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Design and Fabrication of Mechanical Speed Breaker for Power Generation

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Abstract
In the recent period, the need for power is growing per day as the population grows. Now, almost every vehicle creates pollution and we are using its mechanical energy just for transportation purposes only instead of something else even, but now we have a solution to this problem with a technique that helps to overcome the pollution that is produced by "conventional source of power generation" as well as energy generate and also should be eco-friendly. Such power that will be generated by this method will be used for traffic lights as well as signals. The economy depends on energy and its approaches to development simultaneously which indicates more energy production. This research work clarifying that how we can generate power by linear motion is converted into rotary motion (using the rack-pinion method). It also shows a thorough analysis of power generating with the help of a speed breaker and emphasizes an idea which shows that with the help of a specially designed speed breaker power could easily be generated which having the aim of producing electrical power using the weight of vehicles and can be utilized for street light, signals, etc.
Keywords: Mechanical speed breaker, Power generation, Rack and Pinion, Crank mechanism.

Introduction

Electricity generation has become a critical concern in our society today, necessitating the need for development. Energy recovery and Renewable energy are now regarded as the maximum effective techniques for mitigating the environmental and financial consequences of excessive fossil fuel use. One of the biggest wastes of energy is speed limiters. The car loses its energy when it hits a speed limiter/bump and slows down[1][2]. Several works and research have been done on speed breakers that generate energy. Speed breaker helps for low accidental cases as well as limited speed of vehicle maintain by it. Without a speed breaker, there will be more risk for an accident and the main cause for such accidents are these blind turns because of which drivers are unaware of vehicle speed, so here speed breaker helps to slow down the speed and prevent accidental situations at the bending road. The extreme weather conditions and poor road infrastructure of hills areas may baffle the driver's sense[3][4]. To solve these issues of road safety, a driver warning system fixed under the speed hump has been designed which to be self-sufficient for the requirements of energy. A speed breaker mechanism made up of a shaft, gear train mechanism, and rack and pinion is

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capable of generating energy with the use of a gear assembly and will be positioned on one side of the road to create power when a vehicle passes over it [5][6][7].

Method And Materials

Machine description

The basic ideas for this machine that are stablished on road is to produce energy with moving towards green energy. The mechanism on road arranged under the Speed Breaker is a sturdy frame structure consisting of several components: chain, rack and pinion, flywheel and pinion duly mounted on shafts, and some other components such as coil springs, bearings, and a dome-shaped boss[4].

Material selection

For this design of speed breaker, we use that type of material which produce low sound and effective for noise pollution as well as. Appropriate selection of materials can help reduce wear, noise, and corrosion. It also facilitates maintenance and increases service life. Machine frame, shaft and dome-shaped attachment. The iron content is between 99.70-99.90% and the carbon content is between 0.10 -0.30%. It has a balanced ratio of strength, toughness and ductility. Springs - (oil hardened carbon steel), corrosion resistance and good wear[8].

Principle And Operation

As we all know that vehicles moving on the road have a lot of kinetic energy and potential energy so, we use this energy for power production and use them as a source of light on streets and road traffic. When a moving vehicle hits the speed bumps, the speed breaker's springs are compressed and the dome is depressed. Dome is basically the upper part of this design that help to create reciprocating movement for rack and pinion mechanism. The rack and pinion system converts some of the vehicle's energy into rotational motion and sends it to the shaft, while the remainder is stored in the speed breaker’s springs. Its rotating motion is multiplied in the spur gears and chain drive before being sent to the alternator. Once the vehicle leaves the speed breaker, the springs start returning to their previous original shape, releasing the stored energy to the shaft to rack and pinion gears for conversion to rotational motiondue to this reverse motion we can use this motion for again generation of power and hence power generation can be more efficient [8].The prototype model of the speed breaker assembly shown in the figure 1.

