Innovative Approach To Harvest Kinetic Energy From Roadway Pavement

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Introduction

Roadways infrastructure are continuously subjected to solar radiation, vibration, and traffic-induced stresses and deflection.

These wasted energies can be harvested in the form of electric power.

Goal

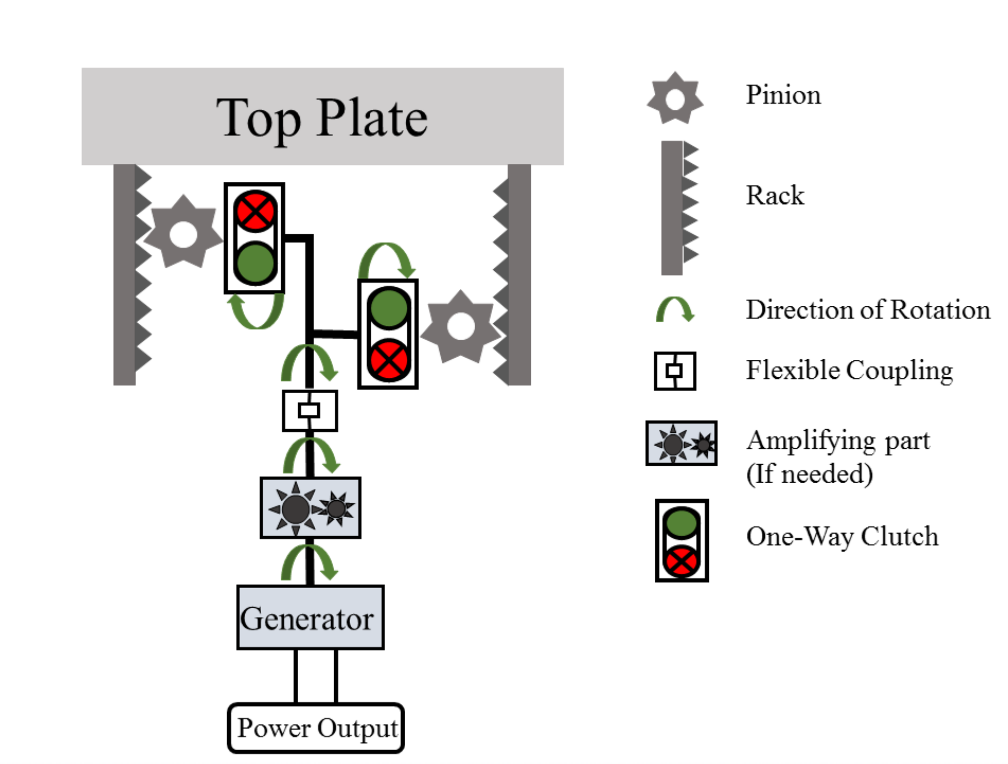
Design and develop a novel electromagnetic technology to harvest kinetic energy and use it to roadways facilities

Objectives

- **Developing electromagnetic devices capable of harvesting kinetic energy from the traffic-induced vibrations and displacements**
- **Evaluating the feasibility of using the energy harvesters considering their performance and output electrical power.**

Main Concept

Exploring energy harvesting from the roadway infrastructure and convert it to generate electrical power.



Theoretical Background

- **An energy harvesting device based on electromagnetic technology By using Faraday's Law**

