Effect of Rice Husk Ash on Shear Strength of Soil in Changkat Chermin, Perak

by

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ABBREVIATIONS AND NOMENCLATURES

CaO	Calcium Oxide
LL	Liquid Limit
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
PI	Plasticity Index
PL	Plastic Limit
RHA	Rice Husk Ash
SEM	Scanning Electron Micrograph
USCS	Unified Soil Classification System
UTP	Universiti Teknologi PETRONAS
XRF	X-ray Fluorescence

CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Civil Engineering Programme
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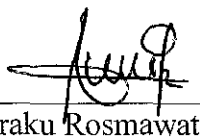
Approved by,



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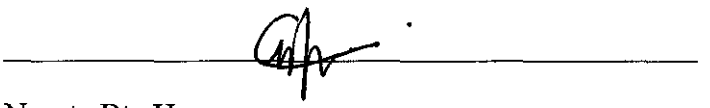
TRONOH, PERAK

January 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



Noreta Bte Hasan

ABSTRACT

Nowadays, the replacement of natural soils, aggregates and cement with solid industrial by-product is highly desirable. It makes an attractive alternative due to its lower cost and availability in many parts of the world. Several studies had been done using different stabilizing agents for stabilization such as lime, calcium oxide, coal combustion products and others. Even though the stabilizing agents are available the materials that used for stabilization, the cost are quiet expensive especially on lime. Considering the high cost of cement and lime, the utilization of Rice Husk Ash (RHA) instead of dumping as waste materials provides a significant contribution for the country's economy and solution to the environmental pollution problems. The stabilization of Malaysian soil by mixing with RHA, a locally available waste material, to improve its engineering properties is described. The main objective for this project is to investigate the benefit of using RHA for soil stabilization. This study covers the basic characteristics of soil and RHA, compaction, shear strength parameters and Atterberg limit. The samples were subjected to unconfined compression tested immediately as compacted and after curing for 3, 7 and 14 days at temperature of $(30 \pm 2)^0$C to develop water content- strength relationship. This soil was mixed with different percentages of RHA varying from 0% to 30% with increment of 6% by dry weight of soil. Soil samples were collected from oil-palm state at Changkat Cermin, Perak while RHA were obtained by burning of rice husk using standard incinerator. The mixtures between soil and RHA had increased the compaction and shear strength behavior. The optimum dry density was achieved when RHAA content was in range of 12 % – 18. The particles sizes of soil-RHA mixtures became more solid and contain lesser air voids compared to the untreated soil. The bonding between these materials indicated that RHA act as filler due of the lack of cementatious properties of RHA to form a pozzolonic reaction. From the experiments conducted, it can be concluded that the addition of RHA has improved the engineering properties of soft soil significantly.

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CHAPTER 1

INTRODUCTION

1.1 Background Study

Many procedures have been developed to improve the engineering behavior of soil by incorporating a wide range of stabilizing agents, additives and conditioners. The effectiveness of such agents relies on the formation of cementing bonds between the particles in the soil system. The most common cementing agents used are cement and lime.

Soil stabilization has been widely recommended for the construction of various elements of the pavements. In recent years the replacement of natural soils, aggregates and cement with solid industrial by-product such as phosphogypsum, fly ash and Rice Husk Ash (RHA) is highly desirable. Thus, the use of these various waste products in Civil Engineering construction currently gained considerable attention in view of the shortage and high costs of suitable conventional aggregates, increasing costs of waste disposal and environmental constraints.

1.2 Problem Statement

Recently, the need for locally manufactured construction materials is increasing due to greater demands for new road and housing units created by growing population. Over the years, the availability of conventional materials has not been sufficient to meet the

demand of growing population over the years. This shortage problem makes the construction materials more expensive and unaffordable to a large portion of the world's population. Thus, the replacement of a proportion of waste materials such as fly ash and RHA offers improved the soil properties to meet the desired requirement.

Rice husk is a major agriculture byproduct obtained from paddy. The husk is disposed off either by dumping it in an open heap near the mill site or on the roadside to be burnt later. Burning the rice husk generates about 15%- 20% of its weight as ash. The ash being light is easily carried by wind and water, thus contributing to air and water pollution. The huge quantity of ash generated requires large areas for disposal. Its effective utilization by exploiting its inherent properties is the only way to solve the environmental and disposal problems of ash.

1.3 Scope of Study

The objectives of this study;

- to determine mix proportions of RHA and soil to achieve optimum percentage.
- to investigate the effect of the RHA on the shear strength of the soil.
- to examine the possibility of RHA to stabilize the soil solely.

The scopes of the study;

- Fixed on shear strength of soil specimen as below; which the rice husk ash as the stabilizer by conducting the unconfined compressive strength tests.

    - Soil + 0% of RHA + optimum moisture content
    - Soil + 6% of RHA + optimum moisture content
    - Soil + 12% of RHA + optimum moisture content
    - Soil + 18% of RHA + optimum moisture content
    - Soil + 24% of RHA + optimum moisture content
    - Soil + 30% of RHA + optimum moisture content

- Conducting the compaction test to determine the optimum moisture content for mixed in the indicated percentage of RHA as above

CHAPTER 2

LITERATURE REVIEW / THEORY

2.1 Soil

Soils may be separated into three very broad categories: non-cohesive, cohesive and organic soils. In the case of non-cohesive soils, the soil particles do not tend to stick together. Cohesive soils are characterized by very small particle size where surface chemical effects predominate. The particles do tend to stick together which is the result of water-particle interaction and attractive forces between particles. Cohesive soils are therefore both sticky and plastic, (Cheng Liu, 2001).

Cheng Liu (2001) also indicated that soils can strictly categorize in terms of shear strength. Gravel and sand, with soil grains coarser than 0.075 mm are coarse-grained (also referred to as granular soils); silt and clay, with soils grains finer than 0.075 mm, are fined granular.

Many problem soils cause major damage to structures and embankments, and cannot be easily identified using routine soil testing procedures. According to Raul Flores-Berrones (2005), 'A simple way to improve a problem soil site is to remove the problem soils and replace them with higher quality materials. The use of chemical additives is another effective technique to improve problem soils. Chemical substances such as lime and Portland cement can be used alone or in combination to reduce the swelling and dispersion potentials of soils. Various other soil improvement techniques are also available and can be used if their cost is justifiable'.

'Soils are compacted to improve the stability of fills – reducing the likelihood of failures and enhancing safety. Soil fills settle and compress over time. The amount of settlement depends upon the initial compaction rate, among other things', (Wendi Goldsmith, 2001)

2.2 Soil stabilization

Generally, stabilized soil is a composite material that results from combination and optimization of properties in individual constituent materials, (E.A Basha et al., 2005).

'Soil stabilization is only one of several techniques available to the soil engineer, and its selection for any problem should be made only after a comparison with other techniques shows it to be the best solution to the problem', (T. W. Lambe, 1987). T.W. Lambe (1987) also indicated that the objectives of the soil stabilization are;

a. Increase and decrease strength, or reduce the sensitivity of strength to environment changes, especially moisture changes
b. Increase and decrease permeability
c. Reduce compressibility
d. Reduce frost susceptibility

The application of principles of soil stabilization may differ from one place to others due to the condition of the soil itself. 'Soil type and climatic conditions affect the characteristics of stabilized soil materials as well as technical methods and procedures' (E.A Basha et al., 2005).

According to the T. W. Lambe (1987), there are two types of stabilization, which are mechanical stabilization and additive stabilization (also known as chemical stabilization). Mechanical stabilization consists of two methods of changing soil properties; the arrangement of soil particles and the addition or removal of soil particles.

Chemical stabilization is the modification of the properties of a locally available soil to improve its engineering performance. The two most commonly used chemical stabilization methods are lime stabilization and cement stabilization. Additive such as by-product materials can be added to the soil-lime and soil-cement mixtures to further enhance the properties of the stabilized soil, (Arzu Okucu et al., 2007).

Others studies examined the possibility of improving soil properties such as increasing shear strength, reducing settlement, and minimizing the swelling problems by using solid waste,(Basha, 2005). Soil stabilizations have been used in various applications like improvement of shear strength, load bearing capacity, soil stabilization, filter, drainage system and many others. Several studies have been made on soil stabilization using different stabilizing agents. Pyne (1955) showed the effectiveness of addition of calcium chloride to soil treatment. Lopez and Castano (2001) used calcium oxide as a stabilization technique on clay soils in order to inhibit its expansion-contraction properties. Ghafoori and Cai (1997), and Ghafoori (2000), used coal combustion by-products in roller compacted concrete, roadway and parking lots. Moreover, recent research showed that pozzolanic material coupled with rice husk ash was a potential material for soil improvement. But according to J. James et al (1986), the quality of the pozzolanas to stabilize the soil are depending on burning time, temperature, cooling time and also grinding conditions.

According to Basha (2005),

> Well-established techniques of soil stabilization are often used to obtain geotechnical materials improve through the addition into soil of such cementing agents such as Portland cement, lime asphalt, etc. Replacement of natural soils, aggregates and cement with solid industrial by-product is highly desirable. In some cases, a by-product is inferior to traditional earthen materials. Due to its lower cost, however, it makes an attractive alternative if adequate performance can be obtained. In other cases, a by-product may have attributes superior to those of traditional earthen materials. Often selected materials are added to industrial by-products to generate a material with well-controlled and superior properties.

The statement is agreed by Chindaprasirt (2007) that stated 'the agricultural by-products such as fly-ash and RHA are receiving more attention now since their uses generally improve the properties of the blended cement concrete, the cost and the reduction of negative environmental effects'.

Haji Ali (1992) makes an opinion that amount of research concerning stabilization of soil with agents such as cement, lime, lime plus additives such as fly ash and salts, bitumen and polymers is available in the literature, but soil stabilization with lime/cement and RHA is a relatively new method.

2.3 Rice Husk Ash (RHA)

Rice husk is an agricultural waste material generated in rice producing countries, especially in Asia. Rice husk is one of the major agricultural by-products and is available in many parts of the world, (Chindaprasirt, 2007).

Hj Ali (1992) stated that,

> Rice husk is a major agricultural by-product obtained from the foodcrop of paddy. For every 4 tons of rice produced, 1 ton is rice husk. Rice husk has a chemical composition which typically corresponds to the following: cellulose (40-45%), lignin (25-30%), ash (15-20%) and moisture (8-15%). The ash is mainly derived from the opaline which is present in the cellular structure of husk and about 90% of which is silica. The silica content in the rice husk depends on the following:
>
> (a) the variety of the rice
> (b) soil and climate conditions
> (c) prevailing temperature
> (d) agricultural practices ranging from application of fertilizers and insecticides

As reported by Odogola R. Wilfred (2006),

Over 90% of the rice husks in the major rice growing countries of Asia are utilized as fuel (either directly or in briquette form), for commercial rice mill steam generators. In contrary, it is just left as waste which could be an environmental hazard around the mill. The immediate option at smallholder level is to use the husks as a source of fuel using simple cooking stoves now available in open market.

Houstin (1972) reported that the properties of the RHA depend greatly on whether the husks had undergone complete destructive distillation or had only been partially burnt. He also had classified the RHA into;

1 – high-carbon char

2 – low-carbon (gray) ash

3 – carbon-free (pink or white) ash

Traditionally, rice husk is been considered as a waste material and has generally been disposed of by dumping or burning, although some has been used as a low-grade fuel. This RHA is a great environment threat causing damage to the land and the surrounding area in which it is dumped. A lot of ways are being thought of for disposing them by making commercial use of this RHA.

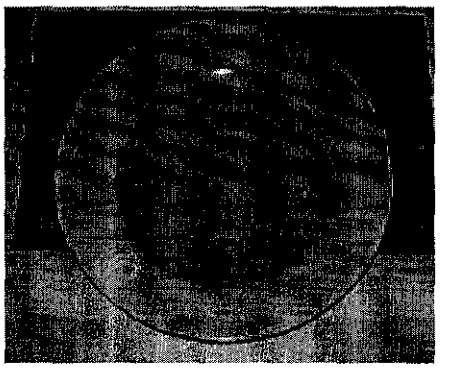


Figure 2.1: Raw rice husk (A Muthadhi, 2007)

Wen-Hwei (1986) reported the composition of RHA minerals as in Table 2.1. The RHA is usually high in ash compared to other biomass fuels which is close to 20%. The ash

consists of 80% - 90% silica, highly porous and lightweight, with a very high external surface area. Its absorbent and insulating properties are useful to many industrial applications. However, according to Rahman (1987), there is a lack of adequate data to fully understand the behavior of RHA for effective utilization.

Table 2.1: Composition of RHA minerals (Wen-Hwei, 1986)

MINERAL	COMPOSITION (%)
SiO_2	86.90 – 97.30
K_2O	0.58 – 2.50
Na_2O	0.00 – 1.75
CaO	0.20 – 1.50
MgO	0.12 – 1.96
Fe_2O_3	≈0.54
P_2O_5	0.2 – 2.85
SO_3	0.1 – 1.13
CI	≈0.42

'Rice husk ash contains mostly silica (90--95%) besides minor amounts of calcium, magnesium, potassium, sodium, phosphorus and sulphur along with trace amounts of aluminium, manganese and iron which vary according to the soil and manures used, as shown in Table 2.2. Compared to the conventional sources of silica, rice husk ash as a ceramic raw material possesses advantages like fine particle size and higher reactivity due to its amorphous nature', (Rama Rao, 1989).

Table 2.2: Mineral component of ash in various countries

	Weight % of ash from			
Component	USA[1]	India[2]	Malaysia[3]	Hyderabad
Si as Sio_2	94.50	94.5	93.10	89.4

Ca as CaO	0.25	0.48	0.41	2.55
Mg as MgO	0.23	0.23	1.59	1.30
Al	Trace	0.21	0.21	3.81
Fe	Trace	0.54	0.21	1.95
Mn	Trace	1.09	Not examined	0.03
K as K_2O	1.1	Trace	2.31	
Na as Na_2O	0.78	Trace	Not examined	
P as P_2O_3	0.53	Trace	Not examined	
S as SO_4	1.13	Trace	0.10	

Source: [1]Hough and Barr (1956); [2] Borthakur et al (1980); [3] E A Basha et al (2005)

2.4 Shear Strength

Like other engineering materials, when soil loaded for a long time period, it will fail. This failure will normally be a shear failure, and the maximum resistance of the soil to shearing stresses is known as shear strength.

The shear strength of a soil mass is the internal resistance per unit area that the soil mass can offer to resist failure and sliding along any plane inside it. The understanding of the nature of shearing resistance is required in order to analyze soil stability problems such as bearing capacity, slope stability and lateral pressure on earth retaining structures.

Shear strength results from frictional resistance to sliding, interlocking between adjacent solid particles in the soil, and cohesion and adhesion between adjacent soil particles. Because the ability of soil to support an imposed load is determined by its shear strength, the shear strength of soil is of great importance in foundation design, lateral earth pressure calculation, slope stability analysis, pile design, and others considerations, (Cheng Liu, 2001).

The shear strength or shearing resistance of a soil depends on a large number of factors, but is generally considered to be made up of:

a) the internal friction between the grains
b) the cohesion of the grains.

Cohesion is due to the intermolecular bond between the adsorbed water surrounding each grain, especially in fine-grained soils. Therefore, the value of the cohesion will thus vary with soil water content, grain size of soil and its compaction.' (Mohamed A.F. Abd El Maksoud, 1994).

According to Lawrence J. Sikora et al (2000) stabilization and strength gain continue slowly with time called 'curing'.

Dr J N Jha (2006) gave an opinion that the dependence of strength development on curing period for lime-RHA stabilization provides a considerable factor of safety for design based on 7 days, 28 days or 56 days strength.

'The rate of curing may proceed rapidly at higher temperature and rain may affect the compaction and strength of stabilized soil', (M.J. Dumbleton, 1962).

CHAPTER 3

METHODOLOGY

3.1 Introduction

The methodology would involve certain processes such as defining the materials used for the laboratory work and briefly description of certain test methods that been carried out. Table 3.3 below is the summary laboratory tests that have been conducted.

Table 3.3: Summary of laboratory tests

Mix description	XRF	Moisture content	Mechanical analysis	Atterberg limits	Specific gravity	Standard proctor test	Unconfined compression test (days)			
							0	3	7	14
RHA	✓				✓					
Soil + 0%	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil + 6%			✓	✓	✓	✓	✓	✓	✓	✓
Soil + 12%			✓	✓	✓	✓	✓	✓	✓	✓
Soil + 18%			✓	✓	✓	✓	✓	✓	✓	✓
Soil + 24%			✓	✓	✓	✓	✓	✓	✓	✓
Soil + 30%			✓	✓	✓	✓	✓	✓	✓	✓

3.2 Material and Sample Preparation

The materials that are used for this project were RHA, soil and water. The RHA is supplied by UTP, where the ashes obtained from burning of rice husk, under controlled temperature in the incinerator. After the incinerated, the ashes have been grinded using Los Angeles Abrasion machine (Figure 3.2).

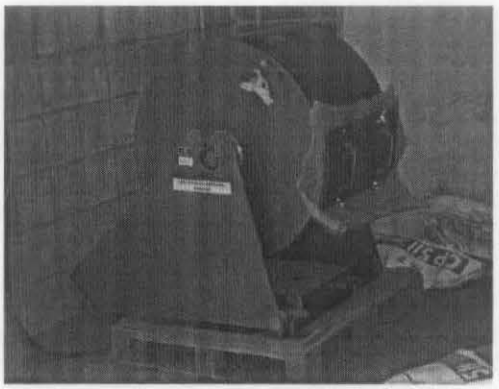


Figure 3.2: Los Angeles Abrasion

The percentages of the RHA are varied; 0%, 6%, 12%, 18%, 24%, and 30% from the total mass of the soil. This decision is based on the previous researches found on journals and due of time limitation in completing this study.

Meanwhile, the soils were obtained from a palm estate situated in Ladang Perbadanan Firma Berhad, Changkat Chermin, Perak. The soil was stored in containers in UTP Civil Engineering Laboratory to maintain the moisture content of the soil before the laboratory works began. Before further testing the soil, the samples were been dried at 105^0C for 24 hours in the oven-dried soil.

3.3 Laboratory Tests

3.3.1 X – Ray Fluorescence

The elements of the soil and RHA are determined by conducting the XRF analysis. XRF analysis is fast, non-destructive environmentally friendly analysis method with very high accuracy and reproducibility. All elements of the periodic table from beryllium to californium can be measured qualitatively, semi quantitatively and quantitatively in powders, solids and liquids. Concentrations of up to 100% were analyzed directly, without any dilution, with reproducibility better than ± 0.1 %. Typical limits of detection are from 0.1 to 10 ppm. Most modern x – ray spectrometers with modular sample changers enable fast, flexible sample handling and adaptation to customer – specific automation processes (Figure 3.3).

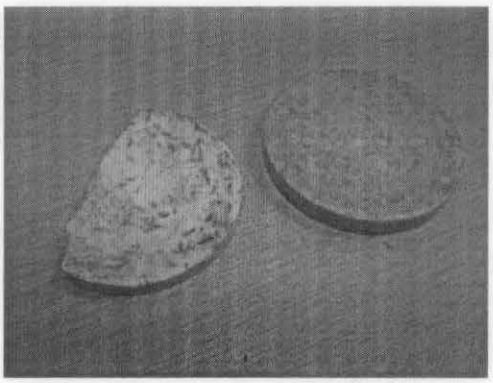


Figure 3.3: Samples for XRF

3.3.2 Scanning electron micrograph analysis (SEM)

An instrument similar to an electron microscope in that a beam of electrons instead of visible light is used to magnify the surface of a sample. The electrons are deflected, collected, accelerated, and directed against a scintillator. The surface image produced is of less magnification than that produced by an electron microscope, but it appears three dimensional and lifelike. The electrons emitted from the sample are then

scanned to form a magnified image which allows the examination of the structure, relief, and morphology of materials at between 20 and 50000 times magnification. In addition to its great magnification, the SEM also has a great depth of field. Most SEM also have a facility to analyze the X-rays given off by the target as a result of its bombardment and, as each element in the periodic table produces its own X-ray spectrum, this can be used to determine the elemental content of the sample.

3.3.3 Moisture content

The moisture content of soil (also known as water content) is an indicator of the amount of water present in soil. The procedure started with determines the moist of the soil sample. Further, the samples is drying in an oven at a temperature of $110^{\circ} \pm 5^{\circ}C$ for 24 hours to remove moisture and then the mass of the remaining oven-dried sample is measured, indicated as the mass of soil solids in the sample.

3.3.4 Mechanical Analysis

Mechanical analysis is the determination of the size range of particles present in a soil, expressed as a percentage of the total dry weight. Two methods generally used to find the particle-size distribution of soil; sieve analysis – for particle sizes larger than 0.075 mm in diameter and hydrometer analysis – for particle sizes smaller than 0.075 mm in diameter. In this analysis, soil with and without RHA 0%, 6%, 12%, 18%, 24% and 30%) have been done to determine the distribution curve.

3.3.4.1 Sieve Analysis

Sieve analysis consists of shaking 2000 g of samples through a set of sieves that have progressively smaller openings U.S. Standard sieve numbers and the sizes of openings for 15 minutes. The samples that used for this test included soil with and without percentage of RHA. The apparatus is having an opening of equal size and shape through which grains smaller than the size of the opening will pass, while larger grains are retained (Figure 3.4).

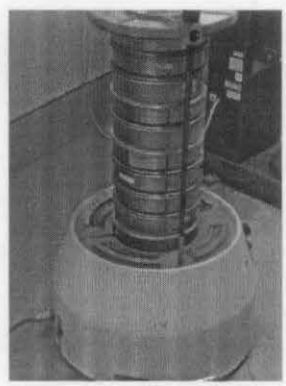


Figure 3.4: Sieves

3.3.4.2 Hydrometer

According to ASTM D 422-63, the 50 g of samples is dispersed in order to eliminate particle coagulation by mixing the samples with a sodium hexametaphosphate solution and stirring the mixture thoroughly. The samples also are prepared as a same as the previous test. After dispersion, the samples which are water slurry is transferred to a glass sedimentation cylinder and agitated manually. The cylinder is then placed in a convenient location, and hydrometer readings are taken at specific time intervals until 24 hours have elapsed (Figure 3.5). The grain – size distribution is determined from computations using the hydrometer readings as a function of time.

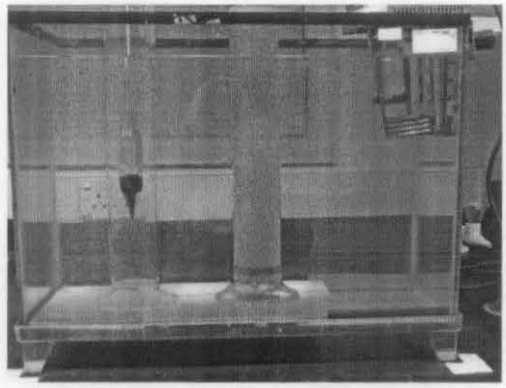


Figure 3.5: Hydrometer

3.3.5 Consistency Limits tests

The moisture content, in percent, at which the transition from solid to semisolid state takes place, is defined as the shrinkage limit. The moisture content at the point of transition from semisolid to plastic state is the plastic limit, and from plastic to liquid state is the liquid limit. These parameters are also known as Atterberg limits. For liquid limit and plastic limit, the soil and RHA were sieved through 425 mm. Materials that retained on that sieve were rejected for this test. The soils, then, were oven-dried before the test. The tests were carried out on the soil with different proportion of RHA (0%, 6%, 12%, 18%, 24% and 30%).

3.3.5.1 Liquid Limit (LL)

The liquid limit of samples was determined by using fall cone method. The liquid limit is defined as the moisture content at which a standard cone of apex 30^0 is used. The weight of 0.78 N is allowed to drop from a position of point contact with the sample surface. The distance of the weight and the surface was 20 mm and reading is taken after 5 seconds (Figure 3.6)

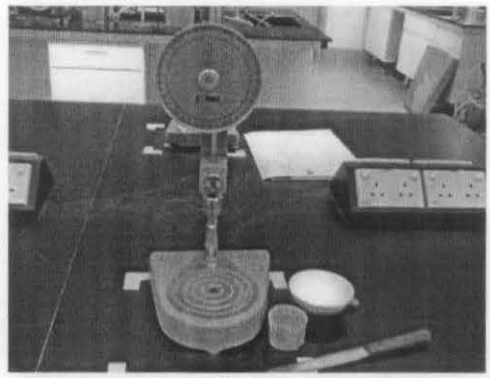


Figure 3.6: Fall Cone equipment

3.3.5.2 Plastic Limit (PL)

The plastic limit is defined as the moisture content in percent, at which the samples were rolled between the fingers and the rolling surface until a 3.2 mm diameter thread is obtained. The resulting mass is rolled once more between the fingers and the rolling surface until another thread of the same diameter is obtained. The soil becomes drier by losing moisture by time the soil is rolled out. The process is repeated until the thread crumbles and the soil no longer can be rolled into a thread. At this point, the plastic limit is assumed to have been reached, and the water content is determined.

Book of 'Soil Properties – Testing, Measurement and Evaluation (2003)' stated that the plasticity index (PI) is the difference between the liquid limit and the plastic limit of a soil;

$$PI = LL - PL \quad \text{.....Eqn. 1}$$

3.3.6 Specific Gravity

The soil, RHA and mixture of soil with the each percentage of RHA are determined. The 300g of samples and water were filled in a pycnometer by taking care the existing of air bubbles in accordance with ASTM D 854. Then, the mass of the pycnometer with

filled with water and sample is measured. The sample – and – water mixture is then poured onto an evaporating dish and dried in an oven to determine the mass of solids. But it is applied if the sample containing natural moisture content. After that, the mass of the pycnometer when filled with water is determined (Figure 3.7).

Figure 3.7: Pycnometer

3.3.7 Standard Proctor test

The dry density-moisture content relationship is obtained by conducting the Standard Proctor test (Figure 3.8). Similar tests were conducted for various soil-RHA mixes. MDD and OMC were determined for each mix. To prepared the samples, the soil mixtures, with and without RHA, were thoroughly mixed with various moistures contents to compaction. The samples were sieve through 425 mm before proceed the testing. The reason of finding the OMC is to ensure the amount of water that will be suitable to react with the each percentage of RHA. Before the samples have been compacted, the samples were mixing by using mixer to make the samples became homogenous with water (Figure 3.9). The OMC and MDD are measured after constructing a compaction curve.

Figure 3.8: Standard Proctor

Figure 3.9: Mixer

3.3.8 Unconfined compression test

The UCT was conducted to investigate the approximate shear strength in terms of total stress (Figure 3.10). The selected of this test is because it is the simplest, easiest and least expensive for investigating the shear strength.

Each specimen used in unconfined compression tests (soil with and without RHA) were compacted in a cylindrical mould at OMC and MDD of each specimens. The Standard Proctor test is used to compact the specimens. After the compaction, Universal Extruder used to extrude the specimens. Specimens were, after molded, cured in a Humidity Oven at $(30\pm2)^0$C before being tested. Curing times adopted were 3 days, 7 days and 14 days. As the control of the curing comparison, immediate test have been conducted. At least three specimens were tested for each case.

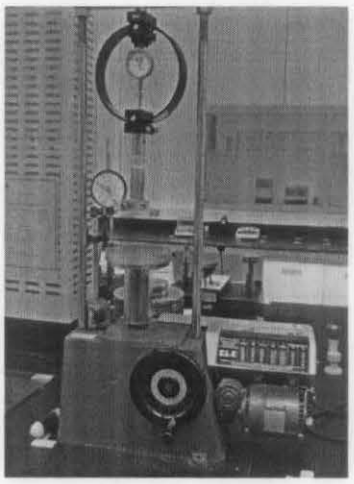


Figure 3.10: Unconfined Compression Test

3.4 Hazard Analysis

3.4.1 Equipment: Unconfined Compression Test

Application: Used to investigate shear strength

Table 3.4: Job Safety Analysis of Unconfined Compression Test

Hazards	Precaution
Finger stuck while switch on the motor	• Keep away finger • Use safety glove
Finger stuck while lowering the machine	• Keep away finger

plate and to remove the specimen	• Use safety glove

3.4.2 Equipment: Standard Proctor

Application: Used to obtain the maximum dry unit weight of compaction and the optimum moisture content

Table 3.5: Job Safety Analysis of Standard Proctor

Hazards	Precaution
Noise	• Use ear plug
Dirt while compacting the soil	• Use safety mask and goggle

3.4.3 Equipment: Sieve shaker

Application: Used to determine the size range of particles present in a soil

Table 3.6: Job Safety Analysis of Sieve Shaker

Hazards	Precaution
Noise	• Use ear plug
Finger stuck while placing and removing the sieve	• Keep away finger • Use safety glove
Dirt from the soil	• Use safety mask and goggle

3.4.4 Equipment: Universal Extruder

Application: Used to extrude sample from mould

Table 3.7: Job Safety Analysis of Universal Extruder

Hazards	Precaution
Finger stuck while placing and removing the specimen	• Keep away finger • Use safety glove

3.4.5 Equipment: Los Angeles Abrasion machine

Application: Used to grind soil and RHA

Table 3.8: Job Safety Analysis of Los Angeles Abrasion machine

Hazards	Precaution
Noise	• Use ear plug
Finger stuck while placing and removing the covering	• Keep away finger • Use safety glove
Dirt from the soil	• Use safety mask and goggle

3.4.6 Equipment: Rice Husk Ash Incinerator

Application: Used to burn RHA in temperature of 300^{o}

Table 3.9: Job Safety Analysis of Rice Husk Ash Incinerator

Hazards	Precaution
Heat from the incinerator	• Use safety glove
Dirt from the rice husk	• Use safety mask and goggle

3.4.7 Equipment: Drying Oven

Application: Used to determine the moisture content in the soil by drying / removing the moisture

Table 3.10: Job Safety Analysis of Drying Oven

Hazards	Precaution
Heat (105^0C)	• Use safety glove

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter, all the results acquired for the determination of properties of soil such as particle-size distribution, particle density and consistency of soils are shown. Several tests have been carried out such as the composition of the RHA and soil, the determination of moisture content of soils, consistency limit tests, specific gravity, particle size analysis and hydrometer.

