ADDIS ABABA UNIVERSITY

ADDIS ABABA INSTITUTE OF TECHNOLOGY (AAIT)
SCHOOL OF CIVIL AND ENVIROMETAL ENGINEERING
GEOTECHNICAL ENGINEERING STREAM
POST-GRADUATE STUDIES

EFFECT OF STRAIN RATE ON UNDRAINED SHEAR STRENGTH AND SENSITIVITY OF RED CLAY SOIL FOUND IN ADDIS ABABA

By
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March, 2018
Addis Ababa
Ethiopia

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A thesis submitted to the school of graduate studies of Addis Ababa University, Addis Ababa Institute of Technology (AAiT), School of Civil and Environmental Engineering, Post-Graduate studies in partial fulfillment of the requirements for the Masters of Science in Geotechnical Engineering Stream of Civil and Environmental Engineering School.

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DECLARATION

I, the undersigned, declare that this thesis is my own original work performed under the supervision of my research advisor Dr.-Ing Samuel Tadesse, School of Civil and Environmental Engineering, Addis Ababa University as part of the Degree of Master of Science in Geotechnical Engineering Program in accordance with the rule and regulation of the institute and all sources of materials used for this thesis have also been duly acknowledged.

Name: Rabia Hussen

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Date: March, 2018

Dedicated to

My

Father

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Table of Contents

Abbreviations and symbols

AA	Addis Ababa
AAiT	Addis Ababa institute of Technology
AAU	Addis Ababa University
Ac	Activity number
a.m.s.l	above mean sea level
AASHTO	American Association of Highway and Transportation Officials
ASTM	American Society of Testing and Materials
CFEM	Canadian Foundation Engineering Manual,
C	Clay content
Cc	Compression index
CH	Inorganic clays of high plasticity
CL	Inorganic cays of low to medium plasticity
CSA	Central Statistic Agency
Cu	Undrained shear strength
Cv	Coefficient of consolidation
D	Diameter of sample used for un confined compressive strength test
E	Void ratio
eo	Initial void ratio
FS	Free Swell
Gs	Specific gravity
H_{dr}	Drainage height
Ht, Hs	Height of specmen
Hi, Ho	Initial height
H	Height used for un confined compressive strength test
q_u	Unconfined compressive strength test
LL	Liquid Limit
MD	Mass of dry soil

ML	Inorganic silts of low plasticity
MH	Inorganic silts of high plasticity
MW	Mass of wet soil g
MC/NMC	Natural moisture content
MDD	Maximum dry density
N	Number of Sample
OCR	Over consolidation ratio
OH	Organic clays of medium of high plasticity
OL	Organic silts of low plasticity
OMC	Optimum moisture content
Pc	Pre consolidation pressure
Po	Overberden pressure
PI	Plastic Index
PL	Plastic Limit
qu	Unconfined compressive strength test
St	sensitivity
t90	time in which 90 % of consolidation occurred
USCS	Unified Soil Classification System
UC	Unconfined compressive strength test
%	Percentage
ε	Strain rate

List of Tables

List of Figures

ABSTRACT

Soil presents itself to be one of the most complicated materials owing to widespread variation of its properties which changes in both geometrical composition and time based contexts. For design and analysis of any structure supported by soil, the shear strength parameters of the soil are vital and they should be obtained from laboratory and in-situ tests. Since the shear strength parameters are not intrinsic properties of soil, there are a number of factors which affect the estimates obtained from tests, out of which rate of loading or shearing and the initial degree of compaction poses to be the most important factors that should be taken in to account while conducting the tests.

In Addis Ababa lot of construction activities are seen like foundation structure of heavy duty machineries, high rise building, slope stability in embankment fill, design of highway pavements and deep vertical excavation. In doing such activities the strength and properties of soil which the structures to be built must be studied. The shear strength of the soil is affected by the rate of strain. So it is necessary to incorporate the effect of varying strain rate on such geotechnical problems. In this study, the effect of strain rate on undrained shear strength of both undisturbed and remolded samples and sensitivity of red clay soil are investigated using unconfined compression tests.

In this thesis, the UC tests were carried out on undisturbed and remolded samples using different strain rates which are obtained from the coefficient of consolidation for each load increment of one-dimensional consolidation. The strain rates are (0.37, 0.84, 1.03, 1.12, 1.61, 1.75) and (0.23, 0.53, 0.61, 0.68, 1.06, 1.14) for the undisturbed and remolded samples respectively. The remolded samples are tested for both strain rates in order to determine sensitivity accordingly.

The undrained shear strength increases from (62.7 to 256.5) kPa and from (59.6 to 157.5) kPa as the strain rate increases from (0.37 to 1.75) mm/min for undisturbed and remolded samples respectively and also from (45.3 to 123.9) kPa as the strain rate increases from (0.23 to 1.14) mm/min for the remolded samples. The failure strain decreases from (8.95 to 3.29) % and from (15 to 7.24) % as the strain rate increases from (0.37-1.75) mm/min for undisturbed and remolded samples respectively and also from (15 to 9.21) % as the strain rate increases from (0.23 to 1.14) mm/min for the remolded samples. The sensitivity increases from (1.05 to 1.63) and (1.38 to 2.07) as the strain rate increases from (0.37 to 1.75) and (0.23 to 1.14) respectively.

The test results show that, as the strain rate increases the undrained shear strength increases and the failure strain slightly decreases for both undisturbed and remolded samples and also the sensitivity increases. Besides on the basis of their sensitivity, the soil in the study area can be classified as insensitive.

Keywords: Strain rate, Undrained shear strength, sensitivity, red clay soil

Chapter One

1. Introduction

1.1. General

Soil is a natural property of earth, which is formed by small pieces of mineral particles and it may contain water, air and organic materials. It supports every construction which is designed by human such as buildings, retaining walls and embankments. There are many types of soils. The main soil groups are granular soil, fine-grained soil and organic soil. Soil presents itself to be one of the most complicated materials owing to widespread variation of its properties which changes in both geometrical composition and time based contexts.

The safety of any geotechnical structure is dependent on the strength of the soil. If the soil fails a structure founded on it can collapse. Soil fails either in tension or shear. However in majority of soil mechanics problems (such as bearing capacity, lateral earth pressure against retaining wall, slope stability, etc.) only failure in shear requires consideration. Therefore for design and analysis of any structure supported by soil, the shear strength parameters of the soil are vital and they should be obtained from laboratory and in-situ tests. Since the shear strength parameters are not inherent properties of soil, there are a number of factors which affect the estimates obtained from tests, out of which rate of loading or shearing, initial moisture content and the initial degree of compaction poses to be the most important factors that should be taken in to account while conducting the tests. [Das, B. M. 200]

1.2. Background of the Research

Addis Ababa is the capital city of the country, as a result, a lot of construction activities are seen. Such as foundation structure of heavy duty machinery, high rise building, slope stability in embankment fill, highway pavements and deep excavation. In doing such activities the strength and properties of soil in which the structures to be built must be studied. The shear strength of the soil is one the most important aspect in the design of the above-mentioned construction works and it is affected by the rate of strain. Soi1 is necessary to incorporate this factor. In this study, the effect of strain rate on the undrained shear strength of both undisturbed and remolded samples are presented and sensitivity of red clay due to the change in strain rate is also investigated using unconfined compression test. The unconfined compression test is carried out using different strain rates and the mechanisms behind it are studied.

1.3. Statement of the Problem

Determining the effect of strain rate on the shear strength of clay soil is essential for geotechnical problems like slope stability analysis, foundation design, bearing capacity calculation and earth quick analysis. The shear failure of a mass of soil does not simply fall to a constant rate, but to a certain extent depends on the degree and rate of displacement. Specifically, the aim was to attempt to ascertain the relationship between strain rate and undrained shear strength.

1.4. Hypothesis

Since the shear strength parameters are not inherent properties of soil, there are a number of factors which affect the estimates obtained from tests, out of which rate of loading or shearing and the initial degree of compaction poses to be the most important factors that should be taken in to account while conducting the tests. Different codes suggest different rates of strain for laboratory shear tests. Prior works by researchers have pointed out that the undrained shear strength of clay soil is affected by variation in strain rate

1.5 Objectives of the Study

1.5.1General Objective

The main objective of the study is to investigate the effect of strain rate on undrained shear strength and sensitivity of red clay soil found in Addis Ababa using unconfined compression test at different strain rates.

1.5.2 Specific Objective

The Specific Objectives of this research are:

- To perform unconfined compression test on both undisturbed and remolded samples from Addis Ababa on red clay soil using different strain rates.

- To evaluate the effect of strain rate on the undrained shear strength of red clay soil and the mechanism behind it is studied and verified.
- To compare the effect of strain rate on undrained shear strength for undisturbed and remolded samples.
- To evaluate the effect of strain rate on sensitivity of red clay found in Addis Ababa.

1.6Methodology

To achieve the objectives of this research the following methodology will be implemented.

1.6.1 Pre field work

- Existing literature related to clay soils, undrained shear strength, strain rate, unconfined compression test, sensitivity of clay will be thoroughly reviewed and studied
- The accepted theories and practices in the topic areas are used.

1.6.2 Field work

- Study site identification for the assessment and selection of the test sites and its description
- Soil samplings have been conducted based on a well-scheduled fieldwork program.
- Excavating a trial pits and sufficient samples have been collected.
- Disturbed and Undisturbed samples are gathered.

Figure 1-1 typical profile of sample area (kolfe area)

1.6.3Laboratory works

Laboratory tests on collected samples were conducted and some of the geotechnical properties were determined. The tests are conducted on a soil samples collected from kolfe area of Addis Ababa city.

The following tests are carried out on all collected samples according to ASTM (American Society for Testing Materials).

- ***Index Property Tests (***natural moisture content, specific gravity, consistency limit and particle size distribution tests.)
- ***One dimensional Odometric test.***
- ***Unconfined compression test.***
- Based on the theories and laboratory tests performed the results obtained have been analyzed
- Finally conclusion and recommendation are made.

1.7 Scope of the Study

The current research work focuses on Western part of Addis Ababa where red clay soil is dominantly found especially around Kolfe area. In order to achieve the general as well as specific objectives, disturbed and undisturbed samples were collected at depths of 2.5 m. The remolded samples were prepared by compacting the undisturbed samples using standard compaction and it was assumed that the remolded samples are nearly of the same moisture content and density to that of the undisturbed samples even if there may be very little variation due to sample preparation. While conducting the unconfined compression strength tests both undisturbed and remolded samples were tasted at strain rates (ε mm/min) of (0.37, 0.84, 1.03, 1.12, 1.61, 1.75) and (0.23, 0.53, 0.61, 0.68, 1.06, 1.14) for remolded samples only which were determined from the coefficient of consolidation values for each load increment from one dimensional consolidation as per ASTM standard by using this formula $C_v = (0.848*H_{dr}^2)/t90$ and $\varepsilon = 0.1C_v/H_{dr}^2$.

1.8 Application of Results

The fact that the compressive strength of a soil is a function of the time required to reach the failure load has long been recognized. However, this area of soil mechanics has not been extensively explored and much work remains to be done, in order that the effects of strain rate variation can be properly evaluated. The specific areas where this information would be of the greatest benefit are as follows:

(a) Stability of slopes subjected to earthquakes and other forms of transient loading, and also different stability problems such as evaluation of earth pressure, bearing capacity of footings and foundations, stability of embankments and earth dams,

(b) Design of highway pavements,

(c) Design of airfield pavements, and

(d) Transmission of forces from explosions through soils, so determining the effect of strain rate for such activities is a crucial thing.

1.9 Limitations

This research study may undergo some limitations on remolding of the samples for unconfined compressive strength tests since it was done by using standard compaction method only due to shortage of time and undisturbed samples. Remolding with modified compaction was not done.

1.10 Organization of the Thesis

The thesis has been divided in to six Chapters. In this introductory Chapter general, background of the research, statement of the problem, hypothesis, objective, research methodology, scope of the study, application of results, Limitations and organization of the thesis work is presented. The second Chapter gives a brief literature review which discusses about clay mineralogy, Origin and Mineral Composition of Ethiopian Red Clay, Shear strength of soils, stress strain behavior, effect of strain rate, soil remolding and sensitivity of soil. Sampling area description is dealt with in Chapter three. In the fourth Chapter the types of laboratory tests conducted with results for the research are described in detail. The laboratory test results discussion are presented in Chapter five. Chapter six contains the conclusions and recommendations drawn from the research. At last in the appendix the raw data is shown.

Chapter Two

2. Literature Review

2.1. General

2.1.1 Clay Mineralogy

The term clay can refer both to a size and to a class of minerals. As a size term, it refers to all constituents of a soil smaller than a particular size, usually 0.002 mm in engineering classifications. As a mineral term, it refers to specific clay minerals that are distinguished by small particle size, an electrical charge, plasticity when mixed with water and high weathering resistance .Clay minerals are produced mainly from the chemical weathering and decomposition of feldspars, such as orthoclase and plagioclase, and some micas. They are small in size and very flaky in shape. [Mitchell, 1993]

The thickness of clays is very small relative to their length and breadth, in some cases as thin as $1/100^{th}$ of the length. Therefore, they have high to very high specific surface values. These surfaces carry a small negative electrical charge that will attract the positive end of water molecules. This charge depends on the soil mineral and may be affected by an electrolyte in the pore water. This causes some additional forces between the soil grains which are proportional to the specific surface. Thus, a lot of water may be held as adsorbed water within clay mass. The following table shows examples of mineral grain specific surfaces. The more elongated or flaky a particle is the greater will be its specific surface. The various clay minerals are formed by the stacking combinations of basic sheet structures with different forms of bonding between the combined sheets. The main clay minerals are: Kaolinite Illite and Montmorillonite. [Lesilie, 2000]

Table 2-1 Examples of clay mineral grain specific surfaces [Lesilie, 2000]

Mineral/Soil	**Grain width, d (μm)**	**Thickness**	**Specific Surface m^2/N**
Kaolinite	2.0 - 0.3	≈0.2d	2
Illite	2.0 - 0.2	≈0.1d	8
Montmorillonite	1.0 - 0.01	≈0.01d	80

2.1.2 Origin and Mineral Composition of Addis Ababa Red Clay soils

The red clay soil in Addis Ababa covers North and North-west of the city. Geotechnical drilling data and engineering geological map of Addis Ababa, reveal that red clays in Addis Ababa are dominantly underlain by basalts; basic (dark colored) igneous rock rich in iron and magnesium (Kebede Tsehayu et al.,1990). Geotechnical data from 1996 to 2014 shows red clays in Addis Ababa are extensively distributed around Gulele sub-city, Burayu and part of Kolfe Keraniyo specifically around Atanatera. Some part of Addis Ketema and Arada sub-cities are also covered with red clays. (Lamesgin Melesse, 2014). Besides, from the engineering geological map of Addis Ababa (Kebede Tsehayu et al., 1990), localities where red clays are found are underlain by dominantly of basalts although there are places in Gulele where red clays are underlain by rhyolite. Summary on properties of Addis Ababa red clay soil is shown below.

Table 2-2 Properties of Addis Ababa red clay soils from previous research

Properties	**Hailemariam** (1992)	**Medhanit (2009)**	**(Samuel ,1989)**		
Location	Addis Ababa	Addis Ababa	Kolfe	Semen Gebeya	Rufael
Clay content (%)	48 -73	55-65	58-70	53-68	50-70
Activity	-	0.11-0.70	-	-	-
LL (%)	54-81	39-106	61-75	57-76	56-75
PI (%)	21 - 30	9 -40	30-43	33-47	29-41
Shrinkage limit (%)	14 -22	12-20	15-21	14-25	14-20
Free swell (%)	10 -40	5- 80	15-45	15-50	30-40
Specific gravity	2.61 -2.79	2.6-2.8	2.66- 2.73	2.70-2.77	2.66- 2.74
Unconfined compression strength, qu(kN/m2)	49 - 250	64 - 213	-	-	-
Plasticity Chart	-	CH,CL,MH,	CH	CH	CH

2.1.3 Unconfined compressive Shear Strength Properties of Addis Ababa Red Clay Soil from previous studies

Different authors have investigated the shear strength of red clay soil in Addis Ababa. (Samuel .T, 1989) determined the unconsolidated undrained shear strength of red clay soils from Kolfe, Semen-Gebeye and Rufael area were 185, 180 and 180 kN/m^2 respectively. (Hailemariam .A, 1992) stated that unconfined compressive strength of Addis Ababa is 89 kN/m^2 and undrained shear strength is 45 kN/m^2 at an average moisture content of 29% and the unconfined compressive strength ranges between 49-250 kPa with moisture of 22-34 %. (Sisay.Y, 2005) explained the unconfined compressive strength of red clay samples collected from Kolfe area were ranges between 127-317 kPa during his studies on correlation between standard penetration and unconfined compression strength of Addis Ababa red clay soils. Soressa, M. 2016 states that UCS values for undisturbed sample collected from Bethel area ranges from 422.48 – 431.22 kPa and 429.28 – 440.99 kPa at 1.5m and 3m depth below the ground respectively.

From the above result, it is clearly observed that the unconfined compressive strength values of red clay soil in Addis Ababa highly differ from site to site from the previous studies. The difference may be due to initial moisture content, compaction density and testing rate contributes most importantly to strength variation. Besides type and properties of the soil, testing method, sampling time and depth also affects the result obtained from tests.

2.2. Shear strength of soils

The shear strength of soil describes the maximum shear stress that a soil can sustain in its incipient failure condition. The shear resistance is a combinatorial effect of friction and interlocking of particles (for granular soils), and possible cementation or bonding at particle contacts (in the presence of fine particles). Shear strength is also influenced by the volumetric changes occurring during shearing (which is manifested as contractive or dilative behavior) which result in the augmentation or attenuation of the net vertical stress on the shearing plane. The shear strength of soil is of special relevance amongst various geotechnical soil properties and it is one of the most essential entities for analyzing and solving different stability problems such as evaluation of earth pressure, bearing capacity of footings and foundations, Earth quick analysis of structures and slope stability or stability of embankments and earth dams. [50th Indian geotechnical conference] .The failure conditions of a soil may be expressed in terms of limiting shear stress, called shear strength, or as a function of principal stresses. The shearing resistance of soil is constituted of the following main components. [Kumari, D., 2009]

- The structural resistance to displacement of the soil because of the interlocking of the particles.
- The frictional resistance to translocation between the individual soil particles at their contact points.
- Cohesion or adhesion between the surfaces of the soil particles.

The shear strength in cohesionless soil results from inter-granular friction alone, while in cohesive soils it results both from internal friction as well as cohesion. Strength is the measure of the maximum stress state that can be induced in a material without it failing. The shear strength of a soil is indicative of the stability and strength of the soil under various conditions of loading, compaction, and moisture content. However, the shear strength value determined experimentally is not an exceptional constant, which is the characteristic of the material, but can vary with the method of testing. Shear strength parameters are crucial for stability analyses against slope failures and landslides. Soils with high shear strength will be able to support structures without failing. Otherwise, the structure will not be stable and side effects will occur, either, in the short term or long term depending on the shear strength.

2.2.1 Unconfined compression test

The unconfined compression test is by far the most popular method of soil shear testing because it is one of the fastest and cheapest methods of measuring shear strength. The method is used primarily for cohesive soils recovered from thin-walled sampling tubes. The unconfined compression test is inappropriate for dry sands or crumbly clays because the materials would fall apart without some land of lateral confinement. [Das, B. M. 2002]

The unconfined compression test is a very useful method for determining the shearing resistance of foundation soils. The test gives a quick determination of the shearing strength value of the soil in either its undisturbed or remolded state or under undrained conditions. It is extremely useful in the determination of the bearing capacity and sensitivity of soils and in other problems of soil mechanics especially those involving the $\phi = 0$ concept .The test is also being used increasingly in many parts of the world. [Das, B. M. 2002]

The unconfined compression test is a special type of unconsolidated-undrained test that is commonly used for clay specimens. In this test, the confining pressure σ_3 is 0. An axial load is rapidly applied to the specimen to cause failure. At failure, the total minor principal stress is zero and the total major principal stress is σ_1.Because the undrained shear strength is independent of the confining pressure as long as the soil is fully saturated and fully undrained. [Das, B. M. 2002]

2.2.2 Undrained shear strength

Undrained shear strength is used in design and analysis of foundations, retaining structures and embankments. Undrained condition occurred when the excess pore water pressure cannot drain at least quickly from the soil. (i.e change in u is different from zero).During undrained shearing the volume of soil remains constant, consequently, the tendency towards volume change induces a pressure in the pore water. The most critical condition for the soil usually occurs immediately after construction, which represents the undrained condition, when the undrained shear strength is basically equal to cohesion (cu). [Das, B. M. 2002]

This is expressed as: $(\sigma 1/2) = q_u/2= C_u$

Where q_u = unconfined compressive strength and C_u=undrained shear strength

The undrained shear strength C_u is the radius of the Mohr's total stress circle and can be represented as shown in the figure 2.1.

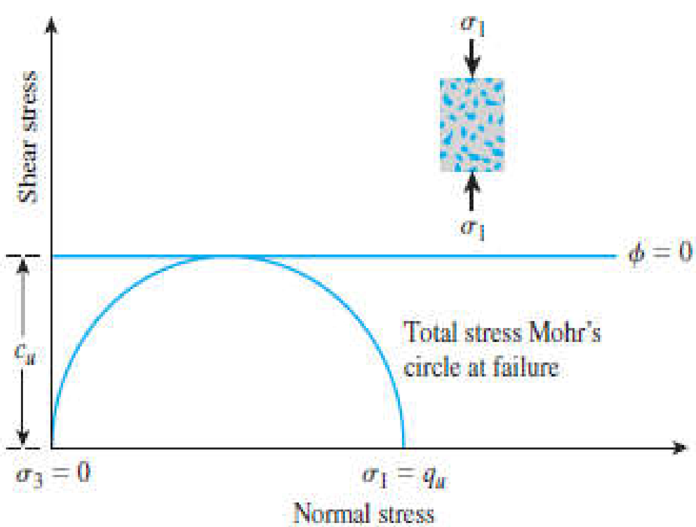

Figure 2-1 Mohr's Circle representation for unconfined compression test [Das, B. M. 2002]

2.3. Stress-Strain Behavior

The stress-strain behaviors of soils are different for different types and condition of soils. Soils like some quick clay, cemented soils, heavily over consolidated clays and dense sands have brittle nature. But Remolded and insensitive clays and loose sands have ductile nature. Increasing in pre shear consolidation pressure increases the modules of deformation as well as strength of clay soils. An increase in confining pressure has also similar effect for cohesion less soils. The pore water pressure of saturated clay increases while shearing, if drainage is not allowed. The amount of pore water pressure increment is dependent on interaction between fabric and stress state and the ease with which shear deformation can develop overall changes or transfer of normal stress from soil structure to the pore water pressure. The stress-strain behavior of soils is influenced by the density, drainage condition, stress history, loading path, and rate of loading. It is evident that to establish a single constitutive equation for the stress-strain relationship of soils is an enormous task. The stability analysis for problems in geotechnical engineering is concerned with the failure concept in which the soil is treated as a rigid plastic solid. Defining the failure state of the soil as a state of stress at which a small increment of stress will induce a relatively large increment of strain. For constant value of total minor principal stress the magnitude of the pore pressure developed in undrained loading may depend more on the strain than on the stress. [Mitchell, J. K., 1976].

2.4 Theory on rate effects

Strain rate is the change in strain **(deformation)** of a material with respect to time. The strain rate at some point within the material measures the rate at which the distances of adjacent parcels of the material change with time in the neighborhood of that point. The basis of rate process theory is that atoms, molecules and/or particles participating in a time dependent flow or deformation process, termed "flow units" are constrained from movement relative to each other by virtue of energy barriers separating adjacent equilibrium positions. [Glasstone, Laider and Eyring, 1941].

Briaud and Garland (1985) explained the physical reasons for rate-dependent properties of clays. They attribute rate dependent properties to three elements: pore water, particle contacts and water/soil skeleton interaction.

1. Water in pores is more viscous than clay particles. Water is a Newtonian fluid so by doubling the shearing rate of water the shear strength will also double. Therefore, the higher the water contents of the clay, the higher the viscosity of the clay.

2. Viscosity is also a factor in the particle contacts of the clay. These contacts consist of a mineral particle and its adsorbed water layer penetrating into the adsorbed water layer of another mineral particle. The viscosity of the adsorbed water layer is greater than that of the free water in pores. Therefore, if the overlap of adsorbed water layers becomes greater, then the viscosity of the clay will be greater. The overlap of layers is greater in over consolidated clays because they are forced closer together. Higher viscosity can also be seen if the adsorbed layers are thicker, such as with clays having high plasticity indexes.

3. Shear strength due to water/soil skeleton interaction varies with the rate of shear in the soil. The path of least resistance is found when the rate of shear is slow. With faster rates, the soil skeleton does not have time to deform and find the path of least resistance. Shear strength goes up with increased rate of strain. With higher rates of strain, pore pressures become more negative or less positive increases the shear strength of the soil. Permeability therefore affects the strain rate effects because with lower permeability, pore pressure does not dissipate when soil is sheared quickly, but it will dissipate if load is applied slowly enough.

2.4.1. Previous works on effect of Strain rate on Shear Strength

Admasu, T. (2003) showed, by triaxial shear tests on remolded samples, the strain rate affects both stress-strain relationship and strength of soil. As the strain rate increases the shear strength of soil also increases, but the strain rate has more pronounced effect on cohesion and little effect on angle of internal friction of the soil. The values of cohesion obtained from modified failure envelope for strain rate of 0.001mm/min, 0.01mm/min, 0.1mm/min and 1mm/min are 40.82kPa, 44.76kPa, 52.8kPa and 102.51kPa respectively.

Findings from the Literature review on the effect of strain rate on the undrained shear strength of clay soil by Biruk, A. (2007) showed that, the rate at which a saturated soil sheared increases, the undrained shear strength also increases. The rate effect up on strength caused by a change in the excess pore water generated during the shear process. While shearing saturated soil, it is advisable to use strain rate which insure the equalization of pore pressure in the specimen.

Investigations of the effect of the rate of loading on the shear strength characteristics of soils constitute an important aspect of the study of the strength characteristics of soils. Casagrande and Shannon, 1949 showed, by unconfined compression and triaxial shear tests, an increase in strength due to decrease in time of loading on Cambridge clay and on an unspecified sand. Seed, H.B., J.K., Mitchell and C.K. Chan, 1960 reported the effects of the duration and rate of loading on the unconfined compressive strength of compacted clay. The strength was found to decrease initially and thereafter increase with time. Goldstein, M. and Ter-Stepanian, 1957 have shown the unconfined and triaxial shear strength of compacted or undisturbed soil to reduce as the rate of loading decreases. The strength was found to decrease linearly with the logarithm of time when the clays were saturated. De Castro, I.C. and S.A. Ola, 1983 conducted drained triaxial tests on compacted Fadama soils from Nigeria and reported that, in general, at low strains the modulus of elasticity and deviator stress at failure increased with increasing rate of strain whilst the excess pore water pressure decreased with increased rate of strain. Supnik, R.H., 1962 in his work on "rate sensitivity" reported that materials were more rate sensitive if they were more viscoelastic and that the size and distribution of the viscous components controlled or limited the rate of sensitivity of a material. On vane shear tests several investigators reported the importance of the effect of time on the strength and sensitivity of cohesive soils. For example, Skempton, A.W. and R.D. Norothy, 1952 reported a loss in cohesion with decrease in rate of rotation. Torstension, B.A., 1977 showed that the shear strength values were appreciably affected by the testing rate, and also showed that, at the lowest speed of rotation, the stress-strain curve did not resemble that of a strain-softening material but of an ideal elastic plastic material. A clay soil, when tested by means of the unconfined compression apparatus, shows significant change in strength, as well as stress-strain behavior with variation in strain rate.

Clays have consistently been shown to exhibit significant “rate effects”, while with sand this phenomenon is less pronounced as displayed by Hyde et al. 1998. Factors other than grain size may also influence the effect of load rate phenomena.

Leroueil and Marques 1996 found that due to viscosity in clays, Su increases by about 10% per log cycle increase in load rate but decreases about 10% for each 120 C increase in dry temperature. Other factors that influence rate effects include, but are not limited to: plasticity index, over consolidation ratio (O.C.R.), soil structure, water content and aging. Though all of these factors have been shown to affect strain rate phenomenon, little research has been done to quantify their effects.

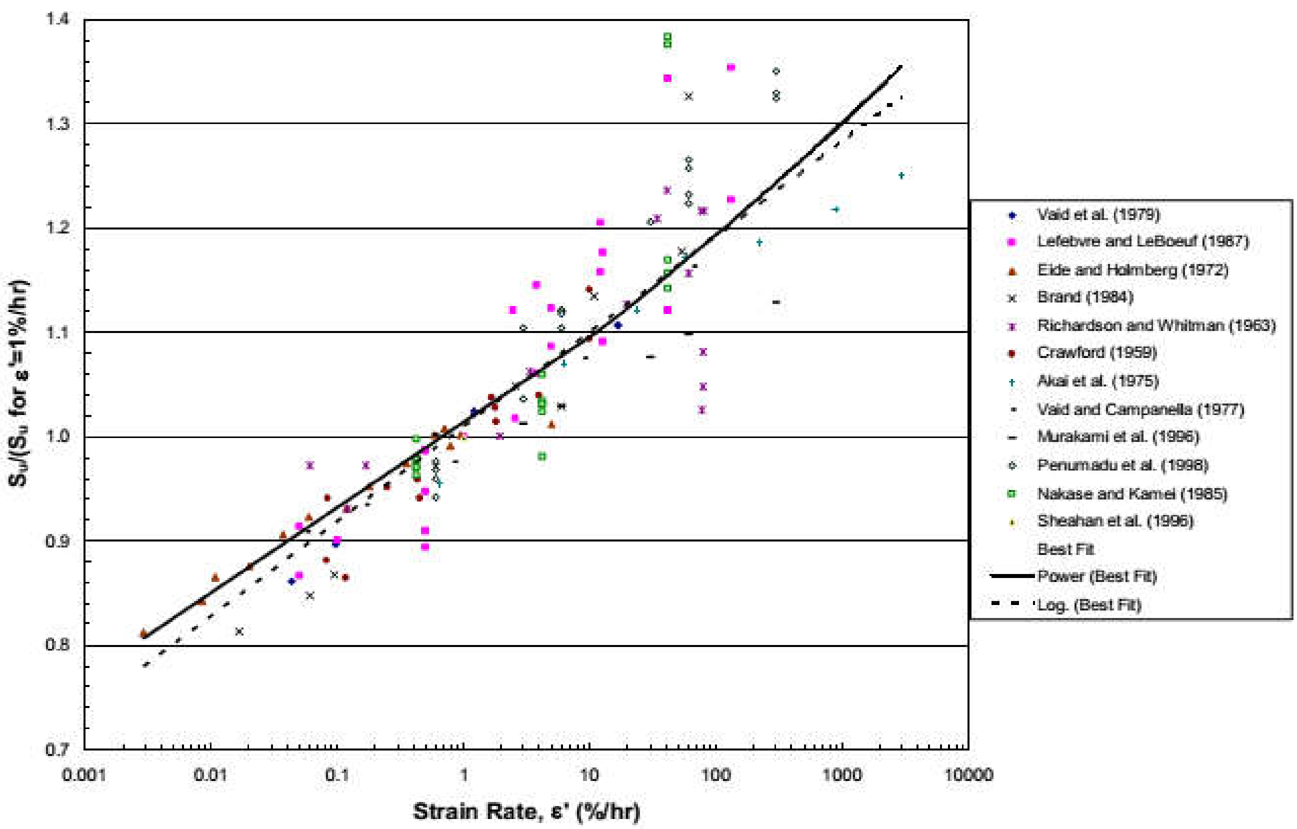

Figure 2-2 Effect of Strain Rate on Undrained Shear Strength [Leroueil and Marques 1996]

Also shown in fig. 2.3 a line that corresponds to the variation in strength with strain rate of 10% per log cycle of strain rate. For most of the soils it appears that below a strain rate of about 0.1% per second, the strain rate effect is less than 10% per log cycle. Above about 0.1% per second, the strain rate effect increases above 10% per log cycle. Above about 100% per second some of the results (Cheng, 1980, Yang and Japp, 1967) suggest that the strain rate effect increases dramatically.

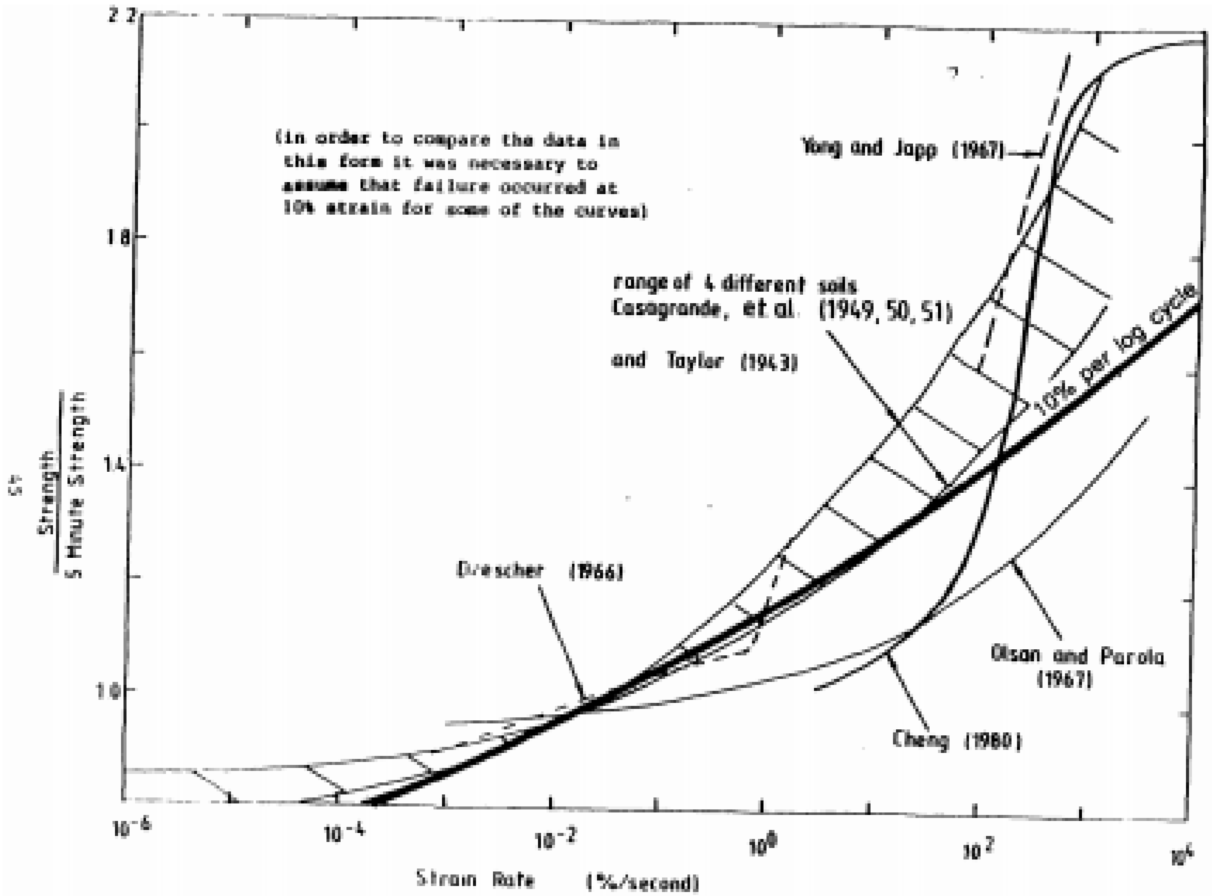

Figure 2-3 Comparison of some of the results reported by different authors regarding the effect of strain rate on the strength of long specimens (Kutter, 1982)

During the earthquake or volcanic activities, the strength of slip surface material of reactive landslide may be change. For the accurate stability analysis or repair of a reactive landslide, this factor should be taken into account. Hence, the study of strain rate effect on the shear strength of soil materials is very important from the geotechnical engineering point of view. The effect of shearing should be investigated to realistically simulate the development process of slip zone (Skempton, A. W., and D .J. Petley, 1967) Furthermore, for all tests on clays the transient compressive strength was greater than the static compressive strength. (Casagrande and Shannon, 1948a, 1948b, 1949)

2.5 Soil Remolding

Soil as construction and foundation material can be used in its natural or undisturbed state or remolded state to meet the specific requirement such as to obtain satisfactory engineering properties like shear strength, compressibility, or permeability. When the soil is remolded, the fabric of soil is progressively disrupted and the behavior of the soil is altered. Depending on the size and strength of the soil particle, particle arrangement may alter the water retention and mechanical behavior of the soil and make it different from that of undisturbed soil of the same mineralogy. On remolded samples shear strength value lower than that for the Undisturbed because cohesion is less after the original fabric is destroyed. [Nagaraj, H.B. and A. Sridharan, (2000)]

2.6. Sensitivity of soil

The sensitivity of soil is an indication of the reduction in shear strength of soil when it is subjected to any disturbance, e.g. when it is remolded or when it is subjected to monotonic or cyclic loading. For many naturally deposited clay soils, the unconfined compression strength is much less when the soils are tested after remolding without any change in the moisture content. This property of clay soil is called sensitivity. Soil sensitivity is defined as the ratio of the undrained shear strength of undisturbed soil to the undrained shear strength of remolded soil at the same water content, i.e. the degree of sensitivity is the ratio of the unconfined compression strength in an undisturbed state to that in a remolded state. This is expressed as:

$$S_t = q_u\,(\text{undisturbed}) / q_u\,(\text{remolded})$$

The sensitivity ratio of most clays ranges from about 1 to 8; however, highly flocculent marine clay deposits may have sensitivity ratios ranging from about 10 to 80. Some clay turn to viscous liquids upon remolding, and these clays are referred to as “quick” clays. The loss of strength of clay soils from remolding is caused primarily by the destruction of the clay particle structure that was developed during the original process of sedimentation [Das, B. M. (2002].

The unconfined compressive strength of undisturbed and remolded samples are presented in fig 2.4 shown below. This shows qu for remolded samples are lower than that of undisturbed ones even having the same mineralogical composition.

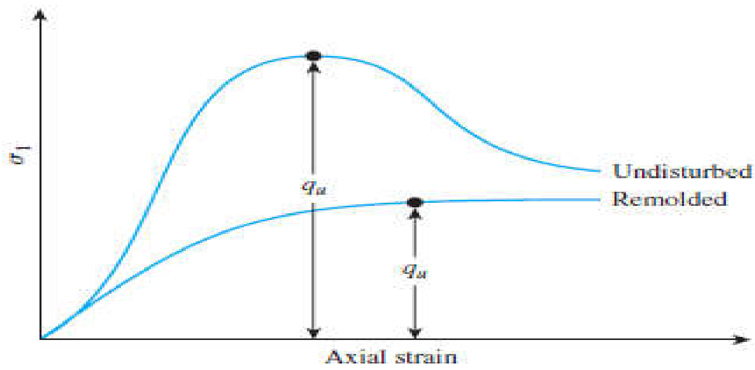

Figure 2-4 Unconfined compression strength for undisturbed and remolded clay [Das, B. M. (2002]

2.6.1 Classification of sensitivity of soil by different authors

Soil sensitivity is an important measure of the loss of strength and structure in the soil body under the effect of static or seismic loading. Several scales (or ranges) are used to classify sensitive clays according to their sensitivity level, from low sensitivity to extra quick. The sensitivity values of soil were initially classified in the 3rd and 4th editions of the Canadian Foundation Engineering Manual, CFEM (1992) and CFEM (2006), as given in Table 2.3 below; these were later changed in the Errata, given by Table 2.4.

Table 2-3 Sensitivity classifications in CFEM (1992).

Classification	S_t
Low sensitivity	< 10
Medium sensitivity	10 – 40
High sensitivity	> 40

Table 2-4 Sensitivity classifications in CFEM (2006) Errata.

Classification	S_t
Low sensitivity	< 2
Medium sensitivity	2 – 4
Extra (High) sensitivity	4 – 8
Quick	> 16

Sensitive soils are classified according to the value of soil sensitivity, S_t. Skempton et al. (1952) showed that most clays, except for heavily over-consolidated and boulder clays, lose some of their strength when remolded, and proposed the sensitivity classifications shown in Table 2.5. Sensitivity of 2 to 4 is common among normally consolidated clays, but 4 to 8 is also frequently encountered.

Table 2-5 Skempton et al. (1952) classification.

Classification	S_t
Insensitive clays	~ 1
Low sensitivity clays	1 – 2
Medium sensitivity clays	2 – 4
Sensitive clays	4 – 8
Extra-sensitive clays	> 8
Quick clays	> 16

Since most Norwegian quick-clays show sensitivity values higher than 16, which is the highest value at the Skempton et al. (1952) scale, Rosenquist (1953) extended the scale with the values shown in Table 2.6. Rankka et al. (2004) presented a scale of sensitivity for Swedish sensitive clays, given in Table 2.7.

Table 2-6 Rosenquist (1953) classification.

Classification	S_t
Insensitive clays	~ 1
Slightly sensitive clays	1 – 2
Medium sensitive clays	2 – 4
Very sensitive clays	4 – 8
Slightly quick clays	8 –16
Medium quick clays	16 – 32
Very quick clays	32 – 64
Extra quick clays	> 64

Table 2-7 Swedish classification (2004).

Classification	S_t
Low sensitivity	$S_t \leq 8$
Medium Sensitivity	$8 < S_t \leq 30$
High sensitivity[1]	$S_t > 30$

Holtz et al. (1981) compared the USA classification (where highly sensitive clays are rare) and the Swedish Classification (where highly sensitive clays are common), as shown in Table 2.8.

Table 2-8 Comparison of USA and Swedish classifications.

	S_t	
Classification	USA	Sweden
Low sensitivity	2 – 4	< 10
Medium sensitivity	4 – 8	10 – 30
High sensitivity	8 – 16	30 – 50
Quick	> 16	50 – 100
Extra quick		> 100

Bowles (1996) presented different general classifications to show that soils with S_t less than 4 are insensitive, while S_t over 8 represents extra sensitive soil as shown in Table 2.9. This general classification of clays on the basis of their sensitivity.

Table 2-9 Bowles (1996) classification.

Classification	S_t
Insensitive	$S_t \leq 4$
Sensitive	$4 < S_t \leq 8$
Extra sensitive	$S_t > 8$

From the above classifications of soil sensitivity, it can be noted that the CFEM (2006) follows the Swedish system, while its errata follows the USA system. The CFEM (2006) recommended using the Swedish fall cone in the laboratory and the vane test in the field to measure the sensitivity.

Understandably, the wide difference between the sensitivity values in Tables 2.3 and 2.4 has led to some confusion and controversy within the geotechnical community. In general it is clearly observed that, there are significant variations between the different classification systems available.

Chapter Three

3. Description of the Study Area

3.1. General

The project site is found in the western part of the city of Addis Ababa near the Gefersa Reservoir namely Kolfe Keranio sub-city. It borders with the districts of Gullele, Addis Ketema, Lideta and Nifas Silk-Lafto. The site is located at the global UTM [by hand held GPS] coordinates of **N 0998674 E 0468720 and at 2450m** above mean sea level. This area is covered with red clay soil.

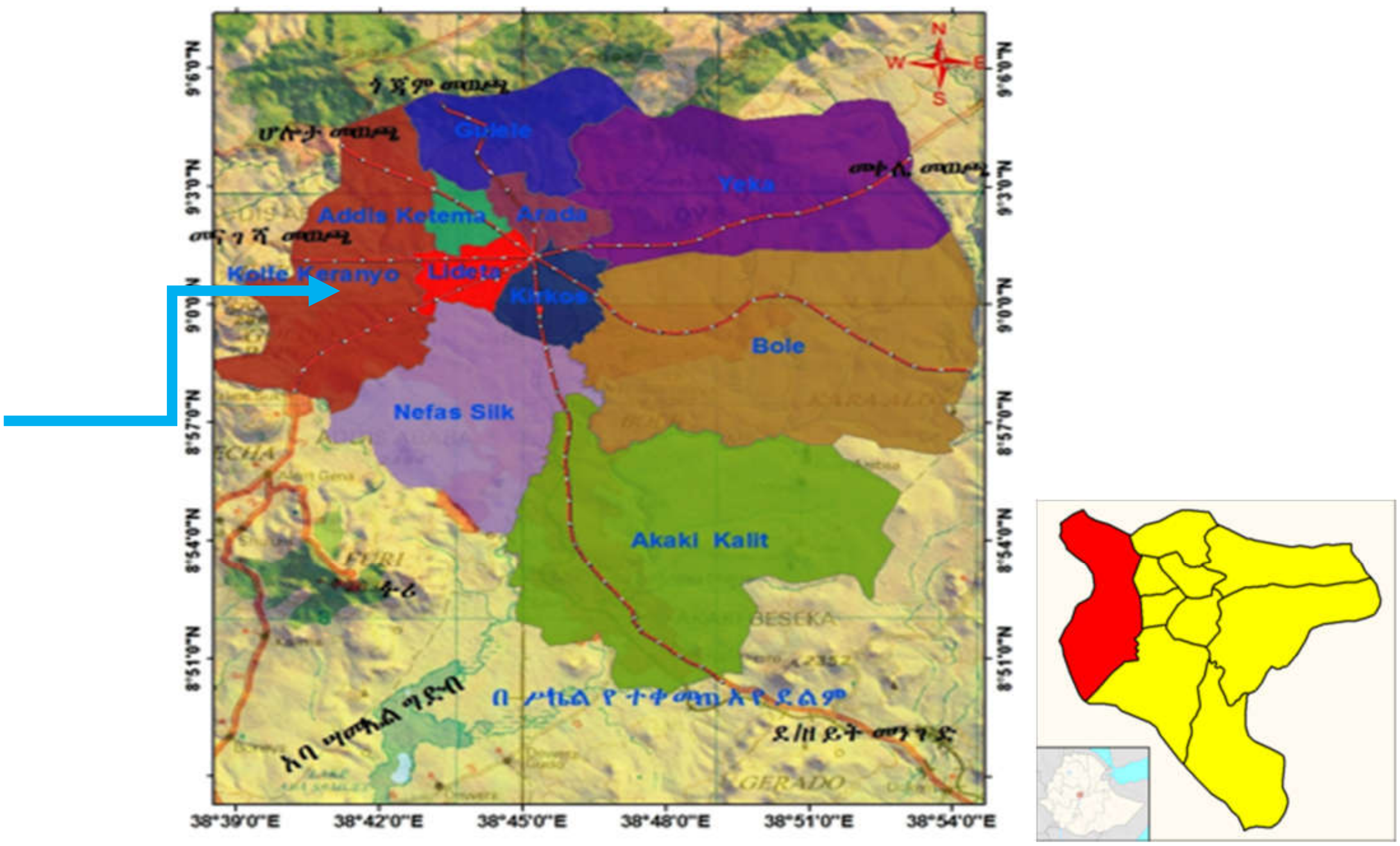

Figure 3-1 Location map of the study area Kolfe Keranio (red) within Addis Ababa

3.2 Climatic Characteristics

The climate of Addis Ababa is cool to temperate with a mean annual temperature of 16 degrees centigrade, and a mean annual rainfall of 1200mm–1600mm (EMA, 1988). The main rainy season in the area falls between June and mid-September, which is winter. While the lesser rains of autumn fall between February and April, which sometimes extends up to mid-May. Heavy and torrential rains that last from few minutes to several hours are common during both rainy seasons.

Addis Ababa is not only the capital city of Ethiopia, but also the biggest and the most highly populated city in the country. The city is situated in the main highland plateau with an average elevation of 2440m above sea level. Due to the rapid expansion of the city and the need to build more houses, currently there is an extensive construction activity going on in every direction of the city including on parts of the study area.

3.3 Geology and Tectonics of the Study Area

Addis Ababa is located in the western margin of the Main Ethiopian rift and consists of different volcanic rocks that range from basic to acidic composition. The vicinity of the city is surrounded by trachyte and rhyolite hills and mountains. In the northern part, the Entoto mountain chains are composed of rhyolite and trachyte which are called the Entoto silicic of the Addis Ababa area. They are associated with the Alaji formation and rest on older basalts. Volcanism initiating the Alaji cycle occurred in late Oligocene - early Miocene times (Tamiru, 2001).

Volcanic mountains such as Wachecha in southwest, Furi in the southern and Yerer in the southeastern parts of Addis Ababa are mainly trachyte in composition. The basalts are outcropping in the central part of Addis Ababa and to the south and north of the Entoto hills some small patches of basalts are capping the Entotosilicic.

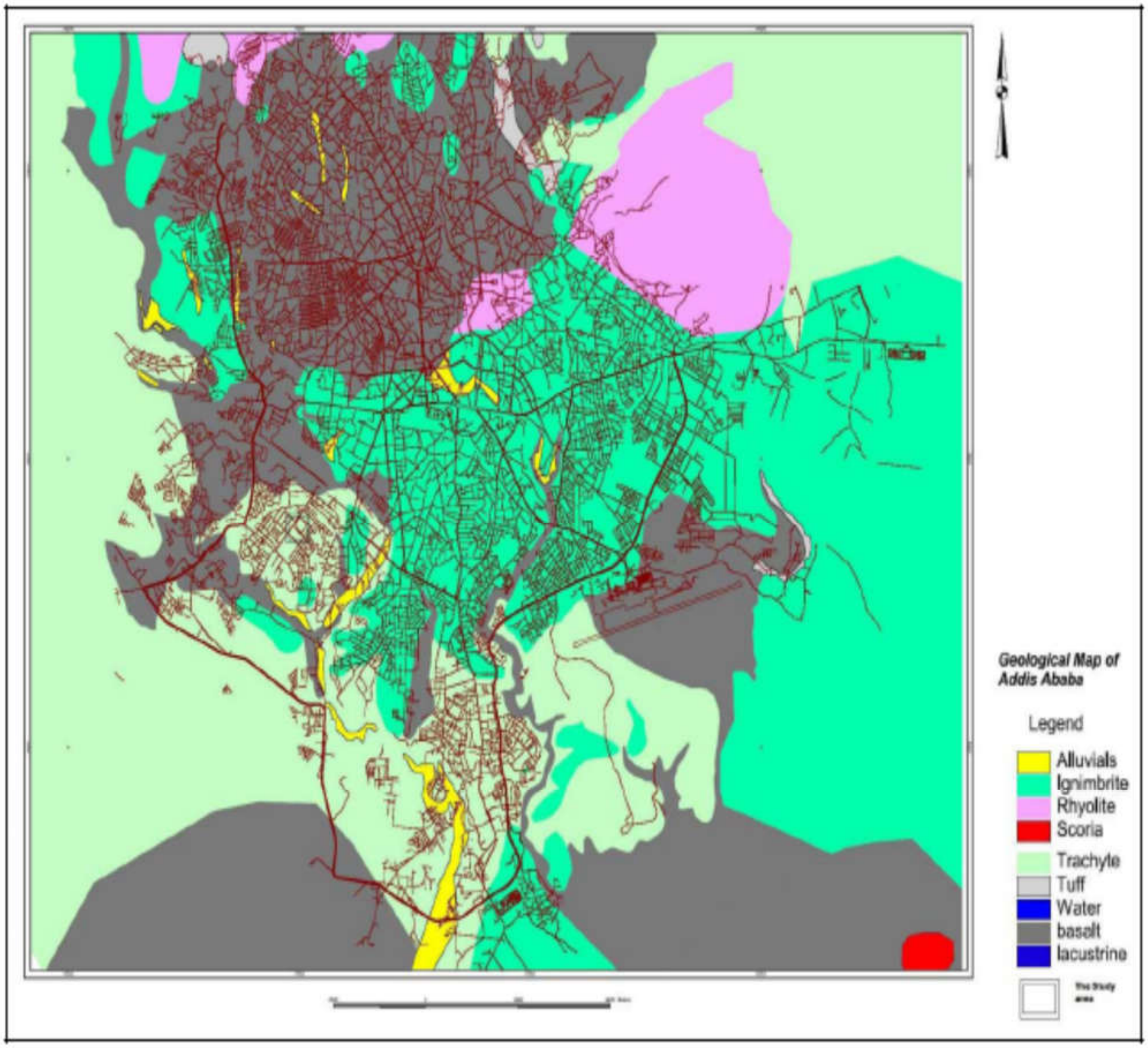

Figure 3-2 Geological map of Addis Ababa and its surroundings (GSE, 1990)

Chapter Four

4. Laboratory Test Results

4.1. General

Soil samples were collected from kolfe area, where red clay soils are known to be found. A test pit was excavated at the site and disturbed and undisturbed samples were taken. The moisture content was determined immediately after sampling and transporting it to laboratory by warping with aplastic bag to avoid moisture loss. Disturbed samples were air dried to constant moisture and sieved with different sieve sizes after pulverizing depending on the requirement of specific test procedure.

Different laboratory tests were conducted on the soil sample according to the need. Among these are natural moisture content, density, specific gravity, Atterberg limits, free swell, particle size analysis and compaction on disturbed samples. Besides one dimensional consolidation and unconfined compression tests were conducted on undisturbed and remolded samples.

4.2. Natural Moisture Content (NMC)

The moisture content of the soil which is defined as the ratio between mass of water to mass of soil solid was determine immediately after the sample was taken from the site. The samples were kept in a plastic bag to prevent moisture loss during transportation from site to laboratory. The method employed for determining the moisture content was oven drying method. The measured amount of wet soil was put in an oven of 105-degree centigrade and kept for 24 hours and examined for weight loss.

For coarse and fine-grained soils, water content can have a significant effect on the soils behavioral properties when used for construction purposes and foundations. Moisture content affects the settlement (consolidation) condition; shear strength and suitability of soil for compaction. Consistency of a fine-grained soil also depends largely on its moisture content. Detail test results are shown in Appendix A1.

4.3Density Determination

The bulk mass density of the soil was determined by the core cutter method. Tube samplers for collecting undisturbed samples were used as means for cutting core of soil sample. The mass of soil inside the tube sampler was divided to the internal volume of tube sampler for obtaining the bulk density of the soil. Detail test results are shown in Appendix A2.

4.4. Specific Gravity Test

Specific gravity which is a measure of heaviness of the soil particles where determined by method of small pychnometer method using a soil sample passing 2mm sieve and oven dried at 105-degree centigrade. Determination of specific gravity is important and it is useful to determine the diameter of the soil grains in hydrometer analysis. Detail test results are shown in Appendix A3.

4.5. Atterberg Limit Test

Soil samples passing 425-micrometer sieve were used for Atterberg limits determination. Casagrand apparatus was used for the determination of Liquid limit (LL).For the determination of Plastic limit (PL) a soil sample was rolled into 3mm thread until it begins to crumble. Plasticity index (PI) is the difference between Liquid limit (LL) and Plastic limit (PL).Plasticity index is important in classifying fine-grained soils and is fundamental to the Casagrande plasticity chart. The larger the plasticity index, the greater will be the engineering problems associated with using the soil as an engineering material, such as foundation support for residential building and road sub-grades [Bowles, 1992]. Detail test results are shown in Appendix A4.

4.6 Free Swell

The swelling tendency was also determined from the samples passing 425-micrometer sieve and oven dried. The 10ml of soil sample was put in water for 24 hours and swelling was examined as a percentage of volume change to the original. Free swell test results indicate the potential expansiveness of soil samples without being loaded. Detail test results are shown in Appendix A5.

4.7. Grain Size Analysis/ Hydrometer test

Since grain size analysis is one of the index property tests, the soil of the study area is examined for its grain size distribution. Grain size divides soil into two distinctive groups, namely fine-grained and coarse-grained soil. Soil particles, which are coarser than 0.075 mm, are generally termed as coarse-grained and the finer ones like silt and clay are considered fine grained. The property of coarse-grained soil is greatly based on grain size distribution while the property of fine-grained soil is influenced by inter-particle force.

Two methods were used to find the particle-size distribution of the soil samples: sieve analysis, for particle sizes larger than 0.075 mm (No. 200) in diameter; and hydrometer analysis for particle-sizes smaller than 0.075 mm in diameter. During hydrometer analysis sodium hexa meta phosphate ($NaPO3$) was used as a dispersion agent, and all analysis was determined based on ASTM D422 procedure. The diameter or size range is adopted from ASTM as follows: > 4.75 mm (No.4) gravel; 4.75 – 0.075 mm (No.200) sand; 0.075 – 0.002 mm silt and < 0.002 mm clay. Detail results of grain-size analysis are presented in Appendix A6.

Table 4-1 Summary of index property test results of the study area

Type of laboratory Tests	Test Results		procedure
	TP1	TP2	
Natural moisture Content (%)	33.02	34.42	ASTM D4959/ ASTM D2216
Field Density (g/cc)	1.94	1.92	ASTM D2937
Specific Gravity	2.75	2.73	ASTM D854
Atterberg Limit Test			ASTM D4318
Liquid Limit (%)	61.25	63.25	
Plastic Limit (%)	27.6	24.43	
Plasticity Index (%)	33.61	38.82	
Free swell (%)	22.5	20	ASTM D 5890
Grain Size Analysis			ASTM D422 & ASTM D2217
Gravel %	0	0	
Sand %	8.11	9.46	
Silt %	19.2	20.1	
Clay %	72.71	70.43	

4.8 Compaction

This test is used to determine the relationship between the moisture content and dry density of soil for a specific comp active effort (energy applied). This effort is the amount of mechanical energy applied to the soil mass.

4.8.1 Standard compaction

Standard Proctor compaction test which simulates light compacting effort was used to obtain the moisture-dry density relationship of the specific soil samples. After obtaining the density and moisture of each compacted soil sample, the maximum dry density (MDD) and optimum moisture content (OMC) are determined. Detail test results are shown in Appendix A7.

4.8.2Modified compaction

Modified Proctor compaction test is used to provide a guide for specifications on field compaction to obtain the moisture-dry density relationship of the specific soil samples and used to simulate heavy compacting effort. The maximum dry density (MDD) and optimum moisture content (OMC) are determined. Detail test results are shown in Appendix A7.

4.9 One dimensional Consolidation Test

One-dimensional consolidation test was carried out to study the stress-strain and compressibility of the soil under different conditions using the apparatus called Oedometer. Tests were carried on undisturbed and remolded samples. Diameters of 50mm soil sample having a height of 18 mm were loaded from 50 kPa to 1600 kPa by doubling the loading. For each loading starting from 50 kPa to 1600 kPa the compression was recorded from the dial gage at intervals of 0.1, 0.25, 0.5, 1, 2, 4, 1440 mins for twenty-four hours. Unloading was also done by steps to examine the unloading behavior. In this study, one-dimensional consolidation tests are performed for both undisturbed and remolded samples and the results are used for the determination of strain rate. Over all summary of the results are presented in table 4.2 and details of test results are shown in Appendix B.

Table 4-2 Summary of One-dimensional consolidation test Results for undisturbed and remolded samples

Consolidation test results for Load intensity from 50-1600 kPa	Undisturbed sample	Remolded sample
C_V (mm^2/min)	0.023-0.0049	0.015-0.003
C_c	0.182	0.240
P_c (kPa)	385	175
OCR	7.94	3.72

4.10. Shear Strength Test

4.10.1 General

The shear strength of soils is an important aspect in many foundation-engineering problems related to stability such as the bearing capacity of shallow foundations and deep foundation, the stability of slopes of dams and embankments, and lateral earth pressure on retaining walls. The purpose of shear strength testing is to establish representative values for the shear strength parameters from laboratory and field testes. The most common laboratory methods employed to obtain shear strength parameters are direct shear test, triaxial compression test, and unconfined compression test. For this research work, only unconfined compression tests were conducted.

4.10.2 Unconfined Compression Test

The unconfined compression test is a special case of the unconsolidated un-drained triaxial test. In this simple test, a cylindrical cohesive specimen without any lateral support is subjected to axial loading, till the sample falls either due to shear along a diagonal plane or by the lateral bulging. The test is undrained test and is based on the assumption that there is no moisture loss during the test. The UC test is one of the easiest and simplest tests for determining a quick estimate of the shear strength of cohesive soils. The test provides an immediate approximate value of the compressive strength of the soil, either in the undisturbed or the remolded condition. It is also widely used to determine the consistency of saturated clays and other cohesive soils (Das, B. M. (2002).

In this thesis, the unconfined compression tests were carried out for both undisturbed and remolded samples with a height of 76 mm and diameter of 38 mm having H/D ratio of 2 using different strain rates which are obtained from the coefficient of consolidation for each load increment of one-dimensional consolidation. While conducting the tests a minimum of two trials for each strain rates are performed and if the results are significantly different, a third trial is done and those give similar values are considered as a final value. The UC testing procedures are followed according to ASTM D2166. Details of the test results are presented in Appendix C and the final summarized results of UC tests are shown in table 4.3 and 4.4.

4.10.2.1 Unconfined Compression Test for undisturbed samples

The UC tests were carried out on undisturbed samples of 38 mm diameter and height of 76 mm after the samples are immediately transported from the site and great care was taken in order not to lose its natural moisture and property during transportation and sample preparation. The tastes were performed at the rates of (0.37 to 1.75 mm/min).

4.10.2.2 Unconfined Compression Test for remolded samples

The remolded samples are prepared by compacting the undisturbed samples using standard compaction as per ASTM standard and based on the basic assumption of no moisture loss during sample preparation and testing. Therefore the remolded samples have nearly the same moisture content and density to that of the undisturbed samples. The samples were prepared with 38mm diameter and height of 76mm and tested at the rates of (0.37 to 1.75 mm/min) and (0.23 to 1.14 mm/min) which is the same strain rate and same load increment to that of undisturbed samples in order to determine sensitivity accordingly.

Table 4-3 Summary of UCS results for Undisturbed and Remolded Samples for the same strain rate

Strain rate ε(mm/min)	UCS (qu) kPa	Cu kPa	Failure strain %	Soil type
1.75	513.09	256.54	3.29	Undisturbed (UN)
	314.99	157.49	7.24	Remolded (RE)
1.61	456.01	228.01	3.75	Undisturbed (UN)
	300.49	150.24	8.16	Remolded (RE)
1.12	327.34	163.67	5.92	Undisturbed (UN)
	241.99	121.00	9.34	Remolded (RE)
1.03	305.96	152.98	6.18	Undisturbed (UN)
	228.09	114.05	10.26	Remolded (RE)
0.84	245.06	122.53	7.11	Undisturbed (UN)
	204.19	102.10	13.95	Remolded (RE)
0.37	125.46	62.73	8.95	Undisturbed (UN)
	119.14	59.57	15	Remolded (RE)

Table 4-4 Summary of UCS results for Undisturbed and Remolded Samples for the same Load increment

load increment (kpa) / Strain rate ε(mm/min)	UCS (qu) kPa	Cu(kPa)	Failure strain %	Soil type
(7-50)/(1.75)	513.09	256.54	3.29	Undisturbed (UN)
(7-50)/ (1.14)	247.83	123.91	9.21	Remolded (RE)
(50-100)/ (1.61)	456.01	228.01	3.75	Undisturbed (UN)
(50-100)/ (1.06)	232.73	116.34	10	Remolded (RE)
(100-200)/ (1.12)	327.34	163.67	5.92	Undisturbed (UN)
(100-200)/ (0.68)	173.3	86.65	14.74	Remolded (RE)
(200-400)/ (1.03)	305.96	152.98	6.18	Undisturbed (UN)
(200-400/ (0.61)	163.62	82.63	15	Remolded (RE)
(400-800) / (0.84)	245.06	122.53	7.11	Undisturbed (UN)
(400-800) / (0.53)	147.63	73.86	14.93	Remolded (RE)
(800-1600)/ (0.37)	125.46	62.73	8.95	Undisturbed (UN)
(800-1600) / (0.23)	90.55	45.27	15	Remolded (RE)

The unconfined compressive strength (UCS) results obtained for the study area were higher as compared to the previous study on Addis Ababa red clay soil. This is because the tests were performed for higher strain rates which may not be used for the previous ones and also the soil of the study area was heavily over consolidated soil. Since the strength is highly affected by strain rate and over consolidation ratio (O.C.R.). But Admasu, T. (2003) showed, by triaxial shear tests on remolded samples, for the rate of 1mm/min the value of cohesion obtained was 102.51kPa. Which is somehow comparable in this research for the rate of 0.84 mm/min to 1.03 mm/min. The value of undrained shear strength (C_u) obtained was 102.1 to 114.05 kPa.

Chapter Five

5. Discussions of the laboratory Test results

5.1. Soil Classification of the study area

The basis for USCS (Unified Soil Classification System) is Liquid Limit and Plasticity Index of a soil. An “A-line” which is defined by an equation (i.e. 0.73*(LL-20)) separates the ‘MH or OH’ and the ‘CH or OH’ designation. In USCS MH means elastic silt, CH means inorganic clay of high plasticity and OH means organic clay or silt.

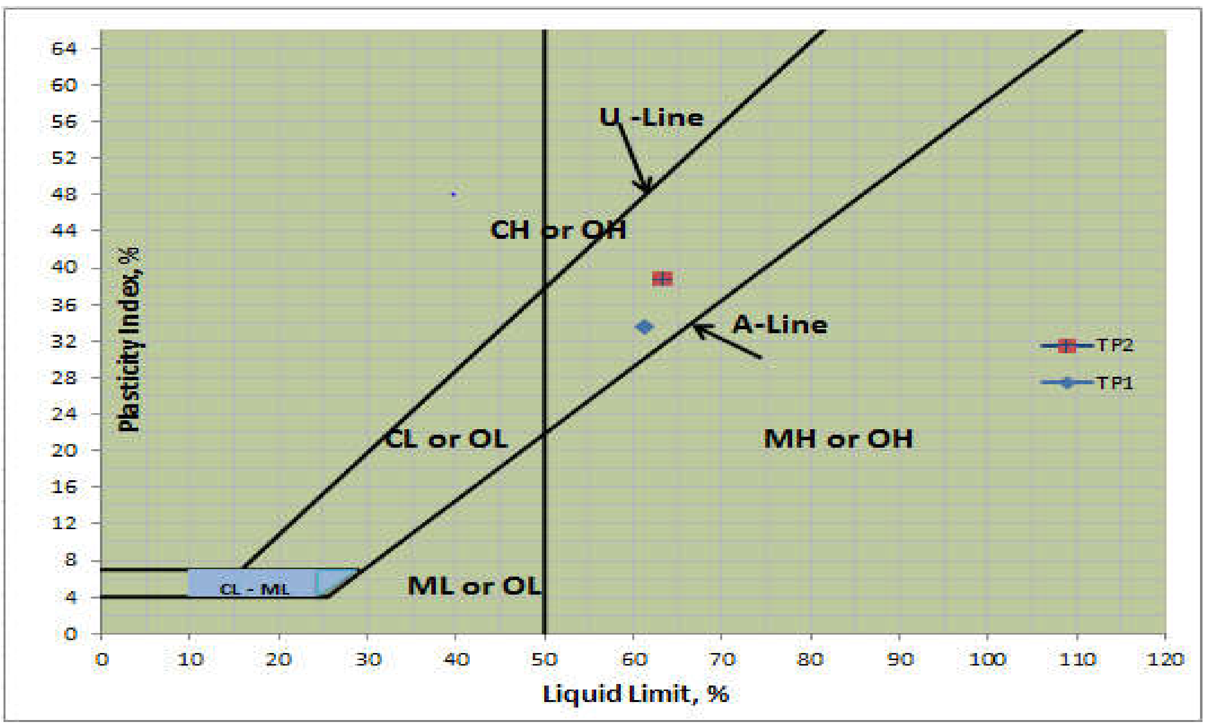

Figure 5-1 Plasticity chart of the study area

According to this classification scheme of the soil of the study area falls in CH/OH region, which shows that the soil is inorganic clay of highly plastic (CH).

5.1.1. Classifications based on activity number

Activity which is defined as the ratio of the plastic index to percent of clay fraction finer than 0.002mm is one means of classifying expansive soils based on their index property. According to Skempton (1953), clays are classified with respect to their activity and the following values show this classification scheme. In terms of potential expansiveness soils with activity less than 0.75 are low, 0.75-1.25 normal and those with greater than 1.25 are highly expansive. [Teferra and Leikun 1999]

Table 5-1 Activity and degree of activity [Teferra and Leikun 1999]

Degree of Activity	Activity
Inactive Clay	Less than 0.75
Normal Clay	0.75 - 1.25
Active Clay	Greater than 1.25

A= Ip/clay fraction

=33.61/72.71= **0.46** and 38.82/70.43= **0.55** for TP1 and TP2 respectively

Where A = Activity and I_P= plasticity index

Based on activity No the soil in the study area is non-expansive or inactive.

These values are presented in the form of chart, which is called Activity Chart, and the soil of the study area is compared to the values and it falls in the range of inactive clay (Figure 5.2).

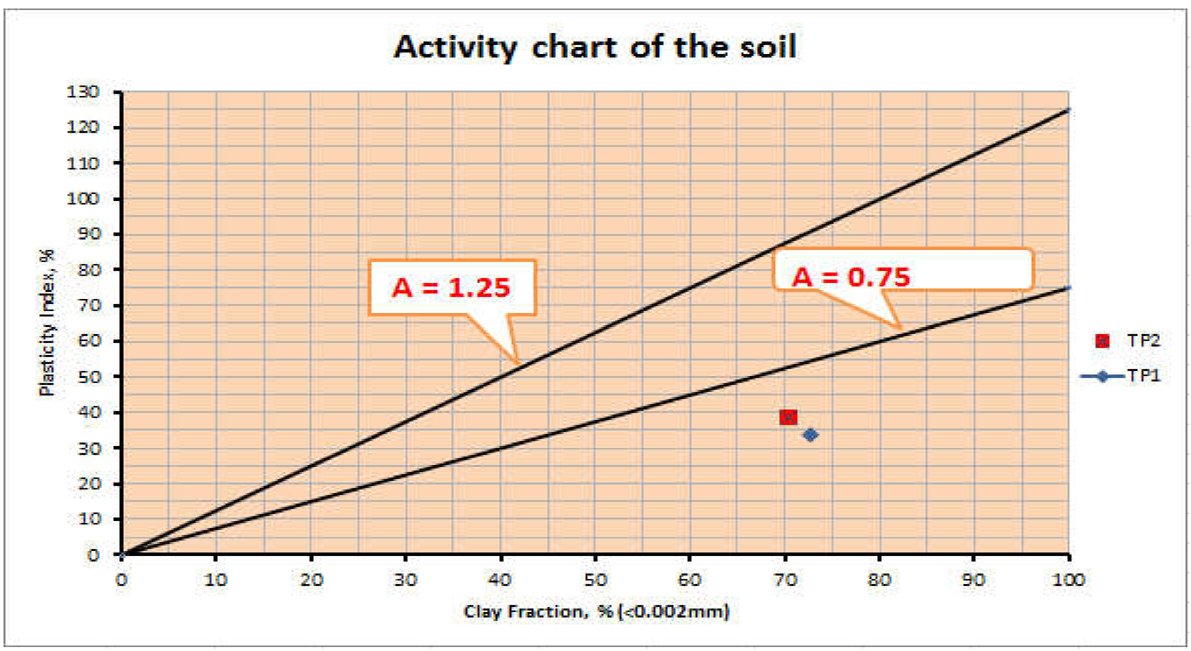

Figure 5-2 Activity chart of the study area

In general, the soil of the study area is inorganic clay of highly plastic and non-expansive or inactive nature.

