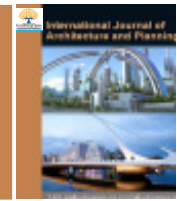




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## Identification of Shallow Foundation in Swampland Banjarmasin

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### Abstract

The condition of the land in Banjarmasin is swamp land (commonly called soft soil) with low bearing capacity so that a special and suitable foundation is needed. This makes the uniqueness and characteristics of the foundations that are often applied in this area. The type of foundation that is often used is to follow materials such as wooden poles or concrete pillars. This is an advanced application of the shallow foundation type. In this study, an in-depth study of the types of foundations on swampy soils in Banjarmasin will be carried out in the form of types including shallow foundations. It will be investigated by comparing the field findings in the area around and outside the city of Banjarmasin. Comparison of the types of foundations found will identify how they are applied. Field observation studies were carried out at various construction sites in Banjarmasin and the surrounding area, especially objects of low-rise buildings and other uses such as fences and earth fill retaining walls. The data is presented in a descriptive manner. The purpose of this study is to provide an applicative description of the foundation in the Banjarmasin swamp land with a comparison of the types of foundations in the surrounding area. It will identify the foundation materials that can be applied and how the application techniques are implemented in the field.

**Keywords:** Identification, Foundation, Soft soil, Swampland

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## 1. Introduction

The type of foundation that is often used in Banjarmasin is for wooden poles and concrete poles in building construction as processing on swamp land (wet = peat) in the form of soft soil. There is a phenomenon that the application of this type of foundation in the field preceded the research, so that the development of field applications preceded the scientific literature. Further research is needed on the application of foundation materials in soft soils with shallow foundation types.

In this research, field observation studies will be conducted at various locations of low-rise simple buildings and other uses such as fences and retaining walls in Banjarmasin and the surrounding area. It is investigated in detail by identifying its application techniques in the field. Then a comparison of types, types, materials (materials) and techniques

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(methods) will be carried out in other areas (outside Banjarmasin) and even from outside the region. From the identification, the advantages and disadvantages of each type with various functions and uses of the foundation will be obtained.

The purpose of this study is to provide an applicative description of the foundation in Banjarmasin with comparison of other materials from other areas. There will be a comparison of foundation materials that can be applied to soft soils and how the application techniques are implemented in the field. It is necessary to reveal how to build or carry out the foundation by considering the condition of the type of soft soil and even water, namely swamp, either slightly dry or high water conditions.

## 2. Comparison of Foundation

Foundation in the land has a variety of uses and should be compared between one area with another area around Banjarmasin (Agusniansyah, 2024a). Usually, swampland foundation refers to stage construction. However, there are other uses for foundations other than the stage, such as foundations for fences and grassland.

The purpose of this research is to compare the foundations in Banjarmasin and its surrounding areas to obtain the methods of implementation, the variety of types of foundations of various shallow foundations on swampy soil. The results of the research show that a shallow foundation can be applied to the slopes with some methods related to the condition of the soil. If the conditions are dry, then a shallow rock foundation can be implemented. There's an advanced problem that how to strengthen the reservoir's support. A shallow foundation is usually for hard soil.

A new concept of a shallow foundation in the meadow (Agusniansyah, 2024b). The foundation is usually a stage building but what about the use of the foundation for special functions such as land grinding or light loads such as fences and walls of houses. A shallow foundation is that stone times usual for hard soil, how in the meadows require special methods of execution. Dry conditions can be carried out stone foundation times, but what about watery conditions. The new model of the foundation with a splash is the method of using concrete plates to level and strengthen the ground support. Then over it stone times.

### 2.1. Foundation In Soft Soil

Wooden poles are widely used for the construction of house elements in Banjarmasin. The wood used is ironwood. The wooden pile foundation uses foundation construction, including log construction, kalam kalang galam construction and "kaca puri" construction (Heldiansyah *et al.*, 2014). This "kaca puri" foundation is considered to behave like a continuous foundation with a long foundation is the length of the galam pole used (Iskandar, 2000).