4.1 Basic properties of soil and RHA

Table 4.11 shows the results of basic properties of the soil and RHA.

Table 4.11: Basic properties of soil and RHA

Properties	Soil	RHA
Moisture content	29.43 %	-
Specific gravity	2.53	2.43
Liquid Limit	50.6 %	-
Plastic Limit	26.96 %	-
Plasticity Index	23.64%	-

The specific gravity of the soil is 2.53 while for the RHA is 2.43. Braja M. Das (2001) indicate that most of the values of specific gravity of soil fall in the range of 2.6 to 2.9.

4.2 Mechanical Analysis

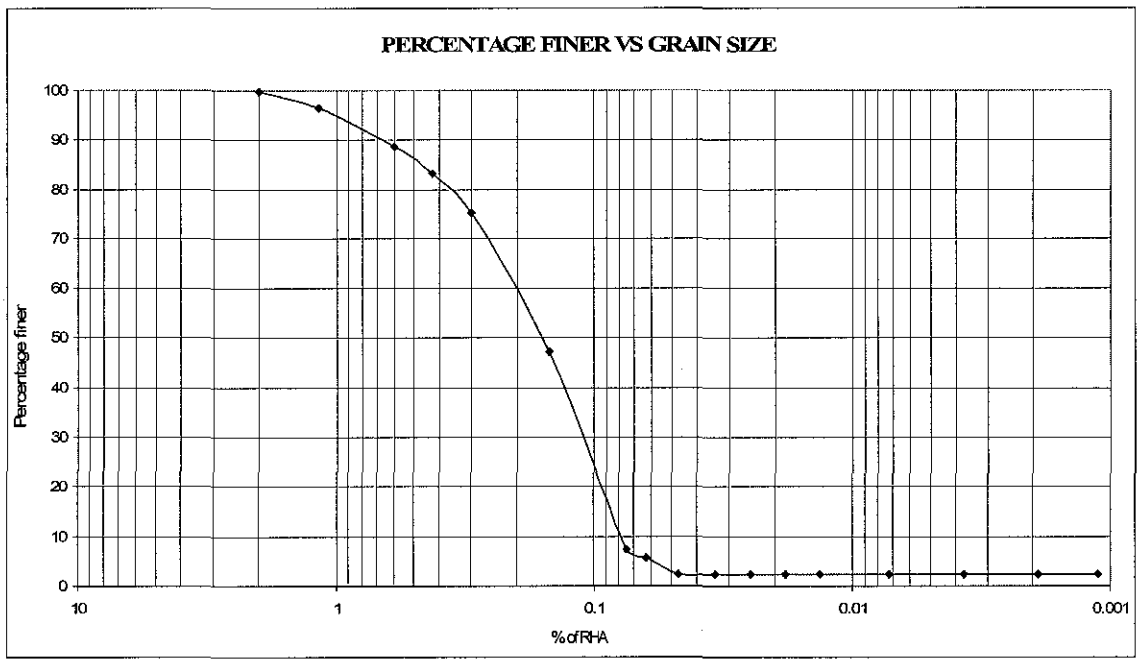


Figure 4.11: Results of particle-size distribution curve of soil

Figure 4.11 illustrated the particle-size distribution curve of soil solely that has been obtained from sieve analysis and hydrometer analysis. The curve indicated the soil is poorly graded, which most of the soil grains are the same sizes. This study was using the USCS to classify the soil. Thus, the soil has been classified as SILTY clay.

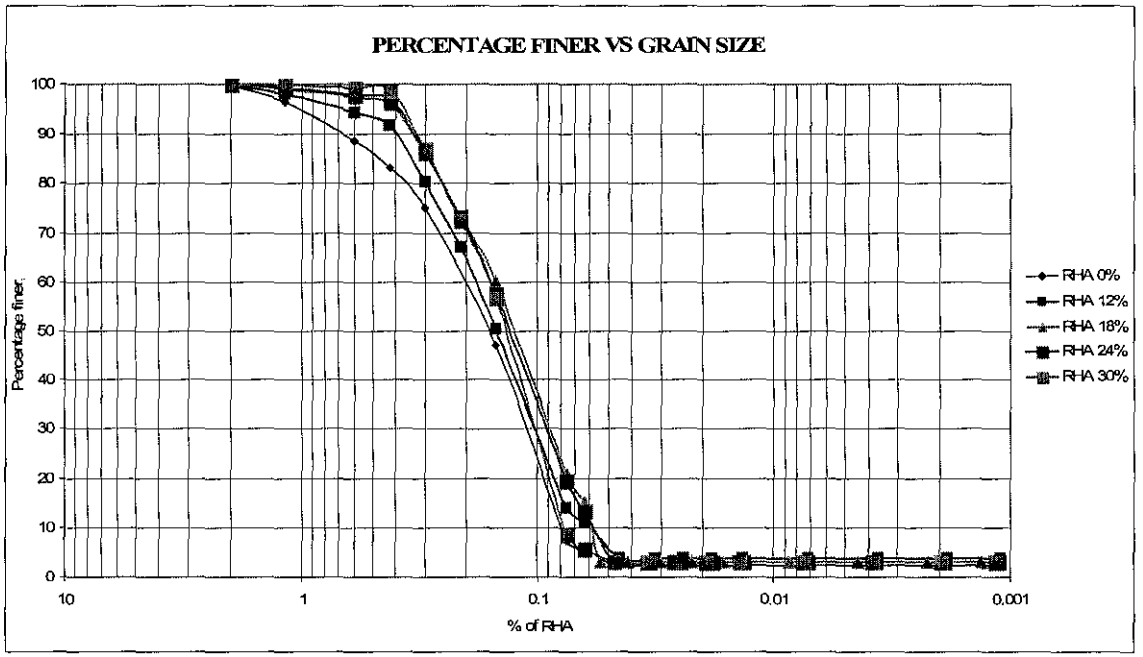


Figure 4.12: Summary of particle size-distribution curve for all percentage of RHA mixed with soil

Figure 4.12 shows the particle-size distribution curve of 0%, 6%, 12%, 18%, 24% and 30% of RHA mixed with the soil. From the Figure 4.11 above, most of the samples grains are the same size due the curve is classified as poorly graded. The trends do not change even after the addition of RHA.

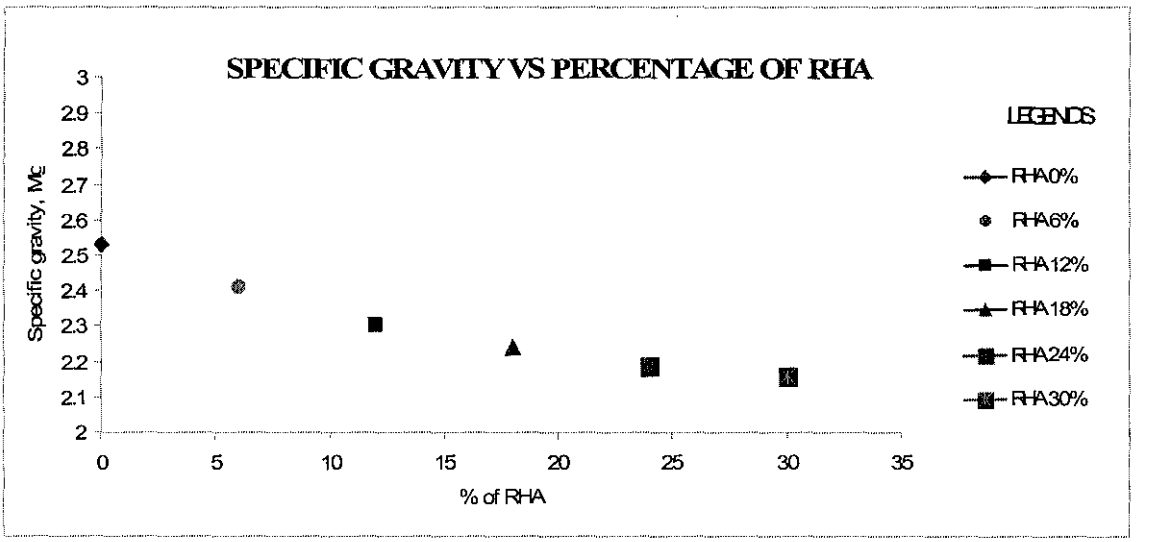
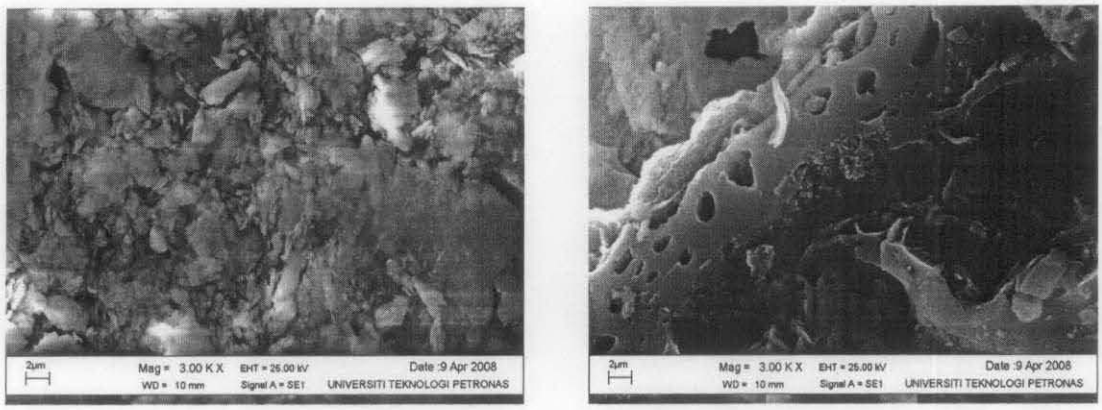


Figure 4.13: Results of specific gravity of soil with RHA contents

Figure 4.13 above shows the SG of various percentage of RHA mixing with soil sample. The SG decreased with respect to increase the RHA. This indicated that the soil is lighter that that of its natural conditions.

4.3 SEM and XRF of soil and RHA

For structural and morphological characteristics, XRF and SEM have been conducted as shown below.



a) SEM of soil at 3000x magnification b) SEM of RHA at 3000x magnification

Figure 4.14: SEM of soil and RHA

The RHA as indicated by SEM micrograph as shown in Figure 4.14(b) is regular well-defined layered structure, smooth and clean surface can be clearly seen, indicating that the RHA is being porous in nature that has a very high surface area. For untreated soil, as in fig. 4.14(a) the soil having irregular shape and scatter similar to cotton.

Table 4.12: Chemical properties of soil and RHA

Properties	**Soil**	**RHA**
Chemical properties	%	%
Silica (SiO_2)	65.2	75.80
Alumina (Al_2O_3)	30.6	-
Iron Oxide (Fe_2O_3)	1.33	1.75
Calcium Oxide (CaO)	0.0394	2.33
Potash (K_2O)	0.152	9.62
Magnesia (MgO)	0.0736	-
P_2O_5	0.229	1.94
Re	0.115	3.71
SO_3	0.290	-
Cl	-	-
MnO	-	-
Compton	1.01	0.61

Rayleigh	1.64	1.07

From Table 4.12 above, RHA contents high silica (75.80%) compared with soil (65.2%). The alumina of soil is 30.6% while for the RHA, it can not detected. The pozzalanic reaction is a minor contribution in stabilizing the soil due of the lack of cementatious properties in RHA.

4.4 Effect of RHA on the consistency limits

The nature of changes of liquid limits, plastic limits and plasticity indices with different percentages of RHA (0%, 6%, 12%, 18%, 24% and 30%) is presented in Figure 4.15. Both liquid and plastic limits increase with increase in RHA, but the plasticity index decreases.

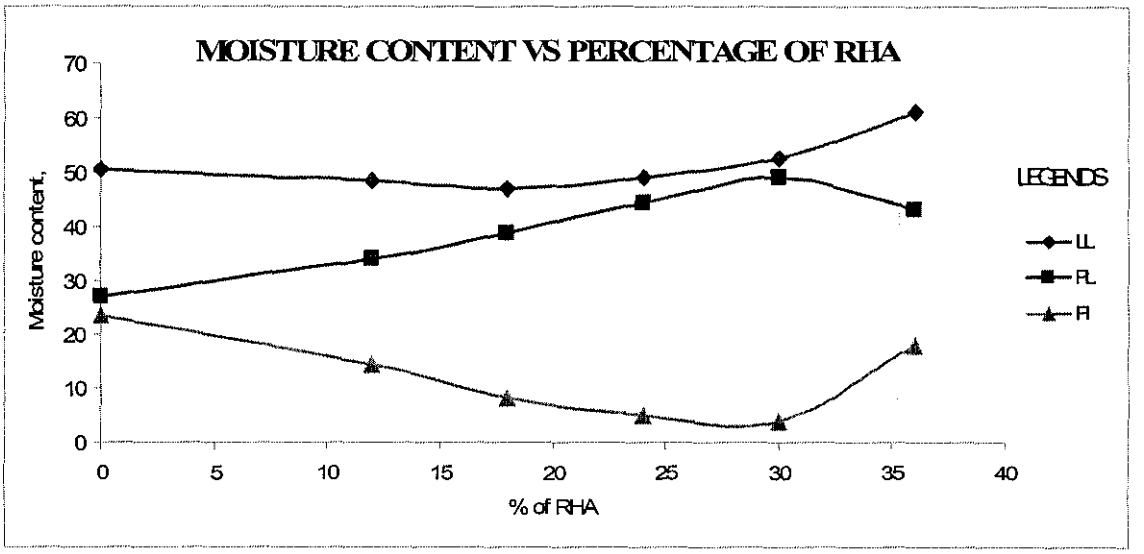


Figure 4.15: Variation of consistency limits of soil with various percentage of RHA

It can be observed that RHA reducing the plasticity of the soils. 30% of RHA shows the lowest value of moisture content, thus the mixture of soil and RHA behaves more like

solid. The optimum amount is in range of 25-30% of RHA. Some researchers reveals an opinion that by generally, 10-15% of RHA show the optimum amount to reduce the plasticity of soil and reducing of PI indicating an improvement. It is an opinion by the author that higher percentage of RHA is obtained compared with previous reaeachers is due of the samples dealing with RHA solely. About 84% of reduction of PI achieved the optimum amount when dealing with 30 % of RHA solely.

4.5 Effect of RHA on the compactibility

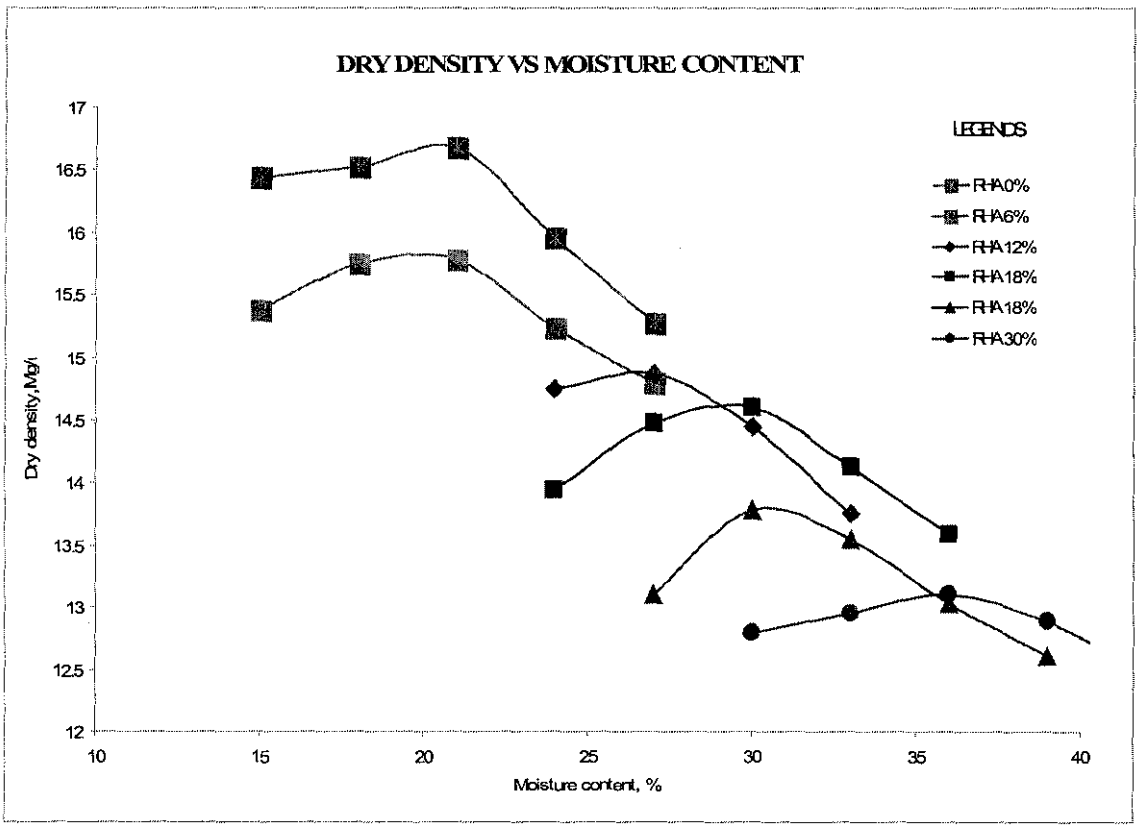


Figure 4.16: Graph of standard Proctor compaction characteristics of soil with RHA content

Figure 4.16 shows the effect of the mixture of soil and RHA on the compaction characteristics. The figure illustrates that adding the RHA increased the OMC. As

agreement with Zhang et al. (1996) and Dr J N Jha (2006), the reason of increasing in OMC is due of the exceeding water absorption by RHA as a result of its porous properties. But, as the percentage of RHA and OMC increased, it decreased the MDD. This phenomenon occurs due of the water takes up spaces that would have been occupied by the solid particles. Some researchers disclose that the reducing in dry density occurs due of both the particles size and specific gravity of the soil and stabilizer. The maximum density does not represent a soil condition with no voids remaining, rather one where the tightest possible packing arrangement is achieved given compaction conditions. Decreasing dry density indicates that it need low compactive energy to attain its MDD. By using low energy of compaction, the cost becomes more economical

4.6 Effect of RHA on the compressive strength

In terms of strength, RHA yields enhancement for this tested soil and this can be stated in Table 4.13 below. The strength developed on soil with various mix proportions of RHA are illustrate in Figure 4.17 below for 0 day, 3 days, 7 days and 14 days.

Table 4.13: Effect of RHA on strength of curing period

RHA (%)	Shear strength of curing period, C_u (kN/ m^2)			
	0 day	3 days	7 days	14 days
0	181.71	374.48	420.98	378.77
6	183.03	414.40	557.99	606.04
12	192.13	462.38	846.91	833.31
18	201.65	459.18	834.78	867.53
24	174.10	446.17	741.74	776.01
30	119.40	435.42	676.40	603.68

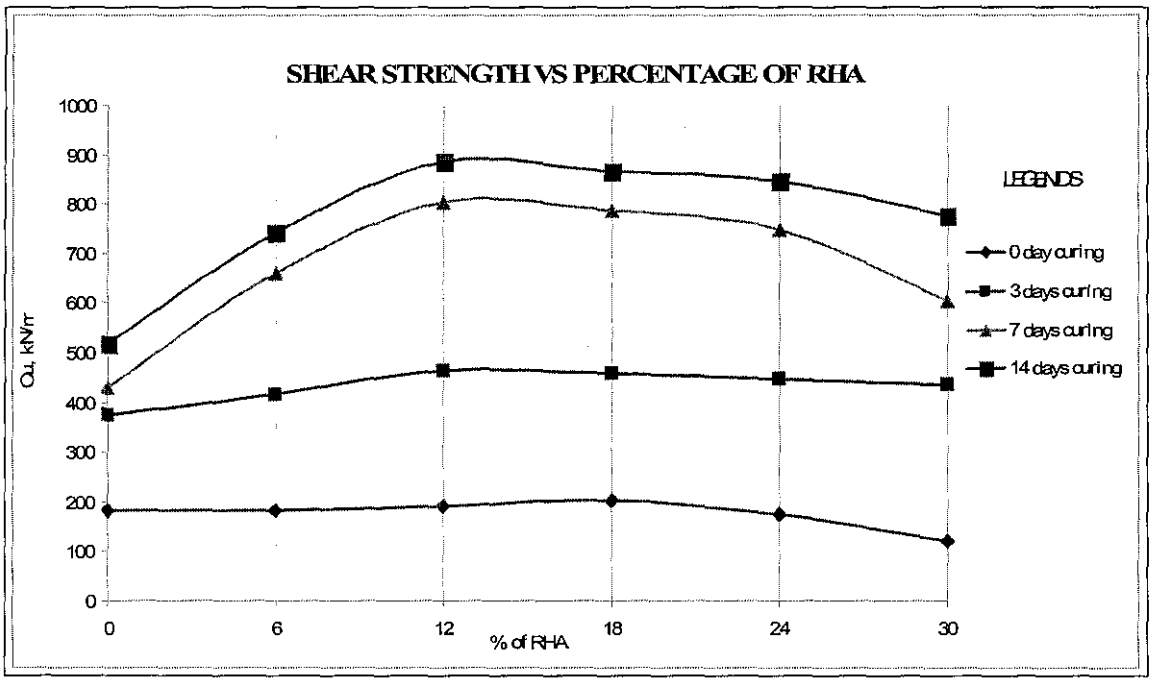


Figure 4.17: Summary of strength development of soil with RHA content at each case of curing

A general pattern is observed in which the strength developed rapidly with the addition of RHA until an optimum condition is reached. The optimum RHA content is observed to be in range of 12% to 18% in all cases. The gain in strength of RHA-stabilized soil is maybe primarily a result of filling pores by RHA between the soil particles due of insufficient availability of lime for pozzolanic reaction. Presence of RHA in the soil beyond the optimum values does not lead to strength development. The reason may be attributed to the insufficient pores of soil, thus the RHA tends to flocculate each others and stick to the surface of soil. In agreement with A Muthadhu et. al. (2007), the RHA tend to increase the water requirement due of the RHA has very high surface area while its average size still remains fairly high. Thus, by increasing the percentage of RHA, more water being absorbed by RHA and makes the sample become softer and stickier until it can not retained its shape. Due of that, less interaction between soils particles occurred until a slurry and suspension is formed and it failed more quickly.

Curing time also give an impact of the strength of the mixture. As shown in Figure 4.17 and Table 4.13 respectively, strength increases gradually with age of curing. The strength increased till 50% by adding 12% of RHA when 7 days curing test, compared with 10% increment of adding 18% of RHA when immediate test. From Figure 4.17 also, it can be seen that the addition of RHA produces not only a higher strength but also higher rate of initial strength development. A range of 12% to 18% RHA content produced the best results for all cases. It can also be observed that the rate of strength increase reduced at the later stage due of insufficient pores of soil, thus the RHA tends to flocculate each others and stick to the surface of soil.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

This study reports the effect of RHA as stabilization agent on soil taken in Changkat Chermin, Perak in term of shear strength. In the light of the test results the following conclusions can be made:

1. The addition of RHA reduces the plasticity index of the soil. As indicated before, the reducing in plasticity is an indicator of improvement
2. The MDD of RHA-soil decreasing with increasing of RHA, but the OMC increased with the increasing of percentage of RHA
3. 12% - 18% of RHA is the optimum range that been observed achieved the optimum shear strength by using the UCT method. Further adding the RHA beyond the range reduced the strength of the soil
4. RHA only can be potentially used stabilize to the soil.

For further research on RHA, the following are recommended:

1. The feasibility of using RHA in stabilization could be further investigated on different temperature for burning the RHA. However, the mineral contents in the RHA should be taken into account.

2. Further research using different types of soil especially on soft soil. It is important to note that soft soil is most required in improvement of the strength. Generally, soft soil contains higher moisture content, high consolidation and also higher compressibility. Thus, when load applied above the soft soil and loading for long time, it will have settlement.

