INVESTIGATING THE EFFECT OF CEMENT KILN DUST QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

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A DISSERTATION SUBMITTED TO THE FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND ENVIRONMENTAL ENGINEERING OF UGANDA CHRISTIAN UNIVERSITY

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ABSTRACT

The research carried out according to this text was aimed at improving the properties poor grade laterite soils using Cement kiln dust and Quarry dust so as to match up to the required physical and mechanical properties of a G45 material for the subbase layer of a road. Lateritic soils are a leached residue formed by the natural process of laterization in tropical and subtropical regions around the world and are often used as materials for roads. The Cement kiln dust used was a waste product of the process of manufacture of cement and the quarry dust was derived from crushed granite stone.

The laterite soils sampled in this research carried out were retrieved from Ntawo Borrow pit and were characterized by a very low California Bearing Ration (CBR), high plasticity index and high CBR swell. This report highlights the methodology followed to improve the quality of the soils to meet the required standards for a G45 material according to the MoWT general specifications for roads and bridge works.

The different tests carried out provided satisfactory results in the blend where 15% cement kiln dust was used with 15 % quarry dust in which the Califonia Bearing Ration was increased from 27% to 57%, the Plasticity index was reduced from 20.0% to 8.9%, and the CBR swell was reduced from 0.54% to 0.35%. These were all up to standards for a subbase material hence Cement kiln dust and quarry dust can indeed be efficiently used for stabilization of laterite soils. This is therefore an important research that incorporates industrial waste materials into construction of roads which promotes sustainability while also enhancing the strength of soil.

DECLARATION.

I, **WEERE JONATHAN**, registration number **M22B32/035** a fourth year Civil and Environmental Engineering student of Uganda Christian University, solemnly declare that the project report is based my own research, experiences and observations and has not been submitted to any institution.

Signature: ………………………………….   Date: …………………………………

APPROVAL.

I therefore approve that this report is for Weere Jonathan, Registration Number M22B32/035 and that this research proposal concept report has been done under my supervision and is ready to be given to the Faculty of Engineering, Design and Technology as one of the requirements for his degree in Civil and Environmental Engineering at Uganda Christian University.

Mr. Henry Ssejemba

ACADEMIC SUPRERVISOR

LECTURER UGANDA CHRISTIAN UNIVERSITY

Signature: ………………………………………… **Date:** ………………………………

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LIST OF ABBREVIATIONS

AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIAL SYSTEM
BS	BRITISH STANDARD
CKD	CEMENT KILN DUST
CBR	CALIFORNIA BEARING RATIO
LL	LIQUID LIMIT
LS	LINEAR SHRINKAGE
MDD	MAXIMUM DRY DENSITY
MoWT	MINISTRY OF WORKS AND TRANSPORT
OMC	OPTIMUM MOISTURE CONTENT
PI	PLASTICITY INDEX
PL	PLASTIC LIMIT
UCU	UGANDA CHRISTIAN UNIVERSITY
USCS	UNIFIED SOIL CLASSIFICATION SYSTEM

CHAPTER 1: INTRODUCTION

1.1 Background of the study

Lateritic soils are a leached residue formed by the natural process of laterization in tropical and subtropical regions around the world. Laterite soils are classified according to their physical properties, chemical composition, geological characteristics, and morphology. The characteristics of laterite soil depend on several aspects, such as the origin process, atmosphere, rain magnitude, temperature, parent rock nature, bed surface qualities, weathering course, and so on, and they can be impacted by the synergetic effect of all these factors. (Kumar et al., 2022).

Laterite soils are primarily made of aluminium, silicon, and iron oxides, and they may contain crystalline phases such as quartz, kaolinite, halloysite, goethite, hematite, and ilmenite. The bulk density of the laterite is determined by its chemical composition, normally ranging from 0.9 and 3.6 g/cm3 and rises with iron content lowers with alumina content. (Kaze et al.,2022).

Laterite soils are utilized to form the subgrade, subbase, and base layers of flexible pavement. This is because of their good strength properties; however, quality laterite soils may not be available in the local area of the road project, so engineers are forced to improve and stabilize the marginal laterite soils to meet the strength requirements for natural gravel used to construct the pavement layers. (Sudla et al., 2018).

Cement and lime are the most commonly employed chemical stabilizers for laterite soils, whereas crushed rock is utilized mechanically. Cement stabilization is frequently utilized because it is readily available, inexpensive, long-lasting, and weather-resistant. Granular soils with suitable particles are ideal for cement stabilization because they use the least quantity of cement.

Mechanical stabilization with crushed rock is another popular way of stabilizing laterite soil due to its availability and proximity. However, stabilization using crushed rock greatly changes the particle size distribution of the soil, lowering its overall cohesiveness. Crushed rock is also non-renewable resource, and ongoing mining exposes it to depletion . (Opara & Ejiogu, 2021).

In addition to cement and lime, industrial waste is also being incorporated in the stabilization of soils. Cement kiln dust is a waste substance produced during cement manufacture. It is very appealing for the use of soil stabilization since it has pozzolanic characteristics.

Cement kiln dust enhances the engineering features of low-quality soils and is a suitable substitute for improving road pavement performance.

The research aims to use cement kiln dust to stabilize laterite soils for subgrade construction, improving engineering features and promoting sustainable infrastructure development in Uganda and abroad.

1.2 PROBLEM STATEMENT

Road failure is increasingly terrible in Uganda today due to several reasons such as rapidly increasing number of cars using the road and substandard quality of materials that make up the road. This is often weak soils that support the road pavement(Nansereko, 2019).

Uganda's climate is primarily tropical, and a significant majority of the soils of Uganda are lateritic in origin. Many academics have previously addressed the instability and strength of laterite soils in construction applications (Ezreig et al., 2022). Laterite soils are utilized to form the subgrade, subbase, and base layers of flexible pavements. (Townsend et al., n.d.).

However, engineers may have to stabilize and adapt marginal laterite soils to meet the strength criteria for natural gravel used to construct the pavement layers because high-quality laterite soils may not be readily available in the location of the road project. (Sudla et al., 2018). Case study of Nasuuti-Nakabago-Ntawo road where the materiaL of the subgrade is laterite soils and the road shows signs of failure as observed by the pot holes and the erosion that was done on the side of the road.

Because lateritic soils contain clay minerals like iron and aluminum oxide, they are reddish-brown in color. They are primarily found in Uganda's tropical areas. These soils are inappropriate when compacted back to their native density because they cannot provide comparatively sufficient resistance to traffic loads due to their low bearing capacity and considerable plasticity, which ranges from 11.2% to 20.7%. (Tugume, 2019). The high clay content of the laterite soils if often affected greatly by change in moisture compositions and often swells which leads to constant weakening of the road over time (Razali et al., 2023).

Laterite soils that are clayey in nature have a tendency to absorb and retain water easily. They turn soft, plastic, and muddy in the rainy season, with a loss of load-bearing capacity. This makes roads very prone to traffic-induced deformation and damage. Cement stabilization reduces this susceptibility by binding soil particles and forming a water-resistant matrix, and sand improves drainage and reduces clay content, making the soil less reactive to water.

1.3 Objectives of study

1.3.1 Main objective

- To assess the stabilization of marginal laterite soils using cement kiln dust and quarry dust for the construction of a subbase layer of a flexible pavement

1.3.2 Specific objectives

i. To determine the engineering properties of laterite soil

ii. To determine the engineering properties of cement fly ash and sand

iii. To determine the engineering properties of the stabilized soil and its ultimate capacity as a road subbase material.

1.4 Research questions/ Hypotheses

1. What are the engineering properties of laterite soils used for road construction?
2. What are the physical and chemical properties of cement kiln dust and quarry dust?
3. What are the engineering properties of laterite soils stabilized with CKD and quarry dust.

1.5 Scope of study

The case study of research is Gwafu-Nabuta road in Mukono at coordinates 0.361298”N,32.719632”E

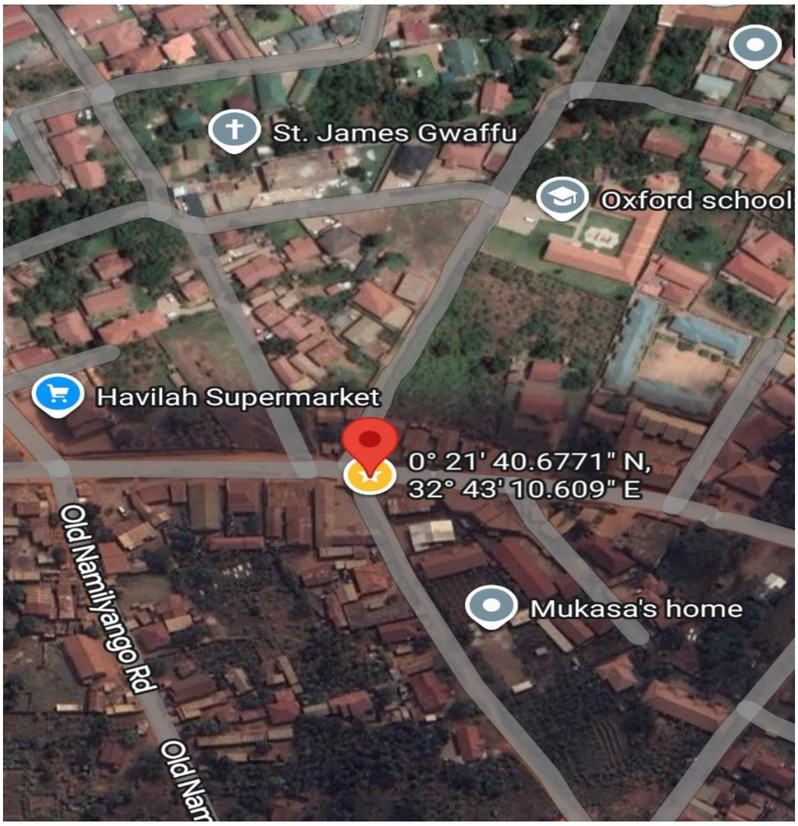


Figure 1: showing the geographical location of the scope

Content scope

The study focused on analyzing the engineering properties of the material, i.e., California bearing ratio, plasticity characteristics, and particle size distribution of the final blended material.

1.6 JUSTIFICATION

Lateritic soils are soils that are usually found with low bearing capacity and high plasticity which at times makes them unsuitable for subbase material

Using cement kiln dust and quarry dust combines together the calcium compounds in CKD and the silica and alumina present laterite soils. This reaction produces additional cementitious chemicals such as calcium silicate hydrate (C-S-H) and calcium aluminate hydrate (C-A-H), which bind soil particles together, increasing soil strength and also decreasing plasticity(Ahereza, 2025). The presence of CKD improves the soil's resistance to moisture-induced damage, such as swelling and shrinkage. (Iyaruk,2022)

Studies have shown that quarry dust once added to laterite soils reduces the liquid limit and also increases the CBR value of the soil(Almeida,2024)

Additionaly CKD and quarry dust are materials that are readily available making them good choices for stabilization of laterite soils.

1.7 Significance of the study

Numerous researchers have studied soil stabilization techniques in great detail, evaluating a variety of stabilizers for their ability to improve soil properties. These studies have established the viability of various stabilizing agents, addressing a range of soil types and conditions. This report seeks to explore and establish the potential of using cement as a mechanical stabilizer for improving the engineering properties of laterite soils as well as the use of cement kiln dust as the binder material to improve bonding.

This study also helps to ascertain whether cement kiln dust may be used to stabilize laterite soil together with quarry dust and improve its engineering qualities. It aims to determine how adding CKD and quarry dust to laterite soil can improve its strength and load-bearing capacity while decreasing its plasticity and general performance in subbase applications. By using industrial byproducts, this project also seeks to improve sustainable building while lowering the general cost of stabilization through incorporating CKD which is industrial waste.

Though these materials have been used in other parts of the world in the stabilization of laterite soils, this research hasn't been done extensively on the composition of laterite soils we have in Uganda, which in itself has a very significant portion of them especially in the central region of the country.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter introduces the research done on the composition of laterite soils, cement kiln dust and quarry dust in effort to justify the ability of the stabilizers to improve the engineering properties of the soil. It also includes the ways in which soil can be stabilized to improve its properties for use as a subbase material.

The physical and chemical characteristics of soils make them complex natural resources. Their composition significantly affects their engineering behavior. They are made up of organic materials, water, air, and mineral particles. In many civil engineering projects, particularly in building, understanding soil mechanics is essential since the stability and longevity of structures are greatly influenced by the characteristics of the underlying soil. (Aboudi Mana, et al., 2017).

2.2 SOIL STABILIZATON

The stabilization of laterite soils for road construction in tropical regions has been a research topic due to the challenges posed by the soils' natural properties. In Uganda, laterite soils are commonly used for low-volume roads but durability and longevity should be ensured. The purpose of this literature review was to examine the current research on the engineering properties of laterite soils and the different stabilization techniques.

According to Yakub et al. (2020), soil stabilization involves modifying soils to improve their physical characteristics, such as shear strength, shrink-swell properties, and other properties, in order to increase the soil's strength. It can also be described as the preservation or modification in order to increase the performance of the soil in its purpose to bear the loads of vehicles using the road(Ingles & Metcalf, 1972).

During the stabilization process, stabilizers are added to the soil in different percentages, and the changes in the soil's parameters are recorded(Amu & Adetuberu, 2010).

Types of soil stabilization include:

1. Mechanical stabilization
2. Chemical stabilization
3. Compaction stabilization

2.2.1 Considerations in the soil stabilization process

This is the first and most important part of soil stabilization which helps to identify the composition of the soil. This is because the engineering properties of soil are primarily governed by the composition of the soil. Therefore, by identifying the properties and composition of the soil, an effective stabilizer can be employed to enhance the engineering performance of the soil.

2. Decide the most feasible and effective method of stabilization. This principle informs us to pick the best possible stabilizer that best supplements the lacking properties in the soil being stabilized. That's to say, a stabilizer employed for clay soils may not be as effective when employed for sandy soil.

3. Design the soil blend considering stability and durability. This principle involves choosing the appropriate blend of neat soil and stabilizer that meets the stability and durability standards required for the purpose for which the soil is to be used.

4. Determine the adequate construction procedure The adequate construction procedure ensures proper compaction of the stabilized layers of material.

2.2.2 Mechanical stabilization

Mechanical stabilization is basically the alteration of the physical composition of the soil for example, grading modulus and any other characteristics of the soil which is can usually be achieved by mixing different materials with different physical properties.(Archibong et al., 2020)

In this topic, Soil composition can be grouped as shown below.

Aggregates.

These typically have particle sizes greater than 75 microns. They provide the skeletal framework for providing internal friction.

Binders.

These typically have particle sizes of less than 75 microns.

They are responsible for providing cohesion in the material.

Factors that affect mechanical stabilization.

- Strength of the aggregate used.
- The inherent mineral composition of soil.
- Gradation of the blended soil.
- Plasticity characteristics of the blended soils.

2.2.3 Chemical stabilization.

Chemical stabilization involves the addition of an additive that causes a reaction with the soil particles and the additive causing an alteration in the properties of the soil(Das, n.d.).

Most common type of chemical stabilization includes cement stabilization and lime stabilization.

2.2.4 Compaction stabilization.

Compaction stabilization involves the use of mechanical methods to remove air gaps from soil, resulting in soil that can hold weight without necessarily failing due to poor strength (Adams, 2014).

One of the main methods of stabilizing soil is dynamic compaction, which involves dumping a heavy weight onto the ground at regular intervals to effectively hammer away abnormalities and provide a flat surface(Adams, 2014).

Compaction by use of vibrations is also another common method used in compaction especially for course aggregates and stones during construction of roads works. This helps in the settlement of the particles hence increasing the bulk density of the soil.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter aims to introduce the different methods and actions that had to be taken to complete the project and achieve each of the objectives of study.

3.2 Materials

laterite soils

The laterite soils were obtained from Ntawo borrow pit around the from which the soil from the road was gotten with coordinates 0°22'21.7"N 32°45'04.4"E. The sample was collected in triplicates from different points within the borrow pit at depths of 0.5 m. a disturbed sample of more than 100kg was as well collected for the use of the other required tests.

Figure 2: showing Ntawo borrow pit

Cement kiln dust.

The cement kiln dust used in this project research was retrieved from Hima cement, Namanve industrial park, Kampala. Pre-calciner kiln dust was better suited for this research since it contains higher amounts of free lime and thus possesses better stabilization characteristics.100kg of this was retrieved to make sure its enough for all the mix ratios that were required for the project.

Quarry dust

Quarry dust for this project research was obtained from Stirling construction company as they had a lot of it from their quarries that source there aggregates for road construction. The Quarry dust was majorly from granite and had a grey consistence. 50kg of it was transported from the storage unit to the Stirling testing lab in Mbalala.

3.3 Methods.

3.3.1 Sample preparation

soil sample

The disturbed soil sample was dried first by spreading on trays and left to air dry for about 2 days and partitioned for various tests.

Quarry dust

The quarry dust was also retrieved from a site owned by stirling construction, transported and placed on trays to dry in the sun for 1 day and was then partitioned to carry out the tests.

Tests done to achieve objectives

3.3.2 Determining the engineering properties of the Laterite soils.

The physical-mechanical properties of the soil will be determined to classify the soil and determine its performance without any stabilization.

Tests carried out include the following:

1. **Proctor compaction test - Maximum dry density (MDD) and Optimum moisture content (OMC) (British Standard 1377 part 2).**

This is an important test that helps to determine the maximum dry density of compacted soil and the moisture content of that soil. The OMC is the amount of water that has to be added to the soil for the best compaction results while doing the CBR test on the soil(ASTM International, 2021). The maximum dry density is also very important as an indicator to show whether the soil in the CBR mold is compacted enough to reach a good percentage of the natural density(ASTM International, 2021).

According to standards it is important to carry out the test on soil that passes the 20mm sieve

A representative sample of atleast15 kgs was needed for this test. The sample was then quartered, and portions picked in alternating quarters to ensure that the particles in the material were uniformly distributed. The sample was split into five equal portions of about 3 kg weight each.

Apparatus

- Measuring cylinder
- 4.5 kg rammer 29
- Five 1-litre molds That molds with detachable baseplates and removable extensions
- Test sieves sizes 20 mm and 5 mm

Test procedure

For each portion, different volumes of water were added so that a graph can be achieved with values of moisture content around the expected optimum moisture content that was estimated by feeling with hand. The material was then compacted in standard cylindrical molds of about 1ltr volume. All the samples were compacted in three layers, applying 62 evenly distributed blows to each layer using a 4.5 kg rammer.

The samples were then trimmed to cut off the excess material so that the compacted material flushes with the mold.

The samples were weighed, and representative samples scraped from to bottom and middle section of the mold were taken to the oven for moisture content determination at about 105°C for 24 hours.

Calculation and plotting

- A graph of moisture vs density was drawn, and the highest point of the graph was taken as the MDD.
- The moisture content at that point was taken as the OMC.

California Bearing Ratio and California Bearing Ratio swell - after 4 days of soaking (British Standard 1377 part 4).

This test is very important in determination of the strength of a material. The strength of a soil layer on the road is typically expressed in terms of their CBR value.

The methods used to determine CBR are one point method and the three point method. The one point method was used for this research.

Sample preparation.

A 6kg soil sample passing through the 20mm test sieve was retrieved and prepared for the CBR test. The sample that passed was then mixed with water to optimum moisture content got through the proctor test and was then sealed and soaked in a basin of water for at least 24 hours before tests were carried out. so it doesn't lose water by evaporation.

Test procedure of the one-point method.

The prepared soil sample is mixed with a calculated amount of water to meet optimum moisture conditions and then compacted in a standard CBR mold with a perforated base plate. The compaction was done in five layers by ramming the soil with 62 well distributed blows using a 4.5

The sample was then trimmed at the top to coincide with the mold.

A filter paper was placed on top of the sample before the perforated swell plates were also connected to the mold. Annular surcharge discs and a dial gauge were mounted.

The mold was soaked in a soaking with the water level almost reaching the mold extention. It was soaked for a total of four days.

After 4 days of soaking, the sample was retrieved from the soaking tank and taken for penetration using a CBR machine.

Calculations were then made to determine the bulk density, dry density, and CBR value.

Atterberg limits (British Standard 1137 part 2) (British Standards Institution, 1990a)**.**

These tests helped to understand the performance of the soil when interacting with moisture. The tests highlighted the moisture content at which the soil transitions from a solid to a plastic state and the moisture content at which the soil transitions from a plastic to a liquid state. These greatly informed the performance of the soil when moisture is added to the soil.

The Atterberg limits tests shall be carried out in duplicates, and the averages calculated to get the final result. i.

Liquid limit

The test was carried out on a soil sample passing through the 425 μm sieve of weight about 400 g. The same sample was used to carry out the plastic limit test and linear shrinkage test.(British Standards Institution, 1990b)

The sample is then placed on a glass plate and water was added before mixing thoroughly with the spatulas until the sample became a thick and consistent paste. The sample was placed in an polyethene bag so as not to lose the water in it and allowed to sit for 16-24 hours to allow the water to penetrate and soak the sample.

Figure 3: shows washing of soil in preparation for atterberg limits determination

Test procedure

After soaking the sample, the sample was tested by adjusting the moisture content and penetrating the sample using a cone penetrometer

the range of penetrations between 14.0 mm – 26.0 mm were noted and the corresponding samples were taken to the oven to determine the moisture within through drying at 105ºC for one day.

Moisture content is then calculated.

A graph of moisture content against the penetration is then plotted and a line of best fit is drawn.

The liquid limit of the soil sample is determined from the graph by reading off the corresponding moisture content coinciding with the cone penetration cone penetration at 20mm. The value has to be expressed as a whole number.

Plastic limit and plasticity index

Part of the prepared sample was initially set aside to dry partially at room temperature. The sample set aside to dry was then used to carry out the plastic limit test.

Test procedure

The dried sample was rolled continuously and carefully into small thin cylindrical shape until breaking was observed.

The sections on the portions at which the breaking took place were then placed in oven so as to dry in order to determine their respective moisture contents.

The average of moisture content was calculated from all the portions of the samples taken and that

Plasticity index PI = Liquid Limit – Plastic Limit

Particle size distribution (British Standard 1377 part 2)

This test helped to determine whether the soil consists of predominately gravel, sand, or silt, and to an extent which of the size ranges was likely to control the engineering performance of the soil. The This test was carried out in duplicates, and the averages were calculated to get the final result.

Sample preparation

The sample was picked from the platform after sun drying for 12 to 16 hours and riffled to obtain a representative sample of a minimum mass of about 10 kg.

The sample weight was also noted down as the dry mass of the soil.

A representative sample was also picked for moisture content.

Apparatus required

- Test sieves: 37 mm, 20 mm, 14 mm, 10 mm, 5 mm, 3.35 mm, 1.18 mm, 600 μm, 300 μm, 75 μm. 39

• Drying oven

• Riffle boxes

• Sieve brushes

Calculations done

✓ Calculating the cumulative mass retained

✓ Calculating the percentage mass retained

✓ Calculating the percentage of passing

✓ Plotting a graph of the grading sieve size against %passing.

✓ Grading modulus was then calculated from the standard formular

3.4 TEST PLAN

Table 1: showing the test plan

LATERITE SOIL (%)	CKD (%)	QUARRY DUST (%)
80	0	20
70	0	30
60	0	40
70	10	20
70	15	15
70	20	10

This was taken with important consideration of the grading modulus of the soil, the CBR and the PI which will require special blend conditions of stabilization to achieve all the required objectives.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter talks about all the outcomes observed from the tests carried out according to the above methodology as well as the relevant analysis about how the soil properties were affected from the addition of the CKD and quarry dust.

4.2 Neat soil

The properties for the neat soil correspond to the first objective and the results are summarized in the table bellow with comparison to the standards according to MoWT. Indication has been shown where the soil doesn't meet the required standards in red.

Table 2: showing the properties of the neat laterite soil

Property	Neat soil	Standard for MoWT general specifications for road works
Liquid limit	44.6	Maximum 40
Plastic limit	24.5	
Plasticity index	20.0	Maximum 14
Linear shrinkage	10.0	Maximum 7
Maximum dry density	2.078	
OMC	14.9	
CBR	27	Minimum 45
CBR swell	0.54	Maximum 0.5
Grading modulus	1.50	Minimum 1.5

4.2.1 Sieve Analysis

This is an important aspect always considered in order to understand the physical properties of the soil especially the particle sizes of the soil particles and how they are distributed.

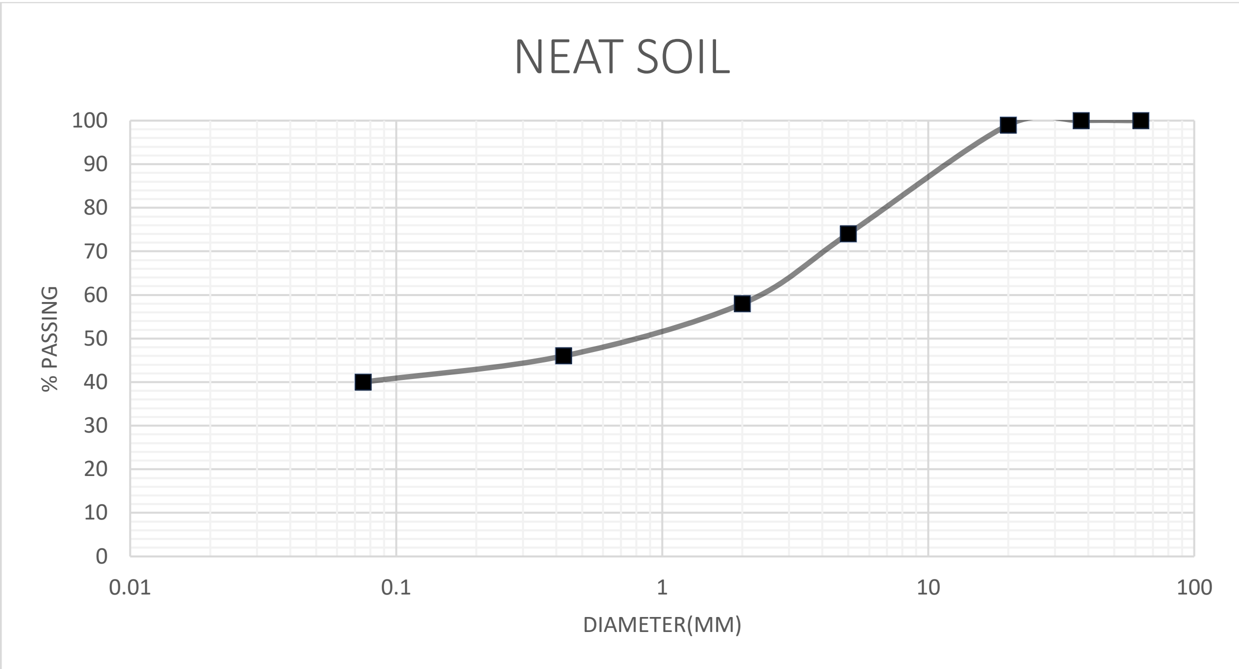


Figure 4: Particle size distribution of neat soil

The soil had a grading modulus of 1.5 which is just passing the minimum standard according to the MoWT general specifications for road and bridge works 2005 meaning that it was on the finer side of the GM.

