The Sustainability of Construction Technology of Mandailing Traditional Wooden House in Sibanggor Julu Village

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Abstract. SibanggorJulu is one of traditional village located in Mandailing, Sumatera Utara. The houses in the village were built by tradition ability from generation to generation. However, the sustainability of craftsmanship and technology slowly lost by cultural and economic change. The objectives of research was to identify and inventory the communities technology and expertise in construct a traditional house and find best solutions to preserve its existence. The identification and inventory is done by making a technical drawings, materialsdecription, and craftsman skills. The research method approaches by qualitative and experimental. It discussed by descriptive analyticfromobservation, interview and study of literature relevant with focus of discussion. The results obtained that the technology of construction of Mandailingtraditional house is currently applied and downward to the next generation. The sustainability of craftsman expertise are preventing because of the availability of local materials and the economic capacity of communities to build their houses. Nevertheless, the traditional houses of Mandailing still have place in the hearts of the community with all its limitations. Finally, the solutions provided to maintain the sustainability by preserving, craftsman training and informing similar material and strength properties.

Keywords: sustainability, construction, traditional house, Mandailing.

1 Introduction

SibanggorJulu Village is a traditional village in Mandailing, Sumatera Utara. The village is very unique and distinctive which is shown by the house form with a strategic location in the BatangGadis National Park (TNBG). TNBG is a tourist spot located at the foot of SorikMarapiMountain. The attraction of SorikMarapiMountain is the entrance for tourists to come to the SibanggorJulu village. Typical architecture should be maintained as another attraction in the TNBG area. Therefore, it is very important to maintain the sustainability of Mandailingtraditional wooden house in SibanggorJulu.

The traditional house in SibanggorJulu is a type of traditional wooden house with the characteristics of a stilt house and palm fiber as the roof covering. The building is made with wood construction and the use of local materials done through traditional craftsmanship skills. However, the houses are threatened with extinction along with economic and cultural developments. The availability of local materials and craftsmanship skills slowly disappear and are not inheritance to the next generation is one of the causes of the loss of tradition of

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establishing traditional wooden houses in SibanggorJulu. In fact, this happened almost all over Mandailing area.

The Knowledge of traditional wooden house construction is an attempt to translate skills, materials, tools and building processes with local knowledge.Thus, it can survive in the community, and technically become a document for learning the reliability of traditional wooden building structures.

2 Methodology

This research was conducted with an experimental and qualitative approach which was explained descriptively analytic. Data obtained from observation, interviews, field and laboratory testing.Research location is in several villages in Mandailing. Some of villages have similar forms of houses, craftsmanship skills, and materials.However, there are some modifications that have been made by the community that reduce its authenticity.Meanwhile, the houses in SibanggorJulu Village are still preserved. Therefore, the locus of SibanggorJulu Village was chosen as the observation location.

3 Traditional Wooden House Of Sibanggor

SibanggorJulu settlement is dominated by wooden houses that are traditionallybuilt, and some of built with conventional. Besides, many houses in the village have been modified, both in form and material.

The location of strategic settlements in TNBG causes the village always be visited by local tourists. The emergence of tourists became the gateway for SibanggorJulu village to improve themselves, especially from architecture. The wooden houses that are still preserved can be introduced to tourists who go through villages. The uniqueness of building techniques and materials used can be an attraction for tourists to get to know the history and culture of Mandailing.

Traditional wooden houses in Mandailing consist of three types, including bagasgodang (the king's house), the house of the royal family, and the community house. The difference in typology of the house is marked by the size of the building, the shape of the roof, the arrangement of spaces, number of column, and ornamentation. Construction is composed of local wood materials, namely Bania, Medang and Surian wood, as well as traditional building techniques. The difference in construction is clearly visible on the roof frame. Bagasgodangroof shape is larger than other types of houses, composed of a complex roof frame, but with a simple arrangement. And the arrangement is different from conventional wooden houses.

Foundations and roofs are the most prominent building components and characterize traditional house architecture in Mandailing. The foundation of stone material was chosen and taken from around the settlement.Foundation joints with building frames do not use bonds found in conventional construction. The stone serves as the foundation of the building frame and aligns the lateral movement of the earth when an earthquake occurs.This foundation construction can be calculated for its strength because it has survived for decades. However, the traditional wooden house in SibanggorJulu is vulnerable to damage and burning, both material and construction.

