Soil Capacity Feasibility Study based on Physical and Mechanical Properties

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Abstract

The foundation of a building is the subgrade. Based on its physical and mechanical properties, the soil serves as a load-bearing structure. The method used in this study is based on research tests done at the Material Testing Laboratory of the Public Works Department of East Nusa Tenggara Province. The soil mechanical properties test looks at the California Bearing Ratio (CBR), the Strength Unconfined Compressive Strength, and the Shear Strength of Soils. The soil physical properties test looks at the grain size distribution, soil compaction, and moisture content. The results of the physical tests on the soil showed that the soil with the lowest gradation rate was 51.44 % and the soil with the highest gradation rate was 95.72 %. Based on the water test, the lowest value was 23, which was 2.73 Ton/M^3. The land in this area has a sandy top cover or sandy top soil. At the bottom, there is white silt soil and clay content, which makes it a regosal type of soil. This soil has general characteristics on the surface, such as coarse-textured sand with low bearing capacity. Physical testing of gradation figures for the lowest soil was 51.44 % and the highest was 95.72 %. Based on the specific gravity test, the value of Soil Density was 2.72 Ton/m^3.

Key Words: Subgrade, Physical, Mechanical Properties, CBR, Unconfined Compressive Strength, Shear Strength of Soils.

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Introduction

The subgrade acts as a load-bearing construction for a building's foundation. As a result of the importance of soil bearing capacity, all construction loads, such as roads and buildings, are deposited into it. To put it another way, soil is made up of non-cemented (chemically bound) solid minerals and weathered organic matter (which is in solid particles), along with the liquids and gases that fill the spaces between them. between the atoms and molecules (Mathur & Gishler, 1955; Braja M. Das, 1993; Wu et al., 2012; Truter et al., 2014; Shi et al., 2018; Albano & Alexidis, 2021). To ensure that the building of hotels and resorts does not adversely affect the physical and mechanical strength of the soil in the coastal area of Pulau Kera, the authors formulate the problem in this study: Subsoil conditions in the coastal area of Pulau Kera as a base for hotel and resort construction If hotels and resorts are to be built on Kera Island's coastline subgrade, what is its security status? Research is restricted to soil samples collected on Kera Island in Pitoby Hotel and Resort development area and analyzed in the lab to determine physical soil properties and soil structure mechanical strength.

Soil physical parameters such as sieve analysis, soil density (Gs), soil moisture content (w), liquid-to-plastic ratio (LLPL), soil porosity (n) and soil void ratio were all part of this investigation. In addition to (e) and (s), cohesiveness (c), wet soil volume weight (yb), dry soil volume weight (yd), and (e) (yd).

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CBR, free compressive strength (unconfined), and shear strength are three soil mechanical parameters that can be evaluated (Shearstrength of soil). Information gathered from tests and measurements. As a consequence of this study, entrepreneurs and investors considering development in Kera Island's coastline area can use the carrying capacity of the resulting soil as a reference. A construction site's soil is always a critical consideration. A building's foundation, or the building itself, is supported by the soil (Joseph, 194). As a result, the subgrade must be able to withstand the forces of traffic without being harmed in order to have an optimal bearing capacity (Hufenus et al., 2006; Wasis et al., 2012; Oriokot, 2014; Akbar & Wesli, 2016; Maabuat, 2016; Marecos et al., 2017; Dhar, & Hussain, 2019; Badaron et al., 2020; Hayadi & Lakawa, 2020; Hayadi et al., 2021). in Hardiyatmo (1992), Jaynes (2004), Rothwell (2012), Rothwell (2013), Ma'azza (2016), Fadhilleh (2017), da Silva, Meldi, and others; (2021).

Quartz and feldspar mineral particles, which are commonly found in gravel. Quartz feldspar minerals, i.e. sand, make up the majority of the material. Microscopic (very small) quartz and mica fragments, known as "silt," comprise most of the soil's microscopic component. A third type of clay is made up primarily of microscopic and submicroscopic particles (cannot be seen, only with a microscope).

Methods

This study uses quantitative methods with the results of research testing in the laboratory. The research was conducted on Kera Island, Kupang Regency, East Nusa Tenggara. The overall location of the island is an area of 457,026 m2 (45.7 Ha) and a circumference of 2,628 m (Master Plan Pitoby Resort). The development plan covers an area of 286,937 m2 (28.7 Ha) or covers an area of 67.8% of the total area of Kera Island. The research sample is where for the location of Kera Island itself, soil samples are taken at three points, the point at the location is sample point one (1) taken at coordinates 10'05'35, 802" LS: 123´33´29´154" TB sample point the second (2) is taken at the coordinates of 10´ 05 25´ 380" South Latitude: 123´ 33´ 23´310" East Longitude and the third (3) is taken at the coordinates of 10´ 05´ 09´ 828" South Latitude: 123´ 33 23´ 958" East Longitude. There are several types of soil samples, including undisturbed soil samples, undisturbed soil aggregates, and disturbed soil samples with different analysis purposes. For the location of the Pitoby Hotel and Resort on Kera Island, Kupang Regency, disturbed soil samples were taken at a depth of 50 cm from the ground surface.

Data Processing and Analysis Techniques

a) Physical properties: Analysis of grains with a sieve (sieve), Moisture content, Atterberg limits.
b) Mechanical properties: California Bearing Ratio, Unconfined Compressive Strength, Shear Strength of Soils.

Results and Discussion

The degradation of soil structure owing to management and treatment functions, as well as numerous construction development difficulties, are produced by soil physical and mechanical qualities, such as soil grains, soil moisture content, soil plasticity, and soil mechanical properties. Building construction on the ground is highly influenced by the shear and compressive soil strengths of the Kera Island Resort construction site, as evidenced by the texture of silty sand, which is a blend of sand and silt, i.e. soil with a particle size between sand and clay. As a result, soil testing and inquiry were carried out as follows.

