WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Comparative Study of Speed Bump Energy Generator with and Without MMR Technology

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ABSTRACT

The objective of this work to analyse the energy generation output of conventional speed breaker technology and improve it with application of MMR technology by simulating a modal that generates electrical energy once vehicle goes over speed breaker. This work is additionally focused on to builds findings energy-generation technique said as MMR (Mechanical Motion Rectifier), that ensures a remarkable increment in power output once installed with existing system. In This work results are in coming up with a modelled system that with improvement in energy output of 65 Joules /vehicle. The advantage of application of the MMR technology were also examined, this work represents that increment of 45% could be occurred by using MMR technology.

1 Overview about Speed breaker

Speed brakers are devices that slow down the traffic, by slowing down vehicles. They were designed in 1953. a physicist annoyed with fast cars passing by his university. Those devices were manufactured from rubber, because it is usually the case. They're generally made in either a circular, sinusoidal, or parabolic shape with a height that's usually between 7 and 10 cm. Their width varies between 360 and 420 cm., while their ramp is from 90 to 180 cm. long.

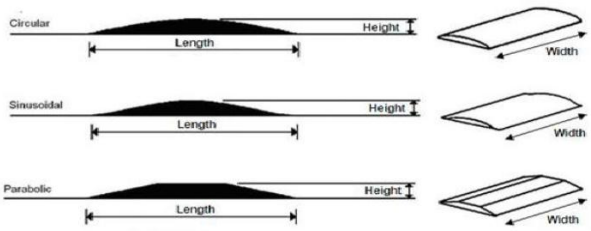

Fig.1

2 Speed Breaker power generation system

This generates energy from speed breaker should primarily acquire energy in a very certain kind from this further convert it into another kind of energy that may be used to generate electricity. the bulk of comes and studies antecedental examined use a system wherever a platform is ironed down once the passage of automobiles. This further event can lead to a movement to bottom side vertically that may later on be regenerate into a motility one, that may enable the generation of power through, for occasion, the application of a generator. so as to convert the mechanical linear movement into a electrical energy one, several mechanisms will be used among that fair measure the roller, magnet, crank-rod, or rack and pinion mechanisms. The system designed and simulated at intervals this study can adopt the rack and pinion mechanism. once the review of previous works and studies, it had been found that this mechanism is that the most used.

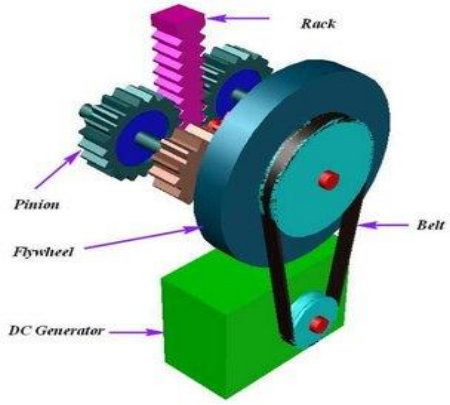

Fig 2

3 Overview about the MMR technology:

The MMR technology, or Mechanical motion rectifier, may be a technology utilized in systems that generate energy from car's suspensions. Those systems recover the energy lost in irregular vibrations of the cars' suspensions by transforming the two-way linear movements of the suspension parts into a unidirectional rotational movement of a generator. this is often done through using the rack and pinion mechanism and two one-way clutches: devices that link two rotating objects, but that allow the transmission of the movement in one direction of rotation only. Within the 1st case where the suspensions of the car are being compressed, the rack moves linearly as shown in figure 3 This causes the primary two pinions that are linked thereto to rotate counter-clockwise. During this 1st phase, the primary one-way clutch is that the only 1 that's engaged which links the generator to the primary pinion. This causes the generator to rotate clockwise

