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The Effect of Screwed Blanket Surfaces as an Addition of Friction Resistance to Pile Foundations

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A B S T R A C T

The most important part in the construction of buildings, both bridges, piers, and buildings, is the construction of the substructure, which is generally called the foundation. The function of the foundation in building construction is to support the entire load of the building and continue the load of the building into the ground. The main objective of this research is to find the best and most effective type of pile, namely the type of pile with plain cover or pile with screw cover. Types of piles currently on the market are plain or non-screwed types. According to the initial analysis of the pile bearing capacity, if the pile is located on soft soil, the most influential pile strength is the soil's adhesion to the blanket (friction). The rougher of pile blanket, the more friction the soil will have on the soil adhesion and will ultimately increase the pile bearing capacity. This study compares the results of the carrying capacity between the two types, namely piles with plain blankets called model 1 and piles with screw covers called model 2. The test objects made in this study have a cross-sectional size and length of 15 cm x 15 cm x 300 cm with materials using reinforced concrete K-350 kg/cm2 (f'c = 28.8 MPa) with 4D10 mm reinforcement and Ø8-150 mm joints. The size of the model 1 test object and the model 2 test object are made the same, but the difference is that in model 2 the pile uses screws, where the entire length of the pile is planned and the outer collar screw is formed. The screw size is 3 cm wide and 1.2 cm thick, the distance between screws is 20 cm. The pile driving test location is located in the Pontianak State Polytechnic. The results of the loading measurements, on the first day the difference in settlement of the piles was not significant, there was a settlement of 1.5mm plain piles and 1.6mm screw piles. The reduction measurements on day 4 were 2.5 mm plain and 2.3 mm screwed. The difference in loading results occurred on day 14, 3.95 mm plain piles and 3.31 mm screw piles, so the difference in loading results was 0.685 mm. If the percentage value of the difference is 17.32%. According to this difference in settlement values, it can be concluded that the use of piles with screw covers is more effective when used as foundation piles. The results of this study can provide information and references to the pile production industry.

Keywords: foundation, pile, screwed, plain

1. Introduction

Many types of foundations that concern us here is the pile foundation. The usual pile foundations are rectangular, round and triangular in shape. The materials used are other than wood (spanning wood) to the use of reinforced concrete with a minimum concrete quality of K-350 kg/cm^2 (f'c = 28.8 MPa). Mini piles are produced directly from the concrete manufacturing plant with varying sizes and shapes with a length of 600 cm. The piles on the market have a plain or smooth pile surface. For piles relying on the strength of adhesion or friction the surface of the pile with a smooth surface when compared to a non-slippery surface (screws), the surface adhesion of screw piles has a greater value, this is the influence of the screw where the rougher surface, the greater the frictional force generated, therefore through this research we try to design mini pile with a screw surface model. In our research, we made 2 types of piles with a screw-shaped surface model with a size of 15 cm x 15 cm x 300 cm with K-350 kg/cm^2 compressive strength of concrete plus percutaneous concrete reinforcement 4D10 with Ø8-150 mm stirrups. As a comparison, piles with a smooth surface are also made with the same size as screw pile models. The test is carried out by means of fixed loading where the ballast load is placed on the embedded piles.

This research was conducted for five months with the stages of work, namely 1) making concrete block test objects; 2) constructing 2 models of reinforced concrete pile test specimens, namely plain and screwed surfaces; 3) Driving the pile into the ground as deep as 250 cm with the head of the pile 50 cm above the ground level; 4) Perform loading on each pile head and assess the test results; 5). Analyze the test results and make conclusions so that they can issue recommendations to the world of the construction industry and provide information to the world of education, especially in the field of civil engineering through materials technology courses and foundation structure courses and concrete work courses.

From the test results and conclusions of this study, it will be able to provide an overview and enter into the world of construction, especially in industries that produce mini pile, and the world of education through materials technology courses and courses on foundation structures and concrete work.