Therefore, it is necessary to trace construction technology in field observations and laboratories tosupport sustainability efforts and maintain the reliability of buildings in a longer period of time, as well as carry out building maintenance according to the character of materials and construction.

4 Construction Technology Of Wooden House

Sibanggor traditional wooden house construction technology can be traced to the method and technique of building construction, which consists of construction, material and craftsmanship skills.

4.1 The Construction and Material

The architecture of the traditional Sibanggor wooden house is a stilt house. The building is composed of components and elements of building, such as foundation, floors, walls, roofs and supporting elements. The characteristics of construction are marked by a frame system composed of column and beams, and walls as fill elements. This house uses local materials, namely stone, timber, bamboo and palm fiber. Overall, the construction of the SibanggorJulu wooden house is a lightweight construction and context with natural conditions.

SibanggorJulu Village is located in PuncakSorikMarapiSubdistrict, Mandailing Natal District. The village is located at foot of SorikMarapi Mountain.MandailingNatal Regency is included in the physiographic unit of GrabenPanyabungan which is part of the Sumatra Fracture System (madina.go.id,2014). Mandailing geological conditions are quite complex with types of rock are Permocarbon to Resen. The land is rocky hard soil. And rocks obtained from lava that came out of volcanic eruptions decades ago. Thus, this village is very close to the earthquake epicenter, especially earthquakes caused by volcanic eruptions.

Fig. 1. The characteristic of environment of SibanggorJulu.

Earthquakes occur and will damage the human environment (ie.buildings) one of which is determined by the distance of the hypocenter or epicenter (Idham, 2014). In addition, the type of soil, the duration of the earthquake and the design of the building also determine the

damage. Earthquake activities around the SorikMarapiMountain area are dominated by type of distant tectonic earthquakes.

The energy of the earthquake force and the load of the building itself greatly affects the physical building as a whole during the earthquake. In addition, environmental factors also determine the effect of the earthquake on buildings. The same magnitude of earthquake in different areas will have a different impact on buildings. Building damage due to earthquake depends on the strength of the earthquake source and the energy waves that are transmitted to the building site are located. Therefore, it is necessary to consider the size of buildings, structural systems, and building materials to reduce the lateral load of earthquakes that shake the building.

Sibanggortimber houses are included in the category of non-engineered buildings that are builtin local or traditional ways and techniques without expert building services. In general, traditional local buildings tend to have a high response to earthquakes. Because of rapid developments and changes of construction technologyare necessary to keep analyzing the reliability and sustainability of these buildings.

Fig. 2. The tie between foundation and column.

The structure of Sibanggortraditional wooden house is a lightweight building structure system, consisting of a column and beam frame system, a wall as a fill element, and palm fiber as a roof covering. Building size is between 4 x 5 meters to 5 x 6 meters. This size can be categorized as a small building. The building function is very simple, consisting of a common room (called pantar), a kitchen (called bolat), and a bedroom (called bilik). The uniqueness of the building is also marked by local materials such as timber, stone, bamboo and palm fiber. These materials are quite light for the building support system which is the foundation, especially to reduce the lateral movement of the earthquake. Overall, the building structure applies a flexible system by applying a mortise-join system connection. In this case, the mortise-joinsystem serves to reduce rigidity in the structure. Therefore, Sibanggortraditional wooden houses can be said to fulfill the requirements of earthquake resistant buildings.And it is necessary to apply for sustainability of the reliability and performance of the building structure. Efforts can be made through determining the level of vulnerability of buildings to earthquakes with the RVS (Rapid Screening Visual) method which aims to categorize the level of security of the building population quickly.

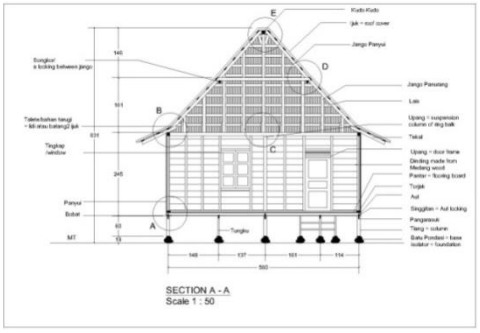

Fig. 3. The construction of tradisional wooden houseof SibanggorJulu.

