ANALYSIS OF CBR VALUE ON PEAT OF OGAN KOMERING ILIR

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Abstract

Peat soil has unique charateristics when viewed from the perpective of its CBR value. This is because the soil contains soil-forming materials, in addition to its high acidity and water content, so that it will affect the bearing capacity of the soil and the value of the California Bearing Ratio (CBR). Research on CBR values in Ogan Komering Ilir Regency was carried out in Tulung Selapan Ilir Village, Tulung Selapan District, and Sumber Hidup Village, East Pedamaran District. The value of the California Bearing Ratio (CBR) of peat soil in Tulung Selapan Ilir Village is 2.83%. Meanwhile, the CBR value of the peat soil in Sumber Hidup Village is 2.82%. According to Bowles, the CBR values of the two locations are categorized as "very poor". Meanwhile, based on Bina Marga, including road subgrade, the category is bad.
Keywords: Peat soil, California Bearing Ratio (CBR), Ogan Komering Ilir

1 INTRODUCTION

Peat soil is formed from piles of dead plant remains, both rotted and not. The stockpile continues to grow because the decomposition process is hampered by anaerobic conditions and/or other environmental conditions that cause the low level of development of decomposing biota. The formation of peat soil is a geogenic process, namely the formation of soil caused by deposition and transportation processes, in contrast to the mineral soil formation process which is generally a pedogenic process [1]. Peats are identical to the remains of plant and animal remains that have rotted for years. When disturbed

or dry, carbon stored in peatlands can be released into the air and become a major source of greenhouse gas emissions [2]. The lowlands that stretch on the East Coast of South Sumatra are swamp land, where this land as one of the natural resources that has great potential, can be used as productive land for agriculture, transportation, and fisheries [3]. The total area of lebak and tidal swamps in South Sumatra is 541,461 ha spread over the Regencies of Ogan Komering Ilir, Musi Banyuasin, and Banyuasin. The peat area in Ogan Komering Ilir Regency has an area of 500,000 ha [4].

Peat soil has unique characteristics in terms of Atterberg boundaries and CBR values. This is because peat soil has a high organic matter content as one of the soil-forming materials, besides its acidity and high-water content so that it will affect the carrying capacity of the soil and the CBR value obtained when the soil is compacted. The CBR (California Bearing Ratio) value of the soil is obtained by conducting CBR tests, both laboratory tests and field tests on compacted soil. The CBR value describes the level of soil density and the quality of the compaction of the embankment to be tested [5]. Construction of civil buildings on peat soils often encounter problems. This is due to the physical properties of peat soil which has low specific gravity and bearing capacity but has high void ratio, moisture content and compression. Many soils are found whose physical properties do not meet the standards for compressibility, permeability, and plasticity values [6]. Damage to the highway is usually in the form of a decline. Where excessive reduction will cause structural damage to the building framework. The damage usually occurs because the soil condition is still unreinforced so that the carrying capacity is low where the basic soil bearing capacity requirement for roads is 6% [7].

Getting the CBR (California Bearing Ratio) value of the soil is a very important thing to do. Because the CBR value will be used for planning the construction of roads or airports to determine the strength of the subgrade [8]. One of the strengths of road construction is determined by the quality of the original soil bearing capacity as a subgrade. The way to determine the bearing capacity of the road subgrade is the CBR

test. The CBR value is used as the basis for planning the next road embankment pavement, depending on the desired road class. The higher the CBR value, the better the subgrade condition. If the original soil has a low bearing capacity, the road construction will quickly experience damage [9].

One of the parameters that becomes a benchmark in determining the ability of the soil in making transportation facilities as roads is the carrying capacity of the soil in the form of the CBR value. The requirements for the bearing capacity of the soil to be categorized as good are if the CBR value based on field testing is 3% and based on the laboratory the value is 6%. While soils that do not meet these requirements Peat soils tend to have low CBR values ranging from 2.595% - 5.709% [10]. The CBR value can be increased by compaction, which in practice will refer to the optimum moisture content and maximum dry density. However, if the CBR value does not meet the required carrying capacity, after a laboratory compaction test using the standard proctor method is carried out on the original soil, it is necessary to mix or replace it with soil with a better CBR value [11].

California Bearing Ratio According to SNI 1744-2012 is the ratio between the penetration load of a type of material and the standard load at the same penetration depth and speed. California Bearing Ratio is a comparison between the test load and standard load with the same depth and speed of penetration and is expressed as a percentage, and the purpose of the CBR experiment is to determine the value of the bearing capacity of the soil in maximum density. As well as CBR testing is used to evaluate the potential strength of subgrade materials, sub-bases and foundations, including materials that are recycled for road and airfield pavements.