Test Results Filter Analysis

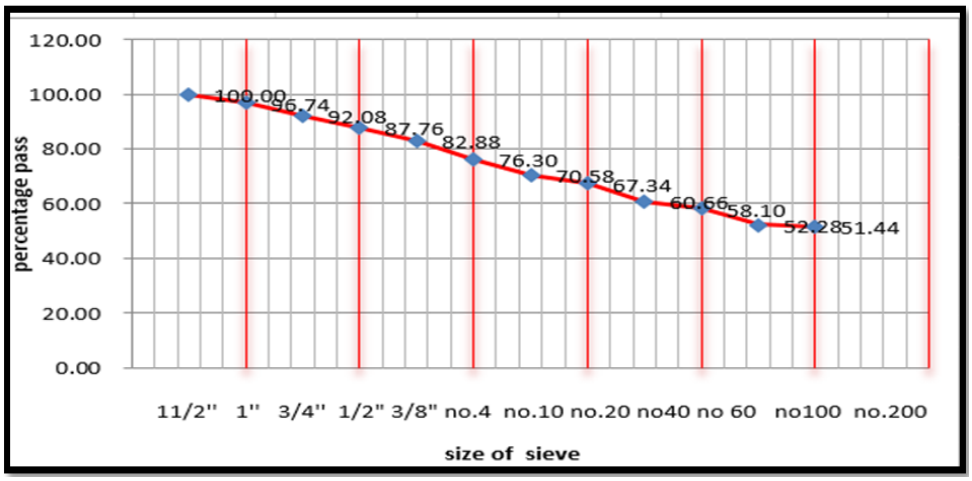
Table 1. Filter analysis

Sample Point	Stuck	Pass Sieve No. 200	Unit	Standard
1	48,56	51,44	%	30%
2	5,14	94,86	%	30%
3	2,28	95,72	%	30%

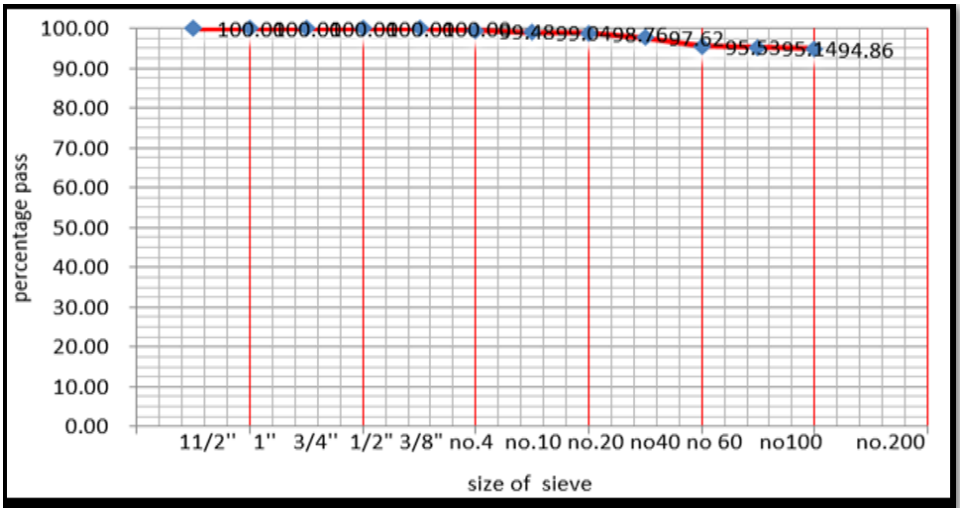
Source: Laboratory Analysis Results

From table 1 above, it can be seen that at the point of the soil sample (1) the retained soil was 48.56% and those that passed the sieve no. 200 were 51.44%, the point of the soil sample (2) that was retained was only 5.14% and those that passed the sieve no. 200 reached 94.86%. While for the soil with sample number (3) the retained soil was only 2.28% and that which passed the filter no. 200 reached 95.72%.

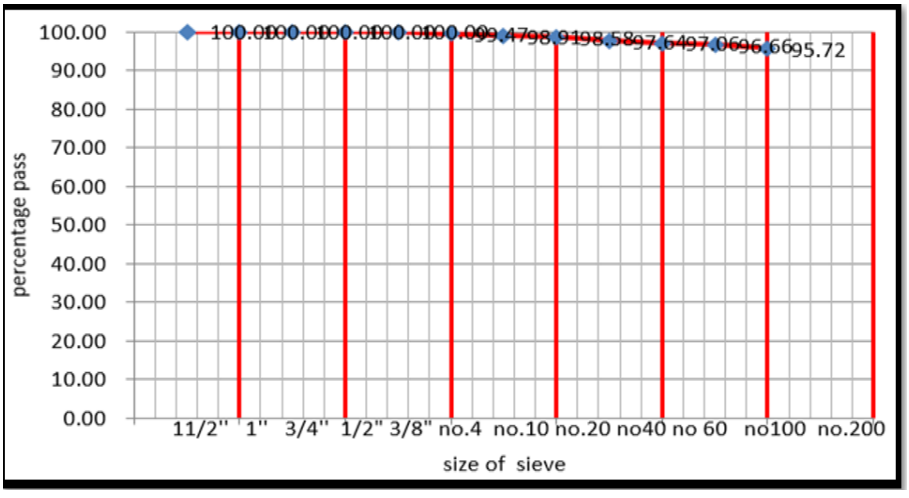
The graph of the grain analysis presentation can be seen in the graph below which shows the presentation of each sample.



Graph 1. Analysis of Sample Point Sieve 1



Graph 2. Analysis of Sample Point Sieve 2



Graph 3. Analysis of Sample Point Sieve 3

Sieve analysis is the process of sifting the test object to determine the weight of the grains that pass from a set of sieves then the percentage figures are depicted on a grain division graph. (SNI 03-1968-1990/2008). Based on the sieve analysis of the soil samples for the construction of the Pitoby Hotel and Resort, Pulau Kera, Kupang Regency, the highest percentage passing the filter

No.200 was found in the 3rd soil sample at the coordinates 10´ 05´ 09´ 828" LS : 123´ 33 23 958" East with 95.72% yield. Referring to SNI 03-1968-1990; Konert, & Vandenberghe (1997); Bowman & Hutka (2002); Blott & Pye (2006); Wood et al., (2008), regarding the sieve analysis test procedure, the specimens that pass the No. 200 sieve analysis are classified as silty clay. Soils that pass the No. 200 sieve greater than 35% in the AASTHO classification are silty loam.

Pitoby Pulau Kera Resort construction site has sandy soil based on sieve analysis of sample points 1-3. Due to the fact that the top layer of 30 cm of top soil (sand or top soil) has a rough and loose texture and is extremely vulnerable to water seepage, it's silty.

When viewed in texture, the soil of Monkey Island's coastline land comprises a mix of large and small primary grains with no binder aggregate. Grain size ranges from 0.002 mm to 2.0 mm. Top soil at Kera Island's Pitoby Hotel and Resort is mostly sand with some clay in it, with some silty soil underneath.

Kera Island, Kupang Regency's Pitoby Hotel and Resort is located in an area with marginal properties of soil texture, water holding capacity, and a wide open area with high wind speeds, all of which contribute to significant disturbance of the subgrade, as revealed by the results of soil grain analysis. Which, in the event of heavy rain, has clay qualities and falls into the poor gradation group. It's not recommended to use pile foundations or buildings with more than three floors on soils with weak gradations, such as those found at the Kera Island resort, unless the subgrade has been stabilized prior to building construction. The Pitoby Kera Island Hotel and Resort, Kupang Regency, can benefit from additional physical and mechanical studies to verify the soil's qualities.

