

## THE VERNACULAR ARCHITECTURE PRINCIPLES IN MAKING MOUNTAIN ROCK FOUNDATION IN KENDARI CITY

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**Abstract** -- Ordinary audiences who do not have formal education such as builders are called vernacular architects. In Kendari City, in general, public housing is built by a vernacular architect. The foundations made by vernacular architects do not use empty stones and sand dunes. The foundation is made partially in the hole and is made partially on the surface of the soil. This research is aimed to formulate the knowledge of vernacular architect on mountain rock foundation. This type of qualitative research with the descriptive approach used in this research. The resource is determined by the snowball method. Data collection was done by observation and in-depth discussion on three construction workers. Data were analyzed by the descriptive method. The research concludes that the vernacular architect in making the mountain rock foundation is rigid but also flexible, in order to respond to earthquake disaster. Rigid principles are found on mountain rock foundations, empty stone plates, nail terms on empty stones, chicken claw foundations, hierarchy on the floor, sloof and foundation relationships. Flexible principles are found in sand dunes, empty stones, anchor depth, and mortar for plaster.

**Keyword:** Vernacular architecture; Kendari City; Mountain rock foundation

### INTRODUCTION

The diverse cultures of hundreds of ethnicities are owned by the state of Indonesia, so there are also hundreds of vernacular building types in Indonesia. The vernacular architecture in Indonesia has something in common because it comes from the same root (Austronesian culture).

The characteristics possessed by vernacular buildings, as follows: 1) Vernacular buildings locally oriented and built by local craftsmen with simple logic (Gartiwa, 2011); 2) Vernacular buildings are called unique, because they are built with hereditary methods and knowledge; 3) Vernacular buildings adapted to the needs and customs of the people; 4) Vernacular buildings are resistant to the natural environment; 5) Vernacular buildings are not supported by correct building principles and theories; and 6) Vernacular architects including the general public and the general public who do not have formal education such as builders (Becalli et al., 2018; Niroumand et al., 2017; Triyadi et al., 2009).

In every construction of a construction project required a strong structural planning, safe, and comfortable. The foundation is one of the buildings that support it (Nuryanto and Wulandari, 2013). The lower structure of a building is called the foundation and is assigned to carry buildings on it (Ghaffarianhoseini et al., 2017; Sitohang and Roesyanto, 2014). The foundation is an important part of the housing development process and is currently required to work effectively (Alessandro, et al, 2013). The work with earthquake-proof requirements on the foundation structure is

adjusted to the following specifications: 1) The foundation needs to be placed on hard ground; 2) The cross-section of the foundation is made symmetrical; 3) The foundation should be avoided from placing on some hard soil and partly soft soil; 4) The length of the floor plan on the building should be followed by a continuous foundation; 5) Constant foundation needs to be made at the same depth; 6). The width of the bottom side of the foundation is made at least 60 cm (Matar et al., 2017; Evita and Supriani, 2012).

The principles of earthquake resistant foundations need to be prepared as follows: 1) Where local foundations are used, they need to be tied to each other rigidly with a fastening block; 2) The foundation on soft soil conditions is used of concrete plate foundation; 3) Foundation pole on hard soil used in stilt house tied with confinement cross (Hidayat and Lindawati, 2008).

The foundation and sloof are categorized as lower structures and assigned to retain the above structures, as well as forwarding the load to the ground with the following conditions: 1) Comparison of cement and sand compositions used in mixture 1: 4; 2) The width of the top of the foundation is made at least 30 cm, the width of the bottom, and minimum width of at least 60 cm. The depth of the foundation is made at least 60 cm; 3) Sloof beams need to be made anchor in the foundation with anchor distance of 1 m and used the size of 12 mm steel reinforcement; 4) The column stretch is anchored to the foundation as deep as 30 cm; 5) The foundation is made using crushed stone; 6) Comparison of cement: sand:

gravel for sloof made with mixed composition of 1: 2: 3; 7) Unassumed simple house made dimension sloof 15 cm x 20 cm. The minimum main drill is made with a diameter of 10 mm and the diameter of the 8 mm diameter reinforcement. The distance of the stirrup is made 150 mm (Direktorat Jenderal Cipta Karya, 2006).

