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Determination of the shrinking and swelling properties of the London Clay Formation: Laboratory Report

Physical Hazards Programme

Internal Report IR/06/058

BRITISH GEOLOGICAL SURVEY

PHYSICAL HAZARDS PROGRAMME

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Determination of the shrinking and swelling properties of the London Clay Formation: Laboratory Report

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Foreword

This report is a published product of a study by the British Geological Survey (BGS) into the shrinking and swelling of London Clay. This is a factual laboratory report showing the results of a suite of tests carried out on samples collected from the London Clay Formation of south-east UK. The study of the London Clay Formation is the fifth phase of the BGS project entitled "The shrinkage and swelling behaviour of UK clay soils", the others having dealt with the clays of the Gault Formation, the mudstones of the Mercia Mudstone Group, the clays of the Lambeth Group, and the Lias Group.

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Summary

This report describes the laboratory tests carried out as part of the British Geological Survey science budget project, into the shrinking and swelling of London Clay Formation. The report outlines the tests carried out and presents the factual results of these tests.

1 Introduction

The behaviour of clay rich geological formations in response to a change in moisture content is often exhibited as shrinking or swelling. The material is able to change volume with a change in effective stress potentially causing a geological hazard for engineering construction. These changes vary with clay content and composition and hence the geological formation.

The work described in this report comprises the fifth stage of a study of the swelling and shrinkage behaviour of major UK clay formations. The study deals with the testing of undisturbed and disturbed samples of the clay in a variety of ways, most of which follow internationally recognised British or American soil mechanics standards. The test methods applied can be broadly grouped into three categories: a) direct swelling tests, b) direct shrinkage tests, c) index tests. The tests resulting from the collection of samples is carried out in the Physical Properties Laboratories at the British Geological Survey (BGS).

The measured moisture content of the natural state of a soil at certain defined test conditions can provide an extremely useful method of classifying cohesive soils and assessing their engineering behaviour. These tests are *Index Properties* but are also known as the Atterberg Limits. The Atterberg Limits are related to the combined effects of particle size and mineral composition. The liquid limit and plastic limit provide the most useful way of identifying and classifying fine-grained soils. Particle size provides quantitative data on the range of sizes of particles and the percentage of clay size particles present. Further information is provided by the particle density test. The purpose of the index tests is to classify the soils and also to investigate correlations between index properties and direct swelling and shrinkage tests.

This phase of the study concentrates on the London Clay Formation of southern England. The London Clay Formation is present in two areas; the London Basin in the south-east, and the Hampshire Basin of the south coast and Isle of Wight. The two areas are what remain of one depositional basin now separated by periods of uplift and erosion (Curry, 1992). Both of these basins are not land limited and extend farther seawards, (the Hampshire Basin extending south-eastwards into the greater Dieppe Basin of the eastern section of the English Channel, and the London Basin being incorporated into the North Sea Basin. The locations of the sample sites visited for this report are given in Table 1 and a sketch map is presented as Figure 1. Twenty-one sites were visited and of those four sites were unsuitable for any form of sample collection (refer to Figure 1).

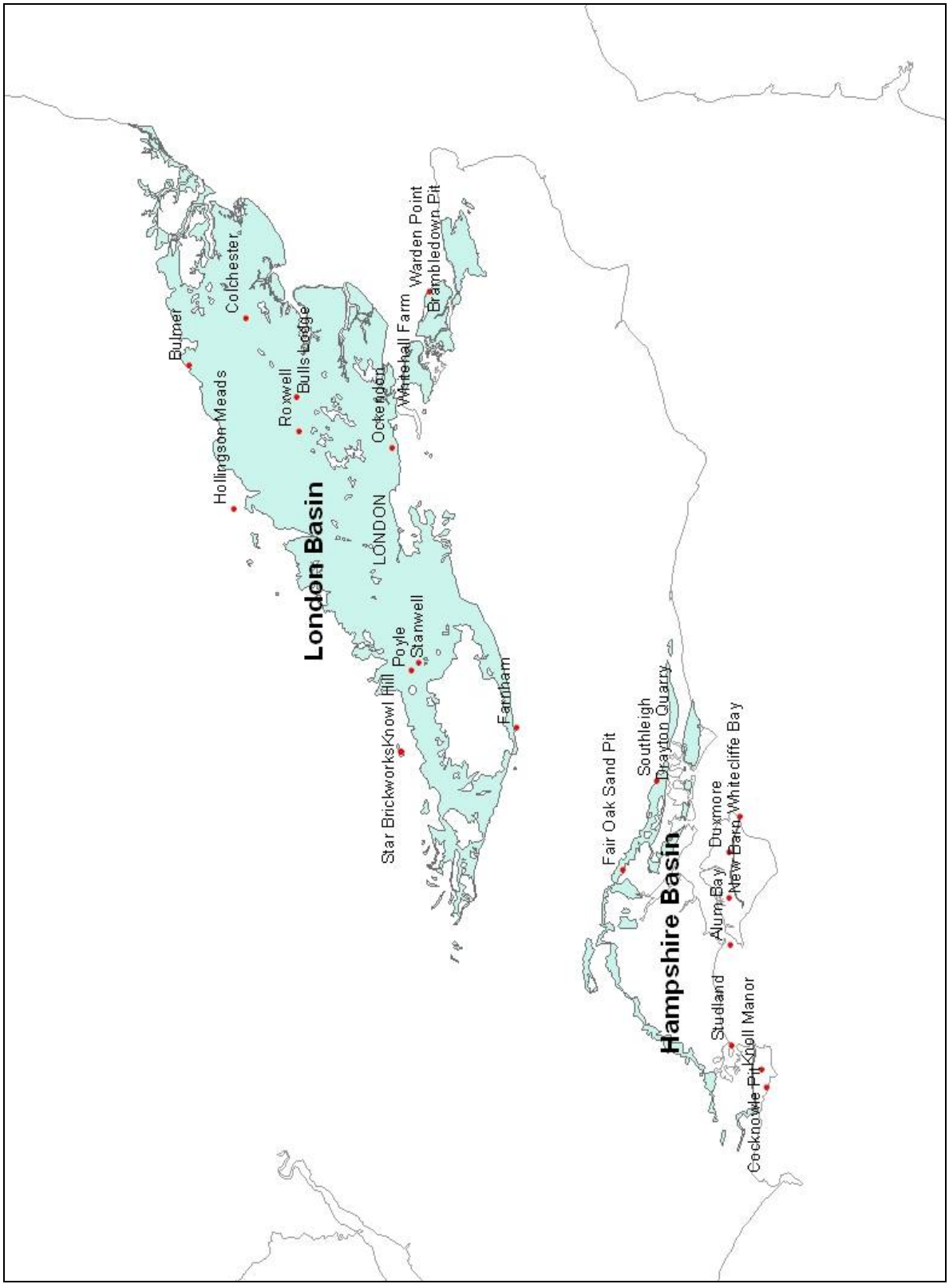
This report describes the test methodologies and the results for the above geotechnical tests used to determine the characteristics of the sampled formation. Oedometer consolidation tests were also carried out and are reported in a BGS internal report (Nelder and Jones, 2004). In addition to the test results reported here, research was also undertaken into the mineralogical and geochemical properties of the samples (Kemp & Wagner, 2006) and Scanning Electron Microscopy (Bouch, 2005). The microfossil data

are complete and published in three BGS internal reports (Wilkinson, 2004a, 2004b, 2005) and a peer reviewed article (Riding *et al.* 2006).

Table 1: Location of Sampling Sites

Name	Site Location (As previously reported)	Sample site	Type	Disturbed sample obtained for index testing	Undisturbed sample	Sample Information (* Samples taken from within Quarry sites. Therefore BGL refers to approximate below normal (non quarried) ground level surface)
Berkshire						
Star Brickworks	SU 816 797	481550 ,179600	Quarry	No	No	NO SAMPLES TAKEN
Knowl Hill	SU 816 795	481600, 179820	Quarry	Yes	Yes	Sample taken approximately 8m BGL*
Essex						
Bulmer	TL 832 382	583230, 238190	Quarry	Yes	Yes	Sample taken approximately 2m BGL*
Ockendon	TQ 614 820	560490, 183860	Quarry	Yes	Yes	S1 - Stiff blocky grey London Clay (unweathered) 10m BGL* S2 - Brown London Clay (weathered) 3m BGL*
Colchester	TL 955 226	595050, 222540	Quarry	Yes	Yes	Sample taken approximately 10m BGL*
Bulls Lodge	TL 747 085	574700, 208500	Quarry	Yes	Yes	Sample taken approximately 6m BGL*
Hollingson Meads Quarry	TL 453 126	545300, 212600	Quarry	Yes	Yes	Sample taken approximately 10m BGL*
Roxwell	TL 657 088	565590, 208660	Landfill	Yes	No	Sample from spoil heap (disturbed clay piled result of new cell construction)
Kent						
Grain Quarry (Whitehall Farm)	TQ 882 762	588200, 176200	Quarry	Yes	Yes	S1 - Brown London Clay (weathered) 3m BGL*; S2 - Grey/black London Clay (unweathered) 4m BGL*
Brambledown Clay Pit	TQ 967 715	596750, 171550	Clay Pit	Yes	Yes	Sample taken approximately 3m BGL*
Warden Point	TR 020 724	602100, 172480	Cliff Face	Yes	Yes	Sample taken approximately 1m above beach level.
Hampshire						
Fair Oak Sand Pit	SU 504 183	450142, 118509	Sand Pit	Yes	Yes	Sample taken approximately 3m BGL*
Surrey						
Southleigh	SU 739 087	473706, 108557	Landfill	Yes	No	Sample from disturbed clay spoil heap (clay pile result of new cell construction)
Farnham	SU 877 475	487750 147550	Quarry	Yes	No	Sample taken approximately 8m BGL*
Poyle	TQ 028 766	502702, 176710	Quarry	Yes	Yes	Sample taken approximately 3m BGL*
Stanwell	TQ 049 746	504890, 174745	Quarry	Yes	Yes	Sample taken approximately 4m BGL*
Sussex						
Drayton Quarry	SU 886 043	488600, 104300	Quarry	No	No	NO SAMPLES TAKEN
IOW						
Duxmore	SZ 650 875	465000, 087500	Quarry	No	No	NO SAMPLES TAKEN
Whitecliffe Bay	SZ 643 580	463970, 085890	Cliff Face	Yes	Yes	S1 - Lower Basement Beds; S2 - Higher up London Clay Succession precise cycle unknown. Samples taken approximately 1m above beach level.
New Barn	SZ 431 868	443100, 086800	Quarry	Yes	No	Sample taken approximately 2m BGL*
Alum Bay	SZ 307 853	430530, 085280	Cliff Face	Yes	Yes	S1 - Near Basement Beds; S2 - Higher up London Clay Succession precise cycle unknown. Sample taken approximately 1m above beach level.
Dorset						
Knoll Manor	SY 977 973	397700, 097300	Clay Pit	Yes	Yes	S1 - Blue/grey unweathered London Clay approximately 2m BGL; S2 - Stratified sandy deposits 2m BGL
Cocknowle Pit	SY 931 823	393100, 082300	Quarry	No	No	NO SAMPLES TAKEN
Studland	SZ 043 824	404167, 082430	Cliff Face	Yes	No	Sample taken approximately 1m above beach Level.

Figure 1: Sketch map of the London Clay Formation outcrop and visited sample sites



2 The London Clay

The London Clay Formation in southern England is confined to the London and Hampshire Basins. It has an extensive outcrop in the London Basin, due to the erosion of much of the overlying deposits. In the Hampshire Basin the outcrop is a narrow strip, less than 3km in width.

In the London Basin the total London Clay Formation thickness is between 90m in the west thickening to 130m in the east, the full thickness is only present in areas where the overlying Bagshot Formation occurs (Figure 2). In the Hampshire Basin the London Clay thickens from Alum Bay in the west (75m) to Whitecliff Bay in the east (142m). Much of the outcrop is covered by Quaternary deposits.

Period	Group	Formation	Thickness
PALAEOGENE	THAMES GROUP	BAGSHOT FORMATION sand, fine-grained with thin clay beds	10-25
		LONDON CLAY FORMATION clay, silty; fine sand clay at base. *Claygate Member*: interbedded sand and clay at top	90-130
		HARWICH FORMATION sand, clayey fine-grained sand and pebble beds	0-10
	LAMBETH GROUP	READING, WOOLWICH and UPNOR FORMATIONS: clay mottled with fine-grained sand, laminated clay, flint pebble beds and shelly clay	10-20

Figure 2: The Stratigraphy of the Palaeogene sequence above and below the London Clay Formation (Ellison, 2004)

The London Clay Formation varies in lithology, being dominantly argillaceous but containing layers with significant proportions of fine sand at the top and bottom of the sequence, and to the west. The term 'London Clay', used in this study, refers to the dominantly clay lithologies within the London Clay Formation. Based on major revisions of the London Clay Formation carried out by King (1981), and later by Ellison *et al.* (1994 & 2004), four informal lithostratigraphical units (Units A to D) and the formally named Claygate Member have now been recognised (Figure 3). Full lithological descriptions of the different Stratigraphical Units can be found in King 1981 and Ellison, 2004. Much of it is covered by a variable thickness of superficial deposits (Ellison, 2004).

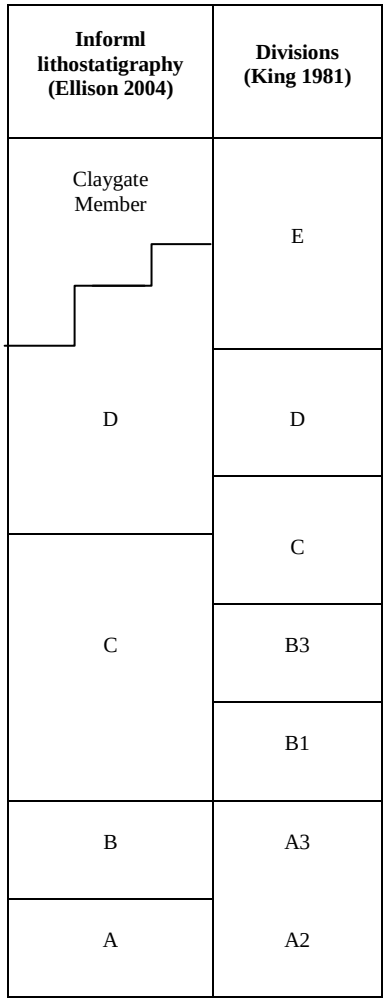


Figure 3: The stratigraphy of the London Clay as presented by Ellison (2004) and King (1981)

The London Clay Formation is of major importance in the fields of geotechnical engineering and engineering geology. It has had an important influence on the development of London's infrastructure particularly as it is a relatively homogeneous and easy tunnelling medium. It underlies most of the district and crops out extensively, except in the south-east where it has been removed by erosion.

3 Site location and Sample Location

The London Clay sites visited were located in two basins in the south of England; the London Basin and the Hampshire Basin. Samples were taken from both basins for comparison. Where possible a variety of samples were taken including undisturbed small tins, specifically for Scanning Electron Microscope (SEM) analysis, and a combination of bulk bag, disturbed and undisturbed cube and U100 tubes.

3.1 LONDON BASIN SAMPLING SITES

3.1.1 Star Brickworks

Star Brickworks (481550, 179600) was originally established as a brick and tile works during the 1820's with clay being extracted from the immediate area. This site is no longer in operation. No samples were taken at this location due to lack of London Clay exposure.

3.1.2 Knowl Hill

Knowl Hill quarry (481600, 179820) is an extension of the site of the Old Star Brickworks on the A4 between Maidenhead and Reading. It is owned by S Grundon Ltd. Its main site is concerned with clay extraction, as well as the removal of the over lying sand and gravels.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed grey unweathered clay at the base of the quarried area (Figure 4). Disturbed bag, SEM and undisturbed U100 tube samples of London Clay were taken at the base of the quarry approximately 8m below non-quarried ground level.

Figure 4: Sampling London Clay at Knowl Hill

3.1.3 Bulmer

Bulmer Brick Works (583230, 238190) is a small site located 5km south west of Sudbury and owned by Bulmer Brick and Tile Company Ltd. The site quarries London Clay in order to make its handmade bricks.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed grey unweathered clay at the base of the quarried area (Figure 5). Disturbed bag, SEM and undisturbed box samples of grey unweathered London Clay were taken approximately 2m below non-quarried ground level.

Figure 5: Unweathered London Clay at Bulmer Brick Works

3.1.4 Colchester

Located on the outskirts of Colchester Town, Colchester quarry (595050, 222540) is Tarmacs largest site in the East Anglia region. The deposits at the site comprise glacial sands and gravels which sit on top of the London Clay and the sites principle operation is sand and gravel extraction.

Disturbed bag, SEM and undisturbed block and box samples of grey unweathered London Clay (Figure 6) were taken approximately 10m below non-quarried ground level.

Figure 6: Sampling unweathered London Clay at Colchester Quarry

3.1.5 Ockendon

Ockendon quarry (560490, 183860) is located on the north eastern outskirts of Ockendon, Just off the M25. It is owned and run by Lafarge Cement Ltd. Its principle operation is the extraction of clays.

Permission was given to enter the newly worked area (Figure 7). Disturbed bag, SEM and undisturbed block samples of grey unweathered and brown weathered London Clay were taken approximately 10m and 3m respectively, below non-quarried ground level.

Figure 7: Sampling London Clay at Ockendon quarry

3.1.6 Bulls Lodge

Bulls Lodge quarry (574700, 208500) is located north west of the village of Boreham on the northern side of the A12, and is owned by Hanson Aggregates Ltd. Its principle operation is sand and gravel extraction.

Disturbed bag, SEM and undisturbed block samples of grey unweathered London Clay (Figure 8) were taken approximately 6m below non-quarried ground level

Figure 8: Sampling unweathered London Clay at Bulls Lodge quarry

3.1.7 Hollingson Meads

Hollingson Meads Quarry (545300, 212600) is located north of Harlow and the River Stort, close to the villages of Gilston and Pye Corner. The site is owned by Frank Lyons Plant Services and its principle operation is sand and gravel extraction.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed clay at the base of the quarried area (Figure 9). Disturbed bag, SEM, undisturbed U100 tube and box samples of grey unweathered London Clay were taken approximately 10m below non-quarried ground level

Figure 9: Sampling unweathered London Clay at Hollingson Meads Quarry

3.1.8 Roxwell

Roxwell landfill site (565590, 208660) is located in the village of Roxwell, Essex, on the A1060. It is owned by Lafarge Aggregates. The site has a long history of sand and gravel extraction and is a well established landfill.

Due to the location of working machinery to the undisturbed exposures at the time of visiting, access to undisturbed London Clay was not possible. Permission was granted to take disturbed bag and SEM samples of unweathered London Clay from a large spoil heap resulting from the construction of a new cell (Figure 11).

Figure 10: Sampling from a spoil heap of unweathered London Clay at Roxwell landfill site

3.1.9 Grain Quarry (Whitehall Farm)

Grain Quarry (Whitehall Farm) (588200, 176200) comprises an area near the coast to the northwest of Grain village and it is accessed along an existing access track through an area of former sand and gravel extraction. The site has been used for the extraction of clay since approximately 1981, however this site is not continually in operation and is worked as and when need arises.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed clay at the base of the quarried area (Figure 12). Disturbed bag, SEM, undisturbed U100 tube and box samples of grey unweathered and brown weathered London Clay were taken approximately 4m and 3m respectively, below non-quarried ground level.

Figure 11: Sampling unweathered London Clay at Grain Quarry (Whitehall Farm)

3.1.10 Brambledown Clay Pit

Brambledown Clay Pit (596750, 171550) is a clay quarry and landfill site (Norwood Landfill) owned by Waste Recycling Group Ltd. The site is located between Lower Road (B2231) and Eastchurch Road (B2008), on the Isle of Sheppey Kent.

Disturbed bag, SEM, undisturbed U100 tube and box samples of grey unweathered London Clay were taken approximately 3m below non-quarried ground level (Figure 12).

Figure 12: Sampling London Clay at Brambledown Clay Pit

3.1.11 Warden Point

Warden Point (602100, 172480) is found on the North Eastern Edge of the Isle of Sheppey is a coastal cliff section with exposed outcropping London Clay. The area is an important World War II defence site located on a section of rapidly eroding coastline, with London Clay landslides and mudflows forming the cliffs down to beach level (Figure 13).

Disturbed bag and SEM samples of grey unweathered London Clay were taken approximately 38m below cliff top level (1m above beach level at the time of visit). No undisturbed samples were taken as the site is completely affected by landsliding.

Figure 13: The London Clay coastal cliffs of Warden Point

3.1.12 Southleigh

Southleigh waste disposal site (473706, 108557) is located to the north-east of Havant and is run by Onyx UK Ltd.

Due to the location of working machinery to the undisturbed exposures at the time of visiting, access to undisturbed London Clay was not possible. Permission was granted to take disturbed bag and SEM samples of unweathered London Clay (Figure 14) from a large spoil heap resulting from the construction of a new cell.

Figure 14: Sampling of London Clay from a spoil heap at Southleigh quarry

3.1.13 Farnham

Farnham quarry (487750, 147550) is located adjacent to Aldershot on the Surrey/Hampshire border. Sand and gravel is extracted to a depth of 4-5m over the 50 ha site. The site is owned and run by Hanson Aggregates Ltd.

Disturbed bag, SEM and undisturbed block samples of grey unweathered London Clay were taken approximately 8m below non-quarried ground level (Figure 15).

Figure 15: Farnham sand and gravel quarry

3.1.14 Poyle

Poyle quarry (502702, 176710) is located in the town of Poyle close to the M25. The site is owned by RMC Aggregates and is a sand and gravel quarry.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed clay at the base of the quarried area (Figure 16). Disturbed bag, SEM and undisturbed U100 tube and box samples of London Clay were taken approximately 3m below non-quarried ground level

Figure 16: Sampling London Clay at Poyle quarry

3.1.15 Stanwell

Stanwell quarry (504890, 174745) is located just north of Stanwell, west of Heathrow Airport adjacent to the M25. The site is owned by RMC Aggregates.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed clay at the base of the quarried area. Disturbed bag, SEM and undisturbed block samples of grey unweathered London Clay (Figure 17) were taken approximately 8m below non-quarried ground level.

Figure 17: Sampling London Clay at Stanwell quarry

3.1.16 Drayton Quarry

The Drayton sand and gravel quarries (488600, 104300) lie to the southeast of Chichester in West Sussex. Working has ceased and a restoration scheme enabled the return of the site to habitats of high nature conservation value. No samples were taken at this time due to the lack of London Clay exposure.

3.2 HAMPSHIRE BASIN SAMPLING SITES

3.2.1 Fair Oak Sandpit

Fair Oak Sandpit (450142, 118509) is a sand extraction pit located to the East of Fair Oak, Hampshire, and owned by Sita Environmental.

Assistance from the site managers and machinery was obtained in order to clear a small area of undisturbed clay at the base of the quarried area. Disturbed bag, SEM and undisturbed U100 tube and box samples of grey unweathered London Clay were taken approximately 3m below non-quarried ground level

Figure 18: Sampling at Fair Oak Sandpit

3.2.2 Duxmore

Duxmore (455000, 087500) is an abandoned chalk quarry visited on the Isle of Wight.

No samples were taken at this time due to lack of exposure.

3.2.3 New Barn

New Barn (443100, 086800) is the site of an old chalk pit.

Extremely poor weathered and disturbed samples of Clay were taken approximately 2m below non-quarried ground level. However on closer inspection these were deemed not to be London Clay and therefore not considered further for testing.

3.2.4 Whitecliff Bay

The London Clay Formation outcrops in the east of the Isle of Wight in the coastal cliffs of Whitecliff Bay (463970, 085890).

Disturbed bag and SEM samples of grey unweathered London Clay were taken from the Cliff face 1m above the beach level at the time of visiting (Figure 19). This equates to approximately 47m below ground level.

Figure 19: Sampling the London Clay at Whitecliff Bay

3.2.5 Alum Bay

The London Clay Formation outcrops in the west of the Isle of Wight in the coastal cliffs of Alum Bay (430530, 085280).

Disturbed bag, SEM and undisturbed box samples of grey unweathered London Clay (Figure 20) were taken from the Cliff face at two locations 1m and 2m above the beach level at the time of visiting. This equates to approximately 65m and 64m below ground level.

Figure 20: Sampling London Clay at Alum Bay

3.2.6 Knoll Manor

Knoll Manor (397700, 097300) in Dorset is owned by Pilkington Brick and Tiles Ltd. The sites principal business is clay extraction for brick making.

Disturbed bag, SEM and undisturbed box samples of grey unweathered London Clay (Figure 21) were taken approximately 2m below non-quarried ground level. Further samples of a stratified sandy layer were also taken for future study if required.

Figure 21: Sampling London Clay at Knoll Manor

3.2.7 Cocknowle Pit

Cocknowle Pit (393100, 082300) is a chalk quarry in Dorset. The site was visited in case an exposure of the London Clay Formation could be identified.

No samples were taken at this time due to a lack of exposure

3.2.8 Studland

The London Clay Formation outcrops in Dorset at the northern end of Studland Bay (404167, 082430). The cliffs and beaches in this area are managed by the National Trust.

Disturbed bag, SEM and undisturbed box samples of grey unweathered London Clay were taken from the Cliff face at 1m above the beach level at the time of visiting (Figure 22). This equates to approximately 8m below ground level.

Figure 22: Sampling London Clay at Studland Bay

4 Definitions & methodologies

The definitions below are based upon those given by BS 1377: Part 1: 1990 (Anon, 1990a). All testing has been carried out using methods provided by BS 1377: Part 2: 1990 (Anon, 1990b) with some alterations as appropriate.

4.1 MOISTURE CONTENT

The moisture content of a soil is assumed to be the amount of water within the pore space between the soil grains. This pore water is removable by oven drying at 105^{o}, and expressed as a percentage of the mass of dry soil.

The moisture content data from the samples were determined at their natural moisture content from the 'disturbed' bag samples collected from each site, on shavings from 'undisturbed' samples used for other tests, and as part of tests carried out on other 'undisturbed' samples. The procedure followed was identical to that described in Anon (1990b, Test 3.2), the determination of moisture content by the oven drying method.

4.2 LIQUID LIMIT

Determinations of the liquid limit (LL) of a soil are carried out on the fraction passing through a 0.425mm sieve. The LL is the moisture content at which a soil passes from the the plastic state to the liquid state, which then behaves like a viscous liquid. This is as determined by the British Standard liquid limit test.

The liquid limit samples were taken at their natural moisture content from the 'disturbed' bag samples collected from each site. The procedure followed was identical to that described in Anon (1990b, Test 4.3), the cone penetrometer (definitive) method of determining the liquid limit.

4.3 PLASTIC LIMIT

The plastic limit is the moisture content at which a soil becomes too dry to be in a plastic condition. Determinations of the plastic limit (PL) of a soil are carried out on the fraction passing through a 0.425mm sieve, by the British Standard plastic limit test.

The plastic limit and plasticity index of the samples were determined at the same time as the liquid limit, using the same samples. The procedure followed was identical to that described in Anon (1990b, Test 5), the determination of the plastic limit, and (Test 5.4) the derivation of the plasticity index.

4.4 PLASTICITY INDEX

The plasticity index (PI) is calculated using the formula below:

$$PI = Liquid\ Limit - Plastic\ Limit$$

4.5 LIQUIDITY INDEX

The liquidity index (LI) is calculated using the formula below:

$$LI = \frac{Natural\ Moisture\ content - Plastic\ Limit}{Plasticity\ Index}$$

4.6 LINEAR SHRINKAGE

The measurement of linear (one-dimensional) shrinkage of fine-grained soils is found by determining the change in length of a semi- circular bar sample of soil when it dries out, starting from near the liquid limit. The test gives the percentage linear shrinkage of a soil.

The standard B. S. method was used for analysis. The linear shrinkage of the samples was determined at the same time as the liquid limit, using the same samples. The procedure followed was identical to that described in (Anon 1990b, Test 6.5), the determination of shrinkage characteristics by linear shrinkage.

4.7 PARTICLE DENSITY

The average mass per unit of volume of solid particles in a sample of soil, where the volume includes any sealed voids contained within the solid particles.

The standard B. S. method was used for analysis. The particle density samples were taken at their natural moisture content from the ‘disturbed’ bag samples collected from each site, and then oven dried. The procedure followed was identical to that described in Anon (1990b, Test 8.3), the determination of particle density by the small pyknometer method.

4.8 PARTICLE SIZE DISTRIBUTION

The particle size analysis shows the percentages of the various grain sizes within the soil as determined by sieving and sedimentation. The samples were taken at their natural moisture content from the ‘disturbed’ bag samples collected from each site. Fine fraction analysis in this project is undertaken using the Micrometrics Sedigraph; therefore there are two main procedures in determining the particle size distribution:

4.8.1 Wet sieving method

The procedure followed was identical to that described in Anon (1990b, Test 9.2), the wet sieving method. After oven drying, the sieve spacing used for analysis of the coarse fraction retained on the 0.063 mm sieve was 0.5Φ to 8.0 mm (-3 Φ) and then as required for larger particles.

4.8.2 Micrometrics Sedigraph analysis of the fine fraction

A 5 g, oven dried, sub-sample was selected from the <0.063 mm washings of the whole sample and mixed with a 0.05% solution of sodium hexametaphosphate to form a suspension. The suspension analysed by the X-ray Sedigraph, the results of which were then integrated with the coarse analysis. The X-ray Sedigraph system was calibrated with a garnet standard prior to testing.

4.9 THREE-DIMENSIONAL SWELLING STRAIN

The three-dimensional swelling strain samples were taken at their natural moisture content from the 'undisturbed' samples collected from each site. The samples were cube-shaped, with all dimensions 50 mm.

The procedure followed was identical to that described in Brown E. T. (ed., 1981, Part 2, Test 3), the suggested method for determination of the swelling strain developed in an unconfined specimen with one exception. The cell assembly is not the same as the one specified, but was designed in the Engineering Geology and Geophysics Group (EGGG) of the British Geological Survey.

Both cells carry out the same operation but their geometry is different. The EGGG cell is oriented so that the three orthogonal sides of the sample are inclined to the horizontal. This enables all three dial gauges to be above the water level in the cell. This means that the waterproof seals present in the original cell are not required for the dial gauges thus reducing errors in the dial gauge readings, due to sticking.

4.10 ONE-DIMENSIONAL SWELLING STRAIN

The one-dimensional swelling strain samples were taken at their natural moisture content, and also at air-dried moisture content, from the 'undisturbed' samples collected from each site. The samples were cylindrical in shape, with a diameter of 6.35mm (2.5 inches) and a length of 16 mm. This length was trimmed so that it was 3 mm less than the original 19 mm long ring, to allow for swelling to occur, within confinement of the ring.

The procedure followed was identical to that described in Anon (1995, Section 4 Construction, Test D 4546, Method A), the standard test method for one-dimensional swell, with one exception. The sample was not loaded after primary swell was complete, but was allowed to finish swelling entirely.

5 Results

5.1 INDEX TESTS

These consist of the moisture content, liquid limit (LL), plastic limit (PL) and plasticity index (PI) test procedures. The index test results shown in Table 2 were all taken at the samples natural moisture content, without pre-drying. The results show that the moisture contents of all 24 samples are fairly similar, with an overall variance of 23.8 %. However, the majority of samples have a moisture content between 20% and 30%. The highest moisture content was recorded in the sample from Brambledown Clay Pit at 35.1%. The lowest was recorded from the cliff face at Studland bay.

The results show that the LL results for all samples have a variance of 57.7 %. The values are slightly higher in the London Basin than the Hampshire, with Knoll Manor (Site 2) in the Hampshire Basin providing the lowest LL of 32% and Colchester in the London Basin the highest of 90.4%.

The PL results are fairly similar for all sites in the London basin, with samples showing a PL of between 21.8% and 36.5%. The PL for the samples from the Hampshire Basin are slightly lower with a range of 16.6% to 28.7%. Over the suite of samples the Plasticity Index results vary by 42.3%

5.2 PARTICLE DENSITY

These results (Table 3) consist of the determination of the particle density procedure. The results show that all twenty-four tested samples have very similar particle densities, within the range of 2.68 – 2.84 Mg/m^3 for the London Basin and a range of 2.64 – 2.74 Mg/m^3 for the Hampshire Basin.

Table 2: Index Test Results

Sample Site	Natural MC %	LL bs (%)	PL bs (%)	PI bs (%)	LI
LONDON BASIN					
Brambledown	35.1	80	36.2	43.8	-0.025
Bulls Lodge	26.7	83	25.5	57.5	0.0217
Bulmer	29.5	48.0	21.8	26.2	0.2932
Colchester S1	28.0	90.4	36.5	53.9	-0.157
Farnham	20.5	72.0	26.6	45.4	-0.134
Grain Quarry S1	28.1	73.9	27.7	46.2	0.0078
Grain Quarry S2	28.0	86.2	28.5	57.7	-0.008
Hollingson	18.6	55.0	25.7	29.3	-0.244
Knowl Hill	31.4	74	28.0	46.0	0.0742
Ockendon S1	28.3	75.8	27.0	48.8	0.0263
Ockendon S2	32.0	68.2	35.8	32.4	-0.119
Poyle	30.5	79.0	34.4	44.6	-0.09
Roxwell	28.6	81.0	36.1	44.9	0.057
Stanwell	27.4	75.0	35	40	-0.191
Warden Point	25.4	83.2	35.2	48	-0.203
HAMPSHIRE BASIN					
Alum Bay S1	17.1	44..2	28.7	15.5	-0.75
Alum Bay S2	19.1	44.4	26.0	18.4	0.374
Fair Oak Sand Pit	26.0	47.1	20.4	26.7	0.2095
Knoll Manor S1	25.6	34	18.5	15.5	0.459
Knoll Manor S2	17.8	32.7	16.6	16.1	0.0735
Southleigh	27.5	66.9	27.1	39.8	0.0108
Studland	11.3	36.2	12.3	23.9	-0.043
Whitecliff Bay S1	18.8	34.6	19.2	15.4	-0.027
Whitecliff Bay S2	14.6	56.7	22.3	34.4	-0.223

Key:

LL Liquid Limit Test PL Plastic Limit Test PI Plasticity Index

LI Liquidity Index bs British Standard Hand Mix

Table 3: Particle Density Results

Sample Site	Particle Density (Mg/m^3)
LONDON BASIN	
Brambledown	2.72
Bulls Lodge	2.84
Bulmer	2.69
Colchester S1	2.76
Farnham	2.75
Grain Quarry S1	2.75
Grain Quarry S2	2.73
Hollingson	2.68
Knowl Hill	2.74
Ockendon S1	2.71
Ockendon S2	2.73
Poyle	2.75
Roxwell	2.74
Stanwell	2.77
Warden Point	2.76

Sample Site	Particle Density (Mg/m^3)
HAMPSHIRE BASIN	
Alum Bay S1	2.70
Alum Bay S2	2.70
Fair Oak Sand Pit	2.70
Knoll Manor S1	2.73
Knoll Manor S2	2.68
Southleigh	2.74
Studland	2.64
Whitecliff Bay S1	2.73
Whitecliff Bay S2	2.74

5.3 PARTICLE SIZE DISTRIBUTION

The particle size distribution results (Table 4) were all determined from an initial mass. The results from the coarse fraction sieving analysis and the fine fraction Sedigraph analysis have been combined to produce percentages of gravel, sand, silt and clay, and full distribution curves for each of the twenty-four samples.

Samples from Knowl Hill in the London Basin and Knoll Manor from the Hampshire basin were the only two samples recording a gravel fraction although negligible (0.2% and 1.7% respectively). The remaining twenty-two samples all show the gravel fraction content to be 0%.

Only two of the London Basin samples contained over 10% sand, these being Bulmer (16.4%) and Hollingson (34.4%). The majority recoded a sand percentage of less than 1%. In contrast, only two sample from the Hampshire Basin displayed a sand percentage of under 10%, Southleigh (1.7%) and Whitecliff Bay S2 (3.8%). The sample with the highest sand content was from Studland Bay giving a result of 49.1% sand.

The sample from Studland displays the lowest silt content with a result of 13.2%.

The percentage of clay per sample was higher in the London Basin samples than in those from the Hampshire Basin. Warden Point provided the sample with the highest clay content over – 72.4%.

5.4 SHRINKAGE TESTS

This consists of the determination of linear shrinkage, the results are shown in Table 5. Linear shrinkage was determined at the point nearest its liquid limit, without pre-drying.

All but two of the twenty-four samples display a linear shrinkage of between 9 % and 21%. The samples from the Hampshire Basin are between 9% and 16% with a value of 6% recorded for Studland Bay. The London Basin samples generally fall within a range of 13% to 20% with samples from Bulmer and Bulls Lodge recording 10% and 28% respectively.

Table 4: Particle Size Distributions

	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
LONDON BASIN				
Brambledown	43.8	50.8	5.3	0
Bulls Lodge	57.4	41.9	0.6	0
Bulmer	56.4	43.6	0	0
Colchester S1	63.1	36.6	0.3	0
Farnham	59.1	40.6	0.3	0
Grain Quarry S1	39.8	59.9	0.3	0
Grain Quarry S2	66.1	33.0	0.9	0
Hollingson	38.8	26.8	34.4	0
Knowl Hill	66.8	30.3	2.7	0.2
Ockendon S1	66.6	33.3	0.1	0
Ockendon S2	57.2	39.4	3.4	0
Poyle	67.3	32.3	0.4	0
Roxwell	65.1	34.6	0.3	0
Stanwell	68.4	31.2	0.4	0
Warden Point	72.4	27	0.6	0
HAMPSHIRE BASIN				
Alum Bay S1	31	27.6	41.3	0
Alum Bay S2	28.7	45.5	25.8	0
Fair Oak Sand Pit	24.4	39.7	35.9	0
Knoll Manor S1	22.9	46	31.1	0
Knoll Manor S2	45.1	37.2	16	1.7
Southleigh	51.4	46.9	1.7	0
Studland	37.6	13.2	49.1	0
Whitecliff Bay S1	30.3	38.5	31.2	0
Whitecliff Bay S2	46.2	50	3.8	0

Table 5: Shrinkage Test Results

Sample Site	Linear Shrinkage (%)
LONDON BASIN	
Brambledown	21
Bulls Lodge	28
Bulmer	10
Colchester S1	19
Farnham	15
Grain Quarry S1	17
Grain Quarry S2	15
Hollingson	14
Knowl Hill	14
Ockendon S1	16
Ockendon S2	17
Poyle	13
Roxwell	16
Stanwell	13
Warden Point	20

Sample Site	Linear Shrinkage (%)
HAMPSHIRE BASIN	
Alum Bay S1	9
Alum Bay S2	10
Fair Oak Sand Pit	10
Knoll Manor S1	11
Knoll Manor S2	12
Southleigh	15
Studland	13
Whitecliff Bay S1	6
Whitecliff Bay S2	16

5.5 SWELLING TESTS

These consist of three-dimensional swelling strain, one-dimensional swelling pressure and, one-dimensional swelling strain. They were carried out on undisturbed samples.

Table 6: 3-D Swell Strain Results

	e_1	e_2	e_3	**3-D Strain Vol. max (%)**
LONDON BASIN				
Brambledown	1.796	0.306	1.196	3.329
Farnham	3.790	3.210	1.756	9.003
Hollingson	1.446	0.772	0.864	3.112
Knowl Hill	3.432	1.578	1.820	6.976
Ockendon S1	0.576	0.190	0.162	0.930
Poyle	2.838	1.210	0.886	5.005
Stanwell	3.268	1.770	2.502	7.725
HAMPSHIRE BASIN				
Fair Oak Sand Pit	0.466	0.220	0.408	1.098
Knoll Manor S1	0.044	0.028	0.036	0.108

Key:

e_1 Maximum Swelling Strain (Vertical) e_2 Maximum Swelling Strain (Horizontal)

e_3 Maximum Swelling Strain (Horizontal) Vol. Maximum Volumetric Strain

Table 7: 1-D Strain Results

	1-D Strain emax (%)	Nat MC value (%)
LONDON BASIN		
Brambledown	1.70	35.78
Bulmer	0.06	41.56
Colchester S1	8.85	26.59
Farnham	0.55	13.04
Hollingson	1.12	25.37
Knowl Hill	4.14	28.93
Ockendon S1	0.53	32.07
Poyle	3.94	29.60
Stanwell	7.43	25.33
HAMPSHIRE BASIN		
Fair Oak Sand Pit	0.26	22.13
Knoll Manor S1	0.00	21.01
Studland	0.58	10.93

Table 8: 1-D Pressure Results

	N/m^2	Nat MC value (%)
LONDON BASIN		
Brambledown	5301	34.77
Bulls Lodge	24176	23.77
Colchester S1	38286	26.79
Farnham	69926	19.94
Hollingson	3364	24.91
Ockendon S1	1968	33.92
Poyle	12991	31.83
Stanwell	48461	26.45
HAMPSHIRE BASIN		
Fair Oak Sand Pit	3947	21.43
Knoll Manor S1	296	23.01
Knoll Manor S2	1772	13.49
Studland	3937	11.40

6 Conclusions

This report presents the factual results the geotechnical tests carried out as part of the British Geological Survey science budget research project into the shrinking and swelling of London Clay Formation.

Further work will be carried out on the results and a technical report on the shrink–swell of the London Clay Formation Clay will published in the near future.

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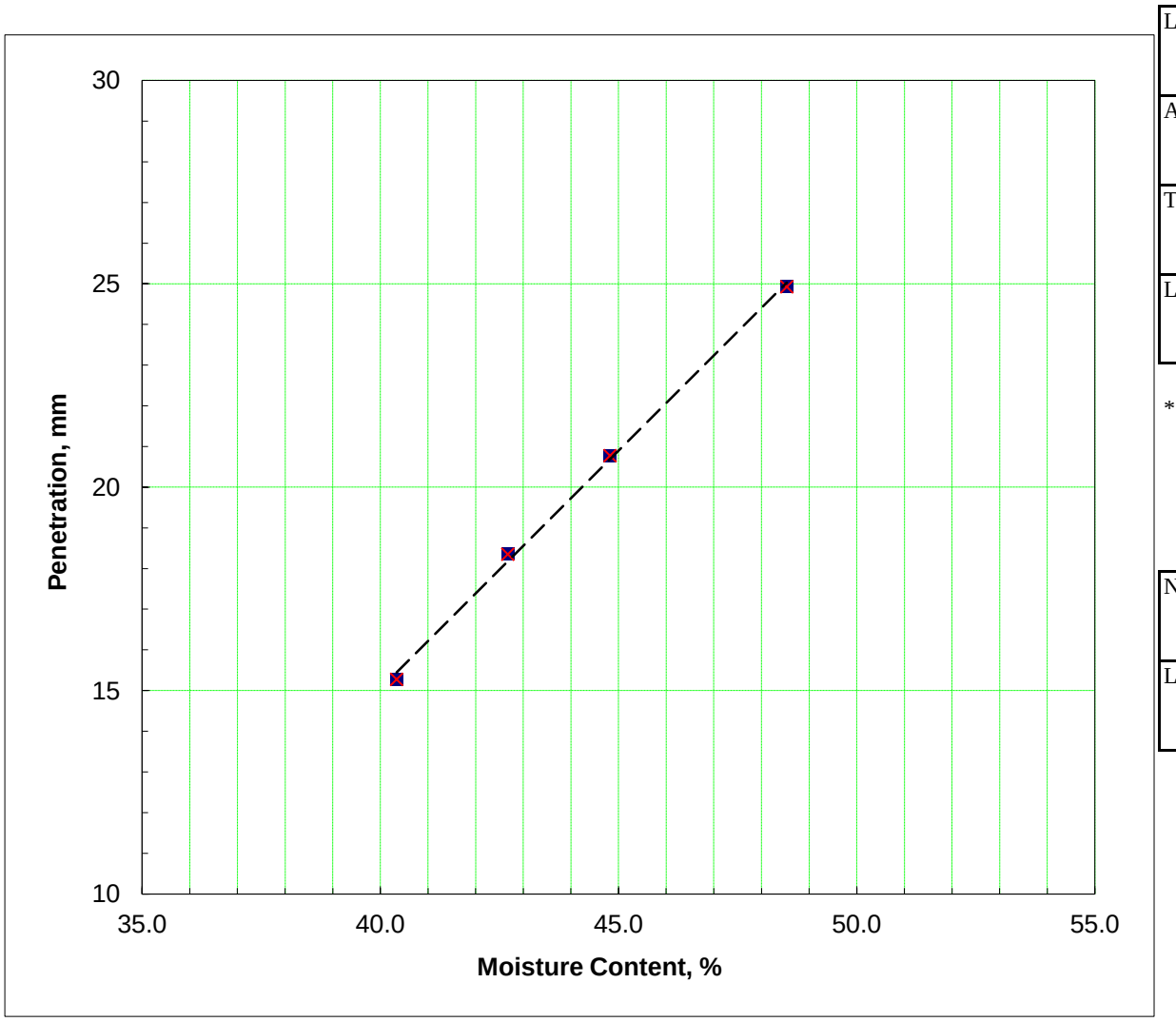
Appendix 1 - Index Test Data

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Alum Bay 1**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	15.30	18.30	20.65	24.75		
(or other M.C. test if stated)	15.25	18.40	20.90	25.10		
	15.275	**18.35**	**20.775**	**24.925**		
CONTAINER	**13**	**14**	**15**	**16**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	30.57	28.00	31.88	30.30	*12.65*	*12.60*
WT. OF DRY SOIL + CONTAINER, g	25.43	23.37	26.03	24.53	*31.05*	*24.93*
WT. OF CONTAINER, g	12.71	12.53	12.99	12.64	*26.96*	*22.17*
WT. OF MOISTURE, g	5.14	4.63	5.85	5.77	4.09	2.76
WT. OF DRY SOIL, g	12.73	10.84	13.04	11.89	14.31	9.57
MOISTURE CONTENT, %	**40.3**	**42.7**	**44.8**	**48.5**	28.6	28.8



Liquid Limit, % ;
44.2

* Plastic Limit, % ;
28.7

Plasticity Index, % ;
15.5

Linear Shrinkage, % ;
8.5

At M.C., % ;
42.7

Trough No. ;
D

Length Dry ;
128.1

* Some Cracks before
3 mm

Nat Moisture Content ;
17.1

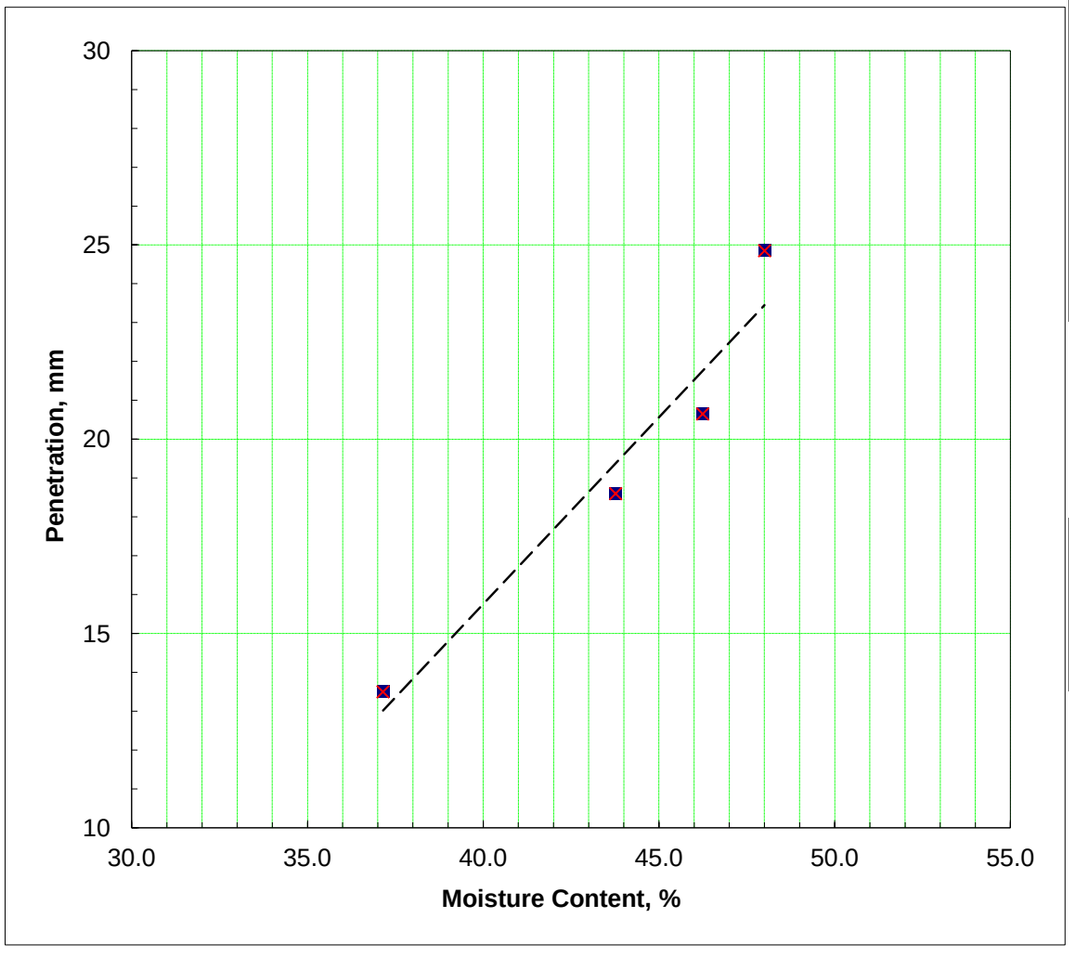
Liquidity Index ;
-0.75

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Alum Bay 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.30	18.40	20.60	24.95		
(or other M.C. test if stated)	13.70	18.80	20.70	24.75		
	13.5	**18.6**	**20.65**	**24.85**		
CONTAINER	**9**	**10**	**11**	**12**	**I**	**II**
WT. OF WET SOIL + CONTAINER, g	32.59	31.16	35.54	30.82	*12.98*	*12.61*
WT. OF DRY SOIL + CONTAINER, g	27.26	25.57	28.29	24.96	*36.34*	*32.30*
WT. OF CONTAINER, g	12.91	12.79	12.61	12.77	*31.53*	*28.23*
WT. OF MOISTURE, g	5.33	5.59	7.25	5.86	4.81	4.07
WT. OF DRY SOIL, g	14.35	12.78	15.68	12.20	18.55	15.62
MOISTURE CONTENT, %	**37.1**	**43.8**	**46.2**	**48.0**	25.9	26.1



Liquid Limit, % ;
44.4

* Plastic Limit, % ;
26.0

Plasticity Index, % ;
18.4

Linear Shrinkage, % ;
10.1

At M.C., % ;
46.2

Trough No. ;
G

Length Dry ;
125.8

* Some Cracks before
3 mm

Nat Moisture Content ;
19.1

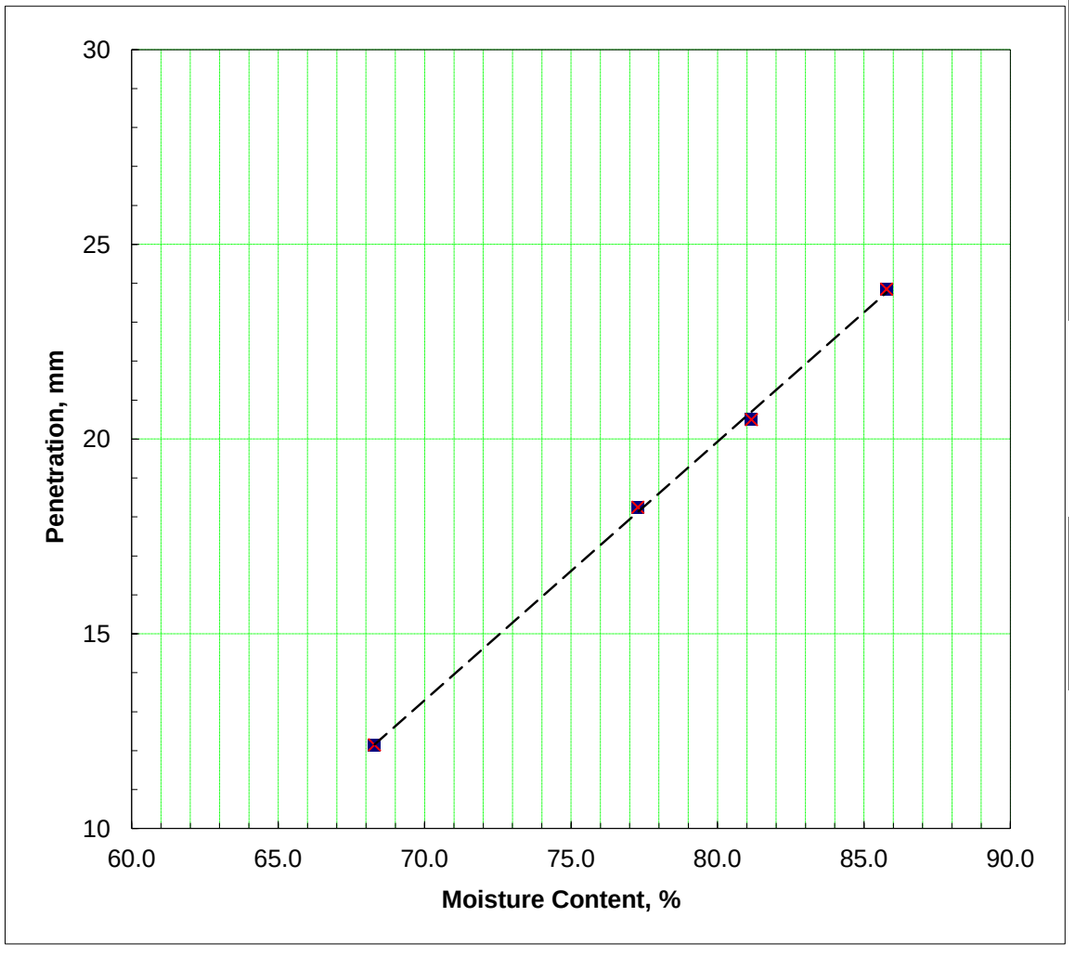
Liquidity Index ;
-0.374

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Brambledown**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.20	18.10	20.60	23.90		
(or other M.C. test if stated)	12.10	18.40	20.40	23.80		
	12.15	**18.25**	**20.5**	**23.85**		
CONTAINER	**25**	**26**	**27**	**28**	**XV**	**XV1**
WT. OF WET SOIL + CONTAINER, g	23.24	20.48	20.79	23.50	*12.56*	*12.59*
WT. OF DRY SOIL + CONTAINER, g	19.01	17.13	17.14	18.50	*28.88*	*24.13*
WT. OF CONTAINER, g	12.81	12.80	12.65	12.67	*24.56*	*21.05*
WT. OF MOISTURE, g	4.23	3.35	3.65	5.00	4.32	3.08
WT. OF DRY SOIL, g	6.20	4.34	4.50	5.83	12.00	8.46
MOISTURE CONTENT, %	**68.3**	**77.3**	**81.2**	**85.8**	36.0	36.4