The Results of Testing the Soil Water Content at the Construction Site of the Pitoby Hotel and Resort on Kera Island, Kupang Regency

The specific gravity of the soil will also determine the type of soil and the percentage of organic matter in the soil sample. Table 2 shows the results of the soil density test which explains the average number of soil density at the resort construction site on Kera Island which is shown at sample points 1-3 is 2.73 gr. Based on the soil density test, the subgrade for the resort construction site on Kera Island according to the AASTHO classification system, is a soil group A-7-5/A-7-6 which is a category of sandy soil, silt, organic clay and which has a general assessment as subgrade, 'currently'.

Table 2. Soil Specific Gravity Test Results

Sample point	Specific gravity	Unit
1	2.73	Ton/m^3
2	2.73	Ton/m^3
3	2.72	Ton/m^3

Source: Laboratory Analysis Results

Due to the soil density, if there is no rock support on the subgrade and the load exceeds the soil's strength, the subgrade at the resort development site on Kera Island will contribute to foundation damage in the form of subsidence, floor cracks, and building collapse as well as subgrade collapse. Because the finer the soil grain, the more stabilization material must be used, which is undoubtedly ineffective and expensive, and because the layer below the construction site of the Pitoby Hotel and Resort, Kera Island, Kupang Regency, contains rocks with quite a bit of rock mass at a depth of 50 cm, this condition c makes stabilization difficult if the gradation value in the sieve analysis test in Table 1 is more than 30% (gradation > 30%). Considering that the soil contains clay and needs to be measured for water content.

Test Results of Soil Compaction and Moisture Content

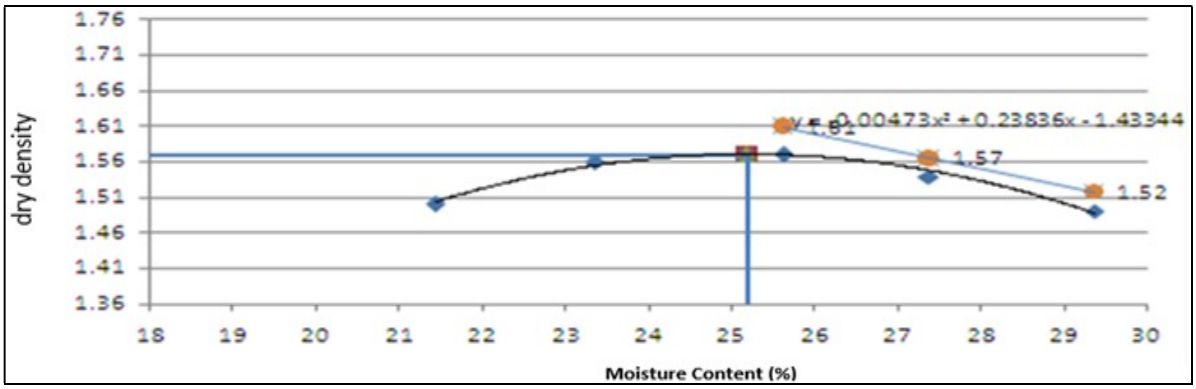
Water content testing is that we ensure the amount of water content in one soil sample at the construction site of the Pitoby Hotel and Resort on Kera Island, Kupang Regency, for the water content tested is laboratory obtained from the comparison between the water contained in the soil and the dry weight of the soil.

Table 3. Water Content

Sample point	Water content	Unit
1	25.64	%
2	23.35	%
3	24.56	%

Source: Laboratory Analysis Results

Based on table 3, the highest water content is in the soil sample at sample point 1, which is 25.64%, the lowest is at Sta 2, which is 23.35%. 2 below where dry density (α d) = 1.57 g and moisture content (W) = 25.64%, then Specific Gravity (Gs) = 2.74



Graph 4. Compaction with the Highest Moisture Content at Sample Point 1

Referring to the PU Geotechnical Sector (2008); Seaforth, (2008); Brown, (2016). Based on typical soil properties, the soil sample with a dry density of 1.2 g/cm^3-1.7 g/cm^3 and a moisture content of 19%-36% is a type of fat clay (inorganic) while soils with dry density 1.0 g/cm^3-1.6 g/cm^3 and moisture content 21%-45% is organic clay. Based on the results of laboratory research, the soil sample obtained at the location of the Kera Island Resort Development, the type of fat clay is seen from the percentage of water content and dry density (wahab, 2017; Sung et al., 2017; Shemiye, 2020; Bobon-Carnice, & Lina, 2021).

With the value of water content and compaction like this, the soil at the Pulau Kera Resort Development site is very susceptible to cracking which is at risk to the soil and can cause damage to the edge of the foundation due to changes in soil water content. Changes in water content in the subgrade in the Kera Island Resort Development area greatly affect the construction of the resort buildings, weak soil strength can be caused by changes in water content, especially on silty sandy soils containing clay such as at the Kera Island Resort Development location, because the soil is clay and sandy. have properties that are strongly influenced by surface forces.

Atterberg Limits Test Results

Testing the liquid limit of the soil at the construction site of Hotels and Resorts on Kera Island, Kupang Regency with the aim of knowing the minimum water content where the nature of a type of soil changes from a liquid state to a plastic state. The aim is to obtain the liquid limit of the soil, so that it can be used to determine the nature and classification of soil at the construction site of Hotels and Resorts on Kera Island, Kupang Regency. (SNI 03-1967-1990/2008 and SNI 03-1966-1990/2008).