Ironwood is used as a house pole in the form of a beam as the main material for poles and sticks that rest on the ground as a support for the house building (Heldiansyah *et al.*, 2014), while galam wood (*Melalueca leucadendron*) is used as a pillar pile. Cerucuk aims to increase soil shear resistance in another sense is soil improvement (Tjandrawibawa *et al.*, 2000; Muda, 2016; Ma'ruf *et al.*, 2015; Anwar, 2019; Rusdiansyah *et al.*, 2015; Suyuti *et al.*, 2018). With this niche, the carrying capacity of the soil has increased. This galam wood cerucuk foundation is very suitable for conditions in swampy areas that are always watery (submerged) because it has a unique property that if it is always submerged, its strength will always be maintained as evidenced by the old building with the galam wood foundation being dismantled. more than 20 (twenty) years (Iskandar, 2000; Yudiawati and Ahmad, 2008). The commonly used galam cones are 3 (three) and 4 (four) meters long for 1 (one) floor buildings and a minimum length of 7 (seven) meters for 2 (two) floors (Agusniansyah, 2024c). The diameter of galam wood on the market is about 12 (twelve) centimeters (Agusniansyah, 2024d). For the carrying capacity of a single galam tree trunk, the maximum load that can be carried is 170-300 kN (Rifky, 2014).

The development of the wooden pole construction of the "kaca puri" type is a theoretical variation. The bottom of the pole/stick is called "kaca puri" while the top is called kalang sunduk. The end of the pole is buried in the ground. Theoretically, this alternative "kaca puri" to withstand a load of 1.25 tons which is expected to be able to support the load of the residential floor structure of 150 kg/m<sup>2</sup>-250 kg/m<sup>2</sup> (Heldiansyah *et al.*, 2014).

Foundations in Banjarmasin are adapted to the soil conditions which have a layer of soft soil with a thickness of up to 25 (twenty five) meters and hard soil on average at a depth of about 35 (thirty five) to 45 (forty five) meters (Yudiawati and Ahmad, 2008; Rifky, 2014). The carrying capacity of this swamp is very low at 0.2 kg/cm<sup>2</sup> (Eliatun *et al.*, 2018).

Soil conditions in Banjarmasin which are mostly swamp land (wetlands) have different conditions between one land plot and another (Nurfansyah *et al.*, 2020), the general conditions are dry soil (overgrown with plants/grass), slightly wet or slightly dry marked by the presence of water during foundation excavation, and soil with high water (fully submerged in water) as shown in Figure 1.



**Figure 1: Land Condition in Banjarmasin**

Source: (Nurfansyah *et al.*, 2020)

The house construction system in Banjarmasin is a wooden pole construction (Eliatun and Darmansyah, 2018), consisting of a row of ironwood poles with short distances to carry the load of the building evenly. Meanwhile, the development of a replacement for ironwood poles is reinforced concrete poles (Afni *et al.*, 2016).

House buildings in Banjarmasin are generally constructed on stilts where the floor of the house is above the ground with wet land conditions (Nurfansyah *et al.*, 2020).

To support this condition, poles are used to support the building of the house. The house is in the form of wooden poles using ironwood material (Figure 2). At the top, after the wooden pillars, a frame construction is used which is usually also made of ironwood material. For infilling/covering walls, bricks are used which are installed standing up, in order to keep the building load lighter. This standing masonry is also suitable for filling walls which are generally constructed of wood frames as well. The wooden frame of this wall is a row of poles that are installed along the wall at a distance of 1 (one) meter.



**Figure 2: Frame Construction House**

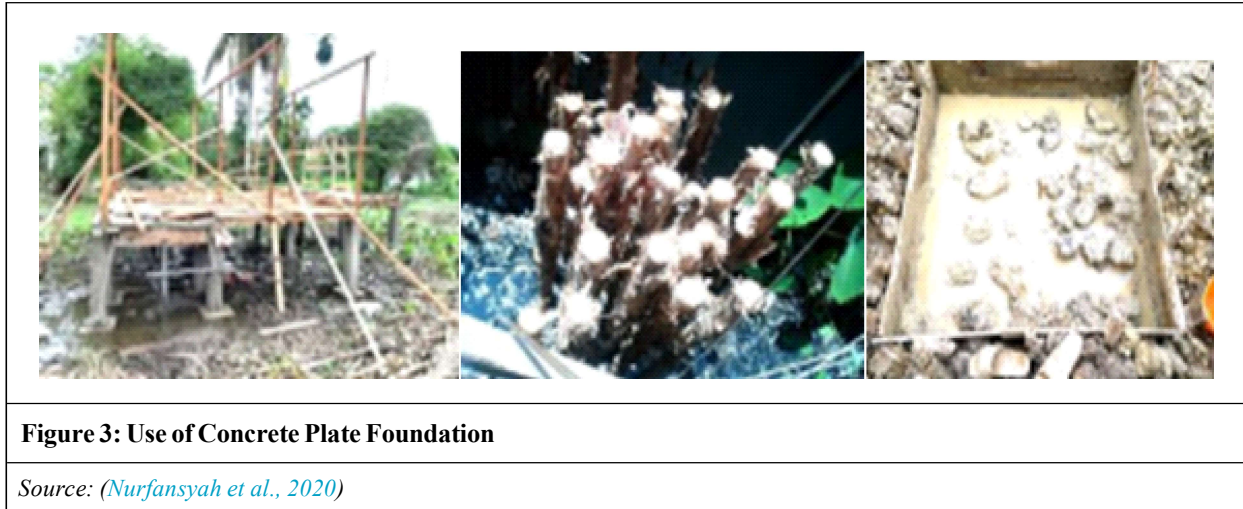
Source: (Nurfansyah *et al.*, 2020)