- **Maxwell–Faraday equation:**

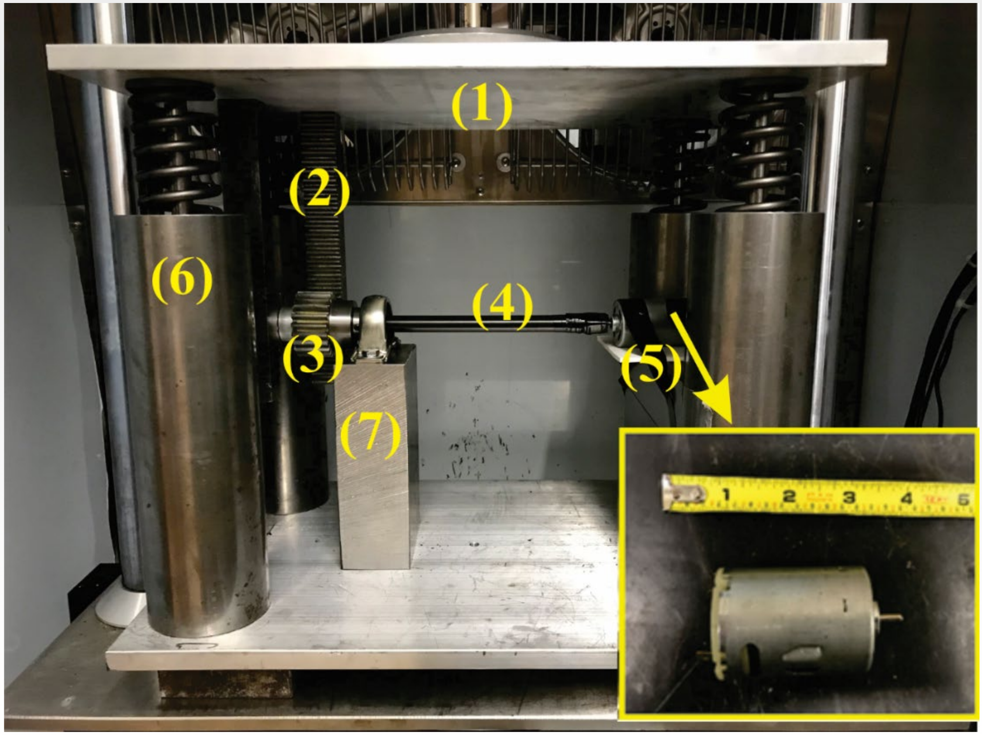
$$\nabla \times E = -\frac{\partial B}{\partial t}$$

where ∇ × is the curl operator, E is the electric field and B is the magnetic field

Preliminary Prototype

The electromagnetic prototype includes:

1) Top plate
2) Rack
3) Pinion and clutch
4) Shaft
5) Generator
6) Support and spring for top plate
7) Support



