FLoQuake

(Flood and Earthquake Safe House)

Nur'Ain Nadhirah Binti Mohd Zabidi, Umaira Safiah Binti Mohd Salahuddin ,
Muhammad Nur Akhyar Bin Mohd Zabidi

SBP Integrasi Kubang Pasu

g-94070233@moe-dl.edu.my

ABSTRACT

Natural disasters such as floods and earthquakes pose major threats to communities in Malaysia, particularly those living in high-risk areas. Their effects are often felt due to the country's geographical location and the impacts of global climate change. In response to the urgent need for safe housing, the FloQuake Safe House project was developed as an innovative and disaster-resilient housing solution.

The project aims to reduce loss of life and property damage through the use of advanced safety technologies and intelligent structural design. FloQuake utilises weather-resistant materials and traditional joinery techniques that do not require nails or screws, making it more flexible and environmentally friendly. Its modular design allows the house to be relocated, reused, or modified according to need, without wasting resources.

Key features include a flexible suspension system to absorb seismic vibrations, a floating platform with anchoring mechanisms to withstand floods and using anti-slip rubber for furniture in the house to reduce the movement of the furniture. Interconnected solar panels are installed on an adjustable fence system that adapts to changing weather conditions. A room or space that can be used as an emergency shelter and also functions as a water storage area during the rainy season for use during droughts.

Simulation tests have shown that FloQuake is more stable and durable than conventional homes. The flexible suspension system has been proven to reduce structural vibrations, while the floating and anchoring design helps stabilise the house during floods. Proposed improvements include the use of recycled materials, real-world field testing, community feedback, and the integration of green technologies such as smart control systems and water filtration. FloQuake offers a safe, sustainable, and adaptive housing solution for the future.

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1.0 INTRODUCTION

1.1 Background

Malaysia are often exposed to impact of various natural disasters such as floods and earthquakes that happen in neighbouring countries . These events not only cause loss of life and injuries, but also cause extensive damage to property and disrupt the daily lives of residents. Shown that communities living in high-risk areas often have difficulty fully recovering from disasters due to the lack of safe and durable shelters.

Most conventional house structures available today are not designed to withstand the direct impact of large-scale natural disasters. In flood situations, for example, The house foundation and base cracked, the walls were damaged and collapsed, the floors broke apart, and the entire house was swept away by the flood waters. In earthquake-prone areas, inflexible building structures can collapse and cause death and serious injury. The lack of integrated safety systems in homes also increases the risk during emergencies.

Recognizing this challenge, an innovative approach was introduced through the FloQuake Safe House project a disaster-resistant house specially designed to adapt to extreme conditions such as floods and earthquakes. Moreover, this house built using durable materials and a flexible structure.

The project not only offers comfortable housing, but also serves as proactive protection for high-risk communities. Through smart design and a focus on safety, the FloQuake Safe House is seen as a high-impact solution that can save lives, minimize damage, and increase community resilience to natural disasters.

1.2 Comparison of Previous Studies

Studies on natural disasters such as earthquakes and floods in Malaysia and neighbouring countries have shown significant impacts on public safety and infrastructure.

Although Malaysia is not located on a major fault line, seismic activities in Indonesia and the Philippines often cause tremors felt in Malaysia, affecting buildings and communities (Malaysian Meteorological Department, 2015).

For instance, the 2015 Ranau earthquake in Sabah, measuring 6.0 on the Richter scale, resulted in fatalities and damage to critical infrastructure such as schools and hospitals.

Research by Ahmad (2016) also highlights that many buildings in Malaysia lack adequate earthquake-resistant designs, increasing the risk of collapse during seismic events. Flooding remains the most frequent natural disaster in Malaysia.

Major floods in Kelantan and Pahang in 2014 affected over 200,000 people and caused extensive damage to homes and public facilities (Ahmad Zaki, 2018).

