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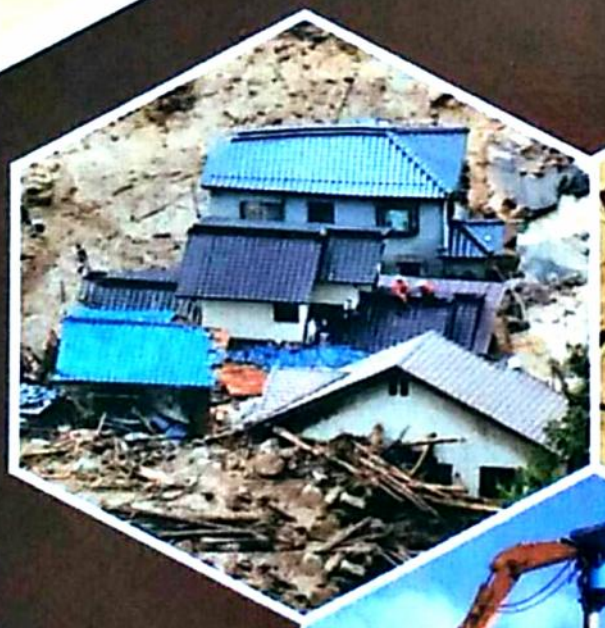

SOFT SOILS 2016

UNIVERSITAS KATOLIK PARAHYANGAN

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HIMPUNAN AHLI TEKNIK TANAH INDONESIA

FIELD TEST OF PROTOTYPE FLOATING FOUNDATIONS ON SOFT SOIL

S. Srihandayani [1], A. Hakam [2] and R. Yuliet [3]

ABSTRACT: Rapid development of the city may be followed by the need of open ground for residential housing. Padang city development should eventually has to take advantage of land where consists of peat and clay which was classified as soft soil. The disadvantages of soft soil that has low bearing capacity, must be balanced with the selection of a right foundation. Residential houses that to have the advantage of relatively small load. The combination of soft soil and small load gives an idea to research investigate the type of foundation that is described in this paper. The foundation was made of PVC pipes (Poly Vinyl Chloride) that planted directly on the soft clay. The load test to foundation models then were conducted with a variety of foundation dimensions and number of pipes. In this tests, the load-settlement behavior of the foundations are studied. To estimate theoretical load capacity and efficiency of the foundations, existing formulas were used. The test result of the single foundation showed good correlation to the analysis. For group foundation, bearing capacity of the theoretical analyses are greater than the field test results. Group foundation with the closed upper cap gives the capacity relatively the same compared to the foundation with the opened cap. There the differences of settlement rate between opened and closed caps for the same load. The efficiency of the group of the foundations are more than 30%.

Keywords: Floating foundation, soft soil, field test

INTRODUCTION

Padang is a city in Sumatra island where many areas with high ground water level or swamp. The type of soil in that areas are generally dominated by peat or soft clay. That areas were formerly used for rice fields. With better understanding of the disaster mitigation and needs of urban development, Padang resident need to stay away from the beach. The soft soil region eventually become an alternative to be used for residential area. The need of residential areas that occupy the soft soil land is also common in other developing countries (Arifuzzaman and Hasan, 2013).

Since soft soil can be used directly for construction, it is necessary to search the good alternative foundation to be use in soft soil area. Construction on soft soil will deal with low bearing capacity and large settlement problems. It would require a special study to find solutions to these problems. Otherwise soft soil improvement methods for soft soil must be applied (Makusa, 2012).

Padang people who occupied an area with soft soil have made houses made of timber-base materials. The advantage of a building with timber construction is it has very relative small load. The wooden houses initially has columns that stand on a stone each. However, nowadays more semi-permanent houses are made. Based on observations from a number of existing houses, there are significant differential settlement occurred in these houses that can be noticed with naked eyes. This evidences indicate that the existing construction need solutions for soft soil problems.

LOAD TEST OF FOUNDATION PROTOTYPE

This study investigates the load-settlement behavior of prototype floating foundations for given vertical loads. The foundation were made of series of PVC (Poly Vinyl Chloride) pipes. This material is available and easily find in markets. This material has also very high workability using simple carpentry tools. In addition, this material has also relatively good resistant against weather, moisture and flexible. Several variations of foundation composition were made to describe bearing capacity and group

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efficiency of the foundation. But this paper simply outlines test results of the foundation group with four piles.