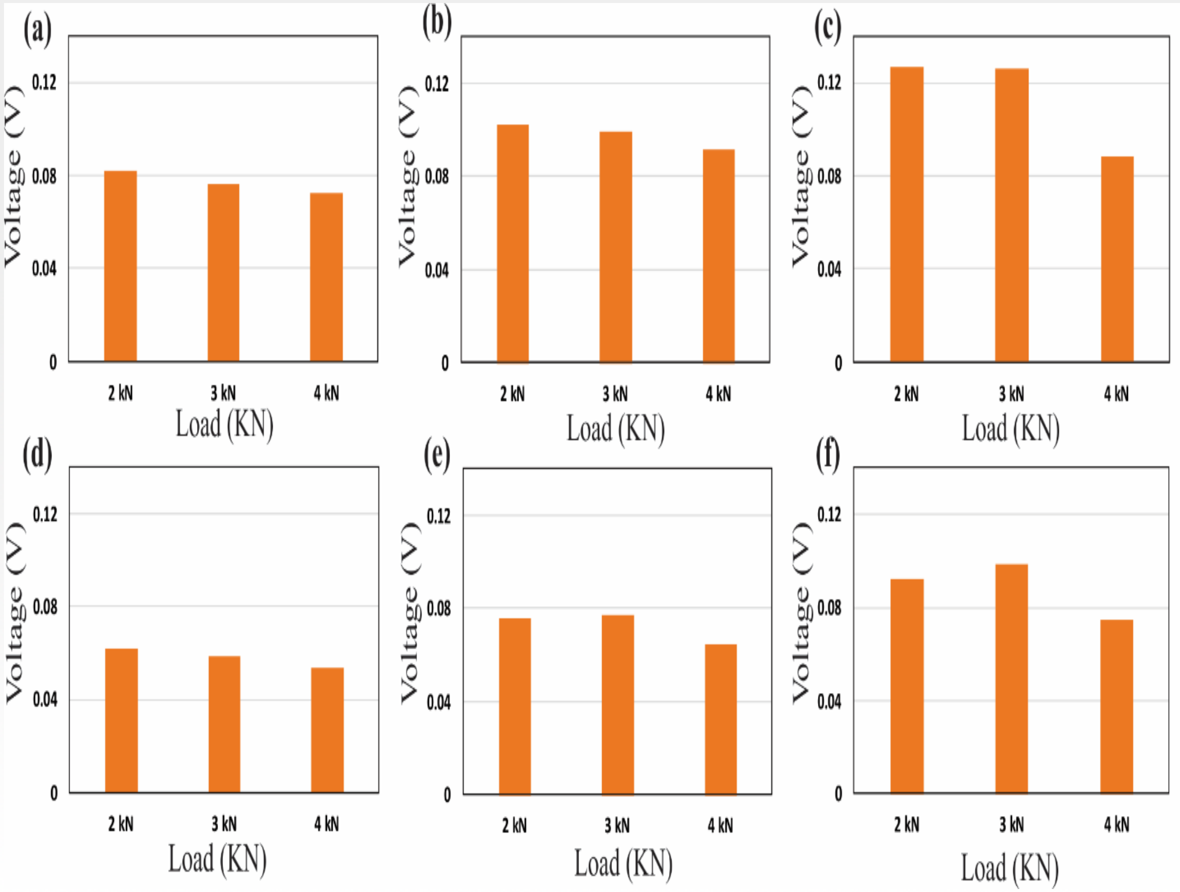
Factorial testing matrix

1. load magnitude, corresponding to the weight of the passing vehicle,
2. Time of loading
3. Interval of loading.

Results

Average voltage readings under various loads, loading time and cycle of loading- unloading time

a) 500ms loading time, 1500ms cycle time
b) 700ms loading time, 1500ms cycle time
c) 1000ms loading time, 1500ms cycle time
d) 500ms loading time, 2000ms cycle time
e) 700ms loading time, 2000ms cycle time
f) 1000ms loading time, 2000ms cycle time



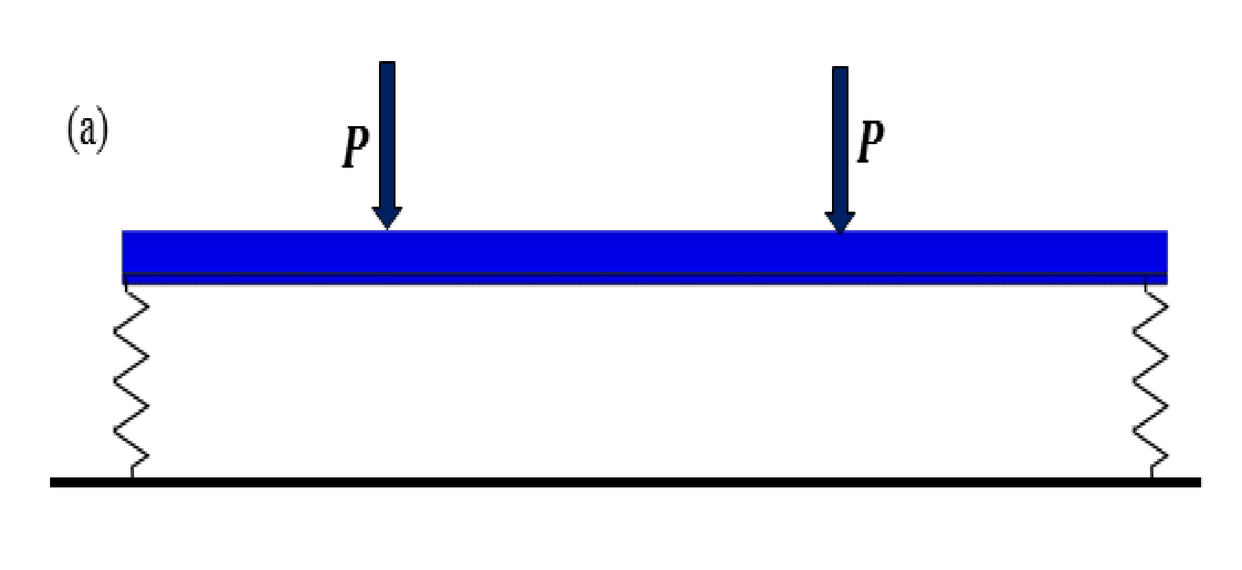
FEM Results

Static analyses

Effects of the maximum load of the vehicle on the top plate.

The Young's modulus of steel, aluminum and heavy-duty rubber were set to 200, 68.6, and 2.89 GPa with Poisson's ratios of 0.3, 0.33 and 0.40, respectively.

