

Richter 9.0

An event to bring out the engineer within each one of you. The goal of the event is to construct a realistic model of a building which will be tested to its limits on a shaker table. This event is designed to give you an idea on the impact of earthquakes on the buildings and the importance of 'earthquake – proofing' a structure. At the core, it's an event based on stability and as the saying goes it truly is a "Survival of the Fittest".

Important Dates:

Release of Problem Statement: 2nd February, 2019

Date of Event: 9th and 10th February, 2019

Date of Results – 10th February, 2019

Note – The above mentioned dates are tentative.

Important Instructions:

- It is a team event with a maximum of **4 members** allowed.
- Materials will be provided at the event location.
- Materials provided are as follows: -
 - i. Plywood strips:
Area of cross-section - **10 mm × 10 mm, 8 mm × 10 mm**
Length - **4 feet**
 - ii. Ply board of size **35 cm × 35 cm**
 - iii. Glue Gun (5 glue sticks) and Fevicol
 - iv. Hammer
 - v. Nails (Nails can only be used to secure and fasten the columns to the Plyboard base)
 - vi. Wood saw

Rules:

- Only given materials are to be used.
- Apart from the quantity of materials provided at the start, any extra item you require, will result in deduction in marks.
- Each floor should have some adequate platform to put load of sandbags on it.

Notes:

- Shake table dimensions: - **35 cm × 35 cm**
- Loads:- **2 kg**

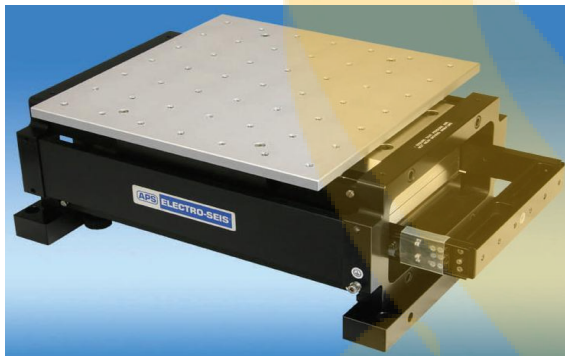


Fig 1 – Shake Table



Fig 2 – Load of 2kg

Additional Weights:

Additional weights will be applied to the model at each floor using standard sand bags of weight **2 kg** to replicate the loading conditions in a real high-rise building. **Therefore additional provisions may be constructed for securing the sand weights onto your model. You can provide 4 to 5 beams at each floor to create a platform for keeping the weights. Also, there should be enough space on each floor to keep the weights.**



Location of Columns:

There should be a **minimum of 10 cm clearance between any two columns in the structure**. They may be placed in the interior but should adhere to the spacing requirement. Figure 1 shows a typical column arrangement along with shear walls. The main outer columns or the bounds of the structure should be within an offset of 2.5 cm from the boundary of the ply board.

