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QiR

Yogyakarta
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IN CONJUCTION WITH :

ICCS 2013
(THE 2ND INTERNATIONAL CONFERENCE ON CIVIC SPACE)

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PREFACE

WELCOME FROM THE QiR 2013 ORGANIZING COMMITTEE

Welcome to the 13th International Conference on QiR (Quality in Research) 2013. It is a great pleasure for Faculty of Engineering Universitas Indonesia to be co-hosting this biennial event with IST-Akprind and Gadjah Mada University, in the spirit of strengthening of cooperation and mutual growth to be world class institution. For the first time, the QiR 2013 is held in one of the most historical city in Indonesia – Yogyakarta. It is with our utmost pleasure to hold this year's QiR 2013 in conjunction with the 2nd International Conference on Civic Space (ICCS 2013) and introducing the International Symposium on Community Development 2013 as a forum to share experience on engaging community for a better life and environment.

The aim of this International Conference with our selected theme, "Exploring Innovation for Enhancement of Human Life and Environment", is to provide an international forum for exchanging knowledge and research expertise as well as creating a prospective collaboration and networking on various fields of science, engineering and design. We hope this conference can be a kick-off for the strengthened action and partnerships on creating a platform for us; national and international thinkers, academics, government officials, business executives and practitioners, to present and discuss the pivotal role of engineers in innovative products which will reduce environmental impacts, applications in sustainable planning, manufacturing, architecture, and many more to grow and ensure the rising prosperity of our society going into the future. Under this theme, the conference focuses on the innovative contributions in science, engineering and design as well as their market perspectives to the existing and future enhancement of human life and environment quality.

Over the period of 15 years, this biennial conference has become an important place of encounter between scholars and practitioners from different countries, cultures and backgrounds discussing contemporary engineering and design issues dealt in their hometown, country or even region. Serving as a platform for an engineering and design dialogue, this conference will have 16 invited speakers and has gathered more than 500 papers from more than 20 countries all over the world:
92 papers on International Symposium on Civil and Environmental Engineering
51 papers on International Symposium on Mechanical and Maritime Engineering
97 papers on International Symposium on Electrical and Computer Engineering
111 papers on International Symposium on Materials and Metallurgy Engineering
31 papers on International Symposium on Architecture, Interior and Urban Planning
57 papers on International Symposium on Chemical and Bioprocess Engineering
71 papers on International Symposium on Industrial Engineering
25 papers on International Symposium on Community Development

My deepest gratitude to all of our speakers, participants and contributors who have given this conference their generous support. I would also like to thank all members of the Organizing Committee and our distinguished International Board of Reviewers for all of their support and advice. Our thanks to all of our sponsors, supporters, exhibitors, and professional associations for their great support and encouragement through committed funding and any other form of help and support. We also owe our success to the full support of the Rector of Universitas Indonesia and the Dean of Faculty of Engineering. Thank you to IEEE Indonesia Section that has supported QiR 2013 to be approved as IEEE Conference. Last but not least, a special thanks to our co-hosts, IST-Akprind and Gadjah Mada University for all of their immense supports in making this conference a success.

Allow me to wish all of you a meaningful and rewarding conference. We wish you a pleasant and memorable stay in Yogyakarta. Thank you and we hope to see you again at the QiR 2015.

Prof. Dr. Ir. Bondan T. Sofyan, M.Si.
Chairman of QiR 2013 Organizing Committee

Symposium F

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Field Study on Undrained Shear Strength of Soft Soil around Micropiles

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ABSTRACT

Micropile (Cerucuk) is widely used to increase the bearing capacity of soft soil in South Kalimantan. Some researchers have reported that the use of micropile can increase the bearing capacity of soft soil. However, most studies were conducted in laboratory. This paper discusses the influence of micropile on undrained shear strength in soft soil around the piles. The study was performed in the field.
In this study, cerucuk used was Galam (Malaleuca Leucadendron) that have a nature-lined leather-wrapped sticks, hard and heavy. Galam has a diameter (D) of 0,10 m and a length of 2 m. Piles were penetrated with different spacing (i.e., 2D, 3D, and 4D). Shear strength was measured directly in the field using the field vane shear. Considering time effect, measurements were made before installation, and 1, 7, 14, and 28 days after installation. The results show that the closer pile the greater the soil shear strength. The piles affect the soil shear strength at a distance up to 0.20 m from the pile. Soil shear strength increases by time up to 14 days.

