

Prototype Development of Traffic Calming Solution: Replacing Speed Hump to Roller Electricity Generator Road

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Our country still considers as growing countries and mostly depends on non-renewable energy as main sources to generated electricity. Therefore, this study is aimed to determine the performance of electrical generating speed breaker using roller mechanism called as roller electricity generator road. Electricity could be generated by modification of conventional speed breaks with roller principle. The most effective method to generate electricity is by increasing the number of vehicles that pass over the speed breaker. These studies have showed the dynamic of fabricated prototype from different speed approach and various weights provided which could affect electric generated by speed breaker. The result showed that the prototype would be able to generate up to 7 watts of maximum power using 4 rollers at the same time. Yet, the amount of power generated also depends on the rating of the selected DC generator and the design of speed breaker itself. Further studies in this area is highly recommended to find out the maximum power could be generated using the mechanism and how these prototype could reduce speed of vehicle in roadway.

Keywords: Traffic Calming, Speed breaker, Electric roller.

1. Introduction

The roles of transportation in Malaysia especially in town and sub urban areas have been enlarged consistent recently. The enlargement of vehicle user in road would cause the roadway has to be straightened and widened earlier than its life capacity. As a result, the increasing of vehicle on the road has caused the increasing of vehicle speed in town and sub urban area. Therefore, these problems have been addressed by residents, pedestrians and cyclists regarding their safety concern. Thus, the establishment of solution for traffic calming is much needed [17; 11]. The solution of traffic calming is considered as development of safety solution for example speed hump or radar speed sign to reduced or diminish the vehicle volumes and speed in order to increase the safety of resident, cyclist and pedestrians [17, 3]. Traffic calming is one of the effective methods to reduce the speeds for a decade in town area in developed countries.

Today, traffic calming solution has become main alternative over the world due to the reduce number of accident and vehicle speeds[7,16]. Speed breaker on the road has



been one of the most traffic calming solution recently. The total of vehicles used the speed breaker have increasing tremendously. Certain of energy are released at the speed breaker while a motor vehicle passed over the speed breaker [4,11].

The rollers which are linked to a generator will rotate or spin as soon as a vehicle passes over the speed breakers on road and the roller would generate electricity. In order to generate electricity, this method could be one of the best methods as the totals of vehicle pass over the speed breaker were increase [3,15]. Roller Electrical Generator plays its role as a main device to covert electrical energy from mechanical energy to produce electricity as the vehicle pass over the roller that have been installed on speed breaker [6, 8]. The generator does not generate electrical energy directly. It would be converted purely from mechanical energy that generated by movement of roller to generate competent electricity [20, 9]. After that, the generated electricity is stored in battery can it can be used based on demand. The energy generated and collected using natural resources are replaced by nature and well known as renewable energy [14]. Renewable energy is always given less pollutant generated and environmental friendly instead of non-renewable energy [12]. In fact, if the supply of fossil fuel is unlimited, renewable energy proven better choice compare to nonrenewable energy [5, 19].

There are a lot of examples of source for renewable energy such as wave, geothermal energy, sunlight, wind as well as biomass [2, 10]. According to previous studies, the maximum power could be generated from speed breaker is 15 Watt and it can generated 4541 joules of kinetic energy and at the same time it could produce 5 Watt of power at less than 5 seconds [13]. As we know, a lot of developing countries across the world are utilizing their renewable energy to develop their countries [18]. There a lot of benefits of renewable energy have found and this is one of the reasons renewable energy are preferable instead of nonrenewable energy. This research was determining the possibility of using unused energy by creating a system that can generating electricity using speed breaker. Thus, this study was aimed to determine the performance of electrical generating speed breaker using roller appliance called as roller electricity generator road. Electrical generating speed breaker is a new concept road technology and design in Malaysia. More knowledge and understanding are needed on technical design factors and material selection that can absorb such a heavy weight on top of that. Therefore, there must be research conducted to find out knowledge in this area.

