International Journal of Research Publication and Reviews, Vol (6), Issue (4), April (2025), Page – 9033-9038

International Journal of Research Publication and Reviews

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

Energy Generation Using Speed Breaker

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ABSTRACT:

The increasing demand for sustainable energy solutions has led to innovative approaches to harnessing untapped energy sources. One such approach is the generation of electricity from speed breakers. This method capitalizes on the kinetic energy of vehicles as they pass over speed breakers, transforming what is typically wasted energy into a valuable resource When a vehicle moves over a speed breaker, the vertical motion of the vehicle can be utilized to drive a mechanical system. This system generally consists of a rack and pinion mechanism. The downward force exerted by the vehicle on the speed breaker causes a rack to move linearly. This linear motion is then converted into rotational motion by the pinion. The rotational motion is subsequently used to drive a generator, which converts the mechanical energy into electrical energy. The generated electricity can be stored in batteries or used directly for various applications such as street lighting, traffic signals, and charging stations for electric vehicles. The system can be integrated with existing infrastructure with minimal modifications, making it a feasible solution for urban and rural areas alike. Moreover, this method of energy generation has the added benefit of reducing the carbon footprint and dependence on non-renewable energy sources. By harnessing the energy produced by the everyday movement of vehicles, this technology contributes to a more sustainable and efficient use of resources.

Keywords— sustainable energy, generation of electricity, mechanical energy into electrical energy, energy generation, carbon footprint

Introduction:

Free energy using speed breakers is an innovative concept that transforms the kinetic energy from moving vehicles into electrical energy. As vehicles drive over specially designed speed breakers, the mechanical energy exerted is captured and converted into electricity using various mechanisms such as rack and pinion systems, hydraulic mechanisms, or piezoelectric materials. This process not only provides a renewable and sustainable source of energy but also reduces the reliance on fossil fuels, thereby lowering carbon emissions. Additionally, this technology can enhance road safety by encouraging better driving practices. This sustainable method not only reduces dependence on fossil fuels and lowers carbon emissions but also enhances road safety by encouraging mindful driving. The implementation of energy-generating speed breakers has been explored in several countries, demonstrating its potential to contribute significantly to the global pursuit of renewable energy solutions and a greener future. Implemented in various pilot projects globally, this technology holds promise for contributing to renewable energy solutions and creating a greener future.

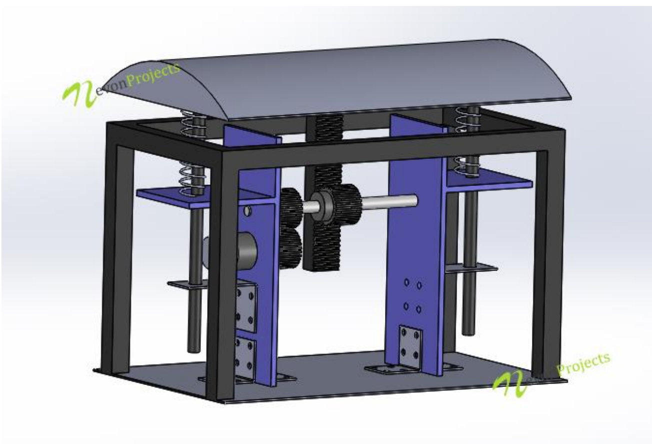


Figure 1: Design of speed breaker

Figure 2: Making phase of project

Define User-Based Problem

- With the increasing demand for electricity and the depletion of conventional energy sources, there is a need for innovative, sustainable, and cost-effective methods to generate power. Urban areas experience significant vehicular traffic, especially at speed breakers, where kinetic energy is wasted as vehicles slow down and accelerate. This untapped energy could be harnessed to generate electricity. However, users face challenges such as high energy costs, dependency on non-renewable sources, and lack of awareness about alternative energy solutions. The project aims to address these issues by designing a system that converts the kinetic energy of vehicles passing over speed breakers into usable electrical energy, benefiting both urban infrastructure and the environment.