Keywords

Cerucuk, micropile, undrained shear strength,field vane shear test, pile distance, time effect.

1. INTRODUCTION

Micropile (cerucuk) is widely used in South Kalimantan to increase bearing capacity of soft soil. It can be proved theoretically as in [1] using NAVFAC DM-7 [2] based on assumption of piles loaded laterally. However, based on laboratory model, Reference [3] reported that bearing capacity resulted in experiment was higher than that of theoretic calculation. Reference [3] also reported that the use of micropile increases the shear strength of soft soil. However, the conclusion was based on laboratory model.

Referenses [4] and [5] reported experiments on piles in the field. According to [4], the use of micropile resulted in increasing the bearing capacity of soft soil. It increases with increasing time. At the age of 4 days, bearing capacity increased by approximately 45%. The increase has reached 97% after the age of 15 days. According to [5], the distance of pile influenced the bearing capacity of pile in the field. For the same length of pile, the sorter the distance the greater bearing capacity of group piles. The study did not address changes in shear strength of the soil around the pile. In fact, this information is very important for the engineers in the calculation.

Reference [6] reported an effect of pile installation on the shear strength parameter of soil. The test was conducted in a triaxial apparatus. It was found that the cohesion and internal friction angle change due to installation of pile. It results in increasing soil strength and reducing settlement. The result was also concluded based on laboratory test. A field test to support the theoretical and experimental results is required. This paper discusses the changes in shear strength of soil around the pile. Distance and time of pile installation were considered in this study.

2. MATERIAL USED AND EXPERIMENTAL TECHNIQUES

2.1 Material Used

Micropile used in this study was the type of wood called Galam (*Malaleuca Leucadendron*). This type of wood is often used as a foundation or soil reinforcement in Kalimantan especially in South Kalimantan. The unique properties of this material is its strength maintained if submerged under water continuously. The pile used has diameter of 10 cm and length of 200 cm.

2.2 Soil Properties

A laboratory test was performed to the soil. The soil properties of soft soil are summarized in Table 1. According to Table 1, soil has very high water content, fine content, and compression index, and very low coarse grain, shear strength, and coeficient of consolidation. Table1 also shows that the soil properties from depth of 0.5 to 3.0 m are similar.

Table 1: Summary of soil properties

Soil properties		Depth (m)	
		0.5-1.0	2.5-3.0
Specific gravity		2.6	2.6
Water content	%	96.8	101
Volumetric weight	Mg/m^3	1.53	1.52
Grain size distribution			
Gravel	%	1.0	1.6
Coarse sand (0.6-2.0 mm)	%	0.7	1.7
Medium sand (0.2-0.6 mm)	%	0.8	1.4
Fine sand (0.05-0.2 mm)	%	4.5	3.9
Silt	%	41.7	22.7
Clay	%	51.3	68.7
Liquid limit	%	55	54
Plastic limit	%	43	46
Plasticity Index	%	12	8
Unconfined compression test			
q_u	kg/cm^2	0.07	0.16
q_r	kg/cm^2	0.03	0.7
s_t		2.13	2.34
Consolidation test			
c_c		0.82	0.55
c_s		0.09	0.14
c_v	cm^2/s	0.02	0.01

2.3 Techniques and Procedures

Undrained shear strength of soil was measured using field vane shear test (FVST) apparatus. This test is the most widely used method for measuring the undrained shear strength of a soil, and is particularly appropriate for assessing very soft and sensitive clays, in case where a soil sample for laboratory testing cannot be obtained. The vane has diameter of 4 cm and height of 8 cm. The test procedures are described in ASTM Standard D-2573 [7]. The diameter effect on the s_u is included in the calculation as discribed in [7].
Piles were installed with the configuration as shown in Figure 1. "s" is distance of pile. Three different distance were used (i.e., 2d, 3d, and 4d, or 20, 30, and 40 cm, respectively) where d is pile diameter. FVSTs were performed in between the piles and also outside the group piles as shown in Figure 1.

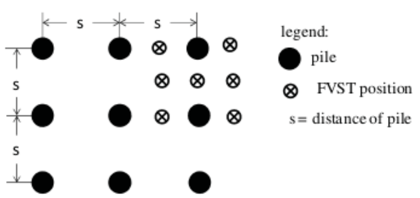

Figure 1: Configuration of pile installation and FVSTs positions

The distance of FVST is approximately 10 cm. For s = 20 cm, there was one FVST in between the piles. For s = 30 and 40 cm, there were 2 and 3, respectively (Figure 2). FVST were conducted after installation period of 1, 7, 14, and 28 days. To ensure that the soil is not disturbed, the test were performed to different group piles for different installation period. For the vertical distance, FVST was carried out each 20 cm to a depth of 200 cm as shown in Figure 2. Field procedures and calculation were performed based on ASTM standard [7].