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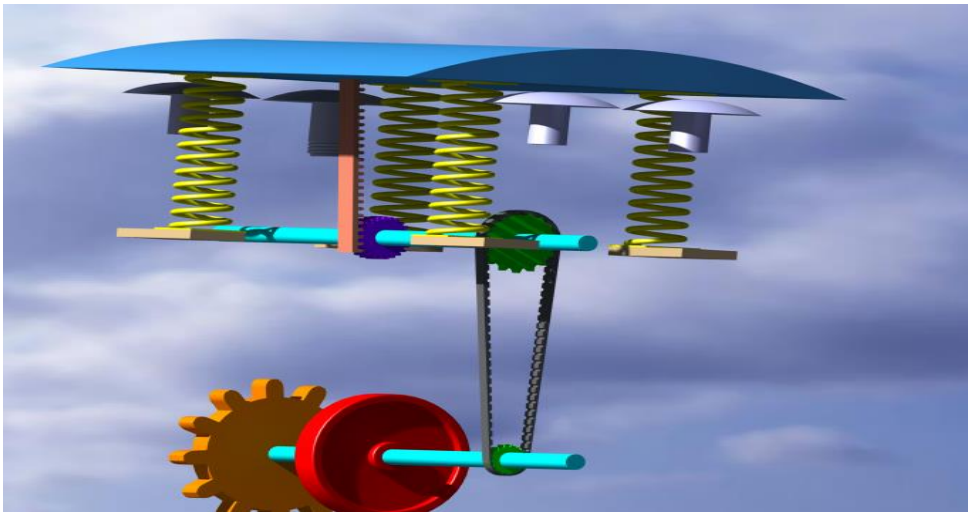

Figure 1. Prototype model of the speed breaker assembly

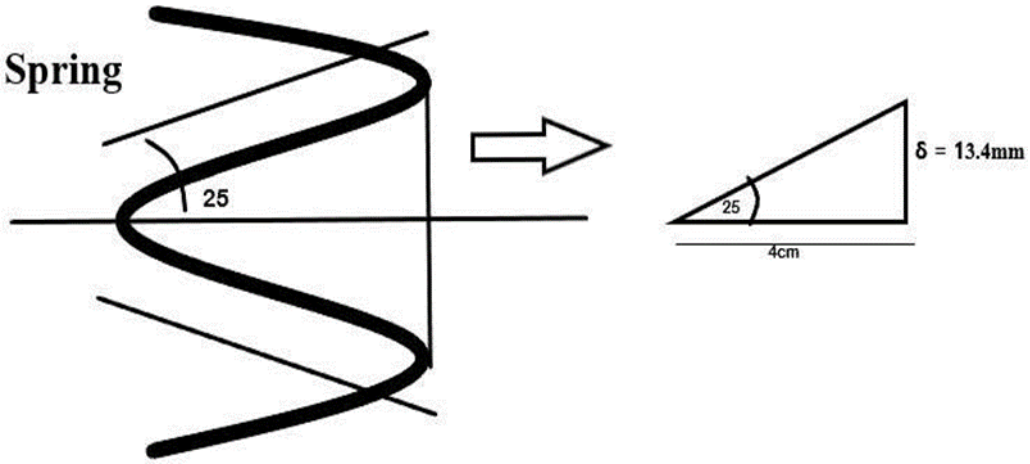

Figure 2. Schematic diagram the coilspring

According to above diagram, shows that for safely working of speed breaker there must be value of the delta will be equal or less than 13.4mm. After designing and fabricating a mechanical breaker for power generation and performing the appropriate tests on the machine to determine its efficiency in terms of improvements and the result of applying different test loads at the same speed, it is also necessary to determine the power generated by the breaker. The generator was put through its paces with an alternating load. Its rotary motion is also multiplied in the chain drive and spur gear before being fed to the generator. This machine generates electrical energy during the compression and return strokes, thus supplying additional power. The operating concept is shown in several machine views. Figure 3. shows the flow chart of the design process[1][6][8].

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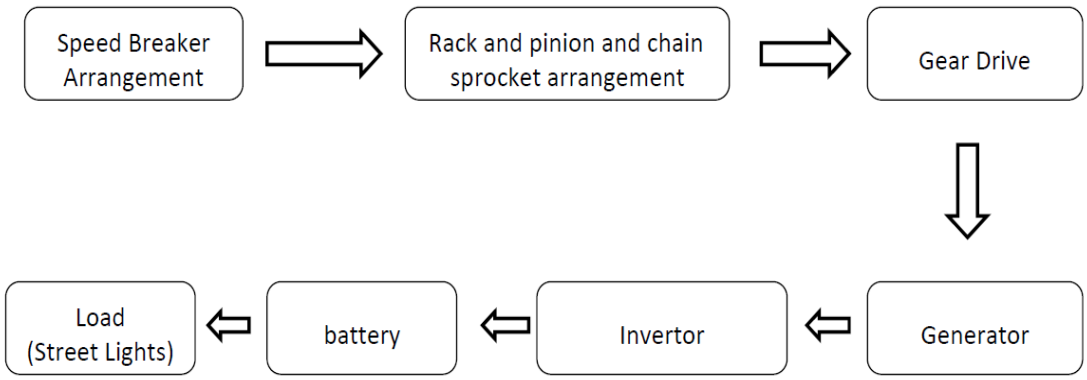

