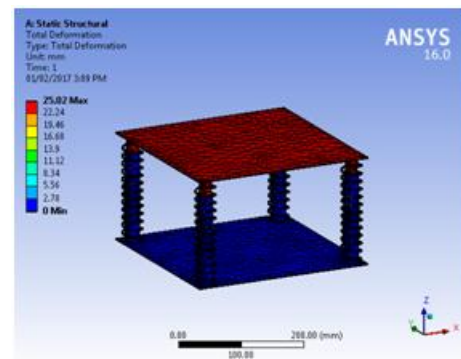
#### 5. SPRINGS:

A spring is defined as an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed. The various important applications of springs are as follows:

1. To cushion, absorb or control energy due to either shock or vibration as in car springs, railway buffers, air-craft landing gears, shock absorbers and vibration dampers.
2. To apply forces, as in brakes, clutches and spring loaded valves.
3. To control motion by maintaining contact between two elements as in cams and followers.
4. To measure forces, as in spring balances and engine indicators.
5. To store energy, as in watches, toys, etc.

#### V. FEA ANALYSIS:

**Structural analysis** The finite element method (FEM) is a powerful technique originally developed for numerical solution of complex problems in structural mechanics, and it remains the method of choice for complex systems. In the FEM, the structural system is modeled by a set of appropriate finite elements interconnected at points called nodes. Elements may have physical properties such as thickness, coefficient of thermal expansion, density, Young's modulus, shear modulus and Poisson's ratio.



**Figure. Total deformation**

#### VI. ADVANTAGES AND APPLICATIONS:

##### ADVANTAGES:

- Power generation is simply due to load by vehicles.
- Power also generated by running or exercising on the step.
- No need fuel input
- This is a Non-conventional system
- Battery can used to store the generated power

##### APPLICATIONS:

Applications of the stair case power generation are,

- This can be implemented on roads and speed breakers to generate electric power.
- In bus station and car parking system.
- In Airports and Lift system.
- In street lights
- Electric escalators

#### VII. CONCLUSION:

In concluding the words of our project, since the power generation vehicles get its energy requirements from the Non-renewable source of energy. There is no need of power from the mains and there is less pollution in this source of energy. It is very useful to the places all roads and as well as all kind of vehicles which is used to generate the non-conventional energy like electricity. It is able to extend this project by using same arrangement and construct so that increase the power production rate by fixing school and colleges, highways etc.

The total cost of project has to be well within our estimated budget. By increasing size and specifications of motor and assembly we can increase the output of system if required in future.

#### **REFERENCES:**

- [1] Aswathaman, V., and M. Priyadharshini. "Every speed breaker is now a source of power." Proc. of 2010 International Conference on Biology, Environment and Chemistry IPCBEE. Vol. 1. 2011.
- [2] G.RamakrishnaPrabu, G.Ethiraj. "Electricity Generation by Speed Breaker." International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 4, Issue 5, May 2015.
- [3] ParulBisht, RajniRawat. "Electricity Generation through Road Ribs using law of Electromagnetic Induction." Conference on Advances in Communication and Control Systems 2013 (CAC2S 2013)
- [4] Sailaja, M., M. Raja Roy, and S. Phani Kumar. "Design of Rack and Pinion Mechanism for Power Generation at Speed Breakers." International Journal of Engineering Trends and Technology (IJETT) – Volume 22 Number 8-April 2015
- [5] Khade, Angad G., and VarunSathe. "A Review: Comparison of different Mechanisms for Electricity Generation using Speed Breaker." Multidisciplinary Journal of Research in Engineering and Technology Volume 1, Issue 2, Pg.202- 206.
- [6] Mohanty, SibaBrata, and SasankShekhar Panda. "An Investigation On Generation Of Electricity Using Foot Step." International Journal Of Engineering Sciences & Research Technology (2014).