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Table A.1.14: Moisture content of soil

Sample	Mass of wet soil + container, g	Mass of dry soil + container, g	Mass of water, g	Mass of container, g	Mass of dry soil, g	Moisture content, %
1	45.56	45.56	6.06	19.02	20.48	29.59
2	60.08	60.08	8.88	21.01	30.19	29.41
3	65.56	65.56	10.16	20.73	34.67	29.30
Average : **29.43 %**						

Table A.1.15: Specific gravity of soil

Jar no.		1	2	3
Mass of jar + gas jar + plate (m_1)	(g)	532.80	537.60	535.90
Mass of jar + gas jar + plate + soil (m_2)	(g)	932.90	938.90	936.00
Mass of jar + gas jar + plate + soil + water (m_3)	(g)	1795.71	1805.67	1788.10
Mass of jar + gas jar + plate + water (m_4)	(g)	1557.28	1547.06	1562.00
Mass of soil ($m_2 - m_1$)	(g)	400.10	401.30	400.10
Mass of water in full jar ($m_4 - m_1$)	(g)	1024.48	1009.46	1026.10
Mass of water used ($m_3 - m_2$)	(g)	862.81	866.77	852.10
Volume of soil particles ($m_4 - m_1$) - ($m_3 - m_2$)	ML	161.67	142.69	174.00
Particles density	Mg/m^3	2.47	2.81	2.30
Average value	Mg/m^3	**2.53**		

Table A.1.16: Specific gravity of RHA

Jar no.		1	2
Mass of jar + gas jar + plate (m_1)	(g)	534.29	537.28
Mass of jar + gas jar + plate + soil (m_2)	(g)	934.14	937.34
Mass of jar + gas jar + plate + soil + water (m_3)	(g)	1720.41	1720.82
Mass of jar + gas jar + plate + water (m_4)	(g)	1449.97	1546.77
Mass of soil ($m_2 - m_1$)	(g)	399.85	400.06
Mass of water in full jar ($m_4 - m_1$)	(g)	915.68	1009.49
Mass of water used ($m_3 - m_2$)	(g)	786.27	783.48

Volume of soil particles $(m_4 - m_1) - (m_3 - m_2)$	ML	129.41	226.01
Particles density	Mg/m^3	3.09	1.77
Average value	Mg/m^3	**2.43**	

Table A.1.17: Liquid Limit of soil

Test No	**1**		**2**		**3**	
Initial dial gauge reading (mm)	0.00	0.00	0.00	0.00	0.00	0.00
Final dial gauge reading (mm)	16.20	16.30	18.40	18.30	21.50	22.00
Average Penetration (mm)	16.25		18.35		21.75	
Container No.	**1**		**2**		**3**	
Mass of wet soil + container (g)	57.43		53.14		58.77	
Mass of dry soil + container (g)	51.06		45.39		48.61	
Mass of container (g)	37.29		29.54		29.32	
Mass of moisture (g)	6.37		7.75		10.16	
Mass of dry soil (g)	13.77		15.85		19.29	
Moisture content %	46.26		48.90		52.67	

Table A.1.18: Plastic Limit of soil

Container no.	**1**	**2**
Mass of wet soil + container (g)	42.00	48.90
Mass of dry soil + container (g)	39.29	46.58
Mass of container (g)	29.28	37.94
Mass of moisture (g)	2.71	2.32
Mass of dry soil (g)	10.01	8.64
Moisture content %	27.07	26.85
Plastic Limit %	**26.96**	

Table A.2.19: 0% of RHA

Sieve Analysis

Opening (mm)	Mass of Empty Sieve (g)	Mass Sieve + Soil Retained (g)	Mass Retained (g)	% Retained	Cummulative % Retained	% Passing
2.00	456.20	456.80	0.60	0.12	0.12	99.88
1.180	424.60	442.20	17.60	3.54	3.66	96.34
0.600	405.90	443.70	37.80	7.60	11.26	88.74
0.425	367.70	395.20	27.50	5.53	16.79	83.21
0.300	370.70	410.80	40.10	8.06	24.85	75.15
0.150	336.00	474.90	138.90	27.93	52.77	47.23
0.075	254.10	452.80	198.70	39.95	92.72	7.28
0.063	328.10	336.60	8.50	1.71	94.43	5.57
0.00	389.50	417.20	27.70	5.57	100.00	0.00

Hydrometer Analysis

Meniscus Reading = 0.005

Temperature = 26

Zero Correction = 1

$C_T = 1.21$

a = 1.028

K factor = 0.01257

Time	Actual Hydrometer Reading	Hydrometer Correction for Meniscus	Effective Length	D mm	Hydrometer Correction RC	% finer P	& adjusted finer PA
0.5	1.03	1.035	7	0.047033	1.24	2.54944	2.2919466
1	1.03	1.035	7.3	0.033962	1.24	2.54944	2.2919466
2	1.028	1.033	7.65	0.024584	1.238	2.545328	2.2882499
4	1.027	1.032	8.35	0.018161	1.237	2.543272	2.2864015
8	1.026	1.031	9.05	0.013369	1.236	2.541216	2.2845532
30	1.024	1.029	9.85	0.007203	1.234	2.537104	2.2808565
120	1.021	1.026	10.5	0.003718	1.231	2.530936	2.2753115
480	1.019	1.024	11	0.001903	1.229	2.526824	2.2716148
1440	1.017	1.022	11.4	0.001118	1.227	2.522712	2.2679181

Table A.2.20: 12% of RHA

Sieve Analysis

Opening (mm)	Mass of Empty Sieve (g)	Mass Sieve + Soil Retained (g)	Mass Retained (g)	% Retained	Cummulative % Retained	% Passing
2.00	454.00	454.30	0.30	0.13	0.13	99.87
1.180	423.90	428.00	4.10	1.84	1.97	98.03
0.600	401.90	410.10	8.20	3.67	5.64	94.36
0.425	365.40	371.10	5.70	2.55	8.19	91.81
0.300	369.50	395.40	25.90	11.59	19.79	80.21
0.212	344.60	373.80	29.20	13.07	32.86	67.14
0.150	347.50	384.80	37.30	16.70	49.55	50.45
0.075	254.00	335.30	81.30	36.39	85.94	14.06
0.063	327.80	334.10	6.30	2.82	88.76	11.24
0.00	389.50	414.60	25.10	11.24	100.00	0.00

Hydrometer Analysis

Meniscus Reading = 0.005

Temperature = 27.4

Zero Correction = 1

$C_T = 2.2$

a = 0.968

K factor = 0.01198

Time	Actual Hydrometer Reading	Hydrometer Correction for Meniscus	Effective Length	D mm	Hydrometer Correction R_C	% finer P	& adjusted finer P_A
0.5	1.035	1.0400	7.00	0.04483	2.2350	4.3270	3.7186
1	1.035	1.0400	7.00	0.03170	2.2350	4.3270	3.7186
2	1.031	1.0360	8.10	0.02411	2.2310	4.3192	3.7119
4	1.027	1.0320	9.20	0.01817	2.2270	4.3115	3.7053
8	1.024	1.0290	10.00	0.01339	2.2240	4.3057	3.7003
30	1.0225	1.0275	10.60	0.00712	2.2225	4.3028	3.6978
120	1.0205	1.0255	11.02	0.00363	2.2205	4.2989	3.6945
480	1.0185	1.0235	11.40	0.00185	2.2185	4.2950	3.6911
1440	1.016	1.0210	12.10	0.00110	2.2160	4.2902	3.6870

Table A.2.21: 18% of RHA

Sieve Analysis

Opening (mm)	Mass of Empty Sieve (g)	Mass Sieve + Soil Retained (g)	Mass Retained (g)	% Retained	Cummulative % Retained	% Passing
2.00	454.60	454.60	0.00	0.00	0.00	100.00
1.180	423.80	427.10	3.30	0.94	0.94	99.06
0.600	401.90	407.80	5.90	1.69	2.63	97.37
0.425	365.30	369.90	4.60	1.31	3.94	96.06
0.300	369.90	404.50	34.60	9.88	13.82	86.18
0.212	344.70	391.00	46.30	13.22	27.05	72.95
0.150	348.10	393.00	44.90	12.82	39.87	60.13
0.075	253.90	391.00	137.10	39.16	79.03	20.97
0.063	327.90	348.50	20.60	5.88	84.92	15.08
0.00	389.50	442.30	52.80	15.08	100.00	0.00

Hydrometer Analysis

Meniscus Reading = 0.005

Temperature = 25

Zero Correction = 1

$C_T = 1.3$

a = 1.028

K factor = 0.01257

Time	Actual Hydrometer Reading	Hydrometer Correction for Meniscus	Effective Length	D mm	Hydrometer Correction R_C	% finer P	& adjusted finer P_A
0.5	1.027	1.0320	9.20	0.05392	1.3270	2.7283	2.4528
1	1.0205	1.0255	10.85	0.04140	1.3205	2.7149	2.4407
2	1.0185	1.0235	11.40	0.03001	1.3185	2.7108	2.4370
4	1.015	1.0200	12.30	0.02204	1.3150	2.7036	2.4306
8	1.0115	1.0165	13.25	0.01618	1.3115	2.6964	2.4241
30	1.0095	1.0145	13.90	0.00856	1.3095	2.6923	2.4204
120	1.0065	1.0115	14.55	0.00438	1.3065	2.6862	2.4149
480	1.0045	1.0095	15.10	0.00223	1.3045	2.6821	2.4112
1440	1.002	1.0070	15.80	0.00132	1.3020	2.6769	2.4065

Table A.2.22: 24% of RHA

Sieve Analysis

Opening (mm)	Mass of Empty Sieve (g)	Mass Sieve + Soil Retained (g)	Mass Retained (g)	% Retained	Cummulative % Retained	% Passing
2.00	454.60	454.90	0.30	0.08	0.08	99.92
1.180	423.80	426.40	2.60	0.70	0.78	99.22
0.600	401.90	406.50	4.60	1.24	2.02	97.98
0.425	365.30	368.90	3.60	0.97	3.00	97.00
0.300	369.90	409.50	39.60	10.69	13.68	86.32
0.212	344.70	393.40	48.70	13.14	26.82	73.18
0.150	348.10	406.10	58.00	15.65	42.47	57.53
0.075	253.90	395.50	141.60	38.21	80.68	19.32
0.063	327.90	350.20	22.30	6.02	86.70	13.30
0.00	389.50	438.80	49.30	13.30	100.00	0.00

Hydrometer Analysis

Meniscus Reading = 0.005

Temperature = 26

Zero Correction = 1

$C_T = 1.65$

a = 1.028

K factor = 0.01257

Time	Actual Hydrometer Reading	Hydrometer Correction for Meniscus	Effective Length	D mm	Hydrometer Correction R_C	% finer P	& adjusted finer P_A
0.5	1.0235	10.1000	7.00	0.04703	1.6735	3.4407	3.0932
1	1.022	10.5000	7.30	0.03396	1.6720	3.4376	3.0904
2	1.0185	11.4000	7.65	0.02458	1.6685	3.4304	3.0840
4	1.0165	11.9500	8.35	0.01816	1.6665	3.4263	3.0803
8	1.013	12.9000	9.05	0.01337	1.6630	3.4191	3.0738
30	1.007	14.4000	9.85	0.00720	1.6570	3.4068	3.0627
120	1.005	15.0000	10.50	0.00372	1.6550	3.4027	3.0590
480	1.0025	15.6500	11.00	0.00190	1.6525	3.3975	3.0544
1440	1	16.3000	11.40	0.00112	1.6500	3.3924	3.0498

Table A.2.23: 30% of RHA

Sieve Analysis

Opening (mm)	Mass of Empty Sieve (g)	Mass Sieve + Soil Retained (g)	Mass Retained (g)	% Retained	Cummulative % Retained	% Passing
2.00	467.40	467.70	0.30	0.08	0.08	99.92
1.180	433.90	434.70	0.80	0.21	0.28	99.72
0.600	404.80	406.30	1.50	0.39	0.67	99.33
0.425	367.30	369.20	1.90	0.49	1.16	98.84
0.300	365.30	411.40	46.10	11.86	13.02	86.98
0.212	339.50	395.30	55.80	14.36	27.38	72.62
0.150	335.50	396.70	61.20	15.75	43.13	56.87
0.075	254.10	442.20	188.10	48.40	91.53	8.47
0.063	328.10	339.00	10.90	2.80	94.34	5.66
0.00	389.40	411.40	22.00	5.66	100.00	0.00

Hydrometer Analysis

Meniscus Reading = 0.005

Temperature = 26

Zero Correction = 1

$C_T = 1.65$

a = 1.028

K factor = 0.01257

Time	Actual Hydrometer Reading	Hydrometer Correction for Meniscus	Effective Length	D mm	Hydrometer Correction R_C	% finer P	& adjusted finer P_A
0.5	1.035	1.0400	7.00	0.04703	1.6850	3.4644	3.1145
1	1.035	1.0400	7.00	0.03326	1.6850	3.4644	3.1145
2	1.028	1.0330	8.90	0.02652	1.6780	3.4500	3.1015
4	1.026	1.0310	9.40	0.01927	1.6760	3.4459	3.0978
8	1.0245	1.0295	9.85	0.01395	1.6745	3.4428	3.0951
30	1.021	1.0260	10.70	0.00751	1.6710	3.4356	3.0886
120	1.019	1.0240	11.30	0.00386	1.6690	3.4315	3.0849
480	1.017	1.0220	11.80	0.00197	1.6670	3.4274	3.0812
1440	1.015	1.0200	12.30	0.00116	1.6650	3.4232	3.0775

Table A.3.24: 6% of RHA

Jar no.			
Mass of jar + gas jar + plate	(m_1)	(g)	536.47
Mass of jar + gas jar + plate + soil	(m_2)	(g)	931.97
Mass of jar + gas jar + plate + soil + water	(m_3)	(g)	1777.01
Mass of jar + gas jar + plate + water	(m_4)	(g)	1553.81
Mass of soil	(m_2 - m_1)	(g)	395.50
Mass of water in full jar	(m_4 - m_1)	(g)	1017.33
Mass of water used	(m_3 - m_2)	(g)	845.04
Volume of soil particles	(m_4 - m_1) - (m_3 - m_2)	ML	172.29
Particles density, □$_s$		Mg/m^3	2.41

Table A.3.25: 12% of RHA

Jar no.			
Mass of jar + gas jar + plate	(m_1)	(g)	537.51
Mass of jar + gas jar + plate + soil	(m_2)	(g)	928.01
Mass of jar + gas jar + plate + soil + water	(m_3)	(g)	1757.53
Mass of jar + gas jar + plate + water	(m_4)	(g)	1552.17
Mass of soil	(m_2 - m_1)	(g)	390.50
Mass of water in full jar	(m_4 - m_1)	(g)	1014.66
Mass of water used	(m_3 - m_2)	(g)	829.52
Volume of soil particles	(m_4 - m_1) - (m_3 - m_2)	ML	185.14
Particles density, r_s		Mg/m^3	2.30

Table A.3.26: 18% of RHA

Jar no.			
Mass of jar + gas jar + plate	(m_1)	(g)	539.40
Mass of jar + gas jar + plate + soil	(m_2)	(g)	893.60
Mass of jar + gas jar + plate + soil + water	(m_3)	(g)	1757.30
Mass of jar + gas jar + plate + water	(m_4)	(g)	1560.90
Mass of soil	(m_2 - m_1)	(g)	354.20

Mass of water in full jar	$(m_4 - m_1)$	(g)	1021.50
Mass of water used	$(m_3 - m_2)$	(g)	863.70
Volume of soil particles	$(m_4 - m_1) - (m_3 - m_2)$	ML	157.80
Particles density, r_s		Mg/m^3	2.24

Table A.3.27: 24% of RHA

Jar no.			
Mass of jar + gas jar + plate	(m_1)	(g)	533.70
Mass of jar + gas jar + plate + soil	(m_2)	(g)	906.00
Mass of jar + gas jar + plate + soil + water	(m_3)	(g)	1760.90
Mass of jar + gas jar + plate + water	(m_4)	(g)	1558.50
Mass of soil	$(m_2 - m_1)$	(g)	372.30
Mass of water in full jar	$(m_4 - m_1)$	(g)	1024.80
Mass of water used	$(m_3 - m_2)$	(g)	854.90
Volume of soil particles	$(m_4 - m_1) - (m_3 - m_2)$	ML	169.90
Particles density, r_s		Mg/m^3	2.19

Table A.3.28: 30% of RHA

Jar no.			
Mass of jar + gas jar + plate	(m_1)	(g)	536.20
Mass of jar + gas jar + plate + soil	(m_2)	(g)	926.10
Mass of jar + gas jar + plate + soil + water	(m_3)	(g)	1763.70
Mass of jar + gas jar + plate + water	(m_4)	(g)	1554.40
Mass of soil	$(m_2 - m_1)$	(g)	389.90
Mass of water in full jar	$(m_4 - m_1)$	(g)	1018.20
Mass of water used	$(m_3 - m_2)$	(g)	837.60
Volume of soil particles	$(m_4 - m_1) - (m_3 - m_2)$	ML	180.60
Particles density, r_s		Mg/m^3	2.16

Table A.4.29: 12% of RHA

Liquid Limit

Test No	1		2		3	
Initial dial gauge reading (mm)	0.00		0.00		0.00	
Final dial gauge reading (mm)	16.55		17.35		22.15	
Container No.	1		2		3	
Mass of wet soil + container (g)	29.60	35.96	32.20	36.80	44.00	39.50
Mass of dry soil + container (g)	26.40	30.70	28.00	31.20	36.50	32.60
Mass of container (g)	19.80	19.60	19.10	19.50	20.90	18.70
Mass of moisture (g)	3.20	5.26	4.20	5.60	7.50	6.90
Mass of dry soil (g)	6.60	11.10	8.90	11.70	15.60	13.90
Moisture content %	48.48	47.39	47.19	47.86	48.08	49.64
average	47.94		47.53		48.86	

Plastic Limit

Container no.	1	2
Mass of wet soil + container (g)	23.60	23.10
Mass of dry soil + container (g)	22.40	22.40
Mass of container (g)	19.00	20.28
Mass of moisture (g)	1.20	0.70
Mass of dry soil (g)	3.40	2.12
Moisture content %	35.29	33.02
Plastic Limit %	34.16	

Table A.4.30: 18% of RHA

Liquid Limit

Test No	1		2		3	
Initial dial gauge reading (mm)	0.00		0.00		0.00	
Final dial gauge reading (mm)	18.35		20.25		26.55	
Container No.	1		2		3	
Mass of wet soil + container (g)	41.10	37.50	37.30	34.40	40.00	38.30
Mass of dry soil + container (g)	34.70	31.90	31.60	30.20	33.10	32.00
Mass of container (g)	20.90	19.80	19.50	21.20	19.60	19.50
Mass of moisture (g)	6.40	5.60	5.70	4.20	6.90	6.30
Mass of dry soil (g)	13.80	12.10	12.10	9.00	13.50	12.50
Moisture content %	46.38	46.28	47.11	46.67	51.11	50.40
average	46.33		46.89		50.76	

Plastic Limit

Container no.	1	2
Mass of wet soil + container (g)	26.80	25.90
Mass of dry soil + container (g)	25.00	24.50
Mass of container (g)	20.34	20.90
Mass of moisture (g)	1.80	1.40
Mass of dry soil (g)	4.66	3.60
Moisture content %	38.63	38.89
Plastic Limit %	38.76	

Table A.4.31: 24% of RHA

Liquid Limit

Test No	1		2		3	
Initial dial gauge reading (mm)	0.00		0.00		0.00	
Final dial gauge reading (mm)	18.50		22.55		25.10	
Container No.	1		2		3	
Mass of wet soil + container (g)	39.80	40.70	38.40	46.10	48.60	55.90
Mass of dry soil + container (g)	33.70	34.20	32.00	37.30	38.70	46.60
Mass of container (g)	21.00	20.70	19.80	19.80	19.70	29.00
Mass of moisture (g)	6.10	6.50	6.40	8.80	9.90	9.30
Mass of dry soil (g)	12.70	13.50	12.20	17.50	19.00	17.60
Moisture content %	48.03	48.15	52.46	50.29	52.11	52.84
average	48.09		51.37		52.47	

Plastic Limit

Container no.	1	2
Mass of wet soil + container (g)	29.60	22.10
Mass of dry soil + container (g)	26.40	21.10
Mass of container (g)	19.80	18.61
Mass of moisture (g)	3.20	1.00
Mass of dry soil (g)	6.60	2.49
Moisture content %	48.48	40.16
Plastic Limit %	44.32	

Table A.4.32: 30% of RHA

Liquid Limit

Test No	1		2		3	
Initial dial gauge reading (mm)	0.00		0.00		0.00	
Final dial gauge reading (mm)	17.40		22.70		25.80	
Container No.	1		2		3	
Mass of wet soil + container (g)	47.30	46.90	55.00	61.70	50.30	53.30
Mass of dry soil + container (g)	38.20	38.10	45.90	47.30	39.90	41.70
Mass of container (g)	20.70	20.70	29.40	21.10	21.30	20.90
Mass of moisture (g)	9.10	8.80	9.10	14.40	10.40	11.60
Mass of dry soil (g)	17.50	17.40	16.50	26.20	18.60	20.80
Moisture content %	52.00	50.57	55.15	54.96	55.91	55.77
average	51.29		55.06		55.84	

Plastic Limit

Container no.	1	2
Mass of wet soil + container (g)	25.80	35.30
Mass of dry soil + container (g)	24.00	33.50
Mass of container (g)	20.80	29.20
Mass of moisture (g)	1.80	1.80
Mass of dry soil (g)	3.20	4.30
Moisture content %	56.25	41.86
Plastic Limit %	**49.06**	

Table B.1.33: 0% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	15	7	1.92	18.90	16.44
2	18	7.06	1.98	19.49	16.52
3	**21**	**7.13**	**2.05**	**20.18**	**16.68**
4	24	7.09	2.01	19.79	15.96
5	27	7.01	1.93	19.00	14.96

Table B.1.34: 6% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	12	8.02	1.7	16.99	15.17
2	15	8.09	1.77	17.69	15.38
3	18	8.18	1.86	18.59	15.75
4	**21**	**8.23**	**1.91**	**19.09**	**15.78**
5	24	8.21	1.89	18.89	15.23
6	27	8.2	1.88	18.79	14.79

Table B.1.35: 12% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	24	8.15	8.15	18.29	14.75
2	**27**	**8.21**	**8.21**	**18.89**	**14.87**
3	30	8.2	8.2	18.79	14.45
4	33	8.15	8.15	18.29	13.75

Table B.1.36: 18% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	24	8.05	1.73	17.29	13.94
2	27	8.16	1.84	18.39	14.48
3	**30**	**8.22**	**1.9**	**18.99**	**14.61**
4	33	8.2	1.88	18.79	14.13
5	36	8.17	1.85	18.49	13.60

Table B.1.37: 24% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	27	6.77	1.69	16.64	13.10
2	**30**	**6.9**	**1.82**	**17.92**	**13.78**
3	33	6.91	1.83	18.02	13.55
4	36	6.88	1.8	17.72	13.03
5	39	6.86	1.78	17.52	12.61

Table B.1.38: 30% of RHA

Mold no.	% of water added	Mass of mould + base plate + compacted soil, kg	Mass of compacted soil, kg	Bulk Density, ρ_m (Mg/m^3)	Dry Density, ρ_d (Mg/m^3)
1	30	6.77	1.69	16.64	12.80
2	33	6.83	1.75	17.23	12.95
3	**36**	**6.89**	**1.81**	**17.82**	**13.10**
4	39	6.9	1.82	17.92	12.89
5	42	6.88	1.8	17.72	12.48
6	45	6.85	1.77	17.43	12.02

Table C.1.39: 0% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m^2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001115	0.00	0.00
20.00	32.00	0.20	0.00	0.27	0.001118	0.04	38.66
40.00	50.00	0.40	0.01	0.55	0.001121	0.07	60.23
60.00	65.00	0.60	0.01	0.82	0.001124	0.09	78.09
80.00	79.00	0.80	0.01	1.10	0.001127	0.11	94.64
100.00	95.00	1.00	0.01	1.37	0.001130	0.13	113.50
120.00	108.00	1.20	0.02	1.64	0.001133	0.15	128.67
140.00	121.00	1.40	0.02	1.92	0.001136	0.16	143.76
160.00	132.00	1.60	0.02	2.19	0.001139	0.18	156.39
180.00	143.00	1.80	0.02	2.47	0.001143	0.19	168.95
200.00	153.00	2.00	0.03	2.74	0.001146	0.21	180.25
220.00	162.00	2.20	0.03	3.01	0.001149	0.22	190.32
240.00	172.00	2.40	0.03	3.29	0.001152	0.23	201.49
260.00	182.00	2.60	0.04	3.56	0.001156	0.25	212.61
280.00	193.00	2.80	0.04	3.84	0.001159	0.26	224.81
300.00	203.00	3.00	0.04	4.11	0.001162	0.27	235.79
320.00	213.00	3.20	0.04	4.38	0.001166	0.29	246.70
340.00	224.00	3.40	0.05	4.66	0.001169	0.30	258.70
360.00	234.00	3.60	0.05	4.93	0.001172	0.32	269.47
380.00	243.00	3.80	0.05	5.21	0.001176	0.33	279.03
400.00	255.00	4.00	0.05	5.48	0.001179	0.34	291.96
420.00	264.00	4.20	0.06	5.75	0.001183	0.36	301.39
440.00	275.00	4.40	0.06	6.03	0.001186	0.37	313.03
460.00	284.00	4.60	0.06	6.30	0.001189	0.38	322.33
480.00	294.00	4.80	0.07	6.58	0.001193	0.40	332.71
500.00	304.00	5.00	0.07	6.85	0.001196	0.41	343.02
520.00	315.00	5.20	0.07	7.12	0.001200	0.43	354.38
540.00	325.00	5.40	0.07	7.40	0.001204	0.44	364.55
560.00	337.00	5.60	0.08	7.67	0.001207	0.45	376.90
580.00	348.00	5.80	0.08	7.95	0.001211	0.47	388.04
600.00	358.00	6.00	0.08	8.22	0.001214	0.48	398.01
620.00	370.00	6.20	0.08	8.49	0.001218	0.50	410.12

640.00	380.00	6.40	0.09	8.77	0.001222	0.51	419.94
660.00	365.00	6.60	0.09	9.04	0.001225	0.49	402.15

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001109	0.00	0.00
20.00	50.00	0.20	0.00	0.27	0.001112	0.07	60.69
40.00	64.00	0.40	0.01	0.53	0.001115	0.09	77.48
60.00	76.00	0.60	0.01	0.80	0.001118	0.10	91.76
80.00	91.00	0.80	0.01	1.07	0.001121	0.12	109.58
100.00	103.00	1.00	0.01	1.33	0.001124	0.14	123.69
120.00	117.00	1.20	0.02	1.60	0.001127	0.16	140.12
140.00	130.00	1.40	0.02	1.87	0.001130	0.18	155.27
160.00	143.00	1.60	0.02	2.13	0.001133	0.19	170.33
180.00	154.00	1.80	0.02	2.40	0.001136	0.21	182.94
200.00	167.00	2.00	0.03	2.67	0.001140	0.23	197.84
220.00	178.00	2.20	0.03	2.93	0.001143	0.24	210.29
240.00	189.00	2.40	0.03	3.20	0.001146	0.26	222.67
260.00	199.00	2.60	0.03	3.47	0.001149	0.27	233.81
280.00	209.00	2.80	0.04	3.73	0.001152	0.28	244.88
300.00	219.00	3.00	0.04	4.00	0.001155	0.30	255.89
320.00	229.00	3.20	0.04	4.27	0.001159	0.31	266.83
340.00	238.00	3.40	0.05	4.53	0.001162	0.32	276.54
360.00	247.00	3.60	0.05	4.80	0.001165	0.33	286.20
380.00	255.00	3.80	0.05	5.07	0.001168	0.34	294.64
400.00	264.00	4.00	0.05	5.33	0.001172	0.36	304.18
420.00	272.00	4.20	0.06	5.60	0.001175	0.37	312.52
440.00	279.00	4.40	0.06	5.87	0.001178	0.38	319.65
460.00	286.00	4.60	0.06	6.13	0.001182	0.39	326.75
480.00	292.00	4.80	0.06	6.40	0.001185	0.39	332.65
500.00	298.00	5.00	0.07	6.67	0.001188	0.40	338.52
520.00	303.00	5.20	0.07	6.93	0.001192	0.41	343.22
540.00	308.00	5.40	0.07	7.20	0.001195	0.42	347.88
560.00	313.00	5.60	0.07	7.47	0.001199	0.42	352.51
580.00	318.00	5.80	0.08	7.73	0.001202	0.43	357.11
600.00	321.00	6.00	0.08	8.00	0.001206	0.43	359.44
620.00	324.00	6.20	0.08	8.27	0.001209	0.44	361.75

640.00	324.00	6.40	0.09	8.53	0.001213	0.44	360.69
660.00	311.00	6.60	0.09	8.80	0.001216	0.42	345.21
680.00	268.00	6.80	0.09	9.07	0.001220	0.36	296.61

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (N)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001122	0.00	0.00
20.00	60.00	0.20	0.00	0.29	0.001125	81.00	71.97
40.00	72.00	0.40	0.01	0.57	0.001129	97.20	86.12
60.00	82.00	0.60	0.01	0.86	0.001132	110.70	97.80
80.00	92.00	0.80	0.01	1.15	0.001135	124.20	109.40
100.00	102.00	1.00	0.01	1.44	0.001139	137.70	120.94
120.00	111.00	1.20	0.02	1.72	0.001142	149.85	131.23
140.00	120.00	1.40	0.02	2.01	0.001145	162.00	141.46
160.00	130.00	1.60	0.02	2.30	0.001149	175.50	152.80
180.00	139.00	1.80	0.03	2.58	0.001152	187.65	162.90
200.00	148.00	2.00	0.03	2.87	0.001155	199.80	172.93
220.00	157.00	2.20	0.03	3.16	0.001159	211.95	182.91
240.00	165.00	2.40	0.03	3.44	0.001162	222.75	191.66
260.00	174.00	2.60	0.04	3.73	0.001166	234.90	201.51
280.00	182.00	2.80	0.04	4.02	0.001169	245.70	210.15
300.00	189.00	3.00	0.04	4.31	0.001173	255.15	217.57
320.00	195.00	3.20	0.05	4.59	0.001176	263.25	223.81
340.00	198.00	3.40	0.05	4.88	0.001180	267.30	226.57
360.00	200.00	3.60	0.05	5.17	0.001183	270.00	228.17
380.00	203.00	3.80	0.05	5.45	0.001187	274.05	230.89
400.00	207.00	4.00	0.06	5.74	0.001191	279.45	234.72
420.00	212.00	4.20	0.06	6.03	0.001194	286.20	239.66
440.00	218.00	4.40	0.06	6.31	0.001198	294.30	245.69
460.00	224.00	4.60	0.07	6.60	0.001202	302.40	251.68
480.00	229.00	4.80	0.07	6.89	0.001205	309.15	256.51
500.00	232.00	5.00	0.07	7.18	0.001209	313.20	259.07
520.00	236.00	5.20	0.07	7.46	0.001213	318.60	262.72
540.00	239.00	5.40	0.08	7.75	0.001216	322.65	265.23
560.00	241.00	5.60	0.08	8.04	0.001220	325.35	266.62
580.00	241.00	5.80	0.08	8.32	0.001224	325.35	265.79
600.00	240.00	6.00	0.09	8.61	0.001228	324.00	263.86