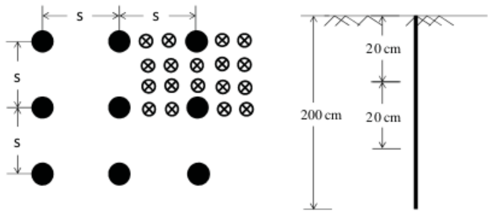

Figure 2: Configuration of pile installation, FVSTs positions, and vertical distance of FVST

3. RESULT AND DISCUSSION

Figure 3 shows typical undrained shear strength (s_u) in kPa obtained from FVST per 20 cm. Sketch of nine FVSTs position is displayed in the right side of the figure. An independent measurement of FVST was performed before pile installation to obtain initial s_u. As shown in the figure, the initial s_u of the soil is approximately 1.8 to 2.0 kPa.

There are two main positions discussed in this study i.e., inside and outside group piles. Points placed inside group piles are 2, 4, 5, and 6, and points outside group piles are 1, 3, 7, and 8. Points 1 and 3 are placed about 10 cm from piles, whereas points 7 and 8 are placed about 20 cm from the piles. According to Figure 3, s_u at points 7 and 8 is similar to the initial s_u. Whereas s_u at points 1 and 3 is higher than that of initial s_u. It can be concluded that piles affect the soil at a distance of less than 20 cm. Similar result was obtained for s = 30 and 40 cm. Figure 3 also shows that s_u at points 2, 4, 5, and 6 increases due to pile installation. Pile affects undrained shear strength of soil inside and outside group piles.

Figure 4 shows change of s_u due to installation of piles after 14 days. As shown in the figure, that s_u of soil is affected by time. Except for s_u at the points of 7 and 8, the values are not changed. This result supports previous statement that piles affect the soil at a distance of less than 20 cm.

Figure 5 shows effect of pile distance and time on s_u of soil. The data in the Figure 5(a) is the average of several measurements at the same position (i.e., in between two piles) and placed 10 cm from pile (e.g., Points 2 and 4 as shown in Figure 3). As shown in Figure 5(a), s_u slightly increases with depth. At this position, the s_u of soil is similar for different distance of piles. It seems that piles affects soil around it. Distance does not give significant effect at least up to a distance of 4d (i.e., 40 cm) used in this study.

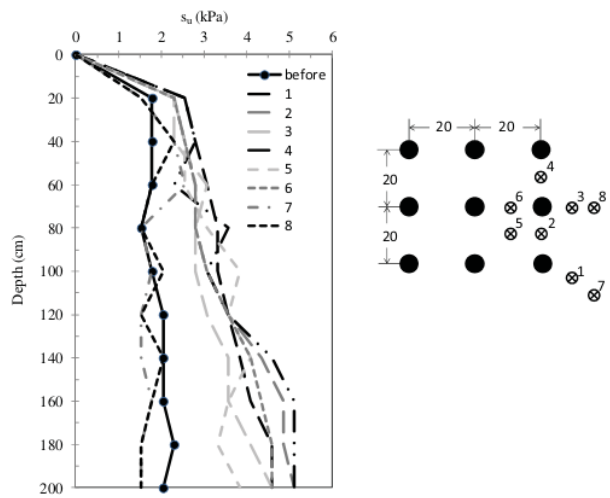

Figure 3: Undrained shear strength of soil by depth for s=20cm after 7days

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Figure 5(b) shows s_u of soil at the same position as data in Figure 5(a) performed at different time. After 1 day installation, s_u of soil is about 2 kPa. This is almost the same as s_u without pile. s_u increases to 3 kPa and 4-5 kPa after 7 and 14 days installation, respectively. After 28 days, s_u is about 4-5 kPa. The results shows that s_u of soil increases due to pile installation and influences by time. Increase of s_u is not significant after 14 days installation.