Problem Definition

- Wasted Energy: The kinetic energy produced by vehicles passing over speed breakers in urban areas is currently not utilized, resulting in energy loss.
- Energy Demand: Increasing reliance on conventional energy sources is leading to a rise in energy costs and environmental degradation.
- Sustainability Gap: There is a lack of sustainable and innovative methods for generating electricity in urban spaces.
- Potential Solution: Speed breakers can be redesigned to capture kinetic energy from vehicles and convert it into usable electrical energy.
- Impact: Implementing such a system can provide a clean, renewable, and decentralized energy source, helping reduce dependence on non-renewable resources.

Literature survey:

Speed breakers can be designed to harness the kinetic energy of vehicles passing over them. This energy is converted into mechanical energy and subsequently into electrical energy using mechanisms like rack-and-pinion systems, roller setups, or hydraulic systems.

2.1. Mechanisms for Energy Conversion:

- Rack and Pinion System: This mechanism converts the linear motion of the speed breaker into rotary motion, which drives a generator to produce electricity. It is efficient but requires precise engineering to minimize energy losses.
- Roller Mechanism: Rollers installed beneath the speed breaker rotate as vehicles pass over, generating electricity through a connected generator. This method is simple but may face durability challenges.
- Hydraulic Systems: Fluid-based systems use the pressure exerted by vehicles to generate power. These systems are robust but can be expensive to install and maintain.
- Crankshaft and Piston Mechanism: This setup uses the downward motion of the speed breaker to move a piston, which generates electricity through a crankshaft.

2.2. Experimental Studies:

- Researchers have conducted experiments to test the efficiency of these mechanisms. For instance, studies have shown that the rack and pinion system can achieve high energy conversion rates when optimized with gear trains and transmission systems.
- Roller mechanisms have been tested in urban areas with heavy traffic, demonstrating their potential to power streetlights and traffic signals.

2.3. Challenges:

- Durability: Speed breakers face constant wear and tear due to heavy vehicles, which can affect the efficiency of the energy conversion systems.
- Cost: Initial installation and maintenance costs can be high, making it challenging for widespread adoption.
- Energy Losses: Inefficiencies in the conversion process can reduce the overall output.

2.4. Environmental Benefits:

- These systems provide a clean and renewable energy source, reducing dependence on fossil fuels.
- They can help lower carbon emissions and contribute to sustainable urban development.

2.5. **Future Scope:**

- Integration with smart grids to store and distribute the generated energy efficiently.
- Development of more durable materials and mechanisms to enhance the lifespan of the systems.

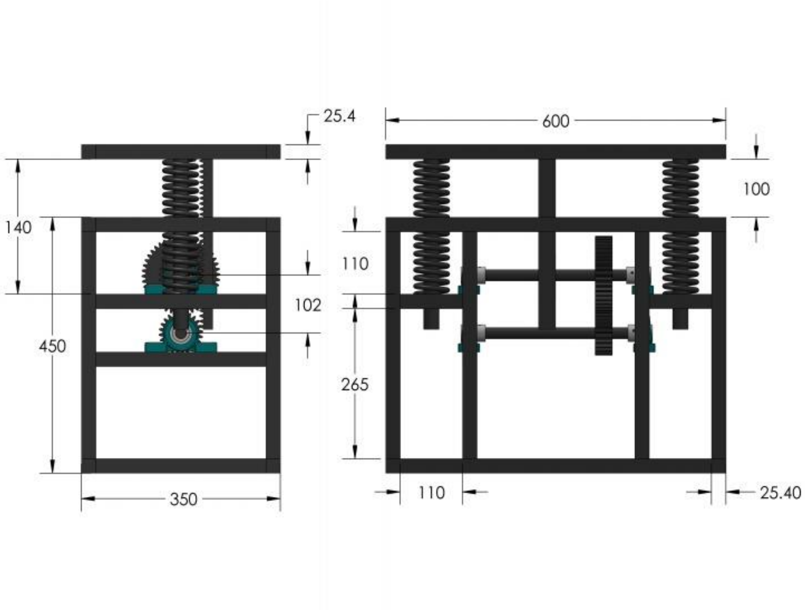


Figure 3: Prototype on AutoCAD

Device Overview:

- The device appears to include components like springs, gears, and a frame, which could be part of the energy conversion mechanism.
- There are two views in the drawing: a front view and a side view, with all major dimensions labeled for clarity.

