



TECHNICAL SPECIFICATIONS 2026

Organized by: The Turkish Catastrophe Insurance Pool (TCIP)
Official Competition Website: <https://binatasarimi.dask.gov.tr>



TCIP Earthquake Resistant Building Design Competition at a Glance

Teams consisting of a minimum of four and a maximum of five undergraduate students from universities may apply to the TCIP Earthquake Resistant Building Design Competition. The majority of the team members (at least three students) must be civil engineering students. A maximum of two architecture students from the same university may be included in the team. If a university does not have an architectural department, teams may optionally include architecture students from another university. Each team must have at least one faculty advisor from the Department of Civil Engineering.

Scaled building models, which will be designed in accordance with the established rules and constructed from balsa wood sticks and sheets, will be subjected to a series of shake table tests in order to experimentally evaluate their seismic response.

The most important success criterion for the model building is that it does not collapse during an earthquake. In addition, technical, economic, and aesthetic factors will also influence the teams' performance as separate evaluation criteria. In the technical scoring, structure's seismic performance (as a function of measured acceleration and the extent of structural damage) will be considered. In the economic scoring, the weight of the model building (amount of material used) and the total floor area will be considered. In the aesthetic scoring, the architectural design of the building and quality of the project presentation (poster and oral presentation) will be taken into account.

The winner of the competition will be the team that achieves the highest total annual income based on a cost-benefit analysis that incorporates the factors summarized above using specified weightings.

The Earthquake Resistant Building Design Competition is structured to encompass the stages of calculation and design, planning, construction, presentation techniques, and physical testing. The competition also provides young civil engineering students with opportunities to work in teams, collaborate across disciplines, and develop their presentation skills.

Within the overall competition scoring, calculation and design, construction, and physical testing carry significant weight, while presentation skills also play a significant role. By emphasizing that tall-building design and construction should be evaluated not only for earthquake resistance but also for functionality and financial performance, the competition provides a highly educational experience.



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1. INTRODUCTION

Earthquakes with severe and destructive impacts have caused significant socio-economic damage globally for many years and continue to pose a major threat. The most effective way to mitigate these impacts is through the design and construction of earthquake-resistant buildings. Any effort aimed at enabling structures to safely withstand potential strong earthquakes is therefore of great value. In this regard, the competition to be organized is of particular importance.

The competition is expected to contribute to the improved education and training of future civil engineers who will play a critical role in the design and construction of earthquake-resistant buildings. By encouraging students to specialize in earthquake engineering, it also aims to support the development of expertise in this field. In addition, the competition holds special significance in raising public awareness about earthquakes in general.

The TCIP Earthquake Resistant Building Design Competition is organized among teams primarily composed of civil engineering students from universities. According to the Technical Specifications of the competition, scaled multi-story building models designed and constructed by the teams will be tested on a shake table during the competition under three different earthquake scenarios, either previously recorded or simulated. The winning team will be determined based on the overall evaluation of the model building's seismic performance under these earthquake effects, together with the scores obtained in the other categories described above.

1.1. Objectives of the TCIP Earthquake Resistant Building Design Competition

- To provide civil engineering and architecture students with the opportunity to gain hands-on experience in the design of earthquake-resistant tall buildings and the construction of building models
- To promote the field of earthquake engineering and encourage students to specialize in this area
- To raise awareness about earthquakes and the importance of earthquake-resistant building design
- To equip civil engineering students with the knowledge and skills required to perform seismic analysis of structures
- To provide civil engineering students with opportunities to collaborate with students from other disciplines

1.2. Definition of the Problem

Within the scope of the competition, participants are expected to design an office building proposed to be located in the Istanbul Financial Center and to construct a corresponding building model. The project consists of twin-towers that share a common base and are connected by bridges at different floor levels. The property owner expects the structure to demonstrate high performance under seismic loads while also achieving a favorable cost-benefit ratio.

Each of the twin towers will consist of a minimum of 20 and a maximum of 30 floors. The ground floor height will be 50% greater than the height of the regular floors.

The seismic performance of the building, whose model will be constructed from balsa wood, will be evaluated through tests conducted on a shake table. In this context, three different levels of strong ground motion (SGM1, SGM2, and SGM3) will be applied to the model structure. The primary objective is to design the structure such that it achieves the life-safety performance level under the design earthquake and does not experience damage severe enough to cause collapse under the maximum earthquake effect.

During the tests, the accelerations at the roof level of the structure will be recorded and the corresponding displacements will be calculated. These values will be used to estimate the monetary losses resulting from damage to structural and non-structural elements as well as equipment.

In the event that the model towers or the bridges connecting them collapse, the resulting economic losses will be calculated by taking into account demolition and debris removal costs, reconstruction costs, and the period during which the building remains out of service. Finally, the annual earthquake cost for each of the three earthquake levels will be determined by dividing the total economic loss by the recurrence period of the respective earthquake.

A cost-benefit analysis will then be conducted to determine the most economically efficient building. Within this framework, the building income will be compared with the total of construction and earthquake costs.

- **Building Income:** Calculated based on the floor areas available for lease. The first two floors (the ground floor and the first regular floor), as well as the 25th floor and above, will generate higher income per square centimeter.
- **Construction Cost:** Calculated based on the weight of the model. A cost increase penalty will be applied to building models that exceed the specified weight and size limits. If the net weight of the model (excluding the wooden base plate, roof plates,

and metal roof sheet) exceeds 1.0 kg, a cost increase penalty will be applied up to a maximum of 1.3 kg. Teams whose model exceeds a net weight of 1.3 kg will lose their eligibility to compete.

- **Earthquake Cost:** Calculated based on the building's performance under seismic loads. Structural analyses will also be conducted for each earthquake level to determine the maximum roof acceleration and relative roof displacement of the model. The calculated maximum roof acceleration and relative roof displacement will be presented as each team's structural performance prediction values. If the predictions for the first strong ground motion level are close to the test results obtained during the competition, the earthquake costs assigned to the teams will be reduced accordingly.
- **Winning Criterion:** The competition ranking will be determined through a cost-benefit analysis, and the team that achieves the highest annual income will be declared the winner.

1.3. Competition Participation Requirements and Registration

As stated in the preliminary specifications, all teams participating in the competition must comply with the following requirements:

- Only students enrolled in undergraduate programs at universities are eligible to participate in the competition.
- Each team must consist of a minimum of 4 and a maximum of 5 students.
- The majority of the team members must be civil engineering students (at least 3 students). A maximum of 2 students from the architecture department of the same university may be included in a team.
- If a university does not have an architectural department, architecture students from another university may be included in the team.
- Each team must be led by an academic advisor from the Department of Civil Engineering.
- All work carried out during the preparation phase of the competition must be performed by the students themselves. If it is determined during the evaluation process that a team has received professional support, a penalty will be imposed.
- Teams must send their questions to the following address:
daskbinatarimi@dask.gov.tr



1.4. Important Dates*

| Competition | Date |
|---|-------------------|
| Submission of the building model information file** | May 4, 2026 |
| Delivery of the building models to the competition venue*** | May 11 - 12, 2026 |
| Presentations and jury voting | May 13, 2026 |
| Shake table tests | May 14, 2026 |
| Award ceremony | May 15, 2026 |

** The right to modify the dates is reserved. In case of any changes, participants will be notified via their email addresses. Participants are therefore advised to regularly check their email accounts for updates.*

*** The file must include the structural performance predictions and the floor area calculations.*

**** The models must be delivered to the competition venue, which will be announced later. The final deadline for delivery is May 12, 2026 at 5:00 PM.*

1.5. Units

The SI unit system will be used throughout the competition.

1.6. Material Supply

The following model construction materials will be provided by TCIP to the teams that qualify to participate in the competition:

- Balsa sticks (300 pieces, 1000 mm in length, with a 6 mm × 6 mm square cross-section)
- Balsa sheets (40 pieces, 1000 mm in length, 100 mm in width, and 3 mm in thickness)
- Wooden roof plates (2 pieces, 100 mm × 100 mm × 8 mm; approximately 260 grams in total)
- Wooden base plate (500 mm × 500 mm × 12 mm; **approximately 2300 grams, perfored**)
- Adhesive
- Green cutting mat

Teams are not allowed to use any materials other than those provided. In addition, the provided materials may not be modified by cutting them to reduce their thickness or by gluing them together to increase their thickness. Accordingly, all beam, column, and diagonal elements must have a 6 mm × 6 mm square cross-section, and all wall elements must have a thickness of 3 mm. If necessary, TCIP will provide one additional wooden base plate and one additional roof plate for each team. After the competition, the return shipping costs of the prepared models will be borne by the participating teams.

2. SCORING

The performance of the model building will be evaluated using a seven-component scoring system:

- Annual income
- Annual construction cost
- Annual earthquake cost
- Structural design
- Aesthetics and architecture
- Presentation
- Poster

The structural performance score will be determined by subtracting the annual construction cost and the annual earthquake cost from the annual income. The detailed scoring method is explained in the sample application provided in **Appendix D**.

2.1. Structural Design, Architecture, Presentation and Poster

2.1.a. Structural Design

The structural design score of each team will be determined based on the evaluation conducted by the jury. The name of the university must be written legibly on a 150 mm × 70 mm sheet of paper and attached to the model at the level of the top floor of the building. The scorecard to be used by the jury for evaluation is provided in **Appendix F.1**.

2.1.b. Architecture

The architectural score of each team will be determined based on the evaluation conducted by the jury. The scorecard to be used by the jury for this evaluation is provided in **Appendix F.2**.

2.1.c. Presentation

Presentations will be open to the public. Each team will deliver a presentation of 8 minutes in total, consisting of 5 minutes for the oral presentation and 3 minutes for questions and answers. The necessary equipment (projector and laptop) will be provided. The scorecard to be used by the jury for evaluation is provided in **Appendix F.3**.

2.1.d. Poster

Each team must prepare a poster presenting its project. The poster must be 85.5 cm in width and 134 cm in height. Since the posters will be placed inside special panels allocated to each team, the specified dimensions must be followed, and thick materials such as cardboard must not be used for printing. The minimum font size for the texts must be 18 points. For the university name, a 40-point font size is recommended. The university name, the DASK logo, and the competition logo must be placed at the top of the poster. The scorecard to be used by the jury for evaluation is provided in **Appendix F.4**. The logos can be obtained from the official website of the competition.

2.1.e. Calculation of Prize Points

The prize point calculation will be based on the scores obtained by each team in the structural design, architecture, presentation, and poster evaluation. These prize points will be awarded only to the top 10 teams in each category. The percentage increase assigned to each ranking position is shown in **Table 2.1**.

Table 2.1. Distribution of Prize Points

| Rank | Structural Design | Architecture | Presentation | Poster |
|------|-------------------|--------------|--------------|--------|
| 1. | 5,0% | 5,0% | 5,0% | 5,0% |
| 2. | 4,5% | 4,5% | 4,5% | 4,5% |
| 3. | 4,0% | 4,0% | 4,0% | 4,0% |
| 4. | 3,5% | 3,5% | 3,5% | 3,5% |
| 5. | 3,0% | 3,0% | 3,0% | 3,0% |
| 6. | 2,5% | 2,5% | 2,5% | 2,5% |
| 7. | 2,0% | 2,0% | 2,0% | 2,0% |
| 8. | 1,5% | 1,5% | 1,5% | 1,5% |
| 9. | 1,0% | 1,0% | 1,0% | 1,0% |
| 10. | 0,5% | 0,5% | 0,5% | 0,5% |
| 11. | 0,0% | 0,0% | 0,0% | 0,0% |

2.2. Earthquake Behavior Predictions

The consistency between the results obtained from structural analyses and the measured values recorded during shake table tests will be evaluated as part of the structural behavior predictions. Prize points that reduce the building's earthquake cost, will be awarded to the teams whose structural behavior predictions are the most accurate.

Teams are expected to predict the structural behavior parameters for two earthquake levels (SGM1 and SGM2):

- For the SGM2 earthquake, which will be announced on the official website of the competition, teams will calculate the maximum roof displacement and absolute acceleration through structural analyses. The calculated values must be submitted to the organizing committee by the date specified in Section 1.4.
- The SGM1 earthquake will be provided to the teams on the first day of the competition finals. Teams will perform their analyses for the SGM1 earthquake within the time allocated before the jury evaluation and must submit the results to daskbinatarimi@dask.gov.tr by 17:00 on the same day.

An appropriate workspace and time will be provided for these analyses. Teams must bring their own laptops with the necessary software installed, along with a fully operational building analysis model ready for use.

2.2.a. Conditions

The values to be calculated through structural analyses for the SGM1 and SGM2 earthquakes (with numerical precision up to two decimal places) are as follows:

$$\text{Predicted Relative Displacement} = \max | \text{Roof Displacement (mm)} - \text{Base Displacement (mm)} |$$

The equation must be calculated in the time domain.

$$\text{Predicted Absolute Acceleration} = \max | \text{Acceleration (g)} |$$

These values calculated by the teams will be displayed on the screen and compared with the **maximum values measured from the two towers** during the shake table tests. The procedure for measuring displacement and acceleration values during the tests is specified in Section 6.6.

