Climate Adaptation In Tambi Traditional Houses, Central Sulawesi, Indonesia

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ABSTRACT

Tambi Traditional House is a traditional house located in Central Sulawesi. This traditional house is a reflection of architectural work that is full of tradition and meaning and contains local wisdom and is a solution to local climate problems. The form of the building and the materials used are two aspects that can be used to identify and analyze climate adaptation in the Tambi traditional house, Central Sulawesi. This study aims to identify, describe and reveal the climate adaptation applied by the Tambi traditional house. The image data taken in this article is secondary data, from scientific journal literature. The main materials used include bonati wood, bamboo, and ijuk, each of which has a specific function in the structure and design of the house. The pillars in the Tambi traditional house use wood because they have high compressive and tensile strength. In addition, because of its resistance to pests and rot, this material is also used as the main frame. Bamboo in the Tambi traditional house is used as a wall element because it is porous so it can support air circulation in the house. Meanwhile, ijuk is used as a roof because of its good water resistance and thermal insulation properties. This study found that the shape of the stage and the steep roof angle are solutions to the local climate. In addition, the local materials used are not only environmentally friendly but also reflect harmony with nature and resources. The results of this study are expected to increase insight into traditional architecture, especially the Tambi traditional house, as an architectural heritage that responds to the climate in its design and materials.

Keywords: Climate adaptation, Architecture, Tambi Traditional Houses

1. Introduction

Traditional Indonesian architecture is a cultural-architectural heritage related to the interaction between humans and their environment. In the context of this interaction, traditional architecture is not only seen from an aesthetic perspective but also an expression of local culture, a response to geographical conditions, and local climate. Awareness of the importance of sustainability and the development of the built environment also supports studies on traditional architecture, especially in exploring the principles of climate adaptation. This is relevant because climate adaptation in traditional architecture has been applied before the concept was introduced in contemporary architectural terminology.

An example of climate adaptation in traditional architecture is the traditional Tambi house in Central Sulawesi. This traditional house shows architectural principles that are a deep understanding of the community towards its surrounding environment, namely humid tropics.

This humid tropical environment is related to its geographical context. The characteristics of the climate in this region are characterized by high rainfall and high humidity. Based on this, local people respond to these environmental challenges through adaptive architectural designs, both in terms of form and material selection.

In terms of form, the traditional tambi house uses a stilt house system with the main structure using wood. The wood used is also selected for its type that is resistant to weather and insect attacks. The roof of the tambi house is saddle-shaped with a steep, towering angle. This roof shape is designed with the aim of accelerating

the flow of rainwater and increasing natural ventilation. The interior is arranged without massive partitions, allowing optimal air circulation to reduce the accumulation of heat and humidity. The open layout also reflects the social and functional values of the Lore community, where the relationship between domestic and collective activities takes place dynamically in one unified space.

The use of local materials is quite an important aspect in the discussion of climate adaptation in tambi houses. Natural materials such as wood, bamboo, ijuk, and materials with other natural fibers have good thermal insulation capabilities. In addition, these materials are also available in the local environment. So because of their availability and ability to reduce heat, withstand humidity and good durability, these materials are chosen for use in traditional tambi houses.The use of local materials also reflects the principle of sustainability and local wisdom values that are oriented towards the balance between humans and nature.

Based on this background, the study of climate adaptation in the Tambi Traditional House is important not only as an effort to preserve traditional architectural knowledge, but also as a source of inspiration for the development of contemporary architectural designs that are more responsive to climate. The main focus of this study is to explore the relationship between building form (including structure and spatial layout) and local materials as two main aspects in climate adaptation strategies.

2. Material and Methods

This study uses a descriptive qualitative method that aims to identify and explore climate adaptation strategies in traditional tambi house architecture. This identification and exploration review two aspects, namely the form of the building and the use of local materials. The qualitative method was chosen because it is in accordance with the objectives of the study and allows researchers to reveal the meaning and context as well as the physical conditions as a whole. The case of this study is the traditional tambi house as the main object. This case study approach was chosen with the consideration of obtaining a complete understanding of an architectural observation object according to the context of its place, culture, and climate.

This study uses secondary data to obtain material on the building form and spatial layout of traditional tambi houses. These secondary data are analyzed qualitatively. The analysis is carried out descriptively-qualitatively which is divided into three parts, namely typology analysis of spatial form, material use analysis, and climate adaptation analysis based on previous analysis findings. The next stage of analysis is the interpretation of the findings to reveal the relationship between building form and material use as a climate adaptation strategy.