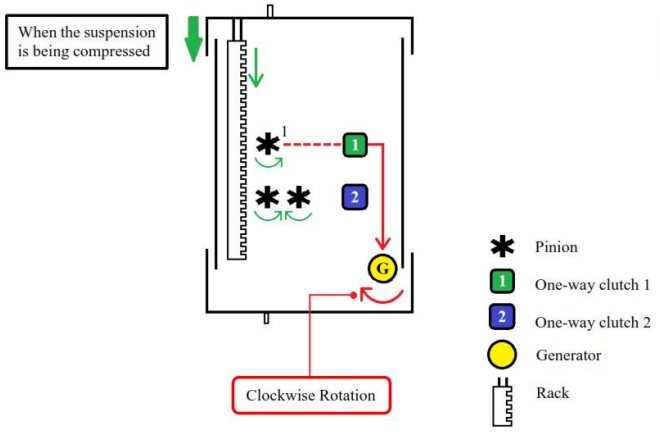

Fig 3

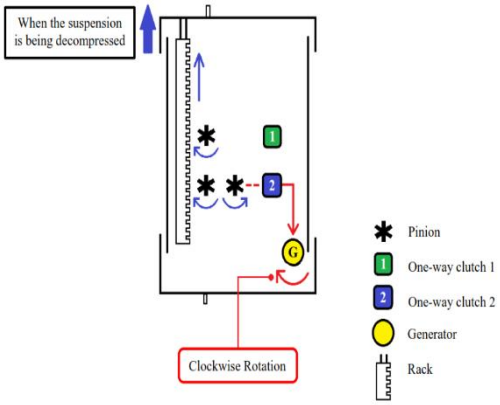

Fig 4

3 Objective of work

Objective of this study is to quantify the real potential of generating electricity from speed breaker, by designing an energy recovery system. This study also intends to measure and examine the premises and findings of previous work, regarding the benefits of adopting the MMR technology. This work will analyse the performance of the energy generation with and without MMR technology.

4 Metdlogy

In this work we consider the MMR technology and the rack and pinion mechanism. The operation of the system are in two steps :

- 1st step : the movement of the system from top to bottom rest.
- 2nd : system will regain its original position by virtue of spring.

Listing of the system's parts

Table 1

Component	Quantity
Rack and pinion mechanism	2
Gear set	2
One-way Clutch	2
Transmission shaft	1
Frame	1
Carapace	1

Listed parts designed with solid works software and assembly of the parts were made by using solid works as well