Laboratory CBR testing is carried out on several specimens, generally depending on the moisture content of compaction and the dry density to be achieved. In general, the laboratory CBR testing (according to the stages) includes the preparation of equipment, material samples and test samples, compaction, determination of the wet mass and

moisture content of the test object, immersion, penetration test, drawing of the relationship curve between load and penetration, and determining the CBR value. The design CBR can also be determined through this CBR test, namely by using the relationship curve between the CBR and the dry density of each test object. Corrected load values shall be determined for each specimen at penetrations of 2.54 mm (0.10 in) and 5.08 mm (0.20 in). The CBR value, expressed in percent, is obtained by dividing the corrected load values on the 22.54 mm (0.10 in) and 5.08 mm (0.20 in) penetrations by the standard loads of 13 kN (3000 lbs) and 20 respectively. kN (4500 lbs), and multiply by 100 in Equation 1.

$$CBR = \frac{corrected\ test\ load}{standart\ load} x\ 100 \quad (1)$$

CBR is generally selected at 2.54 mm (0.10 inch) penetration. If the CBR at 5.08 mm (0.20 in) penetration is greater than the CBR at 2.54 mm (0.10 in) penetration, the CBR test must be repeated. If, after repeated, the same results are obtained, a CBR at 5.08 mm (0.20 in) penetration should be used [12]. Some of the lowlands found in the Ogan Komering Ilir Regency area are peat soil, so this will be a problem for the implementation of construction work for buildings, roads, bridges, as well as for regional development. This is due to the physical and mechanical properties of peat soil. This research was conducted to obtain CBR values on peat soils in Ogan Komering Ilir Regency, using peat soil samples from Tulung Selapan Ilir Village, Tulung Selapan District and Sumber Hidup Village, East Pedamaran District.

2 METHODOLOGY

This study uses a laboratory experimental method, by conducting tests to obtain data and process it to obtain results in the form of parameter values of the objects being tested. The locations for taking the specimens in this study were in Tulung Selapan Ilir Village, Tulung Selapan District and in Sumber Hudup Village, East Pedamaran District with undisturbed samples. This research activity was carried

out at the Soil Mechanics Laboratory, Faculty of Engineering, Tridinanti University, Palembang. Laboratory work begins with preparatory work, namely providing soil samples and tools and materials to be used in testing. The tests carried out are: Testing the physical properties of peat soil, compaction test, and CBR test.

1.1 Physical Properties of Peat Soil

To determine the physical properties of the peat soil used in this study, laboratory tests were used. This is done to determine the characteristics and properties of the soil to be tested. The physical properties of the soil used in the laboratory are as follows: Water content test, specific gravity test, pH test, and fiber content test.

Table 1. *Classification of Peat Soil based on Water Content (ASTM D4427-84).*

Type	Water Content (%)
Extreme	> 1500
High	800-1500
Moderate	300-800
Low	<300

Table 2. *Classification of Peat Soil based on pH (ASTM D4427-84).*

Type	pH
Highly Acidic	< 4.5
Moderately Acidic	4.5–5.5
Slightly Acidic	> 5.5 - < 7
Basic	≥ 7

Table 3. *Classification of Peat Soil based on fiber Content (ASTM D4427-84).*

Type	Fiber Content (%)
Fibric peat	> 67
Helmic peat	33-67
Sapric peat	< 33

1.2 Compaction Test

The purpose of this test is to obtain the optimum moisture content and maximum density. Compaction was carried out using a soil sample that had been dried and filtered through a No.4 sieve, then determined the variation of water content for each soil sample with the addition of ± 2% water.

1.3 CBR (California Bearing Ratio) Test

CBR testing aims to determine the CBR value of soil and aggregate mixture in the laboratory at a certain water content. Through this test, it can be known whether the peat soil meets the specifications to be used as the basis of a structure. The CBR values for the road subgrade criteria can be seen in ***Table. 4*** and ***Table. 5.***

Table 4. *CBR Classification according to Bowles, 1992.*

CBR (%)	Grade	Used
0-3	Very Poor	Sub-grade
3-7	Poor to fair	Sub-grade
7-20	Fair	Sub-base
20-50	Good	Bae of sub-base
>50	Excellent	Base

Table 5. *CBR Classification according to Bina Marga, 2012.*

Section	Grade	CBR (%)
Subgrade	very good	20-30
	good	10-20
	currently	5-10
	bad	<5

3 RESULTS

The purpose of testing the physical properties of the soil is to determine the characteristics of the peat soil being tested. While testing the mechanical properties of the California Bearing Ratio (CBR) test to determine the value of the bearing capacity of the soil by determining the ratio of piston penetration.

3.1 Physical Properties of Peat Soil

To determine the physical properties of the peat soil used in this study, laboratory tests were used, among others: *water content*, *specific gravity*, and pH.

Table 6. *Result of Physical Properties of peat soil.*

Soil Parameters	Location	
	Tulung Selapan District	East Pedamaran District
Water content	231,50	301,33
Specific gravity	1,0767	0,4333
pH	3,18	3,93
Fiber content	64,8%	15%

3.2 Compaction Test

In the compaction test, water is mixed with peat soil that passes sieve analysis no.4. starting from 500 ml, 600 ml, 700 ml, 800 ml, and 900 ml. Then the peat soil is cured for 24 hours. Before pounding it using a hammer which has a weight of 2500 grams, a drop height of 30.5 inches and the number of strokes per layer is 25 times in 3 layers. From this compaction process, a soil compaction curve can be obtained.