Table 4. Atterberg limit values (Laboratory Analysis Results)

Sample Point	LL	PL	PI	standard
1	45,57	32,54	11,43	4%
2	52,25	28,78	23,47	4%
3	43,65	32,45	11,19	4%

Table 5. Liquid Limit Test Value

No	Liquid Limit (LL)		Liquid Limit (SNI 03-1967-1990)				limit plasticity	
	Number of stroke		10	17	28	43	(SNI 03-1966-1990)	
	Grail Number		I	II	III	IV	V	IV
1	Mass of the Grail+wet soil	(gr)	43.75	43.85	37.82	49.80	22.64	22.02
2	Mass of the Grail+Dry soil	(gr)	33.06	32.92	29.45	38.00	20.55	20.02
3	Water Mass(1-2)	(gr)	10.69	10.93	8.37	11.80	2.09	2.00
4	Mass of the Grail	(gr)	14.46	12.79	13.35	13.85	13.15	13.20
5	Dry Soil Mass (2-4)	(gr)	18.60	20.13	16.10	24.15	7.40	6.82
6	Moisture content 3/5*100	%	57.47	54.30	51.99	48.86	28.24	29.33
							28.78	

a	b
-5.75	70.76
10.00	52.25
25.00	52.25
25.00	47.00
x	y
PI	23.47

LL	PL	PI
52.25	28.78	23.47

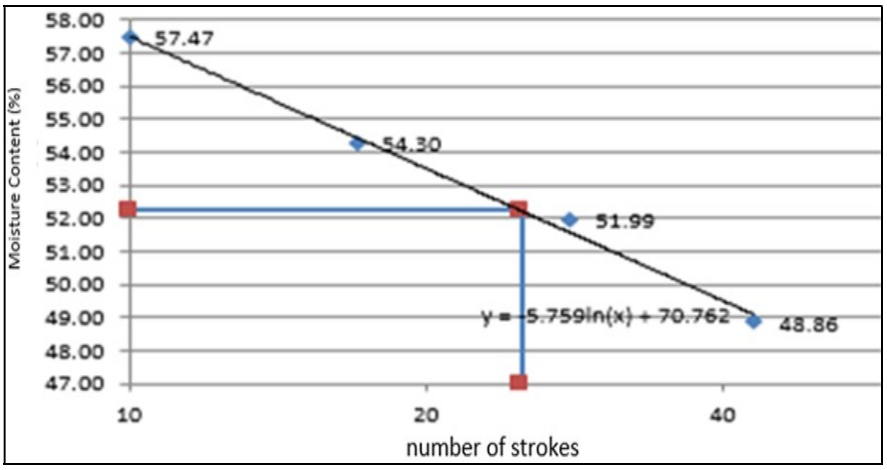


Chart 5. Atterberg Limits

It can be seen in the table and diagram above the PI value of each point based on the results of laboratory tests in assessing the plastic properties of the subgrade for each sample point (1) PI: 11.43%, sample point (2) PI 23.47 and sample point (3) PI: 11.19, it was explained that the soil sample that passed the No. 40 sieve and had a liquid limit value (LL) greater than 41% (>41%), Plastic Index (PI) was greater than 11% (>11%) and a limit plasticity greater than 30% (>30%) in the AASTHO system classification belongs to group A-7-5, this group is loamy soil and has a "Medium" rating as subgrade. Based on the results of testing samples from sample points 1 to 3 at the Kera Island Resort Development site, referring to the AASTHO system classification, it is in group A-7-5 and in group A-7-5, meaning that this group is a type of clay and silt.

The soil at the Hotel and Resort Development location on Kera Island, Kupang Regency, based on the results of the Atterberg limit test, was in accordance with the results of physical observations of the soil, namely the texture of soil grains and seen from the liquid and plastic limits of the soil. So that the soil can be concluded that the soil at the location of the Hotel and Resort Development on Kera Island, Kupang Regency is of moderate type and character as subgrade.

Based on the results of the Atterberg Limits test, the soil properties at the Hotel and Resort Development location on Kera Island, Kupang Regency have a typical nature of sandy soil in the top soil and silty in the subgrade and have clay properties, meaning that if it is dry it will be hard, and if it is dry, it will be hard. Wet will be soft, plastic, and cohesive, expands and shrinks quickly, so it has a large volume change and that happens if it is influenced by water, either surface water in the form of sea water or rain water with high intensity, if it gets wet and saturated on this soil then the clay properties will affect the strength of the building soil can decrease due to excessive soil shrinkage and development, causing damage to road pavement construction around the construction or foundation, because the average value of PI based on the Atterberg Limits test is 11%, the cash nature of silty sand and has kandu only clay.

Actually this soil is not so bad or can be said to have moderate quality as a subgrade if there is no high enough rainfall then there will be no shrinkage and excessive soil development in this soil type.

Results of Mechanical Testing on Soil for Hotel and Resort Development Locations on Kera Island, Kupang Regency

The technical properties are proven by mechanical soil testing to find out how much strength the soil is simulated by the load on it:

CBR Test Results

Laboratory CBR testing is a comparison between the penetration load of a material against a standard material with the same depth and speed of penetration, for disturbed soil samples that have been compacted with 10 blows, 36 times, 65 times and then soaked for 4x24 hours. The purpose of testing the CBR is to determine the surface toughness of the soil layer which will generally be used as a sub-base (backfill) or sub-grade (subgrade) for road construction.

Based on the results of the wet CBR test, a value that states the quality of the subgrade in carrying traffic and mobilization loads during construction

or the load of the building itself is obtained compared to the standard load of crushed stone which has a CBR value of 100%. (SNI 03-1738-1989/2008; Elias et al., 2021; Schaefer et al., 2008; Kim et al., 2010; Vieira & Pereira, 2015; Mwitari, 2017; Douglas, 2018; Christoforidou et al., 2021)

Table 6. CBR values at 3 sample points

STA	Blow 10		Blow 35		Blow 65		Unit	Standard
Print	0,1	0,2	0,1	0,2	0,1	0,2	Inchi	6%
1	0,73	0,84	1,46	1,80	3,98	4,59	%	6%
2	0,46	0,52	1,67	1,85	1,80	2,03	%	6%
3	0,68	0,82	1,80	2,07	3,11	3,46	%	6%

(Laboratory Analysis Results)

Based on the results of laboratory testing successively, the CBR value in the soil sample of the Hotel and Resort Development location on Kera Island, Kupang Regency at the 65th stroke is the sample point (1) is 4.59%, the sample point (2) is 2.03% and the sample point (3) is is 3.46%. The highest CBR value is at the sample point (1) meaning that at 65 strokes with a penetration depth of 0.2 inches it is 4.59%, meaning that if the subgrade at a density of 65 strokes with optimum moisture content is given a piston pressure as deep as 0.2 inches it has a strength quality of 4.59% so that it is compared with reference to SNI, namely the mechanical value of 6% for CBR, the land at the Kera Island Resort Development location is declared "good enough or moderate value" as subgrade (Aziz & Safitri, 2015; Afriani & Juansyah, 2016; Lindawati & Sari 2019; Arif & Agung, 2020). With a fairly good CBR value, it is necessary to pay attention to its use and designation, it is not recommended to use piles or 3 (three) storey buildings.