3. Results and Discussions

This study analyzes climate adaptation in traditional houses through observations of two main aspects, namely building form and material use. The analysis was carried out based on secondary images from research that has been published in scientific journals. The results of the analysis show that the climate adaptation strategy in the Tambi House is comprehensive, integrative, and formed from the community's understanding of their environment. Darojah (2017) explains that in general the Tambi house is divided into three parts, namely the roof, living space, and feet. However, Koesmartadi (2020) states something else. Koesmartadi states in his writing that the Tambi building from Central Sulawesi is a building that has a head and feet, but does not have a body. (Koesmartadi, 2020). Fauzi (2016) explains that in the Tambi house there is no clear distinction between the roof and the walls.

Because of its simple triangular typology, the roof itself functions as a wall at the same time.

Source: (Fauzi, 2016)
Figure 1: Tambi Traditional Houses

Nowadays, the Tambi traditional house is a cultural symbol for the people of Central Sulawesi Province. However, in the past, this traditional house also functioned as a residence for most of the Kaili tribe. (CIF in Bolle, 2017).

3.1. Adaptation of Building Form
Architecturally, the traditional Tambi house shows adaptation to rainfall and humidity through several strategies, including: (1) Stage form or distance from the ground; (2) Gable roof with a steep slope; (3) Minimizing openings in the building walls.

3.1.1. Stage Form
The traditional Tambi house is staged, or provides distance from the ground below. The pillars that support the stage are wooden pillars. This form allows for air circulation on the lower side. This air circulation will reduce humidity and keep the room temperature cool. Functionally, the stage form will protect the house during the rainy season, so that rainwater does not enter the house.

Darojah (2017) stated that the Tambi house has a leg structure made of round (intact) wood and arranged crisscrossed on a stone base. Then to enter the house, residents must use the entrance stairs, namely notched wooden beams. Under certain conditions, these stairs can be moved or put into the house. Meanwhile, according to Rahmatullah (2024), this tambi house has a distinctive stage shape. With a wooden structure that can provide stability and strength so that this house is safe for the environment. In addition, the house is also resistant to rain, floods, and earthquakes as well as attacks from wild animals.

3.1.2. Steep roof
The typical shape of the traditional Tambi house is the steep, saddle-shaped roof. This roof is dominant and almost covers the entire body of the building. The slope of the roof is close to 45 degrees. This slope functions to accelerate the flow of rainwater so as to prevent seepage or leakage. In addition, the shape of the steep roof also allows for the movement of hot air upwards (thermal convection), creating good air circulation in the house. The air cavity between the ceiling and the roof creates a passive insulation zone that helps regulate the temperature in the room. This is also stated in the writing of Darojah (2017) that the roof structure of the Tambi house is saddle-shaped consisting of long gables and ridges. At the top of the house (peak) there is a decoration that symbolizes the highest class in the caste system of society. In local terms, this decoration is called the panapiri knot.

3.1.3. Minimizing Openings
Tambi houses generally have limited window openings, especially on the sides. The minimal openings are the tambi house's response to high rainfall and wind direction. With minimal openings, it can reduce the entry of rainwater into the house. Instead, air ventilation is obtained through gaps between materials or on the roof, which allows air flow without endangering thermal comfort. In Fauzi's writing (2016) it is stated that the Tambi House does not have windows and also does not have room partitions. It can be described that the tambi

house consists of one large room that is used for various daily needs. This tambi house can be inhabited by around 5 members. Inside the house, the room has three areas that have different functions: Lobona, Asari, and Rapu (Kemalasari in Fauzi, 2016).

3.2. Adaptation Through Traditional Spatial Planning

The spatial planning of the Tambi House is designed to be simple but functional, with the principle of flexibility and efficiency of space that supports adaptation to the climate.

3.2.1. Multifunctional Space

The space in the Tambi house is generally not permanently divided. One main room is used for various activities, such as sleeping, gathering, cooking, and receiving guests. This design facilitates air flow and avoids trapping heat or humidity in a closed space. The flexibility of space also allows activities to be adjusted according to weather conditions or the number of occupants. Darojah (2017) explained that the Tambi house has a rectangular plan and low walls. In the middle of the room there is a fireplace that is used as a place to cook. The average size of the building is 6m x 7m with one entrance at the front of the house. Bolle (2017) stated that the average floor area of the Tambi house is 5m x 7m with one access in and out of the house using one entrance and one staircase at the front of the house. In addition, stairs generally have an odd number of steps if the homeowner is a commoner, and an even number if the homeowner is a traditional elder. Meanwhile, Fauzi (2016) stated that the size of the tambi house does not have a specific standard or rule. The size ranges from 3m x 3m to 6m x 9m, depending on the availability and affordability of building materials when the house is built.