From the graph above we observe that the percentage passing sieve of No 200 is 40%, sieve No.40 is 46% and sieve No.10 is 58%. The liquid limit of the soil was found to be 44.6%, the Plastic Limit was 24.5% while the PI is 20.0%.

Analyzing the data received from the tests of the soil, the classification of the soil according to AASHTO is that the soil is A-7-5 classification which is clayey soil

4.2.2 California bearing ratio(CBR)

CBR is a penetration test used to determine the strength of soil in comparison to crushed stone (ASTM D1883, 2016).

This was carried out to evaluate the load bearing strength of soil as subbase material. The CBR value of the soil was 27% as achieved by the one point method of determining CBR.

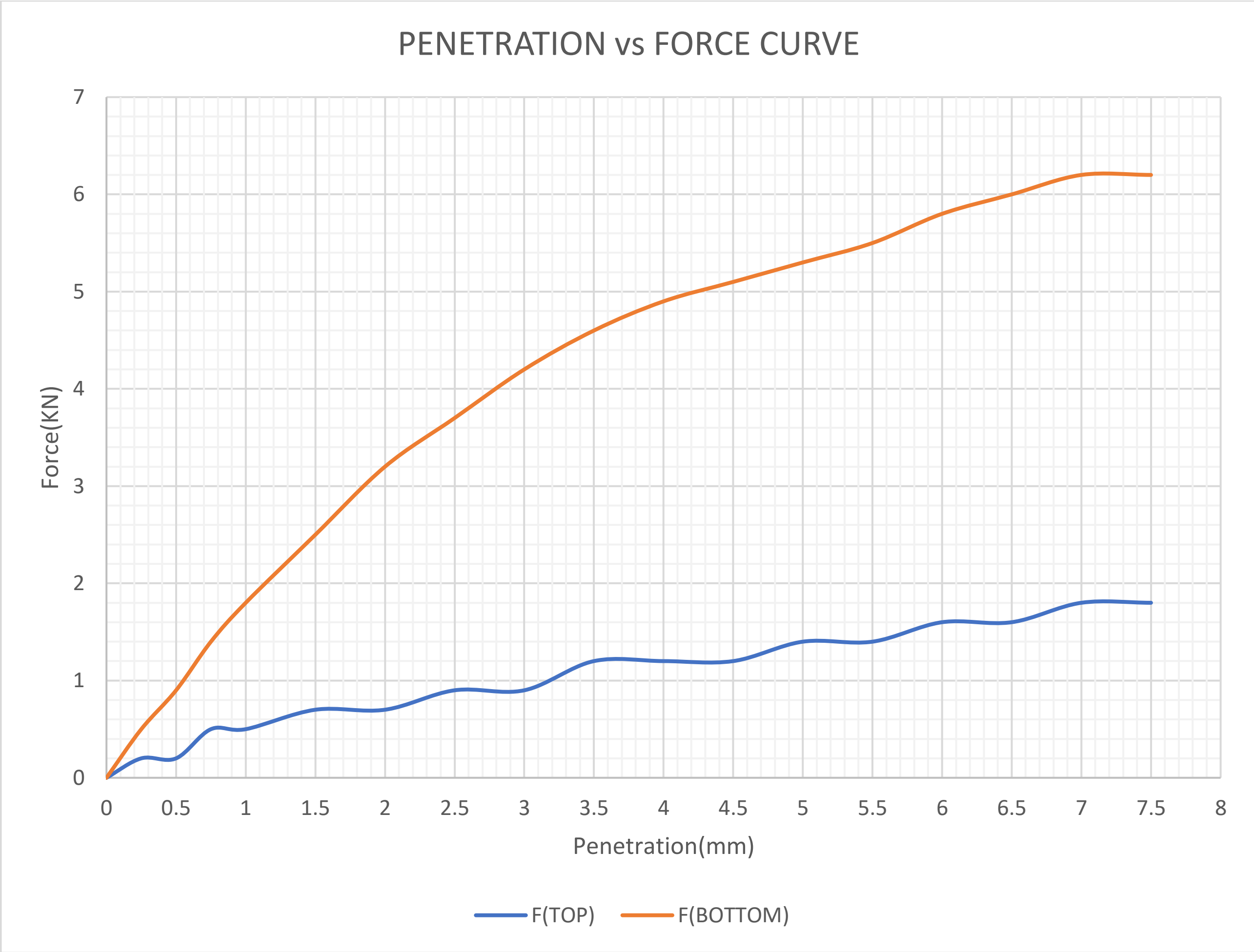


Figure 5: Force vs Penetration curve of neat soil

the CBR done on the soil sample came out with a value of 27 after 62 blows of compaction which is not up to the standard of a subbase G45 material as required by the MoWT general specifications. This shows that the soil has poor load-bearing capacity hence making it unsuitable to support traffic loads unless improved.

High CBR swell

The neat laterite soil was found to have a high **CBR swell value of 0.54%**, just above the recommended maximum of **0.5%**. This shows that the soil shall

shall undergo volume changes when wet which can pavement deformation over time.

Although only slightly above the limit, it is a concern for long-term durability as the soil in turn will lose the original compressive strength leading to damage to the road for example pot holes.

4.2.3 Proctor compaction test

This is a soil test done to determine the MDD of soil and the OMC. They are important coil parameters because it lets us know how much water has to be mixed with the soil before any compacting is done as well as to understand the how much the soil is compacted at any given state.

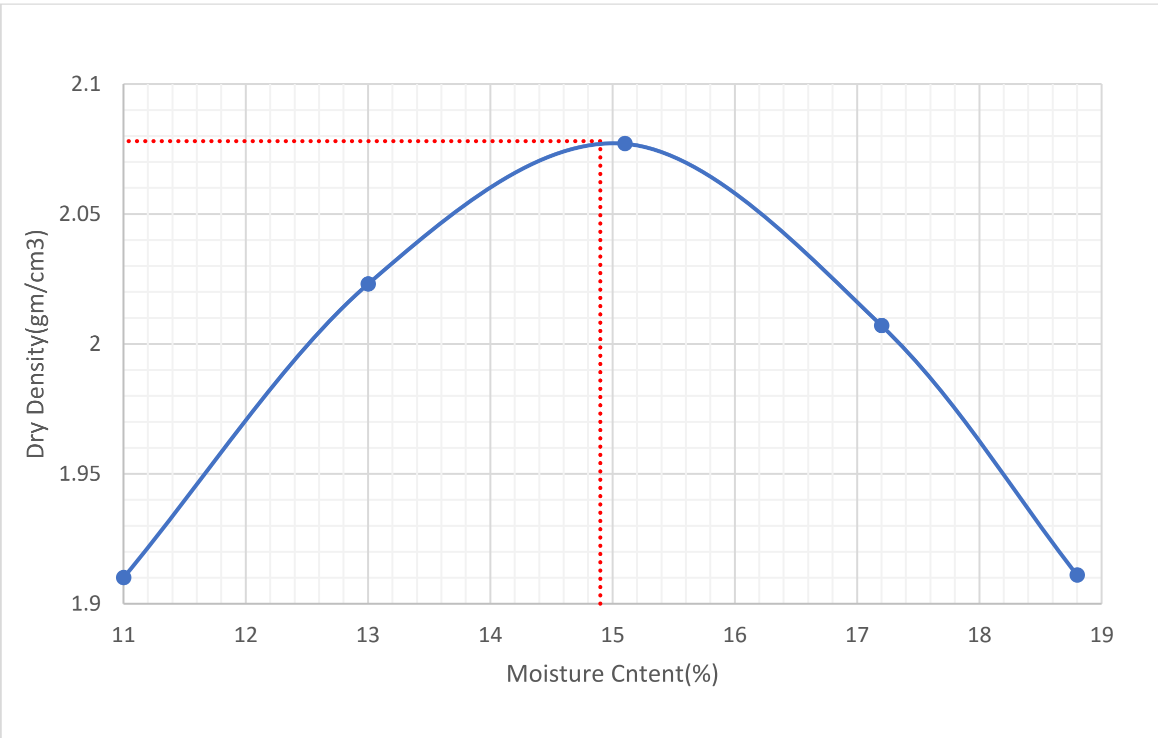


Figure 6: A graph showing Dry Density against Moisture Content of the neat soil

the MDD of the soil sample was found to be at 2.078gm/cm3 and the Optimum moisture content of the soil was 14.9%.

4.2.4 Atterberg limits

These are measures to determine the critical water contents of fine-grained soils with silt and clay content as they have characteristics of plasticity as they transition from solid to liquid. The summery of the Atterberg limits was as shown below.

Table 3: showing the atterberg limits of the soil

Liquid limit	44.6
Plastic limit	24.5
Linear shrinkage	10.0
Plasticity index	20.0

The Liquid Limit (44.6%), Plasticity Index (20.0%), and Linear Shrinkage (10.0%) were found to exceed the allowable limits according to the general specifications of MoWT. This shows that the soil is highly plastic, cohesive, and is prone to swelling when exposed to water over a long period of time, and shrinkage when ths soil is dried. This can eventually lead to pavement cracking and loss of soil strength in case of continuous water absorption and drying. Therefore the properties of this soil required improvement before being used as a subbase material.

Conclusion

From the results acquired by doing the tests for the first objective, the material does not meet the complete standards and parameters set by the MoWT general specifications for a G45 granular subbase material. Therefore, it is important to stabilize the material to match up to the standards required of a G45 material.

4.3 Quarry dust.

The tests carried out on the quarry dust include particle size distribution, specific gravity and bulk density.

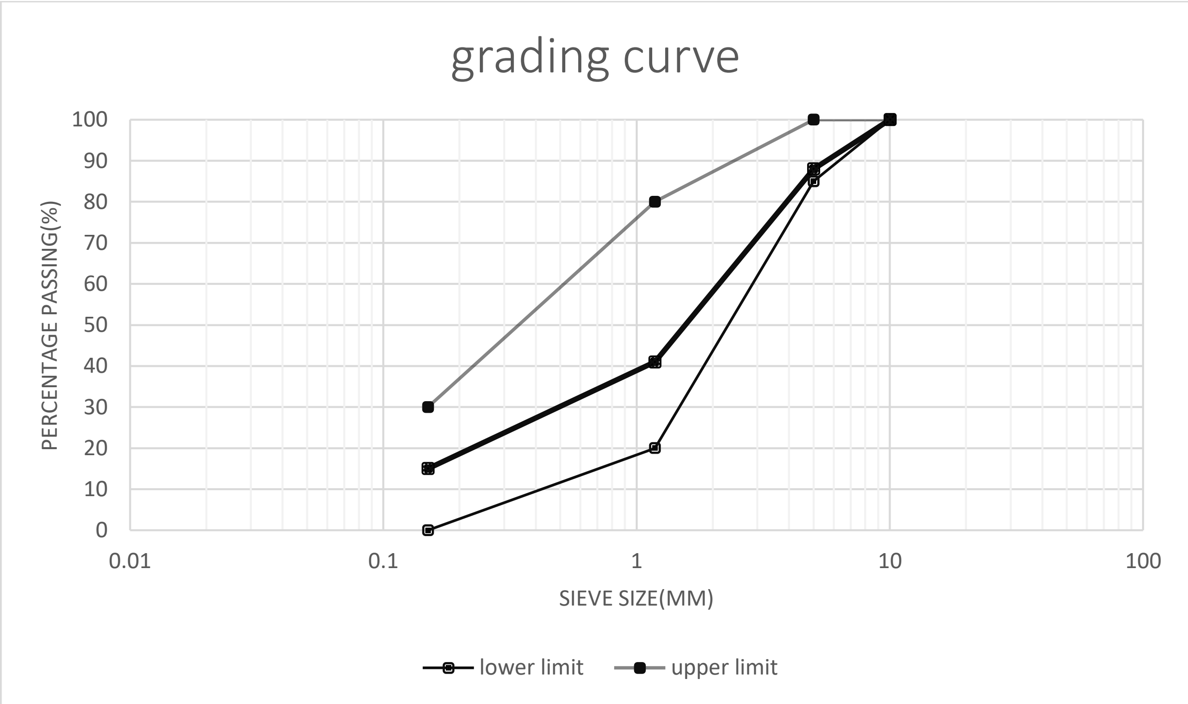


Figure 7: A graph showing particle size distribution of quarry dust

the quarry dust used was of the standard of 0-5mm particle size and had a steep grading curve indicating that it had alot of fine particles but with course particles mixed within. This is important in improving the grading modulus of the soil sample so that even with the addition of the CKD, which is a fine chemical compound, the grading modulus does not fall below the required standards of 1.50.

below is s summery of the average properties of the quarry dust used.

Table 4: showing the physical properties of the quarry dust

Bulk specific gravity	2.650
Bulk specific gravity on saturated dry basis	2.656
Aparent specific gravity	2.667
Water absoprtion	0.3

Conclusion

From the properties of the quarry dust obtained from the tests done on it. It was determined that it would have enough capability to effectively educe the plasticity index of the laterite soil as well as increase the grading modulus to counter the effect of the CKD reducing it.

4.4 Combined effect of quarry dust with cement kiln dust on the soil.

This section shows how the different parameters of the soil were affected after by addition of both quarry dust and cement kiln dust in the different mix proportions .

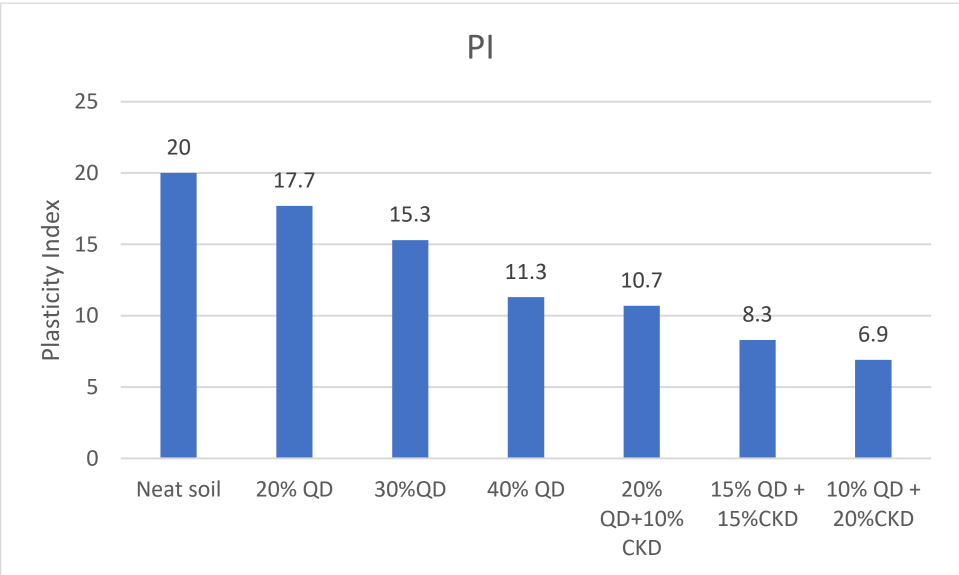


Figure 8:Plasticity index of soil at varying compositions of CKD and quarry dust

The plasticity index is seen to initially be high for the soil above the required standard of 14 according to the MoWT general specifications for roads and bridge works.

As the quarry dust was added to the soil the plasticity index is observed to reduce meaning that the soil becomes less plastic and retains less water.

When the quarry dust percentage in the blend is replaced with CKD the plasticity index is observed to reduce even more than it was for the quarry dust. This shows that CKD is a more effective stabilizer for the reduction of PI. The PI was lowest at the 10% quarry dust and 20% cement kiln dust but the grading reduced more than the required stands hence this was not considered as a perfect blend.

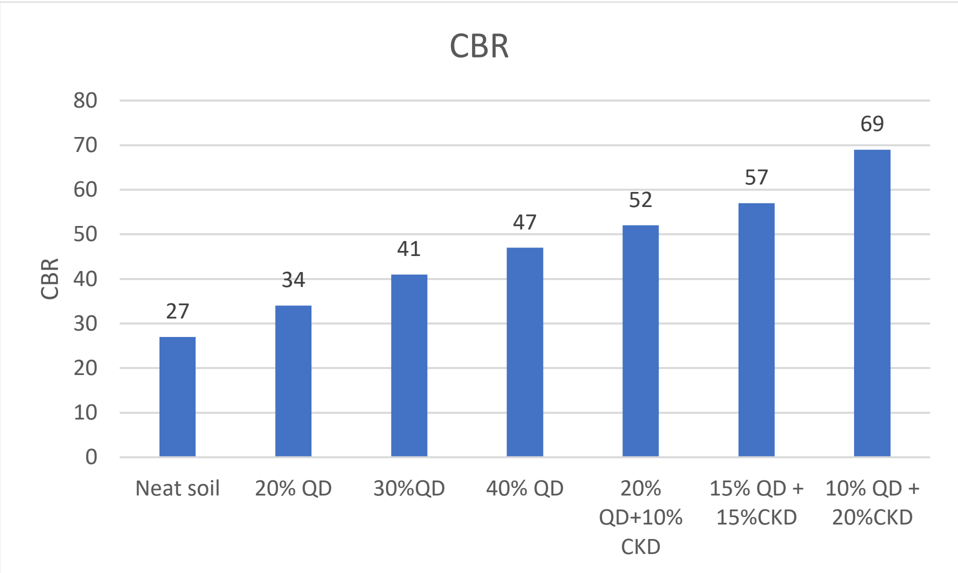


Figure 9: CBR of soil with different compositions of CKD and quarry dust

The CBR is observed to generally be raising with the addition of the quarry dust with increasing percentages. Even with the addition of CKD replacing Quarry dust percentage in the mix, the CBR is observed to increase to even higher threshold without necessarily reducing the soil percentage in the mix. It is important to keep the soil of good proportion in the mix due to availability and viability comparisons between the soil and the materials being used. Due to this it was discussed to take the soil proportion constant of 70% since the plasticity index was in the acceptable range at that proportion.

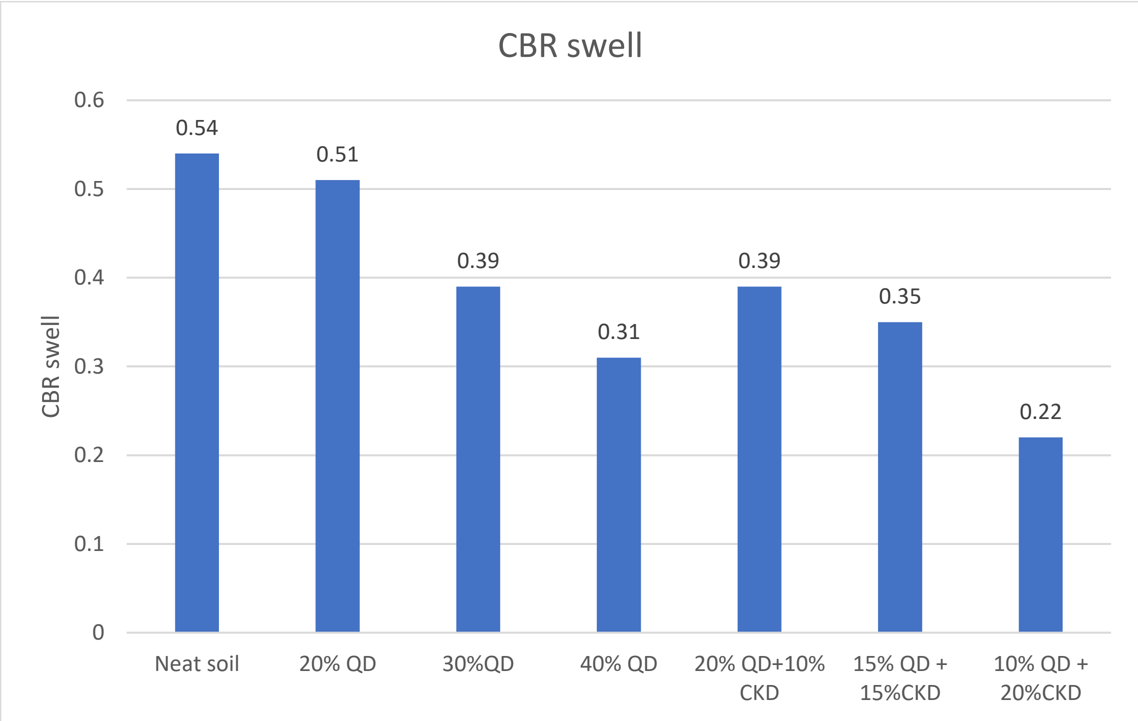


Figure 10: CBR swell of soil with different compositions of CKD and quarry dust

The CBR swell of the laterite soil is seen to reduce as quarry dust is added to the blend. This is due to the replacement of the clayey soils which are plastic in nature and absorb much more water with the non-plastic quarry dust that doesn't expand significantly in comparison when it absorbs water (Dixit et al., 2016).

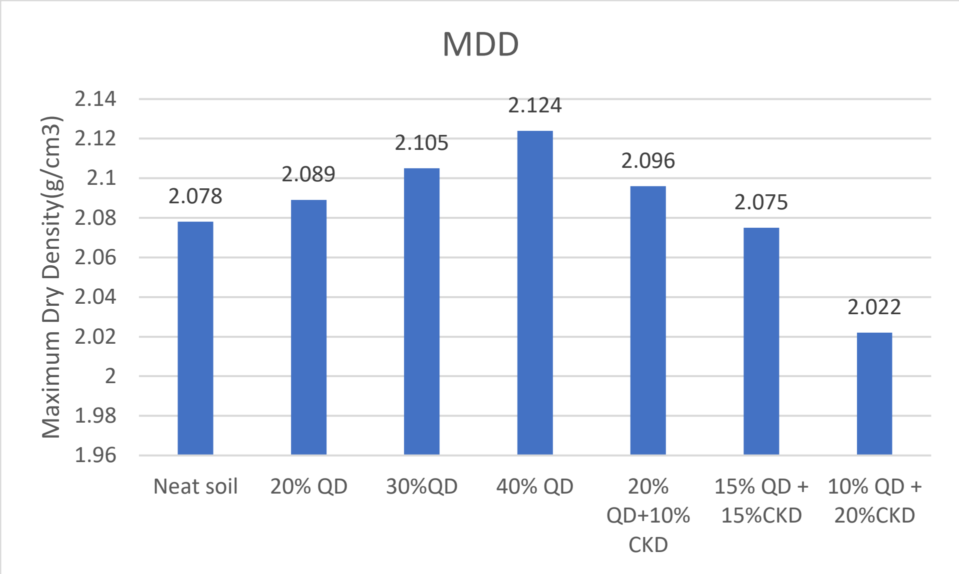


Figure 11: Maximum dry density of soil with different compositions of CKD and quarry dust

The Figure above shows the variation in the maximum dry density of the soil for different amounts of quarry dust and CKD added. Increasing the amount of quarry dust led to a general increase in the maximum dry density of the soil from the initial 2.078g/cm3 to 2.124g/cm3 at the 40% quarry dust blend. This was due the quarry dust having course grained particles as compared to the relatively finer soil. As CKD replaced the proportion of the quarry dust in the soil, the MDD started to see a decrease. This was due to the fact that the CKD is a chemical stabilizer and thus has fine particles(Oni, O. & Oladipupo, 2018)

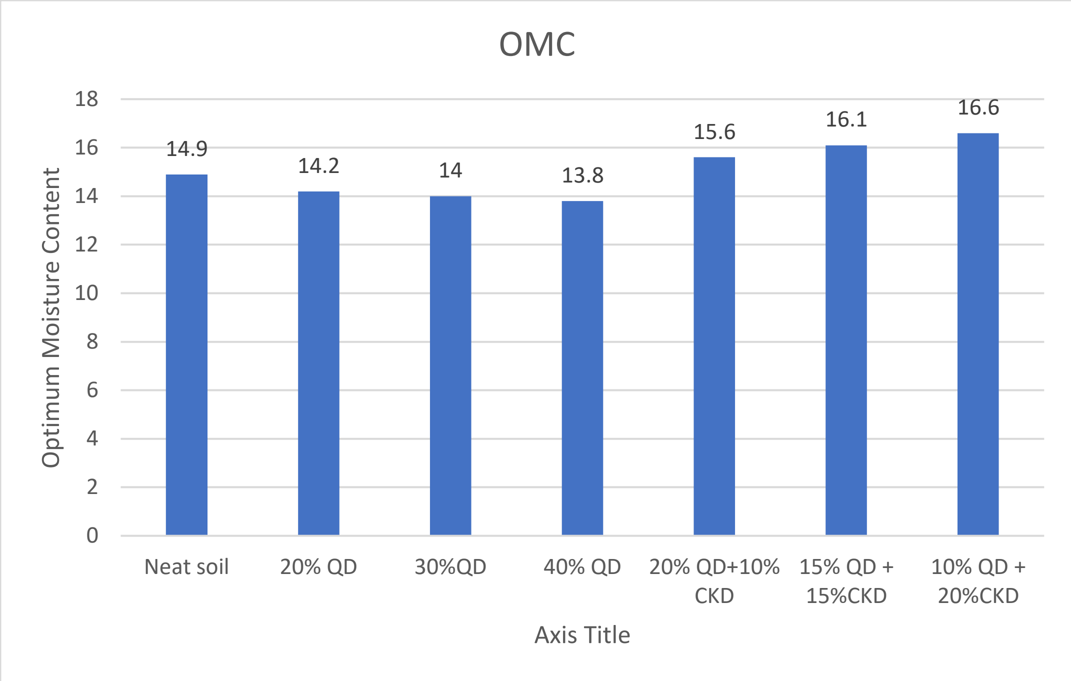


Figure 12: Optimum moisture content of soil with different compositions of CKD and quarry dust

The Figure above shows the variation in Optimum Moisture Content of the sample for different amounts of CKD and quarry dust added. Increasing the amount of quarry dust to the soil used led to a general decrease in the OMC of the soil.

