ANALYSIS OF LIGHTWEIGHT CONCRETE "CAKAR AYAM" FOUNDATION FOR ROAD CONSTRUCTION USING PLAXIS 3D FOUNDATION SOFTWARE

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Abstract. Road settlement often occurs because that soil cannot accommodate the load capacity Therefore, the study to analysis of lightweight concrete "cakar ayam" foundation was conducted The idea of "cakar Ayam" concept was introduced by Prof. Dr. Ir. Sediyatmo. Objective of these studies was achieved which is to determine the settlement value of lightweight concrete "Cakar Ayam" foundation design on soft clay, sand, clayey silt under the different loads. Hence, the effectiveness of lightweight concrete "cakar ayam" foundation on that soil, have been able to determined according the settlement value was obtained. Implementation of research was doing using Plaxis 3D foundation software. The foundation design was various according to the several of the column length. The slab thickness, spacing between column, foundation and column size was fixed. Soil parameters to analyse lightweight concrete "cakar ayam" foundation, was obtained from previous studies and Research Center of Soft Soil, Universiti Tun Hussien Onn Malaysia (RECESS, UTHM). Each design was tested by different loads to get the settlement value. From the results show, the settlements value was obtained show concept of "cakar ayam" foundation, not effective to be implement on soft clay. The settlement value was over 25 mm, when the load 20 kN/m^2 was applied on the foundation, to all length of column on soft clay. However, the settlement value was lower than 25 mm, when the load 40 kN/m^2 was applied on the foundation, to all length of column on sand and clayey silt. From all the settlement value, it could be seen that clayey silt result was more effective than sand. The settlement value also was decrease when the length of pile was increase. In conclusion, the objective of the study was achieved.

Introduction

Foundation is an extremely important structure element in every construction, such as buildings bridges, dam and roads. A foundation is defined as that part of the structure that supports the weigh of the structure and transmits the load to underlying soil or rock [1]. Road construction on the soft soil, such as soft clay, peat, and organic soil has been considered a tough challenge [2][3]. Failure of soil can be improved using the implementation of foundation on road. The purpose of a foundation is to hold up and hold together the structure above it. That is important to ensure that the foundation is really in a good condition to avoid the failure of structure or road construction. The functions of foundation are to be able to reduce the rate of settlement of soil. Settlement means the gradual downward movement of an engineering structure, due to compression of the soil below the foundation.

Materials and Methods

There are several properties that used in plaxis 3D foundation software. There are a few steps tha will be done in order to design foundation using Plaxis 3D foundation software. It is general setting soil parameter, geometry of model and calculation step. The parameter used in the step which is soi parameter, lightweight concrete parameter, load distribution value. Table 1 shows the properties o soil that used in Plaxis 3D foundation software that was obtained from previous researcher data

Soft clay soil which is the soil that obtain from RECESS, UTHM [4]. Clayey silt soil data was obtained from Plaxis buletin [5]. While sand data obtained from Plaxis 3D foundation manual [6].

Table 1 Hardening soil model parameter

Description	Symbol	Unit	Soft clay		Sand	Clayey silt
			0-3.5 m	3.5-10 m		
General						
Material model	Model		Hardening soil model			
Drainage type	Type		Undrained		Drained	Drained
Unit weight above phreatic level	γ_{unsat}	kN/m^3	8.190	12.550	17.0	20.000
Unit weight below phreatic level	γ_{sat}	kN/m^3	15.075	17.32	20.0	20.200
Parameters						
Stiffness						
Secant stiffness for CD triaxial test	(E_{50}^{ref})	kN/m^2	1655.854	2206.588	43000	25000
Tangen odeometer stiffness	(E_{ur}^{ref})	kN/m^2	1324.684	1765.271	43000	25000
Unloading/realoading stiffness	(E_{eod}^{ref})	kN/m^2	10460.00	5642.000	129000	75000
Power for stress level dependency of stiffness	M	-	0.85	0.78	0.50	0.80
Strength						
Cohesion	c'	kN/m^2	7	10	1	25
Friction angle	Φ	-	27	30	34	26
Dilatancy angle	Ψ	-	0	0	4	0
Interfaces						
Strength						
Interface reduction factor	R_{inter}	-	0.5	0.5	0.7	1.0

Results and Discussions

Result that obtain from Plaxis 3D foundation software show that the value of settlement when load applied on foundation. Overall from the result show that "cakar ayam" foundation concept, produce the high value of settlement. This is due to the properties of soil that not suitable to applied this concept. That has been discuss that, that soft soils pose high moisture content, low shear strength and exhibits high compressibility [7]. The illustration of the settlement trend can be seen in Figure 1. The value of settlement that acceptable is 25 mm. From the figure can be seen that the foundation on soft clay only accapetable when load 5KN/m^2, load 10 KN/m^2, and 15 KN/m^2 applied. Start from load 20 KN/m^2 the value of settlement exceed the limit which is 25 mm. So that the foundation concept not suitable to applied on soft clay soil.

