Analysis of spatial changes in simple dwelling based on sustainable architectural approaches

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Abstract. Occupancy in housing built by the developer experienced changes that are not consistent with the original design, no exception to the pure residential housing program housing subsidies. Generally, the changes made to the residential layout occur after occupancy. Grand Permata Residence II Housing, Deli Serdang Regency is the housing that was built by a developer with a limited area of land and a restricted space of land that will be reviewed with a sustainable architectural approach to get alternative changes to an excellent residential spatial layout. Sustainable Architecture Approach is applied to realize housing that guarantees the well-being of its inhabitants. The method used in this study is a qualitative descriptive method with direct observation in the field and analyzed according to the rules of sustainable living. The results of this study are that changes in residential spatial planning and selection of building materials used are following the concept of sustainable architecture towards sustainable development.

1. Introduction

The house is a basic need and is a right for every human being to occupy decent and affordable housing [1]. In meeting housing needs, the government is assisted by a developer/private sector that builds house for sale to the community by selling in cash or installments. One of them is Grand Permata Residence II Housing in Deli Serdang Regency. The study was conducted considering that the limited size of residential space in the simple dwelling subsidy housing program built in bulk by the developer caused a tendency for changes to be made by the residents. These changes are sometimes not by aspects of life for residents, causing problems that can cause discomfort in the concept of sustainable living.

The main objective of sustainable development is to improve the quality of life of people who are the subject of development planning itself [2]. Community welfare is part of the assessment the quality of life [3]. Public awareness about environmental sustainability is a critical issue today where pollution and environmental degradation cannot be avoided. [4]. Human misbehavior regarding views of himself, nature, and the relationship between humans and the environment is the root of the problem of ecological damage [5]. The importance of research on sustainability and low-carbon living in residential environments is due to the consumption of energy and resources not only that enter into buildings, but also in the long term through occupancy and activities. [6]. The relationship between architecture and sustainable concepts is to create a safe space for human life and support the physical and psychological development of human beings. On a smaller scale, architecture also plays a role in the building processes and industries associated with it. Architecture occupies space on natural land, known as an ecological footprint. Naturally, architecture can be seen as the most significant contributor to the destruction of...
nature in a developing city by constructing various buildings for settlements and industry. Correctly, buildings need energy. Appropriate energy management in buildings will create the quality of human life in a more sustainable micro and macro environment [7].

The application of sustainable architecture is in line with the vision of sustainable development to meet human needs in the present and the future. Sustainable development is applied in economic, social, and environmental aspects to meet the needs of its users in a sustainable manner [8]. The increasing green behavior change is divided into several stages [9]. The first stage is knowledge. People must be aware of potential actions, behaviors, technology, or ideas why it is so important to preserve the environment. Financial incentives, a healthy and sustainable environment, energy efficiency, and livability are motivations about green homes. The second stage is persuasive. After the community knows about environmental sustainability, the next step is to form positive and negative attitudes about ecological sustainability. Environmental sustainability must be stated in relation to issues that are very important in human life. The third stage is a decision. People will apply green behavior in their daily lives if they believe that changing green behavior can have a real impact. The fourth stage is implementation. In this phase, it is a real activity. Residents can make modifications in implementing green behavior to suit their needs. The fifth stage is confirmation. For some residents, the implementation stage is the last stage of the behavior change process. At this stage, they need additional information to determine whether to change the behavior correctly. Further information will help define behavior change as the right decision. [10]. Socialization activities of green architecture are essential, to provide education to the occupants about how to implement green behavior [11]. The benefits of this research are expected to be useful for the community in adding insight and knowledge to get shelter and a healthy environment as well as for stakeholders to determine rules/policies in terms of changes in housing-related to recommending a technical solution for residents who will make changes to their dwelling.