5.2. Relation between coefficient of consolidation and intensity of loading

One-dimensional consolidation tests were carried on undisturbed and remolded samples. For each loading starting from 50 kpa to 1600 kPa the dial gage reading was recorded at intervals of 0.1, 0.25, 0.5, 1, 2, 4,8,……. 1440 mins for twenty-four hours. The result of One-dimensional consolidation test is summarized in the table 5.2 below.

Table 5-2 Summary of One-dimensional consolidation test Results for undisturbed and remolded samples for load increment of 50-1600 kPa

Consolidation test results for Load intensity from 50-1600 kPa	Undisturbed sample	Remolded sample
C_v (mm^2/min)	0.023-0.0049	0.015-0.003
C_c	0.182	0.240
P_c (kPa)	385	175
OCR	7.94	3.72

- One-dimensional consolidation test results show that the coefficient of consolidation (C_v) decreases as the intensity of loading increases especially for loadings beyond the pre-consolidation pressure (P_c).This is because for loadings higher than P_c the behavior of the soil will be changed and this result in larger amount deformation.
- As the intensity of loading increases, the coefficients of consolidation (C_v) decreases. Since soil compression takes longer time and void ratio decreases to minimum values, as a result the compressibility increases and have large magnitudes of compression index (C_c) and consequently the coefficients of consolidation decreases.
- The coefficients of consolidation (C_v) values for remolded samples are lower than that of undisturbed samples. Since remolding alters the original geometrical arrangements of the soil and also removes the cementation between the soil particles consequently the behavior of the soil will be changed.
- From the over consolidation value (OCR) the soil in the study area is heavily over consolidated. This may affect the shear strength of the soil.

The (C_v) values are used for the determination of strain rate (ε) for both undisturbed and remolded samples in order to compute UCS values accordingly.

5.3. Comparisons of Undrained shear strength for undisturbed and remolded samples

The undrained shear strengths are computed for the same strain rate (0.37-1.75 mm/min for both undisturbed and remolded samples) and also for same load increment (50-1600 kPa) i.e (1.75-0.37 mm/min for undisturbed) and (1.14-0.23 mm/ min for remolded) samples are presented by the stress-strain graph shown in Fig, 5.3 a, b, c, d.

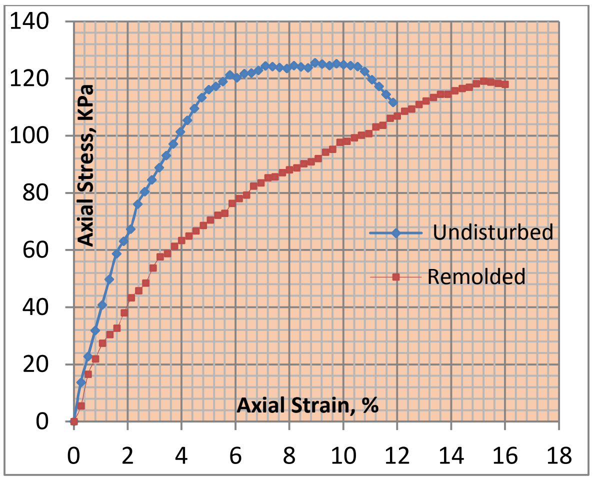

Figure a, qu tasted at ε =0.37 mm/min

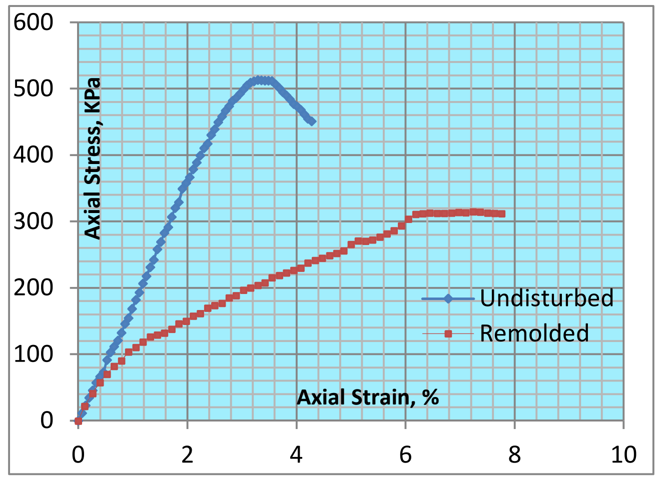

Figure b, qu tasted at ε =1.75 mm/min

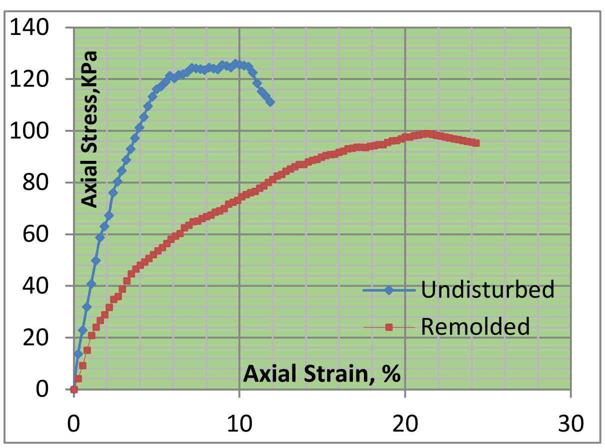

Figure c, qu for load increment 800-1600 kPa

(at ε =0.37mm/min UN & 0.0.23mm/min RE)

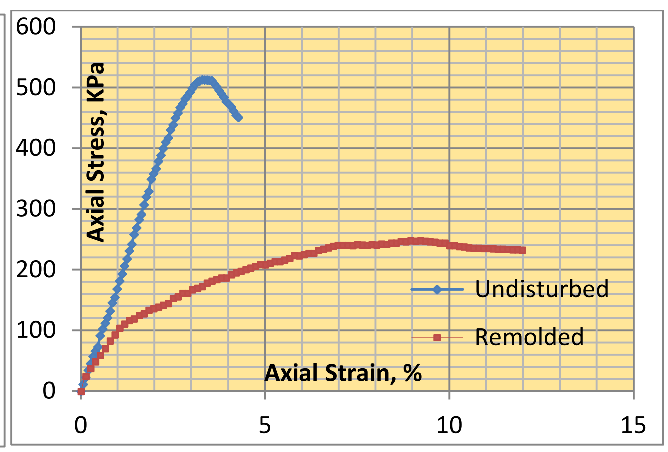

Figure d, qu samples for load increment 7-50 kPa

(at ε 1.75mm/min UN & 1.14 mm/min RE)

Figure 5-3 Summary on comparison of UCS values for undisturbed and remolded samples

From the stress-strain curves shown in fig 5.3, a, b, c, d it is clearly seen that the failure stresses of remolded samples were lower than that of undisturbed samples. This shows the undrained shear strength of remolded sample is lower than that of the undisturbed samples. If samples were remolded, the strength of the material was decreased and its stress-strain behavior was also changed than that of undisturbed one. This is because when the soil is remolded, the fabric of soil is progressively disrupted and the behavior of the soil is altered. Depending on the size and strength of the soil particle, particle arrangement may alter mechanical behavior of the soil and make it different from that of undisturbed soil of the same mineralogy, as a result, the bond between the soil grains become weak thus cohesion is less after the original fabric is destroyed even having the same moisture content.

The other reason for the variation of undrained shear strength of undisturbed and remolded samples may be the effect of aging. Undrained cohesion increased as time of storage (aging) increases at the laboratory for extended periods of time before testing. In this research case, while conducting UCS test for the remolded samples, the time for sample preparation is considered. This may not be enough time for the clay particle to rearrange themselves in a stable manner. Since clay soil needs longer time for particles arrangement .As a result the particle arrangement of the remolded samples becomes weak. Thus the sample can fail with smaller failure stress than that of the undisturbed sample consequently the undrained shear strength become lower than that of the undisturbed one.

The deformations of remolded samples are larger than that of undisturbed samples. This is because the particles arrangement becomes weak and the failure can easily develop throughout the samples so that the stress-strain curves are too long for all remolded samples compared to undisturbed one. Therefore the failure strains of remolded samples are larger than that of undisturbed samples tested at the same strain rate or same load increment to that of undisturbed one.

5.4. Relation between Undrained shear strength and strain rate

5.4.1 Summary of Unconfined Compression Test Result for Undisturbed Samples

The strain rates used for the determination of unconfined compressive strength for the undisturbed samples which were obtained from one-dimensional consolidation test result for a load increment of (50 to 1600) kPa using the formula $C_V= (0.848*Hdr^2)/t90$ and $\varepsilon =0.1C_v/H_{dr}^2$ were (0.37 to 1.75) mm/min. With these rats, the corresponding UCS values are shown in fig 5.4.

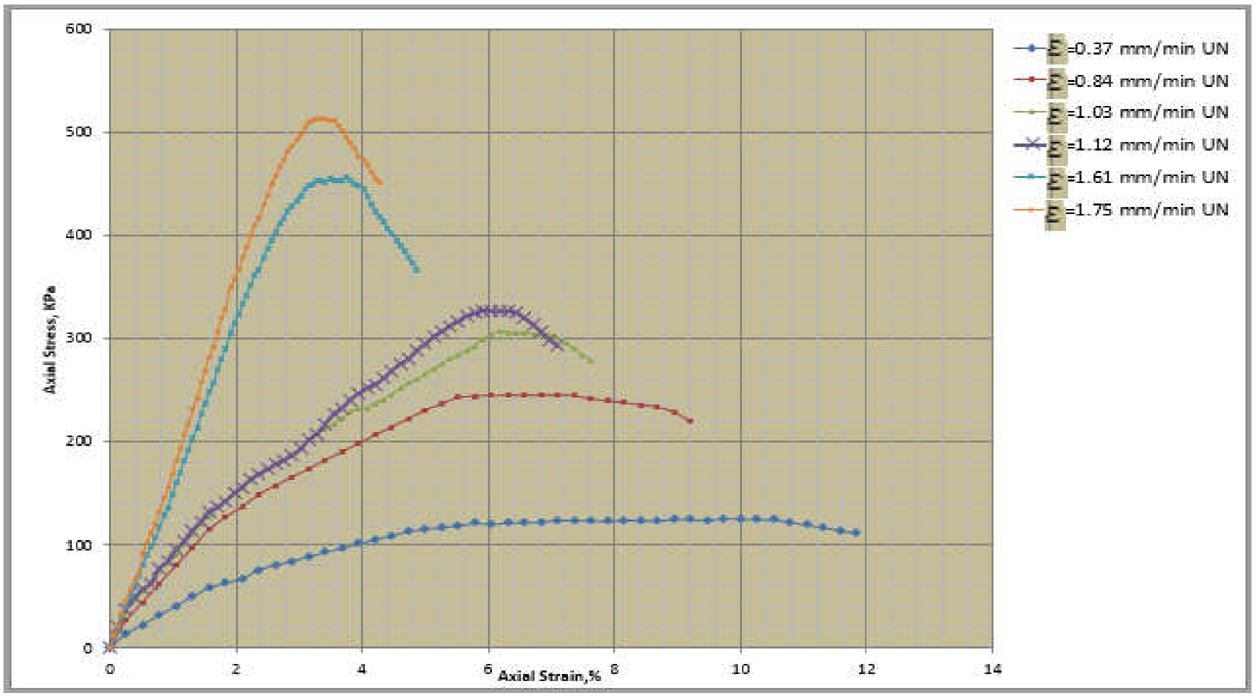

Figure 5-4 Summary of qu for ε =0.37 to 1.75 mm/min for undisturbed sample

The undrained shear strength increases from 62.7 to 256.5 kPa and the failure strains slightly decreases from 8.95 to 3.29 % as the strain rate increases from 0.37 to 1.75 mm/min.

Figure 5-5 summary of failure pattern for undisturbed samples at the rate of (0.37 to 1.75) mm/min

From the above stress-strain curves and visual observation of the samples after failure, the failure modes were nearly vertical for all undisturbed samples. But the continuity and number of failure planes were more for the samples tasted at slower rates than the faster ones. In addition for the faster rates both the incoming load and the induced pore pressure were not uniformly distributed throughout the sample height. As a result, localized dilation and broader peaks near the top part is observed. This shows non-uniform failure modes occurred for the faster rates.

The stress-strain curves are longest for the rates of 0.37 to 0.84 mm/min. Since the load is transferred throughout the sample so that the failure is developed uniformly, as a result, the sample attains peak strength at largest axial strains and after the sample attains peak values, the stress-strain curves continue in a similar manner.

For the rates of 1.03 to 1.12 mm/min, the failure was developed on some part of the samples and the stress-strain curves were relatively shorter and it attains peak strength at smaller axial strains than the rates of 0.37 to 0.84 mm/min. After the sample attains peak values, there was a drop down on the stress-strain curves. This shows that the induced pore pressure and the applied load were transferred on some portion the sample height.

For the rates of 1.61 to 1.75 mm/min the type of failure was different from that of the lower rates, failure was localized only in some part of the samples especially on the top part and broader peaks are observed. The sample attains peak strength at smallest axial strains and also the stress-strain curves were very steeper than the other rates (0.37 to 1.12) mm/min .Besides, there was a high drop down of the curve after it attains peak strength. This is because the applied load is transferred on the top part of the sample and the induced pore pressure is also localized near to the point of load application.

5.4.2 Summary of Unconfined Compression Test Result for Remolded samples of same strain rate to that of undisturbed one

In this case, the remolded samples were tested with the same strain rate which was used in undisturbed samples testing (0.37 to 1.75) mm/min. With these rats, the corresponding UCS values are shown in fig 5.6.

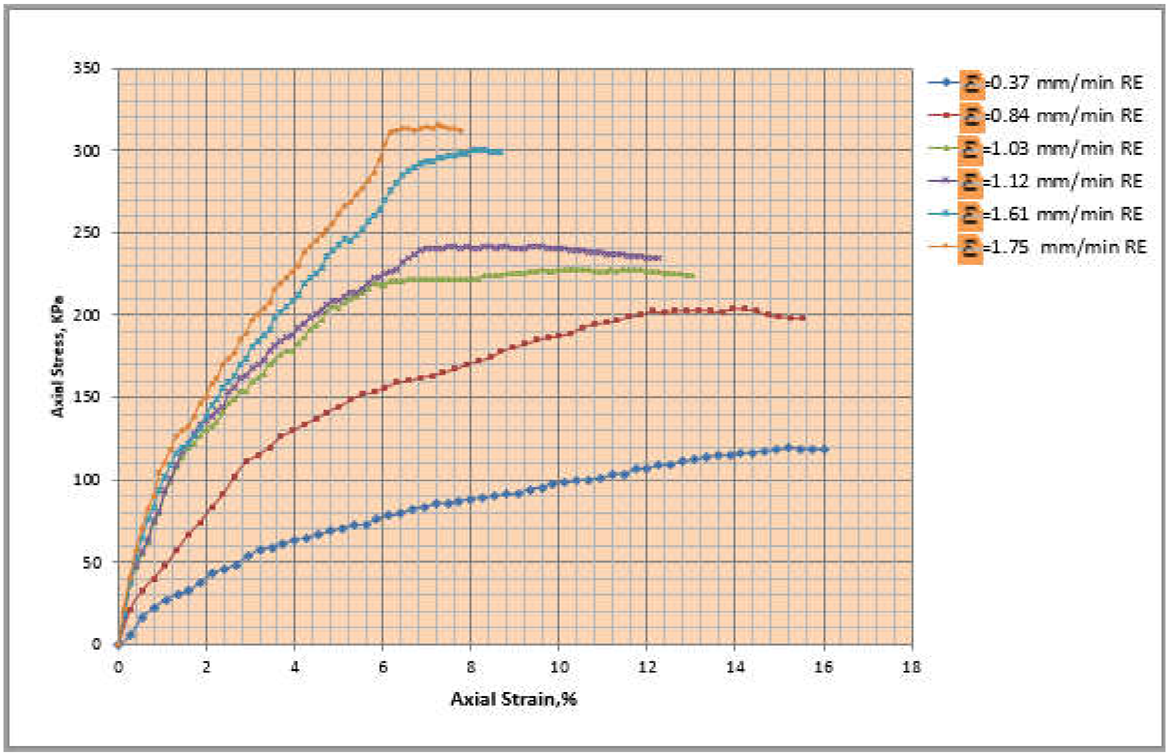

Figure 5-6 Summary of qu for ε =0.37 to 1.75 mm/min for remolded sample

The undrained shear strength increases from (59.6 to 157.5) kPa and the failure strains slightly decreases from (15 to 7.24) % as the strain rate increases from (0.37 to 1.75) mm/min.

Figure 5-7 summary of failure pattern for remolded samples at the rate of (0.37 to 1.75) mm/min

5.4.3 Summary of Unconfined Compression Test Result for Remolded Samples of Same load Increment to That of Undisturbed one

For the remolded samples from one-dimensional consolidation test for each load increment of (50 to 1600) kPa, the corresponding strain rates determined were (1.14 to 0.23) mm/min. With these rats, the corresponding UCS values are shown in fig 5.8.

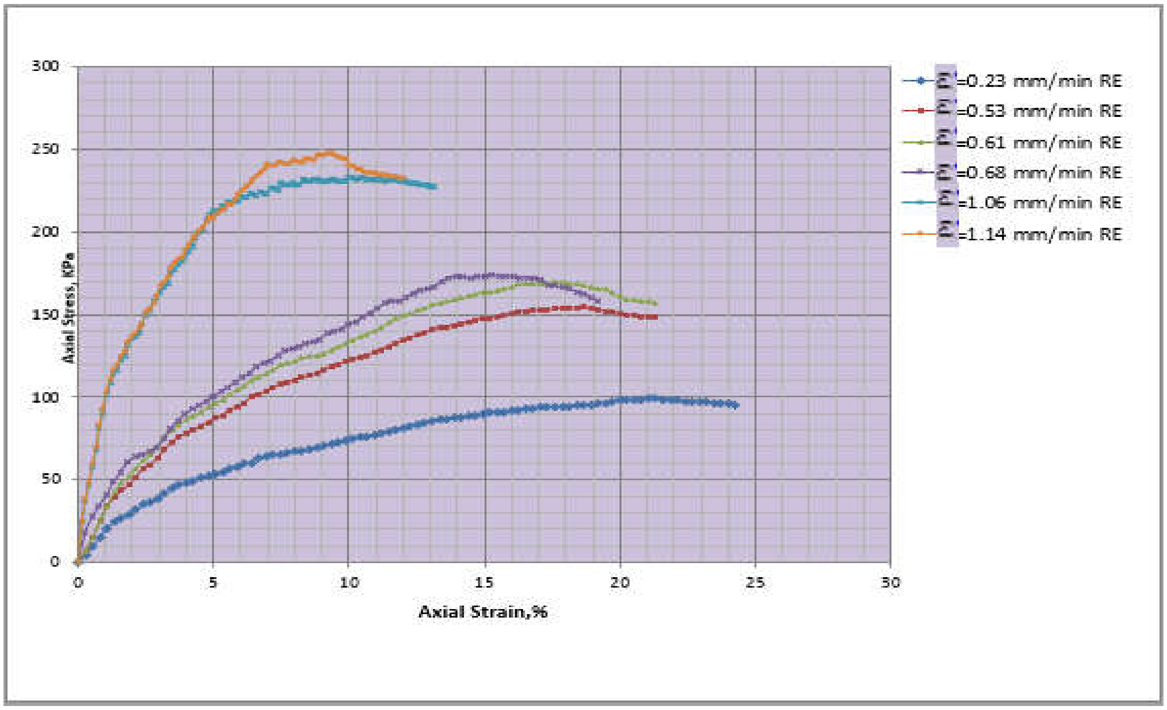

Figure 5-8 Summary of qu for load increment of (50 to 1600) kPa (ε =1.14 to 0.23) mm/min for remolded sample

The undrained shear strength increases from (45.3 to 123.9) kPa and the failure strains slightly decreases from (15 to 9.21) % as the strain rate increases from (0.23 to 1.14) mm/min.

Figure 5-9 summary of failure pattern for remolded samples at the rate of (0.23 to 1.14) mm/min

From the above stress-strain curves of remolded samples which are tasted for the same strain rate and same load increment to that of undisturbed samples and visual observation of the samples after failure, the failure modes were diagonal for all remolded samples but localized bulging in addition to diagonal failure was observed for the faster rates than the slower ones. This shows non-uniform failure modes occurred for the faster rates.

For the remolded samples, after the sample attains peak value, more or less the stress-strain curves continues in a constant manner. This may be due to the sample retain its peak strength even there is smaller change in deformation.

The stress-strain curves were longest for the rates of 0.23 to 0.84 mm/min because of the applied load was transferred throughout the sample and uniform failure mode occurs, as a result, the sample attains peak strength at largest axial strains.

For the rates of 1.03 to 1.14 mm/min in addition to diagonal failure bulging on some part of the samples and the stress-strain curves were relatively shorter and it attains peak strength at smaller axial strains than the rates of 0.23 to 0.84 mm/min. This may be due to the load was transferred from top to some depth of the sample height and the distribution of induced pore pressure was also up to some depth of sample height.

For the rates of 1.61 to 1.75 mm/min diagonal failures with localized bulging near to the top part were observed and also it attains peak strength at smallest axial strains than the other rates (0.23 to 1.14) mm/min. This may be due to non-uniform load transfer mechanisms and the distribution of induced pore pressure is not uniform throughout the sample height.

5.4.4 Over All Summary of Unconfined Compression Test Result Using Different Strain Rates for Undisturbed and Remolded Samples

From the stress-strain curves of undisturbed and remolded samples shown in figure 5-4,5-6 and 5-8, the undrained shear strength increases from 62.7 to 256.5 kPa and from 59.6 to 157.5 kPa as the strain rate increases from 0.37 to 1.75 mm/min using the same strain rate for undisturbed and remolded samples respectively and also from 45.3 to 123.9 kPa as the strain rate increases from 0.23 to 1.14) mm/min for the remolded samples of the same load increment to that of undisturbed samples.

The failure strains slightly decrease from 8.95 to 3.29 % and from 15 to 7.24 % as the strain rate increases from 0.37 to 1.75 mm/min using the same strain rate for undisturbed and remolded samples respectively and also from 15 to 9.21 % as the strain rate increases from 0.23 to 1.14 mm/min for the remolded samples having same load increment to that of undisturbed samples. This is because, for the slower rate, the failure is developed uniformly throughout the sample, as a result, the sample attains peak strength at large axial strains but for the faster rate, the failure is not throughout the sample height rather it is localized only on some portion of the sample height and it attains peak strength at small axial strains. Thus the occurrence of relative movement between the mineral skeleton decreases as the strain rate increases. As a result, a soil will compress much less during a rapid loading than it will during a slow loading of the same magnitude.

In the actual day to day practice, the strength tests of soil are commonly performed at a constant rate of strain but an appropriate strain rate shall be selected prior to commencing a test. In undrained shear, the selected strain rate must ensure the induced pore pressure is uniformity distributed throughout the specimen height. In drained shear, the selected strain rate must ensure the dissipation of induced pore pressure. The estimation of strain rate for testing soil can be made partly on the bases of experimental evidence and partly on the basis of theory. In the analysis of stability of slopes in terms of effective stresses, the pore water pressure distribution is of fundamental importance and its evaluation is one of the prime objectives in the early stages of any stability study.

In undrained test, since the test is quick, it is assumed that there is no dissipation of pore pressure during the test and sample preparation but extremely slow testing rates may be needed to allow a relatively high degree of induced pore pressure distribution uniformly throughout the sample.

Therefore the increase in undrained shear strength with increase in strain rate is probably due to the induced pore pressure between the soil skeleton. This is because of the occurrence of relative movement between the mineral skeleton and the migration pore fluid. When a saturated soil is compressed, water tends to flow out of the soil. However, a certain time is required for this P (t) movement of water to occur as a result the fast compression force creates large pore pressure development.

In this research case, when the tests are performed in slower rates approximately the induced pore pressure is distributed throughout the sample height. But for the faster rates, it seems that the induced pore pressure distribution is concentrated on some localized part and this makes dilation of the sample near the top part. This shows the induced pore pressure is not uniformly distributed throughout the sample.

From this it is clearly observed that, when the tests are performed at faster rates, the induced pore water pressure doesn't have time to dissipate and equally distributed throughout the sample with that fastest load application. As a result, the developed pour pressure is concentrated near to the point of load application and this creates additional resistance capacity to the soil skeleton before the applied load is completely transferred to the soil skeleton. So that the applied load is resisted by the pore pressure developed in addition to the soil skeleton. Therefore the resistance to failure increases as the strain rate increases and consequently the undrained shear strength increases.

From one-dimensional consolidation test result, it is clearly seen that the soil of the study area is heavily over consolidated. Therefore the pore pressure development is large negative pore pressure with less positive pore pressure. With higher rates of strain, pore pressures becoming more negative or less positive increases the shear strength of the soil. The strain-rate effect upon strength will be greatest when negative pore pressures contribute most importantly to strength.

Besides heavily over consolidated clays have higher effective stress after undrained shear than at the start of deformation due to its dilative tendency up on shearing. At the faster strain rates, adjacent soil particles find it more difficult to move relatively, and, unless restrained by increased effective stress. The effect can be thought of either as an increased resistance to compression or as an increased tendency to dilate. Increasing the strain rate applied to a saturated soil means larger effective stresses and consequently greater shear resistance and this leads to an increase in undrained shear strength.

If the sample is too short there will be significant end effects. End effects are caused by the top and bottom loading plates that grip the sample. In this research case a length-to-width ratio of two is used in UCS testing so that too much end effect is not expected. But the failure mode of the samples while testing at faster rate of strain is different from than that of slower one. The reason may be due to end effect of the top movable plate that grip and create wider peaks on the top of the sample as the rate becomes faster. Since at faster rates the upper plate is more contact on the top portion of the sample. This plate can also increase the strength of a soil sample by preventing the formation of the weakest failure plane.

The stress-strain relation curve is alternatively presented using peak UCS versus strain rate in order to understand the relation between strain rate and UCS value.

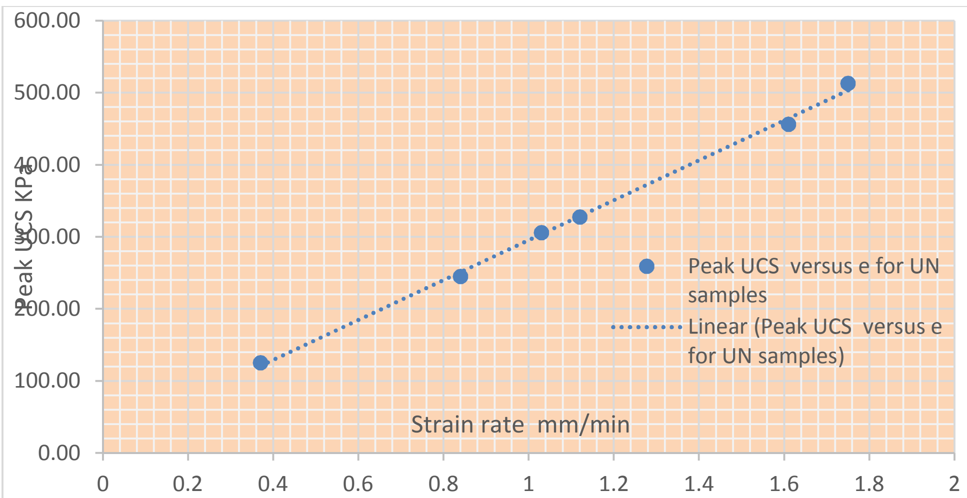

Figure 5-10 peak unconfined compressive strength versus strain rate for undisturbed samples

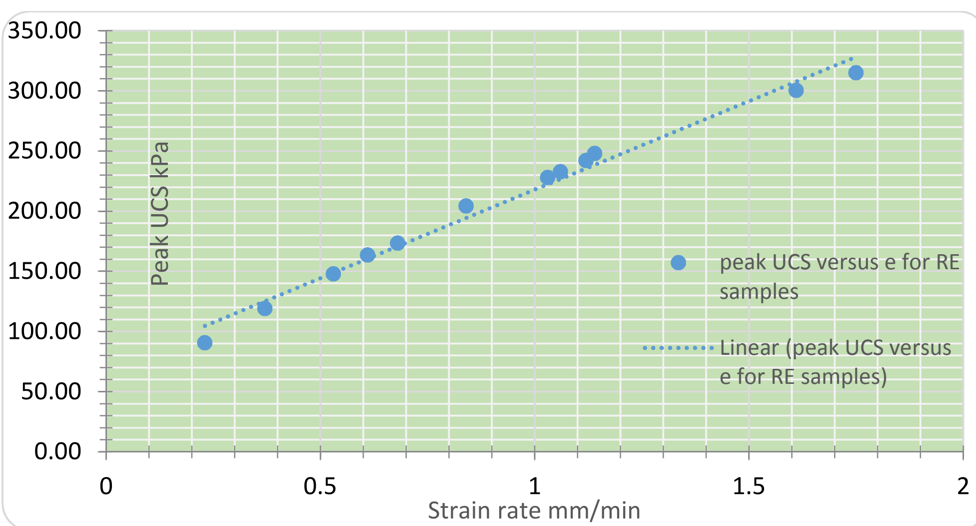

Figure 5-11 peak unconfined compressive strength versus strain rate for remolded samples

From the above UCS versus strain rate values, the undrained shear strength is higher for faster rates as compared to slower rates for both undisturbed and remolded samples. This shows the undrained shear strength increases linearly as the strain rate increases. This is because, as the rate increases, the soil skeleton does not have time to deform and find the path of least resistance and also the way load transfer mechanisms and the induced pore pressure distribution are localized on some portion of the samples especially near the top of the samples. As a result, the failure is not throughout the sample and non-uniform pore pressure distribution throughout the sample height. Besides the soil skeleton gets an additional support from the pore pressure developed and the number of failure plane also decrease as the rate increases. Therefore the resistance of the sample increased and the undrained shear strength also increases. In other words, as the strain rate decreases, multi failure plane occurred throughout the samples and this leads a decrease in resistance and finally, the undrained shear strength decreases. Thus the amount of bonding which acts at a given strain increases as the strain rate increases and hence the higher strength and vice versa.

In order to generalize the discussion on effect of strain rate on undrained shear strength in this thesis, for slower rates, the stress-strain curves are longer than that of the faster rates. Hence the load was transferred uniformly and the induced pore pressure distributes uniformly throughout the sample. (Nearly uniform failure modes and multiple failure planes were observed). As a result, the sample attains peak strength at large axial strains.

However, for faster rates, the slopes of the stress-strain curves are very steep (the curves are too short) and the load is not uniformly transferred and non-uniform induced pour pressure distribution throughout the sample height. (Non-uniform failure modes were observed) and the sample attains peak strength at small axial strains. When shear failure mode occurred in such a manner the deformation was observed only on the localized zone. Therefore the deformations don't represent the whole sample height as it was normally assumed in UCS test. It only represents the material sheared in this localized zone. But the height of the localized zone was not known and the total sample height was used for the calculation of strains, as a result, the stress-strain curve was too short and the sample attains peak strength at smaller axial strains than the actual one occurred.

Besides, for the faster rates, the soil skeleton doesn't have time to find the path of least resistance and the incoming load is resisted by the induced pore pressure developed between the soil skeleton in addition to the soil grains. Therefore, as the strain rate increases, the resistance to failure increases and consequently the undrained shear strength increases.

Based on the unconfined compressive test results of stress-strain curves, failure patterns and visual observation, it is possible to test undisturbed samples of red clay soil in Addis Ababa using strain rates ranging from 0.37 to 1.12 mm/min i.e. 0.5%/min to 1.5%/min but reliable result is obtained in the range of 0.37 to 0.84 mm/min i.e. 0.5%/min to 1.1%/min and remolded samples of red clay soil in Addis Ababa using strain rates ranging from 0.23 to 1.12 mm/min i.e. 0.3%/min to 1.5%/min but reliable result is obtained in the range of 0.23 to 0.84 mm/min i.e. 0.3%/min to 1.1%/min .Since for reliably recommended rates of undisturbed and remolded samples, the failure modes were nearly the same as the basic assumption for undrained shear strength test which state that the failure is uniformly distributed and uniform pore pressure distribution throughout the sample height.

In this thesis, it is clearly observed that, the undrained shear strength increases with increasing strain rate and vice versa for both undisturbed and remolded samples due to the way of load transfer mechanisms and the contribution of the induced pore pressure distribution to the resistance of the soil with varying strain rates.

The effect of strain rate may increase or decrease the shear strength and also the slopes of stress-strain curves which can affect the deformation parameter which intern used for geotechnical problems related to strength and deformation like bearing capacity, settlement analysis, and stability analysis problems. Especially Stability problems were highly concerned with the failure concept (types of failure pattern) and also in the analysis of stability of slopes in terms of effective stresses, the pore water pressure distribution is of fundamental importance and its evaluation is one of the prime objectives in the early stages of any stability study. In this research case, it is clearly observed that, the slopes of the stress-strain curves become very steep as the strain rate increases. Therefore the rate effect should be considered while conducting the tests.

In general, before conducting the strength tests, the consolidation characteristics of the soil should be determined and from that the coefficient of consolidation (C_v) is obtained and the strain rate (ε) .Based on the result, the test will be conducted accordingly. So it is crucial to now the rate at which the load is applied to the tested samples and for which purpose the test is needed.

5.5. Relation between sensitivity and strain rate

The sensitivity of the samples computed for the same strain rates and for the same load increments are shown in table 5.3 and 5.4 and also its relation with strain rate is presented in figure 5.12 and 5.13.

Table 5-3 sensitivity values determined from the same strain rate

Strain rate ε(mm/min)	UCS (qu) Undisturbed kPa	UCS (qu) Remolded kPa	Sensitivity $(S_t)=qu_{UN}/qu_{RE}$
1.75	513.09	314.99	1.63
1.61	456.01	300.49	1.52
1.12	327.34	241.99	1.35
1.03	305.96	228.09	1.34
0.84	245.06	204.54	1.24
0.37	125.46	119.14	1.05

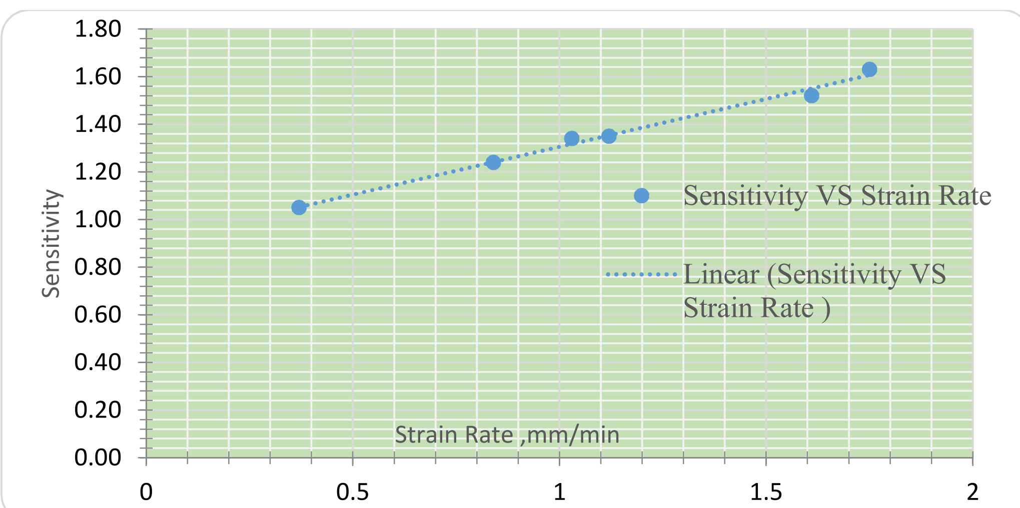

Figure 5-12 Sensitivity versus strain rate obtained from the same strain rate

As the strain rate increases from 0.37 to 1.75 mm/min the sensitivity increases from 1.05 to 1.63 for unconfined compressive strength (UCS) computed for the same strain rate for both samples.

Table 5-4 sensitivity values determined from the same load increment

load increment (kPa)/ Strain rate e(mm/min)	UCS (qu) Undisturbed kPa	UCS (qu) Remolded kPa	Sensitivity (St)=quUN/qu RE
(7-50)/ 0.23RE & 0.37UN	513.09	247.83	2.07
(50-100) 0.53RE & 0.84UN	456.01	232.73	1.95
(100-200) 0.61RE & 1.03UN	327.34	173.30	1.89
(200-400) 0.68RE & 1.12UN	305.96	163.62	1.87
(400-800) 1.06RE & 1.61UN	245.06	147.72	1.66
(800-1600)1.14RE & 1.75UN	125.46	90.55	1.38

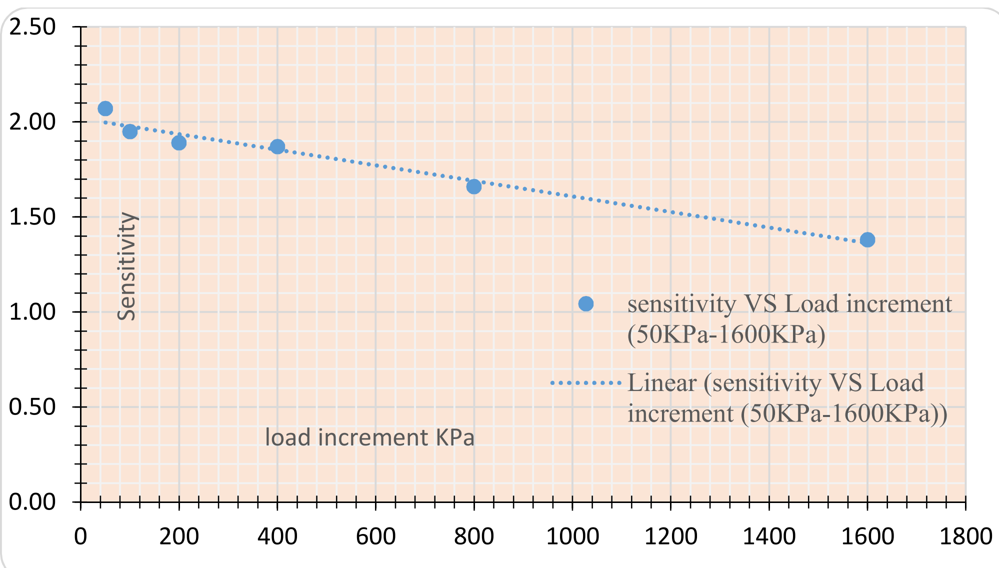

Figure 5-13 Sensitivity versus strain rate obtained from the same load increment

The sensitivity increases from 1.38 to 2.07 for a load decrement of 1600 to 50 kPa for unconfined compressive strength (UCS) computed for the rate of 0.37 to 1.75 mm/min and 0.23 to 1.14 mm/min for undisturbed and remolded samples respectively.

From the sensitivity value computed for both cases as shown in table 5.3 and 5.4 (i.e computed for the same strain rate and same load increment for both undisturbed and remolded samples) the sensitivity increases as the strain rate increases due to remolding sample disturbance increased and bonding between the soil grains were less after remolding as the original fabric is destroyed and particle arrangement become weak and unstable after remolding. As a result, the increase in strength for undisturbed samples is higher than that of the remolded samples.

The sensitivity value is more for sensitivity computed from the same load increment to that of undisturbed samples (i.e for the rate of 0.37 to 1.75 mm/min and 0.23 to 1.14 mm/min for undisturbed and remolded samples respectively) as compared to those computed for the same strain rate for both undisturbed and remolded samples (i.e 0.37 to 1.75 mm/min for both samples). This is because the strain rate of the remolded sample is less as compared to that of the undisturbed samples. As a result, the unconfined compressive strength is also less.

The sensitivity should be determined for a particular strain rate or an accepted increase in undrained shear strength for both undisturbed and remolded samples. Hence for the same type of soil, the strength is highly affected by strain rate and the sensitivity of the soil is dependent on the strength of the soil.

From studies of Abdelmalek, B. (1991). Time effects on the unconfined compressive strength and sensitivity of clay from Ubulu-Uku in the south west of Nigeria. The sensitivity values determined were 1.21, 1.37, and 1.41 for the rates of 0.08, 1, and 2 mm/min respectively. The result is somehow closer for those tasted for the same strain rate in this research case. Which is 1.05 to 1.63 for the rates of 0.37 to 1.75mm/min. But the sensitivity of soil significantly varied from country to country depending on its type, in this research the general classification is considered to determine the sensitivity of the soil in the study area.

Bowles (1996) presented different general classifications of soil sensitivity, to show that soils with St less than 4 are insensitive, S_t between 4 and 8 are sensitive, while S_t over 8 represents extra sensitive soil. .

Based on the above general classification of clays on the basis of their sensitivity, the sensitivity of the soil in the study area falls in the ranges of (1.05 to 1.63 tasted at the same strain rate and 1.38 to 2.07 tasted for the same load increment).Over all from (1.05 to 2.07) which is < 4, therefore, it can be classified as insensitive soil.

Chapter Six

6. Conclusion and Recommendation

6.1. Conclusion

- As the strain rate increases, the undrained shear strength increases for both undisturbed and remolded samples. This may be due to the way of load transfer mechanisms and the contribution of pore pressure distribution to the resistance of the soil with varying strain rates.
- Based on the findings, it is possible to test the red clay soil in Addis Ababa using strain rates ranging from (0.5 to 1.5) %/min for undisturbed and (0.3 to 1.5) %/min for remolded samples. But reliable result is obtained in the range of (0.5 to 1.1) %/min and (0.3 to 1.1) %/min for undisturbed and remolded samples respectively. Since for those rates the failure modes were nearly the same as to the basic assumption for undrained shear strength test which state that the failure is uniformly distributed and uniform pore pressure distribution throughout the sample height.
- The sensitivity increases as the strain rate increases .The sensitivity should be determined for a particular rate of strain or an accepted increase in undrained shear strength for both samples. Besides the soil in the study area can be classified as insensitive.

6.2. Recommendation

- The author recommends that further researches can be conducted with increased number of samples from same areas and additional areas that were not included in this research of Addis Ababa where red clay soil is found and also for other types of soil in order to show the magnitude of effect of strain rate on the local soil.
- The author recommends that this research topic can also be further employed by considering combined moisture content and strain rate on the shear strength and also the role of compaction density on the shear strength under different strain rate since the strength is highly affected by the above-mentioned factors.
- There are significant variations between the different classifications systems available for soil sensitivity. Therefore, the author recommends further research which can be conducted on the sensitivity of red clay soil in Addis Ababa and other areas and also for other types of soil, so that the sensitivity ranges can be clearly defined accordingly for the local soils.

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Appendices

Appendix A: Details of Some laboratory Tests results

Appendix A1:

Table 0-1 Natural Moisture Content Determination

Type of Test: Natural moisture content	Test method: ASTM D4959			
Location: Kolfe area Soil Description: Dark Red clay	Job ref.		Thesis research	
	Depth		2.5m	
	Date		3/21/2017	
Pit No	TP1		TP2	
Sample No	#1	#2	#1	#2
Container No.	B2	A3	G1	H1
Mass of wet soil + container (M_2) , gm	74.60	69.30	80.14	71.23
Mass of dry soil + container (M_3) , gm	60.00	56.00	63.70	57.00
Mass of container (M_1), gm	15.80	15.70	16.00	15.60
mass of moisture (M2 -M_3), gm	14.60	13.30	16.44	14.23
Mass of dry soil (M3 -M1), gm	44.20	40.30	47.70	41.40
Water content, (m2-m3)/(m3- m1)*100% (W)	33.03	33.00	34.47	34.37
Average NMC (%)	**33.02**		**34.42**	

Appendix A2:

Table 0-2 Field Density Determination

Type of Test:Field Density					Test method:		ASTM D2937	
Location: Kolfe area					Job ref.		Thesis research	
Soil Description:Dark Red clay					Depth		2.5m	
					Date		3/21/2017	
Pit No	TP1				TP2			
Test No	#1	#2	#3	#4	#1	#2	#3	#4
Container No.	U1	U2	U3	U4	U5	U6	U7	U8
Mass of soil + Sampler (m2) g	3011.50	3178.10	2914.20	3707.50	3154.10	2896.20	3002.40	3697.50
Mass of Sampler (m1) g	774.70	782.80	861.80	1453.80	792.80	861.80	774.70	1453.80
Mass of Soil (m2- m1)g	2236.80	2395.30	2052.40	2253.70	2361.30	2034.40	2227.70	2243.70
Height of Sampler, (H)cm	13.30	14.30	13.50	14.80	14.10	13.50	13.50	14.80
Diameter of Sampler, (D) cm	10.50	10.50	10.00	10.00	10.50	10.00	10.50	10.00
Volume of Sampler/soil, (V=п*D2/4*H)cm3	1151.1	1237.6	1059.8	1161.8	1220.3	1059.8	1168.4	1161.8
Density, ρ, g/cc	1.943	1.935	1.937	1.940	1.94	1.92	1.91	1.93
Average	**1.94**				**1.92**			

Appendix A3:

Table 0-3 Specific Gravity Determination

Type of Test: Specific Gravity	Test method: ASTM D854			
Location: Kolfe area	Job ref.		Thesis research	
	Depth		2.5m	
Soil Description: Dark Red clay	Date		3/28/2017	
Pit No	TP1		TP2	
Sample No	#1	#2	#1	#2
Pyknometer number	S1	S1	S1	S1
Mass of bottle + soil + water ($m3$) g	165.27	165.32	165.40	165.30
Mass of bottle + soil ($m2$) g	69.80	69.90	70.00	69.90
Mass of bottle full of water ($m4$) g	158.90	158.90	159.00	158.90
Mass of bottle ($m1$) g	59.80	59.80	59.90	59.80
Mass of soil ($m2 - m1$) g	10.00	10.10	10.10	10.10
Mass of water in full bottle ($m4 - m1$) g	99.10	99.10	99.10	99.10
Mass of water used ($m3 - m2$) g	95.47	95.42	95.40	95.40
Volume of soil particles ($m4 - m1$) – ($m3 - m2$) mL	3.63	3.68	3.70	3.70
Specific Gravity ($m2 - m1$)/(($m4 - m1$) – ($m3 - m2$))	2.755	2.745	2.73	2.73
Average (%)	2.75		2.73	

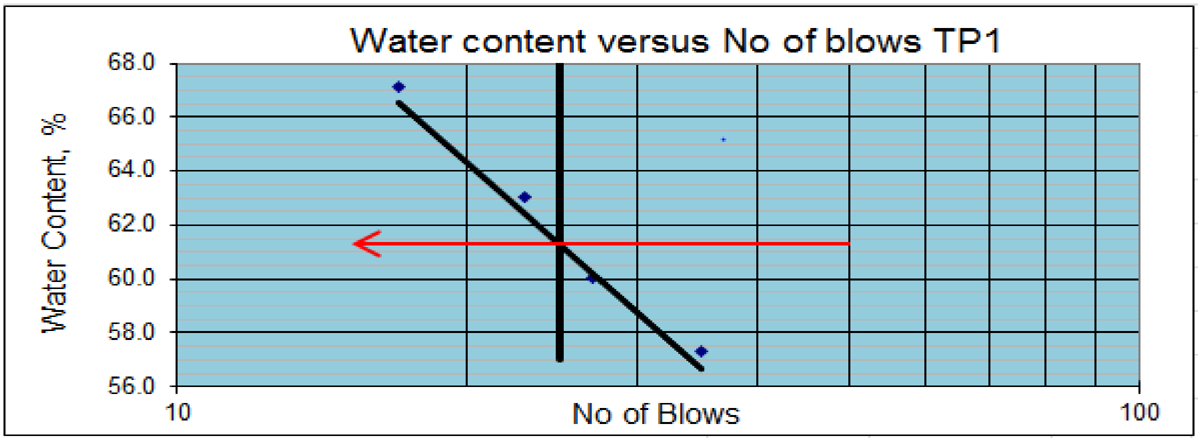
Appendix A4:

Table 0-4 Plastic Limit Determination

Type of Test:Plastic Limit	Test method: ASTM D4318			
Location: Kolfe area	Job ref.		Thesis research	
Soil Description:Dark Red clay	Depth		2.5m	
	Date		4/5/2017	
Pit No	TP1		TP2	
Test No	#1	#2	#1	#2
Container number	A2	Z1	Q5	R10
Mass of wet Soil +container ($m2$) g	18.35	17.45	18.51	17.55
Mass of dry soil + container ($m3$) g	17.80	16.70	18.00	16.90
Mass of container ($m1$) g	15.80	14.00	15.88	14.28
Mass of Moisture ($m2 - m3$) g	0.55	0.75	0.51	0.65
Mass of dry soil ($m3 - m1$) g	2.00	2.70	2.12	2.62
Moisture content, (m2-m3)/(m3- m1)*100% (W)	27.50	27.78	24.06	24.81
Average (%)	**27.64**		**24.43**	

Table 0-5 liquid Limit Determination

Type of Test:Liquid Limit test	Test method: ASTM D4318							
Location: Kolfe area	Job ref.				Thesis research			
Soil Description:Dark Red clay	Depth				2.5m			
	Date				4/5/2017			
Pit No	TP 1				TP 2			
Test No	#1	#2	#3	#4	#1	#2	#3	#4
Container number	G1	H3	A1	B2				
Mass of wet Soil +container (m 2) g	46.45	46.34	45.06	48.20	46.62	46.25	45.44	48.75
Mass of dry soil + container (m 3) g	37.19	37.78	37.27	39.60	36.94	37.52	37.21	39.72
Mass of container (m 1) g	23.40	24.20	24.30	24.60	23.60	23.98	23.50	23.80
Mass of Moisture (m 2 – m 3) g	9.26	8.56	7.79	8.60	9.68	8.73	8.23	9.03
Mass of dry soil (m 3 – m 1) g	13.79	13.58	12.97	15.00	13.34	13.54	13.71	15.92
Moisture content, (m2-m3)/(m3- m1)*100%	67.2	63.0	60.1	57.3	72.6	64.5	60.0	56.7
Number of blows	17	23	27	35	18	24	29	33



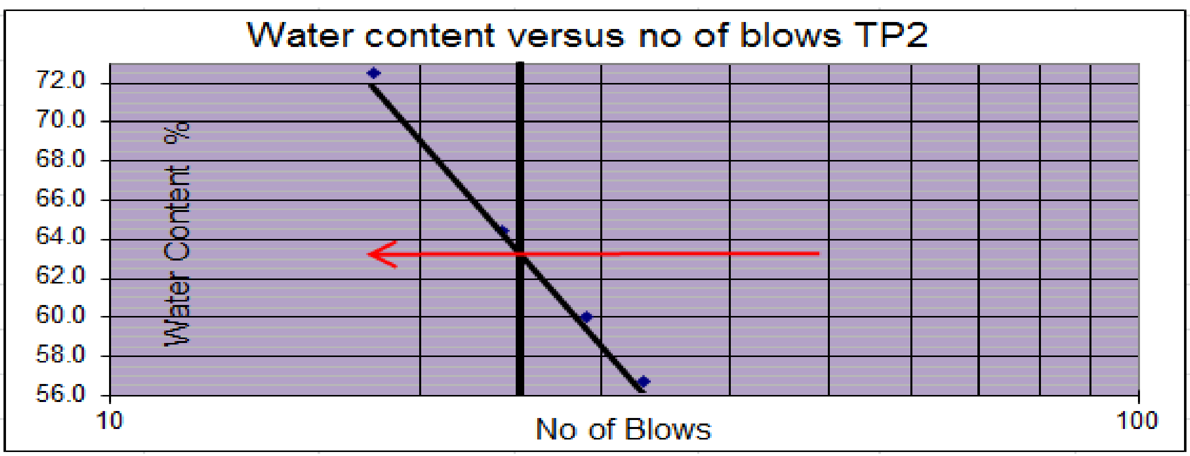


Figure 0-1 water content verses No of blows for TP1 andTP2

TP1			TP2		
LL	PL	PI	LL	PL	PI
61.25	27.64	33.61	63.25	24.43	38.82

Appendix A5:

Table 0-6 Free Swell Capacity Determination

Type of Test: Free swell	Test method: ASTM D 5890			
Location: Kolfe area	Job ref.	Thesis research		
Soil Description: Dark Red clay	Depth	2.5m		
	Date	3/28/2017		
Pit No	TP1		TP2	
Test No	#1	#2	#1	#2
Initial Volume, ml	10.00	10.00	10.00	10.00
Final Volume, ml	12.50	12.00	11.50	12.50
Free Swell, %	25.00	20.00	15.00	25.00
Average (%)	**22.50**		**20.00**	

Appendix A6: Particle size distribution Determination

Table 0-7 wet sieve analysis for TP1

Type of Test: Wet cieve anlysis				Test method: ASTM D2217			
Sieve no	sieve size, mm.	Mass of empty sieve, g	Mass of sieve+soil retained, g	weight soil retained	% retained	% Commulative Retaied	% passing
	75.0						100.00
	63.0						100.00
	50.0						100.00
	37.5						100.00
	25.0						100.00
	19.0						100.00
	12.5						100.00
	9.5						100.00
4.0	4.75	431.0	431.0	0.00	0.00	0.00	100.00
8.0	2.36	389.0	389.0	0.00	0.00	0.00	100.00
10.0	2.00	378.0	378.0	0.00	0.00	0.00	100.00
16.0	1.18	355.0	374.00	19.00	1.90	1.90	98.10
30.0	0.60	313.0	328.45	15.45	1.55	3.45	96.56
40.0	0.425	291.0	305.06	14.06	1.41	4.85	95.15
50.0	0.3	287.0	298.94	11.94	1.19	6.05	93.96
100.0	0.15	268.0	279.76	11.76	1.18	7.22	92.78
200.0	0.075	259.0	267.93	8.93	0.89	8.11	91.89
Pan	Pan	240.0		919	91.9	100	0
	Dry weight before washing	1000					

Table 0-8 Hydrometer analysis TP1

Type of Test:Hydrometer analysis		Test method: ASTM D422	
Location: Kolfe area		Job ref.	Thesis research
		Pit no.	#1
		Sample no.	#1
Soil Description:Dark Red clay		Depth	2.5m
		Date	5/2/2017
		Specific Gravity	2.75
Total oven Dry mass(gm)=	50 gm		

Elapsed Time (min)	Actual Hydrometer Reading	Test Temperature (°C)	Composite Correction	Corrected Hydrometer Reading	Effective Depth (cm)	Coefficient K	Grain Size (mm)	Perc. Finer (%)
0.5	1.0315	17.3	0.0032	1.0283	7.97	0.0137	0.0547	88.94
1	1.0313	17.2	0.0033	1.0280	8.02	0.0138	0.0391	88.00
2	1.0310	17	0.0033	1.0277	8.10	0.0138	0.0278	87.06
4	1.0305	16.8	0.0033	1.0272	8.23	0.0138	0.0198	85.49
8	1.0303	17	0.0033	1.0270	8.29	0.0138	0.0140	84.86
15	1.0295	17.6	0.0033	1.0262	8.50	0.0138	0.0104	82.34
30	1.0285	16.9	0.0033	1.0252	8.76	0.0137	0.0074	79.20
60	1.0278	17,1	0.0032	1.0246	8.95	0.0136	0.0053	77.31
120	1.0260	17,7	0.0031	1.0229	9.42	0.0136	0.0038	71.97
240	1.0251	18	0.0029	1.0222	9.66	0.0134	0.0027	69.77
480	1.0248	19.2	0.0033	1.0215	9.74	0.0137	0.0020	67.57
1440	1.0235	18	0.0031	1.0204	10.08	0.0136	0.0011	64.11

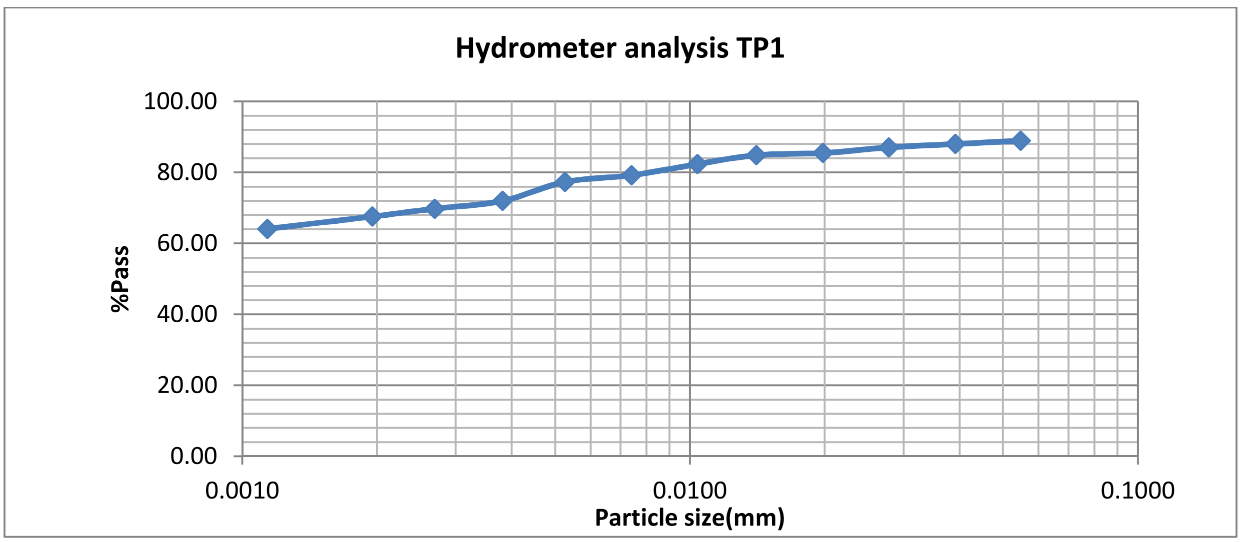


Figure 0-2 percentage pass verses particle size distribution for hydrometer for TP1

Table 0-9 Combination of wet sieve and hydrometer analysis for TP1

Combination of wet sieve and hydrometer analysis TP1	
Particle size (mm)	Percentage pass (%)
75.0	100.0
63.0	100.0
50.0	100.0
37.5	100.0
25.0	100.0
19.0	100.0
12.5	100.0
9.5	100.0
4.75000	100.0
2.00000	100.0
0.42500	95.15
0.30000	93.96
0.15000	92.78
0.07500	91.89
0.05470	88.94
0.03908	88.00
0.02777	87.06
0.01979	85.49
0.01405	84.86
0.01039	82.34
0.00740	79.20
0.00525	77.31
0.00381	71.97
0.00269	69.77
0.00195	67.57
0.00114	64.11

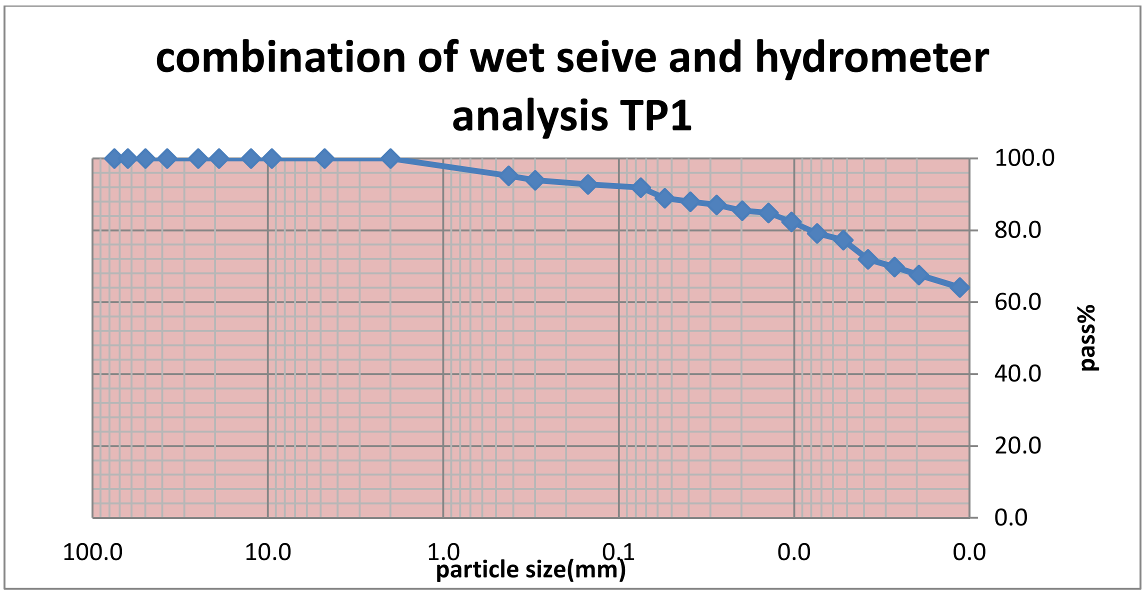


Figure 0-3 percentage pass verses particle size distribution for combined analysis TP1

Table 0-10 summary of combined analysis FOR TP1

Summery(combined) TP1	
1.Particles larger than 4.75mm =	0%
2.Coarse Sand 4.75mm - 0.425mm =	4.85%
3.Fine Sand 0.425mm - 0.075mm =	3.26%
4.Silt 0.075-0.002mm =	19.2%
5.Clay smaller than 0.002mm =	72.71%

Table 0-11 wet sieve analysis for TP2

Type of Test: Wet cieve anlysis				Test method: ASTM D2217			
Sieve no	sieve size, mm.	Mass of empty sieve, g	Mass of sieve+soil retained, g	weight soil retained	% retained	% Commulative Retaied	% passing
	75.0						100.0
	63.0						100.0
	50.0						100.0
	37.5						100.0
	25.0						100.0
	19.0						100.0
	12.5						100.0
	9.5						100.0
4.0	4.75	431.0	431	0.00	0.00	0.00	100.0
8.0	2.36	389.0	389	0.00	0.00	0.00	100.0
10.0	2.00	378.0	378	0.00	0.00	0.00	100.0
16.0	1.18	355.0	378.95	23.95	2.40	2.40	97.61
30.0	0.60	313.00	334.15	21.15	2.12	4.51	95.49
40.0	0.425	291	306.92	15.92	1.59	6.10	93.90
50.0	0.3	287	299.25	12.25	1.2	7.33	92.67
100.0	0.15	268	279.83	11.83	1.2	8.51	91.49
200.0	0.075	259	268.48	9.48	0.9	9.46	90.54
Pan	Pan	240		905	90.5	100	0
	Dry weight before washing	1000					

Table 0-12 Hydrometer analysis TP2

Type of Test:Hydrometer analysis	Test method: ASTM D422	
Location: Kolfe area	Job ref.	Thesis research
	Pit no.	#2
Soil Description:Dark Red clay	Sample no.	#1
	Depth	2.5m
	Date	5/2/2017
	Specific Gravity	2.73
Total oven Dry mass(gm)= 50 gm		

Elapsed Time (min)	Actual Hydrometer Reading	Test Temperature (°C)	Composite Correction	Corrected Hydrometer Reading	Effective Depth (cm)	Coefficient K	Grain Size (mm)	Perc. Finer (%)
0.5	1.0317	17	0.0030	1.0287	7.93	0.0138	0.0550	90.20
1	1.0315	17.3	0.0030	1.0285	7.95	0.0138	0.0389	89.57
2	1.0312	17.2	0.0033	1.0279	8.00	0.0138	0.0276	87.69
4	1.0307	17	0.0032	1.0275	8.20	0.0138	0.0198	86.43
8	1.0305	16.9	0.0033	1.0272	8.23	0.0139	0.0141	85.49
15	1.0297	17.7	0.0030	1.0267	8.40	0.0138	0.0103	83.91
30	1.0287	17.1	0.0032	1.0255	8.74	0.0136	0.0073	80.14
60	1.0280	16.8	0.0031	1.0249	8.93	0.0139	0.0054	78.26
120	1.0262	18	0.0029	1.0233	9.40	0.0136	0.0038	73.23
240	1.0253	17.7	0.0030	1.0223	9.64	0.0138	0.0028	70.09
480	1.0248	18	0.0030	1.0218	9.74	0.0136	0.0019	68.51
1440	1.0237	16.7	0.0031	1.0206	10.06	0.0135	0.0011	64.74

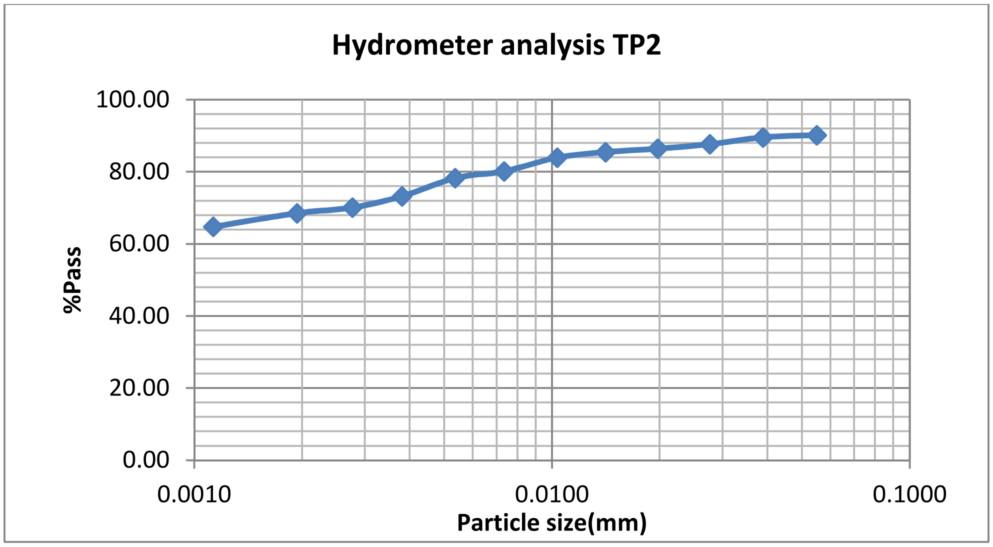


Figure 0-4 percentage pass verses particle size distribution for hydrometer for TP1

Table 0-13 Combination of wet sieve and hydrometer analysis for TP2

Combination of wet sieve and hydrometer analysis TP2	
Particle size (mm)	Percentage pass (%)
75.00000	100.00
63.00000	100.00
50.00000	100.00
37.50000	100.00
25.00000	100.00
19.00000	100.00
12.50000	100.00
9.50000	100.00
4.75000	100.00
2.00000	100.00
0.42500	93.90
0.30000	92.67
0.15000	91.49
0.07500	90.54
0.05496	90.20
0.03891	89.57
0.02760	87.69
0.01976	86.43
0.01410	85.49
0.01033	83.91
0.00734	80.14
0.00536	78.26
0.00381	73.23
0.00277	70.09
0.00194	68.51
0.00113	64.74

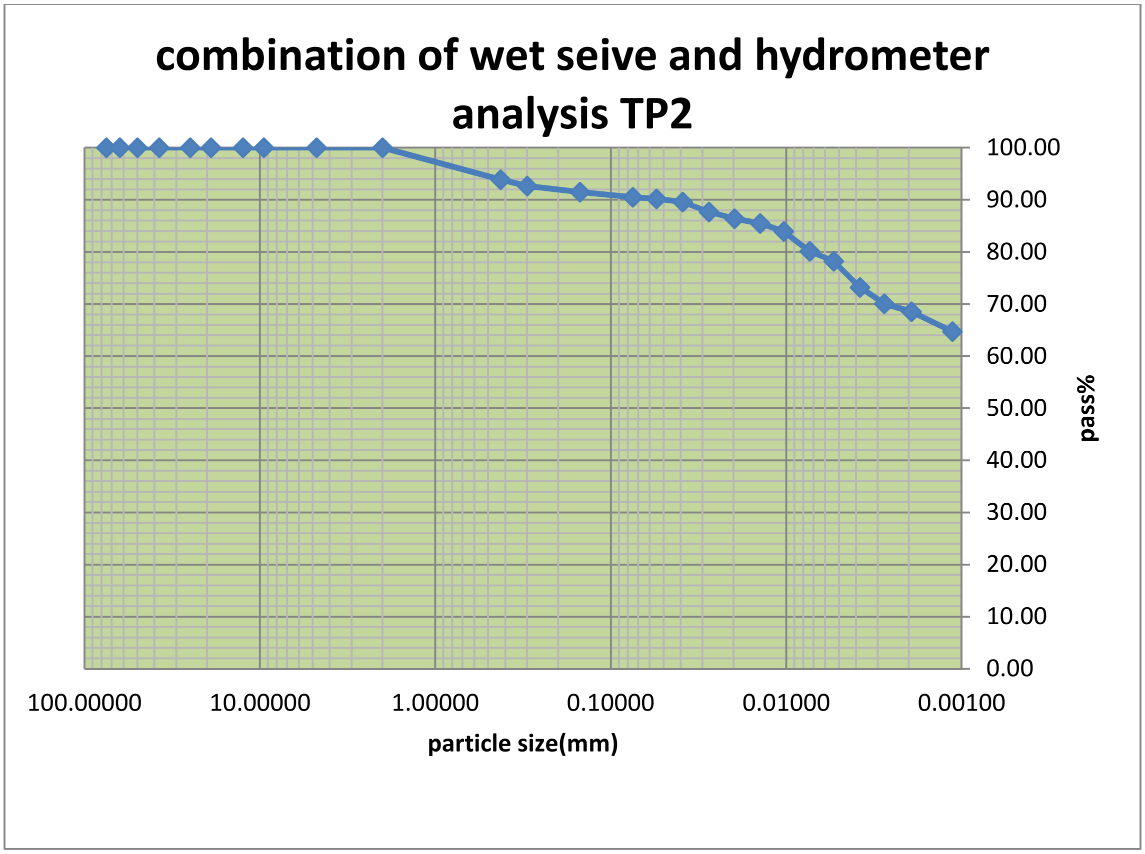


Figure 0-5 percentage pass verses particle size distribution for combined analysis TP2

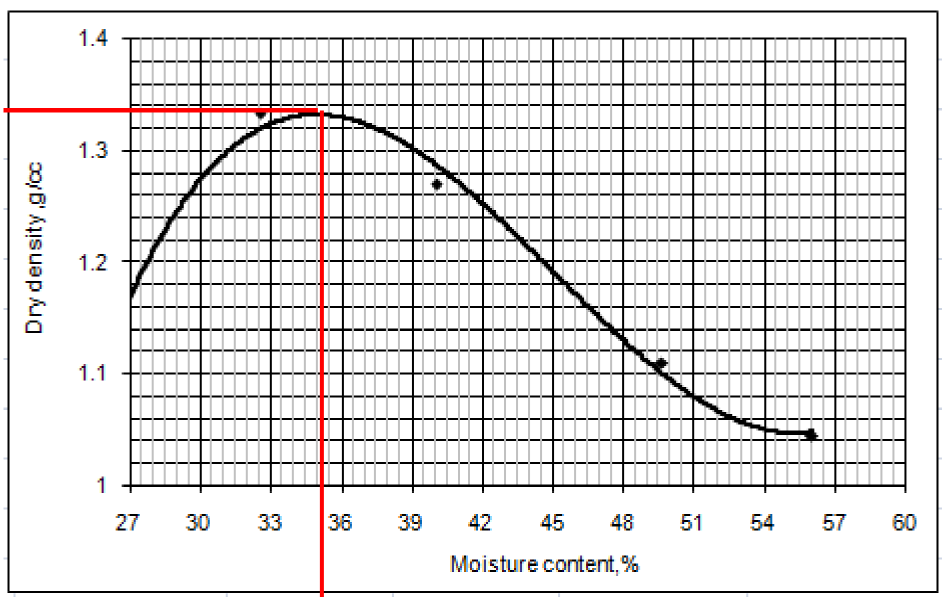
Table 0-14 summary of combined analysis FOR TP2

Summery(combined) for TP2	
1.Particles larger than 4.75mm =	0%
2.Coarse Sand 4.75mm - 0.425mm =	6.10%
3.Fine Sand 0.425mm - 0.075mm =	3.36%
4.Silt 0.075-0.002mm =	20.1%
5.Clay smaller than 0.002mm =	70.43%

