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Soil Stabilization (Subgrade) for Ainaro Lot 2 Road Paper, Timor – Leste

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Abstract

Soil conditions in Timor Leste vary greatly in terms of grain and bearing capacity. The soil found at the laulara solerema location is clay because it can be seen from various types of samples and the results of analysis in the laboratory can determine the quality of the soil and the type of soil. This study aims to determine the characteristics of clay soil in Laura – Solerema as a road pavement material, especially the soil foundation layer.
The method used in determining the mixture through several tests, among others, sieve analysis test, compaction test (standard proctor) CBR (California Bearing Ratio) test, Swelling, Atterberg limit test and compaction test. The results of testing the clay soil in Laura – Solerema partially have values that do not meet the requirements as road pavement materials, especially subgrade layers. The stabilization study aims to study and determine the results of soil test data, to be able to determine the optimum moisture content (OMC) and dry volume (MDD), and the Atterberg limit with CBR values of 95% and 100%.

Keywords :
Clay, Sand and Cbr

1. Introduction

Subgrade is the most important part in road construction, and the problem that occurs in road construction projects is the reduction of road embankment soil, causing damage to asphalt and subsidence of embankment caused by inadequate soil carrying capacity, and excessive soil water content. A common problem that is often experienced in the implementation of road construction is that subgrade soil is not always found that has sufficient capacity to withstand the traffic load above. Roads in laulara – solerema are in some locations influenced by the nature of the soil layer that composes them, including the subgrade of the road made of earth. Soil as the subgrade layer used can be in the form of accumulated soil or unique soil. The nature of the road is strongly influenced by the asphalt layer that forms the road construction. From these problems, what can overcome these problems is soil improvement (stabilization).

Subgrade stabilization is an efficient decision in recognizing good road quality and reducing construction work costs. Clay is a silicate striped mineral molecule that measures under 4 micrometers. Clay contains fine silica or aluminum, these components, silicon, oxygen, and aluminum being the most abundant components. In the development of asphalt roads, the qualityof the soil that is not empowered must be improved (improved) so that it can work at the carrying capacity limit (subgrade) to improve the situation.

Soil stabilization in Sta. 14+070-15+370 B/S from the results of the study identified that it must replace or improve the base soil (subgrade) with accurate material to withstand the load to be built on the road, especially on highways. Research conducted at Sta. 14+070-15+370 B/S on subgrade soils, using the AASTHO T199-01/180-01 method for sieve, Liquid Limit(LL) and Plastic Limit(PL) analysis testing. CBR and SWELLING data testing uses the AASHTO T 193-99 method.

According to Lestari (2013) the asphalt layer generally consists of a layer of asphalt that is arranged from the bottom up, especially the subgrade layer, sub-base layer, base layer and surface layer. course). Subgrade is the first layer of soil in the road structure area. The soil must have adequate bearing capacity to withstand the overburden.

1.2. Formulation of the problem

Based on the above basis, which will be discussed in this study are:

1. How is the land classification in Ainaro Lot 2, Timor - Leste?
2. What is the CBR value of the original and stabilized soil with added materials?

1.3. Scope of problem

The problem limitations of this research are:

1. This research must be carried out in a laboratory
2. Improvement of soft soil in an effort to use it for road material.

3. Lowering the plastic index value of the soil and increasing the CBR . value

1.4. Research purposes

1. To determine the effect of the added additives on the physical properties of the soil.
2. Comparing the CBR value of unstabilized clay with stabilized soil.
3. Knowing the percentage of the optimum water content of the additive that has been increased with additional ingredients.

1.5. Benefits of research

The benefits of this research are:

1. As a science of soil stabilization for the improvement of the subgrade of a road construction, especially some flexible pavements.
2. From the results of the research and calculations carried out, it is expected to be able to provide an overview of the increase in the carrying capacity of the original soil with a mixture of mechanical materials.

