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Standardization of sub-structure design of subsidized housing in South Kalimantan

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Abstract. The subsidized housing construction program is spread over two locations with two types of soil layers in South Kalimantan. Because of the difference in the composition and characteristics of the subsoil, the housing construction requires the standardization of design of sub/lower structure of the buildings namely for the deep foundations and shallow foundations which are used as typical subsidized housing foundations in South Kalimantan. This is necessary to ensure that the mass development of the subsidized housing construction meets the safety, time and cost requirements. The standardization of the structure of the lower building using a type of friction support with 4 m long galam wood piles for corner types and 4 section require 4 and 6 galam wood bars. The standardization of the structure of the lower structure on hard soil using a mountain stone foundation with a foundation width of 0.7 m and a foundation height of 0.7 m requires a foundation area of 1.40 - 3.50 square meter.

1. Introduction

The development of housing is always in line with the increasing demographics of an area. The housing in South Kalimantan, specifically the Subsidized Simple House Program of a million houses is implemented to meet the basic needs of the people in South Kalimantan. One of the facilitators of the program is the South Kalimantan Real Estate Indonesia (REI), which in 2017-2018 carried out the construction of 1500 units of subsidized houses.

Specific to the technical aspects of housing in South Kalimantan is the structure of the lower structure of the building; that is the foundation of which is mostly in the area or in the layers of soft soil and only a small portion of it is in the hard soil.

The researchers have conducted CPT (Cone Penetration Test) tests on Banjarmasin soils. The results show that the hard soil layers with a conus value of > 150 kg/cm2 in Banjarmasin was found at the depth of 35 - 42 m. In some other areas such as Banjarbaru and Tanah Laut, the hard soil is found on the surface; this condition results in the need to consider using different types of foundations from the one used in the soft soils such as in Banjarmasin.

The results of these studies and conditions indicate that the soil layer in South Kalimantan consists of two classification criteria and its support, namely the soft soil layer and hard soil layer. The subsidized housing construction program spreads in locations with the two types of soil layers in South Kalimantan. Because of the different classification and characteristics of the subsoil, the housing construction requires standardization of the design of sub/lower-structure namely deep and shallow foundations which are used as typical subsidized housing foundations in South Kalimantan. This is necessary to ensure that the construction of mass subsidized housing meets the security, time and cost aspects. The purpose of this study is to determine the design of a safe lower structure for subsidized houses in soft and hard soils. Subsequently, the result is made as the standard / prototype of the sub structure for subsidized houses in South Kalimantan.

2. Methodology

The research start by investigating the soil using CPT (Cone Penetration Test). The soil investigation was in the location of subsidized housing around Banjarmasin and Banjarbaru, calculating and analyzing the results of the CPT test, designing the lower structure of the deep foundation and the shallow foundation and making engineering design details in the form of Architectural Images and Detailed Images. The method research is shown in Figure 1.

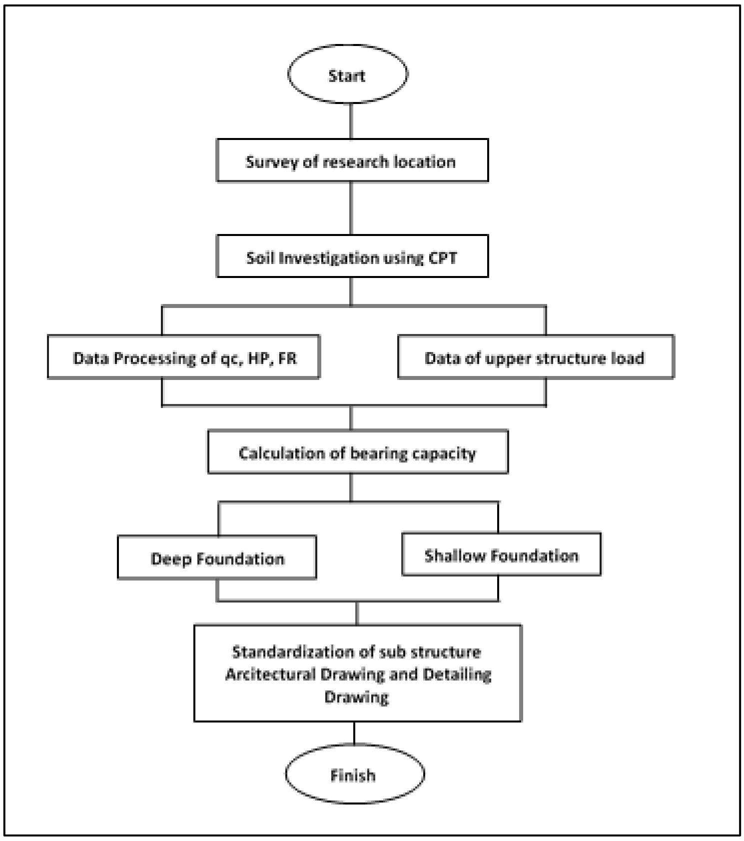


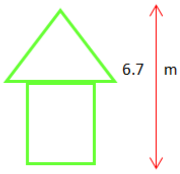
Figure 1. Research flow chart.