Figure 3. Flow chart of Design process

Result And Discussion

Three different masses, namely 1000 kg, 1500 kg, and 2000 kg, are applied to the speed limit systems, and the generated current (I) and voltage (V) are measured. It was found that as the mass increases, the voltage generated also increases. For example, a mass of 1000 kg generates 16.33 watts. The voltage reaches 24.52 watts with a load of 1500 kg and 32.7 watts with a mass of 2000 kg

Furthermore, as predicted, the measured current trend dithers before the observed voltage. The measured currents and voltages are used to determine the output powers. The mass of 1000 kg, 1500 kg, and 2000 kg produces 6.5 watts, 26.2 W, and 44.7 W, respectively. Thus, Figure 4 clearly shows that the output power varies linearly with mass. However, the calculated powers are 0.16 W/kg, 0.40 W/kg, and 0.56 W/kg, respectively, meaning that the power generation per unit mass increases as the mass of the speed-breaker system increases. As a result, the average energy generation per unit mass of 0.37 W/kg shows potential for the speed braking system performance, suggesting that the installation of such systems in existing cars fleeing the roads is worth investigating.

The earlier recommendation to install speed braking systems on roads was based on the assumption that the average vehicle mass is about 1500 kg. As a result, the anticipated power for this mass is estimated to be about 0.56 kW per vehicle. Therefore, it is generally assumed that the power generated will be sufficient to meet the power requirements for nighttime street lighting and to power electronic devices on the roads such as cameras, sensors, and radar devices.

Table: 1 Powers Developed from Speed Breaker in Different Load Condition

Model Calculation	Mass of vehicle	Output power	Output in KW
1	980Kg	961.3 W	0.961KW
2	1100 Kg	1097 W	1.09Kw
3	3300 Kg	3237 W	3.27KW
4	4400Kg	4316.4W	4.31KW

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Table: 2 Stiffness of spring at constant deflection

S. No	Weight	Stiffness of spring
1	980Kg	89.1
2	1100Kg	110
3	3300Kg	330
4	4400Kg	440

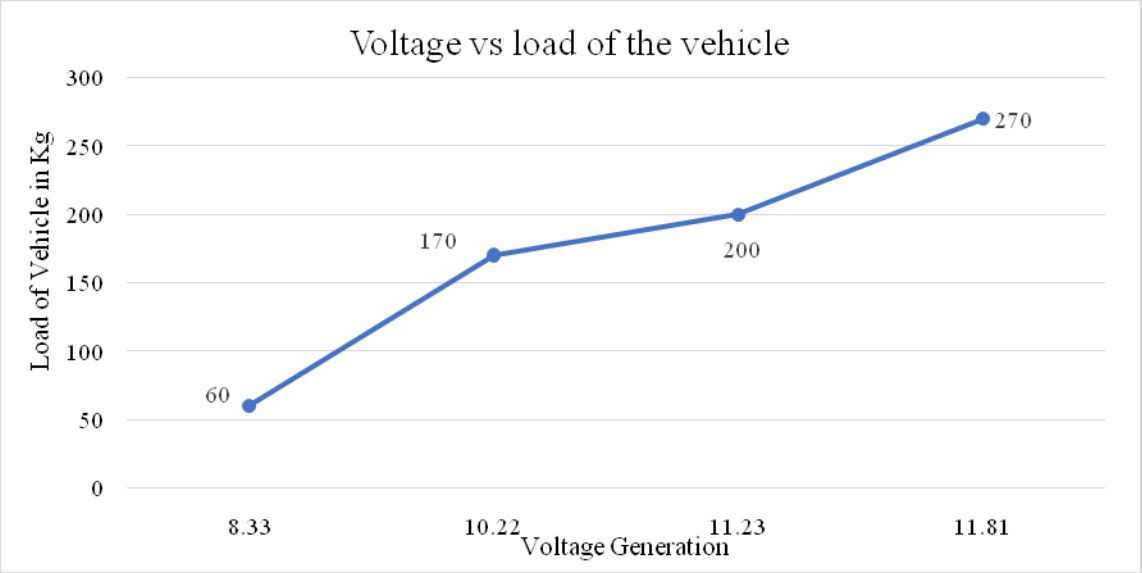

Figure 4. Variation of a load of vehicle in the function of the voltage generation

According to above data given in graph between voltage generation and weight of vehicle, it is clear that on increasing weight of vehicle that will passes over the speed breaker will leads to increase in voltage generation per hours or per day according to calculation.