2. Basic Theory Used

2.1. Soil Stabilization

Soil improvement is an approach to improve or change the description of a less positive subgrade condition as far as the bearing capacity of the soil is used as the basis for its development, it is believed that the subgrade properties can be better. There are several soil adjustment strategies that are generally used with the ultimate goal of working on subgrade properties of poor quality. These techniques combine mechanical adjustment and substance adjustment. This mechanical adjustment is proposed to get the entire soil evaluated so that the subgrade can meet the predetermined details. Adjustment by mechanical means is generally carried out by mixing different soil types,

2.2. Soil classification according to AASHTO.

Subgrade CBR and DCP Test Results The purpose of the laboratory CBR test and in-situ DCP verification is to provide information about the mechanical properties for the upper from the subsurface. To convert the results of DCP to CBR, the following equation developed by Kleyn & Van Heerden (1983) was used:

1. CBR logs = 2.628 -1.273 log

CPIWhere:

2. CPI or cone penetration index is the penetration measured in terms of mm / stroke.

The equation is that if the penetration per stroke becomes very low (less than 3 mm / stroke) the CBR exceeds 100 and becomes negligible so these values are recorded as CBR 100. If the DCP results generally support field density and CBR, there is less emphasis on DCP results. when parts of the site are not suitable for DCP testing, with a number of tests carried out on large gravel sized materials.

Isolated values (CBR ~ 100) were excluded from data analysis.

3. Research of Soil Mechanical Properties

3.1. Soil Compaction Test (Standard Proctor)

The research material used was a soil sample from the laulara – solerema area of Timor Leste. The soil samples were brought to perform several tests to obtain soil properties, soil type, water content, and others. The standard compactor press is used to compact the soil. Proctor there is a relationship between water content and dry volume weight of the soil. There are various types of soil that have an optimum moisture content value to achieve maximum dry volume weight.

According to Hardiyatmo (2010), the motivation behind compaction is as follows:

1. Increase the shear strength of the soil,
2. Reduce compressibility,
3. Lowering the penetrating power, and
4. Reduces volume changes due to changes in water content.

3.2. Atterberg Test

Atterberg is a test method to determine the nature of fine-grained soil (clay or silt) by providing different water content for each sample to be tested.

1. Place a portion of the prepared sample into the liquid limit device cup at the point where the cup rests on the base and spread it so that it is 10mm deep at its deepest point. Form a horizontal surface above the ground. Take care to remove any air bubbles from the soil specimen. Store unused specimens in storage containers.

2. Make a groove in the soil by drawing the groove making tool, tilting the edge forward, through the soil from the top of the cup to the bottom of the cup. When forming the groove, hold the tip of the grooving tool against the cup surface and keep the tool perpendicular to the cup surface.
3. Lift and drop the cup at a rate of 2 drops per second. Continue cranking until the two halves of the soil specimen meet each other at the bottom of the groove. The two halves should meet a distance of 13 mm (1/2 inch).
4. Record the number of drops needed to close the groove.
5. Remove a piece of soil and determine its water content, w.
6. Repeat steps 1 through 5 with soil samples with slightly higher or lower moisture content. Whether water should be added or removed depends on the number of strokes required to cover the forest in the previous sample.

3.3. Swelling

Swell test is the measurement of samples immersed in water to be carried out after reading and before reading to be able to know the water that enters the sample or can know the thickness of the soaked soil.

3.4. Test Cbr (California Bearing Ratio)

According to Sukirman (1995) the California Bearing Ratio (CBR) test determines the strength of the soil or a combination of compacted soil at a certain moisture content. The CBR is the ratio of the embankment required for 0.1"/0.2" soil sample infiltration to the embankment holding standard crushed rock at the 0.1"/0.2" entrance. The CBR value is the proportion (in percent) between the pressing factor required to infiltrate the ground with a 3-inch circular cylinder at a speed of 0.05 inches/min to the pressing factor required to insert a certain standard material and the intentional load required to enter.

1. This test is isolated into two, in particular;
   a. CBR testing without watering (Unsoaked) with restore for 1 day, 3 days and also 7 days.
   b. CBR drenching test (Soak) which is first restored for 3 days and then submerged in water for 4 days to determine the benefits of expanding. After watering, a soil test can be attempted for CBR. CBR testing is carried out on the first soil, soil + sand