2. Materials and Methods

The material for the test object needed depends on how much and the type of test object, including; the test object makes concrete mix design, the test object makes ballast loads from concrete blocks and the test object makes 2 models of mini pile. The materials needed in this study were concrete-making materials, namely cement, sand, crushed stone, water, 12 mm multiplex, mall boards, D10mm and Ø8 mm concrete casting iron.

The flowchart of research implementation activities The Effect of Screwed Blanket Surfaces as an Enhancer of Friction on Pile Foundations. The research procedure conducted as follows Figure 1:

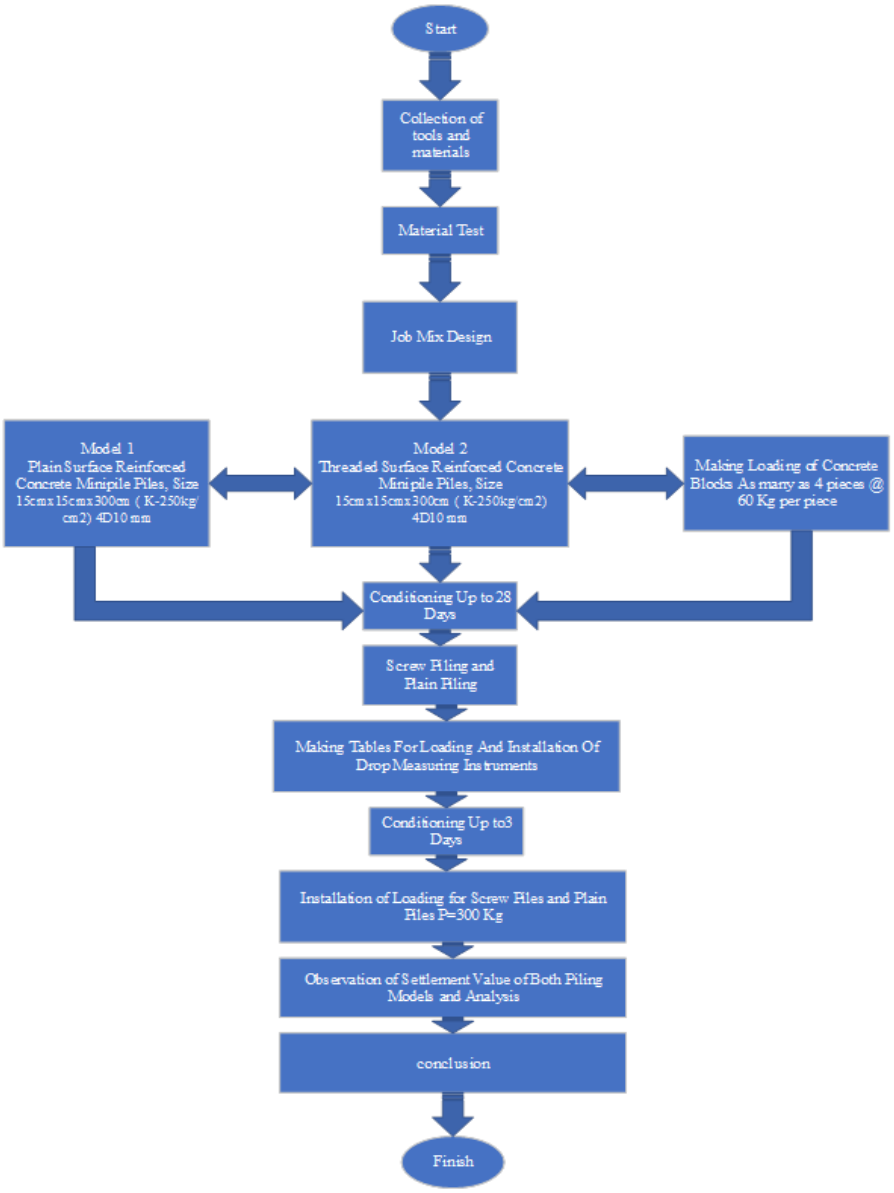

Figure 1. Research flow chart

The Process of Making Test Objects:

a. The form of the test object model, the form of the test object model is made in 2 models, namely; Model 1 is a model of plain or smooth covered concrete mini pile (fig. 2), and Model 2 with screw covered concrete mini pile (fig. 3)