Appendix A7: Compaction (Moisture Density Relation) Determination

Table 0-15 Standard Compaction for TP1

Type of Test:Compaction				Test method: ASTM T 180			
Location: Kolfe area				Job ref.	Thesis research		
				Pit no.	#1		
Soil Description:Dark Red clay				Sample n	#1		
				Depth	2.5m		
				Date	4/26/2017		
No. of blows :	25			Weight of hammer,kg :			2.5
No. of layers :	3			Volume of mold,cm^3 :			944
Proportion retained on 4.75mm(No 4) sieve size:< 20%				Apparent specific gravity :			2.75
A	Mold	No.	1	2	3	4	5
B	Wt. of Mold + Wet Soil	grams	5215	5488	5500	5389	5353
C	Wt. of Mold	grams	3820	3820	3820	3820	3820
D	Wt. Wet Soil	grams	1395	1668	1680	1569	1533
E	Volume of Mold	cu.cm.	944	944	944	944	944
F	Wet Density	gr/cu.cm.	1.478	1.767	1.780	1.662	1.624
G	Container	No.	G2	H6	T1	H4	G2x
H	Wt. Cont + Wet soil	grams	54	62	64	75	74
I	Wt. Cont + Dry soil	grams	50	55	56	62	60
J	Weight of Container	grams	35.5	35.4	35.1	35.7	35.6
K	Weight of water	grams	4.0	6.5	8.3	13.2	13.8
L	Weight of Dry Soil	grams	14.8	20.0	20.6	26.5	24.6
M	Moisture Content	%	27.03	32.58	40.05	49.62	56.01
N	Dry Density	gr/cu.cm.	1.163	1.333	1.271	1.111	1.041



Maximum Dry Density (MDD): 1.336 gm/cc	
Optimum Moisture Content (OMC) : 35 %	

Figure 0-6 Standard compaction curve for TP1

Table 0-16 Modified Compaction for TP1

Type of Test:Compaction				Test method: ASTM T 180			
Location: Kolfe area				Job ref.	Thesis research		
				Pit no.	#1		
Soil Description:Dark Red clay				Sample n	#1		
				Depth	2.5m		
				Date	4/26/2017		
No. of blows : 25				Weight of hammer,kg : 4.5			
No. of layers : 5				Volume of mold,cm^3 : 944			
Proportion retained on 4.75mm(No 4) sieve size:< 20%				Apparent specific gravity : 2.75			
A	Mold	No.	1	2	3	4	5
B	Wt. of Mold + Wet Soil	grams	5352	5535	5571	5604	5348
C	Wt. of Mold	grams	3820	3820	3820	3820	3820
D	Wt. Wet Soil	grams	1532	1715	1751	1784	1528
E	Volume of Mold	cu.cm.	944	944	944	944	944
F	Wet Density	gr/cu.cm.	1.623	1.817	1.855	1.890	1.619
G	Container	No.	X6	X5	A5	G22	
H	Wt. Cont + Wet soil	grams	56	67	56	61	83
I	Wt. Cont + Dry soil	grams	52	60	51	55	67
J	Weight of Container	grams	35.5	35.8	35.6	35.6	35.5
K	Weight of water	grams	4.0	6.9	4.6	6.2	16.2
L	Weight of Dry Soil	grams	16.7	24.6	15.8	19.2	31.3
M	Moisture Content	%	23.95	28.05	29.11	32.38	51.8
N	Dry Density	gr/cu.cm.	1.309	1.419	1.437	1.428	1.067

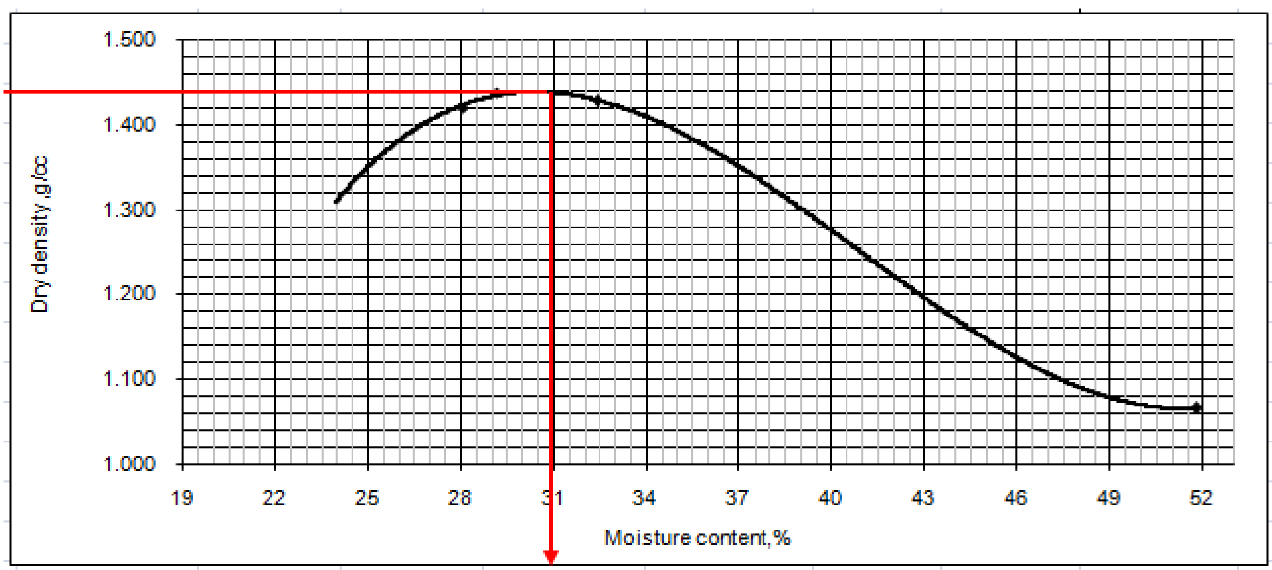


Figure 0-7 Modified compaction curve for TP1

Maximum Dry Density (MDD): 1.44 gm/cc
Optimum Moisture Content (OMC) : 31 %

Appendix B: Determination of coefficient of consolidation and strain rate

One dimensional consolidation test for undisturbed sample

Type of Test: One dimensional oedometer	Test method: ASTM D2435	
Location: Kolfe area	Job ref.	Thesis research
	Pit no.	#1
Soil Description: Dark Red clay	Depth	2.5m
	Date	4/7/2017
Sample Type Undisturbed	Initial Ht. of specimen, mm 18	
Height of ring, mm 20	Initial mass of specimen, g 67.78	
Diameter of ring, mm 50	Initial bulk density, g/cc 1.94	
Ini. Moisture content, % 33.73	Initial dry density, g/cc 1.46	
Final moisture content, % 38.7	Specific gravity, 2.75	

Loading values		
Loading,Kpa		Def. Dial Reading (mm)
7		5
50		5.282
100		5.432
200		5.615
400		5.918
800		6.365
1600		7.065

Un loading Values		
Pressure Decrement,Kpa		Def. Dial Reading (mm)
1600		7.065
800		6.97
400		6.89
200		6.81
100		6.73
50		6.63
7		6.305

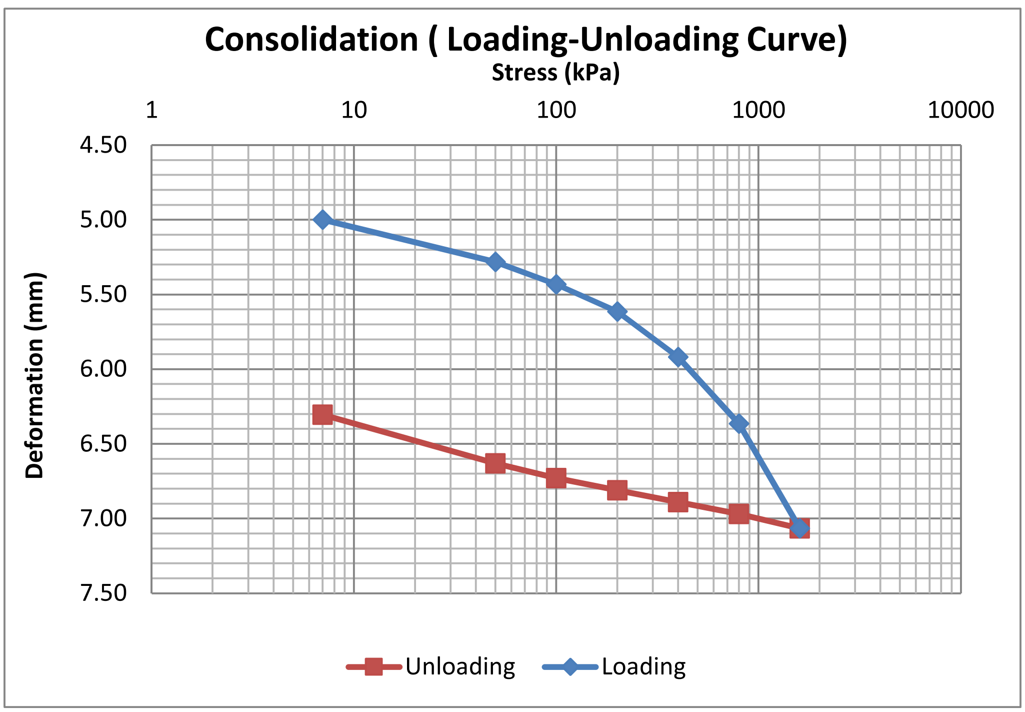


Figure 0-8 one dimensional consolidation Loading-Unloading curve for undisturbed sample

Compression at the end of each loading		
Loading,K pa	Deformation ,mm	Ht of Specimen ,mm
7	0	18
50	0.282	17.72
100	0.432	17.57
200	0.615	17.39
400	0.918	17.08
800	1.365	16.64
1600	2.065	15.94

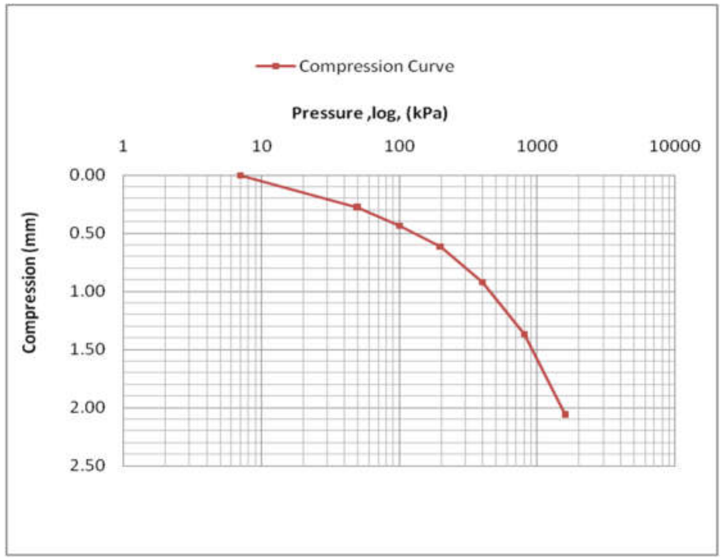


Figure 0-9 Compression curve undisturbed sample

Void ratio at the end of each loading & Coefficient of compression	
Loading,K pa	Void ratio, e
7	0.845
50	0.805
100	0.777
200	0.742
400	0.7
800	0.643
1600	0.59

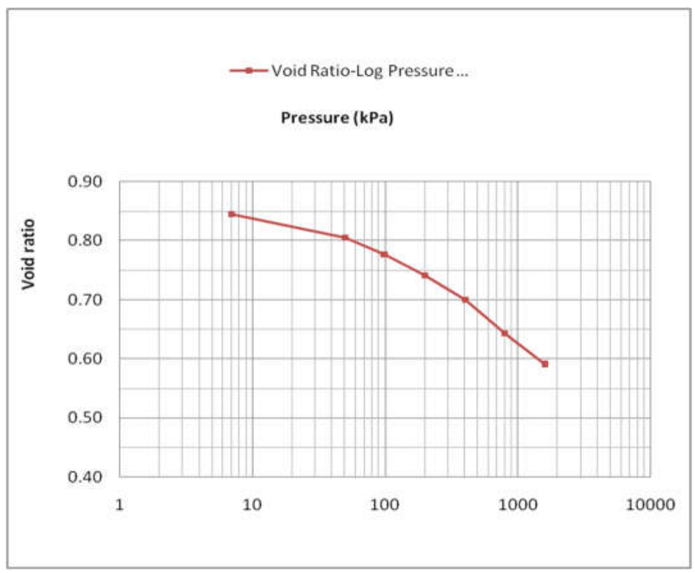


Figure 0-10 Void ratio log pressure curve undisturbed sample

e=(H-Hs)/Hs
Hs=Ho/(1+eo)
Cc= (eA-eB)/log(σZB-σZA)
(0.643-0.59)/(log1600-log400)=0.182

Determination of Pre-consolidation pressure, Pc and over consolidation ratio, OCR using simplified method		
Loading,Kpa	Void ratio, e	
7	0.845	
50	0.816	
100	0.801	
200	0.782	
400	0.751	
800	0.705	
1600	0.634	
1600	0.634	
800	0.643	
400	0.651	
200	0.66	
100	0.668	
50	0.678	
7	0.711	

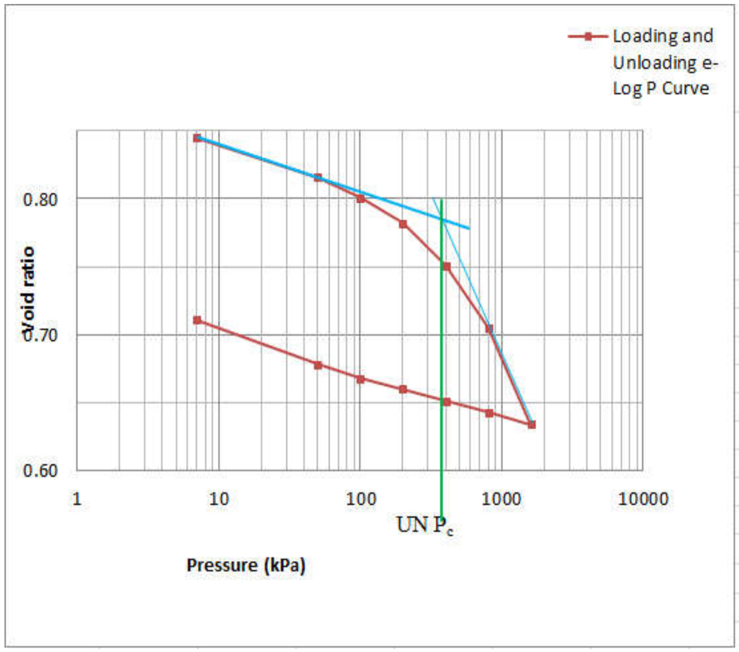


Figure 0-11 pre-consolidation pressure Using simplified method undisturbed sample

Pc =		385 kPa
Po=Unit weight*Depth=		48.5 kPa
OCR=Pc/Po		7.94

Determination of Pre-consolidation pressure, Pc and over consolidation ratio, OCR using Casagrande's Method		
Loading,Kpa	Void ratio, e	
7	0.845	
50	0.816	
100	0.801	
200	0.782	
400	0.751	
800	0.705	
1600	0.634	
1600	0.634	
800	0.643	
400	0.651	
200	0.66	
100	0.668	
50	0.678	
7	0.711	

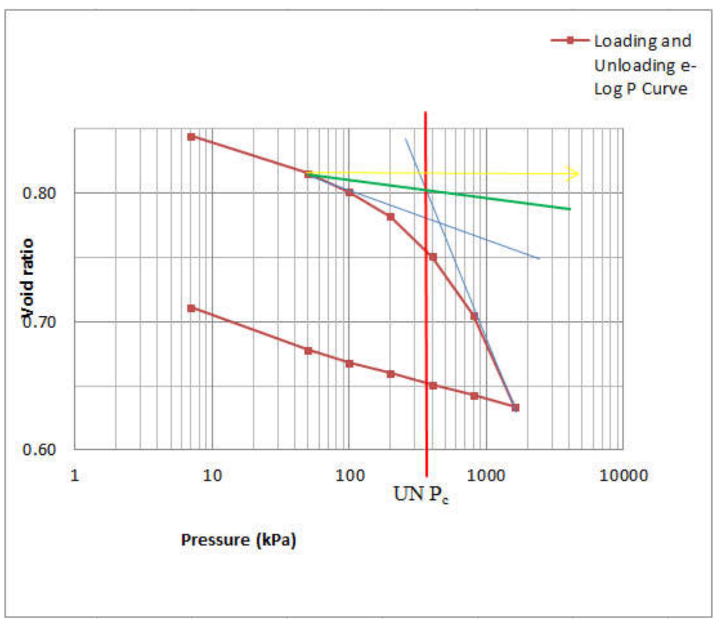


Figure 0-12 pre-consolidation pressure Using casagrande method undisturbed sample

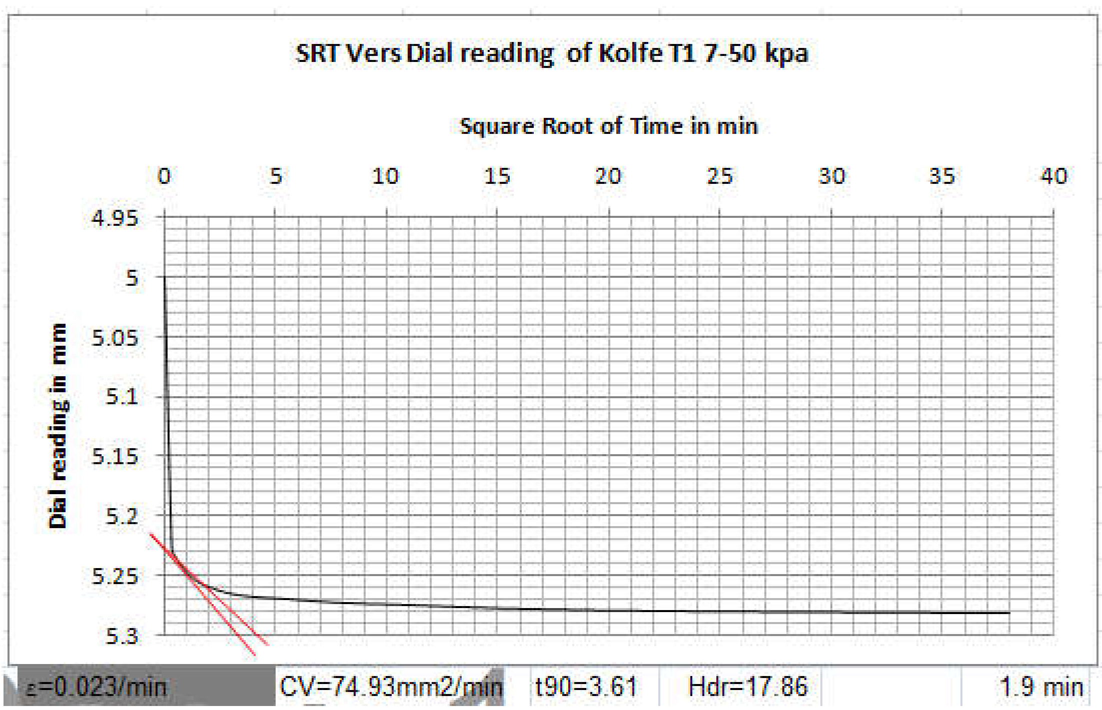
Pc =		385 kPa
Po=Unit weight*Depth=		48.5 kPa
OCR=Pc/Po		7.94

Determination of coefficient of consolidation (Cv) using square root of time method for Undisturbed sample

Cv=(0.848*Hdr2)/t90

Ɛ =0.1Cv/Hdr2

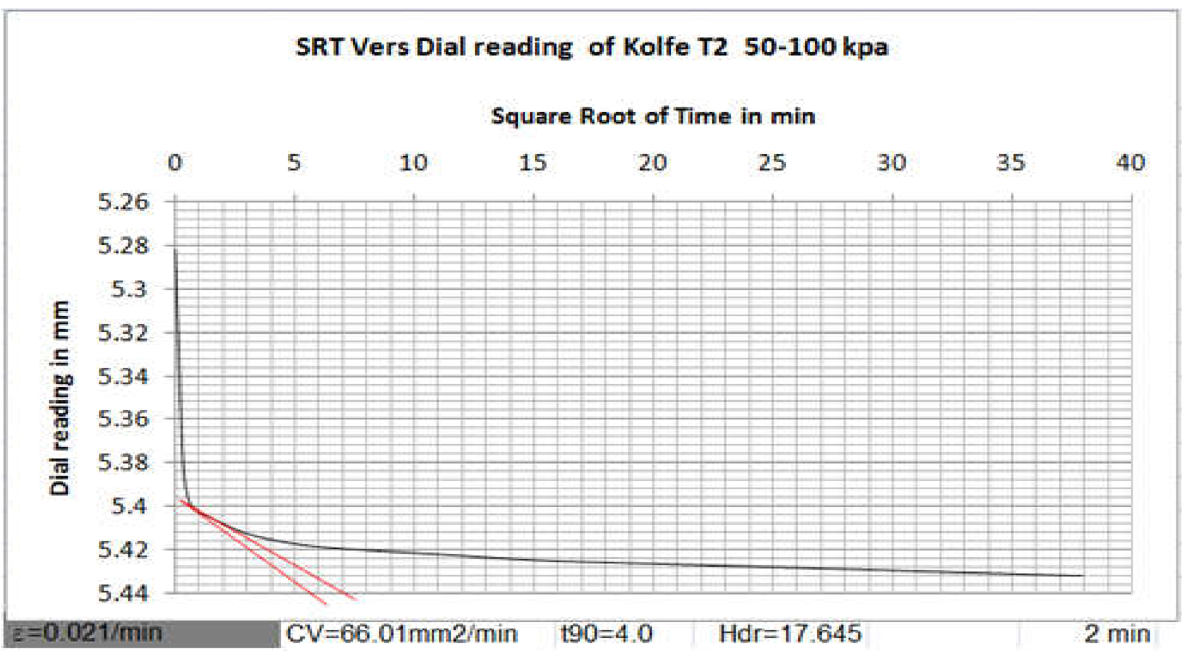
Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 7kpa-50kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5	Hi=18
0.1	0.316	5.227	Hf=17.72
0.25	0.500	5.235	Def=0.282
0.5	0.707	5.241	
1	1.000	5.248	
2	1.414	5.255	
4	2.000	5.26	
8	2.828	5.265	
15	3.873	5.268	
30	5.477	5.27	
60	7.746	5.273	
120	10.954	5.275	
240	15.492	5.278	
480	21.909	5.28	
1440	37.947	5.282	



Ɛ=0.023*76=1.75 mm/min

Figure 0-13 Time deformation curve for load increment of 7-50 undisturbed sample

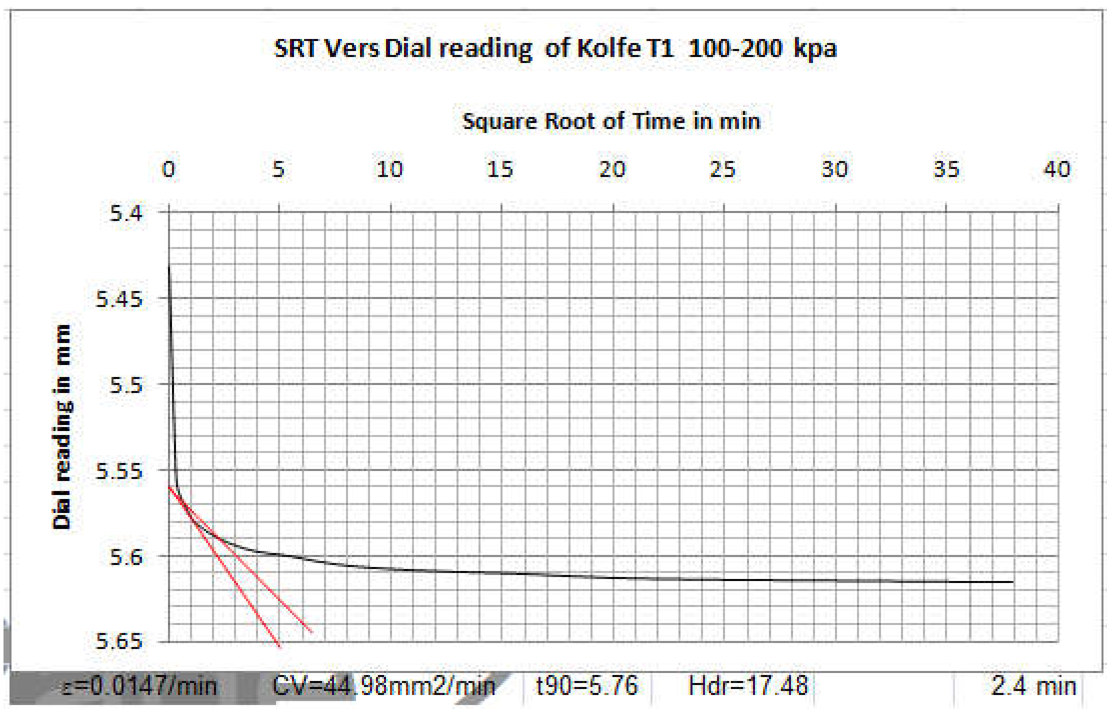
Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 50kpa-100kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5.282	Hi=17.72
0.1	0.316	5.38	Hf=17.57
0.25	0.500	5.395	Def=0.150
0.5	0.707	5.4	
1	1.000	5.403	
2	1.414	5.405	
4	2.000	5.408	
8	2.828	5.412	
15	3.873	5.415	
30	5.477	5.418	
60	7.746	5.42	
120	10.954	5.422	
240	15.492	5.425	
480	21.909	5.427	
1440	37.947	5.432	



ε=0.021*76=1.61 mm/min

Figure 0-14 Time deformation curve for load increment of 50-100 undisturbed sample

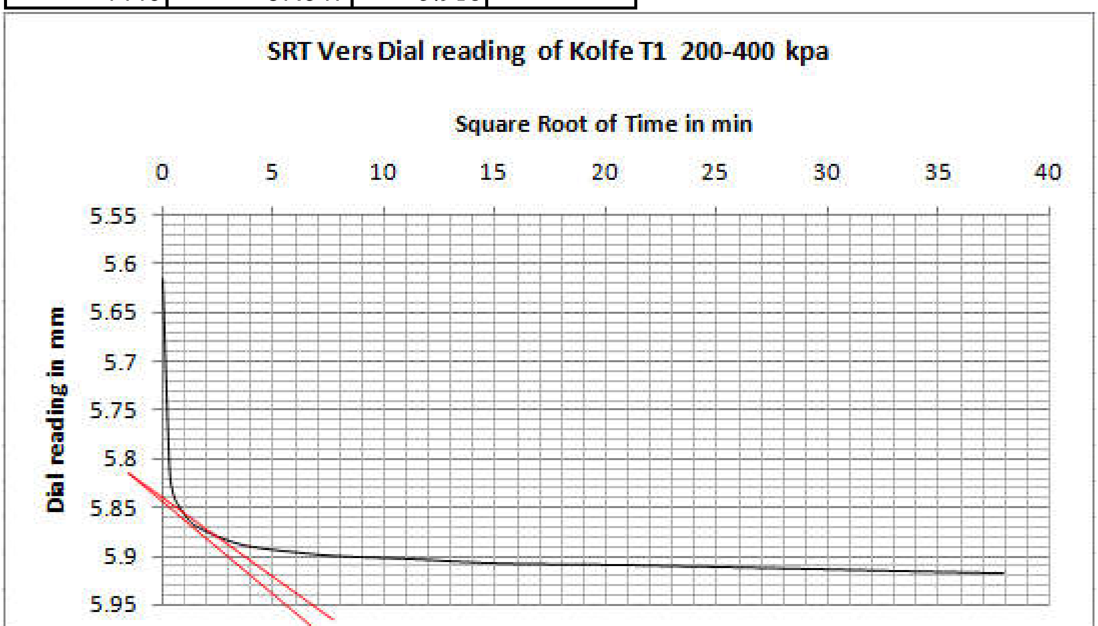
Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 100kpa-200kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5.432	Hi=17.57
0.1	0.316	5.555	Hf=17.39
0.25	0.500	5.565	Def=0.183
0.5	0.707	5.57	
1	1.000	5.578	
2	1.414	5.583	
4	2.000	5.588	
8	2.828	5.593	
15	3.873	5.597	
30	5.477	5.6	
60	7.746	5.605	
120	10.954	5.608	
240	15.492	5.61	
480	21.909	5.613	
1440	37.947	5.615	



ε=0.0147*76=1.12 mm/min

Figure 0-15 Time deformation curve for load increment of 100-200 undisturbed sample

Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 200kpa-400kpa		
Elapsed time in (min)	Square root of time in (min)	reading (mm)	
0	0	5.615	Hi=17.39
0.1	0.316	5.815	Hf=17.08
0.25	0.500	5.838	Def=0.303
0.5	0.707	5.848	
1	1.000	5.858	
2	1.414	5.868	
4	2.000	5.875	
8	2.828	5.883	
15	3.873	5.89	
30	5.477	5.895	
60	7.746	5.9	
120	10.954	5.903	
240	15.492	5.908	
480	21.909	5.91	
1440	37.947	5.918	

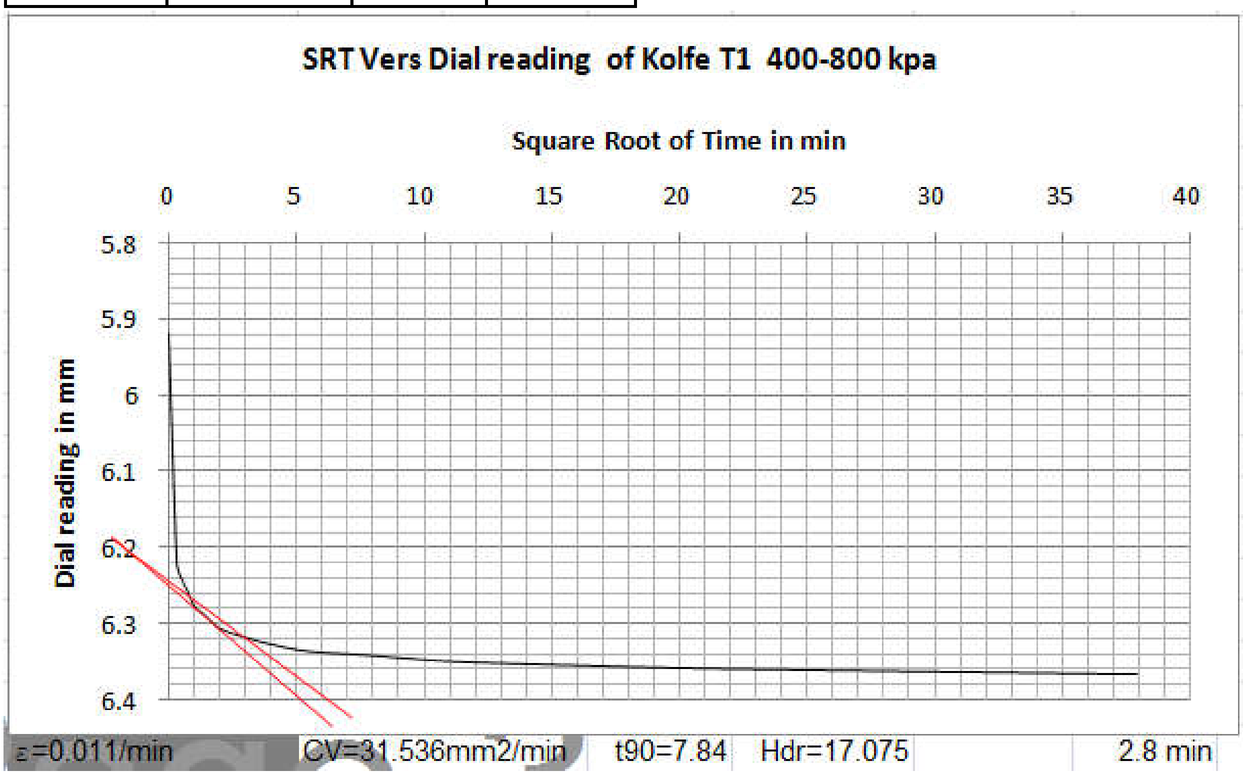


ε=0.0136/min	CV=40.30mm2/min	t90=6.25	Hdr=17.235	2.5 min

ε=0.0136*76=1.03 mm/min

Figure 0-16 Time deformation curve for load increment of 200-400 undisturbed sample

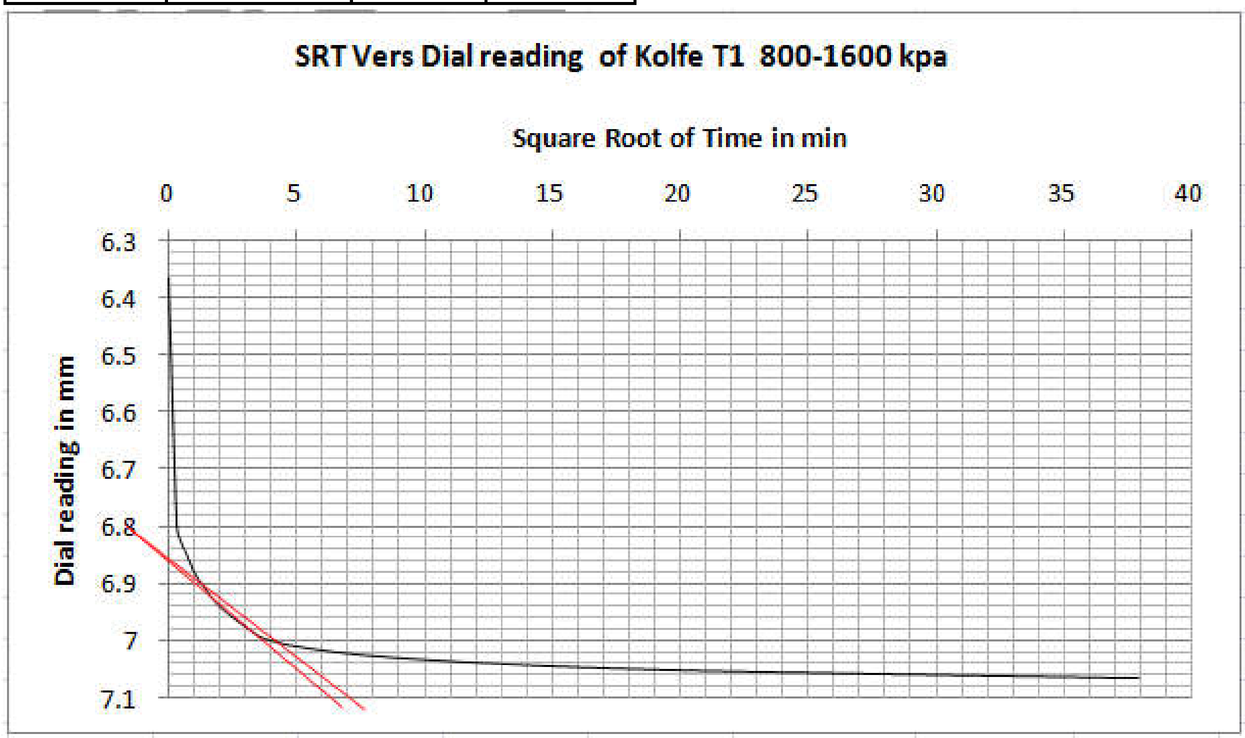
Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 400kpa-800kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5.918	Hi=17.08
0.1	0.316	6.22	Hf=16.64
0.25	0.500	6.24	Def=0.362
0.5	0.707	6.255	
1	1.000	6.275	
2	1.414	6.288	
4	2.000	6.305	
8	2.828	6.315	
15	3.873	6.325	
30	5.477	6.335	
60	7.746	6.34	
120	10.954	6.348	
240	15.492	6.353	
480	21.909	6.358	
1440	37.947	6.365	



ε=0.011*76= 0.84 mm/min

Figure 0-17 Time deformation curve for load increment of 400-800 undisturbed sample

Kolfe Area T1 Un disturbed			H in(mm)
	Load increment 800kpa-1600kpa		
Elapsed time in (min)	Square root of time in (min)	reading (mm)	
0	0	6.365	Hi=16.64
0.1	0.316	6.8	Hf=15.94
0.25	0.500	6.83	Def=0.70
0.5	0.707	6.848	
1	1.000	6.88	
2	1.414	6.908	
4	2.000	6.94	
8	2.828	6.97	
15	3.873	6.998	
30	5.477	7.013	
60	7.746	7.025	
120	10.954	7.035	
240	15.492	7.045	
480	21.909	7.053	
1440	37.947	7.065	



ε=0.0049/min	CV=12.17mm2/min	t90=17.22	Hdr=16.29	4.15 min

ε=0.0049*76= 0.37 mm/min

Figure 0-18 Time deformation curve for load increment of 800-1600 undisturbed sample

One dimensional consolidation test for remolded sample

Type of Test: One dimensional oedometer	Test method: ASTM D2435	
Location: Kolfe area	Job ref.	Thesis research
	Pit no.	#1
Soil Description: Dark Red clay	Depth	2.5m
	Date	4/24/2017
Sample Type Remolded	Initial Ht. of specimen, mm 18	
Height of ring, mm 20	Initial mass of specimen, g 62.96	
Diameter of ring, mm 50	Initial bulk density, g/cc 1.88	
Ini. Moisture content, % 32.80	Initial dry density, g/cc 1.42	
Final moisture content, % 34.87	Specific gravity 2.75	

Loading values	
Loading,Kpa	Def. Dial Reading (mm)
7	4.5
50	4.94
100	5.115
200	5.44
400	5.965
800	6.62
1600	7.26

Unloading Values	
Pressure Decrement,Kpa	Def. Dial Reading (mm)
1600	7.26
800	7.215
400	7.135
200	7.025
100	6.955
50	6.865
7	6.695

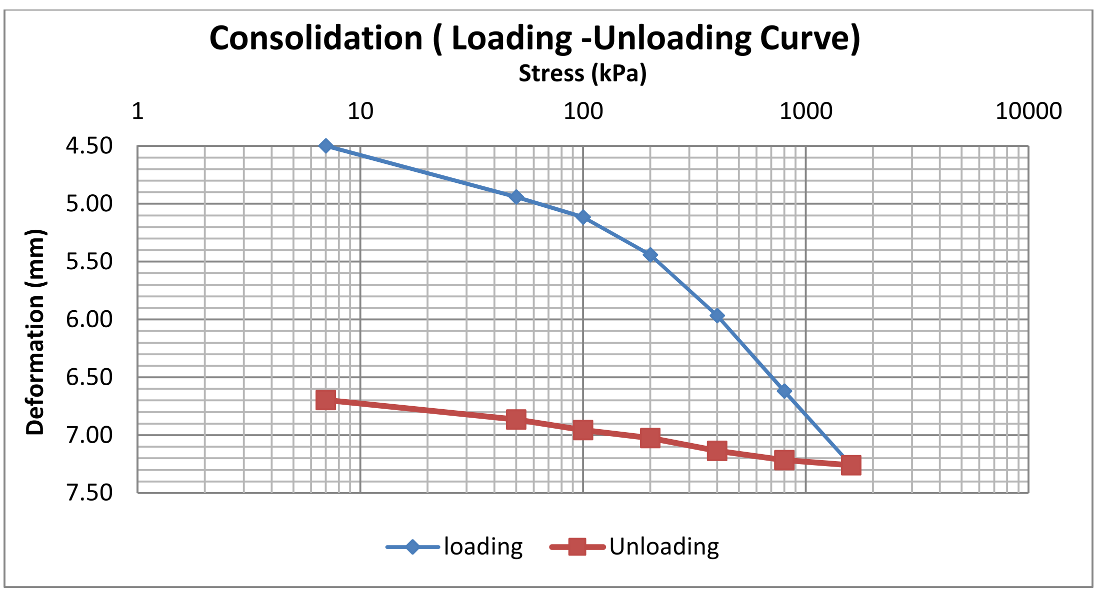


Figure 0-19 one dimensional consolidation Loading-Unloading curve for remolded sample

Compression at the end of each loading		
Loading,Kpa	Deformation ,mm	Ht of Specimen, mm
7	0	18
50	0.44	17.56
100	0.615	17.39
200	0.94	17.06
400	1.465	16.54
800	2.12	15.88
1600	2.760	15.24

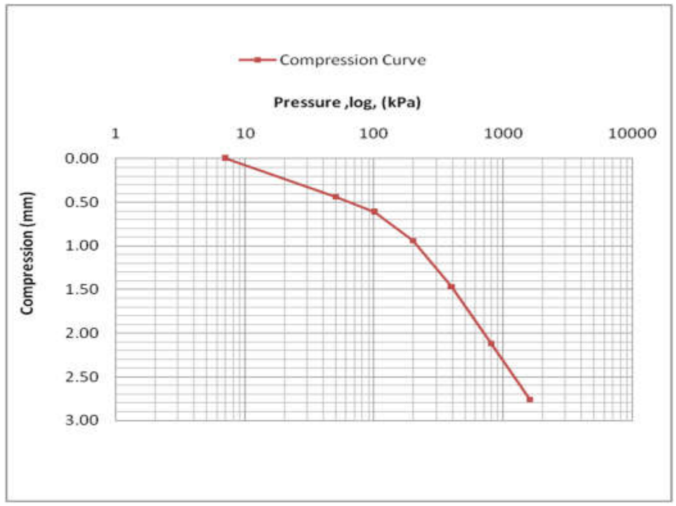


Figure 0-20 Compression curve for remolded sample

Void ratio at the end of each loading & Coefficient of compression	
Loading,Kpa	Void ratio,e
7	1.009
50	0.96
100	0.941
200	0.904
400	0.846
800	0.773
1600	0.701

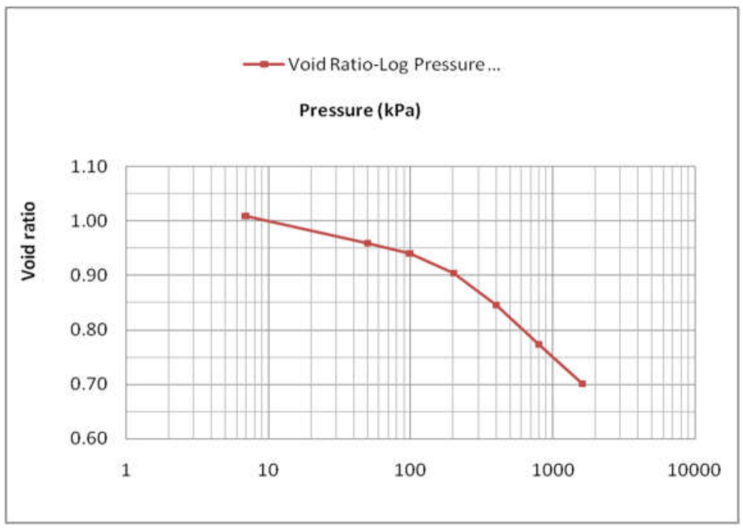


Figure 0-21 Void ratio log pressure curve for each loading of remolded sample

e=(H-Hs)/Hs
Hs=Ho/(1+eo)
Cc= (eA-eB)/log(σZB-σZA)
(0.773-0.701)/(log1600-log800)=0.240

Void ratio at the end of each step of Unloading	
Loading,Kpa	Void ratio,e
1600	0.701
800	0.706
400	0.715
200	0.727
100	0.735
50	0.745
7	0.764

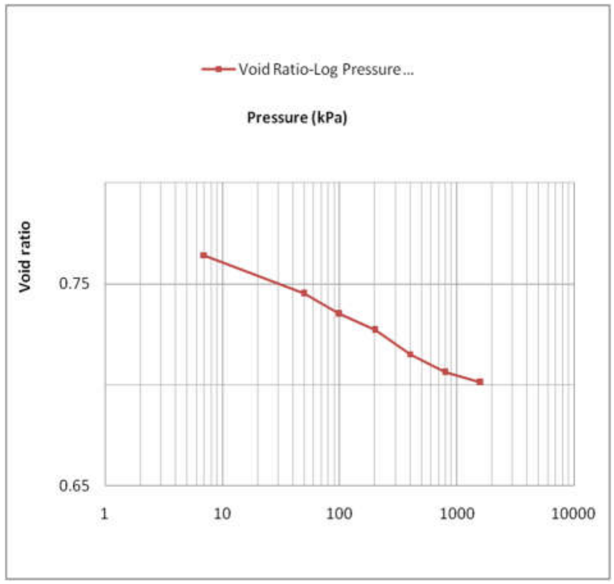


Figure 0-22 Void ratio log pressure curve for each unloading of remolded sample

Loading and Unloading e-Log P Curve	
Loading,Kpa	Void ratio,e
7	1.009
50	0.96
100	0.941
200	0.904
400	0.846
800	0.773
1600	0.701
1600	0.701
800	0.706
400	0.715
200	0.727
100	0.735
50	0.745
7	0.764

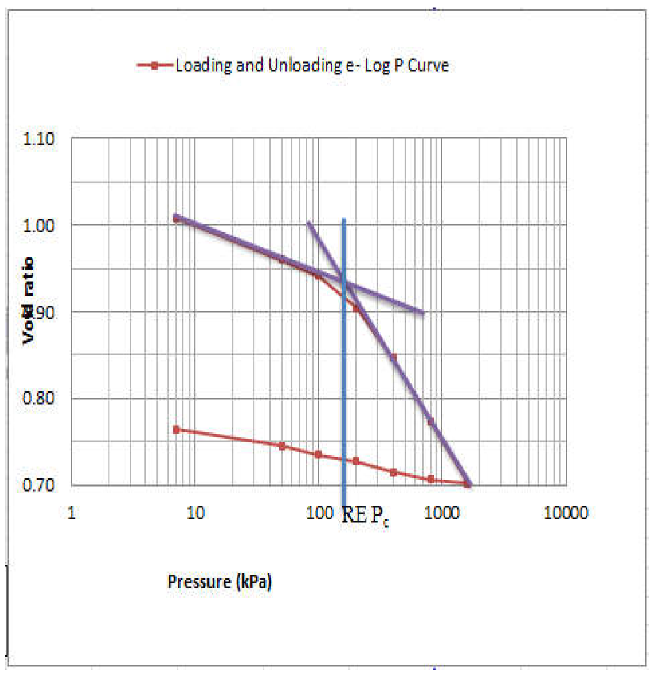


Figure 0-23 Void ratio log pressure curve for each loading and unloading of remolded sample

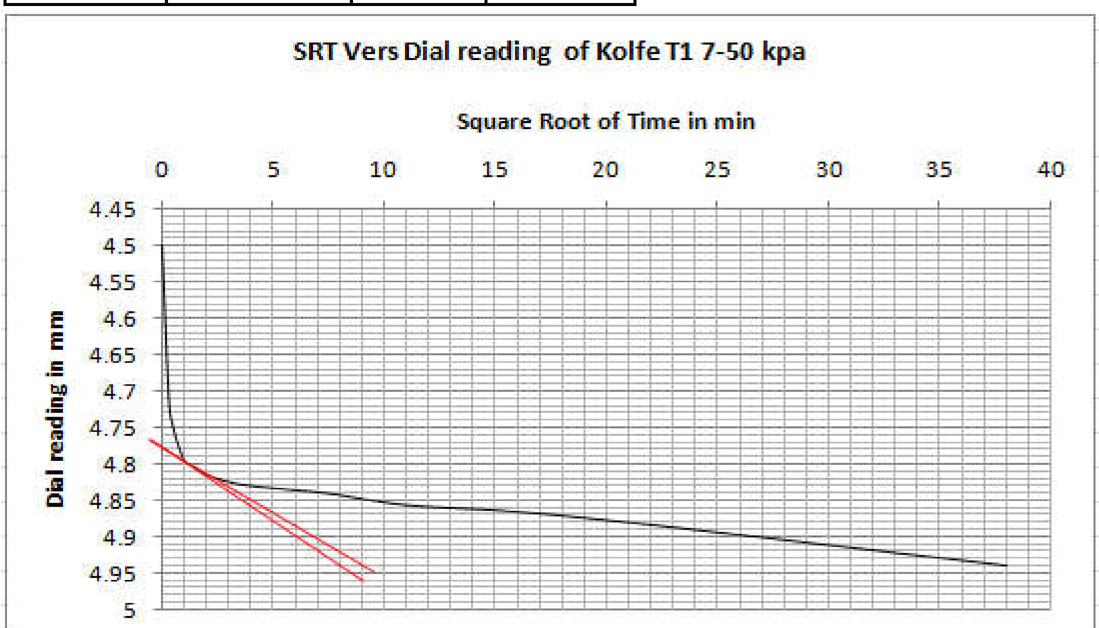
Pc =		175
Po=Unit weight*Depth=		47 KPa
OCR=Pc/Po =		3.72

Determination of coefficient of consolidation (Cv) using square root of time method for Remolded sample

Cv=(0.848*Hdr2)/t90

Ɛ **=0.1Cv/Hdr2**

Kolfe Area T1 Remolded			H in(mm)
	Load increment 7kpa-50kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	4.5	Hi=18
0.1	0.316	4.72	Hf=17.56
0.25	0.500	4.75	Def=0.44
0.5	0.707	4.773	
1	1.000	4.795	
2	1.414	4.805	
4	2.000	4.815	
8	2.828	4.824	
15	3.873	4.83	
30	5.477	4.835	
60	7.746	4.842	
120	10.954	4.857	
240	15.492	4.865	
480	21.909	4.884	
1440	37.947	4.94	

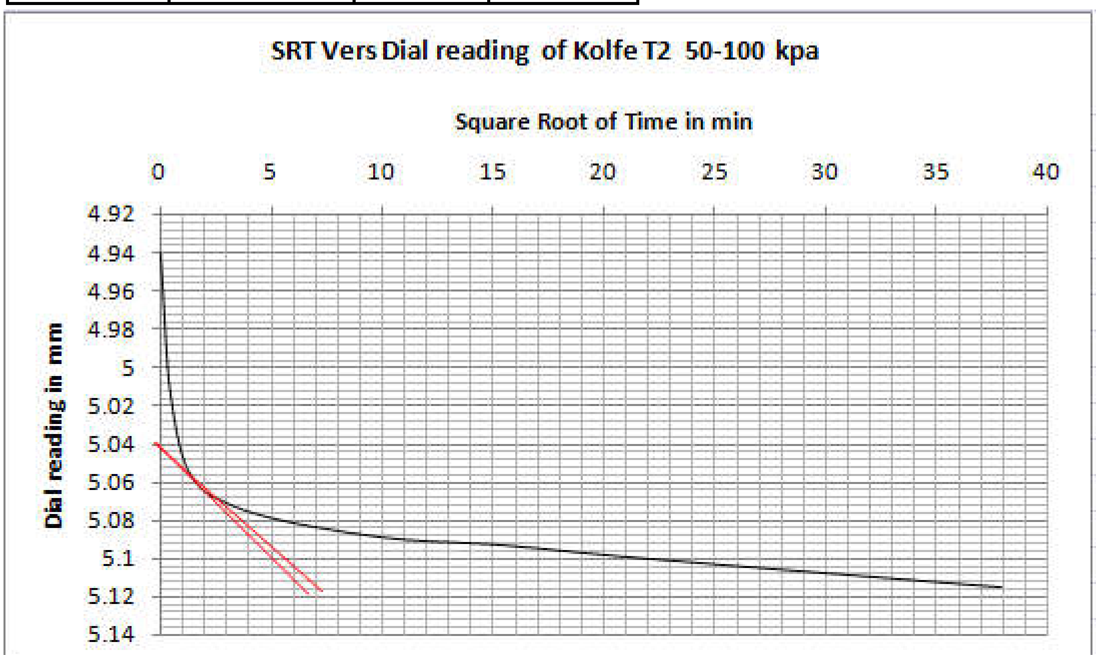


ε=0.015/min | CV=46.54 mm2/min | t90=5.76 | Hdr=17.78 | 2.4 min

Ɛ =0.015*76=1.14 mm/min

Figure 0-24 Time deformation curve for load increment of 7-50 Remolded sample

Kolfe Area T1 Remolded			H in(mm)
	Load increment 50kpa-100kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	4.94	Hi=17.56
0.1	0.316	5.001	Hf=17.39
0.25	0.500	5.018	Def=0.17
0.5	0.707	5.033	
1	1.000	5.047	
2	1.414	5.057	
4	2.000	5.065	
8	2.828	5.07	
15	3.873	5.075	
30	5.477	5.08	
60	7.746	5.085	
120	10.954	5.09	
240	15.492	5.093	
480	21.909	5.1	
1440	37.947	5.115	

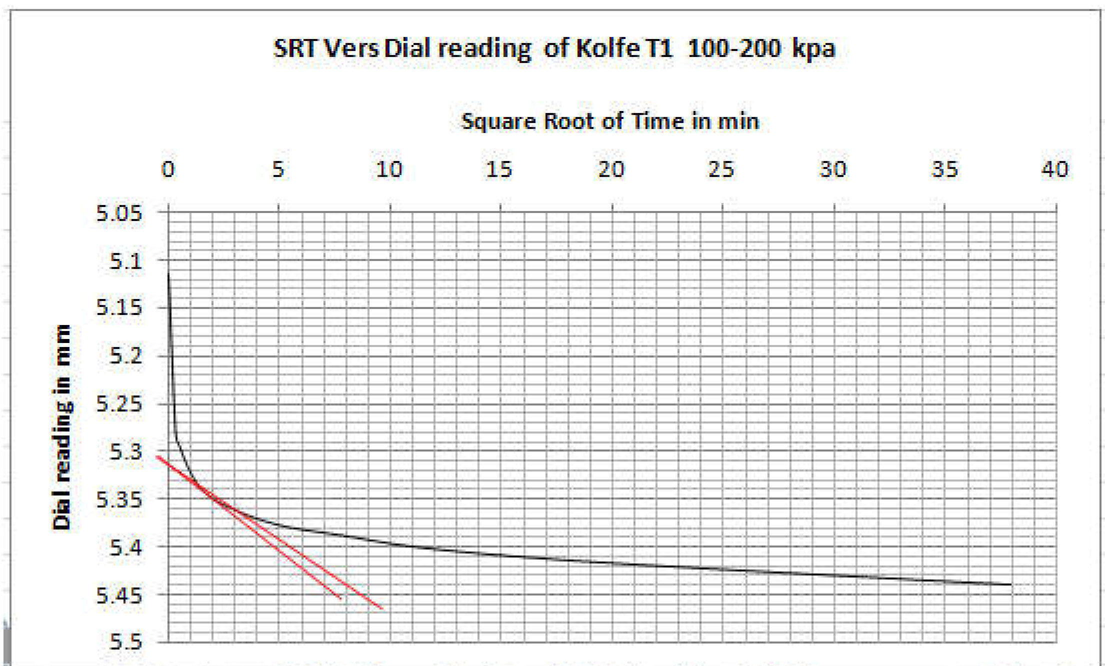


ε=0.014/min	41.43 mm2/min	t90=4.0	Hdr=17.475	2.5 min

Ɛ =0.014*76=1.06 mm/min

Figure 0-25 Time deformation curve for load increment of 50-100 Remolded sample

Kolfe Area T1 Remolded			H in(mm)
	Load increment 100kpa-200kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5.115	Hi=17.39
0.1	0.316	5.282	Hf=17.06
0.25	0.500	5.295	Def=0.33
0.5	0.707	5.308	
1	1.000	5.323	
2	1.414	5.338	
4	2.000	5.35	
8	2.828	5.36	
15	3.873	5.37	
30	5.477	5.38	
60	7.746	5.388	
120	10.954	5.4	
240	15.492	5.41	
480	21.909	5.42	
1440	37.947	5.44	

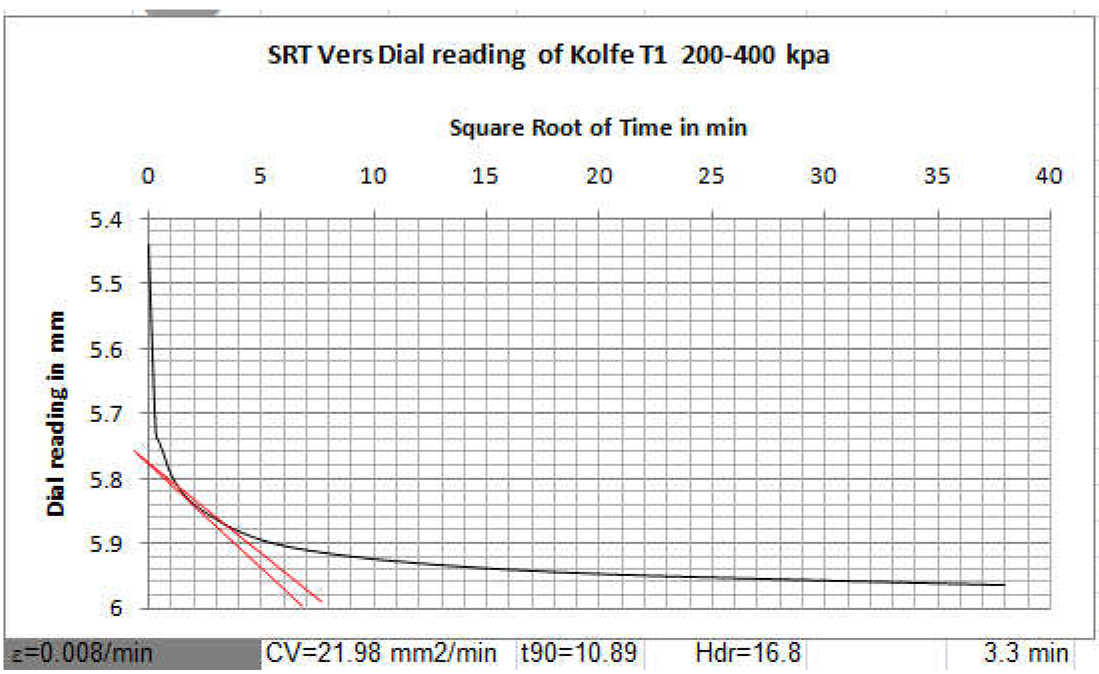


ε=0.009/min | CV=26.18 mm2/min | t90=9.61 | Hdr=17.225 | 3.1 min

ε =0.009*76=0.68 mm/min

Figure 0-26 Time deformation curve for load increment of 100-200 Remolded sample

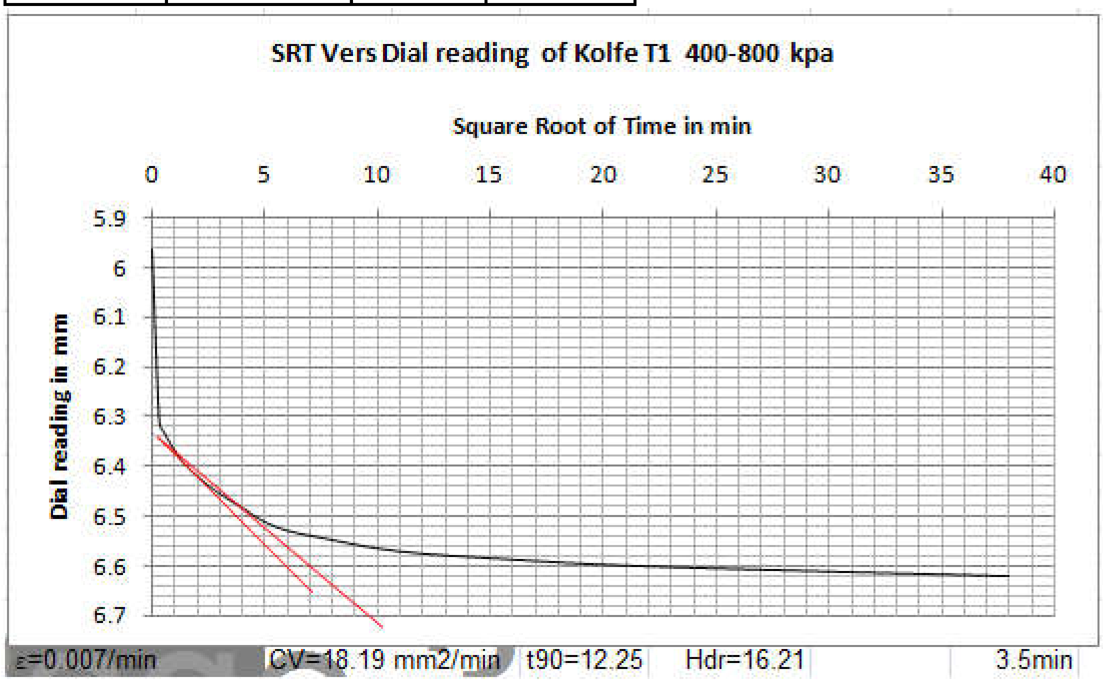
Kolfe Area T1 Remolded			H in(mm)
	Load increment 200kpa-400kpa		
Elapsed time in (min)	Square root of time in (min)	reading (mm)	
0	0	5.44	Hi=17.06
0.1	0.316	5.73	Hf=16.54
0.25	0.500	5.747	Def=0.52
0.5	0.707	5.767	
1	1.000	5.795	
2	1.414	5.818	
4	2.000	5.84	
8	2.828	5.86	
15	3.873	5.88	
30	5.477	5.9	
60	7.746	5.915	
120	10.954	5.928	
240	15.492	5.94	
480	21.909	5.95	
1440	37.947	5.965	



Ɛ =0.008*76=0.61 mm/min

Figure 0-27 Time deformation curve for load increment of 200-400 Remolded sample

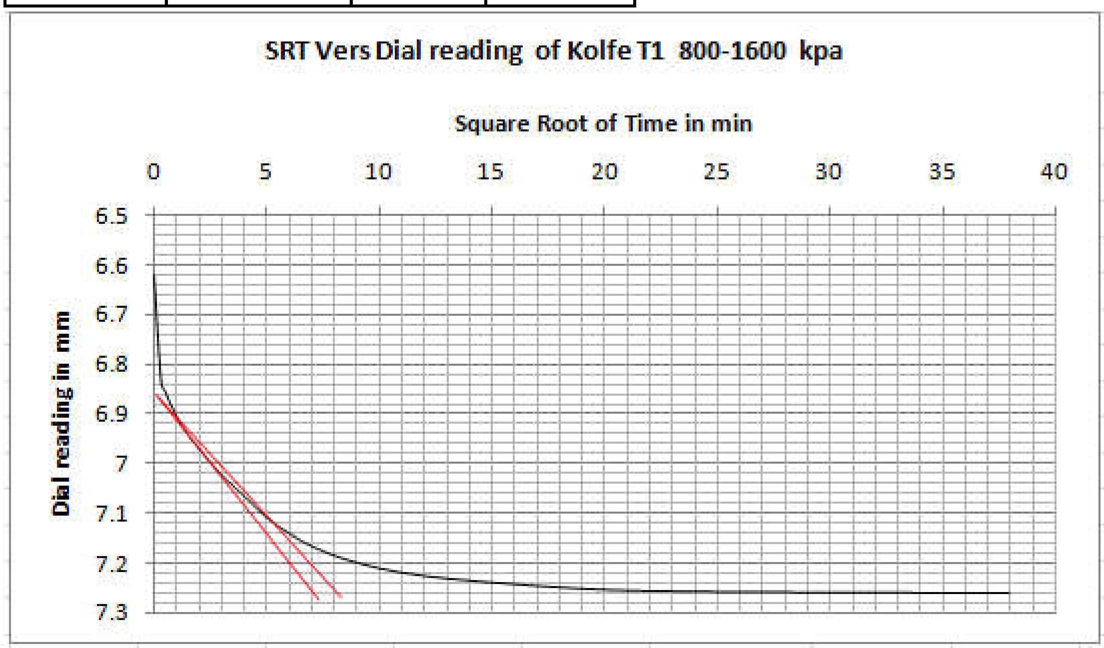
Kolfe Area T1 Remolded			H in(mm)
	Load increment 400kpa-800kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading (mm)	
0	0	5.965	Hi=16.54
0.1	0.316	6.312	Hf=15.88
0.25	0.500	6.33	Def=0.66
0.5	0.707	6.347	
1	1.000	6.368	
2	1.414	6.395	
4	2.000	6.42	
8	2.828	6.45	
15	3.873	6.48	
30	5.477	6.521	
60	7.746	6.545	
120	10.954	6.57	
240	15.492	6.585	
480	21.909	6.6	
1440	37.947	6.62	



ε =0.007*76=0.53 mm/min

Figure 0-28 Time deformation curve for load increment of 400-800 Remolded sample

Kolfe Area T1 Remolded			H in(mm)
	Load increment 800kpa-1600kpa		
Elapsed time in (min)	Square root of time in (min)	Dial reading	
0	0	6.62	Hi=15.88
0.1	0.316	6.838	Hf=15.24
0.25	0.500	6.855	Def=0.64
0.5	0.707	6.878	
1	1.000	6.905	
2	1.414	6.936	
4	2.000	6.97	
8	2.828	7.015	
15	3.873	7.06	
30	5.477	7.125	
60	7.746	7.18	
120	10.954	7.218	
240	15.492	7.24	
480	21.909	7.255	
1440	37.947	7.26	



ε=0.003/min	CV=7.31 mm2/min	t90=28.09	Hdr=15.56	5.3 min

ε =0.003*76=0.23 mm/min

Figure 0-29 Time deformation curve for load increment of 800-1600 Remolded sample

Appendix C: Detail UCS Tests results

Table 0-17 UCS test result of ε =0.37mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		**Project No. : Thesis research**	
Location : Kolfe area		**Pit No. : 1**	
Depth of Sample : 2.5 m		**Test Date :4/26/2017**	
Visual description of soil : Dark red clay		**Sample Type: Undisturbed**	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	**Can No.**	P22
Height (mm)	76.0	**Mass Cont.**	35.4
Area (Ao) mm2	1134.6	**Mass Cont.+wet soil**	80.48
Volume cc	86.2	**Mass Cont.+dry soil**	69.1
Mass (gm)	166.19	**Mass dry soil**	33.7
Wet Density g/cc	1.93	**Mass moisture**	11.38
Moisture Content %	33.8	**Moisture Content %**	33.77
Dry Density g/cc	1.44		

e=0.37 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	**0.00**	0.00
20	5.10	0.2	0.002632	0.26315789	1137.57	**15.61**	13.72
40	8.50	0.4	0.005263	0.52631579	1140.57	**26.01**	22.80
60	11.90	0.6	0.007895	0.78947368	1143.60	**36.41**	31.84
80	15.30	0.8	0.010526	1.05263158	1146.64	**46.82**	40.83
100	18.70	1	0.013158	1.31578947	1149.70	**57.22**	49.77
120	22.10	1.2	0.015789	1.57894737	1152.77	**67.63**	58.66
140	23.80	1.4	0.018421	1.84210526	1155.86	**72.83**	63.01
160	25.49	1.6	0.021053	2.10526316	1158.97	**78.00**	67.30
180	28.89	1.8	0.023684	2.36842105	1162.09	**88.40**	76.07
200	30.60	2	0.026316	2.63157895	1165.24	**93.64**	80.36
220	32.30	2.2	0.028947	2.89473684	1168.39	**98.84**	84.59
240	34.00	2.4	0.031579	3.15789474	1171.57	**104.04**	88.80
260	35.70	2.6	0.034211	3.42105263	1174.76	**109.24**	92.99
280	37.39	2.8	0.036842	3.68421053	1177.97	**114.41**	97.13
300	39.10	3	0.039474	3.94736842	1181.20	**119.65**	101.29
320	40.79	3.2	0.042105	4.21052632	1184.44	**124.82**	105.38
340	42.50	3.4	0.044737	4.47368421	1187.71	**130.05**	109.50
360	44.10	3.6	0.047368	4.73684211	1190.99	**134.95**	113.31
380	45.32	3.8	0.05	5	1194.29	**138.68**	116.12
400	45.89	4	0.052632	5.26315789	1197.60	**140.42**	117.25

420	46.66	4.2	0.055263	5.52631579	1200.94	142.78	118.89
440	47.73	4.4	0.057895	5.78947368	1204.29	146.05	121.28
460	47.46	4.6	0.060526	6.05263158	1207.667067	145.23	120.25
480	48.15	4.8	0.063158	6.31578947	1211.05939	147.34	121.66
500	48.38	5	0.065789	6.57894737	1214.470825	148.04	121.90
520	48.88	5.2	0.068421	6.84210526	1217.901533	149.57	122.81
540	49.63	5.4	0.071053	7.10526316	1221.351679	151.87	124.34
560	49.71	5.6	0.073684	7.36842105	1224.821429	152.11	124.19
580	49.71	5.8	0.076316	7.63157895	1228.310948	152.11	123.84
600	49.71	6	0.078947	7.89473684	1231.820408	152.11	123.49
620	50.24	6.2	0.081579	8.15789474	1235.34998	153.73	124.45
640	50.24	6.4	0.084211	8.42105263	1238.899836	153.73	124.09
660	50.24	6.6	0.086842	8.68421053	1242.47	153.73	123.73
680	51.09	6.8	0.089474	8.94736842	1246.06	156.34	125.46
700	51.09	7	0.092105	9.21052632	1249.67	156.34	125.10
720	50.98	7.2	0.094737	9.47368421	1253.305648	156.00	124.47
740	51.43	7.4	0.097368	9.73684211	1256.9596	157.38	125.20
760	51.43	7.6	0.1	10	1260.634921	157.38	124.84
780	51.43	7.8	0.102632	10.2631579	1264.331797	157.38	124.47
800	51.43	8	0.105263	10.5263158	1268.05042	157.38	124.11
820	50.91	8.2	0.107895	10.7894737	1271.790982	155.78	122.49
840	49.85	8.4	0.110526	11.0526316	1275.553677	152.54	119.59
860	48.99	8.6	0.113158	11.3157895	1279.338703	149.91	117.18
880	47.96	8.8	0.115789	11.5789474	1283.146259	146.76	114.37
900	46.95	9	0.118421	11.8421053	1286.976546	143.67	111.63

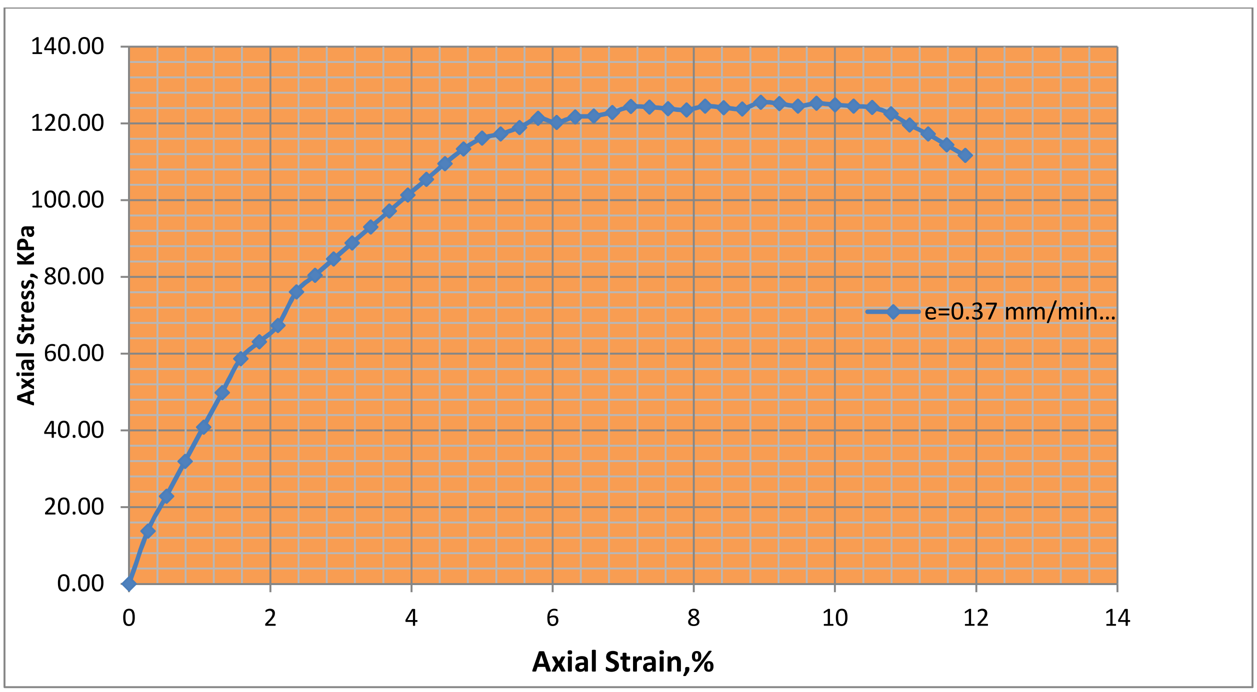


Figure 0-30 qu for ε =0.37 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**125.46 kPa**
	Cohesion© = (qu/2) =	**62.73 kPa**
	Failure strain=	**8.95%**

