



**nzsee**  
NEW ZEALAND SOCIETY FOR  
EARTHQUAKE ENGINEERING

# He Tohu Pūpū

Seismic Design Competition

RULES AND REGULATIONS

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# Behind the name

*He Tohu* means *The Award*

*Pūpū* is the common name for the endangered land snail that dates from the Pliocene era when New Zealand was part of Gondwanaland. The large flax snails (*Placostylus hongii*) survive today in the Hokianga, as well as on the Mokohinau and Poor Knights Islands. Legend tells of the extraordinary sounds produced by the recoiling snail, frightening away enemy warriors and alerting the resident people of approaching danger.

The sculptor Virginia King won the People's Choice Award for her artwork depicting this snail, which was later purchased by Ernst & Young in memory of their employee Lisa Patricia Willems who died during the 2011 Christchurch Earthquake.

Basileostylus bollonsi (Suter, 1908), collected 6 October 1948,  
SW seaward slope, Great Island, New Zealand.

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## 1 Introduction

The New Zealand Society for Earthquake Engineering presents He Tohu Pūpū, the annual Seismic Design Competition for emerging engineers (undergraduates, postgraduates, and early-career practitioners) to be held at the NZSEE 2026 annual technical conference.

The objectives of the competition are:

- To promote the study of earthquake engineering within the NZSEE community.
- To build relationships between NZSEE emerging engineers.
- To promote NZSEE activities and seismic design principles among emerging engineers.

## 2 Problem Statement

The year is 2050, and Wellington has old landmarks: the Bucket Fountain, the Blown Away sign, the Wind Whirler, and the Majestic Centre, but the Mayor wants something new to stamp their name on! Their vision is for an iconic tower, where as many people as possible can use a series of viewing platforms to look out and enjoy the views from high above the city. However, the tower must also be designed to withstand the high seismicity of the Wellington region.

The Mayor has commissioned you to design and build a model of the tower, considering both the architectural form and the load-resisting structural system for the ultimate seismic performance. Detailed constraints are provided in the following sections of these regulations. **Please read the regulations carefully and in their entirety.**

Teams must design and build a small-scale earthquake-resistant building that will be tested on a shake table during the 2026 NZSEE Conference. The model must resist a 30-second motion of increasing shaking intensities, based on the testing standard AC156. Mass blocks will be bolted to the model during testing to simulate typical service loads.

As the shake table is unidirectional, the models will only be tested for loading in one orientation. However, please note that the orientation of each team's model on the shake table will be at the discretion of the SDC Organising Committee members. Models will typically be placed in their least favourable orthogonal orientation, where asymmetric.

## 3 Awards

There is a cash prize to be shared amongst the winning team, plus one year of complementary membership to NZSEE for each team member. All teams will receive a certificate of participation.

## 4 Teams

Each team is required to have four participants and should consist of undergraduates, postgraduates, and/or early-career practitioners (under 30 years old). Due to limits of time and equipment, a maximum of six teams will be allowed to participate in the competition. Full conference registration (rather than single day) is required.

## 5 Presentation

Teams will have the opportunity during the conference to present their model for 3-5 minutes prior to the shake-table testing. This is your chance to briefly summarise your design process and showcase the innovative aspects of your model to the judging panel. There is no expectation for teams to produce accompanying presentation slides.

## 6 Pre-Conference Workshops and Support

Workshops and meetings will be held online in the lead up to the conference to support participants. Participants will be able to ask questions to the organising committee, solicit advice, and get to know each other. These will be held in March and April 2026 – dates will be communicated to teams once registered.

## 7 Scoring

Each team's overall score will be based on two scoring categories: architectural design and innovation, and the seismic performance of the model on the shake table. The seismic performance category is worth **double points** towards the overall team score.

$$\text{Total Points} = \text{Architectural Design and Innovation} + 2 \times \text{Seismic Performance}$$

For both categories, teams will receive a score based on their ranking against the other teams, e.g. if there are six teams, the best team in architectural design and innovation will receive six points for that category, and the same for seismic performance. The architectural design and innovation score will be publicised prior to shake table testing, so the winner of the competition will be known as soon as the testing is concluded. In the unlikely event of a tie, the judging panel will decide the winning team.

### 7.1 Architectural Design and Innovation

A panel of three judges will score the architectural and design philosophy of the models. Scores are awarded on the basis of architectural features, alignment to the design brief, and ingenuity in the structural system. The judges will also consider how well teams communicate their design features (and seismic design thinking) in their presentation. **Innovative seismic load-resisting systems will score highly.**

### 7.2 Seismic Performance on the Shake Table

The team rankings for the seismic performance scores will be determined based on the maximum PGA resisted on the shake table during testing, multiplied by two bonus factors:

$$\text{Seismic Performance} = \text{Maximum PGA} \times \text{View Height Bonus} \times \text{Structural Efficiency Bonus}$$

The Maximum PGA resisted is the maximum level of recorded shake table acceleration that each team's model can withstand without failure during testing.