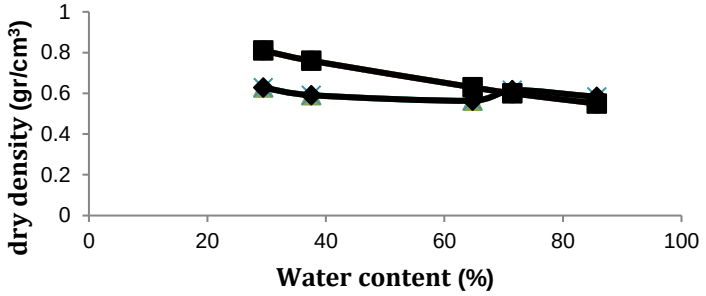

Figure 1. *Peat Soil Compaction Curve, Tulung Selapan District.*

From the ***Figure. 1*****,** can be determined that the optimum moisture content (w_{opt}) = 29.41% and the maximum dry weight ($\gamma_{d\ maks}$) = 0.628 gr/cm^3. So, for the CBR test, 1000 ml of water can be added.

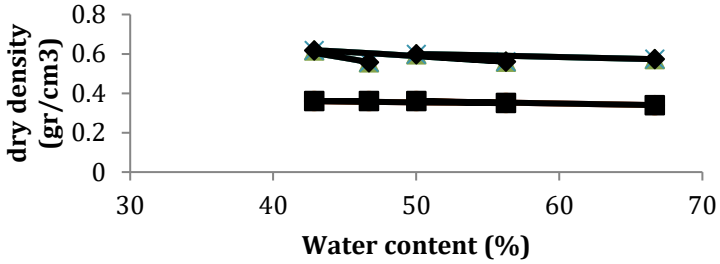

Figure 2. *Peat Soil Compaction Curve, East Pedamaran District*

From the ***Figure. 2***, the maximum dry weight ($\gamma_{d\ maks}$) = 0.30 g/cm^3 and the optimum water content (w_{opt}) = 42.86%. From the results of the Compaction test graph above, it shows that the addition of water is in 600 ml, so for the CBR test, the addition of water is doubled from 600 ml, which is 1200 ml. Sapric peat because it has a fiber content of <33%.

3.3 CBR Test

After the compaction test was carried out, it was continued with the CBR unsoaked test. Peat soil samples that passed filter no.4 were mixed with 1000 ml of water for peat soil in Tulung Selapan District and 1200 ml of water for peat soil in East Pedamaran District. The curing process is then carried out for 24 hours. The CBR test uses 3 molds of peat soil samples at one location. Every mold (has 5 layers of soil each, with 56 collisions. The test used is an automatic CBR Test which is carried out with a penetration dial reading of 0.1 "and 0.2".

3.4 Peat Soil from Tulung Selapan District

The results of the California Bearing Ratio test of peat soil in Tulung Selapan District with 3 samples. Obtained CBR value as in ***Table. 7.***

Table 7. *CBR Test Results for Peat Soil, Tulung Selapan District.*

Sample	CBR (%)	
	Penetration 0,1"	**Penetration 0,2"**
One	1,75	2,33
Two	1,50	2,67
Three	2,00	3,50
Average	1,75	2,83

3.5 Peat Soil from East Pedamaran District

The results of testing the California Bearing Ratio of peat soil in East Pedamaran District with 3 different samples. The CBR value is obtained as in ***Table. 8.***

Table 8. *CBR Test Results for Peat Soil, East Pedamaran District.*

Sample	CBR (%)	
	Penetration 0,1"	**Penetration 0,2"**
One	1,32	2,16
Two	3,00	3,50
Three	1,50	2,83
Average	1,94	2,83

4 CONCLUSIONS

From the results of research on the physical properties of peat soil in Tulung Selan Ilir Village, Tulung Selapan District, it was found that the original soil water content (w): 231.50% that this soil has a high water content including the slighty absorbent, and the density yield (Gs): 1.0767 gr/cm3 this value is below the range in the classification of specific gravity of peat soil, with a pH value (acidity) of 3.18 this peat soil is classified as highly peat. Based on fiber content, it has a value of 64.8% including helmic peat. Meanwhile, the physical properties of peat soil in Sumber Hidup Village, East Pedamaran District. Obtained: Soil water content (w) 301.33% is included in the Moderately Absorbent category with the ability to store and absorb water between 300% to 800%, specific gravity (Gs) is 0.4333%, and acidity (Ph) is 3 ,93. Included in the highly acidic soil. And based on fiber content

including sapric peat because it has a fiber content of 15%. Based on the results of the CBR test, the CBR value of peat soil in Tulung Selapan District at 0.1" penetration is 1.94% and 0.2" penetration is 2.82%. So that the peat soil of Tulung Selapan, according to Bowles (1992) this peat soil classification is "very poor" and according to Bina Marga it is in the "bad" category for subgrade. Based on the results of CBR testing on peat soil in East Pedamaran District, the penetration of 0.1 "is 1.94% and the penetration of 0.2" is 2.82%. According to Bowles (1992), this value is in the range of 0-3% which means "very poor". Based on the Bina Marga criteria, it is considered "bad" to be used as a road base (subgrade) because it is >5%.

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