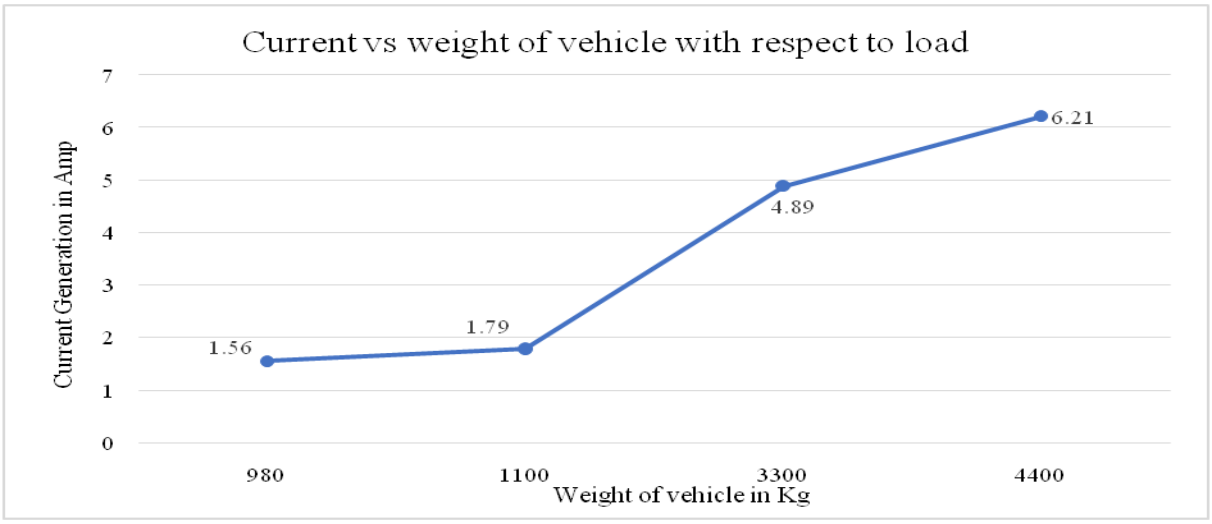

Figure 5. Variation of current with respect to load of vehicle

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According to above data given in graph between current generation and weight of vehicle with respect to load, it is clear that on increasing weight of vehicle that will passes over the speed breaker will leads to increase in current generation per hours or per day according to calculation.

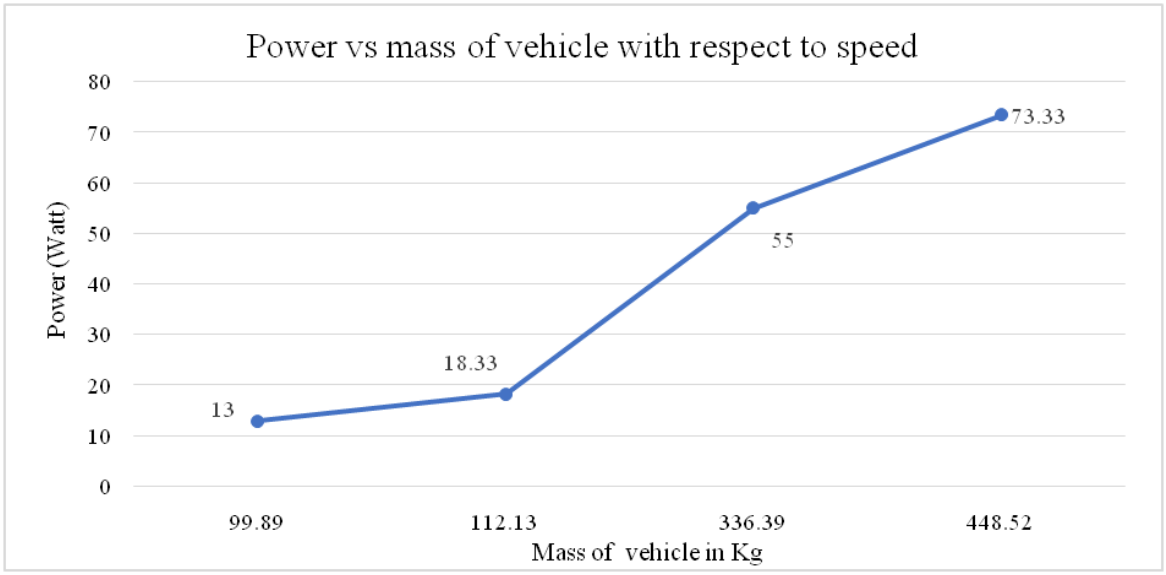

Figure 6. Variation of a power with variation in mass

According to above data given in graph between power generation and weight of vehicle, it is clear that on increasing weight of vehicle that will passes over the speed breaker will leads to increase in power generation.