Liquid Limit, % ;
80.0

* Plastic Limit, % ;
36.2

Plasticity Index, % ;
43.8

Linear Shrinkage, % ;
21.2

At M.C., % ;
81.2

Trough No. ;
H

Length Dry ;
110.4

* Some Cracks before
3 mm

Nat Moisture Content ;
35.1

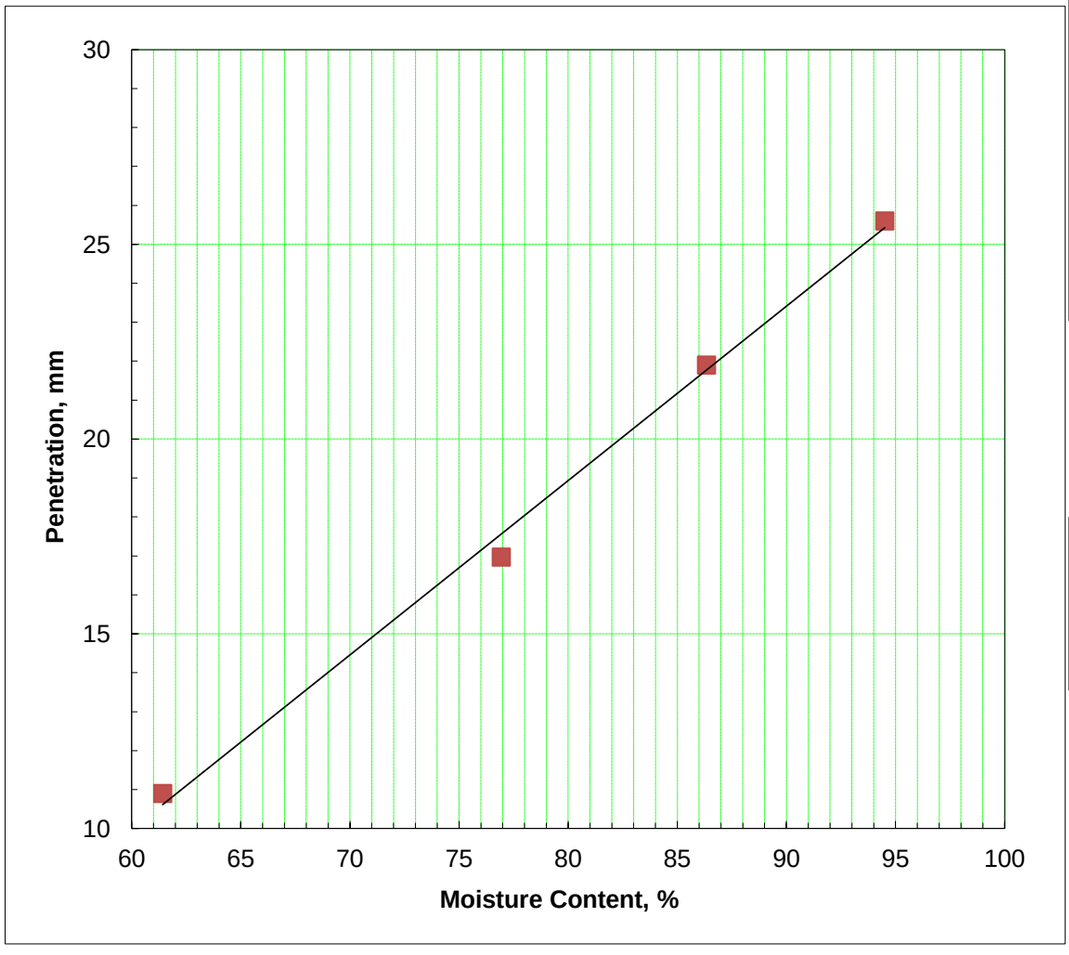
Liquidity Index ;
-0.025

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	M. Kirkham
SAMPLE NO. :		DATE :	
SITE :	**Bulls Lodge**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm (or other M.C. test if stated)	10.90	16.97	21.90	25.60		
	10.90	16.97	21.90	25.60		
CONTAINER	**5**	**6**	**7**	**8**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	12.61	12.63	12.62	12.56	13.14	13.94
WT. OF DRY SOIL + CONTAINER, g	23.99	25.44	25.85	31.68	11.41	12.19
WT. OF CONTAINER, g	19.66	19.87	19.72	22.39	4.54	5.36
WT. OF MOISTURE, g	4.33	5.57	6.13	9.29	1.74	1.75
WT. OF DRY SOIL, g	7.05	7.24	7.10	9.83	6.86	6.83
MOISTURE CONTENT, %	**61.4**	**76.9**	**86.3**	**94.5**	25.3	25.6



Liquid Limit, % ;
83

* Plastic Limit, % ;
25.5

Plasticity Index, % ;
57.5

Linear Shrinkage, % ;
27.5

At M.C., % ;
86.3

Trough No. ;
A

Length Dry ;
101.5

* Some Cracks before
3 mm

Nat Moisture Content ;
26.7

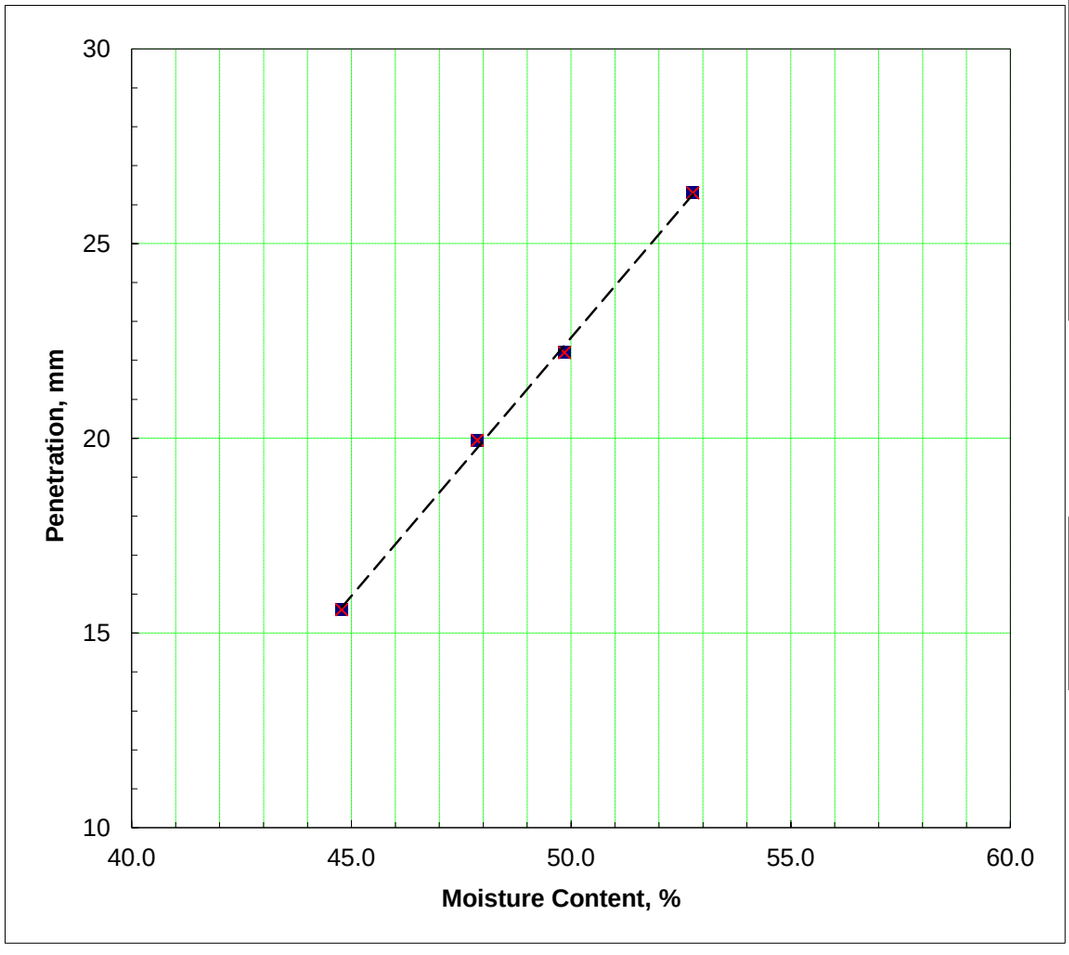
Liquidity Index ;
0.0217

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Bulmer 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	15.70	20.10	22.00	26.10		
(or other M.C. test if stated)	15.50	19.80	22.40	26.50		
	15.6	**19.95**	**22.2**	**26.3**		
CONTAINER	**17**	**18**	**19**	**20**	**X**	**XI**
WT. OF WET SOIL + CONTAINER, g	28.15	22.27	22.07	22.29	14.38	11.46
WT. OF DRY SOIL + CONTAINER, g	23.34	19.18	18.93	18.97	12.82	10.32
WT. OF CONTAINER, g	12.60	12.71	12.64	12.67	5.49	5.23
WT. OF MOISTURE, g	4.81	3.09	3.14	3.32	1.55	1.15
WT. OF DRY SOIL, g	10.74	6.46	6.30	6.29	7.33	5.09
MOISTURE CONTENT, %	**44.8**	**47.9**	**49.8**	**52.8**	21.2	22.5



Liquid Limit, % ;
48.0

* Plastic Limit, % ;
21.8

Plasticity Index, % ;
26.2

Linear Shrinkage, % ;
10.2

At M.C., % ;
49.8

Trough No. ;
E

Length Dry ;
125.8

* Some Cracks before
3 mm

Nat Moisture Content ;
29.5

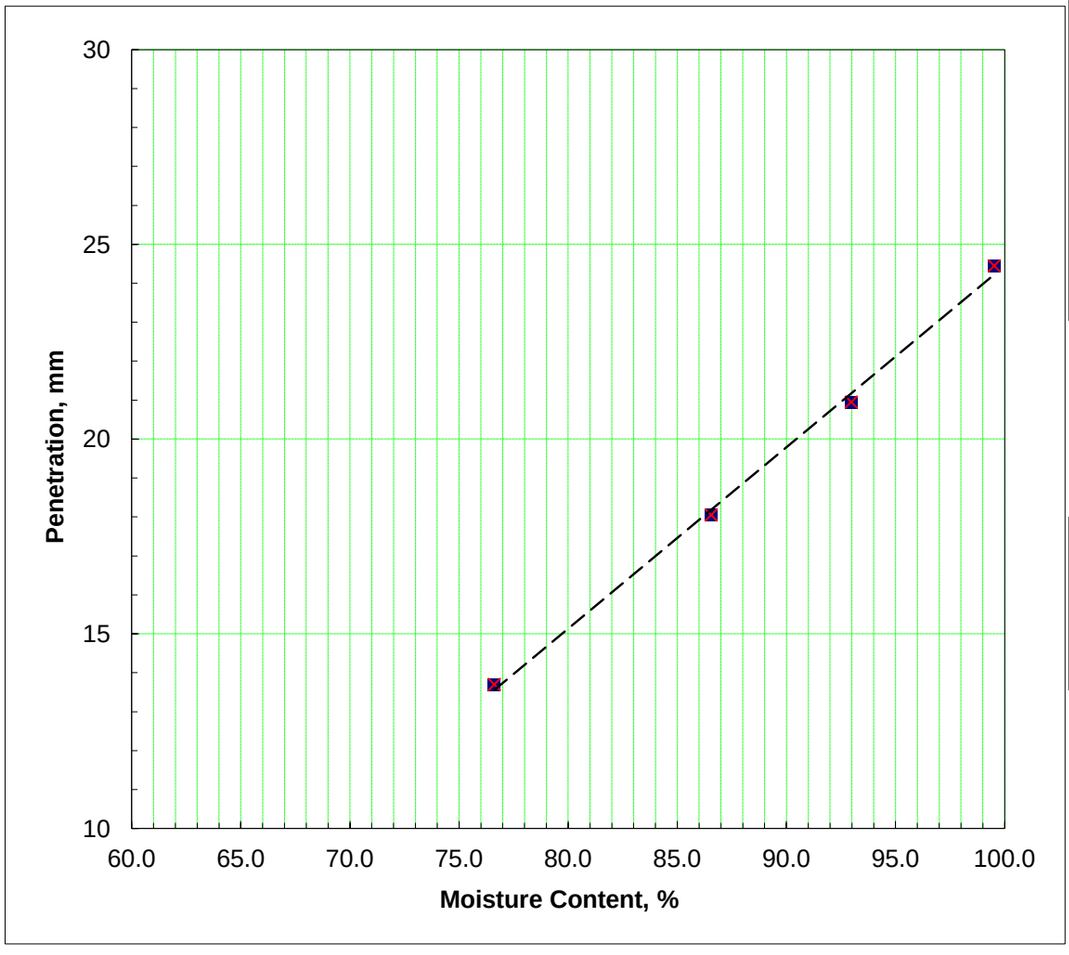
Liquidity Index ;
0.2932

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Colchester**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.80	18.00	21.00	24.70		
(or other M.C. test if stated)	13.60	18.10	20.90	24.20		
	13.7	**18.05**	**20.95**	**24.45**		
CONTAINER	**25**	**26**	**27**	**28**	**XIII**	**XIV**
WT. OF WET SOIL + CONTAINER, g	20.46	22.09	23.88	24.42	*12.56*	*12.62*
WT. OF DRY SOIL + CONTAINER, g	17.14	17.78	18.47	18.56	*27.79*	*25.95*
WT. OF CONTAINER, g	12.81	12.80	12.65	12.67	*23.72*	*22.39*
WT. OF MOISTURE, g	3.32	4.31	5.41	5.86	4.07	3.56
WT. OF DRY SOIL, g	4.33	4.98	5.82	5.89	11.16	9.77
MOISTURE CONTENT, %	**76.6**	**86.6**	**93.0**	**99.5**	36.5	36.4



Liquid Limit, % ;
90.4

* Plastic Limit, % ;
36.5

Plasticity Index, % ;
53.9

Linear Shrinkage, % ;
19.3

At M.C., % ;
93.0

Trough No. ;
G

Length Dry ;
112.9

* Some Cracks before
3 mm

Nat Moisture Content ;
28

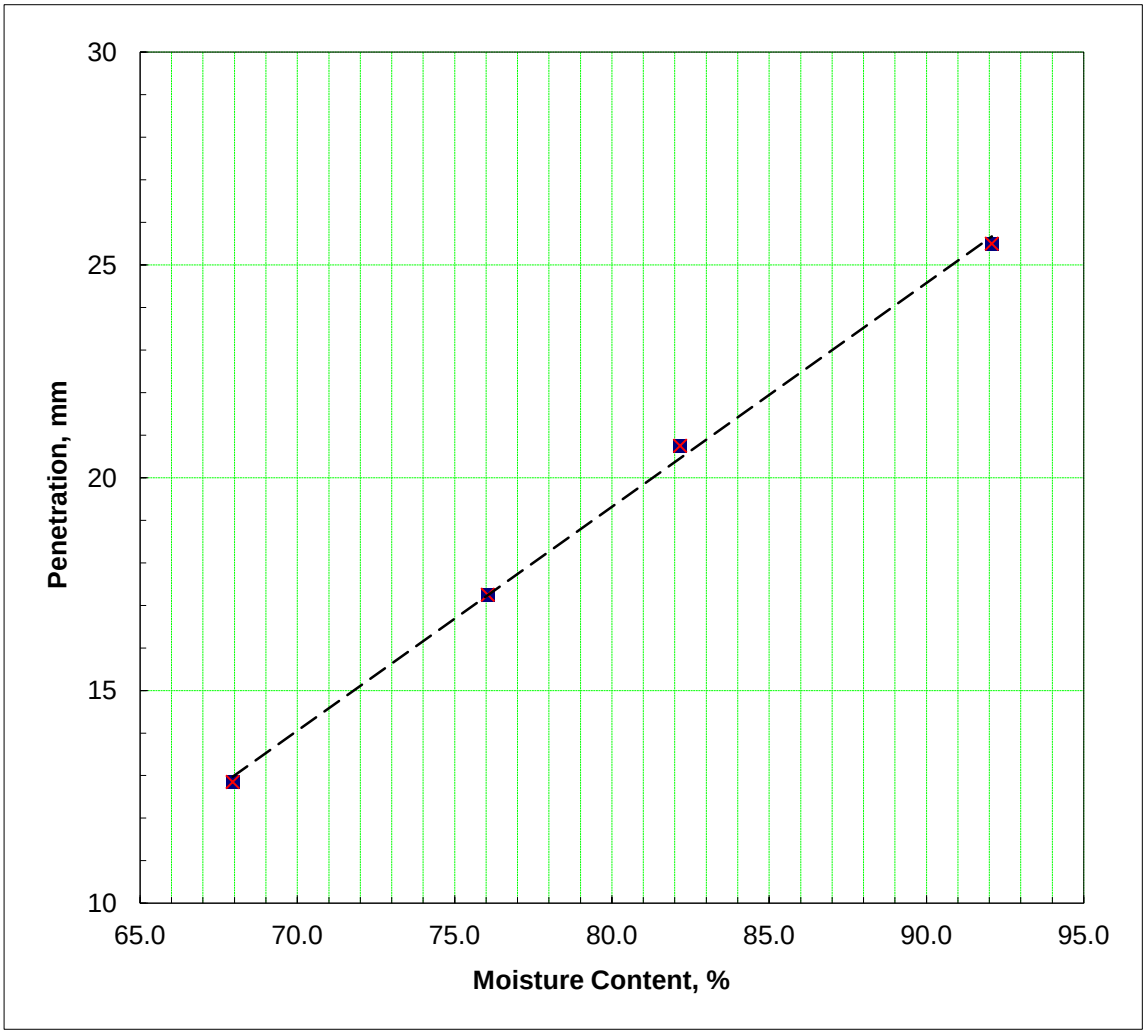
Liquidity Index ;
-0.157

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Colchester (Glauconitic Marl)**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.60	17.20	20.60	25.30		
(or other M.C. test if stated)	13.10	17.30	20.90	25.70		
	12.85	**17.25**	**20.75**	**25.5**		
CONTAINER	**9**	**10**	**11**	**12**	**V**	**VI**
WT. OF WET SOIL + CONTAINER, g	25.66	23.35	22.46	22.75	*12.57*	*12.66*
WT. OF DRY SOIL + CONTAINER, g	20.50	18.79	18.02	17.97	*23.28*	*25.73*
WT. OF CONTAINER, g	12.91	12.79	12.61	12.77	*20.57*	*22.43*
WT. OF MOISTURE, g	5.16	4.56	4.44	4.79	2.71	3.30
WT. OF DRY SOIL, g	7.60	6.00	5.41	5.20	8.00	9.77
MOISTURE CONTENT, %	**67.9**	**76.1**	**82.2**	**92.1**	33.9	33.8



Liquid Limit, % ;
81.2

* Plastic Limit, % ;
33.8

Plasticity Index, % ;
47.4

Linear Shrinkage, % ;
17.9

At M.C., % ;
82.2

Trough No. ;
C

Length Dry ;
115.0

* Some Cracks before
3 mm

Nat Moisture Content ;

Liquidity Index ;
-0.714

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

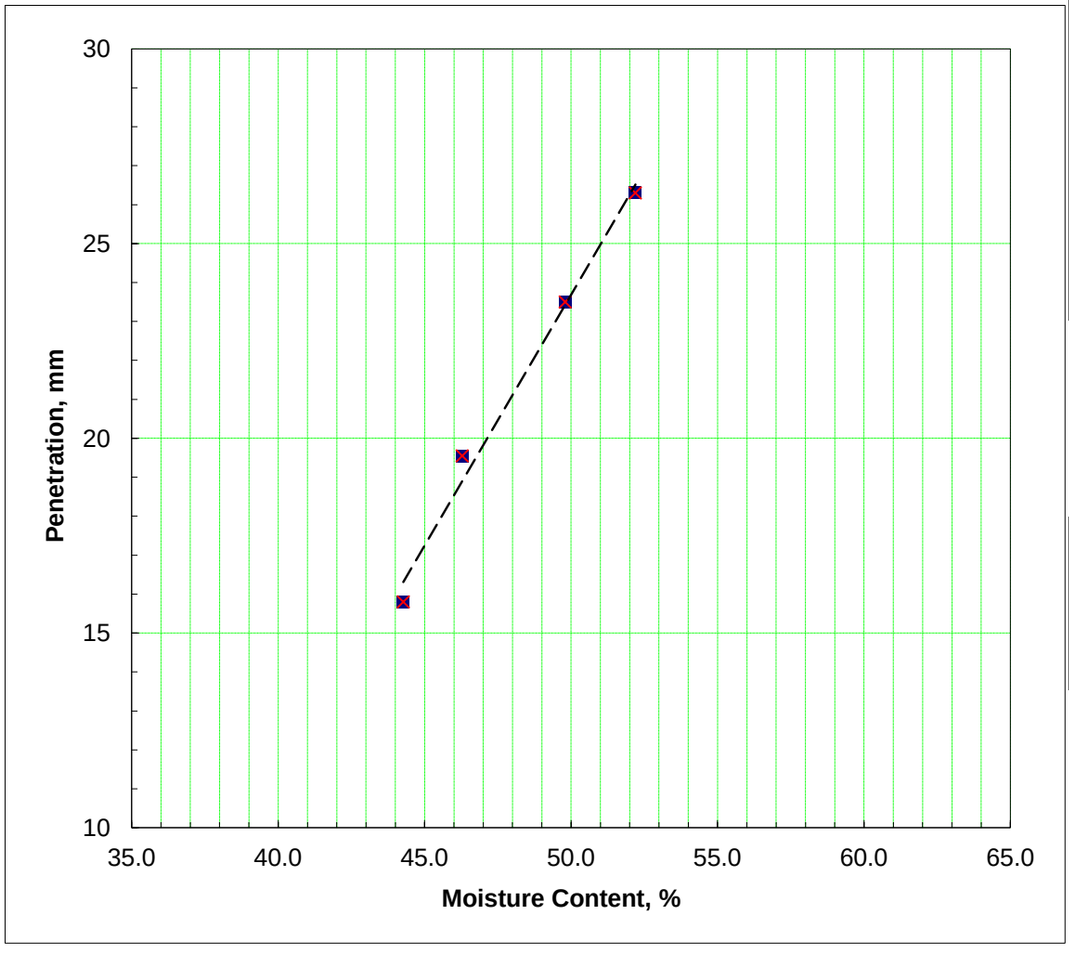
JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Fair Oak**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	15.90	19.70	23.50	26.20		
(or other M.C. test if stated)	15.70	19.40	23.50	26.40		
	15.8	**19.55**	**23.5**	**26.3**		
CONTAINER	**17**	**18**	**19**	**20**	**XV**	**XVI**
WT. OF WET SOIL + CONTAINER, g	22.84	23.46	26.65	26.66	16.05	13.50
WT. OF DRY SOIL + CONTAINER, g	19.70	20.06	22.00	21.87	14.12	11.97
WT. OF CONTAINER, g	12.60	12.71	12.64	12.67	4.65	4.51
WT. OF MOISTURE, g	3.14	3.40	4.66	4.80	1.93	1.53
WT. OF DRY SOIL, g	7.10	7.34	9.36	9.19	9.47	7.46
MOISTURE CONTENT, %	**44.3**	**46.3**	**49.8**	**52.2**	20.4	20.5

Liquid Limit, % ;
47.1

* Plastic Limit, % ;
20.4

Plasticity Index, % ;
26.7



Linear Shrinkage, % ;
10.0

At M.C., % ;
49.8

Trough No. ;
D

Length Dry ;
126.1

* Some Cracks before
3 mm

Nat Moisture Content ;
26

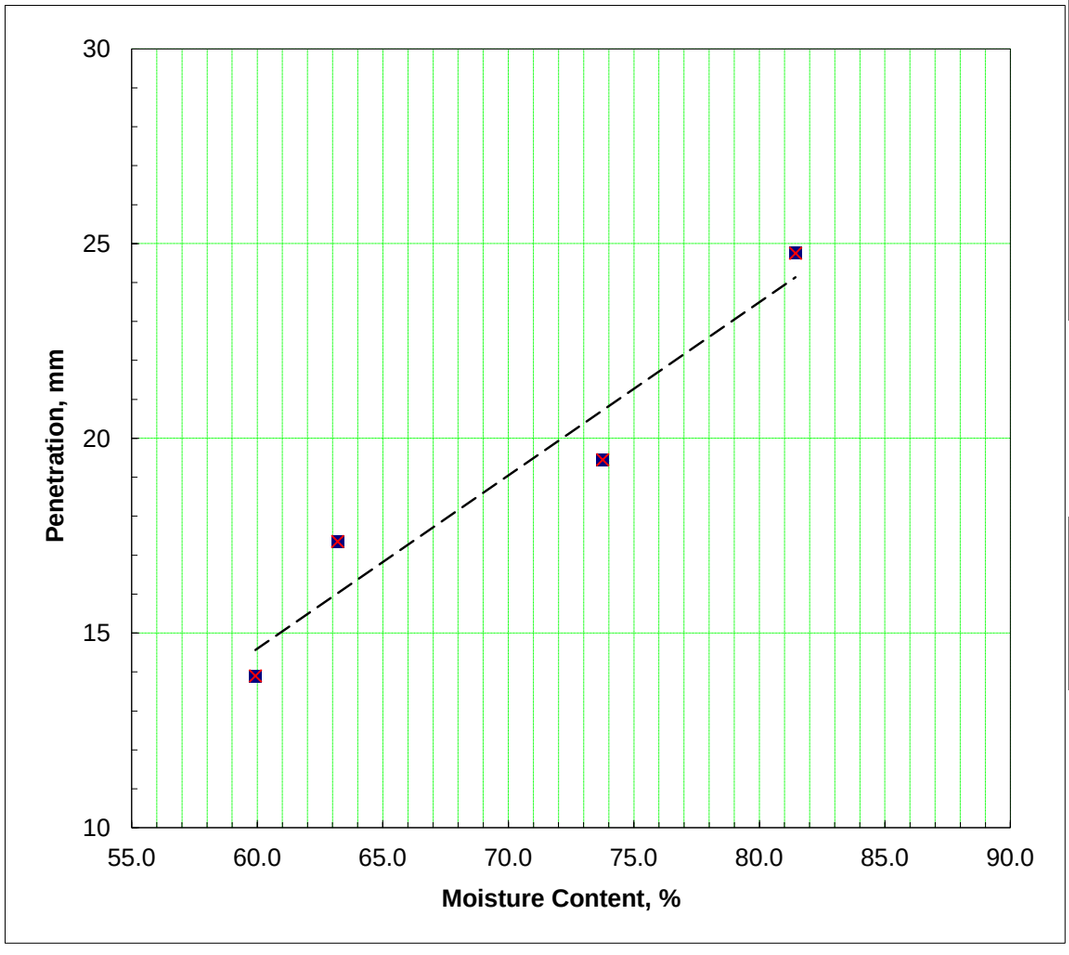
Liquidity Index ;
0.2095

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Farnham**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.70	17.10	19.30	24.70		
(or other M.C. test if stated)	14.10	17.60	19.60	24.80		
	13.9	**17.35**	**19.45**	**24.75**		
CONTAINER	**13**	**14**	**15**	**16**	**VII**	**VIII**
WT. OF WET SOIL + CONTAINER, g	29.93	32.05	28.14	35.59	17.78	15.11
WT. OF DRY SOIL + CONTAINER, g	23.48	24.50	21.71	25.29	15.14	13.06
WT. OF CONTAINER, g	12.71	12.55	12.99	12.64	5.34	5.23
WT. OF MOISTURE, g	6.45	7.55	6.43	10.30	2.65	2.05
WT. OF DRY SOIL, g	10.77	11.95	8.72	12.65	9.80	7.83
MOISTURE CONTENT, %	**59.9**	**63.2**	**73.8**	**81.4**	27.0	26.2



Liquid Limit, % ;
72.0

* Plastic Limit, % ;
26.6

Plasticity Index, % ;
45.4

Linear Shrinkage, % ;
15.3

At M.C., % ;
73.8

Trough No. ;
F

Length Dry ;
118.6

* Some Cracks before
3 mm

Nat Moisture Content ;
20.5

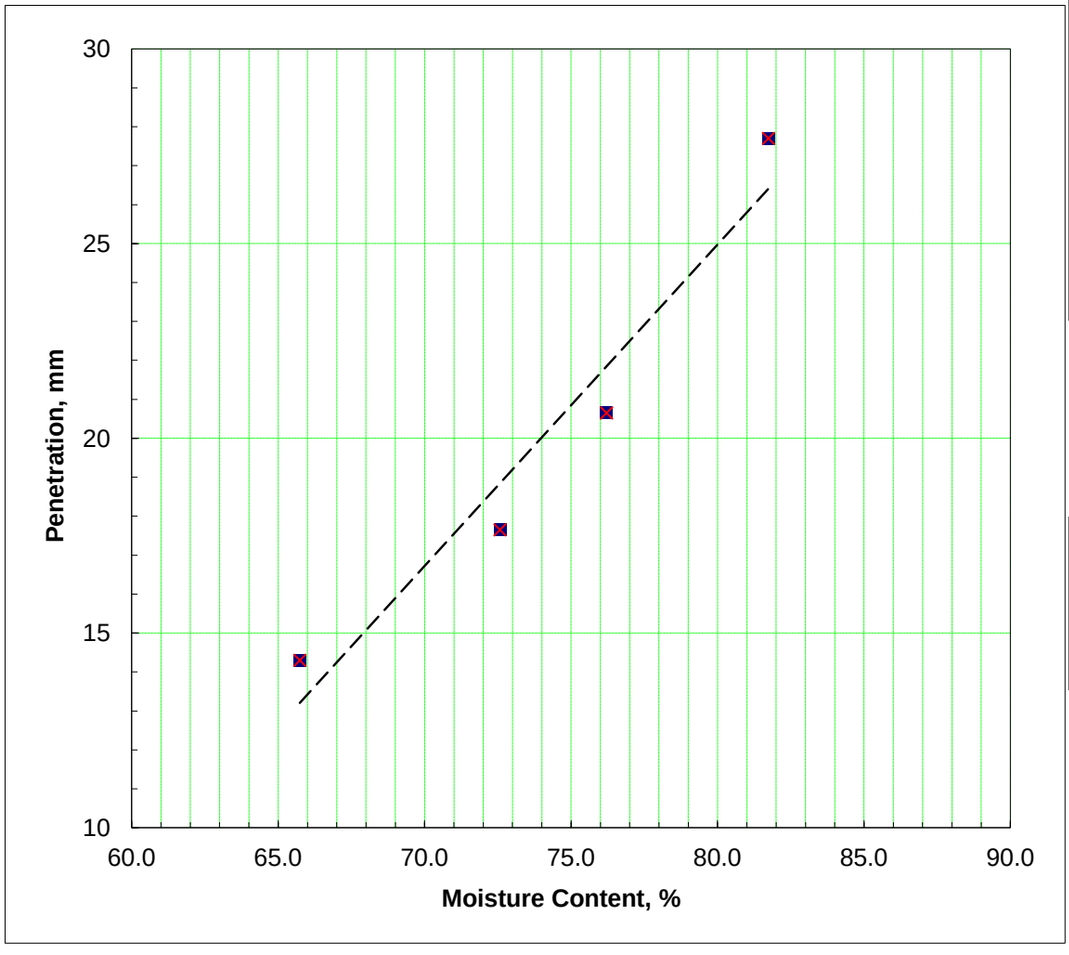
Liquidity Index ;
-0.134

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Grain Quarry 1**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	14.20	18.20	20.60	27.80		
(or other M.C. test if stated)	14.40	17.10	20.70	27.60		
	14.3	**17.65**	**20.65**	**27.7**		
CONTAINER	**29**	**30**	**31**	**32**	**IX**	**X**
WT. OF WET SOIL + CONTAINER, g	23.08	24.15	25.52	23.53	12.68	12.51
WT. OF DRY SOIL + CONTAINER, g	18.93	19.29	20.03	18.63	10.96	10.99
WT. OF CONTAINER, g	12.61	12.60	12.83	12.63	4.76	5.49
WT. OF MOISTURE, g	4.16	4.86	5.49	4.90	1.72	1.52
WT. OF DRY SOIL, g	6.32	6.70	7.21	6.00	6.20	5.49
MOISTURE CONTENT, %	**65.7**	**72.6**	**76.2**	**81.7**	27.8	27.7



Liquid Limit, % ;
73.9

* Plastic Limit, % ;
27.7

Plasticity Index, % ;
46.2

Linear Shrinkage, % ;
17.1

At M.C., % ;
76.2

Trough No. ;
H

Length Dry ;
116.1

* Some Cracks before
3 mm

Nat Moisture Content ;
28.1

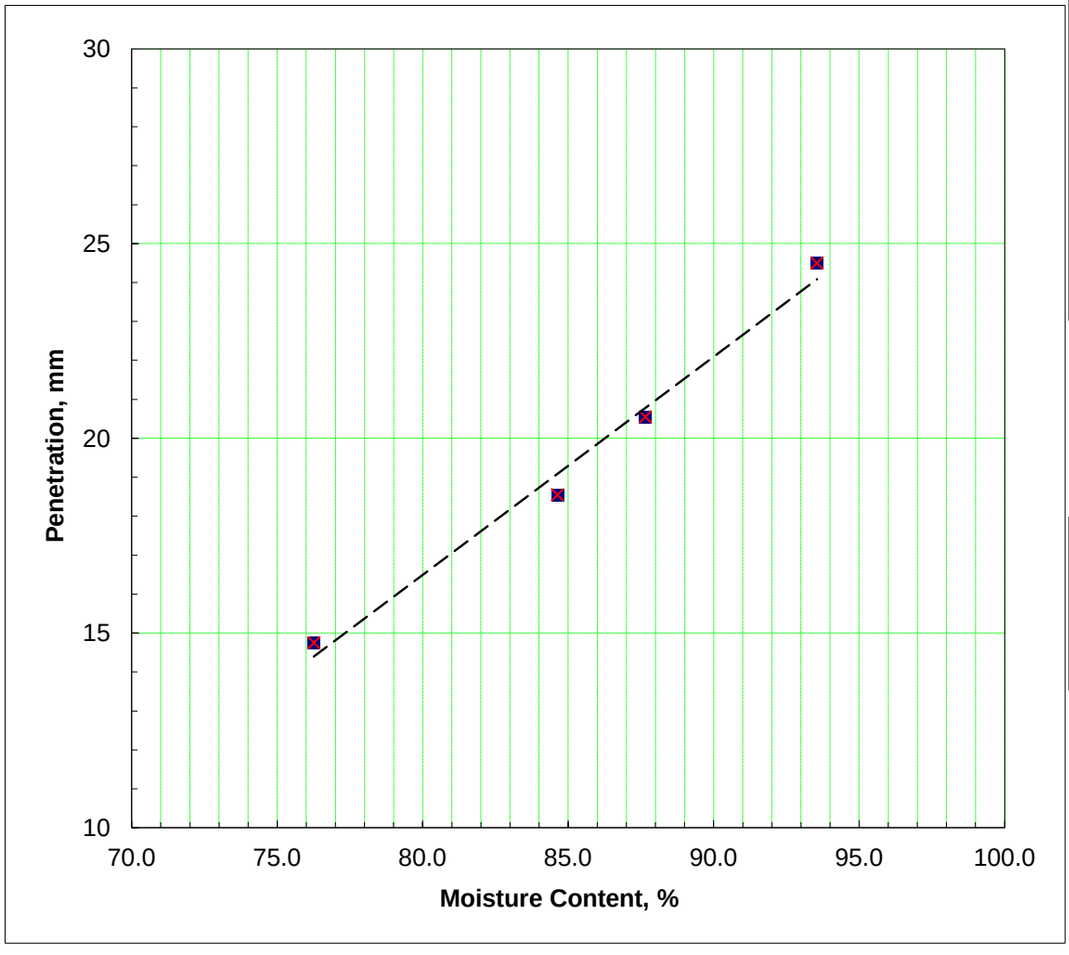
Liquidity Index ;
0.0078

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Grain Quarry 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	15.00	18.50	20.50	24.60		
(or other M.C. test if stated)	14.50	18.60	20.60	24.40		
	14.75	**18.55**	**20.55**	**24.5**		
CONTAINER	**21**	**22**	**23**	**24**	**IX**	**X**
WT. OF WET SOIL + CONTAINER, g	26.41	23.81	23.12	24.04	14.37	15.69
WT. OF DRY SOIL + CONTAINER, g	20.45	18.85	18.22	18.69	12.22	13.46
WT. OF CONTAINER, g	12.63	12.98	12.62	12.97	4.76	5.49
WT. OF MOISTURE, g	5.96	4.96	4.91	5.35	2.15	2.23
WT. OF DRY SOIL, g	7.82	5.86	5.60	5.72	7.46	7.96
MOISTURE CONTENT, %	**76.3**	**84.6**	**87.7**	**93.5**	28.9	28.0



Liquid Limit, % ;
86.2

* Plastic Limit, % ;
28.5

Plasticity Index, % ;
57.7

Linear Shrinkage, % ;
15.1

At M.C., % ;
87.7

Trough No. ;
E

Length Dry ;
118.9

* Some Cracks before
3 mm

Nat Moisture Content ;
28

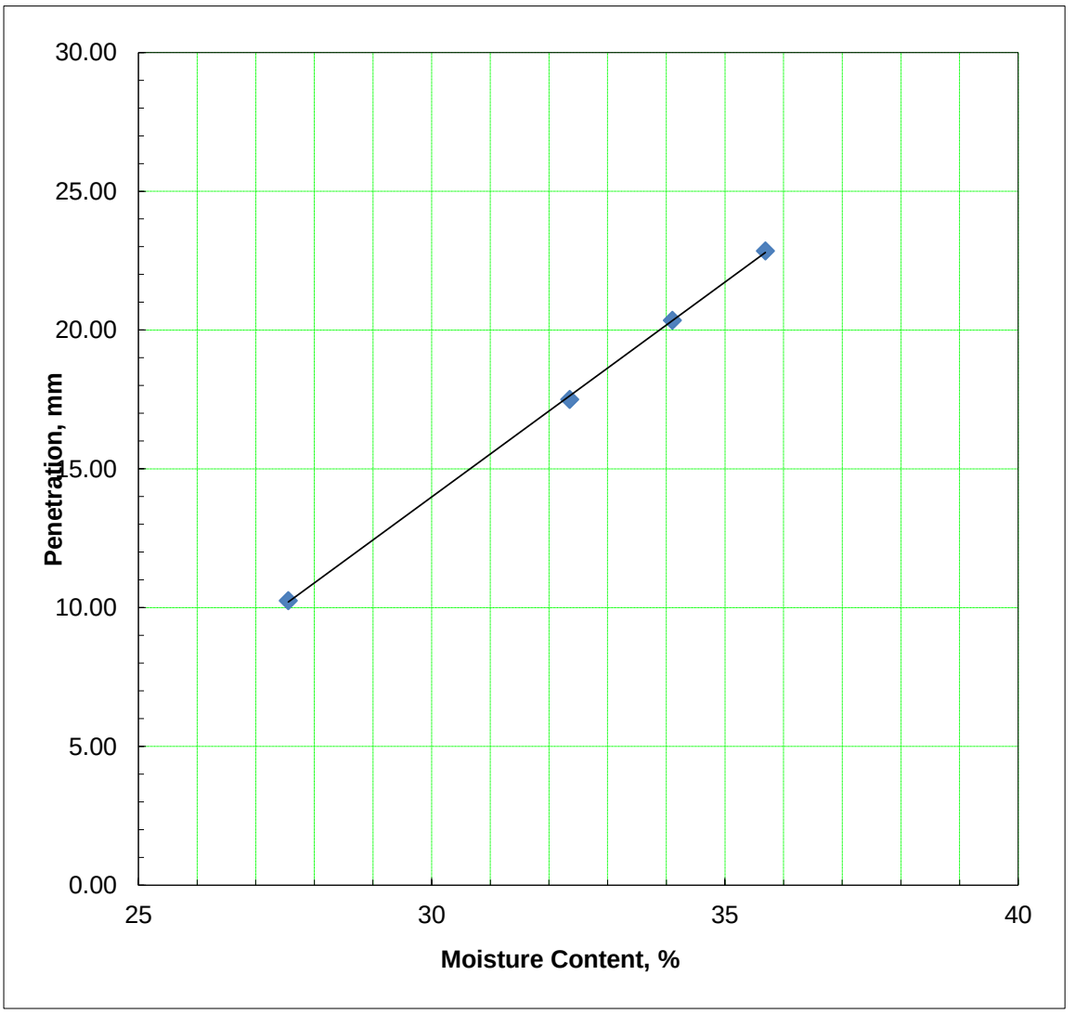
Liquidity Index ;
-0.008

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	M. Kirkham
SAMPLE NO. :		DATE :	
SITE :	**Knoll Manor 1**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm (or other M.C. test if stated)	10.25	17.50	20.35	22.85		
	10.25	17.50	20.35	22.85		
CONTAINER	**1**	**2**	**3**	**4**	**I**	**II**
WT. OF WET SOIL + CONTAINER, g	12.62	12.99	12.61	12.66	19.22	19.12
WT. OF DRY SOIL + CONTAINER, g	26.60	28.74	29.44	36.46	17.06	16.85
WT. OF CONTAINER, g	23.58	24.89	25.16	30.20	5.22	4.70
WT. OF MOISTURE, g	3.02	3.85	4.28	6.26	2.16	2.27
WT. OF DRY SOIL, g	10.96	11.90	12.55	17.54	11.84	12.14
MOISTURE CONTENT, %	**27.6**	**32.4**	**34.1**	**35.7**	18.2	18.7



Liquid Limit, % ;
34

* Plastic Limit, % ;
18.5

Plasticity Index, % ;
15.5

Linear Shrinkage, % ;
11.0

At M.C., % ;
34.1

Trough No. ;
C

Length Dry ;
124.7

* Some Cracks before
3 mm

Nat Moisture Content ;
25.6

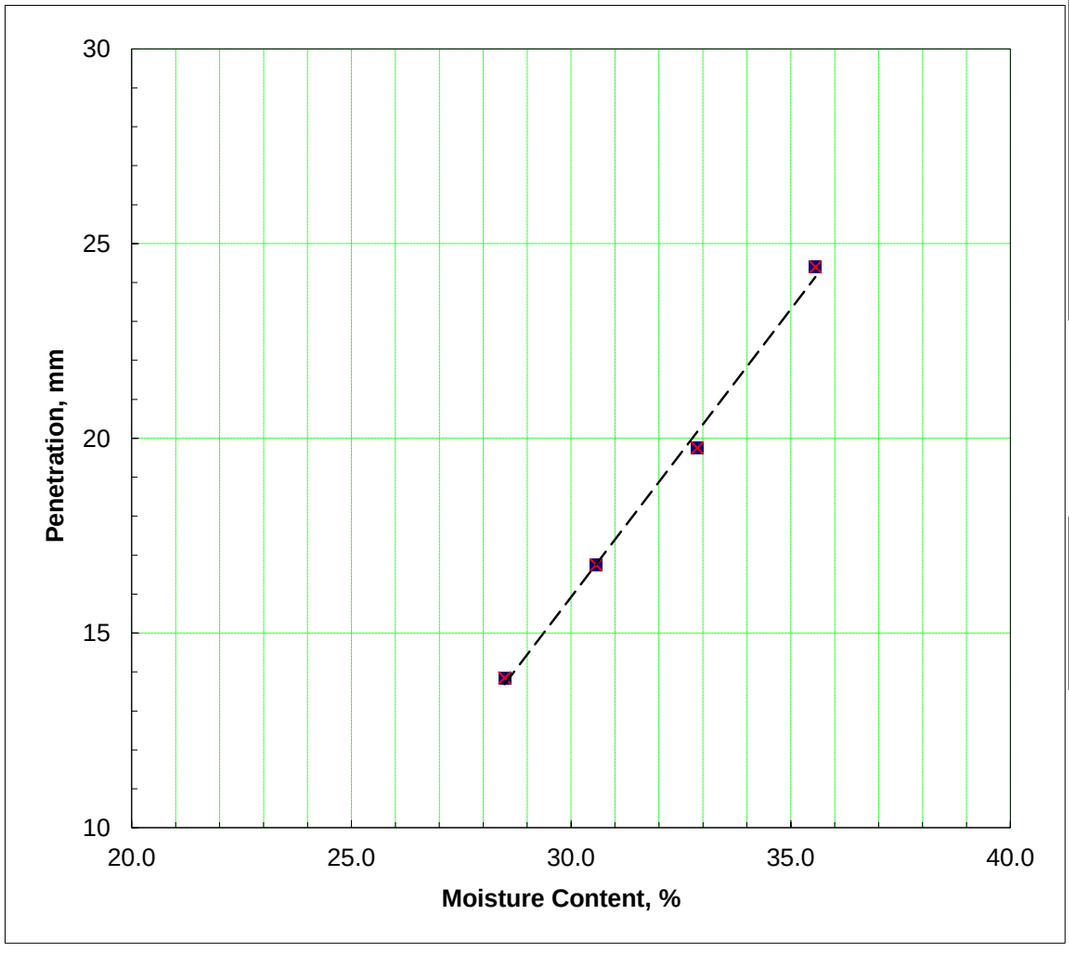
Liquidity Index ;
0.459

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Knoll Manor 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.80	16.80	19.80	24.60		
(or other M.C. test if stated)	13.90	16.70	19.70	24.20		
	13.85	**16.75**	**19.75**	**24.4**		
CONTAINER	**21**	**22**	**23**	**24**	**XIII**	**XIV**
WT. OF WET SOIL + CONTAINER, g	23.49	23.65	22.70	24.45	19.68	14.28
WT. OF DRY SOIL + CONTAINER, g	21.08	21.15	20.21	21.44	17.60	12.91
WT. OF CONTAINER, g	12.63	12.98	12.62	12.97	5.17	4.66
WT. OF MOISTURE, g	2.41	2.50	2.49	3.01	2.07	1.37
WT. OF DRY SOIL, g	8.45	8.17	7.58	8.47	12.43	8.25
MOISTURE CONTENT, %	**28.5**	**30.6**	**32.9**	**35.6**	16.7	16.6



Liquid Limit, % ;
32.7

* Plastic Limit, % ;
16.6

Plasticity Index, % ;
16.1

Linear Shrinkage, % ;
12.2

At M.C., % ;
32.9

Trough No. ;
F

Length Dry ;
122.9

* Some Cracks before
3 mm

Nat Moisture Content ;
17.8

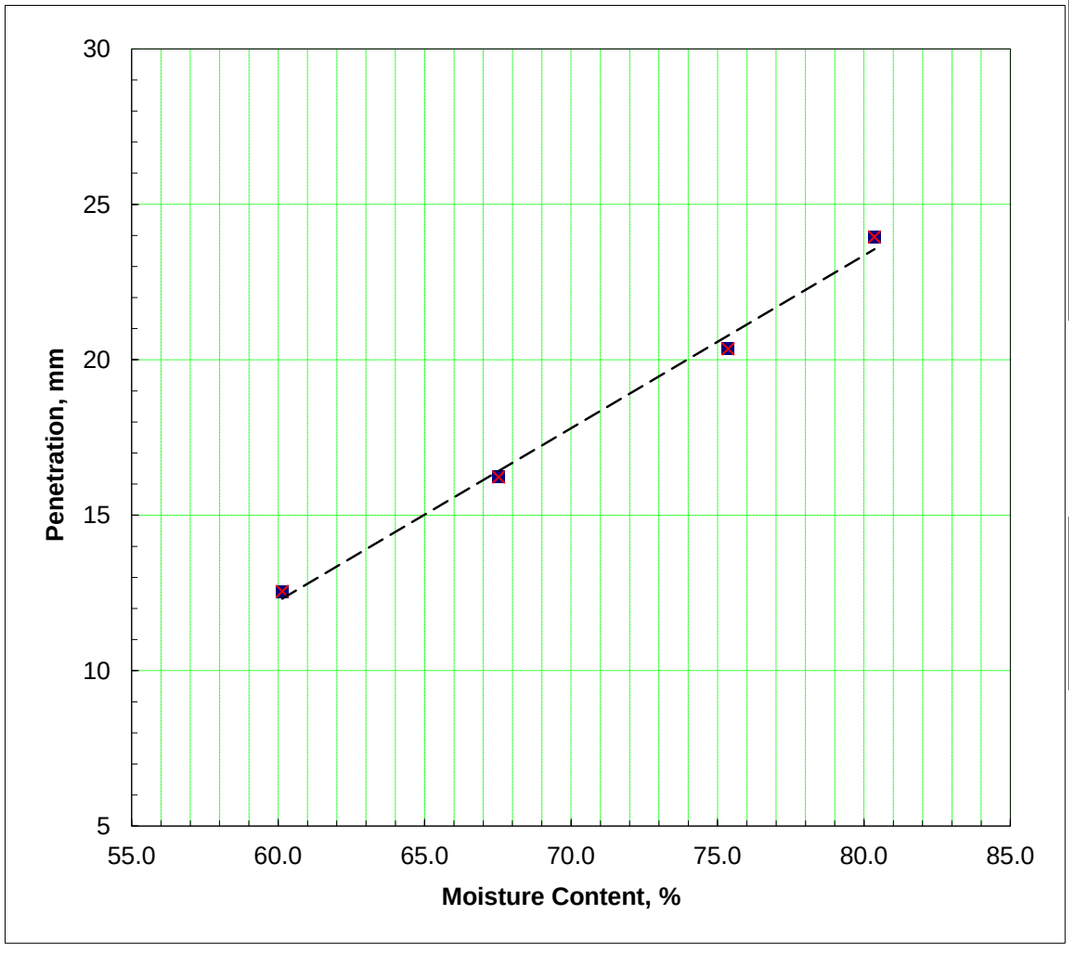
Liquidity Index ;
0.0735

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Knowl Hill**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.30	16.40	20.30	23.90		
(or other M.C. test if stated)	12.80	16.05	20.40	24.00		
	12.55	**16.225**	**20.35**	**23.95**		
CONTAINER	**5**	**6**	**7**	**8**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	33.61	33.40	28.39	30.75	15.59	16.61
WT. OF DRY SOIL + CONTAINER, g	25.78	25.03	21.78	22.69	13.15	14.17
WT. OF CONTAINER, g	12.75	12.65	13.00	12.66	4.54	5.36
WT. OF MOISTURE, g	7.84	8.36	6.61	8.06	2.43	2.44
WT. OF DRY SOIL, g	13.03	12.39	8.77	10.03	8.61	8.81
MOISTURE CONTENT, %	**60.1**	**67.5**	**75.4**	**80.4**	28.3	27.7



Liquid Limit, % ;
74.0

* Plastic Limit, % ;
28.0

Plasticity Index, % ;
46.0

Linear Shrinkage, % ;
14.3

At M.C., % ;
67.5

Trough No. ;
G

Length Dry ;
120.0

* Some Cracks before
3 mm

Nat Moisture Content ;
31.4

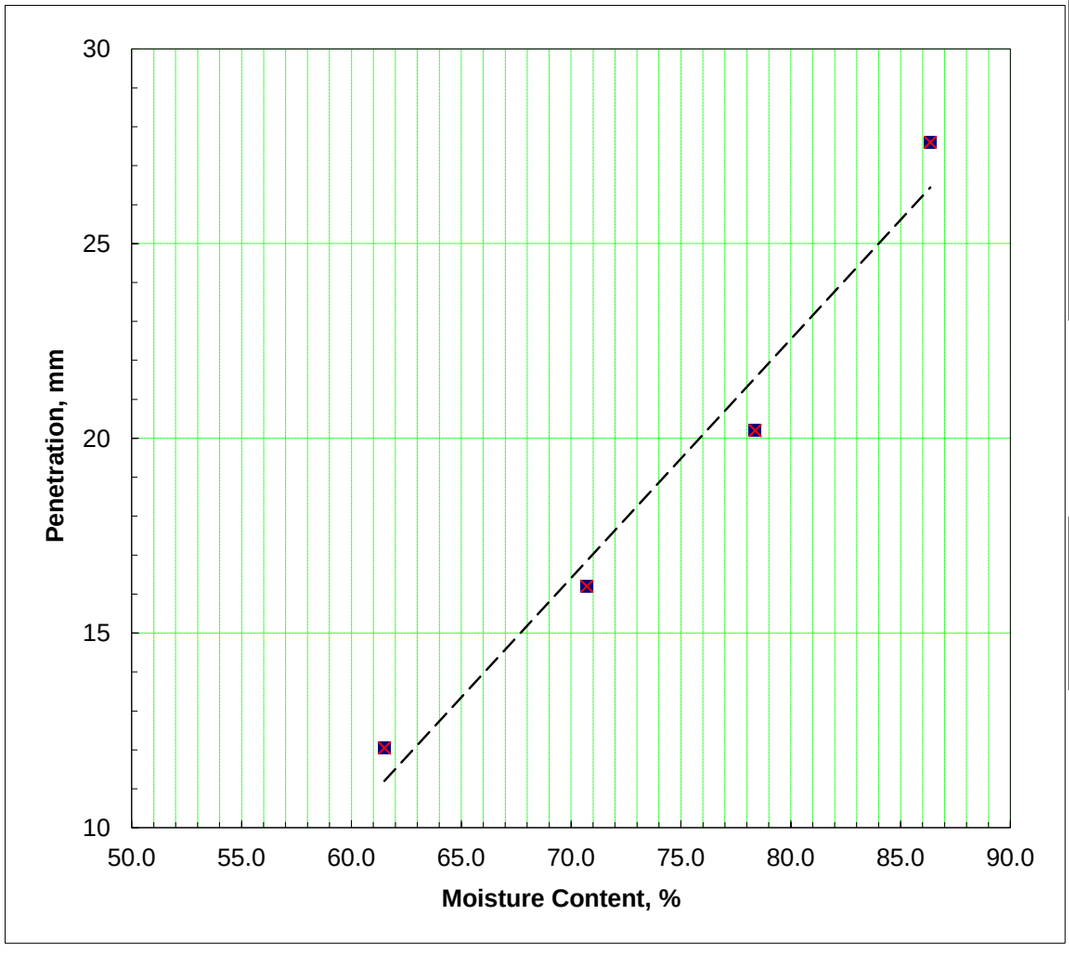
Liquidity Index ;
0.0742

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Ockendon 1**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.00	16.00	20.20	27.50		
(or other M.C. test if stated)	12.10	16.40	20.20	27.70		
	12.05	**16.2**	**20.2**	**27.6**		
CONTAINER	**17**	**18**	**19**	**20**	**IX**	**X**
WT. OF WET SOIL + CONTAINER, g	28.40	24.69	22.52	26.75	13.37	13.46
WT. OF DRY SOIL + CONTAINER, g	22.39	19.73	18.19	20.21	11.51	11.79
WT. OF CONTAINER, g	12.60	12.71	12.67	12.64	4.76	5.49
WT. OF MOISTURE, g	6.02	4.96	4.33	6.54	1.86	1.67
WT. OF DRY SOIL, g	9.79	7.01	5.52	7.57	6.75	6.30
MOISTURE CONTENT, %	**61.5**	**70.7**	**78.4**	**86.3**	27.6	26.5



