A EXPERIMENTAL STUDY OF LABORATORY COMPACTION AND SAND CONE ON FOUNDATION TUB SOIL

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ABSTRACT

Soil is a very important material so that it must be able to support the loads above it, so the soil must have a sufficiently good soil bearing capacity. In this study, the soil compaction was compared with the laboratory compaction method with the sandcone method. The objectives of the study were knowing the characteristics of the soil and knowing the laboratory compaction compares with the sandcone compaction in the foundation tub. Soil is drawn from the same point for the Proctor Test and Sand cone Test. The results of this test are used in the foundation model test. Characteristics testing in the laboratory: moisture content, density, consistency limits (LL, PL), sieve analysis, hydrometer, laboratory compaction and sandcone. Research result It was found that the soil type was based on the AASHTO classification was A-7-5 and the soil classification based on the Unifield Soil Classification System (USCS) was MH. Laboratory compaction (Proctor Test) average moisture content of 32.26%, γ_d maximum 1,33 g/cm³, and the sandcone compaction of model foundation test of soil without foundation γ_d was 1,36 g/cm³, Vertically arranged tire foundation γ_d was 1,36 g/cm³, horizontally arranged tire foundation γ_d was 1,36 g/cm³.

Keywords: *Study, Soil, Proctor Test, Sand Cone Test*

RESEARCH HIGHLIGHTS

1. Evaluation of soil compaction on foundation tub soil were observed.
2. Soil compaction inspection with sandcone provides the best compaction.
3. Increased soil compaction increases the resistance of the soil to the loads placed on it and reduces settlement.

Research Objectives

Soil compaction is one of the mechanical efforts to bring the soil grains together, the volume of the soil will decrease along with the decrease in pore volume (1, 2). However, the grain volume did not change. Compaction can be done by grinding or mashing (2). According to Terzaghi, soil is "soil consisting of grains from the weathering of massive rock masses, where the size of each grain can be as large as gravel-sand-silt-clay and the contact between grains is not cemented, including organic matter (3). The benefits of compaction aim to improve technical properties to obtain the densest soil state, so that it can:

1. Improve soil shear strength,
2. Reducing compatibility, namely decreasing by load,
3. Reducing permeability, and
4. Reducing the soil shrinkage and shrinkage properties.

Several studies have been carried out to analyze soil density in the landfill of the project work carried out with sand cones. Therefore this research aims knowing the characteristics of the soil and knowing the dry density of laboratory soil compaction comparison with sandcone

Methodology

The materials used in this experiment is soil. The landfill taken from the quarry of Pattalassang Village, Gowa Regency, Indonesia. The land is transported by dump truck to the laboratory and then put into the foundation tub soil. The research location was conducted at the Environmental Geotechnical Laboratory, Faculty of Engineering, Hasanuddin University Makassar, in Gowa Regency, South Sulawesi. The research method used in this research is based on the provisions on sand cone testing in accordance with SNI 03-2828-1992, ASTM.D 1556-00 (Field Density Testing Method with Sand Conus Tool) and the Proctor test is adjusted to AASHTO T 99 regulations. SNI- R-03-1742-1989. ASTM-D 698 year 2012 (4, 5). Implementation is also based on calculation standards applicable in Indonesia, including:

1. SNI-03-1965-1990 soil water content testing method,
2. SNI-03-1966-1990 plastic limit testing method,
3. Compaction testing method (proctor) SNI-03-1966-1990,
4. Field Density Testing Method with Conus Sand Tool (Sandcone) SNI-03-2828-1992.

After carrying out these two tests (Proctor Test and Sand Cone Test) and having obtained these results, it is adjusted to the Indonesian National Standard (SNI) which is stipulated in the soil compaction test. The two tests were carried out to find the density value of the soil density (D). The final value on the Sand Cone Test is in the form of a table, while the Proctor Test is in the form of tables and graphs that can be used to compare compaction values between in the laboratory and in the field.

Results & Findings

Table 1. Recapitulation of Soil Physical Characteristics Examination

	Parameter	Symbol	Value	Unit
Volumetric Land	Specific Gravity	Gs	2,68	-
Limits of Land Consistency	Liquid Limits	LL	65,46	%
	Plastic Limits	PL	44,03	%
	Plastic Index	PI	21,43	%
Sieve Analysis and Hydrometer	Sand		29,8	%
	Silt		57,4	%
	Clay		12,8	%
Sand Cone Test	Soil without foundation	γ_{dry}	1,36	gr/cm ³
	Vertically arranged tire foundation	γ_{dry}	1,36	gr/cm ³
	Horizontally arranged tire foundation	γ_{dry}	1,36	gr/cm ³
Proctor Test	Optimum Moisture Content	OMC	32,26	%
	Maximum Dry Density	γ_{dry}	1,33	gr/cm ³

The results of the sieve analysis test on soils are classified as fine-grained soils because the percentage of soil that passes the # 200 sieve is more than 50%. To produce a value

between clay and silt, a hydrometer analysis was performed. The results of the hydrometer analysis showed that the percentage of silt and clay, namely silt, respectively, was obtained as a percentage of 57.4%. While the clay fraction was 12.8%. In the compacting test that needs to be considered is the filling of wet soil into a mold that has 3 layers of the same size or thickness and the number of collisions is 25 times per layer. This compacting test is not only on one mold with three layers but several molds of one to three molds to determine the dry weight ratio of each. After the laboratory compaction test, a calculation analysis is carried out. The steps of the calculation analysis are the calculation of the weight of the wet soil, the calculation of the weight of the wet soil, then the calculation of the moisture content, the calculation of the weight of the dry soil, and the calculation of the weight of the contents when there is no air in the pores (zero air void). To find out the final moisture content, the weight of the five plates must be the same, and in determining the dry bulk density (γ_d) the highest value of each dry bulk density is taken, then plotted according to the graph.