620.00	232.00	6.20	0.09	8.90	0.001232	313.20	254.26

Table C.1.40: 6% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001115	0.00	0.00
20.00	41.50	0.20	0.00	0.27	0.001118	0.06	50.13
40.00	59.50	0.40	0.01	0.55	0.001121	0.08	71.68
60.00	74.50	0.60	0.01	0.82	0.001124	0.10	89.50
80.00	89.00	0.80	0.01	1.10	0.001127	0.12	106.62
100.00	104.00	1.00	0.01	1.37	0.001130	0.14	124.25
120.00	116.00	1.20	0.02	1.64	0.001133	0.16	138.20
140.00	128.50	1.40	0.02	1.92	0.001136	0.17	152.67
160.00	139.00	1.60	0.02	2.19	0.001139	0.19	164.68
180.00	151.00	1.80	0.02	2.47	0.001143	0.20	178.40
200.00	161.50	2.00	0.03	2.74	0.001146	0.22	190.27
220.00	171.50	2.20	0.03	3.01	0.001149	0.23	201.48
240.00	181.50	2.40	0.03	3.29	0.001152	0.25	212.62
260.00	191.50	2.60	0.04	3.56	0.001156	0.26	223.70
280.00	201.50	2.80	0.04	3.84	0.001159	0.27	234.72
300.00	211.00	3.00	0.04	4.11	0.001162	0.28	245.08
320.00	220.50	3.20	0.04	4.38	0.001166	0.30	255.38
340.00	230.50	3.40	0.05	4.66	0.001169	0.31	266.20
360.00	239.50	3.60	0.05	4.93	0.001172	0.32	275.80
380.00	248.00	3.80	0.05	5.21	0.001176	0.33	284.77
400.00	259.00	4.00	0.05	5.48	0.001179	0.35	296.54
420.00	268.00	4.20	0.06	5.75	0.001183	0.36	305.95
440.00	277.50	4.40	0.06	6.03	0.001186	0.37	315.88
460.00	286.00	4.60	0.06	6.30	0.001189	0.39	324.60
480.00	295.00	4.80	0.07	6.58	0.001193	0.40	333.84
500.00	302.50	5.00	0.07	6.85	0.001196	0.41	341.32
520.00	312.00	5.20	0.07	7.12	0.001200	0.42	351.01
540.00	320.00	5.40	0.07	7.40	0.001204	0.43	358.94
560.00	329.50	5.60	0.08	7.67	0.001207	0.44	368.51
580.00	338.00	5.80	0.08	7.95	0.001211	0.46	376.89

600.00	346.00	6.00	0.08	8.22	0.001214	0.47	384.66
620.00	355.50	6.20	0.08	8.49	0.001218	0.48	394.05
640.00	363.50	6.40	0.09	8.77	0.001222	0.49	401.71
660.00	371.00	6.60	0.09	9.04	0.001225	0.50	408.76
680.00	379.50	6.80	0.09	9.32	0.001229	0.51	416.87
700.00	388.00	7.00	0.10	9.59	0.001233	0.52	424.92
720.00	396.00	7.20	0.10	9.86	0.001236	0.53	432.37
740.00	403.50	7.40	0.10	10.14	0.001240	0.54	439.22
760.00	410.50	7.60	0.10	10.41	0.001244	0.55	445.47
780.00	418.50	7.80	0.11	10.68	0.001248	0.56	452.77
800.00	425.50	8.00	0.11	10.96	0.001252	0.57	458.93
820.00	432.00	8.20	0.11	11.23	0.001256	0.58	464.50
840.00	438.00	8.40	0.12	11.51	0.001259	0.59	469.50
860.00	443.50	8.60	0.12	11.78	0.001263	0.60	473.93
880.00	448.00	8.80	0.12	12.05	0.001267	0.60	477.25
900.00	450.50	9.00	0.12	12.33	0.001271	0.61	478.42
920.00	449.50	9.20	0.13	12.60	0.001275	0.61	475.86
940.00	427.00	9.40	0.13	12.88	0.001279	0.58	450.63

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001109	0.00	0.00
20.00	55.00	0.20	0.00	0.27	0.001112	0.07	66.76
40.00	68.00	0.40	0.01	0.53	0.001115	0.09	82.32
60.00	77.50	0.60	0.01	0.80	0.001118	0.10	93.57
80.00	88.00	0.80	0.01	1.07	0.001121	0.12	105.96
100.00	98.50	1.00	0.01	1.33	0.001124	0.13	118.29
120.00	109.00	1.20	0.02	1.60	0.001127	0.15	130.54
140.00	119.00	1.40	0.02	1.87	0.001130	0.16	142.13
160.00	129.00	1.60	0.02	2.13	0.001133	0.17	153.66
180.00	138.00	1.80	0.02	2.40	0.001136	0.19	163.93
200.00	148.00	2.00	0.03	2.67	0.001140	0.20	175.33
220.00	158.00	2.20	0.03	2.93	0.001143	0.21	186.66
240.00	166.50	2.40	0.03	3.20	0.001146	0.22	196.16
260.00	175.00	2.60	0.03	3.47	0.001149	0.24	205.61
280.00	183.50	2.80	0.04	3.73	0.001152	0.25	215.00
300.00	192.00	3.00	0.04	4.00	0.001155	0.26	224.34

320.00	199.50	3.20	0.04	4.27	0.001159	0.27	232.45
340.00	207.50	3.40	0.05	4.53	0.001162	0.28	241.10
360.00	215.00	3.60	0.05	4.80	0.001165	0.29	249.12
380.00	222.50	3.80	0.05	5.07	0.001168	0.30	257.09
400.00	230.50	4.00	0.05	5.33	0.001172	0.31	265.58
420.00	237.50	4.20	0.06	5.60	0.001175	0.32	272.88
440.00	244.50	4.40	0.06	5.87	0.001178	0.33	280.13
460.00	250.50	4.60	0.06	6.13	0.001182	0.34	286.19
480.00	258.00	4.80	0.06	6.40	0.001185	0.35	293.92
500.00	264.00	5.00	0.07	6.67	0.001188	0.36	299.90
520.00	270.00	5.20	0.07	6.93	0.001192	0.36	305.84
540.00	275.50	5.40	0.07	7.20	0.001195	0.37	311.17
560.00	280.50	5.60	0.07	7.47	0.001199	0.38	315.91
580.00	285.00	5.80	0.08	7.73	0.001202	0.38	320.05
600.00	290.00	6.00	0.08	8.00	0.001206	0.39	324.73
620.00	293.50	6.20	0.08	8.27	0.001209	0.40	327.69
640.00	296.50	6.40	0.09	8.53	0.001213	0.40	330.08
660.00	293.00	6.60	0.09	8.80	0.001216	0.40	325.23
680.00	273.50	6.80	0.09	9.07	0.001220	0.37	302.70

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001122	0.00	0.00
20.00	48.50	0.20	0.00	0.29	0.001125	0.07	58.18
40.00	60.50	0.40	0.01	0.57	0.001129	0.08	72.36
60.00	70.50	0.60	0.01	0.86	0.001132	0.10	84.08
80.00	80.50	0.80	0.01	1.15	0.001135	0.11	95.73
100.00	90.50	1.00	0.01	1.44	0.001139	0.12	107.31
120.00	99.50	1.20	0.02	1.72	0.001142	0.13	117.64
140.00	107.50	1.40	0.02	2.01	0.001145	0.15	126.72
160.00	117.00	1.60	0.02	2.30	0.001149	0.16	137.52
180.00	126.00	1.80	0.03	2.58	0.001152	0.17	147.66
200.00	135.00	2.00	0.03	2.87	0.001155	0.18	157.74
220.00	144.00	2.20	0.03	3.16	0.001159	0.19	167.76
240.00	152.50	2.40	0.03	3.44	0.001162	0.21	177.14
260.00	161.50	2.60	0.04	3.73	0.001166	0.22	187.03
280.00	169.50	2.80	0.04	4.02	0.001169	0.23	195.71

300.00	177.50	3.00	0.04	4.31	0.001173	0.24	204.34
320.00	185.00	3.20	0.05	4.59	0.001176	0.25	212.33
340.00	190.00	3.40	0.05	4.88	0.001180	0.26	217.41
360.00	195.50	3.60	0.05	5.17	0.001183	0.26	223.03
380.00	200.50	3.80	0.05	5.45	0.001187	0.27	228.04
400.00	207.00	4.00	0.06	5.74	0.001191	0.28	234.72
420.00	213.50	4.20	0.06	6.03	0.001194	0.29	241.36
440.00	221.00	4.40	0.06	6.31	0.001198	0.30	249.07
460.00	228.00	4.60	0.07	6.60	0.001202	0.31	256.17
480.00	235.00	4.80	0.07	6.89	0.001205	0.32	263.23
500.00	240.50	5.00	0.07	7.18	0.001209	0.32	268.56
520.00	247.00	5.20	0.07	7.46	0.001213	0.33	274.96
540.00	252.50	5.40	0.08	7.75	0.001216	0.34	280.21
560.00	257.00	5.60	0.08	8.04	0.001220	0.35	284.32
580.00	260.50	5.80	0.08	8.32	0.001224	0.35	287.29
600.00	263.50	6.00	0.09	8.61	0.001228	0.36	289.69
620.00	263.00	6.20	0.09	8.90	0.001232	0.36	288.23

Table C.1.41: 12% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001159	0.00	0.00
20.00	51.00	0.20	0.00	0.26	0.001162	0.07	59.27
40.00	69.00	0.40	0.01	0.52	0.001165	0.09	79.97
60.00	84.00	0.60	0.01	0.78	0.001168	0.11	97.10
80.00	99.00	0.80	0.01	1.04	0.001171	0.13	114.14
100.00	113.00	1.00	0.01	1.30	0.001174	0.15	129.94
120.00	124.00	1.20	0.02	1.56	0.001177	0.17	142.22
140.00	136.00	1.40	0.02	1.82	0.001180	0.18	155.57
160.00	146.00	1.60	0.02	2.08	0.001183	0.20	166.56
180.00	159.00	1.80	0.02	2.34	0.001187	0.21	180.91
200.00	170.00	2.00	0.03	2.60	0.001190	0.23	192.91
220.00	181.00	2.20	0.03	2.86	0.001193	0.24	204.84
240.00	191.00	2.40	0.03	3.12	0.001196	0.26	215.58
260.00	201.00	2.60	0.03	3.38	0.001199	0.27	226.26

280.00	210.00	2.80	0.04	3.64	0.001203	0.28	235.75
300.00	219.00	3.00	0.04	3.91	0.001206	0.30	245.19
320.00	228.00	3.20	0.04	4.17	0.001209	0.31	254.58
340.00	237.00	3.40	0.04	4.43	0.001212	0.32	263.91
360.00	245.00	3.60	0.05	4.69	0.001216	0.33	272.07
380.00	253.00	3.80	0.05	4.95	0.001219	0.34	280.19
400.00	263.00	4.00	0.05	5.21	0.001222	0.36	290.47
420.00	272.00	4.20	0.05	5.47	0.001226	0.37	299.58
440.00	280.00	4.40	0.06	5.73	0.001229	0.38	307.54
460.00	288.00	4.60	0.06	5.99	0.001233	0.39	315.46
480.00	296.00	4.80	0.06	6.25	0.001236	0.40	323.32
500.00	301.00	5.00	0.07	6.51	0.001239	0.41	327.87
520.00	309.00	5.20	0.07	6.77	0.001243	0.42	335.65
540.00	315.00	5.40	0.07	7.03	0.001246	0.43	341.21
560.00	322.00	5.60	0.07	7.29	0.001250	0.43	347.81
580.00	328.00	5.80	0.08	7.55	0.001253	0.44	353.30
600.00	334.00	6.00	0.08	7.81	0.001257	0.45	358.75
620.00	341.00	6.20	0.08	8.07	0.001260	0.46	365.23
640.00	347.00	6.40	0.08	8.33	0.001264	0.47	370.61
660.00	352.00	6.60	0.09	8.59	0.001268	0.48	374.88
680.00	359.00	6.80	0.09	8.85	0.001271	0.48	381.25
700.00	364.00	7.00	0.09	9.11	0.001275	0.49	385.45
720.00	369.00	7.20	0.09	9.37	0.001279	0.50	389.63
740.00	373.00	7.40	0.10	9.63	0.001282	0.50	392.72
760.00	377.00	7.60	0.10	9.89	0.001286	0.51	395.79
780.00	382.00	7.80	0.10	10.15	0.001290	0.52	399.88
800.00	386.00	8.00	0.10	10.41	0.001293	0.52	402.89
820.00	389.00	8.20	0.11	10.67	0.001297	0.53	404.84
840.00	393.00	8.40	0.11	10.93	0.001301	0.53	407.82
860.00	396.00	8.60	0.11	11.20	0.001305	0.53	409.73
880.00	400.00	8.80	0.11	11.46	0.001309	0.54	412.65
900.00	403.00	9.00	0.12	11.72	0.001312	0.54	414.53
920.00	405.00	9.20	0.12	11.98	0.001316	0.55	415.35
940.00	409.00	9.40	0.12	12.24	0.001320	0.55	418.22
960.00	411.00	9.60	0.12	12.50	0.001324	0.55	419.01
980.00	413.00	9.80	0.13	12.76	0.001328	0.56	419.80
1000.00	414.00	10.00	0.13	13.02	0.001332	0.56	419.56
1020.00	416.00	10.20	0.13	13.28	0.001336	0.56	420.33
1040.00	418.00	10.40	0.14	13.54	0.001340	0.56	421.08

1060.00	419.00	10.60	0.14	13.80	0.001344	0.57	420.82
1080.00	420.00	10.80	0.14	14.06	0.001348	0.57	420.55

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001145	0.00	0.00
20.00	60.00	0.20	0.00	0.26	0.001148	0.08	70.56
40.00	72.00	0.40	0.01	0.52	0.001151	0.10	84.45
60.00	79.00	0.60	0.01	0.79	0.001154	0.11	92.42
80.00	85.00	0.80	0.01	1.05	0.001157	0.11	99.18
100.00	94.00	1.00	0.01	1.31	0.001160	0.13	109.39
120.00	101.00	1.20	0.02	1.57	0.001163	0.14	117.22
140.00	108.00	1.40	0.02	1.83	0.001166	0.15	125.01
160.00	115.00	1.60	0.02	2.10	0.001169	0.16	132.76
180.00	122.00	1.80	0.02	2.36	0.001173	0.16	140.47
200.00	129.00	2.00	0.03	2.62	0.001176	0.17	148.13
220.00	138.00	2.20	0.03	2.88	0.001179	0.19	158.04
240.00	144.00	2.40	0.03	3.14	0.001182	0.19	164.46
260.00	151.00	2.60	0.03	3.40	0.001185	0.20	171.99
280.00	158.00	2.80	0.04	3.67	0.001188	0.21	179.48
300.00	165.00	3.00	0.04	3.93	0.001192	0.22	186.92
320.00	170.00	3.20	0.04	4.19	0.001195	0.23	192.06
340.00	177.00	3.40	0.04	4.45	0.001198	0.24	199.42
360.00	183.00	3.60	0.05	4.71	0.001202	0.25	205.61
380.00	190.00	3.80	0.05	4.98	0.001205	0.26	212.89
400.00	197.00	4.00	0.05	5.24	0.001208	0.27	220.13
420.00	203.00	4.20	0.06	5.50	0.001212	0.27	226.20
440.00	210.00	4.40	0.06	5.76	0.001215	0.28	233.36
460.00	215.00	4.60	0.06	6.02	0.001218	0.29	238.25
480.00	224.00	4.80	0.06	6.29	0.001222	0.30	247.53
500.00	230.00	5.00	0.07	6.55	0.001225	0.31	253.45
520.00	237.00	5.20	0.07	6.81	0.001229	0.32	260.43
540.00	243.00	5.40	0.07	7.07	0.001232	0.33	266.27
560.00	248.00	5.60	0.07	7.33	0.001235	0.33	270.99
580.00	252.00	5.80	0.08	7.60	0.001239	0.34	274.58
600.00	259.00	6.00	0.08	7.86	0.001243	0.35	281.41
620.00	263.00	6.20	0.08	8.12	0.001246	0.36	284.94

640.00	269.00	6.40	0.08	8.38	0.001250	0.36	290.61
660.00	275.00	6.60	0.09	8.64	0.001253	0.37	296.24
680.00	279.00	6.80	0.09	8.91	0.001257	0.38	299.69
700.00	285.00	7.00	0.09	9.17	0.001260	0.38	305.25
720.00	289.00	7.20	0.09	9.43	0.001264	0.39	308.65
740.00	294.00	7.40	0.10	9.69	0.001268	0.40	313.08
760.00	299.00	7.60	0.10	9.95	0.001271	0.40	317.48
780.00	303.00	7.80	0.10	10.21	0.001275	0.41	320.79
800.00	307.00	8.00	0.10	10.48	0.001279	0.41	324.08
820.00	310.00	8.20	0.11	10.74	0.001283	0.42	326.29
840.00	313.00	8.40	0.11	11.00	0.001286	0.42	328.48
860.00	316.00	8.60	0.11	11.26	0.001290	0.43	330.65
880.00	319.00	8.80	0.12	11.52	0.001294	0.43	332.80
900.00	323.00	9.00	0.12	11.79	0.001298	0.44	335.98
920.00	325.00	9.20	0.12	12.05	0.001302	0.44	337.06
940.00	327.00	9.40	0.12	12.31	0.001306	0.44	338.12
960.00	329.00	9.60	0.13	12.57	0.001310	0.44	339.17
980.00	330.00	9.80	0.13	12.83	0.001313	0.45	339.18
1000.00	329.00	10.00	0.13	13.10	0.001317	0.44	337.14

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001137	0.00	0.00
20.00	37.00	0.20	0.00	0.26	0.001139	0.05	43.84
40.00	49.00	0.40	0.01	0.53	0.001143	0.07	57.90
60.00	59.00	0.60	0.01	0.79	0.001146	0.08	69.53
80.00	69.00	0.80	0.01	1.05	0.001149	0.09	81.10
100.00	79.00	1.00	0.01	1.31	0.001152	0.11	92.61
120.00	88.00	1.20	0.02	1.58	0.001155	0.12	102.88
140.00	95.00	1.40	0.02	1.84	0.001158	0.13	110.77
160.00	104.00	1.60	0.02	2.10	0.001161	0.14	120.94
180.00	113.00	1.80	0.02	2.37	0.001164	0.15	131.05
200.00	122.00	2.00	0.03	2.63	0.001167	0.16	141.11
220.00	131.00	2.20	0.03	2.89	0.001170	0.18	151.11
240.00	140.00	2.40	0.03	3.15	0.001174	0.19	161.05
260.00	149.00	2.60	0.03	3.42	0.001177	0.20	170.94
280.00	157.00	2.80	0.04	3.68	0.001180	0.21	179.63

300.00	166.00	3.00	0.04	3.94	0.001183	0.22	189.41
320.00	175.00	3.20	0.04	4.21	0.001186	0.24	199.13
340.00	182.00	3.40	0.04	4.47	0.001190	0.25	206.53
360.00	191.00	3.60	0.05	4.73	0.001193	0.26	216.15
380.00	198.00	3.80	0.05	4.99	0.001196	0.27	223.45
400.00	207.00	4.00	0.05	5.26	0.001200	0.28	232.96
420.00	215.00	4.20	0.06	5.52	0.001203	0.29	241.29
440.00	224.00	4.40	0.06	5.78	0.001206	0.30	250.69
460.00	232.00	4.60	0.06	6.05	0.001210	0.31	258.92
480.00	241.00	4.80	0.06	6.31	0.001213	0.33	268.21
500.00	249.00	5.00	0.07	6.57	0.001216	0.34	276.34
520.00	258.00	5.20	0.07	6.83	0.001220	0.35	285.52
540.00	266.00	5.40	0.07	7.10	0.001223	0.36	293.54
560.00	273.00	5.60	0.07	7.36	0.001227	0.37	300.42
580.00	280.00	5.80	0.08	7.62	0.001230	0.38	307.24
600.00	287.00	6.00	0.08	7.89	0.001234	0.39	314.03
620.00	294.00	6.20	0.08	8.15	0.001237	0.40	320.77
640.00	296.00	6.40	0.08	8.41	0.001241	0.40	322.03
660.00	309.00	6.60	0.09	8.68	0.001244	0.42	335.21
680.00	315.00	6.80	0.09	8.94	0.001248	0.43	340.73
700.00	321.00	7.00	0.09	9.20	0.001252	0.43	346.22
720.00	328.00	7.20	0.09	9.46	0.001255	0.44	352.74
740.00	333.00	7.40	0.10	9.73	0.001259	0.45	357.08
760.00	339.00	7.60	0.10	9.99	0.001263	0.46	362.46
780.00	344.00	7.80	0.10	10.25	0.001266	0.46	366.73
800.00	350.00	8.00	0.11	10.52	0.001270	0.47	372.03
820.00	354.00	8.20	0.11	10.78	0.001274	0.48	375.18
840.00	359.00	8.40	0.11	11.04	0.001278	0.48	379.36
860.00	362.00	8.60	0.11	11.30	0.001281	0.49	381.40
880.00	367.00	8.80	0.12	11.57	0.001285	0.50	385.52
900.00	370.00	9.00	0.12	11.83	0.001289	0.50	387.52
920.00	374.00	9.20	0.12	12.09	0.001293	0.50	390.54
940.00	377.00	9.40	0.12	12.36	0.001297	0.51	392.49
960.00	356.00	9.60	0.13	12.62	0.001301	0.48	369.52

Table C.1.42: 18% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001117	0.00	0.00
20.00	15.00	0.20	0.00	0.27	0.001120	0.02	18.08
40.00	32.00	0.40	0.01	0.53	0.001123	0.04	38.47
60.00	50.00	0.60	0.01	0.80	0.001126	0.07	59.96
80.00	60.00	0.80	0.01	1.06	0.001129	0.08	71.75
100.00	81.00	1.00	0.01	1.33	0.001132	0.11	96.61
120.00	95.00	1.20	0.02	1.59	0.001135	0.13	113.00
140.00	110.00	1.40	0.02	1.86	0.001138	0.15	130.49
160.00	123.00	1.60	0.02	2.12	0.001141	0.17	145.52
180.00	134.00	1.80	0.02	2.39	0.001144	0.18	158.10
200.00	143.00	2.00	0.03	2.65	0.001147	0.19	168.27
220.00	152.00	2.20	0.03	2.92	0.001150	0.21	178.37
240.00	160.00	2.40	0.03	3.18	0.001154	0.22	187.24
260.00	168.00	2.60	0.03	3.45	0.001157	0.23	196.07
280.00	177.00	2.80	0.04	3.71	0.001160	0.24	206.00
300.00	186.00	3.00	0.04	3.98	0.001163	0.25	215.88
320.00	193.00	3.20	0.04	4.24	0.001166	0.26	223.39
340.00	201.00	3.40	0.05	4.51	0.001170	0.27	232.00
360.00	209.00	3.60	0.05	4.77	0.001173	0.28	240.57
380.00	217.00	3.80	0.05	5.04	0.001176	0.29	249.08
400.00	225.00	4.00	0.05	5.30	0.001179	0.30	257.54
420.00	233.00	4.20	0.06	5.57	0.001183	0.31	265.95
440.00	240.00	4.40	0.06	5.83	0.001186	0.32	273.17
460.00	248.00	4.60	0.06	6.10	0.001189	0.33	281.48
480.00	254.00	4.80	0.06	6.36	0.001193	0.34	287.48
500.00	260.00	5.00	0.07	6.63	0.001196	0.35	293.44
520.00	268.00	5.20	0.07	6.89	0.001200	0.36	301.61
540.00	275.00	5.40	0.07	7.16	0.001203	0.37	308.60
560.00	282.00	5.60	0.07	7.43	0.001206	0.38	315.55
580.00	289.00	5.80	0.08	7.69	0.001210	0.39	322.46
600.00	296.00	6.00	0.08	7.96	0.001213	0.40	329.32
620.00	303.00	6.20	0.08	8.22	0.001217	0.41	336.14

640.00	309.00	6.40	0.08	8.49	0.001220	0.42	341.80
660.00	316.00	6.60	0.09	8.75	0.001224	0.43	348.53
680.00	322.00	6.80	0.09	9.02	0.001228	0.43	354.12
700.00	328.00	7.00	0.09	9.28	0.001231	0.44	359.67
720.00	334.00	7.20	0.10	9.55	0.001235	0.45	365.18
740.00	340.00	7.40	0.10	9.81	0.001238	0.46	370.65
760.00	345.00	7.60	0.10	10.08	0.001242	0.47	374.99
780.00	351.00	7.80	0.10	10.34	0.001246	0.47	380.39
800.00	357.00	8.00	0.11	10.61	0.001249	0.48	385.75
820.00	362.00	8.20	0.11	10.87	0.001253	0.49	389.99
840.00	368.00	8.40	0.11	11.14	0.001257	0.50	395.27
860.00	373.00	8.60	0.11	11.40	0.001261	0.50	399.45
880.00	378.00	8.80	0.12	11.67	0.001264	0.51	403.59
900.00	383.00	9.00	0.12	11.93	0.001268	0.52	407.70
920.00	388.00	9.20	0.12	12.20	0.001272	0.52	411.78
940.00	392.00	9.40	0.12	12.46	0.001276	0.53	414.77
960.00	398.00	9.60	0.13	12.73	0.001280	0.54	419.84
980.00	400.00	9.80	0.13	12.99	0.001284	0.54	420.67
1000.00	405.00	10.00	0.13	13.26	0.001288	0.55	424.63
1020.00	409.00	10.20	0.14	13.52	0.001292	0.55	427.51
1040.00	413.00	10.40	0.14	13.79	0.001296	0.56	430.37
1060.00	416.00	10.60	0.14	14.05	0.001300	0.56	432.16
1080.00	420.00	10.80	0.14	14.32	0.001304	0.57	434.97
1100.00	423.00	11.00	0.15	14.58	0.001308	0.57	436.72
1120.00	425.00	11.20	0.15	14.85	0.001312	0.57	437.43
1140.00	428.00	11.40	0.15	15.12	0.001316	0.58	439.14
1160.00	431.00	11.60	0.15	15.38	0.001320	0.58	440.84
1180.00	432.00	11.80	0.16	15.65	0.001324	0.58	440.48
1200.00	432.00	12.00	0.16	15.91	0.001328	0.58	439.09
1220.00	432.00	12.20	0.16	16.18	0.001332	0.58	437.71
1240.00	429.00	12.40	0.16	16.44	0.001337	0.58	433.29

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001159	0.00	0.00
20.00	72.00	0.20	0.00	0.26	0.001162	0.10	83.62
40.00	105.00	0.40	0.01	0.52	0.001165	0.14	121.63

60.00	124.00	0.60	0.01	0.78	0.001168	0.17	143.27
80.00	140.00	0.80	0.01	1.04	0.001172	0.19	161.33
100.00	153.00	1.00	0.01	1.30	0.001175	0.21	175.85
120.00	165.00	1.20	0.02	1.56	0.001178	0.22	189.14
140.00	175.00	1.40	0.02	1.82	0.001181	0.24	200.07
160.00	180.00	1.60	0.02	2.08	0.001184	0.24	205.24
180.00	195.00	1.80	0.02	2.34	0.001187	0.26	221.75
200.00	203.00	2.00	0.03	2.60	0.001190	0.27	230.24
220.00	212.00	2.20	0.03	2.86	0.001193	0.29	239.80
240.00	221.00	2.40	0.03	3.12	0.001197	0.30	249.31
260.00	230.00	2.60	0.03	3.38	0.001200	0.31	258.77
280.00	239.00	2.80	0.04	3.64	0.001203	0.32	268.17
300.00	248.00	3.00	0.04	3.90	0.001206	0.33	277.51
320.00	256.00	3.20	0.04	4.16	0.001210	0.35	285.69
340.00	264.00	3.40	0.04	4.42	0.001213	0.36	293.82
360.00	273.00	3.60	0.05	4.69	0.001216	0.37	303.01
380.00	280.00	3.80	0.05	4.95	0.001220	0.38	309.93
400.00	288.00	4.00	0.05	5.21	0.001223	0.39	317.91
420.00	295.00	4.20	0.05	5.47	0.001226	0.40	324.74
440.00	303.00	4.40	0.06	5.73	0.001230	0.41	332.63
460.00	310.00	4.60	0.06	5.99	0.001233	0.42	339.38
480.00	318.00	4.80	0.06	6.25	0.001237	0.43	347.17
500.00	325.00	5.00	0.07	6.51	0.001240	0.44	353.83
520.00	332.00	5.20	0.07	6.77	0.001243	0.45	360.44
540.00	339.00	5.40	0.07	7.03	0.001247	0.46	367.02
560.00	346.00	5.60	0.07	7.29	0.001250	0.47	373.55
580.00	352.00	5.80	0.08	7.55	0.001254	0.48	378.96
600.00	358.00	6.00	0.08	7.81	0.001258	0.48	384.33
620.00	365.00	6.20	0.08	8.07	0.001261	0.49	390.74
640.00	370.00	6.40	0.08	8.33	0.001265	0.50	394.97
660.00	375.00	6.60	0.09	8.59	0.001268	0.51	399.17
680.00	380.00	6.80	0.09	8.85	0.001272	0.51	403.34
700.00	385.00	7.00	0.09	9.11	0.001276	0.52	407.48
720.00	390.00	7.20	0.09	9.37	0.001279	0.53	411.59
740.00	395.00	7.40	0.10	9.63	0.001283	0.53	415.67
760.00	399.00	7.60	0.10	9.89	0.001287	0.54	418.67
780.00	403.00	7.80	0.10	10.15	0.001290	0.54	421.65
800.00	407.00	8.00	0.10	10.41	0.001294	0.55	424.60
820.00	411.00	8.20	0.11	10.67	0.001298	0.55	427.53