Each team will be ranked according to its performance prediction for the SGM1 earthquake. The ranking will be based on the **Performance Prediction Score (PPS)** calculated using two

parameters. The first parameter is the maximum relative displacement error ratio (**RDE**), and the second is the maximum absolute acceleration error ratio (AAE).

$$RDE = \frac{\left| \frac{\text{Predicted Relative Displacement}}{\text{Analysis Model Height}} - \text{Measured Roof Drift Ratio} \right|}{\text{Measured Roof Drift Ratio}}$$

$$AAE = \frac{|\text{Predicted Absolute Acceleration} - \text{Measured Absolute Acceleration}|}{\text{Measured Absolute Acceleration}}$$

The PPS is expressed as follows:

$$PPS = RDE + AAE$$

The team with the lowest PPS will receive the highest prize points (PPS prize points). The annual earthquake costs of the top 10 ranked teams will be reduced according to the points given in Table 2.2.

Table 2.2. PPS Prize Points

| Rank | PPS Prize Points |
|------|------------------|
| 1. | 15% |
| 2. | 12% |
| 3. | 10% |
| 4. | 8% |
| 5. | 6% |
| 6. | 5% |
| 7. | 4% |
| 8. | 3% |
| 9. | 2% |
| 10. | 1% |
| 11. | 0% |

2.3. Annual Income

The annual income of the building will depend on the total leasable floor area. The annual rental income per cm² of floor area is given below:

- Ground floor and 1st floor: TRY 1000/cm²
- Floors 2-13: TRY 600/cm²
- Floors 14-24: TRY 700/cm²
- 25th floor and above: TRY 1000/cm²

The leasable floor area for each floor (excluding the bridges) will be calculated using the total plan area defined by the perimeter beams and in compliance with the conditions specified in Section 5.7. The floor area of the bridges may be considered as leasable area; however, roofs of bridges will not be considered as leasable area. Structural elements (columns and shear walls) will not be deducted from the leasable floor area.

For the total leasable floor area in the models, the following upper limit will apply:

- Maximum leasable floor area: 32,000 cm²

For model buildings exceeding this limit, the maximum area value specified above will be used in the calculation. The total leasable area will be determined by summing the floor areas from the ground floor upwards. Any floor area exceeding the maximum leasable floor area limit will not be included in the total leasable floor area calculation

The annual income will be calculated as the sum of the leasable floor area of each floor multiplied by the applicable annual rental income coefficient per cm² specified for that floor.

2.4. Annual Building Cost

The Annual Building Cost will be calculated based on the model weight and the model base area. The model weight will determine the total construction cost, while the base area will determine the land cost. The unit costs to be used in the calculations are given below.

Construction cost per unit weight: TRY 200,000,000/kg

Land cost per unit base area : TRY 30,000/cm²

The annual cost will be calculated by dividing the total construction and land costs by the economic life of the building (100 years).

The base area of the building model is defined as the projection of the maximum outer boundary formed by the floor plates across all levels onto the base plane. Fixed loads added during the shake table tests will not be included in the structural weight. Weight penalties are specified in Sections 5.8.b and 5.9.b.

2.5. Annual Earthquake Cost

The Annual Earthquake Cost (AEC) will be calculated based on the seismic behavior of the building. The method described in Section 6.7 will be used to determine the economic loss. The equipment cost which includes curtain wall systems, HVAC systems, special installations, and equipment, will be used in calculating the economic loss. This value is as follows:

Equipment Cost = TRY 200,000,000

The AEC will be obtained by summing the **Annual Economic Loss (AEL)** values calculated for each component (in TL), after applying the relevant Unsupported Connection Penalties (D1, D2, D3) specified in Section 6.7.c. The calculation will be performed as follows:

$$AEC = AEL_1 (1 + D_1) + AEL_2 (1 + D_2) + AEL_3 (1 + D_3)$$

Here, D1, D2, and D3 are the connection penalties that take into account the loosening and failures in the model, which will be determined by the Technical Advisory Committee after each strong ground motion (SGM1, SGM2, and SGM3, respectively).

2.6. Annual Revenue

The final performance score of each team will be calculated based on its annual net earnings. The team with the highest Annual Revenue (**AR**) will be declared the winner of the competition. The AR will be calculated by subtracting the Adjusted Annual Building Cost (**AABC**) and the Adjusted Annual Earthquake Cost (**AAEC**) from the Adjusted Annual Income (**AAI**).

Penalty Coefficients:

- **N**: Building Dimension Penalty (see Sections 5.1-5.5)
- **M**: Building Weight Penalty (see Sections 5.8, 5.9, 5.12)

The Adjusted Annual Income (AAI) is defined as follows:

$$AAI = (1 + \text{Structural Design Award} + \text{Architecture Award} + \text{Presentation Award} + \text{Poster Award}) \times \text{Annual Income}$$

The Adjusted Annual Building Cost (AABC) is defined as follows:

$$AABC = (1 + N + M) \times \text{Annual Building Cost}$$

The Adjusted Annual Earthquake Cost (AAEC) is defined as follows:

$$AAEC = (1 - \text{PPS Prize}) \times \text{Annual Earthquake Cost}$$



The Annual Revenue (AR) is expressed as follows:

$$AR = AAI - AABC - AAEC$$

3. PRIZES

3.1. Competition Winner and Ranking

Among the teams whose buildings do not collapse under any of the three strong ground motions, the team achieving the highest Annual Revenue (AR) will be declared the winner of the competition.

Teams whose buildings collapse will be ranked in a separate category from those whose buildings do not collapse. Within each category, teams will be ranked according to their AR.

A monetary prize of TRY 125,000 will be allocated to the relevant department of the university whose team ranks first in the competition for the procurement of laboratory equipment. The students of the top three teams will receive the following prizes:

First Team: TRY 100,000 and a laptop computer for each team member as the Türk Reasürans Special Prize

Second Team: TRY 80,000 and a large tablet for each team member

Third Team: TRY 65,000 and a small tablet for each team member

In addition, tablet computers will be awarded to the advisors of the first, second, and third teams.

3.2. Certificate of Appreciation

A certificate of appreciation will be presented to all team members participating in the competition.

3.3. Special Awards

Five special awards will be presented in the competition. All teams receiving a special award will be given a technology gift voucher.

3.3.a. Best Earthquake Performance Special Award

This award will be presented to the team with the lowest Adjusted Annual Earthquake Cost (AAEC).



3.3.b. Best Architecture Special Award

This award will be presented to the team receiving the highest score in the architectural evaluation.

3.3.c. Best Communication Skills and Presentation Special Award

This award will be presented to the team achieving the highest overall score in communication, presentation, and poster evaluations. The total score will be calculated as follows:

$$\text{Total Score} = 2 \times \text{Presentation Score} + \text{Poster Score}$$

In the event of a tie, the team with the higher architecture score will receive the award.

3.3.d. Best Competition Spirit Special Award

The recipient of this award will be determined by the teams participating in the competition.

3.3.e. Türk Reasürans Special Award

The recipient of this award will be determined by Türk Reasürans.

4. COMPETITION SCHEDULE

The following activities will take place during the competition. The schedule may be subject to change, and any updates will be announced on the official website of the competition.

- The building models must be delivered to the competition venue on the date specified in the competition calendar. The models will be unpacked by the team members.
- Sufficient time will be allocated to repair any models that may have sustained damaged during transportation before the oral presentations begin.
- A meeting mandatory for the team leaders will be held before the oral presentations. During this meeting, the competition schedule and the procedures to be followed will be explained in detail. Only one representative from each team should attend the meeting. If the team leader is unable to attend, another team member may participate on their behalf.
- Oral presentations will be held on the first day of the competition. By the time the first presentation begins, all building models must be placed in the designated exhibition area. Once the models are in the exhibition area, no further modifications may be made.

- On the first day of the competition, the technical team will inspect all building models to identify any applications that may result in score deductions or penalties. The use of any material other than the base plate and roof plates provided by TCIP will result in disqualification (see Sections 5.8 and 5.9).
- Shake table earthquake tests will be conducted on the second day after the completion of the poster and oral presentations. Prior to the jury scoring, a building analysis will be carried out using the earthquake motion provided during the competition. The measured values from the strong ground motion loadings will be announced along with the teams' structural behavior predictions.
- The award ceremony will take place on the third day of the competition.

5. BUILDING MODEL

The building models prepared by participating teams must be designed in accordance with the Technical Specifications, optimizing the structural system and floor plans presented in the project proposal, which include the preliminary design and pre-sizing. Modifications may be made to the number of floors, structural system, and floor plans within the framework of engineering, architectural, economic, and other requirements. The use of **any type of damping device or mechanism** in the building model is strictly prohibited. **The Technical Advisory Committee** reserves the right to disqualify any team found in violation of these rules.

This section outlines the rules and limitations related to the building model. Non-compliance may result in a Building Dimension Penalty Factor (**N**), a Building Weight Penalty Factor (**M**), or disqualification. The Technical Advisory Committee has full discretion in determining penalties.

The building models will consist of structural frame elements (see Section 5.3) and structural shear walls (see Section 5.4) attached to the base plate (see Section 5.8), as well as roof plates attached to the top of the model building (see Section 5.9). All connection requirements are specified in Section 5.5. Visuals illustrating the model preparation process are provided in Appendix E.

When preparing models, any cutting method (such as laser cutting, milling, etc.) is permitted, provided that the dimensional limitations of the model elements are respected. Care must be taken to ensure the building model allows for the installation of the weights with the dimensions specified in the Technical Specifications.

5.1. Building Model Materials

All structural frame elements and structural shear walls must be made of provided **balsa wood**. Any structural frame or shear wall element that does not comply will result in disqualification.

5.2. Building Model Dimensions

The model towers must be connected by three bridges. For towers with 25 floors or more, four bridges will be permitted. One of the bridges must be a two-story bridge connecting the top two floors of the towers (see Figure 5.1). The other two (or three) bridges must be single-story, located at any floor levels except the ground floor, and must not receive support from other floors (see Figure 5.1). **There can only be one bridge at any given floor.**

5.2.a. Plan Dimensions

For deviations from the specified dimensions, **0.02** will be added to the **N** factor for every 2 mm deviation. Measurements will be rounded up to the next deviation value. No penalty will be imposed for the first 2 mm deviation.

- **Maximum floor plan dimensions:** 160 mm × 400 mm per tower (measured from the outer faces of the elements defining the floor perimeter; see Figure 5.2)
- **Minimum distance between towers in plan:** 80 mm. Distances below this limit result in disqualification.
- **Bridge width:** 80 mm (see Figure 5.2). Deviations greater than 5 mm result in disqualification.
- **Minimum floor plan dimensions:** 80 mm × 200 mm (measured from the outer faces of the elements defining the floor perimeter)

5.2.b. Number of Floors

Teams that do not comply with the floor limits given below will be disqualified.

- **Maximum number of floors:** 30 (including the ground floor)
- **Minimum number of floors:** 20 (including the ground floor)

5.2.c. Floor Heights in the Building Model

- **Typical floor height:** 60 mm (measured from one floor plane to the adjacent floor plane; see Figure 5.1)
- **Ground floor height:** 90 mm (see Figure 5.1)

All floor heights will be individually inspected by the technical team. For deviations related to this section, **0.05** will be added to the **N** factor for every 4 mm deviation. Measurements

will be rounded up to the next deviation value. No penalty will be imposed for the first 4 mm deviation.