Fig. 1. Graph of Relationship between Moisture Content and Dry Content Weight of Soft Soil

The Sandcone test in this study was carried out to determine the density of the soil in the foundation tub which had been compacted. The tools described herein are limited to soils containing coarse grains of not more than 5 cm. Field Density is the dry weight of the unity of the contents. The sand cone experiment is one type of test carried out in the field to determine the dry bulk density (density) of the original soil or the result of a compaction work carried out on both cohesive and non-cohesive soil. Sand Cone consists of a plastic or glass bottle with a metal cone attached to it. These glass bottles and cones are filled with poorly graded dry Ottawa sand, the weight of which is known. If using other sand, first find the weight of the content of the sand. In the field, a small hole was dug in the compacted soil surface. If the weight of the soil that has been excavated from the hole can be determined (W_{wet}) and the water content of the excavated soil is also known, then the dry weight of the soil (W_{dry}) can be found by the equation:

$$W_{dry} = W_{wet} / (1 + (w / 100)) \quad (1)$$

Where w is moisture content. The value of dry soil fill weight (γ_d) obtained from this experiment is used to evaluate the results of compaction in the field, namely the ratio between the γ_d results of trough compaction with the γ_d results of compaction

experiments in the laboratory. Embankment soil is soil that is more than 35% through the 200% sieve, AASHTO classification A-7-5. Sandcone testing is carried out by the three foundation basins for foundation tub 1 (soil without foundation) width was 300 cm length 250 cm soil thickness was 140 cm, second foundation tub (vertically arranged tire foundation) width was 250 cm length was 300 cm soil thickness was 140 cm, the third foundation tub (horizontally arranged tire foundation) width was 250 cm length was 300 cm soil thickness was 140 cm compaction testing foundation tub shown in Fig. 2.

Fig. 2. Foundation Tub Soil Model

While the results of the sandcone compaction test for foundation tub model soil without foundation an average γ_d of 1.36 g/cm³, the results of compaction sandcone test foundation tub soil, vertically arranged tire foundation an average γ_d of 1.36 g/cm³, the test results sandcone compaction of the foundation tub soil and horizontally arranged tire foundation an average γ_d of 1.36 g/cm³ are shown in Table 2.

Table 2. SandCone Testing Recapitulation

Foundation Tub Soil	γ_d (g/cm ³)	Average γ_d (g/cm ³)
Foundation Tub Soil 1 (Soil without foundation)		
Top layer	1,35	1,36
Middle Layer	1,36	
Bottom layer	1,37	
Foundation Tub Soil 2 (Vertically Arranged Tire Foundation)		
Top layer	1,36	1,36
Middle Layer	1,37	
Bottom layer	1,35	
Foundation Tub Soil 3 (Horizontally Arranged Tire Foundation)		
Top layer	1,37	1,36
Middle Layer	1,35	
Bottom layer	1,36	

Results of Laboratory Compaction Evaluation proctor test and with Sand Cone test on foundation tub soil. This experiment is usually carried out to evaluate the results of compaction work in the field which is expressed in degrees of compaction, which is the ratio between the field γ_d sand cone and the γ_d max. results of compaction experiments in the laboratory in percentage of the field. The value of the dry bulk density for laboratory compaction should not be much different from the dry bulk density in the Sand Cone test.

Comparison evaluation between γ_d compaction tub (sandcone) and γ_d compaction laboratory results are shown in Table 3.

Table 3. Comparison evaluation between γ_d compaction tub (sandcone) and γ_d compaction laboratory results

Density (γd) :	SandCone Test (γd) (g/cm³)	Average (γd) (g/cm³)	Laboratory (Proctor Test) (γd) (g/cm³)	Compaction
Soil Without Foundation				
Top Layer :	γd =1,35	1,36	1,33	
Middle Layer	γd =1,36			
Botton layer	γd =1,37			
Vertically Arranged Tire Foundation				
Top Layer	γd =1,36	1,36	1,33	
Middle Layer	γd= 1,37			
Botton layer	γd = 1,35			
Horizontally Arranged Tire Foundation				
Top Layer	γd = 1,37	1,36	1,33	
Middle Layer:	γd = 1,35			
Botton layer	γd = 1,36			

From the results of both laboratory compaction (compaction) and Sand Cone, the compaction value of the Sand Cone in the foundation soil was greater than 0.03 g / cm³

Conclusion

This research This research to determine the density of landfills with laboratory compaction and sand cone foundation tub soil. Conclusion:

- Soil types are based on the AASHTO classification. was A-7-5 and the soil classification based on the Unifield Soil Classification System (USCS) was MH.
- The maximum dry volume weight value with optimum moisture content. From the graph, it is obtained that the average water content was 32.26 %, the maximum γ_d was 1,33 g / cm³, and the sandcone compaction of model foundation test of soil without foundation γ_d was 1,36 g / cm³, vertically arranged tire foundation γ_d was 1,36 g / cm³, horizontally arranged tire foundation γ_d was 1,36 g / cm³.

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