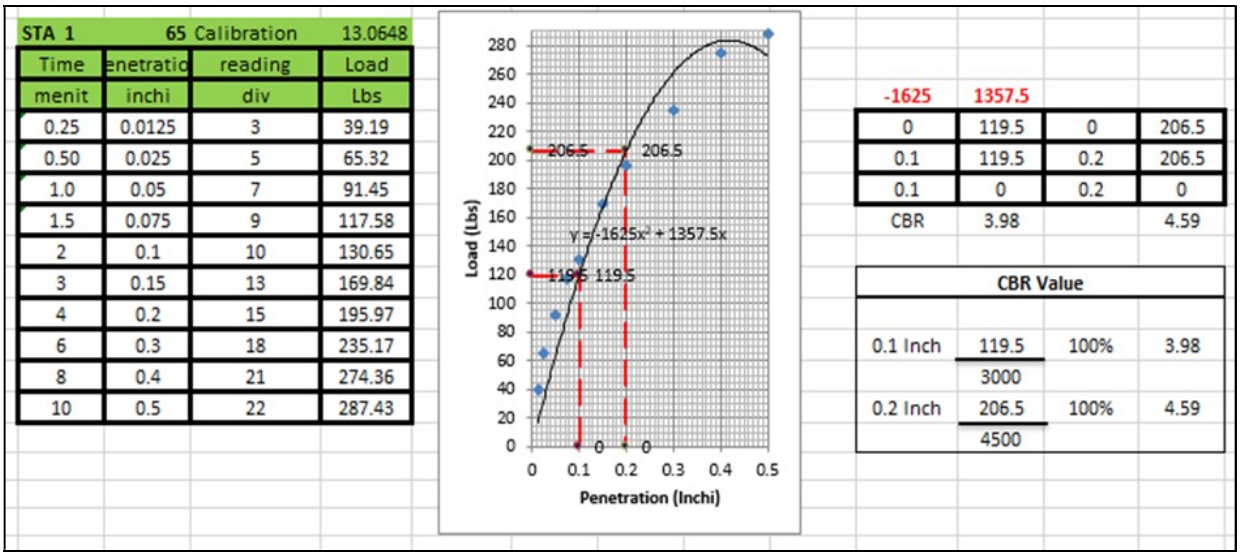


Chart 6. The highest CBr value is at the 1 sample point

The diagram shows the CBR test table at sample point 1 and the graph of the relationship between penetration (x) and Load (y) as well as the CBR penetration values of 0.1 inches (3.98%) and 0.2 inches (4.59%) referring to SNI (03-1738-1989/ 2008; Bandeira et al., 2008; Jayasooriya, 2011; Kousgaard, 2016; Kemmerer, 2019) the soil that is recommended to be used as subgrade has a soaked CBR value (Soaked) 6%, if the soil with a CBR value is like the Hotel and Resort Development location on Kera Island, Kupang Regency, it is necessary to pay attention to the ability of the subgrade because soil damage and instability can occur on roads that are used for the mobilization of equipment and materials due to the non-sturdy surface of the soil layer which will generally be used as a sub grade (subgrade layer) and road construction, namely, grooves (Ruting) this damage and instability is caused by water which weakens the carrying capacity in case of rainfall. heavy rain, will cause the topsoil to decrease because the topsoil of this location is a weak sandy soil In resisting the flow of water so that it is not strong enough to support the load, the soil will fall and form grooves and basins, shoving, and permanent deformation of the subgrade due to unsteadiness, further explanation can be seen from the free compressive strength test.

Free Compressive Strength Test Results Free Compressive Strength

Free compressive strength is the magnitude of the axial load per unit area, axial load is the load parallel to the vertical axis of the test object, stress is the ratio between the load and the cross-sectional area of the test object, axial strain is the ratio between changes in the height of the test object to the initial height of the sample specimen (SNI 03). -3638–1994/2008).

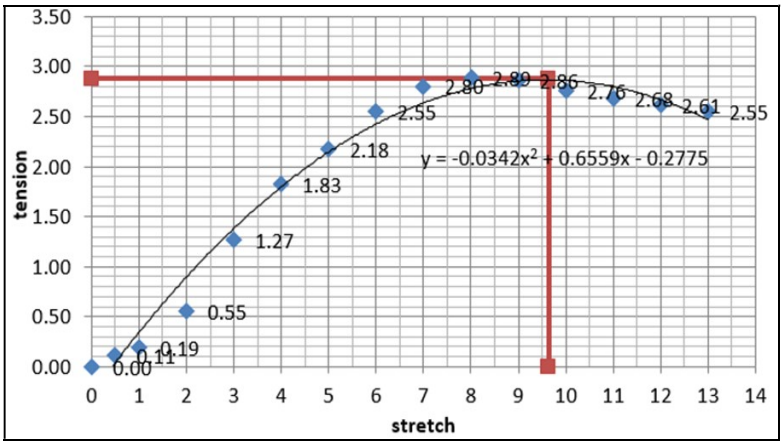


Chart 7. Free compressive strength

(Laboratory Analysis Results)

Chart shows the relationship between strain and stress on the free compressive strength test at the sample point (1) which is a soil sample at the Hotel and Resort Development location on Kera Island, Kupang Regency with the lowest clay soil presentation meaning that the less amount of clay the better the soil strength, in the experiment This polynomial graph shows how the decrease in force due to compression that occurs when the soil sample is destroyed, due to no longer being able to withstand the applied compressive stress, so that the strength of the clay soil is unconfined. qu is defined as the force per unit area of the soil sample, compressive strength of the soil. is the ability of the soil sample to receive the maximum load before the soil sample disintegrates or at a maximum axial strain of 20%. Based on the results of laboratory testing, the value of qu for the gradation percentage is 2.88 kg/cm^2 or 282.36 kN/m^2, meaning that the soil at the Hotel and Resort construction site on Kera Island, Kupang Regency can receive pressure at every 1m^2 must be less than 2.88 kg or 282.36 kN, because if the pressure reaches 2.88 kg/m^2 or 282.36 kN/m^2 then the soil has collapsed. Soil that has a qu value of 200-400 kN/m^2 in the consistency of clay is included in the category of very stiff clay, if the soil sample has a qu value of 100-200 kN/m^2 in the consistency of clay it is included in the category of rigid clay, while for the soil for the Hotel Construction site and Resort on Kera Island, Kupang Regency which has a gradation of qu value 2.88 kg/cm^2 or 282.36 kN/m^2 its consistency to very stiff clay.

Soil damage and instability at the Kera Island Resort Development site can occur if there is a pressure stress that is influenced by the speed of water flow leaving the soil pore cavities due to additional pressure, this will greatly trigger building damage and also subgrade subgrade so that it will cause fractures and holes. on the floor of the building or building foundation, because the pressure or load on the subgrade as the footing of Hotels and Resorts on Kera Island, Kupang Regency must not be greater than the required qu value, namely qu 2.88 kg/cm^2 or 282.36 kN/m^2, and if the load If the excess is given continuously, Sungkur (Shoving) will occur in the form of building foundation collapse and subgrade subsidence and collapse, to further ensure that the soil strength on Monkey Island can be strengthened with soil shear strength test data.