3. Results and analysis

3.1. Specification of upper structure

The upper structure consists of structure of 36-type subsidized house in the soft as shown in Figure 1 and structure of 36-type subsidized house in the hard soil as shown in Figure 2. The data of upper structure of 36-type subsidized house in the soft soil is shown in Table 1, meanwhile of the data of upper structure of 36-type subsidized house in the hard soil is shown in Table 2.

Table 1. Data of upper structure of 36-type subsidized house in the soft soil.

No	Item	Material	Sketch
1	Foundation	Galam	
2	Piles	Ulin	
3	Floor	Tile	
4	Wall		
	Wall	Brick 1/4	
	Interior Wall	Kalsiboard 3.5 mm	
	Celling	Gypsum + Wood Frame	
	Roof	Sokka Roof Cover + Wood Frame	

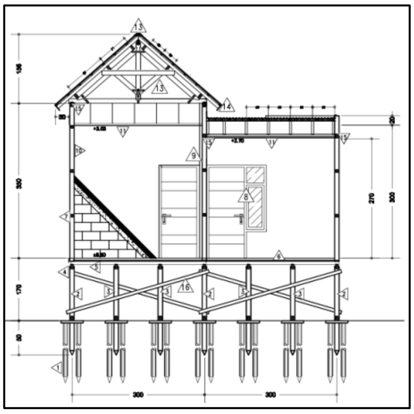
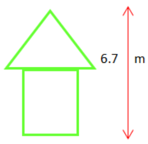


Figure 2. Upper structure of 36-type subsidized house on the soft soil.

Table 2. Data of Upper Structure of 36-type subsidized house in the hard soil.

No	Item	Material	Sketch
1	Foundation	Stone	
2	Piles	Ulin	
3	Floor	Tile	
4	Wall		
	Wall	Brick	
	Celling	Gypsum + Hollow Frame	
	Roof	Metal + Light + Weight Steel Frame	

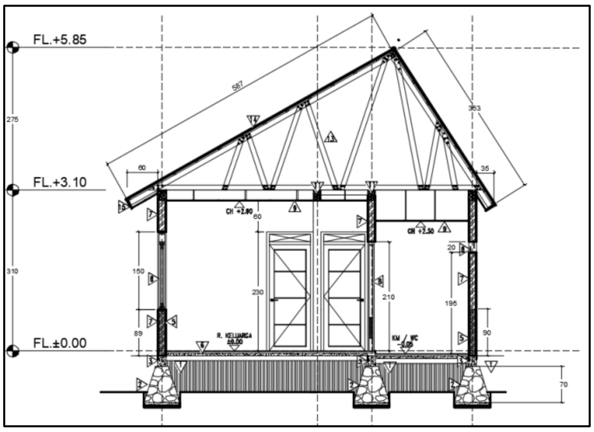


Figure 3. Upper structure of 36-type subsidized house in the hard soil.

3.2. Selection of foundation type

The choice of foundation type is based on the soil type and the soil bearing capacity. The soil layers in South Kalimantan are quite varied. Marzuki and Yudiawati [8] have conducted CPT tests on Banjarmasin soils which show that hard soil layers with a conus value of > 150 kg / cm2 in Banjarmasin were found at around the depth of 35 - 42 m. In some other areas such as Banjarbaru and Tanah Laut, the hard soil is found on the surface, this condition results in the need to consider using different types of foundations with the foundations used in the soft soils such as in Banjarmasin. The typical 36-Type subsidized housing foundation for the soft soil such as in Banjarmasin is the deep Foundation (Galam). The specification of sub structure in the soft soil is shown in Table 3. The hard soil such as in Banjarbaru is the shallow foundations (Mountain Stone). Figure 5 shows the load of Fz 0.05 - 0.48 tons requires 4 piles of galam wood and the Fz load of 0.5 - 0.72 tons requires 6 piles of galam wood. The relationship among the number of N of galam, the length of the section and the area of the section for the corner pillar as shown in Figure 6. The relationship among the number of N of galam, the length of the section and the area of the section for 4 piles of section of the wall line as shown in Figure 7. The relationship among the number of N of galam, the length of the section and the area of the section for 4 piles of section of floor line as shown in Figure 8.