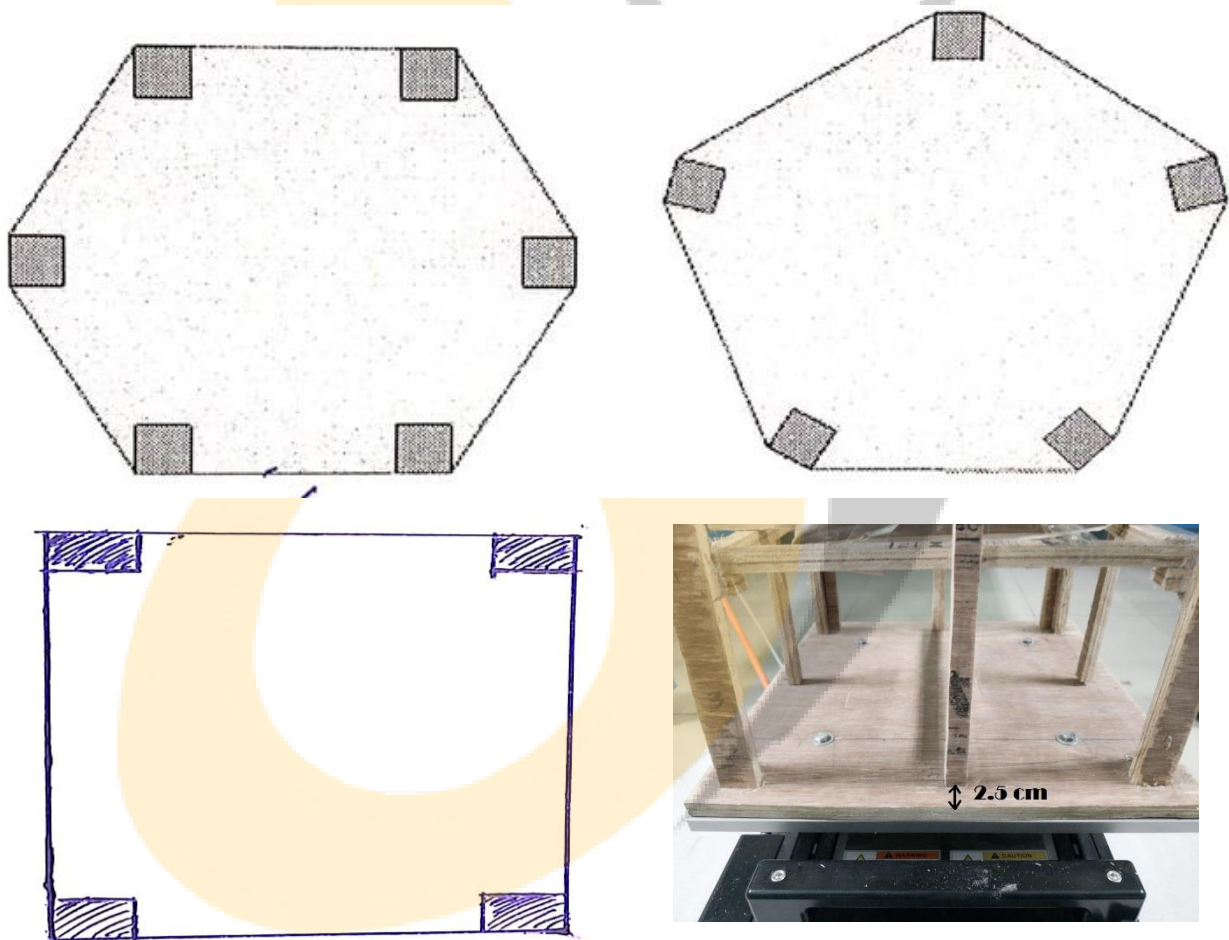


Fig 3 – Location of columns and base

Failure of Building Model:

A model is deemed to have failed under following conditions:

1. Complete collapse of the model.
2. Collapse of one or more storeys.
3. The model has deformed excessively (maximum lateral permanent deformation is more than 5% of the gross building height).
4. Half or more than half of the columns are detached from the base board.
5. Any of lead weights falling off from one of the floors.

Violation Penalty:

Teams will be penalised if:

1. Using other materials that are not specified in the rulebook.
2. Using extra amount of materials other than the provided amount.
3. The dimensions are not adhered to.

Testing Procedure:

The shake table test will commence as follows:

1. Initially, ground motions will be generated by the shaker on the structure by gradually increasing the amplitude of vibrations up to 50 mm.
2. If the structure can resist the ground motion vibrations up to 50 mm, further sinusoidal vibrations will be provided with increasing frequency.