This will then be multiplied by a **View Height Bonus** factor, which accounts for your model meeting the Mayor's brief and designing a tower that provides people with the best possible view.

Each model entered in the competition must have adequate viewing platforms for **at least four mass blocks, and up to eight**, to be bolted during testing to simulate occupancy loading. The minimum dimensions for each viewing platform and the minimum/maximum permissible heights for the viewing platforms' locations are outlined in Section 9. Each model's **View Height Bonus** factor will be calculated based on the combined height of the viewing platforms (measured to the top of each flat floor level), divided by 1000.

For example, consider the following three models:

| Mass Block                      | Viewing Platform Heights (mm) |            |            |
|---------------------------------|-------------------------------|------------|------------|
|                                 | Model A                       | Model B    | Model C    |
| 1                               | 700                           | 450        | 550        |
| 2                               | 600                           | 350        | 450        |
| 3                               | 500                           | 250        | 350        |
| 4                               | 400                           | 150        | 250        |
| 5                               | 300                           |            | 150        |
| 6                               |                               |            | 150        |
| 7                               |                               |            | 150        |
| 8                               |                               |            | 150        |
| <b>View Height Bonus Factor</b> | <b>2.5</b>                    | <b>1.2</b> | <b>2.2</b> |

The PGA will then be multiplied by the **Structural Efficiency Bonus** factor, which accounts for your team producing a lean, efficient structural design. Each model's Structural Efficiency Bonus factor is calculated as:

$$\text{Structural Efficiency Bonus} = \frac{[\text{Total weight of mass blocks added}]}{[\text{Initial structural model weight}]}$$

For example, again considering the following three models:

|   | Model A     | Model B     | Model C     |
|---|-------------|-------------|-------------|
| Model weight (g)                          | 1240        | 1460        | 2350        |
| No. mass blocks added                     | 5           | 4           | 8           |
| Total weight of mass blocks (g)           | 3175        | 2540        | 5080        |
| <b>Structural Efficiency Bonus Factor</b> | <b>2.56</b> | <b>1.74</b> | <b>2.16</b> |

The combined PGA scaling factor for each example model is then shown below.

|                                    | Model A     | Model B     | Model C     |
|------------------------------------|-------------|-------------|-------------|
| View Height Bonus Factor           | 2.5         | 1.2         | 2.2         |
| Structural Efficiency Bonus Factor | 2.56        | 1.74        | 2.16        |
| <b>Total PGA multiplier</b>        | <b>6.40</b> | <b>2.09</b> | <b>4.76</b> |

In this example, if all models resisted the same level of earthquake shaking and failed at 0.6g, Model A would be ranked highest, followed by Model C and then Model B.

If instead Model A resisted up to 0.5g on the shake table, Model B 1.2g, and Model C 0.8g, the scaled PGA scores would be 3.2, 2.5, and 3.8, respectively. Therefore, Model C would be ranked highest for seismic performance, followed by Model A and then Model B.

## 8 Materials and tools

All materials and tools must be sourced by the teams themselves. Teams are welcome to use any tools available to them. The materials of the superstructure are limited to those listed below:

- Wooden dowel (up to 10mm diameter)
- MDF - only for horizontal elements
- Balsa wood
- Popsicle/Stirring sticks (or equivalent crafting wooden sticks)
- Hot glue
- String
- Rubber bands

Non-structural and architectural elements may be made of materials outside of those listed above, however the judging panel must be satisfied that any alternative materials used are not unfairly enhancing the seismic performance of the model.

## 9 Model features

All teams are encouraged to exert their creativity in constructing the model. The building model should also meet the requirements below:

### 9.1 Basic structure

- All models should be composed of typical structural components (beams, columns, walls, braces, etc.).
- The Mayor would like the base of the tower to be open-plan, to create a community-oriented space and accommodate potential future art exhibitions. For this reason, no structural walls are permitted in the lowest 150mm height of the tower. Thus, the lowest viewing platform must be at a height of at least 150mm.
- Adding claddings/decorations to the models for the purpose of aesthetic appearance is allowed and encouraged.

## 9.2 Floor area

- Each viewing platform area must be a minimum of 10,000 mm<sup>2</sup>. Each platform must have adequate space for at least one mass block to be bolted on – refer to Section 10 for specific dimensions.
- Note you are welcome to combine viewing platforms and bolt multiple mass blocks at the same height. However, the viewing platform minimum area will multiply to suit (i.e. 20,000mm<sup>2</sup> minimum for a two-block viewing platform).