This is because as quarry dust, a non-plastic material is added, the percentage of the clay particles in the material blend reduces. (Chetia et al., 2018). A reduction in the percentage of clay materials means that less water is required for a sample to reach its maximum dry density since quarry dusts water absorption is less than that of the clayey soil particles.

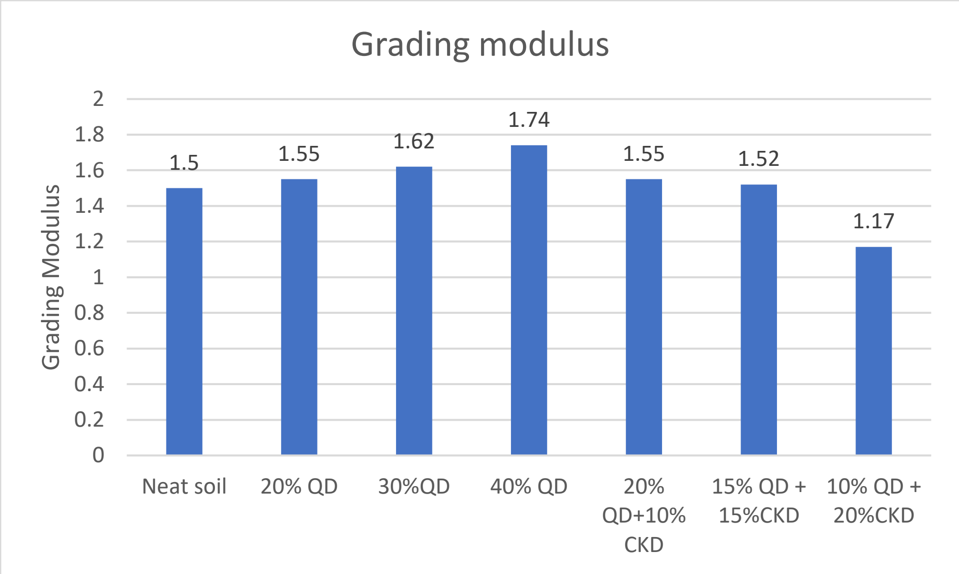


Figure 13: Grading modulus of soil with different compositions CKD and quarry dust

The grading modulus is the relationship between the percentage of fines to the percentage of coarse material within a particular sample. The finer a material, the lower the grading/fineness modulus of the sample, and the reverse is true (Chandran, 2023).

the grading modulus of the material generally increased with an increase in quarry dust percentage. This is due to the fact that it was more course grained as compared to the fine laterite soil.

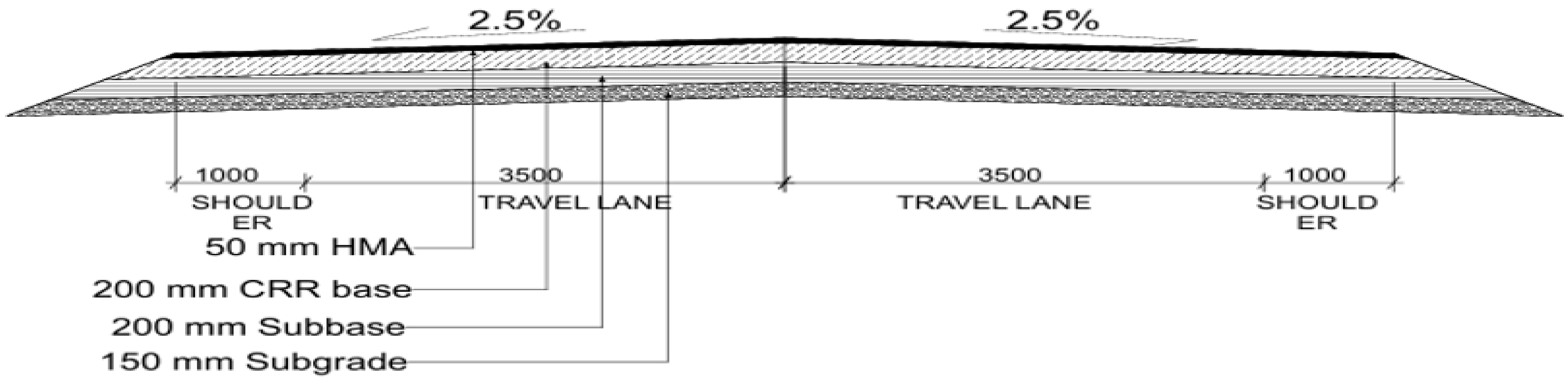
In conclusion, the only blend that didn't meet the standards of the grading index is the one with 20% CKD and 10% quarry dust.

4.5 The best selected blend

From the test results above, the material blend of 15% quarry dust, 15% Cement kiln dust and 70% laterite soil gave the most satisfactory results based on its engineering properties and economic implication. This met all the standards for the MoWT general specifications for road and bridge works. Below is a summery of the improvements done on the soil blended according to the best blend.

Table 5: showing the comparison of properties between neat soil and best blend

Property	Neat soil	Stabilized soil with 15%CKD and 15% QD	Standard for MoWT general specifications for road works
Liquid limit	44.6	30.4	Maximum 40
Plastic limit	24.5	21.5	
Plasticity index	20.0	8.9	Maximum 14
Linear shrinkage	10.0	4.3	Maximum 7
Maximum dry density	2.078	2.075	
OMC	14.9	16.1	
CBR	27	57	Minimum 45
CBR swell	0.54	0.35	Maximum 0.5
Grading modulus	1.50	1.52	Minimum 1.5



ROAD CROSS SECTION	
TITLE	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS
NAME	WEERE JONATHAN
REG NO.	M22B32/035
SCALE	1:50

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion.

The following conclusions were drawn from the tests carried out and observations made during the course of carrying out the project activities.

- From the first objective, the tests done enabled findings that the soil was of classification A-7-5 according to the AASHTO classification system which is fine grained, clayey soil with high plasticity and poor baring capacity. It was therefore very necessary to increase the bearing capacity of the soil as well as to reduce the plasticity index before it could be used as a subbase G45 material.
- From the second objective, the tests done on the quarry dust show that it had a better grading modulus than the soil hence it was important in balancing out the reduction of the grading modulus done by the cement kiln dust since it is a chemical stabilizer with very fine particles.
- From the tests done for the third objective, the CKD and Quarry dust increased the CBR as they were added to the soil sample but the mix with the highest CBR turned out to have a lower grading index than the required standards of the MoWT general specifications for road and bridge construction hence it was discarded from consideration leaving the mix with 15% CKD and 15% Quarry dust as the best proportion.

  The overall findings from the research carried out shows that the CKD and quarry dust successfully achieved all the required parameters that the soil needed to be a G45 material by which the CBR was increased from 27% to 57%, the plasticity index was reduced from 20% to 8.6%, the CBR swell was reduced from 1.54 to 0.35 and the grading modulus was increased from 1.50 to 1.52.

- This research also put emphasis on the importance of sustainable construction practices that utilize industrial waste materials for example Cement Kiln Dust, which in turn contributes to environmental conservation and resource efficiency.

5.2 Recommendations

- Quarry dust that's ground into much smaller particle size can also be used interchangeably with course grained quarry dust since the finer the quarry dust the more active its pozzolanic properties and hence can improve the CBR of the soil much more than when its course grained. The course grained particles are good for reducing the plasticity index of the soil and improving the grading modulus of the soil.
- Cement kiln dust as a stabilizer should be used better on more relatively course grained soils since it reduces the grading modulus below the standards if applied to soil with a grading modulus almost near the lower acceptable limit of a G45 material

References

Sudla, P., Horpibulsuk, S., Chinkulkijniwat, A., Arulrajah, A., Liu, M. D., & Hoy, M. (2018). Marginal lateritic soil/crushed slag blends as an engineering fill material. Soils and Foundations, https://doi.org/10.1016/j.sandf.2018.03.007 58(3), 786–795.

Aboudi Mana, S., Hanafiah, M. & Chowdhury, A., 2017. Environmental characteristics of clay and clay-based minerals. GeoloGy, ecoloGy, and landscapes, pp. 155 - 161.

Dunuweera, S.P. and Rajapakse, R.M.G. (2018) 'Cement Types, Composition, 44 Uses and Advantages of Nanocement, Environmental Impact on Cement Production, and Possible Solutions', Advances in Materials Science and Engineering. Hindawi Limited. https://doi.org/10.1155/2018/4158682. Available at:

Matjie, R. H., Bunt, J. R., & Van Heerden, J. H. P. (2005). Extraction of alumina from coal fly ash generated from a selected low rank bituminous South African coal. *Minerals Engineering*, *18*(3), 299-310.

Alhassani, A.M.J., Kadhim, S.M. and Fattah, A.A. (2021). Stabilization of Clayey Soil Using Cement Kiln Dust as Sustainable Material. IOP Conference Series: Earth and Environmental Science.

Adams, T. (2014). Global Road Technology. [online] GRT. Available at: https://globalroadtechnology.com/3-types-of-soil-stabilization techniques/.

ASTM D1883-16. *Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.* ASTM International, West Conshohocken, PA, 2016.

Adams, T. (2014). types of soil stabilization techniques. *Global Road Technology (GRT)*. https://globalroadtechnology.com/3-types-of-soil-stabilization techniques/.

Ahereza, G. (2025). Investigating the effectiveness of Cement Kiln Dust as an expansive soil stabilizer in road construction. *International Journal of Research and Innovation in Social Science (IJRISS)*, *9(1)*, *1401*, 1401–1412. https://doi.org/10.47772/IJRISS.2025.9010117

Amu, O. O., & Adetuberu, A. A. (2010). Characteristics of bamboo leaf ash stabilization on lateritic soil in highway construction. *International Journal of Engineering and Technology*, *2*, 212–219.

Archibong, G. A., Sunday, E. U., Akudike, J. C., Okeke, O. C., & Amadi, C. (2020). A Review of the Principles and Methods of Soil Stabilization. *International Journal of Advanced Academic Research*, *6*(3), 89–115. https://www.ijaar.org/articles/v6n3/ste/ijaar-ste-v6n3-mar20-p14.pdf

ASTM International. (2021). *Standard test methods for laboratory compaction characteristics of soil using standard effort (ASTM D698/D698M)*.

British Standards Institution. (1990a). *Methods of test for soils for civil engineering purposes -- Part 2: Classification tests*.

British Standards Institution. (1990b). *Methods of test for soils for civil enginnering purposes*.

Ingles, O. G., & Metcalf, J. B. (1972). Soil stabilization: Principles and practice. *Butterworths*.

Nansereko, F. (2019). Causes and Consequences of Traffic Flow in Kampala Capital City.

Doctoral Dissertation, Uganda Management Institute.

Oni, O., &, & Oladipupo, S. (2018). *Effect of cement kiln dust on the geotechnical properties of clay in Ede, South-western Nigeria.*

Razali, R., Rashid, A. S. A., Che Lat, D., Horpibulsuk, S., Roshan, M. J., Rahman, N. S. A., & Ahmad Rizal, N. H. (2023). Shear strength and durability against wetting and drying cycles of lime-stabilised laterite soil as subgrade. *Physics and Chemistry of the Earth*, *132*, 103479. https://doi.org/10.1016/j.pce.2023.103479

APPENDIX

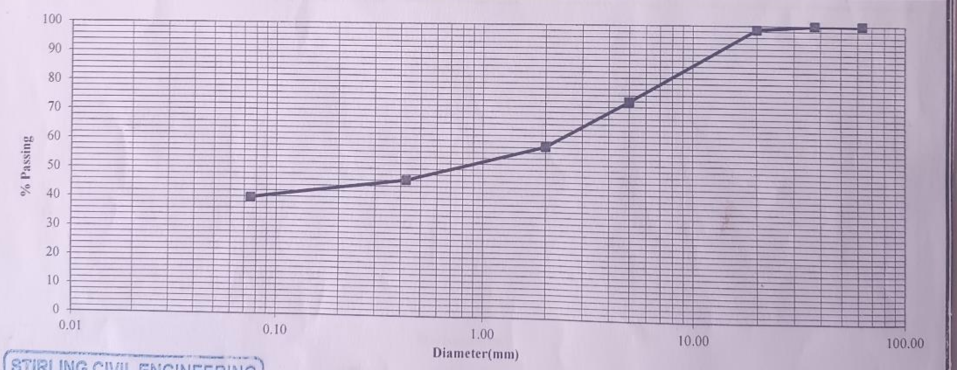
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	NTAWO BPIT	Dry wt. of sample before washing: (g)		6256.3
Depth: (m)		Dry wt. of sample after washing: (g)		3786.3
Material description:	NEAT	Date Sampled:	Date Tested:	Technician
		18/Sep/2025	19/Sep/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	100	100	100
37.5	0.0	0.0	100	80	100
20.0	84.5	1.4	99	60	95
5.0	1553.2	24.8	74	30	65
2.00	972.1	15.5	58	20	50
0.425	758.5	12.1	46	10	30
0.075	404.2	6.5	40	5	15
Total fines	2483.8	39.7			
Bottom Pan	13.8				
Extracted fines	2470.0				
Total sample	6256.3				
Grading Modulus		1.56			



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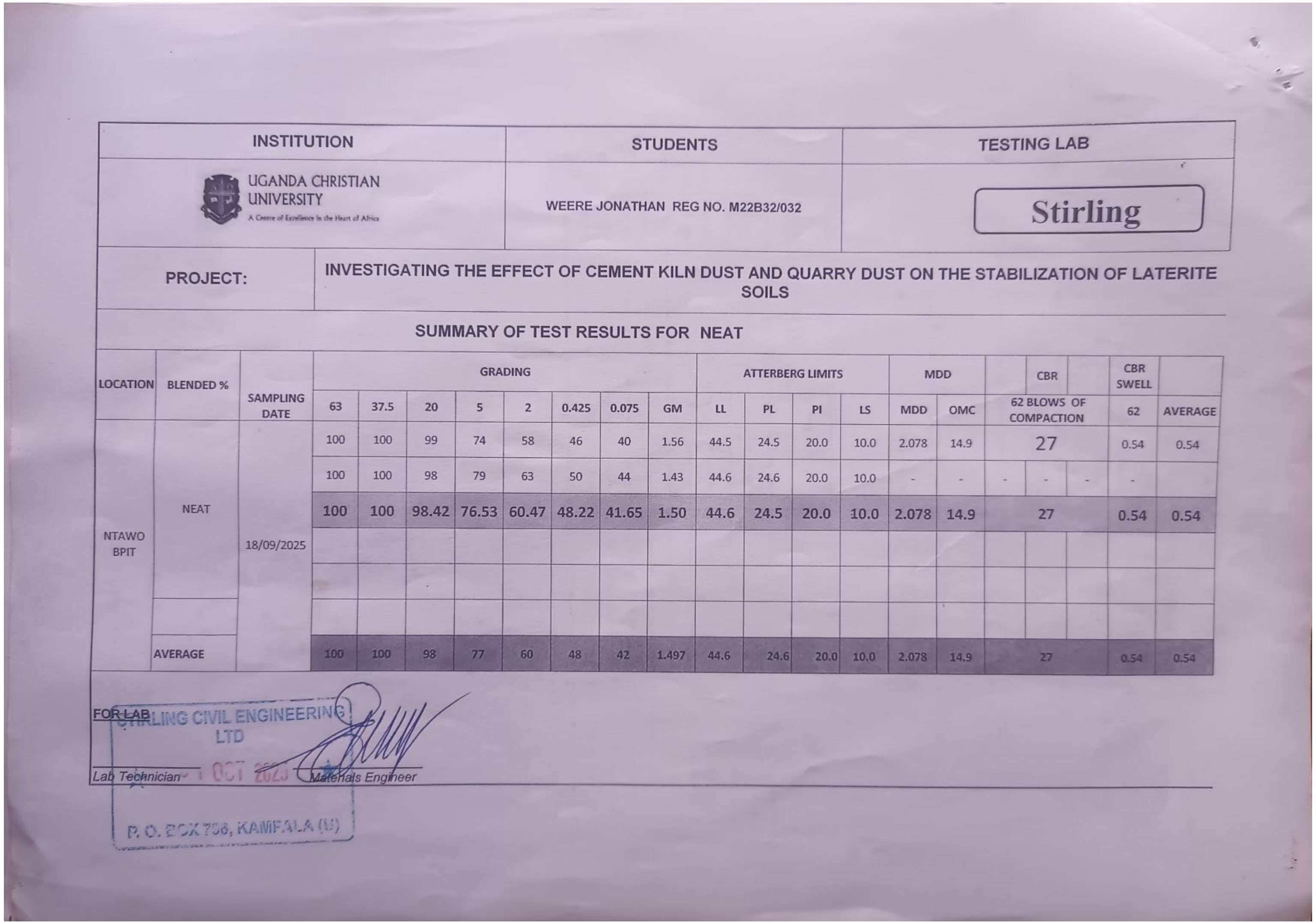
FOR TESTING LAB
01 OCT 2025
Lab Technician
Materials Engineer
P. O. BOX 738, KAMPALA (U)



INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR NEAT

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
NTAWO BPIT	NEAT	18/09/2025	100	100	99	74	58	46	40	1.56	44.5	24.5	20.0	10.0	2.078	14.9	27	0.54	0.54
			100	100	98	79	63	50	44	1.43	44.6	24.6	20.0	10.0	-	-	- - -	-	
			100	100	98.42	76.53	60.47	48.22	41.65	1.50	44.6	24.5	20.0	10.0	2.078	14.9	27	0.54	0.54
	AVERAGE		100	100	98	77	60	48	42	1.497	44.6	24.6	20.0	10.0	2.078	14.9	27	0.54	0.54

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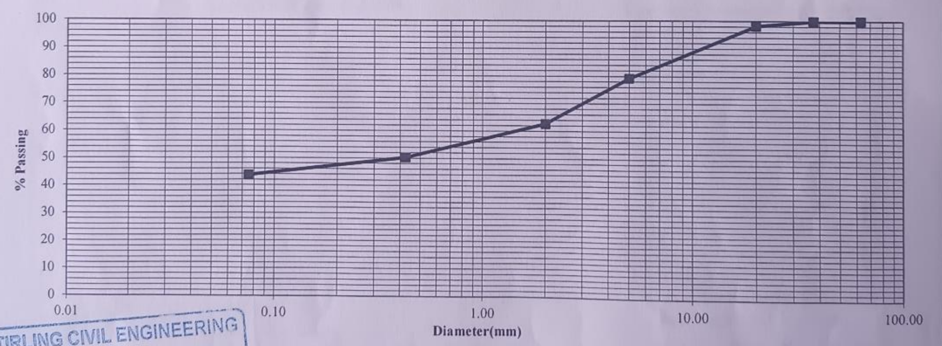
PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	NTAWO BPIT	Dry wt. of sample before washing: (g)		4869.3
Depth: (m)		Dry wt. of sample after washing: (g)		2758.7
Material description:	NEAT	Date Sampled:	Date Tested:	Technician
		18/Sep/2025	19/Sep/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	88.5	1.8	**98**	60	95
5.0	922.4	18.9	**79**	30	65
2.00	807.8	16.6	**63**	20	50
0.425	602.5	12.4	**50**	10	30
0.075	325.0	6.7	**44**	5	15
Total fines	2123.1	43.6			
Bottom Pan	12.5				
Extracted fines	2110.6				
Total sample	4869.3				
Grading Modulus		**1.43**			



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Lab Technician

Materials Engineer

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PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

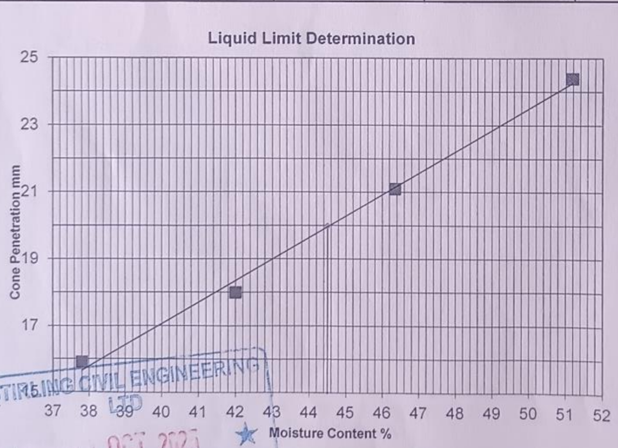
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	NEAT	Technician:	Lab Team
mix	NTAWO BPIT	Sample Date	18/Sep/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	22/Sep/2025
LAYER	NEAT		
Depth:			

PLASTIC LIMIT	Test No.	Q	JL		Average
Mass of wet soil + container (g)		29.37	32.2		30.785
Mass of dry soil + container (g)		27.86	30.3		29.08
Mass of container (g)		21.69	22.53		22.11
Mass of moisture (g)		1.51	1.9		1.705
Mass of dry soil (g)		6.17	7.77		6.97
Moisture content %		24.5	24.5		24.5
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.9	18	21.1	24.4
penetration (mm)		15.9	18.0	21.1	24.4
AVERAGE		15.9	18.0	21.1	24.4
Container No.		PI82	A3	A7	ME
Mass of wet soil + container (g)		40.99	51.77	52.75	55.52
Mass of dry soil + container (g)		31.69	38.51	39.00	39.11
Mass of container (g)		7.09	6.94	9.33	7.05
Mass of moisture (g)		9.3	13.26	13.75	16.41
Mass of dry soil (g)		24.6	31.57	29.67	32.06
Moisture content (%)		37.8	42.0	46.3	51.2
AVERAGE		37.8	42.0	46.3	51.2



Liquid limit (%)	44.5
Plastic limit (%)	24.5
Plasticity Index (%)	20.0
Linear shrinkage	
Trough No.	J
Trough length (cm)	14.0
Specimen length (cm)	12.6
L.shringage =	1.4
% L.shrinkage =	10.0

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Lab Technician		____________

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PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

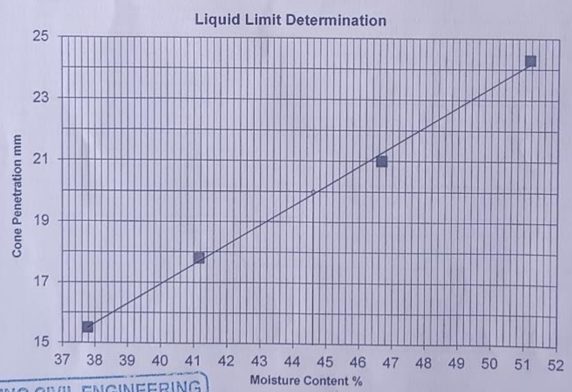
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	NEAT	Technician:	Lab Team
mix	NTAWO BPIT	Sample Date	18/Sep/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	22/Sep/2025
LAYER	NEAT		
Depth:	0		

PLASTIC LIMIT	Test No.	BA	4L		Average
Mass of wet soil + container (g)		34.02	36.46		35.24
Mass of dry soil + container (g)		31.86	33.68		32.77
Mass of container (g)		23.12	22.32		22.72
Mass of moisture (g)		2.16	2.8		2.47
Mass of dry soil (g)		8.74	11.36		10.05
Moisture content %		24.7	24.5		24.6
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.5	17.8	21	24.3
penetration (mm)		15.5	17.8	21.0	24.3
AVERAGE		15.5	17.8	21.0	24.3
Container No.		A6	PA	PI52	P112
Mass of wet soil + container (g)		50.57	51.36	43.68	44.69
Mass of dry soil + container (g)		38.55	38.43	32.04	31.89
Mass of container (g)		6.73	7.01	7.10	6.86
Mass of moisture (g)		12.02	12.93	11.64	12.8
Mass of dry soil (g)		31.82	31.42	24.94	25.03
Moisture content (%)		37.8	41.2	46.7	51.1
AVERAGE		37.8	41.2	46.7	51.1



Liquid limit (%)	44.6
Plastic limit (%)	24.6
Plasticity Index (%)	20.0
Linear shrinkage	
Trough No.	J
Trough length (cm)	14.0
Specimen length (cm)	12.6
L.shringage =	1.4
% L.shrinkage =	10.0

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Materials Engineer.

