



Electric Power Generation through Speed Breakers

¹ Ms.Padmaja Medewar, ² Ms.Sakshi Nandwate, ³Ms.Apurva Kadam, ⁴Ms. Kalpana P. Paithane

^{1,2,3} Student, ⁴Professor, HOD,

^{1,2,3,4} Department of Electronics and Telecommunication Engineering, M.G.M's College of Engineering, Nanded, India

Email: ¹s23_medewar_padmaja@mgmccen.ac.in, ²sd24_nandwate_sakshi@mgmccen.ac.in, ³s23_kadam_apurva@mgmccen.ac.in, ⁴jondhale_kc@mgmccen.ac.in

Abstract: The rapid increase in energy demand and the depletion of conventional energy resources have encouraged researchers to explore alternative and renewable energy sources. One such innovative approach is the generation of electrical energy through speed breakers installed on roads. This system utilizes the mechanical energy produced by vehicles when they pass over a speed breaker and converts it into electrical energy using suitable mechanical and electrical mechanisms such as rack-and-pinion arrangements, springs, and generators. The downward displacement of the speed breaker due to vehicle weight is transformed into rotational motion, which drives a DC generator to produce electricity. The amount of energy generated depends on factors such as vehicle weight, speed, and traffic density. This method not only helps in harvesting otherwise wasted mechanical energy but also contributes to sustainable and eco-friendly power generation. The generated power can be used for low-power applications such as street lighting, traffic signals, and charging small electronic devices, especially in high-traffic and remote areas. Hence, electric power generation through speed breakers offers a promising solution for decentralized, green, and cost-effective energy harvesting.

Key Words: Speed breaker, Energy harvesting, Rack and pinion mechanism, DC generator, Renewable energy, Sustainable power generation, Traffic energy.

1. INTRODUCTION:

The continuous growth in population, urbanization, and industrialization has resulted in a rapid increase in global energy demand. At the same time, conventional energy resources such as coal, petroleum, and natural gas are depleting at a fast rate and cause serious environmental problems, including air pollution and climate change. Therefore, there is a strong need to develop alternative, renewable, and sustainable sources of energy that are environmentally friendly and economically feasible. One of the promising approaches to meet this demand is energy harvesting, which involves capturing small amounts of energy from everyday activities and converting it into usable electrical power. Road traffic is a significant source of unused mechanical energy, especially at speed breakers where vehicles are forced to slow down and exert a downward force on the road surface. This mechanical energy is usually wasted in the form of heat and vibration. The concept of electric power generation through speed breakers aims to utilize this wasted mechanical energy and convert it into electrical energy. When a vehicle passes over a speed breaker, the vertical displacement caused by the vehicle's weight is converted into rotational motion using mechanical mechanisms such as rack-and-pinion, crankshaft, or spring-based systems. This rotational motion drives an electrical generator, producing electricity that can be stored or used directly for low-power applications such as street lighting, traffic signals, and charging small electronic devices. This method is suitable for high-traffic areas and offers a decentralized, eco-friendly energy solution without emissions, supporting sustainable infrastructure and smart city development.

2. LITERATURE REVIEW:

The need for sustainable energy has led researchers to study power generation using speed breakers by capturing the mechanical energy of moving vehicles. When vehicles pass over speed breakers, their vertical motion is converted into electrical energy using mechanisms like rack-and-pinion or spring-based systems connected to generators. Studies show that energy output mainly depends on vehicle weight and traffic density. Heavier vehicles and busy roads produce more power. Although the energy generated by a single vehicle is small, the total energy collected over time can be effectively

used for low-power applications such as street lighting and traffic signals. However, system efficiency and long-term reliability are affected by mechanical losses, friction, and wear of components. Recent studies aim to improve efficiency, durability, and cost using better materials, efficient generators, energy storage, and smart control systems. The technology cannot replace conventional power sources but serves as a useful supplementary and sustainable energy solution.

3. OBJECTIVES:

The main objective of this research is to study the feasibility of generating electrical energy from mechanical energy produced by vehicles passing over speed breakers. The work aims to design and develop a prototype system and analyze the effect of vehicle weight and traffic density on power generation. It also seeks to measure the electrical output, evaluate system efficiency and limitations, and assess the suitability of the generated energy for low-power applications such as street lighting and traffic signals, along with its environmental and economic benefits.