## 9.3 Number of columns fixed on the base board

- There is no restriction on the number of columns fixed on the baseboard.
- Enhancing the fixity of columns to the baseplate beyond simple glue is encouraged.
- The baseboard must be kept flat.

## 9.4 Model base

- Models must be constructed on a solid timber base board (260 mm × 260 mm × 5.5 mm MDF). A 30 mm clearance around the edges of the base board must be kept in order to fix the model onto the shaking table – please do not add any non-structural decorations outside the “site area” zone shown in Figure 2 below. **Teams violating this rule will have points deducted and/or be disqualified.**
- The allowable site area is the 200 mm × 200 mm square shown as the dotted lines in Figure 2. The base connections of the tower itself must be within a 150 mm × 150 mm zone, anywhere within the allowable site area. The projection of the entire model onto the base board must be within the 200 mm × 200 mm site area.
- Teams need to drill **8 mm diameter** through-holes in the model base (to accommodate M6 bolts, with tolerance), such that the model can be fixed to the model mounting board on the day of the competition. Bolt holes are to be 220 mm centres apart. Refer to Figure 1 for clarity.

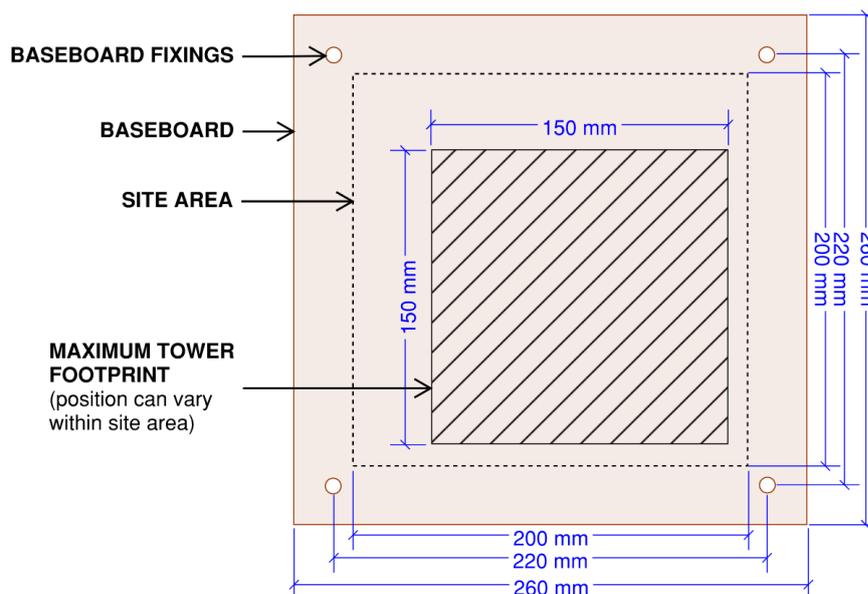


Figure 1: Dimensions of tower footprint and base board

## 9.5 Building and floor heights

- The height of the model, measured from the top of the base board to the top of the uppermost viewing platform level, must be not less than 450 mm and no more than 700 mm.

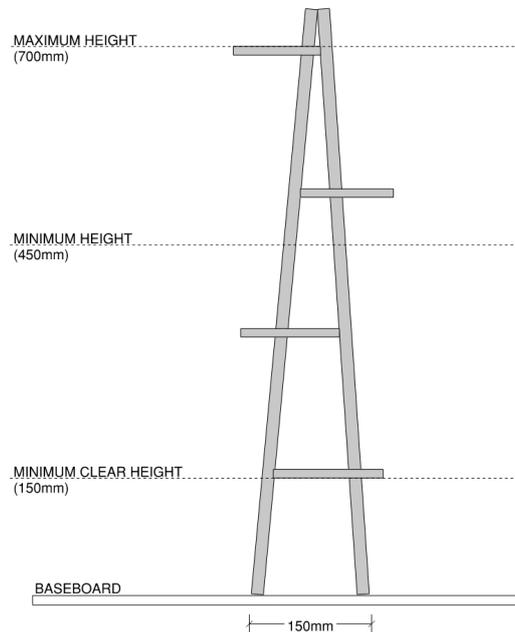


Figure 2: Tower platform level and height requirements

- The clear height to the underside of the first viewing platform level must be at least 150 mm.
- For other platform levels, it is recommended that the clear height be kept to at least 100 mm to facilitate the installation of the mass blocks.
- The thickness of all viewing platform levels should be at least 5 mm, to ensure safe and stable anchoring of the mass blocks at each platform.