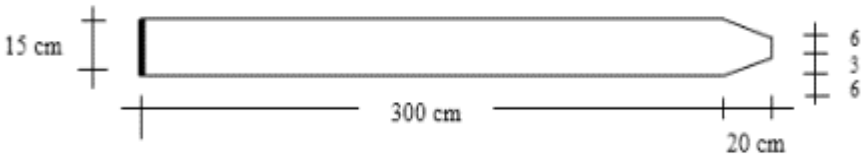

Figure 2. Model of Plain Blanket Piles

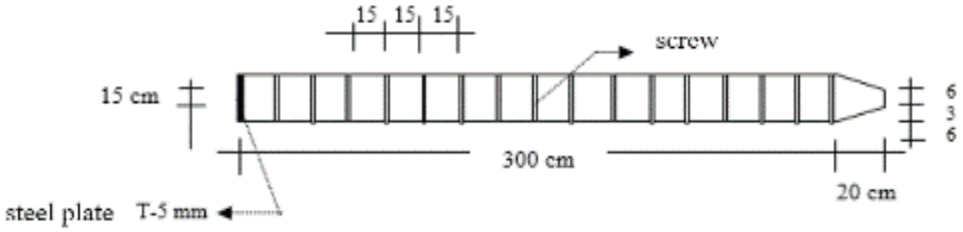

Figure 3. Model of Screwed Blanket Piles

b. Formwork Piles and Concrete Blocks, making piled formwork with a size of 15 cm x 15 cm 300 cm long using a 12 mm thick multiplex board. The manufacture of plain and Screwed piles is the same, the only difference is that Screwed piles are given fins in the form of wood measuring 2 cm x 1 cm with a distance of 15 cm.

c. Reinforcing, the piles using D10 mm bars and Ø 8 mm stirrups which are assembled using tie wire.

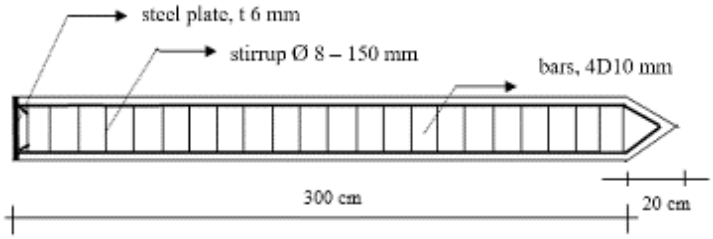

Figure 4. Reinforcing of Pile

d. Casting Concrete, the casting of workpieces between all workpieces is treated the same, namely with compressive strength of concrete K-350 kg/cm^2 (f'c = 28.8 MPa). Mixing concrete using a concrete mixer machine and manual concrete compaction. The composition of the mix is taken from the results of the concrete mix design or job mix formula concrete. After casting and compacting and leveling, concrete curing is carried out in the following order; after casting the concrete, it is covered with plastic mat, then the age of the concrete is 1 day to 3 days, watering the surface of the concrete with water is carried out, after which the concrete is allowed to dry for 28 days. After 28 days the concrete can be used for mini pile.

e. Piling, the piles were driven using a wooden tripod leg with a hammer weighting 75 kg. The rest of the stakes that are driven are left 50 cm from the ground surface. Depth of piling is 250 cm. The distance between the plain piles and screw piles is 3 meters, this is to ensure that there is no soil crushing effect between the 2 piles.

