PAPER NAME

19. The Effect of Bamboo Ash and Banan a Stock Fiber Utilization on Soil Mechani c Properties - UKITOI

WORD COUNT

2937 Words

CHARACTER COUNT

14047 Characters

PAGE COUNT

8 Pages

FILE SIZE

214.4KB

SUBMISSION DATE

Feb 12, 2023 1:22?PM GMT+7

REPORT DATE

Feb 12, 2023 1:22?PM GMT+7

6% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 3% Internet database
- 6% Publications database
- Crossref database
- Crossref Posted Content database

Excluded from Similarity Report

- Submitted Works database
- Bibliographic material
- Quoted material
- Small Matches (Less then 10 words)
- Manually excluded sources

The Effect of Bamboo Stock Ash and Banana Stock Fiber Utilization on Soil Mechanical Properies

Parea Rusan Rangan, Marinus Linggi, Escher Kalapadang, Yohanis B. Lotim, Rael Rabang Matasik, Hasyim Basri, Jerry D. Paridi, Regita O. Runtukahu, Feri Daud Biang, Abraham Ganti, Okvian Palinggi'

Civil Engineering Study Program, Faculty of Engineering, Toraja Christian University in Indonesia

email : pareausanrangan68@gmail.com, marinuslinggi@gmail.com, pong.eser@gmail.com, aniestbara@gmail.com, raelrabangmatasik@yahoo.com, achimbima76@gmail.com, jerryparidi@gmail.com, regitaruntukahu@gmail.com, feri.pu@gmail.com, abrahamganti@gmail.com, okvianpalinggi22@gmail.com

Abstract. Because the strength of a structure is directly determined by the ability of the subgrade, the soil used to lay a structure must have a good bearing capacity. It is required to improve the carrying capacity of soils that do not have a strong bearing capacity by stabilizing the soil and adding extra materials. Bamboo stem ash and banana stem fiber were used as stabilizing agents in this research. The goal of this study was to see how applying bamboo stem ash and banana stem fiber affected the soil's bearing capacity. The research method used in this study was an experimental method carried out in the lab by varying the added materials used over a long period of time, namely variations in the mixture of bamboo stem ash as much as 5% and 10%, and variations in the mixture of banana stem fiber as much as 0.5 percent and 1%. Curing for 1 and 7 days to ascertain the value of CBR, which was used to calculate the soil's bearing capacity. The results revealed that adding bamboo stem ash and banana stem fiber to the soil increased the soil carrying capacity (DDT). Both the CBR and the DDT values increased. The increase (DDT) with the addition of bamboo stem ash and banana stem fiber as soil stabilizing agents, namely in the original soil the DDT value was 5.7 after adding 0 percent banana stem fiber and 5 percent bamboo stem ash the DDT value became 5.9 (increased by 3, 38 percent), in the mixed variation of 0 percent banana stem fiber and 10 percent bamboo stem ash the DDT value became 6.2 (an increase of 8.06 percent), after adding 0.5 percent banana stem fiber and 10 percent bamboo (an increase of 12.04 percent).Keywords: Bamboo Trunk Ash, Banana Trunk Fiber, Soil Mechanical Properties.

INTRODUCTION

Land is the most crucial component in any field, notably in the building industry, when it comes to the growth of an area. Because the strength of a structure is directly determined by the ability of the subgrade to accept and carry the load exerted on it, soil used as the foundation for installing a structure must have a strong bearing capacity. The soil's limited bearing ability can shorten the life of any structure built on it. Soil stabilization is one method for repairing and increasing the bearing capacity of the soil.

Soil stabilization is accomplished by mixing a combination of chemical and natural chemicals into the soil and then mixing them together to unify the materials. Soil stabilization using chemicals and organics has been done and has been shown to improve the soil's bearing capacity. Bamboo stem charcoal ash was used in one of the trials.