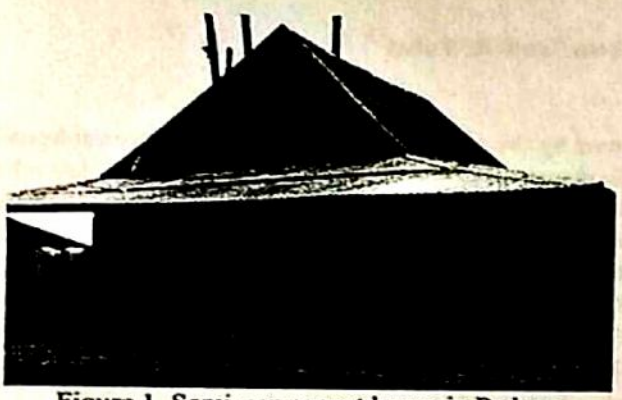


Figure 1. Semi-permanent house in Padang

First test of foundation prototype in this study is done for a single foundation with a diameter of 20cm, length of 30cm and the thickness of 0.4 cm, as shown in Figure 2. The distance between foundation in group is made twice of the diameter, so that the clearance between single foundation is equal to its diameter. Furthermore, each of the various models are named Single, Closed head and Open head. The laboratory test results of soil are shown in Table 1.

The test series of foundation models are conducted by adopting modified CRP procedures (after Hunt, 1986). The modified CRP procedure on foundation is done by increasing a fixed load for one minute each time such that the settlement could be recorded.

Table 1. Soil Parameters

No	Parameter	Symbol	Value	Unit
1	Water content	w	58,642	%
2	Unit Volume	γ	1,648	gr/cm^3
3	Specific gravity	Gs	2,592	-
4	Atterberg Limits	LL	59,372	%
		PL	40,347	%
		PI	19,025	%
7	Direct Shear Test	ϕ	7,990	°
		c	0,098	kg/cm^2
8	UCST	q_u	0,258	kg/cm^2
9	Finer content	f %	74,384	%
10	Consolidation	C_v	0,034	cm^2/sec.
		P_c	0,130	kg/cm^2
11	UU-Triaxial Test	ϕ_u	0,00	°
		c_u	0,08	kg/cm^2

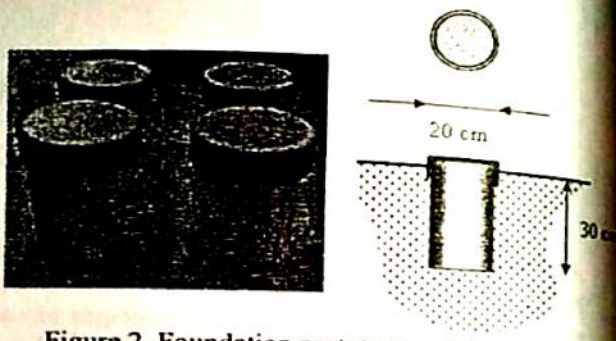


Figure 2. Foundation prototype and dimension

TESTING RESULTS

In order to comparison study, the calculation of the bearing capacity of a single foundation by using classical theory. End bearing capacity of the foundation is using Terzaghi and Meyerhof method, for carrying friction the α method is employed.

Then with an outer diameter of the pipe, Do = 20 cm, thickness of the pipe, h = 0.4 cm, inside diameter, Di= 19.2 cm and the length of pipe, L= 30 cm, the friction capacity is obtained by the α method. Based on soil parameters obtained from laboratory testing, the ultimate bearing capacity of a single foundation is Q_s = 100,48 kg

The buoyant effect of Closed head foundation due to the water pressure can be calculated as:

$$F_a = \pi . (^1/_2\ Di)^2 . H . \gamma_w$$
$$= \pi\ 92{,}16\ cm^2 .30\ cm\ (0{,}000981\ kg/cm^3)$$
$$= 8{,}517\ kg$$

End bearing capacity of the foundation on saturated clay is calculated using Meyerhof method, (the cohesion is taken 2/3 of that one from test Triaxial):

$$Q_p = c_u\ A_p\ N_c$$
$$Q_p = (0{,}053\ kg/cm^2)\ (24{,}618\ cm^2)\ (9)$$
$$= 11{,}8164\ kg$$

Meanwhile for Terzaghi method is:

Q_p = 10,887 kg

The results of the field tests are plotted in the term of load-settlement and settlement-time curves. The load maximum from the test for the single foundation is 180 kg.