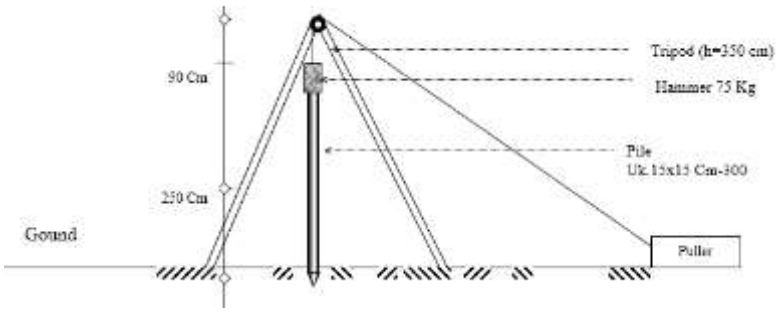

Figure 5. Piling

3. Results and Discussions

Observations were made every day starting at the time of loading, where the loading was carried out at 10 AM and observations of the initial decline at 16 PM in the afternoon, as well as the completion of the following day was recorded at every 16 PM. From the results of observations of the two types of pile test objects in the field, the following observations were obtained:

- Depth of driving 250 + 20 cm sharp tip of the pile.
- The dimensions of the pile are 15 cm x 15 cm.
- 1 stick smooth/plain surface blanket.
- Rough surface blanket / screw 1 stick
- Loading weighing 380 kg.
- Planted on clay type soil (Pontianak State Polytechnic location, Indonesia).
- Planning in rainy weather conditions (wet field conditions).

According to the results of observation the initial decline was greater than in the following days. This can be seen from table 1. Observation results for reducing pile loading below:

Table 1

Observation Result For Reducing Piling Loading

Days to	Depth of pile settlement Plain Pile (mm)	Depth of pile settlement Screw Pile (mm)	Difference in pile maximum settlement (mm)
1	1.50	1.60	-0.10
2	1.80	1.90	-0.10
3	2.10	2.20	-0.10
4	2.50	2.30	0.20
5	2.70	2.40	0.30
6	3.00	2.50	0.50
7	3.10	2.70	0.40
8	3.30	2.90	0.40
9	3.50	3.10	0.40
10	3.70	3.25	0.45
11	3.85	3.26	0.59
12	3.91	3.27	0.64
13	3.95	3.28	0.67
14	3.96	3.31	0.69
15	3.96	3.31	0.65

Analysis of the settlement of the piles after loading, can be seen in Table 1. At the beginning of loading on the first day, the settlement of the foundation is quite large, namely 1.5 mm for plain blanket piles, while the blanket screw piles have a settlement of 1.6 mm so that the difference in settlement is -0.1mm. At the beginning of loading. The settlement of the piles on the 4th day began so that there was an exchange of values where the settlement of the plain piles was greater by 0.2 mm. On the first day, settlement has not occurred completely, on the 4th day, consolidation has occurred on the ground around the pile cover, where in the screw area which was previously not completely filled with soil, then on the 5th day and above, all screw gaps are fully filled, so the addition the bonding power of the concrete is increasing and it even passes through plain sheet piles. The most significant difference in settlement of the two types of foundation occurred at the 14th day of loading, the settlement of plain blanket piles was 3.955 m, while the settlement of screw pile piles was 3.31 mm, so the difference in settlement was 0.685 mm. If seen from table 1 and from the graphical figure, the settlement of plain piles on the 14th day was almost stagnant, whereas for screwed piles the settlement was stagnant on the 10th day where the difference in settlement from the following day was very small. This shows that on the 10th day soil compression against the concrete blanket adhesion has occurred. If we compare the two types of piles, the difference in the reduction is quite striking when seen on the 14th day with the following comparison:

Table 2

Percentage of Settlement Value between Plain Pile and Screw Pile

Models	Type Of Pile (mm)	Settlement (mm)	Difference in pile maximum settlement (mm)	Percentage (%)
1	Plain Pile	3.955	0.685	17.32
2	Screw Pile	3.310	0.685	17.32