The foundation stone for earthquake resistant houses is made with the following rules: The foundation is made with an average depth of 60 cm, a width of 30 cm, and a width of 50 cm. The surface of an excavated bottom is dumped with  $\pm$  10 cm thickness of sand dew and sprinkled with water evenly (Supriani, 2009). Thus it can be concluded that the foundation rock material is made with a rigid principle (eg: the foundation needs to be tied to rigid) but also flexible (eg: foundation pole located on the house stage). In Kendari City, in general, public housing is built by builders (vernacular architects). Homes built by vernacular architects have simple structures such as foundations. Empty stones and sand dunes are not used in making foundations by vernacular architects. The foundation is made by a vernacular architect partially in the hole and partially reappeared above the ground. This research is aimed to formulate the knowledge of vernacular architect on mountain rock foundation.

## METHOD

This research was conducted in Wuawua Village, Wuawua Sub-district, Kendari City, Southeast Sulawesi. This type of qualitative research with the descriptive approach used in this research. The foundation is made by experienced construction workers (at least 10 years), often making the foundation, and the construction workers are understood and know about the foundation is the criteria for determining the source. The resource is determined by the snowball method. Data collection is done by observation of the foundation being made and the finished foundation. Data collection was also conducted by an in-depth discussion of three construction workers.

Understanding of foundation, foundation function, foundation type for house, foundation hole, sand for foundation, sand under foundation, sand, trapezoidal foundation, foundation, stone for foundation, foundation stone, the pattern of arrangement of the foundation stone, the definition of empty stone, the function of empty stone, the thickness of the empty stone, the location of the empty stone, the understanding of the nail on the empty stone, the foundation poer plate using the foundation of mountain rock, the relationship between sloof and foundation, the depth of anchor in the foundation, the mortar ratio on the

foundation, the foundation hoarding, the cause of the foundation damage, and the hierarchy on the floor are questions posed to construction workers. Data were analyzed by a descriptive method so that the principles of a rigid and flexible foundation were found.

## RESULT AND DISCUSSION

The foundation is also referred to as a base on a building to be erected. The foundation functioned as follows: 1) The foundation is made as the beginning (base) to make the building; 2) The foundation is functioned to hold the load on it, such as wall load; 3) Foundation functioned so that the building wall is not easy to crack and the building body free from water immersion, because the foundation can lift the body of the house. The types of foundations for simple houses consist of mountain rock foundations, chicken claw foundations, and foundations of hanging/stakes/earth spikes. The type of foundation for the area where the aqueous soil structure is used is the foundation of earth nail or foundation that is assembled from bamboo, foundation poer plate, and mountain rock foundation. Chicken claw foundation is interpreted the same as the foundation poer plate. Punch foundation made of concrete plates (bottom) and in the center placed the pole or shoes. Poer plates functioned so that the foundation is not easily down to the aqueous soil structure.

A large compression force from the foundation can be retained by the foundation of the plate poer. The foundation of the earth nails is strung together using a bamboo material because the bamboo material is resistant to water. Foundation terrace is a continuation of the foundation of the house body. The terrace foundation is not made of red stone. The shape of the foundation pit was made a box because it was easy and quickly dug. The trapezoid-made foundation pit formation tends to be difficult to dig.

The clean sand material is used in making foundations. Good sand is used to make the foundation white and not mixed with soil or mud because the soil and mud do not bind each other with a mixture of cement and sand. In Kendari City, sand pohara material is a good type of sand when used as a mixture of concrete, because it has been tested, black, and good strength. A sand cover should be used with an empty stone. Overlay sand functioned as bending rock foundation. The foundation that does not wear sand is categorized as a non-limiting foundation. When the soil is cracked, the cracked cavities will be filled with sand, so the soil is again solid. The shape of the rock foundation made of symmetrical trapezoidal rock. The trapezoidal symmetrical

shape is defined as a stable form to withstand vibration and shear forces since the strong shape is characterized by the ever wider form. The main strength of the line foundation lies at the base of the foundation. Decrease tends to be easily experienced in the form of a boxed foundation.