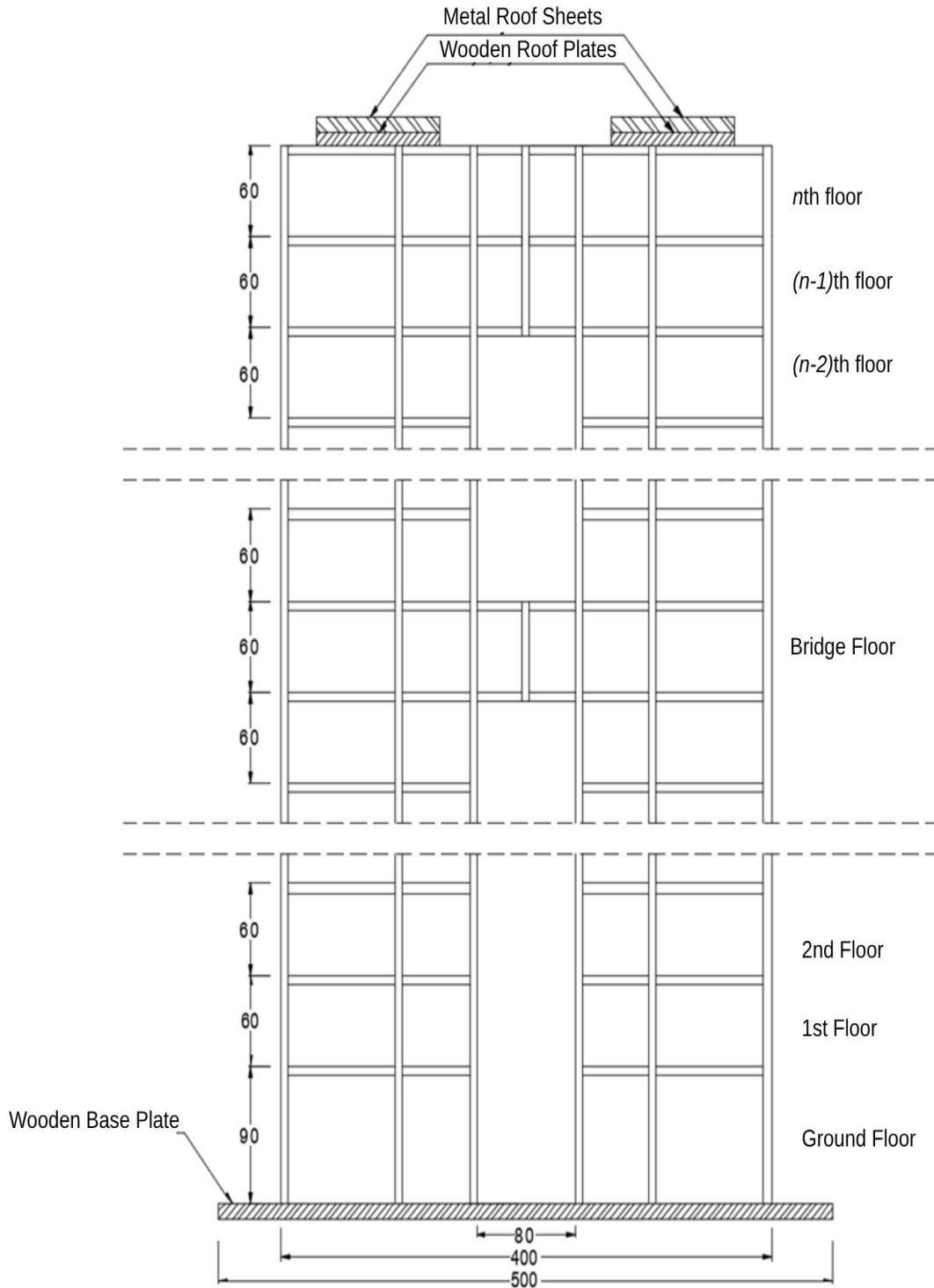


Figure 5.1. Building section elevation

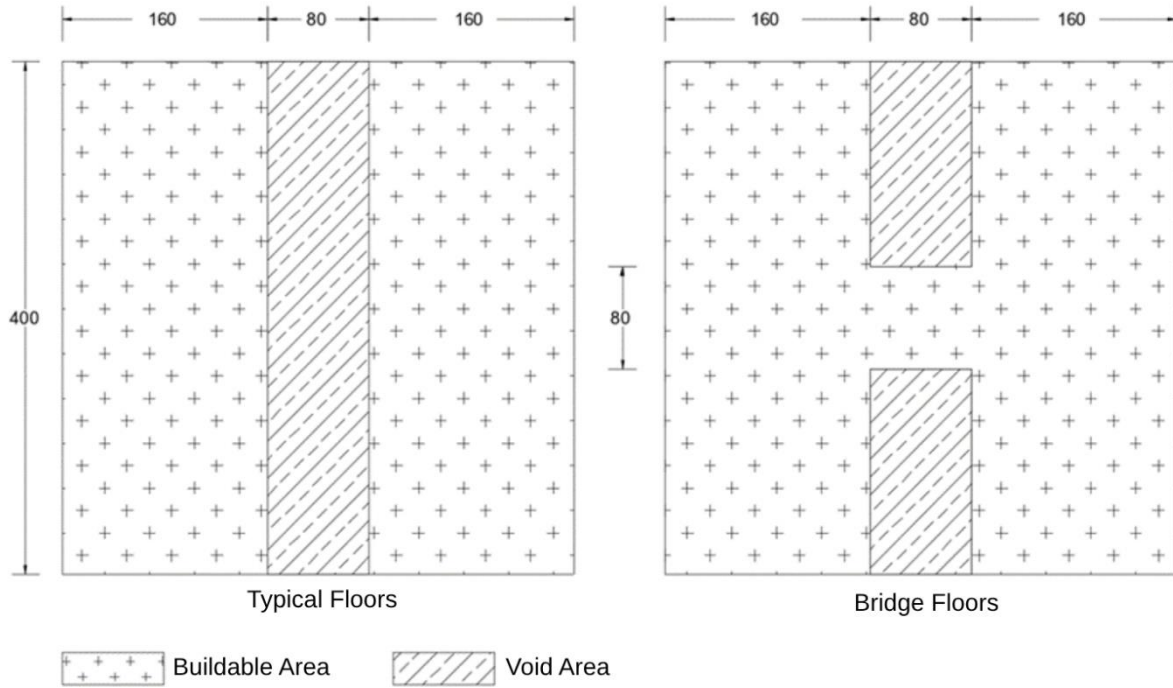


Figure 5.2. Typical Floor and Bridge-Connected Floor Plans

5.3. Structural Frame and Bridge Elements

Structural frames and bridges shall be constructed using balsa sticks only.

The cross-sectional dimensions of the members shall be as follows:

- Rectangular members: 6 mm × 6 mm

5.4. Structural Shear Walls

5.4.a. Dimensions of Structural Shear Walls

Structural shear walls shall comply with the following requirements:

- Thickness: 3 mm
- Minimum length (in plan): 30 mm
- Maximum length (in plan): 70 mm*

* Balsa sticks attached to the ends of the shear wall are included in the maximum length.

5.4.b. Requirements for Structural Shear Walls

Each violation of these requirements outlined in this section results in an addition of **0.05** to the **N** factor.

Shear walls must extend at least one story height. Structural frame members may connect to shear walls, but must satisfy the moment-resisting connection requirements. Vertically aligned columns may be attached along the entire short edge of the shear wall.

In plan view, shear walls must not contact each other, except where the short side of one wall connects to the long side of an adjacent wall.

5.5. Structural Connections

5.5.a. Requirements for Structural Connections

Each violation related to the requirements specified in this section results in an addition of **0.05** to the **N** factor. Only adhesive (glue) may be used in the connections of structural members. Notched or interlocking joints at the ends of the sticks are not permitted. However, angled cuts are allowed for geometric purposes (see Figure A.7).

These connection requirements also apply to bridge-to-tower connections, which must be rigid. **Bridge elements must terminate at the tower, i.e., no bridge element shall be continuous through a tower. Likewise, extension of tower beams into the bridges are not allowed.** Failure to comply with these requirements will result in disqualification.

All columns and shear walls in contact with the base plate must be fixed to the base plate using adhesive.

The connection details illustrated in Figure A.7 also apply to bridges.

5.5.b. Dimensions of Structural Connections

Each violation related to the requirements specified in this section results in an addition of **0.01** to the **N** factor. Measurements shall be rounded up to the next deviation value. If gusset plates are used in moment-resisting frame members, their height and length must not exceed three times the maximum cross-sectional dimension of the connected frame member (Figure A.6). The thickness of the gusset plates must not exceed the minimum cross-sectional dimension of the connected members. Gusset plates may be attached to both sides of the connection; however, the total thickness must remain within the limit.

5.6. Fixed Load Connections

Before shake table tests, fixed loads will be added to the building model at specified floors using metal weight plates attached to the ends of rods (see Section 6.4). The balsa members in contact with these load elements must safely support the loads during shaking. **For this purpose, a 13-16 mm clearance must be maintained in these regions to allow for the weight connections .**

Fixed loads will be placed on every third floor of each tower, centered on the tower floor plates, and oriented perpendicular to both the shaking direction and the bridge axes (see Figure A.5).

The loads will be installed on the structure by team members using nuts and/or washers. Photographs and dimensional information for the fixed load components are provided in Figure A.4, while Figure A.5. shows a typical floor plan illustrating their placement. Teams are strongly advised to perform trial installations beforehand to verify proper assembly. **It is the responsibility of the teams to ensure that the fixed load components are correctly mounted on the model. After each ground motion test, the fixed loads will be inspected for loosening and/or potential damage to adjacent structural elements. If any such condition is observed, the Technical Advisory Board may evaluate the building as collapsed (see Sections 6.7.a and 6.7.c).**

Washers, nuts, and metal weight plates must not extend beyond the exterior boundary defined by the perimeter beams. Fixed loads must be installed so as not to cause failure of any structural connections, frame members, or shear walls of the model building. The nuts must also be tightened to ensure a secure and stable installation.

5.7. Floor Requirements

The use of any damping device on the floors is strictly prohibited. Teams using such devices will be disqualified.

Only floors meeting the following requirements will be counted as “rentable floor area”:

- Each floor must have continuous perimeter beams that clearly define the floor area.
- The plane defined by the top surfaces of the perimeter beams must be level and free of irregularities.
- A 60 mm diameter disk from above must not pass through any rentable floor plane defined by the perimeter beams. Floor areas that are not counted as rentable floor area are not required to comply with this requirement.

Each floor must be clearly numbered and visible to the jury. The ground floor shall be labeled as ‘ground floor’, and the floor above the ground floor shall be labeled as ‘1st floor’.

The labels do not need to be made of balsa wood; however, they must not compromise the structural performance of the model or interfere with the installation of the fixed loads.

Each rentable floor must have at least two access points or doorways that provide the occupants access to any area of the rentable floor. A sufficient access point is defined as an unobstructed opening with the following minimum dimensions:

- **Width:** 25 mm
- **Height:** 40 mm

5.8. Building Model Base Plate

5.8.a. Plan Dimensions of the Building Model Base Plate

A single-piece square plywood base plate measuring 500 mm × 500 mm will be used to secure the building model to the shaking table. This base plate will be provided to the teams by DASK, and its use is mandatory. No element of the building model shall be located closer than 25 mm to the outer edge of the model base plate (see Figure A.3).

5.8.b. Conditions for the Building Model Base Plate

Grooves or notches on the base plate for positioning columns and shear walls are allowed; however, drilling holes is not permitted. Drilling or thinning the base plate to reduce its weight will result in an addition of **0.5** to the **M** factor.

5.9. Building Model Roof Wooden and Metal Sheet Plates

The roof plates are non-structural elements which will be used to attach the accelerometers to the building model. The roof plates must be level when installed. Details of the metal roof plates are provided in Figures A.1 and A.2.

5.9.a. Plan Dimensions of the Roof Plates

Two plywood roof plates, each measuring 100 mm × 100 mm x 8 mm, will be delivered to the teams in advance of the competition. At the competition site, each team will be provided with two metal plates, measuring 100 mm × 100 mm x 10 mm and weighing 800 gr each, which must be securely bonded to the roof wooden plates by the teams. The accelerometers will be mounted on the building models by the Competition's Technical Team through the pre-drilled holes in the metal plates (see Figure A.1).

5.9.b. Requirements for the Building Model Roof Plate

Grooves or notches on the roof plates are allowed, but they may only be used to position columns and shear walls. The roof plates must not be cut, thinned, or otherwise modified to reduce weight. Any violation of this rule will result in an addition of **0.5** to the **M** factor.

5.10. Damping Devices or Mechanisms

The use of damping devices or mechanisms in the building models is **not permitted**.

5.11. Building Facades

Surface cladding on building facades or painting of the wooden elements is not permitted. The Technical Advisory Board reserves the right to disqualify any team found in violation of this rule.

5.12. Weight of the Building Model

The net weight of the building model (excluding the wooden base plate, roof plates, and metal roof plates) must not exceed 1.0 kg.

For every 50 grams exceeding the permitted weight, 0.1 will be added to the **M** factor. Any weight within a penalty interval will be rounded up to the next interval. The weight penalty will apply for building models that weigh up to 1.3 kg **Teams whose model exceeds a net weight of 1.3 kg will be disqualified from the competition.**

6. STRONG GROUND MOTION TEST

The building model will be subjected to three different strong ground motions. The structural performance under each strong ground motion will be used to calculate the **Annual Earthquake Cost**. Horizontal acceleration records will be measured using accelerometers placed on the roof and the base of the building model (see Figures A.1 and A.7).

6.1. Scaled Strong Ground Motion Records

The building models will be subjected to three scaled or simulated strong ground motions, referred to as SGM1, SGM2, and SGM3. Records for SGM2 and SGM3 will be posted on the official website of the competition, while SGM1 will be provided to the teams on the first day of the competition finals.

6.2. Shaking Table

Testing will be conducted on a shaking table with a top platform measuring 500 mm × 500 mm and a load capacity of 50 kg at ± 2 g acceleration.

6.3. Mounting the Model on the Shake Table

The shaking direction will be parallel to the bridge axes. Teams will rigidly fix the building model to the shaking table using the base plate (see Figure E.11).

6.4. Floor Weights

For each tower, floor weights will consist of **one steel rod and six weight plates** (see Figure A.4). These weights will be securely mounted to the frame perpendicular to the shaking direction (see Figure A.5). The roof weight will be represented by the wooden roof plate and the metal plate. The metal plate will be rigidly bonded to the plywood roof plate by the teams (see Figure A.2).

- Floor weight (approx.): 0.80 kg (total 1.60 kg)
- Roof weight (approx.): 1.10 kg (total 2.20 kg)
- Vertical distance between weights: 180 mm
- Diameter of the steel rod: 12 mm

Floor weights will be installed every three floors.

For each tower, the roof weight consists of one metal plate measuring 100 mm × 100 mm × 10 mm (800 grams), one wooden roof plate measuring 100 mm × 100 mm × 8 mm (130 grams), and an L-shaped connection plate (100 grams) to which an accelerometer (70 grams) is attached.

The accelerometer will be fixed using the L-shaped connection plate (see Figures A.1 and A.2).

6.5. Measurement Devices

Three accelerometers will be used in the competition. One accelerometer will be mounted on the shaking table, while the other two will be mounted on the metal roof plates of each tower.

6.6. Data Processing

Acceleration records will first be transformed into the frequency domain using the Fourier Transform. After applying appropriate numerical filters and making necessary corrections,

the data will be converted back to the time domain. Displacements will then be obtained by double integration of the corrected acceleration time series.