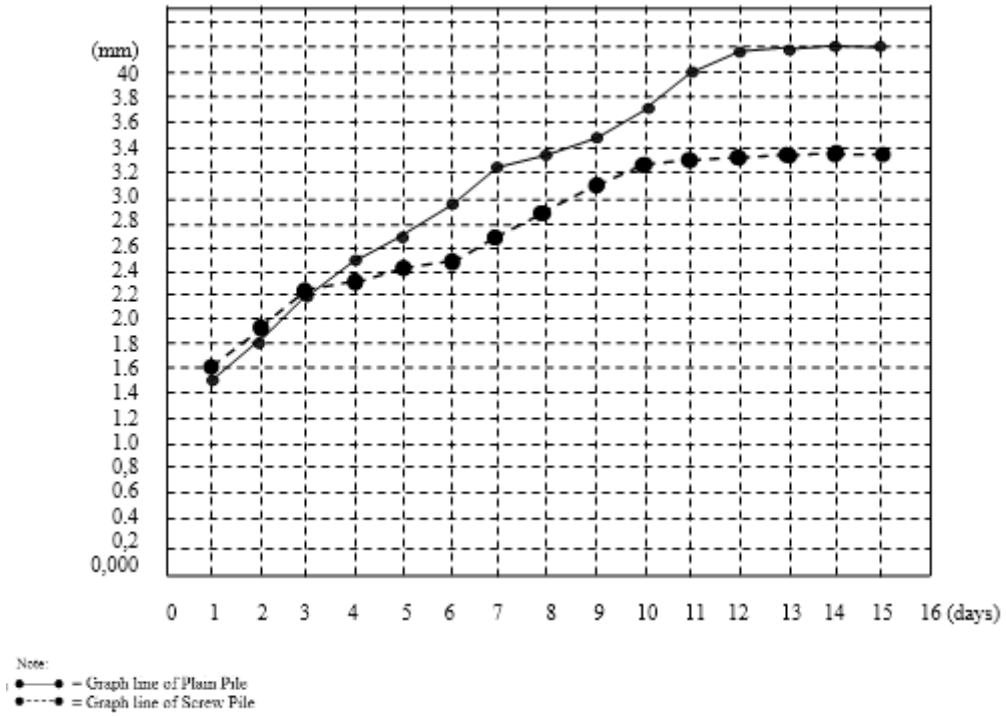

Figure 6. Graph of settlement of Plain Piles and Screw Piles

From the results of the loading tests on the two types of piles, it can be concluded: first, the use of pile foundations using screw-covered piles is very effective on shallow pile foundations (test object depth of 250 cm), meaning that the pile does not reach hard ground, due to the strength of the bearing capacity. located on a sheet of screwed concrete. The rougher the pile cover, the better the lethality of the pile resistance. The second is where the comparison of the results of the loading results in a percentage difference of 17.32%, meaning almost 1 screw pile 1: 3 plain pile with a note that the use of screw pile piles is only used for shallow foundation driving (not reaching hard soil). It can also be interpreted that the use of screw pile foundations can save costs of 17.32% when using screw pile piles.

4. Conclusion

The results of this study as follows; 1) The length of the piles of the test specimens, both plain blankets and rough/Screwed blankets, is 15 cm x 15 cm with a pile length of 300 cm + 20 as the pile taper. 2) Driving from the ground level as deep as 250 cm + 20 taper poles, the remaining length of 50 cm that is not embedded is used for placing the load. 3) The loading weight of 380 kg made of concrete blocks. 4) The loading was carried out after 3 days of driving. 5) The results of the settlement of the piles from loading can be seen in table.1 where the difference in settlement values is 3.955 mm for plain piles and equal to 3.11 mm drop in Screwed pile. The difference between the two settlement values is 0.685mm, so the percentage difference is 17.32% where the settlement value of piles with blanket piles is greater than the settlement of piles with screw covers.

Suggestions From this study we can suggest the following: 1) The results of this study are more suitable for the use of foundation piles on clay soils (soils that have a soft structure) because what works on the piles is the lining of the piles, not the ends of the piles. The results obtained from this study are not definitive results because this research should be carried out several times, this is due to the weather and climate conditions which are also very influential. 3) This test only uses a stretch size of 1 cm and a distance of 15 cm. Of course, the screw size and spacing also greatly affect the results of the study.

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