P.O. BOX 796, KAMPALA (U)

Lab Technician

STUDENTS

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PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS			
Test Reference No.	Lab. Reference No.	Date Sampled	Date Tested	Technician
LOCATION	NTAWO BPIT	18/Sep/25	19/Sep/25	Lab team
Material description:	NEAT	Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

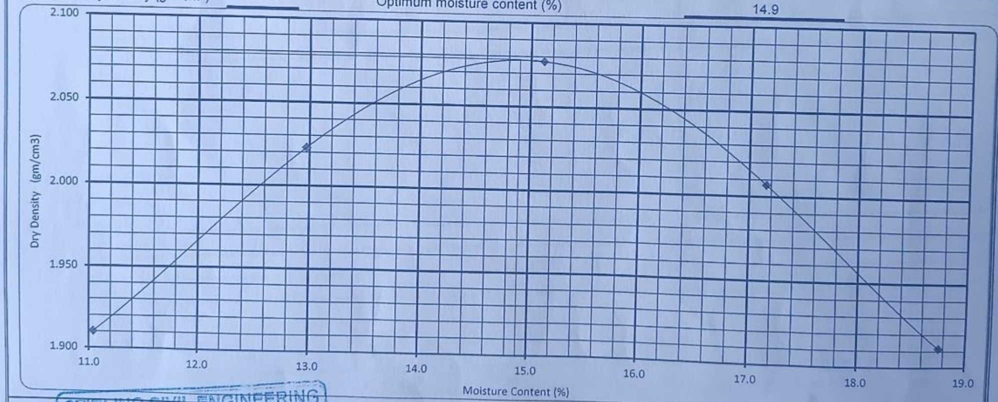
MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	120	180	240	300	360
Mass of Compacted soil + mould	gm	5,426	5,590	5,696	5,656	5,575
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	2121	2285	2391	2351	2270
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	2.121	2.285	2.391	2.351	2.270

DATA FOR PROCTOR CURVE

Container No.		EX	HM	EVE	ODD	DT
Mass of wet soil + Container	gm	1,956.0	2,067.0	2,758.0	1,943.0	1,751.0
Mass of dry soil + container	gm	1,815.0	1,892.0	2,496.0	1,739.0	1,561.0
Mass of container	gm	538.0	543.0	763.0	550.0	548.0
Mass of water added	gm	141	175	262	204	190
Mass of dry soil	gm	1277	1349	1733	1189	1013
Moisture content	%	11.0	13.0	15.1	17.2	18.8
Dry density	g/cm^3	1.910	2.023	2.077	2.007	1.911

Maximum dry density (gm/cm^3) 2.078 Optimum moisture content (%) 14.9



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Lab Technician Materials Engineer

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	18/Sep/25
Location:	NTAWO BPIT	Casting date :	22/Sep/25
		Testing Date :	29/Sep/25
		Technician :	: Lab team
Sample Description:	NEAT	**Volume of Mould used (m^3)**	**2305**

Natural moisture of air dried sample			Volume of water added	
Tin No.	Y2Y		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	2436		MDD (Mg/m^3)	2.078
Tin + oven dry soil sample (g)	2301		N.M.C (%)	9.1
Tin (g)	823		OMC (%)	14.9
Dry soil sample	1478		Added OMC (%)	5.8
Water (g)	135		Calculated dry wt of soil (g)	5452.0
N.M.C (%)	9.1		Water added (g)	**317**
Average (%)	9.1		**Water added (mL)**	**317**

Number of blows		62			
Number of layer		5			
Water Content Determination		Before Soaking		After Soaking	
Tare No		EVE	-	DEO	-
Mass of wet sample + Tare	g	2256	-	1968	-
Mass of dry sample + Tare	g	2059	-	1702	-
Mass of Tare	g	763	-	155	-
Mass of water	g	197	-	266	-
Mass of dry sample	g	1296	-	1547	-
Water content	%	15.2	-	17.2	-
Average water Content	%	15.2		17.2	
Density determination					
Mould No		3			
Mass of mould + soil	g	10775		10879	
Mass of mould	g	5551		5551	
Mass of soil	g	5224		5328	
Volume of the mould	cm3	2305		2305	
Moist density	g/cm3	2.266		2.312	
Dry density	g/cm3	1.967		1.972	
Swell Determination					
Date		Hour		D.Gauge Reding	
Initial reading		96 hrs		8.56	
Final reading				9.25	
Height of the specimen				127	
Height of swell				0.69	
		Swelling(%)		**0.54**	

Observations

For the Lab

Lab. Technician | Materials Engineer

STIRLING CIVIL ENGINEERING LTD
OCT 2025
P.O. BOX 786, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date	18/Sep/25
Location:		Penetration Date	29/Sep/25
Depth :		Technician	: : Lab team
Sample Description :	: NEAT		

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	3		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312

Speed :... ... ...mm/min.		Top		Bottom									
Penetration of the plunger (mm)	Time (s)	Reading *10³mm	Force (KN)	Reading *10³mm	Force (KN)								
0	**0**	0	0.0	0	0.0								
0.25	**12**	1	0.2	2	0.5								
0.5	**24**	1	0.2	4	0.9								
0.75	**35**	2	0.5	6	1.4								
1	**47**	2	0.5	8	1.8								
1.5	**71**	3	0.7	11	2.5								
2	**94**	3	0.7	14	3.2								
2.5	**118**	4	0.9	16	3.7								
3	**142**	4	0.9	18	4.2								
3.5	**165**	5	1.2	20	4.6								
4	**189**	5	1.2	21	4.9								
4.5	**213**	5	1.2	22	5.1								
5	**236**	6	1.4	23	5.3								
5.5	**260**	6	1.4	24	5.5								
6	**283**	7	1.6	25	5.8								
6.5	**307**	7	1.6	26	6.0								
7	**331**	8	1.8	27	6.2								
7.5	**354**	8	1.8	27	6.2								

Observations

STIRLING CIVIL ENGINEERING LTD

For the Contractor

Lab. Technician 01 OCT 2025 *Materials Engineer*

P. O. BOX 796, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 18/Sep/25
Location:		Testing Date : 29/Sep/25
Depth:		Technician : Lab team
Sample Description: NEAT		

PENETRATION vs FORCE CURVE

	62 blows			
	Force		CBR	
	Bottom	Top	Bottom	Top
2.5 mm Penetration	3.7	0.9	28	7
5.0 mm Penetration	5.3	1.4	27	7
Average	4.5	1.2	27.3	7.0
Retained CBR	27.3			
Observations	CBR= 27.3			

STIRLING CIVIL ENGINEERING LTD
For the Lab
01 OCT 2025
P. O. BOX 758, KAMPALA (U)

Lab Technician | *Materials Engineer*

INSTITUTION	STUDENT	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY	WEERE JONATHAN REG NO. M22B32/032	Stirling
PROJECT	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS	

SPECIFIC GRAVITY & WATER ABSORPTION FINE AGGREGATES

(AASHTO ; T84—00)

ASTM DESIGNATION ; C128—97

LOCATION:	OPERATOR:
SAMPLE No	SAMPLE DATE 10-Nov-25
TYPE: QUARRY DUST (O/6 mm)	TESTING DATE 13-Nov-25

TEST NO		A	B	C
[A] wt. of oven dry sample in air	(gm)	508.52		514.05
[B] wt. of pycnometer filled with water	(gm)	1807.51		1772.01
[C] wt. of pycnometer with specimen and water	(gm)	2125.5		2093.2
[S] wt of saturated surface dry sample	(gm)	509.7		515.43
Bulk Specific Gravity on oven dry basis	$\frac{A}{(B+S-C)}$	2.653		2.646
Bulk Specific Gravity on saturated surface dry basis	$\frac{S}{(B+S-C)}$	2.659		2.654
Apparent Specific Gravity	$\frac{A}{(B+A-C)}$	2.669		2.665
Water Absorption(%)=	$\frac{100(S-A)}{A}$	0.2		0.3

AVERAGE RESULTS	
BULK SPECIFIC GRAVITY	2.650
BULK SPECIFIC GRAVITY ON SATURATED SURFACE DRY BASIS	2.656
APPARENT SPECIFIC GRAVITY	2.667
WATER ABSORPTION	0.3

FOR TESTING LAB

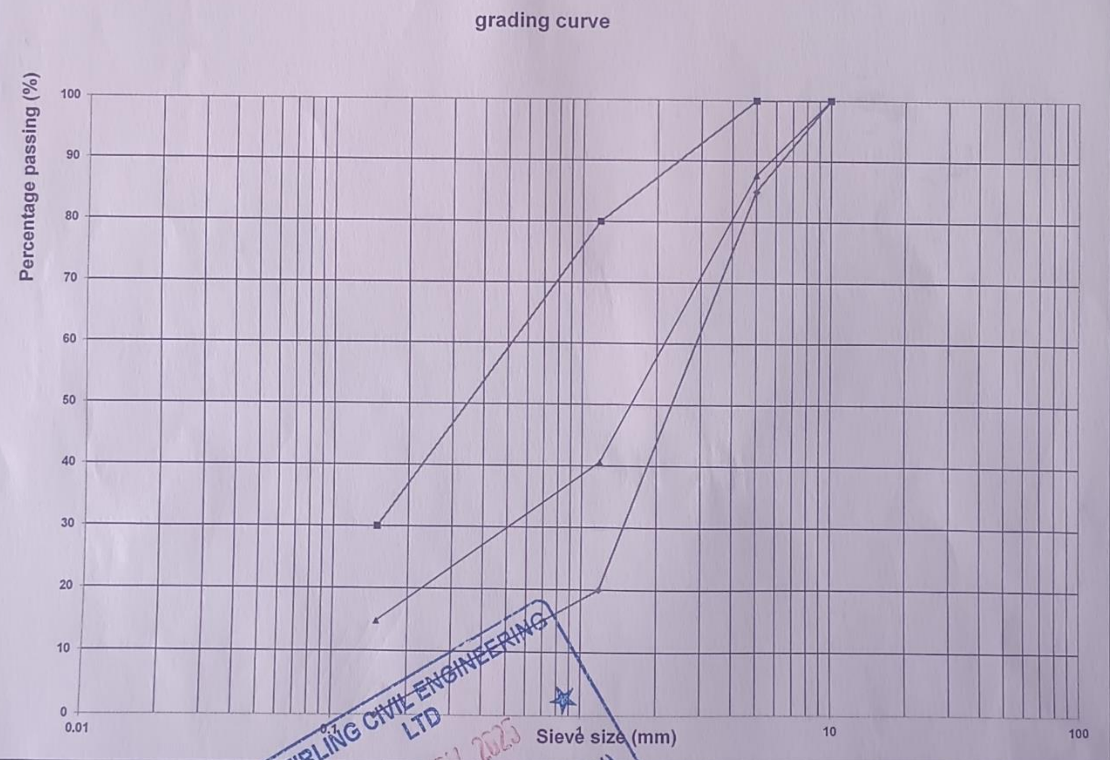
STIRLING CIVIL ENGINEERING LTD

P.O. BOX 783, KAMPALA

INSTITUTION	STUDENT	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling Civil Engineering Ltd Stirling

PROJECT :	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS		
Test	DETERMINATION OF PARTICAL SIZE DISTRIBUTION	Date Sampled	10/Nov/2025
		Date Tested	11/Nov/2025
Sample description	CRUSHER DUST	SIZE (mm)	CRUSHER DUST (0-6 mm)
		Sample	A

INITIAL DRY MASSS (A)	3670.2		Technician		
BS sieve size (mm)	Partial mass retained (g)	percentage retained (%)	Percentage Passing (%)	Grading envelope	
				Lower Limit	Upper limit
10	0.0	0.0	100	100	100
5	452.3	12.3	88	85	100
1.18	1727.4	47.1	41	20	80
0.425				-	-
0.3				-	-
0.15	947.2	25.8	15	0	30
PAN	223.6	6.1			



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26 NOV 2025
P. O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 80% GRAVEL WITH 20% QUARRY DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	80% GRAVEL WITH 20% QUARRY DUST	10/11/2025	100	100	96	75	60	48	39	1.54	43	25.3	17.7	9.2	2.089	14.2	34	0.51	0.51
			100	99	89	70	57	45	41	1.57	43.1	25.4	17.7	9.2	-	-	- - -	-	
			100	99.53	92.78	72.39	58.22	46.5	40.05	1.55	43.1	25.4	17.7	9.2	2.089	14.2	34	0.51	0.51
	AVERAGE		100	100	93	72	58	47	40	1.552	43.1	25.4	17.7	9.2	2.089	14.2	34	0.51	0.51

FOR LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 733, KAMPALA (U)

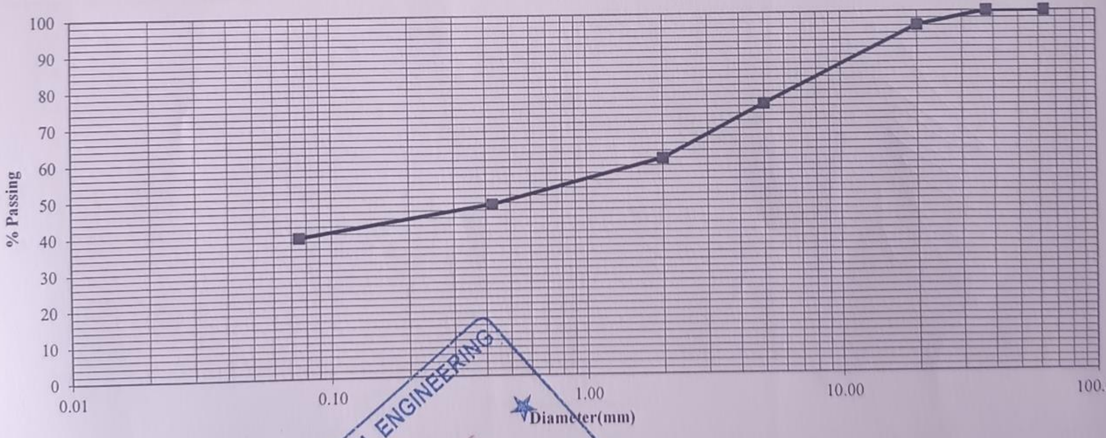
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	**WEERE JONATHAN REG NO. M22B32/032**	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5014.7
Depth: (m)		Dry wt. of sample after washing: (g)		3078.3
Material description:	80% GRAVEL WITH 20% QUARRY DUST	Date Sampled:	Date Tested:	Technician
			11/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	196.1	3.9	**96**	60	95
5.0	1075.5	21.4	**75**	30	65
2.00	740.0	14.8	**60**	20	50
0.425	619.5	12.4	**48**	10	30
0.075	426.9	8.5	**39**	5	15
Total fines	1956.7	39.0			
Bottom Pan	20.3				
Extracted fines	1936.4				
Total sample	5014.7				
Grading Modulus		**1.54**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
NOV 2025
P. O. BOX 733, KAMPALA (U)

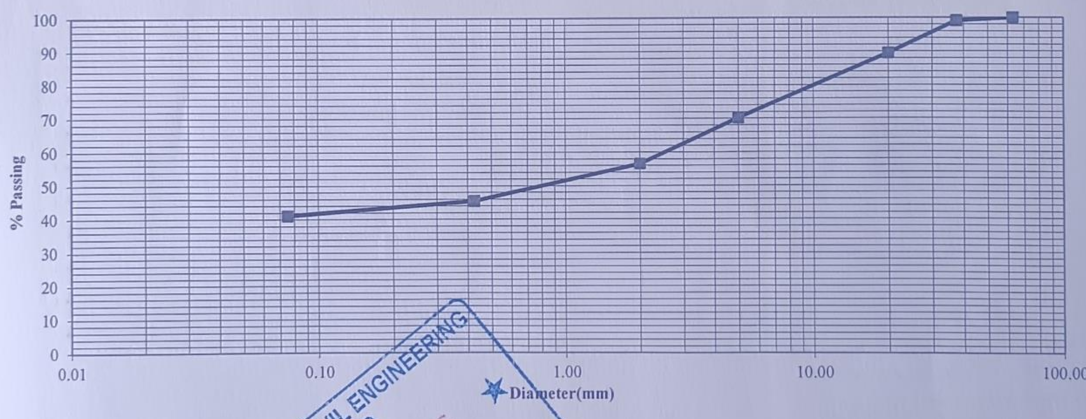
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5354.2
Depth: (m)		Dry wt. of sample after washing: (g)		3166.3
Material description:	80% GRAVEL WITH 20% QUARRY DUST	Date Sampled:	Date Tested:	Technician
			11/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	50.4	0.9	**99**	80	100
20.0	513.0	9.6	**89**	60	95
5.0	1035.8	19.3	**70**	30	65
2.00	727.1	13.6	**57**	20	50
0.425	593.1	11.1	**45**	10	30
0.075	235.2	4.4	**41**	5	15
Total fines	2199.6	41.1			
Bottom Pan	11.7				
Extracted fines	2187.9				
Total sample	5354.2				
Grading Modulus		**1.57**			



FOR TESTING LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	**INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS**

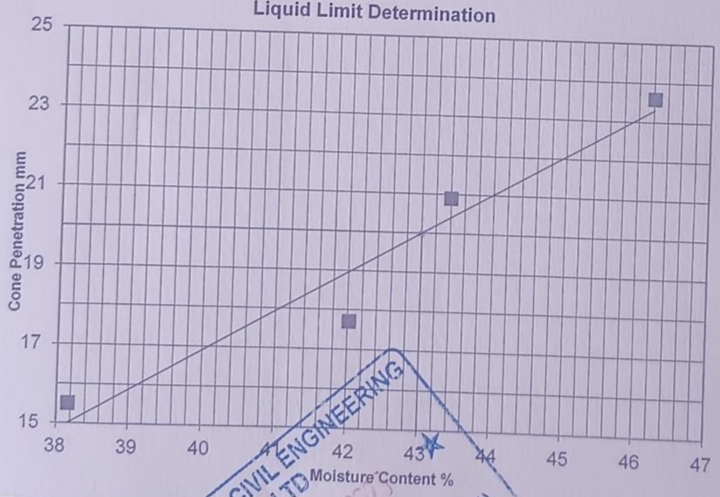
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	80% GRAVEL WITH 20% QUARRY DU:	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	80% GRAVEL WITH 20% QUARRY DUST		
Depth:			

PLASTIC LIMIT	Test No.	KK	JL		Average
Mass of wet soil + container (g)		34.5	37.67		36.085
Mass of dry soil + container (g)		32.03	34.59		33.31
Mass of container (g)		22.21	22.52		22.365
Mass of moisture (g)		2.47	3.1		2.775
Mass of dry soil (g)		9.82	12.07		10.945
Moisture content %		25.2	25.5		25.3
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.5	17.7	20.9	23.6
penetration (mm)		15.5	17.7	20.9	23.6
AVERAGE		15.5	17.7	20.9	23.6
Container No.		PA	PI8	PII2	AO
Mass of wet soil + container (g)		53.10	53.15	47.97	52.75
Mass of dry soil + container (g)		40.40	39.38	35.54	38.35
Mass of container (g)		7.12	6.61	6.90	7.19
Mass of moisture (g)		12.7	13.77	12.43	14.4
Mass of dry soil (g)		33.28	32.77	28.64	31.16
Moisture content (%)		38.2	42.0	43.4	46.2
AVERAGE		38.2	42.0	43.4	46.2



Liquid limit (%)	43.0
Plastic limit (%)	25.3
Plasticity Index (%)	17.7
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	12.7
L.shringage =	1.3
% L.shrinkage =	9.2

Remarks:

TESTING LAB		STUDENTS
Materials Engineer.		
Lab Technician		

STIRLING CIVIL ENGINEERING LTD P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	**INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS**

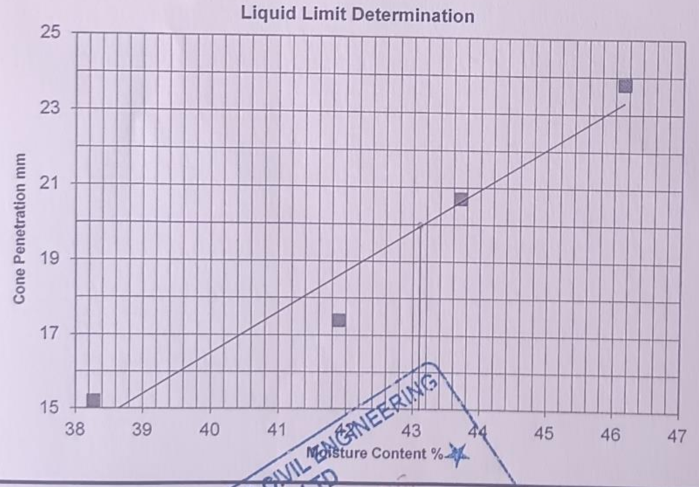
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	80% GRAVEL WITH 20% QUARRY DUS	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	80% GRAVEL WITH 20% QUARRY DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	OO	JN		Average
Mass of wet soil + container (g)		31.48	33.88		32.68
Mass of dry soil + container (g)		29.48	31.54		30.51
Mass of container (g)		21.67	22.25		21.96
Mass of moisture (g)		2	2.3		2.17
Mass of dry soil (g)		7.81	9.29		8.55
Moisture content %		25.6	25.2		25.4
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.2	17.4	20.7	23.8
penetration (mm)		15.2	17.4	20.7	23.8
AVERAGE		15.2	17.4	20.7	23.8
Container No.		PI26	VE	PIBO	FORD
Mass of wet soil + container (g)		54.70	52.46	45.10	51.53
Mass of dry soil + container (g)		41.50	38.98	33.58	37.55
Mass of container (g)		7.01	6.80	7.22	7.24
Mass of moisture (g)		13.2	13.48	11.52	13.98
Mass of dry soil (g)		34.49	32.18	26.36	30.31
Moisture content (%)		38.3	41.9	43.7	46.1
AVERAGE		38.3	41.9	43.7	46.1



Liquid limit (%)	43.1
Plastic limit (%)	25.4
Plasticity Index (%)	17.7
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	12.7
L.shringage =	1.3
% L.shrinkage =	9.2

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	
Lab Technician	

STIRLING CIVIL ENGINEERING LTD
2 3 NOV 2025
P. O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS				
Test Reference No.	Lab. Reference No.		Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB		10/Nov/25	11/Nov/25	Lab team
Material description:	80% GRAVEL WITH 20% QUARRY DUST		Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

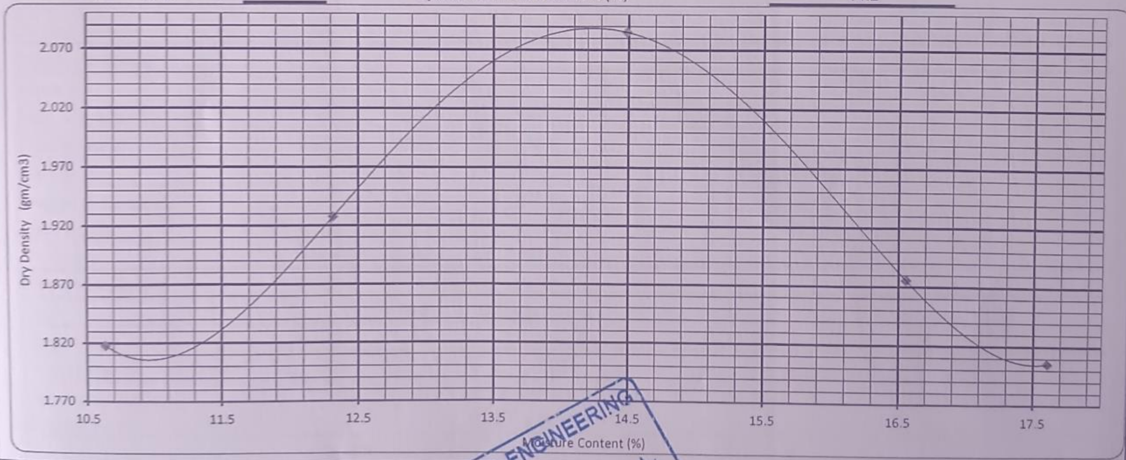
MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	150	210	270	330	390
Mass of Compacted soil + mould	gm	5,326	5,480	5,702	5,501	5,438
Mass of Mould	gm	3,315	3,315	3,315	3,315	3,315
Mass of Compacted soil	gm	2011	2165	2387	2186	2123
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	2.011	2.165	2.387	2.186	2.123

DATA FOR PROCTOR CURVE

Container No.		BKX	BAR	EVE	NBM	BA
Mass of wet soil + Container	gm	2,808.0	2,975.0	2,612.0	2,930.0	3,027.0
Mass of dry soil + container	gm	2,615.0	2,737.0	2,378.0	2,627.0	2,689.0
Mass of container	gm	801.0	805.0	763.0	797.0	769.0
Mass of water added	gm	193	238	234	303	338
Mass of dry soil	gm	1814	1932	1615	1830	1920
Moisture content	%	10.6	12.3	14.5	16.6	17.6
Dry density	g/cm^3	1.818	1.928	2.085	1.875	1.805

Maximum dry density (gm/cm^3) 2.089 Optimum moisture content (%) 14.2



Remarks:

FOR TESTING LAB

Lab Technician	Materials Engineer		

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 793, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	13/Nov/25
		Testing Date :	20/Nov/25
Sample Description:	80% GRAVEL WITH 20% QUARRY DUST	Technician :	: Lab team
		Volume of Mould used (m^3)	**2305**

Natural moisture of air dried sample			Volume of water added	
Tin No.	RF		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	1258		MDD (Mg/m^3)	2.089
Tin + oven dry soil sample (g)	1200		N.M.C (%)	5.1
Tin (g)	57		OMC (%)	14.2
Dry soil sample	1143		Added OMC (%)	9.1
Water (g)	58		Calculated dry wt of soil (g)	5695.5
N.M.C (%)	5.1		Water added (g)	521
Average (%)	5.1		**Water added (mL)**	**521**

Number of blows		62			
Number of layer		5			
Water Content Determination		Before Soaking		After Soaking	
Tare No		Y2Y	-	EVE	-
Mass of wet sample + Tare	g	2355	-	2043	-
Mass of dry sample + Tare	g	2165	-	1875	-
Mass of Tare	g	835	-	767	-
Mass of water	g	190	-	168	-
Mass of dry sample	g	1330	-	1108	-
Water content	%	14.3	-	15.2	-
Average water Content	%	14.3		15.2	
Density determination					
Mould No		Y			
Mass of mould + soil	g	12375		12422	
Mass of mould	g	7000		7000	
Mass of soil	g	5375		5422	
Volume of the mould	cm3	2305		2305	
Moist density	g/cm3	2.332		2.352	
Dry density	g/cm3	2.040		2.043	

Swell Determination		
Date	Hour	D.Gauge Reding
Initial reading	96 hrs	1.9
Final reading		2.55
Height of the specimen		127
Height of swell		0.65
	Swelling(%)	**0.51**
Observations		

For the Lab			
Lab. Technician	*Materials Engineer*		

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date	10/Nov/25
Location:		Penetration Date	20/Nov/25
Depth :		Technician	: : Lab team
Sample Description :	80% GRAVEL WITH 20% QUARRY DUST		

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	Y		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312

Speed : … … … … ..mm/min.