Liquid Limit, % ;
75.8

* Plastic Limit, % ;
27.0

Plasticity Index, % ;
48.8

Linear Shrinkage, % ;
16.4

At M.C., % ;
78.4

Trough No. ;
E

Length Dry ;
117.0

* Some Cracks before
3 mm

Nat Moisture Content ;
28.3

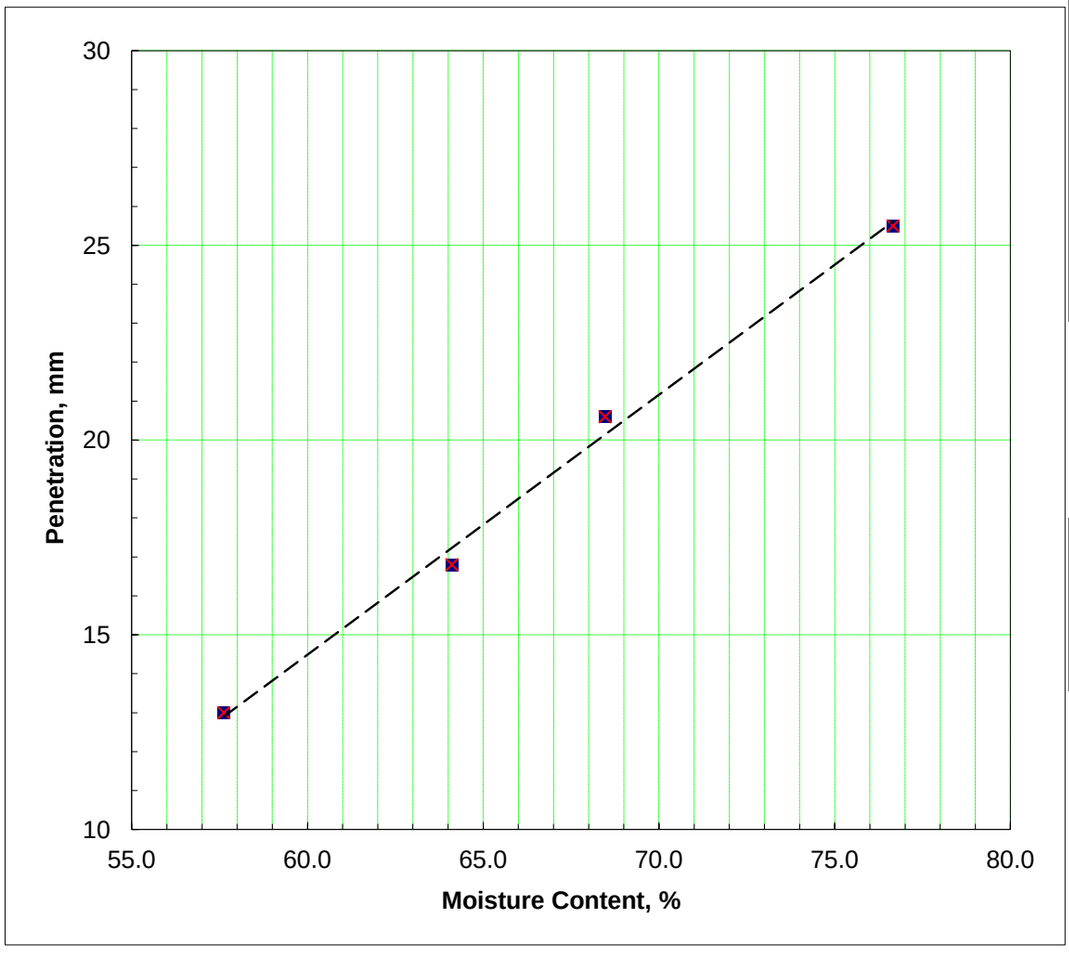
Liquidity Index ;
0.0263

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Ockendon 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.80	16.80	20.40	25.40		
(or other M.C. test if stated)	13.20	16.80	20.80	25.60		
	13	**16.8**	**20.6**	**25.5**		
CONTAINER	**13**	**14**	**15**	**16**	**VII**	**VIII**
WT. OF WET SOIL + CONTAINER, g	24.28	23.88	25.96	22.50	*13.07*	*12.82*
WT. OF DRY SOIL + CONTAINER, g	20.05	19.46	20.69	18.22	*28.98*	*27.11*
WT. OF CONTAINER, g	12.71	12.55	12.99	12.64	*24.77*	*23.35*
WT. OF MOISTURE, g	4.23	4.43	5.27	4.28	4.21	3.76
WT. OF DRY SOIL, g	7.34	6.90	7.70	5.58	11.70	10.53
MOISTURE CONTENT, %	**57.6**	**64.1**	**68.5**	**76.7**	36.0	35.7



Liquid Limit, % ;
68.2

* Plastic Limit, % ;
35.8

Plasticity Index, % ;
32.4

Linear Shrinkage, % ;
16.8

At M.C., % ;
68.5

Trough No. ;
D

Length Dry ;
116.5

* Some Cracks before
3 mm

Nat Moisture Content ;
32

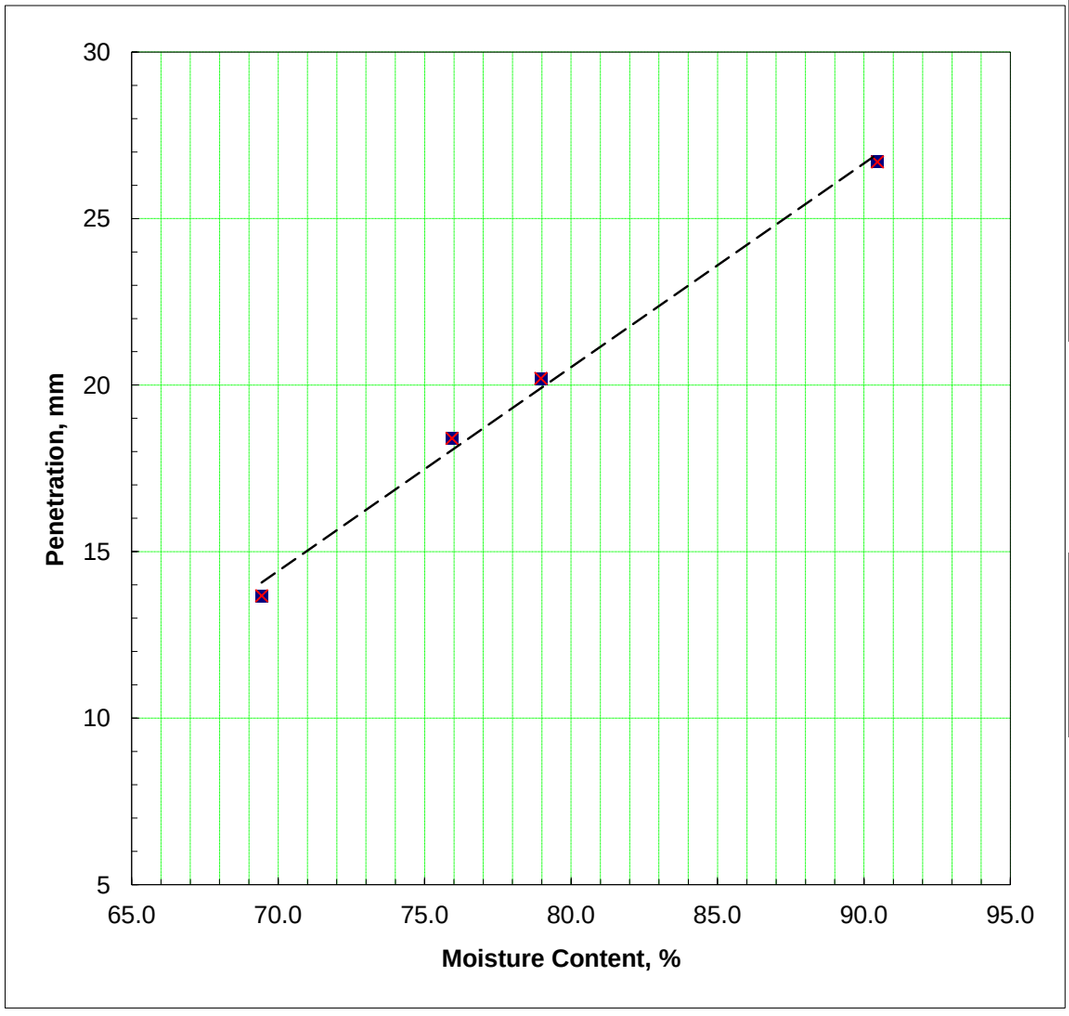
Liquidity Index ;
-0.119

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Poyle**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.70	18.50	20.10	26.80		
(or other M.C. test if stated)	13.65	18.30	20.30	26.60		
	13.68	**18.4**	**20.2**	**26.7**		
CONTAINER	**21**	**22**	**23**	**24**	**XI**	**XII**
WT. OF WET SOIL + CONTAINER, g	24.04	21.61	23.39	24.09	*12.99*	*12.63*
WT. OF DRY SOIL + CONTAINER, g	19.37	17.89	18.64	18.81	*24.81*	*26.46*
WT. OF CONTAINER, g	12.63	12.98	12.62	12.97	*21.79*	*22.92*
WT. OF MOISTURE, g	4.68	3.72	4.75	5.28	3.02	3.54
WT. OF DRY SOIL, g	6.74	4.90	6.02	5.84	8.80	10.29
MOISTURE CONTENT, %	**69.4**	**75.9**	**79.0**	**90.5**	34.3	34.4



Liquid Limit, % ;
79.0

* Plastic Limit, % ;
34.4

Plasticity Index, % ;
44.6

Linear Shrinkage, % ;
12.9

At M.C., % ;
79.0

Trough No. ;
F

Length Dry ;
122.0

* Some Cracks before
3 mm

Nat Moisture Content ;
30.5

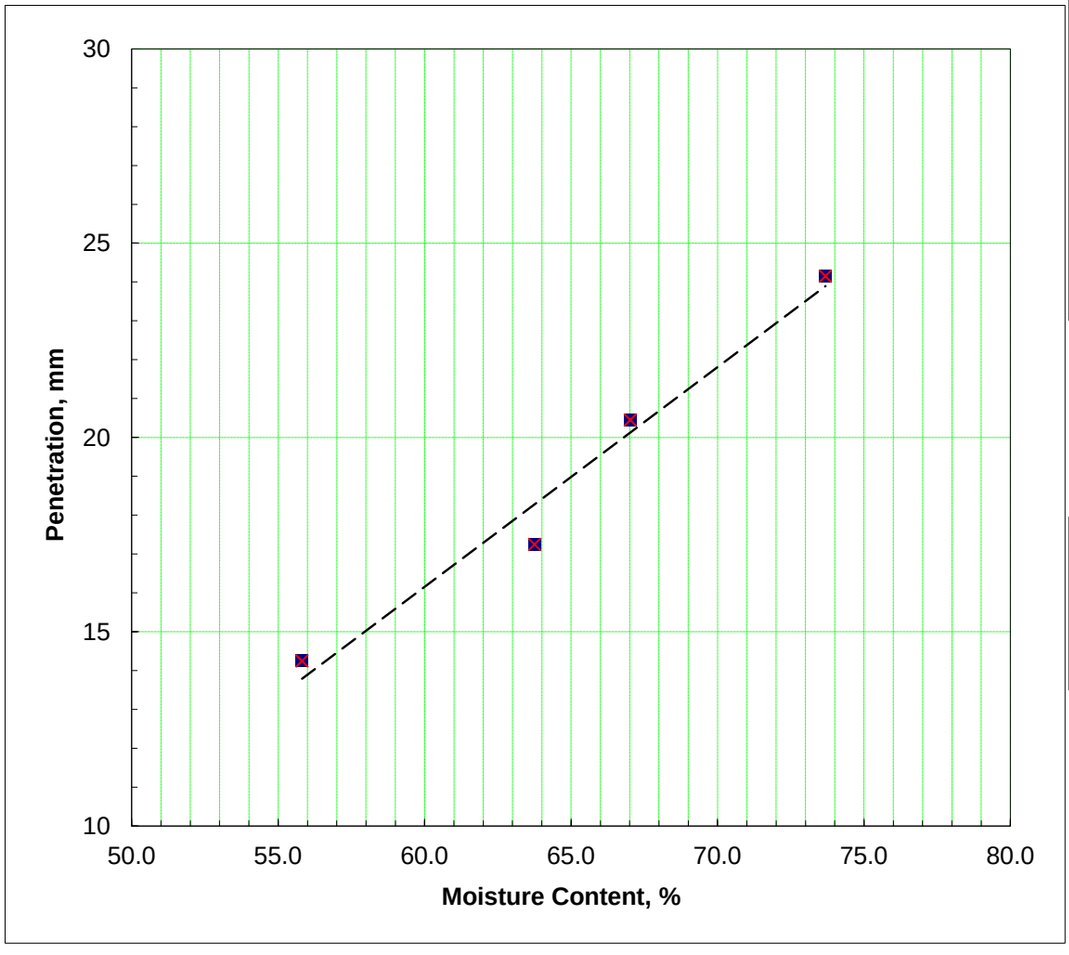
Liquidity Index ;
-0.09

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Southleigh**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	14.20	17.00	20.35	24.00		
(or other M.C. test if stated)	14.30	17.50	20.55	24.30		
	14.25	**17.25**	**20.45**	**24.15**		
CONTAINER	**1**	**2**	**3**	**4**	**I**	**II**
WT. OF WET SOIL + CONTAINER, g	32.34	31.42	30.77	34.02	17.66	16.26
WT. OF DRY SOIL + CONTAINER, g	25.29	24.28	23.55	24.94	14.99	13.80
WT. OF CONTAINER, g	12.67	13.06	12.78	12.63	5.20	4.70
WT. OF MOISTURE, g	7.04	7.15	7.22	9.08	2.67	2.45
WT. OF DRY SOIL, g	12.62	11.21	10.77	12.32	9.79	9.10
MOISTURE CONTENT, %	**55.8**	**63.7**	**67.0**	**73.7**	27.2	26.9



Liquid Limit, % ;
66.9

* Plastic Limit, % ;
27.1

Plasticity Index, % ;
39.8

Linear Shrinkage, % ;
14.6

At M.C., % ;
67.0

Trough No. ;
C

Length Dry ;
119.5

* Some Cracks before
3 mm

Nat Moisture Content ;
27.5

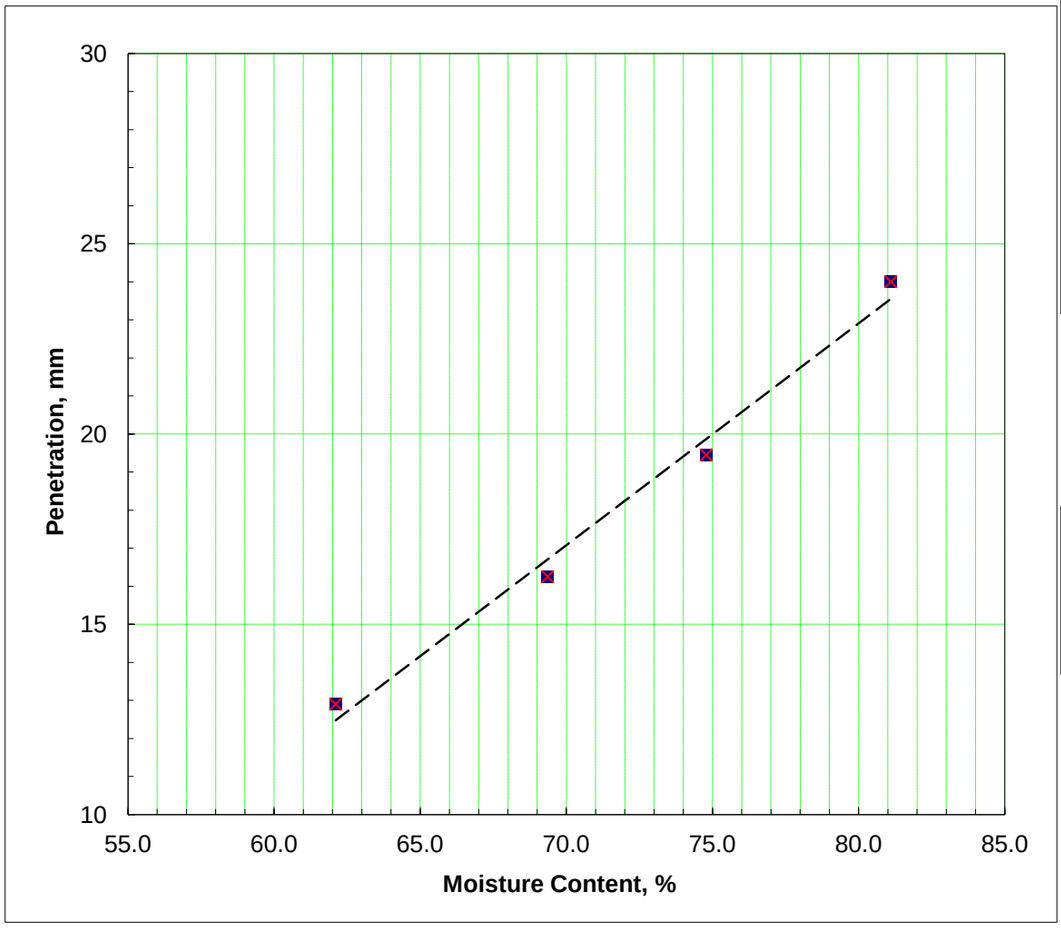
Liquidity Index ;
0.0108

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Stanwell**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.10	16.00	19.40	23.90		
(or other M.C. test if stated)	12.70	16.50	19.50	24.10		
	12.9	**16.25**	**19.45**	**24**		
CONTAINER	**9**	**10**	**11**	**12**	**V**	**VI**
WT. OF WET SOIL + CONTAINER, g	31.44	32.40	34.01	30.39	*12.62*	*12.97*
WT. OF DRY SOIL + CONTAINER, g	24.34	24.37	24.85	22.50	*24.56*	*27.44*
WT. OF CONTAINER, g	12.91	12.79	12.61	12.77	*21.46*	*23.69*
WT. OF MOISTURE, g	7.10	8.03	9.16	7.89	3.10	3.75
WT. OF DRY SOIL, g	11.43	11.58	12.24	9.73	8.84	10.72
MOISTURE CONTENT, %	**62.1**	**69.4**	**74.8**	**81.1**	35.1	35.0



Liquid Limit, % ;
75.0

* Plastic Limit, % ;
35.0

Plasticity Index, % ;
40.0

Linear Shrinkage, % ;
12.5

At M.C., % ;
74.8

Trough No. ;
B

Length Dry ;
122.5

* Some Cracks before
3 mm

Nat Moisture Content ;
27.4

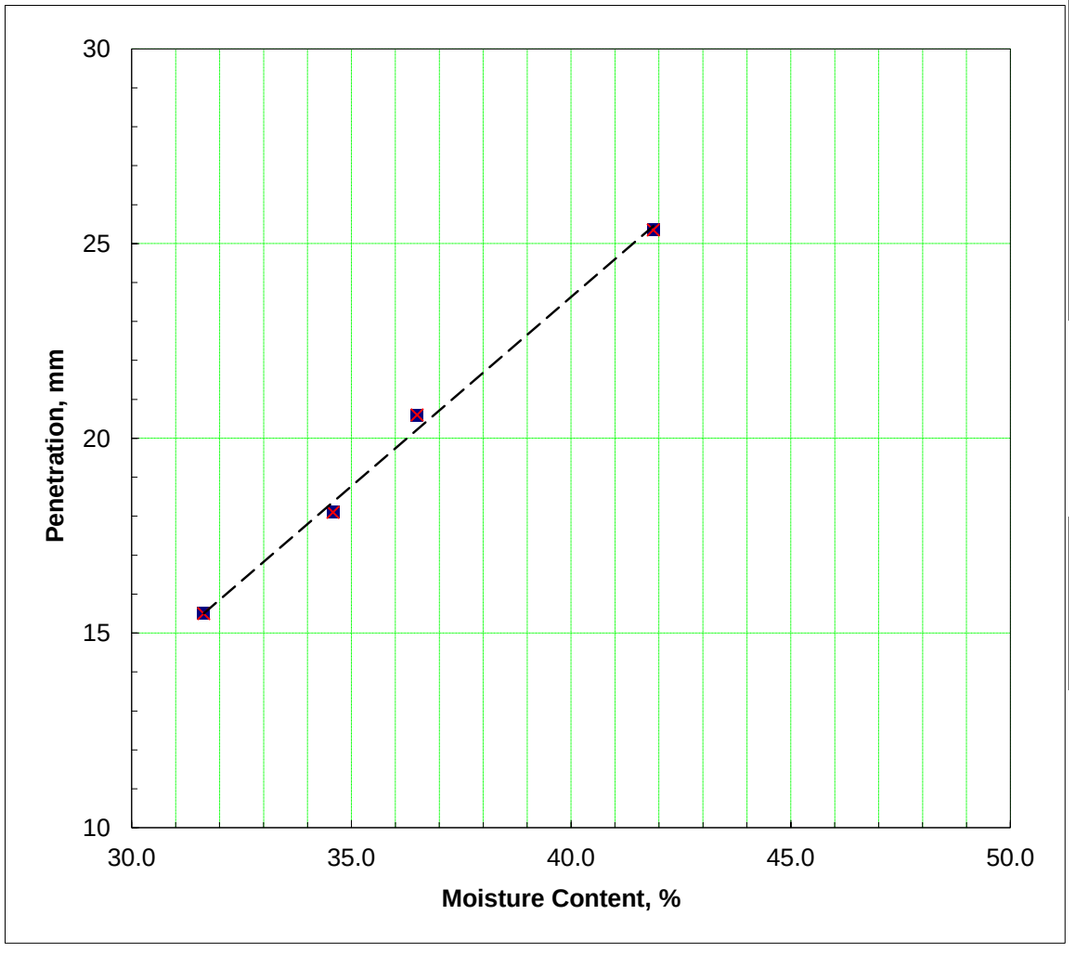
Liquidity Index ;
-0.191

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Studland**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	15.60	17.90	20.40	25.50		
(or other M.C. test if stated)	15.40	18.30	20.80	25.20		
	15.5	**18.1**	**20.6**	**25.35**		
CONTAINER	**21**	**22**	**23**	**24**	**XI**	**XII**
WT. OF WET SOIL + CONTAINER, g	27.53	29.41	26.61	28.96	15.53	16.43
WT. OF DRY SOIL + CONTAINER, g	23.95	25.19	22.87	24.24	14.40	15.24
WT. OF CONTAINER, g	12.63	12.98	12.62	12.97	5.23	5.54
WT. OF MOISTURE, g	3.58	4.22	3.74	4.72	1.14	1.19
WT. OF DRY SOIL, g	11.32	12.20	10.25	11.27	9.17	9.71
MOISTURE CONTENT, %	**31.6**	**34.6**	**36.5**	**41.9**	12.4	12.3



Liquid Limit, % ;
36.2

* Plastic Limit, % ;
12.3

Plasticity Index, % ;
23.9

Linear Shrinkage, % ;
12.5

At M.C., % ;
36.5

Trough No. ;
E

Length Dry ;
122.5

* Some Cracks before
3 mm

Nat Moisture Content ;
11.3

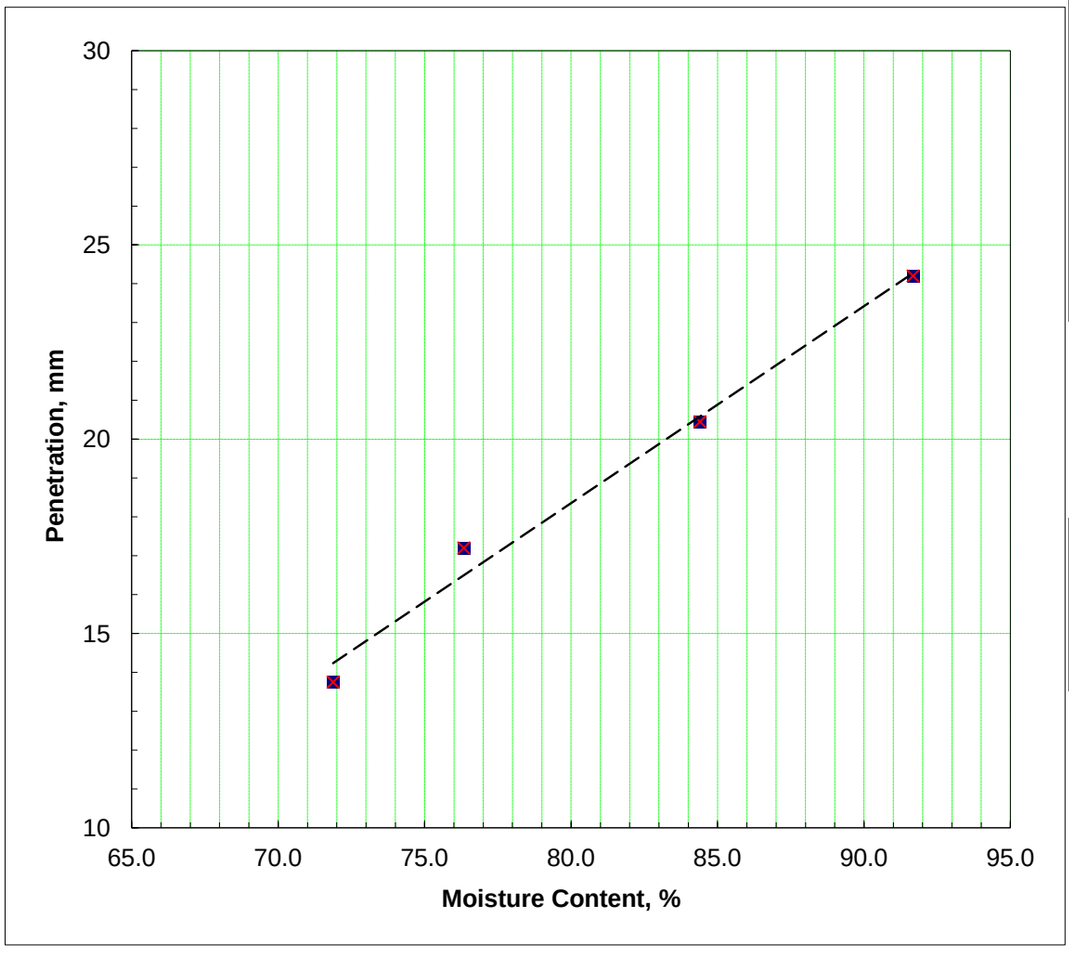
Liquidity Index ;
-0.043

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Warden Point**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	13.50	17.10	20.70	24.00		
(or other M.C. test if stated)	14.00	17.30	20.20	24.40		
	13.75	**17.2**	**20.45**	**24.2**		
CONTAINER	**1**	**2**	**3**	**4**	**I**	**II**
WT. OF WET SOIL + CONTAINER, g	28.99	27.94	26.89	25.86	*12.62*	*12.97*
WT. OF DRY SOIL + CONTAINER, g	22.16	21.50	20.43	19.53	*24.59*	*25.83*
WT. OF CONTAINER, g	12.67	13.06	12.78	12.63	*21.48*	*22.48*
WT. OF MOISTURE, g	6.82	6.44	6.46	6.33	3.11	3.35
WT. OF DRY SOIL, g	9.49	8.44	7.65	6.91	8.86	9.51
MOISTURE CONTENT, %	**71.9**	**76.3**	**84.4**	**91.7**	35.1	35.2



Liquid Limit, % ;
83.2

* Plastic Limit, % ;
35.2

Plasticity Index, % ;
48.0

Linear Shrinkage, % ;
20.0

At M.C., % ;
84.4

Trough No. ;
A

Length Dry ;
112.0

* Some Cracks before
3 mm

Nat Moisture Content ;
25.4

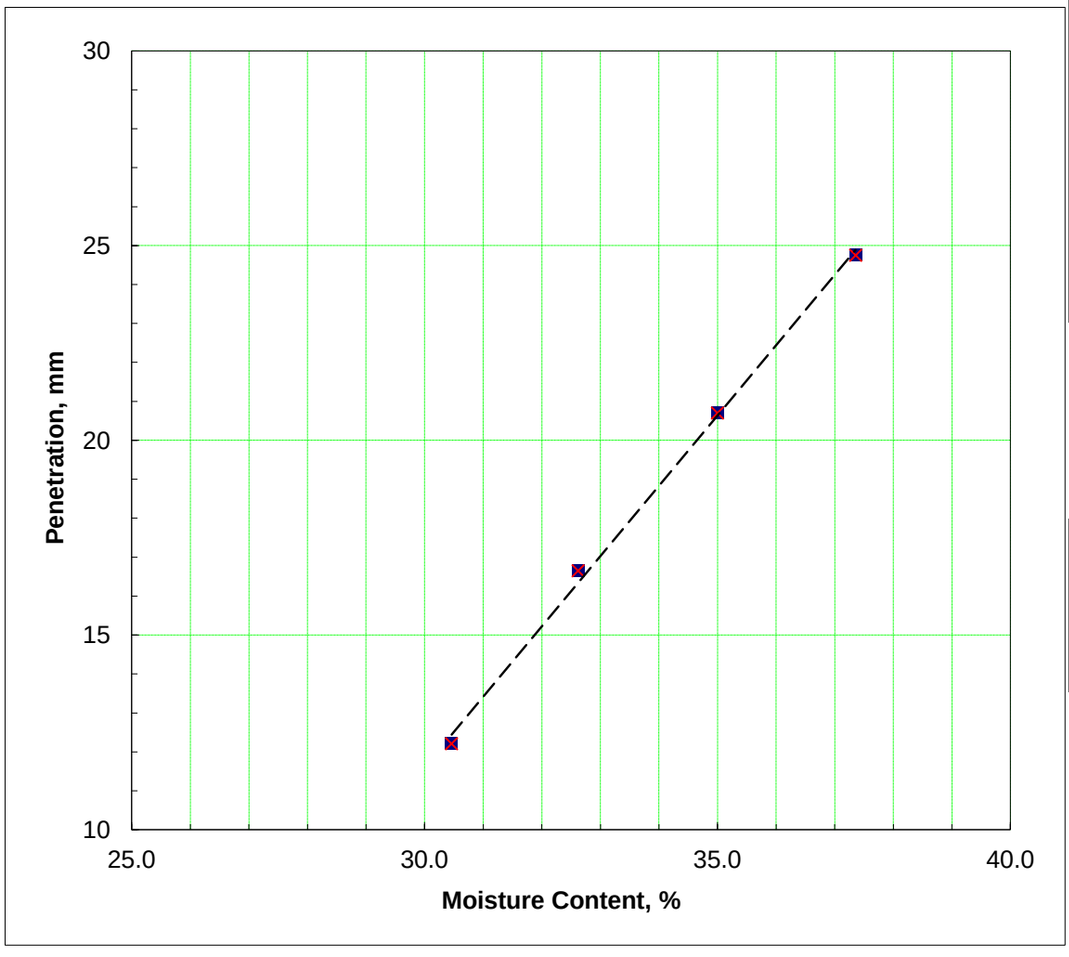
Liquidity Index ;
-0.203

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	S. Doran
SAMPLE NO. :		DATE :	
SITE :	**Whitecliffe Bay1**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.25	16.70	20.90	24.90		
(or other M.C. test if stated)	12.17	16.60	20.50	24.60		
	12.21	**16.65**	**20.7**	**24.75**		
CONTAINER	**17**	**18**	**19**	**20**	**XV**	**XVI**
WT. OF WET SOIL + CONTAINER, g	34.12	25.10	23.69	26.32	19.11	14.37
WT. OF DRY SOIL + CONTAINER, g	29.10	22.06	20.83	22.61	16.80	12.77
WT. OF CONTAINER, g	12.60	12.71	12.64	12.67	4.65	4.51
WT. OF MOISTURE, g	5.03	3.05	2.87	3.71	2.31	1.61
WT. OF DRY SOIL, g	16.50	9.34	8.19	9.94	12.15	8.26
MOISTURE CONTENT, %	**30.5**	**32.6**	**35.0**	**37.4**	19.0	19.4



Liquid Limit, % ;
34.6

* Plastic Limit, % ;
19.2

Plasticity Index, % ;
15.4

Linear Shrinkage, % ;
6.3

At M.C., % ;
35.0

Trough No. ;
H

Length Dry ;
131.2

* Some Cracks before
3 mm

Nat Moisture Content ;
18.8

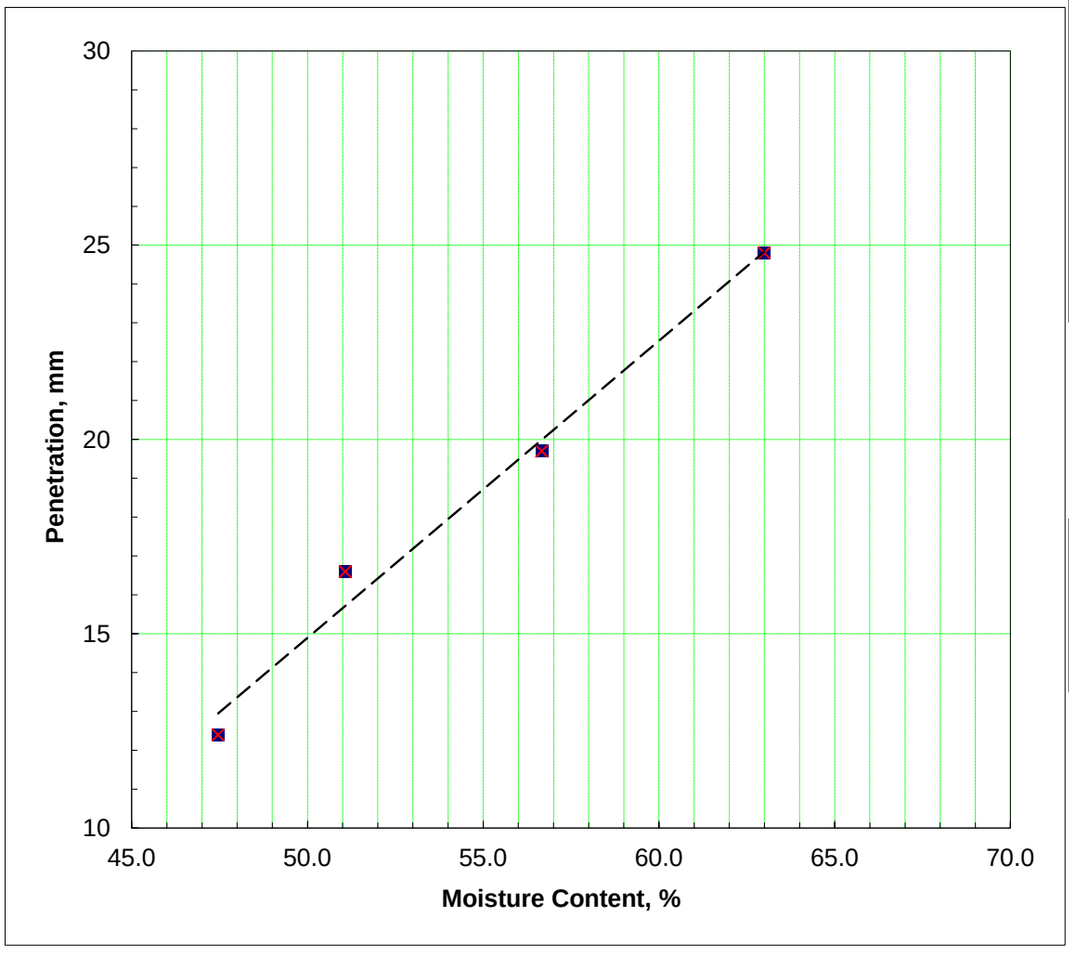
Liquidity Index ;
-0.027

Determination of Liquid Limits, Plastic Limits, and Linear Shrinkage of a Soil.

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	N. Williams
SAMPLE NO. :		DATE :	
SITE :	**Whitecliffe 2**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm	12.20	16.40	19.60	24.70		
(or other M.C. test if stated)	12.60	16.80	19.80	24.90		
	12.4	**16.6**	**19.7**	**24.8**		
CONTAINER	**5**	**6**	**7**	**8**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	28.74	24.41	23.12	21.55	12.83	14.45
WT. OF DRY SOIL + CONTAINER, g	23.59	20.44	19.46	18.12	11.29	12.83
WT. OF CONTAINER, g	12.75	12.65	13.00	12.66	4.54	5.36
WT. OF MOISTURE, g	5.15	3.98	3.66	3.44	1.53	1.63
WT. OF DRY SOIL, g	10.84	7.79	6.46	5.46	6.75	7.46
MOISTURE CONTENT, %	**47.5**	**51.1**	**56.7**	**63.0**	22.7	21.8



Liquid Limit, % ;
56.7

* Plastic Limit, % ;
22.3

Plasticity Index, % ;
34.4

Linear Shrinkage, % ;
15.7

At M.C., % ;
56.7

Trough No. ;
B

Length Dry ;
118.0

* Some Cracks before
3 mm

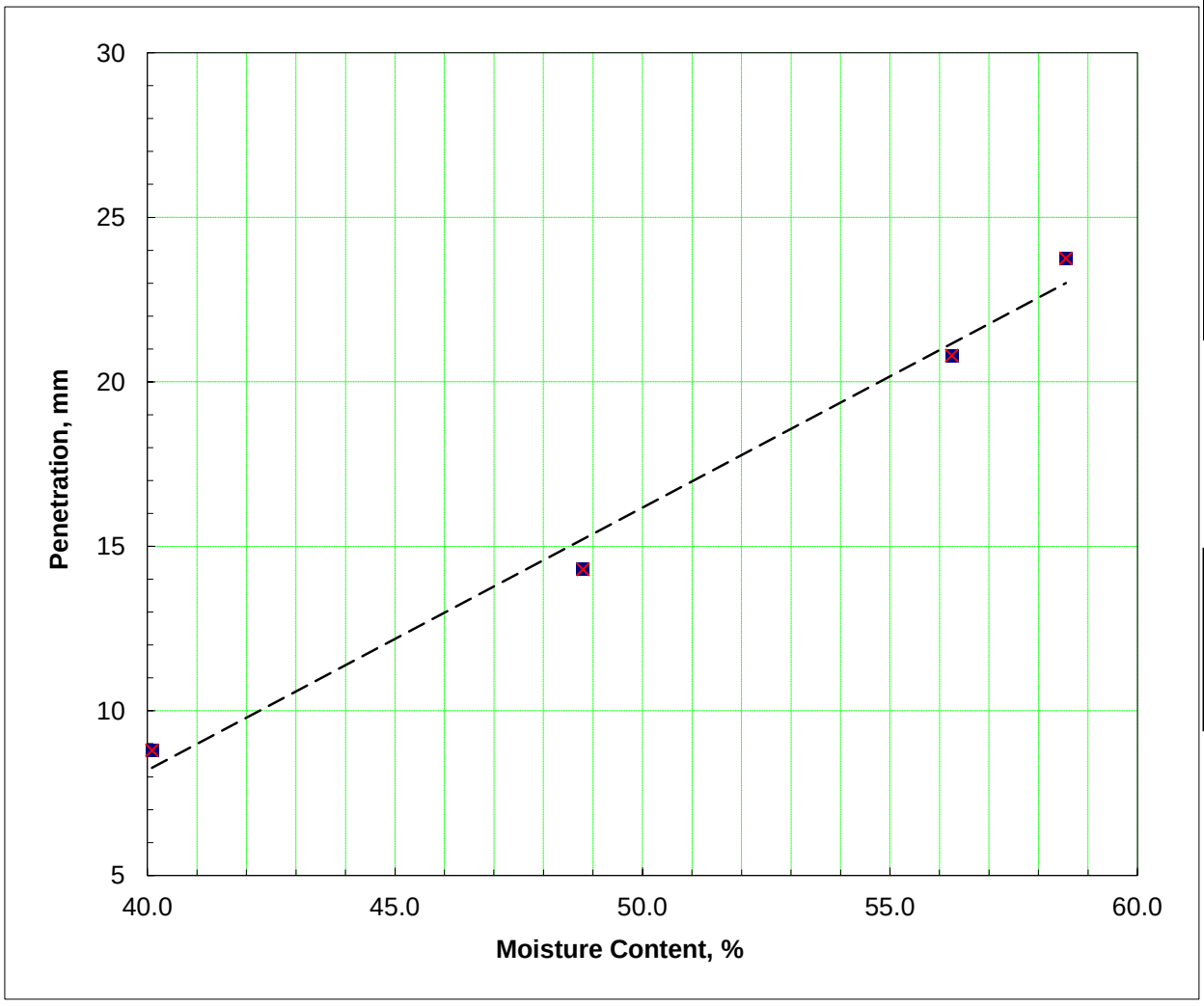
Nat Moisture Content ;
14.6

Liquidity Index ;
-0.223

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	M. P. Kirkham
SAMPLE NO. :		DATE :	04/07/2007
SITE :	**Hollingson**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm (or other M.C. test if stated)	8.80	14.30	20.80	23.75		
	8.80	14.30	20.80	23.75		
CONTAINER	**5**	**6**	**7**	**8**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	27.92	39.98	40.89	33.53	23.13	23.96
WT. OF DRY SOIL + CONTAINER, g	23.59	31.06	30.85	25.93	20.99	21.65
WT. OF CONTAINER, g	12.79	12.78	13.00	12.95	12.74	12.60
WT. OF MOISTURE, g	4.33	8.92	10.04	7.60	2.14	2.31
WT. OF DRY SOIL, g	10.80	18.28	17.85	12.98	8.25	9.05
MOISTURE CONTENT, %	**40.1**	**48.8**	**56.2**	**58.6**	25.9	25.5



Liquid Limit, % ;
55

* Plastic Limit, % ;
25.7

Plasticity Index, % ;
29.3

Linear Shrinkage, % ;
14

At M.C., % ;
17.9

Trough No. ;
F

Length Dry ;
120.0

* Some Cracks before
3 mm

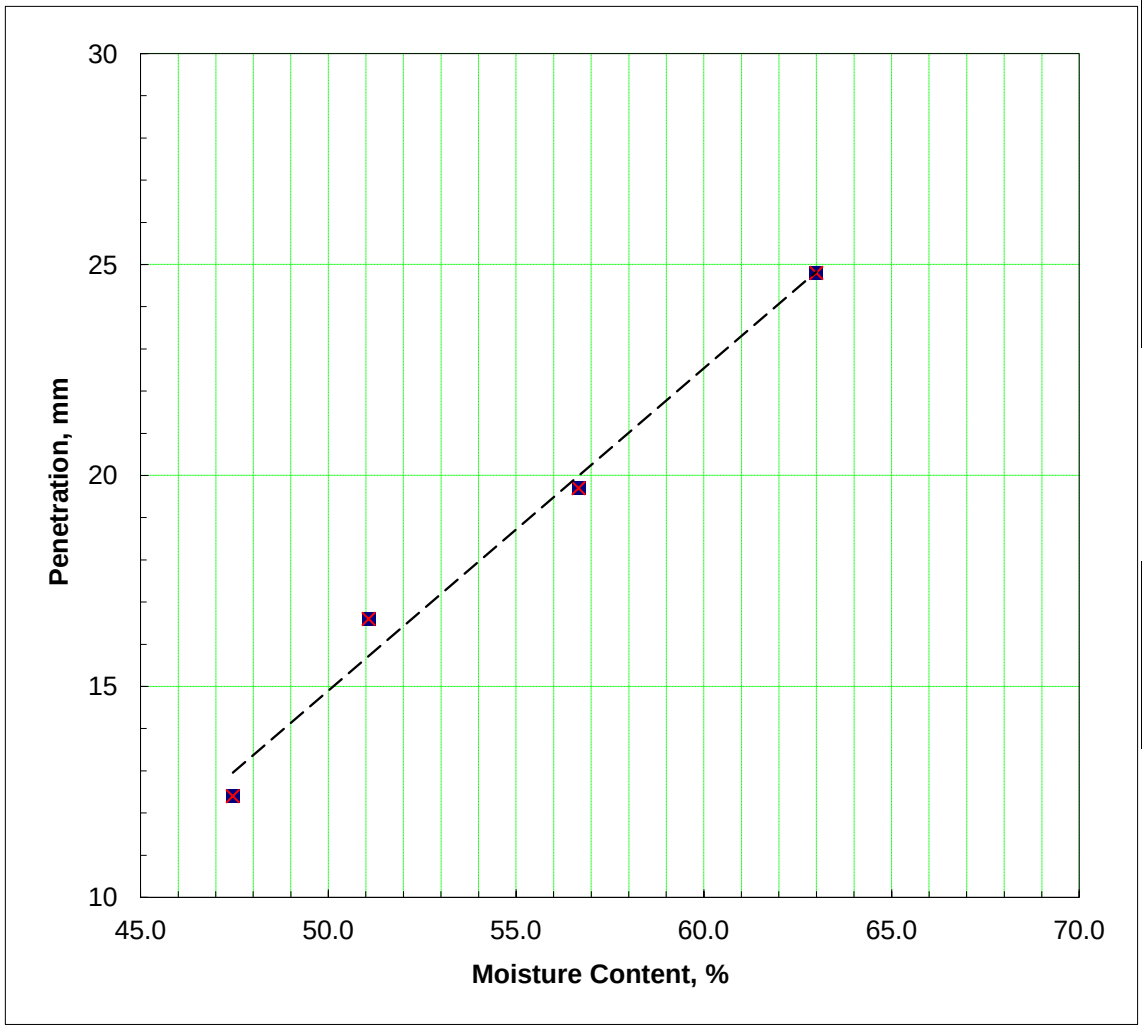
Nat Moisture Content ;
18.6

Liquidity Index ;
-0.244

ENGINEERING GEOLOGY
& GEOPHYSICS GROUP

JOB :	E1320S83	OPERATOR :	M. P. Kirkham
SAMPLE NO. :		DATE :	
SITE :	**Roxwell**	DESCRIPTION OF SAMPLE :	London Clay
TEST DETAILS :	B. S. Test		

	Liquid Limits				Plastic Limits	
	1	**2**	**3**	**4**	**I**	**II**
PENETRATION, mm (or other M.C. test if stated)	9.40	13.75	20.10	23.80		
	9.40	13.75	20.10	23.80		
CONTAINER	**5**	**6**	**7**	**8**	**III**	**IV**
WT. OF WET SOIL + CONTAINER, g	26.38	38.77	36.37	37.60	22.43	24.96
WT. OF DRY SOIL + CONTAINER, g	21.36	28.14	25.66	25.87	19.83	21.68
WT. OF CONTAINER, g	12.64	12.66	12.57	12.65	12.59	12.62
WT. OF MOISTURE, g	5.02	10.63	10.71	11.73	2.60	3.28
WT. OF DRY SOIL, g	8.72	15.48	13.09	13.22	7.24	9.06
MOISTURE CONTENT, %	**57.6**	**68.7**	**81.8**	**88.7**	35.9	36.2



Liquid Limit, % ;
81

* Plastic Limit, % ;
36.1

Plasticity Index, % ;
44.9

Linear Shrinkage, % ;
15.7

At M.C., % ;
81.8

Trough No. ;
B

Length Dry ;
118.0

* Some Cracks before
3 mm

Nat Moisture Content ;
28.6

Liquidity Index ;
-0.166

Appendix 2 - Density Test Data

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Alum Bay S1	
Pyknometer Number			359	478
Mass of Bottle+Soil+Water	m3	g	83.759	81.880
Mass of Bottle + Soil	m2	g	36.750	34.628
Mass of Bottle full of Water	m4	g	79.044	77.624
Mass of Bottle	m1	g	29.269	27.858
Mass of Soil	m2-m1	g	7.481	6.770
Mass of Water in full Bottle	m4-m1	g	49.775	49.766
Mass of Water used	m3-m2	g	47.009	47.252
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.766	2.514
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.705	2.693
Average Value, Þs		Mg/m3	2.70	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Alum Bay S2	
Pyknometer Number			483	122
Mass of Bottle+Soil+Water	m3	g	83.020	90.326
Mass of Bottle + Soil	m2	g	36.306	43.883
Mass of Bottle full of Water	m4	g	77.833	85.162
Mass of Bottle	m1	g	28.070	35.679
Mass of Soil	m2-m1	g	8.236	8.204
Mass of Water in full Bottle	m4-m1	g	49.763	49.483
Mass of Water used	m3-m2	g	46.714	46.443
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.049	3.040
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.701	2.699
Average Value, Þs		Mg/m3	2.70	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Brambledown	
Pyknometer Number			160	359
Mass of Bottle+Soil+Water	m3	g	88.267	85.156
Mass of Bottle + Soil	m2	g	39.812	38.945
Mass of Bottle full of Water	m4	g	82.583	79.044
Mass of Bottle	m1	g	30.826	29.269
Mass of Soil	m2-m1	g	8.986	9.676
Mass of Water in full Bottle	m4-m1	g	51.757	49.775
Mass of Water used	m3-m2	g	48.455	46.211
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.302	3.564
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.721	2.715
Average Value, Þs		Mg/m3	2.72	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Bulls Lodge	
Pyknometer Number			478	767
Mass of Bottle+Soil+Water	m3	g	83.748	89.200
Mass of Bottle + Soil	m2	g	37.316	42.345
Mass of Bottle full of Water	m4	g	77.623	83.160
Mass of Bottle	m1	g	27.861	33.016
Mass of Soil	m2-m1	g	9.455	9.329
Mass of Water in full Bottle	m4-m1	g	49.762	50.144
Mass of Water used	m3-m2	g	46.432	46.855
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.330	3.289
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.839	2.836
Average Value, Þs		Mg/m3	2.84	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Bulmer	
Pyknometer Number			359	483
Mass of Bottle+Soil+Water	m3	g	84.666	82.741
Mass of Bottle + Soil	m2	g	38.202	35.894
Mass of Bottle full of Water	m4	g	79.042	77.833
Mass of Bottle	m1	g	29.270	28.068
Mass of Soil	m2-m1	g	8.932	7.826
Mass of Water in full Bottle	m4-m1	g	49.772	49.765
Mass of Water used	m3-m2	g	46.464	46.847
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.308	2.918
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.700	2.682
Average Value, Þs		Mg/m3	2.69	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Colchester S1	
Pyknometer Number			767	709
Mass of Bottle+Soil+Water	m3	g	88.984	89.447
Mass of Bottle + Soil	m2	g	42.139	42.825
Mass of Bottle full of Water	m4	g	83.160	83.544
Mass of Bottle	m1	g	33.013	33.561
Mass of Soil	m2-m1	g	9.126	9.264
Mass of Water in full Bottle	m4-m1	g	50.147	49.983
Mass of Water used	m3-m2	g	46.845	46.622
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.302	3.361
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.764	2.756
Average Value, Þs		Mg/m3	2.76	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Fair Oak Sand Pit	
Pyknometer Number			14	41
Mass of Bottle+Soil+Water	m3	g	82.918	78.538
Mass of Bottle + Soil	m2	g	36.608	31.226
Mass of Bottle full of Water	m4	g	75.947	74.825
Mass of Bottle	m1	g	25.528	25.325
Mass of Soil	m2-m1	g	11.080	5.901
Mass of Water in full Bottle	m4-m1	g	50.419	49.500
Mass of Water used	m3-m2	g	46.310	47.312
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	4.109	2.188
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.697	2.697
Average Value, Þs		Mg/m3	2.70	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Farnham	
Pyknometer Number			709	1378
Mass of Bottle+Soil+Water	m3	g	90.102	86.003
Mass of Bottle + Soil	m2	g	43.876	39.807
Mass of Bottle full of Water	m4	g	83.544	80.348
Mass of Bottle	m1	g	33.561	30.923
Mass of Soil	m2-m1	g	10.315	8.884
Mass of Water in full Bottle	m4-m1	g	49.983	49.425
Mass of Water used	m3-m2	g	46.226	46.196
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.757	3.229
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.746	2.751
Average Value, Þs		Mg/m3	2.75	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Grain Quarry S1	
Pyknometer Number			14	122
Mass of Bottle+Soil+Water	m3	g	81.548	90.173
Mass of Bottle + Soil	m2	g	34.334	43.566
Mass of Bottle full of Water	m4	g	75.947	85.162
Mass of Bottle	m1	g	25.529	35.679
Mass of Soil	m2-m1	g	8.805	7.887
Mass of Water in full Bottle	m4-m1	g	50.418	49.483
Mass of Water used	m3-m2	g	47.214	46.607
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.204	2.876
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.748	2.742
Average Value, Þs		Mg/m3	2.75	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Grain Quarry S2	
Pyknometer Number			41	42
Mass of Bottle+Soil+Water	m3	g	79.010	79.081
Mass of Bottle + Soil	m2	g	31.935	31.842
Mass of Bottle full of Water	m4	g	74.825	74.720
Mass of Bottle	m1	g	25.325	24.974
Mass of Soil	m2-m1	g	6.610	6.868
Mass of Water in full Bottle	m4-m1	g	49.500	49.746
Mass of Water used	m3-m2	g	47.075	47.239
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.425	2.507
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.726	2.740
Average Value, Þs		Mg/m3	2.73	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Hollingson	
Pyknometer Number			709	478
Mass of Bottle+Soil+Water	m3	g	87.398	80.958
Mass of Bottle + Soil	m2	g	39.714	33.161
Mass of Bottle full of Water	m4	g	83.544	77.624
Mass of Bottle	m1	g	33.561	27.858
Mass of Soil	m2-m1	g	6.153	5.303
Mass of Water in full Bottle	m4-m1	g	49.983	49.766
Mass of Water used	m3-m2	g	47.684	47.797
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.299	1.969
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.676	2.693
Average Value, Þs		Mg/m3	2.68	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Knoll Manor S1	
Pyknometer Number			2052	359
Mass of Bottle+Soil+Water	m3	g	84.810	83.479
Mass of Bottle + Soil	m2	g	38.092	36.264
Mass of Bottle full of Water	m4	g	79.676	79.044
Mass of Bottle	m1	g	29.979	29.269
Mass of Soil	m2-m1	g	8.113	6.995
Mass of Water in full Bottle	m4-m1	g	49.697	49.775
Mass of Water used	m3-m2	g	46.718	47.215
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.979	2.560
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.723	2.732
Average Value, Þs		Mg/m3	2.73	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Knoll Manor S2	
Pyknometer Number			12	42
Mass of Bottle+Soil+Water	m3	g	80.703	81.093
Mass of Bottle + Soil	m2	g	34.923	35.120
Mass of Bottle full of Water	m4	g	74.635	74.720
Mass of Bottle	m1	g	25.233	24.973
Mass of Soil	m2-m1	g	9.690	10.147
Mass of Water in full Bottle	m4-m1	g	49.402	49.747
Mass of Water used	m3-m2	g	45.780	45.973
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.622	3.774
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.675	2.689
Average Value, Þs		Mg/m3	2.68	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Knowl Hill	
Pyknometer Number			12	179
Mass of Bottle+Soil+Water	m3	g	79.490	84.108
Mass of Bottle + Soil	m2	g	32.868	36.237
Mass of Bottle full of Water	m4	g	74.635	79.179
Mass of Bottle	m1	g	25.233	28.474
Mass of Soil	m2-m1	g	7.635	7.763
Mass of Water in full Bottle	m4-m1	g	49.402	50.705
Mass of Water used	m3-m2	g	46.622	47.871
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.780	2.834
Particle Density, Þs =	m2-m1 / (m4-m1)-(m3-m2)	Mg/m3	2.746	2.739
Average Value, Þs		Mg/m3	2.74	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Ockenden S1	
Pyknometer Number			767	179
Mass of Bottle+Soil+Water	m3	g	89.426	85.620
Mass of Bottle + Soil	m2	g	42.938	38.674
Mass of Bottle full of Water	m4	g	83.160	79.179
Mass of Bottle	m1	g	33.016	28.476
Mass of Soil	m2-m1	g	9.922	10.198
Mass of Water in full Bottle	m4-m1	g	50.144	50.703
Mass of Water used	m3-m2	g	46.488	46.946
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.656	3.757
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.714	2.714
Average Value, Þs		Mg/m3	2.71	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Ockenden S2	
Pyknometer Number			122	483
Mass of Bottle+Soil+Water	m3	g	91.600	84.043
Mass of Bottle + Soil	m2	g	45.823	37.882
Mass of Bottle full of Water	m4	g	85.162	77.833
Mass of Bottle	m1	g	35.679	28.069
Mass of Soil	m2-m1	g	10.144	9.813
Mass of Water in full Bottle	m4-m1	g	49.483	49.764
Mass of Water used	m3-m2	g	45.777	46.161
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.706	3.603
Particle Density, Þs =	$\frac{\text{m2-m1}}{\text{(m4-m1)-(m3-m2)}}$	Mg/m3	2.737	2.724
Average Value, Þs		Mg/m3	2.73	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Poyle	
Pyknometer Number			767	1378
Mass of Bottle+Soil+Water	m3	g	88.909	86.275
Mass of Bottle + Soil	m2	g	42.046	40.226
Mass of Bottle full of Water	m4	g	83.160	80.348
Mass of Bottle	m1	g	33.017	30.923
Mass of Soil	m2-m1	g	9.029	9.303
Mass of Water in full Bottle	m4-m1	g	50.143	49.425
Mass of Water used	m3-m2	g	46.863	46.049
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.280	3.376
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m3	2.753	2.756
Average Value, Þs		Mg/m3	2.75	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Roxwell	
Pyknometer Number			122	483
Mass of Bottle+Soil+Water	m3	g	90.654	82.467
Mass of Bottle + Soil	m2	g	44.330	35.367
Mass of Bottle full of Water	m4	g	85.162	77.833
Mass of Bottle	m1	g	35.679	28.070
Mass of Soil	m2-m1	g	8.651	7.297
Mass of Water in full Bottle	m4-m1	g	49.483	49.763
Mass of Water used	m3-m2	g	46.324	47.100
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	3.159	2.663
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m3	2.739	2.740
Average Value, Þs		Mg/m3	2.74	
		Operator	**Checked**	**Approved**