Studies by the Department of Irrigation and Drainage Malaysia (2015) found that many houses in flood-prone areas lack proper flood-resistant designs, leading to high property losses. Additionally, flash floods in Kuala Lumpur and Selangor highlight the need for housing designs that are more adaptive and resistant to sudden rises in water levels.

2.0 PROBLEM STATEMENTS

2.1 Problem Descriptions

Several major problems have been identified related to natural disasters such as earthquakes and floods which pose serious risks to the safety of residents and properties in Malaysia, especially in high-risk areas. Among the key issues are:

1.Safety and Loss of Life

Earthquakes can cause building collapses and significant loss of life. For example, the 2015 Ranau earthquake resulted in fatalities due to buildings not being designed to withstand seismic activity. Similarly, the 2004 tsunami affected coastal areas of Malaysia that were ill-prepared for such disasters.

2.Damage to Property and Infrastructure

Floods often cause extensive damage to homes, public facilities, and critical infrastructure such as roads and hospitals. Many traditional houses and existing buildings lack technology or designs that can mitigate the effects of floods or earthquakes, resulting in high property losses.

3.Preparedness and Recovery Costs

The absence of houses specifically designed to withstand natural disasters leads to increased recovery and relocation costs. Rebuilding takes significant time and expense. Additionally, the lack of effective early warning systems increases the risk of injuries and fatalities.

2.2 Scope of the Problems

Based on the problem statements, the scope of issues addressed by FloQuake Safe House is limited to housing and infrastructure located in the following high-risk areas:

1.Residential areas prone to earthquakes in regions affected by seismic tremors, especially in East Malaysia and near fault lines.

2.Communities vulnerable to flooding, including low-lying areas such as parts of Kelantan, Pahang, and Kuala Lumpur.

2.3 Purpose of The Research

The purpose of the research is to :

1. Develop an innovative safe house design that can withstand natural disasters such as earthquakes and floods.

2.Integrate advanced safety technologies into residential buildings to reduce the risk of loss of life and property damage.

3.Improve community resilience by providing affordable, durable, and disaster-resistant housing solutions for high-risk areas in Malaysia.

3.0 METHODOLOGY OF THE PROJECT

3.1 Project Design and Details

FLOQUAKE is a flood and earthquake safe house designed to protect residents in high-risk areas of Malaysia. The house features:

1. Safety features: Equipped with a suspension system to minimize earthquake vibrations, a floating platform and floating agents with low density to maximize buoyancy during floods.
2. Solar panels: Multiple interconnected solar panels The rain collector system channels rainwater to a safe space.
3. Furniture modifications: anti-slip rubber for furniture in the house to reduce the movement of the furniture
4. Safe space : space that can be used as an emergency shelter and also functions as a water storage area during the rainy season for use during droughts.
5. Anchoring system: An anchor (sauh) to stabilize the house's position while floating.

Figures illustrating the design and components include:

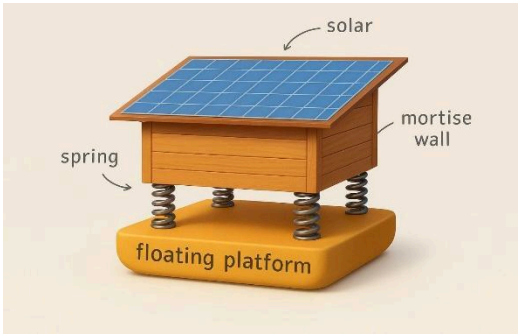


Figure 1: Structure of the house



Figure 2: furniture anti-slip

3.2 Materials and Tools

The project utilized the following materials and tools:

1. Durable, flexible construction materials applying traditional mortise (tanggam) joint techniques for enhanced structural strength.
2. A solar panel system, inspired by sunflowers that track sunlight for maximum absorption.
3. A water-repellent rainwater system for disaster zones, inspired by frogs and lotus leaves. Uses EPDM or HDPE liners with food-grade tanks.
4. Floating agents of low density to maximize buoyancy influence by the aired barrels for flood.
5. Suspension system components for vibration absorption
6. Furniture with rubber or anti slip rubber

3.3 How FLOQUAKE Safe House Works During Natural Disasters

3.3.1 Earthquake

- The suspension system reduces the transfer of seismic vibrations to the house, minimizing structural shaking and damage.
- Shock-absorbent foundations and the use of flexible tanggam joints allow the structure to absorb and dissipate earthquake energy, preventing collapse.
- Inside, anti-slip rubber is used for furniture in the house to reduce the movement of the furniture.