Table 3. The specification of sub structure in the soft soil.

No	Item
1	Construction: Galam Wood Pile Foundation
2	Pile Dimension Ø 8 cm
3	Support Type: *Friction*
4	Length of Embedded Pile: 4 m
5	Qc: 1.0 Kg/cm^2
6	Maximum Load: 0.72
7	Single Capacity : 0.31 Ton
8	P allowable Pil: 0.15 Ton
9	Average Group FK: 2.00 (axial)
10	Max Immediate Settlement: 0.1 cm
11	Max Consolidation Settlement, t = 1 year: 2.76 cm
12	Max Consolidation Settlement, t = 5 years: 6.17 cm
13	Max Consolidation Settlement, t = 10 years: 8.73 cm
14	Consolidation Settlement, 90%: 42.40

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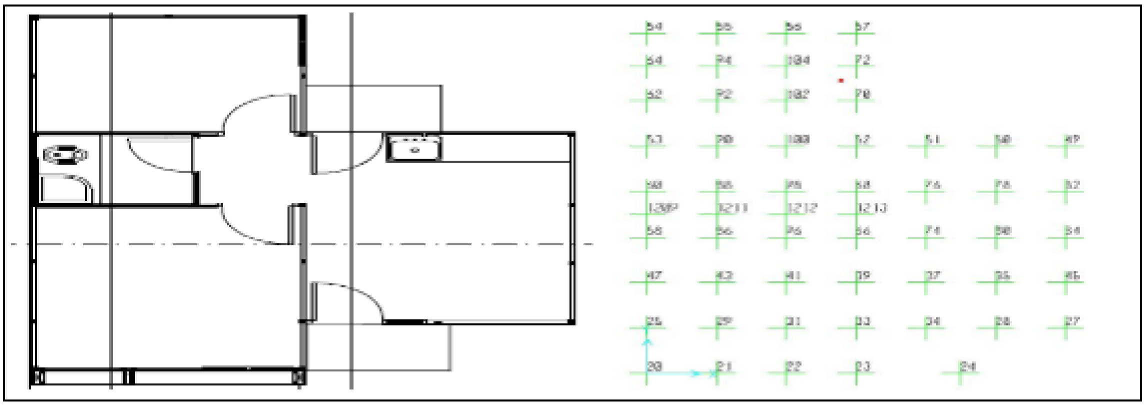

Figure 4. The lay-out of 36-type subsidized house and the number of joint reactions.

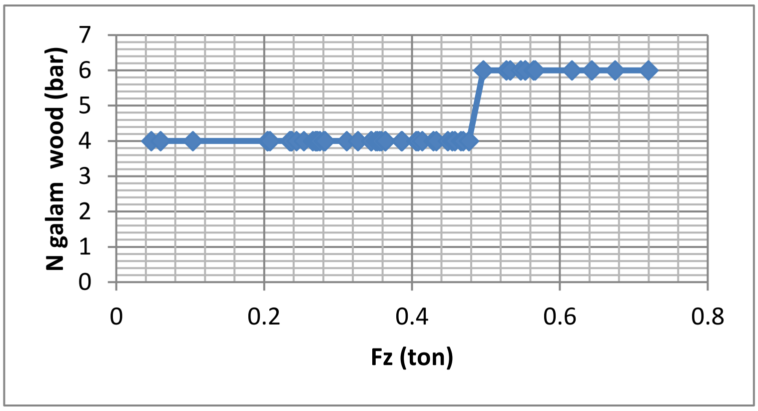

Figure 5. The relationship between Fz (load) and N number of galam wood pile.