Timber is the dominant building material that forms the Sibanggor house. Besides timber, other materials are bamboo, palm fiber and stone. The types of woodmaterials used include: Bania, Surian, medang, buluh soma (Schizostachyum BrachyladumKurz), and arena / enau / bargot (ArengaPinnataMerr.).

These building materials were obtained from the area around the village. The growth location of each material is in preserve forests, in community plantations, and grows wild around settlements. Bania is a type of hard wood, Surian is lighter than others, Medang gives off a distinctive aroma, and BuluhSomais a wild plant that has a harder character than other bamboo species in the SibanggorJulu area.

Based on the Indonesian Forest Management Unit (KPHI), timber forest products in Mandailing Natal are dominated by Medang (Litsia firma HK.F), Kelat (XylopiaaltissimaBoerl), Lesions (Tarretia), Meranti (Shoreasp), Resak (FaticaSongaV.Si), and Laban (Vitexpubescensvalil), Kapur, Kruing, Bania, Merbau,Rengas. The wood is very potential to be developed or utilized.

Timber is mainly used to build houses in Mandailing Natal, including Sibanggor. Bania is a type of wood generallyused for structure compared to Medang. They are used on columns and beams.Other woods namely Surian are usually used for building elements such as walls, door-window frames, and floor boards. Moreover, bamboo is also used as a building element, among others, as a wall, underpurlin, and to tiedthe roof covering.

The wood age ranges ± 20 to 30 years. Before apply as building components,the woods first dried through natural processes. The process is done by drying the wood in the sun for ± 2 weeks or more, depending on the sun's heat. After the building is built, maintenance of building materials is carried out in a natural and chemical treatment process.Natural treatments occur through theburning process, when the cooking process is in the kitchen area. In addition, the chemical method used is to apply oil to timber parts, especially those that intersect with the outside area.

The characteristics of wood materials used for Sibanggortraditional wooden house are as follows(Winoto, 2014).

1. Bania known as Meranti Merah. The wood included in a primary class of wood.Specification of density is 0.05, durability classified in class III and IV, strength in class II and IV on timber industry’s Indonesia. If Bania used as column and beams, then its durability can last long for several years. However, if this type of wood is associated with moist soil, then its durability is very short about ± 3 years. This wood is quickly attacked by insects and is rarely attacked by dry wood powder.

2. Surian included in the jungle wood category that included in a secondary class of commercial timber. Surian known as good quality wood.This wood has economic value. It is a good quality of wood and not easy to decomposition and attack by insect. The wood sizes range from 40 to 60 meters. Almost all parts of wood can be used because it has a free of branches can reach a height of 25 meters. Wood diameter ranges from 1 to 3 meters with a height of 2 meters. Wood characters are physically broken and overlap on the trunk. This wood is characterized by the colour of the bark which is whitish brown and grayish, and release a distinctive aroma when it cut. It is a lightweight timberand suitable for building materials, especially for walls, door-window frames, and floor boards.Specification of density is 0.39, durability classified in class III and IV, strength in class III and IV on timber industry's Indonesia.

3. Medang included in the Meranti category. It isa primary class of wood. Durability classified in class III and IV, strength in class II and V on timber industry's Indonesia. The durability of Medangis not different from Bania and Surian. There are speciesof Medangsusceptible to insect-attack and dry wood powder, some are not.

4. Schizostachyum Brachycladumis known as Bamboo Betung / Petung.Type of bamboo forms area cluster, timeless, green throughout the year. Theculm has a length of 10-15 meters and a diameter of 60-80 mm. The Intermodeshas a thickness of 3-5 mm and a length of 20-50 cm, smooth, pointed and cylindrical. Bamboo Betung including the appropriate type of bamboo usedfor buildings. Bamboo in the Sibanggor wooden house is used as a wall, a purlin, and joinery. Bamboo is not the main material in the Sibanggor wooden house, but can be used as a substitute for a member of roof frame because of its lightweight.

Based on the results of field testing using a Sylvatest measuring instrument (Nasution, 2018), in general the Modulus of Elasticity (MoE) Static averages 12432.77 Mpa. Based on SNI 7973: 2013 included in the E12-E13 quality wood category. This type of wood meets the requirements for building structural components (column, beams, floor boards, walls, roof ring beams, and roof frames). From the test results found MoE below the average which indicates a change or decrease in strength or quality of wood due to cracking or weathering due to age.