The properties of soft clay cause that it not suitable in "Cakar Ayam" foundation concept. Soft clay stiffness parameter is low. Beside that the value of cohesion low, that cause can soil shear strength. It can be seen based on cohesion value in formula of shear strength parameter in term of effective stress [8].

Result that obtain from Plaxis 3D foundation software show that the value of settlement of sand when load applied on foundation. Overall from the result show that "cakar ayam" foundation concept, produce the acceptable value of settlement. This is due to the properties of soil that suitable to apply this concept. The illustration of the settlement trend can be seen in Figure 2. The value of settlement that acceptable is 25 mm. From the figure can be seen that the value of settlement on foundation is accapetable when load on sand. . The value of settlement was decrease when lengths of pile increase. So that the foundation concept is suitable to applied on sand.

The properties of sand will help to implement "cakar ayam" foundation concept. It will help to reduce the value of settlement. The value of cohesion of sand is low, but the value of friction is height. The value of friction of sand will help to increase strength of soil. It is can be seen based on formula of shear strength parameter in term of effective stress[8]. Sand stiffness parameter is height will help to reduce the value of settlement. This is because stiffness values also depend on the effective stress value on sand.Rotation of pipe columns will be counter back by lateral earth pressure, that acting around the pipe columns. So that passive pressure will help to reduce settlement value [8].

Result that obtain from Plaxis 3D foundation software show that the value of settlement of clayey silt when load applied on foundation. Overall from the result show that "cakar ayam" foundation concept, produce the acceptable value of settlement. This is due to the properties of soil that suitable to apply this concept. The illustration of the settlement trend can be seen in Figure 3. The value of settlement that acceptable is 25 mm. From the figure can be seen that the value of settlement on foundation is accapetable when load on clayey silt. The value of settlement was decrease when lengths of pile increase. So that the foundation concept is suitable to applied on clayey silt.

The properties of clayey silt will help to implement "Cakar Ayam" foundation concept. It will help to reduce the value of settlement. The value of cohesion and friction of soil is height. This will help to increase strength of soil. It is can be seen based on formula of shear strength parameter in term of effective stress [8]. Furthermore, clayey silt stiffness parameter is height will help to reduce the value of settlement. Deflection that occurs on the concrete slab of chicken-foot foundation will cause the pipe columns to rotate about axis. Rotation of pipe columns will be counter back by lateral earth pressure, that acting around the pipe columns. So that passive pressure will help to reduce settlement value [8]. Overall, the value of settlement also rather low this is because the unit weight of lightweight concrete will reduce the value of settlement result [10]. It would make the settlement value more safety.

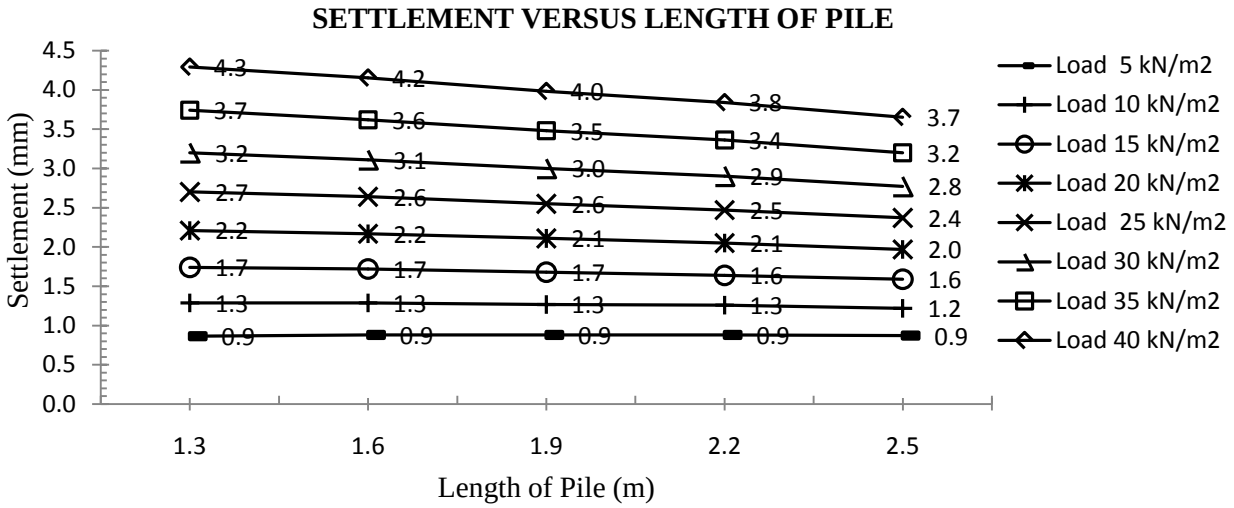

Figure 1 Graph settlements versus length of pile on clayey silt, with different distribution load