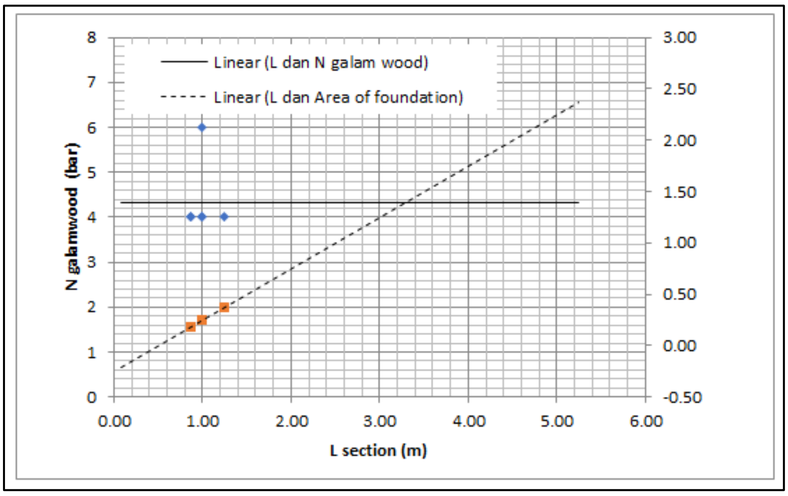

Figure 6. The relationship among the number of N of galam, the length of the section and the area of the section for the corner pillar.

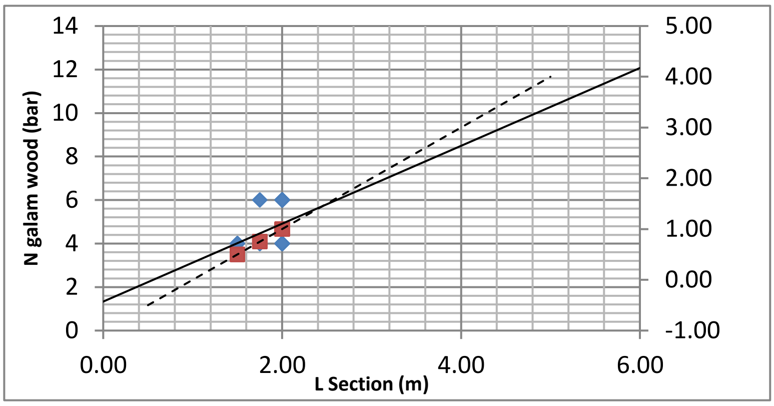

Figure 7. The relationship among the number of N of galam, the length of the section and the area of the section for 4 piles of section of the wall line.

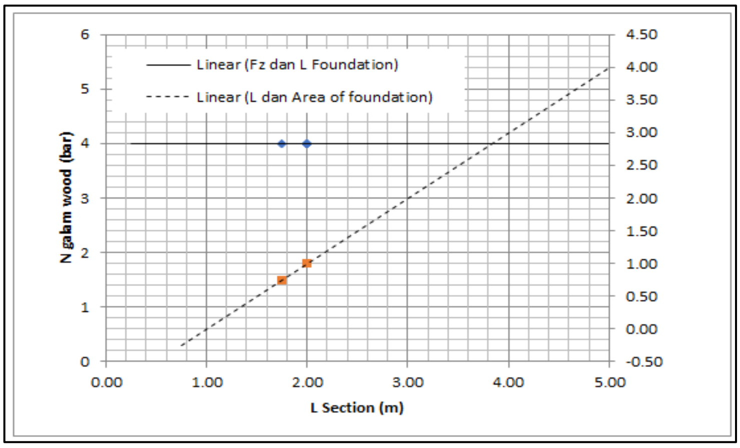

Figure 8. The relationship among the number of N of galam, the length of the section and the area of the section for 4 piles of section of floor line.

The typical 36-Type subsidized housing foundation for hard soil such in shallow foundation (stone installation). The specification of sub structure in the soft soil is shown in Table 4. The lay-out of 36-type subsidized house and the number of joint reactions as shown in Figure 9. The relationship among Fz, number of N of galam wood, the length of the section and the area of the section for the corner piles as shown in Figure 10. The relationship among Fz, the length of section and the area of the section for the 4 section as shown in Figure 11.

Table 4. The specification of sub structure in the hard soil.

No	Item
1	Construction: Shallow Foundation /Stone Installation
2	Foundation Width: 0.7 m
3	Foundation Height: 0.7 m
4	Qc: 10 Kg/cm^2
5	Maximum Load: 2.452 Ton
6	Max Immediate Settlement: 0.14 cm
7	Max Consolidation Settlement, t = 1 year: 0.17 cm
8	Max Consolidation Settlement, t = 10 years: 0.20 cm