4. CIRCUIT DIAGRAM:

Generating electricity from speed breakers involves converting a vehicle's kinetic energy into rotational motion via mechanisms like rack-and-pinion or chain-sprocket, driving a DC generator, charging a battery, and using an inverter to supply AC power, commonly for streetlights. The basic circuit connects the generator to a rectifier (if AC), then a charge controller to the battery, and finally an inverter to power loads, with a control circuit managing operations like automatic streetlights.



Fig.1 Electric power generation through speed breakers

5. WORKING PRINCIPLE:

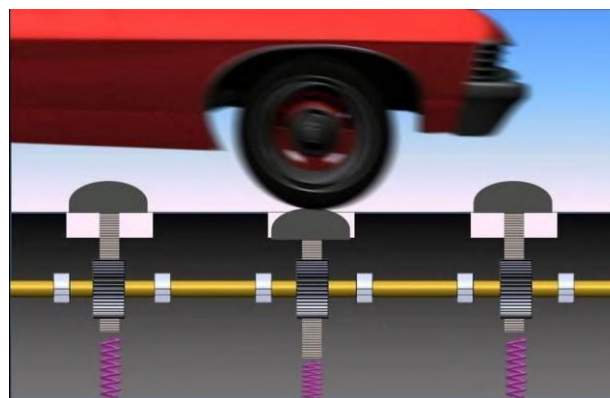


Fig. 2: Speed Breakers

The general principle involves converting the vertical motion of a vehicle passing over a speed bump into rotational motion, which drives a generator.

1. Mechanical Energy Capture: As a vehicle passes over a specially designed speed breaker (or "power hump"), a movable platform is pushed down. This linear/reciprocating motion is captured by mechanical linkages.

2. Motion Conversion: A mechanism, often using a rack and pinion assembly or a roller system, converts the linear vertical motion into continuous rotational motion.

3. Speed Multiplication: The rotational speed is often increased using a system of gears and sprockets to a level sufficient to turn a generator efficiently.

4. Electricity Generation: The mechanical energy is fed into a DC generator (dynamo), which produces electrical energy via electromagnetic induction.

5.Storage and Regulation: The generated power, which can be inconsistent, is stored in a rechargeable battery (e.g., lead-acid or lithium-ion) to ensure a stable and continuous power supply.

6.Powering LEDs: The stored energy is then used to power LED light strips or other low-power devices, often via a control circuit that can include inverters (to convert DC to AC if needed for specific systems) or light-sensing systems to activate the lights at night.



Fig.3 : Electricity generated

6.METHODOLOGY:

The methodology begins with the design and development of a movable speed breaker mechanism capable of converting the downward force of passing vehicles into mechanical energy. A spring-loaded or rack-and-pinion system is used to convert the vertical displacement of the speed breaker into rotational motion. The mechanical structure is designed to ensure smooth operation, minimum friction, and safety for vehicles. In the next stage, the rotational motion obtained from the mechanical system is coupled to a DC generator to convert mechanical energy into electrical energy. The generated output is passed through a rectifier and voltage regulation circuit to obtain a stable DC supply. The electrical energy produced is stored in a rechargeable battery using a charge controller to prevent overcharging and ensure efficient energy storage. Finally, experimental testing is carried out by allowing different types of vehicles to pass over the speed breaker under varying traffic conditions. The voltage, current, and power output are measured and recorded using appropriate measuring instruments. The collected data is analyzed to study the effect of vehicle weight and traffic density on energy generation, as well as to evaluate system efficiency, reliability, and practical feasibility.

7.RESULTS:

The experimental results confirmed that electrical energy can be successfully generated from vehicles passing over the speed breaker. It was observed that the output voltage and current increased with vehicle weight, as heavier vehicles produced greater mechanical displacement of the speed breaker mechanism. Light vehicles generated comparatively lower electrical output, while cars and heavy vehicles produced higher and more consistent power levels. The results also showed that traffic density has a significant impact on total energy generation. In low-traffic conditions, the energy output was irregular and minimal, whereas in high-traffic conditions, the cumulative electrical energy increased steadily over time. Although the energy generated per vehicle was small, continuous traffic enabled sufficient energy accumulation for charging batteries and powering low-energy devices. Mechanical and electrical losses reduced the overall efficiency due to friction and generator losses. However, proper alignment, lubrication, and efficient components improved performance. The system operated safely without affecting vehicle comfort, making it suitable as a supplementary energy source in high-traffic areas.