Table 0-18 UCS test result of ε =0.84 mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		**Project No. : 1**	
Location : Kolfe Area		**Pit No. : 1**	
Depth of Sample : 2.5 m		**Test Date :4/26/2017**	
Visual description of soil : Dark red clay		**Sample Type: Undisturbed**	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	**Can No.**	H6
Height (mm)	76.0	**Mass** Cont.	35.4
Area (Ao) mm2	1134.6	**Mass** Cont.+wet soil	69.17
Volume cc	86.2	**Mass** Cont.+dry soil	60.65
Mass (gm)	167.0	**Mass** dry soil	25.25
Wet Density g/cc	1.9	**Mass** moisture	8.52
Moisture Content %	33.7	**Moisture Content %**	33.74
Dry Density g/cc	1.4		

e=0.84 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	9.98	0.2	0.002632	0.263158	1137.57	30.54	26.85
40	16.64	0.4	0.005263	0.526316	1140.57	50.92	44.64
60	23.30	0.6	0.007895	0.789474	1143.60	71.30	62.35
80	29.95	0.8	0.010526	1.052632	1146.64	91.65	79.93
100	36.61	1	0.013158	1.315789	1149.70	112.03	97.44
120	43.27	1.2	0.015789	1.578947	1152.77	132.41	114.86
140	47.99	1.4	0.018421	1.842105	1155.86	146.85	127.05
160	51.84	1.6	0.021053	2.105263	1158.97	158.63	136.87
180	56.58	1.8	0.023684	2.368421	1162.09	173.13	148.99
200	59.91	2	0.026316	2.631579	1165.24	183.32	157.33
220	63.23	2.2	0.028947	2.894737	1168.39	193.48	165.60
240	66.56	2.4	0.031579	3.157895	1171.57	203.67	173.85
260	69.89	2.6	0.034211	3.421053	1174.76	213.86	182.05
280	73.22	2.8	0.036842	3.684211	1177.97	224.05	190.20
300	76.55	3	0.039474	3.947368	1181.20	234.24	198.31
320	79.88	3.2	0.042105	4.210526	1184.44	244.43	206.37
340	83.20	3.4	0.044737	4.473684	1187.71	254.59	214.36
360	86.53	3.6	0.047368	4.736842	1190.99	264.78	222.32
380	89.86	3.8	0.05	5	1194.29	274.97	230.24
400	92.71	4	0.052632	5.263158	1197.60	283.69	236.88

420	94.25	4.2	0.055263	5.526316	1200.94	**288.41**	240.15
440	95.01	4.4	0.057895	5.789474	1204.29	290.73	241.41
460	95.47	4.6	0.060526	6.052632	1207.67	**292.14**	241.90
480	96.05	4.8	0.063158	6.315789	1211.06	**293.91**	242.69
500	96.92	5	0.065789	6.578947	1214.47	**296.58**	244.20
520	97.09	5.2	0.068421	6.842105	1217.90	**297.10**	243.94
540	**97.81**	**5.4**	**0.071053**	**7.105263**	**1221.35**	**299.30**	**245.06**
560	97.81	5.6	0.073684	7.368421	1224.82	**299.30**	244.36
580	96.95	5.8	0.076316	7.631579	1228.31	**296.67**	241.52
600	96.42	6	0.078947	7.894737	1231.82	**295.05**	239.52
620	95.97	6.2	0.081579	8.157895	1235.35	**293.67**	237.72
640	95.49	6.4	0.084211	8.421053	1238.90	**292.20**	235.85
660	94.86	6.6	0.086842	8.684211	1242.47	**290.27**	233.62
680	93.19	6.8	0.089474	8.947368	1246.06	**285.16**	228.85
700	89.86	7	0.092105	9.210526	1249.67	**274.97**	220.03

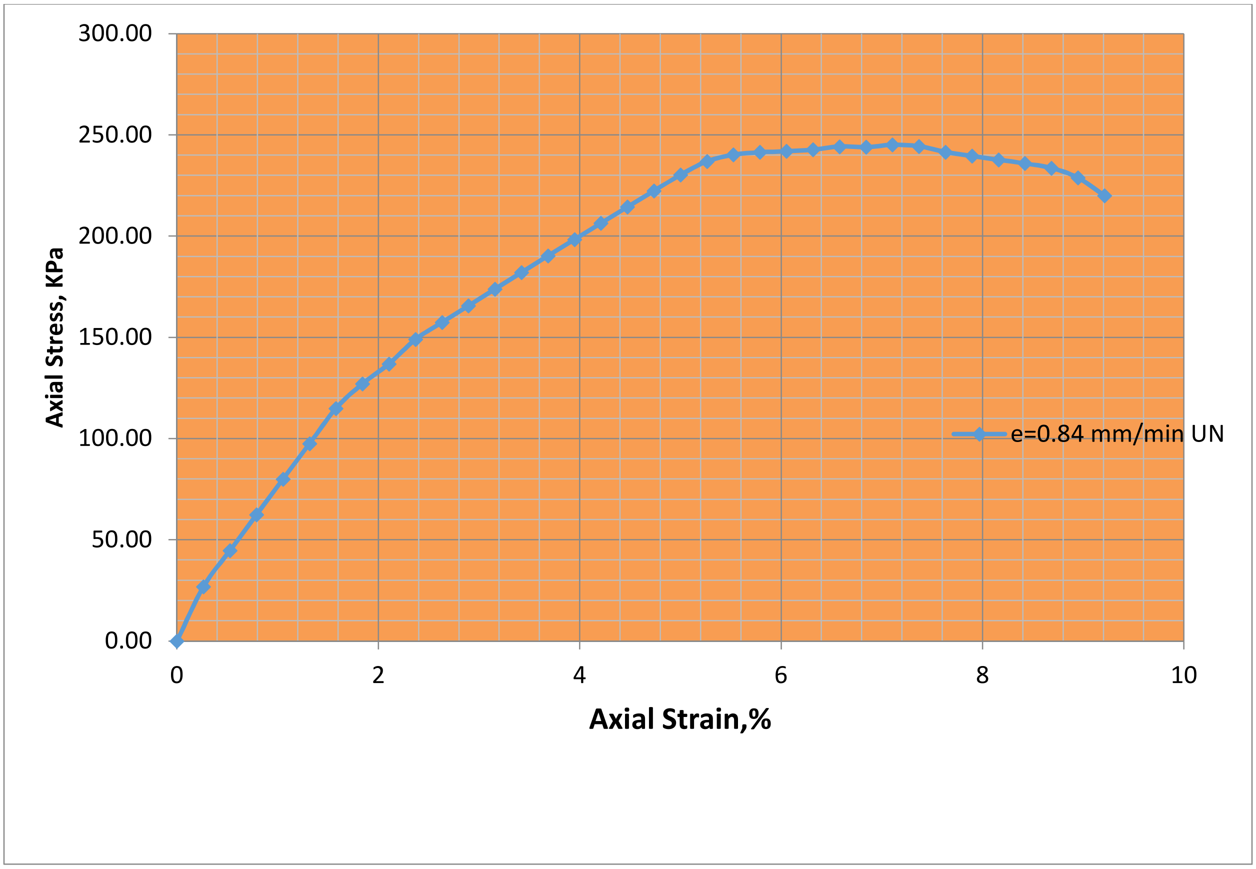


Figure 0-31 qu for ε =0.84 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**245.06 kPa**
	Cohesion© = (qu/2) =	**122.53 kPa**
	Failure strain=	**7.11%**

Table 0-19 UCS test result of ε =1.03 mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	H10
Height (mm)	76.00	Mass Cont.	35.5
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	86.98
Volume cc	86.23	Mass Cont.+dry soil	74
Mass (gm)	167.70	Mass dry soil	38.5
Wet Density g/cc	1.94	Mass moisture	12.98
Moisture Content %	33.71	Moisture Content %	33.71
Dry Density g/cc	1.45		

e=1.03 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)* 1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	6.82	0.1	0.0013	0.13157895	1136.07	20.87	18.37
20	13.51	0.2	0.0026	0.26315789	1137.57	41.34	36.34
30	16.63	0.3	0.0039	0.39473684	1139.07	50.89	44.67
40	20.74	0.4	0.0053	0.52631579	1140.57	63.46	55.64
50	23.46	0.5	0.0066	0.65789474	1142.09	71.79	62.86
60	27.93	0.6	0.0079	0.78947368	1143.60	85.47	74.73
70	30.7	0.7	0.0092	0.92105263	1145.12	93.94	82.04
80	33.88	0.8	0.0105	1.05263158	1146.64	103.67	90.41
90	37.8	0.9	0.0118	1.18421053	1148.17	115.67	100.74
100	41.69	1	0.0132	1.31578947	1149.70	127.57	110.96
110	45.24	1.1	0.0145	1.44736842	1151.23	138.43	120.25
120	47.89	1.2	0.0158	1.57894737	1152.77	146.54	127.12
130	51.39	1.3	0.0171	1.71052632	1154.32	157.25	136.23
140	53.78	1.4	0.0184	1.84210526	1155.86	164.57	142.38
150	56.74	1.5	0.0197	1.97368421	1157.42	173.62	150.01
160	59.04	1.6	0.0211	2.10526316	1158.97	180.66	155.88
170	61.91	1.7	0.0224	2.23684211	1160.53	189.44	**163.24**
180	64.02	1.8	0.0237	2.36842105	1162.09	195.90	168.58
190	65.76	1.9	0.025	2.5	1163.66	201.23	172.92
200	67.73	2	0.0263	2.63157895	1165.24	207.25	177.86
210	69.52	2.1	0.0276	2.76315789	1166.81	212.73	182.32
220	71.31	2.2	0.0289	2.89473684	1168.39	218.21	186.76
230	73.74	2.3	0.0303	3.02631579	1169.98	225.64	192.86
240	77.25	2.4	0.0316	3.15789474	1171.57	236.39	201.77
250	79.6	2.5	0.0329	3.28947368	1173.16	243.58	207.62

260	81.36	2.6	0.0342	3.42105263	1174.76	248.96	211.93
270	83.22	2.7	0.0355	3.55263158	1176.36	254.65	216.47
280	85.56	2.8	0.0368	3.68421053	1177.97	261.81	222.26
290	87.83	2.9	0.0382	3.81578947	1179.58	268.76	227.84
300	89.6	3	0.0395	3.94736842	1181.20	274.18	232.12
310	89.9	3.1	0.0408	4.07894737	1182.82	275.09	232.58
320	91.2	3.2	0.0381	4.21052632	1179.50	279.07	236.60
330	93.09	3.3	0.0434	4.34210526	1186.07	284.86	240.17
340	95.26	3.4	0.0447	4.47368421	1187.71	291.50	245.43
350	97.65	3.5	0.0461	4.60526316	1189.34	298.81	251.24
360	99.74	3.6	0.0474	4.73684211	1190.99	305.20	256.26
370	101.2	3.7	0.0487	4.86842105	1192.63	309.67	259.65
380	103.51	3.8	0.05	5	1194.29	316.74	265.21
390	105.44	3.9	0.0513	5.13157895	1195.94	322.65	269.78
400	107.37	4	0.0526	5.26315789	1197.60	328.55	274.34
410	109.68	4.1	0.0539	5.39473684	1199.27	335.62	279.85
420	111.18	4.2	0.0553	5.52631579	1200.94	340.21	283.29
430	113.18	4.3	0.0566	5.65789474	1202.61	346.33	287.98
440	115.1	4.4	0.0579	5.78947368	1204.29	352.21	292.46
450	117.72	4.5	0.0592	5.92105263	1205.98	360.22	298.70
460	119.94	4.6	0.0605	6.05263158	1207.67	367.02	303.91
470	120.92	4.7	0.0618	6.18421053	1209.36	370.02	305.96
480	120.92	4.8	0.0632	6.31578947	1211.06	370.02	305.53
490	120.92	4.9	0.0645	6.44736842	1212.76	370.02	305.10
500	120.92	5	0.0658	6.57894737	1214.47	370.02	304.67
510	120.92	5.1	0.0671	6.71052632	1216.18	370.02	304.24
520	120.92	5.2	0.0684	6.84210526	1217.90	370.02	303.81
530	120.89	5.3	0.0697	6.97368421	1219.6242	369.92	303.31
540	119.93	5.4	0.0711	7.10526316	1221.3517	366.99	300.48
550	117.73	5.5	0.0724	7.23684211	1223.0841	360.25	294.55
560	115.84	5.6	0.0737	7.36842105	1224.8214	354.47	289.41
570	113.79	5.7	0.075	7.5	1226.5637	348.20	283.88
580	111.92	5.8	0.0763	7.63157895	1228.3109	342.48	278.82

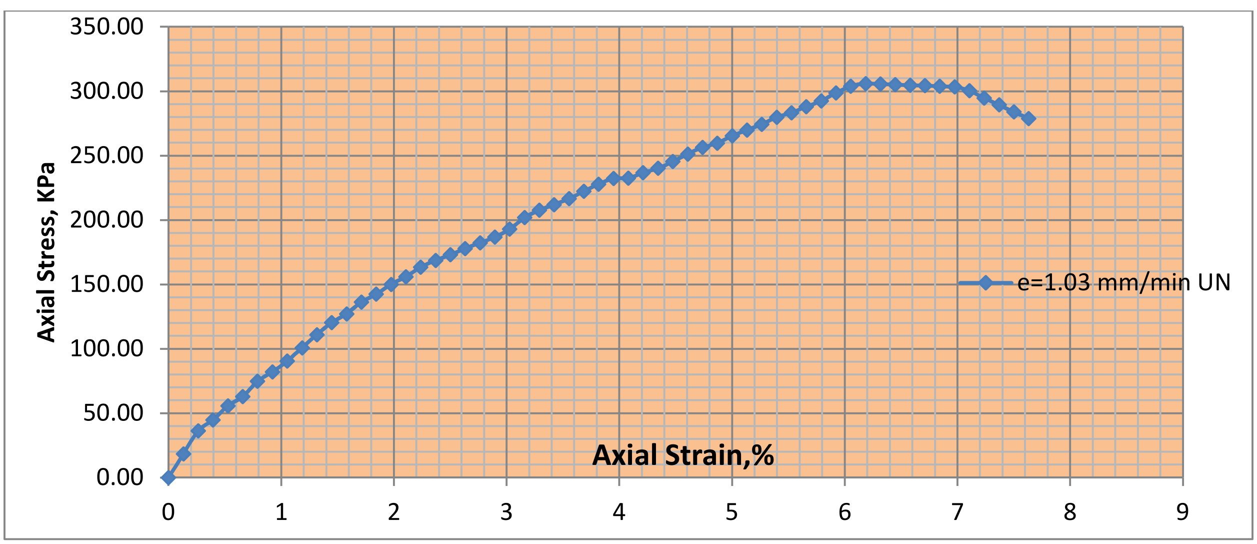


Figure 0-32 qu for ε =1.03 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**305.96 kPa**
	Cohesion© = (qu/2) =	**152.98 kPa**
	Failure strain=	**6.18%**

Table 0-20 UCS test result of ε =1.12 mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		Moisture Content Deternimation	
Diameter (mm)	38.00	Can No.	M3
Height (mm)	76.00	Mass Cont.	35.30
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	87.45
Volume cc	86.23	Mass Cont.+dry soil	74.30
Mass (gm)	166.72	Mass dry soil	39.00
Wet Density g/cc	1.93	Mass moisture	13.15
Moisture Content %	33.72	Moisture Content %	33.72
Dry Density g/cc	1.45		

e=1.12 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	7.42	0.1	0.0013	0.131579	1136.07	22.71	19.99
20	14.06	0.2	0.0026	0.263158	1137.57	43.02	37.82
30	18.21	0.3	0.0039	0.394737	1139.07	55.72	48.92
40	21.11	0.4	0.0053	0.526316	1140.57	64.60	56.64
50	23.47	0.5	0.0066	0.657895	1142.09	71.82	62.88
60	28.84	0.6	0.0079	0.789474	1143.60	88.25	77.17
70	31.33	0.7	0.0092	0.921053	1145.12	95.87	83.72
80	35.98	0.8	0.0105	1.052632	1146.64	110.10	96.02
90	38.63	0.9	0.0118	1.184211	1148.17	118.21	102.95
100	42.98	1	0.0132	1.315789	1149.70	131.52	114.39
110	46.07	1.1	0.0145	1.447368	1151.23	140.97	122.45
120	49.89	1.2	0.0158	1.578947	1152.77	152.66	132.43
130	51.39	1.3	0.0171	1.710526	1154.32	157.25	136.23
140	53.78	1.4	0.0184	1.842105	1155.86	164.57	142.38
150	56.74	1.5	0.0197	1.973684	1157.42	173.62	150.01
160	59.04	1.6	0.0211	2.105263	1158.97	180.66	155.88
170	61.91	1.7	0.0224	2.236842	1160.53	189.44	**163.24**
180	64.02	1.8	0.0237	2.368421	1162.09	195.90	168.58
190	65.76	1.9	0.025	2.5	1163.66	201.23	172.92
200	67.73	2	0.0263	2.631579	1165.24	207.25	177.86
210	69.52	2.1	0.0276	2.763158	1166.81	212.73	182.32
220	71.31	2.2	0.0289	2.894737	1168.39	218.21	186.76
230	73.74	2.3	0.0303	3.026316	1169.98	225.64	192.86
240	77.25	2.4	0.0316	3.157895	1171.57	236.39	201.77
250	79.6	2.5	0.0329	3.289474	1173.16	243.58	207.62
260	83.36	2.6	0.0342	3.421053	1174.76	255.08	217.13
270	87.22	2.7	0.0355	3.552632	1176.36	266.89	226.88
280	89.56	2.8	0.0368	3.684211	1177.97	274.05	232.65
290	92.83	2.9	0.0382	3.815789	1179.58	284.06	240.81
300	95.18	3	0.0395	3.947368	1181.20	291.25	246.57
310	97.52	3.1	0.0408	4.078947	1182.82	298.41	252.29
320	98.45	3.2	0.0381	4.210526	1179.50	301.26	255.41
330	101.38	3.3	0.0434	4.342105	1186.07	310.22	261.55
340	104.31	3.4	0.0447	4.473684	1187.71	319.19	268.74

350	107.24	3.5	0.0461	4.605263	1189.34	328.15	275.91
360	109	3.6	0.0474	4.736842	1190.99	333.54	280.05
370	112.52	3.7	0.0487	4.868421	1192.63	344.31	288.70
380	114.86	3.8	0.05	5	1194.29	351.47	294.29
390	117.79	3.9	0.0513	5.131579	1195.94	360.44	301.38
400	120.13	4	0.0526	5.263158	1197.60	367.60	306.94
410	122.48	4.1	0.0539	5.394737	1199.27	374.79	312.51
420	124.24	4.2	0.0553	5.526316	1200.94	380.17	316.56
430	126.58	4.3	0.0566	5.657895	1202.61	387.33	322.08
440	127.75	4.4	0.0579	5.789474	1204.29	390.92	324.60
450	129.01	4.5	0.0592	5.921053	1205.98	394.77	327.34
460	129.01	4.6	0.0605	6.052632	1207.67	394.77	326.89
470	129.01	4.7	0.0618	6.184211	1209.36	394.77	326.43
480	129.01	4.8	0.0632	6.315789	1211.06	394.77	325.97
490	129.01	4.9	0.0645	6.447368	1212.76	394.77	325.51
500	126.83	5	0.0658	6.578947	1214.47	388.10	319.56
510	124.61	5.1	0.0671	6.710526	1216.18	381.31	313.53
520	121.91	5.2	0.0684	6.842105	1217.90	373.04	306.30
530	118.93	5.3	0.0697	6.973684	1219.62	363.93	298.39
540	116.89	5.4	0.0711	7.105263	1221.35	357.68	292.86

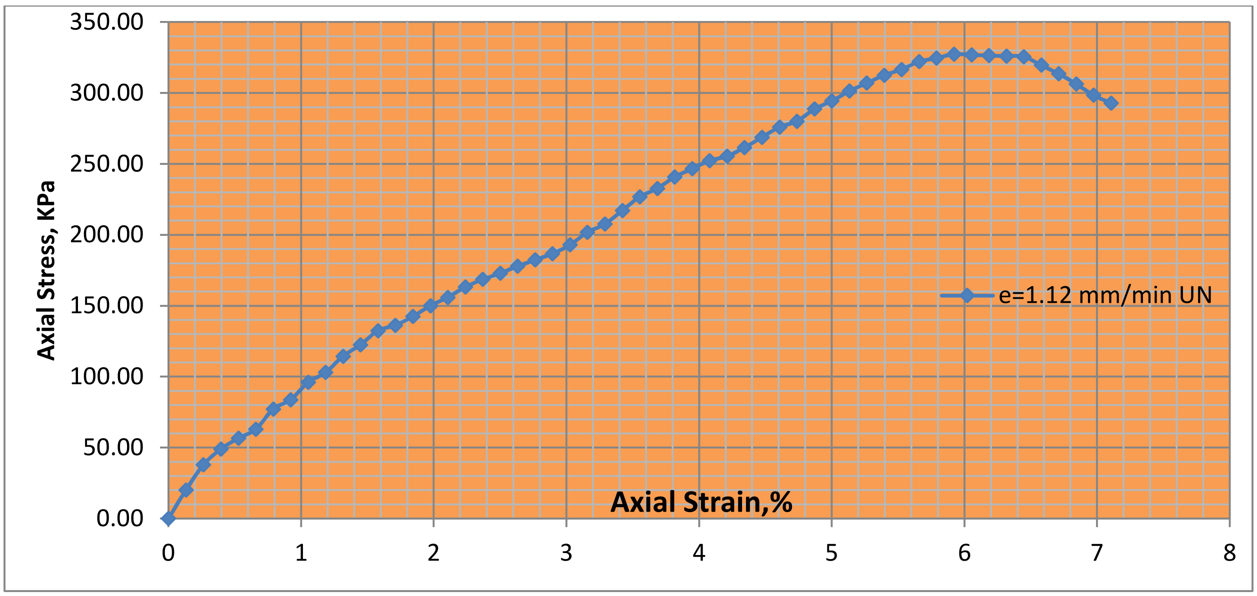


Figure 0-33 qu for ε =1.12 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**327.34 kPa**
	Cohesion© = (qu/2) =	**163.67 kPa**
	Failure strain=	**5.92%**

Table 0-21 UCS test result of ε =1.61 mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	Can No.	G1
Height (mm)	76.0	Mass Cont.	35.5
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	99.3
Volume cc	86.2	Mass Cont.+dry soil	83.2
Mass (gm)	166.9	Mass dry soil	47.7
Wet Density g/cc	1.9	Mass moisture	16.1
Moisture Content %	33.8	Moisture Content %	33.75
Dry Density g/cc	1.4		
e=1.61 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0.0000	1134.57	0.00	0.00
5	3.74	0.05	0.0006579	0.0658	1135.32	11.44	10.08
10	7.49	0.1	0.0013158	0.1316	1136.07	22.92	20.17
15	11.23	0.15	0.0019737	0.1974	1136.82	34.36	30.23
20	14.98	0.2	0.0026316	0.2632	1137.57	45.84	40.30
25	18.72	0.25	0.0032895	0.3289	1138.32	57.28	50.32
30	21.73	0.3	0.0039474	0.3947	1139.07	66.49	58.38
35	26.06	0.35	0.0046053	0.4605	1139.82	79.74	69.96
40	29.96	0.4	0.0052632	0.5263	1140.57	91.68	80.38
45	33.70	0.45	0.0059211	0.5921	1141.33	103.12	90.35
50	36.70	0.5	0.0065789	0.6579	1142.09	112.30	98.33
55	39.70	0.55	0.0072368	0.7237	1142.84	121.48	106.30
60	43.44	0.6	0.0078947	0.7895	1143.60	132.93	116.24
65	47.94	0.65	0.0085526	0.8553	1144.36	146.70	128.19
70	50.93	0.7	0.0092105	0.9211	1145.12	155.85	136.10
75	55.43	0.75	0.0098684	0.9868	1145.88	169.62	148.02
80	59.91	0.8	0.0105263	1.0526	1146.64	183.32	159.88
85	63.66	0.85	0.0111842	1.1184	1147.40	194.80	169.77
90	68.16	0.9	0.0118421	1.1842	1148.17	208.57	181.65
95	71.90	0.95	0.0125	1.2500	1148.93	220.01	191.49
100	76.40	1	0.0131579	1.3158	1149.70	233.78	203.34
105	80.14	1.05	0.0138158	1.3816	1150.47	245.23	213.16
110	85.38	1.1	0.0144737	1.4474	1151.23	261.26	226.94
115	89.13	1.15	0.0151316	1.5132	1152.00	272.74	236.75
120	93.63	1.2	0.0157895	1.5789	1152.77	286.51	248.54
125	96.62	1.25	0.0164474	1.6447	1153.54	295.66	256.30
130	101.86	1.3	0.0171053	1.7105	1154.32	311.69	270.02
135	105.86	1.35	0.0177632	1.7763	1155.09	323.93	280.44
140	109.35	1.4	0.0184211	1.8421	1155.86	334.61	289.49
145	115.05	1.45	0.0190789	1.9079	1156.64	352.05	304.38
150	119.09	1.5	0.0197368	1.9737	1157.42	364.42	314.85
155	122.09	1.55	0.0203947	2.0395	1158.19	373.60	322.57
160	125.83	1.6	0.0190476	2.1053	1156.60	385.04	332.91
165	129.58	1.65	0.0217105	2.1711	1159.75	396.51	341.90
170	133.32	1.7	0.0223684	2.2368	1160.53	407.96	351.53
175	137.07	1.75	0.0230263	2.3026	1161.31	419.43	361.17
180	139.31	1.8	0.0236842	2.3684	1162.09	426.29	366.83
185	143.80	1.85	0.0243421	2.4342	1162.88	440.03	378.40
190	146.81	1.9	0.025	2.5000	1163.66	449.24	386.06
195	150.55	1.95	0.0256579	2.5658	1164.45	460.68	395.62
200	153.54	2	0.0263158	2.6316	1165.24	469.83	403.21

205	156.53	2.05	0.0269737	2.6974	1166.02	478.98	410.78
210	158.78	2.1	0.0276316	2.7632	1166.81	485.87	416.41
215	161.78	2.15	0.0282895	2.8289	1167.60	495.05	423.99
220	163.28	2.2	0.0289474	2.8947	1168.39	499.64	427.63
225	165.53	2.25	0.0296053	2.9605	1169.19	506.52	433.23
230	167.77	2.3	0.0302632	3.0263	1169.98	513.38	438.79
235	170.02	2.35	0.0309211	3.0921	1170.77	520.26	444.37
240	171.52	2.4	0.0315789	3.1579	1171.57	524.85	447.99
245	172.27	2.45	0.0322368	3.2237	1172.36	527.15	449.64
250	173.62	2.5	0.0328947	3.2895	1173.16	531.28	452.86
255	173.62	2.55	0.0335526	3.3553	1173.96	531.28	452.55
260	173.62	2.6	0.0342105	3.4211	1174.76	531.28	452.24
265	174.54	2.65	0.0348684	3.4868	1175.56	534.09	454.33
270	174.54	2.7	0.0355	3.5526	1176.3633	534.09	454.02
275	174.54	2.75	0.0362	3.6184	1177.1663	534.09	453.71
280	174.54	2.8	0.0368	3.6842	1177.9703	534.09	453.40
285	175.67	2.8500	0.0375	3.7500	1178.7755	537.5502	456.02
290	174.76	2.9	0.0382	3.8158	1179.5818	534.77	453.35
295	173.73	2.95	0.0388	3.8816	1180.3892	531.61	450.37
300	172.76	3	0.0395	3.9474	1181.1977	528.65	447.55
305	172.13	3.05	0.0401	4.0132	1182.0072	526.72	445.61
310	169.44	3.1	0.0408	4.0789	1182.8180	518.49	438.35
315	166.22	3.15	0.0414	4.1447	1183.6298	508.63	429.72
320	164.12	3.2	0.0421	4.2105	1184.4427	502.21	424.00
325	161.96	3.25	0.0428	4.2763	1185.2568	495.60	418.14
330	160.02	3.3	0.0434	4.3421	1186.0719	489.66	412.84
335	157.74	3.35	0.0441	4.4079	1186.8882	482.68	406.68
340	155.74	3.4	0.0447	4.4737	1187.7056	476.56	401.25
345	153.63	3.45	0.0454	4.5395	1188.5242	470.11	395.54
350	151.54	3.5	0.0461	4.6053	1189.3438	463.71	389.89
355	149.42	3.55	0.0467	4.6711	1190.1646	457.23	384.17
360	147.39	3.6	0.0474	4.7368	1190.9866	451.01	378.69
365	145.33	3.65	0.0480	4.8026	1191.8097	444.71	373.14
370	143.17	3.7	0.0487	4.8684	1192.6339	438.10	367.34

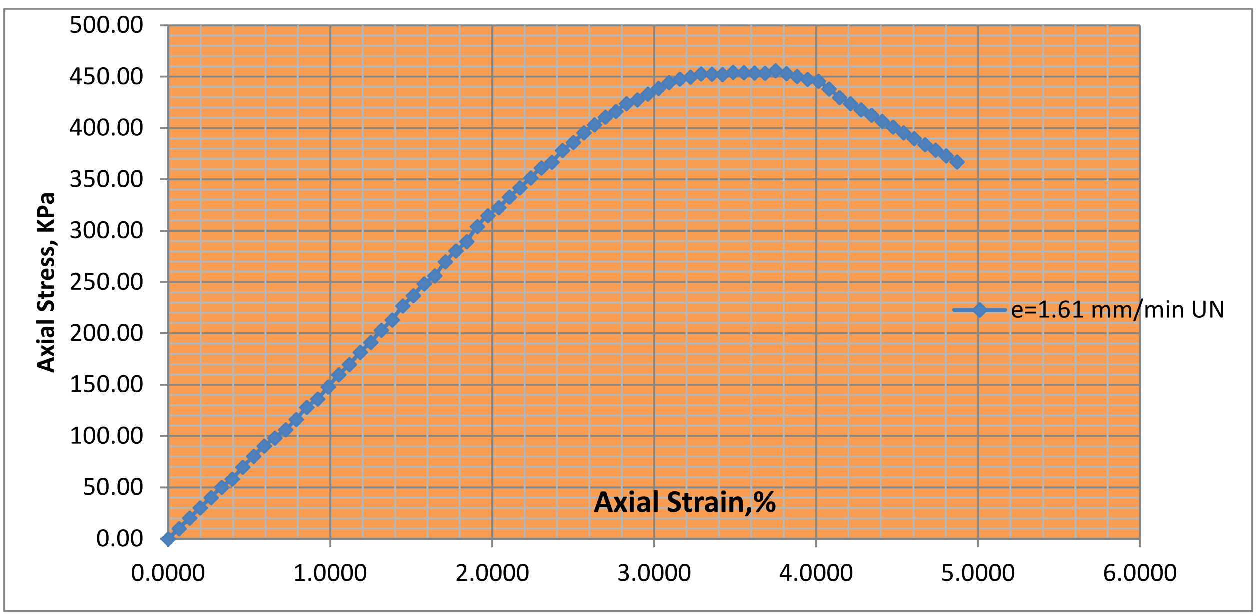


Figure 0-34 qu for ε =1.61 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**456.02 kPa**
	Cohesion© = (qu/2) =	**228.01 kPa**
	Failure strain=	**3.75%**

Table 0-22 UCS test result of ε =1.75 mm/min for undisturbed sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	X2
Height (mm)	76.00	Mass Cont.	35.3
Area (A_o) mm2	1134.57	Mass Cont.+wet soil	78.63
Volume cc	86.23	Mass Cont.+dry soil	67.7
Mass (gm)	168.03	Mass dry soil	32.4
Wet Density g/cc	1.95	Mass moisture	10.93
Moisture Content %	33.73	Moisture Content %	33.73
Dry Density g/cc	1.46		

e=1.75 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0.0000	0	1134.57	0.00	0.00
5	4.26	0.05	0.0007	0.065789	1135.32	13.04	11.48
10	8.52	0.1	0.0013	0.131579	1136.07	26.07	22.95
15	12.77	0.15	0.0020	0.197368	1136.82	39.08	34.37
20	17.03	0.2	0.0026	0.263158	1137.57	52.11	45.81
25	21.29	0.25	0.0033	0.328947	1138.32	65.15	57.23
30	24.70	0.3	0.0039	0.394737	1139.07	75.58	66.35
35	27.25	0.35	0.0046	0.460526	1139.82	83.39	73.16
40	34.06	0.4	0.0053	0.526316	1140.57	104.22	91.38
45	38.32	0.45	0.0059	0.592105	1141.33	117.26	102.74
50	41.73	0.5	0.0066	0.657895	1142.09	127.69	111.81
55	45.13	0.55	0.0072	0.723684	1142.84	138.10	120.84
60	49.39	0.6	0.0079	0.789474	1143.60	151.13	132.16
65	54.50	0.65	0.0086	0.855263	1144.36	166.77	145.73
70	57.91	0.7	0.0092	0.921053	1145.12	177.20	154.75
75	63.02	0.75	0.0099	0.986842	1145.88	192.84	168.29
80	68.13	0.8	0.0105	1.052632	1146.64	208.48	181.82
85	72.38	0.85	0.0112	1.118421	1147.40	221.48	**193.03**
90	77.49	0.9	0.0118	1.184211	1148.17	237.12	206.52
95	81.75	0.95	0.0125	1.25	1148.93	250.16	217.73
100	86.86	1	0.0132	1.315789	1149.70	265.79	231.18
105	91.12	1.05	0.0138	1.381579	1150.47	278.83	242.36
110	97.08	1.1	0.0145	1.447368	1151.23	297.06	258.04
115	101.34	1.15	0.0151	1.513158	1152.00	310.10	269.18
120	106.45	1.2	0.0158	1.578947	1152.77	325.74	282.57
125	109.85	1.25	0.0164	1.644737	1153.54	336.14	291.40
130	115.81	1.3	0.0171	1.710526	1154.32	354.38	307.00
135	120.92	1.35	0.0178	1.776316	1155.09	370.02	320.33
140	124.33	1.4	0.0184	1.842105	1155.86	380.45	329.15
145	131.99	1.45	0.0191	1.907895	1156.64	403.89	349.19
150	135.40	1.5	0.0197	1.973684	1157.42	414.32	357.97
155	138.81	1.55	0.0204	2.039474	1158.19	424.76	366.74
160	143.06	1.6	0.0190	2.105263	1156.60	437.76	378.49
165	147.32	1.65	0.0217	2.171053	1159.75	450.80	388.70
170	151.58	1.7	0.0224	2.236842	1160.53	463.83	399.67
175	155.84	1.75	0.0230	2.302632	1161.31	476.87	410.63
180	158.39	1.8	0.0237	2.368421	1162.09	484.67	417.07
185	163.50	1.85	0.0243	2.434211	1162.88	500.31	430.23
190	166.91	1.9	0.0250	2.5	1163.66	510.74	438.91
195	171.16	1.95	0.0257	2.565789	1164.45	523.75	449.78
200	174.57	2	0.0263	2.631579	1165.24	534.18	458.43

205	177.98	2.05	0.0270	2.697368	1166.02	544.62	467.07
210	180.53	2.1	0.0276	2.763158	1166.81	552.42	473.45
215	183.94	2.15	0.0283	2.828947	1167.60	562.86	482.06
220	185.64	2.2	0.0289	2.894737	1168.39	568.06	486.19
225	188.20	2.25	0.0296	2.960526	1169.19	575.89	492.56
230	190.75	2.3	0.0303	3.026316	1169.98	583.70	498.89
235	193.31	2.35	0.0309	3.092105	1170.77	591.53	505.25
240	195.01	2.4	0.0316	3.157895	1171.57	596.73	509.34
245	195.86	2.45	0.0322	3.223684	1172.36	599.33	511.22
250	**196.71**	**2.5**	**0.0329**	**3.289474**	**1173.16**	**601.93**	**513.09**
255	196.71	2.55	0.0336	3.355263	1173.96	601.93	512.74
260	196.71	2.6	0.0342	3.421053	1174.76	601.93	512.39
265	196.71	2.65	0.0349	3.486842	1175.56	601.93	512.04
270	196.71	2.7	0.035526	3.552632	1176.36328	601.93	511.69
275	194.86	2.75	0.036184	3.618421	1177.16626	596.27	506.53
280	192.98	2.8	0.036842	3.684211	1177.97034	590.52	501.30
285	190.71	2.85	0.0375	3.75	1178.77551	583.57	495.07
290	188.83	2.9	0.038158	3.815789	1179.58179	577.82	489.85
295	186.80	2.95	0.038816	3.881579	1180.38917	571.61	484.25
300	184.10	3	0.039474	3.947368	1181.19765	563.35	476.93
305	182.81	3.05	0.040132	4.013158	1182.00725	559.40	473.26
310	180.98	3.1	0.040789	4.078947	1182.81795	553.80	468.20
315	178.58	3.15	0.041447	4.144737	1183.62977	546.45	461.68
320	176.02	3.2	0.042105	4.210526	1184.4427	538.62	454.75
325	174.71	3.25	0.0428	4.276316	1185.26	534.61	451.05

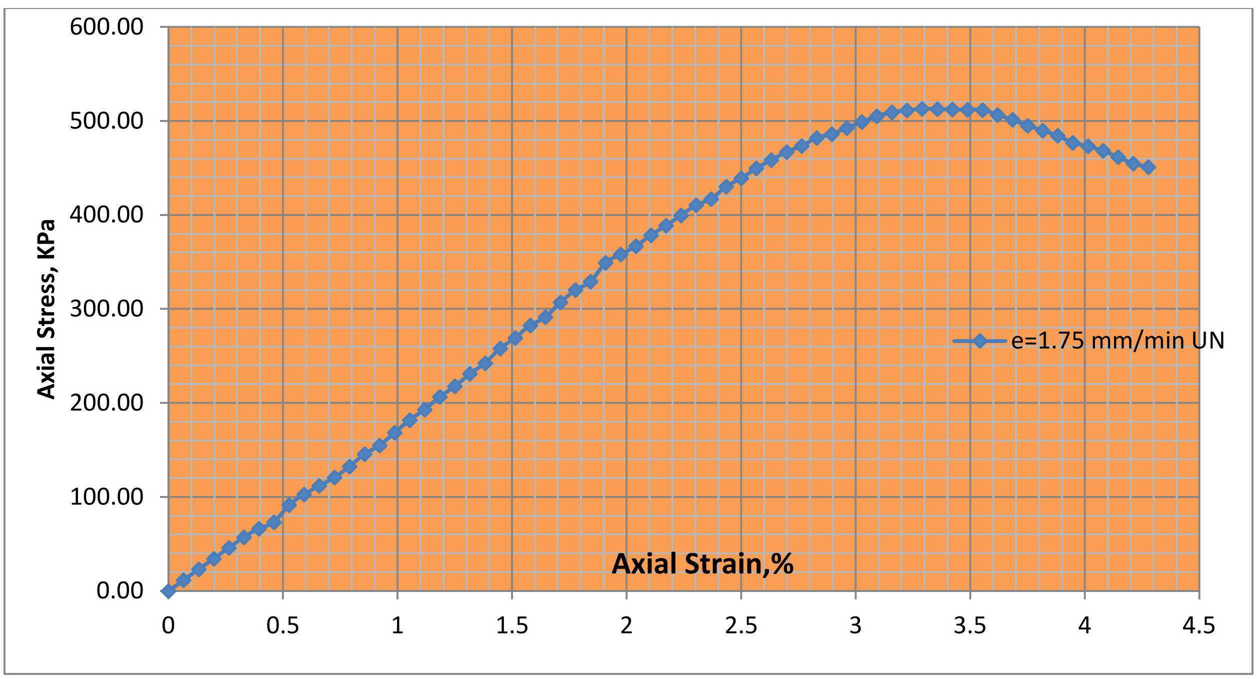


Figure 0-35 qu for ε =1.75 mm/min UN

Remark:	**Unconfined Compressive Strength (qu)=**	**513.09 kPa**
	Cohesion© = (qu/2) =	**256.54 kPa**
	Failure strain=	3.29%

Table 0-23 UCS test result of ε =0.37 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Determination	
Diameter (mm)	38.0	Can No.	O4
Height (mm)	75.0	Mass Cont.	35.4
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	91.72
Volume cc	85.1	Mass Cont.+dry soil	77.8
Mass (gm)	161.2	Mass dry soil	42.4
Wet Density g/cc	1.9	Mass moisture	13.92
Moisture Content %	32.8	Moisture Content %	32.83
Dry Density g/cc	1.4		
e=0.37 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.06	0.2	0.0027	0.26667	1137.61	6.30	5.54
40	6.17	0.4	0.0053	0.53333	1140.65	18.88	16.55
60	8.21	0.6	0.008	0.8	1143.72	25.12	21.97
80	10.27	0.8	0.0107	1.06667	1146.80	31.43	27.40
100	11.46	1	0.0133	1.33333	1149.90	35.07	30.50
120	12.32	1.2	0.016	1.6	1153.02	37.70	32.70
140	14.38	1.4	0.0187	1.86667	1156.15	44.00	38.06
160	16.43	1.6	0.0213	2.13333	1159.30	50.28	43.37
180	17.42	1.8	0.024	2.4	1162.47	53.31	45.86
200	18.49	2	0.0267	2.66667	1165.66	56.58	48.54
220	20.53	2.2	0.0293	2.93333	1168.86	62.82	53.75
240	22.10	2.4	0.032	3.2	1172.08	67.63	57.70
260	22.59	2.6	0.0347	3.46667	1175.32	69.13	58.81
280	23.63	2.8	0.0373	3.73333	1178.57	72.31	61.35
300	24.47	3	0.04	4	1181.85	74.88	63.36
320	25.15	3.2	0.0427	4.26667	1185.14	76.96	64.94
340	25.93	3.4	0.0453	4.53333	1188.45	79.35	66.76
360	26.75	3.6	0.048	4.8	1191.78	81.86	68.68
380	27.54	3.8	0.0507	5.06667	1195.12	84.27	70.51
400	28.27	4	0.0533	5.33333	1198.49	86.51	72.18
420	28.62	4.2	0.056	5.6	1201.88	87.58	72.87
440	30.10	4.4	0.0587	5.86667	1205.28	92.11	76.42
460	30.84	4.6	0.0613	6.13333	1208.71	94.37	78.08
480	31.41	4.8	0.064	6.4	1212.15	96.11	79.29
500	32.74	5	0.0667	6.66667	1215.61	100.18	82.41
520	33.30	5.2	0.0693	6.93333	1219.10	101.90	83.58
540	34.11	5.4	0.072	7.2	1222.60	104.38	85.37
560	34.31	5.6	0.0747	7.46667	1226.12	104.99	85.63
580	34.99	5.8	0.0773	7.73333	1229.67	107.07	87.07
600	35.51	6	0.08	8	1233.23	108.66	88.11
620	35.91	6.2	0.0827	8.26667	1236.81	109.88	88.84

640	36.59	6.4	0.0853	8.53333	1240.42	111.97	90.26
660	36.97	6.6	0.088	8.8	1244.05	113.13	90.94
680	37.53	6.8	0.0907	9.06667	1247.70	114.84	92.04
700	38.56	7	0.0933	9.33333	1251.37	117.99	94.29
720	39.08	7.2	0.096	9.6	1255.06	119.58	95.28
740	40.20	7.4	0.0987	9.86667	1258.77	123.01	97.72
760	40.48	7.6	0.1013	10.1333	1262.51	123.87	98.11
780	41.08	7.8	0.104	10.4	1266.26	125.70	99.27
800	41.60	8	0.1067	10.6667	1270.04	127.30	100.23
820	41.94	8.2	0.1093	10.9333	1273.85	128.34	100.75
840	43.08	8.4	0.112	11.2	1277.67	131.82	103.18
860	43.42	8.6	0.1147	11.4667	1281.52	132.87	103.68
880	44.60	8.8	0.1173	11.7333	1285.39	136.48	106.17
900	45.03	9	0.12	12	1289.29	137.79	106.87
920	45.88	9.2	0.1227	12.2667	1293.20	140.39	108.56
940	46.37	9.4	0.1253	12.5333	1297.15	141.89	109.39
960	47.20	9.6	0.128	12.8	1301.11	144.43	111.01
980	47.84	9.8	0.1307	13.0667	1305.11	146.39	112.17
1000	48.50	10	0.1333	13.3333	1309.12	148.41	113.37
1020	49.13	10.2	0.136	13.6	1313.16	150.34	114.49
1040	49.29	10.4	0.1387	13.8667	1317.23	150.83	114.50
1060	49.97	10.6	0.1413	14.1333	1321.32	152.91	115.72
1080	50.50	10.8	0.144	14.4	1325.43	154.53	116.59
1100	50.85	11	0.1467	14.6667	1329.58	155.60	117.03
1120	51.51	11.2	0.1493	14.9333	1333.74	157.62	118.18
1140	52.09	11.4	0.152	15.2	1337.94	159.40	119.14
1160	52.09	11.6	0.1547	15.4667	1342.16	159.40	118.76
1180	52.09	11.8	0.1573	15.7333	1346.41	159.40	118.39
1200	52.09	12	0.16	16	1350.68	159.40	118.01

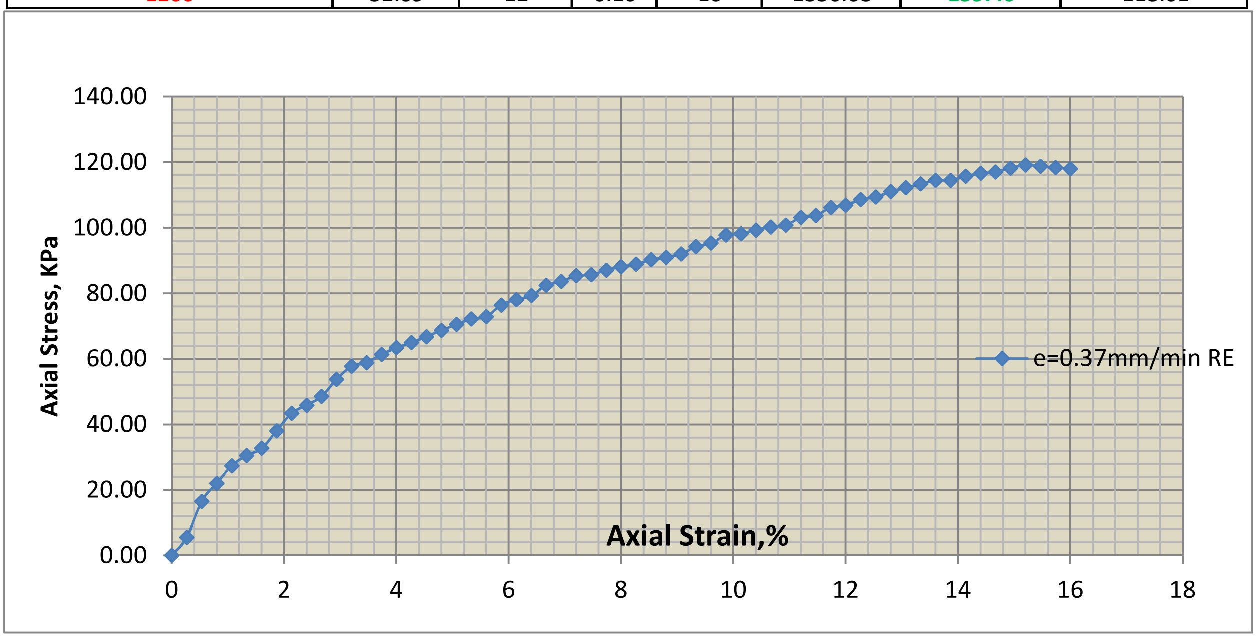


Figure 0-36 qu for ε =0.37 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**119.14 kPa**
	Cohesion© = (qu/2) =	**59.57 kPa**
	Failure strain=	**15.00%**

Table 0-24 UCS test result of ε =0.84 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	t2
Height (mm)	76.0	Mass Cont.	35.6
Area (A_o) mm2	1134.6	Mass Cont.+wet soil	95.77
Volume cc	86.2	Mass Cont.+dry soil	80.9
Mass (gm)	162.2	Mass dry soil	45.3
Wet Density g/cc	1.9	Mass moisture	14.87
Moisture Content %	32.8	Moisture Content %	32.83
Dry Density g/cc	1.4		
e=0.84 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)= (LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	7.98	0.2	0.0026	0.2632	1137.57	24.42	21.47
40	12.06	0.4	0.0053	0.5263	1140.57	36.90	32.36
60	15.11	0.6	0.0079	0.7895	1143.60	46.24	40.43
80	17.91	0.8	0.0105	1.0526	1146.64	54.80	47.80
100	21.52	1	0.0132	1.3158	1149.70	65.85	57.28
120	25.15	1.2	0.0158	1.5789	1152.77	76.96	66.76
140	28.04	1.4	0.0184	1.8421	1155.86	85.80	74.23
160	31.69	1.6	0.0211	2.1053	1158.97	96.97	83.67
180	34.65	1.8	0.0237	2.3684	1162.09	106.03	91.24
200	38.90	2	0.0263	2.6316	1165.24	119.03	102.15
220	42.46	2.2	0.0289	2.8947	1168.39	129.93	111.20
240	43.99	2.4	0.0316	3.1579	1171.57	134.61	114.90
260	46.07	2.6	0.0342	3.4211	1174.76	140.97	120.00
280	48.62	2.8	0.0368	3.6842	1177.97	148.78	126.30
300	50.18	3	0.0395	3.9474	1181.20	153.55	130.00
320	51.74	3.2	0.0421	4.2105	1184.44	158.32	133.67
340	53.33	3.4	0.0447	4.4737	1187.71	163.19	**137.40**
360	54.91	3.6	0.0474	4.7368	1190.99	168.02	141.08
380	56.51	3.8	0.05	5	1194.29	172.92	144.79
400	58.11	4	0.0526	5.2632	1197.60	177.82	148.48
420	59.72	4.2	0.0553	5.5263	1200.94	182.74	152.17
440	60.34	4.4	0.0579	5.7895	1204.29	184.64	153.32
460	61.64	4.6	0.0605	6.0526	1207.67	188.62	156.18
480	62.96	4.8	0.0632	6.3158	1211.06	192.66	159.08
500	63.59	5	0.0658	6.5789	1214.47	194.59	160.22

520	64.65	5.2	0.0684	6.8421	1217.90	197.83	162.43
540	65.23	5.4	0.0711	7.1053	1221.35	199.60	163.43
560	66.18	5.6	0.0737	7.3684	1224.82	202.51	165.34
580	67.17	5.8	0.0763	7.6316	1228.31	205.54	167.34
600	68.42	6	0.0789	7.8947	1231.82	209.37	169.96
620	69.54	6.2	0.0816	8.1579	1235.35	212.79	172.25
640	70.59	6.4	0.0842	8.4211	1238.90	216.01	174.35
660	72.28	6.6	0.0868	8.6842	1242.47	221.18	178.01
680	73.53	6.8	0.0895	8.9474	1246.06	225.00	180.57
700	74.51	7	0.0921	9.2105	1249.67	228.00	182.45
720	75.67	7.2	0.0947	9.4737	1253.31	231.55	184.75
740	76.64	7.4	0.0974	9.7368	1256.96	234.52	186.58
760	77.19	7.6	0.1	10	1260.63	236.20	187.37
780	78.21	7.8	0.1026	10.263	1264.33	239.32	189.29
800	79.86	8	0.1053	10.526	1268.05	244.37	192.71
820	80.98	8.2	0.1079	10.789	1271.79	247.80	194.84
840	81.55	8.4	0.1105	11.053	1275.55	249.54	195.64
860	82.24	8.6	0.1132	11.316	1279.34	251.65	196.71
880	83.55	8.8	0.1158	11.579	1283.15	255.66	199.25
900	84.24	9	0.1184	11.842	1286.98	257.77	200.29
920	85.41	9.2	0.1211	12.105	1290.83	261.35	202.47
940	85.41	9.4	0.1237	12.368	1294.71	261.35	201.86
960	86.23	9.6	0.1263	12.632	1298.61	263.86	203.19
980	86.23	9.8	0.1289	12.895	1302.53	263.86	202.58
1000	86.81	10	0.1316	13.158	1306.48	265.64	203.32
1020	86.81	10.2	0.1342	13.421	1310.45	265.64	202.71
1040	86.81	10.4	0.1368	13.684	1314.44	265.64	202.09
1060	87.98	10.6	0.1395	13.947	1318.46	269.22	204.19
1080	87.98	10.8	0.1421	14.211	1322.51	269.22	203.57
1100	87.98	11	0.1447	14.474	1326.58	269.22	202.94
1120	86.97	11.2	0.1474	14.737	1330.67	266.13	200.00
1140	86.97	11.4	0.15	15	1334.79	266.13	199.38
1160	86.97	11.6	0.1526	15.263	1338.94	266.13	198.76
1180	86.97	11.8	0.1553	15.526	1343.11	266.13	198.14

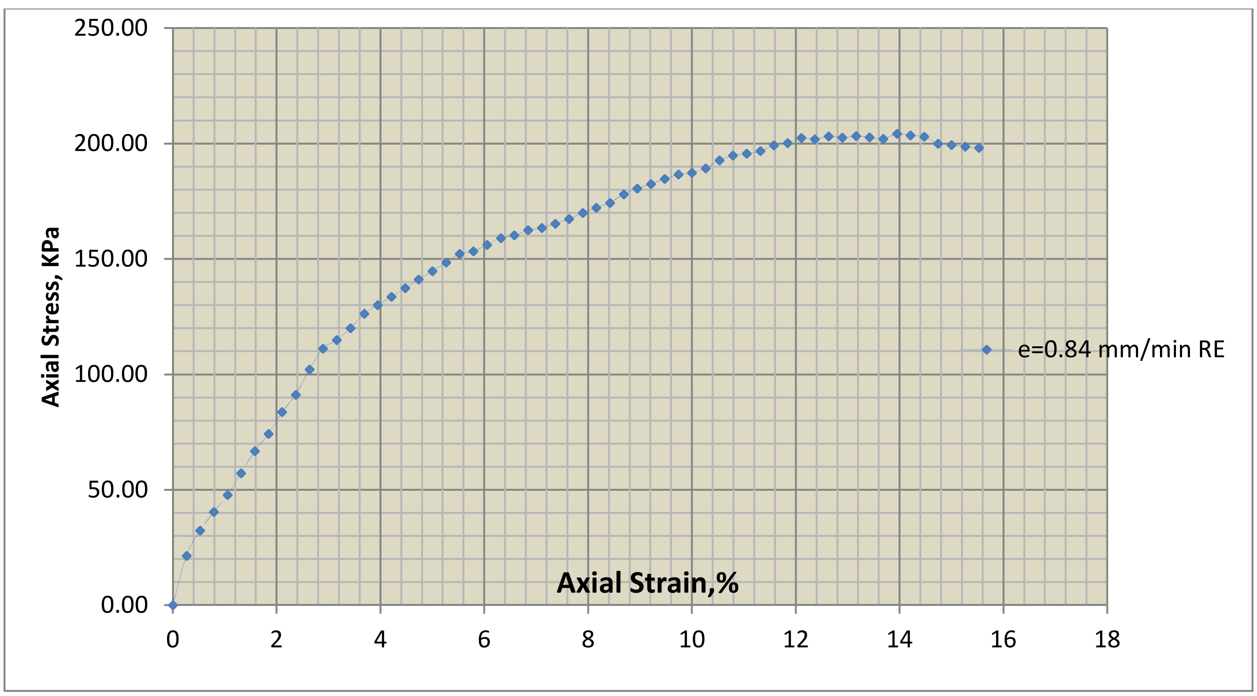


Figure 0-37 qu for ε =0.84 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**204.19 kPa**
	Cohesion© = (qu/2) =	**102.10 kPa**
	Failure strain=	**13.95%**

Table 0-25 UCS test result of ε =1.03 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	B7
Height (mm)	76.00	Mass Cont.	35.40
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	84.00
Volume cc	86.23	Mass Cont.+dry soil	72.00
Mass (gm)	162.58	Mass dry soil	36.60
Wet Density g/cc	1.89	Mass moisture	12.00
Moisture Content %	32.79	Moisture Content %	32.79
Dry Density g/cc	1.42		
e=1.03 mm/min			

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	6.37	0.1	0.00132	0.1316	1136.07	19.49	17.16
20	13.77	0.2	0.00263	0.2632	1137.57	42.14	37.04
30	17.61	0.3	0.00395	0.3947	1139.07	53.89	47.31
40	20.69	0.4	0.00526	0.5263	1140.57	63.31	55.51
50	23.22	0.5	0.00658	0.6579	1142.09	71.05	62.21
60	27.50	0.6	0.00789	0.7895	1143.60	84.15	73.58
70	29.99	0.7	0.00921	0.9211	1145.12	91.77	80.14
80	34.51	0.8	0.01053	1.0526	1146.64	105.60	92.10
90	37.17	0.9	0.01184	1.1842	1148.17	113.74	99.06
100	40.41	1	0.01316	1.3158	1149.70	123.65	107.55
110	42.82	1.1	0.01447	1.4474	1151.23	131.03	113.82
120	44.90	1.2	0.01579	1.5789	1152.77	137.39	119.19
130	45.95	1.3	0.01711	1.7105	1154.32	140.61	121.81
140	47.92	1.4	0.01842	1.8421	1155.86	146.64	126.86
150	49.43	1.5	0.01974	1.9737	1157.42	151.26	130.68
160	50.26	1.6	0.02105	2.1053	1158.97	153.80	132.70
170	51.25	1.7	0.02237	2.2368	1160.53	156.83	135.13
180	53.36	1.8	0.02368	2.3684	1162.09	163.28	140.51
190	55.54	1.9	0.025	2.5	1163.66	169.95	146.05
200	56.62	2	0.02632	2.6316	1165.24	173.26	148.69
210	58.79	2.1	0.02763	2.7632	1166.81	179.90	154.18
220	58.79	2.2	0.02895	2.8947	1168.39	179.90	153.97
230	60.97	2.3	0.03026	3.0263	1169.98	186.57	159.46
240	62.06	2.4	0.03158	3.1579	1171.57	189.90	162.09
250	63.16	2.5	0.03289	3.2895	1173.16	193.27	164.74
260	65.35	2.6	0.03421	3.4211	1174.76	199.97	170.22
270	66.46	2.7	0.03553	3.5526	1176.36	203.37	172.88
280	67.56	2.8	0.03684	3.6842	1177.97	206.73	175.50
290	68.66	2.9	0.03816	3.8158	1179.58	210.10	178.11
300	68.66	3	0.03947	3.9474	1181.20	210.10	177.87
310	70.88	3.1	0.04079	4.0789	1182.82	216.89	183.37
320	71.98	3.2	0.04211	4.2105	1184.44	220.26	185.96
330	74.21	3.3	0.04342	4.3421	1186.07	227.08	191.46
340	75.33	3.4	0.04474	4.4737	1187.71	230.51	194.08
350	76.44	3.5	0.04605	4.6053	1189.34	233.91	196.67
360	78.68	3.6	0.04737	4.7368	1190.99	240.76	202.15
370	79.80	3.7	0.04868	4.8684	1192.63	244.19	204.75
380	79.85	3.8	0.05	5	1194.29	244.34	204.59
390	81.02	3.9	0.05132	5.1316	1195.94	247.92	207.30
400	82.15	4	0.05263	5.2632	1197.60	251.38	209.90
410	82.76	4.1	0.05395	5.3947	1199.27	253.25	211.17
420	84.01	4.2	0.05526	5.5263	1200.94	257.07	214.06
430	85.02	4.3	0.05658	5.6579	1202.61	260.16	216.33
440	86.10	4.4	0.05789	5.7895	1204.29	263.47	218.77
450	86.10	4.5	0.05921	5.9211	1205.98	263.47	218.47
460	86.10	4.6	0.06053	6.0526	1207.67	263.47	218.16
470	87.38	4.7	0.06184	6.1842	1209.36	267.38	221.09
480	87.38	4.8	0.06316	6.3158	1211.06	267.38	220.78
490	87.38	4.9	0.06447	6.4474	1212.76	267.38	220.47
500	88.09	5	0.06579	6.5789	1214.47	269.56	221.95

510	88.09	5.1	0.06711	6.7105	1216.18	269.56	221.64
520	88.09	5.2	0.06842	6.8421	1217.90	269.56	221.33
530	88.40	5.3	0.06974	6.9737	1219.62	270.50	221.79
540	88.40	5.4	0.07105	7.1053	1221.35	270.50	221.48
550	88.40	5.5	0.07237	7.2368	1223.08	270.50	221.17
560	88.82	5.600	0.07368	7.3684	1224.82	271.79	221.90
570	88.82	5.700	0.075	7.5	1226.56	271.79	221.59
580	88.82	5.8	0.07632	7.6316	1228.31	271.79	221.27
590	89.14	5.9	0.07763	7.7632	1230.06	272.77	221.75
600	89.14	6	0.07895	7.8947	1231.82	272.77	221.44
610	89.51	6.1	0.08026	8.0263	1233.58	273.90	222.04
620	89.51	6.2	0.08158	8.1579	1235.35	273.90	221.72
630	90.59	6.3	0.08289	8.2895	1237.12	277.21	224.07
640	90.59	6.4	0.08421	8.4211	1238.90	277.21	223.75
650	91.00	6.5	0.08553	8.5526	1240.68	278.46	224.44
660	91.00	6.6	0.08684	8.6842	1242.47	278.46	224.12
670	91.64	6.7	0.08816	8.8158	1244.26	280.42	225.37
680	91.64	6.8	0.08947	8.9474	1246.06	280.42	225.04
690	92.05	6.9	0.09079	9.0789	1247.86	281.67	225.72
700	92.05	7	0.09211	9.2105	1249.67	281.67	225.40
710	92.68	7.1	0.09342	9.3421	1251.49	283.60	226.61
720	92.68	7.2	0.09474	9.4737	1253.31	283.60	226.28
730	93.14	7.3	0.09605	9.6053	1255.13	285.01	227.07
740	93.14	7.4	0.09737	9.7368	1256.96	285.01	226.74
750	93.14	7.5	0.09868	9.8684	1258.79	285.01	226.41
760	93.70	7.6	0.1	10	1260.63	286.72	227.44
770	93.70	7.7	0.10132	10.132	1262.48	286.72	227.11
780	94.24	7.8	0.10263	10.263	1264.33	288.38	228.09
790	94.24	7.9	0.10395	10.395	1266.19	288.37	227.75
800	94.24	8	0.10526	10.526	1268.05	288.37	227.42
810	94.24	8.1	0.10658	10.658	1269.92	288.37	227.08
820	94.24	8.2	0.10789	10.789	1271.79	288.37	226.75
830	94.33	8.3	0.10921	10.921	1273.67	288.65	226.63
840	94.33	8.4	0.11053	11.053	1275.55	288.65	226.29
850	94.76	8.5	0.11184	11.184	1277.44	289.97	226.99
860	94.76	8.6	0.11316	11.316	1279.34	289.97	226.65
870	95.29	8.7	0.11447	11.447	1281.24	291.59	227.58
880	95.29	8.8	0.11579	11.579	1283.15	291.59	227.24
890	95.53	8.9	0.11711	11.711	1285.06	292.32	227.48
900	95.53	9	0.11842	11.842	1286.98	292.32	227.14
910	95.53	9.1	0.11974	11.974	1288.90	292.32	226.80
920	95.53	9.2	0.12105	12.105	1290.83	292.32	226.46
930	95.53	9.3	0.12237	12.237	1292.77	292.32	226.12
940	95.53	9.4	0.12368	12.368	1294.71	292.32	225.78
950	95.53	9.5	0.125	12.5	1296.65	292.32	225.44
960	95.53	9.6	0.12632	12.632	1298.61	292.32	225.10
970	95.53	9.7	0.12763	12.763	1300.56	292.32	224.77
980	95.53	9.8	0.12895	12.895	1302.53	292.32	224.43
990	95.53	9.9	0.13026	13.026	1304.50	292.32	224.09

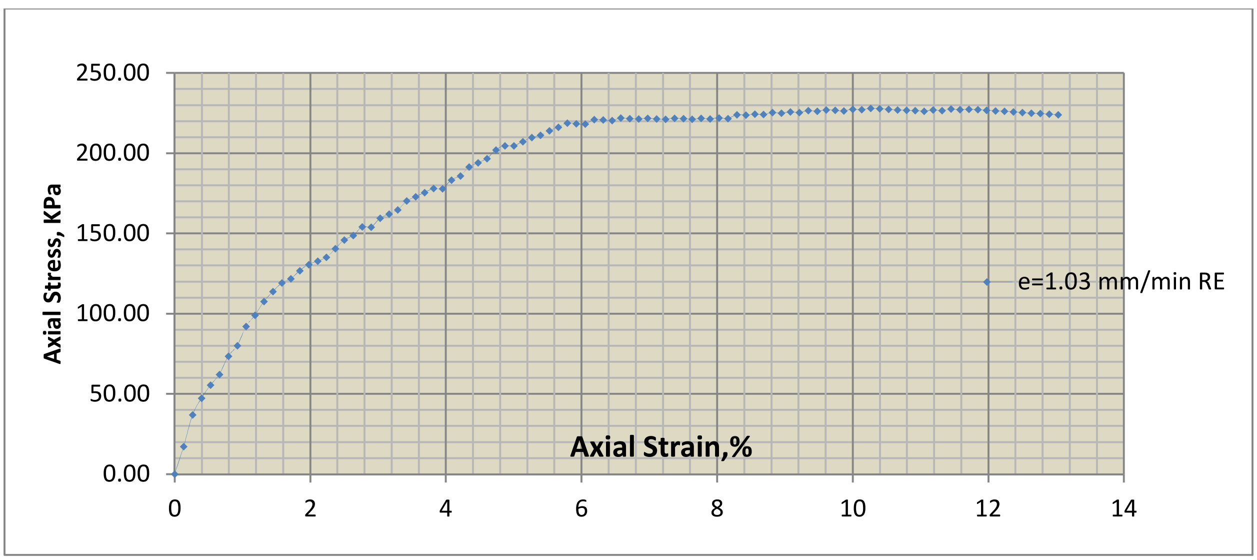


Figure 0-38 qu for ε =1.03 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**228.09 kPa**
	Cohesion© = (qu/2) =	**114.05 kPa**
	Failure strain=	**10.26%**

Table 0-26 UCS test result of ε =1.12 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Deternimation	
Diameter (mm)	38.00	Can No.	H3
Height (mm)	76.00	Mass Cont.	35.60
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.68
Volume cc	86.23	Mass Cont.+dry soil	73.30
Mass (gm)	161.84	Mass dry soil	37.70
Wet Density g/cc	1.88	Mass moisture	12.38
Moisture Content %	32.84	Moisture Content %	32.84
Dry Density g/cc	1.41		
e=1.12 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	6.46	0.1	0.00132	0.1316	1136.07	19.77	17.40
20	13.95	0.2	0.00263	0.2632	1137.57	42.69	37.52
30	17.81	0.3	0.00395	0.3947	1139.07	54.50	47.84
40	20.92	0.4	0.00526	0.5263	1140.57	64.02	56.13
50	23.47	0.5	0.00658	0.6579	1142.09	71.82	62.88
60	27.89	0.6	0.00789	0.7895	1143.60	85.34	74.63
70	30.32	0.7	0.00921	0.9211	1145.12	92.78	81.02
80	34.98	0.8	0.01053	1.0526	1146.64	107.04	93.35
90	37.63	0.9	0.01184	1.1842	1148.17	115.15	100.29
100	40.98	1	0.01316	1.3158	1149.70	125.40	109.07
110	44.07	1.1	0.01447	1.4474	1151.23	134.85	117.14
120	46.1	1.2	0.01579	1.5789	1152.77	141.07	122.37
130	48.2	1.3	0.01711	1.7105	1154.32	147.49	127.77
140	50.41	1.4	0.01842	1.8421	1155.86	154.25	133.45
150	51.52	1.5	0.01974	1.9737	1157.42	157.65	136.21
160	52.64	1.6	0.02105	2.1053	1158.97	161.08	138.98
170	53.76	1.7	0.02237	2.2368	1160.53	164.51	141.75
180	54.88	1.8	0.02368	2.3684	1162.09	167.93	144.51
190	58.26	1.9	0.025	2.5	1163.66	178.28	153.20
200	59.39	2	0.02632	2.6316	1165.24	181.73	155.96
210	61.67	2.1	0.02763	2.7632	1166.81	188.71	161.73
220	62.46	2.2	0.02895	2.8947	1168.39	191.13	163.58
230	63.95	2.3	0.03026	3.0263	1169.98	195.69	167.26
240	64.91	2.4	0.03158	3.1579	1171.57	198.62	169.54
250	66.25	2.5	0.03289	3.2895	1173.16	202.73	172.80
260	68.55	2.6	0.03421	3.4211	1174.76	209.76	178.56
270	69.71	2.7	0.03553	3.5526	1176.36	213.31	181.33
280	70.86	2.8	0.03684	3.6842	1177.97	216.83	184.07
290	71.89	2.9	0.03816	3.8158	1179.58	219.98	186.49
300	72.56	3	0.03947	3.9474	1181.20	222.03	187.97
310	74.35	3.1	0.04079	4.0789	1182.82	227.51	192.35
320	75.51	3.2	0.04211	4.2105	1184.44	231.06	195.08
330	76.68	3.3	0.04342	4.3421	1186.07	234.64	197.83
340	77.84	3.4	0.04474	4.4737	1187.71	238.19	200.55
350	79.01	3.5	0.04605	4.6053	1189.34	241.77	203.28
360	80.18	3.6	0.04737	4.7368	1190.99	245.35	206.01
370	81.36	3.7	0.04868	4.8684	1192.63	248.96	208.75
380	81.36	3.8	0.05	5	1194.29	248.96	208.46
390	82.53	3.9	0.05132	5.1316	1195.94	252.54	211.17
400	83.7	4	0.05263	5.2632	1197.60	256.12	213.86
410	83.7	4.1	0.05395	5.3947	1199.27	256.12	213.57
420	84.88	4.2	0.05526	5.5263	1200.94	259.73	216.27
430	86.06	4.3	0.05658	5.6579	1202.61	263.34	218.98
440	87.49	4.4	0.05789	5.7895	1204.29	267.72	222.30
450	87.99	4.5	0.05921	5.9211	1205.98	269.25	223.26
460	88.94	4.6	0.06053	6.0526	1207.67	272.16	225.36
470	89.46	4.7	0.06184	6.1842	1209.36	273.75	226.36
480	89.97	4.8	0.06316	6.3158	1211.06	275.31	227.33
490	91.96	4.9	0.06447	6.4474	1212.76	281.40	232.03
500	92.98	5	0.06579	6.5789	1214.47	284.52	234.27