The mathematical formula is not used by the vernacular architect in making the foundation but is based on the experience of the craftsmen. The height of the foundation for simple non-storied building is made with the size of 50 cm, 60 cm, and 70 cm. The width of the foundation head is made with a size of 25 cm. The width of foundation base is made with size 80-100 cm. The width of the foundation base can be made more than 100 cm if the load is located on a heavy foundation. The width of the foundation base is adjusted to the width of the sloof base. The height of the two-floor building foundation is 70-80 cm in size and the width of the foundation head is 30 cm in size, due to the large compressive force owned by the two-floor building. The higher the wall is made, the greater the force of the press. Thus, the shape of the foundation should be large because it is adjusted to the weight of the wall (the second floor consists of two stacking walls). The base width of the foundation for the level building is made 80-100 cm. Above the foundation head on a two-floor building there is a sloof with a width of 20 cm.

Rock rivers and mountain rock is a good type of rock used as a foundation rock material. A material of mountain rocks or river rocks selected to create a foundation based on the location of the building was erected. If the location is a lot of rock material, the stone is used rock mountain. Rocks that are processed from combustion products are not well used for foundation rock material because it is easy to crack. The shape of a large rock is best used as a foundation material, because the larger the rock, the more solid foundation of the building. If the form of a large rock is difficult to obtain, it can be used a variety of rock forms.

Rock foundation material is prepared using a pattern. Stone mounts are arranged without a pattern is feared easily shifted. The pattern of a compilation of mountain rock is equated with the pattern of arrangement of red stone. A red stone pattern is arranged by way of grout at the bottom and grout at the top is not found each other. The pattern of arrangement of stones like this is categorized as a pattern of arrangement of foundation stone that is responsive to earthquake natural disaster so that the foundation is expected not easy to crack and broken. The pattern of the foundation stone placement is arranged by means of the largest stone placed at the bottom, then the

medium-sized stone, and then the small stone. Large stones are placed at the bottom because large stones can prevent collapse.

An empty stone is defined as a rock at the bottom of the ground that is arranged without stacking or the rock that is located at the bottom of the foundation (after the mountain rock pair). Empty stones are used as follows: 1) Vibration dampers generated by earthquake disasters; 2) Empty stones are used to place the foundations of mountain rocks; 3) Empty stones are used to flatten the position of the mountain rocks standing on it; and 4) Empty stones are used to solidify the ground. Empty stone thickness made situational. If the blank stone thickness in the drawing is made 20 cm, but the stone available at the location is larger or smaller in size, then the stone available at that location can be used. An empty stone that is suitable to be used with large size and formed round, because durability is stronger and not easily broken. The type of stone times formed with wide easily broken, because of the fibrous texture.

An empty stone pairs need to be leaned on a quarry or out a few centimeters from the lower end of the foundation stone bed. If an empty stone is not leaned on the excavation, then the mountain rock on it is feared to easily shift. Empty stone pairs need to be used on the foundation. A foundation that does not use an empty stone partner is doubtful of its strength. Empty stones are not used on foundations when buildings are erected in sharp contoured areas. If an empty stone is used on a tread that has a sharp contour, then the empty stones will fall down. In the pairs of empty stones, there is the term nail. The term nails are referred to as an empty stone pair that uses mortar. Nails are generally used on treads with sharp contours and are used on talud foundations.