840.00	415.00	8.40	0.11	10.93	0.001302	0.56	430.43
860.00	419.00	8.60	0.11	11.19	0.001305	0.57	433.31
880.00	423.00	8.80	0.11	11.45	0.001309	0.57	436.16
900.00	426.00	9.00	0.12	11.71	0.001313	0.58	437.96
920.00	429.00	9.20	0.12	11.97	0.001317	0.58	439.75
940.00	431.00	9.40	0.12	12.23	0.001321	0.58	440.49
960.00	433.00	9.60	0.12	12.49	0.001325	0.58	441.22
980.00	434.00	9.80	0.13	12.75	0.001329	0.59	440.93
1000.00	435.00	10.00	0.13	13.01	0.001333	0.59	440.62
1020.00	436.00	10.20	0.13	13.27	0.001337	0.59	440.32
1040.00	434.00	10.40	0.14	13.53	0.001341	0.59	436.98

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001123	0.00	0.00
20.00	37.00	0.20	0.00	0.26	0.001126	0.05	44.37
40.00	46.00	0.40	0.01	0.53	0.001129	0.06	55.02
60.00	58.00	0.60	0.01	0.79	0.001132	0.08	69.18
80.00	69.00	0.80	0.01	1.06	0.001135	0.09	82.08
100.00	80.00	1.00	0.01	1.32	0.001138	0.11	94.92
120.00	91.00	1.20	0.02	1.59	0.001141	0.12	107.68
140.00	100.00	1.40	0.02	1.85	0.001144	0.14	118.01
160.00	110.00	1.60	0.02	2.12	0.001147	0.15	129.46
180.00	120.00	1.80	0.02	2.38	0.001150	0.16	140.85
200.00	129.00	2.00	0.03	2.64	0.001153	0.17	151.00
220.00	138.00	2.20	0.03	2.91	0.001156	0.19	161.10
240.00	146.00	2.40	0.03	3.17	0.001160	0.20	169.97
260.00	154.00	2.60	0.03	3.44	0.001163	0.21	178.80
280.00	162.00	2.80	0.04	3.70	0.001166	0.22	187.57
300.00	170.00	3.00	0.04	3.97	0.001169	0.23	196.29
320.00	177.00	3.20	0.04	4.23	0.001172	0.24	203.81
340.00	185.00	3.40	0.04	4.50	0.001176	0.25	212.43
360.00	191.00	3.60	0.05	4.76	0.001179	0.26	218.72
380.00	199.00	3.80	0.05	5.03	0.001182	0.27	227.24
400.00	207.00	4.00	0.05	5.29	0.001186	0.28	235.72
420.00	215.00	4.20	0.06	5.55	0.001189	0.29	244.15
440.00	223.00	4.40	0.06	5.82	0.001192	0.30	252.52

460.00	230.00	4.60	0.06	6.08	0.001196	0.31	259.72
480.00	239.00	4.80	0.06	6.35	0.001199	0.32	269.12
500.00	246.00	5.00	0.07	6.61	0.001202	0.33	276.22
520.00	258.00	5.20	0.07	6.88	0.001206	0.35	288.88
540.00	268.00	5.40	0.07	7.14	0.001209	0.36	299.22
560.00	275.00	5.60	0.07	7.41	0.001213	0.37	306.16
580.00	283.00	5.80	0.08	7.67	0.001216	0.38	314.17
600.00	290.00	6.00	0.08	7.93	0.001220	0.39	321.02
620.00	297.00	6.20	0.08	8.20	0.001223	0.40	327.82
640.00	205.00	6.40	0.08	8.46	0.001227	0.28	225.62

Table C.1.43: 24% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001155	0.00	0.00
20.00	28.00	0.20	0.00	0.26	0.001158	0.04	32.64
40.00	40.00	0.40	0.01	0.52	0.001161	0.05	46.51
60.00	51.00	0.60	0.01	0.78	0.001164	0.07	59.14
80.00	61.00	0.80	0.01	1.04	0.001167	0.08	70.55
100.00	70.00	1.00	0.01	1.30	0.001170	0.09	80.74
120.00	79.00	1.20	0.02	1.56	0.001173	0.11	90.89
140.00	86.00	1.40	0.02	1.83	0.001177	0.12	98.68
160.00	94.00	1.60	0.02	2.09	0.001180	0.13	107.57
180.00	101.00	1.80	0.02	2.35	0.001183	0.14	115.27
200.00	107.00	2.00	0.03	2.61	0.001186	0.14	121.79
220.00	115.00	2.20	0.03	2.87	0.001189	0.16	130.55
240.00	121.00	2.40	0.03	3.13	0.001192	0.16	136.99
260.00	128.00	2.60	0.03	3.39	0.001196	0.17	144.53
280.00	135.00	2.80	0.04	3.65	0.001199	0.18	152.02
300.00	142.00	3.00	0.04	3.91	0.001202	0.19	159.47
320.00	148.00	3.20	0.04	4.17	0.001205	0.20	165.76
340.00	155.00	3.40	0.04	4.43	0.001209	0.21	173.12
360.00	161.00	3.60	0.05	4.69	0.001212	0.22	179.33
380.00	168.00	3.80	0.05	4.95	0.001215	0.23	186.62
400.00	173.00	4.00	0.05	5.22	0.001219	0.23	191.65

420.00	179.00	4.20	0.05	5.48	0.001222	0.24	197.75
440.00	185.00	4.40	0.06	5.74	0.001225	0.25	203.81
460.00	191.00	4.60	0.06	6.00	0.001229	0.26	209.84
480.00	198.00	4.80	0.06	6.26	0.001232	0.27	216.93
500.00	203.00	5.00	0.07	6.52	0.001236	0.27	221.79
520.00	210.00	5.20	0.07	6.78	0.001239	0.28	228.79
540.00	216.00	5.40	0.07	7.04	0.001243	0.29	234.67
560.00	221.00	5.60	0.07	7.30	0.001246	0.30	239.43
580.00	227.00	5.80	0.08	7.56	0.001250	0.31	245.24
600.00	233.00	6.00	0.08	7.82	0.001253	0.31	251.01
620.00	239.00	6.20	0.08	8.08	0.001257	0.32	256.75
640.00	245.00	6.40	0.08	8.34	0.001260	0.33	262.45
660.00	250.00	6.60	0.09	8.60	0.001264	0.34	267.04
680.00	255.00	6.80	0.09	8.87	0.001267	0.34	271.60
700.00	260.00	7.00	0.09	9.13	0.001271	0.35	276.14
720.00	266.00	7.20	0.09	9.39	0.001275	0.36	281.70
740.00	271.00	7.40	0.10	9.65	0.001278	0.37	286.17
760.00	276.00	7.60	0.10	9.91	0.001282	0.37	290.61
780.00	282.00	7.80	0.10	10.17	0.001286	0.38	296.07
800.00	287.00	8.00	0.10	10.43	0.001290	0.39	300.44
820.00	293.00	8.20	0.11	10.69	0.001293	0.40	305.83
840.00	297.00	8.40	0.11	10.95	0.001297	0.40	309.10
860.00	302.00	8.60	0.11	11.21	0.001301	0.41	313.38
880.00	306.00	8.80	0.11	11.47	0.001305	0.41	316.60
900.00	310.00	9.00	0.12	11.73	0.001309	0.42	319.79
920.00	313.00	9.20	0.12	11.99	0.001313	0.42	321.93
940.00	318.00	9.40	0.12	12.26	0.001316	0.43	326.11
960.00	321.00	9.60	0.13	12.52	0.001320	0.43	328.21
980.00	325.00	9.80	0.13	12.78	0.001324	0.44	331.31
1000.00	328.00	10.00	0.13	13.04	0.001328	0.44	333.36
1020.00	331.00	10.20	0.13	13.30	0.001332	0.45	335.40
1040.00	334.00	10.40	0.14	13.56	0.001336	0.45	337.43
1060.00	336.00	10.60	0.14	13.82	0.001340	0.45	338.42
1080.00	337.00	10.80	0.14	14.08	0.001344	0.45	338.40
1100.00	339.00	11.00	0.14	14.34	0.001348	0.46	339.38
1120.00	341.00	11.20	0.15	14.60	0.001353	0.46	340.34
1140.00	342.00	11.40	0.15	14.86	0.001357	0.46	340.30
1160.00	342.00	11.60	0.15	15.12	0.001361	0.46	339.25
1180.00	337.00	11.80	0.15	15.38	0.001365	0.45	333.27

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001147	0.00	0.00
20.00	38.00	0.20	0.00	0.26	0.001150	0.05	44.60
40.00	54.00	0.40	0.01	0.52	0.001153	0.07	63.21
60.00	67.00	0.60	0.01	0.78	0.001156	0.09	78.22
80.00	80.00	0.80	0.01	1.05	0.001159	0.11	93.15
100.00	91.00	1.00	0.01	1.31	0.001162	0.12	105.68
120.00	101.00	1.20	0.02	1.57	0.001166	0.14	116.98
140.00	111.00	1.40	0.02	1.83	0.001169	0.15	128.22
160.00	121.00	1.60	0.02	2.09	0.001172	0.16	139.40
180.00	130.00	1.80	0.02	2.35	0.001175	0.18	149.37
200.00	140.00	2.00	0.03	2.62	0.001178	0.19	160.43
220.00	149.00	2.20	0.03	2.88	0.001181	0.20	170.28
240.00	157.00	2.40	0.03	3.14	0.001184	0.21	178.94
260.00	165.00	2.60	0.03	3.40	0.001188	0.22	187.55
280.00	174.00	2.80	0.04	3.66	0.001191	0.23	197.25
300.00	180.00	3.00	0.04	3.92	0.001194	0.24	203.49
320.00	188.00	3.20	0.04	4.19	0.001197	0.25	211.96
340.00	195.00	3.40	0.04	4.45	0.001201	0.26	219.25
360.00	201.00	3.60	0.05	4.71	0.001204	0.27	225.38
380.00	207.00	3.80	0.05	4.97	0.001207	0.28	231.47
400.00	214.00	4.00	0.05	5.23	0.001211	0.29	238.64
420.00	220.00	4.20	0.05	5.49	0.001214	0.30	244.65
440.00	228.00	4.40	0.06	5.76	0.001217	0.31	252.84
460.00	234.00	4.60	0.06	6.02	0.001221	0.32	258.78
480.00	241.00	4.80	0.06	6.28	0.001224	0.33	265.78
500.00	246.00	5.00	0.07	6.54	0.001228	0.33	270.53
520.00	253.00	5.20	0.07	6.80	0.001231	0.34	277.45
540.00	259.00	5.40	0.07	7.06	0.001234	0.35	283.23
560.00	264.00	5.60	0.07	7.33	0.001238	0.36	287.89
580.00	270.00	5.80	0.08	7.59	0.001241	0.36	293.60
600.00	275.00	6.00	0.08	7.85	0.001245	0.37	298.19
620.00	280.00	6.20	0.08	8.11	0.001249	0.38	302.75
640.00	285.00	6.40	0.08	8.37	0.001252	0.38	307.28
660.00	290.00	6.60	0.09	8.63	0.001256	0.39	311.78
680.00	295.00	6.80	0.09	8.90	0.001259	0.40	316.25
700.00	302.00	7.00	0.09	9.16	0.001263	0.41	322.82
720.00	307.00	7.20	0.09	9.42	0.001267	0.41	327.22

740.00	312.00	7.40	0.10	9.68	0.001270	0.42	331.59
760.00	317.00	7.60	0.10	9.94	0.001274	0.43	335.93
780.00	321.00	7.80	0.10	10.20	0.001278	0.43	339.18
800.00	325.00	8.00	0.10	10.47	0.001281	0.44	342.40
820.00	330.00	8.20	0.11	10.73	0.001285	0.45	346.65
840.00	333.00	8.40	0.11	10.99	0.001289	0.45	348.78
860.00	336.00	8.60	0.11	11.25	0.001293	0.45	350.89
880.00	340.00	8.80	0.12	11.51	0.001297	0.46	354.02
900.00	344.00	9.00	0.12	11.77	0.001300	0.46	357.12
920.00	346.00	9.20	0.12	12.04	0.001304	0.47	358.14
940.00	350.00	9.40	0.12	12.30	0.001308	0.47	361.20
960.00	352.00	9.60	0.13	12.56	0.001312	0.48	362.18
980.00	353.00	9.80	0.13	12.82	0.001316	0.48	362.12
1000.00	349.00	10.00	0.13	13.08	0.001320	0.47	356.94

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001172	0.00	0.00
20.00	22.00	0.20	0.00	0.26	0.001120	0.03	26.52
40.00	40.00	0.40	0.01	0.52	0.001123	0.05	48.10
60.00	52.00	0.60	0.01	0.77	0.001126	0.07	62.37
80.00	63.00	0.80	0.01	1.03	0.001129	0.09	75.37
100.00	74.00	1.00	0.01	1.29	0.001131	0.10	88.29
120.00	83.00	1.20	0.02	1.55	0.001134	0.11	98.77
140.00	92.00	1.40	0.02	1.80	0.001137	0.12	109.20
160.00	100.00	1.60	0.02	2.06	0.001140	0.14	118.38
180.00	108.00	1.80	0.02	2.32	0.001143	0.15	127.52
200.00	116.00	2.00	0.03	2.58	0.001146	0.16	136.60
220.00	124.00	2.20	0.03	2.83	0.001149	0.17	145.63
240.00	132.00	2.40	0.03	3.09	0.001153	0.18	154.62
260.00	140.00	2.60	0.03	3.35	0.001156	0.19	163.55
280.00	148.00	2.80	0.04	3.61	0.001159	0.20	172.44
300.00	155.00	3.00	0.04	3.86	0.001162	0.21	180.11
320.00	164.00	3.20	0.04	4.12	0.001165	0.22	190.06
340.00	170.00	3.40	0.04	4.38	0.001168	0.23	196.48
360.00	177.00	3.60	0.05	4.64	0.001171	0.24	204.02
380.00	184.00	3.80	0.05	4.90	0.001174	0.25	211.52
400.00	191.00	4.00	0.05	5.15	0.001178	0.26	218.97
420.00	197.00	4.20	0.05	5.41	0.001181	0.27	225.24

440.00	203.00	4.40	0.06	5.67	0.001184	0.27	231.46
460.00	210.00	4.60	0.06	5.93	0.001187	0.28	238.79
480.00	216.00	4.80	0.06	6.18	0.001190	0.29	244.94
500.00	222.00	5.00	0.06	6.44	0.001194	0.30	251.05
520.00	229.00	5.20	0.07	6.70	0.001197	0.31	258.26
540.00	235.00	5.40	0.07	6.96	0.001200	0.32	264.29
560.00	241.00	5.60	0.07	7.21	0.001204	0.33	270.29
580.00	247.00	5.80	0.07	7.47	0.001207	0.33	276.25
600.00	252.00	6.00	0.08	7.73	0.001210	0.34	281.06
620.00	258.00	6.20	0.08	7.99	0.001214	0.35	286.94
640.00	261.00	6.40	0.08	8.25	0.001217	0.35	289.47
660.00	267.00	6.60	0.09	8.50	0.001221	0.36	295.29
680.00	272.00	6.80	0.09	8.76	0.001224	0.37	299.97
700.00	278.00	7.00	0.09	9.02	0.001228	0.38	305.72
720.00	282.00	7.20	0.09	9.28	0.001231	0.38	309.24
740.00	288.00	7.40	0.10	9.53	0.001235	0.39	314.93
760.00	294.00	7.60	0.10	9.79	0.001238	0.40	320.57
780.00	298.00	7.80	0.10	10.05	0.001242	0.40	324.01
800.00	302.00	8.00	0.10	10.31	0.001245	0.41	327.41
820.00	306.00	8.20	0.11	10.56	0.001249	0.41	330.80
840.00	310.00	8.40	0.11	10.82	0.001252	0.42	334.16
860.00	313.00	8.60	0.11	11.08	0.001256	0.42	336.42
880.00	317.00	8.80	0.11	11.34	0.001260	0.43	339.73
900.00	319.00	9.00	0.12	11.59	0.001263	0.43	340.88
920.00	321.00	9.20	0.12	11.85	0.001267	0.43	342.02
940.00	322.00	9.40	0.12	12.11	0.001271	0.43	342.08
960.00	322.00	9.60	0.12	12.37	0.001274	0.43	341.08
980.00	306.00	9.80	0.13	12.63	0.001278	0.41	323.17

Table C.1.44: 30% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001151	0.00	0.00
20.00	19.00	0.20	0.00	0.26	0.001155	0.03	22.22
40.00	25.00	0.40	0.01	0.52	0.001158	0.03	29.16
60.00	31.00	0.60	0.01	0.78	0.001161	0.04	36.06

80.00	36.00	0.80	0.01	1.04	0.001164	0.05	41.77
100.00	41.00	1.00	0.01	1.31	0.001167	0.06	47.44
120.00	46.00	1.20	0.02	1.57	0.001170	0.06	53.09
140.00	52.00	1.40	0.02	1.83	0.001173	0.07	59.85
160.00	57.00	1.60	0.02	2.09	0.001176	0.08	65.43
180.00	62.00	1.80	0.02	2.35	0.001179	0.08	70.98
200.00	67.00	2.00	0.03	2.61	0.001182	0.09	76.50
220.00	71.00	2.20	0.03	2.87	0.001186	0.10	80.85
240.00	75.00	2.40	0.03	3.13	0.001189	0.10	85.17
260.00	80.00	2.60	0.03	3.40	0.001192	0.11	90.61
280.00	85.00	2.80	0.04	3.66	0.001195	0.11	96.01
300.00	90.00	3.00	0.04	3.92	0.001198	0.12	101.38
320.00	94.00	3.20	0.04	4.18	0.001202	0.13	105.60
340.00	100.00	3.40	0.04	4.44	0.001205	0.14	112.03
360.00	103.00	3.60	0.05	4.70	0.001208	0.14	115.08
380.00	108.00	3.80	0.05	4.96	0.001212	0.15	120.34
400.00	112.00	4.00	0.05	5.22	0.001215	0.15	124.45
420.00	116.00	4.20	0.05	5.48	0.001218	0.16	128.54
440.00	120.00	4.40	0.06	5.75	0.001222	0.16	132.60
460.00	125.00	4.60	0.06	6.01	0.001225	0.17	137.75
480.00	128.00	4.80	0.06	6.27	0.001228	0.17	140.66
500.00	132.00	5.00	0.07	6.53	0.001232	0.18	144.65
520.00	136.00	5.20	0.07	6.79	0.001235	0.18	148.62
540.00	141.00	5.40	0.07	7.05	0.001239	0.19	153.65
560.00	145.00	5.60	0.07	7.31	0.001242	0.20	157.57
580.00	149.00	5.80	0.08	7.57	0.001246	0.20	161.46
600.00	152.00	6.00	0.08	7.83	0.001249	0.21	164.24
620.00	156.00	6.20	0.08	8.10	0.001253	0.21	168.09
640.00	159.00	6.40	0.08	8.36	0.001256	0.21	170.83
660.00	163.00	6.60	0.09	8.62	0.001260	0.22	174.63
680.00	167.00	6.80	0.09	8.88	0.001264	0.23	178.40
700.00	170.00	7.00	0.09	9.14	0.001267	0.23	181.09
720.00	174.00	7.20	0.09	9.40	0.001271	0.23	184.82
740.00	177.00	7.40	0.10	9.66	0.001275	0.24	187.46
760.00	180.00	7.60	0.10	9.92	0.001278	0.24	190.09
780.00	183.00	7.80	0.10	10.19	0.001282	0.25	192.70
800.00	186.00	8.00	0.10	10.45	0.001286	0.25	195.28
820.00	190.00	8.20	0.11	10.71	0.001290	0.26	198.90
840.00	193.00	8.40	0.11	10.97	0.001293	0.26	201.45
860.00	196.00	8.60	0.11	11.23	0.001297	0.26	203.98
880.00	199.00	8.80	0.11	11.49	0.001301	0.27	206.50

900.00	201.00	9.00	0.12	11.75	0.001305	0.27	207.96
920.00	204.00	9.20	0.12	12.01	0.001309	0.28	210.44
940.00	207.00	9.40	0.12	12.27	0.001313	0.28	212.90
960.00	209.00	9.60	0.13	12.54	0.001317	0.28	214.31
980.00	211.00	9.80	0.13	12.80	0.001320	0.28	215.72
1000.00	213.00	10.00	0.13	13.06	0.001324	0.29	217.11
1020.00	214.00	10.20	0.13	13.32	0.001328	0.29	217.47
1040.00	215.00	10.40	0.14	13.58	0.001332	0.29	217.83
1060.00	215.00	10.60	0.14	13.84	0.001336	0.29	217.17
1080.00	215.00	10.80	0.14	14.10	0.001341	0.29	216.52
1100.00	215.00	11.00	0.14	14.36	0.001345	0.29	215.86
1120.00	214.00	11.20	0.15	14.63	0.001349	0.29	214.20
1140.00	212.00	11.40	0.15	14.89	0.001353	0.29	211.55

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001154	0.00	0.00
20.00	13.00	0.20	0.00	0.26	0.001157	0.02	15.17
40.00	17.00	0.40	0.01	0.52	0.001160	0.02	19.79
60.00	20.00	0.60	0.01	0.78	0.001163	0.03	23.22
80.00	23.00	0.80	0.01	1.04	0.001166	0.03	26.63
100.00	25.00	1.00	0.01	1.30	0.001169	0.03	28.87
120.00	28.00	1.20	0.02	1.57	0.001172	0.04	32.25
140.00	30.00	1.40	0.02	1.83	0.001175	0.04	34.46
160.00	33.00	1.60	0.02	2.09	0.001178	0.04	37.80
180.00	35.00	1.80	0.02	2.35	0.001182	0.05	39.99
200.00	39.00	2.00	0.03	2.61	0.001185	0.05	44.44
220.00	43.00	2.20	0.03	2.87	0.001188	0.06	48.86
240.00	45.00	2.40	0.03	3.13	0.001191	0.06	51.00
260.00	50.00	2.60	0.03	3.39	0.001194	0.07	56.51
280.00	54.00	2.80	0.04	3.65	0.001198	0.07	60.87
300.00	58.00	3.00	0.04	3.91	0.001201	0.08	65.20
320.00	61.00	3.20	0.04	4.17	0.001204	0.08	68.39
340.00	64.00	3.40	0.04	4.44	0.001207	0.09	71.56
360.00	69.00	3.60	0.05	4.70	0.001211	0.09	76.94
380.00	73.00	3.80	0.05	4.96	0.001214	0.10	81.17
400.00	77.00	4.00	0.05	5.22	0.001217	0.10	85.39
420.00	80.00	4.20	0.05	5.48	0.001221	0.11	88.47
440.00	84.00	4.40	0.06	5.74	0.001224	0.11	92.63

460.00	88.00	4.60	0.06	6.00	0.001228	0.12	96.78
480.00	91.00	4.80	0.06	6.26	0.001231	0.12	99.80
500.00	95.00	5.00	0.07	6.52	0.001234	0.13	103.90
520.00	99.00	5.20	0.07	6.78	0.001238	0.13	107.97
540.00	103.00	5.40	0.07	7.04	0.001241	0.14	112.02
560.00	107.00	5.60	0.07	7.30	0.001245	0.14	116.04
580.00	111.00	5.80	0.08	7.57	0.001248	0.15	120.04
600.00	115.00	6.00	0.08	7.83	0.001252	0.16	124.01
620.00	119.00	6.20	0.08	8.09	0.001255	0.16	127.96
640.00	122.00	6.40	0.08	8.35	0.001259	0.16	130.82
660.00	126.00	6.60	0.09	8.61	0.001263	0.17	134.72
680.00	130.00	6.80	0.09	8.87	0.001266	0.18	138.60
700.00	134.00	7.00	0.09	9.13	0.001270	0.18	142.46
720.00	137.00	7.20	0.09	9.39	0.001274	0.18	145.23
740.00	142.00	7.40	0.10	9.65	0.001277	0.19	150.10
760.00	145.00	7.60	0.10	9.91	0.001281	0.20	152.82
780.00	149.00	7.80	0.10	10.17	0.001285	0.20	156.58
800.00	153.00	8.00	0.10	10.44	0.001288	0.21	160.32
820.00	157.00	8.20	0.11	10.70	0.001292	0.21	164.03
840.00	159.00	8.40	0.11	10.96	0.001296	0.21	165.64
860.00	163.00	8.60	0.11	11.22	0.001300	0.22	169.31
880.00	168.00	8.80	0.11	11.48	0.001304	0.23	173.99
900.00	170.00	9.00	0.12	11.74	0.001307	0.23	175.54
920.00	174.00	9.20	0.12	12.00	0.001311	0.23	179.14
940.00	177.00	9.40	0.12	12.26	0.001315	0.24	181.69
960.00	180.00	9.60	0.13	12.52	0.001319	0.24	184.22
980.00	184.00	9.80	0.13	12.78	0.001323	0.25	187.75
1000.00	187.00	10.00	0.13	13.04	0.001327	0.25	190.24
1020.00	190.00	10.20	0.13	13.31	0.001331	0.26	192.71
1040.00	193.00	10.40	0.14	13.57	0.001335	0.26	195.17
1060.00	195.00	10.60	0.14	13.83	0.001339	0.26	196.59
1080.00	198.00	10.80	0.14	14.09	0.001343	0.27	199.01
1100.00	201.00	11.00	0.14	14.35	0.001347	0.27	201.42
1120.00	203.00	11.20	0.15	14.61	0.001351	0.27	202.80
1140.00	204.00	11.40	0.15	14.87	0.001355	0.28	203.18
1160.00	206.00	11.60	0.15	15.13	0.001360	0.28	204.54
1180.00	208.00	11.80	0.15	15.39	0.001364	0.28	205.89
1200.00	208.00	12.00	0.16	15.65	0.001368	0.28	205.26
1220.00	208.00	12.20	0.16	15.91	0.001372	0.28	204.62
1240.00	208.00	12.40	0.16	16.18	0.001377	0.28	203.99
1260.00	206.00	12.60	0.16	16.44	0.001381	0.28	201.40

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001157	0.00	0.00
20.00	18.00	0.20	0.00	0.26	0.001160	0.02	20.95
40.00	25.00	0.40	0.01	0.52	0.001163	0.03	29.02
60.00	31.00	0.60	0.01	0.78	0.001166	0.04	35.89
80.00	36.00	0.80	0.01	1.04	0.001169	0.05	41.57
100.00	42.00	1.00	0.01	1.30	0.001172	0.06	48.37
120.00	49.00	1.20	0.02	1.56	0.001175	0.07	56.28
140.00	54.00	1.40	0.02	1.82	0.001178	0.07	61.86
160.00	61.00	1.60	0.02	2.08	0.001182	0.08	69.70
180.00	68.00	1.80	0.02	2.34	0.001185	0.09	77.49
200.00	74.00	2.00	0.03	2.61	0.001188	0.10	84.10
220.00	80.00	2.20	0.03	2.87	0.001191	0.11	90.68
240.00	87.00	2.40	0.03	3.13	0.001194	0.12	98.35
260.00	94.00	2.60	0.03	3.39	0.001197	0.13	105.97
280.00	100.00	2.80	0.04	3.65	0.001201	0.14	112.43
300.00	107.00	3.00	0.04	3.91	0.001204	0.14	119.98
320.00	113.00	3.20	0.04	4.17	0.001207	0.15	126.36
340.00	120.00	3.40	0.04	4.43	0.001211	0.16	133.83
360.00	126.00	3.60	0.05	4.69	0.001214	0.17	140.13
380.00	132.00	3.80	0.05	4.95	0.001217	0.18	146.41
400.00	138.00	4.00	0.05	5.21	0.001221	0.19	152.64
420.00	144.00	4.20	0.05	5.47	0.001224	0.19	158.84
440.00	150.00	4.40	0.06	5.73	0.001227	0.20	165.00
460.00	155.00	4.60	0.06	5.99	0.001231	0.21	170.03
480.00	161.00	4.80	0.06	6.25	0.001234	0.22	176.12
500.00	167.00	5.00	0.07	6.51	0.001238	0.23	182.18
520.00	172.00	5.20	0.07	6.77	0.001241	0.23	187.11
540.00	178.00	5.40	0.07	7.03	0.001244	0.24	193.10
560.00	183.00	5.60	0.07	7.30	0.001248	0.25	197.96
580.00	189.00	5.80	0.08	7.56	0.001251	0.26	203.88
600.00	195.00	6.00	0.08	7.82	0.001255	0.26	209.76
620.00	199.00	6.20	0.08	8.08	0.001259	0.27	213.46
640.00	204.00	6.40	0.08	8.34	0.001262	0.28	218.20
660.00	210.00	6.60	0.09	8.60	0.001266	0.28	223.98
680.00	214.00	6.80	0.09	8.86	0.001269	0.29	227.60
700.00	220.00	7.00	0.09	9.12	0.001273	0.30	233.31
720.00	224.00	7.20	0.09	9.38	0.001277	0.30	236.87