Fauzi also explained that the wooden floor in the tambi house is called Lobona. Lobona is used as a shared space and is used flexibly. Examples of activities carried out in lobona are gathering, eating or receiving guests. Another part of the tambi house is asari. Asari is a high stage made of wooden planks that can be used for sleeping and as a place to store valuables. Asari surrounds the room and is made clearly recognizable as a transition between the floor and the walls/roof. The surface of Asari is 35 cm higher than Lobona. While Rapu is the "peak" of the house. Asari serves three different functions at the same time, as a home kitchen, as a fireplace to warm the room and as a source of light at night. (Fauzi, 2016)

3.2.2. Spatial Orientation to Climate

Local culture regulates the orientation of Tambi houses, which may only face north or south (Darisandi in Fauzi, 2016). Facing the sun directly is prohibited by local customary law. There is no information about the reasons for this prohibition, but from a technical perspective, it is related to the adaptation of the house to the climate. The direction of the face will help the house to maintain a relatively stable temperature throughout the day. The location is very close to the equator where the sun's path divides the sky relatively in the middle without going too far north or south. The north and south orientation for building openings is also adopted in many modern buildings. The placement of the house and the orientation of the entrance tend to pay attention to the direction of the wind and sun. This orientation shows the ecological awareness of the community towards passive thermal comfort.

3.3. Adaptation Through Local Materials

The use of local materials in the Tambi House is an important part of the climate adaptation strategy. The materials chosen reflect local knowledge about the physical properties and their resistance to humid tropical conditions.

3.3.1. Bonati Wood as the Main Structure

Bonati wood is used for the main structure of the building because of its resistance to humidity and termite attacks. This wood is dense but flexible, easy to shape, and can last a long time if maintained regularly. The use of wood as the main structural element also provides a more comfortable thermal effect compared to modern materials such as concrete or metal, which absorb and reflect excessive heat.

The structure of the Tambi house is a stilt house with short supporting pillars that are no more than 1 meter high. There are 9 pillars and they are attached to each other with wooden beams that are doweled. The pillars support the floor and frame of the house by supporting the foundation in the form of large square stones at the bottom. The pillars that support the uprightness of this Central Sulawesi traditional house are generally made of bonati wood, a type of forest wood that has a strong texture and is resistant to decay. The pillars support the floor frame made of planks. The floor of the house itself is made of planks arranged close together. (Bolle, 2017)

3.3.2. Bamboo and Woven Walls
Some houses use bamboo or woven bamboo as secondary walls or interior partitions. Woven allows for natural cross ventilation, while also functioning as a good thermal insulator. This material is lightweight, easily obtained, and can be partially replaced if damaged, reflecting the principle of material sustainability.
The materials used for the floor are mostly wooden planks while the roof is made of bamboo mats with dry palm leaves. This shows that Tambi uses lightweight materials with low thermal capacity. The results of the study showed that the use of these materials cannot meet the need for comfort for 24 hours because the interior space experiences under heating at certain points at night. However, the heat generated by Rapu is very useful for overcoming under heating conditions in this interior space. (Fitriaty in Fauzi, 2016).

3.3.3. Roofs from Palm Fiber or Rumbia Leaves
The traditional roof of the Tambi house uses palm fiber or rumbia leaves that are arranged tightly. In addition to being resistant to rain and heat, this material also functions as natural insulation that keeps the indoor temperature stable. The fiber structure of the palm fiber allows air to flow and heat does not directly penetrate into the interior space.

4. Conclusion

The results of this study show that the traditional tambi house in Central Sulawesi, Indonesia is an example of vernacular architecture that applies contextual climate adaptation strategies. Through a qualitative approach, analysis of building forms (architecture and spatial planning) and the use of local materials reveals that the local community's response to the environment is not partial, but rather an integrated system that reflects a strong ecological and cultural understanding.
Some effective strategies for traditional tambi houses in responding to or adapting to the climate are the stage form, steep gable roofs, and limited openings. These three things answer local problems, namely high rainfall and humidity. So this strategy can increase thermal comfort for its occupants. In terms of spatial planning, with open and open spaces, air circulation will be smoother and open up the possibility for functional adaptations that are adjusted to the needs of the occupants.
On the other hand, the selection and use of local materials reflect the principles of environmentally friendly architecture. These materials are not only in accordance with local climate conditions, but also strengthen the values of local wisdom. The integration of form and material is key to creating climate-resilient

housing without relying on modern mechanical technology.

Traditional tambi architecture reflects knowledge that is appropriate for responding to local climate challenges. In the current context, this knowledge can provide input and considerations in the design of buildings in tropical areas based on locality.

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