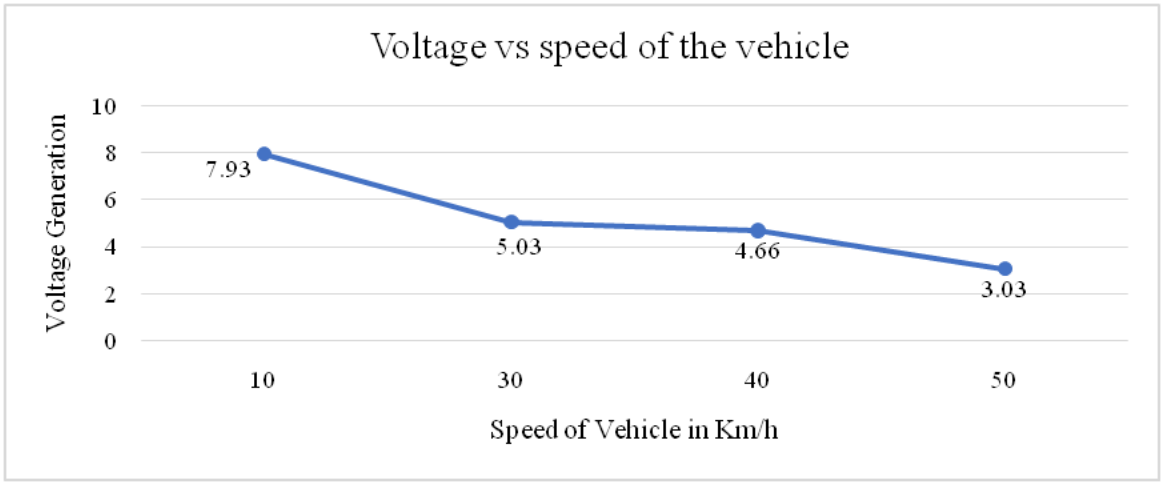

Figure 7. Variation of the voltage generated in the function of the speed of the vehicle

According to above data given in graph between voltage generation and speed of vehicle, it is clear that on increasing speed of vehicle that will passes over the speed breaker will leads to

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decrease in voltage generation. Because if the vehicle moves slow speed, it certainly applies the pressure to the speed breaker for a longer period of time, resulting in the highest voltage produced. While we keep on increasing the speed of the vehicle crushes over the speed breaker, it certainly applies the pressure to the speed breaker for a shorter period of time, resulting in the low voltage produced.