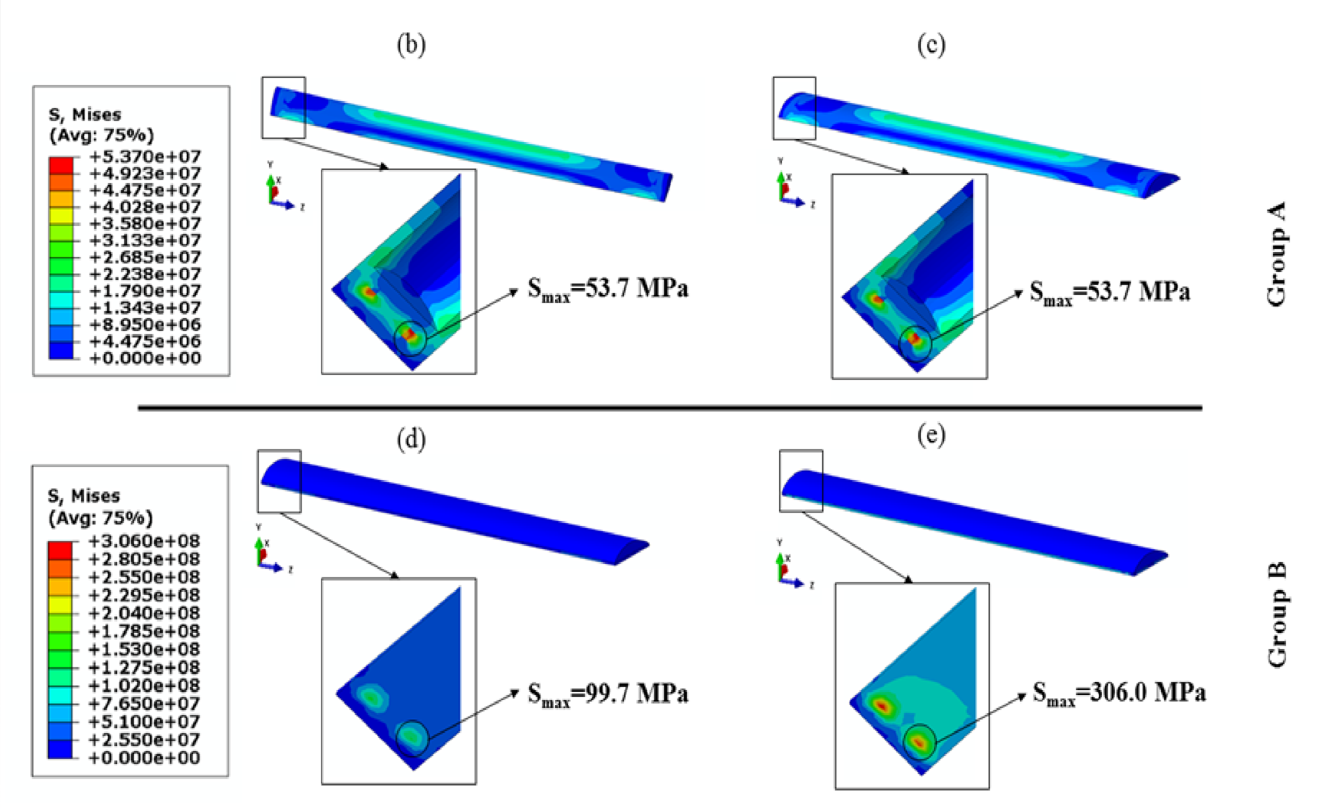
Two concentrated forces of 3773 N, spaced at 1.77 m off center



FEM Results

Stresses and deflections were studied to compare performance

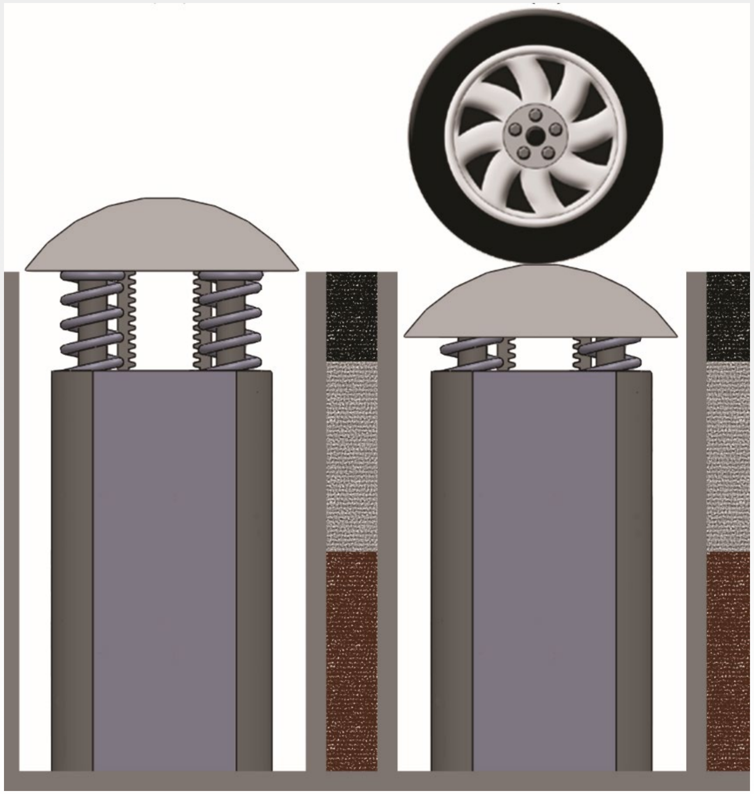
Stress distribution on the top plate made of (b) Aluminum, (c) Steel, (d) Heavy duty rubber with aluminum Frame and (e) Heavy duty rubber with steel frame