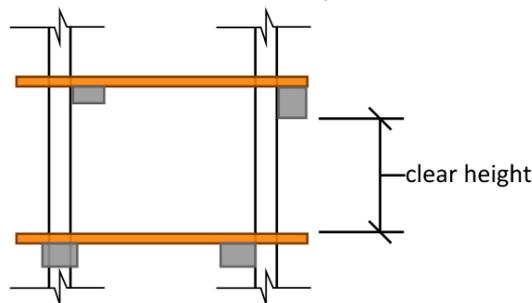


Figure 3: Definition of clear height

## 10 Requirements for Mass Blocks

In this competition, additional mass blocks will be added to represent the typical vertical loading exerted on the viewing platforms. The weight of each mass block is about 635 g. The dimension of each mass block is 50 mm x 40 mm x 40 mm thick, made of mild steel, with a through-hole drilled vertically in the centre of the 50 mm x 40 mm face. It will be anchored to the floors using a bolt (M8), a nut, and two larger-diameter washers.

Each viewing platform will have one mass block bolted to it during testing. Teams must drill at least one (**8 mm diameter**) through-hole anywhere on each of their model viewing platforms

through which to attach the mass blocks and **must ensure that the mass blocks can be physically installed**. Mass blocks will be added by the teams prior to model shaking. Mass blocks, bolts, nuts, and washers will be supplied by the organising team prior to the shake table test.

**Teams must inform the organising committee of the thickness of their model floors before the conference**, so that the correct length M8 bolts for securing the mass blocks can be sourced.

## 11 Mounting models onto the shaking table

All teams must present their finished model for display and judging by lunchtime of the first day of the conference. The models will then be measured, judged, and inspected for infringements of the design criteria.

The presentations will be held during the breakfast session on the second day of the conference. After the presentations, the judging panel will finalise the architectural and design scores awarded to each team. Prior to the testing portion of the competition, which will be held during lunchtime on the second day of the conference, the teams will install their model on the shake table and attach the mass blocks.

**Please recall that the shake table is unidirectional, hence the models will only be tested via loading in one direction. However, the orientation of each team's model on the shake table will be at the discretion of the SDC Organising Committee members. Models will typically be placed in their least favourable orthogonal orientation, where asymmetric.**

Due to the shake table dimensions, a mounting board (see Section 9.5) will be anchored to the shake table, allowing anchoring of more than one model. Teams fix their models to the mounting boards prior to the competition. Mounting boards with anchored models will be anchored to the shake table by the teams. Please, see details below:

- The organisers will provide each team with the required items to fix models to the mounting boards and confirm the orientation at which they are required to install their model.
- During the period of mounting the models onto the shaking table and fixing the mass blocks, it is not permitted to strengthen the structure of the model.
- Mass blocks must be installed on the viewing platform plate and not over the boundary of the diaphragm. Mass blocks must not be in contact with columns, braces or cladding. Otherwise, teams may choose where masses are located on the viewing platform plate.
- Mass blocks are not installed on the load platform until after the model has been connected to the shake table.
- After all teams completed the task of mounting their models onto the shaking table and fixing the mass blocks, staff will check whether the base board screws on the four corners of each model are secure. Nevertheless, each team is still completely responsible for fixing the model onto the shaking table. The team shall raise no objection if the base board fixings loosen during the test, which shall count as failure of the structure.
- After the model is confirmed by the judges, any changes to the number and the arrangement of the mass blocks are not allowed.

## 12 Testing procedure

### 12.1 Loading protocol

The models will be anchored to the shake table via the MDF model mounting board and subjected to a motion scaled to incrementally increasing intensities until structural failure occurs. The intensity measure for the sake of the competition will be PGA.

The shake table will be run using 'open-loop' control, meaning the actual response of the shake table and mounting board may vary by some amount from the input motions (i.e., there will be some uncertainty in the actual applied accelerations and displacements). This includes the potential for the model mounting board to move in the vertical direction (due to mounting board stiffness).

The organising committee members may vary the magnitudes of the applied motions as they see fit on the day, depending on how the various structures are performing, competition time constraints, etc.

## 13 Structural failure criteria

A model will be judged as having failed when any of the following conditions occur.

- Any floor or viewing platform is unstable or collapsed.
- The number of columns detached from the base board is larger than or equal to one half of the total number of columns.
- The residual displacement of the inclined model, which is the horizontal distance measured from the original to final position at the uppermost viewing platform level, is greater than or equal to 100 mm.
- The base board fixings have significantly loosened during the test.
- Failure of non-structural elements which the judging panel deems would, in a real-scale building, constitute a life-safety hazard.
- The judging panel is otherwise in consensus that a model has failed in the test.

The failed model(s) will be removed from the shaking table before the next test.



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