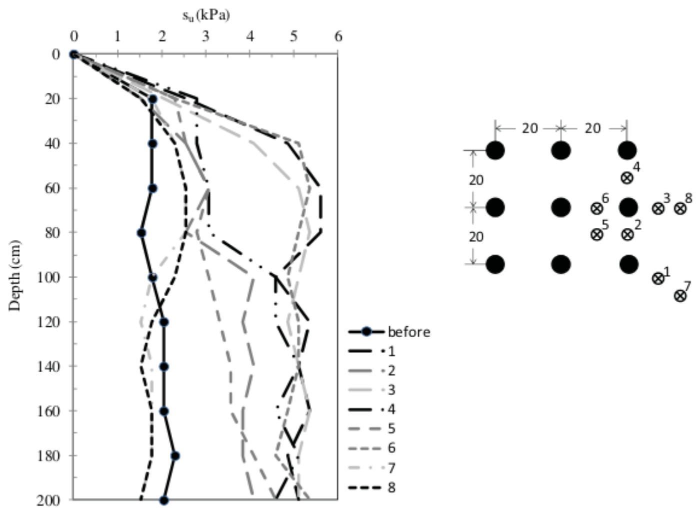


Figure 4: Undrained shear strength of soil by depth for s=20cm after 14 days

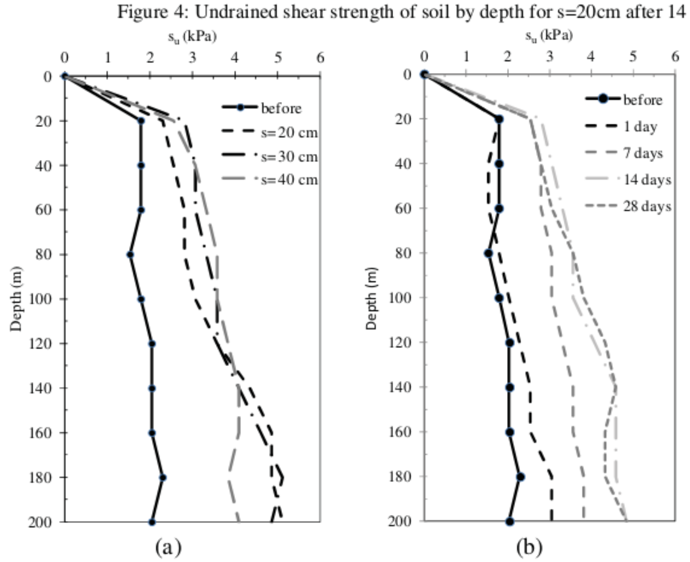
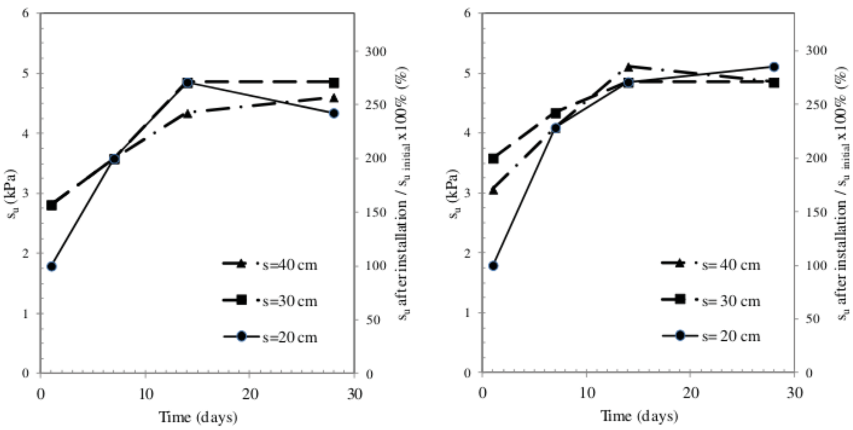


Figure 5: Undrained shear strength of soil (a) distance effect, and (b) time effect