Penetration of the plunger (mm)	Time (s)	Top Reading $*10^3$mm	Top Force (KN)	Bottom Reading $*10^3$mm	Bottom Force (KN)
0	**0**	0	0.0	0	0.0
0.25	**12**	4	0.9	6	1.4
0.5	**24**	5	1.2	8	1.8
0.75	**35**	6	1.4	10	2.3
1	**47**	7	1.6	12	2.8
1.5	**71**	8	1.8	14	3.2
2	**94**	9	2.1	16	3.7
2.5	**118**	10	2.3	20	4.6
3	**142**	12	2.8	22	5.1
3.5	**165**	13	3.0	24	5.5
4	**189**	14	3.2	26	6.0
4.5	**213**	15	3.5	27	6.2
5	**236**	16	3.7	28	6.5
5.5	**260**	17	3.9	29	6.7
6	**283**	18	4.2	30	6.9
6.5	**307**	19	4.4	31	7.2
7	**331**	20	4.6	32	7.4
7.5	**354**	21	4.9	33	7.6

Observations

For the Contractor

Lab. Technician	*Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P.O. BOX 793, KAMPALA (U)

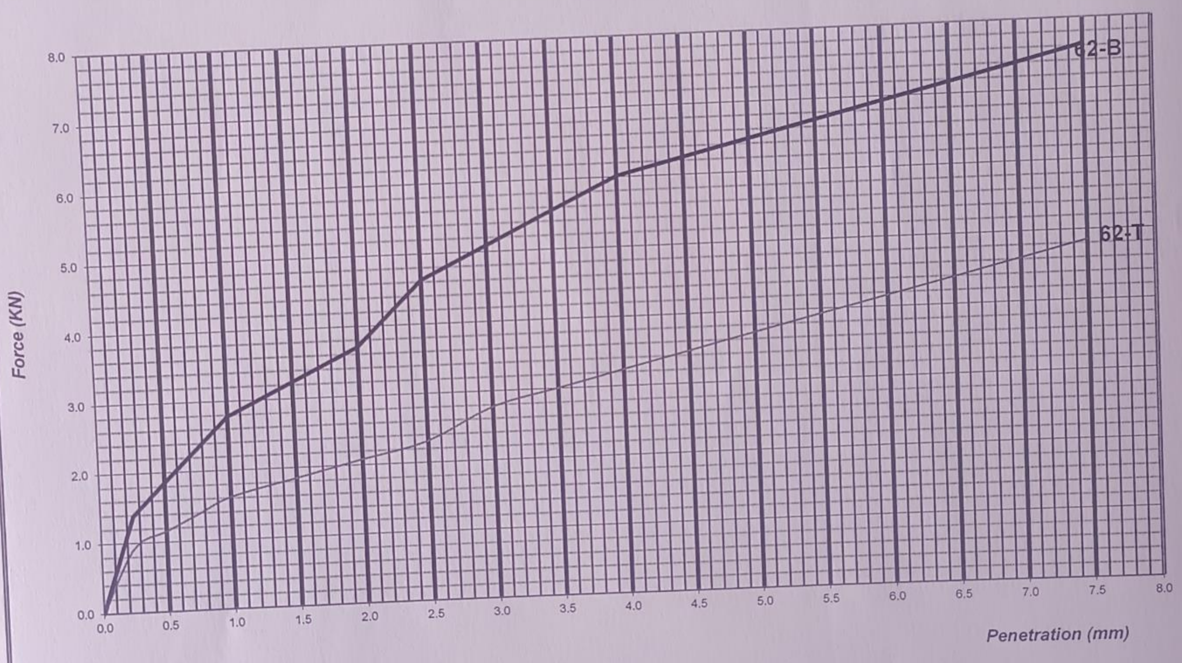
Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 10/Nov/25
		Testing Date : 20/Nov/25
Location:		Technician : Lab team
Depth:		
Sample Description:	80% GRAVEL WITH 20% QUARRY DUST	

PENETRATION vs FORCE CURVE



	62 blows			
	Force		CBR	
	Bottom	Top	Bottom	Top
2.5 mm Penetration	4.6	2.3	35	17
5.0 mm Penetration	6.5	3.7	32	19
Average	5.5	3.0	33.[illegible]	18.0
Retained CBR	33.7			
Observations	CBR= 33.7			

For the Lab	
Lab. Technician	Materials Engineer

STIRLING CIVIL ENGINEERING LTD P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 70% GRAVEL WITH 30% QUARRY DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	70% GRAVEL WITH 30% QUARRY DUST	10/11/2025	100	100	97	68	56	43	40	1.61	41.7	26.4	15.3	9.2	2.105	14.0	41	0.39	0.39
			100	97	92	67	56	43	39	1.63	41.6	26.3	15.3	9.2	-	-	- - -	-	
			100	98.47	94.18	67.62	55.54	42.87	39.74	1.62	41.7	26.4	15.3	9.2	2.105	14.0	41	0.39	0.39
	AVERAGE		100	[illegible]	94	68	56	43	40	1.618	41.7	26.3	15.3	9.2	2.105	14.0	41	0.39	0.39

FOR LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 753, KAMPALA (U)

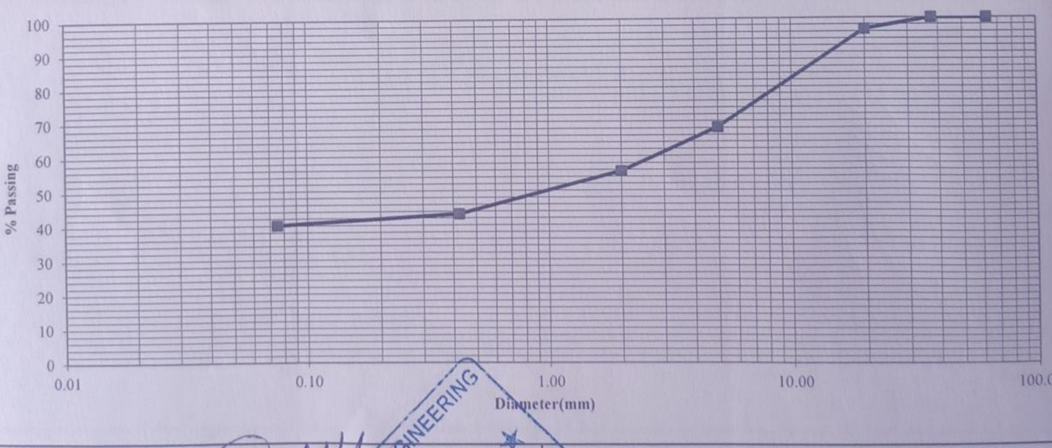
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		4498.6
Depth: (m)		Dry wt. of sample after washing: (g)		2705.5
Material description:	70% GRAVEL WITH 30% QUARRY DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	11/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	149.6	3.3	**97**	60	95
5.0	1282.7	28.5	**68**	30	65
2.00	567.1	12.6	**56**	20	50
0.425	555.2	12.3	**43**	10	30
0.075	138.2	3.1	**40**	5	15
Total fines	1805.8	40.1			
Bottom Pan	12.7				
Extracted fines	1793.1				
Total sample	4498.6				
Grading Modulus		**1.61**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD 2? NOV 2025 P.O. BOX 70?, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5025.8
Depth: (m)		Dry wt. of sample after washing: (g)		3060.9
Material description:	70% GRAVEL WITH 30% QUARRY DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	11/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	153.9	3.1	**97**	80	100
20.0	264.0	5.3	**92**	60	95
5.0	1236.8	24.6	**67**	30	65
2.00	580.1	11.5	**56**	20	50
0.425	653.3	13.0	**43**	10	30
0.075	160.8	3.2	**39**	5	15
Total fines	1976.9	39.3			
Bottom Pan	12.0				
Extracted fines	1964.9				
Total sample	5025.8				
Grading Modulus		**1.63**			

FOR TESTING LAB

Lab Technician   *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P. O. BOX 753, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

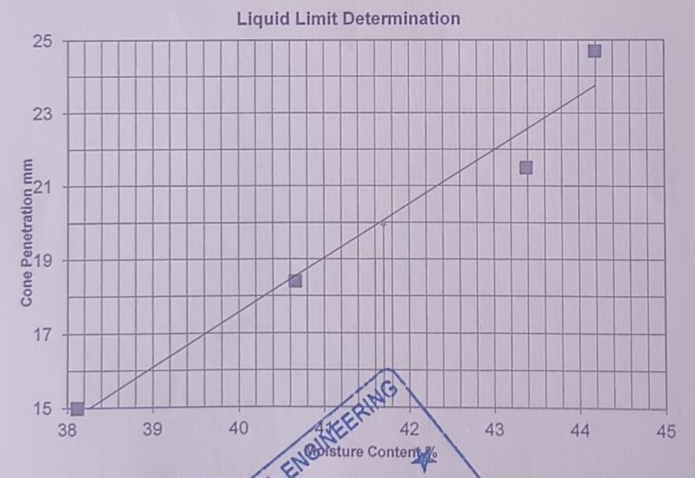
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 30% QUARRY DU	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 30% QUARRY DUST		
Depth:			

PLASTIC LIMIT	Test No.	4P	OG		Average
Mass of wet soil + container (g)		27.17	32.21		29.69
Mass of dry soil + container (g)		26.15	29.96		28.055
Mass of container (g)		22.31	21.4		21.855
Mass of moisture (g)		1.02	2.3		1.635
Mass of dry soil (g)		3.84	8.56		6.2
Moisture content %		26.6	26.3		26.4
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.0	18.4	21.5	24.7
penetration (mm)		15.0	18.4	21.5	24.7
AVERAGE		15.0	18.4	21.5	24.7
Container No.		PI42	A5	PI33	PIBO
Mass of wet soil + container (g)		53.74	55.74	54.30	57.20
Mass of dry soil + container (g)		40.91	41.64	39.98	41.90
Mass of container (g)		7.25	6.96	6.97	7.28
Mass of moisture (g)		12.83	14.1	14.32	15.3
Mass of dry soil (g)		33.66	34.68	33.01	34.62
Moisture content (%)		38.1	40.7	43.4	44.2
AVERAGE		38.1	40.7	43.4	44.2



Liquid limit (%)	41.7
Plastic limit (%)	26.4
Plasticity Index (%)	15.3
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	12.7
L.shringage =	1.3
% L.shrinkage =	9.2

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	
Lab Technician	

STIRLING CIVIL ENGINEERING LTD
26 NOV 2025
P.O. BOX 783, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

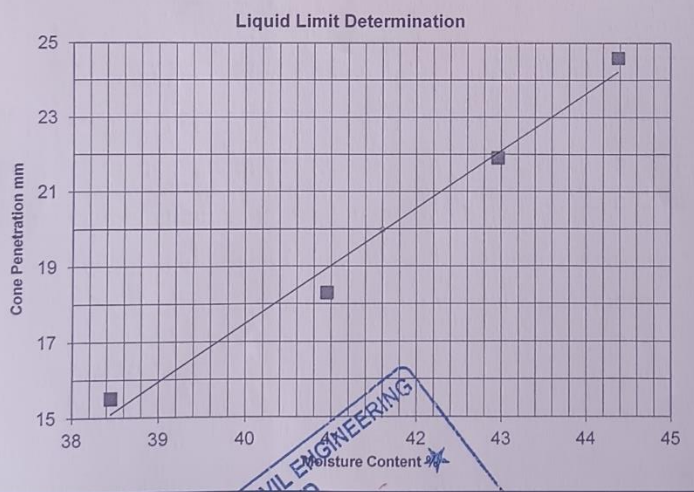
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 30% QUARRY DU:	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 30% QUARRY DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	OO	DJ		Average
Mass of wet soil + container (g)		30.16	32.3		31.23
Mass of dry soil + container (g)		28.39	30.31		29.35
Mass of container (g)		21.66	22.76		22.21
Mass of moisture (g)		1.77	2.0		1.88
Mass of dry soil (g)		6.73	7.55		7.14
Moisture content %		26.3	26.4		26.3
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.5	18.3	21.9	24.6
penetration (mm)		15.5	18.3	21.9	24.6
AVERAGE		15.5	18.3	21.9	24.6
Container No.		PI33	VE	KO	PI43
Mass of wet soil + container (g)		65.08	52.21	51.19	59.93
Mass of dry soil + container (g)		48.92	39.04	37.92	43.67
Mass of container (g)		6.89	6.88	7.03	7.03
Mass of moisture (g)		16.16	13.17	13.27	16.26
Mass of dry soil (g)		42.03	32.16	30.89	36.64
Moisture content (%)		38.4	41.0	43.0	44.4
AVERAGE		38.4	41.0	43.0	44.4



Liquid limit (%)	41.6
Plastic limit (%)	26.3
Plasticity Index (%)	15.3
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	12.7
L.shringage =	1.3
% L.shrinkage =	9.2

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	
Lab Technician	

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P.O.BOX 753, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS				
Test Reference No.	Lab. Reference No.		Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB		10/Nov/25	11/Nov/25	Lab team
Material description:	70% GRAVEL WITH 30% QUARRY DUST		Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

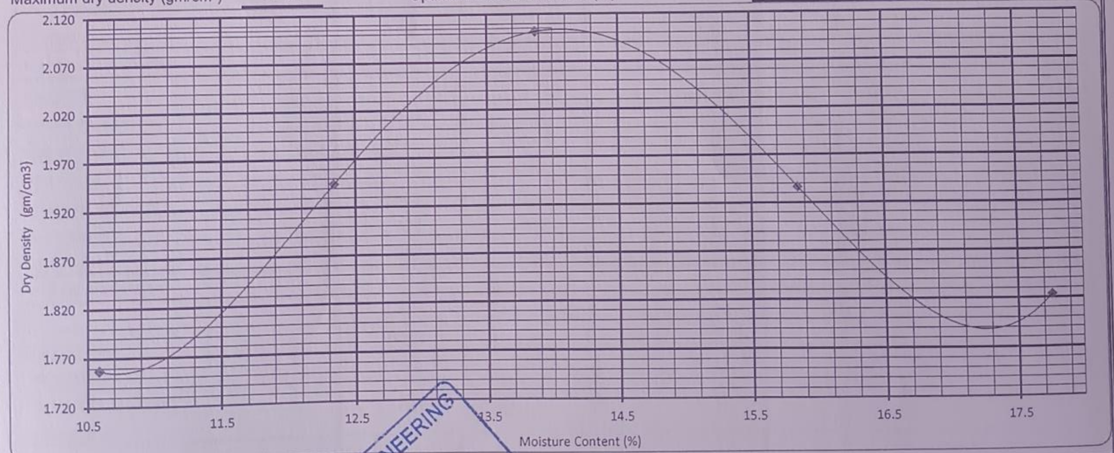
MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	80	140	200	260	320
Mass of Compacted soil + mould	gm	5,248	5,489	5,698	5,548	5,452
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	1943	2184	2393	2243	2147
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	1.943	2.184	2.393	2.243	2.147

DATA FOR PROCTOR CURVE

Container No.		NBM	BKX	Y2Y	ACB	BBC
Mass of wet soil + Container	gm	2,895.0	2,925.0	2,715.0	2,695.0	2,960.0
Mass of dry soil + container	gm	2,694.0	2,691.0	2,486.0	2,433.0	2,635.0
Mass of container	gm	795.0	795.0	835.0	780.0	805.0
Mass of water added	gm	201	234	229	262	325
Mass of dry soil	gm	1899	1896	1651	1653	1830
Moisture content	%	10.6	12.3	13.9	15.8	17.8
Dry density	g/cm^3	1.757	1.944	2.102	1.936	1.823

Maximum dry density (gm/cm^3) 2.105 Optimum moisture content (%) 14.0



Remarks:

FOR TESTING LAB

Lab Technician Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P.O. BOX ..., KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	13/Nov/25
		Testing Date :	20/Nov/25
Sample Description:	70% GRAVEL WITH 30% QUARRY DUST	Technician :	Lab team
		Volume of Mould used (m^3)	**2305**

Natural moisture of air dried sample			**Volume of water added**	
Tin No.	UK		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	1896		MDD (Mg/m^3)	2.105
Tin + oven dry soil sample (g)	1799		N.M.C (%)	9.2
Tin (g)	750		OMC (%)	14.0
Dry soil sample	1049		Added OMC (%)	4.8
Water (g)	97		Calculated dry wt of soil (g)	5445.2
N.M.C (%)	9.2		Water added (g)	**261**
Average (%)	9.2		**Water added (mL)**	**261**

Number of blows		62				
Number of layer		5				
Water Content Determination		Before Soaking		After Soaking		
Tare No		KT	-	BAR	-	
Mass of wet sample + Tare	g	2040	-	2974	-	
Mass of dry sample + Tare	g	1888	-	2686	-	
Mass of Tare	g	800	-	803	-	
Mass of water	g	152	-	288	-	
Mass of dry sample	g	1088	-	1883	-	
Water content	%	14.0	-	15.3	-	
Average water Content	%	14.0		15.3		
Density determination						
Mould No		HT				
Mass of mould + soil	g	11315		11387		
Mass of mould	g	5845		5845		
Mass of soil	g	5470		5542		
Volume of the mould	cm3	2305		2305		
Moist density	g/cm3	2.373		2.405		
Dry density	g/cm3	2.082		2.086		
Swell Determination						
Date		Hour		D.Gauge Reding		
Initial reading		96 hrs		6.32		
Final reading				6.82		
Height of the specimen				127		
Height of swell				0.5		
		Swelling(%)		**0.39**		
Observations						

For the Lab			
Lab. Technician	*Materials Engineer*		

STIRLING CIVIL ENGINEERING LTD
2 NOV 2025
P. O. BOX 795, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:		
Location:		Sampling Date	10/Nov/25
Depth :		Penetration Date	20/Nov/25
Sample Description :	70% GRAVEL WITH 30% QUARRY DUST	Technician	: Lab team

Number of blows per layer	62		
Number of layers	5		
Mould No	HT	5	5
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312
Speed :……………mm/min.			

Penetration of the plunger (mm)	Time (s)	Top Reading $*10^3$mm	Top Force (KN)	Bottom Reading $*10^3$mm	Bottom Force (KN)								
0	0	0	0.0	0	0.0								
0.25	12	3	0.7	2	0.5								
0.5	24	5	1.2	3	0.7								
0.75	35	6	1.4	4	0.9								
1	47	7	1.6	9	2.1								
1.5	71	10	2.3	14	3.2								
2	94	13	3.0	17	3.9								
2.5	118	14	3.2	24	5.5								
3	142	16	3.7	28	6.5								
3.5	165	18	4.2	31	7.2								
4	189	19	4.4	32	7.4								
4.5	213	20	4.6	33	7.6								
5	236	21	4.9	34	7.9								
5.5	260	22	5.1	35	8.1								
6	283	23	5.3	36	8.3								
6.5	307	24	5.5	37	8.6								
7	331	25	5.8	38	[illegible]								
7.5	354	26	6.0	[illegible]	9.0								

Observations

For the Contractor

Lab. Technician	*Materials Engineer*

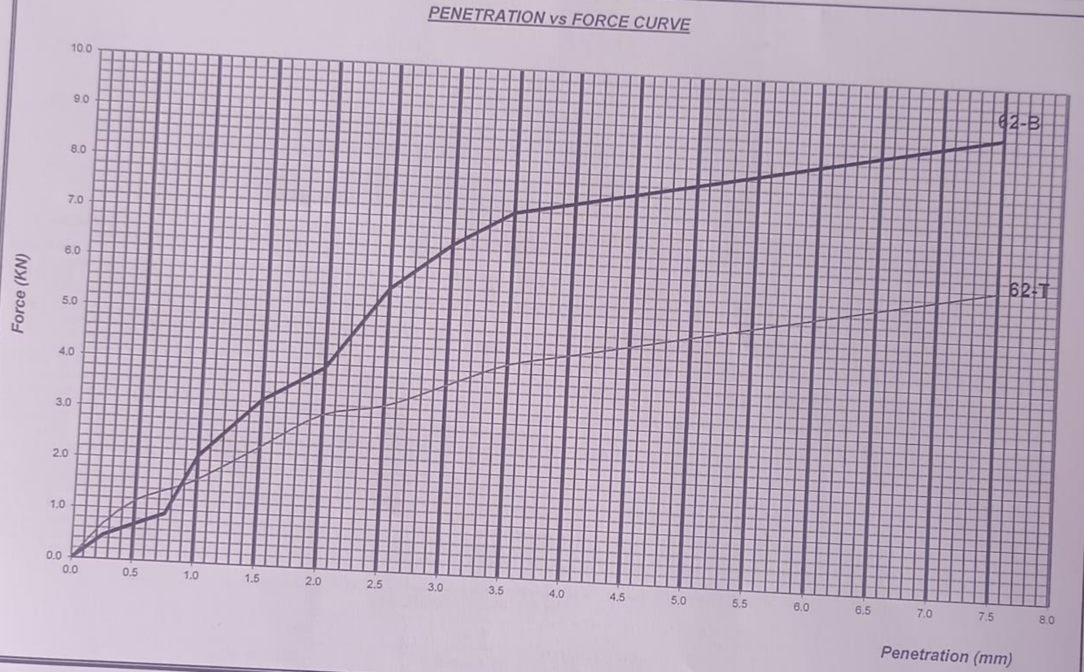
STIRLING CIVIL ENGINEERING LTD
P.O.BOX 750, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 10/Nov/25
Location:		Testing Date : 20/Nov/25
Depth:		Technician : Lab team
Sample Description: 70% GRAVEL WITH 30% QUARRY DUST		



	62 blows			
	Force		CBR	
	Bottom	Top	Bottom	Top
2.5 mm Penetration	5.5	3.2	42	24
5.0 mm Penetration	7.9	4.9	39	24
Average	6.7	4.0	40.6	24.4
Retained CBR	40.6			
Observations	CBR= 40.6			

For the Lab

Lab. Technician | *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	**Stirling**
PROJECT	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS	

STABLISED CBR

(BS 1924 PART 2 1)

Load applied 140kpa/s

70% GRAVEL WITH 30% QUARRY DUST 0% KILN DUST

M/c of air dried sample			
Tin No.		RWE	
Tin + Wet soil	gm	3,274.0	
Tin + Dry Soil	gm	3,126.0	
Tin	gm	815.0	
Water	gm	148.0	
Dry Soil	gm	2,311.0	
M/c	%	6.4	
Av. M/c	%	6.4	

	M/c After Mixing		
Stabliser	CEMENT KILN DUST		
Content	0.0		
Tin No.	NMT		
Tin + Wet Soil	3,048.0		
Tin + Dry Soil	2,765.0		
Tin	778.0		
Water	283.0		
Dry Soil	1,987.0		
M/c	14.2		

(a)MDD 2.105 kg/m3

(c)WD 2,947 kg/m3

(d)OMC 14.0 %

(b)Air Dry M/c 6.4 %

(e)M/c to add 7.6 %

(F) volume 2.305

Date prepared 15/Nov/25 Date immerse 22/Nov/25 Date tested 29/Nov/25

Mould No.			
Factor(f)			
(h)Wet Soil to fill mould c x f x %comp	2.305		
(j) Wt of air dried soil	6,792.8		
Air dry M/c	6,000		
(k) soil dry wt (100j/100+b)	6.4		
Stabliser	5,638.9		
(m)Stablisers content %	CEMENT KILN DUST		
(n) Stabliser to add k x(m/100)	0.0		
Water Addition((j+n)x(d-b))/(100+b)	0.0		
Wt. per layer CBR Only h/3	428.3		
	2,264.3		

SPECIMEN WEIGHT CHECK			
No. of blows	62.0	62.0	AVERAGE
Mould No.	7 DAYS AIR TIGHT	7 DAYS AIR TIGHT, 7 DAYS SOAKED	
Stabliser	CEMENT KILN DUST	CEMENT KILN DUST	
Content %	0.0	0.0	
Mould g	A	B	
Wet Soil g	5,022.0	4,899.0	
Compaction M/c %	14.2	14.2	
Dry density kg/m3	1,907	1,860	
%Compaction	90.6	88.4	
FORCE	[illegible].6	4.4	
UCS	0.254	0.2[illegible]	0.25

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 793, KAMPALA (U)
26 NOV 2025

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 60% GRAVEL WITH 40% QUARRY DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	60% GRAVEL WITH 40% QUARRY DUST	10/11/2025	100	100	95	64	50	40	36	1.74	37.85	26.7	11.2	5.7	2.124	13.8	47	0.31	0.31
			100	100	96	64	50	40	37	1.73	37.9	26.5	11.4	5.7	-	-	- - -	-	
			100	100	95.57	64.39	49.84	40.15	36.22	1.74	37.9	26.6	11.3	5.7	2.124	13.8	47	0.31	0.31
	AVERAGE		100	100	96	64	50	40	36	1.738	37.9	26.5	11.3	5.7	2.124	13.8	47	0.31	0.31

FOR LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 733, KAMPALA (U)

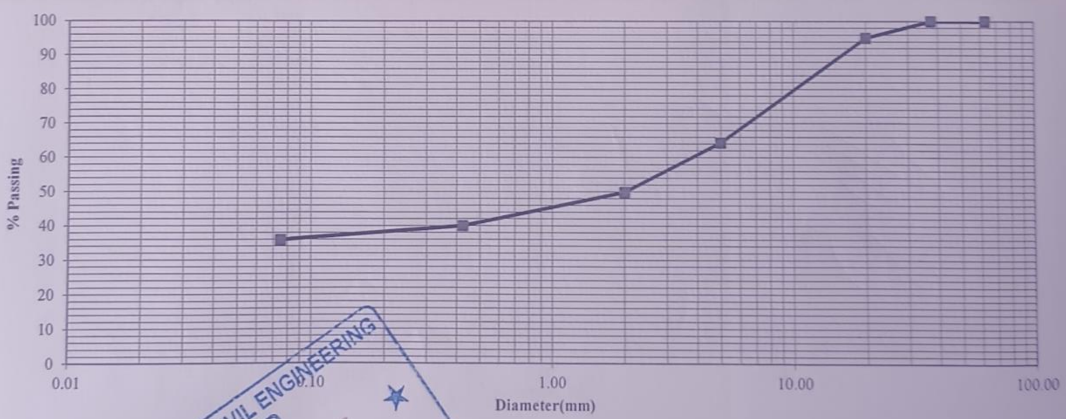
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:			
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)			4587.4
Depth: (m)		Dry wt. of sample after washing: (g)			2983.0
Material description:	60% GRAVEL WITH 40% QUARRY DUST	Date Sampled:	Date Tested:	Technician	
		10/Nov/2025	11/Nov/2025	Lab team	

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	100	100	100
37.5	0.0	0.0	100	80	100
20.0	226.1	4.9	95	60	95
5.0	1408.2	30.7	64	30	65
2.00	669.0	14.6	50	20	50
0.425	451.6	9.8	40	10	30
0.075	186.4	4.1	36	5	15
Total fines	1646.1	35.9			
Bottom Pan	41.7				
Extracted fines	1604.4				
Total sample	4587.4				
Grading Modulus		1.74			



FOR TESTING LAB.