Shear Strength Test Results Shear Strength

Soil shear stress is the resistance of the soil to deformation when given a shear stress, the shear strength of the soil is the maximum shear resistance or stress that the soil can withstand under certain loading conditions, the failure of the test object is the stress when the test object

collapses, usually taken at the maximum shear stress. (SNI 03-2813-1992/2008)

The results of the shear strength test on the soil at the Hotel and Resort construction site on Kera Island, Kupang Regency can be seen in the diagram below. m2 or 0.24123 kg/cm^2

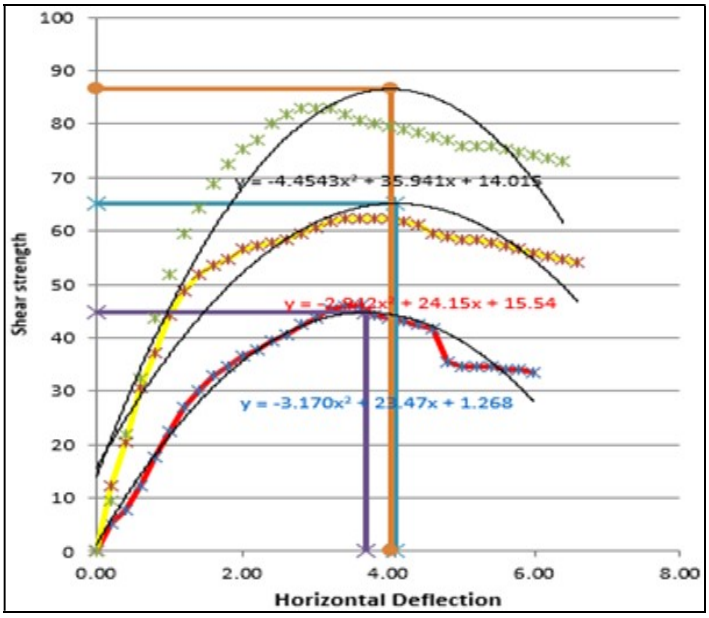


Chart 8. Sliding Strength
(Laboratory Analysis Results)

Chart The above shows the relationship between stress and horizontal deflection in the free compressive strength test which is the lowest percentage of clay soil, meaning that in this experiment the polynomial graph shows how the stress reduction due to compression occurs when the soil sample collapses due to no longer being able to withstand shear stresses.

The finer the soil grains, the higher the clay, so that it greatly affects the carrying capacity, on the contrary, the coarser the soil grains, the greater the shear strength, therefore the shear strength test using water content is the same as the free compressive strength test, soil samples are taken at the construction site. Hotels and Resorts on Kera Island, Kupang Regency have an average consistency of medium clay, which is represented by a shear value of 23.65 kN/m^2 or 0.24123 kg/cm^2.

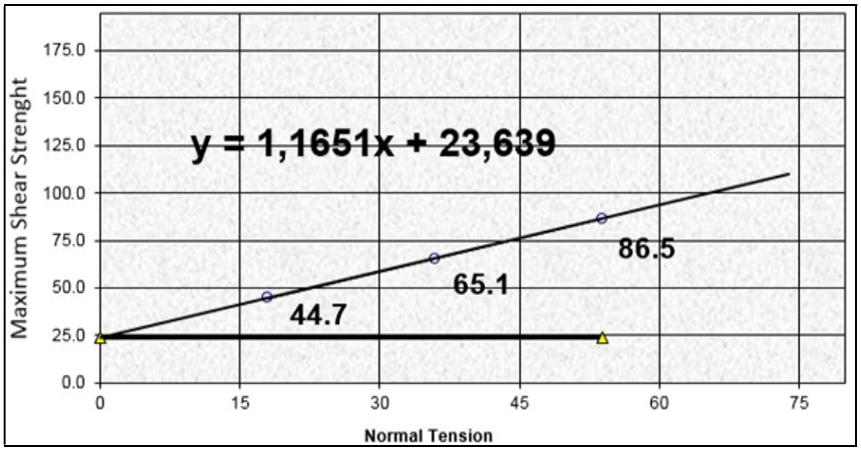


Chart 9. Sliding Angle
(Laboratory Analysis Results)

The picture above is a graph of the shear angle that passes through the 200 sieve with a fairly low percentage of clay, soil with a shear stress (cohesion) of 0.24 kg/cm^2-0.48 kg/cm^2 has the consistency of medium clay. If there is additional stress on the subgrade at the Pulau Kera resort construction site due to the load on the topsoil, it will always be followed by slack followed by a decrease in the subsoil structure, shear failure due to exceeding the bearing capacity of the soil will result in an uneven settlement (differential settlement) and in the end there will be a decrease in the entire construction of the building causing complex damage to the buildings on the land.

Instability and subgrade damage can also be caused by shear stress due to exceeding the bearing capacity of the soil for shear stress, the shear stress imposed on the subgrade at the Pulau Kera resort construction site every one square meter (1m^2) is more than 23.65 kN/m^2 or 0.24123 kg/ cm^2. If it exceeds the required shear strength it will cause failure due to excessive shear loads.

The shear strength of the soil is strongly influenced by the type of soil, and the ability of the soil to pass water, the occurrence of soil damage due to shear can occur at the construction site of Hotels and Resorts on Kera Island, Kupang Regency, if there is excessive mobilization of heavy equipment during the project development process.