2. Methodology

This study was carried out at Civil Engineering Lab, Universiti Tenaga Nasional, Kajang. A four-sided structure structure with sizes of 750mm x 500mm (as shown in Figure 1) is made-up using conventional steel frame. These frames are made of mild steel. Appropriate measurements consist of 4 frames and attached to a rectangular form of support using welding. 3 roller shafts are installed on respective edge of the steel frame with the support of 6 of casted iron pillow block bearings. Every bearing have been installed permanently on the frame structure using 2 bolts as shown in Figure 2. Next, 2 pieces of wooden boards (1 and 2 in Figure 5) with measurements of 800mm x have been installed on the main 1200mm structure to provide enough slope as a speed breaker. The total of 4 Type 'A' sprocket wheel of 24 (3, 4, 5and 6 in Figure 5) teeth are installed for every side of the roller shaft. Next, 3 roller shaft were attach side by side by



sprocket chain in order to give consistent movement and rotation of the roller shaft along the way with type 'A' sprocket wheel of 40 tooth (3 and 7 in Figure 5) is installed on the outside section of the outer roller (13 in Figure 5). At the same time, Type 'A' sprocket wheel of 40 teeth is linked with a smaller Type 'A' sprocket wheel of 18 tooth (14 in Figure 5) using sprocket chain. The smaller sprocket is connected to the shaft of 12 Volt of DC dynamos(Figure 4 and DC Dynamo in Figure 5). These 12 Volt of DC Dynamo is installed permanently on specific arrangement using nuts and bolts so that shaft would have consistent rotation. Plan view of prototype model roller electricity have shown in Figure 4.



Figure 1: Rectangular frame structure



Figure 2: Bearing installed on rectangular steel frame using 2 bolts



Figure 3: Chain Drive



Figure 4: Specific arrangement of Direct Current (DC) Dynamo



Figure 5: Top view of Prototype model

Efficiency and performance should be one of the important elements in development of fabricated roller electricity generator road. Therefore practical and data collection would aspect should be addressed in these studies. At least 3 trials must be conducted before the real data collection begun. The initial collected data including current and voltage produced by different speed of two-wheeled of vehicle. The various speed of vehicle have been taken starting form 10 km/hr up to 40km/hr in order



to determine the significant impact of different speed on the electric generated by using these prototype. After that, current and voltage generated by the DC generator will be tried using different weight of two-wheeled vehicle. KYORITSU Kew Mate Model 2000 Multimeter has been used as testing device in order to determine the current and voltage generated by prototype. Lastly, output power has been determine using formula based on the collected current and voltage produced. The analysis of power could be considered output as instantaneous electric power. Since the studied only develop small scale of prototype for speed hump to generated electricity, the prototype only can be tested for low weight vehicle such as by bicycle and motorcycle only.



Figure 6: The data collected in studies

Power could be expressed as product of Current and Voltage produced by Direct Current (DC) generator. Therefore, the total output power produced by Direct Current (DC) generator could be determined by using equation 1 below:

$$P = IV \tag{1}$$

Where,

P = Power (Watt, W)
I = Current (Ampere, A)
V = Output Voltage (Voltage, V)
t = Time (second, s)

3. Result and Analysis

Result

The data collection of roller electricity generator road is very necessary in order to determine the current and voltage produced by prototype. Several trials have been taken in order to produce consistency of collected data. In these studies that specific load have been selected using two wheeled vehicle added by would be man weight considered as experimental data with constant speed breaker as well as with various speed of two-wheeled vehicle. The result of voltage and current produced using two-wheeled vehicle passes through the prototype with variation speed have shown in Figure 7. The graph shows voltage and current generated with variations of different speed. 9 volts of voltage was a highest voltage produced at 30 km/hr speed of vehicle. It observed that, the highest and lowest current produced by the DC generator is 0.561A and 0.22A, respectively. But, the current produced consistent result between 0.2 A and 0.4 A when the vehicle through the prototype with various speed. The lowest voltage produced in these studies is 2.31 V when the vehicle is passing at 10 km/hr constantly. Meanwhile, the average peak voltage produced is 8.97 V when the vehicle passing at 30km/hr. Yet, the voltage produced starting to decrease when the speed reach 35km/hr until 40km/hr due to reducing the frictional force between the shaft of steel roller and the tire of two wheeled vehicle. Based on the initial monitoring, it can be justified that the higher speed of vehicle would affect the direct contact of front and back tires with steel roller shaft and reducing the friction force between both of it. As a result, the effective speed of vehicle is only at 30 km/hr. The graph of out power at the various speed of two wheeled vehicle have shown in Figure 8.



