



PiezoElectric Roads

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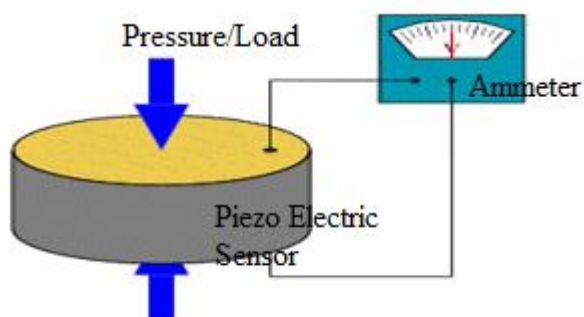
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Abstract: Piezoelectric roads are a fascinating innovation in sustainable technology. By embedding piezoelectric materials beneath the surface of Speed Breaker, these smart roads generate electricity from the pressure and vibrations produced by vehicles passing over them. Essentially, as vehicles drive on these roads, the pressure creates a small amount of electricity through the piezoelectric effect. This generated electricity can be used to power street lights, road signs, traffic signals, or even be fed back into the grid. In our project, College Campus Vehicle Volume is surveyed and PiezoElectric Speed Breaker is designed as per the Volume of traffic in College Campus. The Size of the piezoelectric sensors also decided as per the traffic volume. Eight sensors of 50mm diameter has taken and its connected in series. The sensors are placed in the speed breaker. It is covered by the rubber sheet so that load will be transferred evenly to the sensors. Each Stamp of the vehicle it will produce Electricity and it is stored in the battery. Electricity produced for one hour is measured using Voltmeter. Electricity plays a vital role in the socio-economic development of a country. The demand for energy has increased drastically. Conventional sources of energy are depleting at a fast rate. The demand for electricity can be partly fulfilled by harnessing renewable energy.

Keywords: Piezo Electric Sensor, Speedbreaker, Compressible material, Load, Peak Voltage.

1. INTRODUCTION:



Working of Piezoelectric Sensors

Piezoelectric roads are a fascinating innovation in sustainable technology. By embedding piezoelectric materials beneath the surface of roads, these smart roads generate electricity from the pressure and vibrations produced by vehicles passing over them. Essentially, as vehicles drive on these roads, the pressure creates a small amount of electricity through the piezoelectric

effect. This generated electricity can be used to power street lights, road signs, traffic signals, or even be fed back into the grid. One of the key advantages of piezoelectric roads is their ability to convert mechanical energy from traffic into electrical energy without creating additional pollution or consuming extra resources. This green technology not only reduces the carbon footprint of transportation infrastructure but also helps in sustainable energy production. Additionally, these roads can contribute to energy efficiency and aid in the development of smart cities by promoting the use of renewable energy sources. Piezoelectric roads have the potential to revolutionize the way we think about roadways and energy generation. They can be integrated into existing infrastructure or built into new road construction projects. By harnessing the power of movement, these roads offer a unique solution to capturing energy from everyday activities and transforming it into a usable form. While piezoelectric roads are still in the early stages of development and implementation, ongoing research and pilot projects are demonstrating their feasibility and benefits. As technology advances and costs decrease, we may see a wider adoption of piezoelectric roads in the future, contributing to a more sustainable and energy-efficient transportation system. Piezoelectricity is a unique and fascinating property of certain materials that enables them to generate an electric charge in response to mechanical stress, such as pressure or vibration

2. PIEZOELECTRIC ROADS:

Our paper, “PIEZOELECTRIC ROADS” mainly focuses on energy resources. The main objectives are