Bamboo is still abundant in Indonesia, particularly in the province of South Sulawesi, specifically in North Toraja Regency, but in daily life, the Toraja people mostly use it to build huts for rambu tuka' and rambu solo' celebrations, as well as for firewood and charcoal. The product of combustion is discarded right away.

The use of bamboo stem ash as a soil stabilizing agent is possible. Aisyah Fitri (2020) investigated the compaction of the original clay's dry weight value of 1.762 gr/cm3, which rose by 5%, 10%, and 15% following the addition of bamboo stem ash, resulting in 1.769 gr/cm3, 1.7gr/cm3, and 1.775 gr/cm3 accordingly.

The use of wood charcoal powder and fiber as a soil stabilization material has also been investigated (Brandon Winslow Lope Agnes T. Mandagi, Josef ER Sumampouw, 2019). Using wood charcoal powder and plastic sack fiber, the variation of mixing wood charcoal powder is 0%, 2%, 4%, 8%, and plastic sack fibers are 0%, 0.25%, 0.45%, 0.85%. According to the test results, adding wood charcoal powder and plastic sack fiber increased the CBR value, with the highest value occurring when adding a mixture of 4 percent wood charcoal powder and 0.2 percent plastic sack fiber, which increased the original soil CBR value of 18.647 percent to 28.807 percent. In this study, an experimental research method was applied. Because banana tree trunks are high in fiber, the authors of this study will use them as an ingredient.

LITETARURE REVIEW

Soil Stabilization

Soil stabilization is a technique that involves adding something to the soil in order to improve its characteristics and retain shear strength (Hardiyatmo, 2002). The goal of soil stabilization is to bind and combine the material aggregates that already exist. Volume stability, strength or bearing capacity, permeability, and stability or durability are some of the soil attributes that can be improved via stabilization. Some of the activities done to stabilize the soil, according to Bowles (1991), are as follows:

1. Make the soil more dense.
2. Increasing cohesiveness by adding inactive material.
3. Adding compounds to the soil to create chemical and/or physical changes.
4. Reduction of the water table (soil drainage).
5. Replacing contaminated soil.

In general, the procedure for soil stabilization includes of one or more of the following jobs (Bowles, 1991):

1. Mechanical, i.e. compaction with rollers, large things dropped, explosions, static pressure, texturing, freezing, heating, and so on.
2. Additives, such as gravel for cohesive soils and clay for granular soils, as well as chemical admixtures such cement, limestone, coal ash, volcanic ash, limestone and/or cement, asphalt cement, sodium and calcium chloride, paper mill waste, and others.

Soil Mechanical Properties

1. Soil Compactor

Compaction with a soil compactor is an attempt to raise the density of the soil by compressing particles with mechanical energy (Bowles, 1991). The compaction effort will result in a drop in soil volume, a decrease in pore volume, but no change in grain volume. Grinding or pounding is commonly used to accomplish this. When the soil is compacted to saturation and almost all of the air is removed, maximum dry density is attained at very high moisture content. Soil particles interfere with each other at low moisture levels, while adding moisture allows for larger bulk density. Soil saturation begins to counteract this impact around the time of peak density.

In the compaction experiment, the final moisture content of the soil sample can be estimated as follows:

$$D = B + \frac{(B + C)}{A} \times 100\%$$

The following equation can be used to compute the value of wet density (Wet Density):

$$Wwet = (W2 - W1)$$

The following equation can be used to compute the value of the volume mold on the wet density (Wet Density):

$$Volume\ Mould = \frac{1}{4}\ x\ \pi r\ x\ d^2\ x\ t$$

The following equation can be used to compute the value of the wet volume weight on the wet density (Wet Density):

$$\gamma_{wet} = \frac{W_{wet}}{V_{Mould}}$$

The following equation is used to calculate the weight of water on the water content (Water Content):

$$Ww = W2 - W3$$

The following equation is used to compute the value of dry soil weight on water content (Water Content).