The thickness of an empty stone pair on the nail is made 30-40 cm. Nails are used to harden the ground beneath it or to grasp the ground so that the mountain rock pairs can stand on it firmly. Foundation poer plates can be assisted by a mountain rock foundation when needed. The foundation of the plate poer needs to be assisted with the foundation of the mountain rock if it is to hold the brick wall/brick and as a supporter of the sloof power. If the soil is displaced, the sloof block is not easy to move, because the foundation of the mountain rocks sloof support firmly. The foundation of the plate poer is used to hold the floor plate, so the foundation does not need to be assisted with the foundation of the mountain rocks, in the Fig. 1.



Figure 1. Foundation of poer plate assisted with mountain rock foundation

Sloof and foundation made one package. One package means that the sloof and foundation can not be separated because the house has a heavy load (iron bars, concrete, steel, wood, and so on). Sloof and foundation are used to withstand wall loads. If the sloof is broken, then to support the wall is used mountain rock foundation as an alternative structure. The foundation is also used to avoid the iron sloof in contact with the soil, so the sloof iron does not rust. The depth of iron that is planted in the foundation is made  $\frac{1}{2}$  the height of the foundation. Plastering mortar for a foundation when needed.

The distance of stone and the strength of the foundation is used as the basis of mortar plastering. If the stone distance is close together, then the foundation stone does not need to be filled with mortar. If the stone distance is not close together, then the stone needs to be filled with mortar. If a mortar is not used, it is feared the strength of the foundation is low. Mortar is required in arranging mountain rocks as adhesives so that the stones are attached to each other. The mortar comparison for the foundation was used with a mixture of 1: 3 mixture; 1: 4; and 1: 5. The best mortar plastering ratio is made with a 1: 4 mixture, because it is easy to dry, solid foundation, and the foundation is not easily cracked or broken. Mortar made with a mixture of 1: 1 and 1: 2 is feared the foundation of broken and the use of building materials to be inefficient. If the shape of a large

mountain rock, then mortar made with a thickness of about 3 cm.

The foundation of the building needs to be stockpiled so as not to easily shift and the stone material is not easily broken. Good stockpiling consists of two ways, as follows; 1) Stockpiling made flat with sloof, because of the location of the floor rebate above sloof. Rigid floor rebates are placed on top of the sloof, because the floor rebate is attached to the building wall so it is not easily broken, in the Fig. 2; and 2). Stockpiles need to be lowered by 5 cm from the sloof head for a floor rebate plan. The foundation is stockpiled based on the dried sloof. Sloof can be dry after waiting for 3 hours or two days or a week or based on the climate of an area and the quality of the ingredients.

When the sloof is dry, the foundation should be avoided from the stamped foot because sloof easily displaced. Damage to the foundation can be caused by mortar materials and the work of builders who do not experience. Foundation damage can be caused by mortar mixtures that tend to be less well, less mature or less cement. Whether or not the foundation work is based on the experience of a craftsman. Based on the experience that the artisans who work quickly, in general workmanship produced tend not good. Workers who work slowly, generally the work produced tends to be good.



Figure 2. The foundation is stockpiled

The hierarchy on the floor is based on heaps and foundations. The hierarchy on the floor made more than 10 cm does not use a heap, but the foundation is made level. The foundation level is followed by a sloof block (the ringbalk beam is straight and not stratified). The columns located on the hierarchical floor are measured not from the as-columns, but measured from the sides of the columns. Hierarchical foundation strength can be helped by floor rebates. Dredges are used on a hierarchical floor. The floor in the bathroom was lowered from the heap. The floor in the body of the house needs to be made higher than the floor in the bathroom, so that water from the shower is not splashed out.

#### CONCLUSION

The research concludes that the vernacular architect in making the mountain foundation stone is rigid but also flexible, in order to respond to earthquake disaster. Rigid principles are found on mountain rock foundations, empty stone plates, nail terms on empty stones, chicken claw foundations, hierarchy on the floor, sloof and foundation relationships. Flexible principles are found in sand dunes, empty stones, anchor depth, and mortar for plaster. Foundation of poer plate called by Vernacular architect as a chicken claw foundation. Chicken claw foundation has its own uniqueness. This study can be continued to examine the knowledge of vernacular architect against chicken claw foundation.

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