Name ______________________________ Period: ___ Earthquake Engineering STEM Challenge

Do Now: Read and annotate the article on the back of this handout. Answer the questions below.

1. How do earthquake-proof buildings react to an earthquake compared to other buildings?

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2. What is shear? Why should we be concerned with it?

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3. What are some ways that a building can be designed to withstand an earthquake?

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Design your Earthquake-resistant skyscraper in the space below. Be sure to include two design strategies from the reading or the video. Once your design is approved, start building!

Our Design	We used the following strategies in our design: 1. 2.
	Criteria of the challenge: • You will have 30 straws, 1 meter of masking tape, scissors, and a double-sided foam square to attach your tower to the shake table. • You will submit a "blue print" of your tower plan that includes at least two design strategies. • Height will be measured to the tallest support platform on your tower. • You will have 30 minutes to build the tower. • Your tower will be tested on the shake table for 10 seconds at the moderate category strength (5-5.9). • If it remains standing, it will be tested for 10 seconds at the major category strength (7-7.9).

Results and Redesign Ideas: ____

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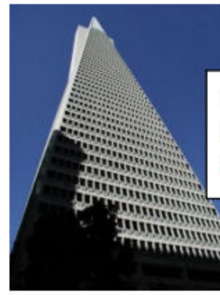
Earthquake Engineering Challenges Reading
(Read this & answer the questions on the other side.)

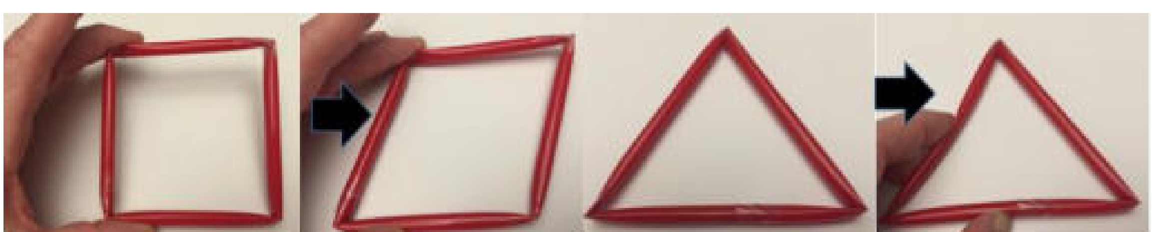


The Transamerica Building in San Francisco withstood a major quake in 1989.

Earthquakes can cause much loss of life and millions of dollars in damage to cities. While most building designs need not consider the stresses produced when the ground shakes, buildings in areas that are earthquake prone need to be designed to withstand such pressures. In these areas, engineers face the challenge of designing more robust buildings to withstand the effects of earthquakes. Earthquake-proof buildings are often designed to bend and sway with the motion of an earthquake instead of cracking and breaking under the pressure. Have you ever looked at a really tall building such as a skyscraper pictured above? While it may appear fragile and delicate, it is designed to be sturdy and strong so as to withstand natural elements such as wind, rain, lightning, and tornadoes. In addition, since it is located in an active earthquake zone known as the San-Andreas Fault, the building is reinforced with a variety of structural supports.

Because earthquakes can cause foundations to move, and even entire buildings to crumple, engineers include structural design techniques that help buildings withstand damage from earthquake forces. The side-to-side motion of an earthquake can cause the top and bottom of a building to move in different directions. This side-to-side motion, often called shear, can be very damaging.

To minimize this damaging shear, cross bracing, shock absorbers and tapered geometry are three useful techniques that can help. Earthquake-proof buildings will typically include cross bracing that form triangles within its design geometry. All triangles have one thing in common (apart from having three sides): they form a stable shape. They are the building blocks of many structures because their shape gives them an unusual ability to bear large forces without bending or warping.



Square bends easily when force is applied | Triangle bears force without bending

If you make a square out of straws like the one pictured above, it takes just a little push on the side to find out that it doesn't tend to stay square. Do the same with a triangle, and you can push and pull on it yet it still has a propensity to keep its shape. You see, a triangle is inherently rigid and tough. This is why, when you look closely around, you will see triangles all over the place. You can find them in bridges, construction cranes, houses and, of course, earth-quake proof buildings where super stable structures can save lives and lessen the impact of this type of natural disaster.

In this STEM Challenge, you will act as an earthquake engineer and develop and test a small model of earthquake-proof skyscraper (tower). Your tower should have columns (legs) that extend from the base of the tower and cross braces that divide the legs up into shorter and shorter units. Since shock absorbers are usually built underground, they will not be included in this model. A large base that is tapered (becomes narrower as you move up) is also recommended. Their goal is to minimize the impact of shear through reinforcement and smart construction.