510	93.94	5.1	0.06711	6.7105	1216.18	287.46	236.36
520	95.13	5.2	0.06842	6.8421	1217.90	291.10	239.02
530	95.97	5.3	0.06974	6.9737	1219.62	293.67	240.79
540	96.08	5.4	0.07105	7.1053	1221.35	294.00	240.72
550	96.08	5.5	0.07237	7.2368	1223.08	294.00	240.38
560	96.08	5.6	0.07368	7.3684	1224.82	294.00	240.04
570	96.83	5.7	0.075	7.5	1226.56	296.30	241.57
580	96.83	5.8	0.07632	7.6316	1228.31	296.30	241.23
590	96.83	5.9	0.07763	7.7632	1230.06	296.30	240.88
600	97.17	6	0.07895	7.8947	1231.82	297.34	241.38
610	97.17	6.1	0.08026	8.0263	1233.58	297.34	241.04
620	97.17	6.2	0.08158	8.1579	1235.35	297.34	240.69
630	97.66	6.3	0.08289	8.2895	1237.12	298.84	241.56
640	97.66	6.4	0.08421	8.4211	1238.90	298.84	241.21
650	97.66	6.5	0.08553	8.5526	1240.68	298.84	240.87
660	98.08	6.6	0.08684	8.6842	1242.47	300.12	241.55
670	98.08	6.7	0.08816	8.8158	1244.26	300.12	241.21
680	98.08	6.8	0.08947	8.9474	1246.06	300.12	240.86
690	98.08	6.9	0.09079	9.0789	1247.86	300.12	240.51
700	98.08	7	0.09211	9.2105	1249.67	300.12	240.16
710	98.97	7.1	0.09342	9.3421	1251.49	302.85	241.99
720	98.97	7.2	0.09474	9.4737	1253.31	302.85	241.64
730	98.97	7.3	0.09605	9.6053	1255.13	302.85	241.29
740	98.97	7.4	0.09737	9.7368	1256.96	302.85	240.94
750	98.97	7.5	0.09868	9.8684	1258.79	302.85	240.59
760	98.97	7.6	0.1	10	1260.63	302.85	240.23
770	98.97	7.7	0.10132	10.132	1262.48	302.85	239.88
780	98.97	7.8	0.10263	10.263	1264.33	302.85	239.53
790	98.97	7.9	0.10395	10.395	1266.19	302.85	239.18
800	98.97	8	0.10526	10.526	1268.05	302.85	238.83
810	98.97	8.1	0.10658	10.658	1269.92	302.85	238.48
820	98.97	8.2	0.10789	10.789	1271.79	302.85	238.13
830	98.97	8.3	0.10921	10.921	1273.67	302.85	237.78
840	98.97	8.4	0.11053	11.053	1275.55	302.85	237.42
850	98.97	8.5	0.11184	11.184	1277.44	302.85	237.07
860	98.97	8.6	0.11316	11.316	1279.34	302.85	236.72
870	98.97	8.7	0.11447	11.447	1281.24	302.85	236.37
880	98.97	8.8	0.11579	11.579	1283.15	302.85	236.02
890	98.97	8.9	0.11711	11.711	1285.06	302.85	235.67
900	98.97	9	0.11842	11.842	1286.98	302.85	235.32
910	98.97	9.1	0.11974	11.974	1288.90	302.85	234.97
920	98.97	9.2	0.12105	12.105	1290.83	302.85	234.62
930	98.97	9.3	0.12237	12.237	1292.77	302.85	234.26

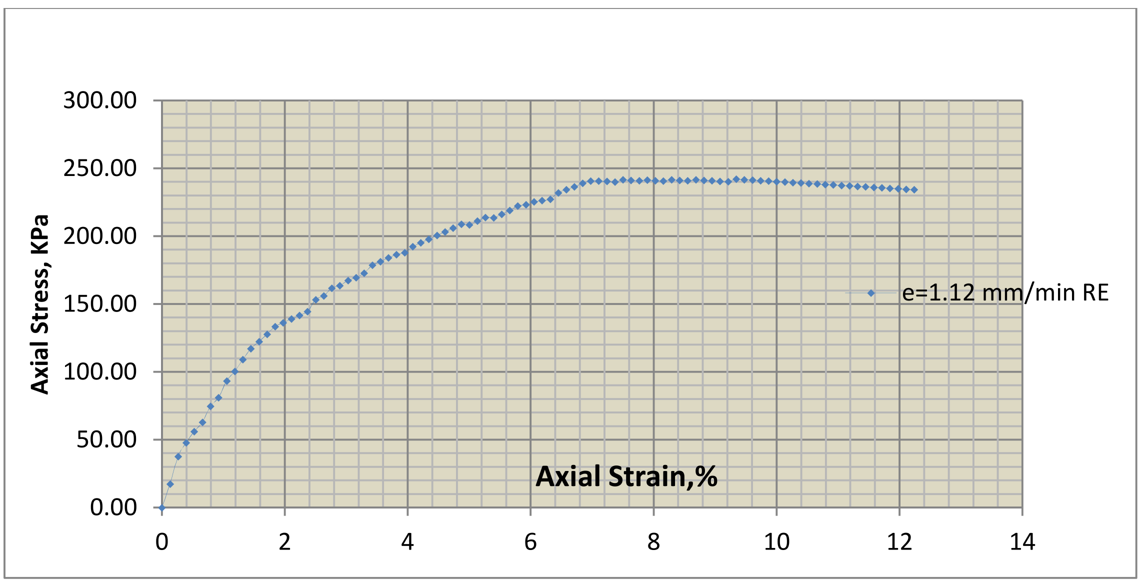


Figure 0-39 qu for ε =1.12 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**241.99 kPa**
	Cohesion© = (qu/2) =	**121.00 kPa**
	Failure strain=	**9.34%**

Table 0-27 UCS test result of ε =1.61 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		**Project No. : 1**	
Location :Kolfe Area		**Pit No. : 1**	
Depth of Sample : 2.5 m		**Test Date :4/26/2017**	
Visual description of soil : Dark red clay		**Sample Type: Remolded**	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	**Can No.**	Y1
Height (mm)	76.0	**Mass Cont.**	35.7
Area (Ao) mm2	1134.6	**Mass Cont.+wet soil**	86.98
Volume cc	86.2	**Mass Cont.+dry soil**	74.3
Mass (gm)	162.2	**Mass dry soil**	38.6
Wet Density g/cc	1.9	**Mass moisture**	12.68
Moisture Content %	32.8	**Moisture Content %**	32.85
Dry Density g/cc	1.4		
e=1.61 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	7.06	0.1	0.001316	0.131579	1136.07	21.60	19.02
20	14.13	0.2	0.002632	0.263158	1137.57	43.24	38.01
30	19.78	0.3	0.003947	0.394737	1139.07	60.53	53.14
40	24.01	0.4	0.005263	0.526316	1140.57	73.47	64.42
50	28.25	0.5	0.006579	0.657895	1142.09	86.45	75.69
60	31.08	0.6	0.007895	0.789474	1143.60	95.10	83.16
70	35.31	0.7	0.009211	0.921053	1145.12	108.05	94.36
80	38.14	0.8	0.010526	1.052632	1146.64	116.71	101.78
90	40.96	0.9	0.011842	1.184211	1148.17	125.34	109.16
100	43.79	1	0.013158	1.315789	1149.70	134.00	116.55
110	45.20	1.1	0.014474	1.447368	1151.23	138.31	120.14
120	45.83	1.2	0.015789	1.578947	1152.77	140.24	121.65
130	47.61	1.3	0.017105	1.710526	1154.32	145.69	126.21
140	49.44	1.4	0.018421	1.842105	1155.86	151.29	130.89
150	52.26	1.5	0.019737	1.973684	1157.42	159.92	138.17
160	55.09	1.6	0.021053	2.105263	1158.97	168.58	145.45
170	56.50	1.7	0.022368	2.236842	1160.53	172.89	148.97
180	59.33	1.8	0.023684	2.368421	1162.09	181.55	156.23
190	60.74	1.9	0.025	2.5	1163.66	185.86	159.72
200	62.15	2	0.026316	2.631579	1165.24	190.18	163.21
210	64.98	2.1	0.027632	2.763158	1166.81	198.84	170.41
220	66.39	2.2	0.028947	2.894737	1168.39	203.15	173.87
230	69.22	2.3	0.030263	3.026316	1169.98	211.81	181.04
240	70.63	2.4	0.031579	3.157895	1171.57	216.13	184.48
250	72.04	2.5	0.032895	3.289474	1173.16	220.44	187.90
260	73.45	2.6	0.034211	3.421053	1174.76	224.76	191.32
270	76.28	2.7	0.035526	3.552632	1176.36	233.42	198.42
280	77.69	2.8	0.036842	3.684211	1177.97	237.73	201.81
290	79.10	2.9	0.038158	3.815789	1179.58	242.05	205.20
300	80.52	3	0.039474	3.947368	1181.20	246.39	208.59
310	81.93	3.1	0.040789	4.078947	1182.82	250.71	211.96
320	84.75	3.2	0.042105	4.210526	1184.44	259.34	218.95
330	86.17	3.3	0.043421	4.342105	1186.07	263.68	222.31
340	87.58	3.4	0.044737	4.473684	1187.71	267.99	225.64
350	88.99	3.5	0.046053	4.605263	1189.34	272.31	228.96
360	91.82	3.6	0.047368	4.736842	1190.99	280.97	235.91
370	93.23	3.7	0.048684	4.868421	1192.63	285.28	239.20
380	94.64	3.8	0.05	5	1194.29	289.60	242.49
390	96.05	3.9	0.051316	5.131579	1195.94	293.91	245.76
400	96.05	4	0.052632	5.263158	1197.60	293.91	245.42

410	97.47	4.1	0.053947	5.394737	1199.27	298.26	248.70
420	98.88	4.2	0.06	5.53	1200.94	302.57	251.95
430	100.89	4.3	0.056579	5.657895	1202.61	308.72	256.71
440	102.71	4.4	0.057895	5.789474	1204.29	314.29	260.98
450	104.12	4.5	0.059211	5.921053	1205.98	318.61	264.19
460	106.53	4.6	0.060526	6.052632	1207.67	325.98	269.93
470	108.94	4.7	0.061842	6.184211	1209.36	333.36	275.65
480	110.85	4.8	0.063158	6.315789	1211.06	339.20	280.09
490	112.88	4.9	0.064474	6.447368	1212.76	345.41	284.81
500	114.18	5	0.065789	6.578947	1214.47	349.39	287.69
510	115.34	5.1	0.067105	6.710526	1216.18	352.94	290.20
520	116.22	5.2	0.068421	6.842105	1217.90	355.63	292.00
530	116.89	5.3	0.069737	6.973684	1219.62	357.68	293.27
540	117.13	5.4	0.071053	7.105263	1221.35	358.42	293.46
550	117.95	5.5	0.072368	7.236842	1223.08	360.93	295.10
560	118.16	5.6	0.073684	7.368421	1224.82	361.57	295.20
570	118.87	5.7	0.075	7.5	1226.56	363.74	296.55
580	119.11	5.8	0.076316	7.631579	1228.31	364.48	296.73
590	119.83	5.9	0.077632	7.763158	1230.06	366.68	298.10
600	120.14	6	0.078947	7.894737	1231.82	367.63	298.44
610	120.86	6.1	0.080263	8.026316	1233.58	369.83	299.80
620	121.31	6.2	0.081579	8.157895	1235.35	371.21	300.49
630	121.31	6.3	0.082895	8.289474	1237.12	371.21	300.06
640	121.31	6.4	0.084211	8.421053	1238.90	371.21	299.63
650	121.31	6.5	0.085526	8.552632	1240.68	371.21	299.20
660	121.31	6.6	0.086842	8.684211	1242.47	371.21	298.77

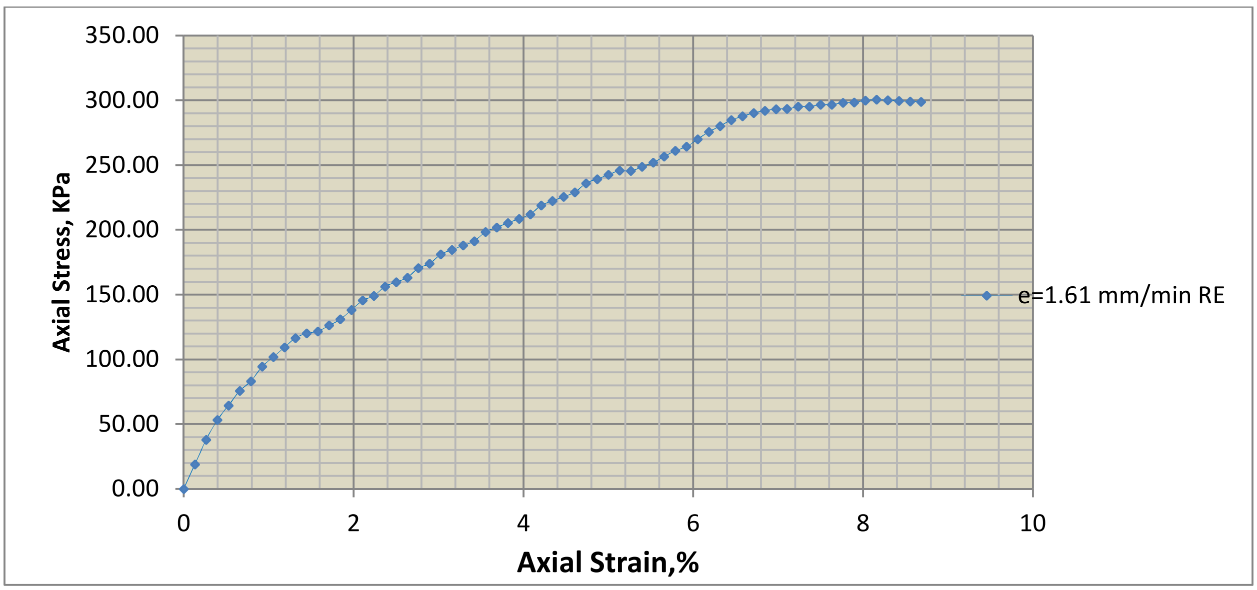


Figure 0-40 qu for ε =1.61 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**300.49 kPa**
	Cohesion© = (qu/2) =	**150.24 kPa**
	Failure strain=	**8.16%**

Table 0-28 UCS test result of ε =1.75 mm/min for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/26/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	G2
Height (mm)	76.00	Mass Cont.	37.3
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	99.74
Volume cc	86.23	Mass Cont.+dry soil	84.3
Mass (gm)	162.15	Mass dry soil	47
Wet Density g/cc	1.88	Mass moisture	15.44
Moisture Content %	32.85	Moisture Content %	32.85
Dry Density g/cc	1.42		
e=1.75 mm/min			

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	8.13	0.1	0.001316	0.115972	1136.07	24.88	21.90
20	15.35	0.2	0.002632	0.263158	1137.57	46.97	41.29
30	21.5	0.3	0.003947	0.394737	1139.07	65.79	57.76
40	26.1	0.4	0.005263	0.526316	1140.57	79.87	70.02
50	30.71	0.5	0.006579	0.657895	1142.09	93.97	82.28
60	33.78	0.6	0.007895	0.789474	1143.60	103.37	90.39
70	38.88	0.7	0.009211	0.921053	1145.12	118.97	103.90
80	41.46	0.8	0.010526	1.052632	1146.64	126.87	110.64
90	44.53	0.9	0.011842	1.184211	1148.17	136.26	118.68
100	47.6	1	0.013158	1.315789	1149.70	145.66	126.69
110	48.79	1.1	0.014474	1.447368	1151.23	149.30	129.68
120	49.93	1.2	0.015789	1.578947	1152.77	152.79	132.54
130	52.2	1.3	0.017105	1.710526	1154.32	159.73	138.38
140	55.27	1.4	0.018421	1.842105	1155.86	169.13	146.32
150	56.81	1.5	0.019737	1.973684	1157.42	173.84	150.20
160	59.88	1.6	0.021053	2.105263	1158.97	183.23	158.10
170	61.42	1.7	0.022368	2.236842	1160.53	187.95	161.95
180	64.49	1.8	0.023684	2.368421	1162.09	197.34	169.81
190	66.02	1.9	0.025	2.5	1163.66	202.02	173.61
200	67.56	2	0.026316	2.631579	1165.24	206.73	177.42
210	70.63	2.1	0.027632	2.763158	1166.81	216.13	185.23
220	72.16	2.2	0.028947	2.894737	1168.39	220.81	188.99
230	75.23	2.3	0.030263	3.026316	1169.98	230.20	196.76
240	76.77	2.4	0.031579	3.157895	1171.57	234.92	200.51
250	78.3	2.5	0.032895	3.289474	1173.16	239.60	204.23
260	79.84	2.6	0.034211	3.421053	1174.76	244.31	207.97
270	82.91	2.7	0.035526	3.552632	1176.36	253.70	215.67
280	84.45	2.8	0.036842	3.684211	1177.97	258.42	219.37
290	85.98	2.9	0.038158	3.815789	1179.58	263.10	223.04
300	87.52	3	0.039474	3.947368	1181.20	267.81	226.73
310	89.05	3.1	0.040789	4.078947	1182.82	272.49	230.38
320	92.12	3.2	0.042105	4.210526	1184.44	281.89	237.99
330	93.66	3.3	0.043421	4.342105	1186.07	286.60	241.64
340	95.19	3.4	0.044737	4.473684	1187.71	291.28	245.25
350	96.73	3.5	0.046053	4.605263	1189.34	295.99	248.87
360	98.27	3.6	0.047368	4.736842	1190.99	300.71	252.48
370	99.8	3.7	0.048684	4.868421	1192.63	305.39	256.06
380	101.87	3.8	0.05	5	1194.29	311.72	261.01
390	103.96	3.9	0.051316	5.131579	1195.94	318.12	266.00
400	104.96	4	0.052632	5.263158	1197.60	321.18	268.18

410	106.94	4.1	0.053947	5.394737	1199.27	327.24	272.86
420	108.79	4.2	0.055263	5.526316	1200.94	332.90	277.20
430	110.81	4.3	0.056579	5.657895	1202.61	339.08	281.95
440	112.76	4.4	0.057895	5.789474	1204.29	345.05	286.51
450	115.89	4.5	0.059211	5.921053	1205.98	354.62	294.05
460	119.95	4.6	0.060526	6.052632	1207.67	367.05	303.93
470	122.94	4.7	0.061842	6.184211	1209.36	376.20	311.07
480	123.84	4.8	0.063158	6.315789	1211.06	378.95	312.91
490	124.18	4.9	0.064474	6.447368	1212.76	379.99	313.33
500	124.18	5	0.065789	6.578947	1214.47	379.99	312.89
510	124.18	5.1	0.067105	6.710526	1216.18	379.99	312.45
520	124.65	5.2	0.068421	6.842105	1217.90	381.43	313.19
530	125.15	5.3	0.069737	6.973684	1219.62	382.96	314.00
540	125.15	5.4	0.071053	7.105263	1221.35	382.96	313.55
550	125.9	5.5	0.072368	7.236842	1223.08	385.25	314.99
560	125.9	5.6	0.073684	7.368421	1224.82	385.25	314.54
570	125.48	5.7	0.075	7.5	1226.56	383.97	313.04
580	125.48	5.8	0.076316	7.631579	1228.31	383.97	312.60
590	125.48	5.9	0.077632	7.763158	1230.06	383.97	312.15

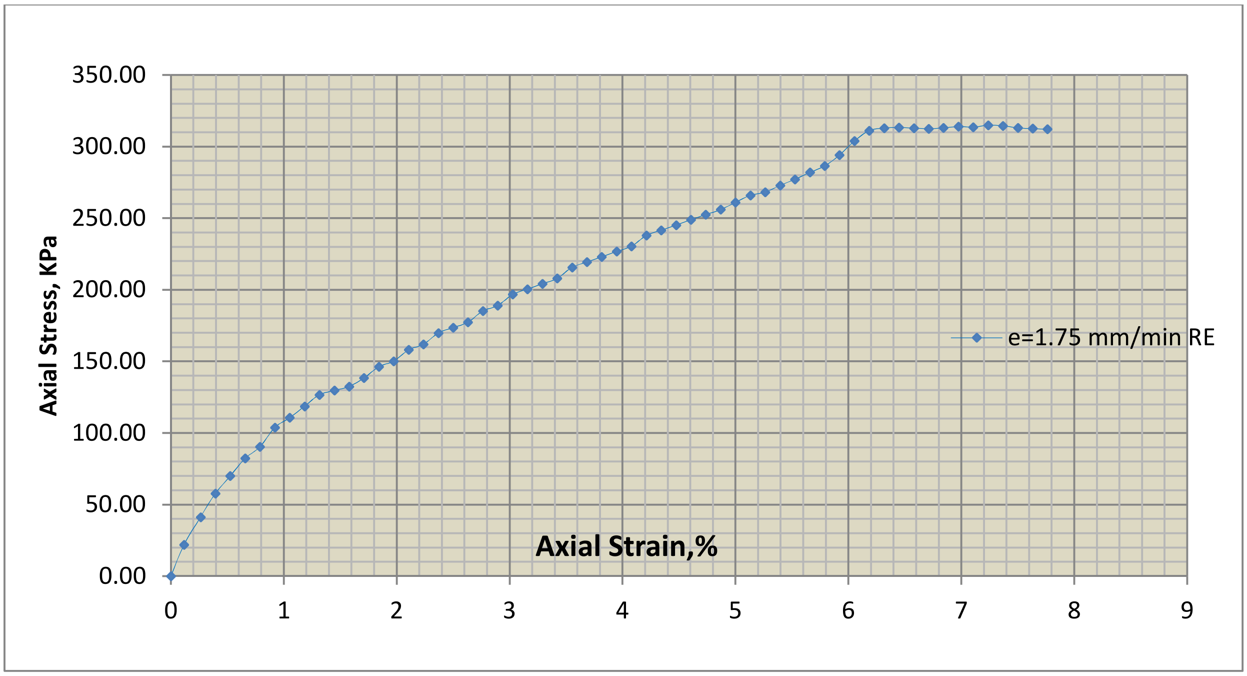


Figure 0-41 qu for ε =1.75 mm/min RE

Remark:	**Unconfined Compressive Strength (qu)=**	**314.99 kPa**
	Cohesion© = (qu/2) =	**157.49 kPa**
	Failure strain=	**7.24%**

Table 0-29 UCS test result for load increment of 800-1600 (ε =0.23 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Determination	
Diameter (mm)	38.0	Can No.	X2
Height (mm)	75.0	Mass Cont.	35.3
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	90.98
Volume cc	85.1	Mass Cont.+dry soil	77.22
Mass (gm)	161.0	Mass dry soil	41.92
Wet Density g/cc	1.9	Mass moisture	13.76
Moisture Content %	32.8	Moisture Content %	32.82
Dry Density g/cc	1.4		
e=0.23 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.003060*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	1.56	0.2	0.0027	0.26667	1137.61	4.77	4.20
40	3.45	0.4	0.0053	0.53333	1140.65	10.56	9.26
60	5.68	0.6	0.008	0.8	1143.72	17.38	15.20
80	7.80	0.8	0.0107	1.06667	1146.80	23.87	20.81
100	9.05	1	0.0133	1.33333	1149.90	27.69	24.08
120	10.05	1.2	0.016	1.6	1153.02	30.75	26.67
140	10.93	1.4	0.0187	1.86667	1156.15	33.45	28.93
160	12.03	1.6	0.0213	2.13333	1159.30	36.81	31.75
180	13.24	1.8	0.024	2.4	1162.47	40.51	34.85
200	13.72	2	0.0267	2.66667	1165.66	41.98	36.02
220	14.81	2.2	0.0293	2.93333	1168.86	45.32	38.77
240	16.11	2.4	0.032	3.2	1172.08	49.30	42.06
260	17.17	2.6	0.0347	3.46667	1175.32	52.54	44.70
280	17.96	2.8	0.0373	3.73333	1178.57	54.96	46.63
300	18.59	3	0.04	4	1181.85	56.89	48.13
320	19.12	3.2	0.0427	4.26667	1185.14	58.51	49.37
340	19.70	3.4	0.0453	4.53333	1188.45	60.28	50.72
360	20.33	3.6	0.048	4.8	1191.78	62.21	52.20
380	20.93	3.8	0.0507	5.06667	1195.12	64.05	53.59
400	21.48	4	0.0533	5.33333	1198.49	65.73	54.84
420	22.21	4.2	0.056	5.6	1201.88	67.96	56.55
440	22.89	4.4	0.0587	5.86667	1205.28	70.04	58.11
460	23.45	4.6	0.0613	6.13333	1208.71	71.76	59.37
480	23.88	4.8	0.064	6.4	1212.15	73.07	60.28
500	24.87	5	0.0667	6.66667	1215.61	76.10	62.60
520	25.32	5.2	0.0693	6.93333	1219.10	77.48	63.55
540	25.92	5.4	0.072	7.2	1222.60	79.32	64.87
560	26.09	5.6	0.0747	7.46667	1226.12	79.84	65.11
580	26.58	5.8	0.0773	7.73333	1229.67	81.33	66.14
600	26.96	6	0.08	8	1233.23	82.50	66.90
620	27.30	6.2	0.0827	8.26667	1236.81	83.54	67.54
640	27.81	6.4	0.0853	8.53333	1240.42	85.10	68.60
660	28.10	6.6	0.088	8.8	1244.05	85.99	69.12
680	28.53	6.8	0.0907	9.06667	1247.70	87.30	69.97
700	29.30	7	0.0933	9.33333	1251.37	89.66	71.65
720	29.70	7.2	0.096	9.6	1255.06	90.88	72.41
740	30.11	7.4	0.0987	9.86667	1258.77	92.14	73.20
760	30.77	7.6	0.1013	10.1333	1262.51	94.16	74.58
780	31.22	7.8	0.104	10.4	1266.26	95.53	75.45
800	31.63	8	0.1067	10.6667	1270.04	96.79	76.21

820	31.90	8.2	0.1093	10.9333	1273.85	97.61	76.63
840	32.51	8.4	0.112	11.2	1277.67	99.48	77.86
860	33.00	8.6	0.1147	11.4667	1281.52	100.98	78.80
880	33.67	8.8	0.1173	11.7333	1285.39	103.03	80.15
900	34.22	9	0.12	12	1289.29	104.71	81.22
920	34.88	9.2	0.1227	12.2667	1293.20	106.73	82.53
940	35.25	9.4	0.1253	12.5333	1297.15	107.87	83.16
960	35.88	9.6	0.128	12.8	1301.11	109.79	84.38
980	36.37	9.8	0.1307	13.0667	1305.11	111.29	85.27
1000	36.86	10	0.1333	13.3333	1309.12	112.79	86.16
1020	37.33	10.2	0.136	13.6	1313.16	114.23	86.99
1040	37.47	10.4	0.1387	13.8667	1317.23	114.66	87.05
1060	37.99	10.6	0.1413	14.1333	1321.32	116.25	87.98
1080	38.38	10.8	0.144	14.4	1325.43	117.44	88.61
1100	38.65	11	0.1467	14.6667	1329.58	118.27	88.95
1120	39.15	11.2	0.1493	14.9333	1333.74	119.80	89.82
1140	39.59	11.4	0.152	15.2	1337.94	121.15	90.55
1160	39.87	11.6	0.1547	15.4667	1342.16	122.00	90.90
1180	40.04	11.8	0.1573	15.7333	1346.41	122.52	91.00
1200	40.50	12	0.16	16	1350.68	123.93	91.75
1220	40.82	12.2	0.1627	16.2667	1354.98	124.91	92.19
1240	41.36	12.4	0.1653	16.5333	1359.31	126.56	93.11
1260	41.58	12.6	0.168	16.8	1363.67	127.23	93.30
1280	41.90	12.8	0.1707	17.0667	1368.05	128.21	93.72
1300	42.01	13	0.1733	17.3333	1372.47	128.55	93.66
1320	42.12	13.2	0.176	17.6	1376.91	128.89	93.61
1340	42.50	13.4	0.1787	17.8667	1381.38	130.05	94.15
1360	42.71	13.6	0.1813	18.1333	1385.88	130.69	94.30
1380	43.01	13.8	0.184	18.4	1390.41	131.61	94.66
1400	43.18	14	0.1867	18.6667	1394.96	132.13	94.72
1420	43.70	14.2	0.1893	18.9333	1399.55	133.72	95.55
1440	44.12	14.4	0.192	19.2	1404.17	135.01	96.15
1460	44.33	14.6	0.1947	19.4667	1408.82	135.65	96.29
1480	44.75	14.8	0.1973	19.7333	1413.50	136.94	96.88
1500	45.29	15	0.2	20	1418.21	138.59	97.72
1520	45.43	15.2	0.2027	20.2667	1422.96	139.02	97.69
1540	45.78	15.4	0.2053	20.5333	1427.73	140.09	98.12
1560	46.10	15.6	0.208	20.8	1432.54	141.07	98.47
1580	46.42	15.8	0.2107	21.0667	1437.38	142.05	98.82
1600	46.66	16	0.2133	21.3333	1442.25	142.78	99.00
1620	46.66	16.2	0.216	21.6	1447.16	142.78	98.66
1640	46.66	16.4	0.2187	21.8667	1452.10	142.78	98.33
1660	46.66	16.6	0.2213	22.1333	1457.07	142.78	97.99
1680	46.66	16.8	0.224	22.4	1462.08	142.78	97.66
1700	46.66	17	0.2267	22.6667	1467.12	142.78	97.32
1720	46.66	17.2	0.2293	22.9333	1472.19	142.78	96.98
1740	46.66	17.4	0.232	23.2	1477.31	142.78	96.65
1760	46.66	17.6	0.2347	23.4667	1482.45	142.78	96.31
1780	46.66	17.8	0.2373	23.7333	1487.64	142.78	95.98
1800	46.66	18	0.24	24	1492.86	142.78	95.64
1820	46.66	18.2	0.2427	24.2667	1498.11	142.78	95.31

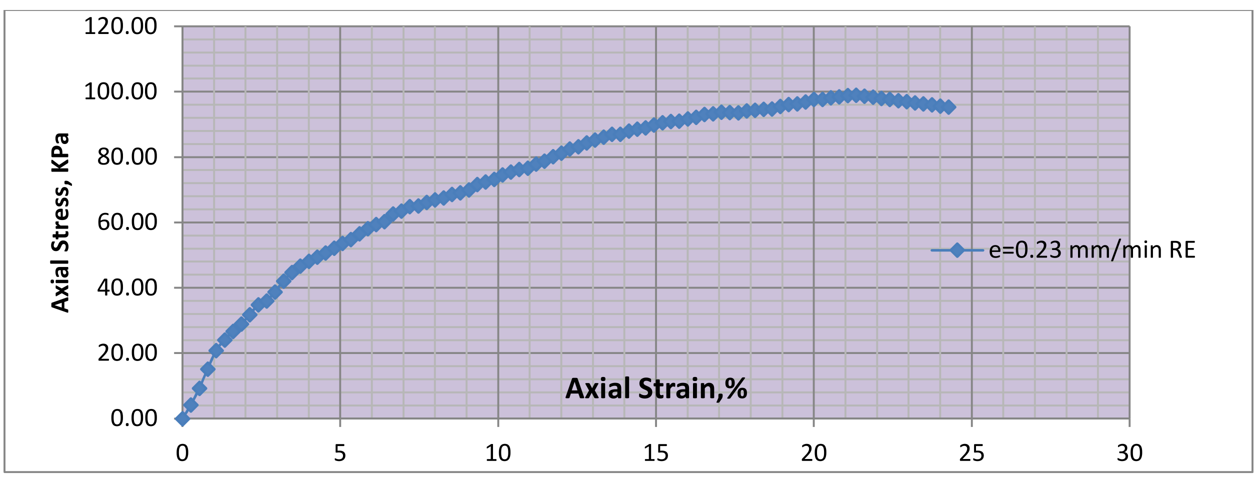


Figure 0-42 qu for load increment of 800-1600 kPa (ε =0.23 mm/min)

Remark:	**Unconfined Compressive Strength (qu)=**	**90.55 kPa**
	Cohesion© = (qu/2) =	**45.27 kPa**
	Failure strain=	**15.00%**

Table 0-30 UCS test result for load increment of 400-800 (ε =0.53 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Deternimation	
Diameter (mm)	38.0	Can No.	G1
Height (mm)	75.0	Mass Cont.	35.5
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	91.12
Volume cc	85.1	Mass Cont.+dry soil	77.38
Mass (gm)	160.8	Mass dry soil	41.88
Wet Density g/cc	1.9	Mass moisture	13.74
Moisture Content %	32.8	Moisture Content %	32.81
Dry Density g/cc	1.4		
e=0.53 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.54	0.2	0.0027	0.2667	1137.61	7.77	6.83
40	5.60	0.4	0.0053	0.5333	1140.65	17.14	15.02
60	9.22	0.6	0.008	0.8000	1143.72	28.21	24.67
80	12.68	0.8	0.0107	1.0667	1146.80	38.80	33.83
100	14.71	1	0.0133	1.3333	1149.90	45.01	39.14
120	16.32	1.2	0.016	1.6000	1153.02	49.94	43.31
140	17.76	1.4	0.0187	1.8667	1156.15	54.35	47.01
160	19.54	1.6	0.0213	2.1333	1159.30	59.79	51.58
180	21.52	1.8	0.024	2.4000	1162.47	65.85	56.65
200	22.50	2	0.0267	2.6667	1165.66	68.85	59.07
220	24.08	2.2	0.0293	2.9333	1168.86	73.68	63.04
240	26.19	2.4	0.032	3.2000	1172.08	80.14	68.38
260	27.90	2.6	0.0347	3.4667	1175.32	85.37	72.64
280	29.20	2.8	0.0373	3.7333	1178.57	89.35	75.81
300	30.23	3	0.04	4.0000	1181.85	92.50	78.27
320	31.07	3.2	0.0427	4.2667	1185.14	95.07	80.22
340	32.03	3.4	0.0453	4.5333	1188.45	98.01	82.47
360	33.04	3.6	0.048	4.8000	1191.78	101.10	84.83
380	34.01	3.8	0.0507	5.0667	1195.12	104.07	87.08
400	34.91	4	0.0533	5.3333	1198.49	106.82	89.13
420	36.09	4.2	0.056	5.6000	1201.88	110.44	91.89
440	37.18	4.4	0.0587	5.8667	1205.28	113.77	94.39
460	38.10	4.6	0.0613	6.1333	1208.71	116.59	96.46
480	39.55	4.8	0.064	6.4000	1212.15	121.02	99.84
500	40.44	5	0.0667	6.6667	1215.61	123.75	101.80
520	41.13	5.2	0.0693	6.9333	1219.10	125.86	103.24
540	42.13	5.4	0.072	7.2000	1222.60	128.92	105.45
560	43.22	5.6	0.0747	7.4667	1226.12	132.25	107.86
580	43.86	5.8	0.0773	7.7333	1229.67	134.21	109.14
600	44.36	6	0.08	8.0000	1233.23	135.74	110.07
620	45.20	6.2	0.0827	8.2667	1236.81	138.31	111.83
640	45.66	6.4	0.0853	8.5333	1240.42	139.72	112.64
660	46.37	6.6	0.088	8.8000	1244.05	141.89	114.06
680	47.63	6.8	0.0907	9.0667	1247.70	145.75	116.81
700	48.28	7	0.0933	9.3333	1251.37	147.74	118.06
720	48.92	7.2	0.096	9.6000	1255.06	149.70	119.27
740	50.00	7.4	0.0987	9.8667	1258.77	153.00	121.55
760	50.74	7.6	0.1013	10.1333	1262.51	155.26	122.98
780	51.39	7.8	0.104	10.4000	1266.26	157.25	124.19
800	51.82	8	0.1067	10.6667	1270.04	158.57	124.85

820	52.85	8.2	0.1093	10.9333	1273.85	161.72	126.95
840	53.63	8.4	0.112	11.2000	1277.67	164.11	128.44
860	54.72	8.6	0.1147	11.4667	1281.52	167.44	130.66
880	55.63	8.8	0.1173	11.7333	1285.39	170.23	132.43
900	56.68	9	0.12	12.0000	1289.29	173.44	134.52
920	57.28	9.2	0.1227	12.2667	1293.20	175.28	135.54
940	58.31	9.4	0.1253	12.5333	1297.15	178.43	137.55
960	59.10	9.6	0.128	12.8000	1301.11	180.85	138.99
980	59.92	9.8	0.1307	13.0667	1305.11	183.36	140.49
1000	60.69	10	0.1333	13.3333	1309.12	185.71	141.86
1020	61.11	10.2	0.136	13.6000	1313.16	187.00	142.40
1040	61.73	10.4	0.1387	13.8667	1317.23	188.89	143.40
1060	62.38	10.6	0.1413	14.1333	1321.32	190.88	144.46
1080	62.82	10.8	0.144	14.4000	1325.43	192.23	145.03
1100	63.64	11	0.1467	14.6667	1329.58	194.74	146.47
1120	64.35	11.2	0.1493	14.9333	1333.74	196.91	147.64
1140	64.59	11.4	0.152	15.2000	1337.94	197.65	147.72
1160	65.06	11.6	0.1547	15.4667	1342.16	199.08	148.33
1180	65.81	11.8	0.1573	15.7333	1346.41	201.38	149.57
1200	66.35	12	0.16	16.0000	1350.68	203.03	150.32
1220	67.20	12.2	0.1627	16.2667	1354.98	205.63	151.76
1240	67.58	12.4	0.1653	16.5333	1359.31	206.79	152.13
1260	68.08	12.6	0.168	16.8000	1363.67	208.32	152.77
1280	68.27	12.8	0.1707	17.0667	1368.05	208.91	152.70
1300	68.41	13	0.1733	17.3333	1372.47	209.33	152.52
1320	69.05	13.2	0.176	17.6000	1376.91	211.29	153.45
1340	69.44	13.4	0.1787	17.8667	1381.38	212.49	153.82
1360	69.79	13.6	0.1813	18.1333	1385.88	213.56	154.10
1380	70.05	13.8	0.184	18.4000	1390.41	214.35	154.17
1400	70.41	14	0.1867	18.6667	1394.96	215.45	154.45
1420	70.16	14.2	0.1893	18.9333	1399.55	214.69	153.40
1440	70.16	14.4	0.192	19.2000	1404.17	214.69	152.89
1460	69.91	14.6	0.1947	19.4667	1408.82	213.92	151.85
1480	69.91	14.8	0.1973	19.7333	1413.50	213.92	151.34
1500	69.72	15	0.2	20.0000	1418.21	213.34	150.43
1520	69.72	15.2	0.2027	20.2667	1422.96	213.34	149.93
1540	69.72	15.4	0.2053	20.5333	1427.73	213.34	149.43
1560	69.72	15.6	0.208	20.8000	1432.54	213.34	148.93
1580	69.72	15.8	0.2107	21.0667	1437.38	213.34	148.43
1600	69.72	16	0.2133	21.3333	1442.25	213.34	147.92

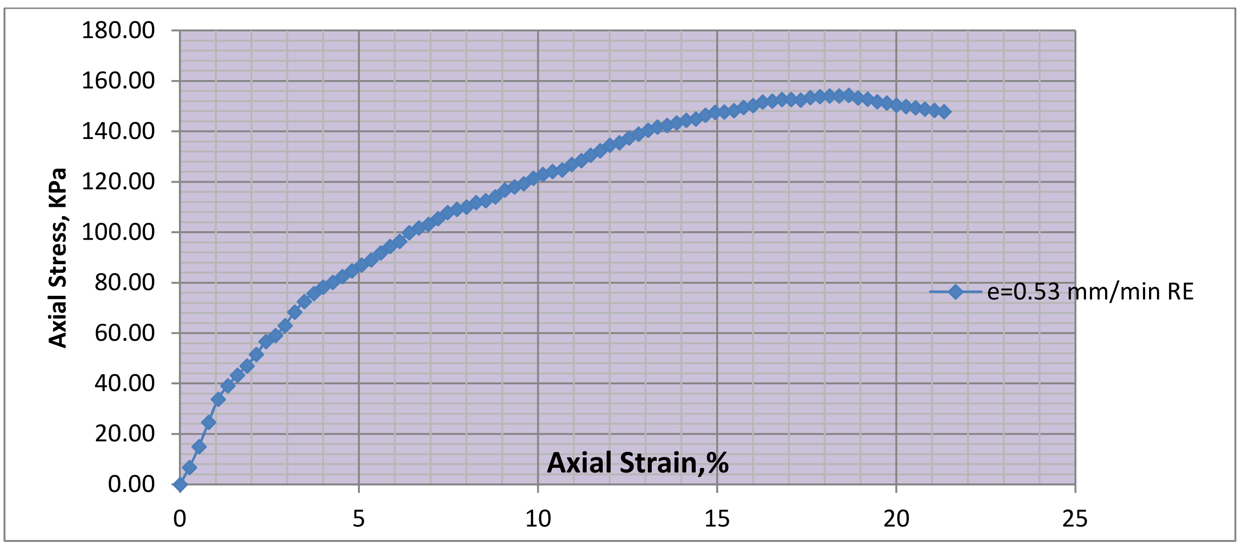


Figure 0-43 qu for load increment of 400-800 kPa (ε =0.53 mm/min)

Remark:	**Unconfined Compressive Strength (qu)=**	**147.72 kPa**
	Cohesion© = (qu/2) =	**73.86 kPa**
	Failure strain=	**15.00%**

Table 0-31 UCS test result for load increment of 200-400 (ε =0.61 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	Can No.	H3
Height (mm)	75.0	Mass Cont.	35.60
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	90.21
Volume cc	85.1	Mass Cont.+dry soil	76.71
Mass (gm)	158.9	Mass dry soil	41.11
Wet Density g/cc	1.9	Mass moisture	13.5
Moisture Content %	32.8	Moisture Content %	32.84
Dry Density g/cc	1.4		
e=0.61 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.001	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.55	0.2	0.0027	0.26667	1137.61	7.80	6.86
40	5.62	0.4	0.0053	0.53333	1140.65	17.20	15.08
60	9.26	0.6	0.008	0.8	1143.72	28.34	24.77
80	12.73	0.8	0.0107	1.06667	1146.80	38.95	33.97
100	15.96	1	0.0133	1.33333	1149.90	48.84	42.47
120	18.04	1.2	0.016	1.6	1153.02	55.20	47.88
140	19.63	1.4	0.0187	1.86667	1156.15	60.07	51.95
160	21.60	1.6	0.0213	2.13333	1159.30	66.10	57.01
180	23.51	1.8	0.024	2.4	1162.47	71.94	61.89
200	24.64	2	0.0267	2.66667	1165.66	75.40	64.68
220	26.87	2.2	0.0293	2.93333	1168.86	82.22	70.34
240	28.95	2.4	0.032	3.2	1172.08	88.59	75.58
260	30.84	2.6	0.0347	3.46667	1175.32	94.37	80.29
280	32.27	2.8	0.0373	3.73333	1178.57	98.75	83.78
300	33.41	3	0.04	4	1181.85	102.23	86.50
320	34.34	3.2	0.0427	4.26667	1185.14	105.08	88.67
340	35.40	3.4	0.0453	4.53333	1188.45	108.32	91.15
360	36.52	3.6	0.048	4.8	1191.78	111.75	93.77
380	37.59	3.8	0.0507	5.06667	1195.12	115.03	96.25
400	38.59	4	0.0533	5.33333	1198.49	118.09	98.53
420	39.90	4.2	0.056	5.6	1201.88	122.09	101.59
440	41.09	4.4	0.0587	5.86667	1205.28	125.74	104.32
460	42.11	4.6	0.0613	6.13333	1208.71	128.86	106.61
480	43.71	4.8	0.064	6.4	1212.15	133.75	110.34
500	44.69	5	0.0667	6.66667	1215.61	136.75	112.50
520	45.47	5.2	0.0693	6.93333	1219.10	139.14	114.13
540	46.59	5.4	0.072	7.2	1222.60	142.57	116.61
560	47.77	5.6	0.0747	7.46667	1226.12	146.18	119.22
580	48.50	5.8	0.0773	7.73333	1229.67	148.41	120.69
600	49.03	6	0.08	8	1233.23	150.03	121.66
620	49.96	6.2	0.0827	8.26667	1236.81	152.88	123.61
640	50.47	6.4	0.0853	8.53333	1240.42	154.44	124.50
660	50.92	6.6	0.088	8.8	1244.05	155.82	125.25
680	51.43	6.8	0.0907	9.06667	1247.70	157.38	126.13
700	52.51	7	0.0933	9.33333	1251.37	160.68	128.40
720	53.54	7.2	0.096	9.6	1255.06	163.83	130.54
740	54.48	7.4	0.0987	9.86667	1258.77	166.71	132.44
760	55.50	7.6	0.1013	10.1333	1262.51	169.83	134.52
780	56.39	7.8	0.104	10.4	1266.26	172.55	136.27
800	57.27	8	0.1067	10.6667	1270.04	175.25	137.98

820	58.41	8.2	0.1093	10.9333	1273.85	178.73	140.31
840	59.40	8.4	0.112	11.2	1277.67	181.76	142.26
860	60.61	8.6	0.1147	11.4667	1281.52	185.47	144.72
880	61.73	8.8	0.1173	11.7333	1285.39	188.89	146.95
900	62.78	9	0.12	12	1289.29	192.11	149.00
920	63.44	9.2	0.1227	12.2667	1293.20	194.13	150.11
940	64.58	9.4	0.1253	12.5333	1297.15	197.61	152.35
960	65.46	9.6	0.128	12.8	1301.11	200.31	153.95
980	66.38	9.8	0.1307	13.0667	1305.11	203.12	155.64
1000	67.22	10	0.1333	13.3333	1309.12	205.69	157.12
1020	67.68	10.2	0.136	13.6	1313.16	207.10	157.71
1040	68.37	10.4	0.1387	13.8667	1317.23	209.21	158.83
1060	69.09	10.6	0.1413	14.1333	1321.32	211.42	160.00
1080	69.68	10.8	0.144	14.4	1325.43	213.22	160.87
1100	70.47	11	0.1467	14.6667	1329.58	215.64	162.19
1120	71.27	11.2	0.1493	14.9333	1333.74	218.09	163.51
1140	71.54	11.4	0.152	15.2	1337.94	218.91	163.62
1160	72.06	11.6	0.1547	15.4667	1342.16	220.50	164.29
1180	72.89	11.8	0.1573	15.7333	1346.41	223.04	165.66
1200	73.49	12	0.16	16	1350.68	224.88	166.49
1220	74.47	12.2	0.1627	16.2667	1354.98	227.88	168.18
1240	74.90	12.4	0.1653	16.5333	1359.31	229.19	168.61
1260	75.04	12.6	0.168	16.8	1363.67	229.62	168.39
1280	75.47	12.8	0.1707	17.0667	1368.05	230.94	168.81
1300	75.81	13	0.1733	17.3333	1372.47	231.98	169.02
1320	76.49	13.2	0.176	17.6	1376.91	234.06	169.99
1340	76.49	13.4	0.1787	17.8667	1381.38	234.06	169.44
1360	76.49	13.6	0.1813	18.1333	1385.88	234.06	168.89
1380	76.49	13.8	0.184	18.4	1390.41	234.06	168.34
1400	76.49	14	0.1867	18.6667	1394.96	234.06	167.79
1420	76.03	14.2	0.1893	18.9333	1399.55	232.65	166.23
1440	76.03	14.4	0.192	19.2	1404.17	232.65	165.69
1460	76.03	14.6	0.1947	19.4667	1408.82	232.65	165.14
1480	75.41	14.8	0.1973	19.7333	1413.50	230.75	163.25
1500	74.68	15	0.2	20	1418.21	228.52	161.13
1520	74.01	15.2	0.2027	20.2667	1422.96	226.47	159.15
1540	74.01	15.4	0.2053	20.5333	1427.73	226.47	158.62
1560	74.01	15.6	0.208	20.8	1432.54	226.47	158.09
1580	74.01	15.8	0.2107	21.0667	1437.38	226.47	157.56
1600	74.01	16	0.2133	21.3333	1442.25	226.47	157.03

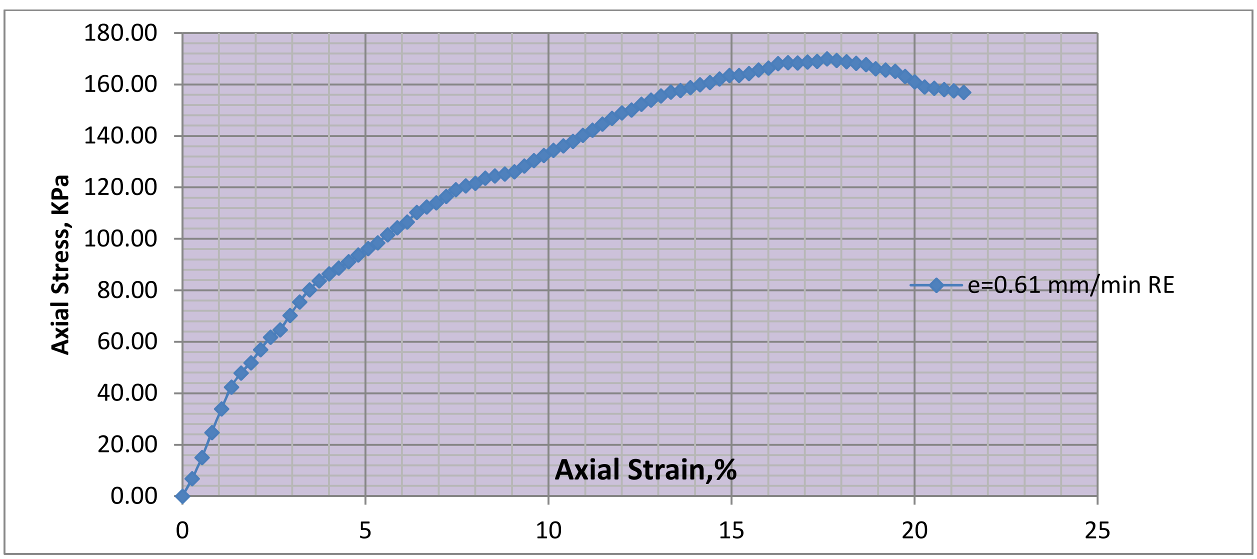


Figure 0-44 qu for load increment of 200-400 kPa (ε =0.61 mm/min)

Remark: Unconfined Compressive Strength (qu)=	**163.62 kPa**
Cohesion© = (qu/2) =	**81.81 kPa**
Failure strain=	**15.00%**

Table 0-32 UCS test result for load increment of 100-200 (ε =0.68 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Deternimation	
Diameter (mm)	38.0	Can No.	H10
Height (mm)	76.0	Mass Cont.	35.5
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	96.57
Volume cc	86.2	Mass Cont.+dry soil	81.48
Mass (gm)	161.7	Mass dry soil	45.98
Wet Density g/cc	1.9	Mass moisture	15.09
Moisture Content %	32.8	Moisture Content %	32.82
Dry Density g/cc	1.4		
e=0.68 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)= (LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0.0000	1134.57	0.00	0.00
20	6.83	0.2	0.0026	0.2632	1137.57	20.90	18.37
40	10.30	0.4	0.0053	0.5263	1140.57	31.52	27.63
60	12.92	0.6	0.0079	0.7895	1143.60	39.54	34.57
80	15.30	0.8	0.0105	1.0526	1146.64	46.82	40.83
100	18.39	1	0.0132	1.3158	1149.70	56.27	48.95
120	20.49	1.2	0.0158	1.5789	1152.77	62.70	54.39
140	22.96	1.4	0.0184	1.8421	1155.86	70.26	60.78
160	24.08	1.6	0.0211	2.1053	1158.97	73.68	63.58
180	24.61	1.8	0.0237	2.3684	1162.09	75.31	64.80
200	25.52	2	0.0263	2.6316	1165.24	78.09	67.02
220	26.43	2.2	0.0289	2.8947	1168.39	80.88	69.22
240	28.56	2.4	0.0316	3.1579	1171.57	87.39	74.60
260	31.06	2.6	0.0342	3.4211	1174.76	95.04	80.90
280	33.08	2.8	0.0368	3.6842	1177.97	101.22	85.93
300	34.62	3	0.0395	3.9474	1181.20	105.94	89.69
320	35.84	3.2	0.0421	4.2105	1184.44	109.67	92.59
340	36.85	3.4	0.0447	4.4737	1187.71	112.76	**94.94**
360	37.98	3.6	0.0474	4.7368	1190.99	116.22	97.58
380	39.18	3.8	0.05	5.0000	1194.29	119.89	100.39
400	40.34	4	0.0526	5.2632	1197.60	123.44	103.07
420	41.40	4.2	0.0553	5.5263	1200.94	126.68	105.49
440	42.80	4.4	0.0579	5.7895	1204.29	130.97	108.75
460	44.09	4.6	0.0605	6.0526	1207.67	134.92	111.72
480	45.18	4.8	0.0632	6.3158	1211.06	138.25	114.16
500	46.90	5	0.0658	6.5789	1214.47	143.51	118.17
520	47.95	5.2	0.0684	6.8421	1217.90	146.73	120.48
540	48.78	5.4	0.0711	7.1053	1221.35	149.27	122.21
560	49.96	5.6	0.0737	7.3684	1224.82	152.88	124.82
580	51.25	5.8	0.0763	7.6316	1228.31	156.83	127.68
600	52.01	6	0.0789	7.8947	1231.82	159.15	129.20
620	52.61	6.2	0.0816	8.1579	1235.35	160.99	130.32
640	53.60	6.4	0.0842	8.4211	1238.90	164.02	132.39
660	54.15	6.6	0.0868	8.6842	1242.47	165.70	133.36
680	54.99	6.8	0.0895	8.9474	1246.06	168.27	135.04
700	56.49	7	0.0921	9.2105	1249.67	172.86	138.32
720	57.25	7.2	0.0947	9.4737	1253.31	175.19	139.78
740	58.02	7.4	0.0974	9.7368	1256.96	177.54	141.25
760	59.30	7.6	0.1	10.0000	1260.63	181.46	143.94
780	60.18	7.8	0.1026	10.2632	1264.33	184.15	145.65
800	61.53	8	0.1053	10.5263	1268.05	188.28	148.48

820	62.76	8.2	0.1079	10.7895	1271.79	192.05	151.00
840	63.98	8.4	0.1105	11.0526	1275.55	195.78	153.49
860	65.42	8.6	0.1132	11.3158	1279.34	200.19	156.48
880	66.42	8.8	0.1158	11.5789	1283.15	203.25	158.40
900	66.42	9	0.1184	11.8421	1286.98	203.25	157.92
920	67.43	9.2	0.1211	12.1053	1290.83	206.34	159.85
940	68.87	9.4	0.1237	12.3684	1294.71	210.74	162.77
960	69.87	9.6	0.1263	12.6316	1298.61	213.80	164.64
980	70.28	9.8	0.1289	12.8947	1302.53	215.06	165.11
1000	71.08	10	0.1316	13.1579	1306.48	217.50	166.48
1020	72.83	10.2	0.1342	13.4211	1310.45	222.86	170.06
1040	73.90	10.4	0.1368	13.6842	1314.44	226.13	172.04
1060	74.58	10.6	0.1395	13.9474	1318.46	228.21	173.09
1080	74.58	10.8	0.1421	14.2105	1322.51	228.21	172.56
1100	74.58	11	0.1447	14.4737	1326.58	228.21	172.03
1120	75.36	11.2	0.1474	14.7368	1330.67	230.60	173.30
1140	75.36	11.4	0.15	15.0000	1334.79	230.60	172.76
1160	76.04	11.6	0.1526	15.2632	1338.94	232.68	173.78
1180	76.04	11.8	0.1553	15.5263	1343.11	232.68	173.24
1200	76.34	12	0.1579	15.7895	1347.30	233.60	173.38
1220	76.34	12.2	0.1605	16.0526	1351.53	233.60	172.84
1240	76.34	12.4	0.1632	16.3158	1355.78	233.60	172.30
1260	76.61	12.6	0.1658	16.5789	1360.05	234.43	172.37
1280	76.61	12.8	0.1684	16.8421	1364.36	234.43	171.82
1300	76.61	13	0.1711	17.1053	1368.69	234.43	171.28
1320	75.23	13.2	0.1737	17.3684	1373.05	230.20	167.66
1340	75.23	13.4	0.1763	17.6316	1377.43	230.20	167.12
1360	75.08	13.6	0.1789	17.8947	1381.85	229.74	166.26
1380	75.08	13.8	0.1816	18.1579	1386.29	229.74	165.73
1400	74.18	14	0.1842	18.4211	1390.76	226.99	163.21
1420	74.18	14.2	0.1868	18.6842	1395.27	226.99	162.69
1440	73.16	14.4	0.1895	18.9474	1399.80	223.87	159.93
1460	72.49	14.6	0.1921	19.2105	1404.36	221.82	157.95

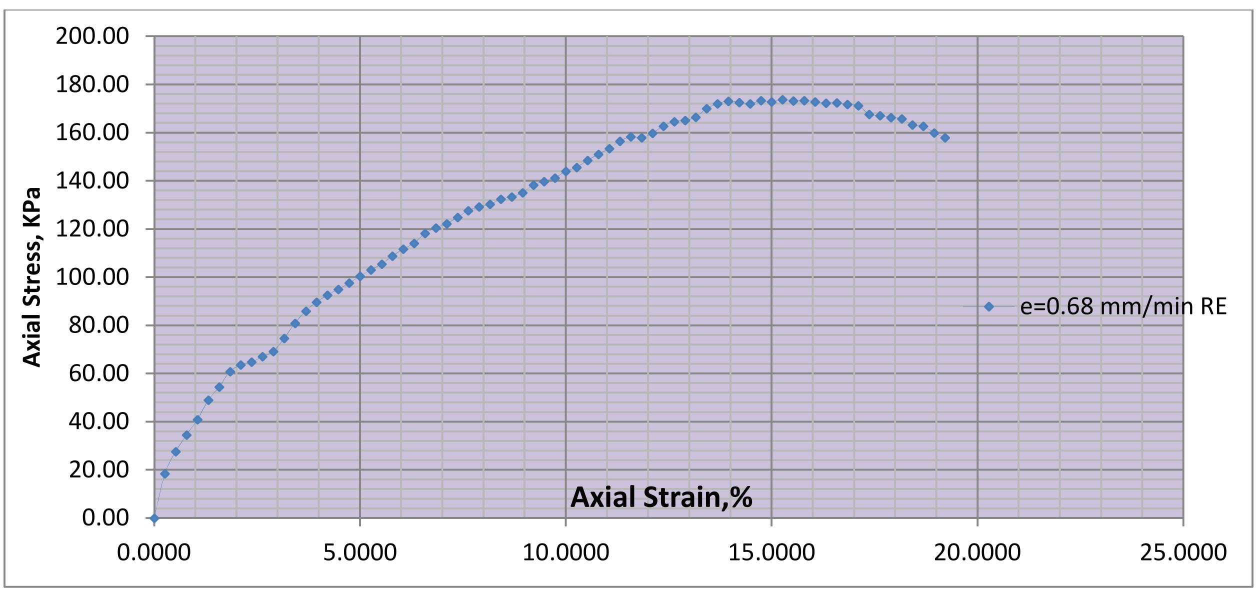


Figure 0-45 qu for load increment of 100-200 kPa (ε =0.68 mm/min)

Remark: Unconfined Compressive Strength (qu)=	**173.30 kPa**
Cohesion© = (qu/2) =	**86.65 kPa**
Failure strain=	**14.74%**

Table 0-33 UCS test result for load increment of 50-100 (ε =1.06 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		Moisture Content Determination	
Diameter (mm)	38.00	Can No.	H6
Height (mm)	76.00	Mass Cont.	35.4
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.23
Volume cc	86.23	Mass Cont.+dry soil	72.92
Mass (gm)	162.46	Mass dry soil	37.52
Wet Density g/cc	1.88	Mass moisture	12.31
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.42		
e=1.06 mm/min			

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	8.93	0.1	0.00132	0.1316	1136.07	27.33	24.05
20	13.80	0.2	0.00263	0.2632	1137.57	42.23	37.12
30	17.66	0.3	0.00395	0.3947	1139.07	54.04	47.44
40	21.66	0.4	0.00526	0.5263	1140.57	66.28	58.11
50	25.62	0.5	0.00658	0.6579	1142.09	78.40	68.64
60	30.29	0.6	0.00789	0.7895	1143.60	92.69	81.05
70	34.15	0.7	0.00921	0.9211	1145.12	104.50	91.26
80	38.17	0.8	0.01053	1.0526	1146.64	116.80	101.86
90	40.78	0.9	0.01184	1.1842	1148.17	124.79	108.68
100	42.89	1	0.01316	1.3158	1149.70	131.24	114.15
110	43.98	1.1	0.01447	1.4474	1151.23	134.58	116.90
120	46.10	1.2	0.01579	1.5789	1152.77	141.07	122.37
130	47.18	1.3	0.01711	1.7105	1154.32	144.37	125.07
140	49.52	1.4	0.01842	1.8421	1155.86	151.53	131.10
150	51.18	1.5	0.01974	1.9737	1157.42	156.61	135.31
160	51.62	1.6	0.02105	2.1053	1158.97	157.96	136.29
170	52.61	1.7	0.02237	2.2368	1160.53	160.99	138.72
180	54.77	1.8	0.02368	2.3684	1162.09	167.60	144.22
190	57.03	1.9	0.025	2.5	1163.66	174.51	149.97
200	58.14	2	0.02632	2.6316	1165.24	177.91	152.68
210	60.36	2.1	0.02763	2.7632	1166.81	184.70	158.30
220	61.30	2.2	0.02895	2.8947	1168.39	187.58	160.54
230	62.61	2.3	0.03026	3.0263	1169.98	191.59	163.75
240	63.74	2.4	0.03158	3.1579	1171.57	195.04	166.48
250	64.85	2.5	0.03289	3.2895	1173.16	198.44	169.15
260	67.09	2.6	0.03421	3.4211	1174.76	205.30	174.76
270	68.23	2.7	0.03553	3.5526	1176.36	208.78	177.48
280	69.36	2.8	0.03684	3.6842	1177.97	212.24	180.18
290	70.49	2.9	0.03816	3.8158	1179.58	215.70	182.86
300	71.34	3	0.03947	3.9474	1181.20	218.30	184.81
310	72.78	3.1	0.04079	4.0789	1182.82	222.71	188.28
320	73.91	3.2	0.04211	4.2105	1184.44	226.16	190.95
330	76.20	3.3	0.04342	4.3421	1186.07	233.17	196.59
340	77.34	3.4	0.04474	4.4737	1187.71	236.66	199.26
350	78.48	3.5	0.04605	4.6053	1189.34	240.15	201.92
360	80.78	3.6	0.04737	4.7368	1190.99	247.19	207.55
370	81.94	3.7	0.04868	4.8684	1192.63	250.74	210.24
380	83.08	3.8	0.05	5	1194.29	254.22	212.87
390	83.08	3.9	0.05132	5.1316	1195.94	254.22	212.57
400	84.20	4	0.05263	5.2632	1197.60	257.65	215.14
410	84.20	4.1	0.05395	5.3947	1199.27	257.65	214.84
420	85.39	4.2	0.05526	5.5263	1200.94	261.29	217.57
430	85.39	4.3	0.05658	5.6579	1202.61	261.29	217.27
440	86.11	4.4	0.05789	5.7895	1204.29	263.50	218.80
450	86.11	4.5	0.05921	5.9211	1205.98	263.50	218.49
460	87.21	4.6	0.06053	6.0526	1207.67	266.86	220.97
470	87.21	4.7	0.06184	6.1842	1209.36	266.86	220.66
480	88.27	4.8	0.06316	6.3158	1211.06	270.11	223.03
490	88.27	4.9	0.06447	6.4474	1212.76	270.11	222.72
500	88.27	5	0.06579	6.5789	1214.47	270.11	222.41
510	89.01	5.1	0.06711	6.7105	1216.18	272.37	223.96
520	89.01	5.2	0.06842	6.8421	1217.90	272.37	223.64
530	89.01	5.3	0.06974	6.9737	1219.62	272.37	223.32
540	90.34	5.4	0.07105	7.1053	1221.35	276.44	226.34
550	90.34	5.5	0.07237	7.2368	1223.08	276.44	226.02
560	90.34	5.600	0.07368	7.3684	1224.82	276.44	225.70
570	91.81	5.700	0.075	7.5	1226.56	280.94	229.05
580	91.81	5.8	0.07632	7.6316	1228.31	280.94	228.72
590	91.81	5.9	0.07763	7.7632	1230.06	280.94	228.39
600	92.20	6	0.07895	7.8947	1231.82	282.13	229.04

610	92.20	6.1	0.08026	8.0263	1233.58	282.13	228.71
620	92.20	6.2	0.08158	8.1579	1235.35	282.13	228.38
630	93.58	6.3	0.08289	8.2895	1237.12	286.35	231.47
640	93.58	6.4	0.08421	8.4211	1238.90	286.35	231.14
650	93.58	6.5	0.08553	8.5526	1240.68	286.35	230.80
660	93.99	6.6	0.08684	8.6842	1242.47	287.61	231.48
670	93.99	6.7	0.08816	8.8158	1244.26	287.61	231.15
680	93.99	6.8	0.08947	8.9474	1246.06	287.61	230.81
690	93.99	6.9	0.09079	9.0789	1247.86	287.61	230.48
700	93.99	7	0.09211	9.2105	1249.67	287.61	230.15
710	94.70	7.1	0.09342	9.3421	1251.49	289.78	231.55
720	94.70	7.2	0.09474	9.4737	1253.31	289.78	231.21
730	94.70	7.3	0.09605	9.6053	1255.13	289.78	230.88
740	94.70	7.4	0.09737	9.7368	1256.96	289.78	230.54
750	94.70	7.5	0.09868	9.8684	1258.79	289.78	230.21
760	95.88	7.6	0.1	10	1260.63	293.39	232.73
770	95.88	7.7	0.10132	10.132	1262.48	293.39	232.39
780	95.88	7.8	0.10263	10.263	1264.33	293.39	232.05
790	96.29	7.9	0.10395	10.395	1266.19	294.65	232.70
800	96.29	8	0.10526	10.526	1268.05	294.65	232.36
810	96.29	8.1	0.10658	10.658	1269.92	294.65	232.02
820	96.29	8.2	0.10789	10.789	1271.79	294.65	231.68
830	96.29	8.3	0.10921	10.921	1273.67	294.65	231.34
840	96.57	8.4	0.11053	11.053	1275.55	295.50	231.67
850	96.57	8.5	0.11184	11.184	1277.44	295.50	231.32
860	96.57	8.6	0.11316	11.316	1279.34	295.50	230.98
870	97.14	8.7	0.11447	11.447	1281.24	297.25	232.00
880	97.14	8.8	0.11579	11.579	1283.15	297.25	231.66
890	97.14	8.9	0.11711	11.711	1285.06	297.25	231.31
900	97.14	9	0.11842	11.842	1286.98	297.25	230.97
910	97.14	9.1	0.11974	11.974	1288.90	297.25	230.62
920	97.14	9.2	0.12105	12.105	1290.83	297.25	230.28
930	97.14	9.3	0.12237	12.237	1292.77	297.25	229.93
940	97.14	9.4	0.12368	12.368	1294.71	297.25	229.59
950	97.14	9.5	0.125	12.5	1296.65	297.25	229.24
960	97.14	9.6	0.12632	12.632	1298.61	297.25	228.90
970	97.14	9.7	0.12763	12.763	1300.56	297.25	228.55
980	97.14	9.8	0.12895	12.895	1302.53	297.25	228.21
990	97.14	9.9	0.13026	13.026	1304.50	297.25	227.86
1000	97.14	10	0.13158	13.158	1306.48	297.25	227.52

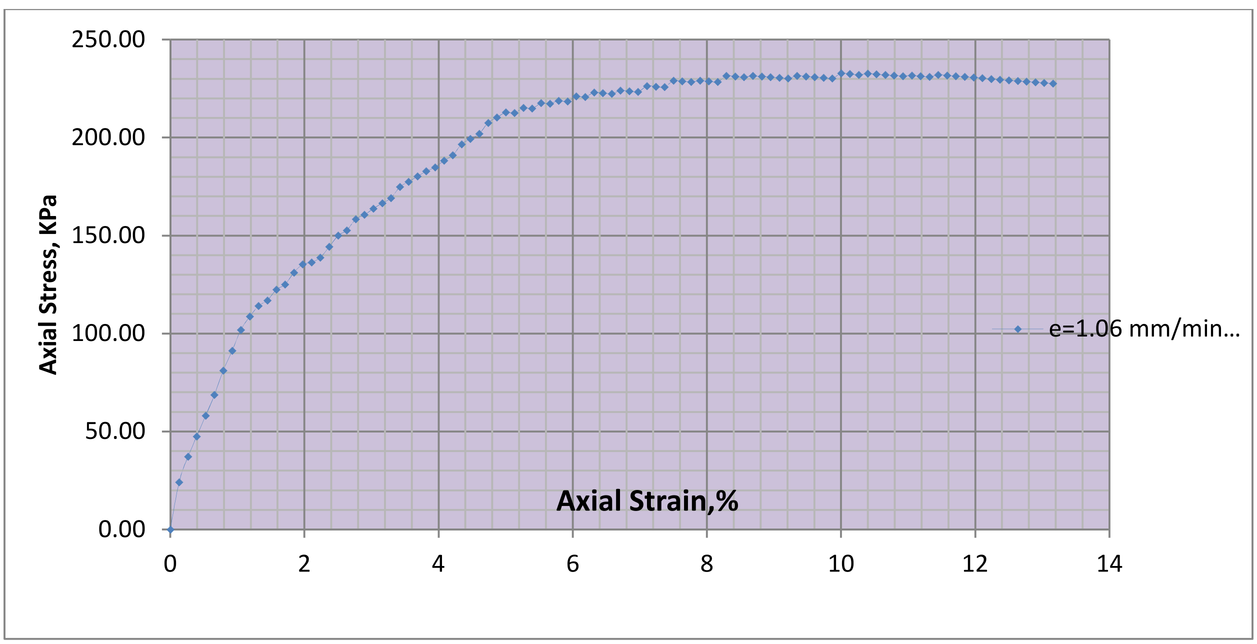


Figure 0-46 qu for load increment of 50-100 kPa (ε =1.06 mm/min)

Remark:	**Unconfined Compressive Strength (qu)=**	**232.73 kPa**
	Cohesion© = (qu/2) =	**116.37 kPa**
	Failure strain=	**10.00%**

Table 0-34 UCS test result for load increment of 7-50 (ε =1.14 mm/min) for remolded sample