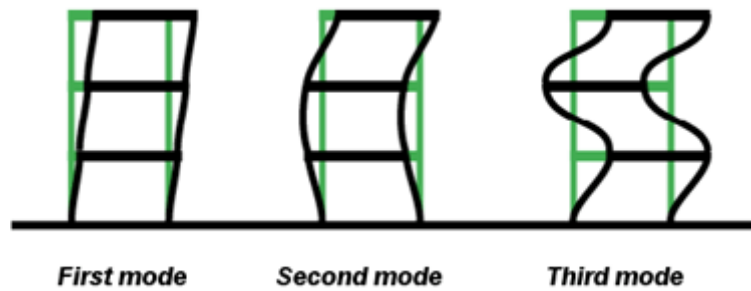


Fig 4 – Modes of vibrations in seismic motions

Judging criteria:

- The competing models will be judged on the basis of how well they fare on the shaker table.
- Early you finish, benefits you get (Time taken to finish the structure).
- The models will also be inspected on how well they adhere to the rules established during construction.
- The model should adhere to realistic structures.
- 75% - Efficiency

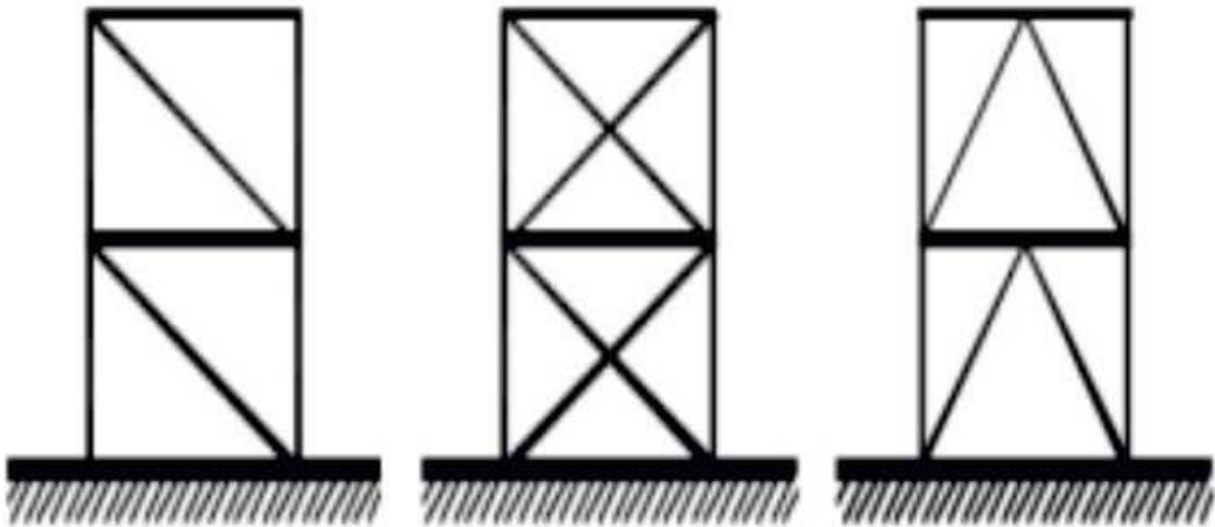
Efficiency will be measured according to:

$$\text{Efficiency} = \frac{\text{Magnitude of Amplitude of Ground motion}}{\text{Weight of the Structure}} \times 100$$

- 15% - Application of the Design in the real world scenario
- 10% - Aesthetics and How well the model abides by the rules
- As mentioned earlier, If the structure can resist the ground motion vibrations up to 50 mm, further sinusoidal vibrations will be provided with increasing frequency. **Additional points will be awarded for successfully per 5 hertz frequency.**

Some Suggestions and Guidelines:

1. Best design is the one in which each and every member has a purpose and used according to its capability. Don't put unnecessary elements.
2. Try to keep your structure as light as possible because weight is the main criteria in judging.
3. New and innovative designs will be preferred. But innovation must be actionable i.e. the design should be such that it can be actually built in reality.
4. You can provide earthquake resistant members like bracings in your structure to make it safer.
5. Read the problem statement carefully. Avoid any kind of controversies. Don't violate the specified rules, otherwise your



design may be disqualified or penalty weight may be added to the original weight of structure.

6. **The decision of judges will be final, and no further debate will be entertained.**

Fig 5 – Some examples for structure design

NOTE:

Please Keep Checking the Website and Rule Book regularly for any further updates.

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