Conclusion

1. The results of soil testing, for physical testing the gradation rate for the lowest soil is 51.44% and the highest is 95.72%, based on the specific gravity test the value of Soil Density is 2.72 Ton/m3 and 2.73 Ton/m3, based on the water content test, the lowest value is 23.35%, the highest reached 25.64%, for the Atterberg test, the highest PI value was 23.47% and the lowest PI 11.19%, meaning that the soil has moderate to poor quality as a soil component and the characteristics are typical of sandy soil in the top soil and silty in the subgrade and has properties clayey means that if in a dry state it will be hard, and if wet it will be soft, plastic, and cohesive, expands and shrinks quickly and the results of mechanical testing obtained the highest strength quality CBR value 4.59% and the lowest strength quality 2.03%, Free Compressive Strength Value obtained a value of qu 2.88 kg/cm2 or a quality shear strength of 282.36 kN/m2, meaning that, when viewed from the mechanical test which gives an overview of the mechanical ability of the soil based on the SNI standard of soil at the location of hotels and resorts in the category of moderate bearing capacity as subgrade.
2. Based on AASHTO soil as soil that has a clay value, which is a moderate to poor soil category as a subgrade according to its classification and clay content.
3. Disturbance due to the work. This regional track (loader) screw contributes to the land cover of the ground surface, the surface soil will be disturbed and the vegetation that strengthens the soil will be cut and cleaned, therefore the strength of the soil in this path will definitely decrease.
4. The soil in this area has a top cover or sandy top soil which at the bottom there is white silt soil and clay content and can be categorized as a regosal type of soil, this soil has general characteristics on the surface, namely coarse textured sand with low bearing capacity. physical test the gradation rate for the lowest soil is 51.44% and the highest is 95.72%, based on the specific gravity test the value of soil density is 2.72 tons/m3 and 2.73 tons/m3, based on the water content test, the lowest value is 23.35%, the highest is 25.64%, for the Atterberg test The highest PI value is 23.47% and the lowest PI is 11.19%, meaning that the soil has moderate to poor quality as a physical soil component and the results of mechanical testing obtained the CBR value for the highest strength quality 4.59% and the lowest strength quality 2.03%. qu value 2.88 kg/cm2 or quality shear strength 282.36 kN/m2 means that the tan strength physically and mechanically unable to carry the load of heavy equipment, if it is not supported by rock mass, the soil will experience texture damage, peel off, be transported and experience a decline and collapse.

Suggestions and Recommendations

Equipment mobilization activities for project needs, especially large vehicles such as trucks transporting materials and heavy equipment, are at risk of subgrade subsidence, therefore, based on the soil strength values obtained above, it can be concluded that disturbances due to equipment mobilization and large vehicle traffic as well as heavy equipment (Walas, doser, Drop Hammer,

Manual Stamper, Transport Ship) on the ground surface causing disturbances in the form of pressure loads and shear loads that will cause the soil to deform or collapse to the surface, especially if triggered by the intensity of a long duration of time, the load will be compression and shear that comes from the load of private vehicles, motorcycles, trucks and heavy equipment will further aggravate the soil, in the form of deformation or collapse.

References

Afriani, L., & Juansyah, Y. (2016). Pengaruh fraksi pasir dalam campuran tanah lempung terhadap nilai cbr dan indeks plastisitas untuk meningkatkan daya dukung tanah dasar. Rekayasa: Jurnal Ilmiah Fakultas Teknik Universitas Lampung, 20(1), 23-32.

Akbar, S.J., & Wesli, W. (2016). Studi Korelasi Daya Dukung Tanah Dengan Indek Tebal Perkerasan Jalan Menggunakan Metode Bina Marga. Teras Jurnal, 4(1).

Albano, A., & Alexiadis, A. (2021). Non-symmetrical collapse of an empty cylindrical cavity studied with Smoothed Particle Hydrodynamics. Applied Sciences, 11(8), 3500.

Alfian, Rian, Afriani, Lusmeilia, Iswan, 2015. Studi Analisis Daya Dukung Tanah Lempung Berplastisitas Tinggi yang Dicampur Zeolit

Arif, M.R.A., & Agung, P.A.M. (2020). Pengaruh Penambahan Serbuk Bata Merah Terhadap Nilai CBR. Prokons: Jurnal Teknik Sipil, 14(2), 47-53.

ASTM D 2850-87 (Unconsolidated-Undrained)

Aziz, M.M., & Safitri, R. (2015). Peningkatan Kekuatan Tanah Dasar Jalan Tanjung Api-Api Menggunakan Bahan Tambah Chemical Geopolymer Ditinjau Dari Nilai CBR (Doctoral dissertation, Politeknik Negeri Sriwijaya).

B.Peck Ralph dan Karl Terzaghi, 1993, Mekanika Tanah Dalam Praktek Rekayasa Edisi Kedua Jilid 1, Erlangga, Jakarta.

Badaron, S.F., Lawalenna, S., Harianto, T., & Rahman, D. (2020). Soaking effect on bearing capacity of subgrade material. In IOP Conference Series: Earth and Environmental Science (Vol. 419, No. 1, p. 012084). IOP Publishing.

Bandeira, A.A., Merighi, J.V., & Fortes, R.M. (2008). A Study of the HMA Layer Thickness Reduction When Applied Over Lateritic Soils Cement Base in Airfield. In Proceeding of 10th International Conference on Application of Advanced Technologies in Transportation–AATT.

Blott, S.J., & Pye, K. (2006). Particle size distribution analysis of sand-sized particles by laser diffraction: an experimental investigation of instrument sensitivity and the effects of particle shape. Sedimentology, 53(3), 671-685.

Bobon-Carnice, P.A., & Lina, S.B. (2021). Changes in Carbon and Nutrient Stocks of Secondary Forest Transformations Under Ultisol in Leyte Island, Philippines. Mindanao Journal of Science and Technology, 19(1).

Bowles, J.E., 1993, Sifat-Sifat Dan Geoteknik Tanah, Terjemahan Hainim,J.K., erlangga, Jakarta

Bowman, G.M., & Hutka, J. (2002). Particle size analysis. Soil physical measurement and interpretation for land evaluation, 224-239.

Brown, A.P. (2016). Application of ozone in dissolved air flotation (DAF) for enhanced removal of TOC and suspended solids in pulp and paper wastewaters. Temple University.

Christoforidou, E., Bobet, A., Nantung, T., & Bourdeau, P.L. (2021). Use of Geosynthetics on Subgrade and on Low and Variable Fill Foundations.

Da Silva, L.F., Fruett, T., Zinn, Y.L., Inda, A.V., & do Nascimento, P.C. (2019). Genesis, morphology and mineralogy of Planosols developed from different parent materials in southern Brazil. Geoderma, 341, 46-58.

Das. Braja M., (1995), Mekanika Tanah (Prinsip-Prinsip Rekayasa Geoteknis) Jilid I, Erlangga, Jakarta

Das, Braja M, (1985), Mekanika Tanah (Prinsip-Prinsip Rekayasa Geoteknis) Jilid II, Erlangga, Jakarta.

Dhar, S., & Hussain, M. (2019). The strength and microstructural behavior of lime stabilized subgrade soil in road construction. International Journal of Geotechnical Engineering.

Douglas, R.A. (2018). Low-volume road engineering: Design, construction, and maintenance. CRC Press.

Elias, V., Christopher, B.R., Berg, R.R., & Berg, R.R. (2001). Mechanically stabilized earth walls and reinforced soil slopes: design and construction guidelines (updated version) (No. FHWA-NHI-00-043). United States. Federal Highway Administration.

Fadhillah, H.M. (2017). Perencanaan Perbaikan Tanah Lunak Pada Pembangunan Cluster D Kawasan Kota Summarecon Bandung Menggunakan Kombinasi Metode Vacuum Consolidation Dengan Prefabricated Vertical Drain (Doctoral dissertation, Universitas Brawijaya).