740.00	229.00	7.40	0.10	9.64	0.001280	0.31	241.46
760.00	235.00	7.60	0.10	9.90	0.001284	0.32	247.07
780.00	240.00	7.80	0.10	10.16	0.001288	0.32	251.60
800.00	245.00	8.00	0.10	10.42	0.001292	0.33	256.10
820.00	249.00	8.20	0.11	10.68	0.001295	0.34	259.52
840.00	254.00	8.40	0.11	10.94	0.001299	0.34	263.96
860.00	256.00	8.60	0.11	11.20	0.001303	0.35	265.26
880.00	262.00	8.80	0.11	11.46	0.001307	0.35	270.68
900.00	267.00	9.00	0.12	11.72	0.001311	0.36	275.03
920.00	270.00	9.20	0.12	11.99	0.001314	0.36	277.30
940.00	274.00	9.40	0.12	12.25	0.001318	0.37	280.58
960.00	278.00	9.60	0.13	12.51	0.001322	0.38	283.83
980.00	280.00	9.80	0.13	12.77	0.001326	0.38	285.02
1000.00	284.00	10.00	0.13	13.03	0.001330	0.38	288.23
1020.00	287.00	10.20	0.13	13.29	0.001334	0.39	290.40
1040.00	289.00	10.40	0.14	13.55	0.001338	0.39	291.54
1060.00	291.00	10.60	0.14	13.81	0.001342	0.39	292.68
1080.00	292.00	10.80	0.14	14.07	0.001346	0.39	292.79
1100.00	292.00	11.00	0.14	14.33	0.001350	0.39	291.91
1120.00	285.00	11.20	0.15	14.59	0.001355	0.38	284.04

Table C.2.45: 0% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001141	0.00	0.00
20.00	83.00	0.20	0.00	0.27	0.001144	0.11	97.97
40.00	155.00	0.40	0.01	0.54	0.001147	0.21	182.46
60.00	222.00	0.60	0.01	0.80	0.001150	0.30	260.62
80.00	290.00	0.80	0.01	1.07	0.001153	0.39	339.53
100.00	324.00	1.00	0.01	1.34	0.001156	0.44	378.31
120.00	348.00	1.20	0.02	1.61	0.001159	0.47	405.23
140.00	404.00	1.40	0.02	1.88	0.001162	0.55	469.16
160.00	460.00	1.60	0.02	2.14	0.001166	0.62	532.74
180.00	533.00	1.80	0.02	2.41	0.001169	0.72	615.59
200.00	610.00	2.00	0.03	2.68	0.001172	0.82	702.59
220.00	685.00	2.20	0.03	2.95	0.001175	0.92	786.80
240.00	755.00	2.40	0.03	3.22	0.001179	1.02	864.81
260.00	828.00	2.60	0.03	3.48	0.001182	1.12	945.80
280.00	876.00	2.80	0.04	3.75	0.001185	1.18	997.85
300.00	879.00	3.00	0.04	4.02	0.001188	1.19	998.48
320.00	875.00	3.20	0.04	4.29	0.001192	1.18	991.16
340.00	719.00	3.40	0.05	4.56	0.001195	0.97	812.17

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001129	0.00	0.00
20.00	74.00	0.20	0.00	0.27	0.001132	0.10	88.22
40.00	132.00	0.40	0.01	0.55	0.001136	0.18	156.93
60.00	197.00	0.60	0.01	0.82	0.001139	0.27	233.56
80.00	255.00	0.80	0.01	1.09	0.001142	0.34	301.49
100.00	320.00	1.00	0.01	1.37	0.001145	0.43	377.30
120.00	354.00	1.20	0.02	1.64	0.001148	0.48	416.23
140.00	420.00	1.40	0.02	1.91	0.001151	0.57	492.46
160.00	480.00	1.60	0.02	2.19	0.001155	0.65	561.24

180.00	529.00	1.80	0.02	2.46	0.001158	0.71	616.81
200.00	504.00	2.00	0.03	2.73	0.001161	0.68	586.01

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001131	0.00	0.00
20.00	80.00	0.20	0.00	0.26	0.001134	0.11	95.23
40.00	150.00	0.40	0.01	0.53	0.001137	0.20	178.08
60.00	210.00	0.60	0.01	0.79	0.001140	0.28	248.65
80.00	261.00	0.80	0.01	1.05	0.001143	0.35	308.22
100.00	324.00	1.00	0.01	1.32	0.001146	0.44	381.60
120.00	371.00	1.20	0.02	1.58	0.001149	0.50	435.79
140.00	411.00	1.40	0.02	1.84	0.001152	0.55	481.48
160.00	439.00	1.60	0.02	2.11	0.001155	0.59	512.90
180.00	489.00	1.80	0.02	2.37	0.001159	0.66	569.78
200.00	529.00	2.00	0.03	2.64	0.001162	0.71	614.72
220.00	545.00	2.20	0.03	2.90	0.001165	0.74	631.60
240.00	543.00	2.40	0.03	3.16	0.001168	0.73	627.58
260.00	521.00	2.60	0.03	3.43	0.001171	0.70	600.51

Table C.2.46: 6% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001141	0.00	0.00
20.00	86.00	0.20	0.00	0.27	0.001144	0.12	101.51
40.00	162.50	0.40	0.01	0.54	0.001147	0.22	191.29
60.00	236.00	0.60	0.01	0.80	0.001150	0.32	277.06
80.00	310.50	0.80	0.01	1.07	0.001153	0.42	363.54
100.00	368.00	1.00	0.01	1.34	0.001156	0.50	429.69
120.00	419.00	1.20	0.02	1.61	0.001159	0.57	487.91
140.00	482.00	1.40	0.02	1.88	0.001162	0.65	559.74
160.00	539.00	1.60	0.02	2.14	0.001166	0.73	624.23

180.00	591.00	1.80	0.02	2.41	0.001169	0.80	682.58
200.00	664.00	2.00	0.03	2.68	0.001172	0.90	764.78
220.00	729.50	2.20	0.03	2.95	0.001175	0.98	837.91
240.00	790.00	2.40	0.03	3.22	0.001179	1.07	904.90
260.00	829.00	2.60	0.03	3.48	0.001182	1.12	946.94
280.00	855.50	2.80	0.04	3.75	0.001185	1.15	974.50
300.00	860.00	3.00	0.04	4.02	0.001188	1.16	976.90
320.00	857.50	3.20	0.04	4.29	0.001192	1.16	971.34
340.00	719.00	3.40	0.05	4.56	0.001195	0.97	812.17

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001129	0.00	0.00
20.00	58.00	0.20	0.00	0.27	0.001132	0.08	69.14
40.00	92.00	0.40	0.01	0.55	0.001136	0.12	109.37
60.00	126.00	0.60	0.01	0.82	0.001139	0.17	149.38
80.00	143.50	0.80	0.01	1.09	0.001142	0.19	169.66
100.00	193.00	1.00	0.01	1.37	0.001145	0.26	227.56
120.00	215.50	1.20	0.02	1.64	0.001148	0.29	253.38
140.00	258.00	1.40	0.02	1.91	0.001151	0.35	302.51
160.00	297.00	1.60	0.02	2.19	0.001155	0.40	347.27
180.00	334.50	1.80	0.02	2.46	0.001158	0.45	390.02
200.00	406.00	2.00	0.03	2.73	0.001161	0.55	472.07
220.00	460.50	2.20	0.03	3.01	0.001164	0.62	533.93
240.00	530.00	2.40	0.03	3.28	0.001168	0.72	612.78
260.00	595.00	2.60	0.04	3.55	0.001171	0.80	685.99
280.00	654.50	2.80	0.04	3.83	0.001174	0.88	752.45
300.00	677.00	3.00	0.04	4.10	0.001178	0.91	776.11
320.00	650.00	3.20	0.04	4.37	0.001181	0.88	743.03

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001131	0.00	0.00
20.00	50.00	0.20	0.00	0.26	0.001134	0.07	59.52
40.00	95.00	0.40	0.01	0.53	0.001137	0.13	112.78

60.00	135.00	0.60	0.01	0.79	0.001140	0.18	159.85
80.00	170.50	0.80	0.01	1.05	0.001143	0.23	201.35
100.00	212.00	1.00	0.01	1.32	0.001146	0.29	249.69
120.00	245.50	1.20	0.02	1.58	0.001149	0.33	288.37
140.00	275.50	1.40	0.02	1.84	0.001152	0.37	322.74
160.00	307.00	1.60	0.02	2.11	0.001155	0.41	358.68
180.00	358.00	1.80	0.02	2.37	0.001159	0.48	417.14
200.00	403.00	2.00	0.03	2.64	0.001162	0.54	468.31
220.00	447.00	2.20	0.03	2.90	0.001165	0.60	518.03
240.00	528.00	2.40	0.03	3.16	0.001168	0.71	610.24
260.00	593.00	2.60	0.03	3.43	0.001171	0.80	683.50
280.00	638.00	2.80	0.04	3.69	0.001174	0.86	733.36
300.00	603.00	3.00	0.04	3.95	0.001178	0.81	691.23

Table C.2.47: 12% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001129	0.00	0.00
20.00	89.00	0.20	0.00	0.26	0.001132	0.12	106.11
40.00	170.00	0.40	0.01	0.52	0.001135	0.23	202.16
60.00	250.00	0.60	0.01	0.78	0.001138	0.34	296.52
80.00	331.00	0.80	0.01	1.04	0.001141	0.45	391.57
100.00	412.00	1.00	0.01	1.30	0.001144	0.56	486.12
120.00	490.00	1.20	0.02	1.55	0.001147	0.66	576.64
140.00	560.00	1.40	0.02	1.81	0.001150	0.76	657.28
160.00	618.00	1.60	0.02	2.07	0.001153	0.83	723.44
180.00	649.00	1.80	0.02	2.33	0.001156	0.88	757.72
200.00	718.00	2.00	0.03	2.59	0.001159	0.97	836.06
220.00	774.00	2.20	0.03	2.85	0.001162	1.04	898.87
240.00	825.00	2.40	0.03	3.11	0.001166	1.11	955.54
260.00	830.00	2.60	0.03	3.37	0.001169	1.12	958.76
280.00	835.00	2.80	0.04	3.63	0.001172	1.13	961.95
300.00	841.00	3.00	0.04	3.89	0.001175	1.14	966.26
320.00	840.00	3.20	0.04	4.14	0.001178	1.13	962.51

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001162	0.00	0.00
20.00	75	0.20	0.00	0.26	0.001165	0.10	86.93
40.00	155	0.40	0.01	0.52	0.001168	0.21	179.18
60.00	234	0.60	0.01	0.78	0.001171	0.32	269.80
80.00	414	0.80	0.01	1.04	0.001174	0.56	476.09
100.00	492	1.00	0.01	1.30	0.001177	0.66	564.30
120.00	567	1.20	0.02	1.56	0.001180	0.77	648.60
140.00	640	1.40	0.02	1.82	0.001183	0.86	730.18
160.00	710.00	1.60	0.02	2.08	0.001186	0.96	807.89
180.00	780	1.80	0.02	2.34	0.001190	1.05	885.19
200.00	850	2.00	0.03	2.60	0.001193	1.15	962.06
220.00	917	2.20	0.03	2.86	0.001196	1.24	1035.12
240.00	1072	2.40	0.03	3.12	0.001199	1.45	1206.85
260.00	1102	2.60	0.03	3.38	0.001202	1.49	1237.29
280.00	1120	2.80	0.04	3.64	0.001206	1.51	1254.12
300.00	1141	3.00	0.04	3.90	0.001209	1.54	1274.19
320.00	1158	3.20	0.04	4.16	0.001212	1.56	1289.67
340.00	1164	3.40	0.04	4.42	0.001215	1.57	1292.84
360.00	1164	3.60	0.05	4.68	0.001219	1.57	1289.32
380.00	1104	3.80	0.05	4.94	0.001222	1.49	1219.53

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001122	0.00	0.00
20.00	90	0.20	0.00	0.27	0.001125	0.12	108.04
40.00	160	0.40	0.01	0.54	0.001128	0.22	191.55
60.00	239	0.60	0.01	0.81	0.001131	0.32	285.35
80.00	309	0.80	0.01	1.07	0.001134	0.42	367.92
100.00	372	1.00	0.01	1.34	0.001137	0.50	441.74
120.00	435	1.20	0.02	1.61	0.001140	0.59	515.14
140.00	375	1.40	0.02	1.88	0.001143	0.51	442.87

Table C.2.48: 18% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001201	0.00	0.00
20.00	90.00	0.20	0.00	0.26	0.001204	0.12	100.93
40.00	170.00	0.40	0.01	0.52	0.001207	0.23	190.15
60.00	252.00	0.60	0.01	0.77	0.001210	0.34	281.14
80.00	333.00	0.80	0.01	1.03	0.001213	0.45	370.54
100.00	409.00	1.00	0.01	1.29	0.001216	0.55	453.93
120.00	480.00	1.20	0.02	1.55	0.001220	0.65	531.33
140.00	550.00	1.40	0.02	1.80	0.001223	0.74	607.23
160.00	620.00	1.60	0.02	2.06	0.001226	0.84	682.72
180.00	690.00	1.80	0.02	2.32	0.001229	0.93	757.80
200.00	750.00	2.00	0.03	2.58	0.001232	1.01	821.52
220.00	781.00	2.20	0.03	2.83	0.001236	1.05	853.22
240.00	791.00	2.40	0.03	3.09	0.001239	1.07	861.85
260.00	595.00	2.60	0.03	3.35	0.001242	0.80	646.57

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001091	0.00	0.00
20.00	84.00	0.20	0.00	0.28	0.001094	0.11	103.66
40.00	156.00	0.40	0.01	0.55	0.001097	0.21	191.98
60.00	230.00	0.60	0.01	0.83	0.001100	0.31	282.26
80.00	299.00	0.80	0.01	1.10	0.001103	0.40	365.92
100.00	358.00	1.00	0.01	1.38	0.001106	0.48	436.91
120.00	420.00	1.20	0.02	1.65	0.001109	0.57	511.15
140.00	483.00	1.40	0.02	1.93	0.001112	0.65	586.18
160.00	548.00	1.60	0.02	2.20	0.001116	0.74	663.20
180.00	580.00	1.80	0.02	2.48	0.001119	0.78	699.95
200.00	630.00	2.00	0.03	2.75	0.001122	0.85	758.14
220.00	670.00	2.20	0.03	3.03	0.001125	0.90	804.00
240.00	700.00	2.40	0.03	3.30	0.001128	0.95	837.62
260.00	700.00	2.60	0.04	3.58	0.001131	0.95	835.24
280.00	695.00	2.80	0.04	3.85	0.001135	0.94	826.90

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001152	0.00	0.00
20.00	81.00	0.20	0.00	0.28	0.001155	0.11	94.65
40.00	148.00	0.40	0.01	0.55	0.001158	0.20	172.47
60.00	209.00	0.60	0.01	0.83	0.001162	0.28	242.88
80.00	276.00	0.80	0.01	1.10	0.001165	0.37	319.85
100.00	342.00	1.00	0.01	1.38	0.001168	0.46	395.24
120.00	405.00	1.20	0.02	1.65	0.001171	0.55	466.74
140.00	450.00	1.40	0.02	1.93	0.001175	0.61	517.14
160.00	472.00	1.60	0.02	2.20	0.001178	0.64	540.90
180.00	539.00	1.80	0.02	2.48	0.001181	0.73	615.95
200.00	598.00	2.00	0.03	2.75	0.001185	0.81	681.44
220.00	653.00	2.20	0.03	3.03	0.001188	0.88	742.01
240.00	698.00	2.40	0.03	3.30	0.001191	0.94	790.89
260.00	730.00	2.60	0.04	3.58	0.001195	0.99	824.80
280.00	773.00	2.80	0.04	3.85	0.001198	1.04	870.89
300.00	795.00	3.00	0.04	4.13	0.001202	1.07	893.11
320.00	792.00	3.20	0.04	4.40	0.001205	1.07	887.19

Table C.2.49: 24% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001145	0.00	0.00
20.00	70.00	0.20	0.00	0.26	0.001148	0.09	82.33
40.00	127.00	0.40	0.01	0.52	0.001151	0.17	148.97
60.00	197.00	0.60	0.01	0.79	0.001154	0.27	230.47
80.00	274.00	0.80	0.01	1.05	0.001157	0.37	319.71
100.00	350.00	1.00	0.01	1.31	0.001160	0.47	407.30
120.00	425.00	1.20	0.02	1.57	0.001163	0.57	493.27
140.00	503.00	1.40	0.02	1.83	0.001166	0.68	582.24
160.00	567.00	1.60	0.02	2.10	0.001169	0.77	654.58
180.00	635.00	1.80	0.02	2.36	0.001173	0.86	731.12

200.00	700.00	2.00	0.03	2.62	0.001176	0.95	803.80
220.00	756.00	2.20	0.03	2.88	0.001179	1.02	865.76
240.00	795.00	2.40	0.03	3.14	0.001182	1.07	907.97
260.00	814.00	2.60	0.03	3.40	0.001185	1.10	927.16
280.00	821.00	2.80	0.04	3.67	0.001188	1.11	932.59
300.00	832.00	3.00	0.04	3.93	0.001192	1.12	942.52
320.00	838.00	3.20	0.04	4.19	0.001195	1.13	946.73
340.00	846.00	3.40	0.04	4.45	0.001198	1.14	953.15
360.00	847.00	3.60	0.05	4.71	0.001202	1.14	951.66
380.00	847.00	3.80	0.05	4.98	0.001205	1.14	949.05
400.00	786.00	4.00	0.05	5.24	0.001208	1.06	878.27

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001158	0.00	0.00
20.00	30.00	0.20	0.00	0.26	0.001161	0.04	34.88
40.00	85.00	0.40	0.01	0.52	0.001164	0.11	98.57
60.00	145.00	0.60	0.01	0.78	0.001167	0.20	167.70
80.00	205.00	0.80	0.01	1.04	0.001170	0.28	236.48
100.00	265.00	1.00	0.01	1.30	0.001173	0.36	304.89
120.00	360.00	1.20	0.02	1.56	0.001176	0.49	413.09
140.00	429.00	1.40	0.02	1.82	0.001180	0.58	490.97
160.00	491.00	1.60	0.02	2.08	0.001183	0.66	560.43
180.00	540.00	1.80	0.02	2.34	0.001186	0.73	614.72
200.00	590.00	2.00	0.03	2.60	0.001189	0.80	669.85
220.00	640.00	2.20	0.03	2.86	0.001192	0.86	724.68
240.00	695.00	2.40	0.03	3.12	0.001195	0.94	784.85
260.00	761.00	2.60	0.03	3.38	0.001199	1.03	857.07
280.00	835.00	2.80	0.04	3.64	0.001202	1.13	937.88
300.00	902.00	3.00	0.04	3.90	0.001205	1.22	1010.39
320.00	1070.00	3.20	0.04	4.16	0.001208	1.44	1195.34
340.00	1126.00	3.40	0.04	4.42	0.001212	1.52	1254.48
360.00	1148.00	3.60	0.05	4.69	0.001215	1.55	1275.51
380.00	1152.00	3.80	0.05	4.95	0.001218	1.56	1276.46
400.00	1155.00	4.00	0.05	5.21	0.001222	1.56	1276.28
420.00	1155.00	4.20	0.05	5.47	0.001225	1.56	1272.77
440.00	1163.00	4.40	0.06	5.73	0.001228	1.57	1278.06
460.00	1169.00	4.60	0.06	5.99	0.001232	1.58	1281.11
480.00	1172.00	4.80	0.06	6.25	0.001235	1.58	1280.84

500.00	1171.00	5.00	0.07	6.51	0.001239	1.58	1276.19
520.00	1171.00	5.20	0.07	6.77	0.001242	1.58	1272.64
540.00	1171.00	5.40	0.07	7.03	0.001246	1.58	1269.09
560.00	1171.00	5.60	0.07	7.29	0.001249	1.58	1265.53
580.00	1171.00	5.80	0.08	7.55	0.001253	1.58	1261.98
600.00	1174.00	6.00	0.08	7.81	0.001256	1.58	1261.65
620.00	1126.00	6.20	0.08	8.07	0.001260	1.52	1206.65

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001145	0.00	0.00
20.00	71.00	0.20	0.00	0.26	0.001148	0.10	83.50
40.00	139.00	0.40	0.01	0.52	0.001151	0.19	163.05
60.00	205.00	0.60	0.01	0.79	0.001154	0.28	239.83
80.00	270.00	0.80	0.01	1.05	0.001157	0.36	315.04
100.00	340.00	1.00	0.01	1.31	0.001160	0.46	395.67
120.00	396.00	1.20	0.02	1.57	0.001163	0.53	459.61
140.00	430.00	1.40	0.02	1.83	0.001166	0.58	497.74
160.00	485.00	1.60	0.02	2.10	0.001169	0.65	559.91
180.00	545.00	1.80	0.02	2.36	0.001173	0.74	627.50
200.00	603.00	2.00	0.03	2.62	0.001176	0.81	692.41
220.00	635.00	2.20	0.03	2.88	0.001179	0.86	727.20
240.00	650.00	2.40	0.03	3.14	0.001182	0.88	742.37
260.00	683.00	2.60	0.03	3.40	0.001185	0.92	777.95
280.00	729.00	2.80	0.04	3.67	0.001188	0.98	828.09
300.00	734.00	3.00	0.04	3.93	0.001192	0.99	831.50
320.00	734.00	3.20	0.04	4.19	0.001195	0.99	829.24
340.00	726.00	3.40	0.04	4.45	0.001198	0.98	817.95
360.00	734.00	3.60	0.05	4.71	0.001202	0.99	824.70
380.00	748.00	3.80	0.05	4.98	0.001205	1.01	838.12
400.00	755.00	4.00	0.05	5.24	0.001208	1.02	843.63
420.00	752.00	4.20	0.06	5.50	0.001212	1.02	837.96
440.00	752.00	4.40	0.06	5.76	0.001215	1.02	835.64
460.00	754.00	4.60	0.06	6.02	0.001218	1.02	835.53
480.00	757.00	4.80	0.06	6.29	0.001222	1.02	836.52
500.00	753.00	5.00	0.07	6.55	0.001225	1.02	829.77
520.00	678.00	5.20	0.07	6.81	0.001229	0.92	745.03

Table C.2.50: 30% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001085	0.00	0.00
20.00	68.00	0.20	0.00	0.27	0.001088	0.09	84.37
40.00	113.00	0.40	0.01	0.54	0.001091	0.15	139.83
60.00	163.00	0.60	0.01	0.81	0.001094	0.22	201.15
80.00	218.00	0.80	0.01	1.08	0.001097	0.29	268.30
100.00	263.00	1.00	0.01	1.35	0.001100	0.36	322.80
120.00	310.00	1.20	0.02	1.61	0.001103	0.42	379.45
140.00	353.00	1.40	0.02	1.88	0.001106	0.48	430.90
160.00	370.00	1.60	0.02	2.15	0.001109	0.50	450.41
180.00	412.00	1.80	0.02	2.42	0.001112	0.56	500.16
200.00	453.00	2.00	0.03	2.69	0.001115	0.61	548.42
220.00	528.00	2.20	0.03	2.96	0.001118	0.71	637.45
240.00	570.00	2.40	0.03	3.23	0.001121	0.77	686.25
260.00	610.00	2.60	0.03	3.50	0.001124	0.82	732.37
280.00	643.00	2.80	0.04	3.77	0.001128	0.87	769.83
300.00	675.00	3.00	0.04	4.04	0.001131	0.91	805.89
320.00	714.00	3.20	0.04	4.30	0.001134	0.96	850.06
340.00	710.00	3.40	0.05	4.57	0.001137	0.96	842.92
360.00	690.00	3.60	0.05	4.84	0.001140	0.93	816.87
380.00	610.00	3.80	0.05	5.11	0.001144	0.82	720.12

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001104	0.00	0.00
20.00	50.00	0.20	0.00	0.27	0.001107	0.07	60.95
40.00	93.00	0.40	0.01	0.53	0.001110	0.13	113.07
60.00	141.00	0.60	0.01	0.80	0.001113	0.19	170.97
80.00	197.00	0.80	0.01	1.07	0.001116	0.27	238.23
100.00	251.00	1.00	0.01	1.33	0.001119	0.34	302.71
120.00	300.00	1.20	0.02	1.60	0.001122	0.41	360.82
140.00	358.00	1.40	0.02	1.87	0.001125	0.48	429.42

160.00	417.00	1.60	0.02	2.13	0.001129	0.56	498.83
180.00	429.00	1.80	0.02	2.40	0.001132	0.58	511.78
200.00	488.00	2.00	0.03	2.67	0.001135	0.66	580.58
220.00	541.00	2.20	0.03	2.93	0.001138	0.73	641.87
240.00	596.00	2.40	0.03	3.20	0.001141	0.80	705.18
260.00	660.00	2.60	0.03	3.47	0.001144	0.89	778.76
280.00	698.00	2.80	0.04	3.73	0.001147	0.94	821.32
300.00	745.00	3.00	0.04	4.00	0.001150	1.01	874.19
320.00	790.00	3.20	0.04	4.27	0.001154	1.07	924.42
340.00	660.00	3.40	0.05	4.53	0.001157	0.89	770.15

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	q_u (kN/m^2)
0.00	0.00	0.00	0.00	0.00	0.001087	0.00	0.00
20.00	35.00	0.20	0.00	0.27	0.001090	0.05	43.36
40.00	43.00	0.40	0.01	0.54	0.001093	0.06	53.12
60.00	58.00	0.60	0.01	0.81	0.001096	0.08	71.46
80.00	88.00	0.80	0.01	1.08	0.001099	0.12	108.13
100.00	108.00	1.00	0.01	1.34	0.001102	0.15	132.34
120.00	140.00	1.20	0.02	1.61	0.001105	0.19	171.09
140.00	180.00	1.40	0.02	1.88	0.001108	0.24	219.37
160.00	236.00	1.60	0.02	2.15	0.001111	0.32	286.83
180.00	290.00	1.80	0.02	2.42	0.001114	0.39	351.49
200.00	340.00	2.00	0.03	2.69	0.001117	0.46	410.96
220.00	380.00	2.20	0.03	2.96	0.001120	0.51	458.04
240.00	418.00	2.40	0.03	3.23	0.001123	0.56	502.45
260.00	455.00	2.60	0.03	3.49	0.001126	0.61	545.40
280.00	554.00	2.80	0.04	3.76	0.001129	0.75	662.23
300.00	617.00	3.00	0.04	4.03	0.001133	0.83	735.47
320.00	658.00	3.20	0.04	4.30	0.001136	0.89	782.15
340.00	684.00	3.40	0.05	4.57	0.001139	0.92	810.77
360.00	709.00	3.60	0.05	4.84	0.001142	0.96	838.04
380.00	690.00	3.80	0.05	5.11	0.001145	0.93	813.27

C.3 Data sheets of shear strength for 7 days curing

Table C.3.51: 0% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001106	0.00	0.00
20.00	58.00	0.20	0.00	0.27	0.001109	0.08	70.63
40.00	108.00	0.40	0.01	0.53	0.001112	0.15	131.17
60.00	173.00	0.60	0.01	0.80	0.001115	0.23	209.55
80.00	246.00	0.80	0.01	1.07	0.001118	0.33	297.17
100.00	321.00	1.00	0.01	1.33	0.001121	0.43	386.72
120.00	395.00	1.20	0.02	1.60	0.001124	0.53	474.59
140.00	462.00	1.40	0.02	1.87	0.001127	0.62	553.58
160.00	531.00	1.60	0.02	2.13	0.001130	0.72	634.53
180.00	598.00	1.80	0.02	2.40	0.001133	0.81	712.65
200.00	663.00	2.00	0.03	2.67	0.001136	0.90	787.95
220.00	725.00	2.20	0.03	2.93	0.001139	0.98	859.28
240.00	671.00	2.40	0.03	3.20	0.001142	0.91	793.09