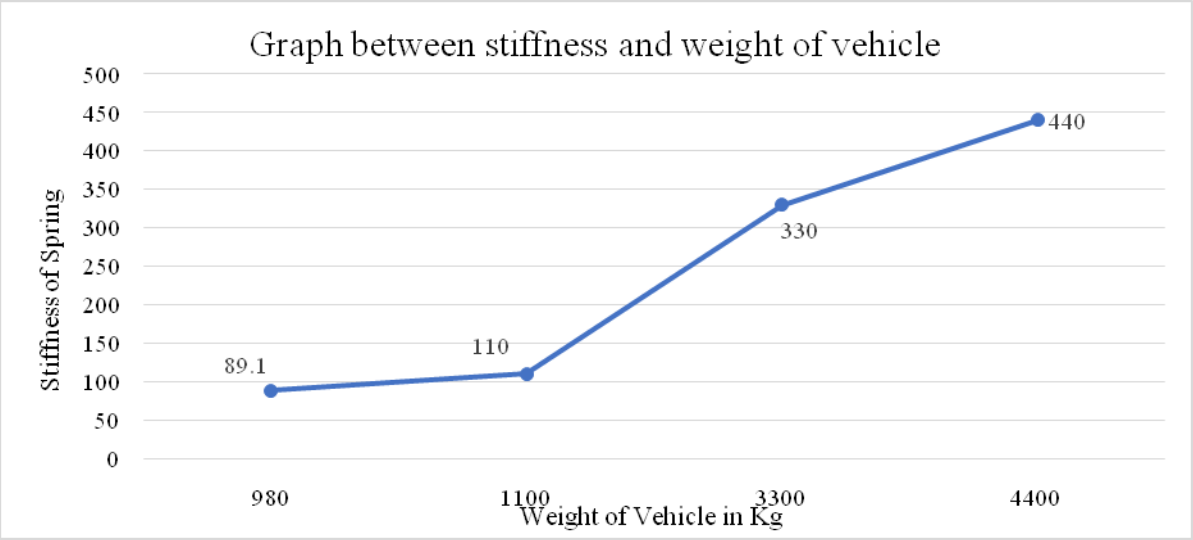

Figure 8. Variation of the stiffness of spring in the function of the weight of the vehicle

According to above data given in graph between stiffness of spring and weight of vehicle, it is clear that on increasing weight of vehicle that will passes over the speed breaker will be required to increase the stiffness of the spring.

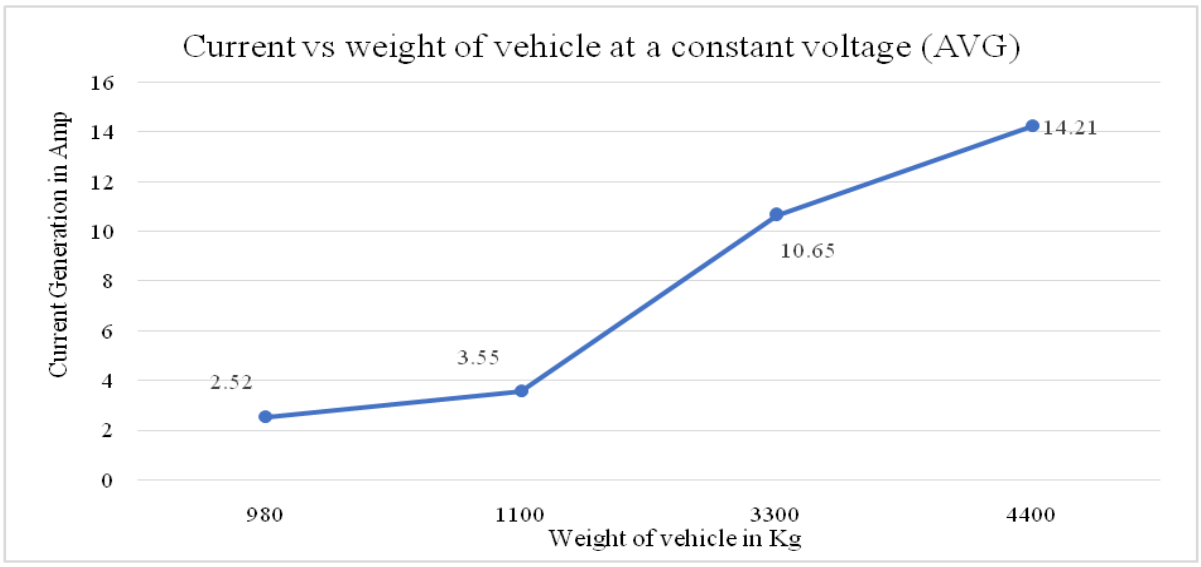

Figure 9. Variation of the current generated in the function of the weight of the vehicle

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When vehicle of several masses that are shown in graph passes over the speed breaker there will be variation in generating current as shown in graph, as we can see that at 980 Kg of vehicle can generate 1.56A current and further as shown in above graph.

Conclusion

The use of energy is an indicator of a country's development. Therefore, it can be concluded that a person must use more and more energy to achieve prosperity, and that paper is the best source of energy we have in our daily lives. Although some road users complain about the speed limit signs, they are an effective way to promote road safety. Another advantage is that they may be used to generate power, because at low speed of vehicle more power generate due to full load on speed breaker arrangement. The vehicle generally produces only pollution and uses mechanical energy solely for transportation, but now we will be able to use the weight of vehicles for power generation, which is electricity through speed breakers installed across highways and roadways, and the produced power will be used for signal, street lights, and so on. Because the speed breaker is a source of energy waste, we may reduce it using this strategy. This may generate between 19 and 45 KW of electricity each day. This power generation is eco-friendly and does not require any fuel, hence referring to green energy.

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