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## OPTIMIZATION OF INDOOR HEALTH AND COMFORT BASED ON GREENSHIP HOMES 1.0 IN COMMERCIAL HOUSING

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### ABSTRACT

Aceh high population density causes pressure on the housing sector, and the increasing number of housing developers results in increasingly varied housing types. Royal De' Khansa housing was chosen because it is expected to contribute to sustainable development. CO<sub>2</sub> emissions from buildings can have an impact on human health, and GreenSHIP Homes 1.0 is a standardization of the implementation of sustainability practices that can help improve the health and comfort of indoor residential homes. This study aims to calculate the value of IHC criteria in residential houses and provide recommendations for optimizing indoor air quality using qualitative methods and explanatory descriptive approaches. This research was conducted using qualitative methods with a descriptive and explanatory approach. The study grouped the population into a homogeneous classification with all existing houses in the Royal De' Khansa housing. Royal De' Khansa housing types 65 and 85 have met 80% of the IHC category. Types 110 and 120 have met 85% of the IHC category or equivalent to 10 of the 13 IHC points that must be met. Residents are satisfied with this residence in terms of comfort, cleanliness, noise, ventilation, and lighting. The application of GreenSHIP Homes 1.0 in commercial housing in Aceh Besar can provide benefits in optimizing the health and comfort of the room. By meeting 80-85% of the IHC category, Royal De' Khansa housing can provide a healthy and comfortable environment for its residents.

**Keywords:** air conditioning, indoor health and comfort, lighting, residential.

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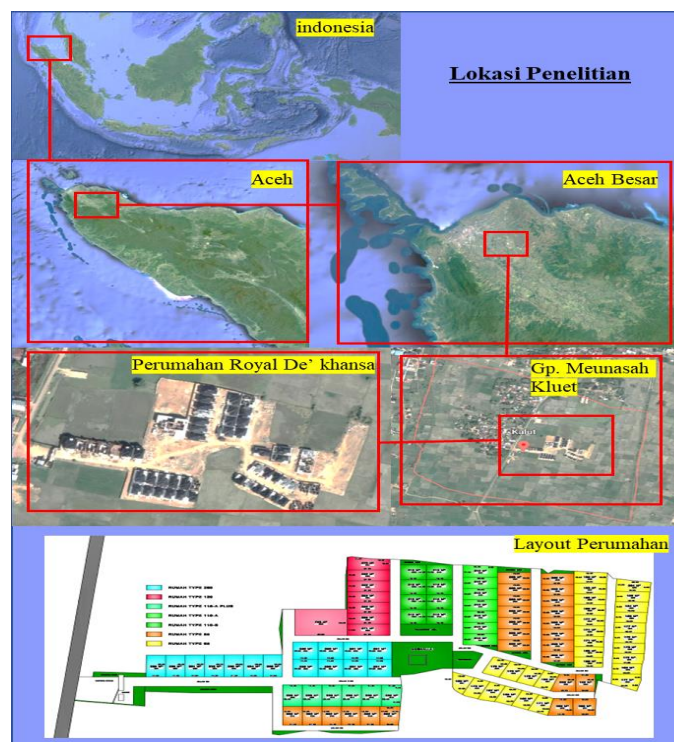
### INTRODUCTION

Housing development in Indonesia is increasing rapidly, triggered by population growth which increasingly puts pressure on built-up land (Prihatin, 2015). On a micro-scale, housing expansion in Aceh results from an environmental imbalance that requires public awareness of sustainable development (Siregar et al., 2020). The Royal De' Khansa Aceh Besar housing was chosen because it is the only middle to upper-class commercial housing in the Aceh Besar Region, so it is expected to be able to provide maximum contribution in supporting sustainable development-the largest emitter of greenhouse gases (Anifah et al., 2021). Buildings generate about 30-40% of CO<sub>2</sub> emissions. Buildings influence environmental imbalances (Hidayati et al., 2020). The house, the built environment, is the smallest unit in life as a place to live and interact (Effendi et al., 2018). So that a house is an object that is required to follow the environment's carrying capacity. GreenSHIP Homes 1.0 is a system for assessing the implementation of sustainable development and efforts to achieve standardization that applies to builders and building users (Diniari et al., 2021). GreenSHIP Homes 1.0 is a benchmark for sustainable development in the residential aspect. The GreenSHIP Homes 1.0 criteria will be the standardization of environmentally sound homes in general health (Indonesia, 2014). Indoor Health and Comfort are part of the GreenSHIP Homes 1.0 criteria as a direct prevention