Variations and modifications of wooden poles are found using concrete poles and foundations, while the top of the building from the floor upwards continues to use wooden frame construction. The size of the slab foundation looks about 90 x 90 cm. The concept of replacing the construction of a row of wooden poles and changing the loading system into a local bearing load. As a result, there must be the use of larger horizontal wooden beams as a load divider between the concrete piles. The large wooden beams used must of course be larger than the wooden beams composed of wooden poles (Nurfansyah *et al.*, 2020).

## 2.2. Foundation Other than Wooden Piles

For the construction of modern (permanent) buildings, variations and modifications are carried out in the form of replacing wooden pole materials with concrete pole materials (Nurfansyah *et al.*, 2020). While the foundation is used concrete slabs.

For the concrete slab foundation, galam piles are used to improve the bearing capacity of the soil (Figure 3). Group composition is used. For one concrete slab, several combinations of the number of stakes and the width of the concrete slab are used. From the field findings, the smallest concrete slab size is 90 x 90 cm using a minimum of 9 (nine) galam stakes measuring 3 to 5 meters. Concrete slab measuring 120 x 120 cm uses 16 to 25 pieces of galam stakes measuring 5 to 7 meters. The use of galam piles in this group arrangement is commonly used to accept local loads such as the concrete slab foundation mentioned above.



### 3. Methods

This research is a qualitative Research with descriptive methods and data collection through surveys/field observations. Field observation studies are more focused than theoretical analysis. The stages of the research are: identification of foundations on soft soil, survey/observation of foundation field studies in Banjarmasin, comparison of foundations in other areas around Banjarmasin, analysis of the use of foundations, and finally conclusions and suggestions.

**Identification of Foundations in Wetlands:** Review the literature related to the construction of wetlands in Banjarmasin, the use of materials, construction and connection systems.

**Foundation Filed Survey/Observation in Banjarmasin:** Survey to collect field data related to the application of building foundations on soft soil (swamp/wet) Banjarmasin. The survey was conducted at various construction sites in Banjarmasin. Both on housing objects and individual objects. The object chosen is related to the phenomenon of factual conditions to find problems that have relevance to the research.

Data collection techniques were carried out by direct observation and survey to the location of observation and interviews. The data obtained were analyzed qualitatively. Disclosure of survey/observation results is done graphically and presented descriptively.

Comparison of foundation in other neighbourhoods is obtained from sources from outside the city of Banjarmasin, even from outside the region, who will provide identification of project description data and will be analyzed. From the analysis of this type of foundation, it will be seen whether it is possible to have other forms or variations in the development of foundations on soft soil.

**Usage Analysis of Foundation:** The identified type of foundation will be analyzed according to its use. Analysis of usability according to the load function of the foundation includes: 1 (one) floor low building, fence, and retaining wall of earthfill. Identification of uses will describe materials (materials), methods of implementation and others.

**Conclusions and Recommendations:** The conclusion of the analysis and research results will answer the problem of identifying comparisons of foundations in Banjarmasin and other areas, followed by suggestions.

### 4. Results and Discussion

The selection of the foundation is carried out by considering the condition of the land and according to the load it bears. According to land conditions, Banjarmasin has 3 (three) characteristics of land conditions, namely dry conditions,

shallow water, and deep water. Meanwhile, according to the load (or its use) the foundation referred to in this paper is a shallow foundation for buildings (low level), fences and earthfill walls. In general, the known shallow foundations are stone material or reinforced concrete slabs.

On dry land, it is usually in the form of hard soil so that it has a large soil bearing capacity to support the foundation load. But in watery conditions land (in this case Banjarmasin) has soft soil with low soil bearing capacity. This watery/swampy land is not like hard land which is strong to support the foundation load directly. This marshland does not have sufficient bearing capacity to support the building.