The graph showed that at the speed of 30 km/hr would generate the significant watt of power.



Figure 7: The graph of speed vehicle, speed and current



Figure 8: The graph of output power.

In these studies, the data is collected as the vehicle speed of 30 km/hr passes through the prototype and by altering the weight of the twowheeled vehicle. The voltage produced as the vehicle passes through the speed breaker with a different set of weight of human weight. 30 km/hr has been selected as constant speed vehicle to perform these tests. The voltage produced by speed breaker was taken with three different passengers for every trial due to less amount of variation of weight. The graph of vehicle + Man weight against voltage and current have shown in Figure 9. The graph shows that, the highest voltage produced was 9.17 Volt at 225 kg of vehicle + Man weight and the highest current produced was 0.5 Ampere at 170 kg of vehicle + Man weight. Figure 10 shows the graph of out power produced by vehicle + man weight.



Figure 9: The graph of vehicle + Man weight against voltage and current.



Figure 10: The graph of vehicle + man weight and output power.

In these studies, it is essential to identified and acknowledge the effect of various speed of vehicle in generation of electricity. For instead, a vehicle speed of 20 km/hr would not be able to give same impact on the prototype as vehicle speed of 40 km/hr. These theories would identify the significant impact of dynamic factors of prototype by altering the variation of speed on the two-wheeled vehicles. By obtaining the result on experiment, it justified that the effect of speed vehicle on the electric generation should be acknowledged. As stated before, the higher of output voltage produced as the faster DC shaft turns. Based on the current data produced versus the vehicle + man weight in Figure 9, . It is observed that the lowest and highest current produced by the DC generator is 0.44A and 0.5A, respectively. Yet, the current generated is consistent when vehicle passed through the prototype with various speed. It also appropriate to identify the influence of the vehicle weight towards electric generated instead of effect of speed only. At the same



time, predict that a vehicle with 170 kg of weight would give same influence as a vehicle with 225 kg of weight towards fabricated roller [1, 18]. The effect of weight could also be considered as main parameter in electric generation based on the result obtain. The increasing of friction force between roller shaft and tire would affect by increasing of the weight of vehicle. Thus, the lighter the vehicle, the lower the voltage produced.

Roller electricity generator has used the simple principle where the energy converted form kinetic energy of the vehicle converted into useful energy which can be considered as renewable energy. The 12 volts of direct current (DC) generator could convert energy from mechanical energy into electric energy. Based on the output power analysis, it shows that the output power based on the different speed and weight can be calculated using equation 1.

According speed factors, the output power produced rises up to 4.84W from 0.59W as the speed of vehicle approaching 30km/hr from 10km/h. Meanwhile, based on of weight factors, the output power produced is approaching 4.31W from 4.18W and the output power decrease consistently from 170 kg to 215 kg and increase again from 215 kg to 255 kg of vehicle weight as shown in Figure 10. The highest voltage found at8.84 Volts and highest current produced is 0.54 Ampere. There were several studied have been done to design speed hump to generated electricity and by using roller method was a cheapest method to develop speed bump instead on using other method. Since there is no development of speed hump to roller electricity generator road in this country yet, therefore the outcome of these studied could be new invention and development of generating new sources of electricity by changing traditional speed hump to roller electricity generator road.

4. Conclusion

This studied was aimed to determine the performance of replacing speed breaker using roller mechanism become electric generator called as roller electricity generator road. The result shows that highest power can generate using roller mechanism was 4.84W at the vehicle speed of 30km/hr. Nevertheless, the rating of Direct Current (DC) generator used and the specification of speed breaker design would give significant influence on the amount of power generated. These innovations consider as new finding in order to identify alternative source of energy especially renewable energy using traditional method to reduce traffic calming and speed vehicle. Speed breaker could produce electricity based on traffic volume which indicates a good possibility to reused waste energy in developed area. The electric produced using these rollers can be used as power supply for traffic signals, traffic lighting and signboard. The outcome of these studied showed the significant electricity could be generated by new innovation. Further studied in these innovations are highly recommended in future including designs, specification, testing and meet with local condition as well as local regulation. The result showed only small scale of electricity generated and perhaps it could as a new source of electricity in future. These approaches are suitable for developing countries like Malaysia which could start use renewable energy as main source for electric generations.

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