KNOX
GRAMMAR
SCHOOL

STATE

DA VINCI DECATHLON 2022

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 9, 10 & 11

ENGINEERING

TEAM NUMBER _____

Total	Rank
/56	

PATTERNS OF DISASTER

BACKGROUND

Natural disasters occur in patterns around the world. Historically, these patterns have been predictable and manageable through the analysis of historical data, climate patterns, geographical characteristics and a variety of other factors. However, the advent of climate change has seen patterns of natural disasters across the world change significantly, as they become more frequent, more unpredictable and more destructive.

One key form of natural disaster whose pattern of destruction has seen significant change in recent years are tsunamis. Tsunamis are a series of giant waves in a body of water caused by the displacement of a large volume of water. Tsunamis are generated by underwater earthquakes and volcanic eruptions.

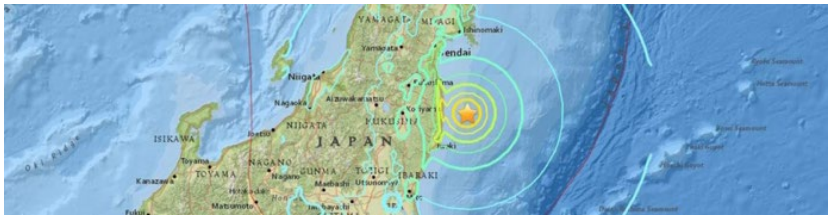
In particular, Japan's geographical location near the boundary of two tectonic plates makes it highly susceptible to tsunamis. Infamously, the Tōhoku Tsunami hit Japan on the 11th of March 2011 and resulted in the death of 20,000 individuals and the Fukushima Daiichi nuclear disaster. This tsunami was caused by the largest fault slip ever recorded.

An engineer's job is to develop structures that withstand natural disasters and preserve human life. Engineers use models to assess the validity of designs by simulating and predicting the results of larger scale projects. By using models, the risk to human life is diminished, allowing engineers to improve their designs by modifying and retesting.

THE TASK

You have been commissioned to develop a tsunami-resistant house that will be constructed in Miyako – the hardest hit city in the Tōhoku Tsunami. Your task is to develop a model of your tsunami-resistant house out of the materials provided.

Before constructing your model, design your tsunami-resistant house by completing section 1 of the question booklet. Once your model is complete, reflect on your creation by completing section 2 of the question booklet.



DESIGN PARAMETERS

You will have **sixty minutes** to design, construct and reflect upon your tsunami-resistant house model. Your creation will be marked based on its:

- Tsunami-resistance capacity,
- Creativity and originality,
- Cultural appropriateness,
- Design aesthetics,
- Structural build quality,
- Use of materials.

You will be provided with various materials. It is up to you to decide what materials to use to construct your tsunami-resistant house model. The materials available are as follows:

- 4 pieces of A4 paper,
- 2 pieces of A4 cardboard,
- 10 popsicle sticks,
- 10 plastic straws,
- 1 sheet of cellophane,
- Your own sticky tape (use sparingly).

Glue and staples are prohibited and will result in disqualification from the task.

VIRTUAL COMPETITION

If you are competing virtually, please upload images and/or a video of your tsunami-resistant house model. Remember that this is all that your marker will see, so ensure your images and video do justice to, and capture all aspects and functionality of your creation.

SECTION 1

PRELIMINARY DESIGN

A) PRELIMINARY DESIGN SKETCH (4 MARKS)

Draw a brief sketch of your tsunami-resistant house. Draw with approximate proportions and label key features that contribute to its tsunami resistance capacity.

B) DESIGN ANALYSIS (4 MARKS)

Explain and justify the mechanisms you have implemented to withstand a tsunami. You may refer to your preliminary design sketch in your answer.

SECTION 2

DESIGN REFLECTION

A) CRITICAL ANALYSIS (4 MARKS)

Engineers must critically analyse their work in order to improve their future designs. Identify the key flaws in your model and propose solutions to these challenges.

B) REAL-WORLD APPLICATION (4 MARKS)

Is your model valid for its real world application? Justify your answer and comment on the components of your design that must be modified to make it suitable for the real world.

END OF PAPER

MARKING CRITERIA

QUESTION BOOKLET

Question	Skilful	Sound	Limited
Section 1 A	4	3-2	1
Section 1 B	4	3-2	1
Section 2 A	4	3-2	1
Section 2 B	4	3-2	1
Total	/16		

MODEL

Criteria	Skillful	Effective	Sound	Basic	Limited
Tsunami-resistance capacity	10-9	8-7	6-5	4-3	2-1
Creativity and originality	10-9	8-7	6-5	4-3	2-1
Cultural appropriateness	5	4	3	2	1
Design aesthetics	5	4	3	2	1
Structural build quality	5	4	3	2	1
Use of materials	5	4	3	2	1
Total	/40				

Note to marker: If the task is completed in person and resources are available, the “Tsunami-resistance capacity” section of the criteria can be tested by simulating a tsunami. Tip over a bucket filled with approximately 1L of water approximately 0.5m in front of the model and assess resistance.

TOTAL

/56