LIGHTWEIGHT BRICKS AS AN ALTERNATIVE MATERIAL FOR BUILDINGS

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Keywords:
lightweight bricks, sustainable materials, environmentally friendly, construction, buildings

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Abstract: The current crisis in building construction materials has encouraged the need for many innovations in developing new materials with alternative raw materials that are available sustainably. The concept of sustainability in the development of construction materials is needed to maintain the existence of these materials so that their availability can be guaranteed for now and in the future. This study describes lightweight bricks as an alternative material to replace red bricks, which are already rare and difficult to obtain. Red bricks made of clay are difficult to make due to the crisis of productive land as a source of raw materials. The existing productive lands are widely used for primary needs such as agriculture, plantations, infrastructure, and buildings. The composition of lightweight brick materials with economic doses can maintain the availability of raw materials for some time to come. The components that are also planned can be replaced by other materials if they are no longer available at a certain time in the future. Developing construction materials by considering sustainable and environmentally friendly concepts can reduce the negative impacts of damage to social, economic, and environmental aspects.

INTRODUCTION

Lightweight bricks are now widely used as a substitute for red bricks as building wall fillers. Red bricks made of clay have decreased in use due to limited raw materials in the form of clay. Clay is rarely found on productive empty land because empty land is used for agricultural land and buildings. This study aims to describe lightweight bricks as an alternative material in buildings that have replaced red bricks, stones, and cement blocks as building wall fillers. Agung Sedayu (2024) researched the application of sustainable materials from the present to the future so that the existence of buildings can be maintained optimally. Building materials can be easily obtained from raw materials on earth in a certain period. The material must also be environmentally friendly so that it supports the success of the green building concept (Sedayu, 2020). The material must be easily applied and connected to other materials in construction implementation. Lightweight bricks, one of the building materials, must be made by considering sustainable construction (Gunawan, 2024). The selection of construction

materials that are not environmentally friendly or the use of unsustainable resources hurts the environment. In addition, the negative impact on social and economic aspects will also increase along with environmental damage. Therefore, selecting more sustainable materials is very urgent to minimize the negative impact on infrastructure and building development's social, economic, and environmental aspects. The concept of sustainability that is successfully implemented will maintain the availability and performance of infrastructure and buildings that are more beneficial to human welfare and the surrounding environment.

RESEARCH METHODS

This research uses the method of literature study and previous research. Review of literature and previous studies by examining the novelty and uniqueness compared to this research. The literature study can make this research a novelty and unique. Comparison between literature and research is also carried out to obtain variables, methods, and research results that are novel and unique. The results of this study can be used as additional references to conduct further research in more detail with a wider scope.

RESULTS AND DISCUSSION

Lightweight bricks are made from a mixture of silica sand, cement, limestone, gypsum, water, and aluminum powder, preserved by heating and under high pressure using an autoclave machine. The autoclave machine manufactures lightweight bricks by producing chemical reactions, creating gas and air bubbles in the constituent materials. In the autoclave machine, chemical reactions are triggered by temperature and pressure settings controlled at a certain level (Aida & Nugroho, 2023). The gas and air bubbles produced will fill the lightweight bricks, forming pores that can reduce the constituent materials' volume so that the bricks become lightweight. During autoclaving, the machine produces the right temperature and pressure to harden and dry the lightweight bricks. The Hebel brand's first lightweight brick was made using technology from Germany. There are two ways to make the Hebel lightweight bricks. The first method is autoclaved aerated concrete (AAC), mixing raw materials and giving them high-temperature water vapor pressure in an autoclave machine. The second method is Cellular Lightweight Concrete (CLC), which mixes the components of Hebel without a chemical process through natural drying without a machine, but this technique is rarely used. The CLC method produces concrete heavier than AAC because CLC produces conventional concrete by replacing coarse aggregate with air-wrapping foam from its components. CLC lightweight

bricks are rarely used compared to AAC lightweight bricks. Most lightweight bricks are grayish-white, with dimensions of Length = 60cm, width = 20cm, and thickness = 7.5 cm. To make a building wall per m2, 8-9 lightweight bricks/m2 and 60-70 red bricks per m2 are needed. Lightweight bricks have a much lighter weight than red bricks. Lightweight bricks weigh 50-75 Kg/m2, while red bricks weigh 200-250 Kg/m2. So, the self-weight load of lightweight bricks is smaller than red bricks. The self-weight of the material will affect the specifications of the building structure, including the dimensions and materials
used for the structural elements (Raharjo & Soebagio, 2020).