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Southleigh	
Pyknometer Number			179	709
Mass of Bottle+Soil+Water	m3	g	83.996	87.856
Mass of Bottle + Soil	m2	g	36.050	40.367
Mass of Bottle full of Water	m4	g	79.179	83.546
Mass of Bottle	m1	g	28.474	33.561
Mass of Soil	m2-m1	g	7.576	6.806
Mass of Water in full Bottle	m4-m1	g	50.705	49.985
Mass of Water used	m3-m2	g	47.946	47.489
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.759	2.496
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.746	2.727
Average Value, Þs		Mg/m^3	2.74	
		Operator	**Checked**	**Approved**
		MK	DCE	

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Stanwell	
Pyknometer Number			160	1378
Mass of Bottle+Soil+Water	m3	g	87.575	86.275
Mass of Bottle + Soil	m2	g	38.641	40.209
Mass of Bottle full of Water	m4	g	82.583	80.348
Mass of Bottle	m1	g	30.826	30.923
Mass of Soil	m2-m1	g	7.815	9.286
Mass of Water in full Bottle	m4-m1	g	51.757	49.425
Mass of Water used	m3-m2	g	48.934	46.066
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.823	3.359
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.768	2.765
Average Value, Þs		Mg/m^3	2.77	
		Operator	**Checked**	**Approved**
		MK	DCE	

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Studland	
Pyknometer Number			179	767
Mass of Bottle+Soil+Water	m3	g	83.643	87.052
Mass of Bottle + Soil	m2	g	35.652	39.282
Mass of Bottle full of Water	m4	g	79.179	83.160
Mass of Bottle	m1	g	28.474	33.016
Mass of Soil	m2-m1	g	7.178	6.266
Mass of Water in full Bottle	m4-m1	g	50.705	50.144
Mass of Water used	m3-m2	g	47.991	47.770
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.714	2.374
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.645	2.639
Average Value, Þs		Mg/m^3	2.64	
		Operator	**Checked**	**Approved**
		MK	DCE	

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Warden Point	
Pyknometer Number			42	483
Mass of Bottle+Soil+Water	m3	g	78.566	81.883
Mass of Bottle + Soil	m2	g	30.997	34.441
Mass of Bottle full of Water	m4	g	74.720	77.833
Mass of Bottle	m1	g	24.973	28.070
Mass of Soil	m2-m1	g	6.024	6.371
Mass of Water in full Bottle	m4-m1	g	49.747	49.763
Mass of Water used	m3-m2	g	47.569	47.442
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.178	2.321
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.766	2.745
Average Value, Þs		Mg/m^3	2.76	
		Operator	**Checked**	**Approved**
		MK	DCE	

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Whitecliffe Bay S1	
Pyknometer Number			14	478
Mass of Bottle+Soil+Water	m3	g	80.342	82.834
Mass of Bottle + Soil	m2	g	32.467	36.070
Mass of Bottle full of Water	m4	g	75.947	77.624
Mass of Bottle	m1	g	25.530	27.858
Mass of Soil	m2-m1	g	6.937	8.212
Mass of Water in full Bottle	m4-m1	g	50.417	49.766
Mass of Water used	m3-m2	g	47.875	46.764
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	2.542	3.002
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.729	2.736
Average Value, Þs		Mg/m^3	2.73	
		Operator	**Checked**	**Approved**
		MK	DCE	

Particle Density (Pyknometer). BS 1377: Part 2: 1990, Test 8.4

Specimen Reference			Whitecliffe Bay S2	
Pyknometer Number			478	709
Mass of Bottle+Soil+Water	m3	g	84.620	90.713
Mass of Bottle + Soil	m2	g	38.874	44.871
Mass of Bottle full of Water	m4	g	77.624	83.544
Mass of Bottle	m1	g	27.858	33.561
Mass of Soil	m2-m1	g	11.016	11.310
Mass of Water in full Bottle	m4-m1	g	49.766	49.983
Mass of Water used	m3-m2	g	45.746	45.842
Volume of Soil Particles	(m4-m1)-(m3-m2)	mL	4.020	4.141
Particle Density, Þs =	$\frac{m2-m1}{(m4-m1)-(m3-m2)}$	Mg/m^3	2.740	2.731
Average Value, Þs		Mg/m^3	2.74	
		Operator	**Checked**	**Approved**
		MK	DCE	

Appendix 3 - Particle Size Data and Plots

Project: Shrink Swell **Country:** UK
Sample No: Alum1 **Date:**

Coarse fraction analysis
Starting wt/g 201.88 g **<0.063mm** 118.39 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.040	0.0	0.0	100.0
2.00	-1.00	0.010	0.0	0.0	100.0
1.41	-0.50	0.020	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.020	0.0	0.0	100.0
0.50	1.00	0.050	0.0	0.1	99.9
0.425	1.25	0.040	0.0	0.1	99.9
0.36	1.50	0.020	0.0	0.1	99.9
0.25	2.00	0.080	0.0	0.1	99.9
0.180	2.50	0.110	0.1	0.2	99.8
0.125	3.00	0.250	0.1	0.3	99.7
0.090	3.50	16.670	8.3	8.6	91.4
0.063	4.00	66.170	32.8	41.4	58.6

Fine fraction analysis
Sample Alum1

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.88	100.0
+2	0.05	0.0
-2.0 + 0.063	83.44	41.3
- 0.063 (back calc)	118.39	58.6
Total	201.88	100

Particle size	Percentage
Gravel	0.0
Sand	41.3
Silt	27.6
Clay	31.0

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	85.4	50.1
0.050	85.0	49.8
0.040	84.3	49.4
0.030	83.8	49.1
0.025	83.6	49.0
0.020	83.6	49.0
0.015	83.0	48.7
0.010	79.5	46.6
0.0080	76.9	45.1
0.0060	73.1	42.9
0.0050	70.3	41.2
0.0040	65.4	38.4
0.0030	59.0	34.6
0.0020	52.9	31.0
0.0015	49.0	28.7
0.0010	43.0	25.2

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Alum2 **Date:**

Coarse fraction analysis
Starting wt/g 203.04 g **<0.063mm** 150.75 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.00	0.0	0.0	100.0
0.71	0.50	0.01	0.0	0.0	100.0
0.50	1.00	0.01	0.0	0.0	100.0
0.425	1.25	0.01	0.0	0.0	100.0
0.36	1.50	0.02	0.0	0.0	100.0
0.25	2.00	0.16	0.1	0.1	99.9
0.180	2.50	0.47	0.2	0.3	99.7
0.125	3.00	0.61	0.3	0.6	99.4
0.090	3.50	1.12	0.6	1.2	98.8
0.063	4.00	49.88	24.6	25.8	74.2

Fine fraction analysis
Sample Alum2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	203.04	100.0
+2	0.00	0.0
-2.0 + 0.063	52.29	25.8
- 0.063 (back calc)	150.75	74.2
Total	203.04	100

Particle size	Percentage
Gravel	0.0
Sand	25.8
Silt	45.5
Clay	28.7

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	70.5	52.3
0.050	69.0	51.2
0.040	66.5	49.4
0.030	64.4	47.8
0.025	63.9	47.4
0.020	63.9	47.4
0.015	63.8	47.4
0.010	61.7	45.8
0.0080	59.1	43.9
0.0060	55.4	41.1
0.0050	52.5	39.0
0.0040	46.9	34.8
0.0030	42.2	31.3
0.0020	38.7	28.7
0.0015	36.2	26.9
0.0010	32.9	24.4

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Brambledown **Date:**

Coarse fraction analysis
Starting wt/g 203.24 g **<0.063mm** 192.37 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.00	0.0	0.0	100.0
0.71	0.50	0.00	0.0	0.0	100.0
0.50	1.00	0.01	0.0	0.0	100.0
0.425	1.25	0.01	0.0	0.0	100.0
0.36	1.50	0.01	0.0	0.0	100.0
0.25	2.00	0.03	0.0	0.0	100.0
0.180	2.50	0.04	0.0	0.0	100.0
0.125	3.00	0.09	0.0	0.1	99.9
0.090	3.50	0.65	0.3	0.4	99.6
0.063	4.00	10.03	4.9	5.3	94.7

Fine fraction analysis
Sample Brambledown

Particle size (mm)	Wt/g	Wt %
Start weight (g)	203.24	100.0
+2	0.00	0.0
-2.0 + 0.063	10.87	5.3
- 0.063 (back calc)	192.37	94.7
Total	203.24	100

Particle size	Percentage
Gravel	0.0
Sand	5.3
Silt	50.8
Clay	43.8

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	95.4	90.3
0.050	95.3	90.2
0.040	95.3	90.2
0.030	94.9	89.8
0.025	94.4	89.4
0.020	94.1	89.1
0.015	93.3	88.3
0.010	89.7	84.9
0.0080	96.2	91.1
0.0060	79.4	75.2
0.0050	73.7	69.8
0.0040	66.0	62.5
0.0030	56.7	53.7
0.0020	46.3	43.8
0.0015	39.3	37.2
0.0010	30.0	28.4

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Bulls Lodge **Date:**

Coarse fraction analysis
Starting wt/g 201.45 g **<0.063mm** 200.19 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.010	0.0	0.0	100.0
0.50	1.00	0.010	0.0	0.0	100.0
0.425	1.25	0.010	0.0	0.0	100.0
0.36	1.50	0.010	0.0	0.0	100.0
0.25	2.00	0.010	0.0	0.0	100.0
0.180	2.50	0.010	0.0	0.0	100.0
0.125	3.00	0.010	0.0	0.0	100.0
0.090	3.50	0.080	0.0	0.1	99.9
0.063	4.00	1.100	0.5	0.6	99.4

Fine fraction analysis
Sample Bulls Lodge

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.45	100.0
+2	0.00	0.0
-2.0 + 0.063	1.26	0.6
- 0.063 (back calc)	200.19	99.4
Total	201.45	100

Particle size	Percentage
Gravel	0.0
Sand	0.6
Silt	41.9
Clay	57.4

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.7	99.1
0.050	99.1	98.5
0.040	97.3	96.7
0.030	92.9	92.3
0.025	89.8	89.2
0.020	86.7	86.2
0.015	82.7	82.2
0.010	76.0	75.5
0.0080	72.6	72.1
0.0060	69.1	68.7
0.0050	67.2	66.8
0.0040	64.9	64.5
0.0030	61.8	61.4
0.0020	57.8	57.4
0.0015	55.4	55.1
0.0010	52.1	51.8

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Bulmer S2 **Date:**

Coarse fraction analysis
Starting wt/g 202.55 g **<0.063mm** 169.35 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.02	0.0	0.0	100.0
1.00	0.00	0.07	0.0	0.0	100.0
0.71	0.50	0.14	0.1	0.1	99.9
0.50	1.00	0.21	0.1	0.2	99.8
0.425	1.25	0.12	0.1	0.3	99.7
0.36	1.50	0.08	0.0	0.3	99.7
0.25	2.00	0.23	0.1	0.4	99.6
0.180	2.50	0.17	0.1	0.5	99.5
0.125	3.00	0.15	0.1	0.6	99.4
0.090	3.50	1.09	0.5	1.1	98.9
0.063	4.00	30.92	15.3	16.4	83.6

Fine fraction analysis
Sample Bulmer S2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	202.55	100.0
+2	0.00	0.0
-2.0 + 0.063	33.20	16.4
- 0.063 (back calc)	169.35	83.6
Total	202.55	100

Particle size	Percentage
Gravel	0.0
Sand	16.4
Silt	80.4
Clay	3.2

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	97.8	81.8
0.050	97.6	81.6
0.040	96.0	80.3
0.030	90.8	75.9
0.025	88.7	74.2
0.020	87.6	73.2
0.015	83.1	69.5
0.010	76.3	63.8
0.0080	71.5	59.8
0.0060	64.9	54.3
0.0050	58.2	48.7
0.0040	36.0	30.1
0.0030	5.9	4.9
0.0020	3.8	3.2
0.0015	3.8	3.2
0.0010	3.5	2.9

% <0.425mm	99.7

Project: Shrink Swell **Country:** UK
Sample No: Colchester **Date:**

Coarse fraction analysis
Starting wt/g 200.31 g **<0.063mm** 199.59 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.040	0.0	0.0	100.0
2.83	-1.50	0.020	0.0	0.0	100.0
2.00	-1.00	0.010	0.0	0.0	100.0
1.41	-0.50	0.010	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.010	0.0	0.0	100.0
0.50	1.00	0.010	0.0	0.1	99.9
0.425	1.25	0.020	0.0	0.1	99.9
0.36	1.50	0.010	0.0	0.1	99.9
0.25	2.00	0.020	0.0	0.1	99.9
0.180	2.50	0.010	0.0	0.1	99.9
0.125	3.00	0.020	0.0	0.1	99.9
0.090	3.50	0.040	0.0	0.1	99.9
0.063	4.00	0.490	0.2	0.4	99.6

Fine fraction analysis
Sample Colchester

Particle size (mm)	Wt/g	Wt %
Start weight (g)	200.31	100.0
+2	0.07	0.0
-2.0 + 0.063	0.65	0.3
- 0.063 (back calc)	199.59	99.6
Total	200.31	100

Particle size	Percentage
Gravel	0.0
Sand	0.3
Silt	36.6
Clay	63.1

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.6	99.2
0.050	99.3	98.9
0.040	98.4	98.0
0.030	96.1	95.8
0.025	94.3	94.0
0.020	92.1	91.8
0.015	88.3	88.0
0.010	82.9	82.6
0.0080	80.6	80.3
0.0060	77.4	77.1
0.0050	75.6	75.3
0.0040	73.4	73.1
0.0030	70.4	70.1
0.0020	63.3	63.1
0.0015	63.2	63.0
0.0010	59.3	59.1

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Fair Oak **Date:**

Coarse fraction analysis
Starting wt/g 202.5 g **<0.063mm** 129.81 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.04	0.0	0.0	100.0
0.71	0.50	0.03	0.0	0.0	100.0
0.50	1.00	0.06	0.0	0.1	99.9
0.425	1.25	0.06	0.0	0.1	99.9
0.36	1.50	0.03	0.0	0.1	99.9
0.25	2.00	0.06	0.0	0.1	99.9
0.180	2.50	0.11	0.1	0.2	99.8
0.125	3.00	0.19	0.1	0.3	99.7
0.090	3.50	3.02	1.5	1.8	98.2
0.063	4.00	69.09	34.1	35.9	64.1

Fine fraction analysis
Sample Fair Oak

Particle size (mm)	Wt/g	Wt %
Start weight (g)	202.50	100.0
+2	0.00	0.0
-2.0 + 0.063	72.69	35.9
- 0.063 (back calc)	129.81	64.1
Total	202.50	100

Particle size	Percentage
Gravel	0.0
Sand	35.9
Silt	39.7
Clay	24.4

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	77.4	49.6
0.050	77.0	49.4
0.040	76.6	49.1
0.030	76.1	48.8
0.025	75.3	48.3
0.020	74.1	47.5
0.015	72.8	46.7
0.010	69.2	44.4
0.0080	66.1	42.4
0.0060	60.9	39.0
0.0050	56.2	36.0
0.0040	49.5	31.7
0.0030	43.4	27.8
0.0020	38.0	24.4
0.0015	34.0	21.8
0.0010	28.3	18.1

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Farnham **Date:**

Coarse fraction analysis
Starting wt/g 202.88 g **<0.063mm** 202.28 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.02	0.0	0.0	100.0
1.00	0.00	0.02	0.0	0.0	100.0
0.71	0.50	0.03	0.0	0.0	100.0
0.50	1.00	0.05	0.0	0.1	99.9
0.425	1.25	0.04	0.0	0.1	99.9
0.36	1.50	0.03	0.0	0.1	99.9
0.25	2.00	0.06	0.0	0.1	99.9
0.180	2.50	0.05	0.0	0.1	99.9
0.125	3.00	0.06	0.0	0.2	99.8
0.090	3.50	0.10	0.0	0.2	99.8
0.063	4.00	0.14	0.1	0.3	99.7

Fine fraction analysis
Sample Farnham

Particle size (mm)	Wt/g	Wt %
Start weight (g)	202.88	100.0
+2	0.00	0.0
-2.0 + 0.063	0.60	0.3
- 0.063 (back calc)	202.28	99.7
Total	202.88	100

Particle size	Percentage
Gravel	0.0
Sand	0.3
Silt	40.6
Clay	59.1

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.5	99.2
0.050	99.4	99.1
0.040	99.2	98.9
0.030	99.0	98.7
0.025	98.8	98.5
0.020	98.5	98.2
0.015	98.1	97.8
0.010	95.2	94.9
0.0080	91.8	91.5
0.0060	86.0	85.7
0.0050	81.7	81.5
0.0040	76.0	75.8
0.0030	68.7	68.5
0.0020	59.3	59.1
0.0015	53.8	53.6
0.0010	46.5	46.4

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Grain 1 **Date:**

Coarse fraction analysis
Starting wt/g 200.13 g **<0.063mm** 199.61 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.000	0.0	0.0	100.0
1.00	0.00	0.000	0.0	0.0	100.0
0.71	0.50	0.010	0.0	0.0	100.0
0.50	1.00	0.030	0.0	0.0	100.0
0.425	1.25	0.040	0.0	0.0	100.0
0.36	1.50	0.050	0.0	0.1	99.9
0.25	2.00	0.110	0.1	0.1	99.9
0.180	2.50	0.040	0.0	0.1	99.9
0.125	3.00	0.040	0.0	0.2	99.8
0.090	3.50	0.050	0.0	0.2	99.8
0.063	4.00	0.150	0.1	0.3	99.7

Fine fraction analysis
Sample Grain 1

Particle size (mm)	Wt/g	Wt %
Start weight (g)	200.13	100.0
+2	0.00	0.0
-2.0 + 0.063	0.52	0.3
- 0.063 (back calc)	199.61	99.7
Total	200.13	100

Particle size	Percentage
Gravel	0.0
Sand	0.3
Silt	59.9
Clay	39.8

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	98.1	97.8
0.050	98.0	97.7
0.040	97.0	96.7
0.030	93.8	93.6
0.025	91.0	90.8
0.020	86.0	85.8
0.015	77.0	76.8
0.010	62.9	62.7
0.0080	56.6	56.5
0.0060	50.8	50.7
0.0050	48.2	48.1
0.0040	45.7	45.6
0.0030	42.7	42.6
0.0020	39.9	39.8
0.0015	38.3	38.2
0.0010	35.4	35.3

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Grain 2 **Date:**

Coarse fraction analysis
Starting wt/g 204.56 g **<0.063mm** 202.81 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.00	0.0	0.0	100.0
0.71	0.50	0.01	0.0	0.0	100.0
0.50	1.00	0.01	0.0	0.0	100.0
0.425	1.25	0.01	0.0	0.0	100.0
0.36	1.50	0.01	0.0	0.0	100.0
0.25	2.00	0.03	0.0	0.0	100.0
0.180	2.50	0.03	0.0	0.0	100.0
0.125	3.00	0.05	0.0	0.1	99.9
0.090	3.50	0.15	0.1	0.1	99.9
0.063	4.00	1.45	0.7	0.9	99.1

Fine fraction analysis
Sample Grain 2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	204.56	100.0
+2	0.00	0.0
-2.0 + 0.063	1.75	0.9
- 0.063 (back calc)	202.81	99.1
Total	204.56	100

Particle size	Percentage
Gravel	0.0
Sand	0.9
Silt	33.0
Clay	66.1

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.6	98.7
0.050	99.0	98.2
0.040	97.9	97.1
0.030	96.1	95.3
0.025	94.7	93.9
0.020	93.0	92.2
0.015	90.3	89.5
0.010	85.6	84.9
0.0080	83.3	82.6
0.0060	80.1	79.4
0.0050	77.9	77.2
0.0040	75.4	74.8
0.0030	71.5	70.9
0.0020	66.7	66.1
0.0015	63.8	63.3
0.0010	59.6	59.1

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Hollingson **Date:**

Coarse fraction analysis
Starting wt/g 384 g **<0.063mm** 251.91 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.000	0.0	0.0	100.0
1.00	0.00	0.040	0.0	0.0	100.0
0.71	0.50	0.050	0.0	0.0	100.0
0.50	1.00	0.010	0.0	0.0	100.0
0.425	1.25	0.180	0.0	0.1	99.9
0.36	1.50	0.030	0.0	0.1	99.9
0.25	2.00	0.060	0.0	0.1	99.9
0.180	2.50	0.280	0.1	0.2	99.8
0.125	3.00	1.180	0.3	0.5	99.5
0.090	3.50	52.260	13.6	14.1	85.9
0.063	4.00	78.000	20.3	34.4	65.6

Fine fraction analysis
Sample Hollingson

Particle size (mm)	Wt/g	Wt %
Start weight (g)	384.00	100.0
+2	0.00	0.0
-2.0 + 0.063	132.09	34.4
- 0.063 (back calc)	251.91	65.6
Total	384.00	100

Particle size	Percentage
Gravel	0.0
Sand	34.4
Silt	26.8
Clay	38.8

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	0.0	
0.050	0.0	
0.040	98.7	64.7
0.030	95.6	62.7
0.025	93.8	61.5
0.020	91.2	59.8
0.015	87.6	57.5
0.010	83.0	54.4
0.0080	80.2	52.6
0.0060	76.7	50.3
0.0050	74.6	48.9
0.0040	70.8	46.4
0.0030	65.9	43.2
0.0020	59.1	38.8
0.0015	54.1	35.5
0.0010	49.5	32.5

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Knowl Hill **Date:**

Coarse fraction analysis
Starting wt/g 205.08 g **<0.063mm** 199.17 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.16	0.1	0.1	99.9
2.83	-1.50	0.18	0.1	0.2	99.8
2.00	-1.00	0.03	0.0	0.2	99.8
1.41	-0.50	0.06	0.0	0.2	99.8
1.00	0.00	0.03	0.0	0.2	99.8
0.71	0.50	0.04	0.0	0.2	99.8
0.50	1.00	0.04	0.0	0.3	99.7
0.425	1.25	0.02	0.0	0.3	99.7
0.36	1.50	0.03	0.0	0.3	99.7
0.25	2.00	0.06	0.0	0.3	99.7
0.180	2.50	0.07	0.0	0.4	99.6
0.125	3.00	0.21	0.1	0.5	99.5
0.090	3.50	1.40	0.7	1.1	98.9
0.063	4.00	3.58	1.7	2.9	97.1

Fine fraction analysis
Sample Knowl Hill

Particle size (mm)	Wt/g	Wt %
Start weight (g)	205.08	100.0
+2	0.37	0.2
-2.0 + 0.063	5.54	2.7
- 0.063 (back calc)	199.17	97.1
Total	205.08	100

Particle size	Percentage
Gravel	0.2
Sand	2.7
Silt	30.3
Clay	66.8

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.6	96.7
0.050	99.5	96.6
0.040	99.4	96.5
0.030	98.9	96.1
0.025	98.2	95.4
0.020	96.9	94.1
0.015	95.5	92.7
0.010	91.8	89.2
0.0080	89.4	86.8
0.0060	85.8	83.3
0.0050	83.2	80.8
0.0040	79.8	77.5
0.0030	75.0	72.8
0.0020	68.8	66.8
0.0015	65.1	63.2
0.0010	60.8	59.0

% <0.425mm	99.7

Project: Shrink Swell **Country:** UK
Sample No: Knoll Manor 1 **Date:**

Coarse fraction analysis
Starting wt/g 201.3 g **<0.063mm** 138.77 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.010	0.0	0.0	100.0
1.41	-0.50	0.110	0.1	0.1	99.9
1.00	0.00	0.150	0.1	0.1	99.9
0.71	0.50	0.130	0.1	0.2	99.8
0.50	1.00	0.200	0.1	0.3	99.7
0.425	1.25	0.270	0.1	0.4	99.6
0.36	1.50	0.220	0.1	0.5	99.5
0.25	2.00	0.430	0.2	0.8	99.2
0.180	2.50	0.510	0.3	1.0	99.0
0.125	3.00	0.380	0.2	1.2	98.8
0.090	3.50	4.420	2.2	3.4	96.6
0.063	4.00	55.700	27.7	31.1	68.9

Fine fraction analysis
Sample Knoll Manor 1

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.30	100.0
+2	0.01	0.0
-2.0 + 0.063	62.52	31.1
- 0.063 (back calc)	138.77	68.9
Total	201.30	100

Particle size	Percentage
Gravel	0.0
Sand	31.1
Silt	46.0
Clay	22.9

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	80.7	55.6
0.050	80.3	55.4
0.040	79.8	55.0
0.030	79.3	54.7
0.025	79.2	54.6
0.020	79.2	54.6
0.015	77.8	53.6
0.010	71.5	49.3
0.0080	66.6	45.9
0.0060	59.4	40.9
0.0050	54.6	37.6
0.0040	47.8	33.0
0.0030	40.2	27.7
0.0020	33.2	22.9
0.0015	28.5	19.6
0.0010	21.8	15.0

% <0.425mm	99.6

Project: Shrink Swell **Country:** UK
Sample No: Knoll Manor 2 **Date:**

Coarse fraction analysis
Starting wt/g 204.12 g **<0.063mm** 167.99 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	1.39	0.7	0.7	99.3
2.83	-1.50	1.14	0.6	1.2	98.8
2.00	-1.00	0.92	0.5	1.7	98.3
1.41	-0.50	0.18	0.1	1.8	98.2
1.00	0.00	0.56	0.3	2.1	97.9
0.71	0.50	0.78	0.4	2.4	97.6
0.50	1.00	0.91	0.4	2.9	97.1
0.425	1.25	0.37	0.2	3.1	96.9
0.36	1.50	0.29	0.1	3.2	96.8
0.25	2.00	0.74	0.4	3.6	96.4
0.180	2.50	0.70	0.3	3.9	96.1
0.125	3.00	0.59	0.3	4.2	95.8
0.090	3.50	4.30	2.1	6.3	93.7
0.063	4.00	23.26	11.4	17.7	82.3

Fine fraction analysis
Sample Knoll Manor 2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	204.12	100.0
+2	3.45	1.7
-2.0 + 0.063	32.68	16.0
- 0.063 (back calc)	167.99	82.3
Total	204.12	100

Particle size	Percentage
Gravel	1.7
Sand	16.0
Silt	37.2
Clay	45.1

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	100.4	82.6
0.050	99.9	82.2
0.040	97.7	80.4
0.030	93.4	76.9
0.025	90.8	74.7
0.020	87.5	72.0
0.015	82.9	68.2
0.010	75.3	62.0
0.0080	71.3	58.7
0.0060	67.2	55.3
0.0050	64.8	53.3
0.0040	61.7	50.8
0.0030	56.4	46.4
0.0020	54.8	45.1
0.0015	52.1	42.9
0.0010	47.5	39.1

% <0.425mm	96.9

Project: Shrink Swell **Country:** UK
Sample No: Ockendon S1 **Date:**

Coarse fraction analysis
Starting wt/g 209.41 g **<0.063mm** 209.19 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.000	0.0	0.0	100.0
1.00	0.00	0.000	0.0	0.0	100.0
0.71	0.50	0.000	0.0	0.0	100.0
0.50	1.00	0.010	0.0	0.0	100.0
0.425	1.25	0.010	0.0	0.0	100.0
0.36	1.50	0.010	0.0	0.0	100.0
0.25	2.00	0.010	0.0	0.0	100.0
0.180	2.50	0.010	0.0	0.0	100.0
0.125	3.00	0.010	0.0	0.0	100.0
0.090	3.50	0.010	0.0	0.0	100.0
0.063	4.00	0.150	0.1	0.1	99.9

Fine fraction analysis
Sample Ockendon S1

Particle size (mm)	Wt/g	Wt %
Start weight (g)	209.41	100.0
+2	0.00	0.0
-2.0 + 0.063	0.22	0.1
- 0.063 (back calc)	209.19	99.9
Total	209.41	100

Particle size	Percentage
Gravel	0.0
Sand	0.1
Silt	33.3
Clay	66.6

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.4	99.3
0.050	99.0	98.9
0.040	98.2	98.1
0.030	96.5	96.4
0.025	94.9	94.8
0.020	92.5	92.4
0.015	89.6	89.5
0.010	85.1	85.0
0.0080	82.8	82.7
0.0060	79.2	79.1
0.0050	77.1	77.0
0.0040	74.9	74.8
0.0030	71.4	71.3
0.0020	66.7	66.6
0.0015	63.5	63.4
0.0010	59.4	59.3

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Ockendon S2 **Date:**

Coarse fraction analysis
Starting wt/g 200.09 g **<0.063mm** 193.23 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.02	0.0	0.0	100.0
1.00	0.00	0.01	0.0	0.0	100.0
0.71	0.50	0.04	0.0	0.0	100.0
0.50	1.00	0.08	0.0	0.1	99.9
0.425	1.25	0.04	0.0	0.1	99.9
0.36	1.50	0.02	0.0	0.1	99.9
0.25	2.00	0.70	0.3	0.5	99.5
0.180	2.50	0.09	0.0	0.5	99.5
0.125	3.00	0.17	0.1	0.6	99.4
0.090	3.50	0.26	0.1	0.7	99.3
0.063	4.00	5.43	2.7	3.4	96.6

Fine fraction analysis
Sample Ockendon S2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	200.09	100.0
+2	0.00	0.0
-2.0 + 0.063	6.86	3.4
- 0.063 (back calc)	193.23	96.6
Total	200.09	100

Particle size	Percentage
Gravel	0.0
Sand	3.4
Silt	39.4
Clay	57.2

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.5	96.1
0.050	98.8	95.4
0.040	96.8	93.5
0.030	93.0	89.8
0.025	90.8	87.7
0.020	87.8	84.8
0.015	84.1	81.2
0.010	78.2	75.5
0.0080	75.1	72.5
0.0060	71.9	69.4
0.0050	69.4	67.0
0.0040	66.8	64.5
0.0030	63.6	61.4
0.0020	59.2	57.2
0.0015	56.7	54.8
0.0010	53.7	51.9

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Poyle **Date:**

Coarse fraction analysis
Starting wt/g 201.3 g **<0.063mm** 200.47 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.02	0.0	0.0	100.0
1.00	0.00	0.01	0.0	0.0	100.0
0.71	0.50	0.01	0.0	0.0	100.0
0.50	1.00	0.01	0.0	0.0	100.0
0.425	1.25	0.01	0.0	0.0	100.0
0.36	1.50	0.01	0.0	0.0	100.0
0.25	2.00	0.01	0.0	0.0	100.0
0.180	2.50	0.01	0.0	0.0	100.0
0.125	3.00	0.01	0.0	0.0	100.0
0.090	3.50	0.05	0.0	0.1	99.9
0.063	4.00	0.68	0.3	0.4	99.6

Fine fraction analysis
Sample Poyle

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.30	100.0
+2	0.00	0.0
-2.0 + 0.063	0.83	0.4
- 0.063 (back calc)	200.47	99.6
Total	201.30	100

Particle size	Percentage
Gravel	0.0
Sand	0.4
Silt	32.3
Clay	67.3

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.7	99.3
0.050	99.6	99.2
0.040	99.0	98.6
0.030	99.2	98.8
0.025	98.6	98.2
0.020	97.3	96.9
0.015	95.0	94.6
0.010	90.3	89.9
0.0080	87.3	86.9
0.0060	83.3	83.0
0.0050	80.7	80.4
0.0040	77.5	77.2
0.0030	73.0	72.7
0.0020	67.6	67.3
0.0015	64.2	63.9
0.0010	59.9	59.7

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Roxwell **Date:**

Coarse fraction analysis
Starting wt/g 304.18 g **<0.063mm** 303.14 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.02	0.0	0.0	100.0
1.41	-0.50	0.01	0.0	0.0	100.0
1.00	0.00	0.02	0.0	0.0	100.0
0.71	0.50	0.03	0.0	0.0	100.0
0.50	1.00	0.03	0.0	0.0	100.0
0.425	1.25	0.02	0.0	0.0	100.0
0.36	1.50	0.03	0.0	0.1	99.9
0.25	2.00	0.08	0.0	0.1	99.9
0.180	2.50	0.08	0.0	0.1	99.9
0.125	3.00	0.12	0.0	0.1	99.9
0.090	3.50	0.12	0.0	0.2	99.8
0.063	4.00	0.48	0.2	0.3	99.7

Fine fraction analysis
Sample Roxwell

Particle size (mm)	Wt/g	Wt %
Start weight (g)	304.18	100.0
+2	0.02	0.0
-2.0 + 0.063	1.02	0.3
- 0.063 (back calc)	303.14	99.7
Total	304.18	100

Particle size	Percentage
Gravel	0.0
Sand	0.3
Silt	34.6
Clay	65.1

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	100.3	100.0
0.050	100.3	100.0
0.040	100.3	100.0
0.030	99.3	99.0
0.025	98.2	97.9
0.020	96.5	96.2
0.015	93.8	93.5
0.010	88.8	88.5
0.0080	86.3	86.0
0.0060	82.9	82.6
0.0050	80.6	80.3
0.0040	77.9	77.6
0.0030	74.1	73.8
0.0020	65.3	65.1
0.0015	64.3	64.1
0.0010	62.0	61.8

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Southleigh **Date:**

Coarse fraction analysis
Starting wt/g 204.74 g **<0.063mm** 201.25 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.030	0.0	0.0	100.0
1.41	-0.50	0.010	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.020	0.0	0.0	100.0
0.50	1.00	0.020	0.0	0.0	100.0
0.425	1.25	0.010	0.0	0.0	100.0
0.36	1.50	0.010	0.0	0.1	99.9
0.25	2.00	0.020	0.0	0.1	99.9
0.180	2.50	0.020	0.0	0.1	99.9
0.125	3.00	0.060	0.0	0.1	99.9
0.090	3.50	0.270	0.1	0.2	99.8
0.063	4.00	3.010	1.5	1.7	98.3

Fine fraction analysis
Sample Southleigh

Particle size (mm)	Wt/g	Wt %
Start weight (g)	204.74	100.0
+2	0.03	0.0
-2.0 + 0.063	3.46	1.7
- 0.063 (back calc)	201.25	98.3
Total	204.74	100

Particle size	Percentage
Gravel	0.0
Sand	1.7
Silt	46.9
Clay	51.4

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	87.8	86.3
0.050	87.5	86.0
0.040	87.4	85.9
0.030	87.3	85.8
0.025	87.2	85.7
0.020	87.1	85.6
0.015	86.6	85.1
0.010	82.7	81.3
0.0080	80.0	78.6
0.0060	75.2	73.9
0.0050	71.7	70.5
0.0040	66.1	65.0
0.0030	58.8	57.8
0.0020	52.3	51.4
0.0015	48.2	47.4
0.0010	42.2	41.5

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Stanwell **Date:**

Coarse fraction analysis
Starting wt/g 201.29 g **<0.063mm** 200.42 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.050	0.0	0.0	100.0
2.00	-1.00	0.040	0.0	0.0	100.0
1.41	-0.50	0.010	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.1	99.9
0.71	0.50	0.010	0.0	0.1	99.9
0.50	1.00	0.030	0.0	0.1	99.9
0.425	1.25	0.020	0.0	0.1	99.9
0.36	1.50	0.020	0.0	0.1	99.9
0.25	2.00	0.030	0.0	0.1	99.9
0.180	2.50	0.030	0.0	0.1	99.9
0.125	3.00	0.020	0.0	0.1	99.9
0.090	3.50	0.060	0.0	0.2	99.8
0.063	4.00	0.540	0.3	0.4	99.6

Fine fraction analysis
Sample Stanwell

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.29	100.0
+2	0.09	0.0
-2.0 + 0.063	0.78	0.4
- 0.063 (back calc)	200.42	99.6
Total	201.29	100

Particle size	Percentage
Gravel	0.0
Sand	0.4
Silt	31.2
Clay	68.4

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	100.0	99.6
0.050	100.0	99.6
0.040	99.9	99.5
0.030	99.0	98.6
0.025	98.3	97.9
0.020	97.4	97.0
0.015	95.6	95.2
0.010	91.9	91.5
0.0080	88.9	88.5
0.0060	84.8	84.4
0.0050	82.2	81.8
0.0040	79.0	78.7
0.0030	74.5	74.2
0.0020	68.7	68.4
0.0015	65.0	64.7
0.0010	59.4	59.1

% <0.425mm	99.9

Project: Shrink Swell **Country:** UK
Sample No: Studland **Date:**

Coarse fraction analysis
Starting wt/g 201.01 g **<0.063mm** 102.23 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.030	0.0	0.0	100.0
2.00	-1.00	0.040	0.0	0.0	100.0
1.41	-0.50	0.140	0.1	0.1	99.9
1.00	0.00	0.110	0.1	0.2	99.8
0.71	0.50	0.110	0.1	0.2	99.8
0.50	1.00	0.330	0.2	0.4	99.6
0.425	1.25	0.550	0.3	0.7	99.3
0.36	1.50	0.760	0.4	1.0	99.0
0.25	2.00	8.210	4.1	5.1	94.9
0.180	2.50	19.250	9.6	14.7	85.3
0.125	3.00	45.530	22.7	37.3	62.7
0.090	3.50	17.200	8.6	45.9	54.1
0.063	4.00	6.520	3.2	49.1	50.9

Fine fraction analysis
Sample Studland

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.01	100.0
+2	0.07	0.0
-2.0 + 0.063	98.71	49.1
- 0.063 (back calc)	102.23	50.9
Total	201.01	100

Particle size	Percentage
Gravel	0.0
Sand	49.1
Silt	13.2
Clay	37.6

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	100.0	50.9
0.050	99.8	50.8
0.040	99.2	50.5
0.030	97.6	49.6
0.025	96.7	49.2
0.020	95.9	48.8
0.015	93.6	47.6
0.010	89.7	45.6
0.0080	87.7	44.6
0.0060	84.8	43.1
0.0050	83.0	42.2
0.0040	80.7	41.0
0.0030	77.8	39.6
0.0020	74.0	37.6
0.0015	72.0	36.6
0.0010	69.1	35.1

% <0.425mm	99.3

Project: Shrink Swell **Country:** UK
Sample No: Warden Point **Date:**

Coarse fraction analysis
Starting wt/g 203.21 g **<0.063mm** 202.06 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.00	0.0	0.0	100.0
6.73	-2.75	0.00	0.0	0.0	100.0
5.66	-2.5	0.00	0.0	0.0	100.0
4.76	-2.25	0.00	0.0	0.0	100.0
4.00	-2	0.00	0.0	0.0	100.0
2.83	-1.50	0.00	0.0	0.0	100.0
2.00	-1.00	0.00	0.0	0.0	100.0
1.41	-0.50	0.00	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.010	0.0	0.0	100.0
0.50	1.00	0.010	0.0	0.0	100.0
0.425	1.25	0.010	0.0	0.0	100.0
0.36	1.50	0.010	0.0	0.0	100.0
0.25	2.00	0.010	0.0	0.0	100.0
0.180	2.50	0.010	0.0	0.0	100.0
0.125	3.00	0.010	0.0	0.0	100.0
0.090	3.50	0.080	0.0	0.1	99.9
0.063	4.00	0.990	0.5	0.6	99.4

Fine fraction analysis
Sample Warden Point

Particle size (mm)	Wt/g	Wt %
Start weight (g)	203.21	100.0
+2	0.00	0.0
-2.0 + 0.063	1.15	0.6
- 0.063 (back calc)	202.06	99.4
Total	203.21	100

Particle size	Percentage
Gravel	0.0
Sand	0.6
Silt	27.0
Clay	72.4

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	99.4	98.8
0.050	99.2	98.6
0.040	99.2	98.6
0.030	99.1	98.5
0.025	98.9	98.3
0.020	98.2	97.6
0.015	96.6	96.1
0.010	93.7	93.2
0.0080	91.5	91.0
0.0060	88.1	87.6
0.0050	86.0	85.5
0.0040	83.0	82.5
0.0030	79.0	78.6
0.0020	72.8	72.4
0.0015	69.3	68.9
0.0010	65.0	64.6

% <0.425mm	100.0

Project: Shrink Swell **Country:** UK
Sample No: Whitecliffe2 **Date:**

Coarse fraction analysis
Starting wt/g 201.34 g **<0.063mm** 193.70 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.000	0.0	0.0	100.0
1.00	0.00	0.000	0.0	0.0	100.0
0.71	0.50	0.000	0.0	0.0	100.0
0.50	1.00	0.000	0.0	0.0	100.0
0.425	1.25	0.010	0.0	0.0	100.0
0.36	1.50	0.010	0.0	0.0	100.0
0.25	2.00	0.020	0.0	0.0	100.0
0.180	2.50	0.020	0.0	0.0	100.0
0.125	3.00	0.050	0.0	0.1	99.9
0.090	3.50	0.240	0.1	0.2	99.8
0.063	4.00	7.290	3.6	3.8	96.2

Fine fraction analysis
Sample Whitecliffe2

Particle size (mm)	Wt/g	Wt %
Start weight (g)	201.34	100.0
+2	0.00	0.0
-2.0 + 0.063	7.64	3.8
- 0.063 (back calc)	193.70	96.2
Total	201.34	100

Particle size	Percentage
Gravel	0.0
Sand	3.8
Silt	50.0
Clay	46.2

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	82.1	79.0
0.050	81.7	78.6
0.040	81.0	77.9
0.030	80.5	77.4
0.025	80.3	77.3
0.020	79.5	76.5
0.015	77.8	74.8
0.010	73.9	71.1
0.0080	70.8	68.1
0.0060	66.9	64.4
0.0050	64.2	61.8
0.0040	59.1	56.9
0.0030	53.2	51.2
0.0020	48.0	46.2
0.0015	44.9	43.2
0.0010	40.2	38.7

% <0.425mm	100.0

Project:	**Shrink Swell**	**Country:**	UK
Sample No:	**Whitecliffe 1**	**Date:**	

Coarse fraction analysis

Starting wt/g 203.13 g **<0.063mm** 139.69 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.020	0.0	0.0	100.0
1.00	0.00	0.010	0.0	0.0	100.0
0.71	0.50	0.030	0.0	0.0	100.0
0.50	1.00	0.160	0.1	0.1	99.9
0.425	1.25	0.490	0.2	0.3	99.7
0.36	1.50	0.970	0.5	0.8	99.2
0.25	2.00	4.460	2.2	3.0	97.0
0.180	2.50	3.620	1.8	4.8	95.2
0.125	3.00	3.490	1.7	6.5	93.5
0.090	3.50	15.870	7.8	14.3	85.7
0.063	4.00	34.320	16.9	31.2	68.8

Fine fraction analysis

Sample Whitecliffe 1

Particle size (mm)	Wt/g	Wt %
Start weight (g)	203.13	100.0
+2	0.00	0.0
-2.0 + 0.063	63.44	31.2
- 0.063 (back calc)	139.69	68.8
Total	203.13	100

Particle size	Percentage
Gravel	0.0
Sand	31.2
Silt	38.5
Clay	30.3

Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	81.7	56.2
0.050	81.6	56.1
0.040	81.3	55.9
0.030	80.5	55.4
0.025	80.0	55.0
0.020	79.6	54.7
0.015	77.5	53.3
0.010	73.0	50.2
0.0080	69.3	47.7
0.0060	64.5	44.4
0.0050	61.3	42.2
0.0040	55.6	38.2
0.0030	49.3	33.9
0.0020	44.0	30.3
0.0015	40.3	27.7
0.0010	35.9	24.7

% <0.425mm	99.7

Project: Shrink Swell **Country:** UK
Sample No: Bulmer r **Date:**

Coarse fraction analysis

Starting wt/g 202.5 g **<0.063mm** 169.30 g

Sieve Size (mm)	Sieve Size (ø)	Retained Weight (g)	% Retained	Total % Retained	% Passing
8.00	-3	0.000	0.0	0.0	100.0
6.73	-2.75	0.000	0.0	0.0	100.0
5.66	-2.5	0.000	0.0	0.0	100.0
4.76	-2.25	0.000	0.0	0.0	100.0
4.00	-2	0.000	0.0	0.0	100.0
2.83	-1.50	0.000	0.0	0.0	100.0
2.00	-1.00	0.000	0.0	0.0	100.0
1.41	-0.50	0.02	0.0	0.0	100.0
1.00	0.00	0.07	0.0	0.0	100.0
0.71	0.50	0.14	0.1	0.1	99.9
0.50	1.00	0.21	0.1	0.2	99.8
0.425	1.25	0.12	0.1	0.3	99.7
0.36	1.50	0.08	0.0	0.3	99.7
0.25	2.00	0.23	0.1	0.4	99.6
0.180	2.50	0.17	0.1	0.5	99.5
0.125	3.00	0.15	0.1	0.6	99.4
0.090	3.50	1.09	0.5	1.1	98.9
0.063	4.00	30.92	15.3	16.4	83.6

Fine fraction analysis

Sample Bulmer r

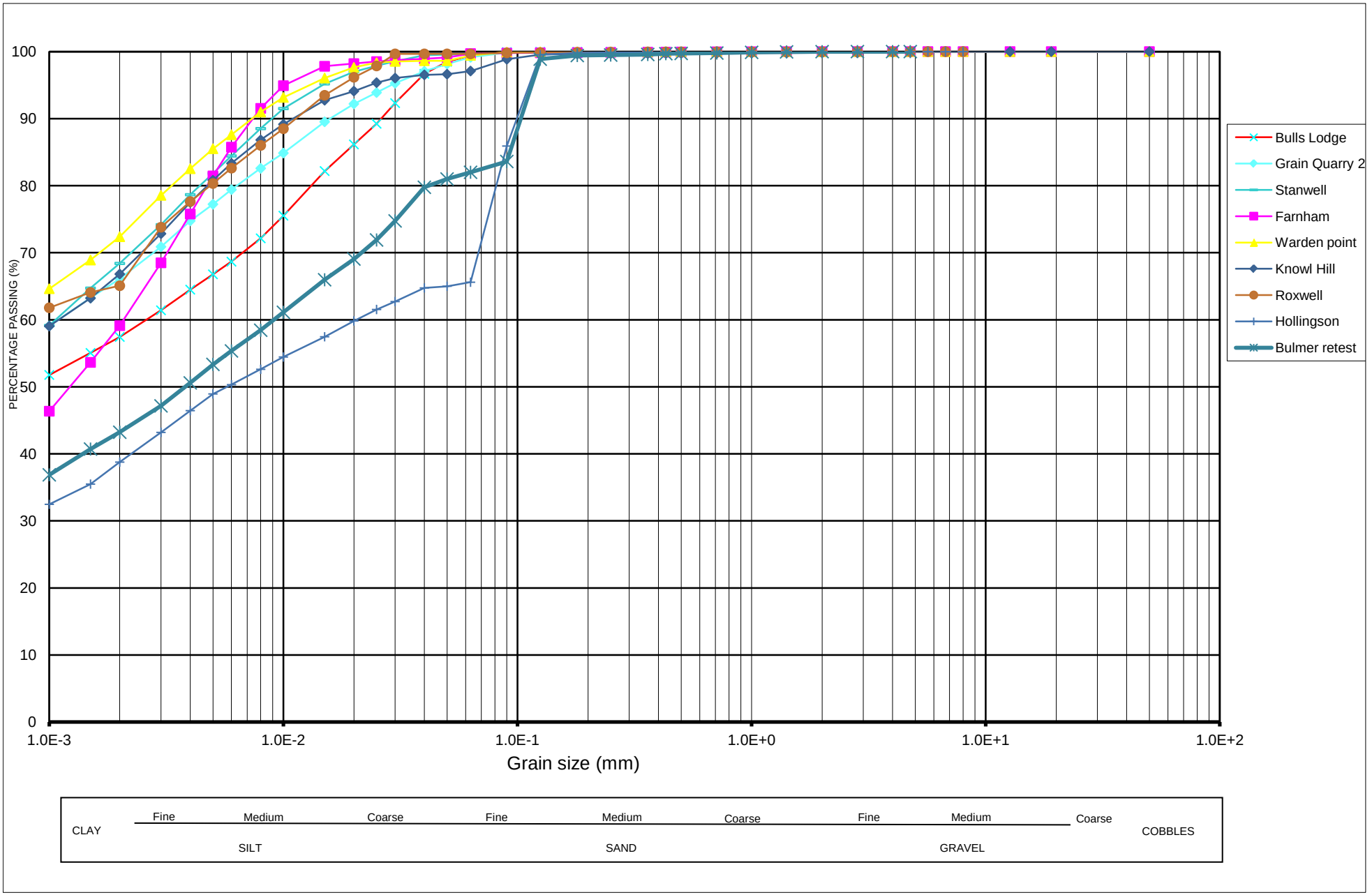
Particle size (mm)	Wt/g	Wt %
Start weight (g)	202.50	100.0
+2	0.00	0.0
-2.0 + 0.063	33.20	16.4
- 0.063 (back calc)	169.30	83.6
Total	202.50	100

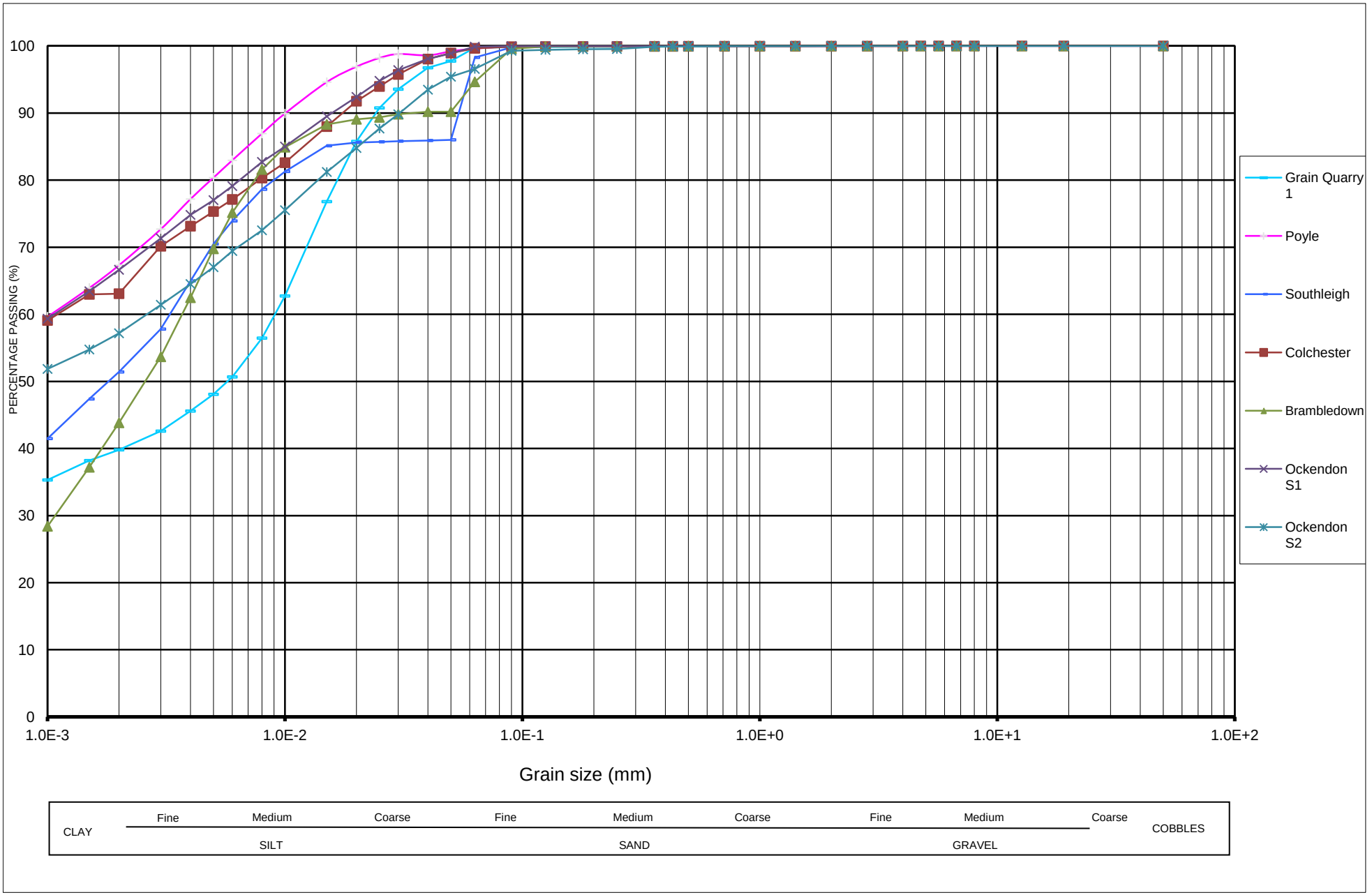
Particle size	Percentage
Gravel	0.0
Sand	16.4
Silt	36.4
Clay	47.2