2. Research methods

This study uses a qualitative method with the following stages: (1) Identify the phenomena through visual observation, field surveys, recording housing conditions with cameras and interviews with residents; (2) Tracing theory with library data. Quoted from the book James Steele, Sustainable Architecture is an architecture that meets the needs of today, without jeopardizing the ability of future generations, to meet their own needs. The requirements differ from one community to another, from one region to another and should be determined by the relevant community. Sustainable architecture is a consequence of the international commitment to sustainable development because architecture is closely related and focused on the human factor by focusing on the main pillars of the concept of sustainable development, namely aspects of the built environment with the development of its environment. Various theories in architecture that support sustainable architecture include energy efficiency, land use efficiency, efficient use of materials, new technologies and materials, and waste management [12]. On the principle of energy conservation, you should use alternative energy sources such as those sourced from sunlight or wind [13]; (3) Apply theory to the object of observation and describe conclusions. The purpose of view is the house in Grand Permata Residence II Housing located on H.M. Puna Sembiring street, Durian Jangak Village, Deli Serdang Regency with the consideration that the area has been built for a long time and has a residential area that meets the general standard of 91 m² of land area with initial building/standard one floor of 36 m² building area. In architecture, a building/dwelling consists of a cover/roof element. Divider/wall and the base cover of the building, which can also be a reference in this study. The discussion of changes in residential spatial planning adjusted to the principles of sustainable architecture is carried out qualitatively to get a figure of changes in residential spatial planning that meet local conditions and climate to obtain comfort and good health for low-income people. The data that has been collected is analyzed descriptively.
3. Results and discussion

Grand Permata Residence II housing is one of the simple dwelling subsidized housing programs located in Deli Serdang Regency, precisely H.M. Puna Sembiring street, Durian Jangak Urban Village, Pancur Batu District (Figure 1). Grand Permata Residence II housing was built and marketed by Developer Rajawali Properti Mandiri in 2014 and started to be inhabited at the end of 2014. This housing has approximately 600 houses of type 36, with an area of about 6 hectares. The available housing has the same size for a land area of 91 m² with a first building/standard 1 (one) floor building area of 36 m². The initial plan and the initial front view of the house can be seen in figure 2. At the beginning, the building was erected with river stone foundations and plastered brick walls and zinc roof covering. Doors, windows, and roof trusses use wood. Floor covering uses ceramic material. Each house uses lighting from PLN and water supply from the wellbore.

Figure 1. Research Location at Grand Permata Residence II Housing
Figure 2. Initial Plan and Initial Front View of Grand Permata Residence II Housing

Turner, in his book Ideas of Program Housing by People, states that changes in occupancy are made by residents against a variety of reasons related to human needs. The encouragement that appears on a person/occupants consciously or unconsciously motivates them to take action with a specific purpose. Changes in occupancy occur due to the lack of a mismatch between the conditions of the first home and the needs of the occupants [14]. The available data shows an initial floor plan of type 36/91 m², which then undergoes space changes in two versions, namely (1) Changes in residential space with the addition of space in the backyard but still leaves the front page for open space; and (2) Changing the residential area that covers the entire land in the back and front to become a closed room (Figure 3).

Figure 3. Plan of residential changes in Grand Permata Residence II Housing

Table 1 explains the application of sustainable architecture towards sustainable development from the results of the analysis of changes in residential space carried out by residents in Grand Permata Residence II Housing.

Table 1. Results of the analysis of the application of sustainable architecture towards sustainable development in Grand Permata Residence II Housing

| No | The concept of sustainable architecture | Change in Occupancy Version 1 | Change in Occupancy Version 2 |
|----|----------------------------------------|-------------------------------|-------------------------------|
| 1  | Efficient use of energy                | Make maximum use of sunlight for natural lighting during the day to reduce the use of electrical energy. The front of | We are utilizing sunlight during the day to reduce the use of electrical energy. |
| en | The facade has open space and in the back that uses side doors that have the potential to produce natural lighting. Where the front of the facade and on the back that uses a closed side door using a canopy that still has the potential to produce natural lighting. |
|---|---|
| en | We are utilizing natural ventilation instead of artificial air conditioning, where there is ventilation at the top of the door and window openings and a garden/open space at the front of the house. There is ventilation at the top of the door and window openings and close the front of the house using a canopy so that natural air can still be enjoyed instead of artificial air conditioning. |
| en | We are using the front vents, side vents, side doors, and the open space at the front so that airflow can directly flow out of the building. We are using front and side vents and side doors so that airflow can flow directly out of the building. |
| en | We are utilizing rainwater in innovative ways to collect and process rainwater for domestic purposes such as watering plants/gardens on the front of the dwelling. |
| en | The concepts of efficient use of energy, such as lighting and natural ventilation are specific concepts for this region despite the tropical climate. |
| en | 2. Land use efficiency We are using the prime land, not all property must be used as buildings, or covered with buildings, because then the available area has enough green area and parks. Use area in this residential location efficiently, compact, and integrated. This can be seen from the changes that do not use up the available area in the front so that the airflow can be maximized. In housing with this version, change does not have green open space because the entire land is a hardened floor. However, in this change, the air circulation is still going well because area is closed using only a canopy (not covering the wall). |
| en | The green potential of plants on the front of the dwelling is maximized by planting flowers or other plants so that the front yard is large enough to change the existing building space to produce reforestation is maintained in the residential area. The green potential of plants in the land can be replaced or maximized by hanging gardens (by hanging plant pots around buildings), hedges, or planting plants on the remaining soil on the shoulder of the residential road. |
Take care of plants on the land, not easily cut down trees, so that existing plants can be part of residential buildings. Take care of existing plants so that they become part of residential buildings.