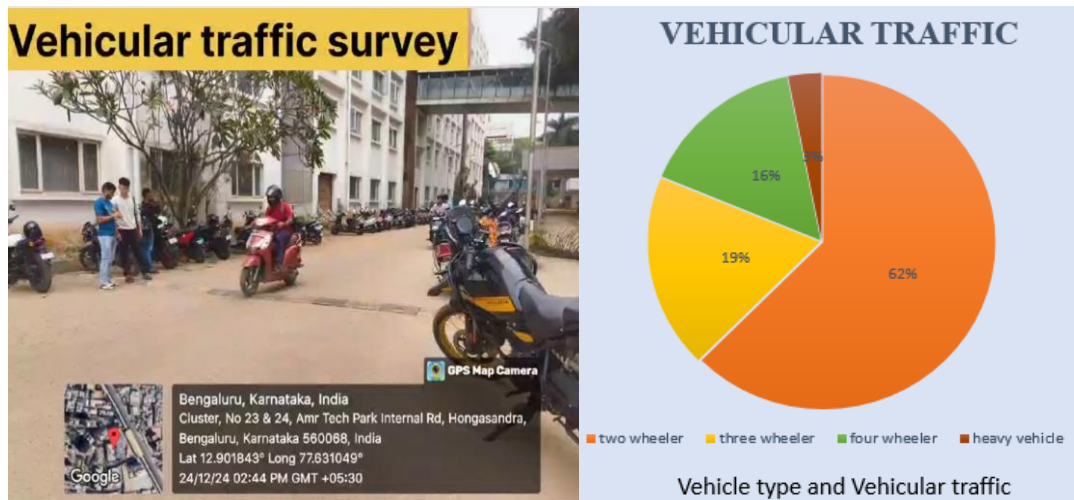
- To generate electricity from vehicular traffic using piezoelectric sensors.
- To create the new source of renewable energy to reduce the use of non-renewable source like coal for the production of electricity.
- To power street lights traffic lights and other road side infrastructure.

3. ARCHITECTURE:

Piezoelectricity is the property that certain crystals have to become electrically polarized when submitted to pressure or vice versa. In other words, it's the capacity of some materials to generate energy when squeezed or pressed. Piezoelectric sensors work by converting mechanical stress, such as pressure or vibration, into an electric charge. When stress is applied, the piezoelectric material deforms, creating a displacement of electric charges within the material. The Methodology is divided phase wise

Phase I

- In this project, College Campus, TOCE, Bommanahalli signal is chosen to test our model.
- Traffic Volume is surveyed for the particular road or signal.



- Number of vehicles passed bommanahalli signal per minute during peak time (morning 9 am- 10:30 am, evening 5 pm-7 pm)
- Calculating the Pressure on speed breaker.
- To fix the size of the piezoelectric sensors, the pressure on the speed breaker per minute need to be calculated.

VEHICLES CROSSED OVER SPEED BREAKER DURING PEAK TIME

Type of vehicles	Number of vehicles
Two wheeler	±40
Three wheeler	±12
Four wheeler (Light vehicles)	±15
Four wheeler (Heavy vehicles)	±2

Phase II

GENERATION OF ELECTRICITY

PIEZOELECTRIC SENSORS

Piezoelectric sensors convert mechanical energy into electrical energy. This technology has the potential to power small devices and sensors. Piezoelectric sensors are renewable, low-maintenance, and have high energy density.



Fig 1. Piezosensors

Construction of speed breaker

A vibrating-type speed breaker is being constructed. When a vehicle crosses the speed breaker, it compresses and then returns to its original position .

Dimensions of speed breaker

- Height : 0.1m
- Width : 0.2m
- Length : 0.5m

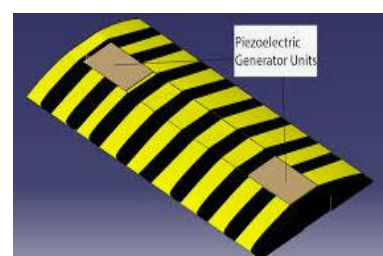


Fig 3. speed breaker

- The Piezosensors are connected in series below the top layer of speed breaker.
- These sensors are connected to battery through uni-directional diode.
- The amount of electricity generated is measured using voltmeter.
- The electricity stored in battery is used for various electric applications.