Hardiyatmo, H.C. 2002. Mekanika Tanah I. Yogyakarta : Gadjah Mada University Press----------. 2017. Stabilisasi Tanah Untuk perkerasan Jalan. Yogjakarta: Gadjah Mada University Press.

Hayadi, H., & Lakawa, I. (2020). Korelasi Nilai CBR Dengan kepadatan Lapangan Subbase Course. Sultra Civil Engineering Journal, 1(2), 1-8.

Hayadi, H., Lakawa, I., & Sulaiman, S. (2021). Korelasi Nilai CBR Dengan kepadatan Lapangan Subbase Course. Sultra Civil Engineering Journal, 2(2), 74-80.

Hufenus, R., Rueegger, R., Banjac, R., Mayor, P., Springman, S. M., & Brönnimann, R. (2006). Full-scale field tests on geosynthetic reinforced unpaved roads on soft subgrade. Geotextiles and Geomembranes, 24(1), 21-37.

Jayasooriya, V.W.P. (2011). Development of a guideline to determine structural capacity of demolition waste as a road construction material (Doctoral dissertation).

Jaynes, W.F., & Zartman, R.E. (2005). Origin of talc, iron phosphates, and other minerals in biosolids. Soil Science Society of America Journal, 69(4), 1047-1056.

Kemmerer, B.W. (2019). A Compositional Analysis of Artificial and Terrestrial Analog Martian Regolith Simulants (Doctoral dissertation, Florida Institute of Technology).

Kim, H., Prezzi, M., & Salgado, R. (2010). Use of dynamic cone penetration and clegg hammer tests for quality control of roadway compaction and construction.

Konert, M., & Vandenberghe, J.E.F. (1997). Comparison of laser grain size analysis with pipette and sieve analysis: a solution for the underestimation of the clay fraction. Sedimentology, 44(3), 523-535.

Kousgaard, A.P. (2016). Material Durability in the Anastylosis of Ancient Structures. The University of Nebraska-Lincoln.

Lindawati, L., & Sari, E.K. (2019). Analisa Pengaruh Penambahan Limbah Gypsum Terhadap Nilai CBR Tanah Dasar di Ruas Jalan BK 1 Desa Tanjung Bulan Kabupaten OKU Timur. Jurnal Deformasi, 4(1), 13-20.

Maabuat, A.W. (2016). Tinjauan Pengujian Unconfined Compression Strength (Ucs) Untuk Lapis Pondasi Soil Cement Base (SCB) (Doctoral dissertation, Politeknik Negeri Manado).

Ma'azza, M.A. (2016). Pengaruh Jarak dan Panjang Kolom dengan Diameter 5cm pada Stabilisasi Tanah Lempung Ekspansif menggunakan Metode Dsm Berpola Triangular terhadap Daya Dukung Tanah (Doctoral dissertation, Universitas Brawijaya).

Marecos, V., Solla, M., Fontul, S., & Antunes, V. (2017). Assessing the pavement subgrade by combining different non-destructive methods. Construction and Building Materials, 135, 76-85.

Mathur, K.B., & Gishler, P.E. (1955). A technique for contacting gases with coarse solid particles. AIChE Journal, 1(2), 157-164.

Meldi, G. (2021). Analisis Kelayakan Sifat Fisik Dan Mekanik Material Pada Quarry Di Pulau Lombok Sebagai Bahan Timbunan Subgrade Jalan (Doctoral dissertation, Universitas_Muhammadiyah_Mataram).

Mwitari, J.N. (2017). Cracking of Jointed Plain Concrete Pavement: A Case Study of Kagere-Ndunyu-Munyange-Gituiga (E571) Road in Othaya, Kenya (Doctoral dissertation, SEMATEC-JKUAT).

NI-03-3432-200X Pengujian Analisa Ukuran Butir.

Oriokot, J.J.O. (2014). Reinforcement of pavement subgrade using granular fill and a geosynthetic layer (Master's thesis, University of Cape Town).

Rothwell, R.G. (Ed.). (2012). Minerals and mineraloids in marine sediments: an optical identification guide. Springer Science & Business Media.

Schaefer, V.R., White, D.J., Ceylan, H., & Stevens, L.J. (2008). Design guide for improved quality of roadway subgrades and subbases. Iowa Highway Research Board (IHRB Project TR-525), 7, 8-72.

Seaforth, C., Tikasingh, T., Gupta, M., & St Rose, G. (2008). A study for the development of a handbook of selected Caribbean herbs for industry.

Shemiye, S. (2020). Investigation Engineering Properties of Soil In Fiche Town (Doctoral Dissertation, Addis Ababa Science And Technology University).

Shi, L., Cheng, X., Liu, Q., & Liu, Z. (2018). Reaction of volatiles from a coal and various organic compounds during co-pyrolysis in a TG-MS system. Part 1. Reaction of volatiles in the void space between particles. Fuel, 213, 37-47.

SNI-03-1967-1990 Pengujian Batas Cair dengan Cassagrade S SNI-03-3420-2016 Pengujian Kadar Air

SNI-M-04-1989-F Pengujian Berat Jenis Tanah

Sung, C.T.B., Ishak, C.F., Abdullah, R., Othman, R., Panhwar, Q.A., & Aziz, M.M.A. (2017). Soil properties (physical, chemical, biological, mechanical). Soils of Malaysia, 103-154.

Truter, L.A., Makgwane, P.R., Zeelie, B., Roberts, S., Böhringer, W., & Fletcher, J.C. (2014). Washcoating of H-ZSM-5 zeolite onto steel microreactor plates–Filling the void space between zeolite crystallite agglomerates particles. Chemical Engineering Journal, 257, 148-158.

Tutumluer, E., Mishra, D., & Butt, A.A. (2009). Characterization of Illinois aggregates for subgrade replacement and subbase.

Vieira, C.S., & Pereira, P.M. (2015). Use of recycled construction and demolition materials in geotechnical applications: A review. Resources, Conservation and Recycling, 103, 192-204.

Wahab, N.B. (2017). Effect Of Reconstituted Method On Shear Strength Properties Of Peat (Doctoral dissertation, Universiti Tun Hussein Onn Malaysia).

ood, F.M., Yamamuro, J.A., & Lade, P.V. (2008). Effect of depositional method on the undrained response of silty sand. Canadian Geotechnical Journal, 45(11), 1525-1537.

Wu, H., Zheng, G., Liu, N., Carney, T.J., Yang, Y., & Cui, Y. (2012). Engineering empty space between Si nanoparticles for lithium-ion battery anodes. Nano letters, 12(2), 904-909.