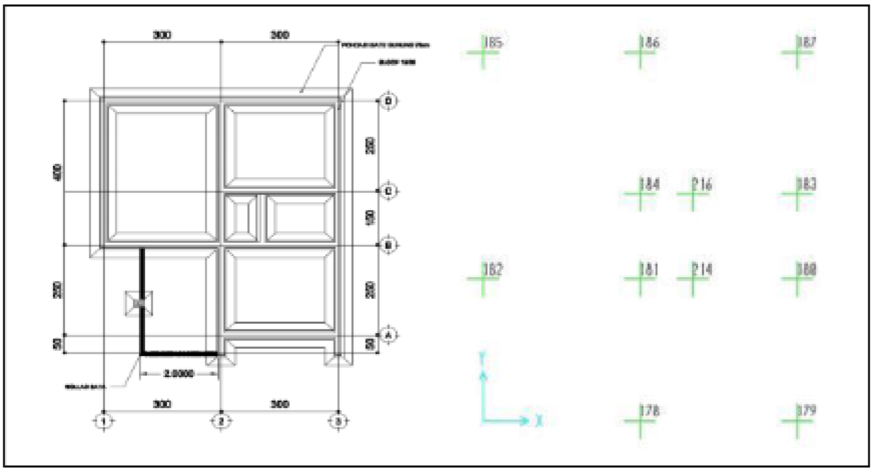

Figure 9. The lay-out of 36-type subsidized house and the number of joint reactions.

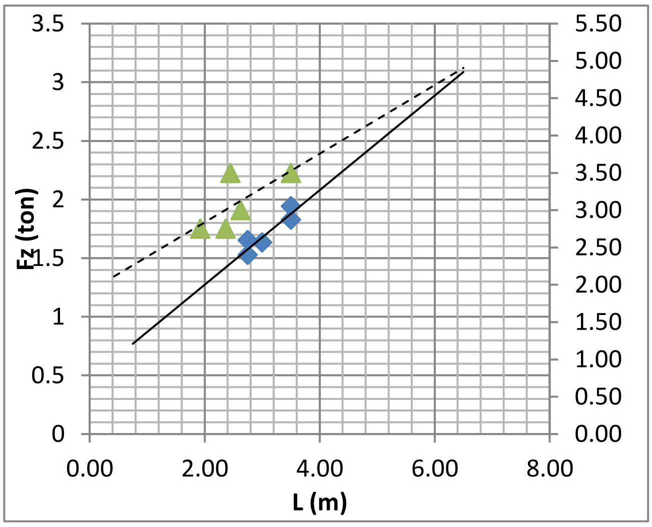

Figure 10. The relationship among Fz, number of N of galam wood, the length of the section and the area of the section for the corner piles.

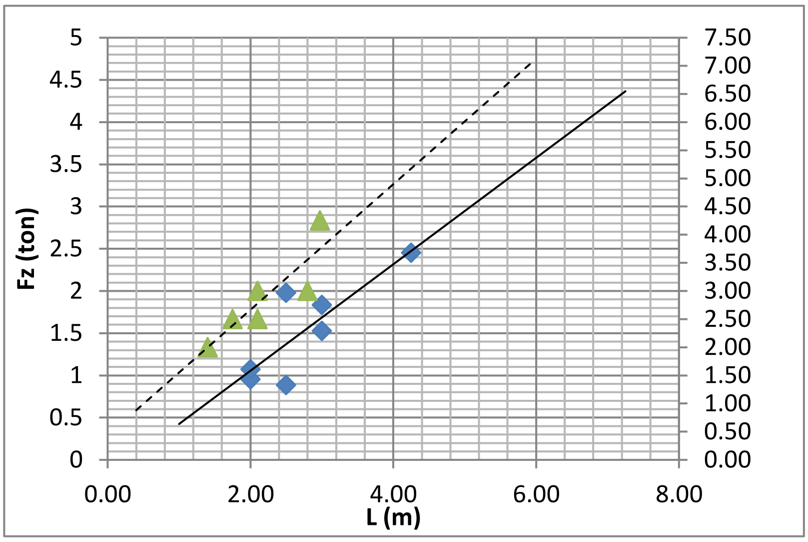

Figure 11. The relationship among Fz, the length of section and the area of the section for the 4 section.

4. Conclusions

The typical foundations of 36-Type subsidized housing for the soft soil such as in Banjarmasin use deep foundations (galam wood) and for the hard soil such as Banjarbaru use shallow foundation (a mountain stone foundation). The proposed standardization of lower/sub-structure on the soft soil using friction type support with 4 m long galam piles for the corner and 4 section types require 4 and 6 galam wood piles. The proposed standardization of low/sub-structure on the hard soil using a stone foundation with a foundation width of 0.7 m and a foundation height of 0.7 m requires a foundation area of 1.40 - 3.50 m^2.

5. References

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