of climate change in general and increasing global temperatures (Lei et al., 2023). Indoor Health and Comfort provides a reference for residential houses producing oxygen, controlling cool air, binding gas and dust, blocking noise, and enhancing the aesthetics of space (Ratnasari & Nurwidyaningrum, 2020). Researchers take this aspect because 80% of occupancy performance is determined by health and comfort in space. This study aims to (1) calculate the value of IHC criteria in residential houses and (2) provide recommendations for optimizing air quality guidelines in residential houses; by implementing the IHC concept, housing that functions as social infrastructure is expected to provide health and comfort for its users (Hidayat et al., 2019). Royal De' Khansa housing types 65 and 85 have fulfilled 80% of the IHC category, and types 110 and 120 have fulfilled 85% of the IHC category.

## METHOD

This research is located in Gampong Meunasah Kluet, Want Jaya District, and Aceh Besar District. Aceh Province. Precisely in the Royal De' Khansa housing complex. This village is an area that has close access to urban areas, namely 1.5 km to the district capital, namely Lambaro, and 10 km to downtown Banda Aceh.



**Figure 1. Research Locations**

This research was conducted using qualitative methods with descriptive and explanatory approaches. This study grouped the population into a homogeneous classification with all the houses in the Royal De' Khansa housing. Different types did not change the variables in the IHC Greenship Homes assessment (Saputra et al., 2021). Thus it can be concluded that the houses included in the category that meets the research are 17 units with the following details:

- a. 3 Units of Type 65 Houses
- b. House Type 85 Total 6 Units
- c. House Type 110 Total 7 Units

d. 1 Unit House Type 120

Sampling with the criteria used to fulfil the GreenShip Home 1.0 assessment, namely:

- a. The developer is still on the housing site
- b. Middle to upper housing or premium type
- c. single tread house type
- d. The house is already inhabited

Observation as the first target in this study involved a sample of 1 (one) housing unit of each type with data processing techniques in the form of descriptive qualitative. At the same time, the second objective of this study was to collect occupant perception data using interviews involving the population, namely all residents of Royal De' Khansa Housing. The data processing technique for the second target uses the Nvivo 12 software to determine the word frequency, which is called Word Cloud Frequency. Primary data were obtained from observing the assessment of GreenShip Homes 1.0 aspects of IHC, documentation and interviews. At the same time, secondary data was obtained from literature studies regarding indoor air quality and aspects that can optimize indoor air.

## **RESULTS AND DISCUSSION**

### **Overview of the Royal De' Khansa Residential Complex**

Royal De' Khansa Housing is a commercial housing development in Aceh in Gampong Meunasah Kluet, Want Jaya District, and Aceh Besar District. PT Khansa Mulia Perkasa built housing at the end of 2019 until now. This housing provides housing type 65-type 260, which includes middle to upper-class housing in Aceh.



**Figure 2. Royal De' Khansa Housing Complex**

This housing was built on a 3-hectare land between the rice fields and plantations of the people of Aceh Besar but is still within the scope of the urban settlement spatial plan. The view in this housing is surrounded by rice fields, providing a beautiful view. The road to this housing includes rural roads, so it is difficult to choose between 4 (four) wheeled vehicles. This housing development has remained strong even during the Covid-19 period in 2020 (Jonkman et al., 2022). As we know, the economic sector is declining and affecting the market. However, house sales have continued to increase until now. Thus, this makes researchers assume that the people of Aceh, especially consumers of Royal De' Khansa Housing, are not only motivated by the need for a place to live.

However, it has been influenced by aspects of comfort, environmental beauty, the health of the built environment, trends and so on so that consumers who choose this housing are considered to recognize aspects of sustainable development and can contribute to increasing IHC.

### IHC Assessment Results

Table 1 below is the result of IHC's assessment of the Royal De' Khansa housing.