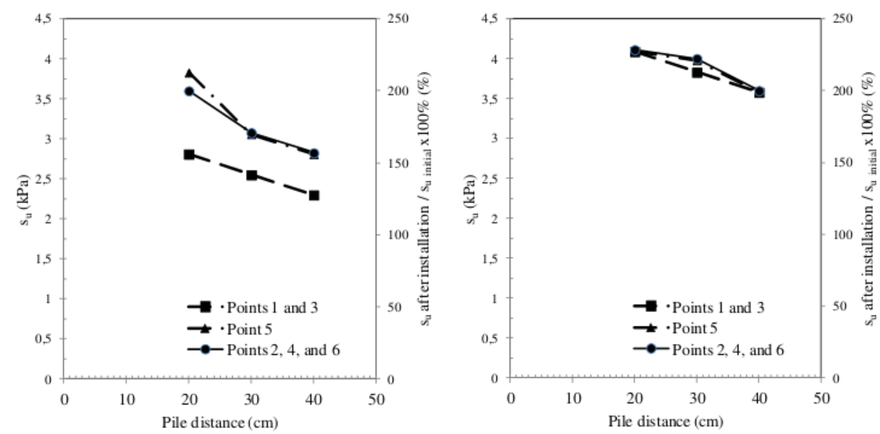
Figure 6 shows s_u of soil as a function of time for different distance of pile. Figures 6(a) and 6(b) show average data of s_u at the same depth (i.e., 200 cm) at points 1 and 3 and at points 2 and 4 as shown in Figure 3, respectively. Figure 6(a) shows clearly that s_u increases significantly up to 4.5-5 kPa or 250% (i.e., 2.5 times the initial s_u) up to 14 days. The similar phenomenon is shown in Figure 6(b). s_u increase significantly up to 5 kPa or 275% (i.e., 2.75 times the initial s_u) up to 14 days.



(a) (b)

Figure 6: Undrained shear strength of soil (a) distance effect (b) time installation effect

Figures 7(a) and 7(b) shows effects of points position and pile distance on the s_u after 1 and 7 days pile installation, respectively. As shown in Figure 7(a), s_u of soil outside the group piles is less than those inside the group piles. s_u of soil in between 2 piles (points 2, 4, and 6) is relative the same as s_u of soil in between four piles (points 5). The value is slightly influenced by the distance of piles. After 7 days, s_u increases and similar for all positions inside and outside of group piles. Similar results are obtained for 14 and 28 days after installation of piles.



(a) (b)

Figure 7: Effects of points position and pile distance (a) after 1 day, and (b) after 7 days installation

4. CONCLUSION

Result of field test of micropiles effects on undrained shear strength of soil around the piles are presented. Distance of piles and time effect are considered in this study. The results revealed that group piles influenced the undrained shear strength of soil at a distance up to 20 cm outside the group. For soil inside the group piles, undrained shear strength incresed from 2.5 to 2.75 times due to pile installation. Increase of shear strength was almost the same for different positions in the group. Pile distance influenced slightly on the values of shear strength. The closer the pile the higher shear strength of piles. Time installation influenced significantly on the undrained shear strength of soil around the pile. The shear strength increased significantly by increasing time up to 14 days. There was no significant effect after 14 days installation.

REFERENCES

[1] L. Karina, and I.B. Mochtar, "Studi Model Perubahan Daya Dukung dan Settlement untuk Pondasi Dengan Pemasangan Mikropile atau Cerucuk", Tugas Akhir Penelitian S1, Jurusan Teknik Sipil, FTSP-ITS, 1995.
[2] NAVFAC DM-7, Design Manual, Soil Mechanics, Foundation, and Earth Structures, Dept. of the Navy, Naval Facilities Engineering Command, USA, 1986.
[3] W. Arya, and I.B. Mochtar, "Pengaruh Penambahan Cerucuk Terhadap Peningkatan Kuat Geser Tanah Lunak Pada Permodelan di Laboratorium", Tesis Magister Teknologi, Institut Teknologi Sepuluh November Surabaya, Surabaya, 2002.
[4] Y. Yudiawati, and Ruspiansyah, "Peningkatan Daya Dukung Cerucuk Galam Sesuai Fungsi Waktu Berdasarkan Hasil Percobaan Pembebanan Lapangan", Laporan Penelitian, Politeknik Negeri, Banjarmasin, 2005.
[5] Y. Yudiawati, and A. Marzuki, "Peningkatan Daya Dukung dan Pengurangan Penurunan Pada Pondasi Dangkal di Atas Tanah Lunak dengan Menggunakan Cerucuk Berdasarkan Percobaan Lapangan," Laporan Penelitian Hibah Bersaing, Politeknik Negeri, Banjarmasin, 2008.
[6] D Damoerin, W. Rahayu, U. Nurhayati, "The effect of timber pile reinforcement to the shear strength of clay under consolidated undrained test", Proceeding of the 12th International Conference on QiR (Quality in Research), 2011.
[7] ASTM, Annual Book of Standards. Volumes 04.08 and 04.09, Soil and rock, ASTM International, West Conshohocken, PA, 1997.

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