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4.2 The Craftmanship

Building knowledge of timber has become a tradition in almost all regions of the archipelago (Armand,2014). Traditional Indonesian society has known this tradition for hundreds of years.However, knowledge of how to build and the building is not generously documentated. Today, documentation on tradisional architecture have been encountered and discussed from a variety of perspectives. The documentation is important to continue to be carried out so that a sustainable tradition can be maintained, even though the artifacts are lost or damaged.

Traditional building consciousness cannot be separated from the periodization of history in Indonesia. Traditional craftsmanshipartistry develops not only in terms of skills, equipment, but art and architecture that have material consciousness. As quoted from Armand (2014), material consciousness is the awareness of a craftsman to produce something of quality with sensitivity to energy, materials, natural environment through local equipment. However,the rapid development slowly eliminated the art of material consciousness from building craftsmen, even architects today. This is important because Indonesia still have well-made traditions, manpowersurplus, rich of natural materials, and prioritizing the equipments, in a period of time.

The traditional SibanggorJulu wooden house was built by techniques, equipment, and craftsmanship skills from generation to generation. The craftsmansip skills slowly disappear and shift into conventional skills. It persists when the techniques and building itself is still in demand and preserved by the community.SibanggorJuluVillage is potentialto maintain its tradition, especially the tradition of wooden houses. The community interest and needs to establish traditional wooden houses still exist, but the availability of skilled human resources is very limited.

The number of experts in traditional wooden houses in SibanggorJulu Village is very limited. Currently,there are only three craftsmen who have close family ties. In addition, other craftsmen are not categorized as an expert but a beginner.The skills of expert craftsmen to the beginners are not done specifically and intentionally. The skills are derived by observing and following building techniques applied by expert craftsmen. This process can shift from noblecraftsmanship skills into practical skills. The desire of the young generation is decline as traditional carpenters. It is caused by a long and difficult work process, financially unable to cover the needs of everyday life. The availability of craftsman, local materials, equipment, and traditional techniques will be lost, if these elements are not inherited and spreaded to the next generation. Efforts must be supported by material consciousness from expert craftsman, who act as architect and finally able to produce traditional architecture that is ethical and aesthetic.

4.3 The Sustainability of Traditional Wooden House of SibanggorJulu

Traditional wooden structures, in this case old or historic buildings, represent an important part of the World Cultural Heritage. The techniques and timber building materials are the history and conservation activities are essential contributions to cultural diversity and cultural wealth globally (Cavalli, 2014). Traditional timber cannot be seen and assessed as a new construction, because the testing continues until now. When a timber structure cannot be conserved, it needs to be repaired or given reinforcement. Therefore, traditional timber testing activities need to be continuously carried out.

Based on the Wood Committee Principles described in the Conservation of Historic Timber Structure (Larsen, 2016), in the effort to preserve and repair the timber structure of historic buildings such as traditional buildings, as much as possible make duplication that aims to reward previous generations' insights, policies and knowledge. This means that 1) when replacing one of the timber structures it should be replaced with the same typeof wood or similar quality, 2) the tools and techniques used are identical or similar to the tools and techniques used by the previous craftsmen to be formed and assembled according to wood. The policies and knowledge of previous generations through material, tools and craftsmanship techniques became authentic historical documents. By duplicating the choices and efforts of the previous generation, the beauty expected by the creator of the structure can be maintained. If the original choices do not prove to last long, then the latest solution must be chosen.

The characteristic change of construct traditional wooden house is by replacing parts of the structure damaged by fungi and insect-attack, or weathered and burned. And the sustainability of traditional craftsmanship skills is to carry out continuous preservation activities.

5 Conclusion

The sustainability of building techniques, local materials, and traditional craftsmanship skills in establishing traditional wooden houses in SibanggorJulu is important to be preserved. Efforts are made through substitution of building materials with local materials that have strength and durability qualities that resemble existing timber, and apply local construction techniques. In term of craftsmanship skills, the approach can be done through participatory community in the form of craftsmanship training for beginner craftsman about the importance of construction and traditional skills to be developed in SibanggorJulu, even in other Mandailing areas.

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