**Table 1. IHC Assessment Results**

| Code  | Objective                                                                                                                                                                                                                     | NO | benchmark                                                                    | Sign | Points     |            |             |             | Information                                                                                                                                                  |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|------------------------------------------------------------------------------|------|------------|------------|-------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |                                                                                                                                                                                                                               |    |                                                                              |      | Type<br>65 | Type<br>85 | Type<br>110 | Type<br>120 |                                                                                                                                                              |
| IHC 1 | Clean Air Circulation (Fresh Air Circulation)                                                                                                                                                                                 |    |                                                                              | 5    |            |            |             |             |                                                                                                                                                              |
|       |                                                                                                                                                                                                                               | 1  | The minimum ventilation area is 5-10% of the floor area.                     | 1    | 1          | 1          | 1           | 1           | the calculation of the opening area with the number of openings to the floor area reaching approximately 9% is consistently fulfilled by all types of houses |
|       | Maintaining the cleanliness of air circulation inside the house (residential space) and maintaining the required ventilation air rate so that thermal health and occupant comfort can be maintained, as well as saving energy | 2A | >75% of the total room area is normally designed with cross ventilation.     | 2    | 2          | 2          | 2           | 2           | 85% of rooms of all types are consistently designed with cross ventilation                                                                                   |
|       |                                                                                                                                                                                                                               | Or |                                                                              |      |            |            |             |             |                                                                                                                                                              |
|       |                                                                                                                                                                                                                               | 2B | 50% of the typical room area is designed with cross ventilation.             | 1    |            |            |             |             |                                                                                                                                                              |
|       |                                                                                                                                                                                                                               | Or |                                                                              |      |            |            |             |             |                                                                                                                                                              |
|       |                                                                                                                                                                                                                               | 2C | For homes with poor outdoor air: Make efforts to maintain indoor air quality | 2    |            |            |             |             |                                                                                                                                                              |
|       |                                                                                                                                                                                                                               | 3  | Have air circulation for the whole bathroom.                                 | 1    | 1          | 1          | 1           | 1           | 100% of bathrooms of every type consistently have air circulation                                                                                            |
|       |                                                                                                                                                                                                                               | 4  | Have air circulation out of the kitchen.                                     | 1    | 1          | 1          | 1           | 1           | 100% of kitchens of each type are consistently ventilated                                                                                                    |

| Code  | Objective                                                                                                   | NO                                | benchmark                                                                                                                      | Sign | Points  |         |          |          | Information                                                                                                                                                                                                                                                                                                                                                     |
|-------|-------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------|------|---------|---------|----------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |                                                                                                             |                                   |                                                                                                                                |      | Type 65 | Type 85 | Type 110 | Type 120 |                                                                                                                                                                                                                                                                                                                                                                 |
| IHC 2 |                                                                                                             | Natural Lighting                  |                                                                                                                                | 2    |         |         |          |          |                                                                                                                                                                                                                                                                                                                                                                 |
|       | Improve the quality of life indoors with good natural lighting and reduce the use of lights during the day. | 1                                 | Natural light can illuminate at least 50% of the area of the house, according to the lux standard based on the applicable SNI. | 2    | 1       | 1       | 2        | 2        | The site conditions are generally very favourable for lighting because it is located near rice fields. However, several houses built close together experience shadows, such as types 65 and 85. Types 110 and 120, because they are directly oriented towards rice fields, tend to have good lighting, so they do not need artificial lighting during the day. |
| IHC 3 |                                                                                                             | Vision Comfort                    |                                                                                                                                | 1    |         |         |          |          |                                                                                                                                                                                                                                                                                                                                                                 |
|       | Prevent visual disturbances due to lighting levels that do not match the accommodation power of the eye.    | 1                                 | Using lamps with room illumination levels (illuminance) following the applicable SNI.                                          | 1    | 1       | 1       | 1        | 1        | 100% of the lamps for each type comply with the applicable SNI for lighting                                                                                                                                                                                                                                                                                     |
| IHC 4 |                                                                                                             | Minimization of Pollutant Sources |                                                                                                                                | 3    |         |         |          |          |                                                                                                                                                                                                                                                                                                                                                                 |
|       | It reduces indoor air pollution from interior material emissions that can harm health.                      | 1                                 | I use paints and coatings containing low Volatile Organic Compounds (VOCs).                                                    | 1    | 0       | 0       | 0        | 0        | The use of paint that does not contain VOCs is still not eligible                                                                                                                                                                                                                                                                                               |