6.7. Evaluation of Economic Loss

The Annual Economic Loss will be calculated by dividing the estimated economic loss by the assumed Earthquake Recurrence Period (Table 6.1). The Total Annual Earthquake Economic Loss will be obtained by summing the Annual Economic Loss values calculated for each earthquake.

Table 6.1. Recurrence Periods of Strong Ground Motions

| Strong Ground Motion | Earthquake Recurrence Period |
|-----------------------------|-------------------------------------|
| SGM1 | 72 years |
| SGM2 | 475 years |
| SGM3 | 2475 years |

Elastic design spectra corresponding to the three earthquake levels were generated for the Istanbul Finance Center site using the AFAD Turkey Earthquake Hazard Maps Interactive Web Application (<https://tdth.afad.gov.tr/TDTH/main.xhtml>) and are provided in **Appendix C**. The procedure in Section 6.7.a applies to the economic loss of collapsed models, while Section 6.7.b applies to the economic loss of non-collapsed models.

6.7.a. Collapse Condition

The Technical Advisory Board will determine whether a collapse has occurred.

Collapse criteria:

A building model will be considered collapsed if any of the following conditions occur:

- Overturning of either tower of the model
- Failure of at least two bridges, defined as:
 - Separation of two or more connections between the bridge and either tower, or,
 - Damage to or separation at the connections of 50% or more of the structural elements (horizontal, vertical, or diagonal) forming the bridge
- Displacement or loosening of more than 50% of the floor weights in either tower
- Detachment of more than 50% of the column and shear wall elements at any floor from their connections in either tower

For collapsed models, the Economic Loss and the Annual Economic Loss will be calculated as follows, each component expressed in TL:

$$\text{Economic Loss}_n = \text{Equipment Cost} + 2 \times \text{Construction Cost} + 3 \times \text{Annual Income}$$

$$\text{Annual Economic Loss}_n = 5 \times \text{Economic Loss}_n / \text{Recurrence Period}_n$$

If collapse occurs during SGM1 or SGM2, the economic loss calculation will assume that collapse also occurs during the subsequent strong ground motions.

6.7.b. Non-Collapse Condition

If collapse does not occur, the total economic loss will be calculated based on the costs associated with structural damage and equipment damage, as follows;

TP1 = Economic loss expressed as a percentage of the Construction Cost

TP2 = Economic loss expressed as a percentage of the Equipment Cost

These two economic loss factors are related to the following two parameters measured during the strong ground motion tests (see Figure A.9).

Maximum Roof Drift Ratio: $\max (\Delta_{\text{roof}} - \Delta_{\text{base}}) / H$

Maximum Roof Acceleration: $\max |a|$ (g)

Since accelerometers will not be attached to the model during the SGM3 ground motion, if collapse does not occur during the SGM3 excitation, the TP1 and TP2 values will be taken as the maximum of the values obtained for SGM2 and 0.50.

Economic Loss Due to Structural Damage (TP1)

Structural damage in the building will be evaluated based on the Maximum Roof Drift Ratio. The loss function relating structural damage to the Interstory Drift Ratio is defined as a cumulative normal distribution function with a mean loss ratio of 0.015 and a standard deviation of 0.005. Figure 6.1 presents the loss function curve expressed in terms of the normalized cost (TP1).

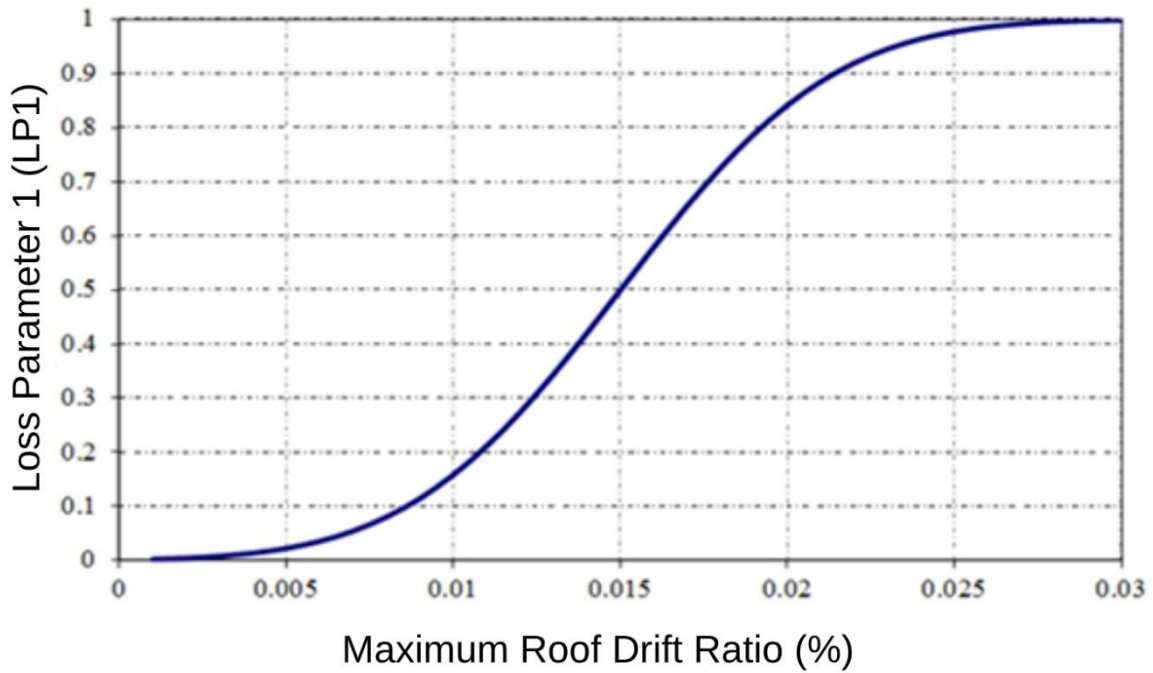


Figure 6.1. Fragility Function Relating the Maximum Roof Drift to TP1

Economic Loss Due to Equipment Damage (TP2)

It is assumed that the building contains equipment sensitive to floor acceleration, with a total value equal to the Equipment Cost. The damage to the building equipment will be related to the Maximum Roof Acceleration. For this purpose, a cumulative normal distribution function with a mean maximum roof acceleration of 1.75 g and a standard deviation of 0.70 g will be used. The graph of the loss function (TP2) is shown in Figure 6.2.

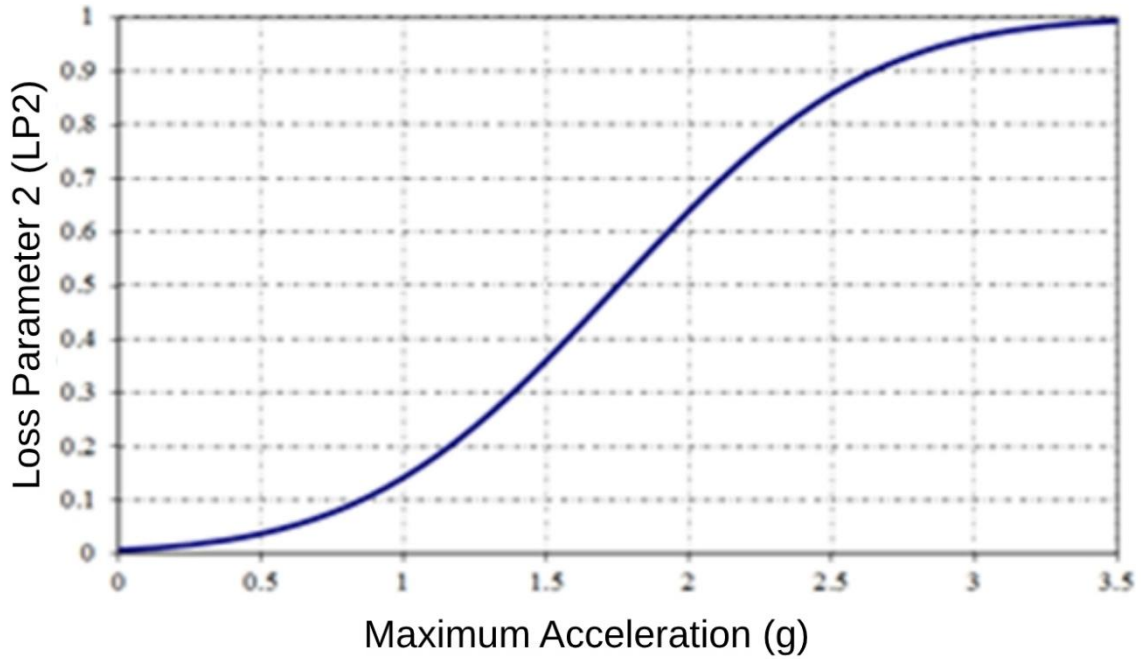


Figure 6.2. Fragility Function Relating the Maximum Acceleration to TP2

The Economic Loss and the Annual Economic Loss for the n-th strong ground motion will be calculated as follows:

$$\mathbf{Economic\ Loss}_n = \mathbf{TP1} \times \mathbf{Construction\ Cost} + \mathbf{TP2} \times \mathbf{Equipment\ Cost}$$

$$\mathbf{Annual\ Economic\ Loss}_n = \mathbf{5} \times \mathbf{Economic\ Loss}_n / \mathbf{Recurrence\ Period}_n$$

In the expressions above, TP1 and TP2 shall be expressed as percentages, costs shall be expressed in TL, and the Recurrence Period shall be expressed in years.

6.7.c. Penalties

After each strong ground motion, the Technical Advisory Board will inspect the building to determine whether any connections have failed. Fallen weights or weights that have significantly deviated from the initial structural configuration of the floor will be considered as failed connections. For each loosening of the threaded rods, 5% will be added to the D factor. The D factor is cumulative and will affect the calculations for the corresponding strong ground motion. In the event of model collapse, the D factor will be taken as 0% for the ground motion during which the collapse occurs and for any subsequent ground motions.



After SGM1 and SGM2, the Technical Advisory Board will examine the connections between the accelerometers, the roof plates, and the structural model. If the Technical Advisory Board determines that the connection between the metal roof plate and the structural model has failed in any tower, it will be assumed that maximum damage has occurred in both the structural system and the equipment for scoring purposes. If the accelerometers are not properly attached to the model after SGM1, they will be removed before SGM2, and it will be assumed that maximum damage has occurred in both the structural system and the equipment for both SGM1 and SGM2. However, metal roof plates not remaining tightly in place shall not be considered a reason to classify the structural model as collapsed.

7. SCORECARDS

In addition to their technical performance, the competing teams will be evaluated by the Competition Jury based on the poster, oral presentation, and the architectural features of the model building. The scorecards used for this evaluation and scoring are provided in **Appendix F**.

8. RULE EXPLANATIONS

All requests for clarification regarding the competition rules, along with the corresponding responses, will be published on the official website of the competition. In the published questions and answers, the name of the university that submitted the question will also be indicated.

To request clarification regarding the rules, the form available on the official competition website must be completed. Competing teams are expected to carefully read the competition rules and the details of the specifications before submitting any questions.

When the clarification pages are updated, team advisors will be notified by email.

TCIP reserves the right to modify the rules, dates, and specifications of the competition, provided that prior notice is given.

TCIP also reserves the right to retain any model among the finalist projects for exhibition purposes.

9. JURY AND OBJECTIONS

The Competition Jury and the Technical Advisory Committee are fully authorized to interpret the rules and manage the competition. They are responsible for scoring and decision-making. All decisions made by the Competition Jury and the Technical Advisory Committee are final.

APPENDIX A. TECHNICAL DETAILS RELATED TO THE MODEL

A.1. Roof-Level Accelerometer Connections

The arrangement of the plywood roof plate, metal roof plate, and accelerometer attached to the building model, are shown in Figure A.1. The plywood roof plate measures **100 mm × 100 mm × 8 mm**. To ensure uniform load distribution, the roof plates must be placed so that their centers coincide with the centers of the towers. The corresponding elevation and plan views of this arrangement are provided in Figure A.2.

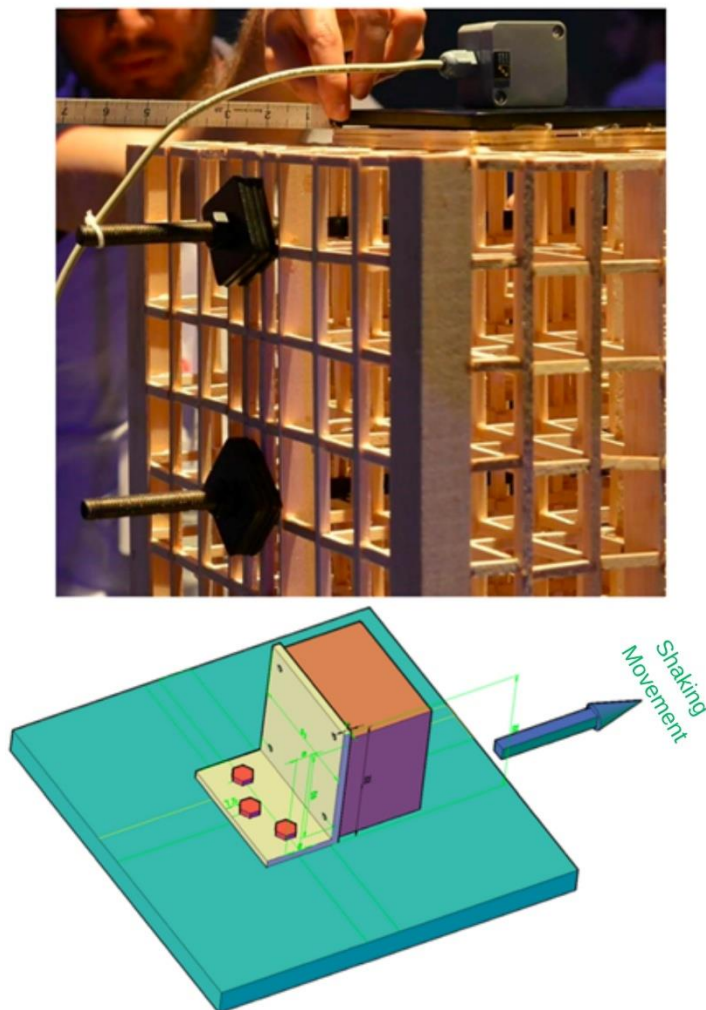


Figure A.1. Measurement setup on the model and the connection between the metal roof plate and the accelerometer

The accelerometer will be fixed to the metal roof plate using an L-shaped connection plate by the technical team of the Seismic Design Competition during the competition.