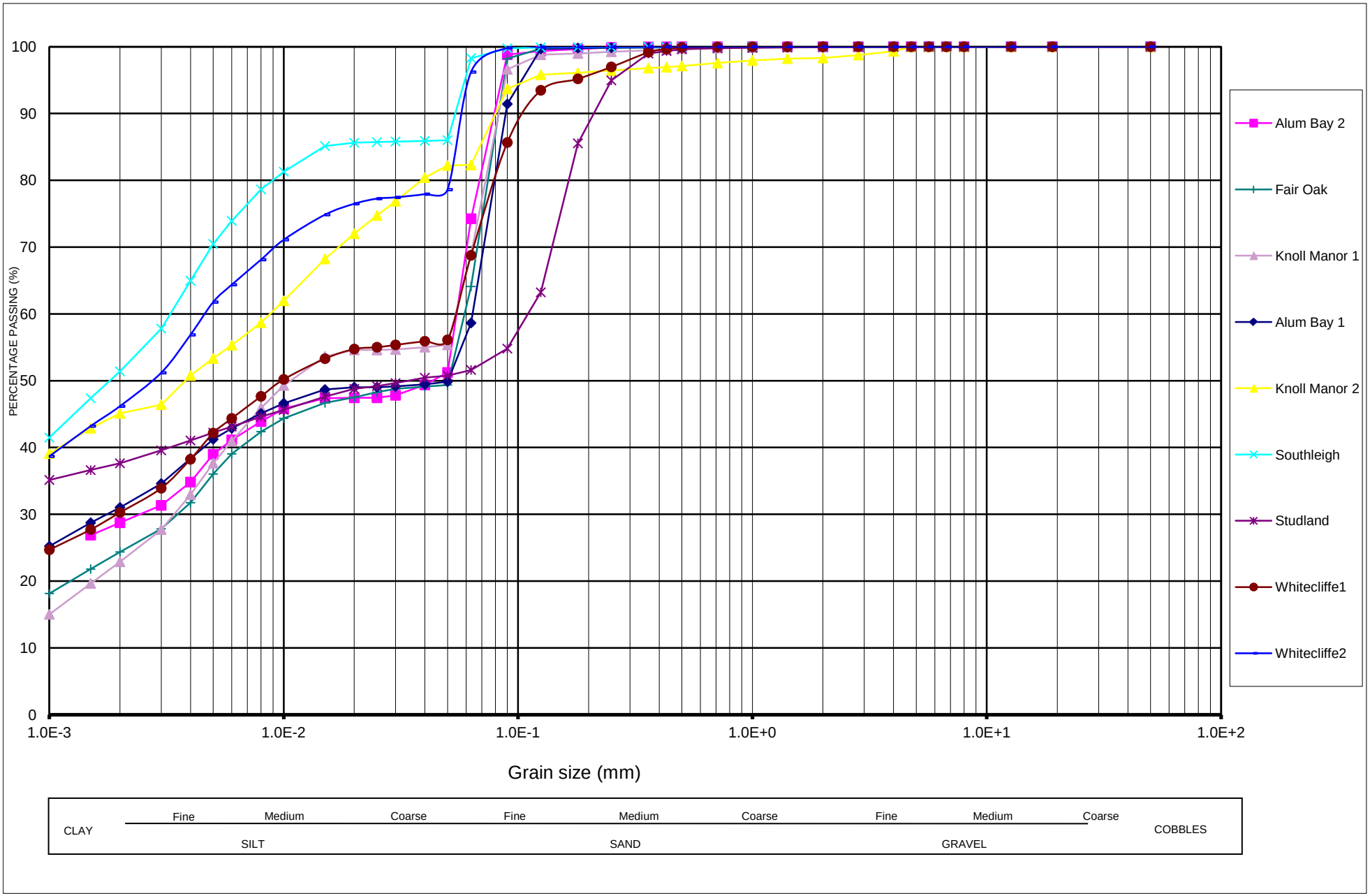
Sedigraph

Particle size (mm)	Cumulative Wt%	Cumulative correct < wt%
0.060	0.0	
0.050	0.0	
0.040	95.4	79.8
0.030	89.4	74.7
0.025	86.0	71.9
0.020	82.6	69.1
0.015	78.9	66.0
0.010	73.1	61.1
0.0080	69.9	58.4
0.0060	66.2	55.3
0.0050	63.8	53.3
0.0040	60.5	50.6
0.0030	56.4	47.2
0.0020	56.4	43.2
0.0015	48.7	40.7
0.0010	51.7	36.9

% <0.425mm	99.7


100
90
80
70
60
50
40
30
20
10
0
PERCENTAGE PASSING (%)
1.0E-3
1.0E-2
1.0E-1
1.0E+0
1.0E+1
1.0E+2
Grain size (mm)
Bulls Lodge
Grain Quarry 2
Stanwell
Farnham
Warden point
Knowl Hill
Roxwell
Hollingson
Bulmer retest
CLAY
Fine
Medium
Coarse
Fine
Medium
Coarse
Fine
Medium
Coarse
COBBLES
SILT
SAND
GRAVEL


100
90
80
70
60
50
40
30
20
10
0
PERCENTAGE PASSING (%)
1.0E-3
1.0E-2
1.0E-1
1.0E+0
1.0E+1
1.0E+2
Grain size (mm)
Grain Quarry 1
Poyle
Southleigh
Colchester
Brambledown
Ockendon S1
Ockendon S2
CLAY
Fine
Medium
Coarse
Fine
Medium
Coarse
Fine
Medium
Coarse
COBBLES
SILT
SAND
GRAVEL


PERCENTAGE PASSING (%)
100
90
80
70
60
50
40
30
20
10
0
1.0E-3
1.0E-2
1.0E-1
1.0E+0
1.0E+1
1.0E+2
Grain size (mm)
Alum Bay 2
Fair Oak
Knoll Manor 1
Alum Bay 1
Knoll Manor 2
Southleigh
Studland
Whitecliffe1
Whitecliffe2
CLAY
Fine
Medium
Coarse
Fine
Medium
Coarse
Fine
Medium
Coarse
COBBLES
SILT
SAND
GRAVEL

Appendix 4 – Swelling Test Data

1D Swell Strain test

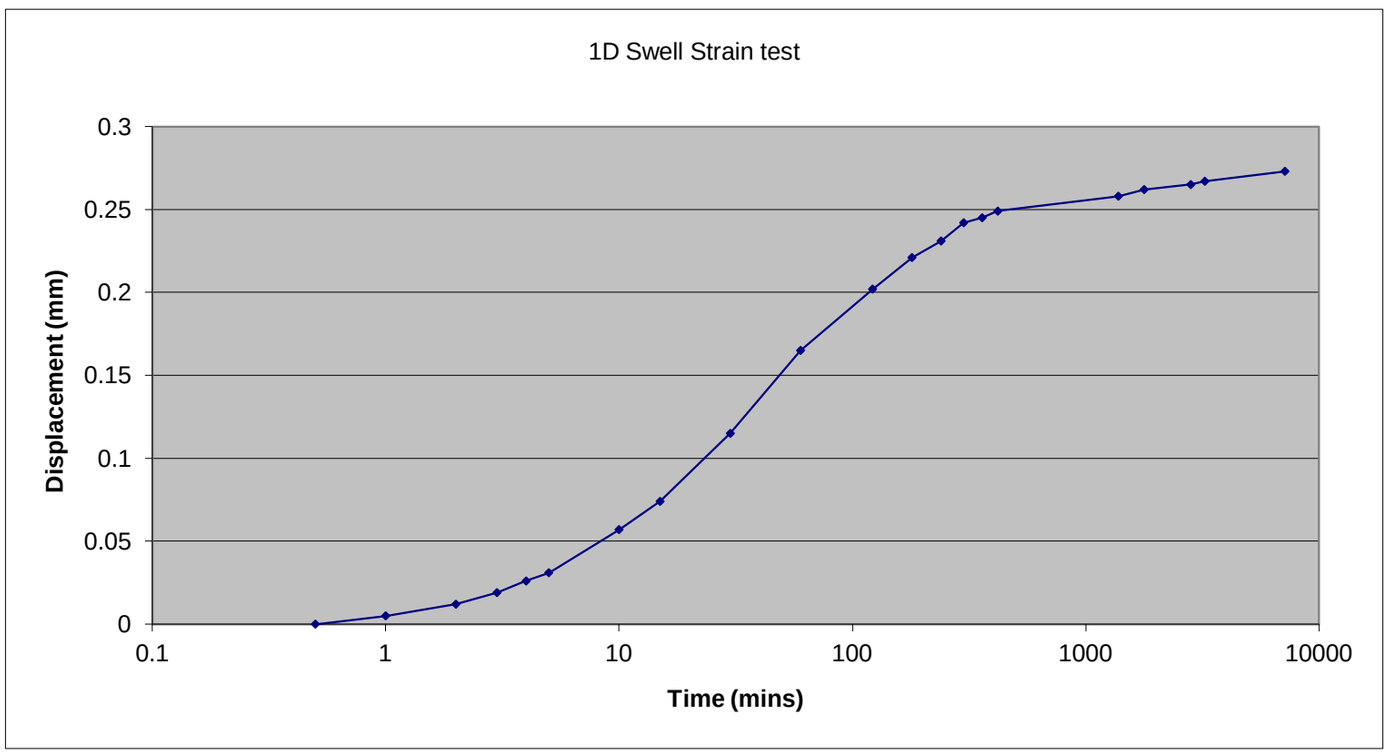
Sample I.D: Brambledown

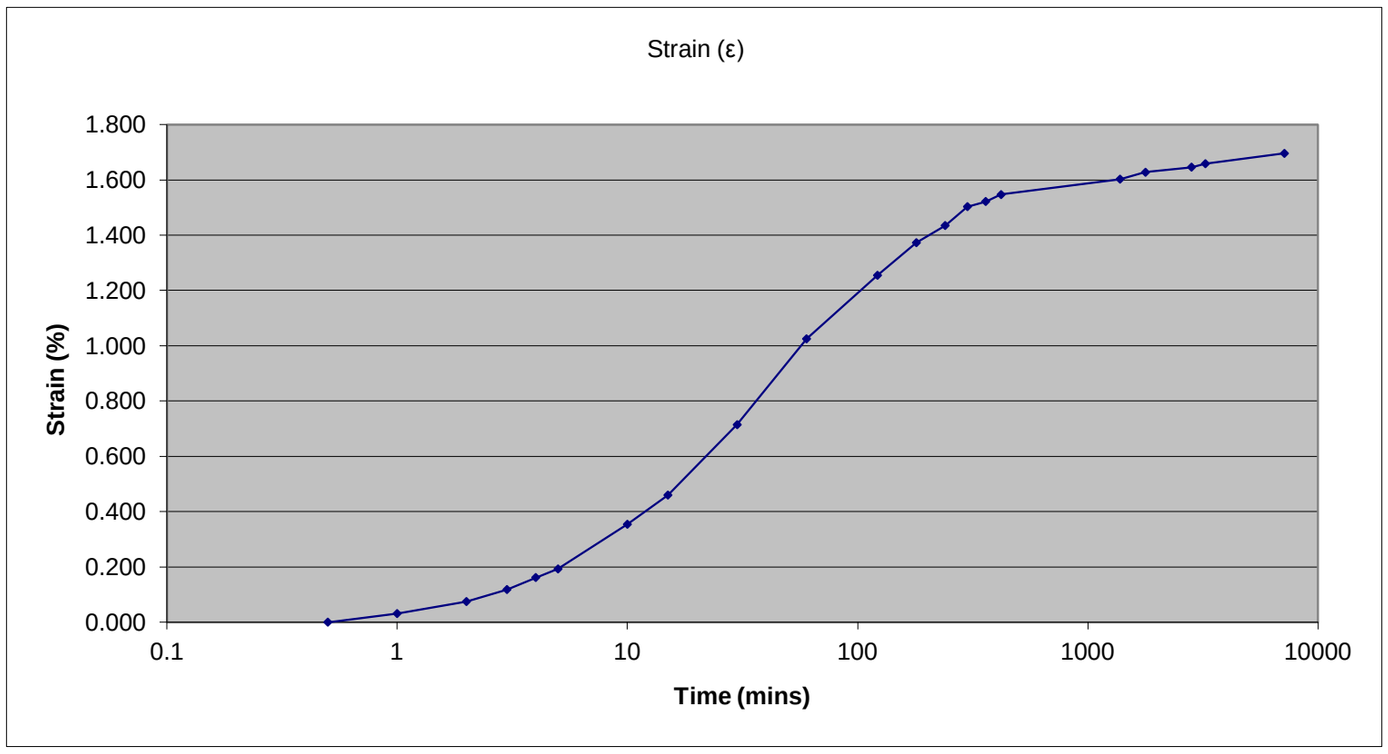
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.52	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	168.17	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.59	M.C Tin2 Mass:	12.76
M.C Tin1 + Wet sample:	84.50	M.C Tin2 + Wet sample:	100.7
M.C Tin1 + Dry sample:	65.61	M.C Tin2 + Dry sample:	77.31
M.C	35.63	M.C	36.24
Average	35.93		

After test Measurements:				
M.C. tin I.D:	X52		M.C. Tin Mass:	12.62
Dish + Ring + Satu. sample:	184.95		Initial M.C:	35.78
Dish + Ring + Dried sample:	156.64		Final M.C:	41.94
Particle Density:	2.72	$Mg \cdot m^{-3}$		
Dry Density:	1.32	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	1.05			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0		0.000
0.5	0	Flood	0.000
1	0.005		0.031
2	0.012		0.075
3	0.019		0.118
4	0.026		0.161
5	0.031		0.193
10	0.057		0.354
15	0.074		0.460
30	0.115		0.714
60	0.165		1.025
122	0.202		1.255
180	0.221		1.373
240	0.231		1.435
300	0.242		1.503
360	0.245		1.522
420	0.249		1.547
1380	0.258		1.602
1780	0.262		1.627
2820	0.265		1.646
3240	0.267		1.658
7140	0.273	End of test	1.696





1D Swell Strain test

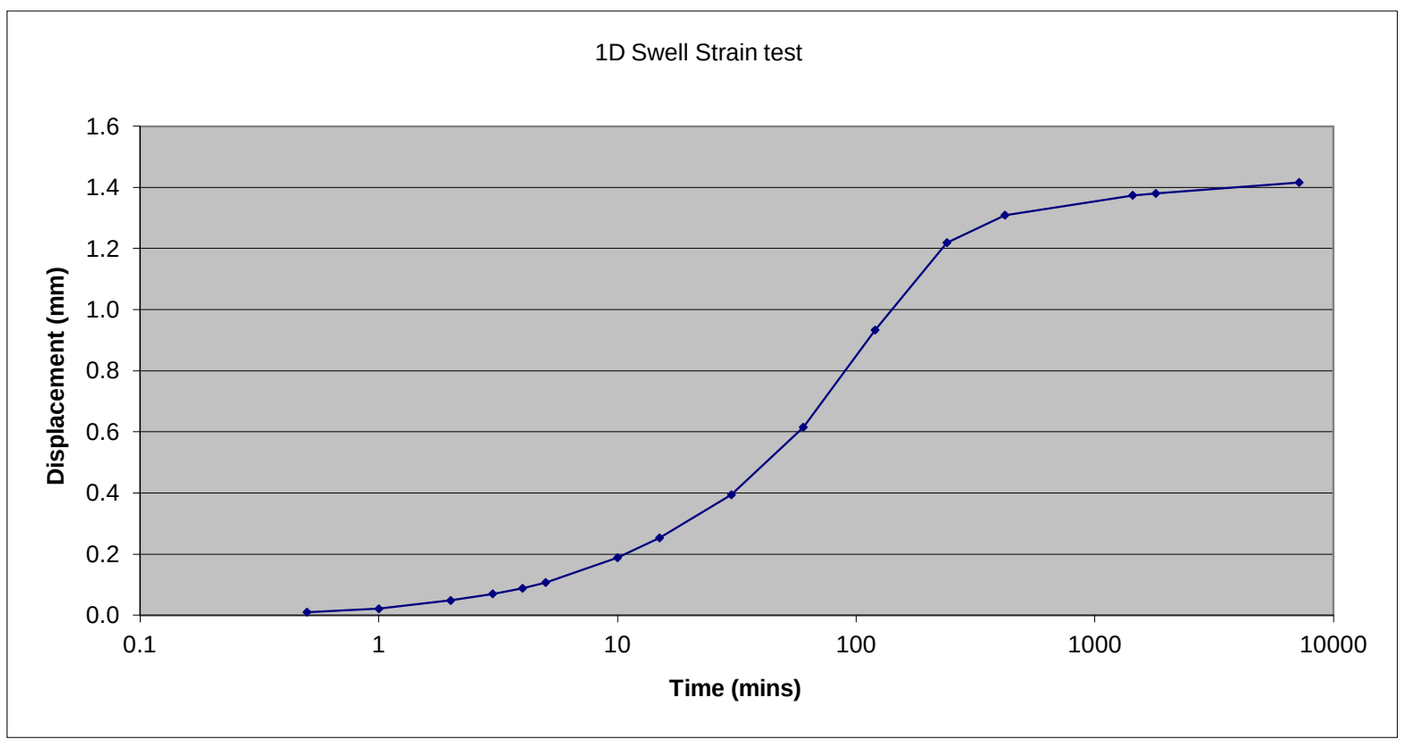
Sample I.D: Colchester

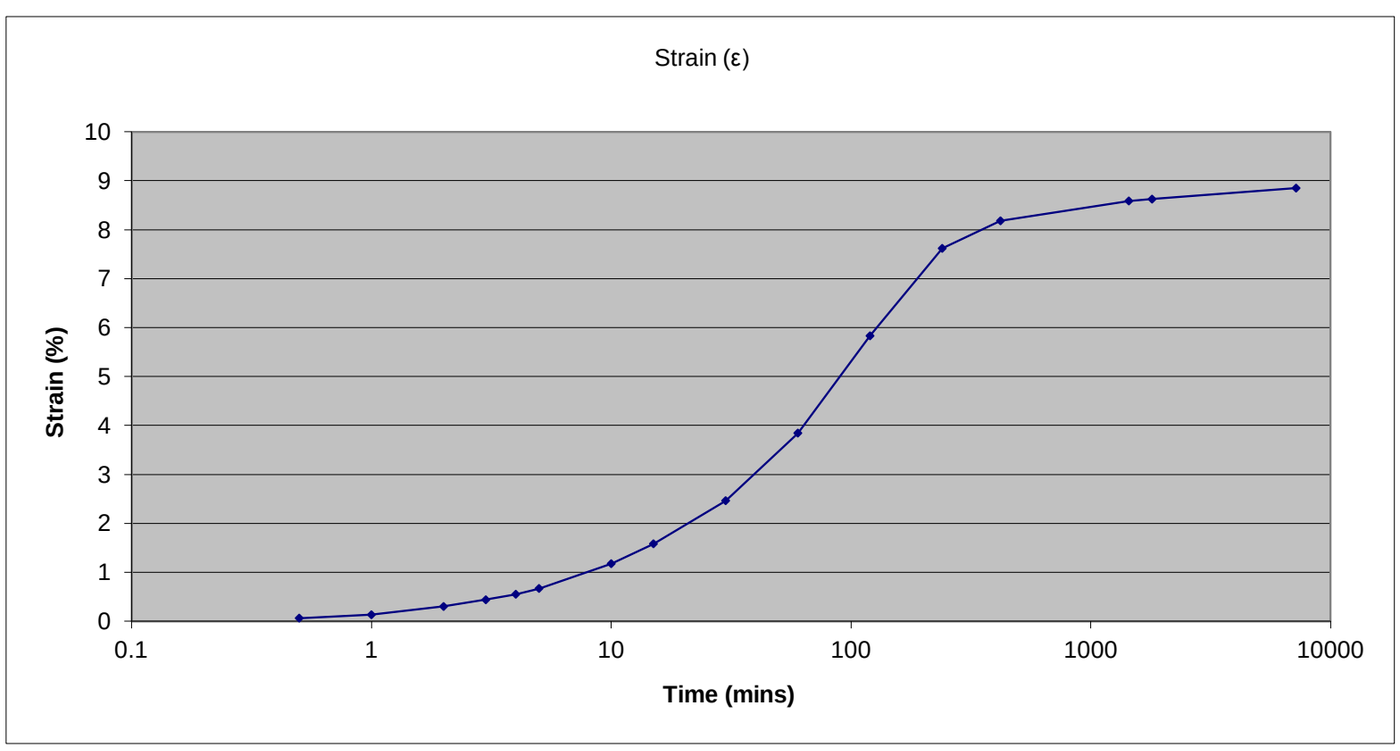
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	77.31	Ring Dimensions:	63.4	19	0.0317	0.00316	6.00E-05
Ring + Orig. sample:	170.81	Sample Dimensions:	63.4	16	0.0317	0.00316	5.05E-05

Moisture content of original sample			
M.C Tin1 ID:	A1	M.C Tin2 ID:	A2
M.C Tin1 Mass:	12.76	M.C Tin2 Mass:	12.61
M.C Tin1 + Wet sample:	86.70	M.C Tin2 + Wet sample:	104.14
M.C Tin1 + Dry sample:	71.14	M.C Tin2 + Dry sample:	84.72
M.C	26.65	M.C	26.93
Average	26.79		

After test measurements:				
M.C. tin I.D:	N/A		M.C. Tin Mass:	0
Dish + Ring + Satu. sample:	179.15		Initial M.C:	26.59
Dish + Ring + Dried sample:	151.17		Final M.C:	37.88
Particle Density:	2.76	$Mg \cdot m^{-3}$		
Dry Density:	1.46	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.89			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.010	Flood	0.063
1	0.021		0.131
2	0.048		0.300
3	0.070		0.438
4	0.088		0.550
5	0.107		0.669
10	0.188		1.175
15	0.253		1.581
30	0.394		2.463
60	0.615		3.844
120	0.933		5.831
240	1.219		7.619
420	1.309		8.181
1440	1.374		8.588
1800	1.380		8.625
7175	1.416		8.850





1D Swell Strain test

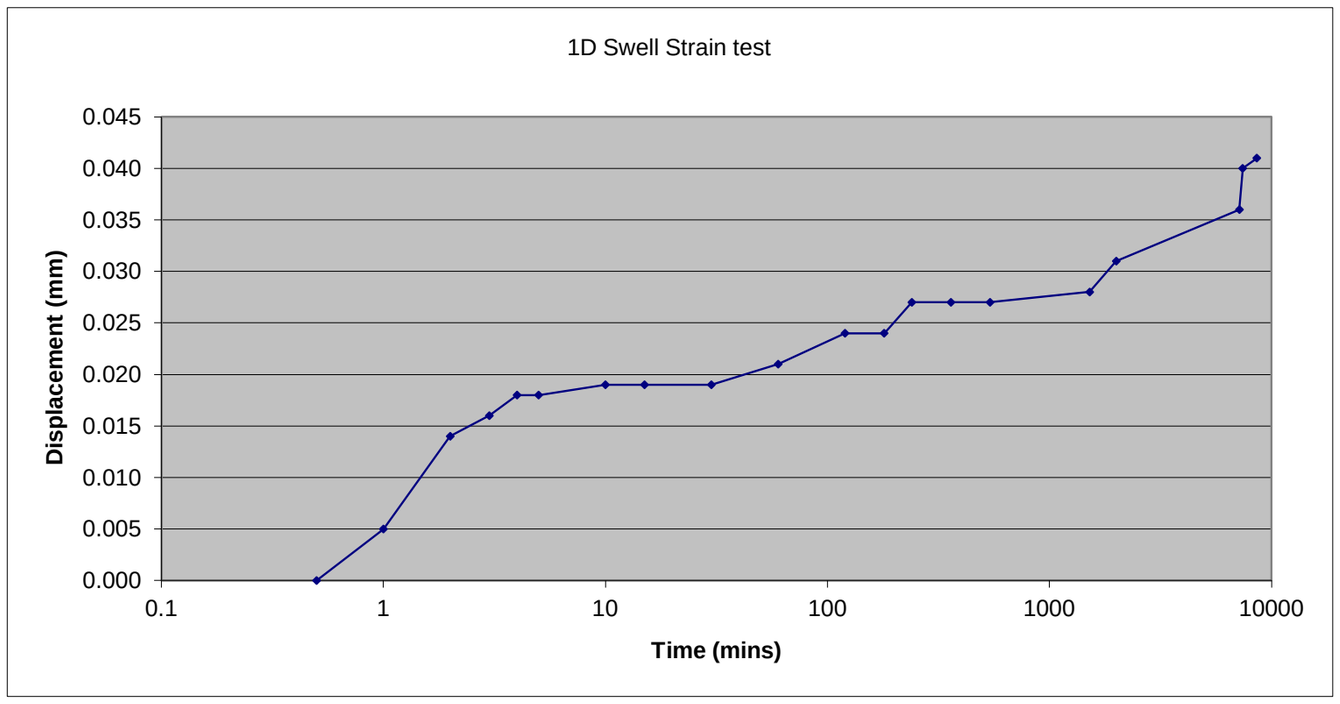
Sample I.D: Fair oak

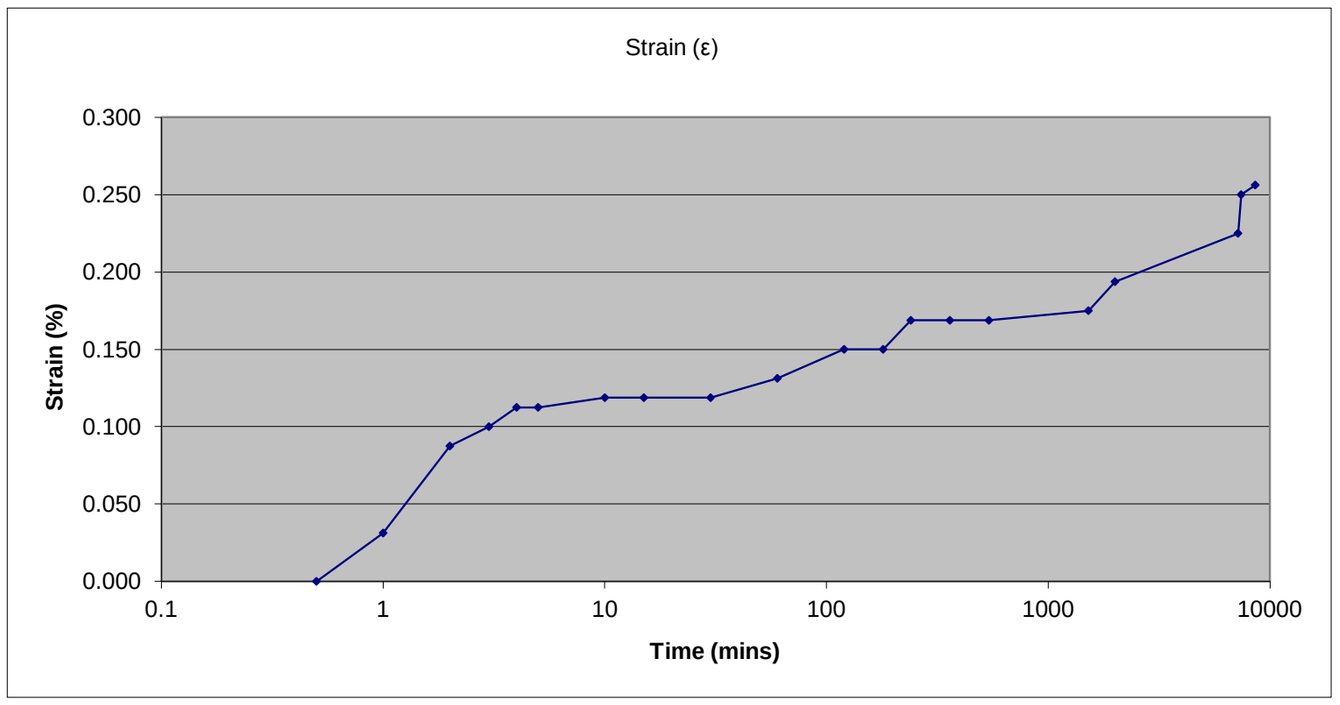
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.95	Ring Dimensions:	63.4	19	0.0317	0.00316	6.00E-05
Ring + Orig. sample:	174.96	Sample Dimensions:	63.4	16	0.0317	0.00316	5.05E-05

Moisture Content of original sample			
M.C Tin1 ID:	B1	M.C Tin2 ID:	B2
M.C Tin1 Mass:	12.67	M.C Tin2 Mass:	12.54
M.C Tin1 + Wet sample:	72.73	M.C Tin2 + Wet sample:	65.94
M.C Tin1 + Dry sample:	61.98	M.C Tin2 + Dry sample:	56.65
M.C	21.80	M.C	21.06
Average	21.43		

After test Measurements:				
M.C. tin I.D:	X26		M.C. Tin Mass:	12.63
Dish + Ring + Satu. sample:	189.76		Initial M.C:	22.13
Dish + Ring + Dried sample:	169.83		Final M.C:	24.83
Particle Density:	2.70	$Mg \cdot m^{-3}$		
Dry Density:	1.59	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.70			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.005		0.031
2	0.014		0.088
3	0.016		0.100
4	0.018		0.113
5	0.018		0.113
10	0.019		0.119
15	0.019		0.119
30	0.019		0.119
60	0.021		0.131
120	0.024		0.150
180	0.024		0.150
240	0.027		0.169
360	0.027		0.169
540	0.027		0.169
1518	0.028		0.175
2000	0.031		0.194
7175	0.036		0.225
7415	0.040		0.250
8585	0.041		0.256





1D Swell Strain test

Sample I.D: Poyle

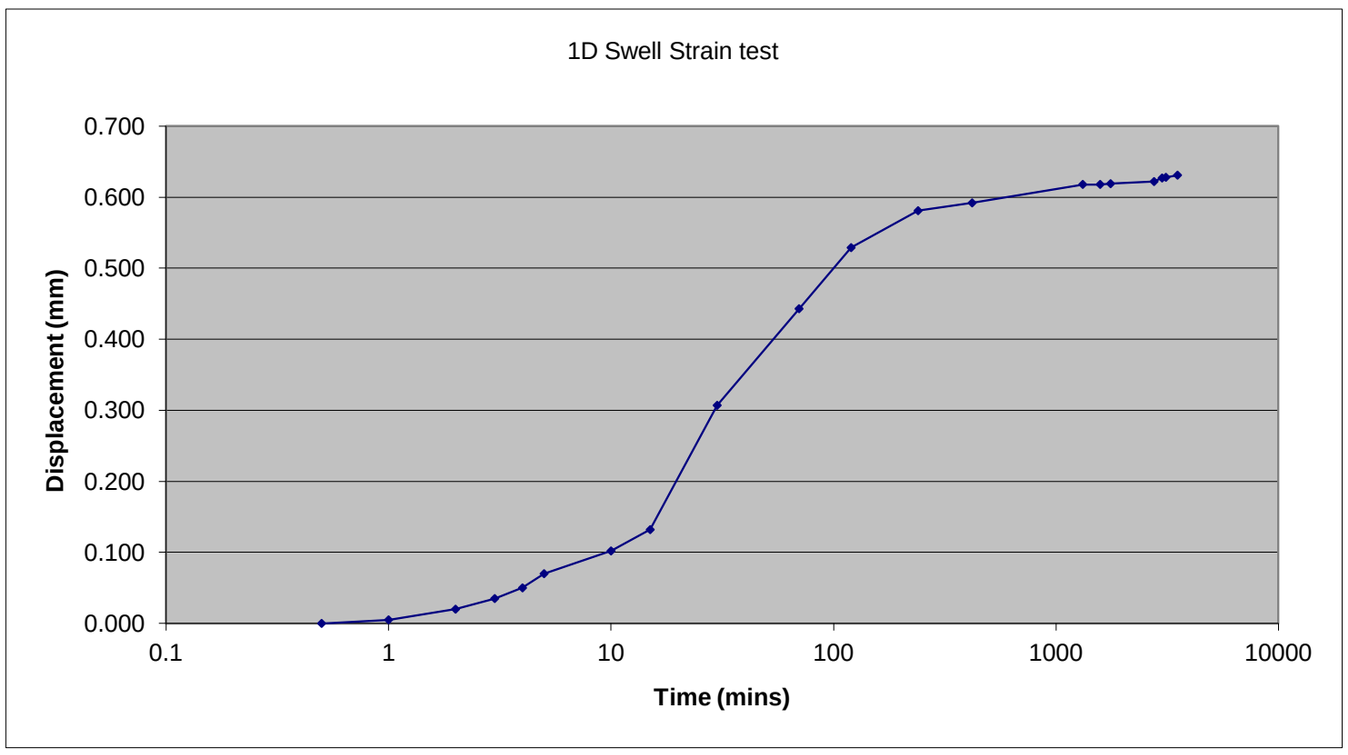
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.65	Ring Dimensions:	63.4	19	0.0317	0.00316	6.00E-05
Ring + Orig. sample:	169.57	Sample Dimensions:	63.4	16	0.0317	0.00316	5.05E-05

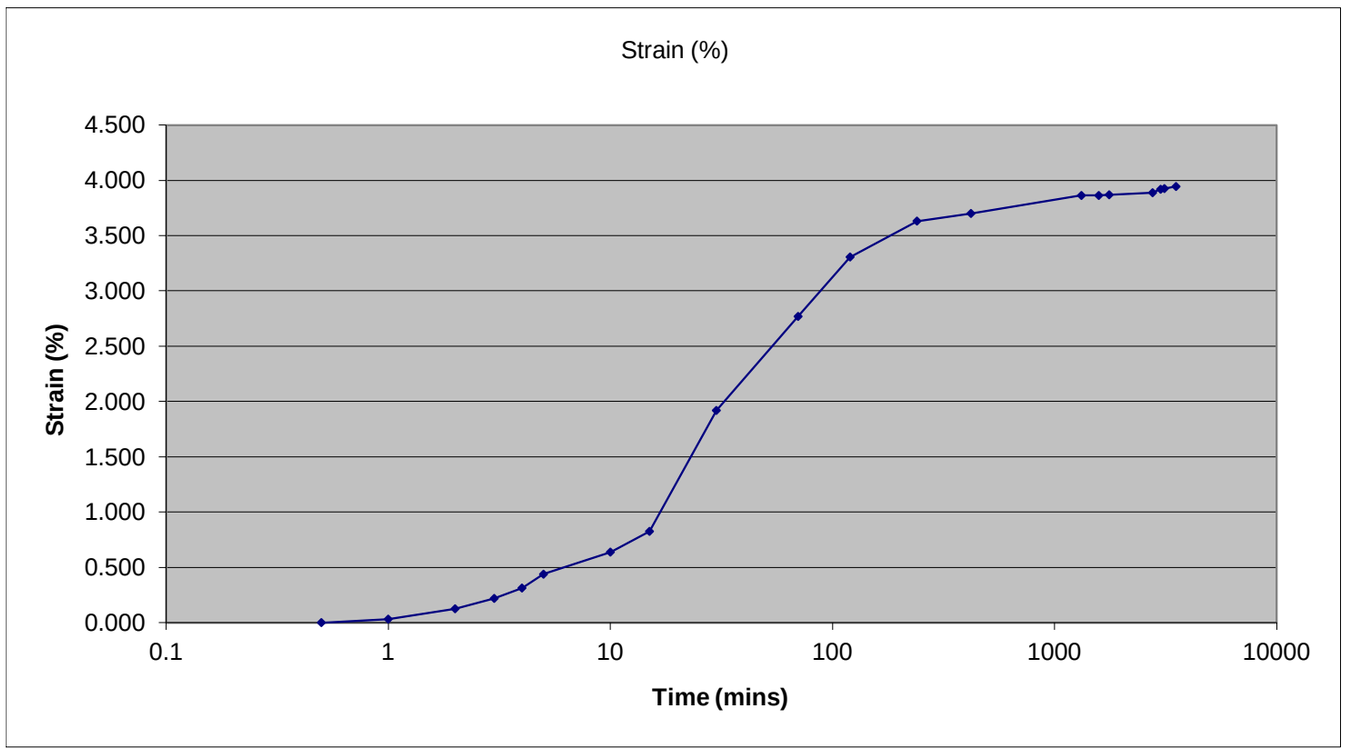
Moisture Content of original sample			
M.C Tin1 ID:	x38	M.C Tin2 ID:	x101
M.C Tin1 Mass:	12.64	M.C Tin2 Mass:	12.55
M.C Tin1 + Wet sample:	83.33	M.C Tin2 + Wet sample:	96.7
M.C Tin1 + Dry sample:	68.01	M.C Tin2 + Dry sample:	77.78
M.C	27.67	M.C	29.01
Average	28.34		

After test Measurements:

M.C. tin I.D:	X101	M.C. Tin Mass:	12.55
Dish + Ring + Satu. sample:	186.61	Initial M.C:	29.60
Dish + Ring + Dried sample:	160.9	Final M.C:	35.86
Particle Density:	2.75	$Mg \cdot m^{-3}$	
Dry Density:	1.42	$Mg \cdot m^{-3}$	
Voids Ratio (e_0)	0.94		

Test readings			Strain (%)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.005		0.031
2	0.020		0.125
3	0.035		0.219
4	0.050		0.313
5	0.070		0.438
10	0.102		0.638
15	0.132		0.825
30	0.307		1.919
70	0.443		2.769
120	0.529		3.306
240	0.581		3.631
420	0.592		3.700
1320	0.618		3.863
1580	0.618		3.863
1760	0.619		3.869
2760	0.622		3.888
3000	0.627		3.919
3120	0.628		3.925
3519	0.631	end of test	3.944





1D Swell Strain test

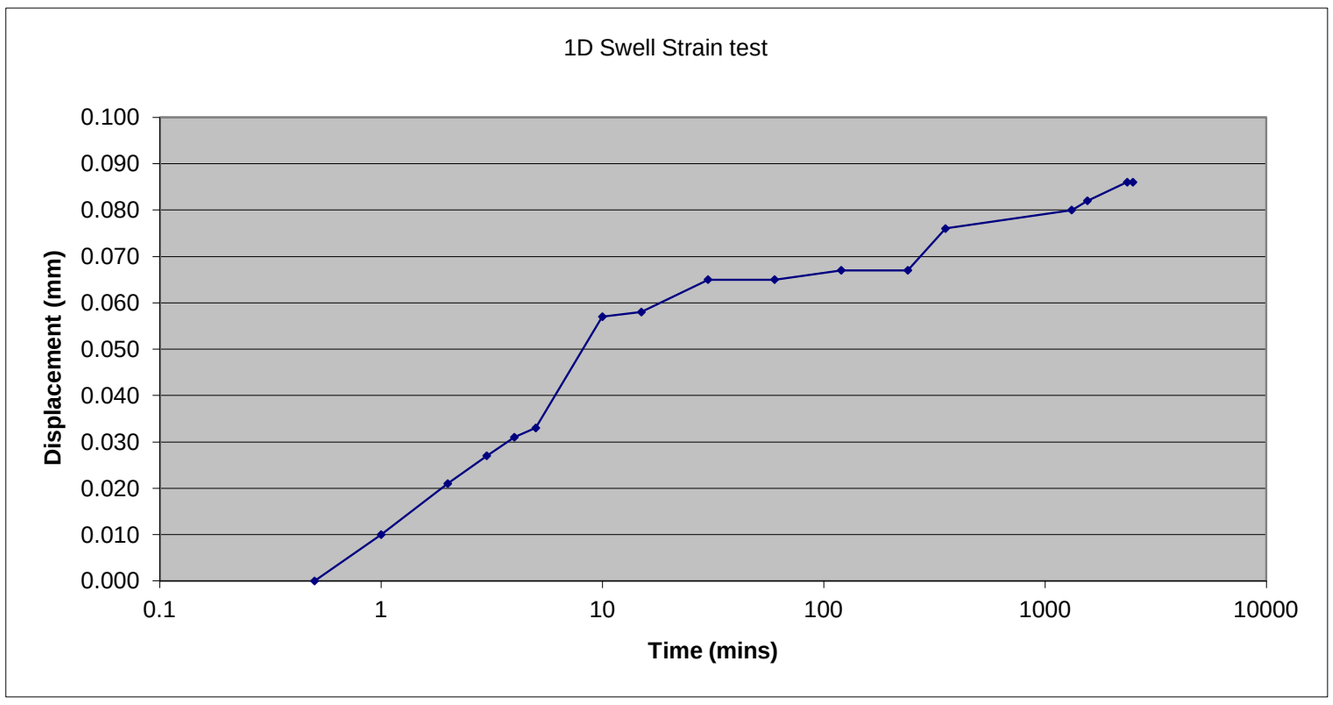
Sample I.D: Ockenden N.B sample in bad condition. Very fissured

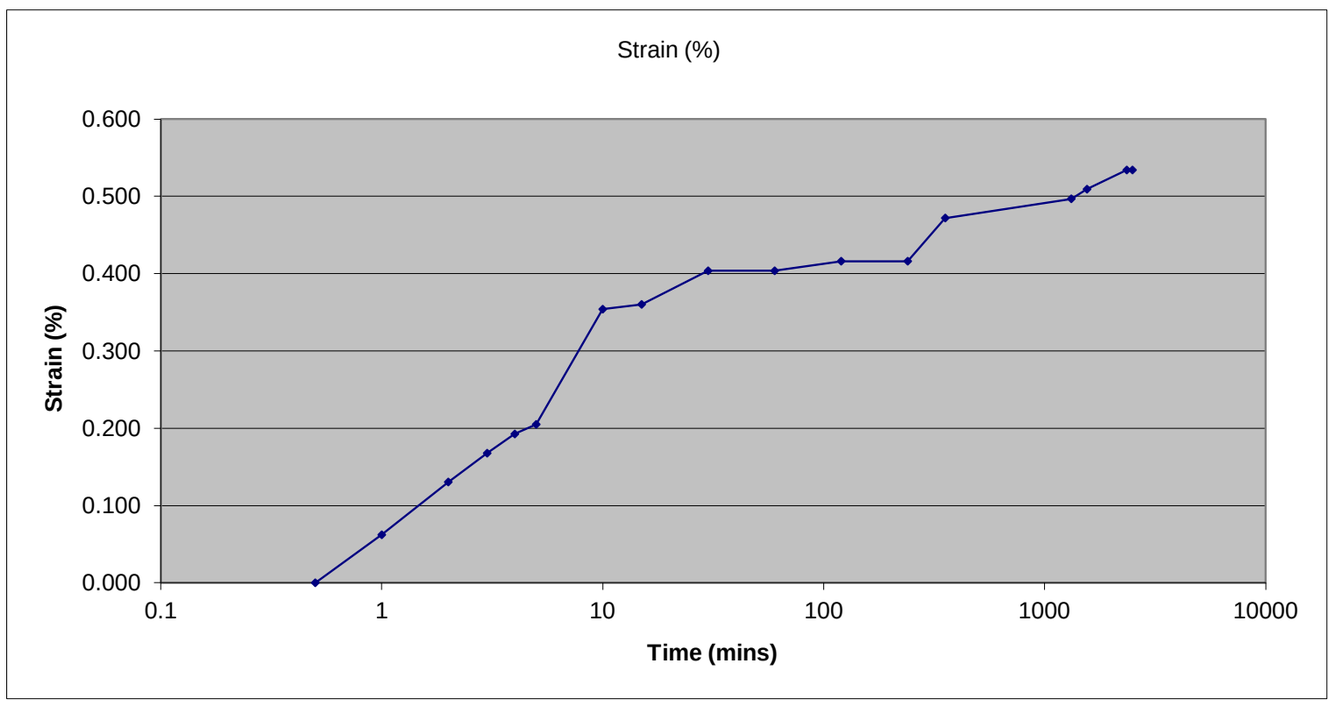
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.53	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	169.03	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.58	M.C Tin2 Mass:	12.75
M.C Tin1 + Wet sample:	85.70	M.C Tin2 + Wet sample:	66.94
M.C Tin1 + Dry sample:	67.24	M.C Tin2 + Dry sample:	53.17
M.C	33.77	M.C	34.07
Average	33.92		

After test Measurements:				
M.C. tin I.D:	X59		M.C. Tin Mass:	12.68
Dish + Ring + Satu. sample:	184.24		Initial M.C:	32.07
Dish + Ring + Dried sample:	159.25		Final M.C:	35.68
Particle Density:	2.71	$Mg \cdot m^{-3}$		
Dry Density:	1.37	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.97			

Test readings			Strain (%)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.010		0.062
2	0.021		0.130
3	0.027		0.168
4	0.031		0.193
5	0.033		0.205
10	0.057		0.354
15	0.058		0.360
30	0.065		0.404
60	0.065		0.404
120	0.067		0.416
240	0.067		0.416
355	0.076		0.472
1320	0.080		0.497
1555	0.082		0.509
2353	0.086		0.534
2497	0.086	end of test	0.534





1D Swell Strain test

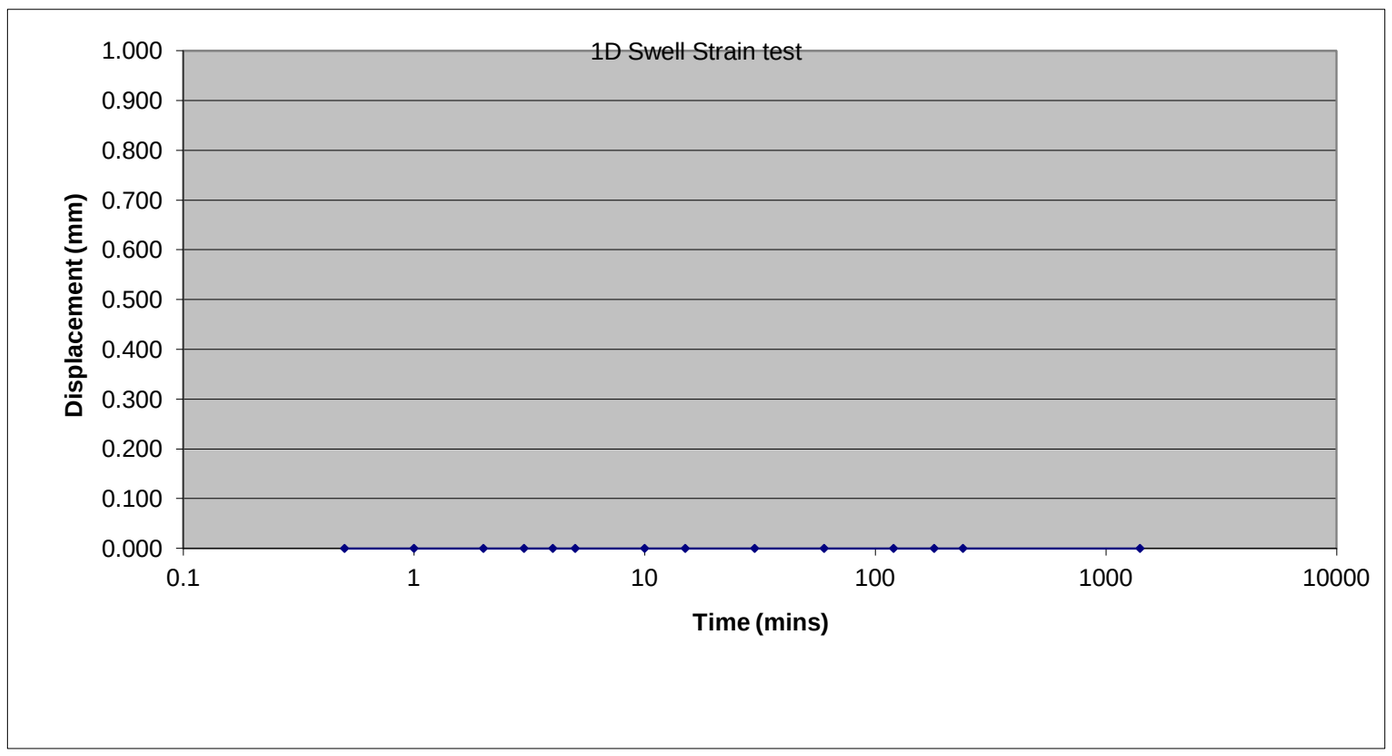
Sample I.D: Knoll Manor 1

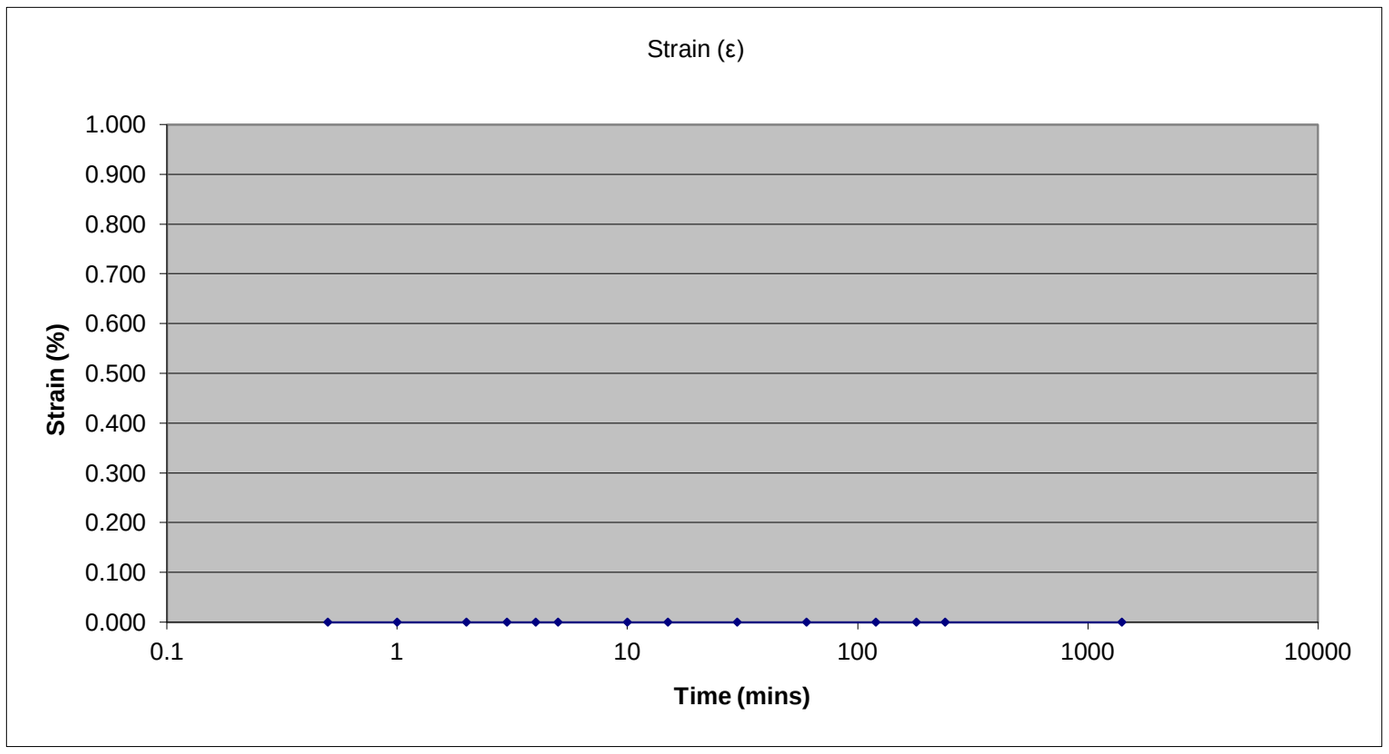
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.61	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	178.79	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X45
M.C Tin1 Mass:	12.78	M.C Tin2 Mass:	12.55
M.C Tin1 + Wet sample:	47.08	M.C Tin2 + Wet sample:	57.30
M.C Tin1 + Dry sample:	40.87	M.C Tin2 + Dry sample:	49.32
M.C	22.11	M.C	21.70
Average	21.90		

After test Measurements:			
M.C. tin I.D:	X77	M.C. Tin Mass:	12.99
Dish + Ring + Satu. sample:	192.68	Initial M.C:	21.01
Dish + Ring + Dried sample:	174.04	Final M.C:	22.07
Particle Density:	2.73	$Mg \cdot m^{-3}$	
Dry Density:	1.66	$Mg \cdot m^{-3}$	
Voids Ratio (e_0)	0.65		

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.000		0.000
2	0.000		0.000
3	0.000		0.000
4	0.000		0.000
5	0.000		0.000
10	0.000		0.000
15	0.000		0.000
30	0.000		0.000
60	0.000		0.000
120	0.000		0.000
180	0.000		0.000
240	0.000		0.000
1405	0.000	end test	0.000





