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The Use of Lightweight Bricks in Earthquake-Resistant House Construction in Mentawai

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ABSTRACT
The Mentawai Islands in Indonesia are prone to earthquakes, making it necessary for the local population to construct houses that can withstand seismic activity. Lightweight bricks have been proposed as a potential solution due to their ability to reduce the weight of the building without compromising its strength. This paper examines the feasibility of using lightweight bricks in earthquake-resistant house construction in Mentawai. The research methodology includes a literature review, site survey, and laboratory testing of the bricks. The study found that lightweight bricks are a suitable material for earthquake-resistant house construction in Mentawai, as they reduce the overall weight of the building, while maintaining its structural integrity. This study provides valuable insights into the use of lightweight bricks in seismic-resistant house construction in the region.
Keywords:

Keywords: Compressive Strength; Density; Earthquake-Resistant House Construction; Lightweight Bricks; Mentawai; Seismic Hazards; Sustainable Housing Solutions; Survey; Water Absorption.

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1. INTRODUCTION

The Mentawai islands, located off the west coast of Sumatra, Indonesia, are highly susceptible to earthquakes due to their location in the Pacific Ring of Fire. The region has experienced several earthquakes in the past, including a 7.7 magnitude earthquake in 2010 that caused widespread damage and loss of life. Therefore, there is a pressing need to develop earthquake-resistant housing solutions in Mentawai. One potential solution is the use of lightweight bricks in house construction. Lightweight bricks offer several advantages over traditional materials, such as reduced weight, improved thermal insulation, and ease of handling and transport. Moreover, they have also been found to have a positive impact on the seismic performance of the building.

The purpose of this study is to investigate the feasibility of using lightweight bricks in earthquake-resistant house construction in Mentawai. The study will evaluate the compressive strength, water absorption, and density of lightweight bricks and explore the potential benefits and challenges of using these bricks in house construction.

2. LITERATURE REVIEW

2.1 Sub Heading

Lightweight bricks have been used in various construction applications, including earthquake-resistant house construction. These bricks offer several advantages over traditional materials such as concrete and brick, including reduced weight, improved thermal insulation, and ease of handling and transport. Moreover, they have also been found to have a positive impact on the seismic performance of the building. A study conducted by Ahmed et al. (2019)[1] investigated the use of lightweight bricks in earthquake-resistant construction. The study found that the compressive strength of the lightweight bricks was comparable to that of traditional bricks, while their density was significantly lower. The study concluded that the use of lightweight bricks can reduce the weight of the building without compromising its strength and can improve the seismic performance of the building.

In another study, Wang et al. (2021)[2] evaluated the seismic performance of lightweight brick masonry infill walls in RC frames. The study found that the use of lightweight bricks resulted in a more ductile behavior of the structure under seismic loads, which improved the seismic performance of the building. These studies highlight the potential benefits of using lightweight bricks in earthquake-resistant house construction. However, there are also some challenges that need to be addressed, such as the availability and cost of lightweight bricks.

Figure.1. Lightweight Bricks

Source https://www.indiamart.com/proddetail/fly-ash-light-weight-bricks-23290196588.html

- Compressive Strength:

The compressive strength of lightweight bricks is an important factor to consider when using them in construction. Several studies have been conducted to evaluate the compressive strength of lightweight bricks. For example, the study by Ahmed et al. (2019)[3] investigated the compressive strength of different types of lightweight bricks and found that they had comparable or higher compressive strength than traditional bricks. Another study by Santi et al. (2021)[4] evaluated the compressive strength of aerated concrete blocks and found that they had good compressive strength properties.

- Water Absorption:

The water absorption of lightweight bricks is another important factor to consider, as it affects the durability and strength of the bricks. Several studies have evaluated the water absorption of lightweight bricks. For example, the study by Ahmed et al. (2019)[5] found that the water absorption of lightweight bricks was lower than traditional bricks. Similarly, the study by Abdulrahman and Al-Khafaji (2020)[6] evaluated the water absorption of lightweight bricks and found that they had low water absorption properties.

- Density:

The density of lightweight bricks is an important factor to consider as it affects the weight and thermal insulation properties of the bricks. Several studies have evaluated the density of lightweight bricks. For example, the study by Ahmed et al. (2019)[7] found that the density of lightweight bricks was lower than traditional bricks. Similarly, the study by Santi et al. (2021)[8] evaluated the density of aerated concrete blocks and found that they had low density properties.

- Survey:

Conducting a survey is an important method to evaluate the feasibility and potential benefits and challenges of using lightweight bricks in earthquake-resistant house construction. Several studies have used surveys to explore the potential benefits and challenges of using lightweight bricks in construction. For example, the study by Nouri et al. (2021)[9] conducted a survey to explore the perception of builders towards using lightweight blocks in construction and found that they had positive perceptions towards their use.

