

# Seismic Outreach Project

6<sup>th</sup> grade – Spring 2016

**ESSENTIAL QUESTION:** How can we use information from past earthquakes to design safer structures for the future?

**COMPOSITION OF TEAMS:** 4-5 students per team

**OVERVIEW:** Teams will construct a structure out of provided K'NEX materials that will experience simulated seismic activity. Teams will also provide calculations, details, and scaled drawings.

**MATERIALS:**

- K'NEX Set (provided)
- Drawing materials (including pens, pencils, or rulers)
- Engineering/Graph Paper (for scaled drawings)

**PROJECT SCENARIO:** The Owner wants to build a tall and distinctive steel building in Downtown San Diego near an active fault. The Owner will rent out the building space to the public. The more attractive the building is and the more floor space the building has, the more rent the owner can make.

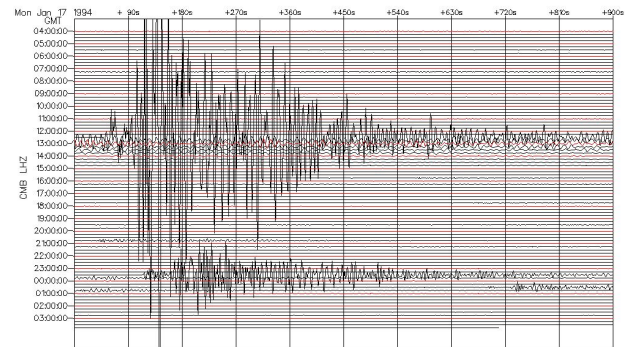
You and your team are a Design-Build Team, which includes sharing the responsibilities of an architect, engineer and contractor. You are competing to win the contract to design and build this new building. You will present a design and a scale model to the owner for review. The owner will choose the design of the building that can make the most rent money and has the best seismic performance.

## CHECKLIST:

- K'NEX Structure (to be tested on shake table)
- Bill of Materials
- Student Waivers and Registration
- Floor Plan Form
- Scaled Construction Blueprint with Calculations
- Scaled Architectural Drawing
- Seismic Safety Report

## RULES/REQUIREMENTS:

- A structure must be constructed only with the pieces provided in the K'NEX set.
- Teams may not exchange pieces among each other. All pieces and quantities used in the structure must be recorded on the Bill of Materials, and signed by the teacher to verify correctness.
- K'NEX pieces may not be painted, glued, melted, bent, or modified.
- The base of the structure must not be bigger than 12"x12".
- Each structure should be at least 22" tall. **Structures with roofs less than 22" from the ground will not be eligible for the Structural Engineer's award.** There is no height limit.
- On the day of the competition, the structure will be **loaded at the first floor above 16"**. A floor is any level plane parallel to the ground that can support a floor beam in two directions away from the columns and supports. Floors must be at least 2" apart. The topmost floor will be considered the roof.
- A scaled architectural drawing of the building should accompany the project.



Drawing guidelines:

- a) The drawing should depict an artistic rendering of the structure;
- b) Any paper or computer program (Google Sketchup) may be used
- c) Selected scale should be indicated
- Scaled construction blueprints of the building must accompany the project.

Blueprint requirements:

- a) One side view and one representative floor plan.
- b) Blueprints should only depict the actual structure built.
- c) Blueprints can only be drawn on the provided engineering/graph paper.
  - d) All distances should be measured and labeled neatly on the drawing.
  - e) In the designated space on the engineering paper, write down the scale used and drawing description.
  - f) Include on a separate sheet, the calculations of at least 10 lines.
- A set of calculation details must be completed on the provided forms.

The calculations include:

- The number of floors, area of each floor in square inches, and the total floor area
- The Bill of Materials, the total building cost, and cost per square inch of floor (performance index).
- Each individual should be prepared to give a presentation of their structure and documents in order to sell their building to the Owner as well as be tested on their knowledge of earthquakes and earthquake engineering.
- In your seismic safety report (typed), you must address/consider the following questions:
  - What causes an earthquake?
  - What are the three types of faults? Describe their movement.
  - What are the three types of seismic waves? Describe their speed, movement, and damage.
  - Identify and describe at least three reinforcements you have used to increase the seismic-strength of your structure. (For example: height, weight distribution, shape, bracing, foundation, materials)

## **EXTENSIONS (Optional)**

### **Predicting the next big one...**

- Using all of the information we have learned about earthquakes, predict where and when the next big one is going to be.

### **How would HTMNC fare in an earthquake...**

- Complete a scaled blueprint of the HTMNC or HTHNC campus. Complete a building analysis of HTMNC and determine how prepared we are for a large earthquake.
- Design an earthquake evacuation plan for our school.

**AWARDS:** An award will be given for each of the following categories in each shaking session:

### **Structural Engineering Award:**

The team with the lowest Performance Index that survives the simulated earthquake will win the Structural Engineering Award.

### **Architecture Award:**

The team with the most aesthetic and creative architectural rendering will win the Architecture Award.

### **Construction Award:**

The team with the most clear and detailed construction drawings of the structure and who demonstrates the best knowledge of earthquakes and earthquake engineering will win the Construction Award.

## HELPFUL RESOURCES

- <http://earthquake.usgs.gov/learn/kids/>
- <http://www.weatherwizkids.com/>
- <http://www.exploratorium.edu/faultline/>
- <http://school.discoveryeducation.com/lessonplans/programs/earthquakes/>
- <http://mceer.buffalo.edu/education/default.asp>
- <http://www.eerc.berkeley.edu/>

## PROJECT BENCHMARKS\*

\*Due to the flexible nature of project-based learning, due dates are subject to change.

Please check Ms. Villarreal's DP or class calendar for updates.

Monday	Tuesday	Wednesday	Thursday	Friday
4	5 Begin Seismic Safety Report	6 Project Launch:UCSD Guest Speaker Half Day	7	8 K'Nex Building Concept Design <b>Science of Earthquakes Webquest Due</b>
11 K'Nex Building & Testing	12 K'Nex Building & Testing	13 <b>SLCs</b> Half Day	14 <b>SLCs</b> Half Day	15 <b>SLCs</b> Half Day
18 6th Grade SBAC Testing	19 6th Grade SBAC Testing	20 6th Grade SBAC Testing	21	22 <b>Bill of Materials Due</b>
25	26	27	28 <b>Blueprints Draft Due</b>	29
MAY 2	3 <b>Architectural Sketch Drafts Due</b>	4 Half Day	5	6 <b>NO SCHOOL "Snow Day"</b>
9 <b>Blueprints Due</b>	10 <b>Architectural Sketch Due</b>	11	12	13
16 Finalize building & documents-->	17 <b>Turn in Packet to Ms. Curtis</b>	18 Half Day	19 <b>Engineering Field Trip to UCSD</b>	20 Building Revisions & Reflection
23	24	25 Reflection Due	26	27