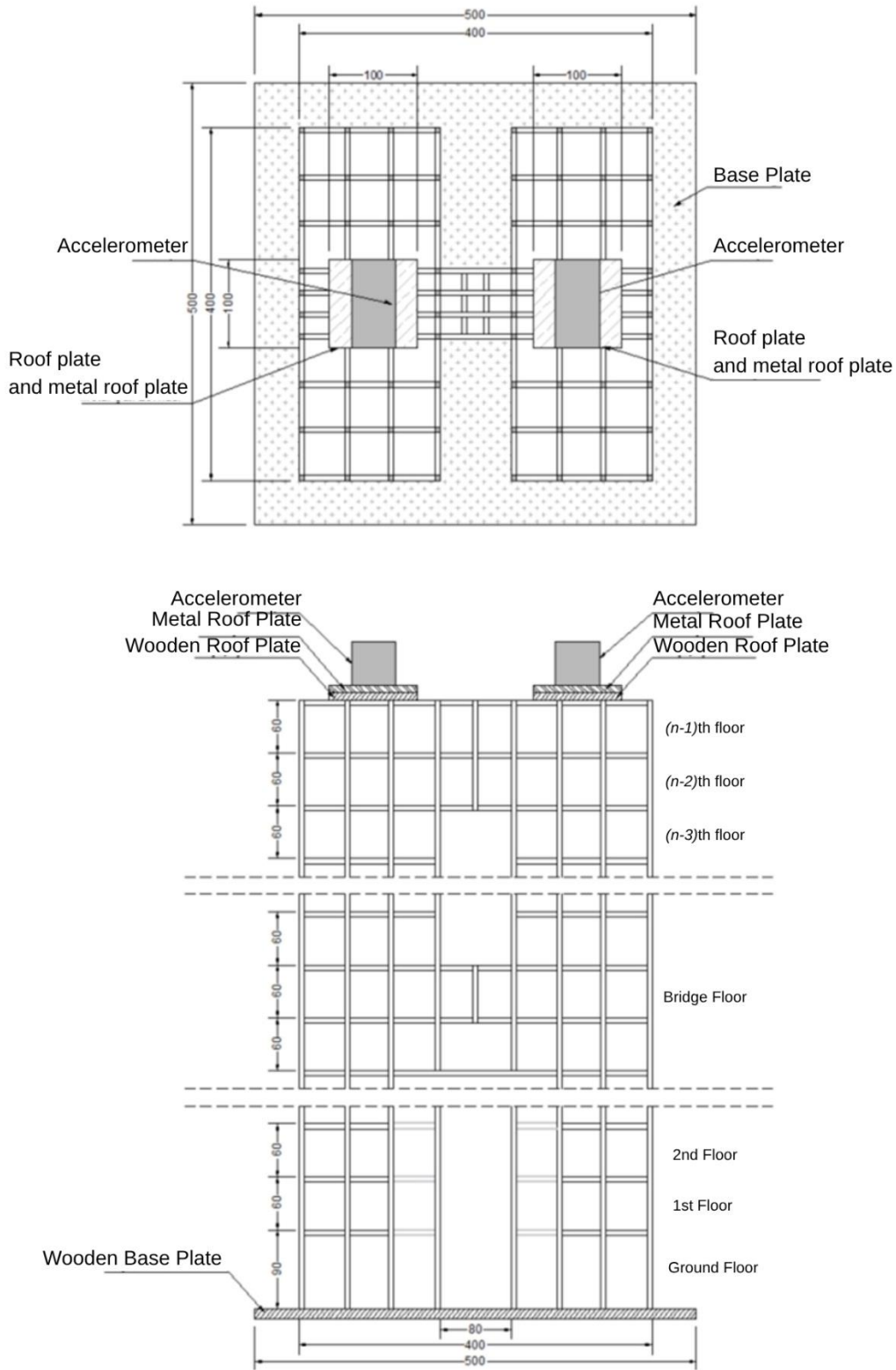


Figure A.2. Plan (top) and section elevation (bottom) views of the plate, metal sheet, and accelerometers at the roof level

A.2. Base Plate

The building model shall be mounted on a plywood base plate measuring 500 mm × 500 mm. The model shall be positioned such that it is centered on the base plate in both structural directions. The plan view corresponding to this arrangement is shown in Figure A.3.

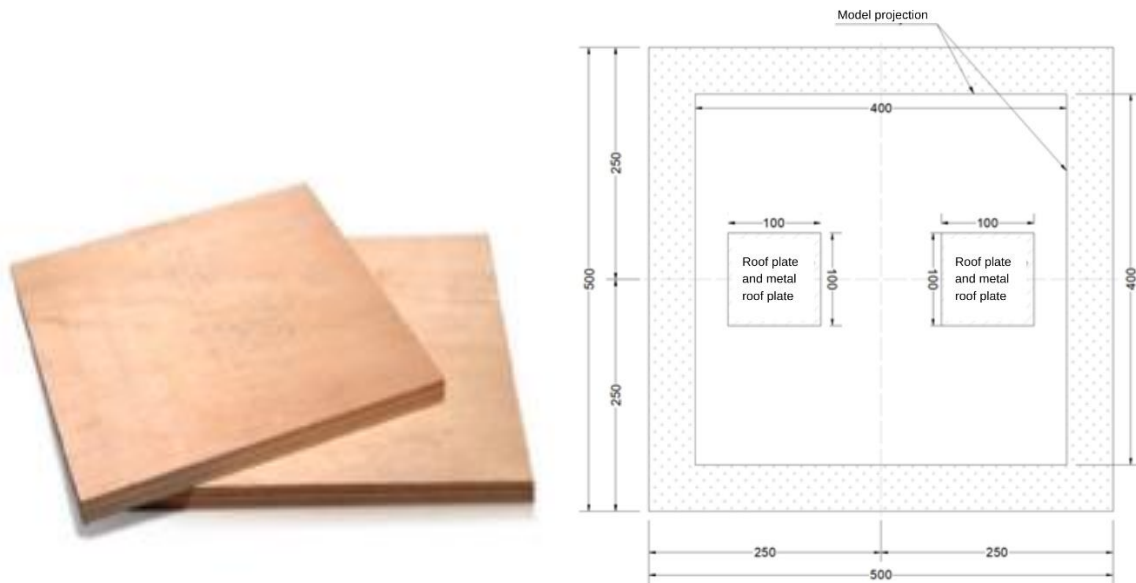


Figure A.3. Base Plate Specifications and Layout Detail

The building model fixed to the base plate will be secured to the shake table by the team members.

A.3. Floor Weights and Loading Scheme

Components of the floor weights to be installed on the building model by the competing teams are shown in Figure A.4.

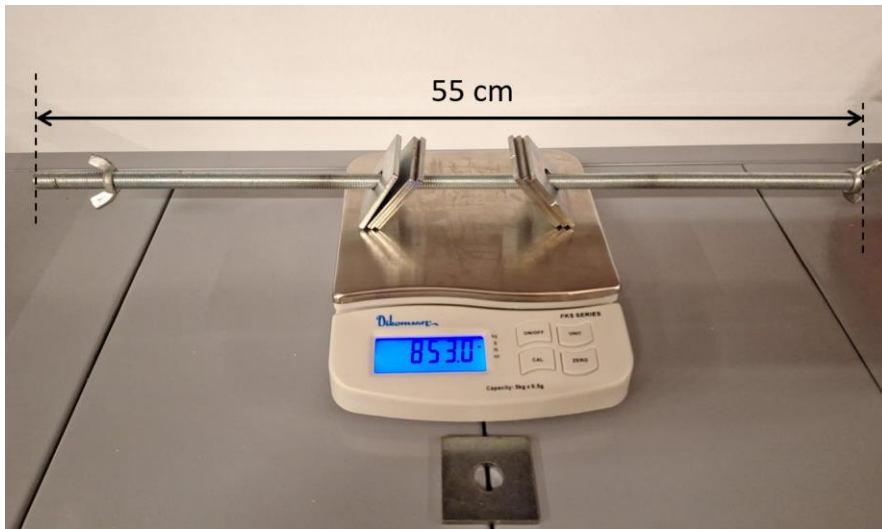
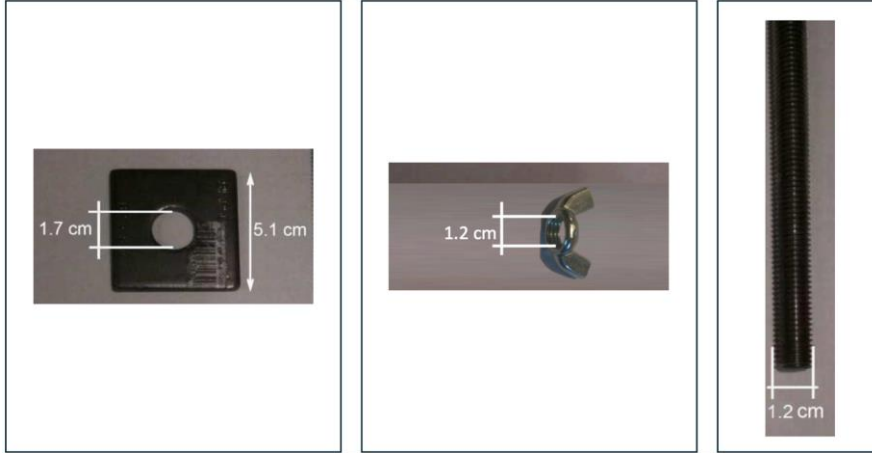


Figure A.4. Floor Weight Components

Floor weights will be installed on the building model at 18 cm vertical intervals, with the first weight at the level of the 2nd floor slab (ceiling of the 1st floor) from the base. As shown in Figure A.5, the weights - whose typical arrangement and connection configuration are illustrated - will be mounted using a steel anchor rod (bolt) passing through the floor plane perpendicular to the shaking direction. Weight plates, which also function as washers, will be placed at both ends, and the assembly secured with one nut and/or washer per end, tightened manually by the team members.

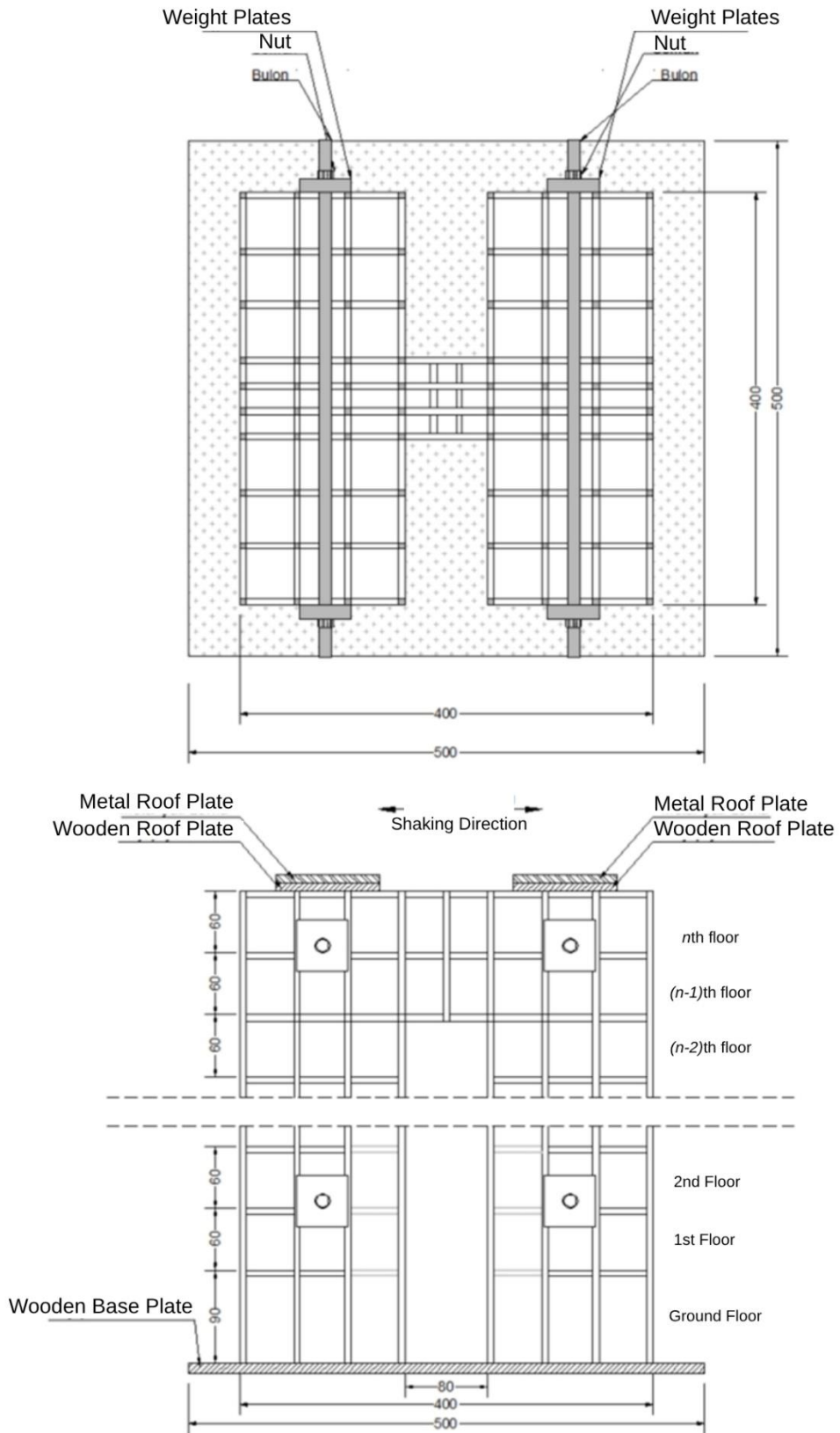


Figure A.5. Typical Floor Weight Configuration

A.4. Gusset Application in Moment-Resisting Connection Regions

For moment-resisting frames, gusset plates may be used in structural members only according to the connection details and dimensions shown in Figures A.6 and A.7. Any connection types not depicted in these figures are prohibited. In the Figure A.6, b denotes the maximum cross-section dimension (width or height) of the connected members.