$$\gamma d = W3 - W1)$$

The following equation is used to compute the value of water content on the water content (Water Content):

$$W = \frac{Ww}{Ws}\ x\ 100\%$$

The following calculation is used to compute the average water content on the water content (Water Content):

$$W = \frac{W1 + W\,2}{2}$$

The following equation is used to compute the value of dry weight on dry density (DryDensity):

$$Wdry\ = \frac{Wwet}{1 + \left(\frac{W}{100}\right)}$$

The following equation is used to compute the value of dry density on dry density (DryDensity):

$$\gamma dry\ = \frac{W_{dry}}{V_{mould}}$$

The following equation is used to compute the weight of the volume of water (w) on dry (DryDensity):

$$\gamma w = \frac{Gs}{(1 + \left(\frac{W}{100}\right) x\ Gs}$$

2. California Bearing Ratio (CBR)

The term CBR refers to the weight required to press a metal piston (3 inch cross-sectional area) into the soil to obtain a specific penetration (penetration) and the weight required to press the piston into crushed rock material in California to reach the same penetration (penetration) (Canonica, 1991).

The Proving Ring is used to assess the load required for a specific penetration as measured by a dial, and the tool used to estimate the amount of CBR has a piston with an area of 3 inches and a vertical downward movement speed of 0.05 inch/minute. The CBR number generally used to calculate the strength of the road foundation is 0.1" penetration for laboratory testing and 0.2" penetration for field testing.

The following is the formula for calculating the CBR value:

- CBR value on penetration

0,1" = $\frac{A}{3000} \times 100\%$

- CBR value on penetration

0,2”= $\frac{B}{4500} \times 100\%$

Where :

A = dial reading at penetration 0.1”

B = dial reading at penetration 0.2”

Bamboo stick ash

Charcoal is a black residue made by eliminating water and volatile components from animals and plants, resulting in impure carbon. Wood, sugar, bones, and other things are typically heated to produce charcoal. The majority of this black, light, easily crushed, and coal-like charcoal is carbon (C), with the remainder being ash and other compounds.

Bamboo stick charcoal is a solid product which is made through a carbonization process under high temperature. Bamboo ash contains silica (Si02); alumina (Al_{203}); Iron III (Fe_{203}); calcium oxide (Cao); magnesium oxide (Mgo); potassium oxide (K_{20}) (Amu and Adetuberu).

Figure 1. Bamboo stick ash

Banana Stem Fiber

Banana stem fibers have a density of 1.3 g/cm3, cellulose content of 63-64 percent, hemicellulose content of 20%, lignin content of 5%, average tensile strength of 600 Mpa, average tensile modulus of 17.85 Gpa, and a 3.36 percent increase in length (Lokantara 2007). Soil reinforcement with fiber in the soil has been extensively researched, and the findings reveal that fiber in the soil can increase soil strength, but not excessively. Fibers, both natural and synthetic, have been used to successfully stabilize sandy soils. Leflaive, 1982 (in Nurhainun, 2000) uses synthetic fibers in the form of continuous threads to reinforce the sand, resulting in TEXSOL, a cohesive sand-synthetic fiber composite. Adi, 1999 (in: Ade Rohaya, 1999) conducted a research of soil reinforcement employing mesh elements, with the findings indicating that the net elements might increase soil strength, tensile strain, and ductility. It is possible to identify the "cohesive" behavior of sandy soil composites with network elements, but their application necessitates careful study.

Figure 2. Banana Stem Fiber

METHOD

This study uses an experimental research method (experimental test) conducted at the Civil Engineering laboratory of the Indonesian Christian University Toraja. The stages in this research are as follows:

1. prepare a soil sample that will be used as research material.
2. prepare stabilizing materials and tools that will be used to make test objects.
3. Testing the physical characteristics of the soil, namely:
   a. Specific gravity
   b. Atterberg limits
   c. Filter analysis
4. Testing the mechanical characteristics of the original soil, namely:
   a. Original soil compaction test
   b. Original soil cbr test
5. Soil testing with added materials.
6. to analyze and discuss the results of soil tests without added materials and with added materials.

