

Dear Professional Engineers in California Government,

I am thrilled to receive the James E. Roberts Award at the 73rd Annual Los Angeles County Science and Engineering Fair. While attending PECG ceremony in 2021, where my brother was honored, I learned about James E. Roberts and his work in retrofitting bridges against earthquakes. After that I started paying more attention to bridges and their features.

The purpose of this project is to retrofit existing bridges against earthquake damage. Currently, government engineers primarily focus on column and bridge section reinforcement. The proposed solution - adding a thin flexible layer of concrete with strategically arranged cables to cover the roads of bridges. Flexible and sturdy cable arrangement with twists would allow bridges to expand and contract through simulated earthquakes.

Instead of bridge columns, use earthquake simulators made of cardboard, rubber bands, and golf balls. Design bridge prototypes by using cardboard molds, 24-gauge galvanized steel wires, scissors to cut wires, and a water and flour mix to simulate concrete. The cable arrangements for bridge prototypes: Bridge #1 – purchased fencing mesh; Bridge #2 – straight wires; Bridge #3 – wires with twists made by hands.

Test bridges simultaneously by attaching them to the earthquake simulators and recording the data with the Vibration Meter Google App. In total, conduct 5 series of earthquakes of different length and intensity stopping each time as noticeable damage occurred. Bridge #1 lacked flexibility; thus, it broke off the columns. Bridge #2 had large cracks and lost chunks of concrete. Bridge #3 was sturdy and flexible; the twists of the cables stretched and slightly recoiled into the original form.

In conclusion, the use of this newly-designed overlay material (cement with strategically intertwined cables) to pave bridge prototypes added flexibility and led to the ability to withstand up to a 6.9 magnitude earthquake. This work could lead to improvements in current techniques for retrofitting existing bridges.

Once again, I would like to express my gratitude to PECG for recognizing my project and awarding me with the James E. Roberts award that serves as an inspiration to me. I will save this money for college. Also, I would like to thank Dr. Tonia Symensma-Cohen, my school's mentor, and my family for supporting me through my journey.

Sincerely,

Andreas Eitel,

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