Figure 3 shows the load-settlement curve from the test for group with 4 closed head foundation. The maximum load which can be carried by this model is about 240 kg. The result of load test on the group foundation with open head is shown in Figure 4. The maximum load from the test of this open group foundation is also 240 kg.

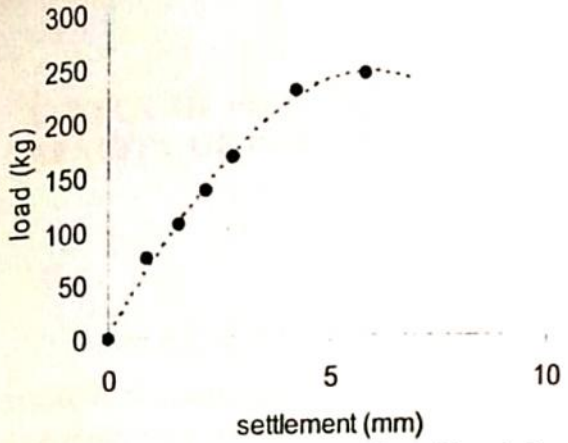
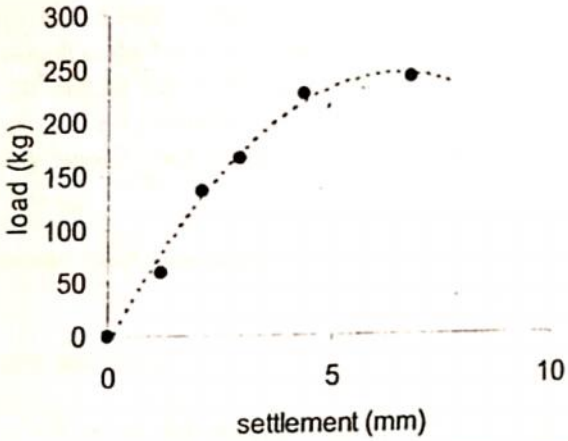


Figure3. Load-settlement for closed head foundations



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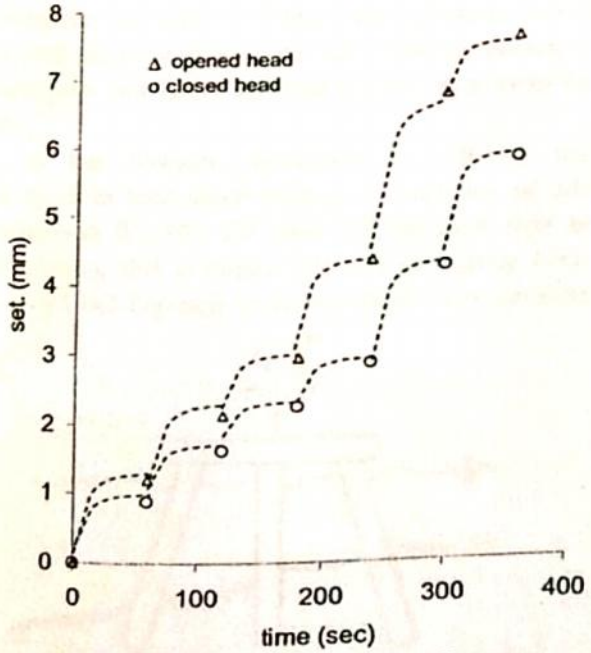

Figure 5. Settlement-time relation for group foundation

It can be seen that both the models of group foundation have low efficiency compared to the result of the single foundation. The efficiency of the group is only about 30%. This value is relatively reasonable since this foundation relies on skin friction. The larger spacing between foundation in group may be increase the efficiency.

The test results of group foundation shows a difference between the two closed and open head in terms of settlement rates (Figure 5). The open head foundation gives larger and faster settlement than the open foundation. The reason of this fact may be due to the release time of trapped air inside the foundation.