Notable Dimensions (Front View):

- Total height of the device: **450 mm.**
- Width of the base: **350 mm.**
- Spring height: **100 mm**, with a spring width of **25.4 mm**.

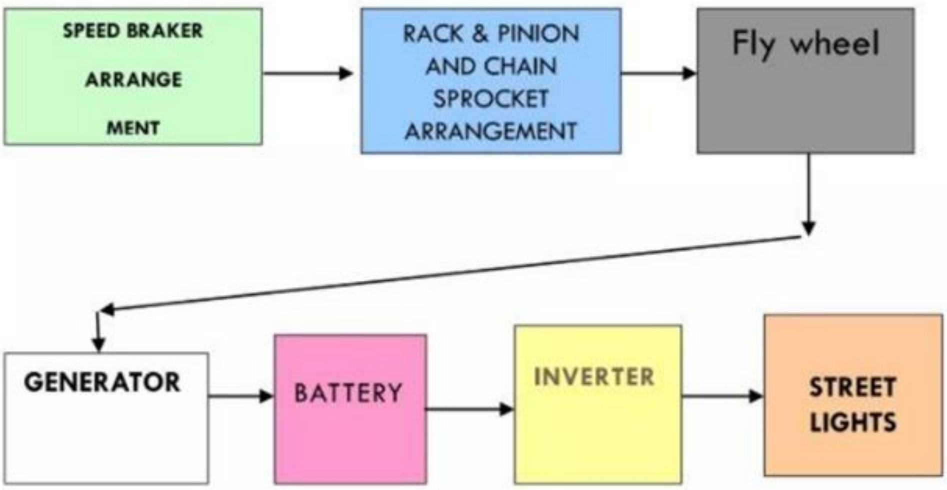
Notable Dimensions (Side View):

- Total height: **265 mm.**
- Width of the base: **110 mm.**
- Other elements like the spring dimensions remain consistent with the front view.

Application for Speed Breaker System:

- Springs: Could be used for absorbing kinetic energy from vehicles as they pass over the speed breaker.
- Gears and mechanical frame: Likely involved in the energy transmission and conversion process.
- Compact Design: The relatively small dimensions suggest that this design could integrate well into urban environments without significant disruption.

Block Diagram:



Process Breakdown:

1. Speed Breaker Arrangement (green box): Vehicles passing over the speed breakers trigger mechanical motion, initiating the energy conversion process.
2. Rack & Pinion and Chain Sprocket Arrangement (blue box): This mechanism transforms the linear motion from the speed breaker into rotary motion, which is used to drive the next stages.
3. Fly Wheel (gray box): The flywheel helps stabilize the energy output by storing the rotational energy and releasing it at a steady rate.
4. Generator (white box): Rotational motion from the flywheel drives the generator, converting mechanical energy into electrical energy.
5. Battery (pink box): The generated electricity is stored in the battery for future use.
6. Inverter (yellow box): Converts the stored direct current (DC) from the battery into alternating current (AC) suitable for powering devices.
7. Street Lights (orange box): The final output powers street lights, showcasing the practical application of the system.

Working Flow:

- Vehicles pass over the speed breaker, generating kinetic energy → Converts the vertical motion into rotational motion → Transmits and amplifies the rotational motion → Stores and stabilizes the rotational energy → Converts the rotational energy into electrical energy
- Stores energy and converts it to usable AC power → Supplies electricity to streetlights or other infrastructure.

Hardware Description:

1. **Battery:**

A battery is a device that stores energy in chemical form and converts it into electrical energy to power various devices and systems. It consists of one or more electrochemical cells, each containing two electrodes: a positive electrode (cathode) and a negative electrode (anode), separated by an electrolyte. When the battery is connected to a circuit, a chemical reaction occurs between the electrodes and the electrolyte, releasing electrons to generate an electric current.

Fig. 4.1 Battery

2. **INVERTER:**

An inverter is an electrical device that converts direct current (DC) into alternating current (AC). It is commonly used in various applications, especially where there's a need to power AC devices using a DC power source, such as batteries or solar panels.