Recommendation for implementation

The prototype:

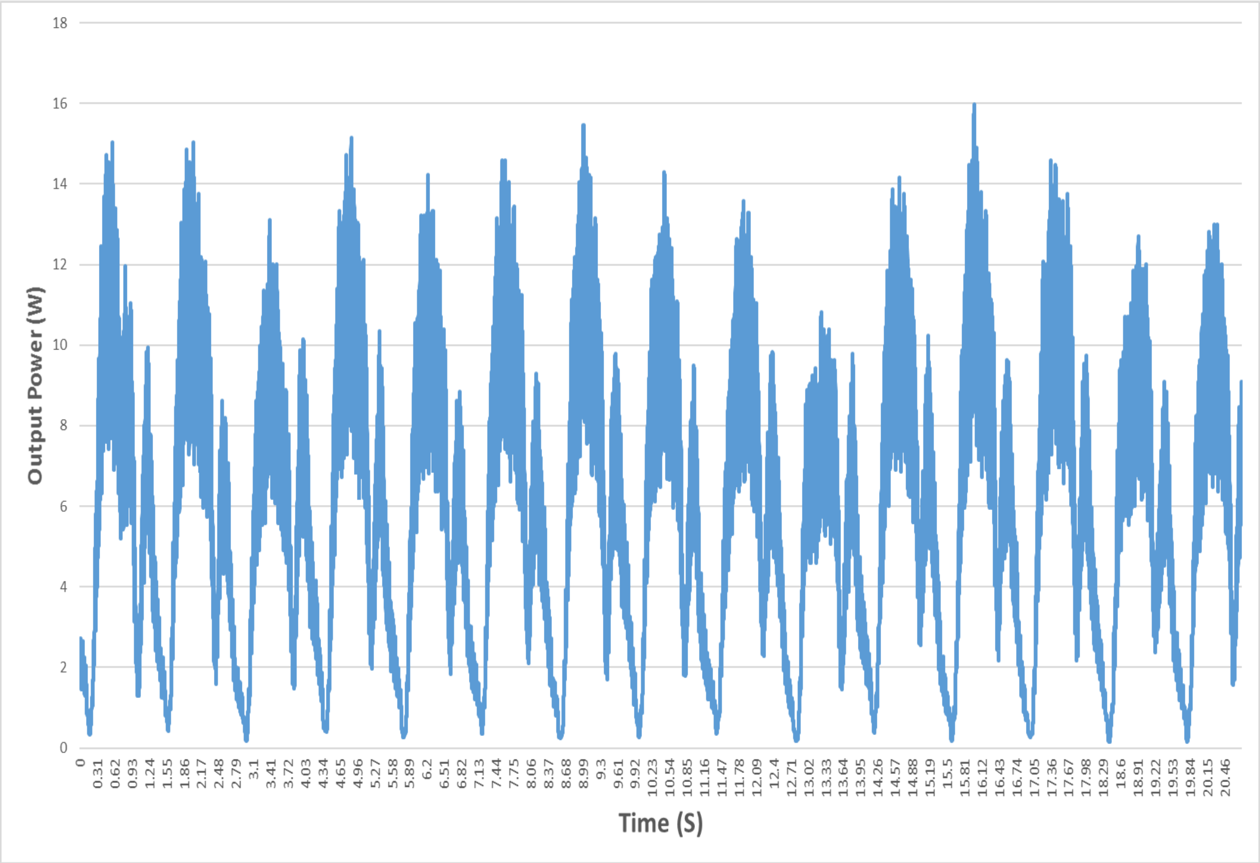
- **Unloaded**
- **Under wheel loading**



Results Of Current Research

- **The maximum recorded output power is more than 18 W for each axle passage**

Output Power Sample



Thank you

Questions?

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