1D Swell Strain test

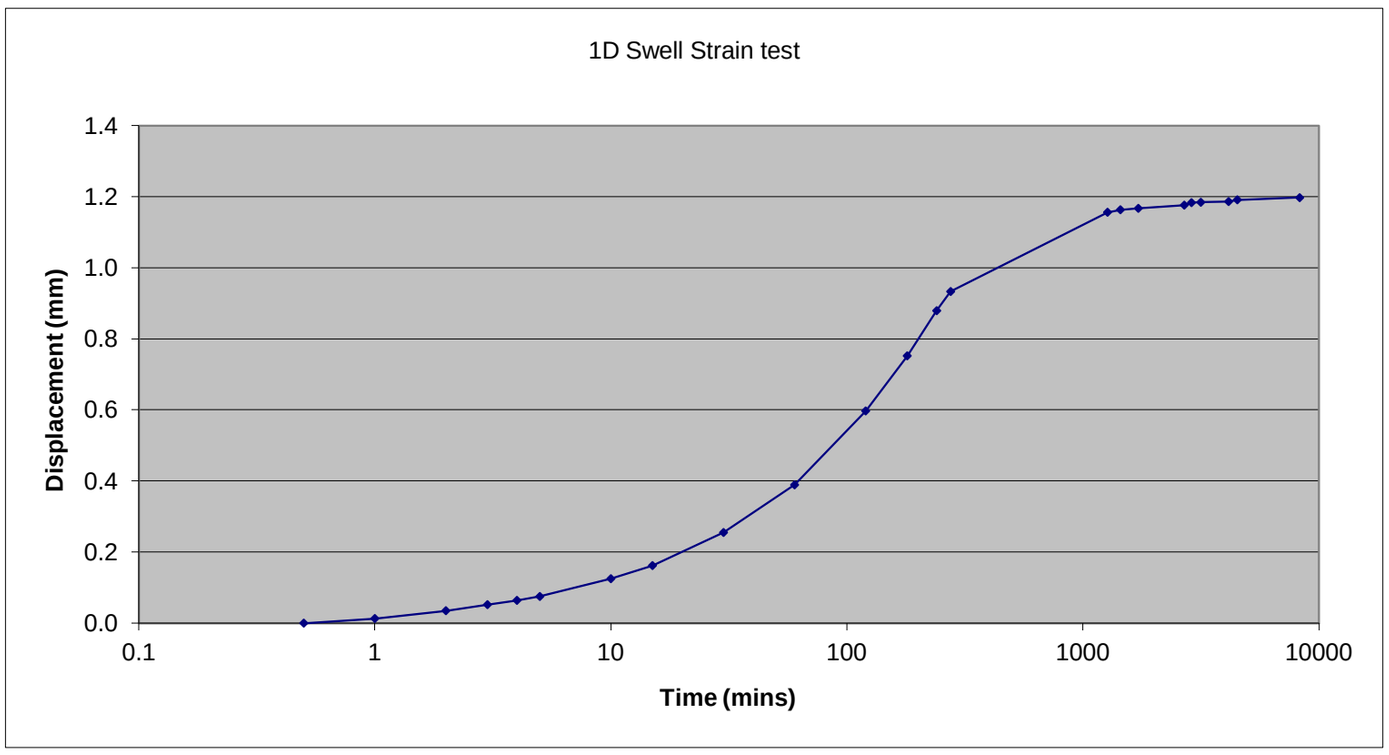
Sample I.D: Stanwell

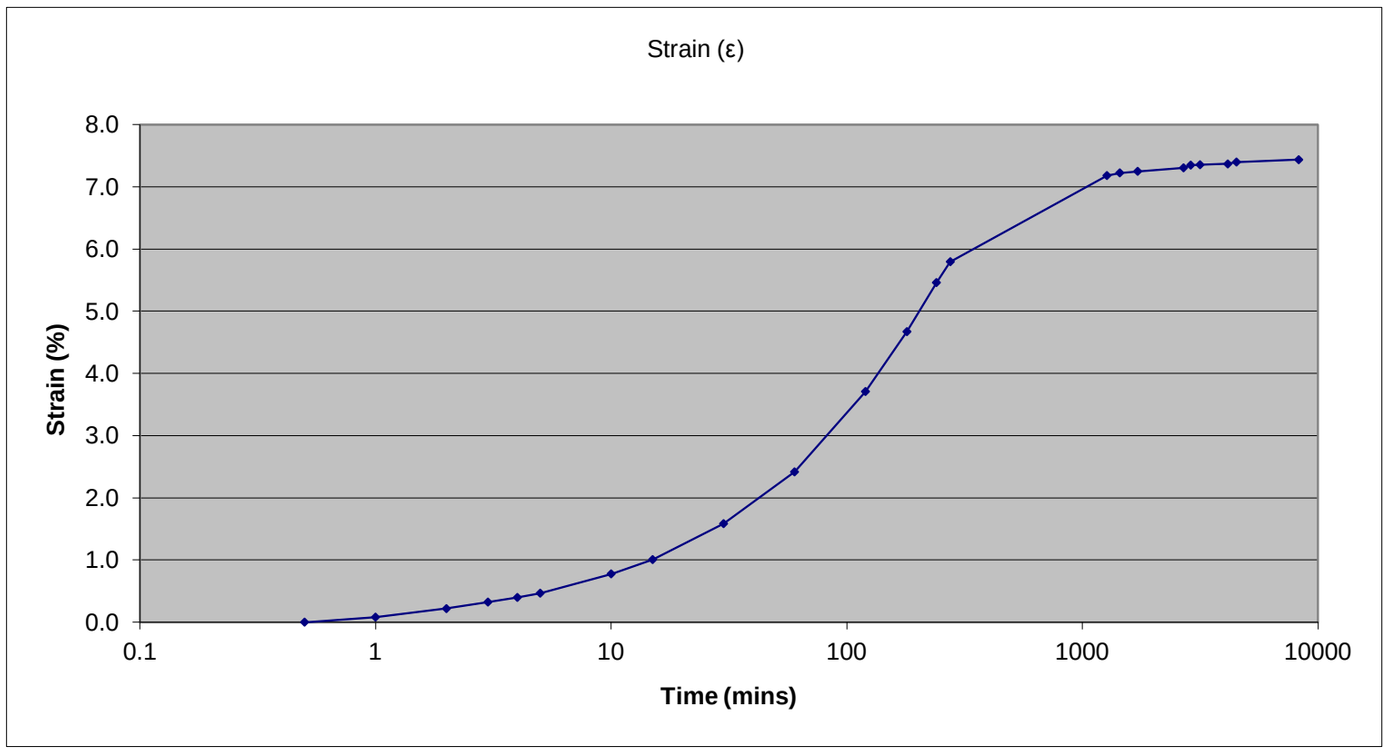
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.49	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	173.01	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	T2	M.C Tin2 ID:	X41
M.C Tin1 Mass:	12.663	M.C Tin2 Mass:	12.79
M.C Tin1 + Wet sample:	86.47	M.C Tin2 + Wet sample:	79.91
M.C Tin1 + Dry sample:	71.05	M.C Tin2 + Dry sample:	65.69
M.C	26.41	M.C	26.88
Average	26.65		

After test Measurements:				
M.C. tin I.D:	T2		M.C. Tin Mass:	12.66
Dish + Ring + Satu. sample:	191.67		Initial M.C:	25.33
Dish + Ring + Dried sample:	166.16		Final M.C:	33.13
Particle Density:	2.77	$Mg \cdot m^{-3}$		
Dry Density:	1.51	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.83			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.013		0.081
2	0.035		0.217
3	0.052		0.323
4	0.064		0.398
5	0.075		0.466
10	0.125		0.776
15	0.162		1.006
30	0.255		1.584
60	0.389		2.416
120	0.597		3.708
180	0.752		4.671
240	0.879		5.460
275	0.933		5.795
1270	1.156		7.180
1440	1.163		7.224
1715	1.167		7.248
2685	1.176		7.304
2880	1.183		7.348
3155	1.184		7.354
4137	1.186		7.366
4505	1.191		7.398
8275	1.197	end test	7.435





1D Swell Strain test

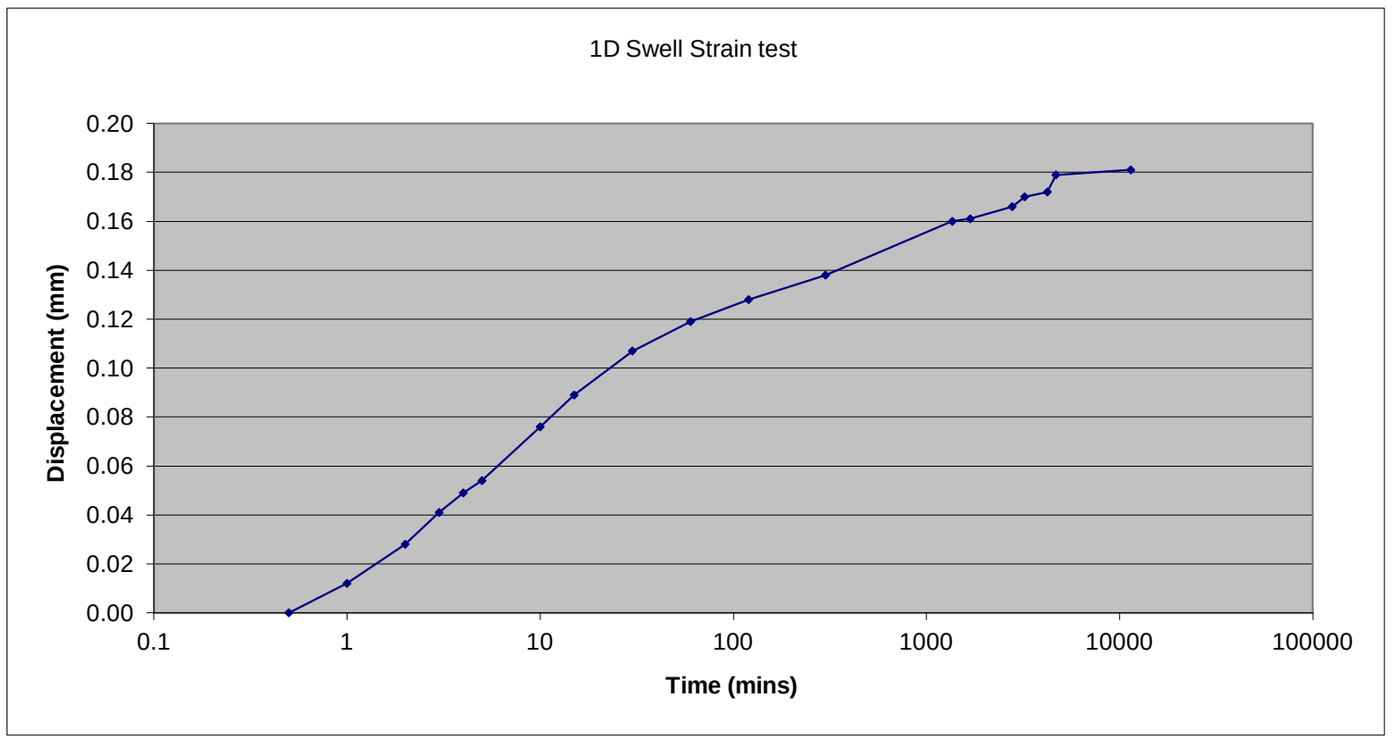
Sample I.D: Hollingson

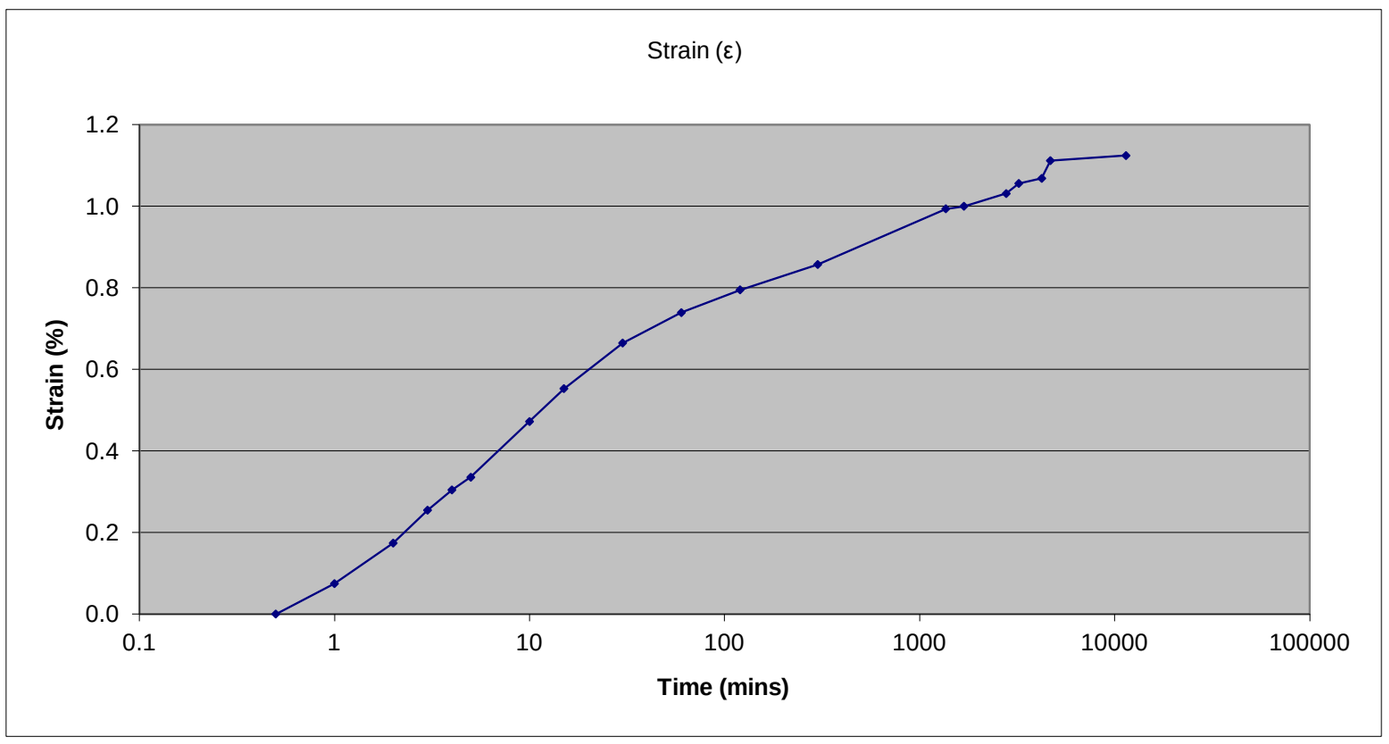
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.62	Ring Dimensions:	63.3	19.1	0.0317	0.00315	6.01E-05
Ring + Orig. sample:	170.25	Sample Dimensions:	63.3	16.1	0.0317	0.00315	5.07E-05

Moisture Content of original sample			
M.C Tin1 ID:	X45	M.C Tin2 ID:	23
M.C Tin1 Mass:	12.7	M.C Tin2 Mass:	12.63
M.C Tin1 + Wet sample:	92.00	M.C Tin2 + Wet sample:	85.98
M.C Tin1 + Dry sample:	75.44	M.C Tin2 + Dry sample:	70.53
M.C	26.39	M.C	26.68
Average	26.54		

After test Measurements:				
M.C. tin I.D:	T12		M.C. Tin Mass:	12.78
Dish + Ring + Satu. sample:	186.12		Initial M.C:	25.37
Dish + Ring + Dried sample:	164.08		Final M.C:	29.51
Particle Density:	2.68	$Mg \cdot m^{-3}$		
Dry Density:	1.47	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.82			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.012		0.075
2	0.028		0.174
3	0.041		0.255
4	0.049		0.304
5	0.054		0.335
10	0.076		0.472
15	0.089		0.553
30	0.107		0.665
60	0.119		0.739
120	0.128		0.795
300	0.138		0.857
1360	0.160		0.994
1685	0.161		1.000
2776	0.166		1.031
3220	0.170		1.056
4222	0.172		1.068
4674	0.179		1.112
11410	0.181	end test	1.124





1D Swell Strain test

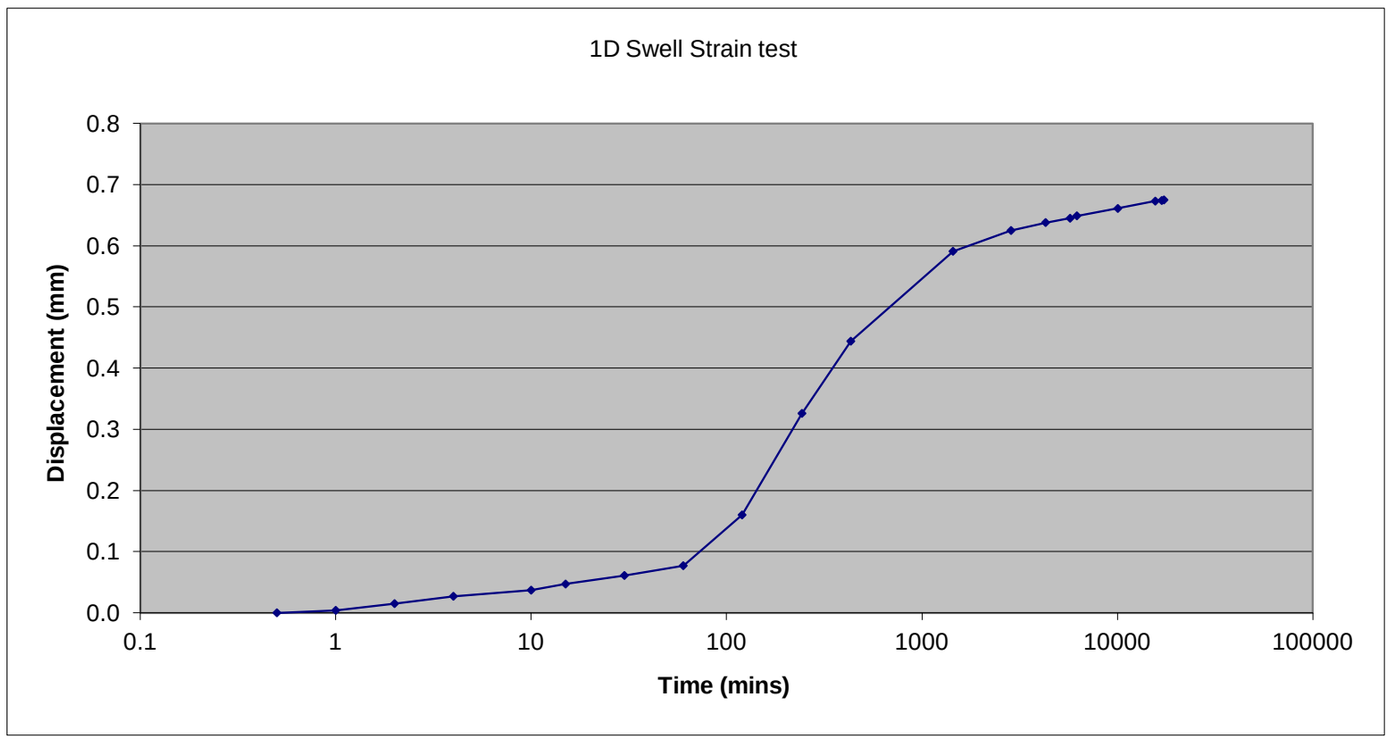
Sample I.D: Knowl Hill

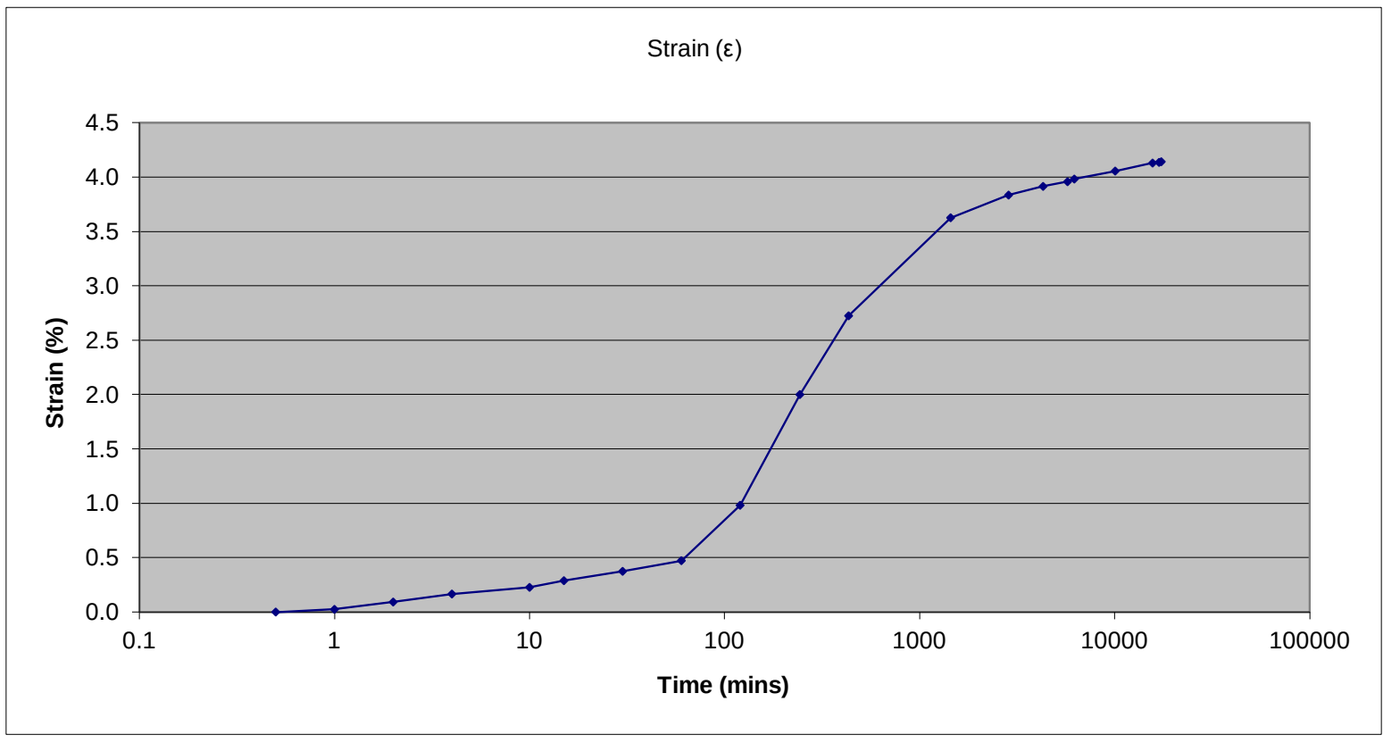
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.63	Ring Dimensions:	63.5	19.3	0.0318	0.00317	6.11E-05
Ring + Orig. sample:	176.49	Sample Dimensions:	63.5	16.3	0.0318	0.00317	5.16E-05

Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X46
M.C Tin1 Mass:	12.78	M.C Tin2 Mass:	12.63
M.C Tin1 + Wet sample:	125.88	M.C Tin2 + Wet sample:	101.44
M.C Tin1 + Dry sample:	100.37	M.C Tin2 + Dry sample:	81.34
M.C	29.12	M.C	29.25
Average	29.19		

After test Measurements:				
M.C. tin I.D:	X36		M.C. Tin Mass:	12.64
Dish + Ring + Satu. sample:	192.17		Initial M.C:	28.93
Dish + Ring + Dried sample:	166.72		Final M.C:	32.86
Particle Density:	2.74	$Mg \cdot m^{-3}$		
Dry Density:	1.50	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.83			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.004		0.025
2	0.015		0.092
4	0.027		0.166
10	0.037		0.227
15	0.047		0.288
30	0.061		0.374
60	0.077		0.472
120	0.160		0.982
243	0.326		2.000
432	0.444		2.724
1440	0.591		3.626
2854	0.625		3.834
4289	0.638		3.914
5724	0.645		3.957
6199	0.649		3.982
10044	0.661		4.055
15619	0.673		4.129
16853	0.674		4.135
17299	0.675	end test	4.141





1D Swell Strain test

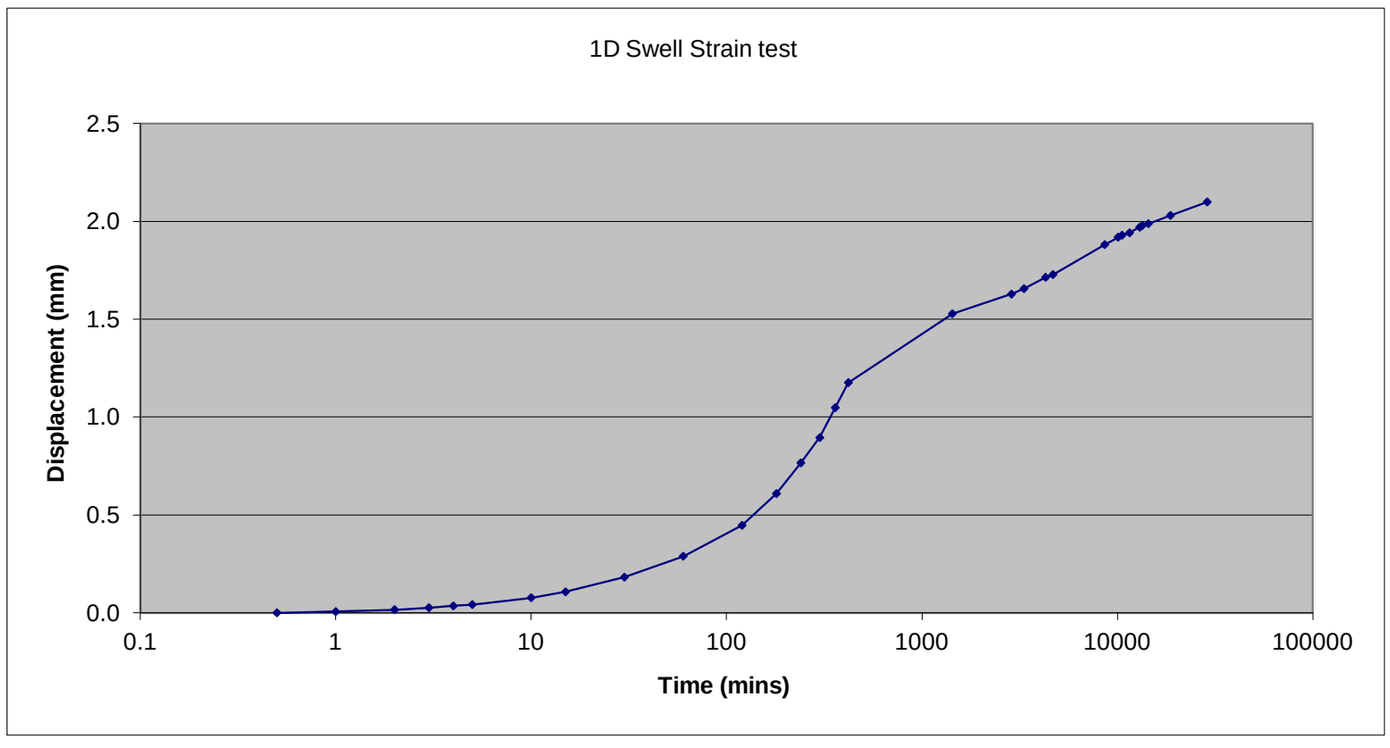
Sample I.D: Farnham

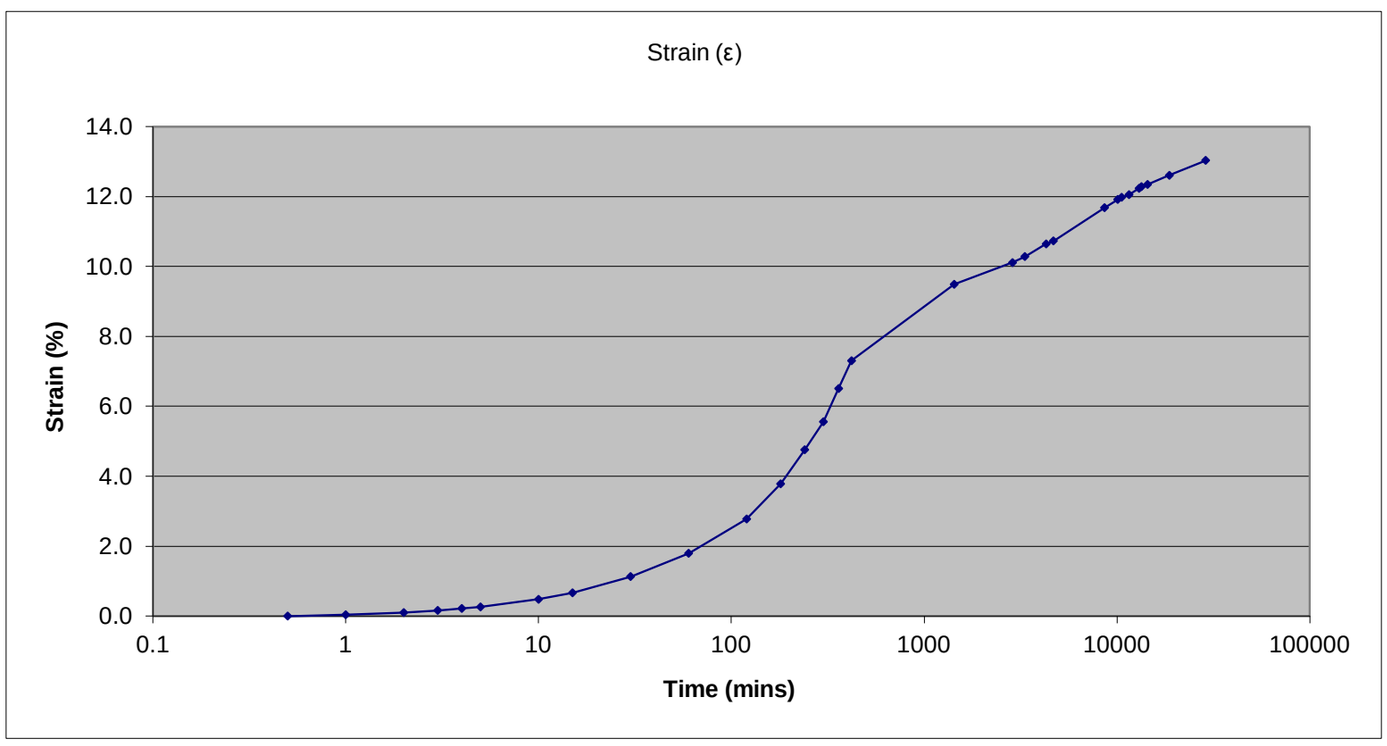
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	76.67	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	183.44	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	9	M.C Tin2 ID:	X102
M.C Tin1 Mass:	12.64	M.C Tin2 Mass:	13.01
M.C Tin1 + Wet sample:	79.21	M.C Tin2 + Wet sample:	83.34
M.C Tin1 + Dry sample:	68.22	M.C Tin2 + Dry sample:	71.68
M.C	19.77	M.C	19.87
Average	19.82		

After test Measurements:				
M.C. tin I.D:	X20		M.C. Tin Mass:	12.61
Dish + Ring + Satu. sample:	201.61		Initial M.C:	22.85
Dish + Ring + Dried sample:	176.19		Final M.C:	29.25
Particle Density:	2.75	$Mg \cdot m^{-3}$		
Dry Density:	1.70	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.61			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.006		0.037
2	0.016		0.099
3	0.026		0.161
4	0.035		0.217
5	0.042		0.261
10	0.077		0.478
15	0.107		0.665
30	0.182		1.130
60	0.289		1.795
120	0.447		2.776
180	0.609		3.783
240	0.766		4.758
300	0.895		5.559
360	1.048		6.509
420	1.176		7.304
1430	1.528		9.491
2870	1.628		10.112
3325	1.656		10.286
4290	1.714		10.646
4675	1.728		10.733
8610	1.881		11.683
10075	1.919		11.919
10560	1.929		11.981
11536	1.941		12.056
13006	1.970		12.236
13382	1.978		12.286
14394	1.988		12.348
18677	2.030		12.609
28795	2.099	End of test	13.037





1D Swell Strain test

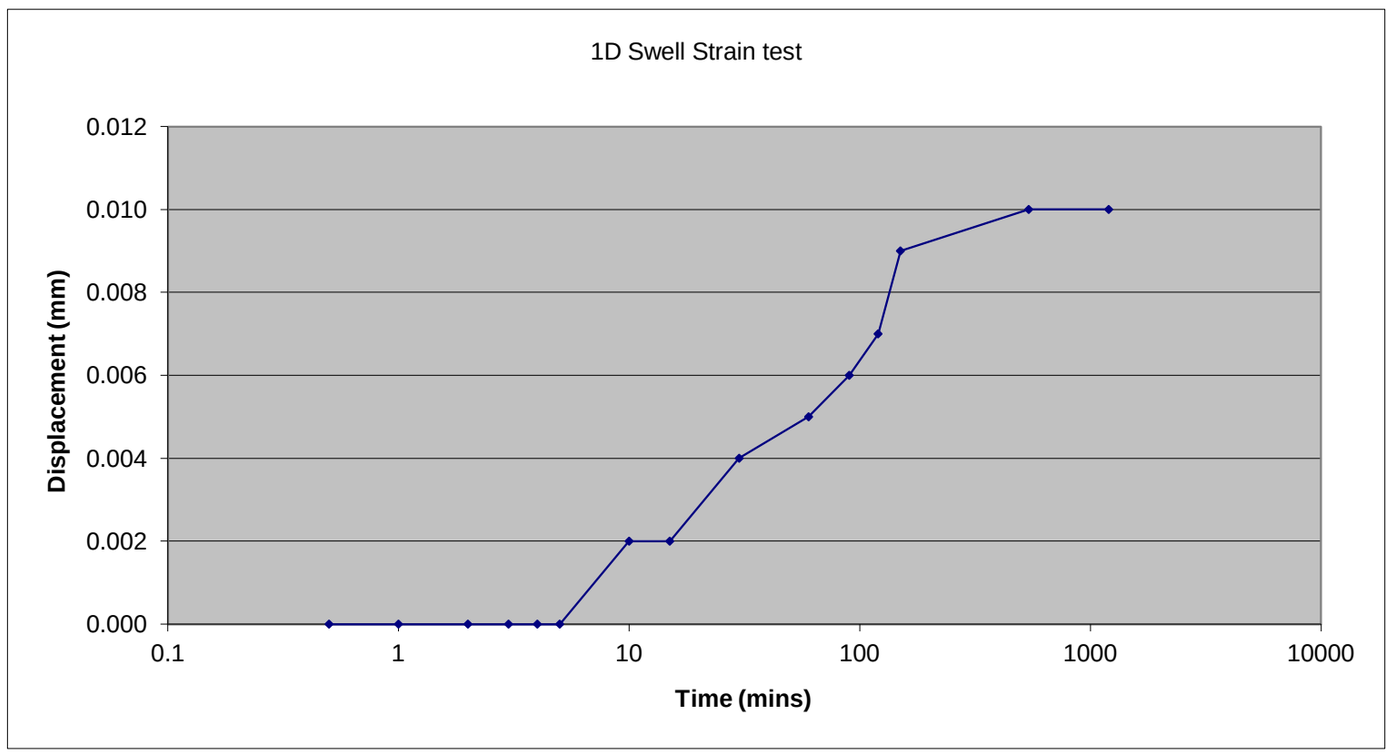
Sample I.D: Bulmer

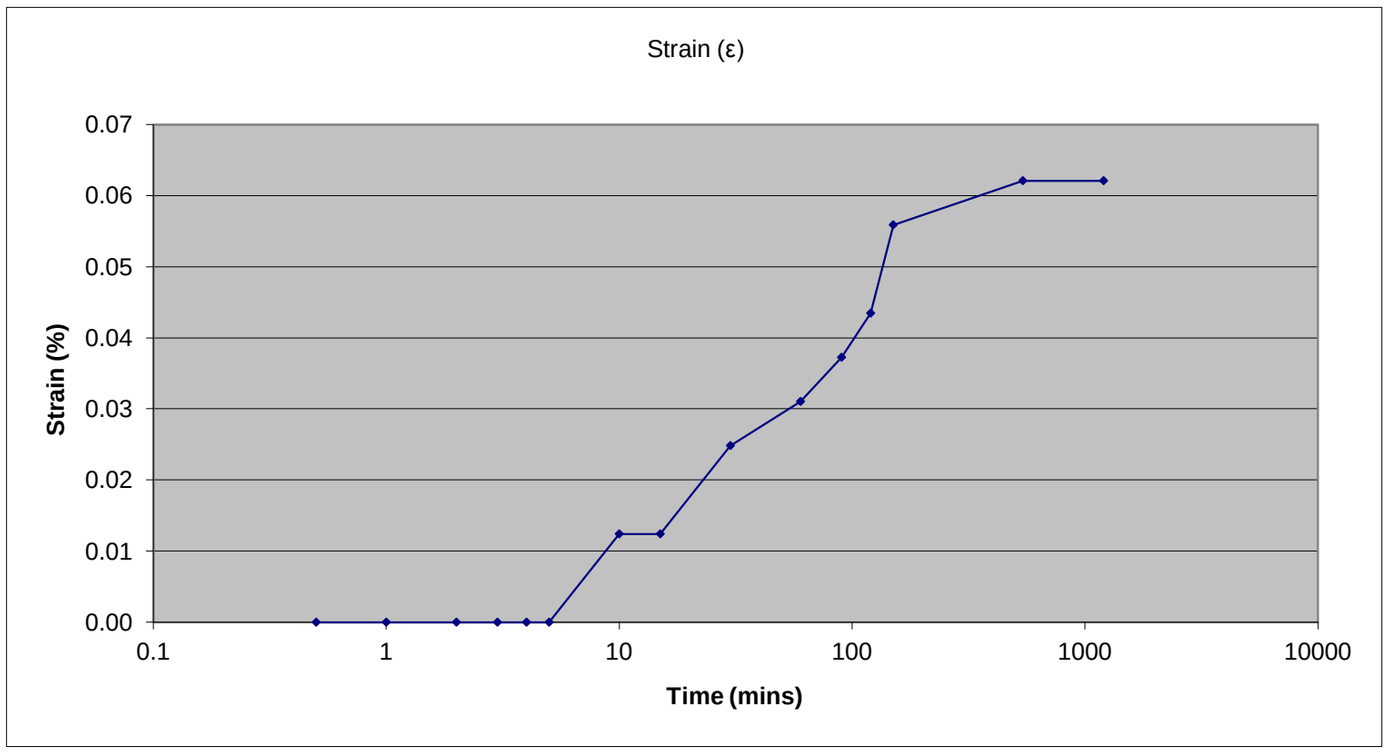
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	77.27	Ring Dimensions:	63.5	19.1	0.0318	0.00317	6.05E-05
Ring + Orig. sample:	171.92	Sample Dimensions:	63.5	16.1	0.0318	0.00317	5.10E-05

Moisture Content of original sample			
M.C Tin1 ID:	2	M.C Tin2 ID:	X46
M.C Tin1 Mass:	13.06	M.C Tin2 Mass:	12.62
M.C Tin1 + Wet sample:	64.06	M.C Tin2 + Wet sample:	65.54
M.C Tin1 + Dry sample:	54.13	M.C Tin2 + Dry sample:	55.92
M.C	24.18	M.C	22.22
Average	23.20		

After test Measurements:			
M.C. tin I.D:	X59	M.C. Tin Mass:	12.67
Dish + Ring + Satu. sample:	176.21	Initial M.C:	41.56
Dish + Ring + Dried sample:	156.80	Final M.C:	29.03
Particle Density:	2.69	$Mg \cdot m^{-3}$	
Dry Density:	1.31	$Mg \cdot m^{-3}$	
Voids Ratio (e_0)	1.05		

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.000		0.000
2	0.000		0.000
3	0.000		0.000
4	0.000		0.000
5	0.000		0.000
10	0.002		0.012
15	0.002		0.012
30	0.004		0.025
60	0.005		0.031
90	0.006		0.037
120	0.007		0.043
150	0.009		0.056
540	0.010		0.062
1200	0.010	End test	0.062





1D Swell Strain test

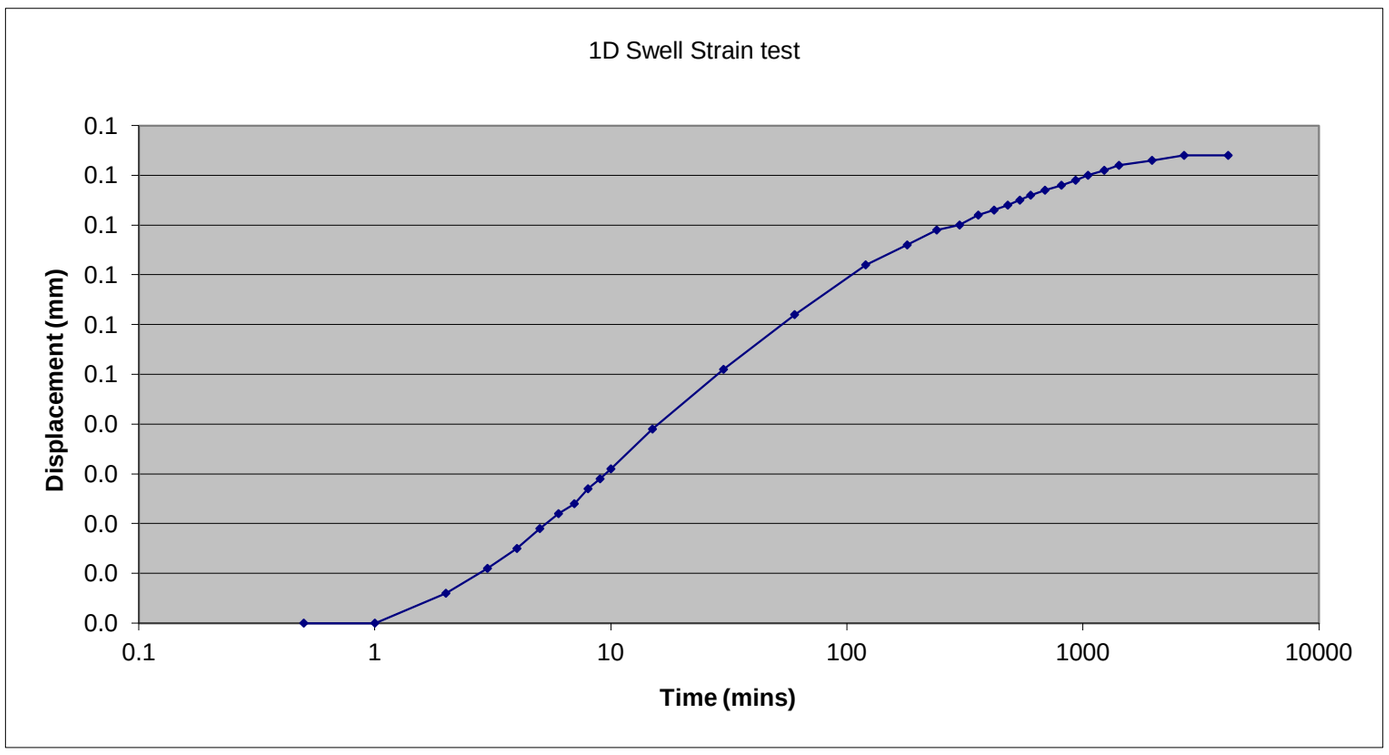
Sample I.D: Studland

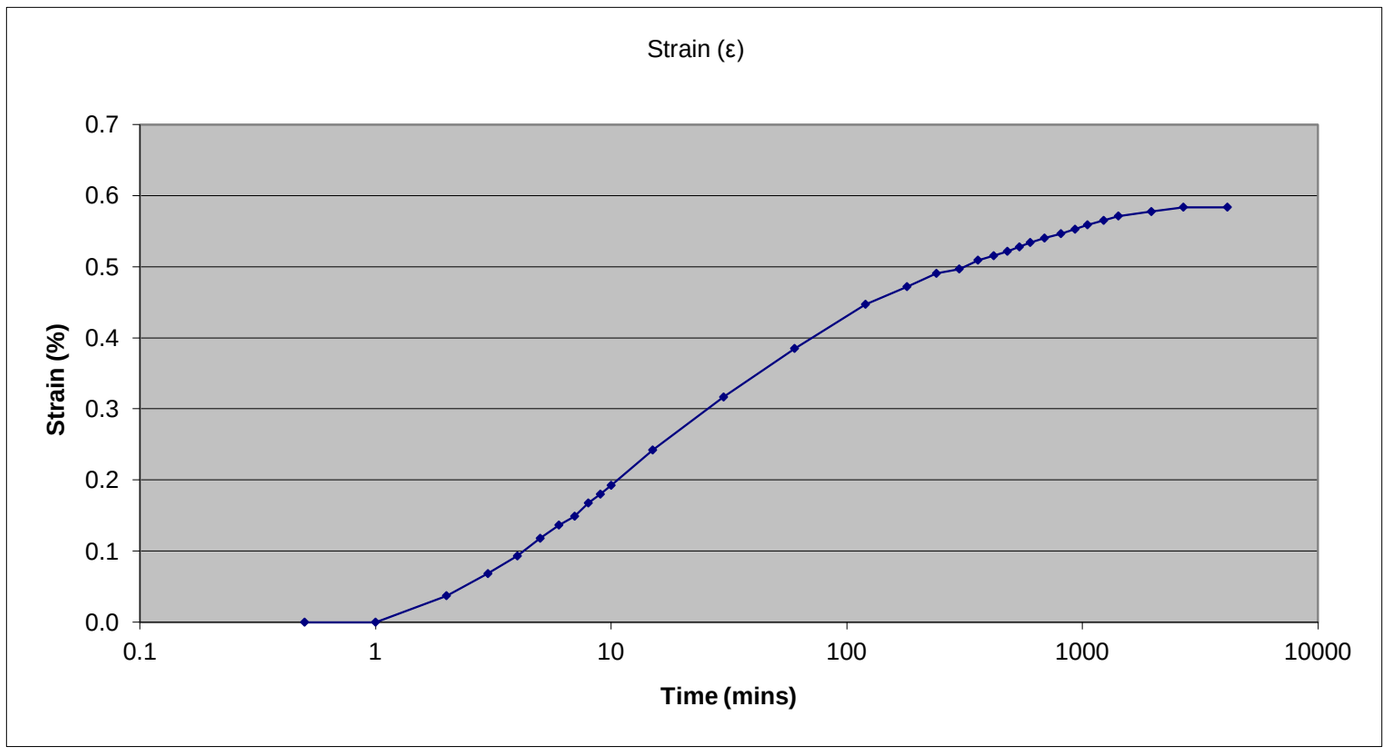
Before test measurements:			Width (mm)	Depth (mm)	Radius(m)	Area (m^2)	Volume (m^3)
Ring weight:	77.28	Ring Dimensions:	63.59	19.1	0.0318	0.00318	6.07E-05
Ring + Orig. sample:	186.8	Sample Dimensions:	63.59	16.1	0.0318	0.00318	5.11E-05

Moisture Content of original sample			
M.C Tin1 ID:	X47	M.C Tin2 ID:	X106
M.C Tin1 Mass:	12.57	M.C Tin2 Mass:	12.73
M.C Tin1 + Wet sample:	36.75	M.C Tin2 + Wet sample:	42.65
M.C Tin1 + Dry sample:	34.63	M.C Tin2 + Dry sample:	40.01
M.C	9.61	M.C	9.68
Average	9.64		

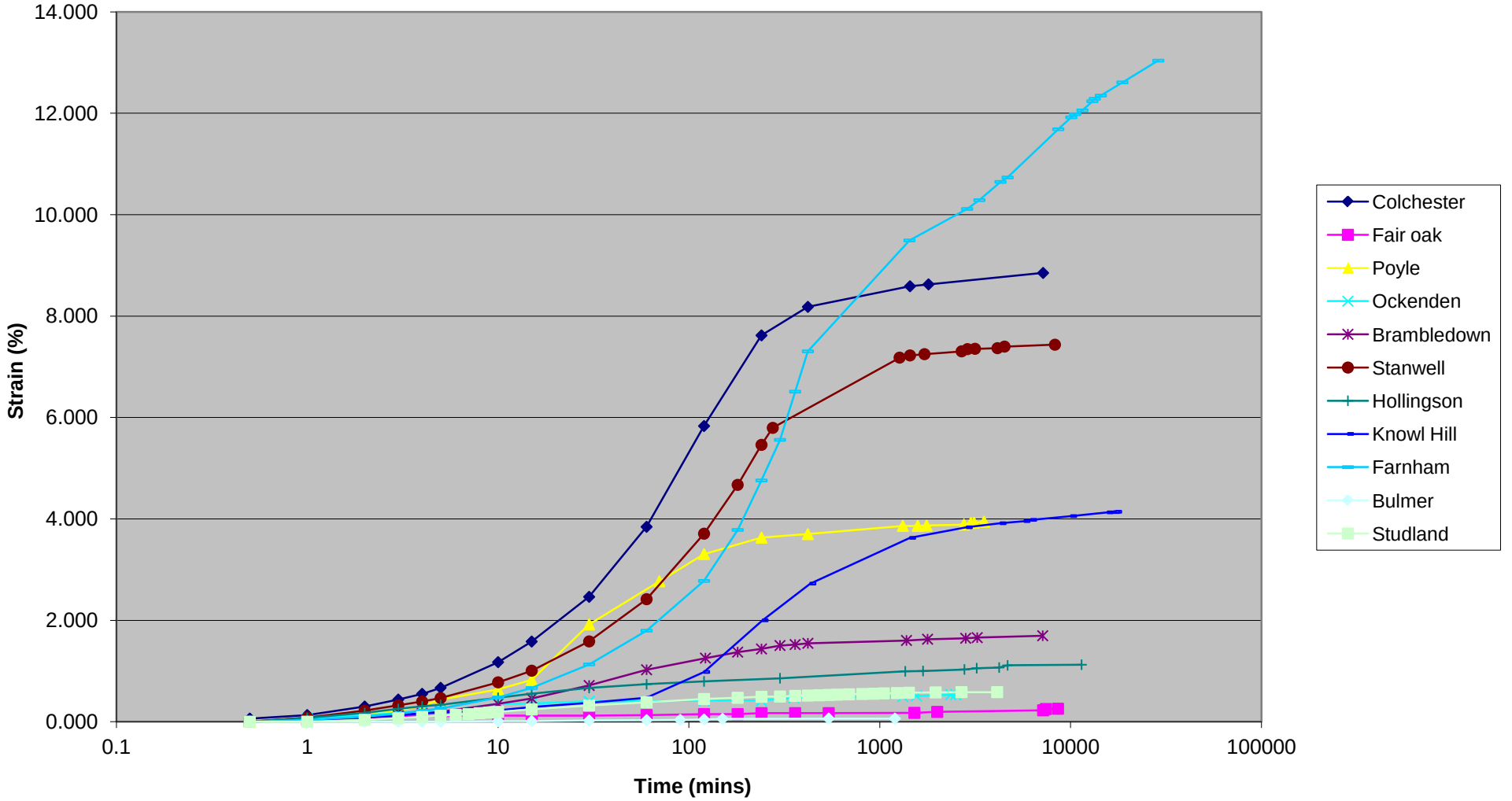
After test Measurements:				
M.C. tin I.D:	300		M.C. Tin Mass:	12.61
Dish + Ring + Satu. sample:	201.31		Initial M.C:	10.93
Dish + Ring + Dried sample:	188.62		Final M.C:	12.85
Particle Density:	2.64	$Mg \cdot m^{-3}$		
Dry Density:	1.93	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.37			

Test readings			Strain (ε)
Time	Reading	Comments	
0	0.000		0.000
0.5	0.000	Flood	0.000
1	0.000		0.000
2	0.006		0.037
3	0.011		0.068
4	0.015		0.093
5	0.019		0.118
6	0.022		0.137
7	0.024		0.149
8	0.027		0.168
9	0.029		0.180
10	0.031		0.193
15	0.039		0.242
30	0.051		0.317
60	0.062		0.385
120	0.072		0.447
180	0.076		0.472
240	0.079		0.491
300	0.080		0.497
360	0.082		0.509
420	0.083		0.516
480	0.084		0.522
540	0.085		0.528
600	0.086		0.534
690	0.087		0.540
810	0.088		0.547
930	0.089		0.553
1050	0.090		0.559
1230	0.091		0.565
1420	0.092		0.571
1960	0.093		0.578
2680	0.094		0.584
4120	0.094		0.584





All Samples: Strain v Time



1D Swell Pressure test

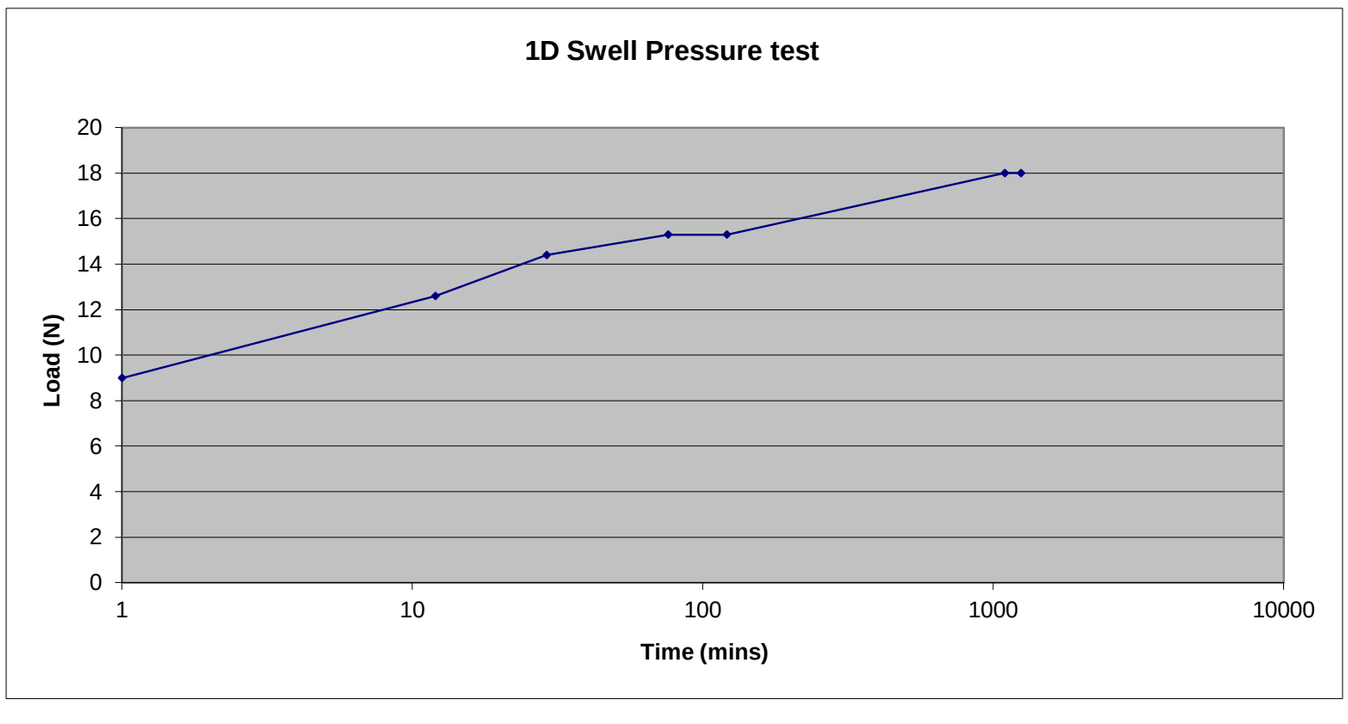
Sample I.D: Fair oak

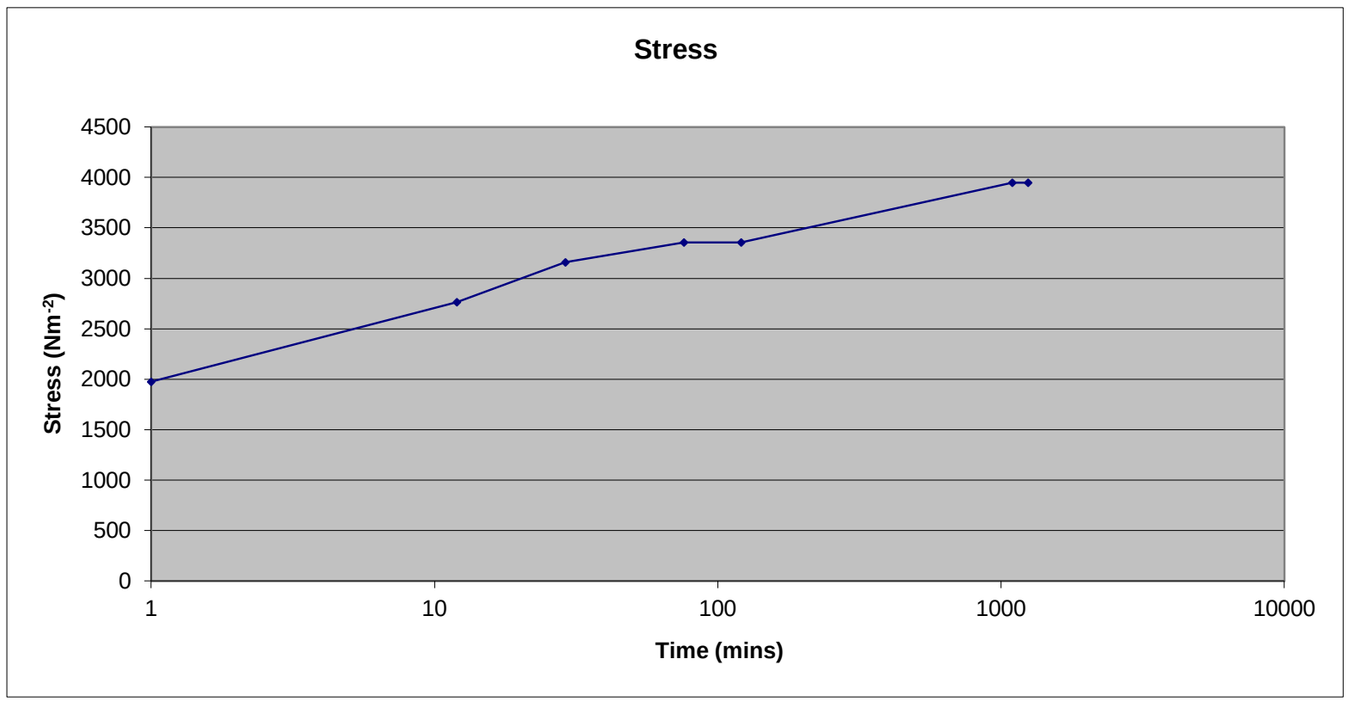
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	99.32	Sample Dimensions:	76.2	19.0	0.0381	0.00456	8.66E-05
Ring + Orig. sample:	263.77						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	B1	M.C Tin2 ID:	B2
M.C Tin1 Mass:	12.67	M.C Tin2 Mass:	12.54
M.C Tin1 + Wet sample:	72.73	M.C Tin2 + Wet sample:	65.94
M.C Tin1 + Dry sample:	61.98	M.C Tin2 + Dry sample:	56.65
M.C	21.80	M.C	21.06
Average	21.43		