Fig. 4.2 Inverter

3. Rack and pinon:

A rack and pinion are a mechanical system used to convert rotational motion into linear motion, or vice versa. It consists of two main components:

1. Rack: A flat, toothed bar or rail.
2. Pinion: A gear that meshes with the rack.

When the pinion rotates, it moves the rack in a straight line, and when the rack moves, it rotates the pinion.

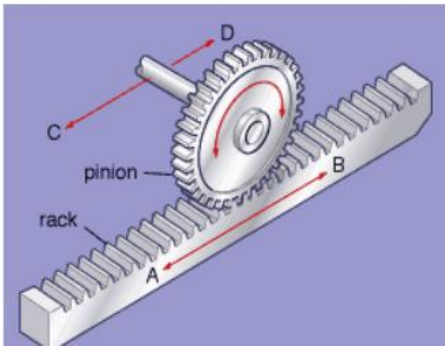


Fig. 4.3 Power transfer coil

Features of a Rack and Pinion System:

1. Compact Design: The mechanism is simple and compact, making it suitable for limited spaces.
2. Efficient Motion Conversion: It effectively converts rotational motion into precise linear motion.
3. High Load Capacity: Capable of handling heavy loads in industrial and automotive applications.
4. Durability: Made from strong materials, ensuring long-lasting operation under various conditions.
5. Wide Applications: Used in steering systems, CNC machines, robotics, and elevators.

4.6. LED Indicators

- Function: LEDs serve as visual indicators to show the energy conversion from mechanical to electrical.
- Features:
  - Turns ON when the speed breaker is pressured.
  - Remains OFF when no vehicle is passed through the speed breaker
  - Provides real-time status feedback to the user.

Future Directions:

The future scope of the energy generation project using speed breakers is vast and promising, with numerous advancements on the horizon. Technological improvements in materials and mechanisms, such as more efficient piezoelectric systems and durable designs, can significantly enhance energy output and system longevity. This technology could become a cornerstone of smart city infrastructure, powering IoT-enabled devices, traffic systems, and public utilities. It holds potential for energy diversification, catering not just to streetlights but also to electric vehicle charging stations, public transport systems, and emergency services. Additionally, combining this system with other renewable sources like solar or wind power could create hybrid setups for continuous energy supply. The project is scalable to larger implementations, including highways and bridges, and can play a pivotal role in rural electrification, providing power to remote areas with limited access. Furthermore, its global implementation and integration into policy frameworks could raise awareness about renewable energy and its significance, paving the way for a more sustainable and energy-efficient future.

Conclusion:

In conclusion, the energy generation project using speed breakers offers a forward-thinking and sustainable solution to address the growing demand for renewable energy sources. By leveraging the kinetic energy of vehicles, this project transforms an often-overlooked resource into a valuable means of generating electricity. The system can power essential public utilities such as streetlights, traffic signals, and even electric vehicle charging stations, thereby enhancing the efficiency of urban infrastructure while reducing dependency on conventional energy sources.

While the project comes with challenges—such as high initial costs, regular maintenance, and traffic-dependent energy output—it also provides a unique opportunity to innovate and inspire green technologies. By focusing on high-traffic areas and employing durable, efficient mechanisms, the system can maximize energy output and remain cost-effective in the long term. Furthermore, the project contributes to environmental sustainability by significantly reducing carbon emissions, promoting awareness about renewable energy, and encouraging the adoption of eco-friendly practices.

As societies strive for cleaner and more sustainable energy alternatives, this initiative holds the potential to revolutionize energy generation methods. It not only addresses energy shortages in underdeveloped and remote areas but also enhances public safety and supports green urban development. The successful implementation of this project could pave the way for future advancements in renewable energy technologies and contribute meaningfully to building a more energy-secure and environmentally responsible world. Through innovation, strategic planning, and overcoming the challenges, this initiative could become a model for sustainable energy solutions globally.

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[5]Free Flowchart Maker - Create Flowcharts Online | Lucidchart (block diagram and circuit diagram)