4.FLOWCHART:

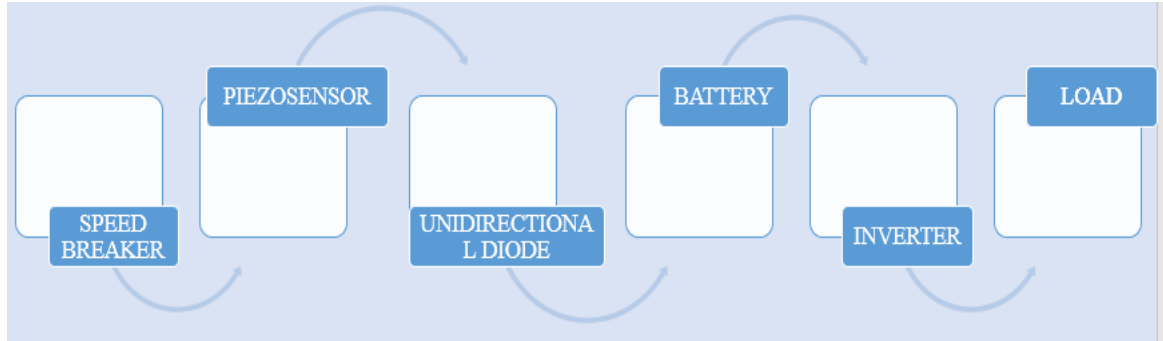


Fig. 1. Flowchart diagram for Piezo electric Roads

5. PICTORIAL REPRESENTATION:

APPLIED METHODOLOGY



Cuboidal Mould



Subgrade (soil)



Base coarse (aggregate)



Mixing Materials



Placing concrete



Embedding sensors



Piezo Electric Road Model



Rubber Sheet Covering Sensors



Sensors in Series Connection



Applying Pressure



Electricity Produced for every Tap



Battery to Store Electricity



Utilize for street lights



Model Speed Breaker

6. RESULTS AND DISCUSSION:

Material characterization

Material characterization is an important part of any project work which gives required sufficient knowledge about materials which are about to be used. The materials used in this investigation are listed below and their properties have been discussed.

Ordinary Portland Cement

In this experimental investigation cement of 53 grade conforming to IS: 12269- 1987 has been used to determine the physical properties of cement. Following table shows the different physical properties of cement.

Table a) Physical Characteristics of Cement

Sl. No.	PROPERTIES	TEST RESULTS
1	Specific gravity	3.15
2	Normal Consistency	30%
3	Setting time	
	a) Initial time	30 mins
	b) Final time	600 mins

Fine Aggregate

The aggregates passing through IS 4.75 mm sieve are termed as fine aggregate. There two types of fine aggregates Natural Sand and M Sand.

Table b) Physical Characteristics of Fine Aggregates

Sl. No.	PROPERTIES	TEST RESULTS
1	Specific gravity	2.74
2	Water absorption	0.96%
3	Fineness modulus	2.88

Coarse aggregate

The aggregates whose size is greater than 4.75 mm are termed as coarse aggregates. In the

present investigation crushed angular type of aggregates which are free from impurities is used which is collected from locally available crusher. Many types of tests are done on coarse aggregates which are tabulated in the below table.

Table b) Physical Characteristics of Coarse Aggregates

Sl. No.	PROPERTIES	TEST RESULTS
1	Specific gravity	2.74
2	Water absorption	0.50%
3	Fineness modulus	3.05

The coarse aggregates tested in laboratory conform to graded zone specified in IS: 383-1970 considered for 20 mm nominal size aggregates.

Vehicle type and Voltage Generated

Here 8 numbers of 35mm dia sensors are used each generates 5 volts maximum. Therefore 8 number of sensor generates 40 volts.

Types of vehicles	Vehicular Traffic	Total Voltage Generated per hour (v)
Two wheelers	40	1600
Three wheelers	12	480
Four wheelers	15	600
Heavy vehicles	2	80

7.CONCLUSION:

- The total voltage generated using piezoelectric sensors in college campus for one hour is 2760 volt's.
- Electricity plays a vital role in the socio-economic development of a country. The demand for energy has increased drastically.

- Output voltage can be increased by embedding more number of sensors.
- The voltage generated can be stored in battery and that can be used to power street lights during night.

4. References:

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