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	P22
Height (mm)	76.00	Mass Cont.	35.4
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	86.12
Volume cc	86.23	Mass Cont.+dry soil	73.59
Mass (gm)	162.54	Mass dry soil	38.19
Wet Density g/cc	1.89	Mass moisture	12.53
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.42		
e=1.14 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	9.15	0.1	0.0013	0.1316	1136.07	28.00	24.65
20	14.1	0.2	0.0026	0.2632	1137.57	43.15	37.93
30	18.06	0.3	0.0039	0.3947	1139.07	55.26	48.52
40	22.14	0.4	0.0053	0.5263	1140.57	67.75	59.40
50	26.18	0.5	0.0066	0.6579	1142.09	80.11	70.14
60	30.94	0.6	0.0079	0.7895	1143.60	94.68	82.79
70	34.89	0.7	0.0092	0.9211	1145.12	106.76	93.23
80	38.99	0.8	0.0105	1.0526	1146.64	119.31	104.05
90	41.67	0.9	0.0118	1.1842	1148.17	127.51	111.06
100	43.83	1	0.0132	1.3158	1149.70	134.12	116.66
110	44.92	1.1	0.0145	1.4474	1151.23	137.46	119.40
120	47.12	1.2	0.0158	1.5789	1152.77	144.19	125.08
130	48.21	1.3	0.0171	1.7105	1154.32	147.52	127.80
140	50.43	1.4	0.0184	1.8421	1155.86	154.32	133.51
150	51.53	1.5	0.0197	1.9737	1157.42	157.68	136.24
160	52.65	1.6	0.0211	2.1053	1158.97	161.11	139.01
170	53.78	1.7	0.0224	2.2368	1160.53	164.57	141.80
180	54.9	1.8	0.0237	2.3684	1162.09	167.99	144.56
190	57.68	1.9	0.025	2.5	1163.66	176.50	151.68
200	58.74	2	0.0263	2.6316	1165.24	179.74	154.26
210	59.77	2.1	0.0276	2.7632	1166.81	182.90	156.75
220	61.69	2.2	0.0289	2.8947	1168.39	188.77	161.56
230	63.97	2.3	0.0303	3.0263	1169.98	195.75	167.31
240	65.13	2.4	0.0316	3.1579	1171.57	199.30	170.11
250	66.28	2.5	0.0329	3.2895	1173.16	202.82	172.88
260	68.58	2.6	0.0342	3.4211	1174.76	209.85	178.64
270	69.73	2.7	0.0355	3.5526	1176.36	213.37	181.38
280	70.88	2.8	0.0368	3.6842	1177.97	216.89	184.12
290	71.04	2.9	0.0382	3.8158	1179.58	217.38	184.29
300	72.94	3	0.0395	3.9474	1181.20	223.20	188.96
310	74.35	3.1	0.0408	4.0789	1182.82	227.51	192.35
320	75.51	3.2	0.0421	4.2105	1184.44	231.06	195.08
330	76.68	3.3	0.0434	4.3421	1186.07	234.64	197.83
340	77.84	3.4	0.0447	4.4737	1187.71	238.19	200.55
350	79.01	3.5	0.0461	4.6053	1189.34	241.77	203.28
360	80.18	3.6	0.0474	4.7368	1190.99	245.35	206.01
370	81.36	3.7	0.0487	4.8684	1192.63	248.96	208.75
380	81.36	3.8	0.05	5	1194.29	248.96	208.46
390	82.53	3.9	0.0513	5.1316	1195.94	252.54	211.17
400	83.7	4	0.0526	5.2632	1197.60	256.12	213.86
410	83.7	4.1	0.0539	5.3947	1199.27	256.12	213.57
420	84.88	4.2	0.0553	5.5263	1200.94	259.73	216.27
430	85.06	4.3	0.0566	5.6579	1202.61	260.28	216.43
440	86.76	4.4	0.0579	5.7895	1204.29	265.49	220.45
450	87.99	4.5	0.0592	5.9211	1205.98	269.25	223.26
460	88.94	4.6	0.0605	6.0526	1207.67	272.16	225.36
470	89.97	4.7	0.0618	6.1842	1209.36	275.31	227.65
480	90.8	4.8	0.0632	6.3158	1211.06	277.85	229.43
490	91.96	4.9	0.0645	6.4474	1212.76	281.40	232.03
500	92.98	5	0.0658	6.5789	1214.47	284.52	234.27

510	93.94	5.1	0.0671	6.7105	1216.18	287.46	236.36
520	94.93	5.2	0.0684	6.8421	1217.90	290.49	238.51
530	95.97	5.3	0.0697	6.9737	1219.62	293.67	240.79
540	96.08	5.4	0.0711	7.1053	1221.35	294.00	240.72
550	96.08	5.5	0.0724	7.2368	1223.08	294.00	240.38
560	96.99	5.6	0.0737	7.3684	1224.82	296.79	242.31
570	96.99	5.7	0.075	7.5	1226.56	296.79	241.97
580	96.99	5.8	0.0763	7.6316	1228.31	296.79	241.62
590	96.99	5.9	0.0776	7.7632	1230.06	296.79	241.28
600	97.97	6	0.0789	7.8947	1231.82	299.79	243.37
610	97.97	6.1	0.0803	8.0263	1233.58	299.79	243.02
620	97.97	6.2	0.0816	8.1579	1235.35	299.79	242.67
630	97.97	6.3	0.0829	8.2895	1237.12	299.79	242.33
640	98.98	6.4	0.0842	8.4211	1238.90	302.88	244.47
650	98.98	6.5	0.0855	8.5526	1240.68	302.88	244.12
660	98.98	6.6	0.0868	8.6842	1242.47	302.88	243.77
670	100.46	6.7	0.0882	8.8158	1244.26	307.41	247.06
680	100.46	6.8	0.0895	8.9474	1246.06	307.41	246.70
690	100.46	6.9	0.0908	9.0789	1247.86	307.41	246.35
700	101.21	7	0.0921	9.2105	1249.67	309.70	247.83
710	101.21	7.1	0.0934	9.3421	1251.49	309.70	247.47
720	100.92	7.2	0.0947	9.4737	1253.31	308.82	246.40
730	100.92	7.3	0.0961	9.6053	1255.13	308.82	246.04
740	100.46	7.4	0.0974	9.7368	1256.96	307.41	244.56
750	100.46	7.5	0.0987	9.8684	1258.79	307.41	244.21
760	98.99	7.6	0.1	10	1260.63	302.91	240.28
770	98.99	7.7	0.1013	10.132	1262.48	302.91	239.93
780	98.47	7.8	0.1026	10.263	1264.33	301.32	238.32
790	98.47	7.9	0.1039	10.395	1266.19	301.32	237.97
800	98	8	0.1053	10.526	1268.05	299.88	236.49
810	98	8.1	0.1066	10.658	1269.92	299.88	236.14
820	98	8.2	0.1079	10.789	1271.79	299.88	235.79
830	98	8.3	0.1092	10.921	1273.67	299.88	235.45
840	98	8.4	0.1105	11.053	1275.55	299.88	235.10
850	98	8.5	0.1118	11.184	1277.44	299.88	234.75
860	98	8.6	0.1132	11.316	1279.34	299.88	234.40
870	98	8.7	0.1145	11.447	1281.24	299.88	234.05
880	98	8.8	0.1158	11.579	1283.15	299.88	233.71
890	98	8.9	0.1171	11.711	1285.06	299.88	233.36
900	98	9	0.1184	11.842	1286.98	299.88	233.01
910	98	9.1	0.1197	11.974	1288.90	299.88	232.66

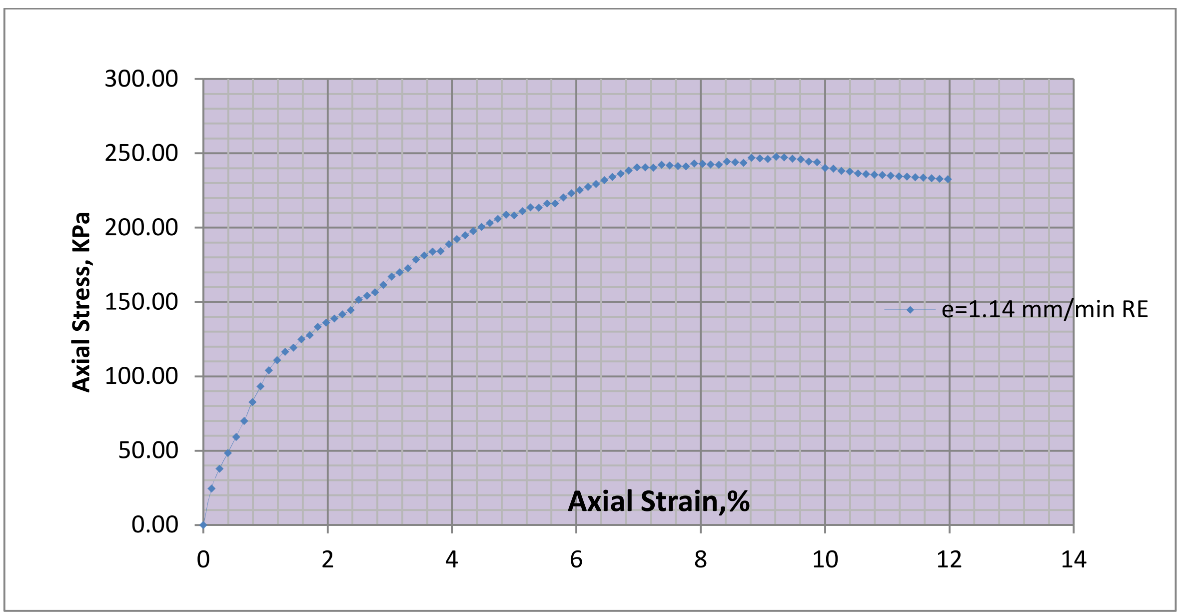


Figure 0-47 qu for load increment of 7-50 kPa (ε =1.14 mm/min)

Remark:	Unconfined Compressive Strength (qu)=	247.83 kPa
	Cohesion© = (qu/2) =	123.91 kPa
	Failure strain=	9.21%

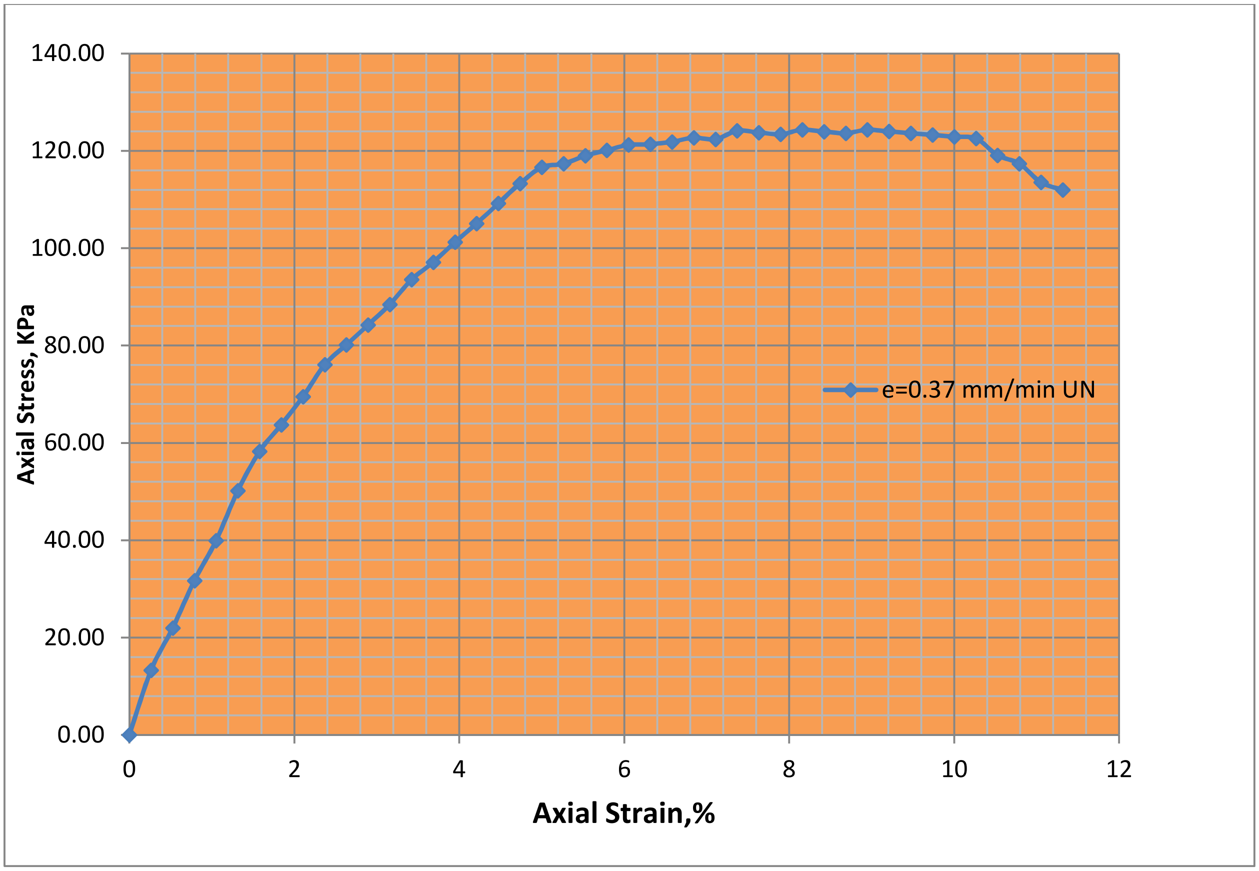
Appendix D: Detail UCS Tests results for additional trial

For Undisturbed Samples of ε =0.37mm/min -1.75 mm/min

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	E5
Height (mm)	76.0	Mass Cont.	35.35
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	81.21
Volume cc	86.2	Mass Cont.+dry soil	69.64
Mass (gm)	167.12	Mass dry soil	34.29
Wet Density g/cc	1.94	Mass moisture	11.57
Moisture Content %	33.7	Moisture Content %	33.74
Dry Density g/cc	1.45		

e=0.37 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (Kpa)=F/Ac
0	0.00	0	0	4	1134.57	0.00	0.00
20	4.94	0.2	0.002632	0.26315789	1137.57	15.12	13.29
40	8.20	0.4	0.005263	0.52631579	1140.57	25.09	22.00
60	11.85	0.6	0.007895	0.78947368	1143.60	36.26	31.71
80	14.97	0.8	0.010526	1.05263158	1146.64	45.81	39.95
100	18.84	1	0.013158	1.31578947	1149.70	57.65	50.14
120	21.95	1.2	0.015789	1.57894737	1152.77	67.17	58.27
140	24.07	1.4	0.018421	1.84210526	1155.86	73.65	63.72
160	26.32	1.6	0.021053	2.10526316	1158.97	80.54	69.49
180	28.89	1.8	0.023684	2.36842105	1162.09	88.40	76.07
200	30.52	2	0.026316	2.63157895	1165.24	93.39	80.15
220	32.16	2.2	0.028947	2.89473684	1168.39	98.41	84.23
240	33.87	2.4	0.031579	3.15789474	1171.57	103.64	88.46
260	35.91	2.6	0.034211	3.42105263	1174.76	109.88	93.54
280	37.39	2.8	0.036842	3.68421053	1177.97	114.41	97.13
300	39.08	3	0.039474	3.94736842	1181.20	119.58	101.24
320	40.68	3.2	0.042105	4.21052632	1184.44	124.48	105.10
340	42.38	3.4	0.044737	4.47368421	1187.71	129.68	109.19
360	44.10	3.6	0.047368	4.73684211	1190.99	134.95	113.31
380	45.51	3.8	0.05	5	1194.29	139.26	116.61
400	45.92	4	0.052632	5.26315789	1197.60	140.52	117.33
420	46.70	4.2	0.055263	5.52631579	1200.94	142.90	118.99
440	47.28	4.4	0.057895	5.78947368	1204.29	144.68	120.13
460	47.84	4.6	0.060526	6.05263158	1207.667067	146.39	121.22
480	48.03	4.8	0.063158	6.31578947	1211.05939	146.97	121.36
500	48.36	5	0.065789	6.57894737	1214.470825	147.98	121.85
520	48.84	5.2	0.068421	6.84210526	1217.901533	149.45	122.71
540	48.84	5.4	0.071053	7.10526316	1221.351679	149.45	122.36
560	49.68	5.6	0.073684	7.36842105	1224.821429	152.02	124.12
580	49.68	5.8	0.076316	7.63157895	1228.310948	152.02	123.76
600	49.68	6	0.078947	7.89473684	1231.820408	152.02	123.41
620	50.19	6.2	0.081579	8.15789474	1235.34998	153.58	124.32
640	50.19	6.4	0.084211	8.42105263	1238.899836	153.58	123.97
660	50.19	6.6	0.086842	8.68421053	1242.47	153.58	123.61
680	50.63	6.8	0.089474	8.94736842	1246.06	154.93	124.33
700	50.63	7	0.092105	9.21052632	1249.67	154.93	123.97
720	50.63	7.2	0.094737	9.47368421	1253.305648	154.93	123.62
740	50.63	7.4	0.097368	9.73684211	1256.9596	154.93	123.26
760	50.63	7.6	0.1	10	1260.634921	154.93	122.90
780	50.63	7.8	0.102632	10.2631579	1264.331797	154.93	122.54
800	49.35	8	0.105263	10.5263158	1268.05042	151.01	119.09
820	48.78	8.2	0.107895	10.7894737	1271.790982	149.27	117.37
840	47.32	8.4	0.110526	11.0526316	1275.553677	144.80	113.52
860	46.81	8.6	0.113158	11.3157895	1279.338703	143.24	111.96

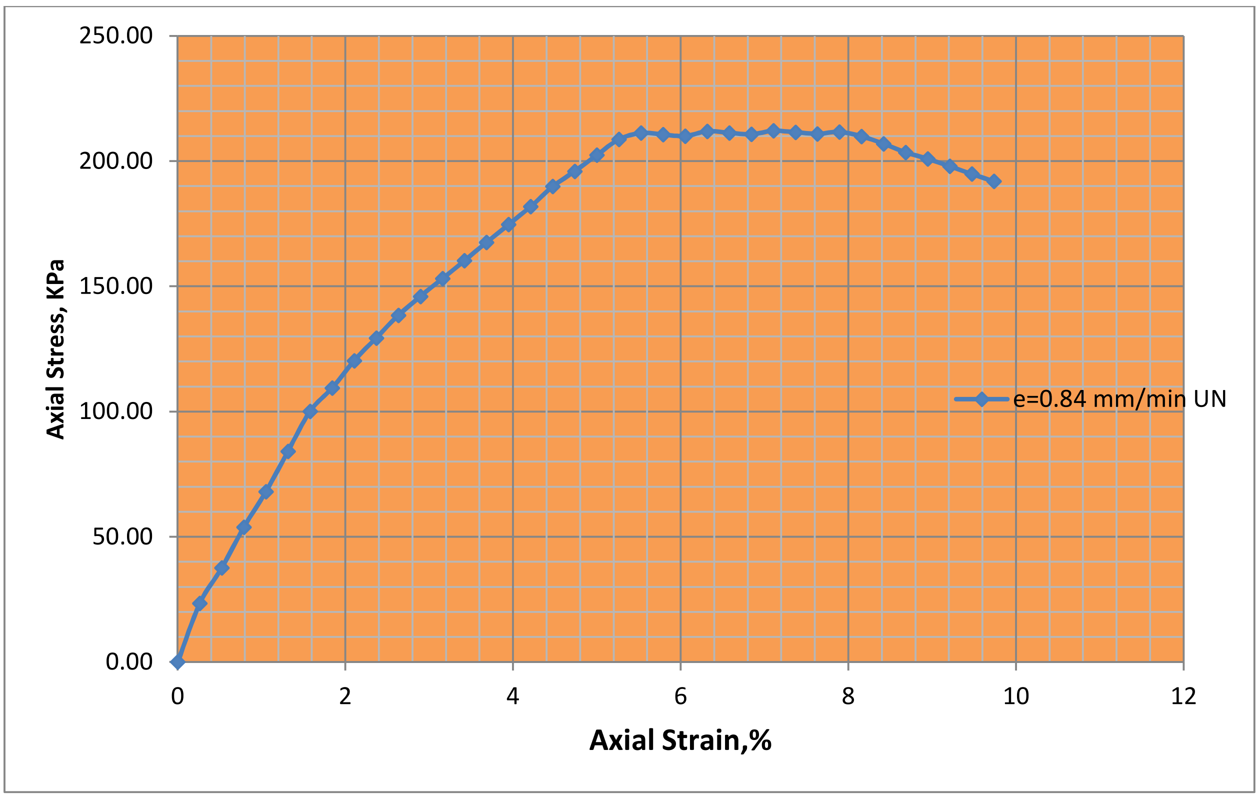


Remark:	Unconfined Compressive Strength (qu)=	124.33	KPa
	Cohesion© = (qu/2) =	62.17	KPa
	Failure strain=	8.95%	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Location : Kolfe Area		**Pit No. : 1**	
Depth of Sample : 2.5 m		**Test Date :4/27/2017**	
Visual description of soil : Dark red clay		**Sample Type: Undisturbed**	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	**Can No.**	G10
Height (mm)	76.00	**Mass Cont.**	35.5
Area (Ao) mm2	1134.57	**Mass Cont.+wet soil**	70
Volume cc	86.23	**Mass Cont.+dry soil**	61.3
Mass (gm)	166.81	**Mass dry soil**	25.8
Wet Density g/cc	1.93	**Mass moisture**	8.7
Moisture Content %	33.72	**Moisture Content %**	33.72
Dry Density g/cc	1.45		
e=0.84 mm/min			

Deform. Dial Rdg (DDR)	**Load Dial Rdg (LDR)**	**Deform. ΔL (mm)=DDR*0.01**	**Strain (ΔL /Lo)**	**Strain (% ε)**	**Corrected Area (Ac=Ao/(1-ε))**	**Load (N)=(LDR *0.00306 *1000**	**Stress (kPa)=F/Ac**
0	0.00	0	0	0	1134.57	**0.00**	0.00
20	8.69	0.2	0.002632	0.263158	1137.57	**26.59**	23.38
40	14.04	0.4	0.005263	0.526316	1140.57	**42.96**	37.67
60	20.13	0.6	0.007895	0.789474	1143.60	**61.60**	53.86
80	25.51	0.8	0.010526	1.052632	1146.64	**78.06**	68.08
100	31.62	1	0.013158	1.315789	1149.70	**96.76**	84.16
120	37.73	1.2	0.015789	1.578947	1152.77	**115.45**	100.15
140	41.33	1.4	0.018421	1.842105	1155.86	**126.47**	109.42
160	45.58	1.6	0.021053	2.105263	1158.97	**139.47**	120.34
180	49.15	1.8	0.023684	2.368421	1162.09	**150.40**	129.42
200	52.70	2	0.026316	2.631579	1165.24	**161.26**	138.39
220	55.74	2.2	0.028947	2.894737	1168.39	**170.56**	145.98
240	58.62	2.4	0.031579	3.157895	1171.57	**179.38**	153.11
260	61.51	2.6	0.034211	3.421053	1174.76	**188.22**	160.22
280	64.50	2.8	0.036842	3.684211	1177.97	**197.37**	167.55
300	67.43	3	0.039474	3.947368	1181.20	**206.34**	174.68
320	70.38	3.2	0.042105	4.210526	1184.44	**215.36**	181.83
340	73.70	3.4	0.044737	4.473684	1187.71	**225.52**	189.88
360	76.28	3.6	0.047368	4.736842	1190.99	**233.42**	195.99
380	79.01	3.8	0.05	5	1194.29	**241.77**	202.44
400	81.66	4	0.052632	5.263158	1197.60	**249.88**	208.65

420	82.89	4.2	0.055263	5.526316	1200.94	**253.64**	211.20
440	82.89	4.4	0.057895	5.789474	1204.29	253.64	210.62
460	82.89	4.6	0.060526	6.052632	1207.67	**253.64**	210.03
480	83.87	4.8	0.063158	6.315789	1211.06	**256.64**	211.92
500	83.87	5	0.065789	6.578947	1214.47	**256.64**	211.32
520	83.87	5.2	0.068421	6.842105	1217.90	**256.64**	210.72
540	84.66	**5.4**	**0.071053**	**7.105263**	**1221.35**	**259.07**	**212.12**
560	84.66	5.6	0.073684	7.368421	1224.82	**259.07**	211.52
580	84.66	5.8	0.076316	7.631579	1228.31	**259.07**	210.92
600	85.21	6	0.078947	7.894737	1231.82	**260.74**	211.67
620	84.73	6.2	0.081579	8.157895	1235.35	**259.27**	209.88
640	83.77	6.4	0.084211	8.421053	1238.90	**256.34**	206.91
660	82.62	6.6	0.086842	8.684211	1242.47	**252.82**	203.48
680	81.82	6.8	0.089474	8.947368	1246.06	**250.37**	200.93
700	80.85	7	0.092105	9.210526	1249.672878	247.401	197.972609
720	79.81	7.2	0.094737	9.473684	1253.305648	244.2186	194.8595703
740	78.84	7.4	0.097368	9.736842	1256.9596	241.2504	191.9317057



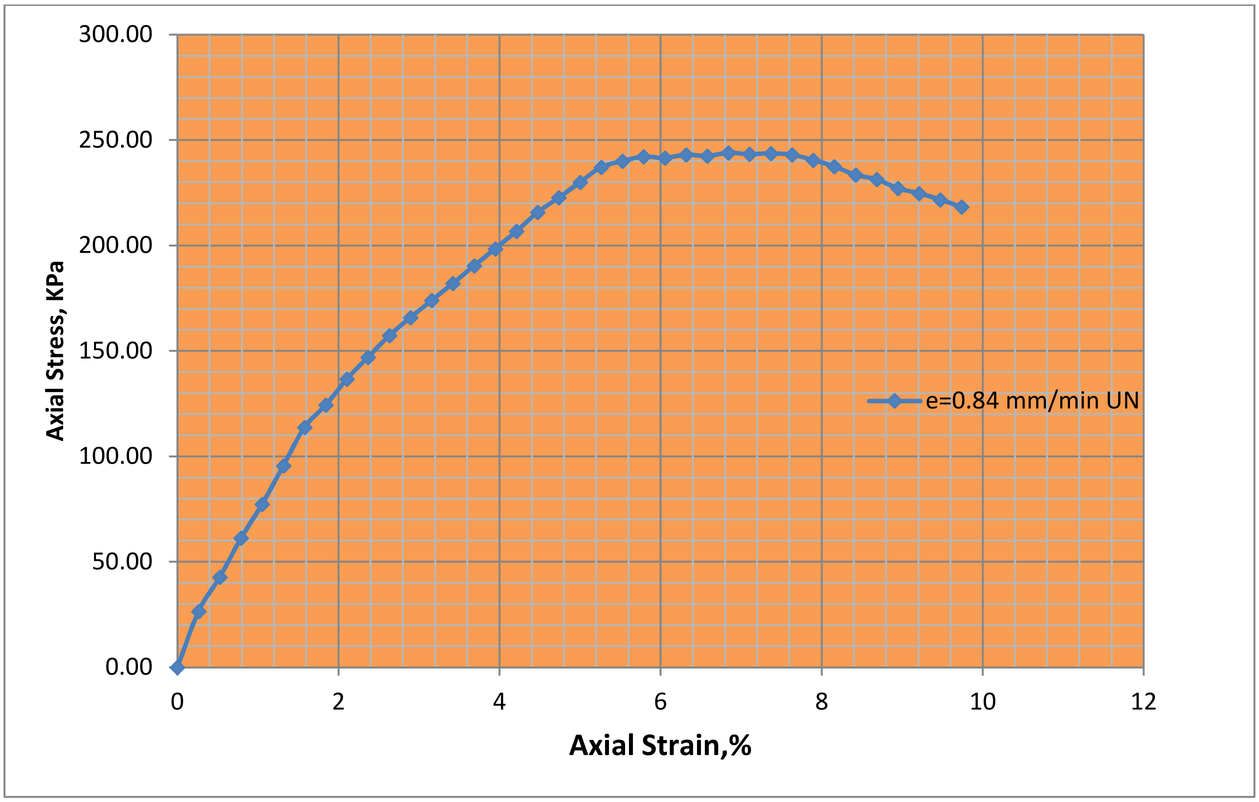
Remark:	**Unconfined Compressive Strength (qu)=**	**212.12**	**KPa**
	Cohesion© = (qu/2) =	**106.06**	**KPa**
	Failure strain=	**7.10%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 3		**Project No. : 1**	
Location : Kolfe Area		**Pit No. : 1**	
Depth of Sample : 2.5 m		**Test Date :4/27/2017**	
Visual description of soil : Dark red clay		**Sample Type: Undisturbed**	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	**Can No.**	P8
Height (mm)	76.00	**Mass Cont.**	35.5
Area (Ao) mm2	1134.57	**Mass Cont.+wet soil**	70
Volume cc	86.23	**Mass Cont.+dry soil**	61.3
Mass (gm)	166.81	**Mass dry soil**	25.8
Wet Density g/cc	1.93	**Mass moisture**	8.7
Moisture Content %	33.72	**Moisture Content %**	33.72
Dry Density g/cc	1.45		

e=0.84 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	9.87	0.2	0.0026316	0.263158	1137.57	30.20	26.55
40	15.96	0.4	0.0052632	0.526316	1140.57	48.84	42.82
60	22.88	0.6	0.0078947	0.789474	1143.60	70.01	61.22
80	28.99	0.8	0.0105263	1.052632	1146.64	88.71	77.36
100	35.93	1	0.0131579	1.315789	1149.70	109.95	95.63
120	42.88	1.2	0.0157895	1.578947	1152.77	131.21	113.82
140	46.97	1.4	0.0184211	1.842105	1155.86	143.73	124.35
160	51.79	1.6	0.0210526	2.105263	1158.97	158.48	136.74
180	55.85	1.8	0.0236842	2.368421	1162.09	170.90	147.06
200	59.89	2	0.0263158	2.631579	1165.24	183.26	157.28
220	63.34	2.2	0.0289474	2.894737	1168.39	193.82	165.89
240	66.61	2.4	0.0315789	3.157895	1171.57	203.83	173.98
260	69.90	2.6	0.0342105	3.421053	1174.76	213.89	182.07
280	73.31	2.8	0.0368421	3.684211	1177.97	224.33	190.44
300	76.62	3	0.0394737	3.947368	1181.20	234.46	198.49
320	80.03	3.2	0.0421053	4.210526	1184.44	244.89	206.76
340	83.75	3.4	0.0447368	4.473684	1187.71	256.28	215.77
360	86.68	3.6	0.0473684	4.736842	1190.99	265.24	222.71
380	89.78	3.8	0.05	5	1194.29	274.73	230.03
400	92.80	4	0.0526316	5.263158	1197.60	283.97	237.11

420	94.19	4.2	0.0552632	5.526316	1200.94	288.22	240.00
440	95.32	4.4	0.0578947	5.789474	1204.29	291.68	242.20
460	95.32	4.6	0.0605263	6.052632	1207.67	291.68	241.52
480	96.21	4.8	0.0631579	6.315789	1211.06	294.40	243.10
500	96.21	5	0.0657895	6.578947	1214.47	294.40	242.41
520	97.11	5.2	0.0684211	6.842105	1217.90	297.16	243.99
540	97.11	**5.4**	**0.0710526**	**7.105263**	**1221.35**	**297.16**	**243.30**
560	97.56	5.6	0.0736842	7.368421	1224.82	298.53	243.74
580	97.56	5.8	0.0763158	7.631579	1228.31	298.53	243.04
600	96.82	6	0.0789474	7.894737	1231.82	296.27	240.51
620	95.88	6.2	0.0815789	8.157895	1235.35	293.39	237.50
640	94.53	6.4	0.0842105	8.421053	1238.90	289.26	233.48
660	93.94	6.6	0.0868421	8.684211	1242.47	287.46	231.36
680	92.47	6.8	0.0894737	8.947368	1246.06	282.96	227.08
700	91.79	7	0.0921053	9.210526	1249.672878	280.88	224.76
720	90.82	7.2	0.0947368	9.473684	1253.305648	277.91	221.74
740	89.66	7.4	0.0973684	9.736842	1256.9596	274.36	218.27



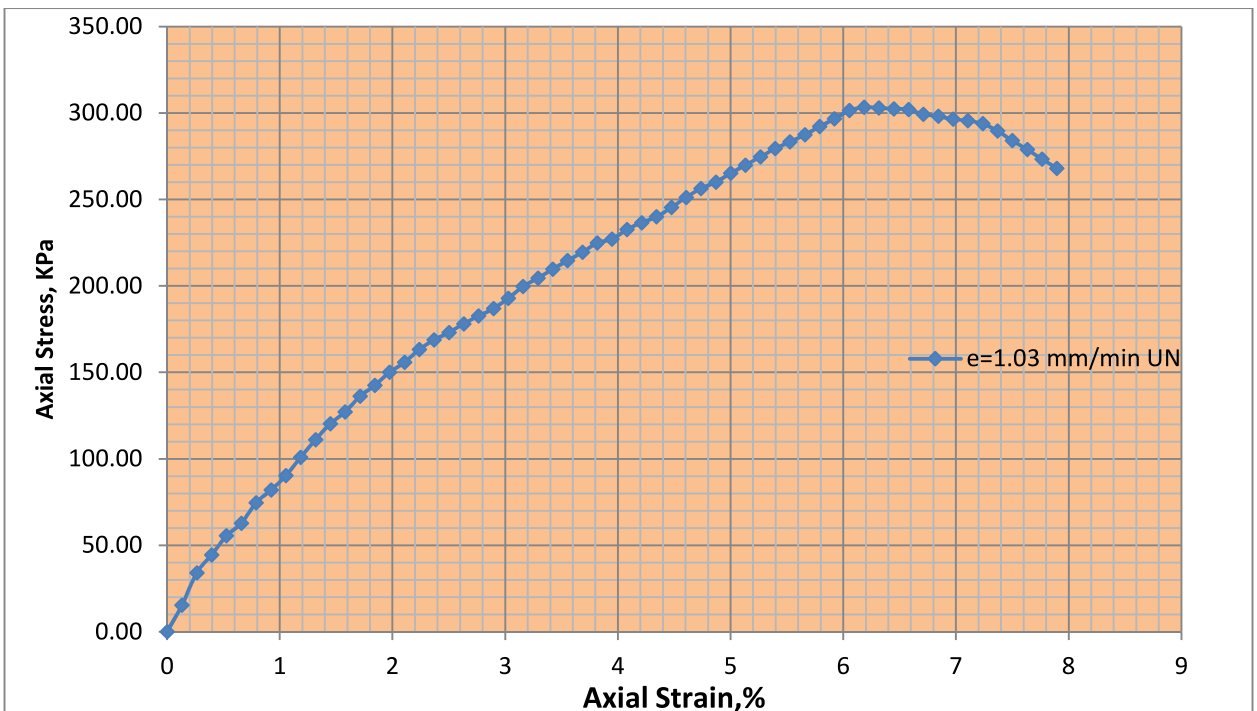
Remark:	**Unconfined Compressive Strength (qu)=**	**243.74**	**KPa**
	Cohesion© = (qu/2) =	**121.87**	**KPa**
	Failure strain=	**7.36%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	Z4
Height (mm)	76.00	Mass Cont.	35.35
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.65
Volume cc	86.23	Mass Cont.+dry soil	72.96
Mass (gm)	168.00	Mass dry soil	37.61
Wet Density g/cc	1.95	Mass moisture	12.69
Moisture Content %	33.74	Moisture Content %	33.74
Dry Density g/cc	1.46		

e=1.03 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (Kpa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	5.73	0.1	0.0013	0.13157895	1136.07	17.53	15.43
20	12.68	0.2	0.0026	0.26315789	1137.57	38.80	34.11
30	16.54	0.3	0.0039	0.39473684	1139.07	50.61	44.43
40	20.68	0.4	0.0053	0.52631579	1140.57	63.28	55.48
50	23.41	0.5	0.0066	0.65789474	1142.09	71.63	62.72
60	27.89	0.6	0.0079	0.78947368	1143.60	85.34	74.63
70	30.67	0.7	0.0092	0.92105263	1145.12	93.85	81.96
80	33.81	0.8	0.0105	1.05263158	1146.64	103.46	90.23
90	37.82	0.9	0.0118	1.18421053	1148.17	115.73	100.79
100	41.72	1	0.0132	1.31578947	1149.70	127.66	111.04
110	45.25	1.1	0.0145	1.44736842	1151.23	138.47	120.28
120	47.88	1.2	0.0158	1.57894737	1152.77	146.51	127.10
130	51.37	1.3	0.0171	1.71052632	1154.32	157.19	136.18
140	53.8	1.4	0.0184	1.84210526	1155.86	164.63	142.43
150	56.76	1.5	0.0197	1.97368421	1157.42	173.69	150.06
160	58.99	1.6	0.0211	2.10526316	1158.97	180.51	155.75
170	61.89	1.7	0.0224	2.23684211	1160.53	189.38	**163.19**
180	64.1	1.8	0.0237	2.36842105	1162.09	196.15	168.79
190	65.82	1.9	0.025	2.5	1163.66	201.41	173.08
200	67.81	2	0.0263	2.63157895	1165.24	207.50	178.07
210	69.64	2.1	0.0276	2.76315789	1166.81	213.10	182.63
220	71.34	2.2	0.0289	2.89473684	1168.39	218.30	186.84
230	73.7	2.3	0.0303	3.02631579	1169.98	225.52	192.76
240	76.45	2.4	0.0316	3.15789474	1171.57	233.94	199.68
250	78.37	2.5	0.0329	3.28947368	1173.16	239.81	204.42

260	80.52	2.6	0.0342	3.42105263	1174.76	246.39	209.74
270	82.49	2.7	0.0355	3.55263158	1176.36	252.42	214.58
280	84.46	2.8	0.0368	3.68421053	1177.97	258.45	219.40
290	86.68	2.9	0.0382	3.81578947	1179.58	265.24	224.86
300	87.63	3	0.0395	3.94736842	1181.20	268.15	227.01
310	89.88	3.1	0.0408	4.07894737	1182.82	275.03	232.52
320	91.18	3.2	0.0381	4.21052632	1179.50	279.01	236.55
330	93	3.3	0.0434	4.34210526	1186.07	284.58	239.93
340	95.21	3.4	0.0447	4.47368421	1187.71	291.34	245.30
350	97.62	3.5	0.0461	4.60526316	1189.34	298.72	251.16
360	99.76	3.6	0.0474	4.73684211	1190.99	305.27	256.31
370	101.33	3.7	0.0487	4.86842105	1192.63	310.07	259.99
380	103.48	3.8	0.05	5	1194.29	316.65	265.14
390	105.46	3.9	0.0513	5.13157895	1195.94	322.71	269.84
400	107.44	4	0.0526	5.26315789	1197.60	328.77	274.52
410	109.51	4.1	0.0539	5.39473684	1199.27	335.10	279.42
420	111.2	4.2	0.0553	5.52631579	1200.94	340.27	283.34
430	112.94	4.3	0.0566	5.65789474	1202.61	345.60	287.37
440	114.96	4.4	0.0579	5.78947368	1204.29	351.78	292.10
450	116.89	4.5	0.0592	5.92105263	1205.98	357.68	296.59
460	118.94	4.6	0.0605	6.05263158	1207.67	363.96	301.37
470	119.86	4.7	0.0618	6.18421053	1209.36	366.77	303.28
480	119.86	4.8	0.0632	6.31578947	1211.06	366.77	302.85
490	119.86	4.9	0.0645	6.44736842	1212.76	366.77	302.43
500	119.86	5	0.0658	6.57894737	1214.47	366.77	302.00
510	118.93	5.1	0.0671	6.71052632	1216.18	363.93	299.24
520	118.62	5.2	0.0684	6.84210526	1217.90	362.98	298.03
530	118.17	5.3	0.0697	6.97368421	1219.6242	361.60	296.48
540	117.93	5.4	0.0711	7.10526316	1221.3517	360.87	295.46
550	117.45	5.5	0.0724	7.23684211	1223.0841	359.40	293.84
560	115.9	5.6	0.0737	7.36842105	1224.8214	354.65	289.56
570	113.82	5.7	0.075	7.5	1226.5637	348.29	283.96
580	111.96	5.8	0.0763	7.63157895	1228.3109	342.60	278.92
590	109.88	5.9	0.0776	7.76315789	1230.0632	336.23	273.35
600	107.89	6	0.0789	7.89473684	1231.8204	330.14	268.01

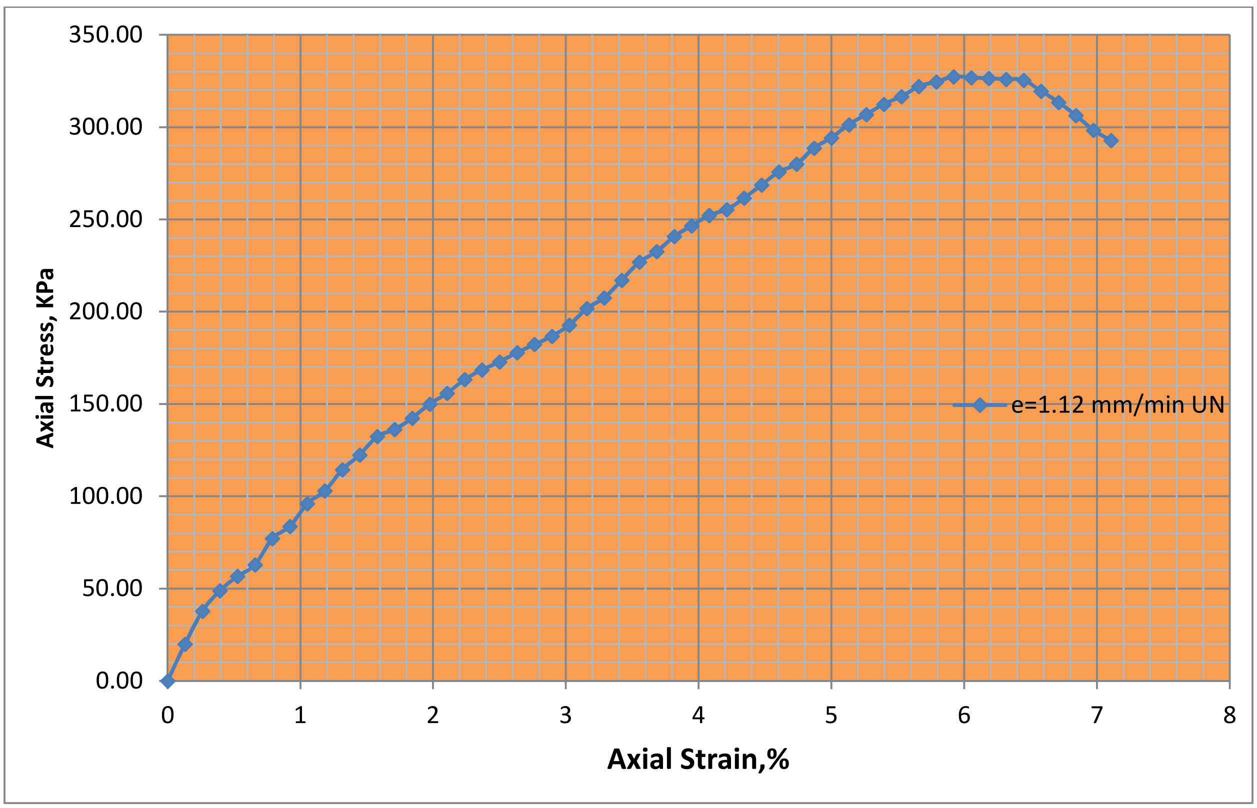


Remark:	Unconfined Compressive Strength (qu)=	303.28	KPa
	Cohesion© = (qu/2) =	151.64	KPa
	Failure strain=	6.18%	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	A6
Height (mm)	76.00	Mass Cont.	35.40
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	86.92
Volume cc	86.23	Mass Cont.+dry soil	73.92
Mass (gm)	167.11	Mass dry soil	38.52
Wet Density g/cc	1.94	Mass moisture	13.00
Moisture Content %	33.75	Moisture Content %	33.75
Dry Density g/cc	1.45		
e=1.12 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (Kpa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	7.5	0.1	0.0013	0.131579	1136.07	22.95	20.20
20	14.11	0.2	0.0026	0.263158	1137.57	43.18	37.96
30	18.23	0.3	0.0039	0.394737	1139.07	55.78	48.97
40	21.14	0.4	0.0053	0.526316	1140.57	64.69	56.72
50	23.91	0.5	0.0066	0.657895	1142.09	73.16	64.06
60	29.02	0.6	0.0079	0.789474	1143.60	88.80	77.65
70	31.35	0.7	0.0092	0.921053	1145.12	95.93	83.77
80	36.03	0.8	0.0105	1.052632	1146.64	110.25	96.15
90	38.65	0.9	0.0118	1.184211	1148.17	118.27	103.01
100	43	1	0.0132	1.315789	1149.70	131.58	114.45
110	45.98	1.1	0.0145	1.447368	1151.23	140.70	122.22
120	49.91	1.2	0.0158	1.578947	1152.77	152.72	132.48
130	51.4	1.3	0.0171	1.710526	1154.32	157.28	136.26
140	53.82	1.4	0.0184	1.842105	1155.86	164.69	142.48
150	56.73	1.5	0.0197	1.973684	1157.42	173.59	149.98
160	59	1.6	0.0211	2.105263	1158.97	180.54	155.78
170	62.03	1.7	0.0224	2.236842	1160.53	189.81	**163.56**
180	64.05	1.8	0.0237	2.368421	1162.09	195.99	168.65
190	65.8	1.9	0.025	2.5	1163.66	201.35	173.03
200	67.71	2	0.0263	2.631579	1165.24	207.19	177.81
210	69.49	2.1	0.0276	2.763158	1166.81	212.64	182.24
220	71.28	2.2	0.0289	2.894737	1168.39	218.12	186.68
230	73.72	2.3	0.0303	3.026316	1169.98	225.58	192.81
240	77.23	2.4	0.0316	3.157895	1171.57	236.32	201.72
250	79.58	2.5	0.0329	3.289474	1173.16	243.51	207.57

260	83.04	2.6	0.0342	3.421053	1174.76	254.10	216.30
270	86.08	2.7	0.0355	3.552632	1176.36	263.40	223.91
280	89.21	2.8	0.0368	3.684211	1177.97	272.98	231.74
290	92.43	2.9	0.0382	3.815789	1179.58	282.84	239.78
300	95.48	3	0.0395	3.947368	1181.20	292.17	247.35
310	97.69	3.1	0.0408	4.078947	1182.82	298.93	252.73
320	99.23	3.2	0.0381	4.210526	1179.50	303.64	257.43
330	101.38	3.3	0.0434	4.342105	1186.07	310.22	261.55
340	103.87	3.4	0.0447	4.473684	1187.71	317.84	267.61
350	106.85	3.5	0.0461	4.605263	1189.34	326.96	274.91
360	109.78	3.6	0.0474	4.736842	1190.99	335.93	282.06
370	112.76	3.7	0.0487	4.868421	1192.63	345.05	289.31
380	114.81	3.8	0.05	5	1194.29	351.32	294.17
390	116.92	3.9	0.0513	5.131579	1195.94	357.78	299.16
400	119.56	4	0.0526	5.263158	1197.60	365.85	305.49
410	121.87	4.1	0.0539	5.394737	1199.27	372.92	310.96
420	123.79	4.2	0.0553	5.526316	1200.94	378.80	315.42
430	125.88	4.3	0.0566	5.657895	1202.61	385.19	320.30
440	126.81	4.4	0.0579	5.789474	1204.29	388.04	322.21
450	127.85	4.5	0.0592	5.921053	1205.98	391.22	324.40
460	127.85	4.6	0.0605	6.052632	1207.67	391.22	323.95
470	127.85	4.7	0.0618	6.184211	1209.36	391.22	323.49
480	128.68	4.8	0.0632	6.315789	1211.06	393.76	325.14
490	127.61	4.9	0.0645	6.447368	1212.76	390.49	321.98
500	126.72	5	0.0658	6.578947	1214.47	387.76	319.29
510	124.73	5.1	0.0671	6.710526	1216.18	381.67	313.83
520	121.59	5.2	0.0684	6.842105	1217.90	372.07	305.50
530	118.43	5.3	0.0697	6.973684	1219.62	362.40	297.14
540	115.92	5.4	0.0711	7.105263	1221.35	354.72	290.43



Remark:	**Unconfined Compressive Strength (qu)=**	**324.40**	**KPa**
	Cohesion© = (qu/2) =	**162.20**	**KPa**
	Failure strain=	**5.92%**	

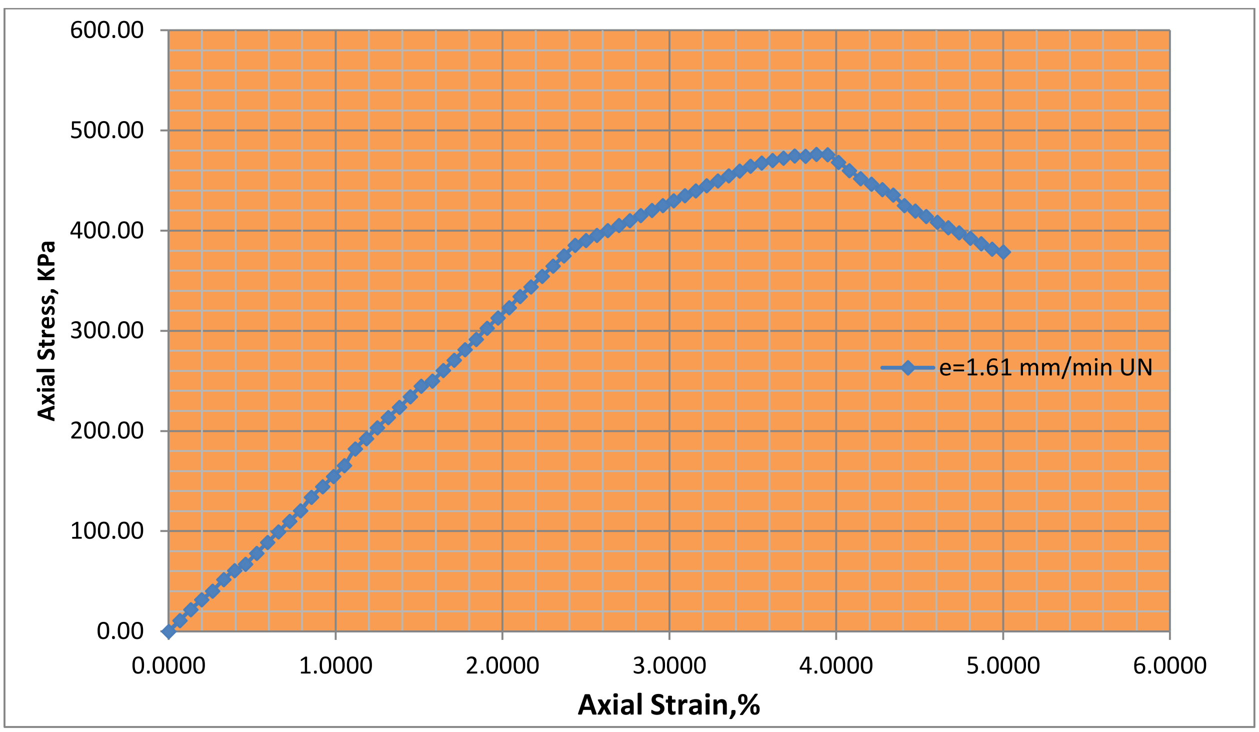
TYPE OF TEST:Unconfined Compressive Strength	**TEST METHOD: ASTM D2166**
Sample No.: 2	**Project No. : Thesis research**
Location : Kolfe area	**Pit No. : 1**
Depth of Sample : 2.5 m	**Test Date :4/27/2017**
Visual description of soil : Dark red clay	**Sample Type: Undisturbed**

Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	**Can No.**	O6
Height (mm)	76.0	**Mass Cont.**	35.4
Area (Ao) mm2	1134.6	**Mass Cont.+wet soil**	98.45
Volume cc	86.2	**Mass Cont.+dry soil**	82.54
Mass (gm)	167.9	**Mass dry soil**	47.14
Wet Density g/cc	1.9	**Mass moisture**	15.91
Moisture Content %	33.8	**Moisture Content %**	33.75
Dry Density g/cc	1.5		

e=1.61 mm/min

Deform. Dial Rdg (DDR)	**Load Dial Rdg (LDR)**	**Deform. ΔL (mm)=DDR*0.01**	**Strain (ΔL /Lo)**	**Strain (% ε)**	**Corrected Area (Ac=Ao/(1-ε))**	**Load (N)=(LDR *0.00306)*1000**	**Stress (kPa)=F/Ac**
0	0.00	0	0	0.0000	1134.57	0.00	0.00
5	4.00	0.05	0.0006579	0.0658	1135.32	12.24	10.78
10	8.12	0.1	0.0013158	0.1316	1136.07	24.85	21.87
15	11.73	0.15	0.0019737	0.1974	1136.82	35.89	31.57
20	15.03	0.2	0.0026316	0.2632	1137.57	45.99	40.43
25	19.28	0.25	0.0032895	0.3289	1138.32	59.00	51.83
30	22.62	0.3	0.0039474	0.3947	1139.07	69.22	60.77
35	25.03	0.35	0.0046053	0.4605	1139.82	76.59	67.20
40	29.06	0.4	0.0052632	0.5263	1140.57	88.92	77.96
45	33.11	0.45	0.0059211	0.5921	1141.33	101.32	88.77
50	37.13	0.5	0.0065789	0.6579	1142.09	113.62	99.48
55	41.14	0.55	0.0072368	0.7237	1142.84	125.89	110.15
60	45.10	0.6	0.0078947	0.7895	1143.60	138.01	120.68
65	50.09	0.65	0.0085526	0.8553	1144.36	153.28	133.94
70	54.07	0.7	0.0092105	0.9211	1145.12	165.45	144.49
75	58.01	0.75	0.0098684	0.9868	1145.88	177.51	154.91
80	62.12	0.8	0.0105263	1.0526	1146.64	190.09	165.78
85	68.31	0.85	0.0111842	1.1184	1147.40	209.03	182.18
90	72.29	0.9	0.0118421	1.1842	1148.17	221.21	192.66
95	76.32	0.95	0.0125	1.2500	1148.93	233.54	203.27
100	80.30	1	0.0131579	1.3158	1149.70	245.72	213.72
105	84.11	1.05	0.0138158	1.3816	1150.47	257.38	223.72
110	88.14	1.1	0.0144737	1.4474	1151.23	269.71	234.28
115	92.18	1.15	0.0151316	1.5132	1152.00	282.07	244.85
120	94.21	1.2	0.0157895	1.5789	1152.77	288.28	250.08
125	98.19	1.25	0.0164474	1.6447	1153.54	300.46	260.47
130	102.22	1.3	0.0171053	1.7105	1154.32	312.79	270.98
135	106.18	1.35	0.0177632	1.7763	1155.09	324.91	281.29
140	110.20	1.4	0.0184211	1.8421	1155.86	337.21	291.74
145	114.45	1.45	0.0190789	1.9079	1156.64	350.22	302.79
150	118.39	1.5	0.0197368	1.9737	1157.42	362.27	313.00
155	122.41	1.55	0.0203947	2.0395	1158.19	374.57	323.41
160	126.45	1.6	0.0190476	2.1053	1156.60	386.94	334.55
165	130.40	1.65	0.0217105	2.1711	1159.75	399.02	344.06
170	134.47	1.7	0.0223684	2.2368	1160.53	411.48	354.56
175	138.44	1.75	0.0230263	2.3026	1161.31	423.63	364.78
180	142.42	1.8	0.0236842	2.3684	1162.09	435.81	375.02
185	146.50	1.85	0.0243421	2.4342	1162.88	448.29	385.50
190	148.52	1.9	0.025	2.5000	1163.66	454.47	390.55
195	150.51	1.95	0.0256579	2.5658	1164.45	460.56	395.52
200	152.49	2	0.0263158	2.6316	1165.24	466.62	400.45

205	154.51	2.05	0.0269737	2.6974	1166.02	472.80	405.48
210	156.48	2.1	0.0276316	2.7632	1166.81	478.83	410.37
215	158.52	2.15	0.0282895	2.8289	1167.60	485.07	415.44
220	160.51	2.2	0.0289474	2.8947	1168.39	491.16	420.37
225	162.51	2.25	0.0296053	2.9605	1169.19	497.28	425.32
230	164.48	2.3	0.0302632	3.0263	1169.98	503.31	430.19
235	166.52	2.35	0.0309211	3.0921	1170.77	509.55	435.23
240	168.51	2.4	0.0315789	3.1579	1171.57	515.64	440.13
245	170.53	2.45	0.0322368	3.2237	1172.36	521.82	445.10
250	172.49	2.5	0.0328947	3.2895	1173.16	527.82	449.91
255	174.50	2.55	0.0335526	3.3553	1173.96	533.97	454.84
260	176.53	2.6	0.0342105	3.4211	1174.76	540.18	459.82
265	178.47	2.65	0.0348684	3.4868	1175.56	546.12	464.56
270	179.89	2.7	0.0355	3.5526	1176.3633	550.46	467.94
275	180.93	2.75	0.0362	3.6184	1177.1663	553.65	470.32
280	181.91	2.8	0.0368	3.6842	1177.9703	556.64	472.55
285	182.88	2.8500	0.0375	3.7500	1178.7755	559.61	474.74
290	182.88	2.9	0.0382	3.8158	1179.5818	559.61	474.42
295	183.83	2.95	0.0388	3.8816	1180.3892	562.52	476.55
300	183.83	3	0.0395	3.9474	1181.1977	562.52	476.23
305	180.91	3.05	0.0401	4.0132	1182.0072	553.58	468.34
310	177.89	3.1	0.0408	4.0789	1182.8180	544.34	460.21
315	174.92	3.15	0.0414	4.1447	1183.6298	535.26	452.22
320	172.94	3.2	0.0421	4.2105	1184.4427	529.20	446.79
325	170.93	3.25	0.0428	4.2763	1185.2568	523.05	441.29
330	168.88	3.3	0.0434	4.3421	1186.0719	516.77	435.70
335	164.92	3.35	0.0441	4.4079	1186.8882	504.66	425.19
340	162.90	3.4	0.0447	4.4737	1187.7056	498.47	419.69
345	160.91	3.45	0.0454	4.5395	1188.5242	492.38	414.28
350	158.89	3.5	0.0461	4.6053	1189.3438	486.20	408.80
355	156.88	3.55	0.0467	4.6711	1190.1646	480.05	403.35
360	154.94	3.6	0.0474	4.7368	1190.9866	474.12	398.09
365	152.93	3.65	0.0480263	4.802632	1191.80966	467.97	392.65
370	150.91	3.7	0.0486842	4.868421	1192.63387	461.78	387.20
375	148.89	3.75	0.0493421	4.934211	1193.45922	455.60	381.75
380	147.85	3.8	0.05	5	1194.28571	452.42	378.82

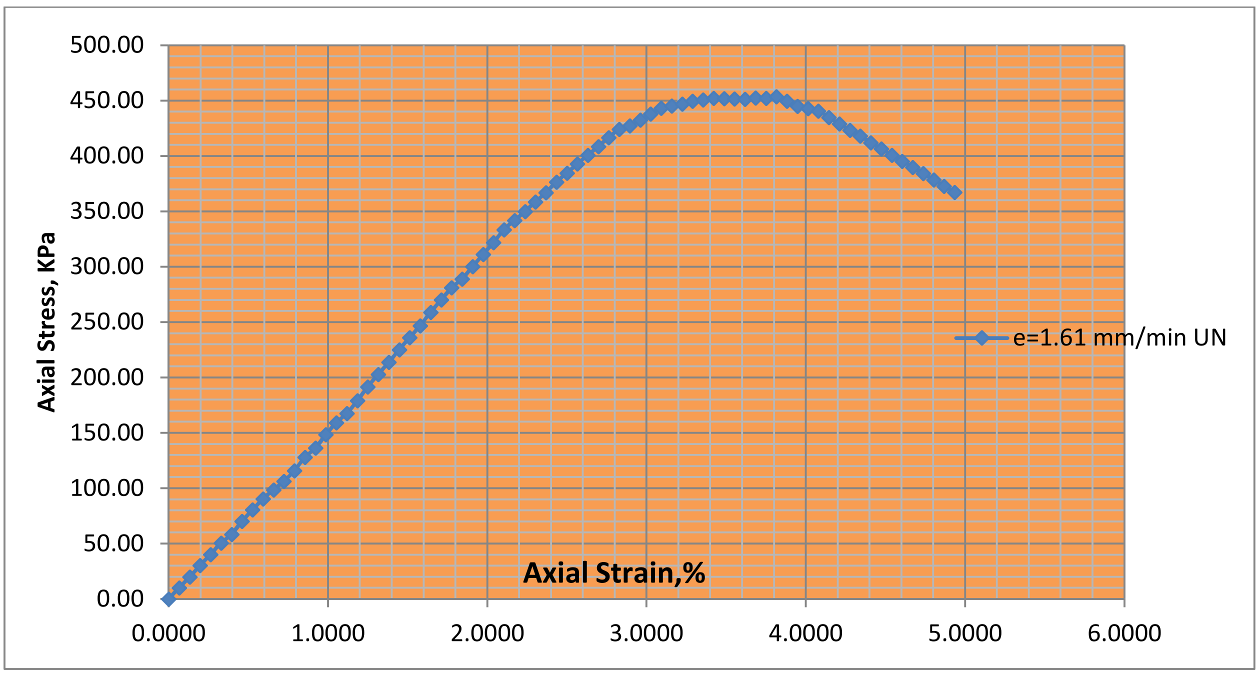


Remark:	**Unconfined Compressive Strength (qu)=**	**476.55**	**KPa**
	Cohesion© = (qu/2) =	**238.28**	**KPa**
	Failure strain=	**3.88%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 3		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	H4
Height (mm)	76.00	Mass Cont.	35.4
Area (A_o) mm2	1134.57	Mass Cont.+wet soil	98.45
Volume cc	86.23	Mass Cont.+dry soil	82.54
Mass (gm)	166.85	Mass dry soil	47.14
Wet Density g/cc	1.93	Mass moisture	15.91
Moisture Content %	33.75	Moisture Content %	33.75
Dry Density g/cc	1.45		
e=1.61 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0.0000	1134.57	0.00	0.00
5	3.77	0.05	0.0006579	0.0658	1135.32	11.54	10.16
10	7.41	0.1	0.0013158	0.1316	1136.07	22.67	19.96
15	11.25	0.15	0.0019737	0.1974	1136.82	34.43	30.28
20	14.96	0.2	0.0026316	0.2632	1137.57	45.78	40.24
25	18.83	0.25	0.0032895	0.3289	1138.32	57.62	50.62
30	21.77	0.3	0.0039474	0.3947	1139.07	66.62	58.48
35	26.17	0.35	0.0046053	0.4605	1139.82	80.08	70.26
40	30.03	0.4	0.0052632	0.5263	1140.57	91.89	80.57
45	33.72	0.45	0.0059211	0.5921	1141.33	103.18	90.41
50	36.74	0.5	0.0065789	0.6579	1142.09	112.42	98.44
55	39.75	0.55	0.0072368	0.7237	1142.84	121.64	106.43
60	43.34	0.6	0.0078947	0.7895	1143.60	132.62	115.97
65	47.90	0.65	0.0085526	0.8553	1144.36	146.57	128.08
70	51.00	0.7	0.0092105	0.9211	1145.12	156.06	136.28
75	55.58	0.75	0.0098684	0.9868	1145.88	170.07	148.42
80	59.64	0.8	0.0105263	1.0526	1146.64	182.50	159.16
85	62.88	0.85	0.0111842	1.1184	1147.40	192.41	167.69
90	67.22	0.9	0.0118421	1.1842	1148.17	205.69	179.15
95	71.98	0.95	0.0125	1.2500	1148.93	220.26	191.71
100	76.21	1	0.0131579	1.3158	1149.70	233.20	202.84
105	80.35	1.05	0.0138158	1.3816	1150.47	245.87	213.71
110	84.72	1.1	0.0144737	1.4474	1151.23	259.24	225.19
115	88.84	1.15	0.0151316	1.5132	1152.00	271.85	235.98
120	93.01	1.2	0.0157895	1.5789	1152.77	284.61	246.89
125	97.64	1.25	0.0164474	1.6447	1153.54	298.78	259.01
130	101.88	1.3	0.0171053	1.7105	1154.32	311.75	270.08
135	106.10	1.35	0.0177632	1.7763	1155.09	324.67	281.07
140	109.21	1.4	0.0184211	1.8421	1155.86	334.18	289.12
145	113.48	1.45	0.0190789	1.9079	1156.64	347.25	300.22
150	117.70	1.5	0.0197368	1.9737	1157.42	360.16	311.18
155	121.81	1.55	0.0203947	2.0395	1158.19	372.74	321.83
160	126.05	1.6	0.0190476	2.1053	1156.60	385.71	333.49
165	129.56	1.65	0.0217105	2.1711	1159.75	396.45	341.84
170	132.72	1.7	0.0223684	2.2368	1160.53	406.12	349.95
175	136.15	1.75	0.0230263	2.3026	1161.31	416.62	358.75
180	139.35	1.8	0.0236842	2.3684	1162.09	426.41	366.93
185	143.15	1.85	0.0243421	2.4342	1162.88	438.04	376.69
190	146.32	1.9	0.025	2.5000	1163.66	447.74	384.77
195	149.56	1.95	0.0256579	2.5658	1164.45	457.65	393.02
200	152.59	2	0.0263158	2.6316	1165.24	466.93	400.71

205	155.72	2.05	0.0269737	2.6974	1166.02	476.50	408.66
210	158.88	2.1	0.0276316	2.7632	1166.81	486.17	416.67
215	161.90	2.15	0.0282895	2.8289	1167.60	495.41	424.30
220	163.18	2.2	0.0289474	2.8947	1168.39	499.33	427.37
225	165.28	2.25	0.0296053	2.9605	1169.19	505.76	432.57
230	167.48	2.3	0.0302632	3.0263	1169.98	512.49	438.03
235	169.59	2.35	0.0309211	3.0921	1170.77	518.95	443.25
240	170.48	2.4	0.0315789	3.1579	1171.57	521.67	445.27
245	171.24	2.45	0.0322368	3.2237	1172.36	523.99	446.96
250	172.40	2.5	0.0328947	3.2895	1173.16	527.54	449.68
255	172.95	2.55	0.0335526	3.3553	1173.96	529.23	450.80
260	173.63	2.6	0.0342105	3.4211	1174.76	531.31	452.27
265	173.63	2.65	0.0348684	3.4868	1175.56	531.31	451.96
270	173.63	2.7	0.0355	3.5526	1176.3633	531.31	451.65
275	173.63	2.75	0.0362	3.6184	1177.1663	531.31	451.34
280	174.23	2.8	0.0368	3.6842	1177.9703	533.14	452.60
285	174.23	2.8500	0.0375	3.7500	1178.7755	533.1438	452.29
290	174.93	2.9	0.0382	3.8158	1179.5818	535.29	453.79
295	173.48	2.95	0.0388	3.8816	1180.3892	530.85	449.72
300	171.76	3	0.0395	3.9474	1181.1977	525.59	444.96
305	171.13	3.05	0.0401	4.0132	1182.0072	523.66	443.02
310	170.38	3.1	0.0408	4.0789	1182.8180	521.36	440.78
315	168.23	3.15	0.0414	4.1447	1183.6298	514.78	434.92
320	166.12	3.2	0.0421	4.2105	1184.4427	508.33	429.17
325	164.00	3.25	0.0428	4.2763	1185.2568	501.84	423.40
330	162.06	3.3	0.0434	4.3421	1186.0719	495.90	418.11
335	159.84	3.35	0.0441	4.4079	1186.8882	489.11	412.09
340	157.80	3.4	0.0447	4.4737	1187.7056	482.87	406.56
345	155.70	3.45	0.0454	4.5395	1188.5242	476.44	400.87
350	153.67	3.5	0.0461	4.6053	1189.3438	470.23	395.37
355	151.61	3.55	0.0467	4.6711	1190.1646	463.93	389.80
360	149.54	3.6	0.0474	4.7368	1190.9866	457.59	384.21
365	147.43	3.65	0.0480	4.8026	1191.8097	451.14	378.53
370	145.32	3.7	0.0487	4.8684	1192.6339	444.68	372.85
375	143.21	3.75	0.0493	4.9342	1193.4592	438.22	367.19

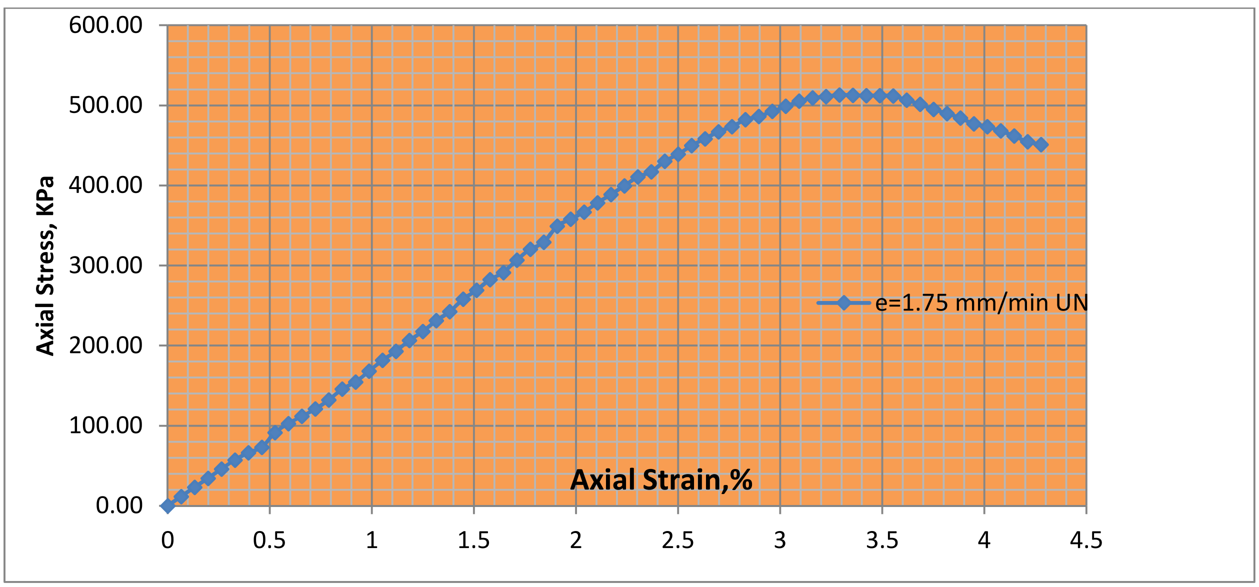


Remark:	**Unconfined Compressive Strength (qu)=**	**453.79**	**KPa**
	Cohesion© = (qu/2) =	**226.90**	**KPa**
	Failure strain=	**3.81%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Undisturbed	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	M5
Height (mm)	76.00	Mass Cont.	35.5
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	79.11
Volume cc	86.23	Mass Cont.+dry soil	68.11
Mass (gm)	167.94	Mass dry soil	32.61
Wet Density g/cc	1.95	Mass moisture	11
Moisture Content %	33.73	Moisture Content %	33.73
Dry Density g/cc	1.46		
e=1.75 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0.0000	0	1134.57	0.00	0.00
5	4.31	0.05	0.0007	0.065789	1135.32	13.19	11.62
10	8.55	0.1	0.0013	0.131579	1136.07	26.16	23.03
15	12.80	0.15	0.0020	0.197368	1136.82	39.17	34.45
20	16.98	0.2	0.0026	0.263158	1137.57	51.96	45.68
25	21.32	0.25	0.0033	0.328947	1138.32	65.24	57.31
30	24.68	0.3	0.0039	0.394737	1139.07	75.52	66.30
35	27.28	0.35	0.0046	0.460526	1139.82	83.48	73.24
40	33.96	0.4	0.0053	0.526316	1140.57	103.92	91.11
45	38.29	0.45	0.0059	0.592105	1141.33	117.17	102.66
50	41.68	0.5	0.0066	0.657895	1142.09	127.54	111.67
55	45.32	0.55	0.0072	0.723684	1142.84	138.68	121.35
60	49.28	0.6	0.0079	0.789474	1143.60	150.80	131.86
65	54.47	0.65	0.0086	0.855263	1144.36	166.68	145.65
70	57.88	0.7	0.0092	0.921053	1145.12	177.11	154.67
75	62.97	0.75	0.0099	0.986842	1145.88	192.69	168.16
80	68.02	0.8	0.0105	1.052632	1146.64	208.14	181.52
85	72.11	0.85	0.0112	1.118421	1147.40	220.66	**192.31**
90	77.37	0.9	0.0118	1.184211	1148.17	236.75	206.20
95	81.80	0.95	0.0125	1.25	1148.93	250.31	217.86
100	86.79	1	0.0132	1.315789	1149.70	265.58	231.00
105	91.09	1.05	0.0138	1.381579	1150.47	278.74	242.28
110	96.95	1.1	0.0145	1.447368	1151.23	296.67	257.69
115	101.13	1.15	0.0151	1.513158	1152.00	309.46	268.63
120	106.38	1.2	0.0158	1.578947	1152.77	325.52	282.38
125	109.76	1.25	0.0164	1.644737	1153.54	335.87	291.16
130	115.74	1.3	0.0171	1.710526	1154.32	354.16	306.82
135	120.87	1.35	0.0178	1.776316	1155.09	369.86	320.20
140	124.12	1.4	0.0184	1.842105	1155.86	379.81	328.59
145	132.01	1.45	0.0191	1.907895	1156.64	403.95	349.25
150	135.51	1.5	0.0197	1.973684	1157.42	414.66	358.26
155	138.79	1.55	0.0204	2.039474	1158.19	424.70	366.69
160	142.97	1.6	0.0190	2.105263	1156.60	437.49	378.25
165	147.04	1.65	0.0217	2.171053	1159.75	449.94	387.96
170	151.40	1.7	0.0224	2.236842	1160.53	463.28	399.20
175	155.67	1.75	0.0230	2.302632	1161.31	476.35	410.18
180	158.21	1.8	0.0237	2.368421	1162.09	484.12	416.59
185	163.32	1.85	0.0243	2.434211	1162.88	499.76	429.76
190	167.00	1.9	0.0250	2.5	1163.66	511.02	439.15
195	171.01	1.95	0.0257	2.565789	1164.45	523.29	449.39
200	174.62	2	0.0263	2.631579	1165.24	534.34	458.57