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P. O. BOX ... KAMPALA (U)

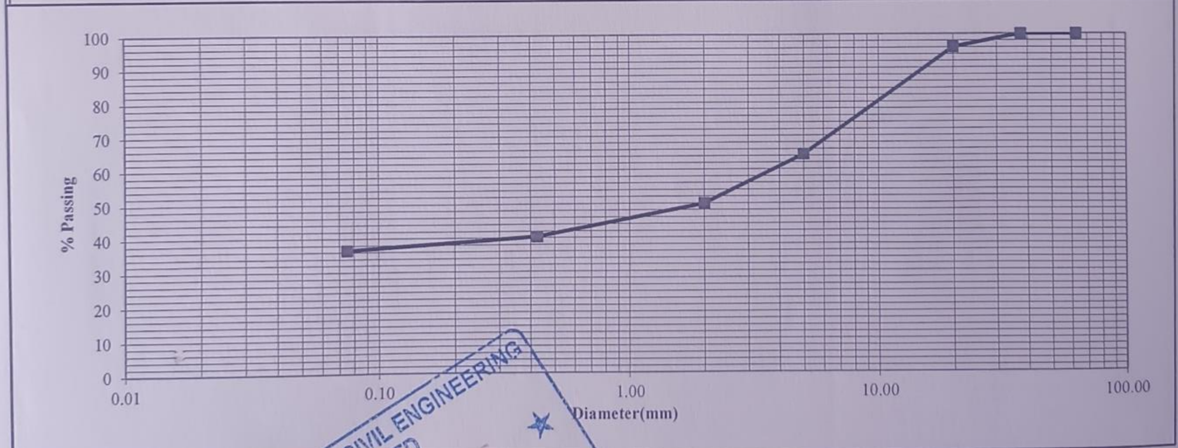
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		4602.1
Depth: (m)		Dry wt. of sample after washing: (g)		2970.0
Material description:	60% GRAVEL WITH 40% QUARRY DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	11/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	181.0	3.9	**96**	60	95
5.0	1457.0	31.7	**64**	30	65
2.00	668.3	14.5	**50**	20	50
0.425	438.9	9.5	**40**	10	30
0.075	174.4	3.8	**37**	5	15
Total fines	1682.5	36.6			
Bottom Pan	50.4				
Extracted fines	1632.1				
Total sample	4602.1				
Grading Modulus		**1.73**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

ATTERBERG LIMITS

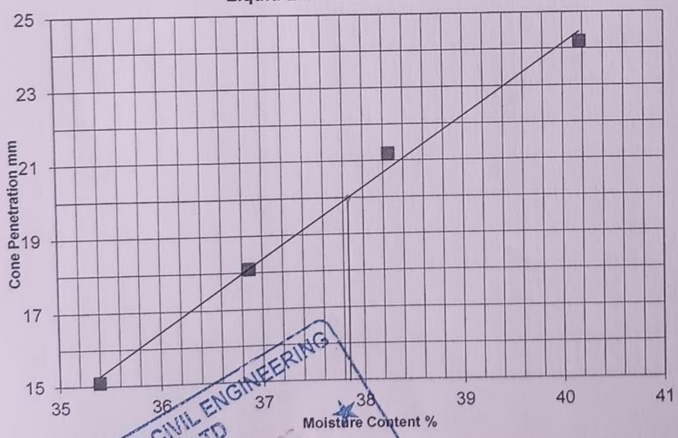
Liquid limit (cone penotrometer) and plastic limit

Material description:	60% GRAVEL WITH 40% QUARRY DUS	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	60% GRAVEL WITH 40% QUARRY DUST		
Depth:			

PLASTIC LIMIT	Test No.	SO	KK		Average
Mass of wet soil + container (g)		35.78	28.86		32.32
Mass of dry soil + container (g)		33.07	27.46		30.265
Mass of container (g)		22.89	22.22		22.555
Mass of moisture (g)		2.71	1.4		2.055
Mass of dry soil (g)		10.18	5.24		7.71
Moisture content %		26.6	26.7		26.7
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.1	18.1	21.2	24.2
penetration (mm)		15.1	18.1	21.2	24.2
AVERAGE		15.1	18.1	21.2	24.2
Container No.		PIBB	PI28	PIMO	PI2O
Mass of wet soil + container (g)		46.68	46.98	50.58	57.81
Mass of dry soil + container (g)		36.26	36.21	38.53	44.57
Mass of container (g)		6.82	7.00	7.03	11.61
Mass of moisture (g)		10.42	10.77	12.05	13.24
Mass of dry soil (g)		29.44	29.21	31.5	32.96
Moisture content (%)		35.4	36.9	38.3	40.2
AVERAGE		35.4	36.9	38.3	40.2

Liquid Limit Determination



Liquid limit (%)	37.9
Plastic limit (%)	26.7
Plasticity Index (%)	11.2
Linear shrinkage	
Trough No.	B
Trough length (cm)	14.0
Specimen length (cm)	13.2
L.shringage =	0.8
% L.shrinkage =	5.7

Remarks

TESTING LAB		STUDENTS
Materials Engineer.		____________
Lab Technician		____________

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	**INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS**

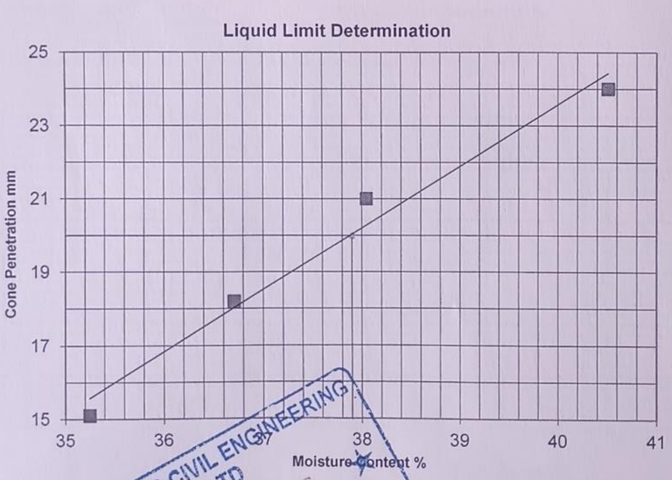
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	60% GRAVEL WITH 40% QUARRY DU	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	60% GRAVEL WITH 40% QUARRY DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	DT	PNU		Average
Mass of wet soil + container (g)		34.23	33.2		33.715
Mass of dry soil + container (g)		31.80	31.05		31.425
Mass of container (g)		22.77	22.84		22.805
Mass of moisture (g)		2.43	2.2		2.29
Mass of dry soil (g)		9.03	8.21		8.62
Moisture content %		26.9	26.2		26.5
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.1	18.2	21	24.0
penetration (mm)		15.1	18.2	21.0	24.0
AVERAGE		15.1	18.2	21.0	24.0
Container No.		PIB6	AX	PI82	4B
Mass of wet soil + container (g)		46.27	47.55	52.52	46.95
Mass of dry soil + container (g)		36.03	36.63	40.01	35.34
Mass of container (g)		6.98	6.88	7.13	6.68
Mass of moisture (g)		10.24	10.92	12.51	11.61
Mass of dry soil (g)		29.05	29.75	32.88	28.66
Moisture content (%)		35.2	36.7	38.0	40.5
AVERAGE		35.2	36.7	38.0	40.5



Liquid limit (%)	37.9
Plastic limit (%)	26.5
Plasticity Index (%)	11.4
Linear shrinkage	
Trough No.	B
Trough length (cm)	14.0
Specimen length (cm)	13.2
L.shringage =	0.8
% L.shrinkage =	5.7

Remarks:

TESTING LAB		STUDENTS
Materials Engineer.		____________
Lab Technician		____________

STIRLING CIVIL ENGINEERING LTD
NOV 2025
P.O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	**WEERE JONATHAN REG NO. M22B32/032**	**Stirling**

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS			
Test Reference No.	Lab. Reference No.	Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB	10/Nov/25	11/Nov/25	Lab team
Material description:	60% GRAVEL WITH 40% QUARRY DUST	Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

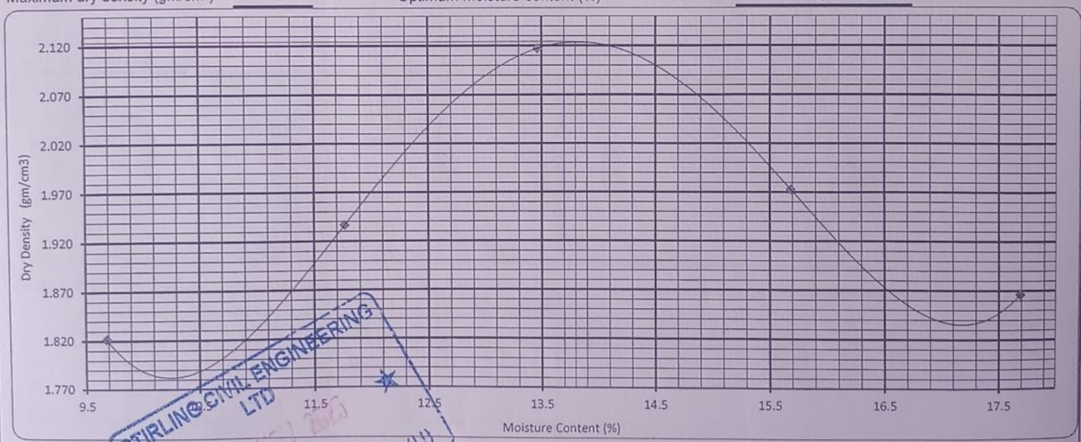
MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	120	180	240	300	360
Mass of Compacted soil + mould	gm	5,303	5,469	5,707	5,587	5,501
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	1998	2164	2402	2282	2196
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	1.998	2.164	2.402	2.282	2.196

DATA FOR PROCTOR CURVE

Container No.		NBM	KT	NMT	UMT	YY
Mass of wet soil + Container	gm	2,484.0	3,131.0	2,991.0	2,915.0	2,650.0
Mass of dry soil + container	gm	2,335.0	2,886.0	2,728.0	2,628.0	2,370.0
Mass of container	gm	796.0	804.0	775.0	798.0	787.0
Mass of water added	gm	149	245	263	287	280
Mass of dry soil	gm	1539	2082	1953	1830	1583
Moisture content	%	9.7	11.8	13.5	15.7	17.7
Dry density	g/cm^3	1.822	1.936	2.117	1.973	1.866

Maximum dry density (gm/cm^3) 2.124 Optimum moisture content (%) 13.8



Remarks:

Lab Technician	Materials Engineer	

STIRLING CIVIL ENGINEERING LTD
P.O. BOX ..., KAMPALA (U)
FOR TESTING LAB

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	13/Nov/25
		Testing Date :	20/Nov/25
Sample Description:	60% GRAVEL WITH 40% QUARRY DUST	Technician :	Lab team
		Volume of Mould used (m^3)	**2305**

Natural moisture of air dried sample			Volume of water added	
Tin No.	GT		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	2541		MDD (Mg/m^3)	2.124
Tin + oven dry soil sample (g)	2405.6		N.M.C (%)	8.5
Tin (g)	810		OMC (%)	13.8
Dry soil sample	1595.6		Added OMC (%)	5.3
Water (g)	135.4		Calculated dry wt of soil (g)	5490.8
N.M.C (%)	8.5		Water added (g)	**294**
Average (%)	8.5		**Water added (mL)**	**294**

Number of blows		62											
Number of layer		5											
Water Content Determination		Before Soaking		After Soaking									
Tare No		ACB	-	KAU	-								
Mass of wet sample + Tare	g	2435	-	2500	-								
Mass of dry sample + Tare	g	2240.8	-	2266	-								
Mass of Tare	g	780	-	799	-								
Mass of water	g	194.2	-	234	-								
Mass of dry sample	g	1460.8	-	1467	-								
Water content	%	13.3	-	16.0	-								
Average water Content	%	13.3		16.0									
Density determination													
Mould No		22											
Mass of mould + soil	g	12750		12893									
Mass of mould	g	7370		7370									
Mass of soil	g	5380		5523									
Volume of the mould	cm3	2305		2305									
Moist density	g/cm3	2.334		2.396									
Dry density	g/cm3	2.060		2.066									
Swell Determination													
Date		Hour		D.Gauge Reding									
Initial reading		96 hrs		6									
Final reading				6.39									
Height of the specimen				127									
Height of swell				0.39									
		Swelling(%)		**0.31**									

Observations

For the Lab

STIRLING CIVIL ENGINEERING LTD 26 NOV 2025 P. O. BOX 733, KAMPALA (U)

Lab. Technician *Materials Engineer*

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY — A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :

Laboratory Reference No.:

Sampling Date 10/Nov/25

Penetration Date 20/Nov/25

Location:

Technician : : Lab team

Depth :

Sample Description : : **60% GRAVEL WITH 40% QUARRY DUST**

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	22		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312

Speed : ... ...mm/min.

Penetration of the plunger (mm)	Time (s)	Top Reading $*10^3$mm	Top Force (KN)	Bottom Reading $*10^3$mm	Bottom Force (KN)
0	**0**	0	0.0	0	0.0
0.25	**12**	2	0.5	3	0.7
0.5	**24**	3	0.7	4	0.9
0.75	**35**	4	0.9	6	1.4
1	**47**	5	1.2	10	2.3
1.5	**71**	8	1.8	15	3.5
2	**94**	13	3.0	20	4.6
2.5	**118**	16	3.7	27	6.2
3	**142**	18	4.2	32	7.4
3.5	**165**	22	5.1	36	8.3
4	**189**	24	5.5	38	8.8
4.5	**213**	27	6.2	39	9.0
5	**236**	29	6.7	40	9.2
5.5	**260**	31	7.2	42	9.7
6	**283**	33	7.6	44	10.2
6.5	**307**	35	8.1	45	10.4
7	**331**	37	8.6	46	10.6
7.5	**354**	[illegible]	8.8	48	11.1

Observations

For the Contractor

Lab. Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 75...

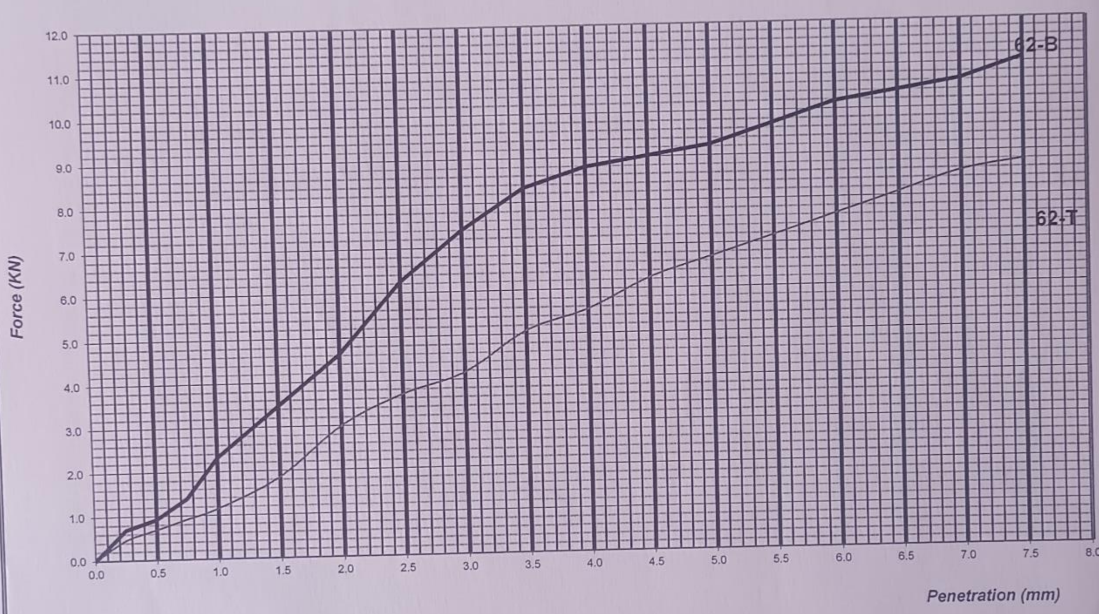
Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 10/Nov/25
Location:		Testing Date : 20/Nov/25
Depth:		Technician : Lab team
Sample Description: 60% GRAVEL WITH 40% QUARRY DUST		

PENETRATION vs FORCE CURVE



	62 blows											
	Force		CBR									
	Bottom	Top	Bottom	Top								
2.5 mm Penetration	6.2	3.7	47	28								
5.0 mm Penetration	9.2	[illegible]	46	34								
Average	7.7	[illegible]	46.7	30.8								
Retained CBR	46.7											
Observations	CBR = 46.7											

For the Lab

Lab. Technician	Materials Engineer		

STIRLING CIVIL ENGINEERING LTD. P. O. BOX 703, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	10/11/2025	100	100	99	79	70	60	52	1.17	28.2	21.2	7.0	3.4	2.022	16.6	69	0.22	0.22
			100	100	99	89	77	59	47	1.16	28.1	21.3	6.8	3.4	-	-	- - -	-	
			100	100	99.09	83.79	73.78	59.78	49.78	1.17	28.2	21.2	6.9	3.4	2.022	16.6	69	0.22	0.22
	AVERAGE		100	100	99	84	74	60	50	1.166	28.2	21.3	6.9	3.4	2.022	16.6	69	0.22	0.22

FOR LAB

STIRLING CIVIL ENGINEERING LTD
Materials Engineer
P. O. BOX 753, KAMPALA (U)

Lab Technician

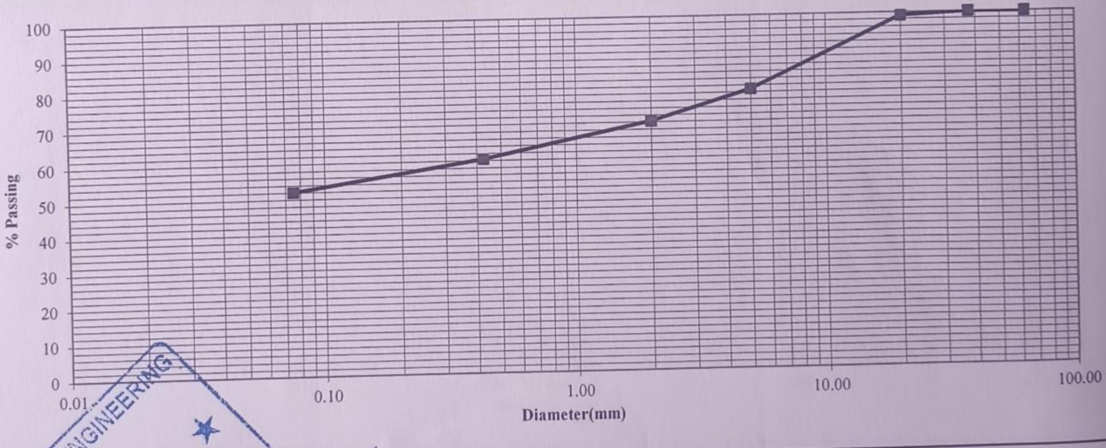
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5527.5
Depth: (m)		Dry wt. of sample after washing: (g)		2688.5
Material description:	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	13/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	55.4	1.0	**99**	60	95
5.0	1106.1	20.0	**79**	30	65
2.00	479.6	8.7	**70**	20	50
0.425	545.5	9.9	**60**	10	30
0.075	461.8	8.4	**52**	5	15
Total fines	2879.1	52.1			
Bottom Pan	40.1				
Extracted fines	2839.0				
Total sample	5527.5				
Grading Modulus		**1.17**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 753, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

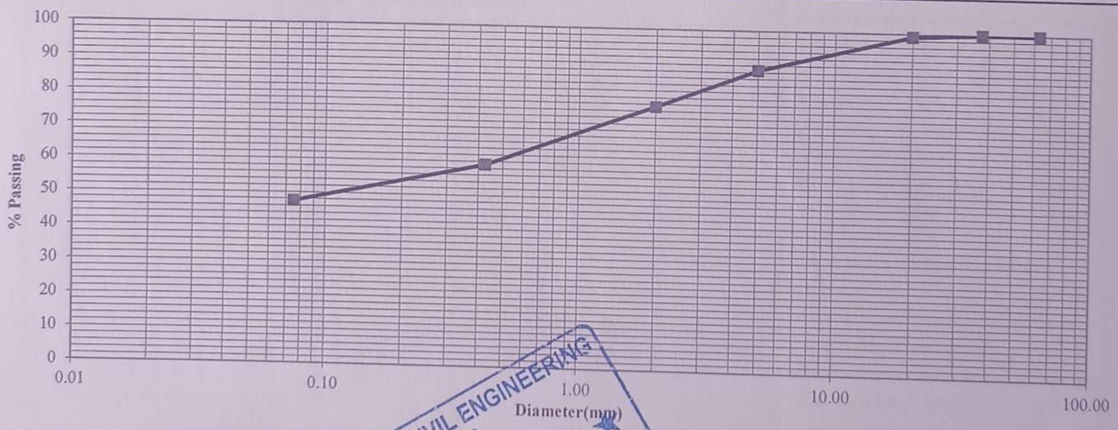
PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:	
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)	5540
Depth: (m)		Dry wt. of sample after washing: (g)	2945.3

Material description:	Date Sampled:	Date Tested:	Technician
70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	10/Nov/2025	13/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	45.7	0.8	**99**	60	95
5.0	585.9	10.6	**89**	30	65
2.00	628.3	11.3	**77**	20	50
0.425	1004.4	18.1	**59**	10	30
0.075	645.3	11.6	**47**	5	15
Total fines	2630.4	47.5			
Bottom Pan	35.7				
Extracted fines	2594.7				
Total sample	5540.0				
Grading Modulus		**1.16**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
26 NOV 2025
P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	**INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS**

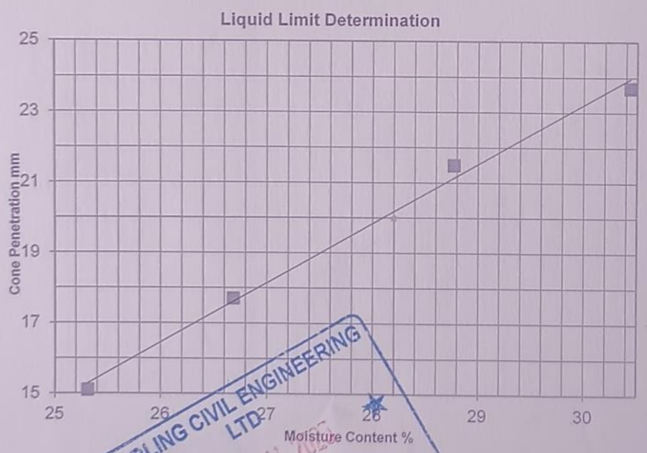
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 10% QUARRY DU:		Technician:	Lab Team
mix	MUKONO LAB		Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4		Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST			
Depth:				

PLASTIC LIMIT	Test No.	4P	BA		Average
Mass of wet soil + container (g)		30.01	32.58		31.295
Mass of dry soil + container (g)		28.67	30.92		29.795
Mass of container (g)		22.34	23.12		22.73
Mass of moisture (g)		1.34	1.7		1.5
Mass of dry soil (g)		6.33	7.8		7.065
Moisture content %		21.2	21.3		21.2
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.1	17.7	21.5	23.7
penetration (mm)		15.1	17.7	21.5	23.7
AVERAGE		15.1	17.7	21.5	23.7
Container No.		4B	PA	PIBO	PI52
Mass of wet soil + container (g)		43.82	49.27	46.28	55.79
Mass of dry soil + container (g)		36.32	40.40	37.56	44.47
Mass of container (g)		6.69	7.16	7.25	7.28
Mass of moisture (g)		7.5	8.87	8.72	11.32
Mass of dry soil (g)		29.63	33.24	30.31	37.19
Moisture content (%)		25.3	26.7	28.8	30.4
AVERAGE		25.3	26.7	28.8	30.4



Liquid limit (%)	28.2
Plastic limit (%)	21.2
Plasticity Index (%)	7.0
Linear shrinkage	
Trough No.	1
Trough length (cm)	14.0
Specimen length (cm)	13.5
L.shringage =	0.5
% L.shrinkage =	3.4

Remarks:

TESTING LAB		STUDENTS
Materials Engineer.		
Lab Technician		

STIRLING CIVIL ENGINEERING LTD
26 NOV 2025
P. O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	**INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS**

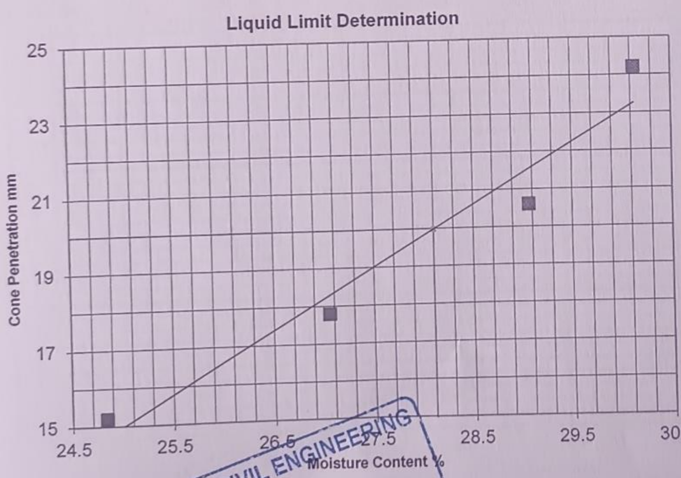
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 10% QUARRY DU	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	DT	Q		Average
Mass of wet soil + container (g)		31.76	30.55		31.155
Mass of dry soil + container (g)		30.2	28.98		29.59
Mass of container (g)		22.78	21.67		22.225
Mass of moisture (g)		1.56	1.6		1.565
Mass of dry soil (g)		7.42	7.31		7.365
Moisture content %		21.0	21.5		21.3
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.2	17.8	20.6	24.2
penetration (mm)		15.2	17.8	20.6	24.2
AVERAGE		15.2	17.8	20.6	24.2
Container No.		PIBB	PI33	A6	VE
Mass of wet soil + container (g)		51.79	52.87	47.00	51.08
Mass of dry soil + container (g)		42.86	43.09	37.97	40.82
Mass of container (g)		6.91	6.94	6.90	6.77
Mass of moisture (g)		8.93	9.78	9.03	10.26
Mass of dry soil (g)		35.95	36.15	31.07	34.05
Moisture content (%)		24.8	27.1	29.1	30.1
AVERAGE		24.8	27.1	29.1	30.1



Liquid limit (%)	28.1
Plastic limit (%)	21.3
Plasticity Index (%)	6.8
Linear shrinkage	
Trough No.	1
Trough length (cm)	14.0
Specimen length (cm)	13.5
L.shringage =	0.5
% L.shrinkage =	3.4

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	________________
Lab Technician	________________

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 783, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	**WEERE JONATHAN REG NO. M22B32/032**	**Stirling**

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS			
Test Reference No.	Lab. Reference No.	Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB	10/Nov/25	13/Nov/25	Lab team
Material description:	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	110	170	230	290	350
Mass of Compacted soil + mould	gm	5,352	5,506	5,665	5,605	5,536
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	2047	2201	2360	2300	2231
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	2.047	2.201	2.360	2.300	2.231