Open design on the front of the dwelling with spaces that open to the garden can be an innovation to integrate outside and inside the building, giving greater space flexibility.

3. Efficient use of material

It is utilizing the remaining material for use also in construction, so that no material is wasted, for example, waste wood can be used as a buffer plant, soil material, sand, the cement that remains can be used to make flower pots.

In this change, there is no residual material reused because of the difference in the form of the addition of the vestibule that requires new content such as a canopy.

It is utilizing used building materials, old components that can still be used, namely the rest of the old building demolition, to hoard the front of the land that will be used as green open space.

It is utilizing used building materials, such as scaffolding wood that can be used as hanging pots or wall plants.

Use materials that are easily found and rarely found as well as possible, especially for materials such as wood. The new material used is only in the form of a roofing material that uses mild steel.

Use materials that are easily found and rarely found as well as possible, especially for materials such as wood. New materials used in the form of roof and canopy material for the addition of the front room using mild steel.

4. The use of new technology and materials

In this building, with changes in space using only natural conditions such as pumps/bore wells, there is usually no facility that uses
| Facility that uses new technology and materials. | It is utilizing new materials through new inventions that can globally open up opportunities to use the latest articles that are quickly produced, inexpensive, and open to innovation, such as bamboo used as scaffolding. Materials used for door and window frames still use wood. |
|---|---|
| 5. Waste management Create a domestic sewage treatment system such as dirty water (black water, gray water) that is independent and does not overload the city's water flow system. In this building, using a biopore system that is useful for water absorption, especially rainwater, so that groundwater can be retained, which causes the groundwater to remain there/not dry. | Innovative ways that are worth a try, such as creating a system of decomposition of organic waste so that it decomposes naturally in the soil, can make things that are commonly used as domestic waste or garbage from materials that can be recycled or can easily be decomposed readily. |

4. Conclusions
The application of sustainable architecture towards sustainable development in the change of residential space in the building type 36 / 91m² in Grand Permata Residence II Housing can be concluded

- Efficient use of energy.

Energy needs to be given special attention by the building designer (architect), especially electrical power, because electricity is closely related to the field of Architecture. Many buildings in Indonesia still have to turn on the lights when used during the day. Of course, this is very unnatural, considering that Indonesia has sunlight. Designs that incorporate less sunlight into the building as occurs in the version 2 residential space changes. The solution that can be given is to increase the opening in the facade, reduce the thickness of the building, or create an atrium that uses skylights. In this case study, the change in residential space version 1, which only covers the back land and still uses the front area as green open space.
• Water conservation.
There needs to be awareness to save water. Indonesia has a reasonably high rainfall, so saving clean water is possible. How to save money (1) Use the rainwater (accommodated), can be used to water plants even to clean bathrooms or terraces; (2) Absorb rainwater into the ground, which often occurs rainwater is directly flows into the gutter. It is does not allow for rain to seep into the ground because all channels are pavemente all over the surface. Besides saving clean water, this method can reduce the level of flooding. Because the channels won't be filled with water.
• Natural material.
The use of natural materials is highly recommended for use because it does not cause pollution. Natural materials also do not radiate heat and do not reflect light. The use of natural materials such as the use of cobble stone in the control tub, in addition to absorbing water, this cobble stone can be overgrown with grass, and this grass will fill the space in the control tub so that initially area turns into a place. In the planning process, a person or stakeholders can provide references for designing buildings/houses and changes that will be made using ecological principles and not just using hardscape.
• The efficiency of land use, material use, and waste management have been implemented well in the changes in residential space version 1 and version 2. In the residential space shift, version 2 requires more attention in utilizing space by making a hanging garden (by hanging pots) potted plants around the building) so that it still has the potential of green plants in the residential space.

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