CONCLUSION

The vertical load test of the prototype foundation on soft soil has been conducted in this study. The test results are presented in the form of load-settlement and settlement-time curves. The test result showed that the bearing capacity of the single foundation is a little greater than it from the analysis. The group foundation with closed head provides the same bearing capacity compared to the open foundations. The efficiency of group foundations is approximately 30% compared to the single foundation. The speed of the settlement of the foundation closed end open is not the same, but this does not give effect to the load-settlement curves. So, that the head conditions of foundation has no effect on the bearing capacity of the group foundation but it increased the settlement.

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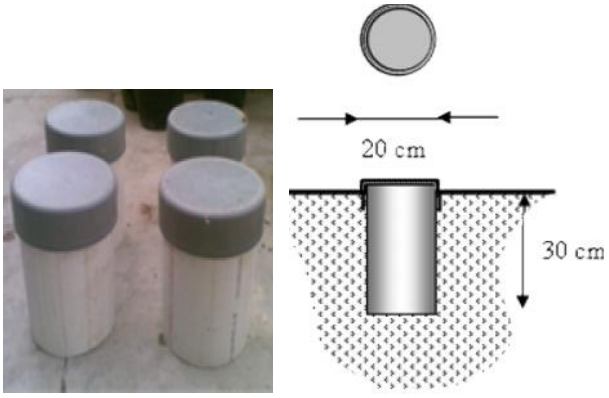

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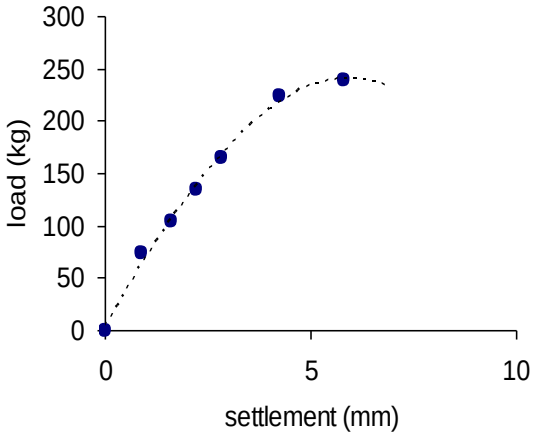

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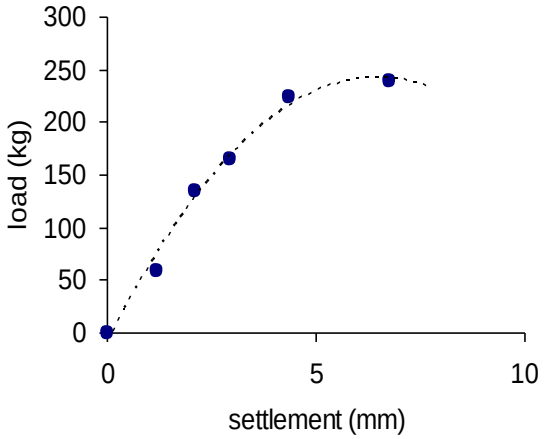

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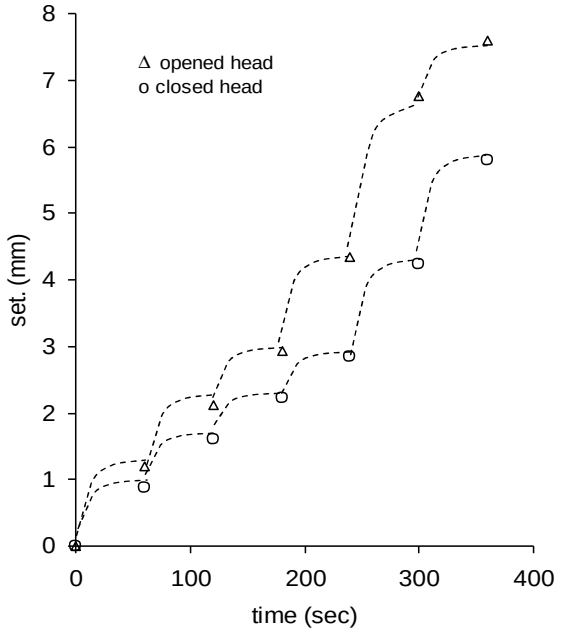

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