205	178.00	2.05	0.0270	2.697368	1166.02	544.68	467.13
210	180.42	2.1	0.0276	2.763158	1166.81	552.09	473.16
215	183.50	2.15	0.0283	2.828947	1167.60	561.51	480.91
220	185.58	2.2	0.0289	2.894737	1168.39	567.87	486.03
225	187.57	2.25	0.0296	2.960526	1169.19	573.96	490.91
230	189.60	2.3	0.0303	3.026316	1169.98	580.18	495.89
235	191.67	2.35	0.0309	3.092105	1170.77	586.51	500.96
240	192.65	2.4	0.0316	3.157895	1171.57	589.51	503.18
245	193.61	2.45	0.0322	3.223684	1172.36	592.45	505.34
250	**195.62**	**2.5**	**0.0329**	**3.289474**	**1173.16**	**598.60**	**510.24**
255	195.81	2.55	0.0336	3.355263	1173.96	599.18	510.39
260	195.81	2.6	0.0342	3.421053	1174.76	599.18	510.04
265	195.81	2.65	0.0349	3.486842	1175.56	599.18	509.70
270	195.81	2.7	0.035526	3.552632	1176.36328	599.18	509.35
275	194.78	2.75	0.036184	3.618421	1177.16626	596.03	506.32
280	192.82	2.8	0.036842	3.684211	1177.97034	590.03	500.89
285	190.69	2.85	0.0375	3.75	1178.77551	583.51	495.01
290	188.72	2.9	0.038158	3.815789	1179.58179	577.48	489.57
295	186.68	2.95	0.038816	3.881579	1180.38917	571.24	483.94
300	184.73	3	0.039474	3.947368	1181.19765	565.27	478.56
305	182.79	3.05	0.040132	4.013158	1182.00725	559.34	473.21
310	180.94	3.1	0.040789	4.078947	1182.81795	553.68	468.10
315	178.91	3.15	0.041447	4.144737	1183.62977	547.46	462.53
320	176.93	3.2	0.042105	4.210526	1184.4427	541.41	457.10
325	174.89	3.25	0.0428	4.276316	1185.26	535.16	451.52



Remark:	Unconfined Compressive Strength (qu)=	510.24	KPa
	Cohesion© = (qu/2) =	255.12	KPa
	Failure strain=	3.29%	

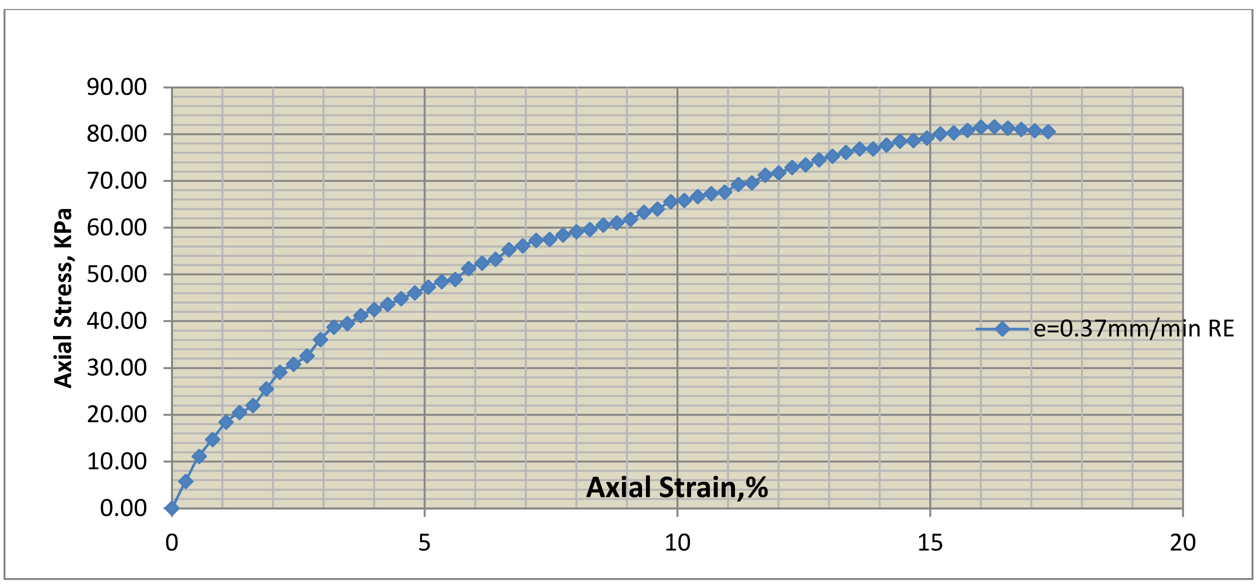
For Remolded Samples of Strain Rate (ε =0.37mm/min-1.75 mm/min)

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	Can No.	N5
Height (mm)	75.0	Mass Cont.	35.5
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	90.88
Volume cc	85.1	Mass Cont.+dry soil	77.2
Mass (gm)	159.7	Mass dry soil	41.7
Wet Density g/cc	1.9	Mass moisture	13.68
Moisture Content %	32.8	Moisture Content %	32.81
Dry Density g/cc	1.4		

e=0.37 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.15	0.2	0.0027	0.26667	1137.61	6.58	5.78
40	4.14	0.4	0.0053	0.53333	1140.65	12.67	11.11
60	5.51	0.6	0.008	0.8	1143.72	16.86	14.74
80	6.89	0.8	0.0107	1.06667	1146.80	21.08	18.38
100	7.69	1	0.0133	1.33333	1149.90	23.53	20.46
120	8.27	1.2	0.016	1.6	1153.02	25.31	21.95
140	9.65	1.4	0.0187	1.86667	1156.15	29.53	25.54
160	11.03	1.6	0.0213	2.13333	1159.30	33.75	29.11
180	11.69	1.8	0.024	2.4	1162.47	35.77	30.77
200	12.41	2	0.0267	2.66667	1165.66	37.97	32.58
220	13.78	2.2	0.0293	2.93333	1168.86	42.17	36.08
240	14.83	2.4	0.032	3.2	1172.08	45.38	38.72
260	15.16	2.6	0.0347	3.46667	1175.32	46.39	39.47
280	15.86	2.8	0.0373	3.73333	1178.57	48.53	41.18
300	16.42	3	0.04	4	1181.85	50.25	42.51
320	16.88	3.2	0.0427	4.26667	1185.14	51.65	43.58
340	17.40	3.4	0.0453	4.53333	1188.45	53.24	44.80
360	17.95	3.6	0.048	4.8	1191.78	54.93	46.09
380	18.48	3.8	0.0507	5.06667	1195.12	56.55	47.32
400	18.97	4	0.0533	5.33333	1198.49	58.05	48.43
420	19.21	4.2	0.056	5.6	1201.88	58.78	48.91
440	20.20	4.4	0.0587	5.86667	1205.28	61.81	51.28
460	20.70	4.6	0.0613	6.13333	1208.71	63.34	52.40
480	21.08	4.8	0.064	6.4	1212.15	64.50	53.22
500	21.97	5	0.0667	6.66667	1215.61	67.23	55.30
520	22.35	5.2	0.0693	6.93333	1219.10	68.39	56.10

540	22.89	5.4	0.072	7.2	1222.60	70.04	57.29
560	23.03	5.6	0.0747	7.46667	1226.12	70.47	57.48
580	23.48	5.8	0.0773	7.73333	1229.67	71.85	58.43
600	23.83	6	0.08	8	1233.23	72.92	59.13
620	24.10	6.2	0.0827	8.26667	1236.81	73.75	59.63
640	24.56	6.4	0.0853	8.53333	1240.42	75.15	60.59
660	24.81	6.6	0.088	8.8	1244.05	75.92	61.03
680	25.19	6.8	0.0907	9.06667	1247.70	77.08	61.78
700	25.88	7	0.0933	9.33333	1251.37	79.19	63.29
720	26.23	7.2	0.096	9.6	1255.06	80.26	63.95
740	26.98	7.4	0.0987	9.86667	1258.77	82.56	65.59
760	27.17	7.6	0.1013	10.1333	1262.51	83.14	65.85
780	27.57	7.8	0.104	10.4	1266.26	84.36	66.62
800	27.92	8	0.1067	10.6667	1270.04	85.44	67.27
820	28.15	8.2	0.1093	10.9333	1273.85	86.14	67.62
840	28.91	8.4	0.112	11.2	1277.67	88.46	69.24
860	29.14	8.6	0.1147	11.4667	1281.52	89.17	69.58
880	29.93	8.8	0.1173	11.7333	1285.39	91.59	71.25
900	30.22	9	0.12	12	1289.29	92.47	71.72
920	30.79	9.2	0.1227	12.2667	1293.20	94.22	72.86
940	31.12	9.4	0.1253	12.5333	1297.15	95.23	73.41
960	31.68	9.6	0.128	12.8	1301.11	96.94	74.51
980	32.11	9.8	0.1307	13.0667	1305.11	98.26	75.29
1000	32.55	10	0.1333	13.3333	1309.12	99.60	76.08
1020	32.97	10.2	0.136	13.6	1313.16	100.89	76.83
1040	33.08	10.4	0.1387	13.8667	1317.23	101.22	76.85
1060	33.54	10.6	0.1413	14.1333	1321.32	102.63	77.67
1080	33.99	10.8	0.144	14.4	1325.43	104.01	78.47
1100	34.15	11	0.1467	14.6667	1329.58	104.50	78.60
1120	34.52	11.2	0.1493	14.9333	1333.74	105.63	79.20
1140	34.99	11.4	0.152	15.2	1337.94	107.07	80.03
1160	35.21	11.6	0.1547	15.4667	1342.16	107.74	80.28
1180	35.56	11.8	0.1573	15.7333	1346.41	108.81	80.82
1200	35.98	12	0.16	16	1350.68	110.10	81.51
1220	36.11	12.2	0.1627	16.2667	1354.98	110.50	81.55
1240	36.11	12.4	0.1653	16.5333	1359.31	110.50	81.29
1260	36.11	12.6	0.168	16.8	1363.67	110.50	81.03
1280	36.11	12.8	0.1707	17.0667	1368.05	110.50	80.77
1300	36.11	13	0.1733	17.3333	1372.47	110.50	80.51



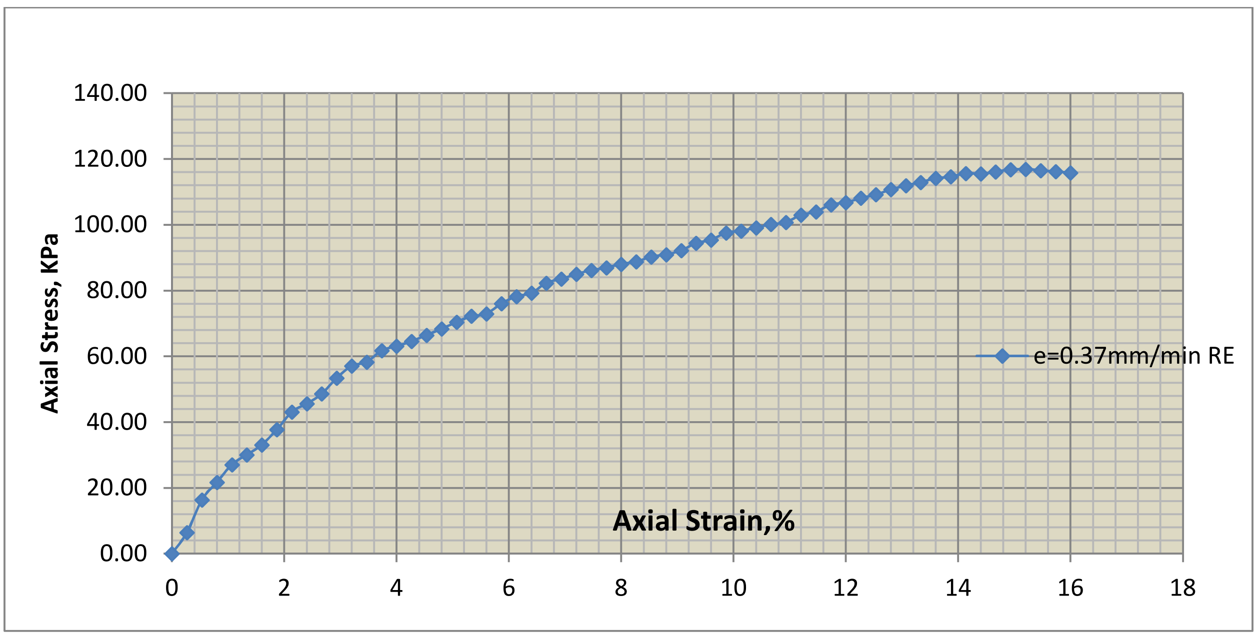
Remark:	**Unconfined Compressive Strength (qu)=**	**80.03**	**KPa**
	Cohesion© = (qu/2) =	**40.01**	**KPa**
	Failure strain=	**15.00%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 3		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	P6
Height (mm)	75.0	Mass Cont.	35.4
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	92.21
Volume cc	85.1	Mass Cont.+dry soil	78.18
Mass (gm)	160.4	Mass dry soil	42.78
Wet Density g/cc	1.9	Mass moisture	14.03
Moisture Content %	32.8	Moisture Content %	32.80
Dry Density g/cc	1.4		

e=0.37 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.003060) *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.40	0.2	0.0027	0.26667	1137.61	7.34	6.46
40	6.12	0.4	0.0053	0.53333	1140.65	18.73	16.42
60	8.11	0.6	0.008	0.8	1143.72	24.82	21.70
80	10.15	0.8	0.0107	1.06667	1146.80	31.06	27.08
100	11.32	1	0.0133	1.33333	1149.90	34.64	30.12
120	12.48	1.2	0.016	1.6	1153.02	38.19	33.12
140	14.27	1.4	0.0187	1.86667	1156.15	43.67	37.77
160	16.32	1.6	0.0213	2.13333	1159.30	49.94	43.08
180	17.33	1.8	0.024	2.4	1162.47	53.03	45.62
200	18.52	2	0.0267	2.66667	1165.66	56.67	48.62
220	20.42	2.2	0.0293	2.93333	1168.86	62.49	53.46
240	21.87	2.4	0.032	3.2	1172.08	66.92	57.10
260	22.40	2.6	0.0347	3.46667	1175.32	68.54	58.32
280	23.78	2.8	0.0373	3.73333	1178.57	72.77	61.74
300	24.38	3	0.04	4	1181.85	74.60	63.12
320	25.03	3.2	0.0427	4.26667	1185.14	76.59	64.63
340	25.81	3.4	0.0453	4.53333	1188.45	78.98	66.46
360	26.64	3.6	0.048	4.8	1191.78	81.52	68.40
380	27.51	3.8	0.0507	5.06667	1195.12	84.18	70.44
400	28.29	4	0.0533	5.33333	1198.49	86.57	72.23
420	28.66	4.2	0.056	5.6	1201.88	87.70	72.97
440	29.97	4.4	0.0587	5.86667	1205.28	91.71	76.09
460	30.90	4.6	0.0613	6.13333	1208.71	94.55	78.23
480	31.39	4.8	0.064	6.4	1212.15	96.05	79.24
500	32.71	5	0.0667	6.66667	1215.61	100.09	82.34
520	33.28	5.2	0.0693	6.93333	1219.10	101.84	83.53

540	33.98	5.4	0.072	7.2	1222.60	103.98	85.05
560	34.52	5.6	0.0747	7.46667	1226.12	105.63	86.15
580	34.96	5.8	0.0773	7.73333	1229.67	106.98	87.00
600	35.47	6	0.08	8	1233.23	108.54	88.01
620	35.89	6.2	0.0827	8.26667	1236.81	109.82	88.80
640	36.59	6.4	0.0853	8.53333	1240.42	111.97	90.26
660	36.97	6.6	0.088	8.8	1244.05	113.13	90.94
680	37.61	6.8	0.0907	9.06667	1247.70	115.09	92.24
700	38.63	7	0.0933	9.33333	1251.37	118.21	94.46
720	39.15	7.2	0.096	9.6	1255.06	119.80	95.45
740	40.13	7.4	0.0987	9.86667	1258.77	122.80	97.55
760	40.51	7.6	0.1013	10.1333	1262.51	123.96	98.19
780	41.00	7.8	0.104	10.4	1266.26	125.46	99.08
800	41.57	8	0.1067	10.6667	1270.04	127.20	100.16
820	41.96	8.2	0.1093	10.9333	1273.85	128.40	100.80
840	43.02	8.4	0.112	11.2	1277.67	131.64	103.03
860	43.53	8.6	0.1147	11.4667	1281.52	133.20	103.94
880	44.58	8.8	0.1173	11.7333	1285.39	136.41	106.13
900	45.00	9	0.12	12	1289.29	137.70	106.80
920	45.69	9.2	0.1227	12.2667	1293.20	139.81	108.11
940	46.28	9.4	0.1253	12.5333	1297.15	141.62	109.18
960	47.09	9.6	0.128	12.8	1301.11	144.10	110.75
980	47.73	9.8	0.1307	13.0667	1305.11	146.05	111.91
1000	48.32	10	0.1333	13.3333	1309.12	147.86	112.95
1020	49.00	10.2	0.136	13.6	1313.16	149.94	114.18
1040	49.34	10.4	0.1387	13.8667	1317.23	150.98	114.62
1060	49.95	10.6	0.1413	14.1333	1321.32	152.85	115.68
1080	50.04	10.8	0.144	14.4	1325.43	153.12	115.53
1100	50.45	11	0.1467	14.6667	1329.58	154.38	116.11
1120	50.91	11.2	0.1493	14.9333	1333.74	155.78	116.80
1140	51.12	11.4	0.152	15.2	1337.94	156.43	116.92
1160	51.12	11.6	0.1547	15.4667	1342.16	156.43	116.55
1180	51.12	11.8	0.1573	15.7333	1346.41	156.43	116.18
1200	51.12	12	0.16	16	1350.68	156.43	115.81



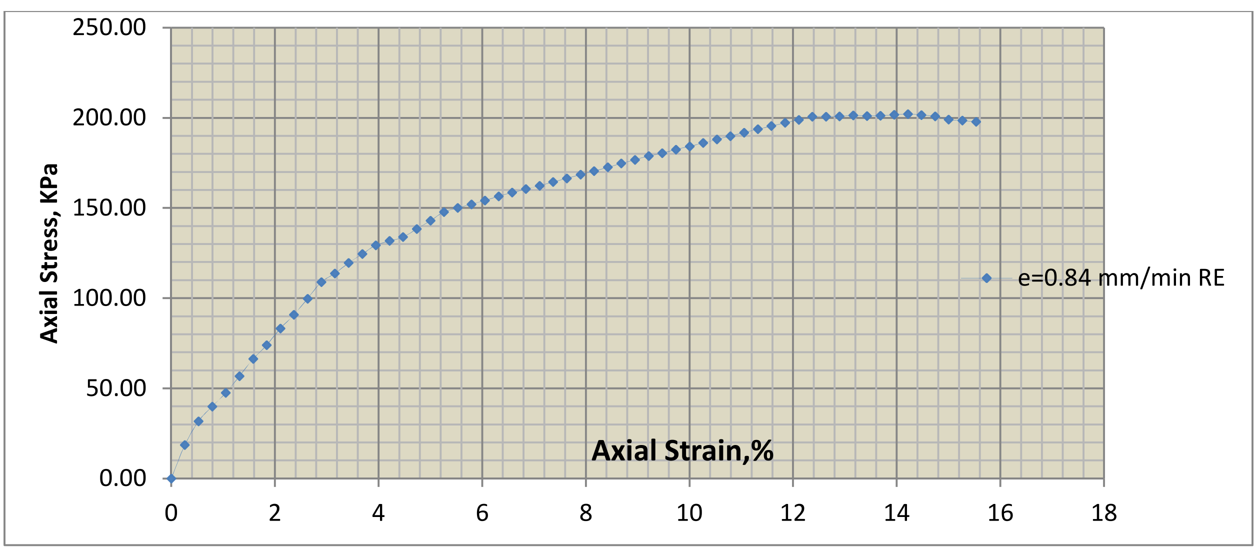
Remark:	Unconfined Compressive Strength (qu)=	116.92	KPa
	Cohesion© = (qu/2) =	58.46	KPa
	Failure strain=	15.00%	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	H14
Height (mm)	76.00	Mass Cont.	35.5
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	95.73
Volume cc	86.23	Mass Cont.+dry soil	80.85
Mass (gm)	161.75	Mass dry soil	45.35
Wet Density g/cc	1.88	Mass moisture	14.88
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.41		

e=0.84 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)= (LDR *0.00306)*1000	Stress (Kpa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	6.88	0.2	0.0026	0.2632	1137.57	21.05	18.51
40	11.83	0.4	0.0053	0.5263	1140.57	36.20	31.74
60	14.93	0.6	0.0079	0.7895	1143.60	45.69	39.95
80	17.78	0.8	0.0105	1.0526	1146.64	54.41	47.45
100	21.31	1	0.0132	1.3158	1149.70	65.21	56.72
120	24.96	1.2	0.0158	1.5789	1152.77	76.38	66.26
140	27.94	1.4	0.0184	1.8421	1155.86	85.50	73.97
160	31.53	1.6	0.0211	2.1053	1158.97	96.48	83.25
180	34.48	1.8	0.0237	2.3684	1162.09	105.51	90.79
200	37.99	2	0.0263	2.6316	1165.24	116.25	99.76
220	41.57	2.2	0.0289	2.8947	1168.39	127.20	108.87
240	43.51	2.4	0.0316	3.1579	1171.57	133.14	113.64
260	45.88	2.6	0.0342	3.4211	1174.76	140.39	119.51
280	47.91	2.8	0.0368	3.6842	1177.97	146.60	124.46
300	49.92	3	0.0395	3.9474	1181.20	152.76	129.32
320	50.98	3.2	0.0421	4.2105	1184.44	156.00	131.71
340	51.97	3.4	0.0447	4.4737	1187.71	159.03	**133.90**

360	53.85	3.6	0.0474	4.7368	1190.99	164.78	138.36
380	55.79	3.8	0.05	5	1194.29	170.72	142.95
400	57.83	4	0.0526	5.2632	1197.60	176.96	147.76
420	58.87	4.2	0.0553	5.5263	1200.94	180.14	150.00
440	59.83	4.4	0.0579	5.7895	1204.29	183.08	152.02
460	60.86	4.6	0.0605	6.0526	1207.67	186.23	154.21
480	61.95	4.8	0.0632	6.3158	1211.06	189.57	156.53
500	62.92	5	0.0658	6.5789	1214.47	192.54	158.53
520	63.88	5.2	0.0684	6.8421	1217.90	195.47	160.50
540	64.81	5.4	0.0711	7.1053	1221.35	198.32	162.38
560	65.79	5.6	0.0737	7.3684	1224.82	201.32	164.36
580	66.80	5.8	0.0763	7.6316	1228.31	204.41	166.41
600	67.83	6	0.0789	7.8947	1231.82	207.56	168.50
620	68.84	6.2	0.0816	8.1579	1235.35	210.65	170.52
640	69.86	6.4	0.0842	8.4211	1238.90	213.77	172.55
660	70.95	6.6	0.0868	8.6842	1242.47	217.11	174.74
680	71.98	6.8	0.0895	8.9474	1246.06	220.26	176.76
700	72.99	7	0.0921	9.2105	1249.67	223.35	178.73
720	73.92	7.2	0.0947	9.4737	1253.31	226.20	180.48
740	74.93	7.4	0.0974	9.7368	1256.96	229.29	182.41
760	75.85	7.6	0.1	10	1260.63	232.10	184.11
780	76.89	7.8	0.1026	10.263	1264.33	235.28	186.09
800	77.92	8	0.1053	10.526	1268.05	238.44	188.03
820	78.91	8.2	0.1079	10.789	1271.79	241.46	189.86
840	79.95	8.4	0.1105	11.053	1275.55	244.65	191.80
860	80.99	8.6	0.1132	11.316	1279.34	247.83	193.72
880	81.94	8.8	0.1158	11.579	1283.15	250.74	195.41
900	82.93	9	0.1184	11.842	1286.98	253.77	197.18
920	83.88	9.2	0.1211	12.105	1290.83	256.67	198.84
940	84.87	9.4	0.1237	12.368	1294.71	259.70	200.59
960	85.16	9.6	0.1263	12.632	1298.61	260.59	200.67
980	85.45	9.8	0.1289	12.895	1302.53	261.48	200.75
1000	85.94	10	0.1316	13.158	1306.48	262.98	201.29
1020	86.09	10.2	0.1342	13.421	1310.45	263.44	201.03
1040	86.44	10.4	0.1368	13.684	1314.44	264.51	201.23
1060	86.92	10.6	0.1395	13.947	1318.46	265.98	201.73
1080	87.36	10.8	0.1421	14.211	1322.51	267.32	202.13
1100	87.36	11	0.1447	14.474	1326.58	267.32	201.51
1120	87.36	11.2	0.1474	14.737	1330.67	267.32	200.89
1140	86.82	11.4	0.15	15	1334.79	265.67	199.03
1160	86.82	11.6	0.1526	15.263	1338.94	265.67	198.42
1180	86.82	11.8	0.1553	15.526	1343.11	265.67	197.80
1200	86.82	12	0.1579	15.789	1347.30	265.67	197.19



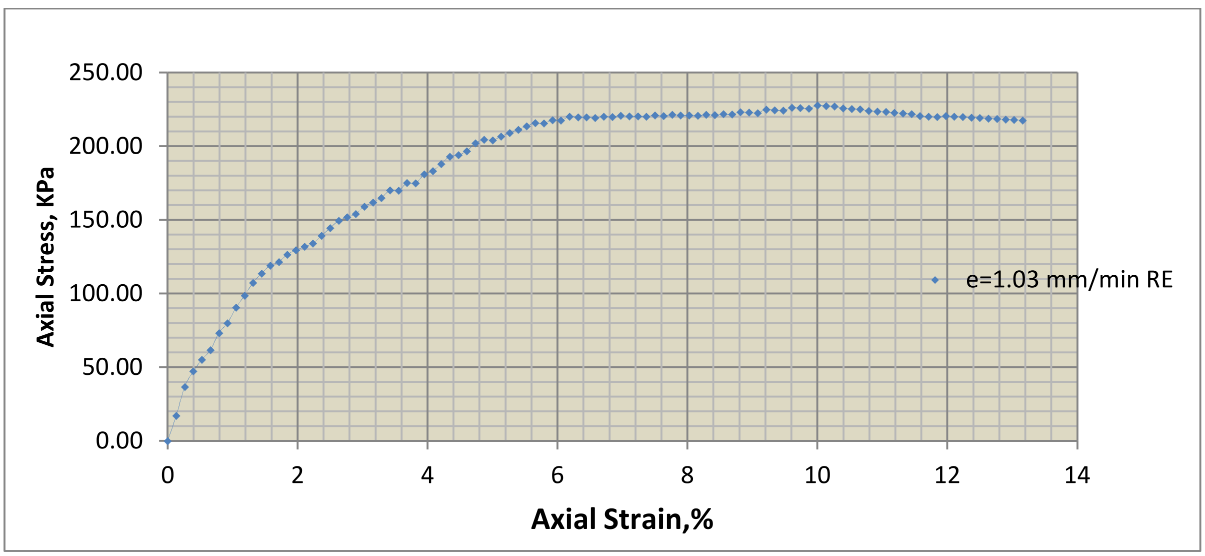
Remark:	**Unconfined Compressive Strength (qu)=**	**202.13**	**KPa**
	Cohesion© = (qu/2) =	**101.07**	**KPa**
	Failure strain=	**14.21%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	B10
Height (mm)	76.00	Mass Cont.	35.32
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.20
Volume cc	86.23	Mass Cont.+dry soil	72.88
Mass (gm)	161.81	Mass dry soil	37.56
Wet Density g/cc	1.88	Mass moisture	12.32
Moisture Content %	32.80	Moisture Content %	32.80
Dry Density g/cc	1.41		

e=1.03 mm/min

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	6.32	0.1	0.00132	0.1316	1136.07	19.34	17.02
20	13.65	0.2	0.00263	0.2632	1137.57	41.77	36.72
30	17.58	0.3	0.00395	0.3947	1139.07	53.79	47.23
40	20.57	0.4	0.00526	0.5263	1140.57	62.94	55.19
50	23.04	0.5	0.00658	0.6579	1142.09	70.50	61.73
60	27.39	0.6	0.00789	0.7895	1143.60	83.81	73.29
70	29.91	0.7	0.00921	0.9211	1145.12	91.52	79.93
80	33.90	0.8	0.01053	1.0526	1146.64	103.73	90.47
90	37.02	0.9	0.01184	1.1842	1148.17	113.28	98.66
100	40.35	1	0.01316	1.3158	1149.70	123.47	107.39
110	42.78	1.1	0.01447	1.4474	1151.23	130.91	113.71
120	44.83	1.2	0.01579	1.5789	1152.77	137.18	119.00
130	45.81	1.3	0.01711	1.7105	1154.32	140.18	121.44
140	47.79	1.4	0.01842	1.8421	1155.86	146.24	126.52
150	48.94	1.5	0.01974	1.9737	1157.42	149.76	129.39
160	49.92	1.6	0.02105	2.1053	1158.97	152.76	131.80
170	50.88	1.7	0.02237	2.2368	1160.53	155.69	134.16
180	52.91	1.8	0.02368	2.3684	1162.09	161.90	139.32
190	54.93	1.9	0.025	2.5	1163.66	168.09	144.45
200	56.89	2	0.02632	2.6316	1165.24	174.08	149.40
210	57.94	2.1	0.02763	2.7632	1166.81	177.30	151.95
220	58.81	2.2	0.02895	2.8947	1168.39	179.96	154.02
230	60.85	2.3	0.03026	3.0263	1169.98	186.20	159.15
240	61.98	2.4	0.03158	3.1579	1171.57	189.66	161.88
250	63.26	2.5	0.03289	3.2895	1173.16	193.58	165.00
260	65.28	2.6	0.03421	3.4211	1174.76	199.76	170.04
270	65.28	2.7	0.03553	3.5526	1176.36	199.76	169.81
280	67.39	2.8	0.03684	3.6842	1177.97	206.21	175.06
290	67.39	2.9	0.03816	3.8158	1179.58	206.21	174.82
300	69.83	3	0.03947	3.9474	1181.20	213.68	180.90
310	70.82	3.1	0.04079	4.0789	1182.82	216.71	183.21
320	72.79	3.2	0.04211	4.2105	1184.44	222.74	188.05
330	74.81	3.3	0.04342	4.3421	1186.07	228.92	193.01
340	75.33	3.4	0.04474	4.4737	1187.71	230.51	194.08
350	76.44	3.5	0.04605	4.6053	1189.34	233.91	196.67
360	78.68	3.6	0.04737	4.7368	1190.99	240.76	202.15
370	79.67	3.7	0.04868	4.8684	1192.63	243.79	204.41
380	79.67	3.8	0.05	5	1194.29	243.79	204.13
390	80.75	3.9	0.05132	5.1316	1195.94	247.10	206.61
400	81.78	4	0.05263	5.2632	1197.60	250.25	208.96
410	82.81	4.1	0.05395	5.3947	1199.27	253.40	211.29
420	83.83	4.2	0.05526	5.5263	1200.94	256.52	213.60
430	84.80	4.3	0.05658	5.6579	1202.61	259.49	215.77
440	84.80	4.4	0.05789	5.7895	1204.29	259.49	215.47
450	85.84	4.5	0.05921	5.9211	1205.98	262.67	217.81
460	85.84	4.6	0.06053	6.0526	1207.67	262.67	217.50
470	86.96	4.7	0.06184	6.1842	1209.36	266.10	220.03
480	86.96	4.8	0.06316	6.3158	1211.06	266.10	219.72
490	87.06	4.9	0.06447	6.4474	1212.76	266.40	219.67
500	87.06	5	0.06579	6.5789	1214.47	266.40	219.36

510	87.53	5.1	0.06711	6.7105	1216.18	267.84	220.23
520	87.53	5.2	0.06842	6.8421	1217.90	267.84	219.92
530	87.98	5.3	0.06974	6.9737	1219.62	269.22	220.74
540	87.98	5.4	0.07105	7.1053	1221.35	269.22	220.43
550	88.11	5.5	0.07237	7.2368	1223.08	269.62	220.44
560	88.11	5.600	0.07368	7.3684	1224.82	269.62	220.13
570	88.56	5.700	0.075	7.5	1226.56	270.99	220.94
580	88.56	5.8	0.07632	7.6316	1228.31	270.99	220.62
590	88.99	5.9	0.07763	7.7632	1230.06	272.31	221.38
600	88.99	6	0.07895	7.8947	1231.82	272.31	221.06
610	89.10	6.1	0.08026	8.0263	1233.58	272.65	221.02
620	89.10	6.2	0.08158	8.1579	1235.35	272.65	220.70
630	89.54	6.3	0.08289	8.2895	1237.12	273.99	221.48
640	89.54	6.4	0.08421	8.4211	1238.90	273.99	221.16
650	89.97	6.5	0.08553	8.5526	1240.68	275.31	221.90
660	89.97	6.6	0.08684	8.6842	1242.47	275.31	221.58
670	90.78	6.7	0.08816	8.8158	1244.26	277.79	223.25
680	90.78	6.8	0.08947	8.9474	1246.06	277.79	222.93
690	90.78	6.9	0.09079	9.0789	1247.86	277.79	222.61
700	91.83	7	0.09211	9.2105	1249.67	281.00	224.86
710	91.83	7.1	0.09342	9.3421	1251.49	281.00	224.53
720	91.83	7.2	0.09474	9.4737	1253.31	281.00	224.21
730	92.79	7.3	0.09605	9.6053	1255.13	283.94	226.22
740	92.79	7.4	0.09737	9.7368	1256.96	283.94	225.89
750	92.79	7.5	0.09868	9.8684	1258.79	283.94	225.56
760	93.80	7.6	0.1	10	1260.63	287.03	227.69
770	93.80	7.7	0.10132	10.132	1262.48	287.03	227.35
780	93.80	7.8	0.10263	10.263	1264.33	287.03	227.02
790	93.41	7.9	0.10395	10.395	1266.19	285.83	225.74
800	93.41	8	0.10526	10.526	1268.05	285.83	225.41
810	93.41	8.1	0.10658	10.658	1269.92	285.83	225.08
820	93.08	8.2	0.10789	10.789	1271.79	284.82	223.96
830	93.08	8.3	0.10921	10.921	1273.67	284.82	223.63
840	93.08	8.4	0.11053	11.053	1275.55	284.82	223.30
850	92.94	8.5	0.11184	11.184	1277.44	284.40	222.63
860	92.94	8.6	0.11316	11.316	1279.34	284.40	222.30
870	92.94	8.7	0.11447	11.447	1281.24	284.40	221.97
880	92.48	8.8	0.11579	11.579	1283.15	282.99	220.54
890	92.48	8.9	0.11711	11.711	1285.06	282.99	220.21
900	92.48	9	0.11842	11.842	1286.98	282.99	219.89
910	92.89	9.1	0.11974	11.974	1288.90	284.24	220.53
920	92.89	9.2	0.12105	12.105	1290.83	284.24	220.20
930	92.89	9.3	0.12237	12.237	1292.77	284.24	219.87
940	92.89	9.4	0.12368	12.368	1294.71	284.24	219.54
950	92.89	9.5	0.125	12.5	1296.65	284.24	219.21
960	92.89	9.6	0.12632	12.632	1298.61	284.24	218.88
970	92.89	9.7	0.12763	12.763	1300.56	284.24	218.55
980	92.89	9.8	0.12895	12.895	1302.53	284.24	218.22
990	92.89	9.9	0.13026	13.026	1304.50	284.24	217.89
1000	92.89	10	0.13158	13.158	1306.48	284.24	217.56

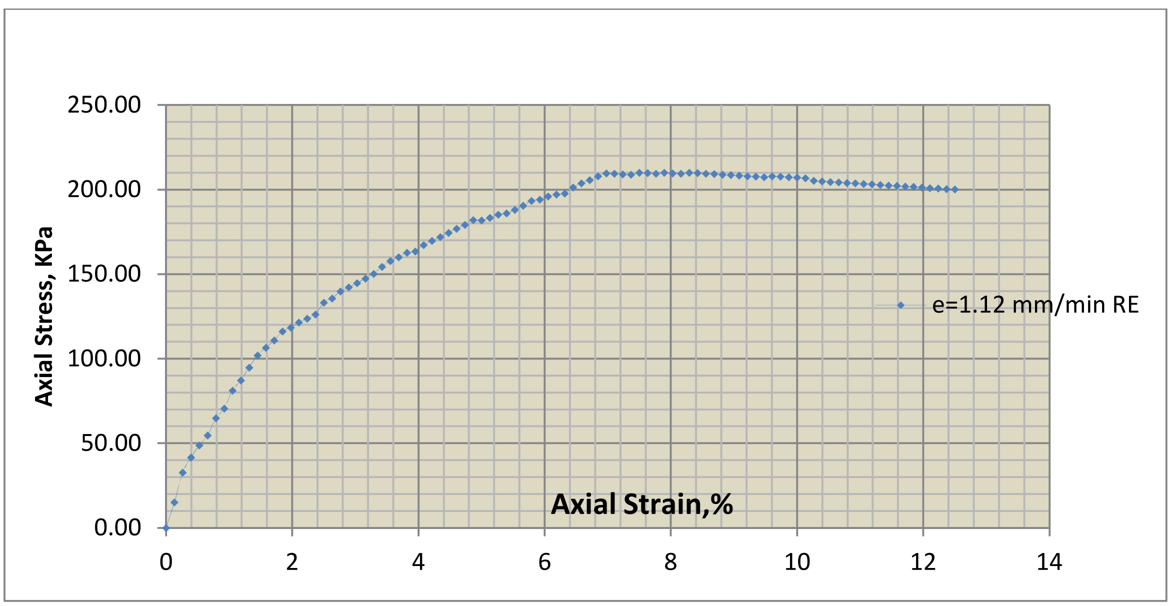


Remark:	**Unconfined Compressive Strength (qu)=**	**227.02**	**KPa**
	Cohesion© = (qu/2) =	**113.51**	**KPa**
	Failure strain=	**10.26%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	A4
Height (mm)	76.00	Mass Cont.	35.50
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.82
Volume cc	86.23	Mass Cont.+dry soil	73.39
Mass (gm)	160.98	Mass dry soil	37.89
Wet Density g/cc	1.87	Mass moisture	12.43
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.41		
e=1.12 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	5.62	0.1	0.0013	0.1316	1136.07	17.20	15.14
20	12.14	0.2	0.0026	0.2632	1137.57	37.15	32.66
30	15.49	0.3	0.0039	0.3947	1139.07	47.40	41.61
40	18.20	0.4	0.0053	0.5263	1140.57	55.69	48.83
50	20.42	0.5	0.0066	0.6579	1142.09	62.49	54.71
60	24.26	0.6	0.0079	0.7895	1143.60	74.24	64.91
70	26.38	0.7	0.0092	0.9211	1145.12	80.72	70.49
80	30.43	0.8	0.0105	1.0526	1146.64	93.12	81.21
90	32.74	0.9	0.0118	1.1842	1148.17	100.18	87.26
100	35.65	1	0.0132	1.3158	1149.70	109.09	94.88
110	38.34	1.1	0.0145	1.4474	1151.23	117.32	101.91
120	40.11	1.2	0.0158	1.5789	1152.77	122.74	106.47
130	41.83	1.3	0.0171	1.7105	1154.32	128.00	110.89
140	43.86	1.4	0.0184	1.8421	1155.86	134.21	116.11
150	44.82	1.5	0.0197	1.9737	1157.42	137.15	118.50
160	45.98	1.6	0.0211	2.1053	1158.97	140.70	121.40
170	46.97	1.7	0.0224	2.2368	1160.53	143.73	123.85
180	47.94	1.8	0.0237	2.3684	1162.09	146.70	126.23
190	50.69	1.9	0.025	2.5	1163.66	155.11	133.30
200	51.67	2	0.0263	2.6316	1165.24	158.11	135.69
210	53.32	2.1	0.0276	2.7632	1166.81	163.16	139.83
220	54.34	2.2	0.0289	2.8947	1168.39	166.28	142.32
230	55.35	2.3	0.0303	3.0263	1169.98	169.37	144.76
240	56.47	2.4	0.0316	3.1579	1171.57	172.80	147.49
250	57.64	2.5	0.0329	3.2895	1173.16	176.38	150.34
260	59.29	2.6	0.0342	3.4211	1174.76	181.43	154.44
270	60.65	2.7	0.0355	3.5526	1176.36	185.59	157.77
280	61.65	2.8	0.0368	3.6842	1177.97	188.65	160.15
290	62.71	2.9	0.0382	3.8158	1179.58	191.89	162.68
300	63.13	3	0.0395	3.9474	1181.20	193.18	163.54
310	64.68	3.1	0.0408	4.0789	1182.82	197.92	167.33
320	65.69	3.2	0.0421	4.2105	1184.44	201.01	169.71
330	66.71	3.3	0.0434	4.3421	1186.07	204.13	172.11
340	67.72	3.4	0.0447	4.4737	1187.71	207.22	174.47
350	68.74	3.5	0.0461	4.6053	1189.34	210.34	176.86
360	69.76	3.6	0.0474	4.7368	1190.99	213.47	179.23
370	70.98	3.7	0.0487	4.8684	1192.63	217.20	182.12
380	70.98	3.8	0.05	5	1194.29	217.20	181.87
390	71.67	3.9	0.0513	5.1316	1195.94	219.31	183.38
400	72.49	4	0.0526	5.2632	1197.60	221.82	185.22
410	72.94	4.1	0.0539	5.3947	1199.27	223.20	186.11
420	73.85	4.2	0.0553	5.5263	1200.94	225.98	188.17
430	74.87	4.3	0.0566	5.6579	1202.61	229.10	190.50
440	76.12	4.4	0.0579	5.7895	1204.29	232.93	193.41
450	76.55	4.5	0.0592	5.9211	1205.98	234.24	194.23
460	77.38	4.6	0.0605	6.0526	1207.67	236.78	196.07
470	77.94	4.7	0.0618	6.1842	1209.36	238.50	197.21
480	78.27	4.8	0.0632	6.3158	1211.06	239.51	197.77
490	79.82	4.9	0.0645	6.4474	1212.76	244.25	201.40
500	80.89	5	0.0658	6.5789	1214.47	247.52	203.81

510	81.73	5.1	0.0671	6.7105	1216.18	250.09	205.64
520	82.76	5.2	0.0684	6.8421	1217.90	253.25	207.94
530	83.59	5.3	0.0697	6.9737	1219.62	255.79	209.72
540	83.59	5.4	0.0711	7.1053	1221.35	255.79	209.43
550	83.59	5.5	0.0724	7.2368	1223.08	255.79	209.13
560	83.59	5.6	0.0737	7.3684	1224.82	255.79	208.83
570	84.23	5.7	0.075	7.5	1226.56	257.74	210.13
580	84.23	5.8	0.0763	7.6316	1228.31	257.74	209.84
590	84.23	5.9	0.0776	7.7632	1230.06	257.74	209.54
600	84.54	6	0.0789	7.8947	1231.82	258.69	210.01
610	84.54	6.1	0.0803	8.0263	1233.58	258.69	209.71
620	84.54	6.2	0.0816	8.1579	1235.35	258.69	209.41
630	84.96	6.3	0.0829	8.2895	1237.12	259.98	210.15
640	84.96	6.4	0.0842	8.4211	1238.90	259.98	209.85
650	84.96	6.5	0.0855	8.5526	1240.68	259.98	209.54
660	84.96	6.6	0.0868	8.6842	1242.47	259.98	209.24
670	84.96	6.7	0.0882	8.8158	1244.26	259.98	208.94
680	84.96	6.8	0.0895	8.9474	1246.06	259.98	208.64
690	84.96	6.9	0.0908	9.0789	1247.86	259.98	208.34
700	84.96	7	0.0921	9.2105	1249.67	259.98	208.04
710	84.96	7.1	0.0934	9.3421	1251.49	259.98	207.74
720	84.96	7.2	0.0947	9.4737	1253.31	259.98	207.43
730	85.33	7.3	0.0961	9.6053	1255.13	261.11	208.03
740	85.33	7.4	0.0974	9.7368	1256.96	261.11	207.73
750	85.33	7.5	0.0987	9.8684	1258.79	261.11	207.43
760	85.33	7.6	0.1	10	1260.63	261.11	207.13
770	85.33	7.7	0.1013	10.132	1262.48	261.11	206.82
780	84.81	7.8	0.1026	10.263	1264.33	259.52	205.26
790	84.81	7.9	0.1039	10.395	1266.19	259.52	204.96
800	84.81	8	0.1053	10.526	1268.05	259.52	204.66
810	84.81	8.1	0.1066	10.658	1269.92	259.52	204.36
820	84.81	8.2	0.1079	10.789	1271.79	259.52	204.06
830	84.81	8.3	0.1092	10.921	1273.67	259.52	203.76
840	84.81	8.4	0.1105	11.053	1275.55	259.52	203.46
850	84.81	8.5	0.1118	11.184	1277.44	259.52	203.15
860	84.81	8.6	0.1132	11.316	1279.34	259.52	202.85
870	84.81	8.7	0.1145	11.447	1281.24	259.52	202.55
880	84.81	8.8	0.1158	11.579	1283.15	259.52	202.25
890	84.81	8.9	0.1171	11.711	1285.06	259.52	201.95
900	84.81	9	0.1184	11.842	1286.98	259.52	201.65
910	84.81	9.1	0.1197	11.974	1288.90	259.52	201.35
920	84.81	9.2	0.1211	12.105	1290.83	259.52	201.05
930	84.81	9.3	0.1224	12.237	1292.77	259.52	200.75
940	84.81	9.4	0.1237	12.368	1294.71	259.52	200.45
950	84.81	9.5	0.125	12.5	1296.65	259.52	200.14

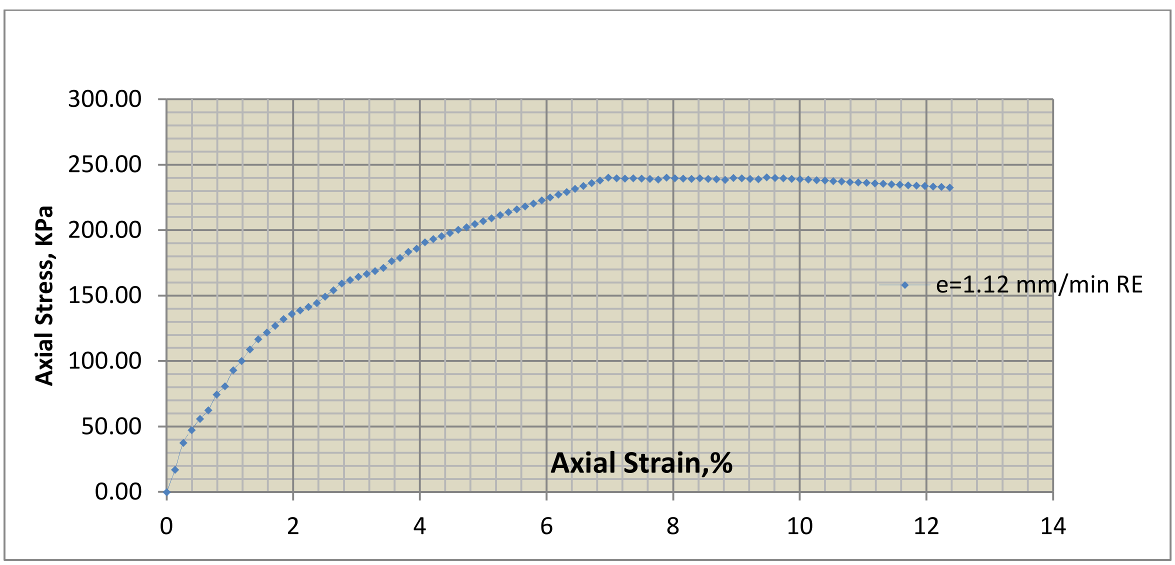


Remark:	**Unconfined Compressive Strength (qu)=**	**208.03**	**KPa**
	Cohesion© = (qu/2) =	**104.02**	**KPa**
	Failure strain=	**9.60%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 3		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	Z8
Height (mm)	76.00	Mass Cont.	35.40
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	86.00
Volume cc	86.23	Mass Cont.+dry soil	73.49
Mass (gm)	162.11	Mass dry soil	38.09
Wet Density g/cc	1.88	Mass moisture	12.51
Moisture Content %	32.84	Moisture Content %	32.84
Dry Density g/cc	1.42		
e=1.12 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	6.35	0.1	0.0013	0.1316	1136.07	19.43	17.10
20	14.02	0.2	0.0026	0.2632	1137.57	42.90	37.71
30	17.65	0.3	0.0039	0.3947	1139.07	54.01	47.42
40	20.84	0.4	0.0053	0.5263	1140.57	63.77	55.91
50	23.32	0.5	0.0066	0.6579	1142.09	71.36	62.48
60	27.82	0.6	0.0079	0.7895	1143.60	85.13	74.44
70	30.28	0.7	0.0092	0.9211	1145.12	92.66	80.91
80	34.91	0.8	0.0105	1.0526	1146.64	106.82	93.16
90	37.58	0.9	0.0118	1.1842	1148.17	114.99	100.16
100	41	1	0.0132	1.3158	1149.70	125.46	109.12
110	43.97	1.1	0.0145	1.4474	1151.23	134.55	116.87
120	45.98	1.2	0.0158	1.5789	1152.77	140.70	122.05
130	47.95	1.3	0.0171	1.7105	1154.32	146.73	127.11
140	49.94	1.4	0.0184	1.8421	1155.86	152.82	132.21
150	51.49	1.5	0.0197	1.9737	1157.42	157.56	136.13
160	52.58	1.6	0.0211	2.1053	1158.97	160.89	138.83
170	53.67	1.7	0.0224	2.2368	1160.53	164.23	141.51
180	54.85	1.8	0.0237	2.3684	1162.09	167.84	144.43
190	56.76	1.9	0.025	2.5	1163.66	173.69	149.26
200	58.73	2	0.0263	2.6316	1165.24	179.71	154.23
210	60.81	2.1	0.0276	2.7632	1166.81	186.08	159.48
220	61.83	2.2	0.0289	2.8947	1168.39	189.20	161.93
230	62.85	2.3	0.0303	3.0263	1169.98	192.32	164.38
240	63.84	2.4	0.0316	3.1579	1171.57	195.35	166.74
250	64.79	2.5	0.0329	3.2895	1173.16	198.26	168.99
260	65.8	2.6	0.0342	3.4211	1174.76	201.35	171.39
270	67.81	2.7	0.0355	3.5526	1176.36	207.50	176.39
280	68.84	2.8	0.0368	3.6842	1177.97	210.65	178.82
290	70.78	2.9	0.0382	3.8158	1179.58	216.59	183.61
300	71.82	3	0.0395	3.9474	1181.20	219.77	186.06
310	73.8	3.1	0.0408	4.0789	1182.82	225.83	190.92
320	74.82	3.2	0.0421	4.2105	1184.44	228.95	193.30
330	75.83	3.3	0.0434	4.3421	1186.07	232.04	195.64
340	76.81	3.4	0.0447	4.4737	1187.71	235.04	197.89
350	77.86	3.5	0.0461	4.6053	1189.34	238.25	200.32
360	78.79	3.6	0.0474	4.7368	1190.99	241.10	202.44
370	79.82	3.7	0.0487	4.8684	1192.63	244.25	204.80
380	80.84	3.8	0.05	5	1194.29	247.37	207.13
390	81.78	3.9	0.0513	5.1316	1195.94	250.25	209.25
400	82.85	4	0.0526	5.2632	1197.60	253.52	211.69
410	83.82	4.1	0.0539	5.3947	1199.27	256.49	213.87
420	84.83	4.2	0.0553	5.5263	1200.94	259.58	216.15
430	85.82	4.3	0.0566	5.6579	1202.61	262.61	218.37
440	86.79	4.4	0.0579	5.7895	1204.29	265.58	220.53
450	87.84	4.5	0.0592	5.9211	1205.98	268.79	222.88
460	88.86	4.6	0.0605	6.0526	1207.67	271.91	225.15
470	89.83	4.7	0.0618	6.1842	1209.36	274.88	227.29
480	90.78	4.8	0.0632	6.3158	1211.06	277.79	229.38
490	91.81	4.9	0.0645	6.4474	1212.76	280.94	231.65
500	92.83	5	0.0658	6.5789	1214.47	284.06	233.90

510	93.82	5.1	0.0671	6.7105	1216.18	287.09	236.06
520	94.80	5.2	0.0684	6.8421	1217.90	290.09	238.19
530	95.74	5.3	0.0697	6.9737	1219.62	292.96	240.21
540	95.74	5.4	0.0711	7.1053	1221.35	292.96	239.87
550	95.74	5.5	0.0724	7.2368	1223.08	292.96	239.53
560	96.02	5.6	0.0737	7.3684	1224.82	293.82	239.89
570	96.02	5.7	0.075	7.5	1226.56	293.82	239.55
580	96.02	5.8	0.0763	7.6316	1228.31	293.82	239.21
590	96.02	5.9	0.0776	7.7632	1230.06	293.82	238.87
600	96.71	6	0.0789	7.8947	1231.82	295.93	240.24
610	96.71	6.1	0.0803	8.0263	1233.58	295.93	239.90
620	96.71	6.2	0.0816	8.1579	1235.35	295.93	239.55
630	96.71	6.3	0.0829	8.2895	1237.12	295.93	239.21
640	97.04	6.4	0.0842	8.4211	1238.90	296.94	239.68
650	97.04	6.5	0.0855	8.5526	1240.68	296.94	239.34
660	97.04	6.6	0.0868	8.6842	1242.47	296.94	238.99
670	97.04	6.7	0.0882	8.8158	1244.26	296.94	238.65
680	97.75	6.8	0.0895	8.9474	1246.06	299.12	240.05
690	97.75	6.9	0.0908	9.0789	1247.86	299.12	239.70
700	97.75	7	0.0921	9.2105	1249.67	299.12	239.35
710	97.75	7.1	0.0934	9.3421	1251.49	299.12	239.01
720	98.53	7.2	0.0947	9.4737	1253.31	301.50	240.57
730	98.48	7.3	0.0961	9.6053	1255.13	301.35	240.09
740	98.48	7.4	0.0974	9.7368	1256.96	301.35	239.74
750	98.48	7.5	0.0987	9.8684	1258.79	301.35	239.39
760	98.48	7.6	0.1	10	1260.63	301.35	239.05
770	98.48	7.7	0.1013	10.132	1262.48	301.35	238.70
780	98.48	7.8	0.1026	10.263	1264.33	301.35	238.35
790	98.48	7.9	0.1039	10.395	1266.19	301.35	238.00
800	98.48	8	0.1053	10.526	1268.05	301.35	237.65
810	98.48	8.1	0.1066	10.658	1269.92	301.35	237.30
820	98.48	8.2	0.1079	10.789	1271.79	301.35	236.95
830	98.48	8.3	0.1092	10.921	1273.67	301.35	236.60
840	98.48	8.4	0.1105	11.053	1275.55	301.35	236.25
850	98.48	8.5	0.1118	11.184	1277.44	301.35	235.90
860	98.48	8.6	0.1132	11.316	1279.34	301.35	235.55
870	98.48	8.7	0.1145	11.447	1281.24	301.35	235.20
880	98.48	8.8	0.1158	11.579	1283.15	301.35	234.85
890	98.48	8.9	0.1171	11.711	1285.06	301.35	234.50
900	98.48	9	0.1184	11.842	1286.98	301.35	234.15
910	98.48	9.1	0.1197	11.974	1288.90	301.35	233.80
920	98.48	9.2	0.1211	12.105	1290.83	301.35	233.45
930	98.48	9.3	0.1224	12.237	1292.77	301.35	233.10
940	98.48	9.4	0.1237	12.368	1294.71	301.35	232.75



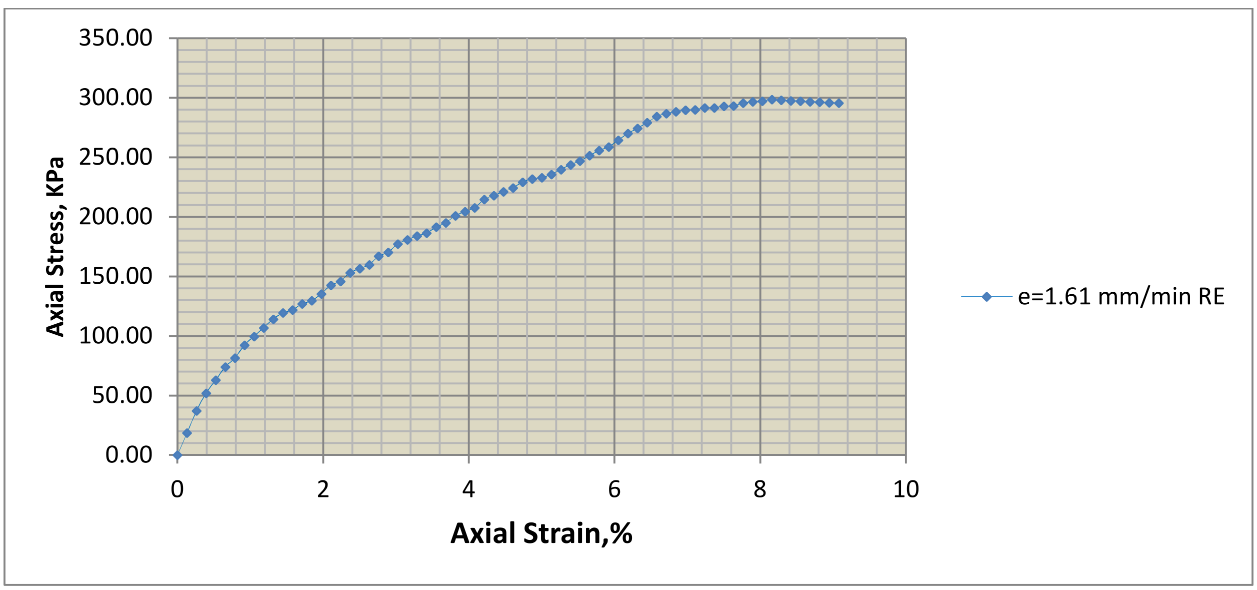
Remark:	**Unconfined Compressive Strength (qu)=**	**240.57**	**KPa**
	Cohesion© = (qu/2) =	**120.28**	**KPa**
	Failure strain=	**9.47%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternination**	
Diameter (mm)	38.0	Can No.	G1
Height (mm)	76.0	Mass Cont.	35.6
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	85.62
Volume cc	86.2	Mass Cont.+dry soil	73.26
Mass (gm)	161.8	Mass dry soil	37.66
Wet Density g/cc	1.9	Mass moisture	12.36
Moisture Content %	32.8	Moisture Content %	32.82
Dry Density g/cc	1.4		

e=1.61 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (Kpa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	6.92	0.1	0.001316	0.131579	1136.07	21.18	18.64
20	13.85	0.2	0.002632	0.263158	1137.57	42.38	37.26
30	19.38	0.3	0.003947	0.394737	1139.07	59.30	52.06
40	23.53	0.4	0.005263	0.526316	1140.57	72.00	63.13
50	27.69	0.5	0.006579	0.657895	1142.09	84.73	74.19
60	30.46	0.6	0.007895	0.789474	1143.60	93.21	81.50
70	34.60	0.7	0.009211	0.921053	1145.12	105.88	92.46
80	37.38	0.8	0.010526	1.052632	1146.64	114.38	99.75
90	40.14	0.9	0.011842	1.184211	1148.17	122.83	106.98
100	42.91	1	0.013158	1.315789	1149.70	131.30	114.21
110	44.92	1.1	0.014474	1.447368	1151.23	137.46	119.40
120	45.94	1.2	0.015789	1.578947	1152.77	140.58	121.95
130	47.89	1.3	0.017105	1.710526	1154.32	146.54	126.95
140	48.97	1.4	0.018421	1.842105	1155.86	149.85	129.64
150	51.21	1.5	0.019737	1.973684	1157.42	156.70	135.39
160	53.99	1.6	0.021053	2.105263	1158.97	165.21	142.55
170	55.37	1.7	0.022368	2.236842	1160.53	169.43	146.00
180	58.14	1.8	0.023684	2.368421	1162.09	177.91	153.09
190	59.53	1.9	0.025	2.5	1163.66	182.16	156.54
200	60.91	2	0.026316	2.631579	1165.24	186.38	159.95
210	63.68	2.1	0.027632	2.763158	1166.81	194.86	167.00
220	65.06	2.2	0.028947	2.894737	1168.39	199.08	170.39
230	67.84	2.3	0.030263	3.026316	1169.98	207.59	177.43

240	69.22	2.4	0.031579	3.157895	1171.57	211.81	180.79
250	70.60	2.5	0.032895	3.289474	1173.16	216.04	184.15
260	71.58	2.6	0.034211	3.421053	1174.76	219.03	186.45
270	73.61	2.7	0.035526	3.552632	1176.36	225.25	191.48
280	75.14	2.8	0.036842	3.684211	1177.97	229.93	195.19
290	77.52	2.9	0.038158	3.815789	1179.58	237.21	201.10
300	78.91	3	0.039474	3.947368	1181.20	241.46	204.42
310	80.29	3.1	0.040789	4.078947	1182.82	245.69	207.71
320	83.06	3.2	0.042105	4.210526	1184.44	254.16	214.58
330	84.45	3.3	0.043421	4.342105	1186.07	258.42	217.88
340	85.83	3.4	0.044737	4.473684	1187.71	262.64	221.13
350	87.21	3.5	0.046053	4.605263	1189.34	266.86	224.38
360	89.23	3.6	0.047368	4.736842	1190.99	273.04	229.26
370	90.37	3.7	0.048684	4.868421	1192.63	276.53	231.87
380	90.89	3.8	0.05	5	1194.29	278.12	232.88
390	92.13	3.9	0.051316	5.131579	1195.94	281.92	235.73
400	93.87	4	0.052632	5.263158	1197.60	287.24	239.85
410	95.52	4.1	0.053947	5.394737	1199.27	292.29	243.72
420	96.90	4.2	0.06	5.53	1200.94	296.51	246.90
430	98.87	4.3	0.056579	5.657895	1202.61	302.54	251.57
440	100.66	4.4	0.057895	5.789474	1204.29	308.02	255.77
450	102.04	4.5	0.059211	5.921053	1205.98	312.24	258.91
460	104.40	4.6	0.060526	6.052632	1207.67	319.46	264.53
470	106.76	4.7	0.061842	6.184211	1209.36	326.69	270.13
480	108.63	4.8	0.063158	6.315789	1211.06	332.41	274.48
490	110.62	4.9	0.064474	6.447368	1212.76	338.50	279.11
500	112.81	5	0.065789	6.578947	1214.47	345.20	284.24
510	113.96	5.1	0.067105	6.710526	1216.18	348.72	286.73
520	114.83	5.2	0.068421	6.842105	1217.90	351.38	288.51
530	115.49	5.3	0.069737	6.973684	1219.62	353.40	289.76
540	115.72	5.4	0.071053	7.105263	1221.35	354.10	289.93
550	116.53	5.5	0.072368	7.236842	1223.08	356.58	291.54
560	116.74	5.6	0.073684	7.368421	1224.82	357.22	291.65
570	117.44	5.7	0.075	7.5	1226.56	359.37	292.99
580	117.68	5.8	0.076316	7.631579	1228.31	360.10	293.17
590	118.81	5.9	0.077632	7.763158	1230.06	363.56	295.56
600	119.48	6	0.078947	7.894737	1231.82	365.61	296.80
610	119.87	6.1	0.080263	8.026316	1233.58	366.80	297.35
620	120.51	6.2	0.081579	8.157895	1235.35	368.76	298.51
630	120.51	6.3	0.082895	8.289474	1237.12	368.76	298.08
640	120.51	6.4	0.084211	8.421053	1238.90	368.76	297.65
650	120.51	6.5	0.085526	8.552632	1240.68	368.76	297.22
660	120.51	6.6	0.086842	8.684211	1242.47	368.76	296.80
670	120.51	6.7	0.088158	8.815789	1244.26	368.76	296.37
680	120.51	6.8	0.089474	8.947368	1246.06	368.76	295.94
690	120.51	6.9	0.090789	9.078947	1247.86	368.76	295.51



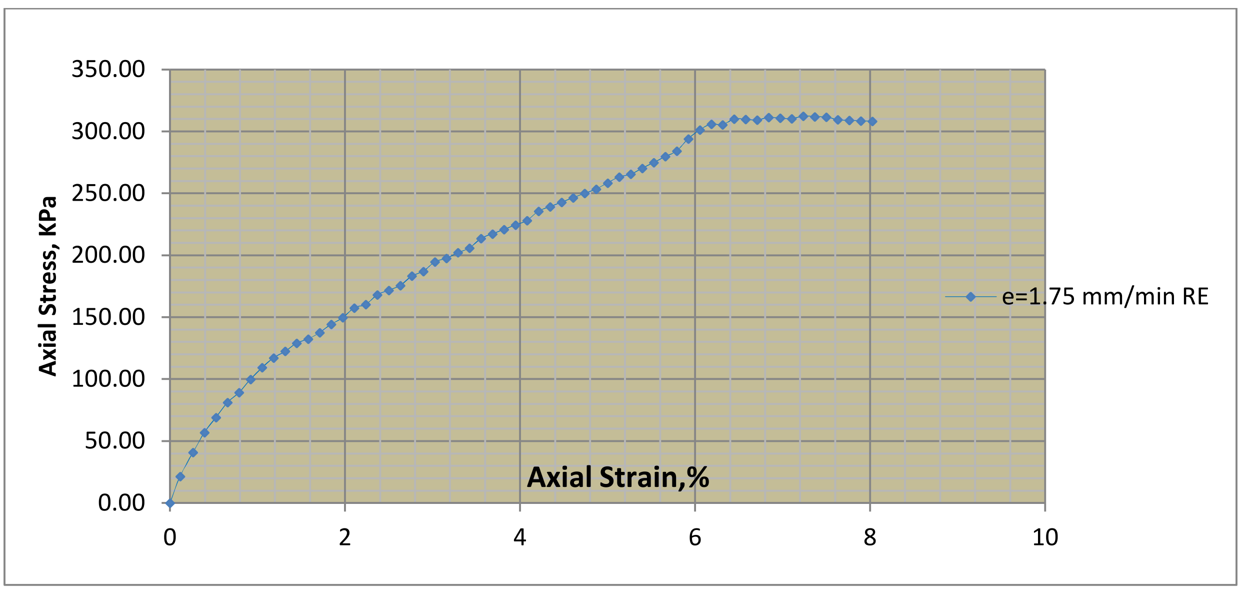
Remark:	**Unconfined Compressive Strength (qu)=**	**298.51**	**KPa**
	Cohesion© = (qu/2) =	**149.25**	**KPa**
	Failure strain=	**8.16%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : 1	
Location :Kolfe Area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :4/27/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.00	Can No.	M8
Height (mm)	76.00	Mass Cont.	37.4
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	88.45
Volume cc	86.23	Mass Cont.+dry soil	75.83
Mass (gm)	162.37	Mass dry soil	38.43
Wet Density g/cc	1.88	Mass moisture	12.62
Moisture Content %	32.84	Moisture Content %	32.84
Dry Density g/cc	1.42		

e=1.75 mm/min

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (Kpa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	8.03	0.1	0.001316	0.115972	1136.07	24.57	21.63
20	15.17	0.2	0.002632	0.263158	1137.57	46.42	40.81
30	21.24	0.3	0.003947	0.394737	1139.07	64.99	57.06
40	25.79	0.4	0.005263	0.526316	1140.57	78.92	69.19
50	30.34	0.5	0.006579	0.657895	1142.09	92.84	81.29
60	33.37	0.6	0.007895	0.789474	1143.60	102.11	89.29
70	37.41	0.7	0.009211	0.921053	1145.12	114.47	99.97
80	40.96	0.8	0.010526	1.052632	1146.64	125.34	109.31
90	44.00	0.9	0.011842	1.184211	1148.17	134.64	117.27
100	46.03	1	0.013158	1.315789	1149.70	140.85	122.51
110	48.61	1.1	0.014474	1.447368	1151.23	148.75	129.21
120	49.92	1.2	0.015789	1.578947	1152.77	152.76	132.51
130	51.94	1.3	0.017105	1.710526	1154.32	158.94	137.69
140	54.56	1.4	0.018421	1.842105	1155.86	166.95	144.44
150	56.61	1.5	0.019737	1.973684	1157.42	173.23	149.67
160	59.69	1.6	0.021053	2.105263	1158.97	182.65	157.60
170	60.81	1.7	0.022368	2.236842	1160.53	186.08	160.34
180	63.85	1.8	0.023684	2.368421	1162.09	195.38	168.13
190	65.36	1.9	0.025	2.5	1163.66	200.00	171.87
200	66.88	2	0.026316	2.631579	1165.24	204.65	175.63
210	69.92	2.1	0.027632	2.763158	1166.81	213.96	183.37
220	71.44	2.2	0.028947	2.894737	1168.39	218.61	187.10
230	74.48	2.3	0.030263	3.026316	1169.98	227.91	194.80

