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| <b>Name</b>          | Leen Al-Sayed                  |
| <b>Grade</b>         | 9                              |
| <b>Project Title</b> | Earthquakes: Last one standing |

| <b>Date</b>               | <b>Information / Data / Accomplishments</b>  |
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| Friday, November 21, 2025 | On this date, I decided on my CYSF project titled: Earthquakes: Last one standing <i>which building design can best withstand a simulated earthquake on a small scale?</i>   |
| Friday, Nov 28, 2025      | On this date, I filled out my CYSF platform basic information and ethics due care form.  |
| Thursday, Dec 11, 2025    | On this date I made my hypothesis and decided on my procedure. Hypothesis: I expect the triangle based pyramid design to be the most effective because it uses the triangle shape design which resists the shearing forces of an earthquake. Procedure: To conduct this experiment I first decided on the purpose of the building that I will be designing, for this specific building it will be a hotel (this hotel will be located in an earthquake zone), so it needs to be aesthetically pleasing and at the same time stable to keep the customers safe and give them a chance to evacuate in case of an earthquake. Then I decided on three main structure designs to test, the first one being a regular rectangular prism as is seen in most buildings, second will be a rectangular prism closer to a cube design, and lastly, the third one will be a triangle-based pyramid. To test these designs I will build a shaker table using two pieces of cardboard/plywood attached by metal springs; Then using the shaker table I will lightly fasten each building design to it using tape and push the top slab to simulate the shaking of an earthquake, I will measure how far I push it in inches. I will do the same to each design five times and measure the damage caused to each design. In the next round I will use the same procedure but push farther this time and each time I will record my findings. |
| Tuesday, Dec 23, 2025     | <p><u>Background Research (first research)</u></p> <p>The First important aspect that we need to note is the difference between earthquake RESISTANT buildings and earthquake PROOF buildings. Earthquake resistant buildings are buildings that are designed to withstand the impact of an earthquake long enough for people to evacuate safely and to prevent total collapse, some examples of buildings that fit this criteria are apartment buildings, business offices, recreational buildings etc. Earthquake proof buildings however, are buildings that need to stay functional during and after an earthquake, these buildings would be essential buildings to keep the society stable, for example, hospitals, firestations, important government buildings etc. These buildings need to have little to no damage and stay safe for use throughout the earthquake. In the case of this experiment we only need to find the best design of an earthquake</p>  |

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|                                | <p>resistant building. Earthquakes produce <u>lateral loads</u> on buildings on the contrary to vertical loads which can be caused by snow piling on the roof.</p> <p><u>Methods used to in earthquake resistant buildings:</u></p> <ul style="list-style-type: none"> <li>● <b>Symmetry:</b> Making a building symmetrical helps distribute the lateral forces of an earthquake evenly across the building. It is especially important for the lower floors to keep the building standing.</li> <li>● <b>Flexibility:</b> One ancient method used by the Greeks in building their earthquake resistant buildings was to add clamps between the building blocks made of iron or wood and covered in lead which made the joints flexible enough to absorb the forces of the earthquake, leaving the building with minimal damage to the building. This method was also used in the legendary columns in which they joined together using wooden pegs and wedges known as polo and empolia.</li> <li>● <b>Diaphragms and Shear walls:</b> Diaphragms are roofs and floors with metal poles built into them to help stabilize the walls, shear walls are diaphragms as vertical walls.</li> </ul>  |
| <p>Wednesday, Dec 24, 2025</p> | <p>On this day I continued my research and decided on the materials that I need to conduct this experiment.</p> <ul style="list-style-type: none"> <li>● <b>Tuned mass Damping:</b> A tuned mass damper is a mechanism used in tall skyscrapers that experience high wind speeds and are prone to unnatural shaking. Dampers are materials that absorb kinetic energy and reduce vibration effects. Dampers can have many forms and in this case it is a mass damper meaning that it uses the force of gravity (mass) to absorb the kinetic energy, in this case caused by the shear forces of an earthquake, and minimize the shaking of the building. An excellent example of a tuned mass damper is the one in the TAIPEI 101 in Taiwan, this tuned mass damper weights 728 tons and is suspended in between the 87 floor and the 92 floor. The TAIPEI 101 is the tallest green building in the world and survived an earthquake with the magnitude of 6.8 Richter without any damage.</li> <li>● <b>Floating Foundations:</b> The idea of a floating foundation is that the foundation of the building or the base of the building is flexible so that in the event of an earthquake the forces are absorbed at the bottom of the building and do not reach the upper floors. This method is especially useful for mass production of stable buildings because it is cost effective and not labor intensive.</li> </ul> |
| <p>Friday, Dec 26, 2025</p>    | <p>On this date I bought the materials needed to conduct this experiment: wooden sticks, foam board, metal springs, duct tape, regular clear tape, hot glue with gun. Additionally I brought a trifold for the presentation.</p>  |