RESEARCH RESULTS AND DISCUSSION

Results of Testing Soil Physical Properties and Soil Classification

Based on laboratory examinations that have been carried out on the characteristics of the original soil taken at that location, the following data were obtained:

Table 1. Real Soil Data Compilation

No	Test Type	Results
1	Water content	23.61%
2	Specific gravity	2,24 gr/cm^3
3	Liquid limit	42.14%
4	Plastic limit	35.80%
5	Plastic index	6.34%
6	Filter analysis (passed 200)	3.2 gr
7	Dry fill weight	1.182 gr/cm^3
8	CBR	8.53%

According to the data above, the proportion of soil that passed the 200 filter when testing the physical qualities of the soil according to AASHTO was 3.2 percent, putting the soil sample in the category of gravel and silty sand or loam. The liquid limit is 42.14 percent (A – 2 – 5), while the plastic index is 6.34 percent (A – 2 – 5). (A -2 -5).

Mechanical Properties Test Results

From the calculation results obtained the results of compaction in each variation of the mixture as follows:

Table 2. Compaction test results for each variation of the mixture

NO	Variations of a mixture of banana stem fiber and bamboo stem ash	Optimum Moisture Content	Dry Density
1	0% Fiber & 5% Ash	29.86	1.25
2	0% Fiber & 10% Ash	30.83	1.27
3	0,5% Fiber & 0% Ash	26.05	1.36
4	0,5% Fiber & 5% Ash	26.92	1.35
5	0,5% Fiber & 10% Ash	26.80	1.23
6	1% Fiber & 0% Ash	26.58	1.36
7	1% Fiber & 5% Ash	27.86	1.33
8	1% Fiber & 10% Ash	25.44	1.23

From the calculation results obtained CBR results for each variation of the mixture and curing as follows:

Table 3. CBR Value Results With the Addition Of Banana Trunk Fiber And Bamboo Trunk Charcoal Ash With 1 Day and 7 Day Ripening

No	Variations of a mixture of banana stem fiber and bamboo stem ash	1 Day Curing CBR Value	7 Days Curing CBR Value
1	0%	8.53	–
2	0% Fiber & 5% Ash	9.25	9.90
3	0% Fiber & 10% Ash	11.17	12.10
4	0,5% Fiber & 0% Ash	9.75	10.48
5	0,5% Fiber & 5% Ash	10.43	10.83
6	0,5% Fiber & 10% Ash	13.10	13.23
7	1% Fiber & 0% Ash	9.72	9.74
8	1% Fiber & 5% Ash	10.68	11.82
9	1% Fiber & 10% Ash	13.03	13.75

From the calculation results, it is found that the DDT value and the increase in the DDT value (%) in each variation of the percentage of the mixture are as follows:

Table 4. DDT value and increase in DDT value (%)

No	Variation of mixture of banana stem fiber and bamboo stem ash(%)	DDT Value	DDT Value Increase (%)
1	0%	5.7	-
2	0% Fiber & 5% Ash	5.9	3.38%
3	0% Fiber & 10% Ash	6.2	8.06%
4	0,5% Fiber & 0% Ash	6.05	5.78%
5	0,5% Fiber & 5% Ash	6.08	6.25%
6	0,5% Fiber & 10% Ash	6.4	10.94%
7	1% Fiber & 0% Ash	5.8	1.72%
8	1% Fiber & 5% Ash	6.18	7.77%
9	1% Fiber & 10% Ash	6.48	12.04%

CONCLUSION

1. According to the findings of a study conducted at the Civil Engineering Laboratory of the Indonesian Christian University Toraja, adding bamboo stem ash and banana stem fiber to a soil sample can increase the bearing capacity of the soil. This may be seen in the study's findings, which show that after adding bamboo stem ash and banana stem fiber, the CBR and DDT values both increased.