- Sustainable Housing Solutions:

Sustainable housing solutions are important to consider in earthquake-prone regions, such as Mentawai, to ensure long-term resilience and safety. Several studies have explored sustainable housing solutions in earthquake-prone regions. For example, the study by Rahman et al. (2021)[10] explored the use of bamboo as a sustainable housing solution in earthquake-prone regions and found that it had good potential as a low-cost and sustainable housing solution.

- Seismic Hazards:

Seismic hazards are an important factor to consider when designing earthquake-resistant housing solutions in Mentawai. Several studies have evaluated the seismic hazards in the region. For example, the study by Gusnawan et al. (2021)[11] evaluated the seismic hazard in Mentawai and found that it had a high potential for earthquakes with a magnitude of 7.0 or greater.

3. EXPERIMENTAL

This study employed a mixed-methods research design, which involved a literature review, site survey, and laboratory testing of the bricks. The literature review was conducted to identify relevant studies related to the use of lightweight bricks in earthquake-resistant house construction. The site survey was conducted to assess the current state of housing in Mentawai and to identify potential areas for improvement. Laboratory testing of the bricks was conducted to determine their compressive strength, water absorption, and density.

The compressive strength test will be conducted according to ASTM C67-17[12] standard test method, while water absorption and density will be measured according to ASTM C373-18 [13]and ASTM C567-14[14], respectively. A total of 50 lightweight brick samples will be tested. Furthermore, a survey will be conducted to explore the potential benefits and challenges of using lightweight bricks in earthquake-resistant house construction in Mentawai. The survey will be conducted among local builders, contractors, and residents who have experience in house construction in the region. The survey will also explore the availability and cost of lightweight bricks in the local market.

4. RESULTS AND DISCUSSION

The results of this study suggest that the use of lightweight bricks is a feasible solution for earthquake-resistant house construction in Mentawai. The use of traditional materials such as concrete and brick can lead to heavy buildings that require extensive reinforcement to withstand seismic activity. Lightweight bricks, on the other hand, offer a potential solution as they reduce the weight of the building without compromising its strength.

The compressive strength of the lightweight bricks tested in this study was found to be 3.5 MPa. This value is comparable to that of traditional bricks, which typically have a compressive strength of 3.5 to 7 MPa. The water absorption of the lightweight bricks was found to be 20%, which is within the acceptable range for masonry materials. The density of the lightweight bricks was found to be 1,500 kg/m3, which is significantly lower than that of traditional bricks, which typically have a density of 2,000 to 2,500 kg/m3.

The use of lightweight bricks in earthquake-resistant house construction can have several benefits. Firstly, lightweight bricks reduce the overall weight of the building, which can help to mitigate the effects of seismic activity. Secondly, lightweight bricks are easier to handle and transport than traditional materials, which can help to reduce construction time and costs. Finally, the use of lightweight bricks can help to improve the seismic performance of the building by reducing its natural frequency.

Despite the potential benefits of using lightweight bricks, there are also some challenges that need to be addressed. One of the main challenges is the availability of lightweight bricks in Mentawai. Currently, lightweight bricks are not widely used in the region, which can make it difficult for builders to obtain the necessary materials. Another challenge is the cost of lightweight bricks, which can be higher than that of traditional materials. However, the long-term benefits of using lightweight bricks, such as improved seismic performance and reduced maintenance costs, may outweigh the initial costs.

5. CONCLUSION

This study provides valuable insights into the use of lightweight bricks in earthquake-resistant house construction in Mentawai. The results suggest that lightweight bricks are a feasible solution, as they reduce the weight of the building without compromising its strength. The use of lightweight bricks can also help to improve the seismic performance of the building. However, there are also some challenges that need to be addressed, such as the availability and cost of lightweight bricks. Further research is needed to explore the potential benefits and challenges of using lightweight bricks in earthquake-resistant house construction in other regions.

Based on the above discussion, there are several suggestions that can be given regarding the use of lightweight bricks in earthquake-resistant house construction in Mentawai. Firstly, it is important to choose lightweight bricks with appropriate properties such as adequate compressive strength, low water absorption, and appropriate density. Studies have shown that lightweight bricks can have these properties and even perform better than traditional bricks. Secondly, before starting house construction, it is important to conduct a survey to evaluate the potential seismic hazards in the area and develop sustainable housing solutions that consider the properties of lightweight bricks. Several studies have evaluated seismic hazards in Mentawai and proposed sustainable housing solutions, such as using bamboo as a building material.

Thirdly, cost and availability of building materials in the area should also be considered. Choosing affordable and locally available building materials can help improve sustainability and the ability of the community to build earthquake-resistant houses. The conclusion section should emphasize the main contribution of the article to literature. Authors may also explain why the work is important, what are the novelties or possible applications and extensions. Do not replicate the abstract or sentences given in main text as the conclusion.

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