DATA FOR PROCTOR CURVE

Container No.		UCU	MJR	UPC	FDC	RWE
Mass of wet soil + Container	gm	3,148.0	2,809.0	2,448.0	2,248.0	2,756.0
Mass of dry soil + container	gm	2,887.0	2,552.0	2,211.0	2,024.0	2,418.0
Mass of container	gm	807.0	791.0	808.0	805.0	813.0
Mass of water added	gm	261	257	237	224	338
Mass of dry soil	gm	2080	1761	1403	1219	1605
Moisture content	%	12.5	14.6	16.9	18.4	21.1
Dry density	g/cm^3	1.819	1.921	2.019	1.943	1.843

Maximum dry density (gm/cm^3) 2.022 Optimum moisture content (%) 16.6

Remarks:

FOR TESTING LAB

Lab Technician	Materials Engineer		

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	15/Nov/25
		Testing Date :	22/Nov/25
Sample Description:	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	Technician :	: Lab team
		Volume of Mould used (m^3)	**2305**

Natural moisture of air dried sample			Volume of water added	
Tin No.	KT		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	3195		MDD (Mg/m^3)	2.022
Tin + oven dry soil sample (g)	3056		N.M.C (%)	6.2
Tin (g)	798		OMC (%)	16.6
Dry soil sample	2258		Added OMC (%)	10.4
Water (g)	139		Calculated dry wt of soil (g)	5630.6
N.M.C (%)	6.2		Water added (g)	590
Average (%)	6.2		**Water added (mL)**	**590**

Number of blows		62			
Number of layer		5			
Water Content Determination		Before Soaking		After Soaking	
Tare No		MJR	-	CR7	-
Mass of wet sample + Tare	g	2348	-	2537	-
Mass of dry sample + Tare	g	2125	-	2260	-
Mass of Tare	g	792	-	770	-
Mass of water	g	223	-	277	-
Mass of dry sample	g	1333	-	1490	-
Water content	%	16.7	-	18.6	-
Average water Content	%	16.7		18.6	
Density determination					
Mould No		33			
Mass of mould + soil	g	12845		12946	
Mass of mould	g	7410		7410	
Mass of soil	g	5435		5536	
Volume of the mould	cm3	2305		2305	
Moist density	g/cm3	2.358		2.402	
Dry density	g/cm3	2.020		2.025	
Swell Determination					
Date		Hour		D.Gauge Reding	
Initial reading		96 hrs		2.10	
Final reading				2.38	
Height of the specimen				127	
Height of swell				0.28	
		Swelling(%)		0.22	

Observations	
For the Lab	
Lab. Technician	*Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 733, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date	10/Nov/25
Location:		Penetration Date	22/Nov/25
Depth :		Technician	: : Lab team
Sample Description :	: 70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST		

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	33		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312

Speed : ... ...mm/min.		Top		Bottom	
Penetration of the plunger (mm)	Time (s)	Reading $*10^3$mm	Force (KN)	Reading $*10^3$mm	Force (KN)
0	**0**	0	0.0	0	0.0
0.25	**12**	4	0.9	8	1.8
0.5	**24**	7	1.6	11	2.5
0.75	**35**	11	2.5	16	3.7
1	**47**	15	3.5	20	4.6
1.5	**71**	23	5.3	27	6.2
2	**94**	31	7.2	33	7.6
2.5	**118**	38	8.8	38	8.8
3	**142**	43	9.9	44	10.2
3.5	**165**	47	10.9	49	11.3
4	**189**	50	11.6	53	12.3
4.5	**213**	53	12.3	57	13.2
5	**236**	55	12.7	61	14.1
5.5	**260**	57	13.2	64	14.8
6	**283**	59	13.6	67	15.5
6.5	**307**	61	14.1	69	16.0
7	**331**	63	14.6	72	16.6
7.5	**354**	65	15.0	75	17.3

Observations

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 733, KAMPALA (U)
23 NOV 2025

	For the Contractor	
Lab. Technician	*Materials Engineer*	

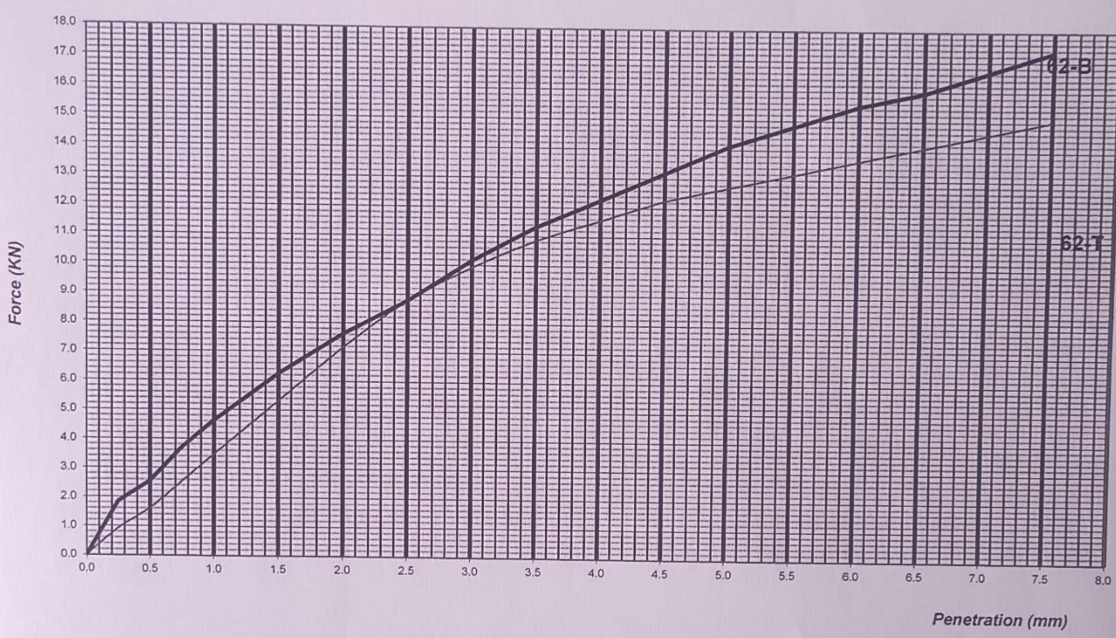
Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 10/Nov/25
Location:		Testing Date : 22/Nov/25
Depth:		Technician : Lab team
Sample Description:	70% GRAVEL WITH 10% QUARRY DUST & 20% KILN DUST	

PENETRATION vs FORCE CURVE



	62 blows												
	Force		CBR										
	Bottom	Top	Bottom	Top									
2.5 mm Penetration	8.8	8.8	66	66									
5.0 mm Penetration	14.1	12.7	71	64									
Average	11.4	10.8	68	65.0									
Retained CBR	68.5												

Observations CBR= 68.5

For the Lab

Lab. Technician	*Materials Engineer*	

STIRLING CIVIL ENGINEERING LTD
P. O. BOX

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling
PROJECT	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS	

STABLISED CBR

(BS 1924 PART 2 1)

Load applied 140kpa/s

70% GRAVEL WITH 10% QUARRY DUST 20% KILN DUST

M/c of air dried sample			
Tin No.		KT	
Tin + Wet soil	gm	3,195.0	
Tin + Dry Soil	gm	3,056.0	
Tin	gm	798.0	
Water	gm	139.0	
Dry Soil	gm	2,258.0	
M/c	%	6.2	
Av. M/c	%	6.2	

M/c After Mixing			
Stabliser	CEMENT KILN DUST		
Content	20.0		
Tin No.	TED		
Tin + Wet Soil	1,985.0		
Tin + Dry Soil	1,725.0		
Tin	150.0		
Water	260.0		
Dry Soil	1,575.0		
M/c	16.5		

(a)MDD 2.022 kg/m3

(c)WD 3.357 kg/m3

(d)OMC 16.6 %

(b)Air Dry M/c 6.2 %

(e)M/c to add 10.4 %

(F) volume 2.305

Date prepared 15/Nov/25 Date immerse 22/Nov/25 Date tested 29/Nov/25

Mould No.			
Factor(f)	2.305		
(h)Wet Soil to fill mould c x f x %comp	7,736.8		
(j) Wt of air dried soil	6,000		
Air dry M/c	6.2		
(k) soil dry wt (100j/100+b)	5,652.1		
Stabliser	CEMENT KILN DUST		
(m)Stablisers content %	20.0		
(n) Stabliser to add k x(m/100)	1,130.4		
Water Addition((j+n)x(d-b))/(100+b)	701.5		
Wt. per layer CBR Only h/3	2,578.9		

SPECIMEN WEIGHT CHECK			
No. of blows	62.0	62.0	AVERAGE
Mould No.	7 DAYS AIR TIGHT	7 DAYS AIR TIGHT, 7 DAYS SOAKED	
Stabliser	CEMENT KILN DUST	CEMENT KILN DUST	
Content %	20.0	20.0	
Mould g	A	B	
Wet Soil g	5,124.0	5,170.0	
Compaction M/c %	16.5	16.5	
Dry density kg/m3	1.908	1.925	
%Compaction	94.4	95.2	
FORCE	17.3	16.4	
UCS	0.951	0.900	0.93

STIRLING CIVIL ENGINEERING LTD 29 NOV 2025 P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	10/11/2025	100	100	91	66	58	48	43	1.51	30.4	21.5	8.9	4.3	2.075	16.1	57	0.35	0.35
			100	100	92	67	57	48	43	1.53	30.4	21.5	8.9	4.3	-	-	- - -	-	
			100	100	91.19	66.24	57.32	48.07	42.53	1.52	30.4	21.5	8.9	4.3	2.075	16.1	57	0.35	0.35
	AVERAGE		100	100	91	66	57	48	43	1.521	30.4	21.5	8.9	4.3	2.075	16.1	57	0.35	0.35

FOR LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 793, KAMPALA (U)

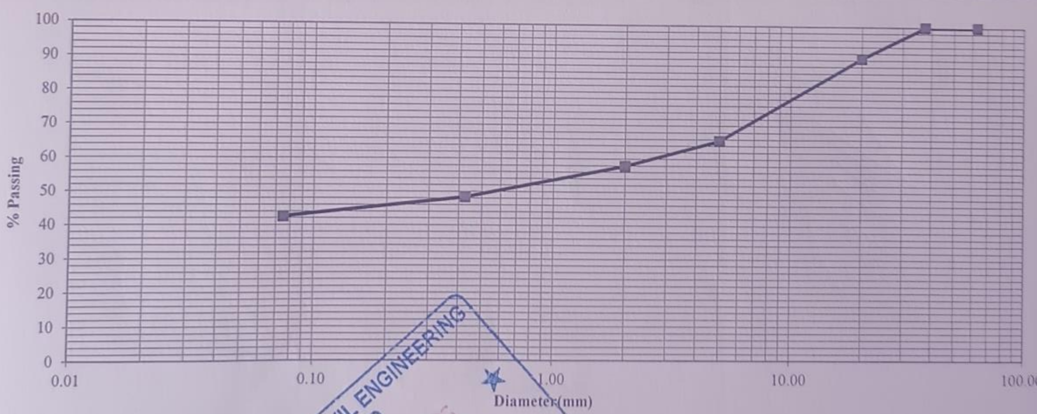
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5514.8
Depth: (m)		Dry wt. of sample after washing: (g)		3202.8
Material description:	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	13/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	100	100	100
37.5	0.0	0.0	100	80	100
20.0	522.2	9.5	91	60	95
5.0	1377.6	25.0	66	30	65
2.00	422.9	7.7	58	20	50
0.425	525.9	9.5	48	10	30
0.075	320.8	5.8	43	5	15
Total fines	2345.4	42.5			
Bottom Pan	33.4				
Extracted fines	2312.0				
Total sample	5514.8				
Grading Modulus		1.51			



FOR TESTING LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
26 NOV 2025
P. O. BOX 793, KAMPALA (U)

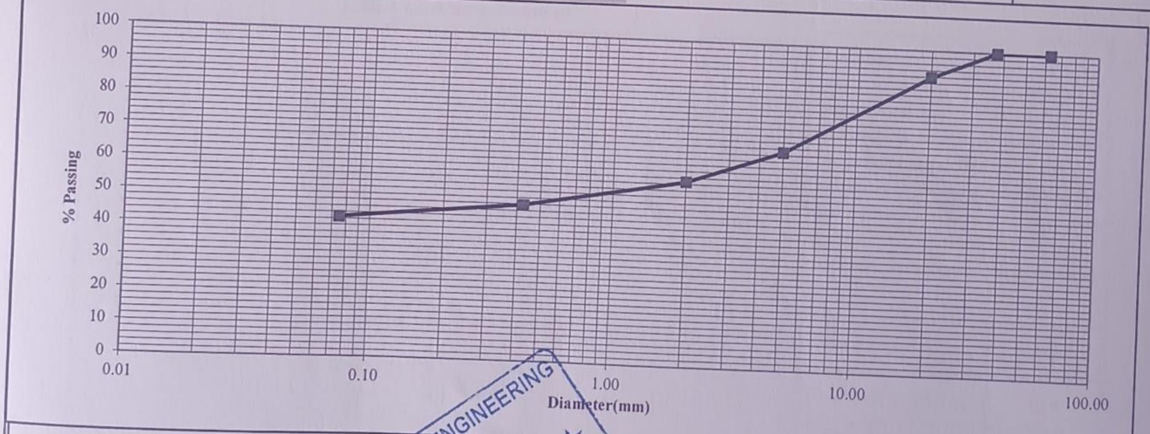
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:	
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)	5557.4
Depth: (m)		Dry wt. of sample after washing: (g)	3233.2
Material description:	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Date Sampled: 10/Nov/2025	Date Tested: 13/Nov/2025
		Technician	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**		
37.5	0.0	0.0	**100**	100	100
20.0	453.3	8.2	**92**	80	100
5.0	1384.9	24.9	**67**	60	95
2.00	565.5	10.2	**57**	30	65
0.425	498.1	9.0	**48**	20	50
0.075	291.6	5.2	**43**	10	30
Total fines	2364.0	42.5		5	15
Bottom Pan	39.8				
Extracted fines	2324.2				
Total sample	5557.4				
Grading Modulus		**1.53**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD 26 NOV 2025 P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

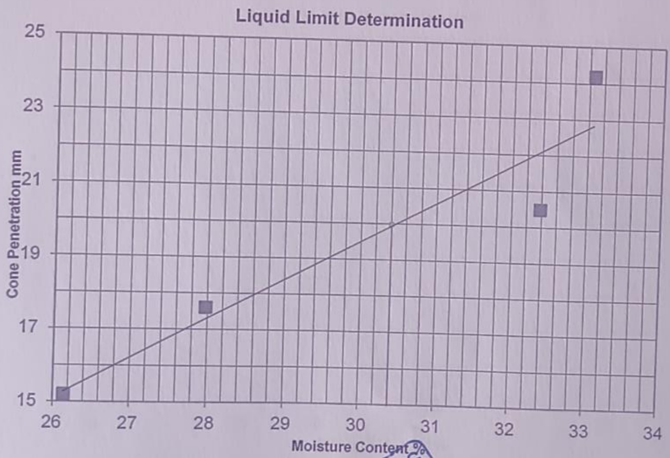
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 15% QUARRY DU		
mix	MUKONO LAB	Technician:	Lab Team
Test method	BS 1377: Part 2, 1990:4.3/4.4	Sample Date	10/Nov/2025
LAYER	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Test Date	14/Nov/2025
Depth:			

PLASTIC LIMIT	Test No.	4L	Q		Average
Mass of wet soil + container (g)		32.83	28.94		30.885
Mass of dry soil + container (g)		30.99	27.64		29.315
Mass of container (g)		22.31	21.69		22
Mass of moisture (g)		1.84	1.3		1.57
Mass of dry soil (g)		8.68	5.95		7.315
Moisture content %		21.2	21.8		21.5
AVERAGE					21.5

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.2	17.6	20.5	24.2
penetration (mm)		15.2	17.6	20.5	24.2
AVERAGE		15.2	17.6	20.5	24.2
Container No.		28PI	PIBB	PIVPN	P152
Mass of wet soil + container (g)		48.15	47.24	48.79	48.93
Mass of dry soil + container (g)		39.62	38.41	38.60	38.56
Mass of container (g)		6.99	6.85	7.13	7.20
Mass of moisture (g)		8.53	8.83	10.19	10.37
Mass of dry soil (g)		32.63	31.56	31.47	31.36
Moisture content (%)		26.1	28.0	32.4	33.1
AVERAGE		26.1	28.0	32.4	33.1



Liquid limit (%)	30.4
Plastic limit (%)	21.5
Plasticity Index (%)	8.9
Linear shrinkage	
Trough No.	J
Trough length (cm)	14.0
Specimen length (cm)	13.4
L.shringage =	0.6
% L.shrinkage =	4.3

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	
Lab Technician	

STIRLING CIVIL ENGINEERING LTD
20 NOV 2025
BOX 7..., KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

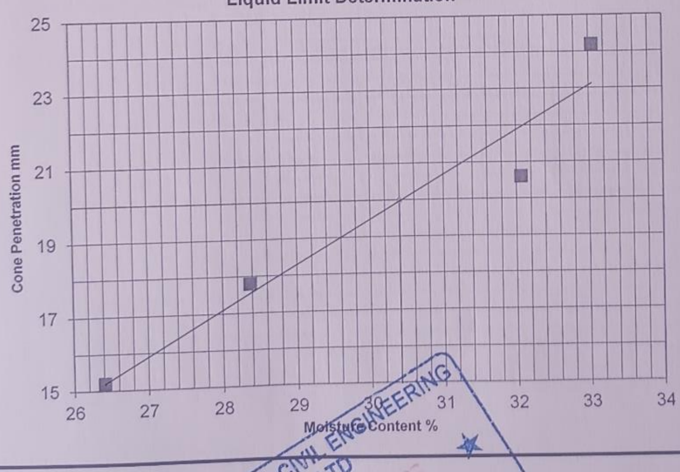
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 15% QUARRY DU	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	13	DT		Average
Mass of wet soil + container (g)		31.68	31.97		31.825
Mass of dry soil + container (g)		30.05	30.34		30.195
Mass of container (g)		22.44	22.78		22.61
Mass of moisture (g)		1.63	1.6		1.63
Mass of dry soil (g)		7.61	7.56		7.585
Moisture content %		21.4	21.6		21.5
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.2	17.8	20.6	24.2
penetration (mm)		15.2	17.8	20.6	24.2
AVERAGE		15.2	17.8	20.6	24.2
Container No.		PI600	PA	4B	AX
Mass of wet soil + container (g)		48.78	52.37	58.82	52.91
Mass of dry soil + container (g)		40.06	42.35	46.16	41.47
Mass of container (g)		7.04	7.03	6.68	6.85
Mass of moisture (g)		8.72	10.02	12.66	11.44
Mass of dry soil (g)		33.02	35.32	39.48	34.62
Moisture content (%)		26.4	28.4	32.1	33.0
AVERAGE		26.4	28.4	32.1	33.0



Liquid limit (%)	30.4
Plastic limit (%)	21.5
Plasticity Index (%)	8.9
Linear shrinkage	
Trough No.	J
Trough length (cm)	14.0
Specimen length (cm)	13.4
L.shringage =	0.6
% L.shrinkage =	4.3

Remarks:

TESTING LAB		STUDENTS
Materials Engineer.		
Lab Technician		

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

Test Reference No.	Lab. Reference No.	Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB	10/Nov/25	13/Nov/25	Lab team
Material description:	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	110	170	230	290	350
Mass of Compacted soil + mould	gm	5,456	5,622	5,714	5,664	5,612
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	2151	2317	2409	2359	2307
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	2.151	2.317	2.409	2.359	2.307

DATA FOR PROCTOR CURVE

Container No.		CR7	EVE	NMT	GMM	Z6T
Mass of wet soil + Container	gm	2,613.0	3,082.0	3,120.0	2,663.0	3,119.0
Mass of dry soil + container	gm	2,410.0	2,790.0	2,793.0	2,368.0	2,731.0
Mass of container	gm	771.0	763.0	766.0	757.0	808.0
Mass of water added	gm	203	292	327	295	388
Mass of dry soil	gm	1639	2027	2027	1611	1923
Moisture content	%	12.4	14.4	16.1	18.3	20.2
Dry density	g/cm^3	1.914	2.025	2.074	1.994	1.920

Maximum dry density (gm/cm^3) 2.075 Optimum moisture content (%) 16.1

Remarks:

FOR TESTING LAB

Lab Technician	Materials Engineer	

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	15/Nov/25
		Testing Date :	22/Nov/25
Sample Description:	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Technician :	: Lab team
		Volume of Mould used (m^3)	**2305**

Natural moisture of air dried sample			**Volume of water added**	
Tin No.	ACB		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	2480		MDD (Mg/m^3)	2.075
Tin + oven dry soil sample (g)	2395		N.M.C (%)	5.2
Tin (g)	775		OMC (%)	16.1
Dry soil sample	1620		Added OMC (%)	10.9
Water (g)	85		Calculated dry wt of soil (g)	5685.2
N.M.C (%)	5.2		Water added (g)	**619**
Average (%)	5.2		**Water added (mL)**	**619**

Number of blows		**62**				
Number of layer		5				
Water Content Determination		Before Soaking		After Soaking		
Tare No		ACB	-	UCU	-	
Mass of wet sample + Tare	g	2093	-	3127	-	
Mass of dry sample + Tare	g	1913	-	2705	-	
Mass of Tare	g	771	-	150	-	
Mass of water	g	180	-	422	-	
Mass of dry sample	g	1142	-	2555	-	
Water content	%	15.8	-	16.5	-	
Average water Content	%	15.8		16.5		
Density determination						
Mould No		2				
Mass of mould + soil	g	10638		10676		
Mass of mould	g	5574		5574		
Mass of soil	g	5064		5102		
Volume of the mould	cm3	2305		2305		
Moist density	g/cm3	2.197		2.214		
Dry density	g/cm3	1.898		1.900		
Swell Determination						
Date		Hour		D.Gauge Reding		
Initial reading		96 hrs		5.69		
Final reading				6.14		
Height of the specimen				127		
Height of swell				0.45		
		Swelling(%)		0.36		
Observations						

For the Lab		
Lab. Technician	*Materials Engineer*	

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P.O. BOX 733, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date	10/Nov/25
Location:		Penetration Date	22/Nov/25
Depth :		Technician	: : Lab team
Sample Description :	: **70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST**		

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	2		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312
Speed :… … … …mm/min.			

Penetration of the plunger (mm)	Time (s)	Top Reading $*10^3$mm	Top Force (KN)	Bottom Reading $*10^3$mm	Bottom Force (KN)
0	**0**	0	0.0	0	0.0
0.25	**12**	3	0.7	7	1.6
0.5	**24**	5	1.2	9	2.1
0.75	**35**	7	1.6	11	2.5
1	**47**	9	2.1	14	3.2
1.5	**71**	12	2.8	18	4.2
2	**94**	16	3.7	24	5.5
2.5	**118**	19	4.4	30	6.9
3	**142**	22	5.1	35	8.1
3.5	**165**	24	5.5	40	9.2
4	**189**	26	6.0	45	10.4
4.5	**213**	28	6.5	49	11.3
5	**236**	30	6.9	53	12.3
5.5	**260**	32	7.4	57	13.2
6	**283**	34	7.9	61	14.1
6.5	**307**	36	8.3	64	14.8
7	**331**	[illegible]	8.8	68	15.7
7.5	**354**	40	9.2	72	16.6

Observations

For the Contractor

Lab. Technician | *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 25, KAMPALA (U)
23 NOV 2025

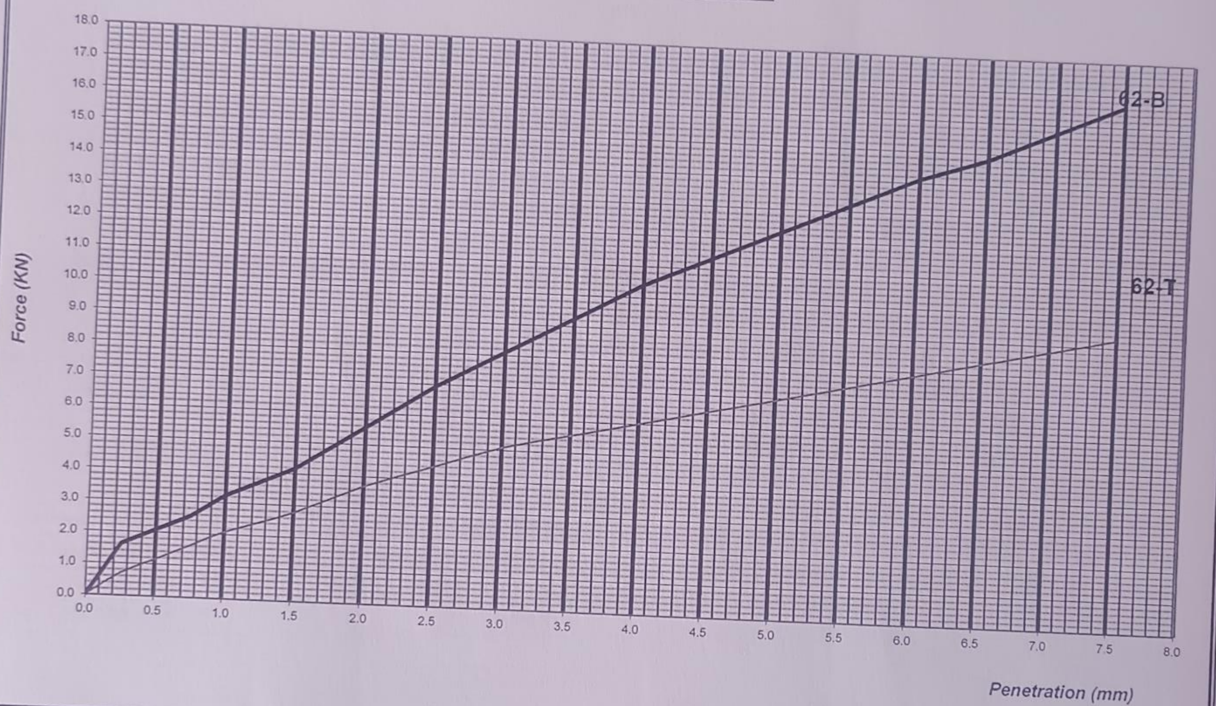
Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:		
Location:		Sampling Date :	10/Nov/25
Depth:		Testing Date :	22/Nov/25
Sample Description:	70% GRAVEL WITH 15% QUARRY DUST & 15% KILN DUST	Technician	: Lab team