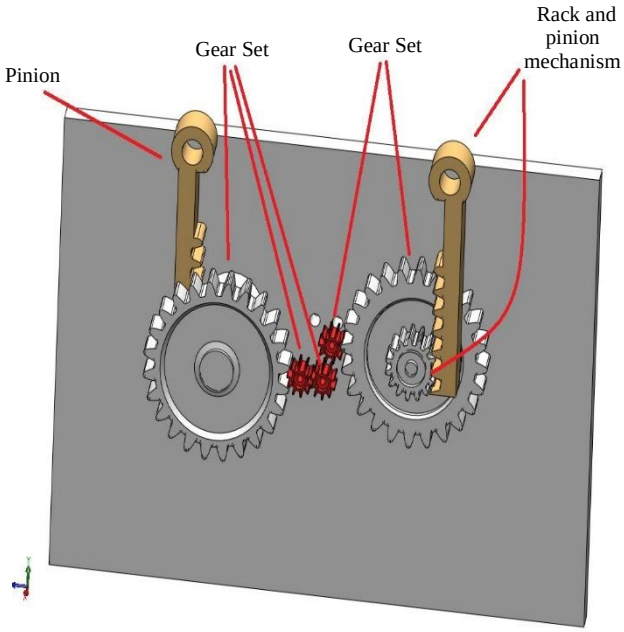

FIG5

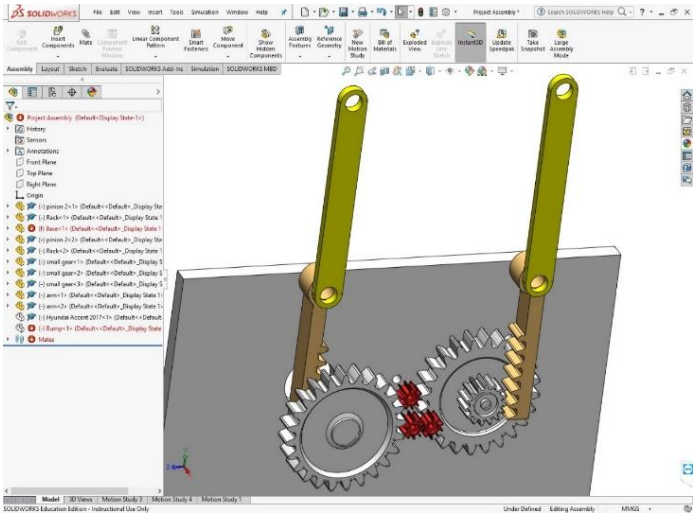

FIG 6

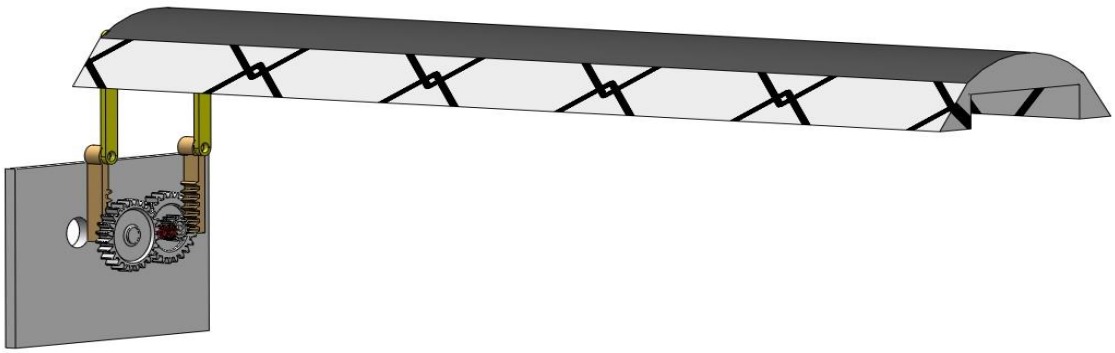

FIG 7 FINAL DESIGN

Final model of the energy recovery system installed on the road.

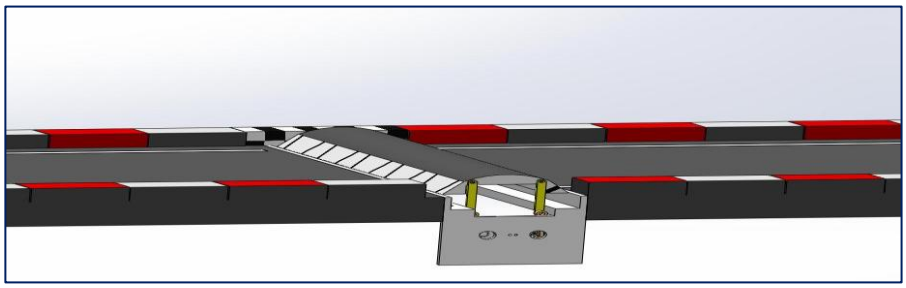

FIG 8 FINAL ASSEMBLY

5 Simulation of system

In this work, the most important parameter for simulation is speed of car. One by one simulations are going to be perform by varying the speed of car

TABLE 2

km/hr	4	5	6	7	8
m/sec	1.1	1.389	1.667	1.944	2.222

The gravity is the initial parameter considered in this work. This parameter directly applied by using a feature in solid works in y axis directives.

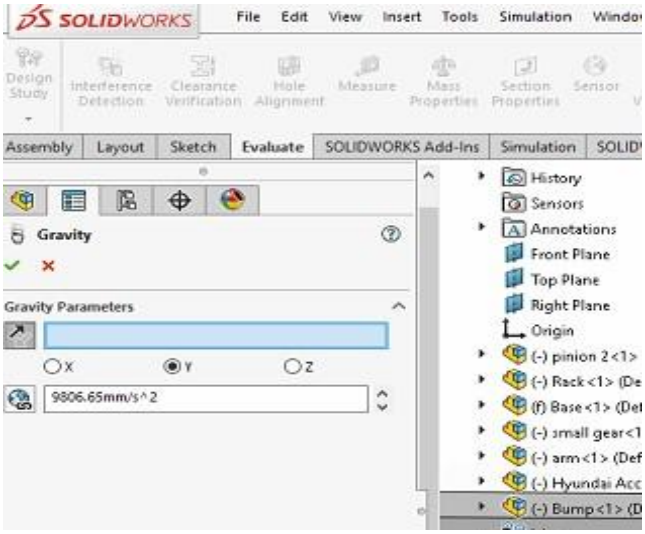

FIG 9

The 2nd input parameter is contact between various parts of the modal.

- The vehicle and the road
- The Vehicle and the system's structure'
- The road and ground clearance of road

the system's shell Those contacts INSURE ACTUATL SIMULATION WITH GRAETER ACCURACY.

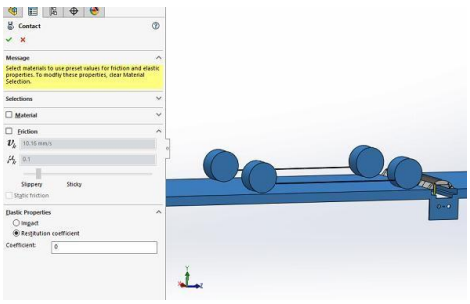

FIG 10 real contact between the vehicle and the road

Frictional Force Is Not Considered In This Work spring is the last considered parameter in this simulation.