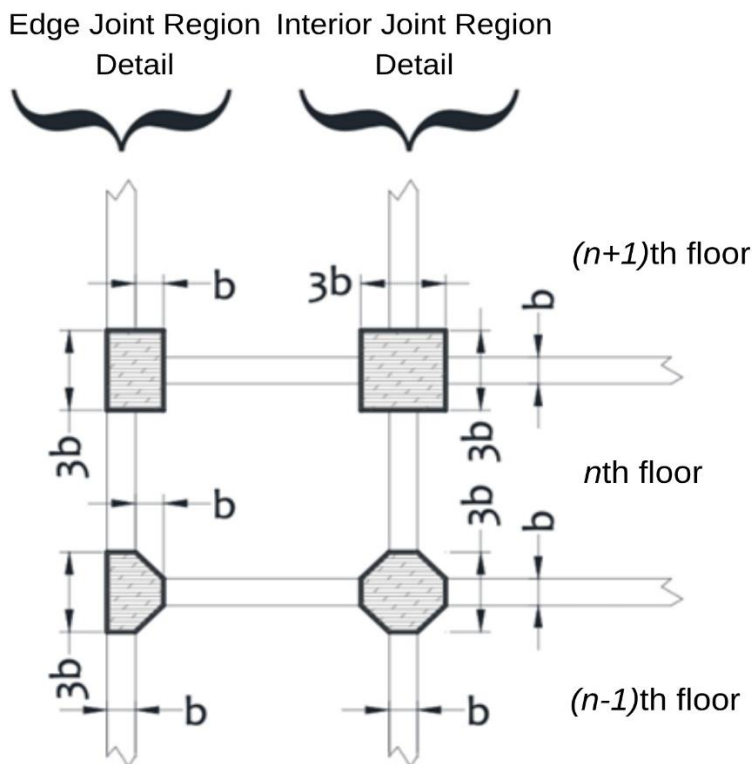


Figure A.6. Gusset connection requirements.

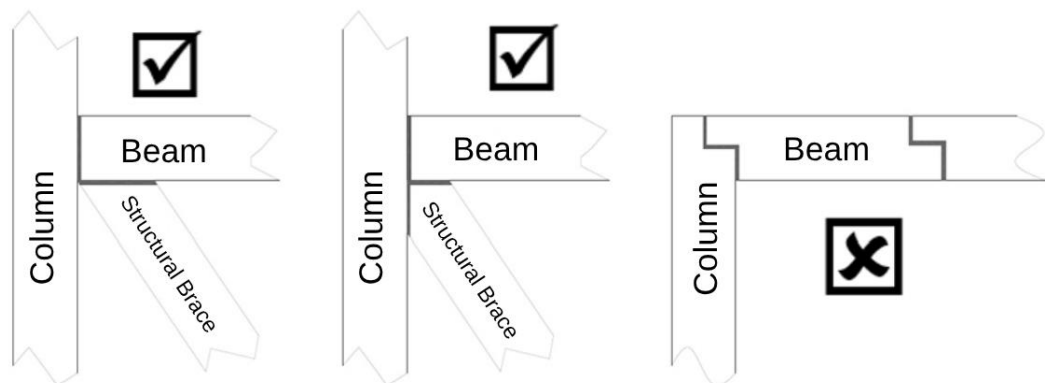


Figure A.7. Permitted and Prohibited (rightmost) Cutting Configurations for Structural System Members

A.5. Shaking and Measurement Procedures

Once the building model has been attached to the shake table, the floor weights installed, and the roof accelerometers mounted, the structural response quantities illustrated in Figure A.8 will be measured during the shake tests. All columns and shear walls of the structural system must be glued to the base plate.

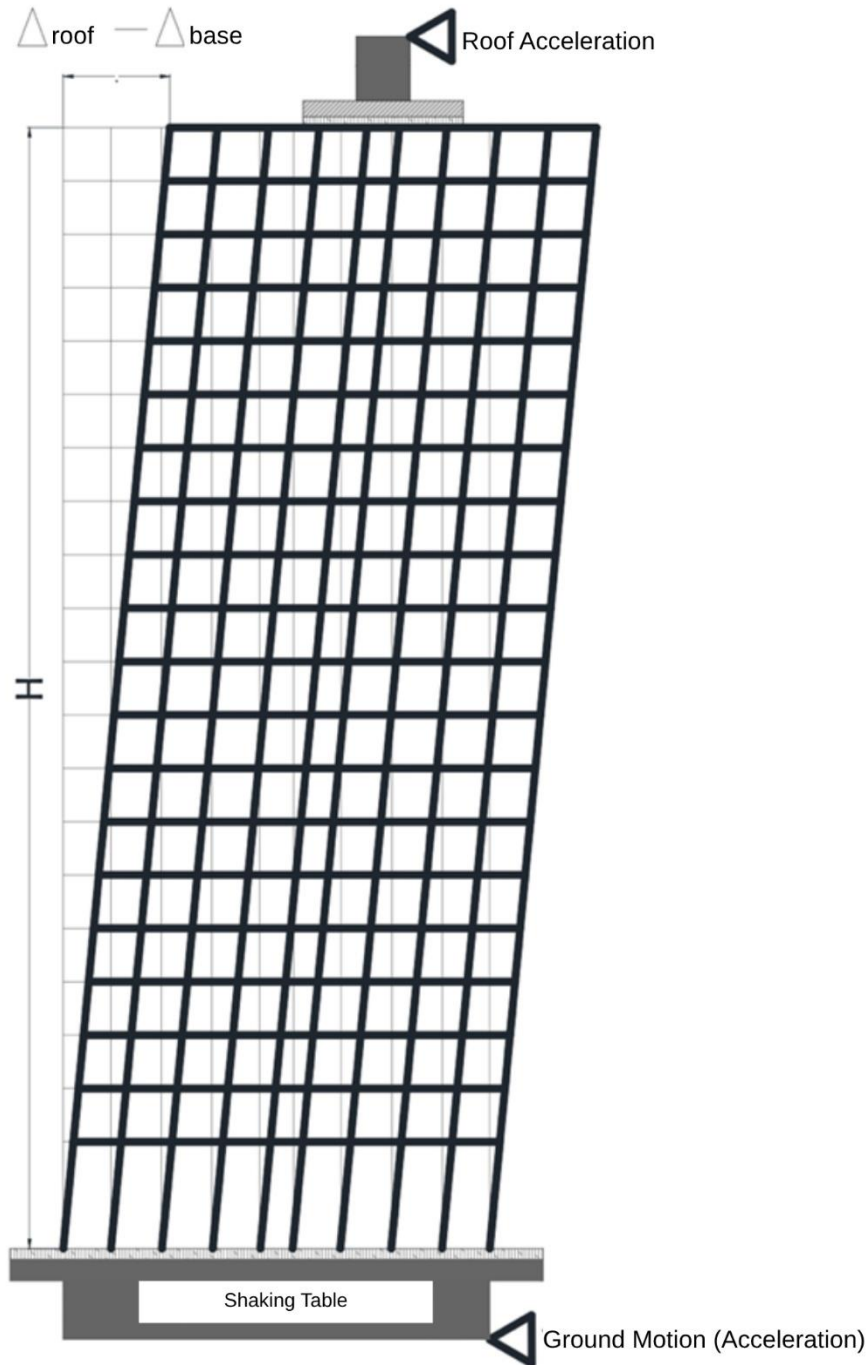


Figure A.8. Elevation view of the test setup

APPENDIX B. SHAKE TABLE

The earthquake tests will be conducted on a shake table with upper platform dimensions of 500 mm × 500 mm and a load capacity of **50 kg for ± 2 g acceleration**. The shake table to be used in the competition is shown in **Figure B.1**.

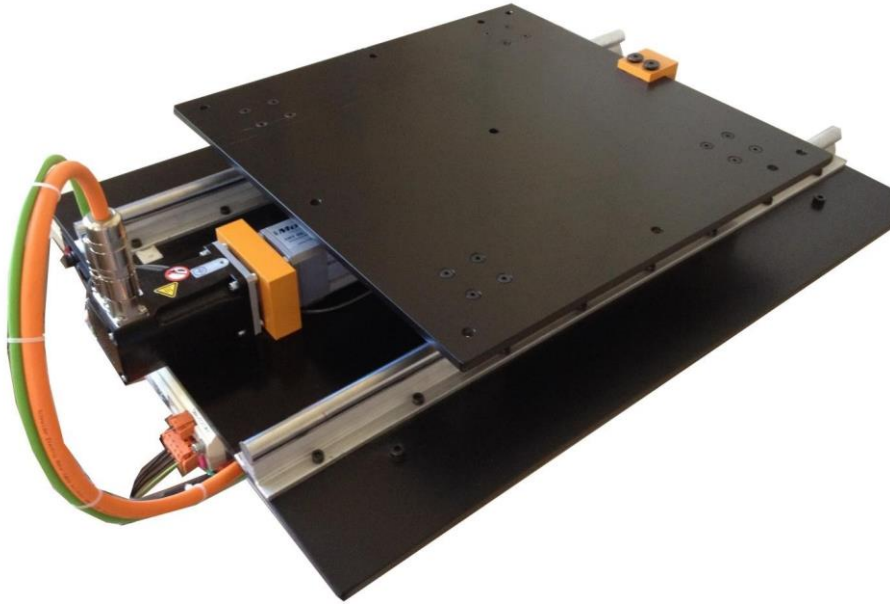


Figure B.1. View of the Shake Table

APPENDIX C. HORIZONTAL ELASTIC DESIGN SPECTRA

The Turkish Building Earthquake Code (2019) defines four different earthquake ground motion levels for the design of buildings under earthquake effects:

Earthquake Ground Motion Level-1 (DD-1)

The DD-1 Earthquake Ground Motion represents a very infrequent earthquake ground motion with a 2% probability of exceedance in 50 years, corresponding to a return period of 2475 years. This earthquake ground motion is also referred to as the **Maximum Considered Earthquake (MCE)**.

Earthquake Ground Motion Level-2 (DD-2)

The DD-2 Earthquake Ground Motion represents an infrequent earthquake ground motion with a 10% probability of exceedance in 50 years, corresponding to a return period of 475 years. This earthquake ground motion is also referred to as the **standard Design Basis Earthquake (DBE)**.

Earthquake Ground Motion Level-3 (DD-3)

The DD-3 Earthquake Ground Motion represents a **frequent earthquake** ground motion with a 50% probability of exceedance in 50 years, corresponding to a return period of 72.

Earthquake Ground Motion Level-4 (DD-4)

The DD-4 Earthquake Ground Motion represents a very frequent earthquake ground motion with a 68% probability of exceedance in 50 years (50% probability of exceedance in 30 years), corresponding to a return period of 43 years. This earthquake ground motion is also referred to as the **service-level earthquake**.

Within the scope of the competition, the 20 to 30-story office building to be designed is assumed to be located in the Istanbul Financial Center. For this location, the site-dependent design spectral acceleration coefficients and spectral corner periods calculated using the AFAD Turkish Earthquake Hazard Maps Interactive Web Application (<https://tdth.afad.gov.tr/TDTH/main.xhtml>) are presented in **Table C.1**.

Table C.1. Site-dependent horizontal elastic spectral acceleration coefficients and spectral corner periods for DD-1, DD-2, DD-3 and DD-4 earthquake levels

| Earthquake Level | S_{DS} | S_{D1} | T_A (s) | T_B (s) |
|------------------|----------|----------|-----------|-----------|
| DD-1 | 1,853 | 0,640 | 0,069 | 0,346 |
| DD-2 | 1,054 | 0,364 | 0,069 | 0,346 |
| DD-3 | 0,465 | 0,148 | 0,064 | 0,319 |
| DD-4 | 0,312 | 0,099 | 0,063 | 0,317 |

The horizontal elastic design spectra generated using the spectral acceleration coefficients provided in Table C.1 are presented in Figure C.1.