2. Increasing the value of soil bearing capacity (DDT) by adding bamboo stem ash and banana stem fiber as soil stabilization materials, namely, in the original soil, the DDT value = 5.7, after adding 0 percent banana stem fiber and 5 percent bamboo stem ash, the DDT value became 5,9 (an increase of 3.38 percent), after adding 0 percent banana stem fiber and 10 percent bamboo stem ash, the DDT value became 6.2 (an increase of 8.06 percent), after adding 0 percent banana (an increase of 12.04 percent).

REFERENCES

1. Aisah Fitri, Journal, Analysis of shear strength and compaction of clay soil with the addition of bamboo stem ash 2020.
2. Bowles, J. 1984. Physical and Geotechnical Properties of Soil (Soil Mechanics). Second edition.erlangga. Jakarta.
3. Brandon Winslow Lope Agnes T. Mandagi, Josef E.R. Sumampouw, Journal, Effect of Addition of Wood Ash and Plastic Bag Fibers on Cbr Values in Laboratory without Soaking.
4. Das, B.M., Noor, E. Dan Mocthtar, I.B., 1983, Soil Mechanics Volume 2, Erlangga Publisher.
5. Das, B. M., 2011, Principle of Foundation Engineering, 7th edition, Cengange Learning, Stamford USA.
6. Dr.Ir.Abdul Madjid, MS Online Lecture Materials, Univ. Sriwijaya By Ibnu Sudarmadji and Eko Sumardiono, Journal of Logic Vol 8.No 9 September 2002.
7. Adi, Ade Rohaya 1999, Amu and Ade Tuberu.

8. Leflaive, 1982; Nurhainun, 2000
9. Soil Mechanics Practicum Guide, Civil Engineering Laboratory, Faculty of Engineering, Indonesian Christian University Toraja.
10. Reffanda Kurniawan Rustam, Herri Purwanto, Adiguna, and Indah Tiara Putri Journal, Effect of Addition of Coconut Shell Charcoal Ash on Shear Strength of Clay Soil in Makati Jaya Area.
11. Sriyati Ramadhani, Journal, Effect of Addition of Coconut Coir Fiber on Parameters of Shear Strength in Sandy Soils.
12. SNI – 03 – 1964 – 2008 Specific Gravity Testing; SNI - 1965 - 2019 Water Content Testing; SNI – 3423 – 2008 Testing for sieve analysis; SNI – 1967 – 2008, Liquid Limit Test; SNI – 1966 – 2008, Plastic Limit Test; SNI – 1742 – 2008, Compaction Test; SNI – 1744 – 2012 CBR Testing.
13. V. M. K. Putri, A. I. Candra, A. Ridwan, Journal, Effect of Addition of Wood Ash and Bamboo Ash on Clay Soil Density, Faculty of Engineering, Kadiri University.

6% Overall Similarity

Top sources found in the following databases:

- 3% Internet database
- 6% Publications database
- Crossref database
- Crossref Posted Content database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	S. Balasubramanian. "Core and Conditional Core Path of Specified Len... Crossref	2%
2	Ibrahim, Andi Herius, Julian Fikri, M. Shaid Ramadhinata, Maryani. "Sta... Crossref	1%
3	bircu-journal.com Internet	1%
4	downloads.hindawi.com Internet	<1%
5	Lucia O Agashua, Adebanji S Ogbiye. "Influence of Cement, Bitumen an... Crossref	<1%
6	businessdocbox.com Internet	<1%
7	Roesyanto, R Iskandar, IP Hastuty, AIU Lubis. "A study of the effectiven... Crossref	<1%

Excluded from Similarity Report

- Submitted Works database
- Quoted material
- Manually excluded sources
- Bibliographic material
- Small Matches (Less then 10 words)

EXCLUDED SOURCES

repository.ukitoraja.ac.id 98%

Internet