"Earthquakes do not kill people, but the structures do"

We as the future engineers need to stand up to the responsibility of making earthquake resistant structures. Tremor @ TAKNEEK provides you the platform to simulate and contribute to a new future.

What is to be done

We expect you to design timber model of an actual structure. We will scale down loads and give you a realistic environment for testing your ideas. Finally, the model built by you will be tested on a horizontal shake table which is unique machine only available at IITK among other IIT's.

Problem Statement

Problem statement can be downloaded from here (will put the link of the problem statement).

Event Structure

Round 1:

In this round your team needs to submit an abstract to "**tremor.takneek@gmail.com**" which should contain the following:

- Complete drawing (isometric, orthographic views) of building with proper dimensioning
- Size of cross section of all the structural members used
- Expected weight and efficiency ratio of your structure (this can be a deciding factor in case of a tie between two teams)
- A brief write up of not more than 100 words explaining what's new or the best part of your design

Based on your abstracts, you will be selected for the second round.

They need to mention in the mail the participant details (name, roll no., pool and mobile number) and the team name.

Last date for submission of abstract is 26th August.

Round 2:

a) Mounting of the Model and Fixing of Steel Weights: We will arrange for each model to be securely mounted onto the 1-Dimensional Earthquake Simulator and to fix the steel weights to the floors of each model.

b) Earthquake-Resistant Test: All models will be tested by simulated shaking tests along a single direction. The direction of excitation will be decided by the judges. The peak shaking accelerations or Peak Ground Acceleration (PGA) will be 0.11g, 0.18g, 0.27g, 0.36g with frequencies ranging from 0.5Hz to 6Hz and duration of about 30 seconds for each round. The following flow chart shows in detail the earthquake resistance test.

- **Series 1** PGA =0.11g
  Check for failure and remove any failed models

- **Series 2** PGA =0.18g
  Check for failure and remove any failed models

- **Series 3** PGA =0.27g
  Check for failure and remove any failed models

- **Series 4** PGA =0.36g
  Stop

Final Check will be done for the failure of any part or the whole structure.

Rules/Guidelines

The abstracts should be mailed to **tremor.takneek@gmail.com** before **26th August**.

- A team can have a maximum of six members.

- 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.

- 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.

- **The decision of judges will be final and no further debate will be allowed**. Therefore it's advisable that don't violate any of the specified rules.

- You will have to send your abstract for the competition first. Best designs will be selected for final round.

- SAP video lectures can be viewed on youtube:
- http://www.youtube.com/watch?v=KFkqOv76QPk
- http://www.youtube.com/watch?v=SSN8GcLnVwQ
- http://www.youtube.com/watch?v=8kax4mzDwxA

- A guide to Seismic Analysis and other basic concepts can be viewed here:
  https://docs.google.com/viewer?a=v&pid=explorer&chrome=true&srcid=0BwPU4Y-N0_1YNDM0OGIyYTMtNDBkZi00NGE4LWFhNWUtNGI1NDU2NGZkNTBh&hl=en

Judging Criteria

Failure of Building Model: A model is deemed to have failed under following conditions:

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

Scoring: The score of an individual team will depend mainly on the efficiency of the building overall which includes various parameters. The final score (S) will be calculated by the following non dimensional function:

S=(I-C)*PGA/0.36g-summation[(0.36g*R)/PGAr]

S=Score

I=Income of the building which will be calculated by the following expression:

I=K*A

A=area of the floor freely available for usage in sq.cm.

K=Rs.1000/sq.cm.(for 1-5 floors)
Rs.1100/sq.cm.(for 6th floor)
Rs.1200/sq.cm.(for 7th floor)

C=Cost of the building which will be based on the mass of the material used and the rate of material will be taken as
Rs.1500/g.

PGA=Peak Ground Acceleration at which the building fails

Repair cost=Rs.1500*m where m is the mass of the member which fails at a particular PGA.

PGAr=The PGA at which the structural member described above fails.

P: Penalty

Bonus: The bonus will be given on two bases:

- **Prediction of base shear and the value of PGA up to which the structure will not fail.**

There will be an oral presentation for 5 minutes for every team where they will explain their structural design. The jury will be given 2 minutes to ask questions to the team. The rankings of the team in the presentation will decide the bonus score by the following equation:

B=0.25*S*(21-R)/20

S: Score R: Rank in the presentation given by the jury

This implies that the 1st ranked team out of 20 teams will get 25% of his score as bonus.

Bonus for the calculated values will be given by the following:

B1=0.1S-(Mod(Actual-Expected)/Actual)*0.1*S

All the terms are as defined before

Final Score: Final score (FS) will be given by the following:

FS=(B+B1+S)*100

Coordinators

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