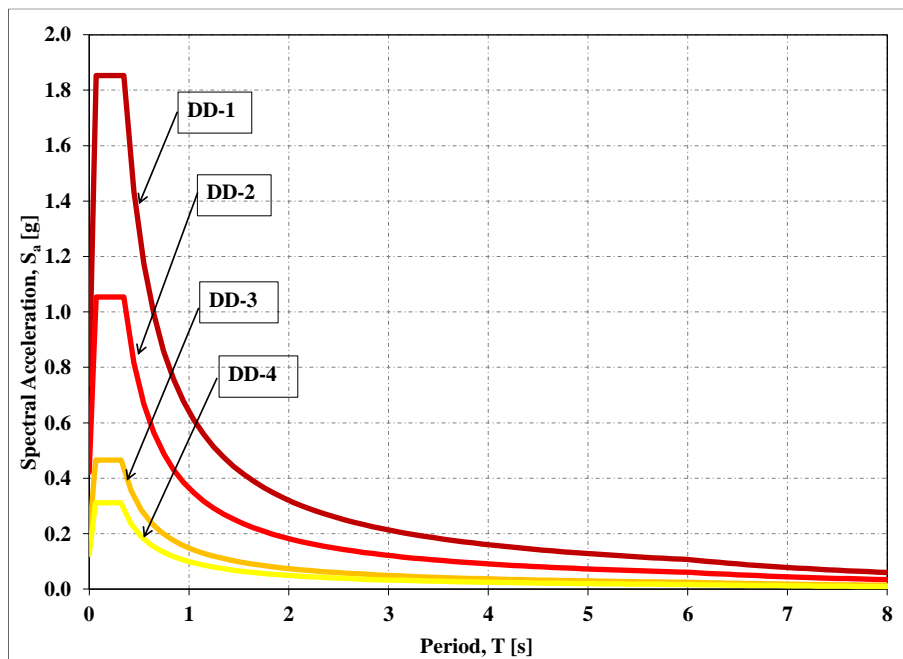


Figure C.1. Horizontal Elastic Design Spectra for DD-1, DD-2, DD-3 and DD-4 Earthquake Levels

APPENDIX D. SAMPLE APPLICATION

In this section, the performance calculation of a sample building model assumed to have 28 stories is presented using the seven-component scoring system, the details of which are provided in Section 2.

1. Annual Revenue

The usable floor areas of the 28-story building are as follows:

Ground Floor and 1st Floor: 2,560 cm²

Floors 2-13: 14,400 cm²

Floors 14-24: 13,200 cm²

Floors 25-27: 3,840 cm²

The total usable floor area is 34,000 cm².

Since the total rentable area cannot exceed 32,000 cm², the rental income will be calculated by summing the floor areas from the ground floor upward.

Ground Floor and 1st Floor: 2,560 cm² × 1000 TL/cm² = 2,560,000 TL/year

Floors 2-13: 14,400 cm² × 600 TL/cm² = 8,640,000 TL/year

Floors 14-24: 13,200 cm² × 700 TL/cm² = 9,240,000 TL/year

Floors 25-27: (32,000 – 2,560 – 14,400 – 13,200) cm² × 1000 TL/cm² = 1,840,000 TL/year

Accordingly, the total annual building revenue is **22,280,000 TL**.

2. Annual Revenue Increase

According to the jury's evaluation, the competing team ranked 4th in structural design, 3rd in architecture, 1st in presentation, and 2nd in poster evaluation. Accordingly, the annual revenue will be increased based on the corresponding award point percentages.

Structural Design Award Score: 3.5%

Architecture Award Score: 4.0%

Presentation Award Score: 5.0%

Poster Award Score: 4.5%

$$\text{Final Annual Revenue (NYG)}: (1 + 0.035 + 0.040 + 0.050 + 0.045) \times 22,280,000 \text{ TL} =$$

26,067,600 TL

3. Annual Building Cost

The base area of the building is 1,600 cm². Considering that the land cost is 30,000 TL/cm² and the economic life of the building is 100 years, the annual land cost is calculated as:

$$\text{Annual land cost} = (1,600 \text{ cm}^2 \times 30,000 \text{ TL/cm}^2) / 100 = 480,000 \text{ TL/year}$$

The net weight of the building is 1.2 kg. Accordingly, the annual construction cost is calculated as:

$$\text{Annual construction cost} = (1.2 \text{ kg} \times 200,000,000 \text{ TL/kg}) / 100 = 2,400,000 \text{ TL/year}$$

The total annual building cost is equal to the sum of the land cost and the construction cost:

$$\text{Annual Building Cost} = 480,000 \text{ TL} + 2,400,000 \text{ TL} = \mathbf{2,880,000 \text{ TL}}$$

4. Increase in Annual Building Cost

There are three floors in the building that exceed the permitted floor heights. The ground floor height is 96 mm, the 3rd floor height is 63 mm, and the 6th floor height is 65 mm. After neglecting the first 4 mm of deviation and rounding the remaining measurements to the next higher deviation level, a building dimension penalty score of N = 10% will be applied to the structure, corresponding to 5% for the ground floor and 5% for the 6th floor.

Since the plan dimensions comply with the requirements, no additional dimension penalty will be applied.

The net weight of the building is 1.2 kg, which exceeds the permitted building weight by 200 g. Accordingly, the building weight penalty is determined as: Building weight penalty = 10% × 200 / 50 = 40%

Considering all penalty scores, the increased annual building cost is calculated as follows:

$$\text{Final Annual Building Cost (NYBM)} = (1 + 0.10 + 0.40) \times 2,880,000 = \mathbf{4,320,000 \text{ TL}}$$

5. Annual Earthquake Cost

The building remained standing under the effects of SGM1 and SGM2, but collapsed under the effects of SGM3. The Maximum Roof Drift Ratios and Maximum Accelerations measured during the tests are presented in Table D.1.

Tablo D.1. Maximum roof drift ratios and maximum accelerations measured during the tests

| Strong Ground Motion | Maximum Roof Drift Ratio | Maximum Acceleration (g) |
|-----------------------------|---------------------------------|---------------------------------|
| SGM1 | 0,006 | 1,02 |
| SGM2 | 0,019 | 2,34 |
| SGM3 | - | - |

No connection damage was observed under SGM1, whereas two connections were found to have failed or loosened during the test under SGM2. Accordingly, the penalty factors (D) were determined as follows:

$$\text{Penalty factor (D1)} = 0 \times 5\% = 0\%$$

$$\text{Penalty factor (D2)} = (0 + 2) \times 5\% = 10\%$$

$$\text{Penalty factor (D3)} = 0\% \text{ (collapse condition)}$$

Using the values measured during the tests under SGM1 and SGM2 and the loss functions presented in Figure D.1, the economic losses due to structural damage and equipment damage are calculated as described in Section 6.7.b. Since collapse did not occur in these cases, the total economic loss is equal to the sum of the losses resulting from structural damage and equipment damage.

For SGM3, where collapse occurred, the economic loss is calculated as described in Section 6.7.a.

$$\text{Economic Loss} = \text{Equipment Cost} + 2 \times \text{Construction Cost} + 3 \times \text{Annual Revenue}$$

The Annual Earthquake Cost is equal to the sum of the economic losses calculated under the three strong ground motions (SGM1, SGM2 and SGM3). A summary of the calculations is presented in Table D.2. The Annual Earthquake Cost is calculated as 8,214,611 TL.

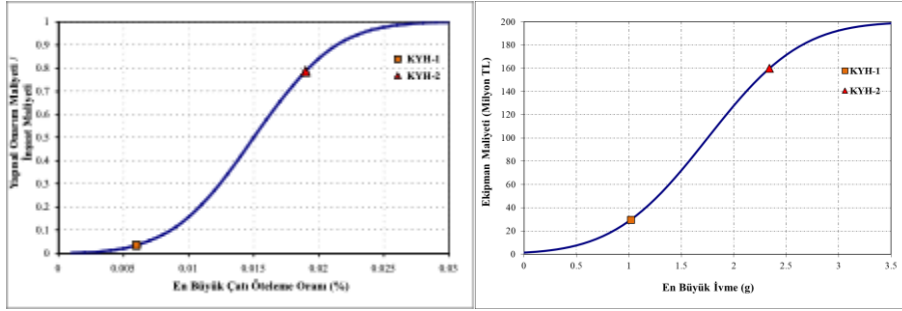


Figure D.1. Representation of economic loss values due to structural damage (left) and equipment damage (right) on the loss functions for SGM1 and SGM2

Table D.2. Annual earthquake cost calculations

| | SGM1 | SGM2 | SGM3 |
|--|-------------|-------------|------------------------|
| Earthquake Return Period (Year) | 72 | 475 | 2475 |
| Collapse Condition | No | No | Yes! |
| D | 0% | 10% | 0% (collapse occurred) |
| TP1 | 0,036 | 0,788 | |
| TP2 × Equipment Cost (TL) | 29.701.446 | 160.069.166 | |
| Structural Damage (TL) | 8.640.000 | 189.120.000 | |
| Equipment Damage (TL) | 29.701.446 | 160.069.166 | |
| Total Economic Loss (TL) | 38.341.446 | 384.108.083 | 746.840.000 |
| Annual Economic Loss (TL) | 2.662.600 | 4.043.243 | 1.508.768 |
| Annual Earthquake Cost (TL) | 8.214.611 | | |

6. Revision of Annual Earthquake Cost

On the other hand, the competing team provided the most accurate prediction of the test values measured under SGM1 and will therefore be awarded the Performance Prediction Score (PTP).

Performance Prediction Score (PPS) = 15%

Using the Performance Prediction Score (PPS), the revised annual earthquake cost is calculated as follows:

Final Annual Earthquake Cost (FAEC) = $(1 - 0.15) \times 8,214,611 = 6,982,419$ TL

7. Final Annual Profit

The Final Annual Profit (FAPYK) is calculated as: $FAP = 26,067,600 - 4,320,000 - 6,982,419 = 14,765,181$ TL

APPENDIX E. MODEL PREPARATION WITH SAMPLE PHOTOGRAPHS



Figure E.1. Materials to Be Used in Model Construction



Figure E.2. Floor weight components



Figure E.3. Saw for Cutting Balsa Wood

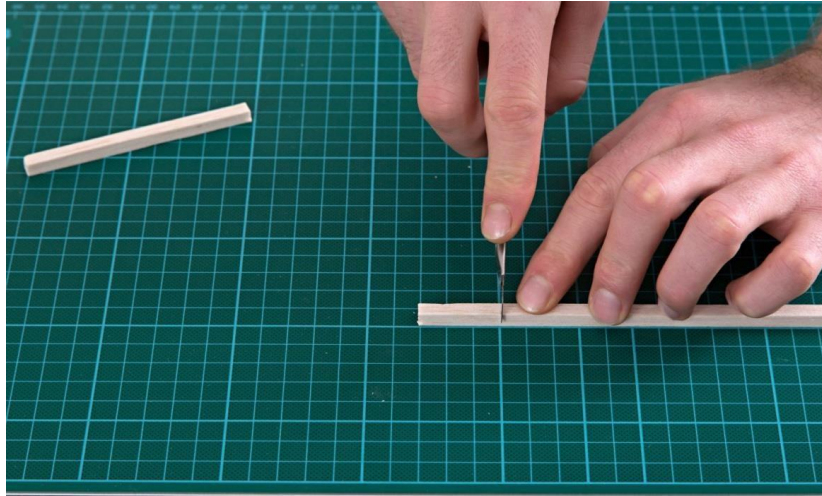


Figure E.4. Cutting Balsa Wood with a Utility Knife on the Cutting Mat



Figure E.5. Gluing of Balsa Sticks

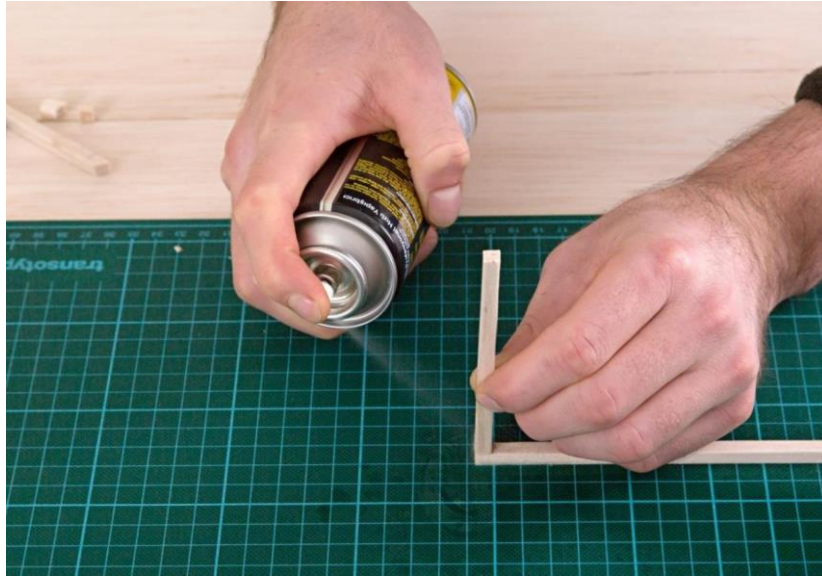


Figure E.6. Spray to Accelerate Bonding (Recommended for Each Gluing Step)