Figure 1. Lightweight brickwork with adhesive cement
Source : Maulana, 2022

Figure 2. Application of lightweight bricks on the walls of house buildings
Source : Maulana, 2022

Figure 1 shows the installation of lightweight bricks with a fairly simple and easy technique, thus speeding up the construction process. In contrast, Figure 2 shows the application of lightweight bricks to the walls of residential buildings. The public often uses lightweight bricks to build buildings. The public considers many advantages and disadvantages when choosing this lightweight brick material. The advantages of lightweight bricks include,

1. Fast installation

Using lightweight bricks can speed up construction work time because they are faster and easier to install. Fast work time will save construction costs

2. Has a fairly high durability

The composition of lightweight brick material is similar to the material in making concrete, especially cement. Concrete material has high durability and durability

3. Functions as a heat insulator

Lightweight bricks act as inhibitors (insulators) for propagating solar heat radiation and air temperature (Riadi et al., 2021). This ability can support thermal comfort in building spaces.

4. Absorbs noise

The pores from the emergence of air bubbles in manufacturing lightweight bricks function as absorbers of disturbances and noise. Poor-quality sounds are also absorbed without reflection.

5. Easy and simple finishing

The simplicity of the lightweight brick wall finishing process can simplify the construction process. Exposed lightweight bricks without plaster are also quite aesthetic and neat.

6. Save costs

Cost savings are not only in the speed of the lightweight brick construction process, but simple materials and installation tools will increase the efficiency of the construction process.

In addition to the advantages, there are also some disadvantages to using lightweight bricks as construction materials. The advantages of lightweight bricks outweigh their disadvantages, motivating people to like using them. Here are some of the disadvantages of lightweight bricks,

1. Construction waste

Installing lightweight bricks will leave quite a lot of construction waste because the large size of lightweight bricks will leave a residue that cannot be reused, especially when cutting for wall openings.

2. Limitations in openings

Large sizes with thin adhesive cement will weaken the lightweight brick pairing. Cutting lightweight bricks for openings will complicate the construction process.

3. Requires special skills

Installing lightweight bricks with precise sizes requires special skills compared to installing red bricks. Lightweight bricks from manufacturers require special and stricter requirements.

The advantages and disadvantages of lightweight bricks are a consideration for the community when applying them to buildings. However, when compared, the advantages are more numerous and greater than the disadvantages, encouraging many people to be interested in this material. Currently, there are many brands of lightweight bricks sold on the market. Several terms and conditions in SNI 8640: 2018 must be met to obtain a reliable performance and quality certificate. SNI 8640: 2018, concerning Specifications for lightweight bricks for wall masonry, provides provisions and requirements for lightweight brick certification in the scope of dimensions, quality, weight, testing, and others. The strength of lightweight bricks is also influenced by the aggregate of the materials that make them up (Pah et al., 2020; Ningrum

et al., 2021)). Several studies have been conducted to develop the components of this lightweight brick to be more reliable. Like concrete, lightweight brick components can also be mixed with coal fly ash. Mixing fly ash can increase lightweight bricks' density and compressive strength (Maulana et al., 2023; Rahmayanti et al., 2023). The drying acceleration of concrete on bricks is also faster than that of conventional concrete. In addition, the volume of cement in the lightweight brick mixture is reduced to save costs. Using a mixture of natural materials such as corn cobs and plant fibers can also reduce the volume of cement in lightweight brick concrete (Widodo et al., 2024). Natural materials in the form of biological objects, in addition to being renewable, also reduce carbon emissions in lightweight brick concrete. Developing lightweight bricks with a mixture of biological components further strengthens the success of implementing sustainable construction materials. The sustainable concept achieved can maintain social, economic, and environmental sustainability.

CONCLUSIONS AND RECOMMENDATION

Lightweight brick material has advantages and disadvantages in its application as a building construction material. However, many people apply it today because the advantages outweigh the disadvantages. When compared to red bricks, lightweight bricks are much lighter in their weight. This will impact the load difference on the building structure. The dimensions and materials of the building structure will certainly have lower specifications. Other advantages of lightweight bricks include fast installation, high durability, the ability to act as a heat insulator, absorb noise, easy and simple finishing processes, and saving costs. The disadvantages include producing construction waste, limited wall openings, and requiring special expertise in installation. The development of lightweight bricks to be reliable and sustainable continues to be improved today. The aggregate components support the reliability of lightweight bricks in compressive strength, while overall sustainability starts from the manufacturing and materials components. The materials that make up lightweight bricks can be selected as reused and recycled materials that align with social, economic, and environmental aspects. The purpose of applying the concept of sustainable materials to lightweight bricks is to achieve the goals of human and natural welfare.

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