**4.1. Identification of Foundation in Banjarmasin**

From the survey results/field observations, it was found that the types of foundations in Banjarmasin are generally divided according to the material of the building supports, namely wooden pile foundations and concrete pile foundations (Figures 4 and 5). For small loads such as buildings (houses) of the semi-permanent type, wooden pile foundations are generally used. As for large loads such as permanent/modern buildings, concrete pile foundations are used.



**Figure 4: Wooden Pile Foundation**

Source: (Author, 2024)



**Figure 5: Concrete Foundation**

Source: (Author, 2024)

**4.2. Identification of Foundations Around Banjarmasin**

Some areas around Banjarmasin have various land conditions, but most of them are dry land conditions. Only a few areas also have water conditions similar to those in Banjarmasin (Figure 6).

In dry land conditions, stone foundations are commonly used in several areas. The type of stone material is local material in the form of mountain rock. In some areas also found the use of limestone for foundations.



**Figure 6: Foundation of Banjarbaru and Banjar Region**

Source: (Author, 2024)



**Figure 7: Foundation of Ground Spice Area**

Source: (Author, 2024)



**Figure 8: Foundation of Amuntai Area**

Source: (Author, 2024)



**Figure 9: Foundation of Tabalong and Tapin Area**

Source: (Author, 2024)



**Figure 10: Foundation of Balangan and Kotabaru Area**

Source: (Author, 2024)

For watery land conditions, pile foundations were found, either wooden piles or concrete piles. Picture. Foundations for Tanah Bumbu, Kotabaru, Kandangan, Amuntai, and Tabalong Areas In some areas, concrete foundations are used even though the land is dry and watery (Figures 7 to 13).



**Figure 11: Rock and Limestone Foundation Material**

Source: (Author, 2024)



**Figure 12: Foundation of Kotabaru, Kandangan, and Amuntai Area**

Source: (Author, 2024)



**Figure 13: Foundation of Kotabaru, Kandangan, and Amuntai Area**

Source: (Author, 2024)

Based on soil conditions, stone foundations are used for dry land conditions according to the load, and this is usually carried out on hard soils.

For light loads (low) 1 (one) floor buildings such as residential houses, in some dry areas you can use stone foundations or wooden pile foundations for light loads. Concrete pile foundations are used for heavier loads or modern buildings. However, for watery land conditions, a wooden pile foundation or concrete pile can be used, but with the reinforcement of wooden stakes (galam).

For the load of the use of the fence, the wooden pile foundation is only for fences with lightweight materials. For heavy fence materials such as brick/stone, the wooden pile foundation is no longer suitable for its function. Must use a concrete pile foundation which is certainly more economically wasteful.

From the comparison of the various types of foundations above, see Table 1.

Type of Foundation	Use	Land Condition
Rock Foundation	Digunakan untuk dinding penahan urugan tanah dan pagar Used for walls holding land and fence	Tanah dalam keadaan kering Soil in dry condition
Wood Pillar Foundation	Digunakan untuk tiang bangunan Used for building pillar	Tanah dalam keadaan berair The soil is wet.
Concrete Plate Foundation	Digunakan untuk tiang bangunan Used for building pillar	Tanah dalam keadaan berair dan kering The soil is wet and dry.

For the load of the earthfill retaining wall, it is not very suitable for a wooden pile foundation but it will be very uneconomical to use a concrete pile foundation.

What about the use of stone foundations on soft soils (watery wetlands) are:

- Done in dry conditions.
- Used deep foundations (stakes).

The method of implementing stone foundations in dry conditions should take into account the condition of the water surface which can change so that it can affect the bearing capacity of the soil from dry with strong bearing capacity to watery conditions with weak bearing capacity.



**Figure 14: Use of Foundation on Soft Soil**

Source: (Author, 2024)



## 5. Conclusion

The use of foundations in Banjarmasin is almost the same as in other areas, depending on the load and condition of the land. In terms of the use of the load it supports, such as low-rise buildings, with watery land conditions with low soil bearing capacity, wooden pile foundations with galam reinforcement are used. But for the use of the fence used a concrete foundation which is economically more expensive. This is because the use of wooden posts is not commonly used for fences with heavy load materials. For the load of multi-storey buildings (heavy) and modern materials used concrete slab foundations.

What is special is when the use of earthfill retaining walls is used, there will be a choice of a concrete foundation or a stone foundation. Concrete foundations can be used but with consideration of the cost of implementation that is no longer economical.

There have been attempts to use stone foundations in some land conditions such as dry land. The implementation of stone foundations on soft soil in the field is carried out when the land conditions are dry. For areas with dry land conditions, the soil conditions are usually harder with greater carrying capacity, so locally available materials, either mountain stone or limestone, are used.

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