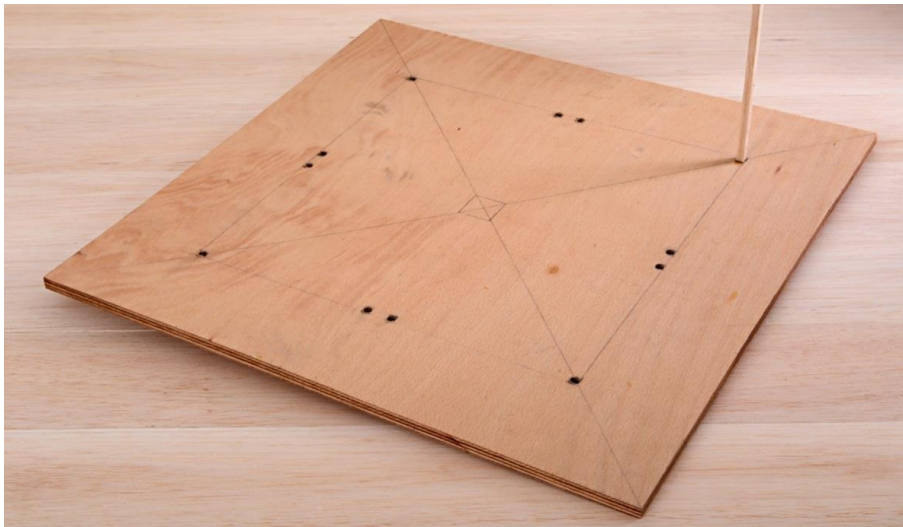


Figure E.7. Typical Base Plate with Column Grooves/Notches

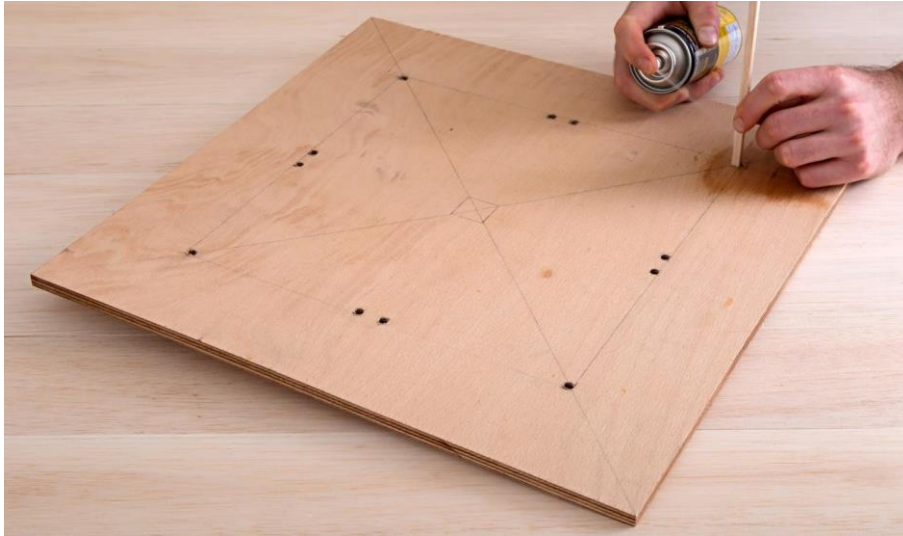


Figure E.8. Gluing the Column to the Base Plate

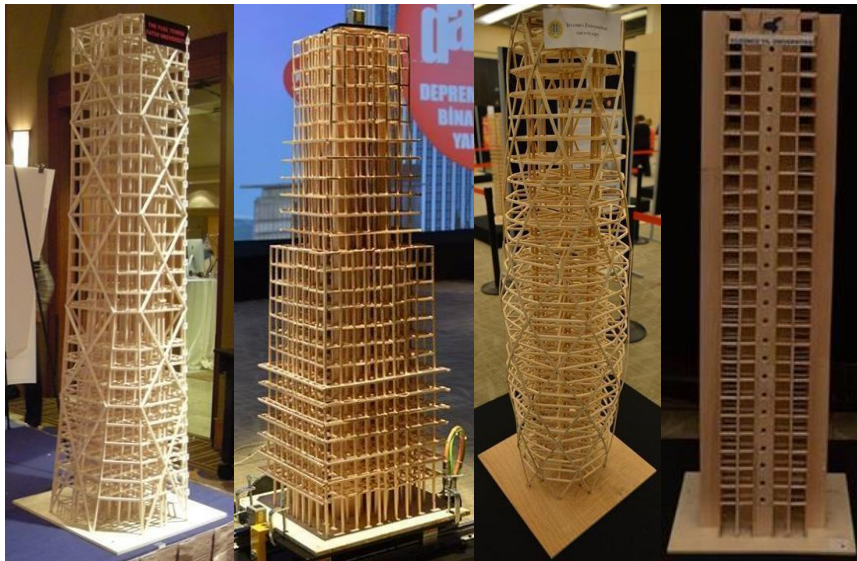


Figure E.9. Sample Models from Previous Years



Figure E.10. Floor Weight Connection Layout (18 cm vertical spacing)

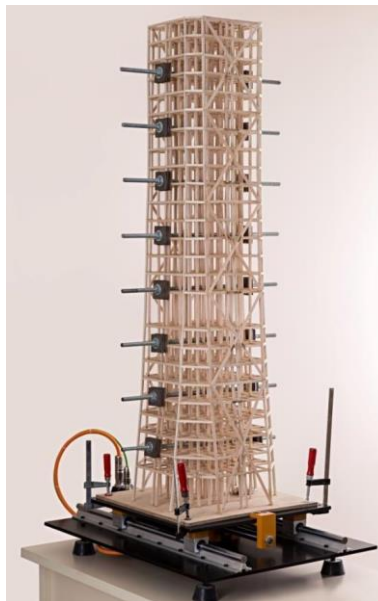


Figure E.11. Model Building with Floor Weights on the Shake Table



Figure E.12. Metal Plate Glued to Roof Wooden Plate by Teams

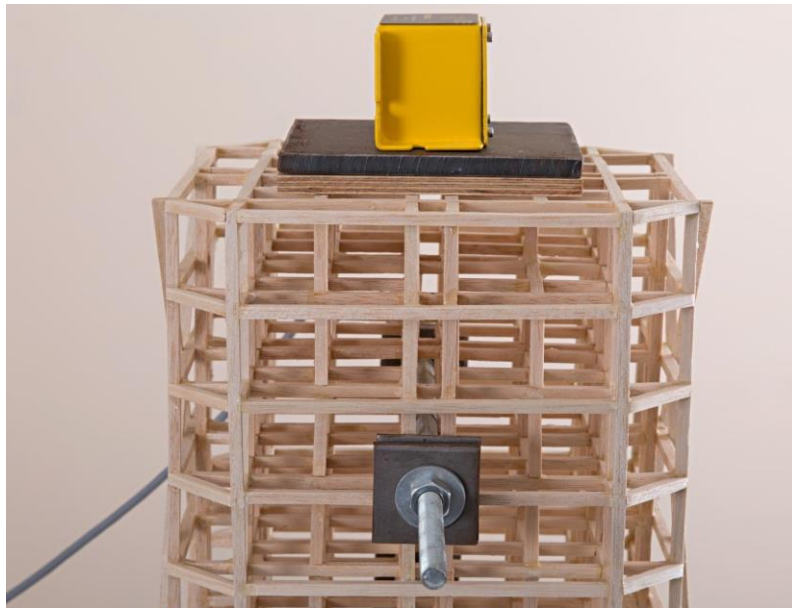


Figure E.13. Roof Weight Components (Wooden Plate, Metal Plate, and Accelerometer)



Figure E.14. The Floor Dead Load Rod Must Be Inserted through an Opening between 1.3 cm and 1.6 cm Wide. The Photograph illustrates an incorrect application with an excessively large gap

APPENDIX F. JURY EVALUATION SCORECARDS

F.1. Scorecard-1: Structural Design

University / Team Name:

Jury Member:

| | Score Range | | | | Score |
|---|---|--|---|--|--------|
| | 0-2 | 3-5 | 6-8 | 9-10 | |
| Structural Concept | <ul style="list-style-type: none"> Not a system suitable for earthquake-resistant structural design. The system used for lateral loads cannot function in harmony with the other structural elements. | May be a system suitable for earthquake-resistant structural design. <ul style="list-style-type: none"> The system used for lateral loads may function in harmony with the other structural elements. | <ul style="list-style-type: none"> A system suitable for earthquake-resistant structural design. The system used for lateral loads functions in harmony with the other structural elements. | A system suitable for earthquake-resistant structural design. <ul style="list-style-type: none"> The system used for lateral loads works perfectly in harmony with the other structural elements. | .../10 |
| Structural Irregularity (see TBEC 2019 Table 3.6) | <ul style="list-style-type: none"> Presence of B2 or B3 structural irregularities | <ul style="list-style-type: none"> No B2 or B3 irregularities but presence of B1 or A1 irregularities | <ul style="list-style-type: none"> No B1, B2, B3 or A1 irregularities but presence of A2 or A3 irregularities | <ul style="list-style-type: none"> No structural irregularities | .../10 |
| Analysis Method | <ul style="list-style-type: none"> Structural analysis method explanation is poor or absent. Highly unrealistic earthquake response predictions. | Structural analysis method explanation is good. <ul style="list-style-type: none"> Unrealistic earthquake response predictions. | Structural analysis method explanation is very good. <ul style="list-style-type: none"> Reasonable earthquake response predictions. | Structural analysis method explanation is excellent. <ul style="list-style-type: none"> Highly reasonable earthquake response predictions. | .../10 |
| Structural Creativity | <ul style="list-style-type: none"> Poor distribution of structural system elements in plan and elevation / Poor construction quality | <ul style="list-style-type: none"> Structural system elements are as symmetric and simple as possible in plan and elevation / Construction quality is adequate | <ul style="list-style-type: none"> Structural system elements are symmetric and simple in plan and elevation and do not hinder architectural functions / Member connection details are properly executed | <ul style="list-style-type: none"> Structural system elements are symmetric and simple in plan and elevation and do not hinder architectural functions / Member connection details are very well executed | .../10 |
| Total | | | | | .../40 |

F.2. Scorecard-2: Architecture

University / Team Name:

Jury Member:

| | Score Range | | | | Score |
|-------------------------------|---------------------------|------------------------------|--------------------------------|--------------------------------|--------|
| | 0-1 | 2-4 | 5-7 | 8-10 | |
| Building Aesthetic Appearance | Poor aesthetic appearance | Good aesthetic appearance | Very good aesthetic appearance | Excellent aesthetic appearance | .../10 |
| 3D View on the Poster | Technically poor | Technically good | Technically very good | Technically excellent | .../10 |
| Functionality of the Design | Not functional at all | Can be considered functional | Highly functional | Excellent functionality | .../10 |
| Model Craftsmanship | Very poor | Poor | Moderate-good | Good-very good | .../10 |
| Design Feasibility | Not realistic at all | Can be considered realistic | Quite realistic | Definitely realistic | .../10 |
| | | | | Total | .../50 |

F.3. Scorecard-3: Presentation

University / Team Name:

Jury Member:

| | Score Range | | | | |
|--------------------------|---|--|---|---|--------------|
| | 0-1 | 2-4 | 5-7 | 8-10 | Score |
| Clarity and Organization | <ul style="list-style-type: none"> - Illogical organization - Poor slide usage - Unclear design concept | <ul style="list-style-type: none"> - Weak organization - Good slide usage - Mostly unclear design concept | <ul style="list-style-type: none"> - Good organization - Very good slide usage - Understandable design concept | <ul style="list-style-type: none"> - Excellent organization - Excellent slide usage - Clearly understandable design concept | .../10 |
| Communication Skills | <ul style="list-style-type: none"> - Poor verbal communication - No rehearsal - Unable to answer questions | <ul style="list-style-type: none"> - Good verbal communication - Very little rehearsal - Attempts to answer questions | <ul style="list-style-type: none"> - Very good verbal communication - Some rehearsal - Understands and answers questions | <ul style="list-style-type: none"> - Excellent verbal communication - Well rehearsed - Clearly understands and answers questions | .../10 |
| | | | | Total | .../20 |

F.4. Scorecard-4: Poster

University / Team Name:

Jury Member:

| | Score Range | | | | |
|--------------------|--|---|--|---|--------|
| | 0-1 | 2-4 | 5-7 | 8-10 | Score |
| Technical Adequacy | Structural design concept is not clear | Structural design concept has been attempted to be explained | Structural design concept is explained | Structural design concept is clearly explained | .../10 |
| Organization | The reader cannot follow the design explanation. Poor use of space. | The reader has difficulty following the design explanation. Good use of space. | The reader can follow the design explanation. Very good use of space. | The reader can easily follow the design explanation. Excellent use of space. | .../10 |
| Readability | Poor use of font size | Good use of font size | Very good use of font size | Excellent use of font size | .../10 |
| Visual Quality | Poor layout Poor 3D visualization. Poor colors and modeling. | Good layout. Good 3D visualization Good colors and modeling | Very good layout Very good 3D visualization Very good colors and modeling. | Excellent layout Excellent 3D visualization Excellent colors and modeling | .../10 |
| | | | | Total | .../40 |