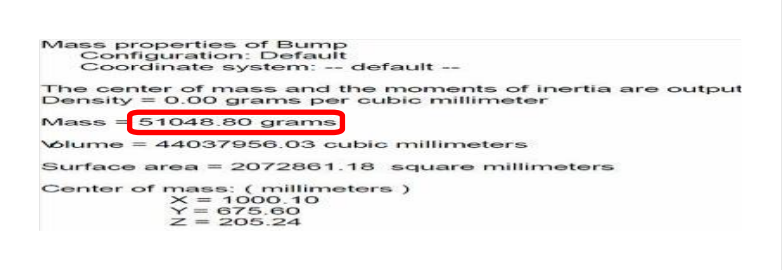

FIG 11 Mass of the system's carapace

Followingly, is the free body diagram of carapace sytem

$$W_{carapace} = F_{Spring}$$

$$M_{carapace} \times g = k \times \Delta L$$

Speed breaker can be push up to 9 cm in full load condition . the initial length of the spring is 9 cm. plus its length when it is completely compressed up to 5 cm. so the conclusion is that length of the spring is 14 cm when full is applied on it Because of certain limitation hit and trail method is applied the calculated values are shown in figure

$$M_{carapace} \times g = k \times (L_0 - 0.14)$$

Plugging the values of $M_{carapace}$ = 51 kg and g = 9.81 gives us:

$$L0 = \frac{500.31}{k} + 0.14$$

Choosing a sample value of k = 10kN/m gives us an initial length of 19cm.

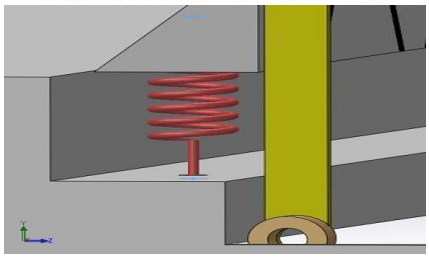

Figure 12 Spring in the simulation file

Simulation output variables:
the output of this work is in the form of the mechanical energy generated by the speed braker the following formula was used to calculate:

$$\mathbf{E} = \frac{\mathbf{1}}{\mathbf{2}} \times \boldsymbol{I} \times \boldsymbol{w}^2$$

Where:
E, is the mechanical energy in Joules
I, moment of inertia of about its axis of rotation in kg m² **w**,

Therefore, the values of the angular velocity are to be obtained from the simulation. The values produced by the simulation will be prompt. The output energy is calculated by using MS excel. The total will be the overall energy output of the system for a specific velocity of the car.

RESULT AND DISCUSSION

The results represent in table 3 elaborates the output energy for the system with the MMR technology. as discussed previously in report", in order to evaluate the advantages of adopting the MMR technology, output energy values will have to be generated for the system without the MMR setup.

TABLE 3

Car Velocity (Km/hr)	Output Energy MMR (joule)
4	49.77
5	51.73
6	65.78
7	77.53
8	80.22

In this work, this setup permits the system to generate energy when the system is going back up too. Then, in order to generate non-MMR results, the amounts of energy that regards to the upward movement were lost.
after calculating that. Comparative results are come up as

Car Velocity (Km/hr)	Output Energy MMR (joule)	Output Energy NON-MMR (joule)
4	49.77	30.84
5	51.73	33.76
6	65.78	45.73
7	77.53	57.01
8	80.22	60.5

the energy output values of this modal with the MMR technique. we can observe that with increment in car velocity the output of the system increases. It can clearly observed that when the velocity of car is 4 km /hr the output of system is 49.77 Joules and when velocity increases up to 8 km /hr the output of the system also increased 80.33 The velocity of passing cars is directly proportional to output of the system up to a certain limits. The average output on 4,5,6,7,8 km/hr velocity has been evolute which is calculated as 65 joule. A comparison between with and without the MMR setup

CONCLUSION

The output of the this designed system, which is 65 Joules, translates to 0.02Wh/car. The load of the street lighting is about 500w/day. this amount of energy generation can be occurred when approximately 20000 cars pass over the breaker on a daily basis in order to power street lights.the advantages of implementing the MMR technology, in this work we concluded that a increment in energy generation could be occurred by 145%.

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