3.3.2 Flood

- The house is mounted on a floating platform supported by multiple low-density floating agents that maximize buoyancy and keep the structure afloat during rising water levels.
- The rain collector system, collects rainwater during floods or droughts, storing clean water in tanks beneath the house for emergency use.
- Waterproof membranes prevent water intrusion, protecting the interior and structural components.

4.0 STUDY RESULTS

4.1 Data Analysis

Initial studies indicate that conventional housing structures in disaster-prone areas are often not equipped to withstand the impacts of natural disasters such as earthquakes and flood. This results in severe property damage, increased casualties, and long-term disruption to communities, particularly in high-risk zones across Malaysia.

The research for FloQuake Safe House was conducted using simulations and structural testing models that reflect real-world disaster scenarios. The study focused on three core aspects:

1. The effectiveness of structural elements such as shock-absorbing foundations and waterproof materials in increasing the house's resistance to earthquakes and flood
2. The performance of a modular floating base system that allows the house to remain buoyant during floods.

3. This house serves its purpose best when facing unexpected situations.

Results from the simulated disaster models demonstrated that FloQuake Safe House showed a significant increase in structural resilience. For example, during a simulated flood, the floating foundation design prevented water intrusion, while shock-absorbent elements reduced damage in an earthquake scenario.

Overall, the findings confirm that FloQuake Safe House presents a viable and practical solution to improve disaster resilience in vulnerable communities. It not only minimizes loss and damage but also enhances the long-term sustainability and safety of residential development in Malaysia and similar regions.

5.0 DISCUSSION AND CONCLUSION

FLoQUAKE is more than just a house it's a smart and resilient shelter designed to protect people and their belongings during natural disasters like floods, tsunamis, and earthquakes. By combining strong, disaster-resistant design with thoughtful safety features, FLoQUAKE offers a practical and reliable solution for communities living in high-risk areas.

With its durable construction and ability to withstand extreme conditions, FLoQUAKE gives residents greater peace of mind. It's built to reduce damage, save lives, and help families feel safer in the face of unexpected events.

In this way, FLoQUAKE aims to not only improve safety and preparedness but also support long-term community resilience. It's a step forward in making homes smarter, stronger, and ready for the challenges of the future.

6.0 SUGGESTIONS FOR FUTURE RESEARCH

1. In the future, FLoQUAKE can be further improved to make it lighter, easier to build, and more practical—especially in emergency situations. There is also potential to use more eco-friendly materials, such as recycled or locally available resources, to reduce environmental impact while maintaining strong protection against natural disasters.

2. It would be valuable to place FLoQUAKE prototypes in communities that face frequent disasters, so they can be tested in real-life conditions. Gathering feedback from residents and local authorities will help improve the design, making it more comfortable, reliable, and suitable for everyday use.

3. This house was initially designed to withstand three disasters — tsunami, earthquake, and flood — as stated in the submitted abstract. However, based on insights gathered from an interview with the National Disaster Management Agency (NADMA), it was determined that there is no effective way to handle a tsunami under any circumstances. Therefore, this

proposal focuses on flood and earthquake scenarios, as well as other unforeseen disaster situations.

FLoQUAKE is designed with people in mind—not just to withstand disasters, but to give families a safer, smarter place to call home. Protecting lives is more important than protecting property. Ongoing research and feedback will help it grow into an even more effective solution for protecting lives and building stronger, more resilient communities

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8.0 APPENDIX