240	75.61	2.4	0.031579	3.157895	1171.57	231.37	197.48
250	77.52	2.5	0.032895	3.289474	1173.16	237.21	202.20
260	79.04	2.6	0.034211	3.421053	1174.76	241.86	205.88
270	82.08	2.7	0.035526	3.552632	1176.36	251.16	213.51
280	83.61	2.8	0.036842	3.684211	1177.97	255.85	217.19
290	85.12	2.9	0.038158	3.815789	1179.58	260.47	220.81
300	86.64	3	0.039474	3.947368	1181.20	265.12	224.45
310	88.16	3.1	0.040789	4.078947	1182.82	269.77	228.07
320	91.20	3.2	0.042105	4.210526	1184.44	279.07	235.61
330	92.72	3.3	0.043421	4.342105	1186.07	283.72	239.21
340	94.24	3.4	0.044737	4.473684	1187.71	288.37	242.80
350	95.76	3.5	0.046053	4.605263	1189.34	293.03	246.38
360	97.29	3.6	0.047368	4.736842	1190.99	297.71	249.97
370	98.80	3.7	0.048684	4.868421	1192.63	302.33	253.50
380	100.87	3.8	0.05	5	1194.29	308.66	258.45
390	102.92	3.9	0.051316	5.131579	1195.94	314.94	263.34
400	103.91	4	0.052632	5.263158	1197.60	317.96	265.50
410	105.89	4.1	0.053947	5.394737	1199.27	324.02	270.18
420	107.90	4.2	0.055263	5.526316	1200.94	330.17	274.93
430	109.94	4.3	0.056579	5.657895	1202.61	336.42	279.74
440	111.89	4.4	0.057895	5.789474	1204.29	342.38	284.30
450	115.91	4.5	0.059211	5.921053	1205.98	354.68	294.11
460	118.90	4.6	0.060526	6.052632	1207.67	363.83	301.27
470	120.92	4.7	0.061842	6.184211	1209.36	370.02	305.96
480	120.92	4.8	0.063158	6.315789	1211.06	370.02	305.53
490	122.93	4.9	0.064474	6.447368	1212.76	376.17	310.17
500	122.93	5	0.065789	6.578947	1214.47	376.17	309.74
510	122.93	5.1	0.067105	6.710526	1216.18	376.17	309.30
520	123.89	5.2	0.068421	6.842105	1217.90	379.10	311.28
530	123.89	5.3	0.069737	6.973684	1219.62	379.10	310.84
540	123.89	5.4	0.071053	7.105263	1221.35	379.10	310.40
550	124.87	5.5	0.072368	7.236842	1223.08	382.10	312.41
560	124.87	5.6	0.073684	7.368421	1224.82	382.10	311.97
570	124.87	5.7	0.075	7.5	1226.56	382.10	311.52
580	124.23	5.8	0.076316	7.631579	1228.31	380.14	309.48
590	124.23	5.9	0.077632	7.763158	1230.06	380.14	309.04
600	124.23	6	0.078947	7.894737	1231.82041	380.14	308.60
610	124.23	6.1	0.080263	8.026316	1233.58267	380.14	308.16



Remark:	**Unconfined Compressive Strength (qu)=**	**312.41**	**KPa**
	Cohesion© = (qu/2) =	**156.20**	**KPa**
	Failure strain=	**7.24%**	

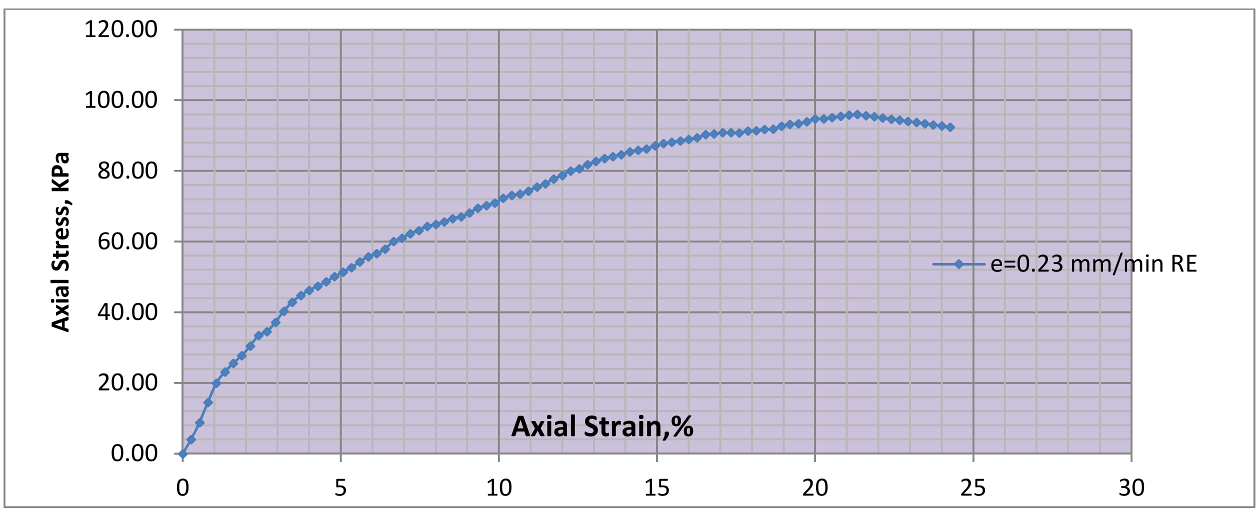
For Remolded Samples of Load Increment (50 kpa -1600 kpa or ε =0.23mm/min-1.14 mm/min)

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.0	Can No.	G2
Height (mm)	75.0	Mass Cont.	37.3
Area (A_o) mm2	1134.6	Mass Cont.+wet soil	88.98
Volume cc	85.1	Mass Cont.+dry soil	76.21
Mass (gm)	159.9	Mass dry soil	38.91
Wet Density g/cc	1.9	Mass moisture	12.77
Moisture Content %	32.8	Moisture Content %	32.82
Dry Density g/cc	1.4		

e=0.23 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	1.50	0.2	0.0027	0.26667	1137.61	4.59	4.03
40	3.31	0.4	0.0053	0.53333	1140.65	10.13	8.88
60	5.45	0.6	0.008	0.8	1143.72	16.68	14.58
80	7.49	0.8	0.0107	1.06667	1146.80	22.92	19.99
100	8.69	1	0.0133	1.33333	1149.90	26.59	23.12
120	9.65	1.2	0.016	1.6	1153.02	29.53	25.61
140	10.49	1.4	0.0187	1.86667	1156.15	32.10	27.76
160	11.55	1.6	0.0213	2.13333	1159.30	35.34	30.49
180	12.71	1.8	0.024	2.4	1162.47	38.89	33.46
200	13.17	2	0.0267	2.66667	1165.66	40.30	34.57
220	14.22	2.2	0.0293	2.93333	1168.86	43.51	37.23
240	15.47	2.4	0.032	3.2	1172.08	47.34	40.39
260	16.48	2.6	0.0347	3.46667	1175.32	50.43	42.91
280	17.24	2.8	0.0373	3.73333	1178.57	52.75	44.76
300	17.85	3	0.04	4	1181.85	54.62	46.22
320	18.36	3.2	0.0427	4.26667	1185.14	56.18	47.41
340	18.91	3.4	0.0453	4.53333	1188.45	57.86	48.69
360	19.52	3.6	0.048	4.8	1191.78	59.73	50.12
380	20.09	3.8	0.0507	5.06667	1195.12	61.48	51.44
400	20.62	4	0.0533	5.33333	1198.49	63.10	52.65
420	21.32	4.2	0.056	5.6	1201.88	65.24	54.28
440	21.97	4.4	0.0587	5.86667	1205.28	67.23	55.78
460	22.39	4.6	0.0613	6.13333	1208.71	68.51	56.68
480	22.93	4.8	0.064	6.4	1212.15	70.17	57.89
500	23.88	5	0.0667	6.66667	1215.61	73.07	60.11
520	24.31	5.2	0.0693	6.93333	1219.10	74.39	61.02
540	24.89	5.4	0.072	7.2	1222.60	76.16	62.30
560	25.33	5.6	0.0747	7.46667	1226.12	77.51	63.22
580	25.87	5.8	0.0773	7.73333	1229.67	79.16	64.38
600	26.15	6	0.08	8	1233.23	80.02	64.89
620	26.53	6.2	0.0827	8.26667	1236.81	81.18	65.64
640	26.98	6.4	0.0853	8.53333	1240.42	82.56	66.56
660	27.26	6.6	0.088	8.8	1244.05	83.42	67.05
680	27.78	6.8	0.0907	9.06667	1247.70	85.01	68.13
700	28.42	7	0.0933	9.33333	1251.37	86.97	69.50
720	28.81	7.2	0.096	9.6	1255.06	88.16	70.24
740	29.21	7.4	0.0987	9.86667	1258.77	89.38	71.01
760	29.85	7.6	0.1013	10.1333	1262.51	91.34	72.35
780	30.28	7.8	0.104	10.4	1266.26	92.66	73.17
800	30.51	8	0.1067	10.6667	1270.04	93.36	73.51

820	30.94	8.2	0.1093	10.9333	1273.85	94.68	74.32
840	31.53	8.4	0.112	11.2	1277.67	96.48	75.51
860	32.01	8.6	0.1147	11.4667	1281.52	97.95	76.43
880	32.66	8.8	0.1173	11.7333	1285.39	99.94	77.75
900	33.19	9	0.12	12	1289.29	101.56	78.77
920	33.83	9.2	0.1227	12.2667	1293.20	103.52	80.05
940	34.19	9.4	0.1253	12.5333	1297.15	104.62	80.65
960	34.80	9.6	0.128	12.8	1301.11	106.49	81.84
980	35.28	9.8	0.1307	13.0667	1305.11	107.96	82.72
1000	35.76	10	0.1333	13.3333	1309.12	109.43	83.59
1020	36.11	10.2	0.136	13.6	1313.16	110.50	84.15
1040	36.43	10.4	0.1387	13.8667	1317.23	111.48	84.63
1060	36.92	10.6	0.1413	14.1333	1321.32	112.98	85.50
1080	37.23	10.8	0.144	14.4	1325.43	113.92	85.95
1100	37.49	11	0.1467	14.6667	1329.58	114.72	86.28
1120	37.98	11.2	0.1493	14.9333	1333.74	116.22	87.14
1140	38.40	11.4	0.152	15.2	1337.94	117.50	87.82
1160	38.67	11.6	0.1547	15.4667	1342.16	118.33	88.16
1180	38.96	11.8	0.1573	15.7333	1346.41	119.22	88.55
1200	39.29	12	0.16	16	1350.68	120.23	89.01
1220	39.60	12.2	0.1627	16.2667	1354.98	121.18	89.43
1240	40.12	12.4	0.1653	16.5333	1359.31	122.77	90.32
1260	40.33	12.6	0.168	16.8	1363.67	123.41	90.50
1280	40.64	12.8	0.1707	17.0667	1368.05	124.36	90.90
1300	40.75	13	0.1733	17.3333	1372.47	124.70	90.85
1320	40.86	13.2	0.176	17.6	1376.91	125.03	90.81
1340	41.23	13.4	0.1787	17.8667	1381.38	126.16	91.33
1360	41.43	13.6	0.1813	18.1333	1385.88	126.78	91.48
1380	41.72	13.8	0.184	18.4	1390.41	127.66	91.82
1400	41.88	14	0.1867	18.6667	1394.96	128.15	91.87
1420	42.39	14.2	0.1893	18.9333	1399.55	129.71	92.68
1440	42.80	14.4	0.192	19.2	1404.17	130.97	93.27
1460	43.00	14.6	0.1947	19.4667	1408.82	131.58	93.40
1480	43.41	14.8	0.1973	19.7333	1413.50	132.83	93.98
1500	43.94	15	0.2	20	1418.21	134.46	94.81
1520	44.07	15.2	0.2027	20.2667	1422.96	134.85	94.77
1540	44.41	15.4	0.2053	20.5333	1427.73	135.89	95.18
1560	44.72	15.6	0.208	20.8	1432.54	136.84	95.52
1580	45.03	15.8	0.2107	21.0667	1437.38	137.79	95.86
1600	45.26	16	0.2133	21.3333	1442.25	138.50	96.03
1620	45.26	16.2	0.216	21.6	1447.16	138.50	95.70
1640	45.26	16.4	0.2187	21.8667	1452.10	138.50	95.38
1660	45.26	16.6	0.2213	22.1333	1457.07	138.50	95.05
1680	45.26	16.8	0.224	22.4	1462.08	138.50	94.73
1700	45.26	17	0.2267	22.6667	1467.12	138.50	94.40
1720	45.26	17.2	0.2293	22.9333	1472.19	138.50	94.07
1740	45.26	17.4	0.232	23.2	1477.31	138.50	93.75
1760	45.26	17.6	0.2347	23.4667	1482.45	138.50	93.42
1780	45.26	17.8	0.2373	23.7333	1487.64	138.50	93.10
1800	45.26	18	0.24	24	1492.86	138.50	92.77
1820	45.26	18.2	0.2427	24.2667	1498.11	138.50	92.45



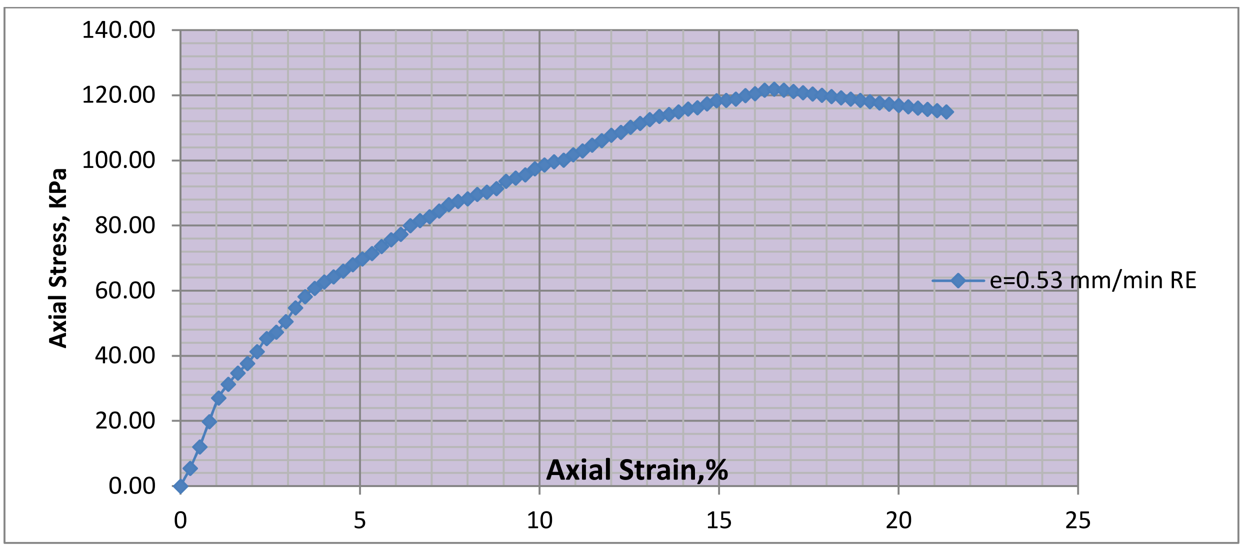
Remark:	**Unconfined Compressive Strength (qu)=**		**87.82**	**KPa**
	Cohesion© = (qu/2) =		**43.91**	**KPa**
	Failure strain=		**15.00%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	Y1
Height (mm)	75.0	Mass Cont.	35.7
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	90.15
Volume cc	85.1	Mass Cont.+dry soil	76.69
Mass (gm)	160.0	Mass dry soil	40.99
Wet Density g/cc	1.9	Mass moisture	13.46
Moisture Content %	32.8	Moisture Content %	32.84
Dry Density g/cc	1.4		

e=0.53 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.04	0.2	0.0027	0.2667	1137.61	6.24	5.49
40	4.49	0.4	0.0053	0.5333	1140.65	13.74	12.05
60	7.40	0.6	0.008	0.8000	1143.72	22.64	19.80
80	10.17	0.8	0.0107	1.0667	1146.80	31.12	27.14
100	11.79	1	0.0133	1.3333	1149.90	36.08	31.37
120	13.09	1.2	0.016	1.6000	1153.02	40.06	34.74
140	14.24	1.4	0.0187	1.8667	1156.15	43.57	37.69
160	15.67	1.6	0.0213	2.1333	1159.30	47.95	41.36
180	17.25	1.8	0.024	2.4000	1162.47	52.79	45.41
200	18.04	2	0.0267	2.6667	1165.66	55.20	47.36
220	19.31	2.2	0.0293	2.9333	1168.86	59.09	50.55
240	21.00	2.4	0.032	3.2000	1172.08	64.26	54.83
260	22.37	2.6	0.0347	3.4667	1175.32	68.45	58.24
280	23.41	2.8	0.0373	3.7333	1178.57	71.63	60.78
300	24.23	3	0.04	4.0000	1181.85	74.14	62.74
320	24.91	3.2	0.0427	4.2667	1185.14	76.22	64.32
340	25.68	3.4	0.0453	4.5333	1188.45	78.58	66.12
360	26.49	3.6	0.048	4.8000	1191.78	81.06	68.02
380	27.27	3.8	0.0507	5.0667	1195.12	83.45	69.82
400	27.99	4	0.0533	5.3333	1198.49	85.65	71.46
420	28.94	4.2	0.056	5.6000	1201.88	88.56	73.68
440	29.81	4.4	0.0587	5.8667	1205.28	91.22	75.68
460	30.55	4.6	0.0613	6.1333	1208.71	93.48	77.34
480	31.71	4.8	0.064	6.4000	1212.15	97.03	80.05
500	32.42	5	0.0667	6.6667	1215.61	99.21	81.61
520	32.98	5.2	0.0693	6.9333	1219.10	100.92	82.78
540	33.77	5.4	0.072	7.2000	1222.60	103.34	84.52
560	34.65	5.6	0.0747	7.4667	1226.12	106.03	86.48
580	35.17	5.8	0.0773	7.7333	1229.67	107.62	87.52
600	35.57	6	0.08	8.0000	1233.23	108.84	88.26
620	36.24	6.2	0.0827	8.2667	1236.81	110.89	89.66
640	36.61	6.4	0.0853	8.5333	1240.42	112.03	90.31
660	37.18	6.6	0.088	8.8000	1244.05	113.77	91.45
680	38.19	6.8	0.0907	9.0667	1247.70	116.86	93.66
700	38.71	7	0.0933	9.3333	1251.37	118.45	94.66
720	39.22	7.2	0.096	9.6000	1255.06	120.01	95.62
740	40.09	7.4	0.0987	9.8667	1258.77	122.68	97.46
760	40.73	7.6	0.1013	10.1333	1262.51	124.63	98.72
780	41.22	7.8	0.104	10.4000	1266.26	126.13	99.61
800	41.58	8	0.1067	10.6667	1270.04	127.23	100.18

820	42.37	8.2	0.1093	10.9333	1273.85	129.65	101.78
840	43.00	8.4	0.112	11.2000	1277.67	131.58	102.98
860	43.88	8.6	0.1147	11.4667	1281.52	134.27	104.78
880	44.60	8.8	0.1173	11.7333	1285.39	136.48	106.17
900	45.44	9	0.12	12.0000	1289.29	139.05	107.85
920	45.92	9.2	0.1227	12.2667	1293.20	140.52	108.66
940	46.75	9.4	0.1253	12.5333	1297.15	143.06	110.28
960	47.39	9.6	0.128	12.8000	1301.11	145.01	111.45
980	48.04	9.8	0.1307	13.0667	1305.11	147.00	112.64
1000	48.58	10	0.1333	13.3333	1309.12	148.65	113.55
1020	48.99	10.2	0.136	13.6000	1313.16	149.91	114.16
1040	49.49	10.4	0.1387	13.8667	1317.23	151.44	114.97
1060	50.02	10.6	0.1413	14.1333	1321.32	153.06	115.84
1080	50.37	10.8	0.144	14.4000	1325.43	154.13	116.29
1100	51.02	11	0.1467	14.6667	1329.58	156.12	117.42
1120	51.59	11.2	0.1493	14.9333	1333.74	157.87	118.36
1140	51.82	11.4	0.152	15.2000	1337.94	158.57	118.52
1160	52.14	11.6	0.1547	15.4667	1342.16	159.55	118.87
1180	52.77	11.8	0.1573	15.7333	1346.41	161.48	119.93
1200	53.20	12	0.16	16.0000	1350.68	162.79	120.53
1220	53.88	12.2	0.1627	16.2667	1354.98	164.87	121.68
1240	54.19	12.4	0.1653	16.5333	1359.31	165.82	121.99
1260	54.19	12.6	0.168	16.8000	1363.67	165.82	121.60
1280	54.19	12.8	0.1707	17.0667	1368.05	165.82	121.21
1300	54.19	13	0.1733	17.3333	1372.47	165.82	120.82
1320	54.19	13.2	0.176	17.6000	1376.91	165.82	120.43
1340	54.19	13.4	0.1787	17.8667	1381.38	165.82	120.04
1360	54.19	13.6	0.1813	18.1333	1385.88	165.82	119.65
1380	54.19	13.8	0.184	18.4000	1390.41	165.82	119.26
1400	54.19	14	0.1867	18.6667	1394.96	165.82	118.87
1420	54.19	14.2	0.1893	18.9333	1399.55	165.82	118.48
1440	54.19	14.4	0.192	19.2000	1404.17	165.82	118.09
1460	54.19	14.6	0.1947	19.4667	1408.82	165.82	117.70
1480	54.19	14.8	0.1973	19.7333	1413.50	165.82	117.31
1500	54.19	15	0.2	20.0000	1418.21	165.82	116.92
1520	54.19	15.2	0.2027	20.2667	1422.96	165.82	116.53
1540	54.19	15.4	0.2053	20.5333	1427.73	165.82	116.14
1560	54.19	15.6	0.208	20.8000	1432.54	165.82	115.75
1580	54.19	15.8	0.2107	21.0667	1437.38	165.82	115.36
1600	54.19	16	0.2133	21.3333	1442.25	165.82	114.97

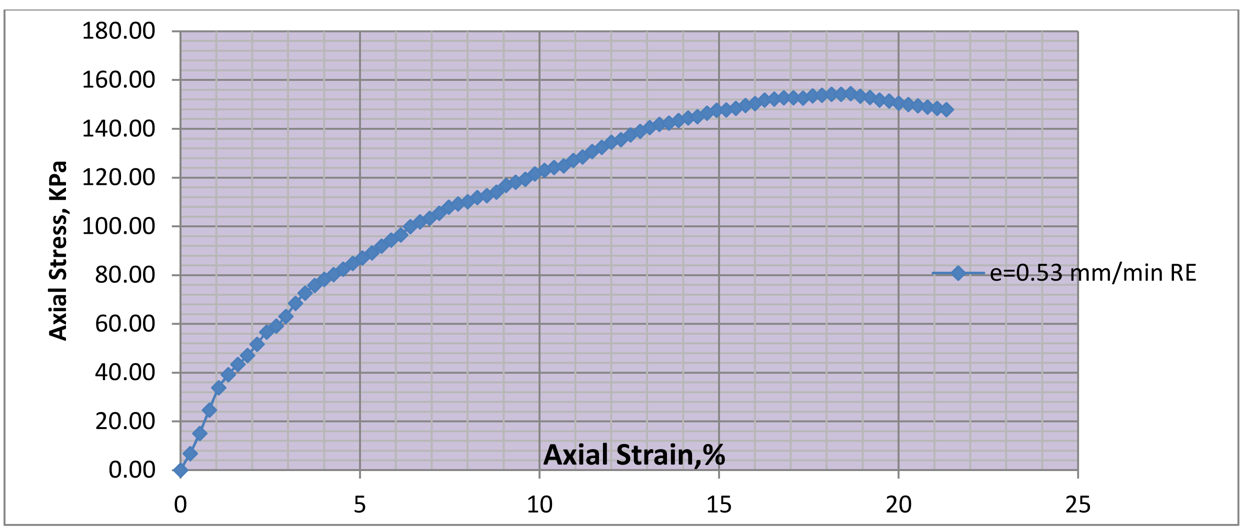


Remark:	**Unconfined Compressive Strength (qu)=**	**118.52**	**KPa**
	Cohesion© = (qu/2) =	**59.26**	**KPa**
	Failure strain=	**15.00%**	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 3		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	G1
Height (mm)	75.0	Mass Cont.	35.4
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	92.3
Volume cc	85.1	Mass Cont.+dry soil	78.24
Mass (gm)	161.0	Mass dry soil	42.84
Wet Density g/cc	1.9	Mass moisture	14.06
Moisture Content %	32.8	Moisture Content %	32.82
Dry Density g/cc	1.4		
e=0.53 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (Kpa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.50	0.2	0.0027	0.2667	1137.61	7.65	6.72
40	5.51	0.4	0.0053	0.5333	1140.65	16.86	14.78
60	9.07	0.6	0.008	0.8000	1143.72	27.75	24.27
80	12.46	0.8	0.0107	1.0667	1146.80	38.13	33.25
100	14.46	1	0.0133	1.3333	1149.90	44.25	38.48
120	16.06	1.2	0.016	1.6000	1153.02	49.14	42.62
140	17.47	1.4	0.0187	1.8667	1156.15	53.46	46.24
160	19.22	1.6	0.0213	2.1333	1159.30	58.81	50.73
180	21.16	1.8	0.024	2.4000	1162.47	64.75	55.70
200	22.13	2	0.0267	2.6667	1165.66	67.72	58.09
220	23.68	2.2	0.0293	2.9333	1168.86	72.46	61.99
240	25.75	2.4	0.032	3.2000	1172.08	78.80	67.23
260	27.43	2.6	0.0347	3.4667	1175.32	83.94	71.42
280	28.71	2.8	0.0373	3.7333	1178.57	87.85	74.54
300	29.72	3	0.04	4.0000	1181.85	90.94	76.95
320	30.55	3.2	0.0427	4.2667	1185.14	93.48	78.88
340	31.49	3.4	0.0453	4.5333	1188.45	96.36	81.08
360	32.48	3.6	0.048	4.8000	1191.78	99.39	83.40
380	33.45	3.8	0.0507	5.0667	1195.12	102.36	85.65
400	34.33	4	0.0533	5.3333	1198.49	105.05	87.65
420	35.49	4.2	0.056	5.6000	1201.88	108.60	90.36
440	36.56	4.4	0.0587	5.8667	1205.28	111.87	92.82
460	37.45	4.6	0.0613	6.1333	1208.71	114.60	94.81
480	38.88	4.8	0.064	6.4000	1212.15	118.97	98.15
500	39.77	5	0.0667	6.6667	1215.61	121.70	100.11
520	40.44	5.2	0.0693	6.9333	1219.10	123.75	101.51
540	41.42	5.4	0.072	7.2000	1222.60	126.75	103.67
560	42.49	5.6	0.0747	7.4667	1226.12	130.02	106.04
580	43.12	5.8	0.0773	7.7333	1229.67	131.95	107.30
600	43.62	6	0.08	8.0000	1233.23	133.48	108.23
620	44.45	6.2	0.0827	8.2667	1236.81	136.02	109.97
640	44.90	6.4	0.0853	8.5333	1240.42	137.39	110.76
660	45.60	6.6	0.088	8.8000	1244.05	139.54	112.16
680	46.84	6.8	0.0907	9.0667	1247.70	143.33	114.88
700	47.46	7	0.0933	9.3333	1251.37	145.23	116.06
720	48.11	7.2	0.096	9.6000	1255.06	147.22	117.30
740	49.17	7.4	0.0987	9.8667	1258.77	150.46	119.53
760	49.91	7.6	0.1013	10.1333	1262.51	152.72	120.97
780	50.53	7.8	0.104	10.4000	1266.26	154.62	122.11
800	50.95	8	0.1067	10.6667	1270.04	155.91	122.76

820	51.98	8.2	0.1093	10.9333	1273.85	159.06	124.87
840	52.73	8.4	0.112	11.2000	1277.67	161.35	126.29
860	54.17	8.6	0.1147	11.4667	1281.52	165.76	129.35
880	55.14	8.8	0.1173	11.7333	1285.39	168.73	131.27
900	56.19	9	0.12	12.0000	1289.29	171.94	133.36
920	56.78	9.2	0.1227	12.2667	1293.20	173.75	134.35
940	57.80	9.4	0.1253	12.5333	1297.15	176.87	136.35
960	58.60	9.6	0.128	12.8000	1301.11	179.32	137.82
980	59.40	9.8	0.1307	13.0667	1305.11	181.76	139.27
1000	60.16	10	0.1333	13.3333	1309.12	184.09	140.62
1020	60.58	10.2	0.136	13.6000	1313.16	185.37	141.17
1040	61.20	10.4	0.1387	13.8667	1317.23	187.27	142.17
1060	61.84	10.6	0.1413	14.1333	1321.32	189.23	143.21
1080	62.30	10.8	0.144	14.4000	1325.43	190.64	143.83
1100	62.57	11	0.1467	14.6667	1329.58	191.46	144.00
1120	63.08	11.2	0.1493	14.9333	1333.74	193.02	144.72
1140	63.50	11.4	0.152	15.2000	1337.94	194.31	145.23
1160	63.50	11.6	0.1547	15.4667	1342.16	194.31	144.77
1180	63.50	11.8	0.1573	15.7333	1346.41	194.31	144.32
1200	64.70	12	0.16	16.0000	1350.68	197.98	146.58
1220	64.70	12.2	0.1627	16.2667	1354.98	197.98	146.11
1240	64.70	12.4	0.1653	16.5333	1359.31	197.98	145.65
1260	67.35	12.6	0.168	16.8000	1363.67	206.09	151.13
1280	67.35	12.8	0.1707	17.0667	1368.05	206.09	150.65
1300	67.35	13	0.1733	17.3333	1372.47	206.09	150.16
1320	68.41	13.2	0.176	17.6000	1376.91	209.33	152.03
1340	68.41	13.4	0.1787	17.8667	1381.38	209.33	151.54
1360	68.41	13.6	0.1813	18.1333	1385.88	209.33	151.05
1380	69.45	13.8	0.184	18.4000	1390.41	212.52	152.85
1400	69.45	14	0.1867	18.6667	1394.96	212.52	152.35
1420	69.45	14.2	0.1893	18.9333	1399.55	212.52	151.85
1440	69.83	14.4	0.192	19.2000	1404.17	213.68	152.17
1460	69.83	14.6	0.1947	19.4667	1408.82	213.68	151.67
1480	69.83	14.8	0.1973	19.7333	1413.50	213.68	151.17
1500	69.83	15	0.2	20.0000	1418.21	213.68	150.67
1520	69.83	15.2	0.2027	20.2667	1422.96	213.68	150.17
1540	69.83	15.4	0.2053	20.5333	1427.73	213.68	149.66
1560	69.83	15.6	0.208	20.8000	1432.54	213.68	149.16
1580	69.83	15.8	0.2107	21.0667	1437.38	213.68	148.66
1600	69.83	16	0.2133	21.3333	1442.25	213.68	148.16

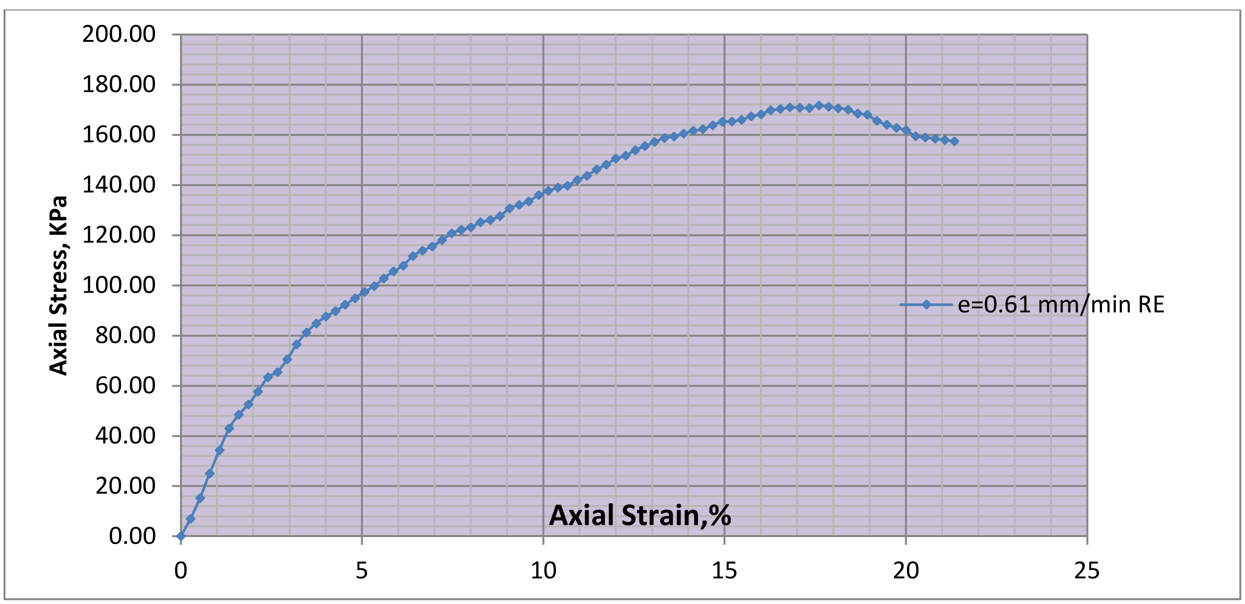


Remark:	**Unconfined Compressive Strength (qu)=**	**145.23**	**KPa**	
	Cohesion© = (qu/2) =	**72.62**	**KPa**	
	Failure strain=	**15.00%**		

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternimation**	
Diameter (mm)	38.0	Can No.	M3
Height (mm)	75.0	Mass Cont.	35.30
Area (Ao) mm2	1134.6	Mass Cont.+wet soil	89.72
Volume cc	85.1	Mass Cont.+dry soil	76.27
Mass (gm)	159.8	Mass dry soil	40.97
Wet Density g/cc	1.9	Mass moisture	13.45
Moisture Content %	32.8	Moisture Content %	32.83
Dry Density g/cc	1.4		
e=0.61 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.001	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
20	2.58	0.2	0.0027	0.26667	1137.61	7.89	6.94
40	5.69	0.4	0.0053	0.53333	1140.65	17.41	15.26
60	9.37	0.6	0.008	0.8	1143.72	28.67	25.07
80	12.88	0.8	0.0107	1.06667	1146.80	39.41	34.37
100	16.15	1	0.0133	1.33333	1149.90	49.42	42.98
120	18.26	1.2	0.016	1.6	1153.02	55.88	48.46
140	19.87	1.4	0.0187	1.86667	1156.15	60.80	52.59
160	21.86	1.6	0.0213	2.13333	1159.30	66.89	57.70
180	24.07	1.8	0.024	2.4	1162.47	73.65	63.36
200	24.94	2	0.0267	2.66667	1165.66	76.32	65.47
220	26.94	2.2	0.0293	2.93333	1168.86	82.44	70.53
240	29.30	2.4	0.032	3.2	1172.08	89.66	76.49
260	31.21	2.6	0.0347	3.46667	1175.32	95.50	81.26
280	32.66	2.8	0.0373	3.73333	1178.57	99.94	84.80
300	33.82	3	0.04	4	1181.85	103.49	87.57
320	34.76	3.2	0.0427	4.26667	1185.14	106.37	89.75
340	35.83	3.4	0.0453	4.53333	1188.45	109.64	92.25
360	36.96	3.6	0.048	4.8	1191.78	113.10	94.90
380	38.05	3.8	0.0507	5.06667	1195.12	116.43	97.42
400	39.06	4	0.0533	5.33333	1198.49	119.52	99.73
420	40.38	4.2	0.056	5.6	1201.88	123.56	102.81
440	41.59	4.4	0.0587	5.86667	1205.28	127.27	105.59
460	42.62	4.6	0.0613	6.13333	1208.71	130.42	107.90
480	44.24	4.8	0.064	6.4	1212.15	135.37	111.68
500	45.23	5	0.0667	6.66667	1215.61	138.40	113.86
520	46.02	5.2	0.0693	6.93333	1219.10	140.82	115.51
540	47.14	5.4	0.072	7.2	1222.60	144.25	117.99
560	48.35	5.6	0.0747	7.46667	1226.12	147.95	120.67
580	49.07	5.8	0.0773	7.73333	1229.67	150.15	122.11
600	49.63	6	0.08	8	1233.23	151.87	123.15
620	50.57	6.2	0.0827	8.26667	1236.81	154.74	125.12
640	51.08	6.4	0.0853	8.53333	1240.42	156.30	126.01
660	51.89	6.6	0.088	8.8	1244.05	158.78	127.63
680	53.29	6.8	0.0907	9.06667	1247.70	163.07	130.69
700	54.01	7	0.0933	9.33333	1251.37	165.27	132.07
720	54.73	7.2	0.096	9.6	1255.06	167.47	133.44
740	55.94	7.4	0.0987	9.86667	1258.77	171.18	135.99
760	56.77	7.6	0.1013	10.1333	1262.51	173.72	137.60
780	57.49	7.8	0.104	10.4	1266.26	175.92	138.93
800	57.97	8	0.1067	10.6667	1270.04	177.39	139.67

820	59.12	8.2	0.1093	10.9333	1273.85	180.91	142.02
840	60.00	8.4	0.112	11.2	1277.67	183.60	143.70
860	61.22	8.6	0.1147	11.4667	1281.52	187.33	146.18
880	62.23	8.8	0.1173	11.7333	1285.39	190.42	148.14
900	63.41	9	0.12	12	1289.29	194.03	150.50
920	64.08	9.2	0.1227	12.2667	1293.20	196.08	151.63
940	65.23	9.4	0.1253	12.5333	1297.15	199.60	153.88
960	66.12	9.6	0.128	12.8	1301.11	202.33	155.50
980	67.03	9.8	0.1307	13.0667	1305.11	205.11	157.16
1000	67.90	10	0.1333	13.3333	1309.12	207.77	158.71
1020	68.36	10.2	0.136	13.6	1313.16	209.18	159.30
1040	69.06	10.4	0.1387	13.8667	1317.23	211.32	160.43
1060	69.79	10.6	0.1413	14.1333	1321.32	213.56	161.62
1080	70.28	10.8	0.144	14.4	1325.43	215.06	162.25
1100	71.18	11	0.1467	14.6667	1329.58	217.81	163.82
1120	71.99	11.2	0.1493	14.9333	1333.74	220.29	165.17
1140	72.26	11.4	0.152	15.2	1337.94	221.12	165.27
1160	72.79	11.6	0.1547	15.4667	1342.16	222.74	165.95
1180	73.63	11.8	0.1573	15.7333	1346.41	225.31	167.34
1200	74.23	12	0.16	16	1350.68	227.14	168.17
1220	75.18	12.2	0.1627	16.2667	1354.98	230.05	169.78
1240	75.61	12.4	0.1653	16.5333	1359.31	231.37	170.21
1260	76.16	12.6	0.168	16.8	1363.67	233.05	170.90
1280	76.38	12.8	0.1707	17.0667	1368.05	233.72	170.84
1300	76.54	13	0.1733	17.3333	1372.47	234.21	170.65
1320	77.26	13.2	0.176	17.6	1376.91	236.42	171.70
1340	77.26	13.4	0.1787	17.8667	1381.38	236.42	171.14
1360	77.26	13.6	0.1813	18.1333	1385.88	236.42	170.59
1380	77.26	13.8	0.184	18.4	1390.41	236.42	170.03
1400	76.80	14	0.1867	18.6667	1394.96	235.01	168.47
1420	76.80	14.2	0.1893	18.9333	1399.55	235.01	167.92
1440	75.98	14.4	0.192	19.2	1404.17	232.50	165.58
1460	75.52	14.6	0.1947	19.4667	1408.82	231.09	164.03
1480	75.16	14.8	0.1973	19.7333	1413.50	229.99	162.71
1500	75.00	15	0.2	20	1418.21	229.50	161.82
1520	74.16	15.2	0.2027	20.2667	1422.96	226.93	159.48
1540	74.16	15.4	0.2053	20.5333	1427.73	226.93	158.94
1560	74.16	15.6	0.208	20.8	1432.54	226.93	158.41
1580	74.16	15.8	0.2107	21.0667	1437.38	226.93	157.88
1600	74.16	16	0.2133	21.3333	1442.25	226.93	157.34

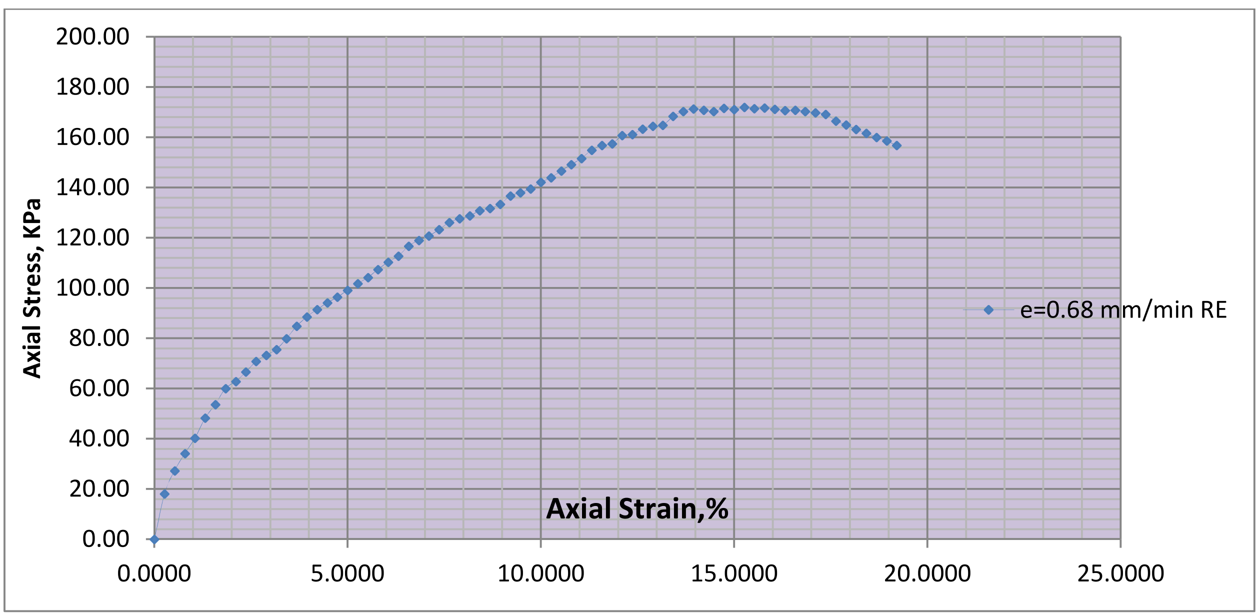


Remark:	Unconfined Compressive Strength (qu)=	165.27	KPa
	Cohesion© = (qu/2) =	82.63	KPa
	Failure strain=	15.00%	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	B7
Height (mm)	76.00	Mass Cont.	35.4
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	95.63
Volume cc	86.23	Mass Cont.+dry soil	80.75
Mass (gm)	160.97	Mass dry soil	45.35
Wet Density g/cc	1.87	Mass moisture	14.88
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.41		
e=0.68 mm/min			

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)= (LDR *0.00306)*1000	Stress (kPa)=F/Ac
0	0.00	0	0	0.0000	1134.57	0.00	0.00
20	6.75	0.2	0.0026	0.2632	1137.57	20.66	18.16
40	10.18	0.4	0.0053	0.5263	1140.57	31.15	27.31
60	12.76	0.6	0.0079	0.7895	1143.60	39.05	34.14
80	15.12	0.8	0.0105	1.0526	1146.64	46.27	40.35
100	18.17	1	0.0132	1.3158	1149.70	55.60	48.36
120	20.24	1.2	0.0158	1.5789	1152.77	61.93	53.73
140	22.68	1.4	0.0184	1.8421	1155.86	69.40	60.04
160	23.79	1.6	0.0211	2.1053	1158.97	72.80	62.81
180	25.31	1.8	0.0237	2.3684	1162.09	77.45	66.65
200	26.97	2	0.0263	2.6316	1165.24	82.53	70.83
220	27.99	2.2	0.0289	2.8947	1168.39	85.65	73.31
240	28.93	2.4	0.0316	3.1579	1171.57	88.53	75.56
260	30.69	2.6	0.0342	3.4211	1174.76	93.91	79.94
280	32.68	2.8	0.0368	3.6842	1177.97	100.00	84.89
300	34.20	3	0.0395	3.9474	1181.20	104.65	88.60
320	35.41	3.2	0.0421	4.2105	1184.44	108.35	91.48
340	36.53	3.4	0.0447	4.4737	1187.71	111.78	**94.12**
360	37.52	3.6	0.0474	4.7368	1190.99	114.81	96.40
380	38.71	3.8	0.05	5.0000	1194.29	118.45	99.18
400	39.86	4	0.0526	5.2632	1197.60	121.97	101.85
420	40.90	4.2	0.0553	5.5263	1200.94	125.15	104.21
440	42.29	4.4	0.0579	5.7895	1204.29	129.41	107.46
460	43.56	4.6	0.0605	6.0526	1207.67	133.29	110.37
480	44.64	4.8	0.0632	6.3158	1211.06	136.60	112.79
500	46.34	5	0.0658	6.5789	1214.47	141.80	116.76
520	47.37	5.2	0.0684	6.8421	1217.90	144.95	119.02
540	48.19	5.4	0.0711	7.1053	1221.35	147.46	120.74
560	49.36	5.6	0.0737	7.3684	1224.82	151.04	123.32
580	50.64	5.8	0.0763	7.6316	1228.31	154.96	126.16
600	51.39	6	0.0789	7.8947	1231.82	157.25	127.66
620	51.98	6.2	0.0816	8.1579	1235.35	159.06	128.76
640	52.96	6.4	0.0842	8.4211	1238.90	162.06	130.81
660	53.50	6.6	0.0868	8.6842	1242.47	163.71	131.76
680	54.33	6.8	0.0895	8.9474	1246.06	166.25	133.42
700	55.81	7	0.0921	9.2105	1249.67	170.78	136.66
720	56.54	7.2	0.0947	9.4737	1253.31	173.01	138.04
740	57.32	7.4	0.0974	9.7368	1256.96	175.40	139.54
760	58.60	7.6	0.1	10.0000	1260.63	179.32	142.24
780	59.46	7.8	0.1026	10.2632	1264.33	181.95	143.91
800	60.79	8	0.1053	10.5263	1268.05	186.02	146.70

820	62.01	8.2	0.1079	10.7895	1271.79	189.75	149.20
840	63.21	8.4	0.1105	11.0526	1275.55	193.42	151.64
860	64.77	8.6	0.1132	11.3158	1279.34	198.20	154.92
880	65.76	8.8	0.1158	11.5789	1283.15	201.23	156.82
900	66.21	9	0.1184	11.8421	1286.98	202.60	157.43
920	67.81	9.2	0.1211	12.1053	1290.83	207.50	160.75
940	68.18	9.4	0.1237	12.3684	1294.71	208.63	161.14
960	69.33	9.6	0.1263	12.6316	1298.61	212.15	163.37
980	69.99	9.8	0.1289	12.8947	1302.53	214.17	164.43
1000	70.37	10	0.1316	13.1579	1306.48	215.33	164.82
1020	72.10	10.2	0.1342	13.4211	1310.45	220.63	168.36
1040	73.16	10.4	0.1368	13.6842	1314.44	223.87	170.32
1060	73.83	10.6	0.1395	13.9474	1318.46	225.92	171.35
1080	73.83	10.8	0.1421	14.2105	1322.51	225.92	170.83
1100	73.83	11	0.1447	14.4737	1326.58	225.92	170.30
1120	74.61	11.2	0.1474	14.7368	1330.67	228.31	171.57
1140	74.61	11.4	0.15	15.0000	1334.79	228.31	171.04
1160	75.28	11.6	0.1526	15.2632	1338.94	230.36	172.04
1180	75.28	11.8	0.1553	15.5263	1343.11	230.36	171.51
1200	75.61	12	0.1579	15.7895	1347.30	231.37	171.73
1220	75.61	12.2	0.1605	16.0526	1351.53	231.37	171.19
1240	75.61	12.4	0.1632	16.3158	1355.78	231.37	170.65
1260	75.94	12.6	0.1658	16.5789	1360.05	232.38	170.86
1280	75.94	12.8	0.1684	16.8421	1364.36	232.38	170.32
1300	75.94	13	0.1711	17.1053	1368.69	232.38	169.78
1320	75.94	13.2	0.1737	17.3684	1373.05	232.38	169.24
1340	74.97	13.4	0.1763	17.6316	1377.43	229.41	166.55
1360	74.53	13.6	0.1789	17.8947	1381.85	228.06	165.04
1380	73.91	13.8	0.1816	18.1579	1386.29	226.16	163.14
1400	73.49	14	0.1842	18.4211	1390.76	224.88	161.69
1420	72.97	14.2	0.1868	18.6842	1395.27	223.29	160.03
1440	72.54	14.4	0.1895	18.9474	1399.80	221.97	158.57
1460	71.95	14.6	0.1921	19.2105	1404.36	220.17	156.77



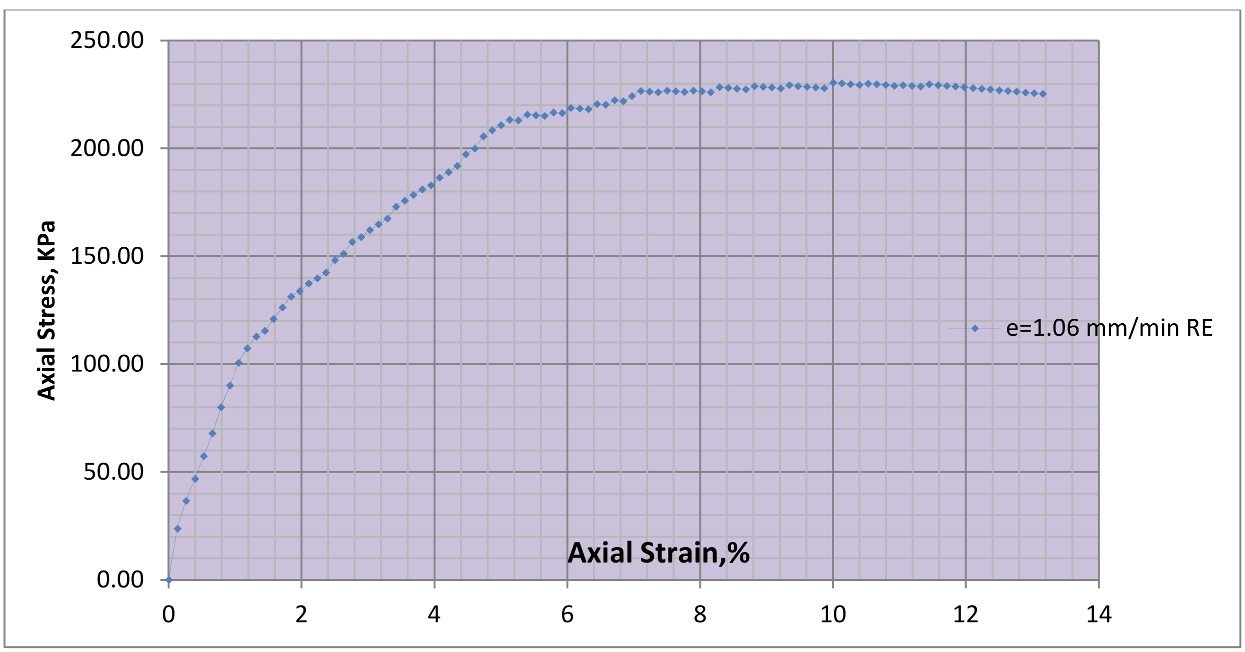
Remark:	Unconfined Compressive Strength (qu)=	171.57	KPa
	Cohesion© = (qu/2) =	85.79	KPa
	Failure strain=	14.74%	

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 2		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Determination**	
Diameter (mm)	38.00	Can No.	t2
Height (mm)	76.00	Mass Cont.	35.6
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	86.00
Volume cc	86.23	Mass Cont.+dry soil	73.55
Mass (gm)	162.21	Mass dry soil	37.95
Wet Density g/cc	1.88	Mass moisture	12.45
Moisture Content %	32.81	Moisture Content %	32.81
Dry Density g/cc	1.42		

e=1.06 mm/min

Deform. Dial Rdg	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR *0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0.00	0	0	0	1134.57	0.00	0.00
10	8.82	0.1	0.00132	0.1316	1136.07	26.99	23.76
20	13.63	0.2	0.00263	0.2632	1137.57	41.71	36.66
30	17.45	0.3	0.00395	0.3947	1139.07	53.40	46.88
40	21.40	0.4	0.00526	0.5263	1140.57	65.48	57.41
50	25.32	0.5	0.00658	0.6579	1142.09	77.48	67.84
60	29.92	0.6	0.00789	0.7895	1143.60	91.56	80.06
70	33.74	0.7	0.00921	0.9211	1145.12	103.24	90.16
80	37.71	0.8	0.01053	1.0526	1146.64	115.39	100.64
90	40.29	0.9	0.01184	1.1842	1148.17	123.29	107.38
100	42.37	1	0.01316	1.3158	1149.70	129.65	112.77
110	43.45	1.1	0.01447	1.4474	1151.23	132.96	115.49
120	45.55	1.2	0.01579	1.5789	1152.77	139.38	120.91
130	47.63	1.3	0.01711	1.7105	1154.32	145.75	126.26
140	49.61	1.4	0.01842	1.8421	1155.86	151.81	131.34
150	50.60	1.5	0.01974	1.9737	1157.42	154.84	133.78
160	52.01	1.6	0.02105	2.1053	1158.97	159.15	137.32
170	53.00	1.7	0.02237	2.2368	1160.53	162.18	139.75
180	54.11	1.8	0.02368	2.3684	1162.09	165.58	142.48
190	56.35	1.9	0.025	2.5	1163.66	172.43	148.18
200	57.56	2	0.02632	2.6316	1165.24	176.13	151.16
210	59.76	2.1	0.02763	2.7632	1166.81	182.87	156.72
220	60.69	2.2	0.02895	2.8947	1168.39	185.71	158.95
230	61.98	2.3	0.03026	3.0263	1169.98	189.66	162.10
240	63.10	2.4	0.03158	3.1579	1171.57	193.09	164.81
250	64.19	2.5	0.03289	3.2895	1173.16	196.42	167.43
260	66.42	2.6	0.03421	3.4211	1174.76	203.25	173.01
270	67.55	2.7	0.03553	3.5526	1176.36	206.70	175.71
280	68.67	2.8	0.03684	3.6842	1177.97	210.13	178.38
290	69.78	2.9	0.03816	3.8158	1179.58	213.53	181.02
300	70.62	3	0.03947	3.9474	1181.20	216.10	182.95
310	72.05	3.1	0.04079	4.0789	1182.82	220.47	186.40
320	73.17	3.2	0.04211	4.2105	1184.44	223.90	189.03
330	74.42	3.3	0.04342	4.3421	1186.07	227.73	192.00
340	76.57	3.4	0.04474	4.4737	1187.71	234.30	197.27
350	77.70	3.5	0.04605	4.6053	1189.34	237.76	199.91
360	79.98	3.6	0.04737	4.7368	1190.99	244.74	205.49
370	81.21	3.7	0.04868	4.8684	1192.63	248.50	208.36
380	82.24	3.8	0.05	5	1194.29	251.65	210.72
390	83.35	3.9	0.05132	5.1316	1195.94	255.05	213.26
400	83.35	4	0.05263	5.2632	1197.60	255.05	212.97
410	84.53	4.1	0.05395	5.3947	1199.27	258.66	215.68
420	84.53	4.2	0.05526	5.5263	1200.94	258.66	215.38
430	84.53	4.3	0.05658	5.6579	1202.61	258.66	215.08
440	85.25	4.4	0.05789	5.7895	1204.29	260.87	216.61
450	85.25	4.5	0.05921	5.9211	1205.98	260.87	216.31
460	86.33	4.6	0.06053	6.0526	1207.67	264.17	218.74
470	86.33	4.7	0.06184	6.1842	1209.36	264.17	218.44
480	86.33	4.8	0.06316	6.3158	1211.06	264.17	218.13
490	87.38	4.9	0.06447	6.4474	1212.76	267.38	220.47
500	87.38	5	0.06579	6.5789	1214.47	267.38	220.16
510	88.33	5.1	0.06711	6.7105	1216.18	270.29	222.24
520	88.33	5.2	0.06842	6.8421	1217.90	270.29	221.93
530	89.37	5.3	0.06974	6.9737	1219.62	273.47	224.23
540	90.46	5.4	0.07105	7.1053	1221.35	276.81	226.64
550	90.46	5.5	0.07237	7.2368	1223.08	276.81	226.32
560	90.46	5.600	0.07368	7.3684	1224.82	276.81	226.00
570	90.89	5.700	0.075	7.5	1226.56	278.12	226.75
580	90.89	5.8	0.07632	7.6316	1228.31	278.12	226.43
590	90.89	5.9	0.07763	7.7632	1230.06	278.12	226.10
600	91.27	6	0.07895	7.8947	1231.82	279.29	226.73

610	91.27	6.1	0.08026	8.0263	1233.58	279.29	226.40
620	91.27	6.2	0.08158	8.1579	1235.35	279.29	226.08
630	92.32	6.3	0.08289	8.2895	1237.12	282.50	228.35
640	92.32	6.4	0.08421	8.4211	1238.90	282.50	228.02
650	92.32	6.5	0.08553	8.5526	1240.68	282.50	227.70
660	92.32	6.6	0.08684	8.6842	1242.47	282.50	227.37
670	93.05	6.7	0.08816	8.8158	1244.26	284.73	228.84
680	93.05	6.8	0.08947	8.9474	1246.06	284.73	228.51
690	93.05	6.9	0.09079	9.0789	1247.86	284.73	228.18
700	93.05	7	0.09211	9.2105	1249.67	284.73	227.85
710	93.74	7.1	0.09342	9.3421	1251.49	286.84	229.20
720	93.74	7.2	0.09474	9.4737	1253.31	286.84	228.87
730	93.74	7.3	0.09605	9.6053	1255.13	286.84	228.54
740	93.74	7.4	0.09737	9.7368	1256.96	286.84	228.20
750	93.74	7.5	0.09868	9.8684	1258.79	286.84	227.87
760	94.93	7.6	0.1	10	1260.63	290.49	230.43
770	94.93	7.7	0.10132	10.132	1262.48	290.49	230.09
780	94.93	7.8	0.10263	10.263	1264.33	290.49	229.75
790	94.93	7.9	0.10395	10.395	1266.19	290.49	229.42
800	95.32	8	0.10526	10.526	1268.05	291.68	230.02
810	95.32	8.1	0.10658	10.658	1269.92	291.68	229.68
820	95.32	8.2	0.10789	10.789	1271.79	291.68	229.35
830	95.32	8.3	0.10921	10.921	1273.67	291.68	229.01
840	95.60	8.4	0.11053	11.053	1275.55	292.54	229.34
850	95.60	8.5	0.11184	11.184	1277.44	292.54	229.00
860	95.60	8.6	0.11316	11.316	1279.34	292.54	228.66
870	96.17	8.7	0.11447	11.447	1281.24	294.28	229.68
880	96.17	8.8	0.11579	11.579	1283.15	294.28	229.34
890	96.17	8.9	0.11711	11.711	1285.06	294.28	229.00
900	96.17	9	0.11842	11.842	1286.98	294.28	228.66
910	96.17	9.1	0.11974	11.974	1288.90	294.28	228.32
920	96.17	9.2	0.12105	12.105	1290.83	294.28	227.98
930	96.17	9.3	0.12237	12.237	1292.77	294.28	227.64
940	96.17	9.4	0.12368	12.368	1294.71	294.28	227.29
950	96.17	9.5	0.125	12.5	1296.65	294.28	226.95
960	96.17	9.6	0.12632	12.632	1298.61	294.28	226.61
970	96.17	9.7	0.12763	12.763	1300.56	294.28	226.27
980	96.17	9.8	0.12895	12.895	1302.53	294.28	225.93
990	96.17	9.9	0.13026	13.026	1304.50	294.28	225.59
1000	96.17	10	0.13158	13.158	1306.48	294.28	225.25



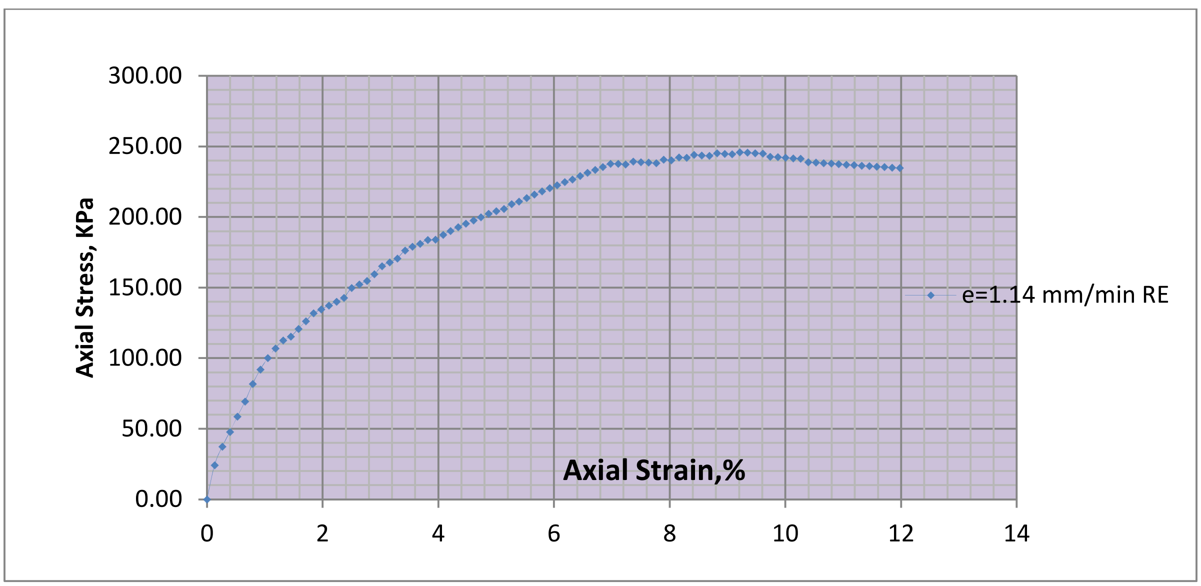
Remark:	Unconfined Compressive Strength (qu)=	230.43 KPa
	Cohesion© = (qu/2) =	115.21 KPa
	Failure strain=	10.00%

TYPE OF TEST:Unconfined Compressive Strength		TEST METHOD: ASTM D2166	
Sample No.: 1		Project No. : Thesis research	
Location : Kolfe area		Pit No. : 1	
Depth of Sample : 2.5 m		Test Date :5/08/2017	
Visual description of soil : Dark red clay		Sample Type: Remolded	
Specimen Data		**Moisture Content Deternination**	
Diameter (mm)	38.00	Can No.	O4
Height (mm)	76.00	Mass Cont.	35.4
Area (Ao) mm2	1134.57	Mass Cont.+wet soil	85.28
Volume cc	86.23	Mass Cont.+dry soil	72.96
Mass (gm)	162.35	Mass dry soil	37.56
Wet Density g/cc	1.88	Mass moisture	12.32
Moisture Content %	32.80	Moisture Content %	32.80
Dry Density g/cc	1.42		

e=1.14 mm/min

Deform. Dial Rdg (DDR)	Load Dial Rdg (LDR)	Deform. ΔL (mm)=DDR*0.01	Strain (ΔL /Lo)	Strain (% ε)	Corrected Area (Ac=Ao/(1-ε))	Load (N)=(LDR *0.00306 *1000	Stress (kPa)=F/Ac
0	0	0	0	0	1134.57	0.00	0.00
10	9.04	0.1	0.0013	0.1316	1136.07	27.66	24.35
20	13.93	0.2	0.0026	0.2632	1137.57	42.63	37.47
30	17.84	0.3	0.0039	0.3947	1139.07	54.60	47.93
40	21.87	0.4	0.0053	0.5263	1140.57	66.94	58.69
50	25.87	0.5	0.0066	0.6579	1142.09	79.15	69.30
60	30.57	0.6	0.0079	0.7895	1143.60	93.54	81.79
70	34.47	0.7	0.0092	0.9211	1145.12	105.48	92.11
80	37.52	0.8	0.0105	1.0526	1146.64	114.82	100.13
90	40.17	0.9	0.0118	1.1842	1148.17	122.92	107.06
100	42.30	1	0.0132	1.3158	1149.70	129.45	112.59
110	43.38	1.1	0.0145	1.4474	1151.23	132.75	115.31
120	45.55	1.2	0.0158	1.5789	1152.77	139.40	120.92
130	47.63	1.3	0.0171	1.7105	1154.32	145.75	126.27
140	49.82	1.4	0.0184	1.8421	1155.86	152.46	131.90
150	50.91	1.5	0.0197	1.9737	1157.42	155.79	134.60
160	52.02	1.6	0.0211	2.1053	1158.97	159.18	137.34
170	53.13	1.7	0.0224	2.2368	1160.53	162.59	140.10
180	54.24	1.8	0.0237	2.3684	1162.09	165.98	142.83
190	56.99	1.9	0.025	2.5	1163.66	174.38	149.86
200	58.04	2	0.0263	2.6316	1165.24	177.59	152.40
210	59.05	2.1	0.0276	2.7632	1166.81	180.70	154.87
220	60.95	2.2	0.0289	2.8947	1168.39	186.51	159.63
230	63.20	2.3	0.0303	3.0263	1169.98	193.40	165.30
240	64.35	2.4	0.0316	3.1579	1171.57	196.91	168.07
250	65.48	2.5	0.0329	3.2895	1173.16	200.38	170.81
260	67.76	2.6	0.0342	3.4211	1174.76	207.34	176.49
270	68.89	2.7	0.0355	3.5526	1176.36	210.81	179.21
280	69.78	2.8	0.0368	3.6842	1177.97	213.53	181.27
290	70.91	2.9	0.0382	3.8158	1179.58	216.98	183.95
300	71.06	3	0.0395	3.9474	1181.20	217.46	184.10
310	72.46	3.1	0.0408	4.0789	1182.82	221.72	187.45
320	73.60	3.2	0.0421	4.2105	1184.44	225.23	190.16
330	74.76	3.3	0.0434	4.3421	1186.07	228.77	192.88
340	75.91	3.4	0.0447	4.4737	1187.71	232.27	195.56
350	76.88	3.5	0.0461	4.6053	1189.34	235.25	197.80
360	77.87	3.6	0.0474	4.7368	1190.99	238.28	200.07
370	78.89	3.7	0.0487	4.8684	1192.63	241.40	202.41
380	79.74	3.8	0.05	5	1194.29	244.00	204.31
390	80.47	3.9	0.0513	5.1316	1195.94	246.24	205.89
400	81.95	4	0.0526	5.2632	1197.60	250.77	209.39
410	82.70	4.1	0.0539	5.3947	1199.27	253.05	211.00
420	83.86	4.2	0.0553	5.5263	1200.94	256.62	213.68
430	84.91	4.3	0.0566	5.6579	1202.61	259.82	216.05
440	85.95	4.4	0.0579	5.7895	1204.29	263.01	218.39
450	86.93	4.5	0.0592	5.9211	1205.98	266.02	220.58
460	87.87	4.6	0.0605	6.0526	1207.67	268.89	222.65
470	88.89	4.7	0.0618	6.1842	1209.36	272.00	224.92
480	89.71	4.8	0.0632	6.3158	1211.06	274.51	226.67
490	90.86	4.9	0.0645	6.4474	1212.76	278.02	229.25
500	91.86	5	0.0658	6.5789	1214.47	281.10	231.46

510	92.81	5.1	0.0671	6.7105	1216.18	284.01	233.52
520	93.79	5.2	0.0684	6.8421	1217.90	287.00	235.65
530	94.82	5.3	0.0697	6.9737	1219.62	290.14	237.90
540	94.93	5.4	0.0711	7.1053	1221.35	290.48	237.83
550	94.93	5.5	0.0724	7.2368	1223.08	290.48	237.50
560	95.83	5.6	0.0737	7.3684	1224.82	293.23	239.40
570	95.83	5.7	0.075	7.5	1226.56	293.23	239.06
580	95.83	5.8	0.0763	7.6316	1228.31	293.23	238.72
590	95.83	5.9	0.0776	7.7632	1230.06	293.23	238.38
600	96.91	6	0.0789	7.8947	1231.82	296.54	240.74
610	96.91	6.1	0.0803	8.0263	1233.58	296.54	240.39
620	97.89	6.2	0.0816	8.1579	1235.35	299.54	242.48
630	97.89	6.3	0.0829	8.2895	1237.12	299.54	242.13
640	98.86	6.4	0.0842	8.4211	1238.90	302.51	244.18
650	98.86	6.5	0.0855	8.5526	1240.68	302.51	243.83
660	98.86	6.6	0.0868	8.6842	1242.47	302.51	243.48
670	99.76	6.7	0.0882	8.8158	1244.26	305.26	245.33
680	99.76	6.8	0.0895	8.9474	1246.06	305.26	244.98
690	99.76	6.9	0.0908	9.0789	1247.86	305.26	244.62
700	100.50	7	0.0921	9.2105	1249.67	307.53	246.09
710	100.50	7.1	0.0934	9.3421	1251.49	307.53	245.74
720	100.50	7.2	0.0947	9.4737	1253.31	307.53	245.38
730	100.50	7.3	0.0961	9.6053	1255.13	307.53	245.02
740	99.76	7.4	0.0974	9.7368	1256.96	305.26	242.85
750	99.76	7.5	0.0987	9.8684	1258.79	305.26	242.50
760	99.76	7.6	0.1	10	1260.63	305.26	242.14
770	99.76	7.7	0.1013	10.132	1262.48	305.26	241.79
780	99.76	7.8	0.1026	10.263	1264.33	305.26	241.44
790	98.91	7.9	0.1039	10.395	1266.19	302.66	239.04
800	98.91	8	0.1053	10.526	1268.05	302.66	238.68
810	98.91	8.1	0.1066	10.658	1269.92	302.66	238.33
820	98.91	8.2	0.1079	10.789	1271.79	302.66	237.98
830	98.91	8.3	0.1092	10.921	1273.67	302.66	237.63
840	98.91	8.4	0.1105	11.053	1275.55	302.66	237.28
850	98.91	8.5	0.1118	11.184	1277.44	302.66	236.93
860	98.91	8.6	0.1132	11.316	1279.34	302.66	236.58
870	98.91	8.7	0.1145	11.447	1281.24	302.66	236.23
880	98.91	8.8	0.1158	11.579	1283.15	302.66	235.88
890	98.91	8.9	0.1171	11.711	1285.06	302.66	235.53
900	98.91	9	0.1184	11.842	1286.98	302.66	235.17
910	98.91	9.1	0.1197	11.974	1288.90	302.66	234.82



Remark:	Unconfined Compressive Strength (qu)=	246.09 KPa
	Cohesion© = (qu/2) =	123.05 KPa
	Failure strain=	9.21%