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001071	0.00	0.00
20.00	43.00	0.20	0.00	0.27	0.001074	0.06	54.05
40.00	98.00	0.40	0.01	0.54	0.001077	0.13	122.84
60.00	150.00	0.60	0.01	0.81	0.001080	0.20	187.51
80.00	211.00	0.80	0.01	1.08	0.001083	0.28	263.05
100.00	276.00	1.00	0.01	1.35	0.001086	0.37	343.14
120.00	338.00	1.20	0.02	1.62	0.001089	0.46	419.07
140.00	391.00	1.40	0.02	1.90	0.001092	0.53	483.45
160.00	236.00	1.60	0.02	2.17	0.001095	0.32	291.00
180.00	273.00	1.80	0.02	2.44	0.001098	0.37	335.69
200.00	303.00	2.00	0.03	2.71	0.001101	0.41	371.54
220.00	350.00	2.20	0.03	2.98	0.001104	0.47	427.98
240.00	395.00	2.40	0.03	3.25	0.001107	0.53	481.65
260.00	445.00	2.60	0.04	3.52	0.001110	0.60	541.11
280.00	471.00	2.80	0.04	3.79	0.001113	0.64	571.11
300.00	481.00	3.00	0.04	4.06	0.001116	0.65	581.60

320.00	540.00	3.20	0.04	4.33	0.001120	0.73	651.09
340.00	590.00	3.40	0.05	4.60	0.001123	0.80	709.37
360.00	640.00	3.60	0.05	4.87	0.001126	0.86	767.30
380.00	694.00	3.80	0.05	5.14	0.001129	0.94	829.67
400.00	750.00	4.00	0.05	5.42	0.001132	1.01	894.06
420.00	550.00	4.20	0.06	5.69	0.001136	0.74	653.77

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001059	0.00	0.00
20.00	78.00	0.20	0.00	0.27	0.001062	0.11	99.16
40.00	141.00	0.40	0.01	0.54	0.001065	0.19	178.77
60.00	203.00	0.60	0.01	0.82	0.001068	0.27	256.67
80.00	261.00	0.80	0.01	1.09	0.001071	0.35	329.10
100.00	320.00	1.00	0.01	1.36	0.001074	0.43	402.38
120.00	355.00	1.20	0.02	1.63	0.001077	0.48	445.16
140.00	355.00	1.40	0.02	1.91	0.001080	0.48	443.92
160.00	391.00	1.60	0.02	2.18	0.001083	0.53	487.58
180.00	452.00	1.80	0.02	2.45	0.001086	0.61	562.08
200.00	508.00	2.00	0.03	2.72	0.001089	0.69	629.96
220.00	556.00	2.20	0.03	3.00	0.001092	0.75	687.55
240.00	604.00	2.40	0.03	3.27	0.001095	0.82	744.81
260.00	620.00	2.60	0.04	3.54	0.001098	0.84	762.39
280.00	630.00	2.80	0.04	3.81	0.001101	0.85	772.50
300.00	615.00	3.00	0.04	4.08	0.001104	0.83	751.97

Table C.3.52: 6% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001106	0.00	0.00
20.00	73.50	0.20	0.00	0.27	0.001109	0.10	89.50
40.00	140.00	0.40	0.01	0.53	0.001112	0.19	170.03
60.00	212.50	0.60	0.01	0.80	0.001115	0.29	257.39
80.00	291.00	0.80	0.01	1.07	0.001118	0.39	351.52

100.00	367.00	1.00	0.01	1.33	0.001121	0.50	442.14
120.00	443.50	1.20	0.02	1.60	0.001124	0.60	532.86
140.00	515.50	1.40	0.02	1.87	0.001127	0.70	617.69
160.00	585.50	1.60	0.02	2.13	0.001130	0.79	699.66
180.00	659.00	1.80	0.02	2.40	0.001133	0.89	785.34
200.00	728.50	2.00	0.03	2.67	0.001136	0.98	865.80
220.00	800.00	2.20	0.03	2.93	0.001139	1.08	948.17
240.00	813.00	2.40	0.03	3.20	0.001142	1.10	960.93
260.00	797.00	2.60	0.03	3.46	0.001145	1.08	939.42

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001071	0.00	0.00
20.00	57.50	0.20	0.00	0.27	0.001074	0.08	72.27
40.00	118.50	0.40	0.01	0.54	0.001077	0.16	148.54
60.00	176.00	0.60	0.01	0.81	0.001080	0.24	220.02
80.00	243.00	0.80	0.01	1.08	0.001083	0.33	302.94
100.00	312.50	1.00	0.01	1.35	0.001086	0.42	388.52
120.00	381.00	1.20	0.02	1.62	0.001089	0.51	472.39
140.00	445.00	1.40	0.02	1.90	0.001092	0.60	550.22
160.00	450.00	1.60	0.02	2.17	0.001095	0.61	554.86
180.00	458.00	1.80	0.02	2.44	0.001098	0.62	563.16
200.00	507.50	2.00	0.03	2.71	0.001101	0.69	622.30
220.00	569.50	2.20	0.03	2.98	0.001104	0.77	696.38
240.00	627.50	2.40	0.03	3.25	0.001107	0.85	765.16
260.00	690.00	2.60	0.04	3.52	0.001110	0.93	839.02
280.00	740.50	2.80	0.04	3.79	0.001113	1.00	897.90
300.00	783.50	3.00	0.04	4.06	0.001116	1.06	947.36
320.00	847.00	3.20	0.04	4.33	0.001120	1.14	1021.25
340.00	907.50	3.40	0.05	4.60	0.001123	1.23	1091.10
360.00	970.00	3.60	0.05	4.87	0.001126	1.31	1162.94
380.00	1029.50	3.80	0.05	5.14	0.001129	1.39	1230.76
400.00	1090.00	4.00	0.05	5.42	0.001132	1.47	1299.36
420.00	1018.00	4.20	0.06	5.69	0.001136	1.37	1210.06

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)

0.00	0.00	0.00	0.00	0.00	0.001059	0.00	0.00
20.00	78.50	0.20	0.00	0.27	0.001062	0.11	99.80
40.00	146.00	0.40	0.01	0.54	0.001065	0.20	185.11
60.00	213.00	0.60	0.01	0.82	0.001068	0.29	269.31
80.00	281.00	0.80	0.01	1.09	0.001071	0.38	354.31
100.00	351.00	1.00	0.01	1.36	0.001074	0.47	441.36
120.00	408.50	1.20	0.02	1.63	0.001077	0.55	512.24
140.00	449.50	1.40	0.02	1.91	0.001080	0.61	562.09
160.00	506.00	1.60	0.02	2.18	0.001083	0.68	630.99
180.00	576.00	1.80	0.02	2.45	0.001086	0.78	716.28
200.00	640.50	2.00	0.03	2.72	0.001089	0.86	794.27
220.00	708.00	2.20	0.03	3.00	0.001092	0.96	875.51
240.00	764.50	2.40	0.03	3.27	0.001095	1.03	942.73
260.00	811.50	2.60	0.04	3.54	0.001098	1.10	997.87
280.00	855.00	2.80	0.04	3.81	0.001101	1.15	1048.39
300.00	889.50	3.00	0.04	4.08	0.001104	1.20	1087.61
320.00	869.00	3.20	0.04	4.36	0.001107	1.17	1059.52

Table C.3.53: 12% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001085	0.00	0.00
20.00	89.00	0.20	0.00	0.27	0.001088	0.12	110.43
40.00	172.00	0.40	0.01	0.54	0.001091	0.23	212.84
60.00	252.00	0.60	0.01	0.81	0.001094	0.34	310.99
80.00	336.00	0.80	0.01	1.08	0.001097	0.45	413.52
100.00	413.00	1.00	0.01	1.35	0.001100	0.56	506.91
120.00	492.00	1.20	0.02	1.61	0.001103	0.66	602.22
140.00	569.00	1.40	0.02	1.88	0.001106	0.77	694.57
160.00	640.00	1.60	0.02	2.15	0.001109	0.86	779.10
180.00	720.00	1.80	0.02	2.42	0.001112	0.97	874.07
200.00	794.00	2.00	0.03	2.69	0.001115	1.07	961.25
220.00	875.00	2.20	0.03	2.96	0.001118	1.18	1056.38
240.00	955.00	2.40	0.03	3.23	0.001121	1.29	1149.77
260.00	1021.00	2.60	0.03	3.50	0.001124	1.38	1225.81
280.00	1091.00	2.80	0.04	3.77	0.001128	1.47	1306.20

300.00	1169.00	3.00	0.04	4.04	0.001131	1.58	1395.68
320.00	1234.00	3.20	0.04	4.30	0.001134	1.67	1469.15
340.00	1288.00	3.40	0.05	4.57	0.001137	1.74	1529.13
360.00	1131.00	3.60	0.05	4.84	0.001140	1.53	1338.95

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001104	0.00	0.00
20.00	72.00	0.20	0.00	0.27	0.001107	0.10	87.77
40.00	139.00	0.40	0.01	0.53	0.001110	0.19	168.99
60.00	202.00	0.60	0.01	0.80	0.001113	0.27	244.93
80.00	275.00	0.80	0.01	1.07	0.001116	0.37	332.55
100.00	349.00	1.00	0.01	1.33	0.001119	0.47	420.90
120.00	424.00	1.20	0.02	1.60	0.001122	0.57	509.97
140.00	499.00	1.40	0.02	1.87	0.001125	0.67	598.55
160.00	572.00	1.60	0.02	2.13	0.001129	0.77	684.24
180.00	643.00	1.80	0.02	2.40	0.001132	0.87	767.08
200.00	712.00	2.00	0.03	2.67	0.001135	0.96	847.07
220.00	789.00	2.20	0.03	2.93	0.001138	1.07	936.11
240.00	860.00	2.40	0.03	3.20	0.001141	1.16	1017.55
260.00	935.00	2.60	0.03	3.47	0.001144	1.26	1103.24
280.00	1010.00	2.80	0.04	3.73	0.001147	1.36	1188.44
300.00	1086.00	3.00	0.04	4.00	0.001150	1.47	1274.33
320.00	1154.00	3.20	0.04	4.27	0.001154	1.56	1350.36
340.00	1225.00	3.40	0.05	4.53	0.001157	1.65	1429.45
360.00	1300.00	3.60	0.05	4.80	0.001160	1.76	1512.73
380.00	1365.00	3.80	0.05	5.07	0.001163	1.84	1583.91
400.00	1430.00	4.00	0.05	5.33	0.001167	1.93	1654.68
420.00	1486.00	4.20	0.06	5.60	0.001170	2.01	1714.63
440.00	1460.00	4.40	0.06	5.87	0.001173	1.97	1679.87

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001087	0.00	0.00
20.00	79.00	0.20	0.00	0.27	0.001090	0.11	97.86
40.00	151.00	0.40	0.01	0.54	0.001093	0.20	186.55
60.00	223.00	0.60	0.01	0.81	0.001096	0.30	274.75

80.00	301.00	0.80	0.01	1.08	0.001099	0.41	369.85
100.00	382.00	1.00	0.01	1.34	0.001102	0.52	468.10
120.00	462.00	1.20	0.02	1.61	0.001105	0.62	564.59
140.00	544.00	1.40	0.02	1.88	0.001108	0.73	662.99
160.00	621.00	1.60	0.02	2.15	0.001111	0.84	754.76
180.00	700.00	1.80	0.02	2.42	0.001114	0.95	848.43
200.00	773.00	2.00	0.03	2.69	0.001117	1.04	934.33
220.00	860.00	2.20	0.03	2.96	0.001120	1.16	1036.62
240.00	925.00	2.40	0.03	3.23	0.001123	1.25	1111.88
260.00	1003.00	2.60	0.03	3.49	0.001126	1.35	1202.29
280.00	1080.00	2.80	0.04	3.76	0.001129	1.46	1290.98
300.00	1164.00	3.00	0.04	4.03	0.001133	1.57	1387.50
320.00	1235.00	3.20	0.04	4.30	0.001136	1.67	1468.01
340.00	1305.00	3.40	0.05	4.57	0.001139	1.76	1546.86
360.00	1380.00	3.60	0.05	4.84	0.001142	1.86	1631.16
380.00	1434.00	3.80	0.05	5.11	0.001145	1.94	1690.20
400.00	1510.00	4.00	0.05	5.38	0.001149	2.04	1774.73
420.00	1568.00	4.20	0.06	5.65	0.001152	2.12	1837.67
440.00	1497.00	4.40	0.06	5.91	0.001155	2.02	1749.46

Table C.3.54: 18% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001084	0.00	0.00
20.00	94.00	0.20	0.00	0.27	0.001087	0.13	116.76
40.00	180.00	0.40	0.01	0.54	0.001090	0.24	222.97
60.00	270.00	0.60	0.01	0.81	0.001093	0.36	333.56
80.00	353.00	0.80	0.01	1.08	0.001096	0.48	434.91
100.00	440.00	1.00	0.01	1.35	0.001099	0.59	540.62
120.00	528.00	1.20	0.02	1.62	0.001102	0.71	646.98
140.00	610.00	1.40	0.02	1.88	0.001105	0.82	745.41
160.00	691.00	1.60	0.02	2.15	0.001108	0.93	842.07
180.00	773.00	1.80	0.02	2.42	0.001111	1.04	939.41
200.00	849.00	2.00	0.03	2.69	0.001114	1.15	1028.92
220.00	923.00	2.20	0.03	2.96	0.001117	1.25	1115.51
240.00	995.00	2.40	0.03	3.23	0.001120	1.34	1199.19

260.00	1070.00	2.60	0.03	3.50	0.001123	1.44	1286.00
280.00	1143.00	2.80	0.04	3.77	0.001126	1.54	1369.90
300.00	1196.00	3.00	0.04	4.04	0.001130	1.61	1429.41
320.00	1245.00	3.20	0.04	4.31	0.001133	1.68	1483.80
340.00	1240.00	3.40	0.05	4.58	0.001136	1.67	1473.69

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001119	0.00	0.00
20.00	30.00	0.20	0.00	0.26	0.001122	0.04	36.11
40.00	90.00	0.40	0.01	0.53	0.001125	0.12	108.04
60.00	155.00	0.60	0.01	0.79	0.001128	0.21	185.57
80.00	228.00	0.80	0.01	1.06	0.001131	0.31	272.24
100.00	301.00	1.00	0.01	1.32	0.001134	0.41	358.44
120.00	378.00	1.20	0.02	1.59	0.001137	0.51	448.92
140.00	453.00	1.40	0.02	1.85	0.001140	0.61	536.55
160.00	528.00	1.60	0.02	2.12	0.001143	0.71	623.69
180.00	600.00	1.80	0.02	2.38	0.001146	0.81	706.82
200.00	670.00	2.00	0.03	2.65	0.001149	0.90	787.14
220.00	745.00	2.20	0.03	2.91	0.001152	1.01	872.87
240.00	823.00	2.40	0.03	3.18	0.001155	1.11	961.63
260.00	900.00	2.60	0.03	3.44	0.001159	1.22	1048.72
280.00	980.00	2.80	0.04	3.71	0.001162	1.32	1138.80
300.00	1059.00	3.00	0.04	3.97	0.001165	1.43	1227.22
320.00	1140.00	3.20	0.04	4.24	0.001168	1.54	1317.44
340.00	1218.00	3.40	0.05	4.50	0.001171	1.64	1403.69
360.00	1293.00	3.60	0.05	4.77	0.001175	1.75	1485.98
380.00	1365.00	3.80	0.05	5.03	0.001178	1.84	1564.37
400.00	1436.00	4.00	0.05	5.30	0.001181	1.94	1641.14
420.00	1504.00	4.20	0.06	5.56	0.001185	2.03	1714.05
440.00	1566.00	4.40	0.06	5.83	0.001188	2.11	1779.70
460.00	1614.00	4.60	0.06	6.09	0.001191	2.18	1829.09
480.00	1591.00	4.80	0.06	6.36	0.001195	2.15	1797.94

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001129	0.00	0.00

20.00	78.00	0.20	0.00	0.26	0.001132	0.11	93.04
40.00	151.00	0.40	0.01	0.53	0.001135	0.20	179.65
60.00	225.00	0.60	0.01	0.79	0.001138	0.30	266.97
80.00	300.00	0.80	0.01	1.06	0.001141	0.41	355.02
100.00	375.00	1.00	0.01	1.32	0.001144	0.51	442.59
120.00	453.00	1.20	0.02	1.58	0.001147	0.61	533.22
140.00	529.00	1.40	0.02	1.85	0.001150	0.71	621.01
160.00	604.00	1.60	0.02	2.11	0.001153	0.82	707.15
180.00	672.00	1.80	0.02	2.37	0.001156	0.91	784.64
200.00	749.00	2.00	0.03	2.64	0.001159	1.01	872.18
220.00	823.00	2.20	0.03	2.90	0.001162	1.11	955.76
240.00	900.00	2.40	0.03	3.17	0.001166	1.22	1042.34
260.00	976.00	2.60	0.03	3.43	0.001169	1.32	1127.28
280.00	1053.00	2.80	0.04	3.69	0.001172	1.42	1212.89
300.00	1118.00	3.00	0.04	3.96	0.001175	1.51	1284.24
320.00	1190.00	3.20	0.04	4.22	0.001178	1.61	1363.19
340.00	1261.00	3.40	0.04	4.48	0.001182	1.70	1440.54
360.00	1330.00	3.60	0.05	4.75	0.001185	1.80	1515.17
380.00	1397.00	3.80	0.05	5.01	0.001188	1.89	1587.09
400.00	1454.00	4.00	0.05	5.28	0.001192	1.96	1647.26
420.00	1501.00	4.20	0.06	5.54	0.001195	2.03	1695.77
440.00	1495.00	4.40	0.06	5.80	0.001198	2.02	1684.28

Table C.3.55: 24% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001046	0.00	0.00
20.00	88.00	0.20	0.00	0.27	0.001049	0.12	113.23
40.00	190.00	0.40	0.01	0.55	0.001052	0.26	243.79
60.00	250.00	0.60	0.01	0.82	0.001055	0.34	319.90
80.00	313.00	0.80	0.01	1.10	0.001058	0.42	399.41
100.00	380.00	1.00	0.01	1.37	0.001061	0.51	483.56
120.00	446.00	1.20	0.02	1.64	0.001064	0.60	565.97
140.00	504.00	1.40	0.02	1.92	0.001067	0.68	637.79
160.00	561.00	1.60	0.02	2.19	0.001070	0.76	707.94
180.00	610.00	1.80	0.02	2.47	0.001073	0.82	767.62

200.00	663.00	2.00	0.03	2.74	0.001076	0.90	831.97
220.00	712.00	2.20	0.03	3.01	0.001079	0.96	890.94
240.00	767.00	2.40	0.03	3.29	0.001082	1.04	957.05
260.00	805.00	2.60	0.04	3.56	0.001085	1.09	1001.62
280.00	839.00	2.80	0.04	3.84	0.001088	1.13	1040.96
300.00	875.00	3.00	0.04	4.11	0.001091	1.18	1082.53
320.00	934.00	3.20	0.04	4.38	0.001094	1.26	1152.22
340.00	960.00	3.40	0.05	4.66	0.001097	1.30	1180.90
360.00	1000.00	3.60	0.05	4.93	0.001101	1.35	1226.57
380.00	1090.00	3.80	0.05	5.21	0.001104	1.47	1333.11
400.00	1168.00	4.00	0.05	5.48	0.001107	1.58	1424.38
420.00	1248.00	4.20	0.06	5.75	0.001110	1.68	1517.53
440.00	1297.00	4.40	0.06	6.03	0.001113	1.75	1572.53
460.00	1263.00	4.60	0.06	6.30	0.001117	1.71	1526.84

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001059	0.00	0.00
20.00	70.00	0.20	0.00	0.27	0.001062	0.09	88.99
40.00	135.00	0.40	0.01	0.54	0.001065	0.18	171.16
60.00	198.00	0.60	0.01	0.82	0.001068	0.27	250.35
80.00	262.00	0.80	0.01	1.09	0.001071	0.35	330.36
100.00	330.00	1.00	0.01	1.36	0.001074	0.45	414.95
120.00	397.00	1.20	0.02	1.63	0.001077	0.54	497.82
140.00	460.00	1.40	0.02	1.91	0.001080	0.62	575.22
160.00	521.00	1.60	0.02	2.18	0.001083	0.70	649.70
180.00	575.00	1.80	0.02	2.45	0.001086	0.78	715.04
200.00	621.00	2.00	0.03	2.72	0.001089	0.84	770.09
220.00	662.00	2.20	0.03	3.00	0.001092	0.89	818.63
240.00	683.00	2.40	0.03	3.27	0.001095	0.92	842.23
260.00	704.00	2.60	0.04	3.54	0.001098	0.95	865.68
280.00	728.00	2.80	0.04	3.81	0.001101	0.98	892.66
300.00	758.00	3.00	0.04	4.08	0.001104	1.02	926.82
320.00	793.00	3.20	0.04	4.36	0.001107	1.07	966.86
340.00	849.00	3.40	0.05	4.63	0.001110	1.15	1032.19
360.00	923.00	3.60	0.05	4.90	0.001114	1.25	1118.95
380.00	995.00	3.80	0.05	5.17	0.001117	1.34	1202.78
400.00	1070.00	4.00	0.05	5.45	0.001120	1.44	1289.73
420.00	1143.00	4.20	0.06	5.72	0.001123	1.54	1373.75

440.00	1194.00	4.40	0.06	5.99	0.001126	1.61	1430.91
460.00	1285.00	4.60	0.06	6.26	0.001130	1.73	1535.50
480.00	1199.00	4.80	0.07	6.54	0.001133	1.62	1428.57

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001052	0.00	0.00
20.00	86.00	0.20	0.00	0.27	0.001055	0.12	110.05
40.00	149.00	0.40	0.01	0.55	0.001058	0.20	190.15
60.00	195.00	0.60	0.01	0.82	0.001061	0.26	248.17
80.00	249.00	0.80	0.01	1.09	0.001064	0.34	316.02
100.00	295.00	1.00	0.01	1.37	0.001067	0.40	373.36
120.00	331.00	1.20	0.02	1.64	0.001070	0.45	417.76
140.00	388.00	1.40	0.02	1.91	0.001073	0.52	488.35
160.00	412.00	1.60	0.02	2.19	0.001076	0.56	517.11
180.00	445.00	1.80	0.02	2.46	0.001079	0.60	556.97
200.00	465.00	2.00	0.03	2.73	0.001082	0.63	580.37
220.00	501.00	2.20	0.03	3.01	0.001085	0.68	623.54
240.00	525.00	2.40	0.03	3.28	0.001088	0.71	651.57
260.00	583.00	2.60	0.04	3.55	0.001091	0.79	721.51
280.00	611.00	2.80	0.04	3.83	0.001094	0.82	754.02
300.00	640.00	3.00	0.04	4.10	0.001097	0.86	787.57
320.00	660.00	3.20	0.04	4.37	0.001100	0.89	809.86
340.00	693.00	3.40	0.05	4.64	0.001103	0.94	847.93
360.00	714.00	3.60	0.05	4.92	0.001107	0.96	871.12
380.00	779.00	3.80	0.05	5.19	0.001110	1.05	947.69
400.00	853.00	4.00	0.05	5.46	0.001113	1.15	1034.73
420.00	930.00	4.20	0.06	5.74	0.001116	1.26	1124.87
440.00	1006.00	4.40	0.06	6.01	0.001119	1.36	1213.27
460.00	1163.00	4.60	0.06	6.28	0.001123	1.57	1398.54
480.00	1207.00	4.80	0.07	6.56	0.001126	1.63	1447.22
500.00	1257.00	5.00	0.07	6.83	0.001129	1.70	1502.76
520.00	1148.00	5.20	0.07	7.10	0.001133	1.55	1368.43

Table C.3.56: 30% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001095	0.00	0.00
20.00	41.00	0.20	0.00	0.27	0.001098	0.06	50.41
40.00	91.00	0.40	0.01	0.54	0.001101	0.12	111.58
60.00	143.00	0.60	0.01	0.80	0.001104	0.19	174.88
80.00	200.00	0.80	0.01	1.07	0.001107	0.27	243.92
100.00	259.00	1.00	0.01	1.34	0.001110	0.35	315.02
120.00	320.00	1.20	0.02	1.61	0.001113	0.43	388.16
140.00	385.00	1.40	0.02	1.87	0.001116	0.52	465.73
160.00	450.00	1.60	0.02	2.14	0.001119	0.61	542.88
180.00	511.00	1.80	0.02	2.41	0.001122	0.69	614.78
200.00	573.00	2.00	0.03	2.68	0.001125	0.77	687.48
220.00	640.00	2.20	0.03	2.95	0.001128	0.86	765.75
240.00	705.00	2.40	0.03	3.21	0.001131	0.95	841.20
260.00	769.00	2.60	0.03	3.48	0.001135	1.04	915.02
280.00	838.00	2.80	0.04	3.75	0.001138	1.13	994.36
300.00	900.00	3.00	0.04	4.02	0.001141	1.22	1064.96
320.00	970.00	3.20	0.04	4.28	0.001144	1.31	1144.58
340.00	1048.00	3.40	0.05	4.55	0.001147	1.41	1233.16
360.00	1119.00	3.60	0.05	4.82	0.001151	1.51	1313.01
380.00	1182.00	3.80	0.05	5.09	0.001154	1.60	1383.03
400.00	1174.00	4.00	0.05	5.36	0.001157	1.58	1369.80

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001060	0.00	0.00
20.00	26.00	0.20	0.00	0.27	0.001062	0.04	33.04
40.00	81.00	0.40	0.01	0.54	0.001065	0.11	102.64
60.00	146.00	0.60	0.01	0.82	0.001068	0.20	184.50
80.00	212.00	0.80	0.01	1.09	0.001071	0.29	267.17
100.00	288.00	1.00	0.01	1.36	0.001074	0.39	361.94

120.00	363.00	1.20	0.02	1.63	0.001077	0.49	454.94
140.00	439.00	1.40	0.02	1.91	0.001080	0.59	548.67
160.00	509.00	1.60	0.02	2.18	0.001083	0.69	634.39
180.00	580.00	1.80	0.02	2.45	0.001086	0.78	720.86
200.00	656.00	2.00	0.03	2.72	0.001089	0.89	813.05
220.00	730.00	2.20	0.03	2.99	0.001092	0.99	902.23
240.00	805.00	2.40	0.03	3.27	0.001095	1.09	992.13
260.00	879.00	2.60	0.04	3.54	0.001098	1.19	1080.29
280.00	956.00	2.80	0.04	3.81	0.001102	1.29	1171.60
300.00	1030.00	3.00	0.04	4.08	0.001105	1.39	1258.72
320.00	1108.00	3.20	0.04	4.36	0.001108	1.50	1350.20
340.00	1083.00	3.40	0.05	4.63	0.001111	1.46	1315.98

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001067	0.00	0.00
20.00	59.00	0.20	0.00	0.27	0.001070	0.08	74.44
40.00	120.00	0.40	0.01	0.54	0.001073	0.16	150.99
60.00	183.00	0.60	0.01	0.81	0.001076	0.25	229.63
80.00	250.00	0.80	0.01	1.09	0.001079	0.34	312.85
100.00	320.00	1.00	0.01	1.36	0.001082	0.43	399.35
120.00	375.00	1.20	0.02	1.63	0.001085	0.51	466.70
140.00	459.00	1.40	0.02	1.90	0.001088	0.62	569.66
160.00	529.00	1.60	0.02	2.17	0.001091	0.71	654.72
180.00	600.00	1.80	0.02	2.44	0.001094	0.81	740.54
200.00	670.00	2.00	0.03	2.71	0.001097	0.90	824.64
220.00	740.00	2.20	0.03	2.98	0.001100	1.00	908.25
240.00	812.00	2.40	0.03	3.26	0.001103	1.10	993.84
260.00	892.00	2.60	0.04	3.53	0.001106	1.20	1088.69
280.00	973.00	2.80	0.04	3.80	0.001109	1.31	1184.21
300.00	1051.00	3.00	0.04	4.07	0.001112	1.42	1275.53
320.00	1052.00	3.20	0.04	4.34	0.001116	1.42	1273.14
340.00	1008.00	3.40	0.05	4.61	0.001119	1.36	1216.43

Table C.4.57: 0% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001106	0.00	0.00
20.00	58.00	0.20	0.00	0.27	0.001109	0.08	70.63
40.00	108.00	0.40	0.01	0.53	0.001112	0.15	131.17
60.00	173.00	0.60	0.01	0.80	0.001115	0.23	209.55
80.00	246.00	0.80	0.01	1.07	0.001118	0.33	297.17
100.00	321.00	1.00	0.01	1.33	0.001121	0.43	386.72
120.00	395.00	1.20	0.02	1.60	0.001124	0.53	474.59
140.00	462.00	1.40	0.02	1.87	0.001127	0.62	553.58
160.00	531.00	1.60	0.02	2.13	0.001130	0.72	634.53
180.00	598.00	1.80	0.02	2.40	0.001133	0.81	712.65
200.00	663.00	2.00	0.03	2.67	0.001136	0.90	787.95
220.00	725.00	2.20	0.03	2.93	0.001139	0.98	859.28
240.00	795.00	2.40	0.03	3.20	0.001142	1.07	939.65
260.00	863.00	2.60	0.03	3.46	0.001145	1.17	1017.22
280.00	942.00	2.80	0.04	3.73	0.001148	1.27	1107.27
300.00	902.00	3.00	0.04	4.00	0.001152	1.22	1057.32