4. Research Methods

4.1. Research Flowchart

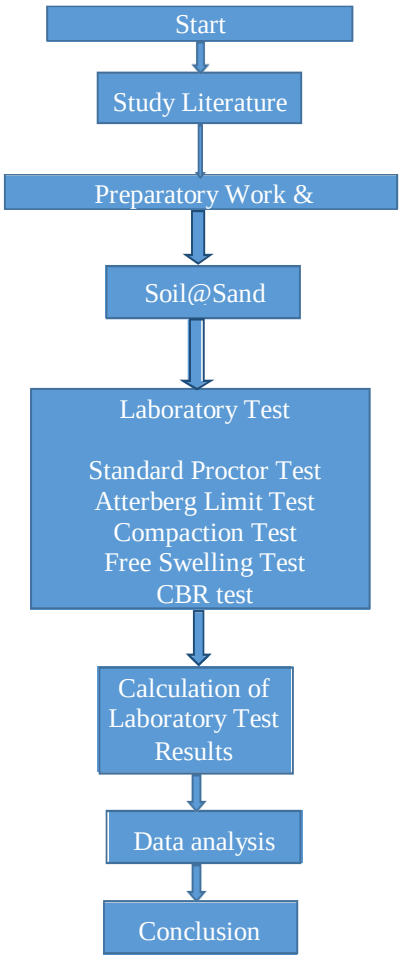

Figure 1. Research Flowchart

4.2. Analysis and Discussion

Before planning the structure of a highway building, the first step is to inspect the soil condition. Soil inspection is carried out to determine whether the soil is in accordance with the predetermined classification. In the research in the laboratory in Cotolau, the test results used only sieve analysis and Atterberg limits. From these results, there is a Liquid Limit value of 38.2%, Plastic Limit 28.6% and Plastic Index 9.6% and the results obtained that the most dominant type of material is clay or group A-6 classification. Can be seen in table 1.

Table 1. Soil classification for road subgrade

General classification	Silt – Clay (More than 35% of all soil samples passed the No 200 sieve)			
Group classification	A-4	A-5	A-6	A-7 A-7-5 A-7-6
Sieve analysis (% pass) No. 10 No. 40 No. 200	Min 36	Min 36	Min 36	Min 36
The nature of the fraction that passed the No. sieve. 40 Liquid limit (LL) Plasticity Index (PI)	Min 40 Max 10	Max 41 Max 10	Max 40 Min 11	Min 41 Min 11
The most dominant type of material	silty land		loamy soil	
Appraisal as subgrade material	Ordinary to ugly			

4.2.1. Testing the Mechanical Properties of Clay Soil

Based on research that has been carried out in the Cotolau laboratory, Dili district, the results are in the form of mechanical properties that describe the strength and stabilization of the soil as listed in table 2.

Table 2. the results of testing the mechanical properties of clay

Soil Mechanical Properties	Score
Maximum volume weight (MDD)	1,874
Optimum moisture content (OMC)	15,000
Plastic Index	11,1
CBR	5.8
Development potential	1.99

Based on table 2 the results obtained and the Proctor compaction test (standard) include the optimum moisture content (OMC) for organic clay of 15,000 and the maximum dry volume weight (MDD) value of 1,874 g/cm2. The value of the optimum water content for the manufacture of CBR specimens. The method used for CBR testing is soaked CBR with an immersion period of 4 days. This method is used to simulate the worst conditions in the field when inundation occurs for a long period of time. The CBR value for organic clay is 5.8 and according to the planning carried out in Laulara – Solerema, it is explained that the CBR value for the subgrade is 8%. Therefore, based on the research results, this organic clay does not meet the requirements as a road subgrade.

5. Conclusions and Recommendations

5.1. Conclusion

From the results of research and analysis that has been done, it can be concluded as follows:

1 Based on the physical properties of the soil from the results of soil investigations from Cotolau Laboratory, it has a dry volume weight (MDD) of 1.874 g/cc, optimum water content (OMC) 15,000 % Liquid Limit 38.2% , Plastic Limit 27.6%, so that the plasticity value index, PI, obtained 11.1% with soil classification A-6 and clayey materials.

2 The 95% CBR value for native land is 5.8% and for 100% with a value of 6.8%, the CBR value for native land does not meet the standards because the standard CBR value for native land is 8.0%. When stabilizing the soil with sand, the CBR value meets the standard, with a mixture of sand. The 95% CBR value for sand is 20% and for 100% it is 35.2%.

5.2. Development Suggestions

In light of the tests and conversations above, some ideas for additional checks can be taken as follows:

1 Additional checks are needed in dissecting the bearing capacity of the soil using different techniques with different loads to determine soil settlement.

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