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| Sunday, Dec 28, 2025  | On this date I began building the buildings and shaker table that I will be using in my experiment and began drawing the 3D sketches for the buildings.   |
| Monday, Dec 29, 2025  | On this date I finished building the buildings and shaker table and began conducting my experiment and recorded my observations and data.   |
| Tuesday, Dec 30, 2025 | <p>On this day I finished conducting my experiment and finalized my observations and data:</p> <p>Description of Buildings</p> <p>Building #1<br/> Height: 12.25 Inch<br/> Length: 4 Inch<br/> Width: 4.25 Inch<br/> Volume: 208.25 Inch<sup>3</sup><br/> Area per floor: 17 inch<sup>2</sup><br/> Number of floors: 3<br/> Classification of shape: Rectangular prism<br/> Perimeter of base: 16.50 Inch</p> <p>Building #2:<br/> Height: 6.25 Inch<br/> Length: 7.75 Inch<br/> Width: 8.5 Inch<br/> Volume: about 412 Inch<sup>3</sup><br/> Area per floor: 65.875 Inch<sup>2</sup><br/> Number of floors: 1<br/> Classification of Shape: Rectangular prism<br/> Perimeter of base: 32.5 Inch</p> <p>Building #3:<br/> Height: 7.5 Inch<br/> Base: 8.25 Inch<br/> Volume: 85 Inch<sup>3</sup><br/> Area per floor: about 34 Inch <sup>2</sup><br/> Number of floors: 1<br/> Classification of shape: triangular based pyramid<br/> Perimeter of base: 24.75 Inch</p> <p>Round 1: Description and Observations:<br/> Description: Buildings stabled by tape and stuck in to board. Shaker table pulled by 1 inch and released 5 times per building. Pulled at x axis.</p> <p>Building #1: 4 foundations</p> |

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|                  | <p>Observations: Considerable amount of shaking at foundation causing upper floors to shake. Damage caused the building to lean toward the right.</p> <p>Building #2: 4 foundations (foundations much longer than other buildings)<br/>Observations: Shaking mostly took place at the joints, minimal damage.</p> <p>Building #3: 3 foundations (foundations much smaller than other buildings)<br/>Observations: Not much shaking only at the top, foundations stayed stable, no considerable damage.</p> <p>Round 2: Description and Observations:<br/>Description: No changes to building designs or foundations. Shaker table pulled by 2 inches and released 5 times per building. Pulled at x axis.</p> <p>Building #1: Observations: point of weakness in joint near foundation causing shaking at the top floors also causing permanent leaning toward the right.</p> <p>Building #2: Observations: more shaking at joins, foundations began to come loose. One foundation almost failed.</p> <p>Building #3: Observations: Minimal shaking, similar to round 1. Did not continue to shake after release, no damage.</p> <p>Round 3: Description and Observations:<br/>Description: Continuous, random aptitude until failure of building (could be caused by loss of foundation or collapse) measuring how long the building will last.</p> <p>Building #1: Time it took to fail: 11 seconds.<br/>Observations: Failure caused by loss of foundation, building rotated clockwise during shaking.</p> <p>Building #2: Time it took to fail: 7 seconds.<br/>Observations: Failure caused by loss of foundation similar to building #1, shaking strongly at joints, other pillars came loose.</p> <p>Building #3: Time it took to fail: 1 minute and 24 seconds<br/>Observations: During shaking one pillar began to come loose and when it failed it pulled the other pillar, causing it to fail as well, the building rotated counterclockwise.</p> |
| Saturday, Jan 24 | On this day I read the teacher feedback that was provided and edited my project based on that. I also began printing out my information to put on my trifold  |

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| Sunday, Jan 25 | On this day I finished printing out my information and adding it to the trifold and began practising my presentation. I also added my information to the CYSF platform. |
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