8.CONCLUSION:

This research demonstrates that electric power generation through speed breakers is a feasible method for harvesting mechanical energy from moving vehicles. The system effectively converts the downward force of vehicles into electrical energy, with higher output observed for heavier vehicles and increased traffic density. Although the power generated per vehicle is limited, the cumulative energy in high-traffic areas can be utilized for low-power applications such as street lighting and traffic signals. However, the system has certain limitations, including mechanical losses, intermittent energy generation, and maintenance requirements due to continuous mechanical operation. Despite these



challenges, the system is environmentally friendly, safe for vehicles, and economically beneficial when installed at suitable locations. Therefore, electric power generation through speed breakers can be considered a practical supplementary energy solution rather than a replacement for conventional power sources.

9. LIMITATIONS:

The electrical energy generated per vehicle is very small, limiting the system to low-power applications only. The output depends heavily on traffic density and vehicle weight, making power generation irregular and unreliable in low-traffic areas; therefore, it cannot be used as a primary power source. Mechanical losses due to friction, misalignment, and continuous operation reduce efficiency, while wear and tear of components increase maintenance costs and reduce long-term reliability. Additionally, the intermittent nature of power generation requires energy storage devices such as batteries or supercapacitors, increasing system complexity and cost. High initial installation costs and improper design may also affect vehicle comfort and road safety.

10. RECOMMENDATIONS:

The speed breaker power generation system should be installed only in locations with high traffic density such as toll plazas, parking areas, and busy urban roads to maximize energy output. High-efficiency generators, low-friction mechanical components, and durable materials should be used to improve performance and reduce energy losses. The design of the speed breaker must ensure vehicle safety and passenger comfort while allowing sufficient mechanical displacement for energy conversion. Regular maintenance and proper lubrication are recommended to minimize wear and extend system life. Efficient energy storage systems such as batteries or supercapacitors should be integrated to ensure continuous power supply.

REFERENCES:

1. Yadav, Durgesh, Sonu Prajapati, and Akash Porwal. "Electric Power Generation through Speed Breakers." International Advanced Research Journal in Science, Engineering and Technology, vol. 7, no. 2, Feb. 2020, pp. 7–10.
2. Chavan, Madhusudan, Suraj Rajesh Karpe, A. N. Mudiraj, B. D. Shinde, B. S. Deshmukh, and R. B. Aurade. "Power Generation Using Speed Breaker." Journal of Electrical and Power System Engineering, 2022.
3. Utikar, Vedant Ajay, Suraj Ramu Gowda, Arnav Ashutosh Kulkarni, and Manas Milind Kulkarni. "Power Generation using Speed Breaker." International Journal of Engineering Research & Technology, vol. 10, no. 09, Sept. 2021.
4. Swapnil Daphal. "Electric Power Generation by Speed Breaker." International Journal of Innovations in Engineering Research and Technology, 27 Mar. 2021.
5. Gupta, Rajat, Suyash Sharma, and Saurabh Gaykawad. "A Revolutionary Technique of Power Generation Through Speed Breaker Power Generators." International Journal of Engineering Research & Technology, vol. 2, no. 08, Aug. 2013.

WEB REFERENCES:

1. Hossain, Shah Mohazzem, C. K. Das, Md. Shahdat Hossan, and Sams Jarin. "Electricity from Wasted Energy of the Moving Vehicle Using Speed Breaker." Jurnal Teknologi (Sciences & Engineering), Universiti Teknologi Malaysia, DOI:10.11113/jt.v73.3256. Journal, accessed 2025.
2. Soumya L. M., Rashmi M. N., and Shashikala N. "Electrical Power Generation Using Speed Breaker Mechanism: An Innovative Approach to Energy Harvesting." International Research Journal on Advanced Engineering Hub (IRJAEH), vol. 2, no. 11, Nov. 2024, pp. 2601–2606, <https://irjaeh.com/index.php/journal/article/view/421>.
3. Joshi, Kalpesh, Gurmeetsingh Relusinghani, Rohan Khanna, Vivek Raut, Rohan Nalage, Ritik Kumar Singh, and Raturaj Rawate. "Power Generation using Speed Breakers and Potholes Detection." IJRASET Journal for Research in Applied Science and Engineering Technology, 2024, <https://www.ijraset.com/research-paper/power-generation-using-speed-breakers-and-potholes-detection>.
4. Prof. Swapnil D. Gaikwad, Akshat K. Kamble, Prathamesh U. Dhanawade, Shivraj S. Yevle, Sahil S. Mane. "Power Generation by Speed Breaker." IJRASET Journal for Research in Applied Science and Engineering Technology, 2023, <https://www.ijraset.com/research-paper/power-generation-by-speed-breaker-of-power-generation-through-speed-breaker-power-generators>