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001071	0.00	0.00
20.00	43.00	0.20	0.00	0.27	0.001074	0.06	54.05
40.00	98.00	0.40	0.01	0.54	0.001077	0.13	122.84
60.00	150.00	0.60	0.01	0.81	0.001080	0.20	187.51
80.00	211.00	0.80	0.01	1.08	0.001083	0.28	263.05
100.00	276.00	1.00	0.01	1.35	0.001086	0.37	343.14
120.00	338.00	1.20	0.02	1.62	0.001089	0.46	419.07
140.00	391.00	1.40	0.02	1.90	0.001092	0.53	483.45
160.00	436.00	1.60	0.02	2.17	0.001095	0.59	537.60
180.00	473.00	1.80	0.02	2.44	0.001098	0.64	581.61
200.00	503.00	2.00	0.03	2.71	0.001101	0.68	616.78

220.00	550.00	2.20	0.03	2.98	0.001104	0.74	672.54
240.00	595.00	2.40	0.03	3.25	0.001107	0.80	725.53
260.00	645.00	2.60	0.04	3.52	0.001110	0.87	784.30
280.00	671.00	2.80	0.04	3.79	0.001113	0.91	813.62
300.00	681.00	3.00	0.04	4.06	0.001116	0.92	823.43
320.00	740.00	3.20	0.04	4.33	0.001120	1.00	892.24
340.00	790.00	3.40	0.05	4.60	0.001123	1.07	949.83
360.00	870.00	3.60	0.05	4.87	0.001126	1.17	1043.05
380.00	940.00	3.80	0.05	5.14	0.001129	1.27	1123.76
400.00	926.00	4.00	0.05	5.42	0.001132	1.25	1103.86

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001059	0.00	0.00
20.00	78.00	0.20	0.00	0.27	0.001062	0.11	99.16
40.00	141.00	0.40	0.01	0.54	0.001065	0.19	178.77
60.00	203.00	0.60	0.01	0.82	0.001068	0.27	256.67
80.00	261.00	0.80	0.01	1.09	0.001071	0.35	329.10
100.00	320.00	1.00	0.01	1.36	0.001074	0.43	402.38
120.00	355.00	1.20	0.02	1.63	0.001077	0.48	445.16
140.00	355.00	1.40	0.02	1.91	0.001080	0.48	443.92
160.00	391.00	1.60	0.02	2.18	0.001083	0.53	487.58
180.00	452.00	1.80	0.02	2.45	0.001086	0.61	562.08
200.00	508.00	2.00	0.03	2.72	0.001089	0.69	629.96
220.00	556.00	2.20	0.03	3.00	0.001092	0.75	687.55
240.00	604.00	2.40	0.03	3.27	0.001095	0.82	744.81
260.00	620.00	2.60	0.04	3.54	0.001098	0.84	762.39
280.00	630.00	2.80	0.04	3.81	0.001101	0.85	772.50
300.00	654.00	3.00	0.04	4.08	0.001104	0.88	799.66
320.00	676.00	3.20	0.04	4.36	0.001107	0.91	824.21
340.00	724.00	3.40	0.05	4.63	0.001110	0.98	880.22
360.00	740.00	3.60	0.05	4.90	0.001114	1.00	897.10
380.00	770.00	3.80	0.05	5.17	0.001117	1.04	930.80
400.00	794.00	4.00	0.05	5.45	0.001120	1.07	957.05
420.00	784.00	4.20	0.06	5.72	0.001123	1.06	942.28

Table C.4.58: 6% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001095	0.00	0.00
20.00	41.00	0.20	0.00	0.27	0.001098	0.06	50.41
40.00	91.00	0.40	0.01	0.54	0.001101	0.12	111.58
60.00	143.00	0.60	0.01	0.80	0.001104	0.19	174.88
80.00	200.00	0.80	0.01	1.07	0.001107	0.27	243.92
100.00	259.00	1.00	0.01	1.34	0.001110	0.35	315.02
120.00	320.00	1.20	0.02	1.61	0.001113	0.43	388.16
140.00	385.00	1.40	0.02	1.87	0.001116	0.52	465.73
160.00	450.00	1.60	0.02	2.14	0.001119	0.61	542.88
180.00	511.00	1.80	0.02	2.41	0.001122	0.69	614.78
200.00	573.00	2.00	0.03	2.68	0.001125	0.77	687.48
220.00	640.00	2.20	0.03	2.95	0.001128	0.86	765.75
240.00	705.00	2.40	0.03	3.21	0.001131	0.95	841.20
260.00	769.00	2.60	0.03	3.48	0.001135	1.04	915.02
280.00	838.00	2.80	0.04	3.75	0.001138	1.13	994.36

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001060	0.00	0.00
20.00	26.00	0.20	0.00	0.27	0.001062	0.04	33.04
40.00	81.00	0.40	0.01	0.54	0.001065	0.11	102.64
60.00	146.00	0.60	0.01	0.82	0.001068	0.20	184.50
80.00	212.00	0.80	0.01	1.09	0.001071	0.29	267.17
100.00	288.00	1.00	0.01	1.36	0.001074	0.39	361.94
120.00	363.00	1.20	0.02	1.63	0.001077	0.49	454.94
140.00	439.00	1.40	0.02	1.91	0.001080	0.59	548.67
160.00	509.00	1.60	0.02	2.18	0.001083	0.69	634.39
180.00	580.00	1.80	0.02	2.45	0.001086	0.78	720.86
200.00	656.00	2.00	0.03	2.72	0.001089	0.89	813.05

220.00	730.00	2.20	0.03	2.99	0.001092	0.99	902.23
240.00	805.00	2.40	0.03	3.27	0.001095	1.09	992.13

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001067	0.00	0.00
20.00	59.00	0.20	0.00	0.27	0.001070	0.08	74.44
40.00	120.00	0.40	0.01	0.54	0.001073	0.16	150.99
60.00	183.00	0.60	0.01	0.81	0.001076	0.25	229.63
80.00	250.00	0.80	0.01	1.09	0.001079	0.34	312.85
100.00	320.00	1.00	0.01	1.36	0.001082	0.43	399.35
120.00	375.00	1.20	0.02	1.63	0.001085	0.51	466.70
140.00	459.00	1.40	0.02	1.90	0.001088	0.62	569.66
160.00	529.00	1.60	0.02	2.17	0.001091	0.71	654.72
180.00	600.00	1.80	0.02	2.44	0.001094	0.81	740.54
200.00	670.00	2.00	0.03	2.71	0.001097	0.90	824.64
220.00	740.00	2.20	0.03	2.98	0.001100	1.00	908.25
240.00	812.00	2.40	0.03	3.26	0.001103	1.10	993.84

Table C.4.59: 12% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001095	0.00	0.00
20.00	41.00	0.20	0.00	0.27	0.001098	0.06	50.41
40.00	91.00	0.40	0.01	0.54	0.001101	0.12	111.58
60.00	143.00	0.60	0.01	0.80	0.001104	0.19	174.88
80.00	200.00	0.80	0.01	1.07	0.001107	0.27	243.92
100.00	259.00	1.00	0.01	1.34	0.001110	0.35	315.02
120.00	320.00	1.20	0.02	1.61	0.001113	0.43	388.16
140.00	385.00	1.40	0.02	1.87	0.001116	0.52	465.73
160.00	450.00	1.60	0.02	2.14	0.001119	0.61	542.88
180.00	511.00	1.80	0.02	2.41	0.001122	0.69	614.78

200.00	573.00	2.00	0.03	2.68	0.001125	0.77	687.48
220.00	640.00	2.20	0.03	2.95	0.001128	0.86	765.75
240.00	705.00	2.40	0.03	3.21	0.001131	0.95	841.20
260.00	769.00	2.60	0.03	3.48	0.001135	1.04	915.02
280.00	838.00	2.80	0.04	3.75	0.001138	1.13	994.36
300.00	900.00	3.00	0.04	4.02	0.001141	1.22	1064.96
320.00	970.00	3.20	0.04	4.28	0.001144	1.31	1144.58
340.00	1048.00	3.40	0.05	4.55	0.001147	1.41	1233.16
360.00	1119.00	3.60	0.05	4.82	0.001151	1.51	1313.01
380.00	1182.00	3.80	0.05	5.09	0.001154	1.60	1383.03
400.00	1245.00	4.00	0.05	5.36	0.001157	1.68	1452.64
420.00	1305.00	4.20	0.06	5.62	0.001160	1.76	1518.34
440.00	1364.00	4.40	0.06	5.89	0.001164	1.84	1582.48
460.00	1428.00	4.60	0.06	6.16	0.001167	1.93	1652.01
480.00	1488.00	4.80	0.06	6.43	0.001170	2.01	1716.51
500.00	1543.00	5.00	0.07	6.70	0.001174	2.08	1774.87
520.00	1592.00	5.20	0.07	6.96	0.001177	2.15	1825.97
540.00	1497.00	5.40	0.07	7.23	0.001180	2.02	1712.07

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001060	0.00	0.00
20.00	26.00	0.20	0.00	0.27	0.001062	0.04	33.04
40.00	81.00	0.40	0.01	0.54	0.001065	0.11	102.64
60.00	146.00	0.60	0.01	0.82	0.001068	0.20	184.50
80.00	212.00	0.80	0.01	1.09	0.001071	0.29	267.17
100.00	288.00	1.00	0.01	1.36	0.001074	0.39	361.94
120.00	363.00	1.20	0.02	1.63	0.001077	0.49	454.94
140.00	439.00	1.40	0.02	1.91	0.001080	0.59	548.67
160.00	509.00	1.60	0.02	2.18	0.001083	0.69	634.39
180.00	580.00	1.80	0.02	2.45	0.001086	0.78	720.86
200.00	656.00	2.00	0.03	2.72	0.001089	0.89	813.05
220.00	730.00	2.20	0.03	2.99	0.001092	0.99	902.23
240.00	805.00	2.40	0.03	3.27	0.001095	1.09	992.13
260.00	879.00	2.60	0.04	3.54	0.001098	1.19	1080.29
280.00	956.00	2.80	0.04	3.81	0.001102	1.29	1171.60
300.00	1030.00	3.00	0.04	4.08	0.001105	1.39	1258.72

320.00	1108.00	3.20	0.04	4.36	0.001108	1.50	1350.20
340.00	1173.00	3.40	0.05	4.63	0.001111	1.58	1425.34
360.00	1242.00	3.60	0.05	4.90	0.001114	1.68	1504.87
380.00	1310.00	3.80	0.05	5.17	0.001117	1.77	1582.72
400.00	1374.00	4.00	0.05	5.45	0.001121	1.85	1655.28
420.00	1442.00	4.20	0.06	5.72	0.001124	1.95	1732.20
440.00	1500.00	4.40	0.06	5.99	0.001127	2.03	1796.66
460.00	1505.00	4.60	0.06	6.26	0.001130	2.03	1797.43
480.00	1560.00	4.80	0.07	6.53	0.001134	2.11	1857.71
500.00	1500.00	5.00	0.07	6.81	0.001137	2.03	1781.05

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001067	0.00	0.00
20.00	59.00	0.20	0.00	0.27	0.001070	0.08	74.44
40.00	120.00	0.40	0.01	0.54	0.001073	0.16	150.99
60.00	183.00	0.60	0.01	0.81	0.001076	0.25	229.63
80.00	250.00	0.80	0.01	1.09	0.001079	0.34	312.85
100.00	320.00	1.00	0.01	1.36	0.001082	0.43	399.35
120.00	375.00	1.20	0.02	1.63	0.001085	0.51	466.70
140.00	459.00	1.40	0.02	1.90	0.001088	0.62	569.66
160.00	529.00	1.60	0.02	2.17	0.001091	0.71	654.72
180.00	600.00	1.80	0.02	2.44	0.001094	0.81	740.54
200.00	670.00	2.00	0.03	2.71	0.001097	0.90	824.64
220.00	740.00	2.20	0.03	2.98	0.001100	1.00	908.25
240.00	812.00	2.40	0.03	3.26	0.001103	1.10	993.84
260.00	892.00	2.60	0.04	3.53	0.001106	1.20	1088.69
280.00	973.00	2.80	0.04	3.80	0.001109	1.31	1184.21
300.00	1051.00	3.00	0.04	4.07	0.001112	1.42	1275.53
320.00	1095.00	3.20	0.04	4.34	0.001116	1.48	1325.18
340.00	1175.00	3.40	0.05	4.61	0.001119	1.59	1417.96
360.00	1245.00	3.60	0.05	4.88	0.001122	1.68	1498.16
380.00	1293.00	3.80	0.05	5.15	0.001125	1.75	1551.48
400.00	1356.00	4.00	0.05	5.43	0.001128	1.83	1622.42
420.00	1345.00	4.20	0.06	5.70	0.001132	1.82	1604.65

Table C.4.60: 18% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001085	0.00	0.00
20.00	61.00	0.20	0.00	0.27	0.001088	0.08	75.71
40.00	129.00	0.40	0.01	0.54	0.001091	0.17	159.67
60.00	200.00	0.60	0.01	0.81	0.001094	0.27	246.88
80.00	278.00	0.80	0.01	1.08	0.001097	0.38	342.24
100.00	350.00	1.00	0.01	1.35	0.001100	0.47	429.70
120.00	463.00	1.20	0.02	1.61	0.001103	0.63	566.89
140.00	579.00	1.40	0.02	1.88	0.001106	0.78	706.98
160.00	622.00	1.60	0.02	2.15	0.001109	0.84	757.40
180.00	693.00	1.80	0.02	2.42	0.001112	0.94	841.53
200.00	770.00	2.00	0.03	2.69	0.001115	1.04	932.46
220.00	846.00	2.20	0.03	2.96	0.001118	1.14	1021.66
240.00	920.00	2.40	0.03	3.23	0.001121	1.24	1107.94
260.00	950.00	2.60	0.03	3.50	0.001124	1.28	1140.89
280.00	1063.00	2.80	0.04	3.77	0.001127	1.44	1273.04
300.00	1138.00	3.00	0.04	4.04	0.001130	1.54	1359.05
320.00	1209.00	3.20	0.04	4.31	0.001134	1.63	1439.79
340.00	1289.00	3.40	0.05	4.57	0.001137	1.74	1530.74
360.00	1360.00	3.60	0.05	4.84	0.001140	1.84	1610.51
380.00	1430.00	3.80	0.05	5.11	0.001143	1.93	1688.61
400.00	1501.00	4.00	0.05	5.38	0.001146	2.03	1767.43
420.00	1572.00	4.20	0.06	5.65	0.001150	2.12	1845.76
440.00	1630.00	4.40	0.06	5.92	0.001153	2.20	1908.41
460.00	1765.00	4.60	0.06	6.19	0.001156	2.38	2060.56
480.00	1815.00	4.80	0.06	6.46	0.001160	2.45	2112.85
500.00	1782.00	5.00	0.07	6.73	0.001163	2.41	2068.47

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001081	0.00	0.00

20.00	70.00	0.20	0.00	0.27	0.001084	0.09	87.16
40.00	150.00	0.40	0.01	0.54	0.001087	0.20	186.27
60.00	229.00	0.60	0.01	0.81	0.001090	0.31	283.59
80.00	310.00	0.80	0.01	1.08	0.001093	0.42	382.86
100.00	396.00	1.00	0.01	1.35	0.001096	0.53	487.74
120.00	479.00	1.20	0.02	1.62	0.001099	0.65	588.36
140.00	560.00	1.40	0.02	1.89	0.001102	0.76	685.97
160.00	640.00	1.60	0.02	2.16	0.001105	0.86	781.81
180.00	720.00	1.80	0.02	2.43	0.001108	0.97	877.11
200.00	795.00	2.00	0.03	2.70	0.001111	1.07	965.81
220.00	874.00	2.20	0.03	2.96	0.001114	1.18	1058.84
240.00	951.00	2.40	0.03	3.23	0.001117	1.28	1148.92
260.00	1031.00	2.60	0.04	3.50	0.001121	1.39	1242.10
280.00	1110.00	2.80	0.04	3.77	0.001124	1.50	1333.54
300.00	1190.00	3.00	0.04	4.04	0.001127	1.61	1425.65
320.00	1270.00	3.20	0.04	4.31	0.001130	1.71	1517.22
340.00	1348.00	3.40	0.05	4.58	0.001133	1.82	1605.87
360.00	1410.00	3.60	0.05	4.85	0.001136	1.90	1674.98
380.00	1475.00	3.80	0.05	5.12	0.001140	1.99	1747.24
400.00	1524.00	4.00	0.05	5.39	0.001143	2.06	1800.15
420.00	1430.00	4.20	0.06	5.66	0.001146	1.93	1684.31

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001077	0.00	0.00
20.00	58.00	0.20	0.00	0.27	0.001080	0.08	72.49
40.00	120.00	0.40	0.01	0.54	0.001083	0.16	149.58
60.00	178.00	0.60	0.01	0.81	0.001086	0.24	221.27
80.00	230.00	0.80	0.01	1.08	0.001089	0.31	285.13
100.00	276.00	1.00	0.01	1.35	0.001092	0.37	341.23
120.00	309.00	1.20	0.02	1.62	0.001095	0.42	380.98
140.00	360.00	1.40	0.02	1.89	0.001098	0.49	442.64
160.00	405.00	1.60	0.02	2.16	0.001101	0.55	496.60
180.00	458.00	1.80	0.02	2.43	0.001104	0.62	560.04
200.00	508.00	2.00	0.03	2.70	0.001107	0.69	619.46
220.00	530.00	2.20	0.03	2.97	0.001110	0.72	644.49
240.00	590.00	2.40	0.03	3.24	0.001113	0.80	715.46

260.00	648.00	2.60	0.04	3.51	0.001116	0.87	783.60
280.00	710.00	2.80	0.04	3.78	0.001120	0.96	856.17
300.00	770.00	3.00	0.04	4.05	0.001123	1.04	925.92
320.00	828.00	3.20	0.04	4.32	0.001126	1.12	992.86
340.00	875.00	3.40	0.05	4.59	0.001129	1.18	1046.26
360.00	920.00	3.60	0.05	4.86	0.001132	1.24	1096.95
380.00	978.00	3.80	0.05	5.13	0.001135	1.32	1162.80
400.00	1020.00	4.00	0.05	5.40	0.001139	1.38	1209.28
420.00	1065.00	4.20	0.06	5.67	0.001142	1.44	1259.03
440.00	1073.00	4.40	0.06	5.94	0.001145	1.45	1264.85
460.00	1089.00	4.60	0.06	6.21	0.001149	1.47	1280.03
480.00	1053.00	4.80	0.06	6.48	0.001152	1.42	1234.15

Table C.4.61: 24% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001085	0.00	0.00
20.00	89.00	0.20	0.00	0.27	0.001088	0.12	110.43
40.00	172.00	0.40	0.01	0.54	0.001091	0.23	212.84
60.00	252.00	0.60	0.01	0.81	0.001094	0.34	310.99
80.00	336.00	0.80	0.01	1.08	0.001097	0.45	413.52
100.00	413.00	1.00	0.01	1.35	0.001100	0.56	506.91
120.00	492.00	1.20	0.02	1.61	0.001103	0.66	602.22
140.00	569.00	1.40	0.02	1.88	0.001106	0.77	694.57
160.00	640.00	1.60	0.02	2.15	0.001109	0.86	779.10
180.00	720.00	1.80	0.02	2.42	0.001112	0.97	874.07
200.00	794.00	2.00	0.03	2.69	0.001115	1.07	961.25
220.00	875.00	2.20	0.03	2.96	0.001118	1.18	1056.38
240.00	955.00	2.40	0.03	3.23	0.001121	1.29	1149.77
260.00	1021.00	2.60	0.03	3.50	0.001124	1.38	1225.81
280.00	1091.00	2.80	0.04	3.77	0.001128	1.47	1306.20
300.00	1169.00	3.00	0.04	4.04	0.001131	1.58	1395.68
320.00	1234.00	3.20	0.04	4.30	0.001134	1.67	1469.15
340.00	1288.00	3.40	0.05	4.57	0.001137	1.74	1529.13
360.00	1131.00	3.60	0.05	4.84	0.001140	1.53	1338.95

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001104	0.00	0.00
20.00	72.00	0.20	0.00	0.27	0.001107	0.10	87.77
40.00	139.00	0.40	0.01	0.53	0.001110	0.19	168.99
60.00	202.00	0.60	0.01	0.80	0.001113	0.27	244.93
80.00	275.00	0.80	0.01	1.07	0.001116	0.37	332.55
100.00	349.00	1.00	0.01	1.33	0.001119	0.47	420.90
120.00	424.00	1.20	0.02	1.60	0.001122	0.57	509.97
140.00	499.00	1.40	0.02	1.87	0.001125	0.67	598.55
160.00	572.00	1.60	0.02	2.13	0.001129	0.77	684.24
180.00	643.00	1.80	0.02	2.40	0.001132	0.87	767.08
200.00	712.00	2.00	0.03	2.67	0.001135	0.96	847.07
220.00	789.00	2.20	0.03	2.93	0.001138	1.07	936.11
240.00	860.00	2.40	0.03	3.20	0.001141	1.16	1017.55
260.00	935.00	2.60	0.03	3.47	0.001144	1.26	1103.24
280.00	1010.00	2.80	0.04	3.73	0.001147	1.36	1188.44
300.00	1086.00	3.00	0.04	4.00	0.001150	1.47	1274.33
320.00	1154.00	3.20	0.04	4.27	0.001154	1.56	1350.36
340.00	1225.00	3.40	0.05	4.53	0.001157	1.65	1429.45
360.00	1300.00	3.60	0.05	4.80	0.001160	1.76	1512.73
380.00	1365.00	3.80	0.05	5.07	0.001163	1.84	1583.91
400.00	1430.00	4.00	0.05	5.33	0.001167	1.93	1654.68
420.00	1486.00	4.20	0.06	5.60	0.001170	2.01	1714.63
440.00	1460.00	4.40	0.06	5.87	0.001173	1.97	1679.87

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001087	0.00	0.00
20.00	79.00	0.20	0.00	0.27	0.001090	0.11	97.86
40.00	151.00	0.40	0.01	0.54	0.001093	0.20	186.55
60.00	223.00	0.60	0.01	0.81	0.001096	0.30	274.75
80.00	301.00	0.80	0.01	1.08	0.001099	0.41	369.85
100.00	382.00	1.00	0.01	1.34	0.001102	0.52	468.10
120.00	462.00	1.20	0.02	1.61	0.001105	0.62	564.59
140.00	544.00	1.40	0.02	1.88	0.001108	0.73	662.99

160.00	621.00	1.60	0.02	2.15	0.001111	0.84	754.76
180.00	700.00	1.80	0.02	2.42	0.001114	0.95	848.43
200.00	773.00	2.00	0.03	2.69	0.001117	1.04	934.33
220.00	860.00	2.20	0.03	2.96	0.001120	1.16	1036.62
240.00	925.00	2.40	0.03	3.23	0.001123	1.25	1111.88
260.00	1003.00	2.60	0.03	3.49	0.001126	1.35	1202.29
280.00	1080.00	2.80	0.04	3.76	0.001129	1.46	1290.98
300.00	1164.00	3.00	0.04	4.03	0.001133	1.57	1387.50
320.00	1235.00	3.20	0.04	4.30	0.001136	1.67	1468.01
340.00	1305.00	3.40	0.05	4.57	0.001139	1.76	1546.86
360.00	1380.00	3.60	0.05	4.84	0.001142	1.86	1631.16
380.00	1434.00	3.80	0.05	5.11	0.001145	1.94	1690.20
400.00	1510.00	4.00	0.05	5.38	0.001149	2.04	1774.73
420.00	1568.00	4.20	0.06	5.65	0.001152	2.12	1837.67
440.00	1549.00	4.40	0.06	5.91	0.001155	2.09	1810.23

Table C.4.62: 30% of RHA

Sample 1

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001095	0.00	0.00
20.00	78.00	0.20	0.00	0.27	0.001098	0.11	95.93
40.00	152.00	0.40	0.01	0.54	0.001101	0.21	186.43
60.00	230.00	0.60	0.01	0.80	0.001104	0.31	281.34
80.00	288.00	0.80	0.01	1.07	0.001107	0.39	351.34
100.00	389.00	1.00	0.01	1.34	0.001110	0.53	473.27
120.00	448.00	1.20	0.02	1.61	0.001113	0.60	543.57
140.00	520.00	1.40	0.02	1.87	0.001116	0.70	629.21
160.00	593.00	1.60	0.02	2.14	0.001119	0.80	715.58
180.00	659.00	1.80	0.02	2.41	0.001122	0.89	793.05
200.00	720.00	2.00	0.03	2.68	0.001125	0.97	864.08
220.00	780.00	2.20	0.03	2.95	0.001128	1.05	933.51
240.00	850.00	2.40	0.03	3.21	0.001131	1.15	1014.48
260.00	920.00	2.60	0.03	3.48	0.001134	1.24	1094.98
280.00	990.00	2.80	0.04	3.75	0.001137	1.34	1175.03

300.00	1057.00	3.00	0.04	4.02	0.001141	1.43	1251.06
320.00	1110.00	3.20	0.04	4.29	0.001144	1.50	1310.12
340.00	1155.00	3.40	0.05	4.55	0.001147	1.56	1359.42
360.00	1127.00	3.60	0.05	4.82	0.001150	1.52	1322.74

Sample 2

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001073	0.00	0.00
20.00	90.00	0.20	0.00	0.27	0.001076	0.12	112.97
40.00	168.00	0.40	0.01	0.54	0.001078	0.23	210.31
60.00	250.00	0.60	0.01	0.81	0.001081	0.34	312.10
80.00	330.00	0.80	0.01	1.08	0.001084	0.45	410.85
100.00	412.00	1.00	0.01	1.35	0.001087	0.56	511.54
120.00	491.00	1.20	0.02	1.62	0.001090	0.66	607.95
140.00	571.00	1.40	0.02	1.89	0.001093	0.77	705.06
160.00	652.00	1.60	0.02	2.16	0.001096	0.88	802.86
180.00	729.00	1.80	0.02	2.44	0.001099	0.98	895.19
200.00	810.00	2.00	0.03	2.71	0.001102	1.09	991.90
220.00	891.00	2.20	0.03	2.98	0.001106	1.20	1088.06
240.00	972.00	2.40	0.03	3.25	0.001109	1.31	1183.66
260.00	1051.00	2.60	0.04	3.52	0.001112	1.42	1276.28
280.00	1135.00	2.80	0.04	3.79	0.001115	1.53	1374.42
300.00	1219.00	3.00	0.04	4.06	0.001118	1.65	1471.99
320.00	1300.00	3.20	0.04	4.33	0.001121	1.76	1565.38
340.00	1362.00	3.40	0.05	4.60	0.001124	1.84	1635.39
360.00	1458.00	3.60	0.05	4.87	0.001128	1.97	1745.70
380.00	1530.00	3.80	0.05	5.14	0.001131	2.07	1826.69
400.00	1602.00	4.00	0.05	5.41	0.001134	2.16	1907.20
420.00	1668.00	4.20	0.06	5.68	0.001137	2.25	1980.09
440.00	1648.00	4.40	0.06	5.95	0.001140	2.22	1950.74

Sample 3

Deformation Dial Reading	Load Dial Reading	Sample Deformation, DL (mm)	Strain	% Strain	Corrected Area A' (m2)	Load (kN)	Stress (kPa)
0.00	0.00	0.00	0.00	0.00	0.001092	0.00	0.00
20.00	94.00	0.20	0.00	0.27	0.001095	0.13	115.85
40.00	131.00	0.40	0.01	0.54	0.001098	0.18	161.02

60.00	171.00	0.60	0.01	0.80	0.001101	0.23	209.62
80.00	254.00	0.80	0.01	1.07	0.001104	0.34	310.52
100.00	334.00	1.00	0.01	1.34	0.001107	0.45	407.22
120.00	415.00	1.20	0.02	1.61	0.001110	0.56	504.60
140.00	493.00	1.40	0.02	1.88	0.001113	0.67	597.81
160.00	572.00	1.60	0.02	2.15	0.001116	0.77	691.71
180.00	650.00	1.80	0.02	2.41	0.001119	0.88	783.88
200.00	726.00	2.00	0.03	2.68	0.001123	0.98	873.12
220.00	814.00	2.20	0.03	2.95	0.001126	1.10	976.26
240.00	883.00	2.40	0.03	3.22	0.001129	1.19	1056.09
260.00	961.00	2.60	0.03	3.49	0.001132	1.30	1146.19
280.00	1038.00	2.80	0.04	3.75	0.001135	1.40	1234.59
300.00	1110.00	3.00	0.04	4.02	0.001138	1.50	1316.55
320.00	1079.00	3.20	0.04	4.29	0.001141	1.46	1276.21