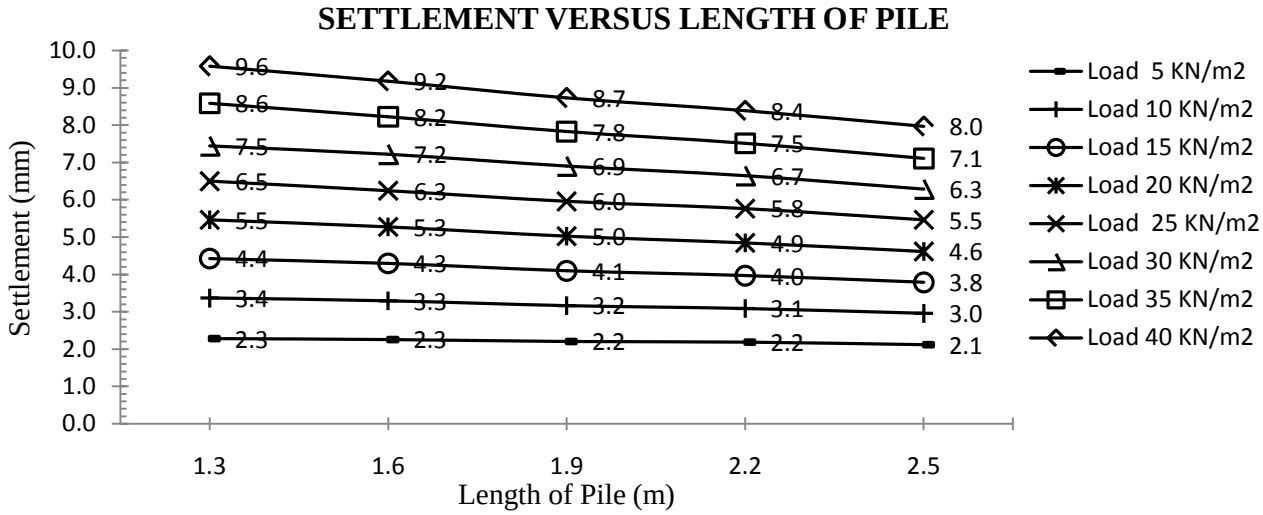

Figure 2 Graph settlement versus length of pile on sand, with different distributin load

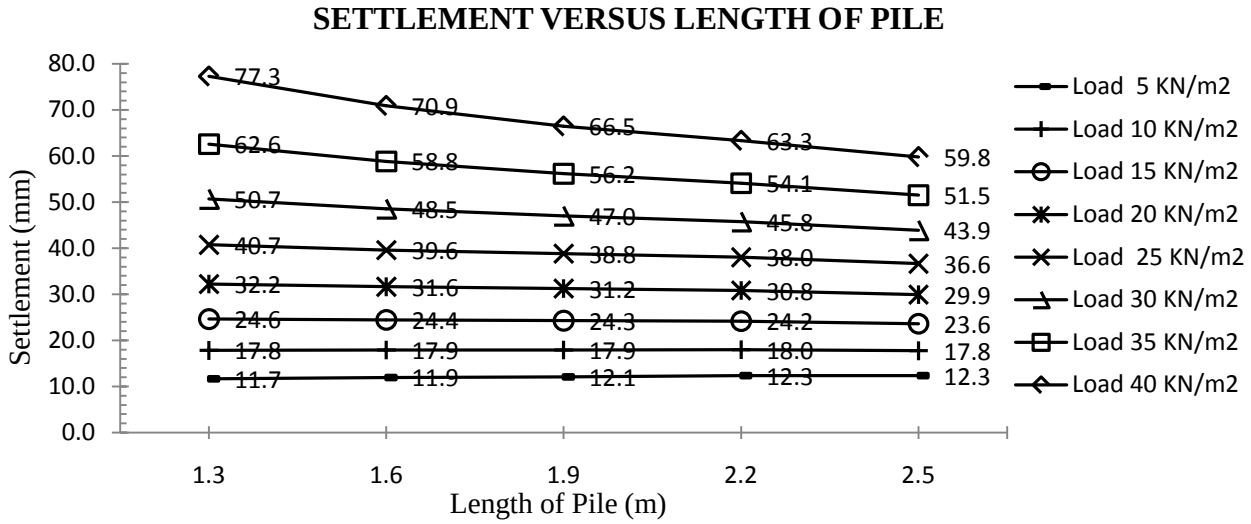

Figure 3 Graph settlement versus length of pile on softclay, with different distribution load

Conclusions

The result show that lightweight “cakar ayam” foundation concept was suitable to be implement on sand and clayey silt soil. This is because all the value that obtained from Plaxis 3D foundation software acceptable, which is under the safe limit, 25 mm. The trends of the settlement also show that when the lengths of “cakar ayam” foundation increase, the values of settlement decrease.Besides that, this concept still not suitable to be implement on soft clay soil. This is because the result show that the settlement value obtained from Plaxis 3D foundation software, still over limit. The results also show that the value of settlement was relatively low. This is affected from the implementation of lightweight concrete “cakar ayam” foundation. The unit weight of concrete is low. This will reduce the selfweight of foundation and the value of settlement. Nevertheless, the research was addressing their objective.

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