

April 4th, 2022

Dear Professional Engineers in California Government,

I am extremely grateful to the Professional Engineers in California Government (PECG) which awarded me the James E. Roberts Award at the 72nd Annual Los Angeles County Science and Engineering Fair of 2022. James E. Roberts is an inspiration for all engineers who strive for greatness.

A proper foundation is important, especially in areas where natural disasters such as earthquakes, hurricanes, tornadoes, and floods are common. Earthquakes and landslides are very common in California and require very strong foundations to help prevent the collapse of many buildings. While I was conducting my project I learned that my Aunt's house was sinking because the house's foundation was falling apart. This further encouraged me to dig deeper and strive for success in my experiment.

My project was "From the Ground Up" in which I tested different foundation designs to see which would perform the best. I also designed a foundation after researching successful foundations used in skyscrapers. The foundations I tested were: slab, crawlspace, basement, pile, and a new foundation that I called "spider."

The goal of my experiment was to find a cost-effective solution to building skyscraper foundations. I mainly focused on house foundations (to see if it was still effective on skyscrapers) but also included the pile foundation which is a common option for a skyscraper foundation. As well as testing the aforementioned foundations, I tested my new spider foundation. The spider foundation received its name from the spider-like web formed from the interconnected horizontal beams lodged in the soil from vertical beams.

In addition to measuring the success of the foundations, I also weighed them. This was used later to calculate the stability score per weight to see how cost-effective the foundation was from a material perspective. This method better helped understand the relationship between weight and performance. For example, although the slab was the lightest, it was the 2nd worst at surviving the simulated earthquake. The spider design had a stability score per weight of 0.28 giving it the advantage of being cheap and the most effective. I hope that this can be a practical design in today's world.

For the spider design to be implemented into real buildings there is one great challenge. This is to find an effective way to excavate the needed area in which the legs of the spider go into. I theorize there might be a way to excavate only the needed area and drive the foundation further into the ground using the same method used for the pile foundations. After the spider foundation is placed firmly into the ground all you need to do is recover it with the excavated soil. The alternative is to dig the entire area out like a basement foundation and fill it in afterward, but I do not believe this to be very cheap.

Finally, I would like to thank the PEEG once more for awarding me with the James E. Roberts Award of 2022. They have supplied tremendous support and enthusiasm throughout the scientific and engineering community and it is a great honor to receive this award. My family, school, and friends have also been a great place to receive advice and support.

Sincerely,

Zach Matise

St. Timothy School, Class of 2023