| Code  | Objective                                       | NO | benchmark                                                                                                                                            | Sign | Points     |            |             |             | Information                                                                                                                                                                  |
|-------|-------------------------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------|------|------------|------------|-------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       |                                                 |    |                                                                                                                                                      |      | Type<br>65 | Type<br>85 | Type<br>110 | Type<br>120 |                                                                                                                                                                              |
|       |                                                 | 2  | Using composite wood products, sealants and adhesives that contain low levels of formaldehyde emissions                                              | 1    | 0          | 0          | 0           | 0           | The use of composite wood, the type of sealant, and the adhesive still needs to meet the requirements. 100% of the material for each type consistently                       |
|       |                                                 | 3  | Do not use products/materials and building components that use lead, mercury                                                                         | 1    | 1          | 1          | 1           | 1           | uses non-lead PVC and non-mercury heavy metals. The use of anti-bacterial materials that international standard certificates can prove still needs to meet the requirements. |
|       |                                                 | 4  | Using anti-bacterial materials can be proven by international standard certificates or credible third parties (issued by other laboratories abroad). | 1    | 0          | 0          | 0           | 0           |                                                                                                                                                                              |
| IHC 5 | Noise Level (Acoustic Level)                    |    |                                                                                                                                                      | 1    |            |            |             |             |                                                                                                                                                                              |
|       | Provides comfort from outside noise disturbance | 1  | The noise level in the Bedroom and Living Room is not more than or following the applicable SNI                                                      | 1    | 1          | 1          | 1           | 1           | In general, the condition of the site is very far from noise facilities because the location is around rice fields and 800m from the city and secondary arterial roads.      |
| IHC 6 | Spatial Comfort                                 |    |                                                                                                                                                      | 1    |            |            |             |             |                                                                                                                                                                              |

| Code                     | Objective                                                                                                             | NO | benchmark                                                             | Sign | Points  |         |          |          | Information                                                                                              |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------|----|-----------------------------------------------------------------------|------|---------|---------|----------|----------|----------------------------------------------------------------------------------------------------------|
|                          |                                                                                                                       |    |                                                                       |      | Type 65 | Type 85 | Type 110 | Type 120 |                                                                                                          |
|                          | Providing comfort, adequacy, and health to occupants in terms of meeting space requirements based on their activities | 1  | The need for space in the building house is at least 9 m2 per person. | 1    | 1       | 1       | 1        | 1        | 100% of the space required for each type complies with healthy home standards of at least 9m2 per person |
| TOTAL VALUE CATEGORY IHC |                                                                                                                       |    |                                                                       | 13   | 10      | 10      | 11       | 11       |                                                                                                          |

Royal De' Khansa housing types 65 and 85 have fulfilled 80% of the IHC category, and types 110 and 120 have fulfilled 85% of the IHC category. In general, there is no difference in the treatment principle or design of the various types, but in the conditioning of each type about the orientation of the location, making types 65 and 85 back to back and side by side with each other causes lighting in the kitchen. Non-main areas and rooms tend to require lighting during the day.

The following is the *Word Cloud Frequency* from the occupants' perceptions when asked for their opinions regarding the outline of IHC, namely lighting and ventilation. This *Word Cloud Frequency* is the most spoken word by the sources to summarise it into a new issue. This was obtained from *coding* that was processed using the Nvivo 12 software based on the results of interviews with all residents of Royal De' Khansa Housing, namely 13 people.



(a) (B)

Figure 3. Word Cloud Frequency from Perception of IHC Occupants (a) Lighting (b) Ventilation

The interview results show that residents are satisfied with this housing in terms of comfort, cleanliness, noise, ventilation, and lighting (Princess Hapsari, 2021). When asked about the lighting, they were delighted with the occupancy. They hope that there will be an expansion of solar power management technologies, such as *photovoltaics*, especially in Aceh. They are very enthusiastic about solar panels; besides replacing the role of paid electricity, they can also replace the minimization of artificial lighting such as lights (Padang et al., 2020). In terms of ventilation, the main

room is equipped with cross ventilation so that ventilation in the house is adequate. Nevertheless, they use fans and air conditioners when the air temperature rises, especially at night before bed.

#### **Recommendations Against IHC Optimization**

- a. Utilizing vegetation to increase oxygen levels around the house makes the atmosphere more comfortable and beautiful. The benchmark is to condition the air for a thermal room in general with a temperature of 25°C and a relative humidity of 60%.
- b. Making water ponds in the garden a small ecosystem that can provide thermal conditioning (Budi et al., 2018).
- c. The use of paints and coatings must be made of materials with low VOC levels or have a certification recognized by the eco-label, and avoid wood with high formaldehyde.
- d. Designing a building or plant envelope that can be used as a noise buffer as an acoustic damper from outside

#### **CONCLUSION**

Royal De' Khansa housing types 65 and 85 have fulfilled 80% of the IHC category. Types 110 and 120 have fulfilled 85% of the IHC category, equivalent to 10 of the 13 IHC points that must be met. Residents are satisfied with this residence in terms of comfort, cleanliness, noise, ventilation, and lighting. They hope solar power management technologies such as photovoltaics will continue developing, especially in Aceh. In terms of ventilation, they are satisfied with the cross-ventilation that has been provided. Optimization can be done in the form of adding vegetation, making puddles, using materials with eco-label recommendations, and adding casing as a buffer zone which can minimize noise.

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