Design Speed Breaker For Road Rain Water Harvesting & Electricity Generation

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Abstract— Large amount of kinetic energy is being wasted on roads on daily basis in different forms which could be use to generate power and this power can be stored in batteries. This project shows clearly how we can generate power by using rack-pinion method where basically linear motion is converted into rotator motion and then can be used to generate electricity. Large amount of electricity can be generated using this method and this method is eco-friendly. In the current situation power has become a basic need for human life. The extensive usage of power has resulted in power crisis, and there is a need to develop methods of optimal utilization, which will not only ease the crisis but also preserve the environment. This paper attempts to show how the power can be generated through the speed breaker. Speed breaker plays very important role in slowing down the traffic and the idea we have come up with the speed breakers is that we can generate power through these speed breakers also. Now-a-day the rain water harvesting is very needed Hence we also include the rain water harvesting on the road side drains. This rain water can be stored into the tanks and which can use to the road side trees or plants it is useful for the environment and nature. Surface and groundwater resources are being utilized faster than they can be recharged. Rainwater harvesting is an old practice that is being adopted by many nations as a viable decentralized water source.

Keywords— Design speed breaker, Electricity generation, Rain water harvesting, Rack and pinion, eco-friendly, Electricity saving, etc.

I. INTRODUCTION

In road rain water harvesting rainwater runs down the pits i.e. store tanks and this water we can use for the road side trees or plants. In rainy season most of the water is wasted along the Roadside Drains and in many places this rain water on road side is flow out hence for this reason we prepare the model to collect this rain water in storing tanks filter it and use this rain water in summer season for road side trees. By this technique we can save the rain water. Without wasting the rain water also we reuse the rain water for road side trees and we cultivate the more trees by this technique. Also we are making the speed breaker when a vehicle crosses the speed breaker it gets pressed & then it gets back to its original position by this concept we generate the electric power. On road vehicles waste a tremendous amount of energy on speed breakers, where there is a necessity to provide speed breaker to control the speed of the vehicles. The annual rate of growth of motor vehicle population in India has been almost 20 percent during the last decade. There is tremendous vehicular growth in year by year. The increasing traffic and number of speed breakers on roads motivate to manufacture an innovative device which can channelize the energy of vehicles that is wasted on speed breakers to some useful work. In this paper it is mainly focused on the principle of Potential Energy to Electrical Energy In this paper it is explained the working of a mechanism to
generate power by converting the potential energy generated by a vehicle going up on a speed breaker into kinetic energy. When the vehicle moves over the inclined plates, it gains height resulting in increase in potential energy, which is wasted in a conventional rumble strip. When the breaker comes down, it moves the breaker up and down. This in turn rotates a geared shaft loaded with recoil springs. The output of this shaft is coupled to a dynamo to convert kinetic energy into electricity. A vehicle weighing 300 kg going up a height of 15 cm on such a rumble strip produces approximately 7.36 watts power developed in one minute.

II. METHODOLOGY

2.1. Rainwater harvesting by using speed breakers
In rainy season most of the water is wasted along the Roadside Drains and in many places this rain water on road side is flow out & mixed with the river then the river or any other source of water is being polluted hence for this reason we prepare the model to collect this rain water in storing tanks filter it and use this rain water in summer season for road side trees. By this technique we can save the rain water. Without wasting the rain water also we reuse the rain water for road side trees and we cultivate the more trees by this technique.
To increase ground water recharge by percolation and decrease the flooding of storm water drains, an infiltration trench could be built by the side of the drain all along the road, wherever possible. The infiltration trench can be 2 feet wide and 2 feet deep and filled with pebbles or aggregates with a top layer of coarse river sand. As the rainwater from the road flows into the infiltration trench, water percolates into the ground. During heavy rainfall, excess water spills over to the storm water drains. The infiltration trenches store water temporarily during rainfall and later for infiltration. These infiltration trenches may be exposed as walk ways or paved with inter-locking pavers, specially designed with gaps in between for water to flow into the infiltration trenches. This water was collected in storage tank and then after water was supplied to the trees by hand pump mechanics i.e. Piston Valve mechanism is used for the lifting the water from the Storage tank.

2.2. Electricity Generation through Speed Breaker
There are different types of mechanism developed for generation of electricity from speed breaker. Among these, the popular ones are Rack and Pinion, Roller and Crankshaft mechanism. For Rack and Pinion and Crankshaft mechanism, basically, it involves weight from vehicles that exerted a force upon the speed breaker. The potential energy from the compression of the dome of the speed breaker is converted into kinetic energy through these mechanisms where the motion is transfer into a generator to generate electricity. In Roller mechanism, the friction force due to the vehicle movement acted upon the roller is then transmitted to chain sprocket arrangements where the rotary motion is then transfer into a generator for electricity generation.