PENETRATION vs FORCE CURVE



	62 blows			
	Force		CBR	
	Bottom	Top	Bottom	Top
2.5 mm Penetration	6.9	4.4	52	33
5.0 mm Penetration	12.3	6.9	61	35
Average	9.6	5.7	56.9	34.0
Retained CBR		56.9		
Observations	CBR= 56.9			

For the Lab

Lab. Technician	*Materials Engineer*	

STIRLING CIVIL ENGINEERING LTD
P.O. BOX ..., KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling
PROJECT	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS	

STABLISED CBR

(BS 1924 PART 2 1)

Load applied 140kpa/s

70% GRAVEL WITH 15% QUARRY DUST 15% KILN DUST

M/c of air dried sample			
Tin No.		ACB	
Tin + Wet soil	gm	2,480.0	
Tin + Dry Soil	gm	2,395.0	
Tin	gm	775.0	
Water	gm	85.0	
Dry Soil	gm	1,620.0	
M/c	**%**	**5.2**	
Av. M/c	**%**	5.2	

M/c After Mixing			
Stabliser	CEMENT KILN DUST		
Content	15.0		
Tin No.	JET		
Tin + Wet Soil	1,265.0		
Tin + Dry Soil	1,111.0		
Tin	130.0		
Water	**154.0**		
Dry Soil	**981.0**		
M/c	**15.7**		

(a)MDD 2.075 kg/m3

(c)WD 3.341 kg/m3

(d)OMC 16.1 %

(b)Air Dry M/c 5.2 %

(e)M/c to add 10.9 %

(F) volume 2.305

Date prepared 15/Nov/25	Date immerse 22/Nov/25	Date tested 29/Nov/25	
Mould No.			
Factor(f)	2.305		
(h)Wet Soil to fill mould c x f x %comp	7,700.4		
(j) Wt of air dried soil	6,000		
Air dry M/c	5.2		
(k) soil dry wt (100j/100+b)	5,700.9		
Stabliser	CEMENT KILN DUST		
(m)Stablisers content %	15.0		
(n) Stabliser to add k x(m/100)	855.1		
Water Addition((j+n)x(d-b))/(100+b)	706.9		
Wt. per layer CBR Only h/3	2,566.8		

SPECIMEN WEIGHT CHECK			
No. of blows	62.0	62.0	AVERAGE
Mould No.	7 DAYS AIR TIGHT	7 DAYS AIR TIGHT, 7 DAYS SOAKED	
Stabliser	CEMENT KILN DUST	CEMENT KILN DUST	
Content %	15.0	15.0	
Mould g	A	B	
Wet Soil g	5,124.0	5,170.0	
Compaction M/c %	15.7	15.7	
Dry density kg/m3	1.921	1.939	
%Compaction	92.6	93.4	
FORCE	13.9	15.3	
UCS	0.761	0.837	0.80

STIRLING CIVIL ENGINEERING LTD
26 NOV 2025
P.O. BOX 783, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

SUMMARY OF TEST RESULTS FOR 70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST

LOCATION	BLENDED %	SAMPLING DATE	GRADING								ATTERBERG LIMITS				MDD		CBR	CBR SWELL	
			63	37.5	20	5	2	0.425	0.075	GM	LL	PL	PI	LS	MDD	OMC	62 BLOWS OF COMPACTION	62	AVERAGE
MUKONO LAB	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	10/11/2025	100	100	92	65	56	47	43	1.54	33.85	23.1	10.8	5.1	2.096	15.6	52	0.39	0.39
			100	100	95	66	56	46	42	1.57	33.7	23.0	10.7	5.1	-	-	- - -	-	
			100	100	93.62	65.41	55.86	46.53	42.49	1.55	33.8	23.1	10.7	5.1	2.096	15.6	52	0.39	0.39
	AVERAGE		100	100	94		56	47	42	1.551	33.8	23.0	10.7	5.1	2.096	15.6	52	0.39	0.39

FOR LAB

Lab Technician

Materials Engineer

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling
PROJECT	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS	

STABLISED CBR | Load applied 140kpa/s

(BS 1924 PART 2 1)

70% GRAVEL WITH 20% QUARRY DUST 10% KILN DUST

M/c of air dried sample		
Tin No.	2I	
Tin + Wet soil gm	2,104.0	
Tin + Dry Soil gm	2,061.0	
Tin gm	750.0	
Water gm	43.0	
Dry Soil gm	1,311.0	
M/c %	3.3	
Av. M/c %	3.3	

M/c After Mixing			
Stabliser	CEMENT KILN DUST		
Content	10.0		
Tin No.	AVE		
Tin + Wet Soil	989.0		
Tin + Dry Soil	869.0		
Tin	78.0		
Water	120.0		
Dry Soil	791.0		
M/c	15.2		

(a)MDD 2.096 kg/m3 | (b)Air Dry M/c 3.3 %

(c)WD 3.269 kg/m3 | (e)M/c to add 12.3 %

(d)OMC 15.6 % | (F) volume 2.305

Date prepared 15/Nov/25 Date immerse 22/Nov/25 Date tested 29/Nov/25

Mould No.			
Factor(f)	2.305		
(h)Wet Soil to fill mould c x f x %comp	7,535.0		
(j) Wt of air dried soil	6,000		
Air dry M/c	3.3		
(k) soil dry wt (100j/100+b)	5,809.5		
Stabliser	CEMENT KILN DUST		
(m)Stablisers content %	10.0		
(n) Stabliser to add k x(m/100)	580.9		
Water Addition((j+n)x(d-b))/(100+b)	785.0		
Wt. per layer CBR Only h/3	2,511.7		

SPECIMEN WEIGHT CHECK			
No. of blows	62.0	62.0	AVERAGE
Mould No.	7 DAYS AIR TIGHT	7 DAYS AIR TIGHT, 7 DAYS SOAKED	
Stabliser	CEMENT KILN DUST	CEMENT KILN DUST	
Content %	10.0	10.0	
Mould g	A	B	
Wet Soil g	5,124.0	5,078.0	
Compaction M/c %	15.2	15.2	
Dry density kg/m3	1.930	1.913	
%Compaction	92.1	91.3	
FORCE	9.0	9.2	
UCS	0.495	0.507	0.50

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5714.2
Depth: (m)		Dry wt. of sample after washing: (g)		3260.5
Material description:	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	13/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	449.4	7.9	**92**	60	95
5.0	1533.7	26.8	**65**	30	65
2.00	531.9	9.3	**56**	20	50
0.425	504.9	8.8	**47**	10	30
0.075	218.6	3.8	**43**	5	15
Total fines	2475.7	43.3			
Bottom Pan	22.0				
Extracted fines	2453.7				
Total sample	5714.2				
Grading Modulus		**1.54**			

FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD
23 NOV 2025
P. O. BOX 793, KAMPALA (U)

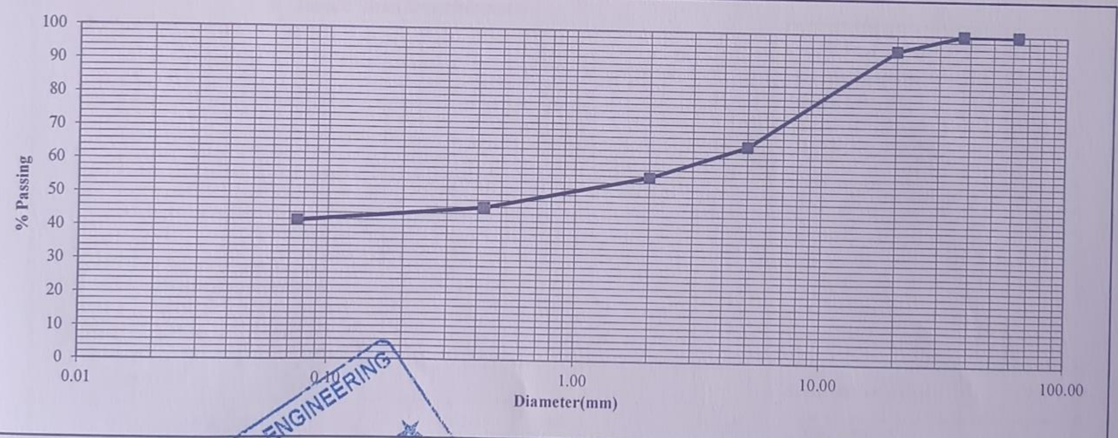
INSTITUTION	STUDENTS NAMES	CONTRACTOR
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT : INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

PARTICLE SIZE DISTRIBUTION (BS 1377 - 2 - 90)

Test Reference No.:		Lab. Refernece No.:		
Location :(km)	MUKONO LAB	Dry wt. of sample before washing: (g)		5525.8
Depth: (m)		Dry wt. of sample after washing: (g)		3252.6
Material description:	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	Date Sampled:	Date Tested:	Technician
		10/Nov/2025	13/Nov/2025	Lab team

Sieve Size (mm)	Weight Retained (g)	Retained (%)	Passing (%)	Grading Limits (G60 & 80)	
63.0	0.0	0	**100**	100	100
37.5	0.0	0.0	**100**	80	100
20.0	270.4	4.9	**95**	60	95
5.0	1634.7	29.6	**66**	30	65
2.00	541.2	9.8	**56**	20	50
0.425	543.2	9.8	**46**	10	30
0.075	234.2	4.2	**42**	5	15
Total fines	2302.1	41.7			
Bottom Pan	28.9				
Extracted fines	2273.2				
Total sample	5525.8				
Grading Modulus		**1.57**			



FOR TESTING LAB

Lab Technician *Materials Engineer*

STIRLING CIVIL ENGINEERING LTD P.O. BOX ..., KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

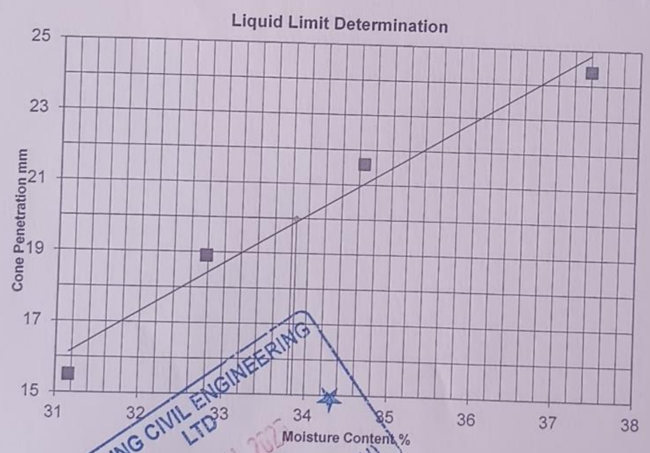
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 20% QUARRY DUS	Technician:	Lab Team
mix	MUKONO LAB		
Test method	BS 1377: Part 2, 1990:4.3/4.4	Sample Date	10/Nov/2025
LAYER	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	Test Date	14/Nov/2025
Depth:			

PLASTIC LIMIT	Test No.	OO	13		Average
Mass of wet soil + container (g)		35.78	35.99		35.885
Mass of dry soil + container (g)		33.16	33.43		33.295
Mass of container (g)		21.67	22.46		22.065
Mass of moisture (g)		2.62	2.6		2.59
Mass of dry soil (g)		11.49	10.97		11.23
Moisture content %		22.8	23.3		23.1
AVERAGE					23.1

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.5	18.9	21.6	24.4
penetration (mm)		15.5	18.9	21.6	24.4
AVERAGE		15.5	18.9	21.6	24.4
Container No.		PI20	PI66	A6	KO
Mass of wet soil + container (g)		51.65	45.56	44.10	46.89
Mass of dry soil + container (g)		42.18	36.06	34.50	36.01
Mass of container (g)		11.79	7.08	6.80	6.92
Mass of moisture (g)		9.47	9.5	9.6	10.88
Mass of dry soil (g)		30.39	28.98	27.7	29.09
Moisture content (%)		31.2	32.8	34.7	37.4
AVERAGE		31.2	32.8	34.7	37.4



Liquid limit (%)	33.9
Plastic limit (%)	23.1
Plasticity Index (%)	10.8
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	13.3
L.shringage =	0.7
% L.shrinkage =	5.1

Remarks:

TESTING LAB

Materials Engineer.

Lab Technician

STUDENTS

STIRLING CIVIL ENGINEERING LTD
P. O. BOX 733, KAMPALA (U)

INSTITUTION	STUDENTS	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT:	INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

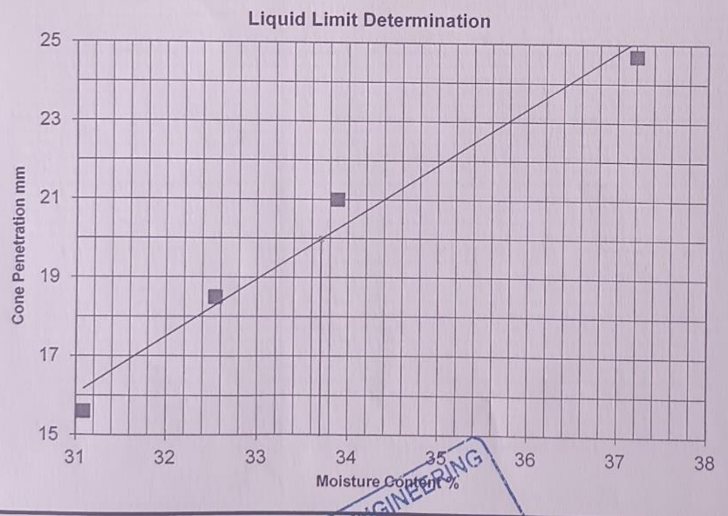
ATTERBERG LIMITS

Liquid limit (cone penotrometer) and plastic limit

Material description:	70% GRAVEL WITH 20% QUARRY DUS	Technician:	Lab Team
mix	MUKONO LAB	Sample Date	10/Nov/2025
Test method	BS 1377: Part 2, 1990:4.3/4.4	Test Date	14/Nov/2025
LAYER	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST		
Depth:	0		

PLASTIC LIMIT	Test No.	LL	PNU		Average
Mass of wet soil + container (g)		35.89	35.17		35.53
Mass of dry soil + container (g)		33.33	32.88		33.105
Mass of container (g)		22.33	22.84		22.585
Mass of moisture (g)		2.56	2.3		2.425
Mass of dry soil (g)		11	10.04		10.52
Moisture content %		23.3	22.8		23.0
AVERAGE					

LIQUID LIMIT	Test No	1	2	3	4
Initial gauge reading (mm)		0	0	0	0
Final gauge reading (mm)		15.6	18.5	21	24.7
penetration (mm)		15.6	18.5	21.0	24.7
AVERAGE		15.6	18.5	21.0	24.7
Container No.		28PI	KF	PI52	PIV6
Mass of wet soil + container (g)		59.30	49.97	60.76	46.85
Mass of dry soil + container (g)		46.89	40.69	47.20	36.06
Mass of container (g)		6.97	12.17	7.18	7.06
Mass of moisture (g)		12.41	9.28	13.56	10.79
Mass of dry soil (g)		39.92	28.52	40.02	29
Moisture content (%)		31.1	32.5	33.9	37.2
AVERAGE		31.1	32.5	33.9	37.2



Liquid limit (%)	33.7
Plastic limit (%)	23.0
Plasticity Index (%)	10.7
Linear shrinkage	
Trough No.	T
Trough length (cm)	14.0
Specimen length (cm)	13.3
L.shringage =	0.7
% L.shrinkage =	5.1

Remarks:

TESTING LAB	STUDENTS
Materials Engineer.	
Lab Technician	

STIRLING CIVIL ENGINEERING LTD
13 NOV 2025
P.O. BOX 793, KAMPALA (U)

INSTITUTION	STUDENTS NAMES	TESTING LAB
UGANDA CHRISTIAN UNIVERSITY	WEERE JONATHAN REG NO. M22B32/032	Stirling

PROJECT: INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

Test Reference No.	Lab. Reference No.	Date Sampled	Date Tested	Technician
LOCATION	MUKONO LAB	10/Nov/25	13/Nov/25	Lab team
Material description:	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	Natural moisture (%) :	11.0	

TEST DATA

Weight of rammer (Kg)	No. of blows per layer	No of layers	Height of drop (mm)	Diameter of mould(mm)	Volume of mould (cm^3)
4.5	27	3	457	100	1,000

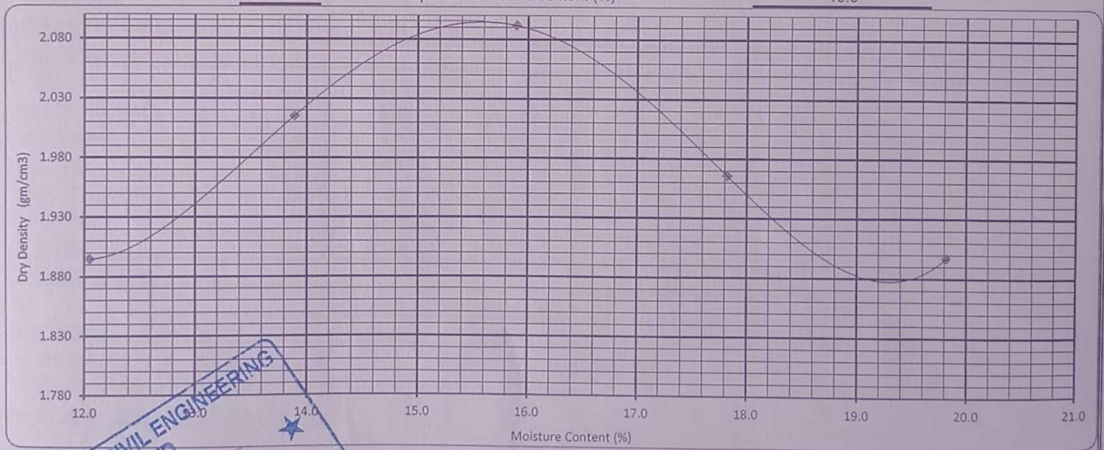
MOISTURE CONTENT DATA

Test No.		1	2	3	4	5
Tin No.		A	A	A	A	A
Water Added	cm^3	80	140	200	260	320
Mass of Compacted soil + mould	gm	5,428	5,600	5,729	5,621	5,578
Mass of Mould	gm	3,305	3,305	3,305	3,305	3,305
Mass of Compacted soil	gm	2123	2295	2424	2316	2273
Volume of mould	cm^3	1,000	1,000	1,000	1,000	1,000
Wet density of soil	g/cm^3	2.123	2.295	2.424	2.316	2.273

DATA FOR PROCTOR CURVE

Container No.		ACB	GMM	KAU	MJR	2I
Mass of wet soil + Container	gm	2,648.0	2,867.0	2,904.0	2,966.0	2,644.0
Mass of dry soil + container	gm	2,447.0	2,610.0	2,615.0	2,637.0	2,339.0
Mass of container	gm	779.0	760.0	797.0	791.0	800.0
Mass of water added	gm	201	257	289	329	305
Mass of dry soil	gm	1668	1850	1818	1846	1539
Moisture content	%	12.1	13.9	15.9	17.8	19.8
Dry density	g/cm^3	1.895	2.015	2.092	1.966	1.897

Maximum dry density (gm/cm^3) 2.096 Optimum moisture content (%) 15.6



Remarks:

FOR TESTING LAB			
Lab Technician	Materials Engineer		

STIRLING CIVIL ENGINEERING LTD
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P. O. BOX 733, KAMPALA (U)

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS 1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date :	10/Nov/25
Location:	MUKONO LAB	Casting date :	15/Nov/25
		Testing Date :	22/Nov/25
Sample Description:	70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST	Technician :	: Lab team
		Volume of Mould used (m^3)	2305

Natural moisture of air dried sample			Volume of water added	
Tin No.	21		Mass of air dried soil (g)	6000
Tin + air dried soil sample (g)	2104		MDD (Mg/m^3)	2.096
Tin + oven dry soil sample (g)	2061		N.M.C (%)	3.3
Tin (g)	750		OMC (%)	15.6
Dry soil sample	1311		Added OMC (%)	12.3
Water (g)	43		Calculated dry wt of soil (g)	5803.2
N.M.C (%)	3.3		Water added (g)	716
Average (%)	3.3		**Water added (mL)**	716

Number of blows		62			
Number of layer		5			
Water Content Determination		Before Soaking		After Soaking	
Tare No		UPC	-	A6	-
Mass of wet sample + Tare	g	2447	-	1905	-
Mass of dry sample + Tare	g	2228	-	1628	-
Mass of Tare	g	808	-	150	-
Mass of water	g	219	-	277	-
Mass of dry sample	g	1420	-	1478	-
Water content	%	15.4	-	18.7	-
Average water Content	%	15.4		18.7	
Density determination					
Mould No		29			
Mass of mould + soil	g	12972		13156	
Mass of mould	g	7421		7421	
Mass of soil	g	5551		5735	
Volume of the mould	cm3	2305		2305	
Moist density	g/cm3	2.408		2.488	
Dry density	g/cm3	2.086		2.095	
Swell Determination					
Date		Hour		D.Gauge Reding	
Initial reading		96 hrs		6.32	
Final reading				6.82	
Height of the specimen				127	
Height of swell					
		Swelling(%)		0.39	

Observations	
For the Lab	
Lab. Technician	*Materials Engineer*

STIRLING CIVIL ENGINEERING LTD P. O. BOX 733, KAMPALA (U) 26 NOV 2025

Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date	10/Nov/25
Location:		Penetration Date	22/Nov/25
Depth :		Technician	: : Lab team
Sample Description :	: 70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST		

Number of blows per layer	62		
Number of layers	5	5	5
Mould No	29		
Capacity of the Proving Ring (KN)	50	50	50
Proving Ring Constant (KN/div.)	0.2312	0.2312	0.2312

Speed : ... ...mm/min.		Top		Bottom	
Penetration of the plunger (mm)	Time (s)	Reading *10³mm	Force (KN)	Reading *10³mm	Force (KN)
0	**0**	0	0.0	0	0.0
0.25	**12**	4	0.9	14	3.2
0.5	**24**	7	1.6	17	3.9
0.75	**35**	10	2.3	20	4.6
1	**47**	12	2.8	23	5.3
1.5	**71**	14	3.2	25	5.8
2	**94**	17	3.9	28	6.5
2.5	**118**	19	4.4	30	6.9
3	**142**	22	5.1	33	7.6
3.5	**165**	24	5.5	35	8.1
4	**189**	27	6.2	38	8.8
4.5	**213**	29	6.7	41	9.5
5	**236**	30	6.9	44	10.2
5.5	**260**	32	7.4	47	10.9
6	**283**	34	7.9	50	11.6
6.5	**307**	35	8.1	5[illegible]	12.5
7	**331**	36	8.3	58	13.4
7.5	**354**	37	8.6	62	14.3

Observations

For the Contractor

Lab. Technician	*Materials Engineer*		

STIRLING CIVIL ENGINEERING LTD
P.O. BOX ... KAMPALA (U)

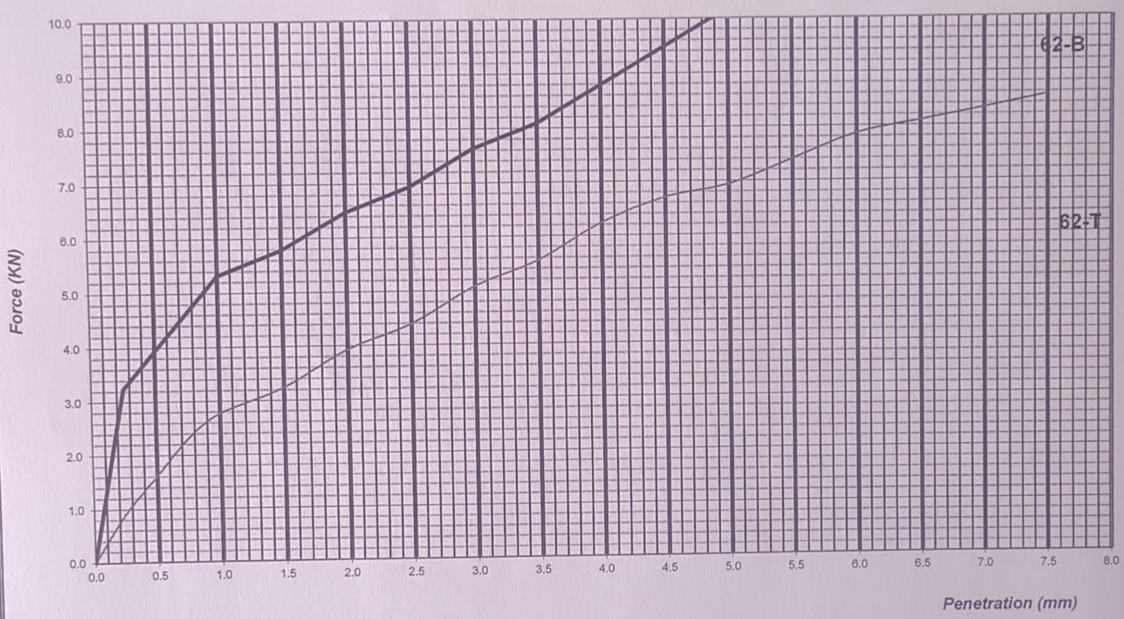
Institution	Students Names	Testing Lab
UGANDA CHRISTIAN UNIVERSITY A Centre of Excellence in the Heart of Africa	WEERE JONATHAN REG NO. M22B32/032	Stirling

INVESTIGATING THE EFFECT OF CEMENT KILN DUST AND QUARRY DUST ON THE STABILIZATION OF LATERITE SOILS

CALIFORNIA BEARING RATIO TEST (BS1377 Part 4)

Test sample reference :	Laboratory Reference No.:	Sampling Date : 10/Nov/25
Location:		Testing Date : 22/Nov/25
Depth:		Technician : Lab team
Sample Description: 70% GRAVEL WITH 20% QUARRY DUST & 10% KILN DUST		

PENETRATION vs FORCE CURVE



	62 blows										
	Force		CBR								
	Bottom	Top	Bottom	Top							
2.5 mm Penetration	6.9	4.4	52	33							
5.0 mm Penetration	10.2	6.9	51	35							
Average	8.6	5.7	51.7	34.0							
Retained CBR											
Observations	CBR= 51.7										

For the Lab		
Lab. Technician	*Materials Engineer*	

STIRLING CIVIL ENGINEERING LTD
P.O. BOX 759, KAMPALA (U)