2.3. Resources Used
   a) Rack and Pinion- It is a type of linear actuator which is used to convert between rotary and linear motion. The flat toothed part is the rack, while the pinion is the gear.
   b) Springs- It is an elastic body that will be distorted when it is being compressed and recover its shape when it is not. For spring, it had concluded the factors that affect the spring are surface imperfection, spring geometry, material selection, design parameters and raw material defect.
   c) Spur Gears -It is a cylinder with the teeth aligned parallel to the axis of rotation.
   d) Flywheel- It is a heavy wheel located on the shaft to smooth out delivery of power from a motor to a machine. It reduces the fluctuation in the speed.
   e) Shaft- A shaft is a rotating element that transmits rotary motion to the other element.
   f) Generator-It is a mechanism that converts the mechanical energy into electrical energy according to the principle of Faraday’s Law in which the flux lines are being cut to generate electromotive force.
g) **Hand Pump mechanism** - Piston Valve mechanism is used for the lifting the water from the stored road rain water harvested.

h) **Water Storage tank** - It is used for storing the road rain water harvesting.

2.4. Design Layout-

![Design Layout of Speed Breaker](image)

**Fig. No.1 Design Layout of Speed Breaker**

### IIIEXPERIMENTAL INVESTIGATION

3.1. Working Principle

Rainwater was collected in storage tank through the trenches and then a hand pump mechanism i.e. Piston Valve mechanism is used for the lifting the water from the stored road rain water harvested. When a car reaches on speed breaker, rack moves downward to generate linear motion. Two pinions are attached to a rack which converts the linear motion of rack into rotary motion. Both pinions have unidirectional motion, like as bicycle sprocket. Two gears are mounted on pinion shaft’s to transfer mechanical power to the common shaft having one gear. At final shaft, a flywheel is used to provide uniform motion. A belt is used to transfer mechanical motion of the common shaft to DC generator. The complete gear box is dipped in lubrication oil sump to minimize frictional losses. There are no chances of slipping between rack and pinions due to guide slots. DC generator generates power which is stored in batteries same as in solar technology. The generated power can be used for the domestic purpose or commercially, which are present near the speed breaker. Whenever the vehicle is allowed to pass over the dome it gets pressed downwards then the springs are attached to the dome and are compressed and the rack which is attached to the bottom of the dome moves downward in reciprocating motion of rack into rotary motion of gears but the two gears rotate in opposite direction. So that the shafts will rotate with certain R.P.M. these shafts are connected through a set of gears to the dynamos, which converts the mechanical energy into electrical energy. The conversion will be proportional to traffic density.

3.2 Energy Estimation

Let us consider,

The mass of any vehicle travelling over the speed breaker = 300Kg (Approximately)

Height of speed brake = 15 cm

Work done = weight of the body x distance travelled by the vehicle

Here, Weight of the Body = 300 Kg x 9.81 = 2943 N

Distance traveled by the body = Height of the speed breaker = 15 cm
Power = Work done/Second = (2943 x 0.15)/60 = 7.3575 Watts
Output Power developed for 1 vehicle passing over the speed Breaker for one minute = 7.3575 watts
Power developed for 60 minutes (1 hr) = 441.45 watts
Power developed for 24 hours = 10.5948 Kw
This power generated by vehicles is more than sufficient to run four street lights in the night time.

IV. IMPLICATIONS OF USING SPEED BREAKER
The power generated through speed breaker mechanism can be considered renewable source which does not pollute the environment. Below are the advantages and challenges of using speed breaker mechanism for power generation

4.1 Advantages
- Stored water can be easily supplied to the plant without using electricity through hand pump mechanism.
- By using this method, electricity will be generated throughout the year without depending on other factors.
- Pollution free power generation.
- Less floor area required and no obstruction to traffic.
- No need of manpower during power generation Require simple construction methods.
- Installation is easier and Cost for maintenance is low.
- During generation no manual work is necessary and All year round energy is available.
- By this technique of road rain water harvesting we can save the rain water.
- Without wasting the rain water we can reuse the rain water for road side trees and we cultivate the more trees by this technique.

4.2 Challenges
- Maintenance will be very difficult.
- Might cause collision.
- We have check mechanism on regular interval of time.
- It may get damage because of rain water.
- Require more suitable and compact mechanism to enhance efficiency.
- By use of road rain water harvesting the road is required large repairing and maintenance cost.
- Selecting suitable generator and springs.
- Achieving proper balance of speed and torque.

V. CONCLUSION
In rainy season most of the water is wasted along the Roadside Drains and in many places this rain water on road side is flow out & mixed with the river then the river or any other source of water is being polluted hence for this reason we prepare the model to collect this rain water in storage tanks filter it and use this rain water in summer season for road side trees. By this technique we can save the rain water. Without wasting the rain water also we reuse the rain water for road side trees and we cultivate the more trees by this technique.

In coming days, demand for electricity generation will be very high as it is need for everyone, speed breaker mechanism will prove great boom for future in electricity generation. Looking at the recent conditions of the electricity crisis in India, government focuses on utilizing the non-conventional energy sources for electricity generation and reducing the share of global warming. So, the techniques described in the paper will also contribute to the power generation nationally with some more modifications in the model. In this paper, we referred different mechanisms and every mechanism has its own advantages and disadvantages. Therefore as per our study we conclude that rack and pinion mechanism is efficient as well as cost effective mechanism for generation of electricity from speed breaker.
REFERENCES