After test Measurements:			
M.C. tin I.D:	N/A	M.C. Tin Mass:	0
Ring + Satu. sample:	267.40	Initial M.C:	23.44
Ring + Dried sample:	232.54	Final M.C:	26.17
Particle Density:	2.70	$Mg \cdot m^{-3}$	
Dry Density:	1.54	$Mg \cdot m^{-3}$	
Voids Ratio (e_0)	0.75		

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0		0	0
1	5		9	1974
12	7		12.6	2763
29	8		14.4	3158
76	8.5		15.3	3355
121	8.5		15.3	3355
1096	10		18	3947
1246	10		18	3947





1D Swell Pressure test

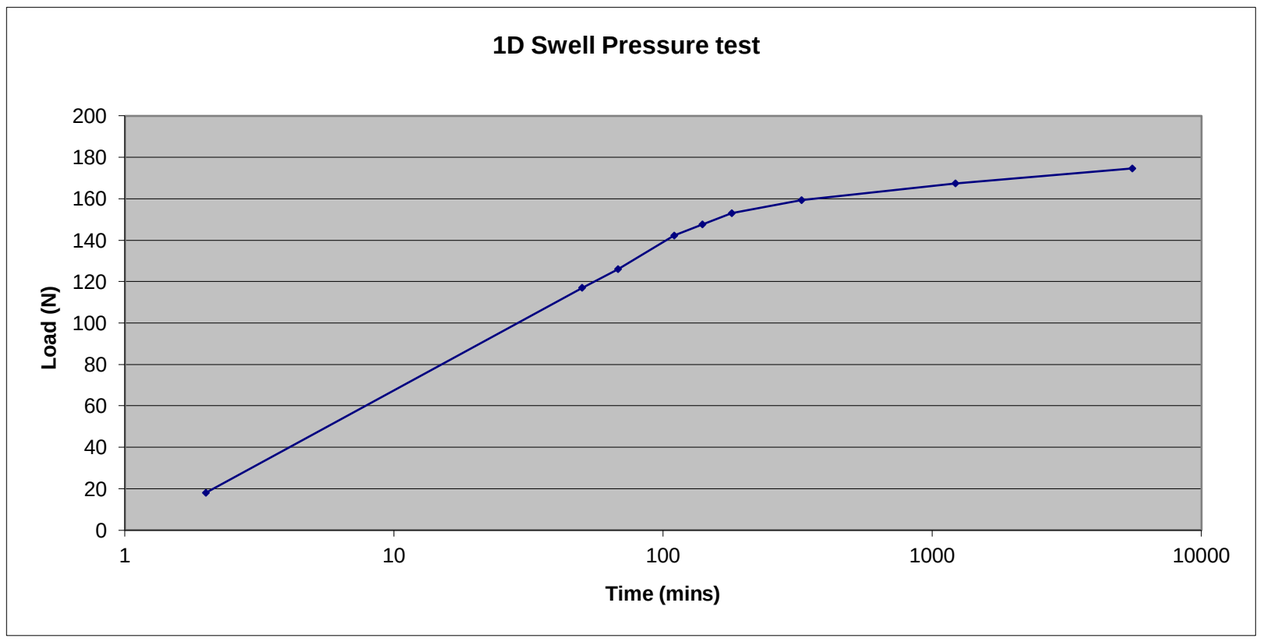
Sample I.D: Colchester

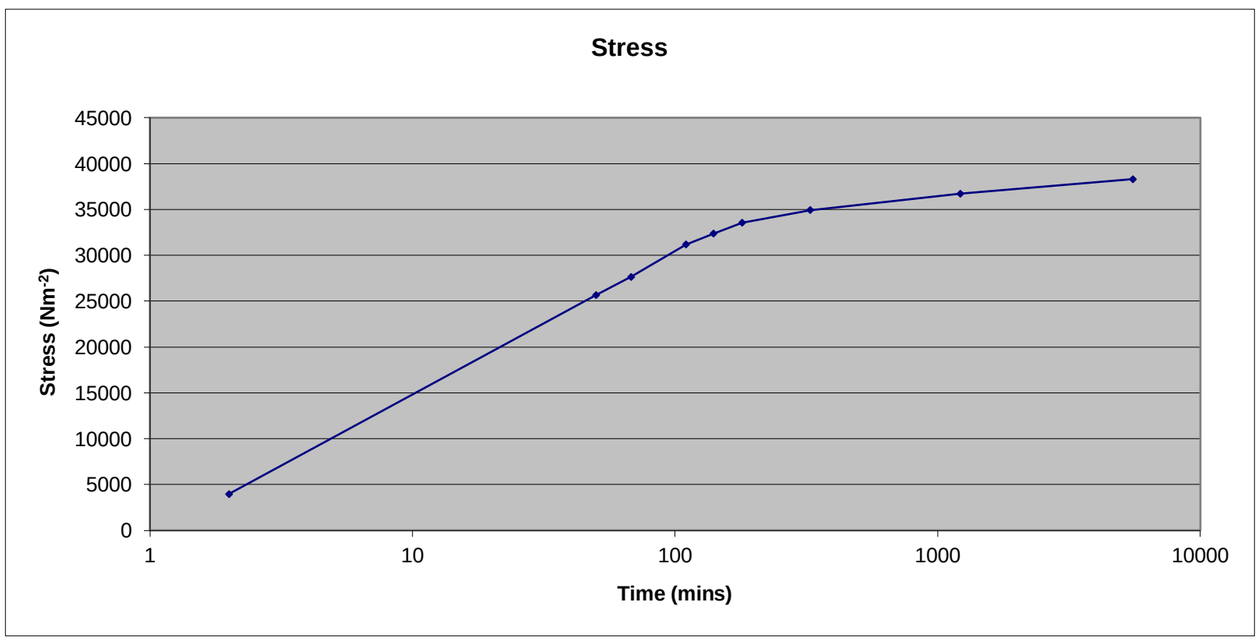
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	97.68	Sample Dimensions:	76.2	19.0	0.0381	0.00456	8.66E-05
Ring + Orig. sample:	255.39						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	A1	M.C Tin2 ID:	A2
M.C Tin1 Mass:	12.76	M.C Tin2 Mass:	12.61
M.C Tin1 + Wet sample:	86.70	M.C Tin2 + Wet sample:	104.14
M.C Tin1 + Dry sample:	71.14	M.C Tin2 + Dry sample:	84.72
M.C	26.65	M.C	26.93
Average	26.79		

After test Measurements:				
M.C. tin I.D:	X20		M.C. Tin Mass:	12.62
Dish + Ring + Satu. sample:	278.22		Initial M.C:	25.99
Dish + Ring + Dried sample:	235.48		Final M.C:	34.14
Particle Density:	2.76	$Mg \cdot m^{-3}$		
Dry Density:	1.44	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.91			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0		0	0
2	10		18	3947
50	65	Motor drive now working	117	25656
68	70		126	27629
110	79		142.2	31182
140	82		147.6	32366
180	85		153	33550
327	88.5		159.3	34931
1220	93		167.4	36708
5540	97		174.6	38286





1D Swell Pressure test

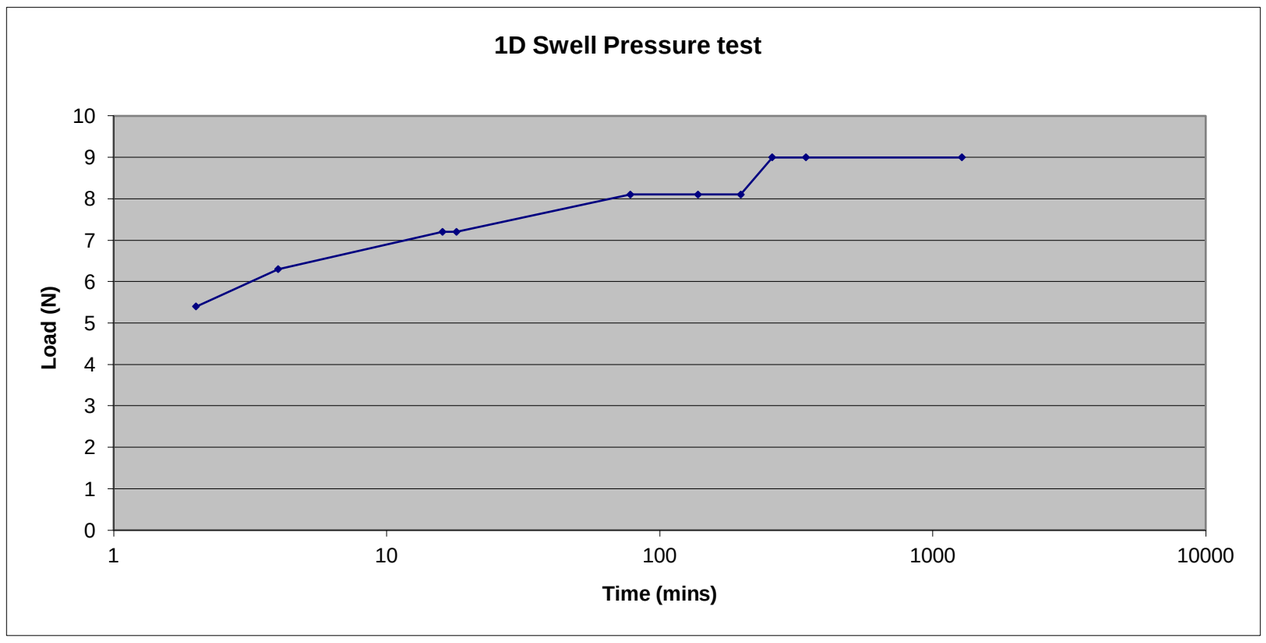
Sample I.D: Ockenden S1 (N.B sample in bad condition. Very fissured)

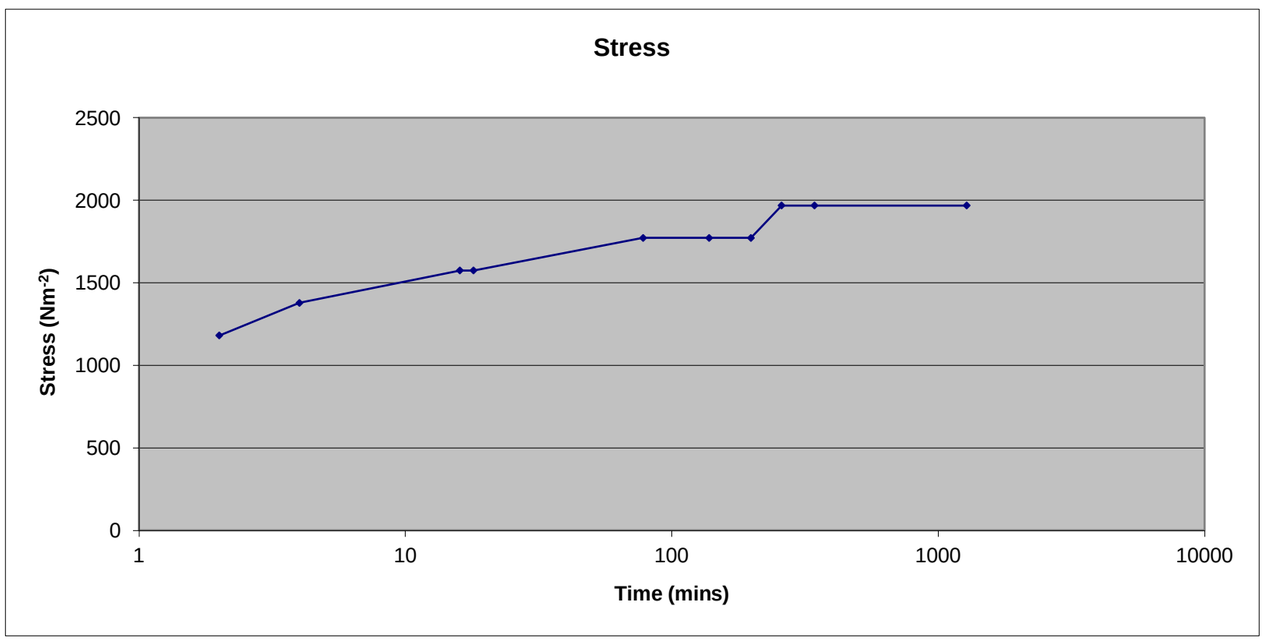
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	95.81	Sample Dimensions:	76.3	18.0	0.0382	0.00457	8.23E-05
Ring + Orig. sample:	234.29						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.58	M.C Tin2 Mass:	12.75
M.C Tin1 + Wet sample:	85.70	M.C Tin2 + Wet sample:	66.94
M.C Tin1 + Dry sample:	67.24	M.C Tin2 + Dry sample:	53.17
M.C	33.77	M.C	34.07
Average	33.92		

After test Measurements:				
M.C. tin I.D:			M.C. Tin Mass:	12.62
Dish + Ring + Satu. sample:	254.09		Initial M.C:	33.05
Dish + Ring + Dried sample:	212.51		Final M.C:	39.95
Particle Density:	2.71	$Mg \cdot m^{-3}$		
Dry Density:	1.26	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	1.14			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0	flood	0	0
2	3		5.4	1181
4	3.5		6.3	1378
16	4		7.2	1575
18	4		7.2	1575
78	4.5		8.1	1772
138	4.5		8.1	1772
198	4.5		8.1	1772
258	5		9	1968
343	5		9	1968
1278	5	test ended	9	1968





1D Swell Pressure test

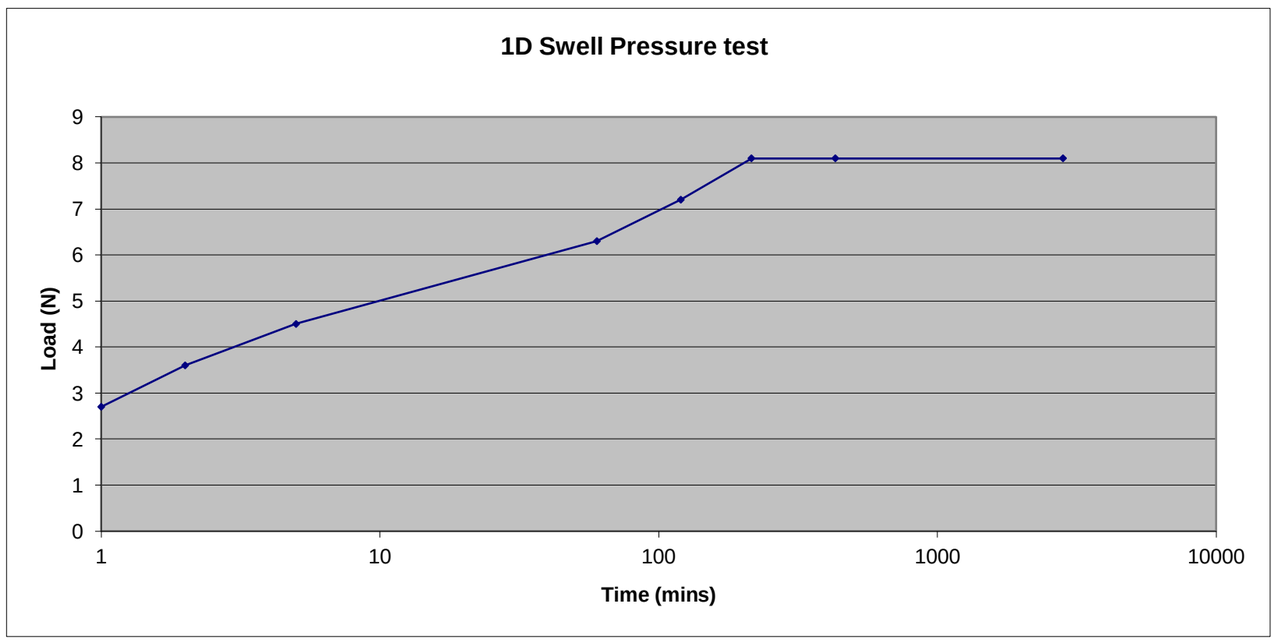
Sample I.D: Knoll Manor S2

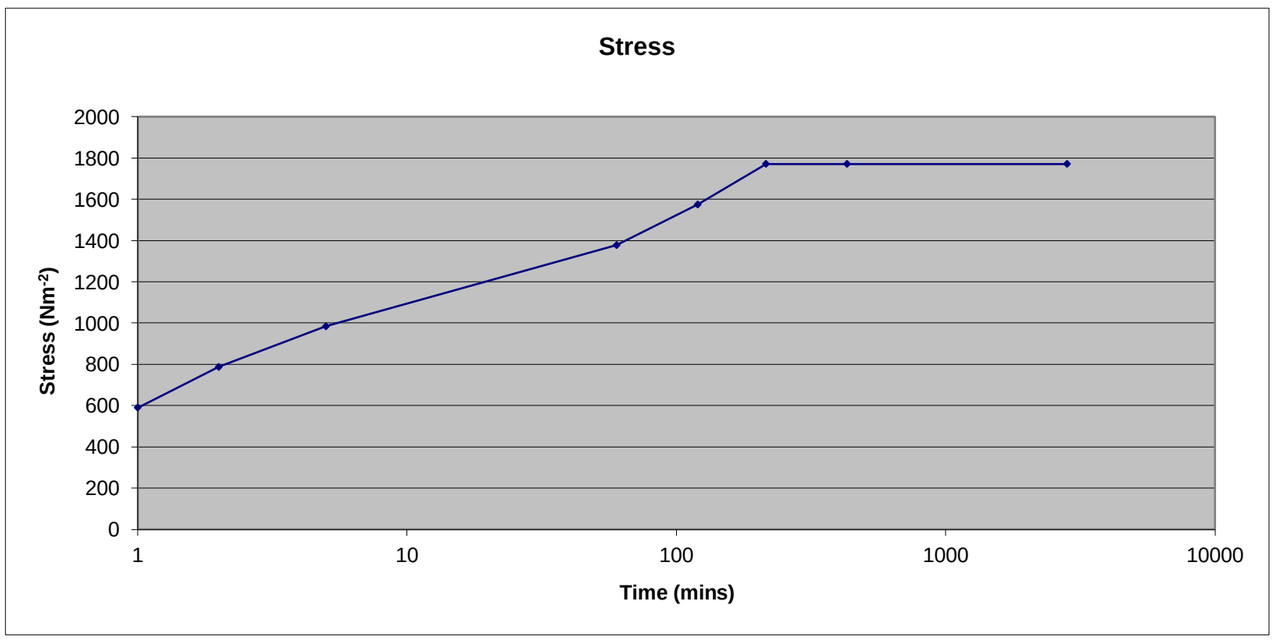
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	98.22	Sample Dimensions:	76.3	18.0	0.03815	0.00457	8.23E-05
Ring + Orig. sample:	240.92						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	12	M.C Tin2 ID:	X8
M.C Tin1 Mass:	12.76	M.C Tin2 Mass:	12.64
M.C Tin1 + Wet sample:	67.95	M.C Tin2 + Wet sample:	65.5
M.C Tin1 + Dry sample:	61.14	M.C Tin2 + Dry sample:	59.46
M.C	14.08	M.C	12.90
Average	13.49		

After test Measurements:				
M.C. tin I.D:	9		M.C. Tin Mass:	12.64
Dish + Ring + Satu. sample:	266.88		Initial M.C:	16.29
Dish + Ring + Dried sample:	233.57		Final M.C:	27.15
Particle Density:	2.68	$Mg \cdot m^{-3}$		
Dry Density:	1.49	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.80			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0	flood	0	0
1	1.5		2.7	591
2	2		3.6	787
5	2.5		4.5	984
60	3.5		6.3	1378
120	4		7.2	1575
215	4.5		8.1	1772
430	4.5		8.1	1772
2820	4.5	end test	8.1	1772





1D Swell Pressure test

Sample I.D: Poyle

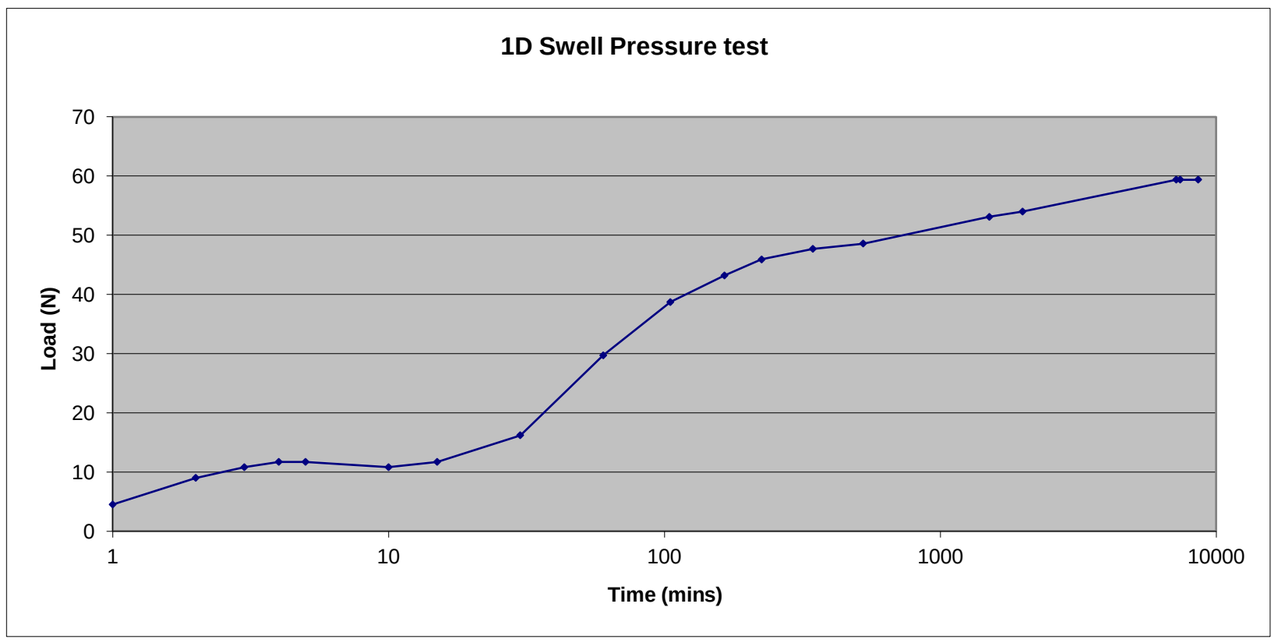
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	97.16	Sample Dimensions:	76.3	19.0	0.0382	0.00457	8.69E-05
Ring + Orig. sample:	252.82						
Load Ring Calibration (N/Div):	1.8						

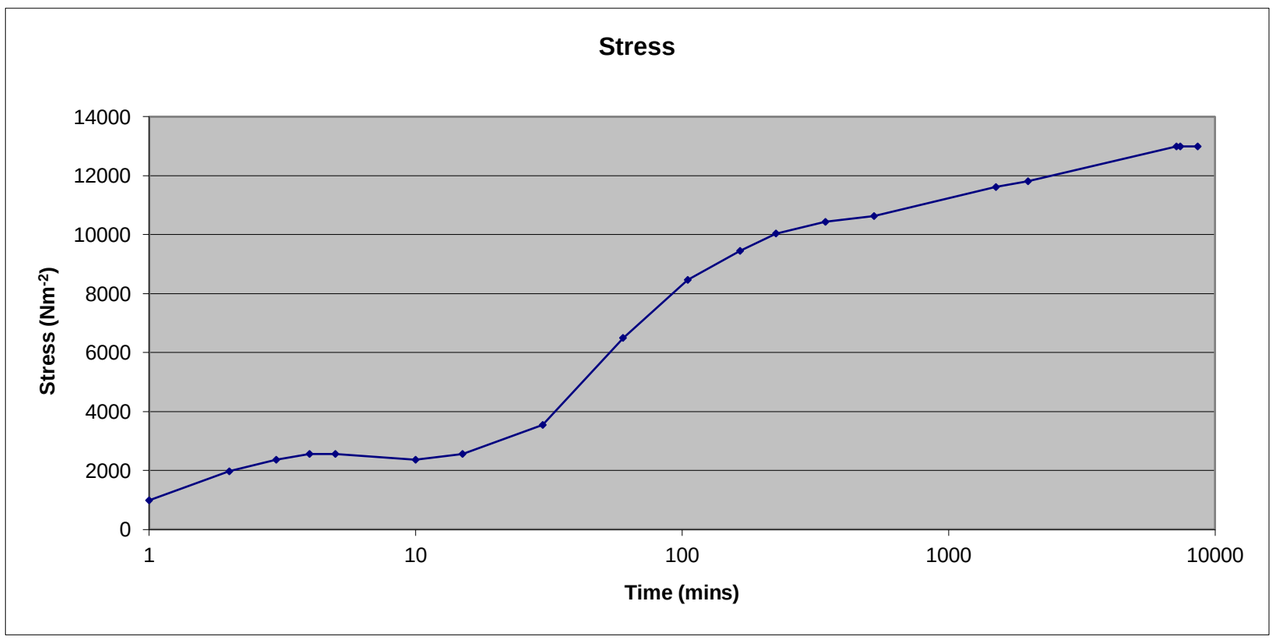
Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X45
M.C Tin1 Mass:	12.79	M.C Tin2 Mass:	12.56
M.C Tin1 + Wet sample:	92.35	M.C Tin2 + Wet sample:	87.41
M.C Tin1 + Dry sample:	72.31	M.C Tin2 + Dry sample:	68.62
M.C	33.67	M.C	33.52
Average	33.59		

After test Measurements:

M.C. tin I.D:	X8		M.C. Tin Mass:	12.63
Dish + Ring + Satu. sample:	271.51		Initial M.C:	31.83
Dish + Ring + Dried sample:	227.87		Final M.C:	36.96
Particle Density:	2.75	$Mg \cdot m^{-3}$		
Dry Density:	1.36	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	1.02			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.0	flood	0.0	0
1	2.5		4.5	984
2	5.0		9.0	1968
3	6.0		10.8	2362
4	6.5		11.7	2559
5	6.5		11.7	2559
10	6.0		10.8	2362
15	6.5		11.7	2559
30	9.0		16.2	3543
60	16.5		29.7	6496
105	21.5		38.7	8464
165	24.0		43.2	9448
225	25.5		45.9	10039
345	26.5		47.7	10432
525	27.0		48.6	10629
1505	29.5		53.1	11613
1986	30.0		54.0	11810
7160	33.0		59.4	12991
7400	33.0		59.4	12991
8600	33.0	end test	59.4	12991





1D Swell Pressure test

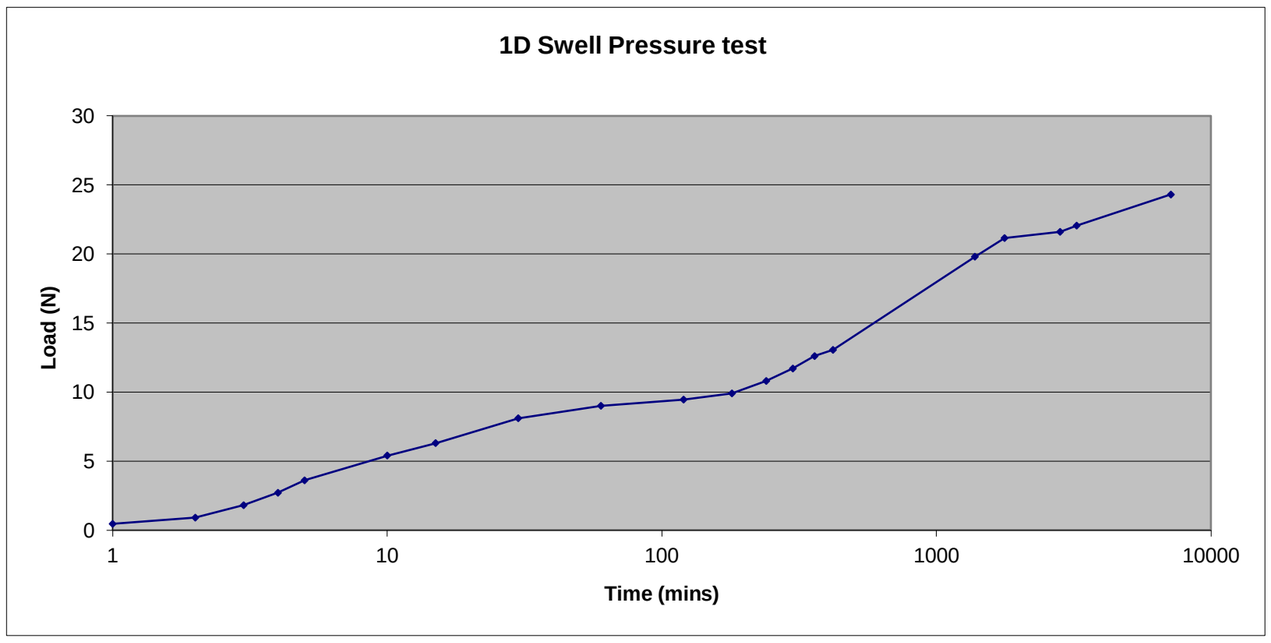
Sample I.D: Brambledown

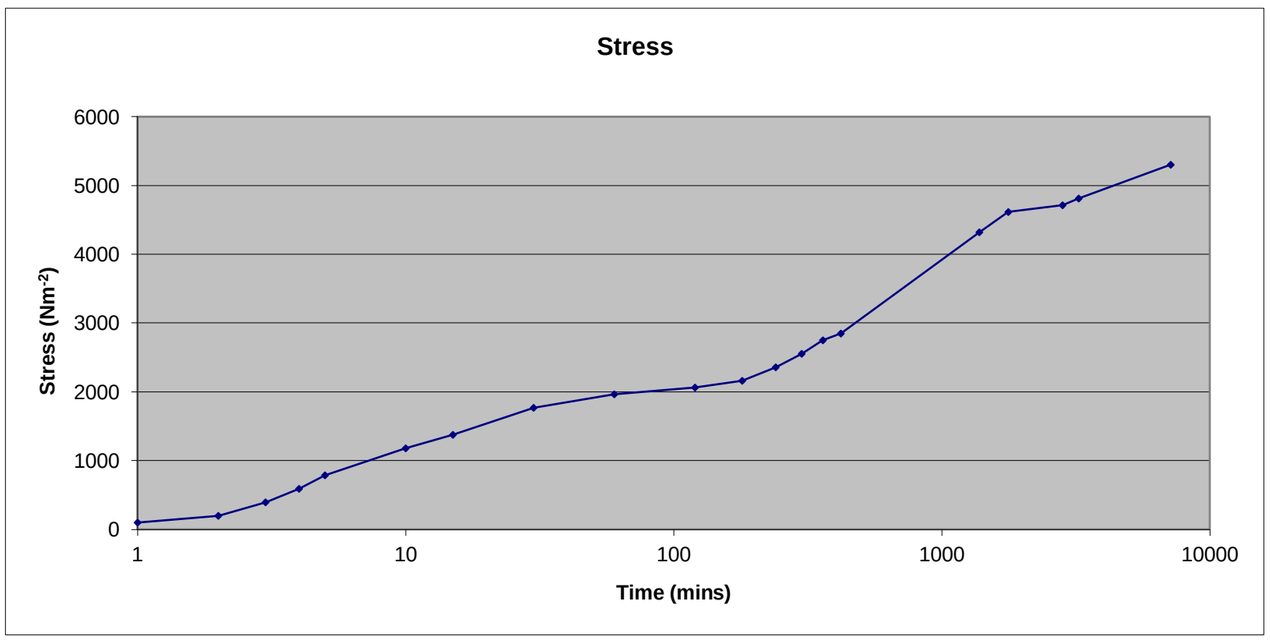
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	98.25	Sample Dimensions:	76.4	18.9	0.0382	0.00458	8.66E-05
Ring + Orig. sample:	254.18						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.59	M.C Tin2 Mass:	12.76
M.C Tin1 + Wet sample:	84.50	M.C Tin2 + Wet sample:	100.7
M.C Tin1 + Dry sample:	65.61	M.C Tin2 + Dry sample:	77.31
M.C	35.63	M.C	36.24
Average	35.93		

After test Measurements:				
M.C. tin I.D:	X26		M.C. Tin Mass:	12.62
Dish + Ring + Satu. sample:	270.63		Initial M.C:	34.77
Dish + Ring + Dried sample:	226.57		Final M.C:	38.08
Particle Density:	2.72	$Mg \cdot m^{-3}$		
Dry Density:	1.34	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	1.04			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0		0.00	0.00
1	0.25		0.45	98.16
2	0.5		0.90	196.32
3	1		1.80	392.64
4	1.5		2.70	588.96
5	2		3.60	785.28
10	3		5.40	1177.92
15	3.5		6.30	1374.24
30	4.5		8.10	1766.89
60	5		9.00	1963.21
120	5.25		9.45	2061.37
180	5.5		9.90	2159.53
240	6		10.80	2355.85
300	6.5		11.70	2552.17
360	7		12.60	2748.49
420	7.25		13.05	2846.65
1380	11		19.80	4319.05
1770	11.75		21.15	4613.53
2820	12		21.60	4711.69
3240	12.25		22.05	4809.86
7140	13.5	End test	24.30	5300.66





1D Swell Pressure test

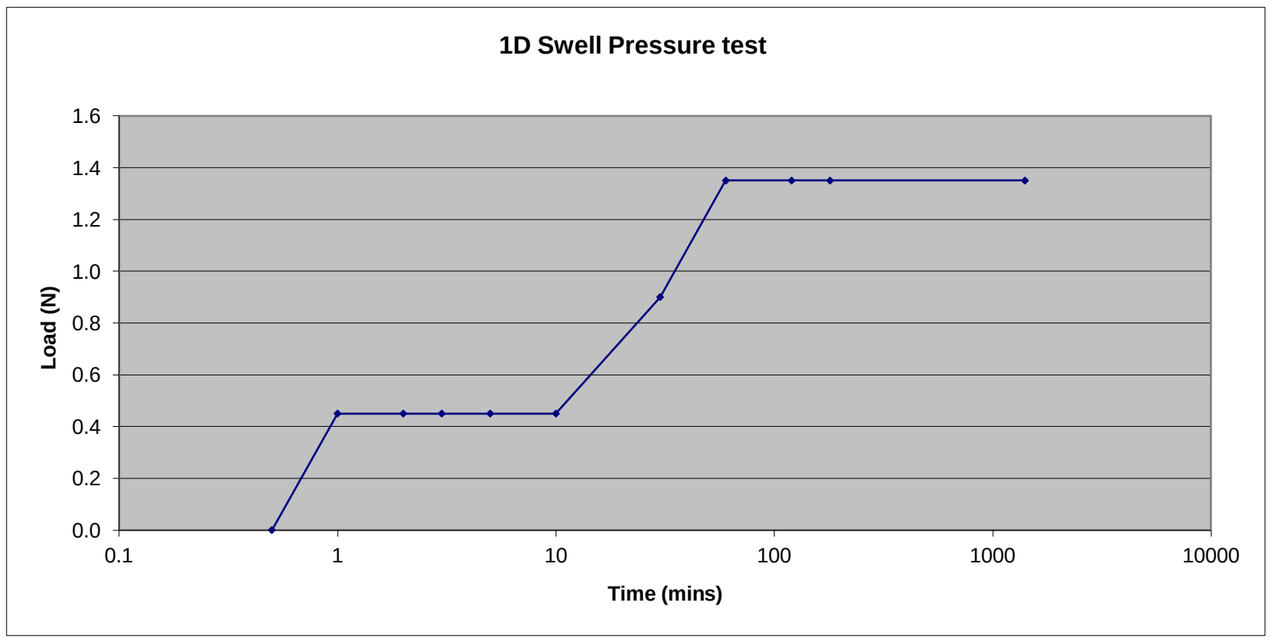
Sample I.D: Knoll Manor S1

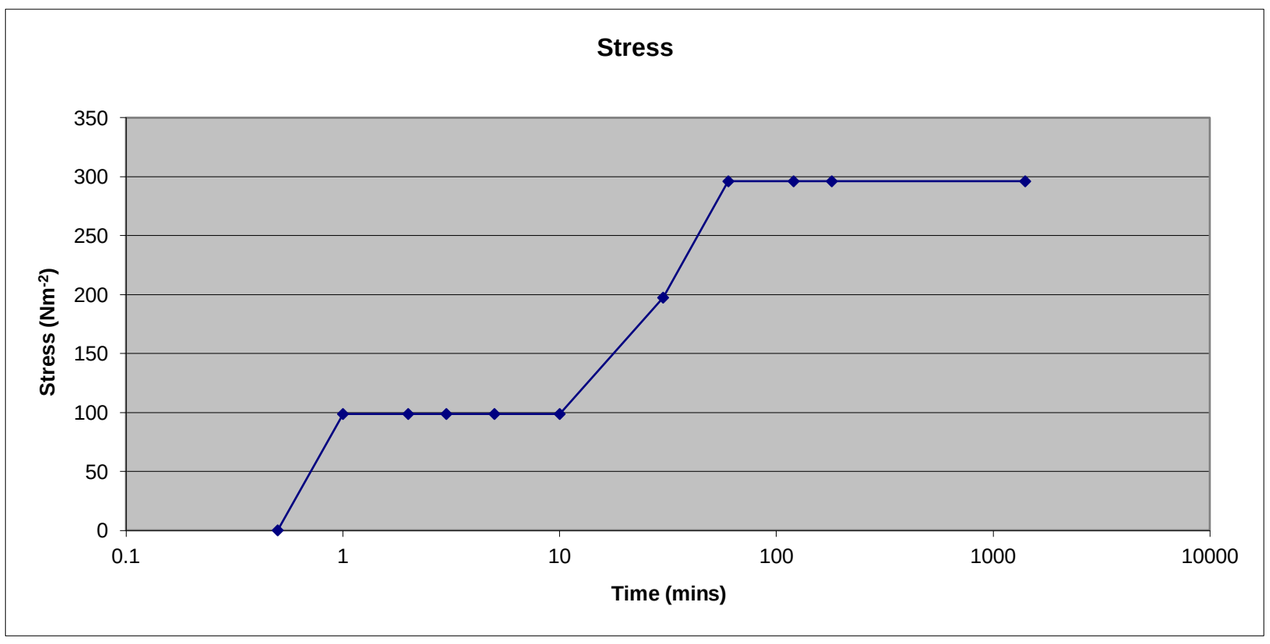
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	95.91	Sample Dimensions:	76.2	18.2	0.0381	0.00456	8.30E-05
Ring + Orig. sample:	259.99						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X45
M.C Tin1 Mass:	12.78	M.C Tin2 Mass:	12.55
M.C Tin1 + Wet sample:	47.08	M.C Tin2 + Wet sample:	57.30
M.C Tin1 + Dry sample:	40.87	M.C Tin2 + Dry sample:	49.32
M.C	22.11	M.C	21.70
Average	21.90		

After test Measurements:				
M.C. tin I.D:	X104		M.C. Tin Mass:	12.75
Dish + Ring + Satu. sample:	274.01		Initial M.C:	23.01
Dish + Ring + Dried sample:	242.05		Final M.C:	23.96
Particle Density:	2.73	$Mg \cdot m^{-3}$		
Dry Density:	1.61	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.70			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0		0.00	0.00
0.5	0	Flood	0.00	0.00
1	0.25		0.45	98.68
2	0.25		0.45	98.68
3	0.25		0.45	98.68
5	0.25		0.45	98.68
10	0.25		0.45	98.68
30	0.5		0.90	197.35
60	0.75		1.35	296.03
120	0.75		1.35	296.03
180	0.75		1.35	296.03
1405	0.75	end test	1.35	296.03





1D Swell Pressure test

Sample I.D: Stanwell

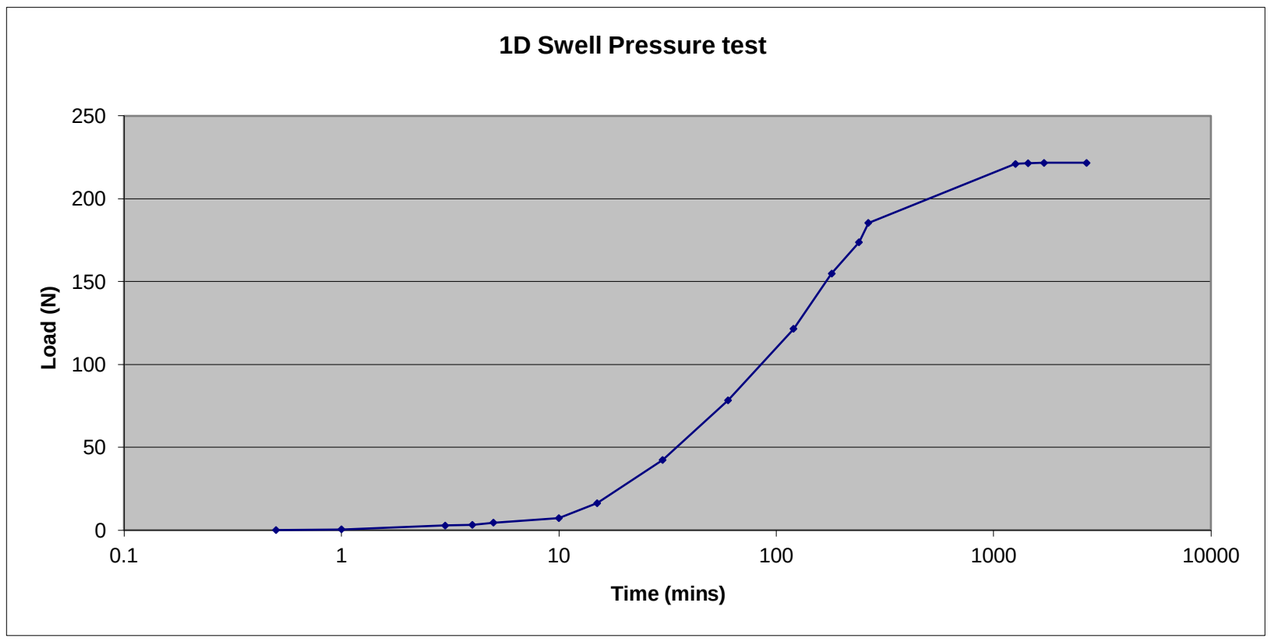
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	97.16	Sample Dimensions:	76.3	18.9	0.03815	0.00457	8.64E-05
Ring + Orig. sample:	263.09						
Load Ring Calibration (N/Div):	1.8						

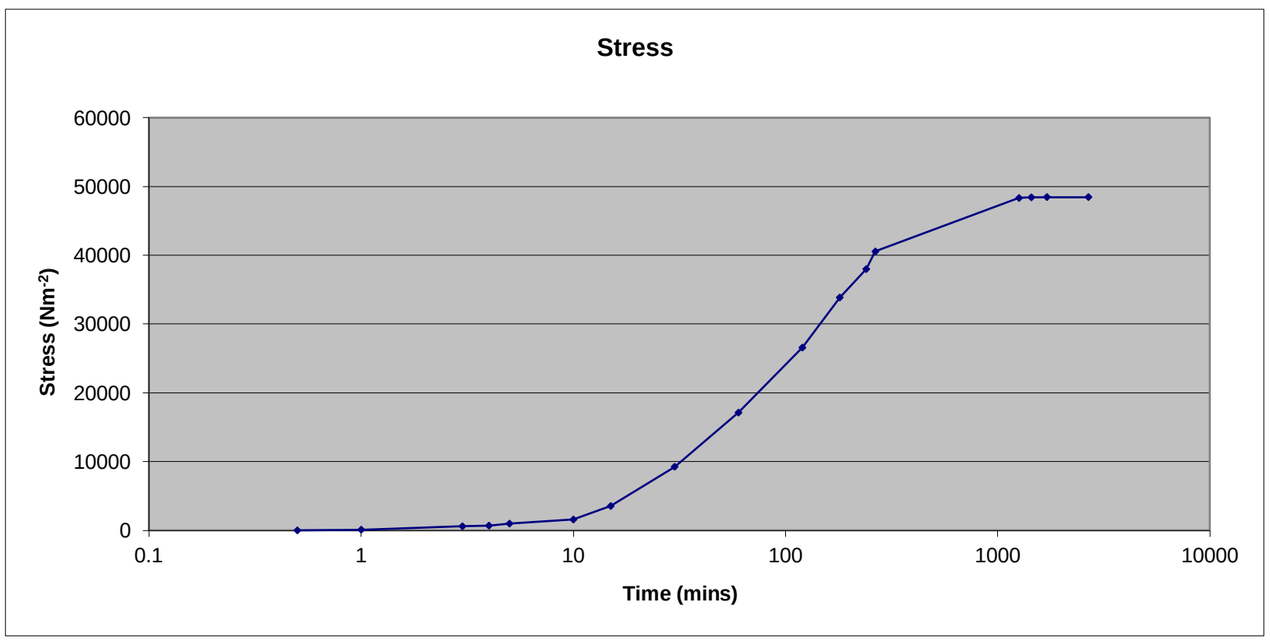
Moisture Content of original sample			
M.C Tin1 ID:	T2	M.C Tin2 ID:	X41
M.C Tin1 Mass:	12.66	M.C Tin2 Mass:	12.79
M.C Tin1 + Wet sample:	86.47	M.C Tin2 + Wet sample:	79.91
M.C Tin1 + Dry sample:	71.05	M.C Tin2 + Dry sample:	65.69
M.C	26.41	M.C	26.88
Average	26.64		

After test Measurements:

M.C. tin I.D:	X41		M.C. Tin Mass:	12.80
Dish + Ring + Satu. sample:	281.63		Initial M.C:	26.45
Dish + Ring + Dried sample:	241.18		Final M.C:	30.83
Particle Density:	2.77	$Mg \cdot m^{-3}$		
Dry Density:	1.52	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.82			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.00		0.00	0
0.5	0.00	Flood	0.00	0
1	0.25		0.45	98
3	1.50		2.70	591
4	1.75		3.15	689
5	2.50		4.50	984
10	4.00		7.20	1575
15	9.00		16.20	3543
30	23.50		42.30	9251
60	43.50		78.30	17125
120	67.50		121.50	26573
180	86.00		154.80	33856
240	96.50		173.70	37989
265	103.00		185.40	40548
1260	122.75		220.95	48323
1440	123.00		221.40	48422
1705	123.10		221.58	48461
2675	123.10	end test	221.58	48461





1D Swell Pressure test

Sample I.D: Bull Lodge

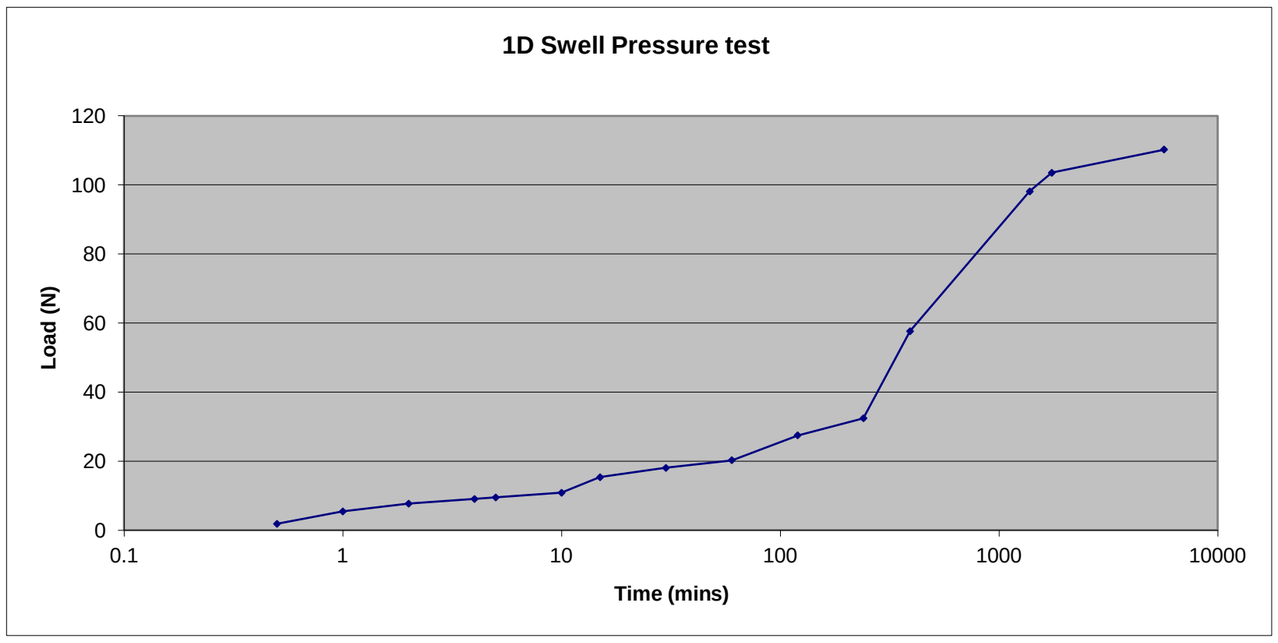
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	98.86	Sample Dimensions:	76.2	18.9	0.0381	0.00456	8.62E-05
Ring + Orig. sample:	272.17						
Load Ring Calibration (N/Div):	1.8						

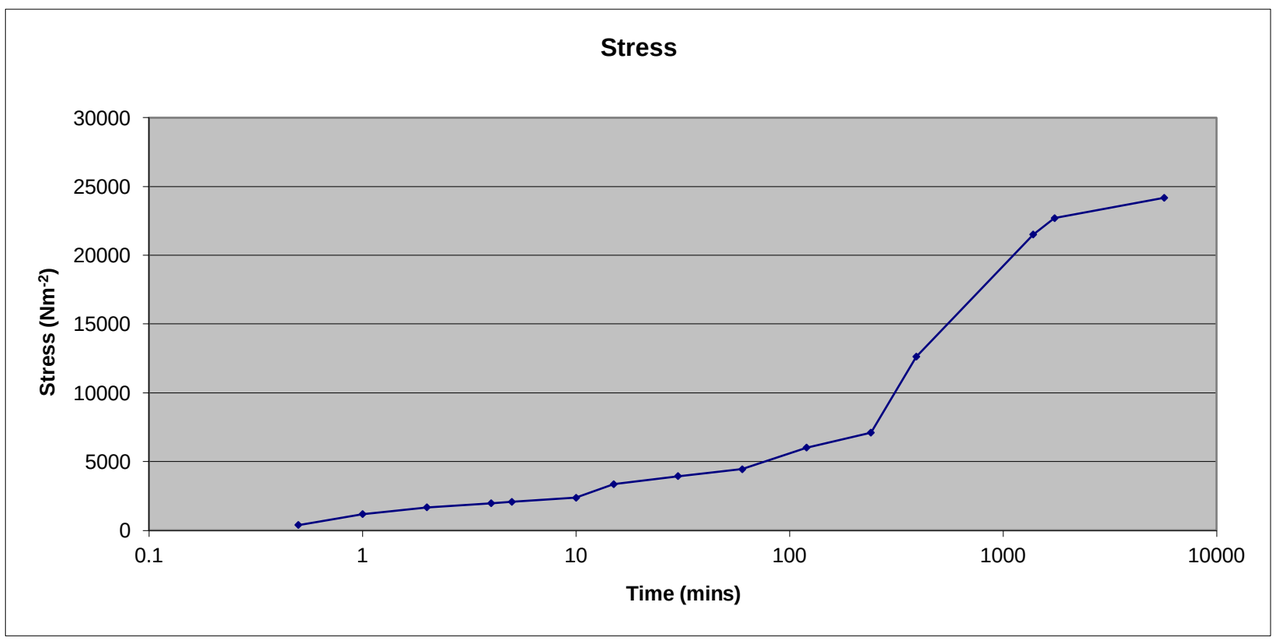
Moisture Content of original sample			
M.C Tin1 ID:	X45	M.C Tin2 ID:	X14
M.C Tin1 Mass:	12.56	M.C Tin2 Mass:	12.79
M.C Tin1 + Wet sample:	101.76	M.C Tin2 + Wet sample:	91.00
M.C Tin1 + Dry sample:	83.63	M.C Tin2 + Dry sample:	75.15
M.C	25.51	M.C	25.42
Average	25.46		

After test Measurements:

M.C. tin I.D:	X42		M.C. Tin Mass:	12.6
Dish + Ring + Satu. sample:	288.97		Initial M.C:	23.77
Dish + Ring + Dried sample:	251.49		Final M.C:	26.77
Particle Density:	2.84	$Mg \cdot m^{-3}$		
Dry Density:	1.62	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.75			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.00		0.00	0
0.5	1.00	Flood	1.80	395
1	3.00		5.40	1184
2	4.25		7.65	1677
4	5.00		9.00	1974
5	5.25		9.45	2072
10	6.00		10.80	2368
15	8.50		15.30	3355
30	10.00		18.00	3947
60	11.25		20.25	4440
120	15.25		27.45	6019
240	18.00		32.40	7105
392	32.00		57.60	12631
1382	54.50		98.10	21511
1742	57.50		103.50	22696
5678	61.25		110.25	24176





1D Swell Pressure test

Sample I.D: Hollingson

Before test measurements:

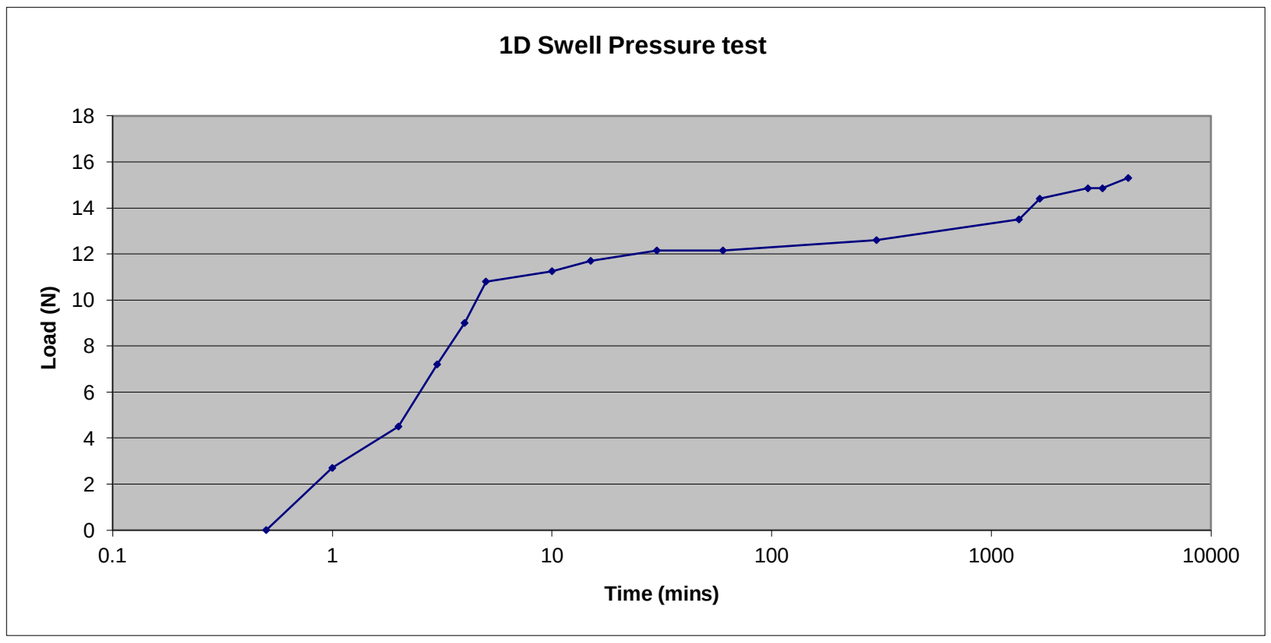
			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	98.26	Sample Dimensions:	76.1	18.8	0.03805	0.00455	8.55E-05
Ring + Orig. sample:	264.88						
Load Ring Calibration (N/Div):	1.8						

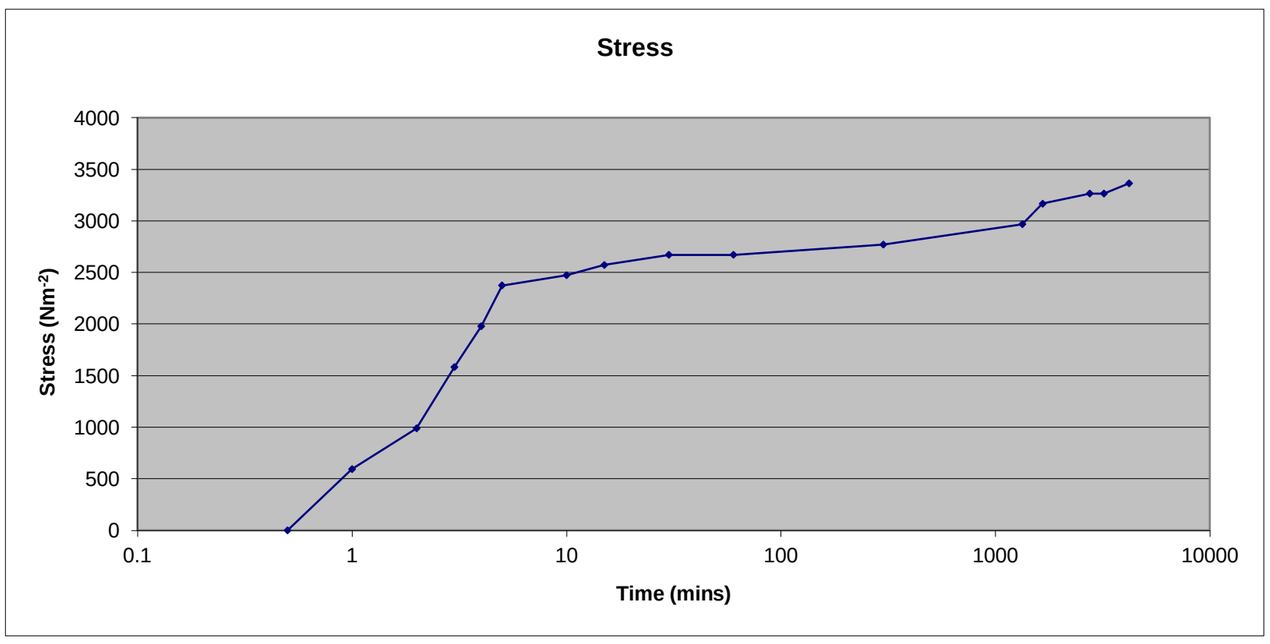
Moisture Content of original sample			
M.C Tin1 ID:	X45	M.C Tin2 ID:	23
M.C Tin1 Mass:	12.7	M.C Tin2 Mass:	12.63
M.C Tin1 + Wet sample:	92.00	M.C Tin2 + Wet sample:	85.98
M.C Tin1 + Dry sample:	75.44	M.C Tin2 + Dry sample:	70.53
M.C	26.39	M.C	26.68
Average	26.54		

After test Measurements:

M.C. tin I.D:	23		M.C. Tin Mass:	12.63
Dish + Ring + Satu. sample:	280.94		Initial M.C:	24.91
Dish + Ring + Dried sample:	244.28		Final M.C:	27.48
Particle Density:	2.68	$Mg \cdot m^{-3}$		
Dry Density:	1.56	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.72			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.00		0.00	0
0.5	0.00	Flood	0.00	0
1	1.50		2.70	594
2	2.50		4.50	989
3	4.00		7.20	1583
4	5.00		9.00	1979
5	6.00		10.80	2374
10	6.25		11.25	2473
15	6.50		11.70	2572
30	6.75		12.15	2671
60	6.75		12.15	2671
300	7.00		12.60	2770
1335	7.50		13.50	2968
1660	8.00		14.40	3166
2751	8.25		14.85	3265
3205	8.25		14.85	3265
4197	8.50		15.30	3364





1D Swell Pressure test

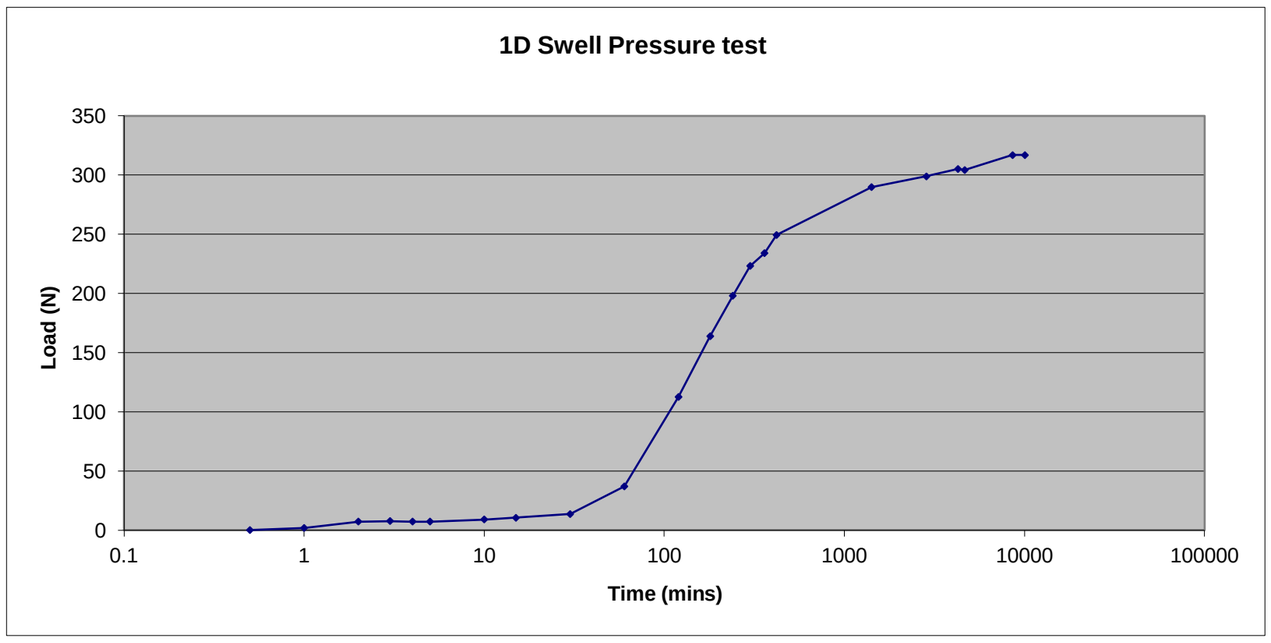
Sample I.D: Farnham

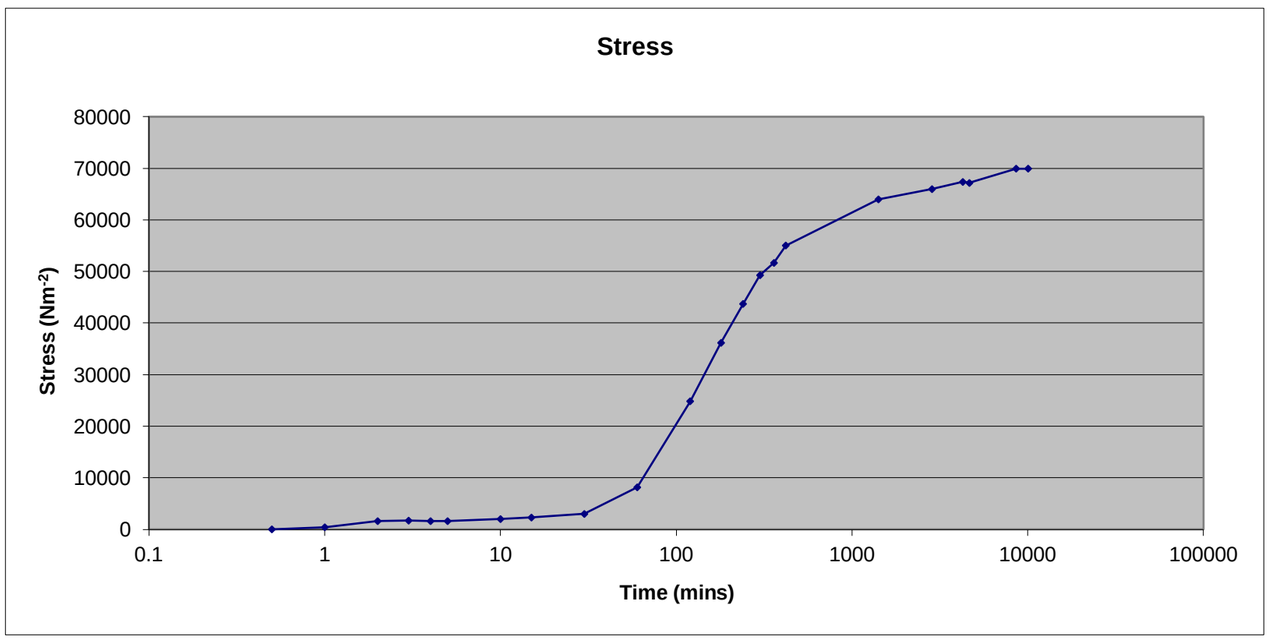
Before test measurements:			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	97.47	Sample Dimensions:	75.95	18.9	0.037975	0.00453	8.56E-05
Ring + Orig. sample:	279.53						
Load Ring Calibration (N/Div):	1.8						

Moisture Content of original sample			
M.C Tin1 ID:	9	M.C Tin2 ID:	X102
M.C Tin1 Mass:	12.64	M.C Tin2 Mass:	13.01
M.C Tin1 + Wet sample:	79.21	M.C Tin2 + Wet sample:	83.34
M.C Tin1 + Dry sample:	68.22	M.C Tin2 + Dry sample:	71.68
M.C	19.77	M.C	19.87
Average	19.82		

After test Measurements:				
M.C. tin I.D:	24		M.C. Tin Mass:	12.96
Dish + Ring + Satu. sample:	295.92		Initial M.C:	19.94
Dish + Ring + Dried sample:	262.22		Final M.C:	22.20
Particle Density:	2.75	$Mg \cdot m^{-3}$		
Dry Density:	1.77	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.55			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.00		0.00	0.00
0.5	0.00	Flood	0.00	0.00
1	1.00		1.80	397.31
2	4.00		7.20	1589.23
3	4.25		7.65	1688.56
4	4.00		7.20	1589.23
5	4.00		7.20	1589.23
10	5.00		9.00	1986.54
15	5.75		10.35	2284.52
30	7.50		13.50	2979.81
60	20.50		36.90	8144.81
120	62.50		112.50	24831.74
180	91.00		163.80	36155.01
240	110.00		198.00	43703.86
300	124.00		223.20	49266.16
360	130.00		234.00	51650.01
420	138.50		249.30	55027.13
1415	161.00		289.80	63966.55
2855	166.00		298.80	65953.09
4275	169.50		305.10	67343.67
4660	169.00		304.20	67145.01
8595	176.00		316.80	69926.17
10060	176.00		316.80	69926.17





1D Swell Pressure test

Sample I.D: Studland

Before test measurements:

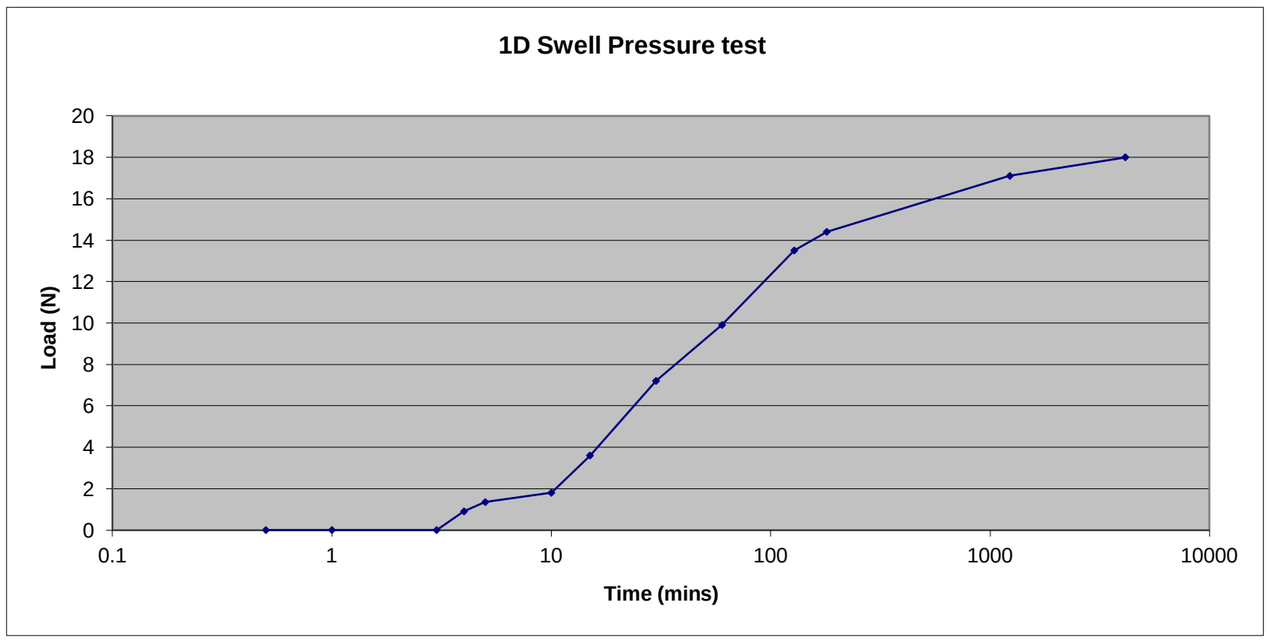
			Width (mm)	Depth (mm)	Radius (m)	Area (m^2)	Volume (m^3)
Ring weight:	120.00	Sample Dimensions:	76.3	18.9	0.03815	0.00457	8.64E-05
Ring + Orig. sample:	308.77						
Load Ring Calibration (N/Div):	1.8						

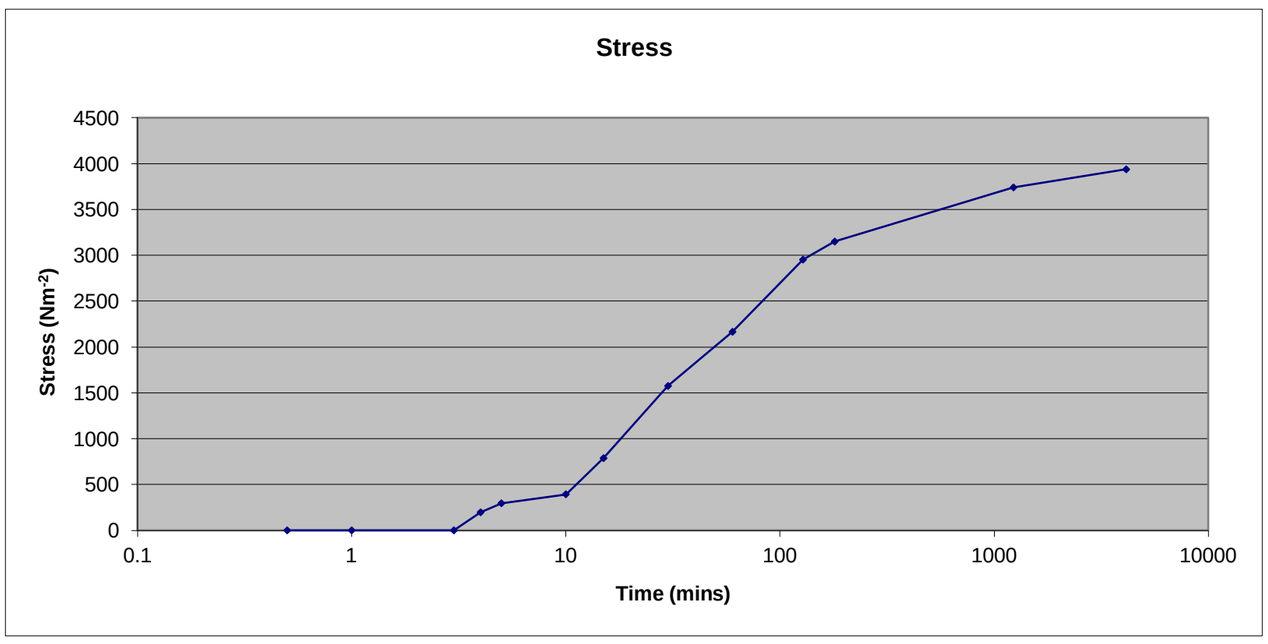
Moisture Content of original sample			
M.C Tin1 ID:	X47	M.C Tin2 ID:	X106
M.C Tin1 Mass:	12.57	M.C Tin2 Mass:	12.73
M.C Tin1 + Wet sample:	36.75	M.C Tin2 + Wet sample:	42.65
M.C Tin1 + Dry sample:	34.63	M.C Tin2 + Dry sample:	40.01
M.C	9.61	M.C	9.68
Average	9.64		

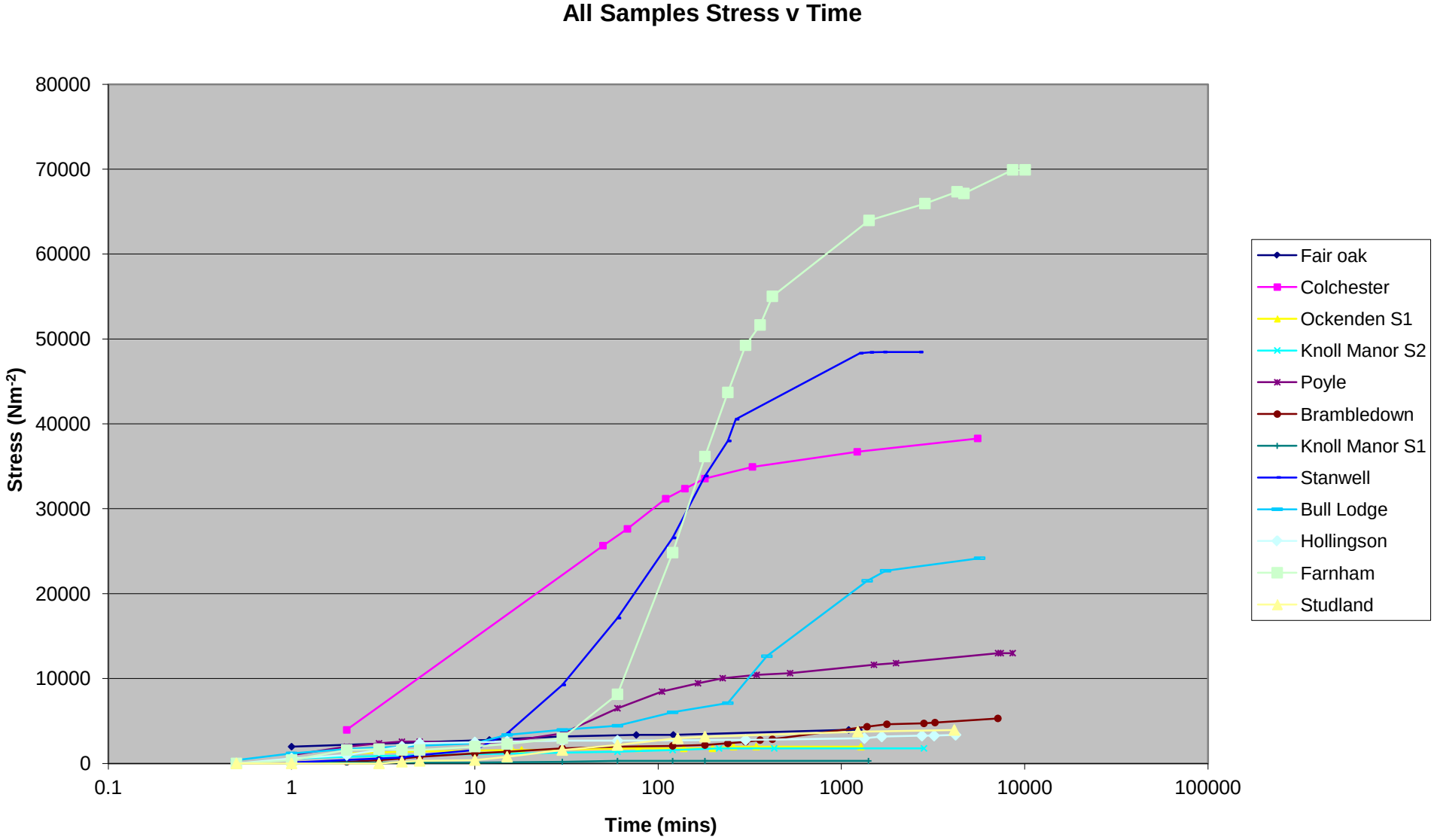
After test Measurements:

M.C. tin I.D:	X101		M.C. Tin Mass:	12.54
Dish + Ring + Satu. sample:	323.76		Initial M.C:	11.40
Dish + Ring + Dried sample:	301.99		Final M.C:	12.85
Particle Density:	2.64	$Mg \cdot m^{-3}$		
Dry Density:	1.96	$Mg \cdot m^{-3}$		
Voids Ratio (e_0)	0.35			

Test readings			Load (N)	Stress (Nm^{-2})
Time	Divisions	Comments		
0	0.00		0.00	0.00
0.5	0.00	Flood	0.00	0.00
1	0.00		0.00	0.00
3	0.00		0.00	0.00
4	0.50		0.90	196.84
5	0.75		1.35	295.25
10	1.00		1.80	393.67
15	2.00		3.60	787.34
30	4.00		7.20	1574.68
60	5.50		9.90	2165.19
128	7.50		13.50	2952.53
180	8.00		14.40	3149.37
1230	9.50		17.10	3739.88
4131	10.00		18.00	3936.71






All Samples Stress v Time
Stress (Nm-2)
80000
70000
60000
50000
40000
30000
20000
10000
0
0.1
1
10
100
1000
10000
100000
Time (mins)
Fair oak
Colchester
Ockenden S1
Knoll Manor S2
Poyle
Brambledown
Knoll Manor S1
Stanwell
Bull Lodge
Hollingson
Farnham
Studland

3D Swell test

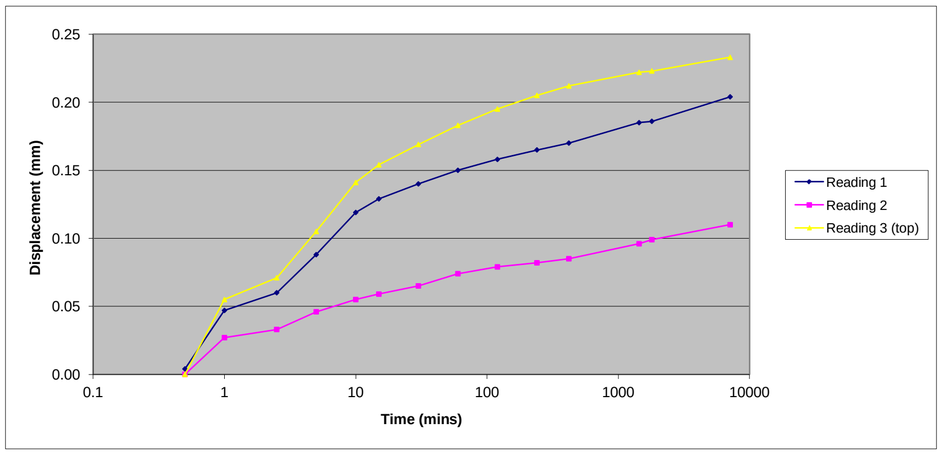
Sample I.D: Fairoak

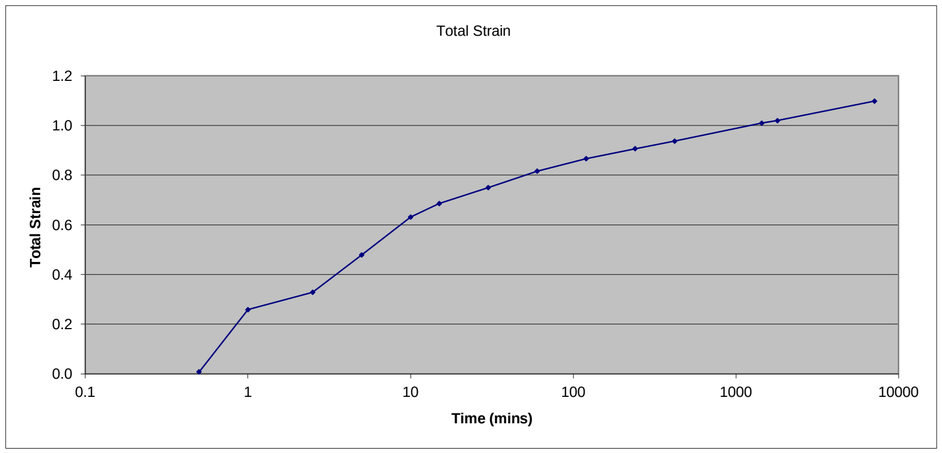
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	234.23	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X52
M.C Tin1 Mass:	12.58	M.C Tin2 Mass:	12.62
M.C Tin1 + Wet sample:	100.9	M.C Tin2 + Wet sample:	93.12
M.C Tin1 + Dry sample:	84.48	M.C Tin2 + Dry sample:	78.65
M.C	22.84	M.C	21.91
Average	22.38		

After test Measurements:				
M.C. tin I.D:	N/A		M.C. Tin Mass:	0
Dish + Satu. sample:	235.18		Initial M.C.	22.77
Dish + Dried sample:	190.79		Final M.C:	23.27
Particle Density:	2.75	$Mg \cdot m^{-3}$		
Dry Density:	1.53	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	0.80			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1	Reading 2	Reading 3 (top)	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.004	0.000	0.000	Flood	0.008	0.000	0.000	125010	0.008
1	0.047	0.027	0.055		0.094	0.054	0.110	125323	0.258
2.5	0.060	0.033	0.071		0.120	0.066	0.142	125410	0.328
5	0.088	0.046	0.105		0.176	0.092	0.210	125598	0.479
10	0.119	0.055	0.141		0.238	0.110	0.282	125789	0.631
15	0.129	0.059	0.154		0.258	0.118	0.308	125857	0.685
30	0.140	0.065	0.169		0.280	0.130	0.338	125937	0.750
60	0.150	0.074	0.183		0.300	0.148	0.366	126020	0.816
120	0.158	0.079	0.195		0.316	0.158	0.390	126083	0.866
240	0.165	0.082	0.205		0.330	0.164	0.410	126133	0.907
420	0.170	0.085	0.212		0.340	0.170	0.424	126171	0.937
1440	0.185	0.096	0.222		0.370	0.192	0.444	126262	1.009
1800	0.186	0.099	0.223		0.372	0.198	0.446	126274	1.019
7110	0.204	0.110	0.233		0.408	0.220	0.466	126372	1.098





3D Swell test

Sample I.D: Poyle

Before test measurements: Height/Width/Length (mm) mm^3

Orig. sample weight: 225.01 Sample Dimensions: 50 125000

Moisture Content of original sample			
M.C Tin1 ID:	x38	M.C Tin2 ID:	x101
M.C Tin1 Mass:	12.64	M.C Tin2 Mass:	12.55
M.C Tin1 + Wet sample:	83.33	M.C Tin2 + Wet sample:	96.7
M.C Tin1 + Dry sample:	68.01	M.C Tin2 + Dry sample:	77.78
M.C	27.67	M.C	29.01
Average	28.34		

After test Measurements:

M.C. tin I.D: X38 M.C. Tin Mass: 12.65

Dish + Satu. sample: 249.79 Initial M.C. 31.44

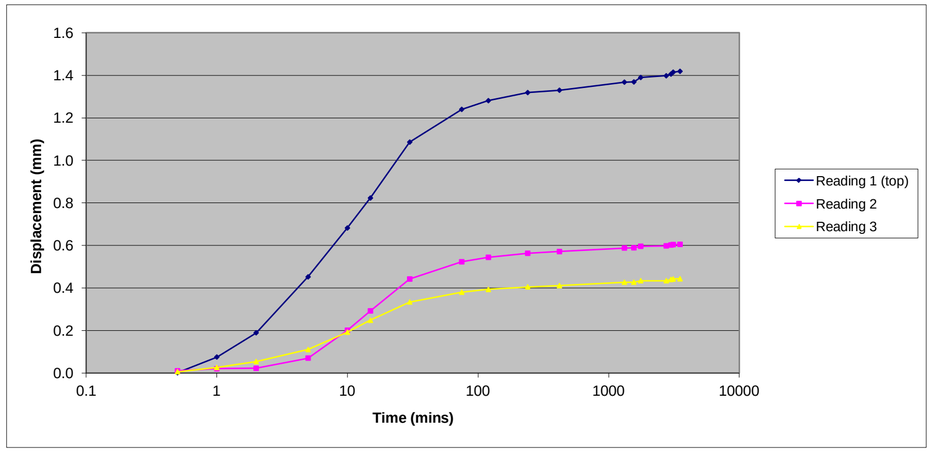
Dish + Dried sample: 183.84 Final M.C: 38.52

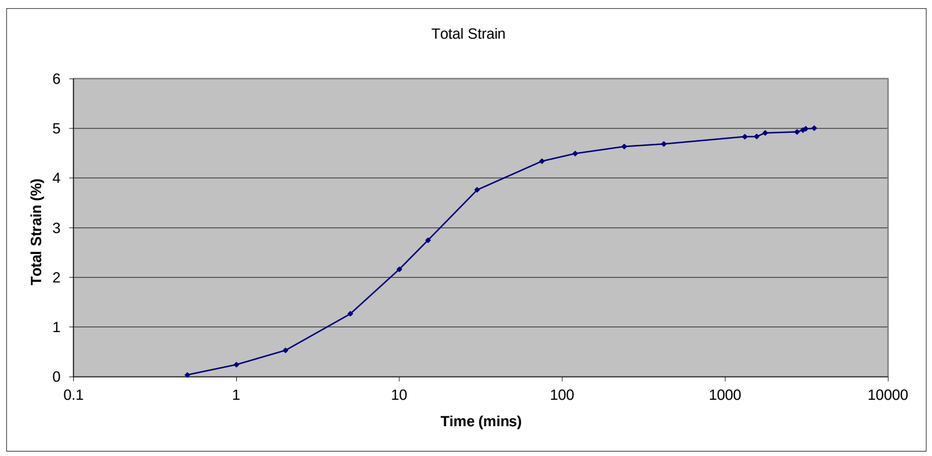
Particle Density: 2.75 $Mg \cdot m^{-3}$

Dry Density: 1.37 $Mg \cdot m^{-3}$

Voids Ratio (e_0): 1.01

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1 (top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.001	0.010	0.006	Flood	0.002	0.020	0.012	125043	0.034
1	0.075	0.020	0.026		0.150	0.040	0.052	125303	0.242
2	0.189	0.022	0.054		0.378	0.044	0.108	125663	0.531
5	0.452	0.070	0.110		0.904	0.140	0.220	126584	1.268
10	0.682	0.201	0.192		1.364	0.402	0.384	127703	2.162
15	0.823	0.292	0.248		1.646	0.584	0.496	128433	2.747
30	1.086	0.442	0.334		2.172	0.884	0.668	129705	3.764
75	1.240	0.523	0.380		2.480	1.046	0.760	130424	4.339
120	1.281	0.544	0.393		2.562	1.088	0.786	130616	4.493
240	1.319	0.563	0.405		2.638	1.126	0.810	130793	4.634
420	1.330	0.571	0.411		2.660	1.142	0.822	130857	4.686
1320	1.368	0.588	0.427		2.736	1.176	0.854	131040	4.832
1560	1.369	0.589	0.427		2.738	1.178	0.854	131045	4.836
1760	1.390	0.596	0.434	sample disturbed?	2.780	1.192	0.868	131135	4.908
2760	1.398	0.598	0.434		2.796	1.196	0.868	131160	4.928
3000	1.406	0.602	0.44		2.812	1.204	0.880	131207	4.965
3120	1.415	0.604	0.442		2.830	1.208	0.884	131240	4.992
3519	1.419	0.605	0.443		2.838	1.210	0.886	131256	5.005





3D Swell test

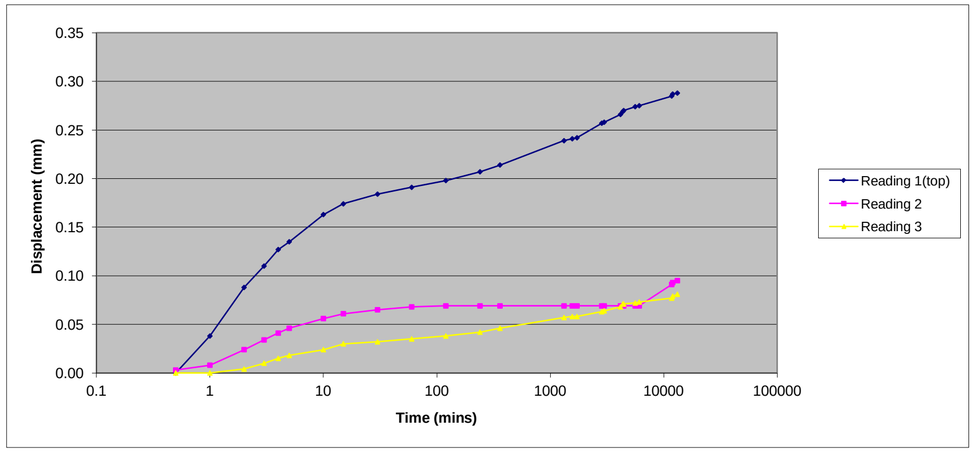
Sample I.D: Ockenden S1 N.B sample in bad condition. Very fissured

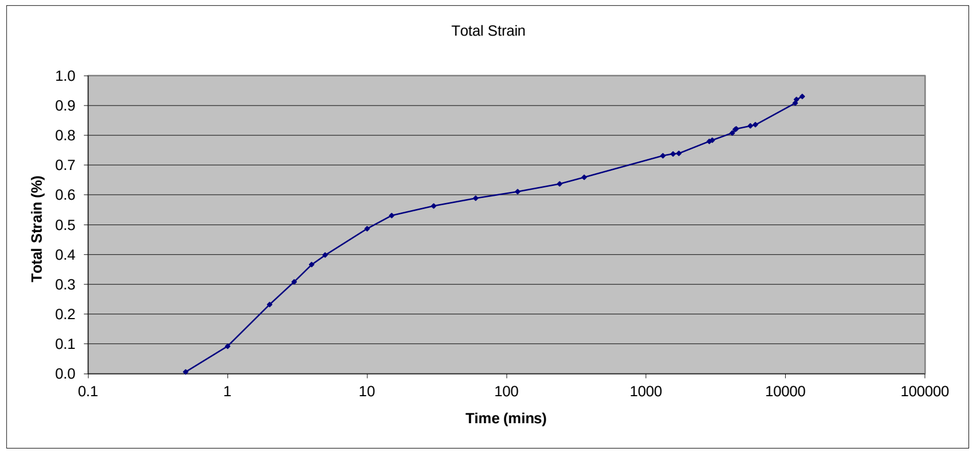
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	215.69	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.58	M.C Tin2 Mass:	12.75
M.C Tin1 + Wet sample:	85.70	M.C Tin2 + Wet sample:	66.94
M.C Tin1 + Dry sample:	67.24	M.C Tin2 + Dry sample:	53.17
M.C	33.77	M.C	34.07
Average	33.92		

After test Measurements:				
M.C. tin I.D:	12.00		M.C. Tin Mass:	12.77
Dish + Satu. sample:	236.30		Initial M.C.	34.67
Dish + Dried sample:	172.93		Final M.C:	39.57
Particle Density:	2.71	$Mg \cdot m^{-3}$		
Dry Density:	1.28	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	1.12			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1(top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.003	0.000	Flood	0.000	0.006	0.000	125008	0.006
1	0.038	0.008	0.000		0.076	0.016	0.000	125115	0.092
2	0.088	0.024	0.004		0.176	0.048	0.008	125290	0.232
3	0.110	0.034	0.010		0.220	0.068	0.020	125385	0.308
4	0.127	0.041	0.015		0.254	0.082	0.030	125458	0.366
5	0.135	0.046	0.018		0.270	0.092	0.036	125498	0.398
10	0.163	0.056	0.024		0.326	0.112	0.048	125608	0.487
15	0.174	0.061	0.030		0.348	0.122	0.060	125663	0.531
30	0.184	0.065	0.032		0.368	0.130	0.064	125703	0.563
60	0.191	0.068	0.035		0.382	0.136	0.070	125736	0.589
120	0.198	0.069	0.038		0.396	0.138	0.076	125764	0.611
240	0.207	0.069	0.042		0.414	0.138	0.084	125796	0.637
360	0.214	0.069	0.046		0.428	0.138	0.092	125824	0.659
1320	0.239	0.069	0.057		0.478	0.138	0.114	125914	0.731
1561	0.241	0.069	0.058		0.482	0.138	0.116	125922	0.737
1718	0.242	0.069	0.058		0.484	0.138	0.116	125924	0.739
2839	0.257	0.069	0.063		0.514	0.138	0.126	125974	0.780
2982	0.258	0.069	0.064		0.516	0.138	0.128	125979	0.784
4149	0.266	0.069	0.068		0.532	0.138	0.136	126010	0.808
4354	0.269	0.069	0.071		0.538	0.138	0.142	126025	0.820
4430	0.270	0.069	0.071		0.540	0.138	0.142	126027	0.822
5594	0.274	0.069	0.072		0.548	0.138	0.144	126040	0.832
6076	0.275	0.069	0.073		0.550	0.138	0.146	126045	0.836
11731	0.285	0.091	0.077		0.570	0.182	0.154	126135	0.908
11971	0.287	0.093	0.079		0.574	0.186	0.158	126150	0.920
13171	0.288	0.095	0.081	end test	0.576	0.190	0.162	126163	0.930





3D Swell test

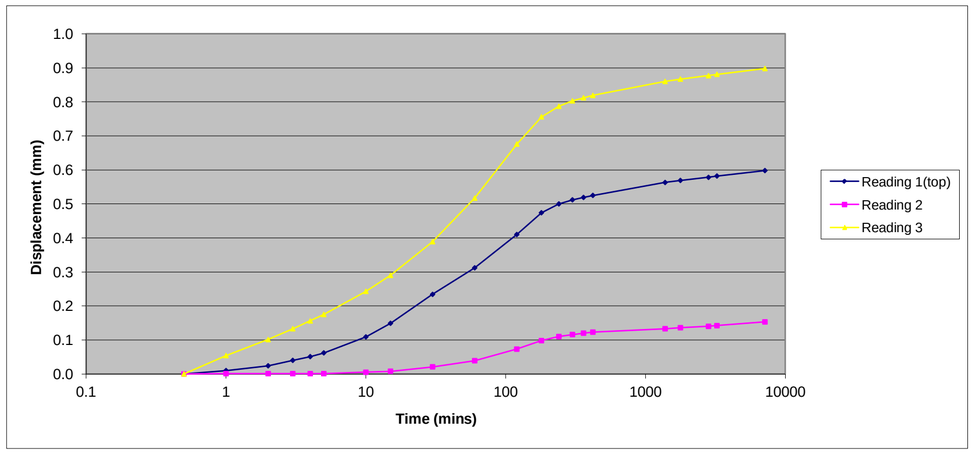
Sample I.D: Brambledown

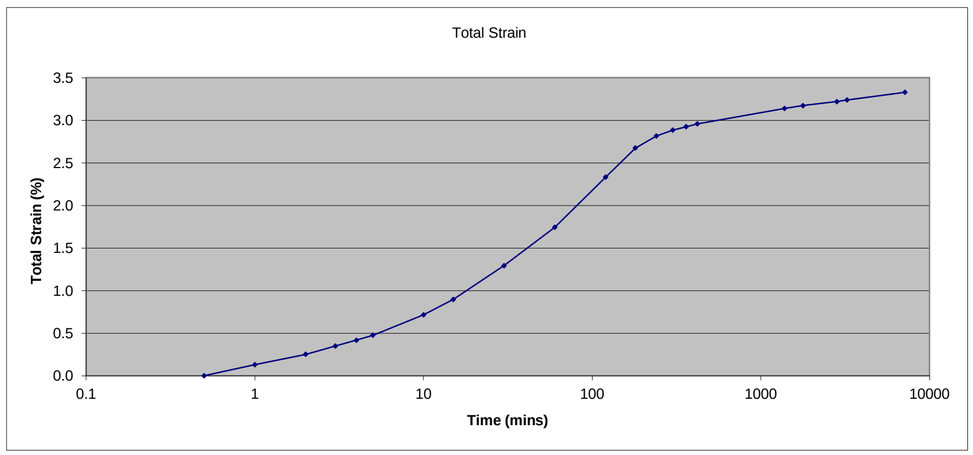
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	218.80	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X40	M.C Tin2 ID:	X104
M.C Tin1 Mass:	12.59	M.C Tin2 Mass:	12.76
M.C Tin1 + Wet sample:	84.50	M.C Tin2 + Wet sample:	100.7
M.C Tin1 + Dry sample:	65.61	M.C Tin2 + Dry sample:	77.31
M.C	35.63	M.C	36.24
Average	35.93		

After test Measurements:				
M.C. tin I.D:	12		M.C. Tin Mass:	12.76
Dish + Satu. sample:	273.63		Initial M.C.	41.29
Dish + Dried sample:	167.62		Final M.C:	68.46
Particle Density:	2.72	$Mg \cdot m^{-3}$		
Dry Density:	1.24	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	1.20			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1(top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.000	0.000	Flood	0.000	0.000	0.000	125000	0.000
1	0.010	0.001	0.054		0.020	0.002	0.108	125163	0.130
2	0.024	0.001	0.101		0.048	0.002	0.202	125315	0.252
3	0.040	0.001	0.133		0.080	0.002	0.266	125435	0.348
4	0.051	0.001	0.156		0.102	0.002	0.312	125520	0.416
5	0.062	0.001	0.175		0.124	0.002	0.350	125596	0.476
10	0.109	0.005	0.243		0.218	0.010	0.486	125894	0.715
15	0.149	0.008	0.29		0.298	0.016	0.580	126120	0.896
30	0.234	0.021	0.389		0.468	0.042	0.778	126615	1.292
60	0.312	0.039	0.517		0.624	0.078	1.034	127180	1.744
120	0.410	0.073	0.676		0.820	0.146	1.352	127915	2.332
180	0.474	0.098	0.756		0.948	0.196	1.512	128344	2.675
240	0.500	0.110	0.787		1.000	0.220	1.574	128519	2.815
300	0.512	0.116	0.803		1.024	0.232	1.606	128606	2.885
360	0.519	0.120	0.812		1.038	0.240	1.624	128657	2.925
420	0.525	0.123	0.819		1.050	0.246	1.638	128697	2.958
1380	0.563	0.133	0.860		1.126	0.266	1.720	128924	3.139
1775	0.569	0.136	0.867		1.138	0.272	1.734	128964	3.172
2820	0.578	0.140	0.877		1.156	0.280	1.754	129023	3.218
3240	0.582	0.142	0.881		1.164	0.284	1.762	129049	3.239
7140	0.598	0.153	0.898	End of test	1.196	0.306	1.796	129161	3.329





3D Swell test

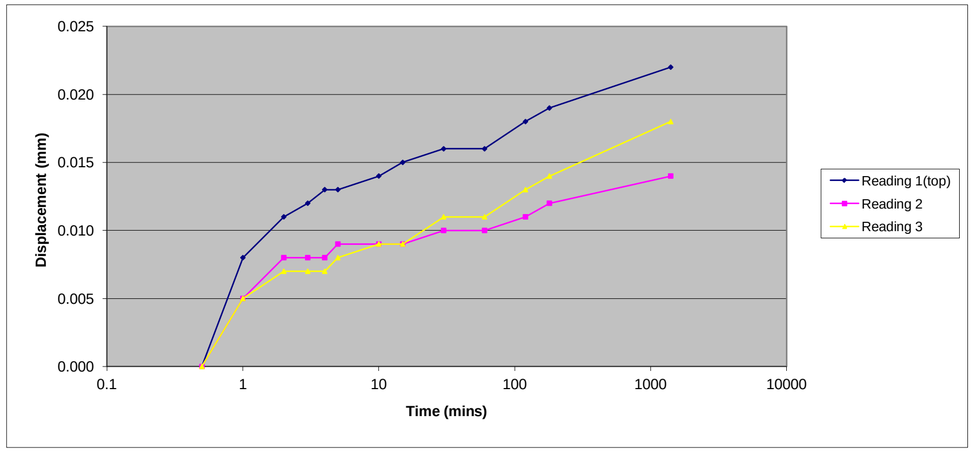
Sample I.D: Knoll Manor 1

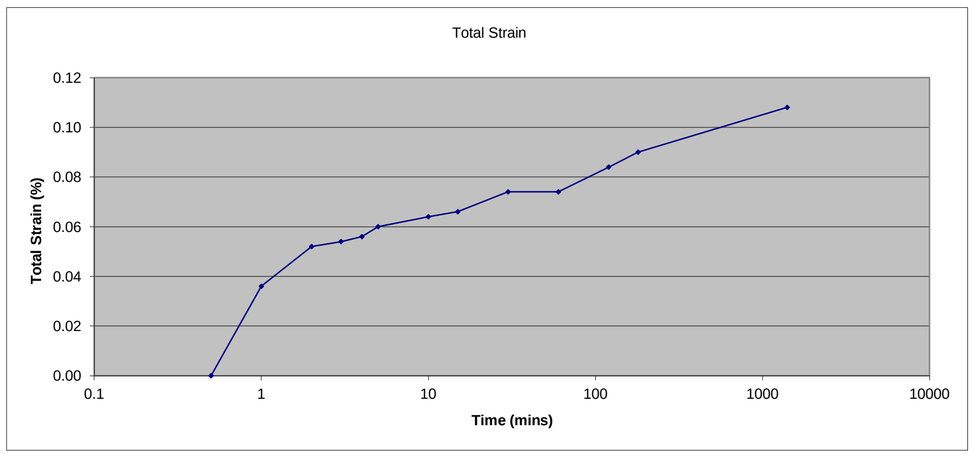
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	248.74	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X45
M.C Tin1 Mass:	12.78	M.C Tin2 Mass:	12.55
M.C Tin1 + Wet sample:	47.08	M.C Tin2 + Wet sample:	57.30
M.C Tin1 + Dry sample:	40.87	M.C Tin2 + Dry sample:	49.32
M.C	22.11	M.C	21.70
Average	21.90		

After test Measurements:				
M.C. tin I.D:	X40		M.C. Tin Mass:	12.58
Dish + Satu. sample:	263.4		Initial M.C.	21.75
Dish + Dried sample:	216.88		Final M.C:	22.77
Particle Density:	2.73	$Mg \cdot m^{-3}$		
Dry Density:	1.63	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	0.67			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1(top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.000	0.000	Flood	0.000	0.000	0.000	125000	0.000
1	0.008	0.005	0.005		0.016	0.010	0.010	125045	0.036
2	0.011	0.008	0.007		0.022	0.016	0.014	125065	0.052
3	0.012	0.008	0.007		0.024	0.016	0.014	125068	0.054
4	0.013	0.008	0.007		0.026	0.016	0.014	125070	0.056
5	0.013	0.009	0.008		0.026	0.018	0.016	125075	0.060
10	0.014	0.009	0.009		0.028	0.018	0.018	125080	0.064
15	0.015	0.009	0.009		0.030	0.018	0.018	125083	0.066
30	0.016	0.010	0.011		0.032	0.020	0.022	125093	0.074
60	0.016	0.010	0.011		0.032	0.020	0.022	125093	0.074
120	0.018	0.011	0.013		0.036	0.022	0.026	125105	0.084
180	0.019	0.012	0.014		0.038	0.024	0.028	125113	0.090
1405	0.022	0.014	0.018	end test	0.044	0.028	0.036	125135	0.108





3D Swell test

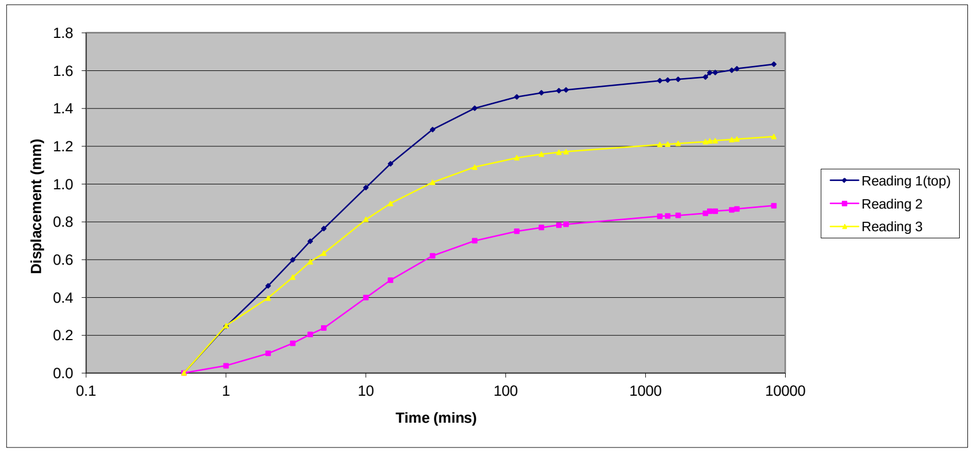
Sample I.D: Stanwell

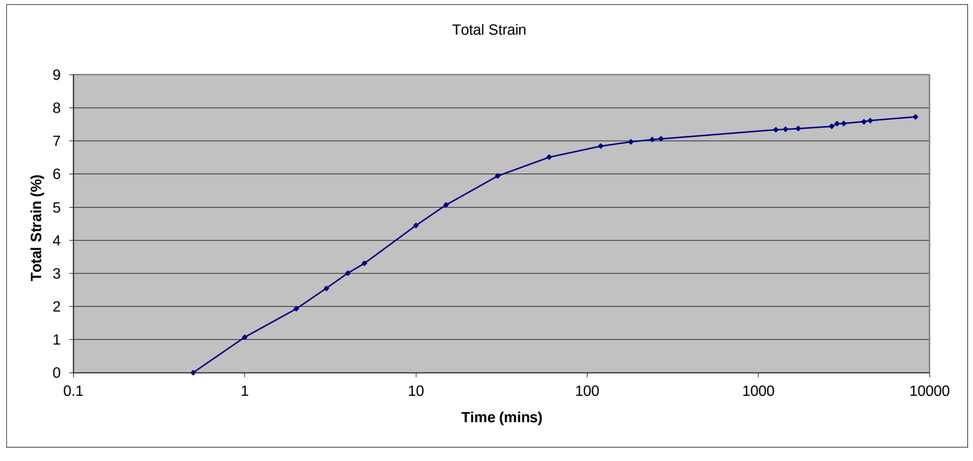
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	221.86	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	T2	M.C Tin2 ID:	X41
M.C Tin1 Mass:	12.663	M.C Tin2 Mass:	12.79
M.C Tin1 + Wet sample:	86.47	M.C Tin2 + Wet sample:	79.91
M.C Tin1 + Dry sample:	71.05	M.C Tin2 + Dry sample:	65.69
M.C	26.41	M.C	26.88
Average	26.65		

After test Measurements:				
M.C. tin I.D:	X48		M.C. Tin Mass:	12.70
Dish + Satu. sample:	257.15		Initial M.C.	26.52
Dish + Dried sample:	188.05		Final M.C:	39.41
Particle Density:	2.77	$Mg \cdot m^{-3}$		
Dry Density:	1.40	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	0.97			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1(top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.000	0.000	Flood	0.000	0.000	0.000	125000	0.000
1	0.247	0.038	0.25		0.494	0.076	0.500	126342	1.073
2	0.461	0.104	0.396		0.922	0.208	0.792	127416	1.933
3	0.599	0.157	0.507		1.198	0.314	1.014	128181	2.545
4	0.697	0.204	0.588		1.394	0.408	1.176	128756	3.005
5	0.764	0.238	0.634		1.528	0.476	1.268	129131	3.305
10	0.981	0.399	0.813		1.962	0.798	1.626	130558	4.447
15	1.107	0.491	0.897		2.214	0.982	1.794	131337	5.069
30	1.288	0.620	1.009		2.576	1.240	2.018	132429	5.944
60	1.401	0.700	1.089		2.802	1.400	2.178	133140	6.512
120	1.461	0.750	1.139		2.922	1.500	2.278	133557	6.846
180	1.483	0.770	1.158		2.966	1.540	2.316	133716	6.973
240	1.494	0.782	1.168		2.988	1.564	2.336	133803	7.042
270	1.498	0.787	1.171		2.996	1.574	2.342	133834	7.067
1265	1.547	0.829	1.209		3.094	1.658	2.418	134172	7.337
1440	1.55	0.831	1.211		3.100	1.662	2.422	134190	7.352
1710	1.554	0.834	1.215		3.108	1.668	2.430	134219	7.375
2680	1.566	0.845	1.224		3.132	1.690	2.448	134303	7.442
2880	1.589	0.856	1.228		3.178	1.712	2.456	134402	7.522
3150	1.590	0.856	1.229		3.180	1.712	2.458	134408	7.526
4133	1.602	0.863	1.235		3.204	1.726	2.470	134473	7.578
4500	1.610	0.868	1.238		3.220	1.736	2.476	134515	7.612
8270	1.634	0.885	1.251	End test	3.268	1.770	2.502	134657	7.725





3D Swell test

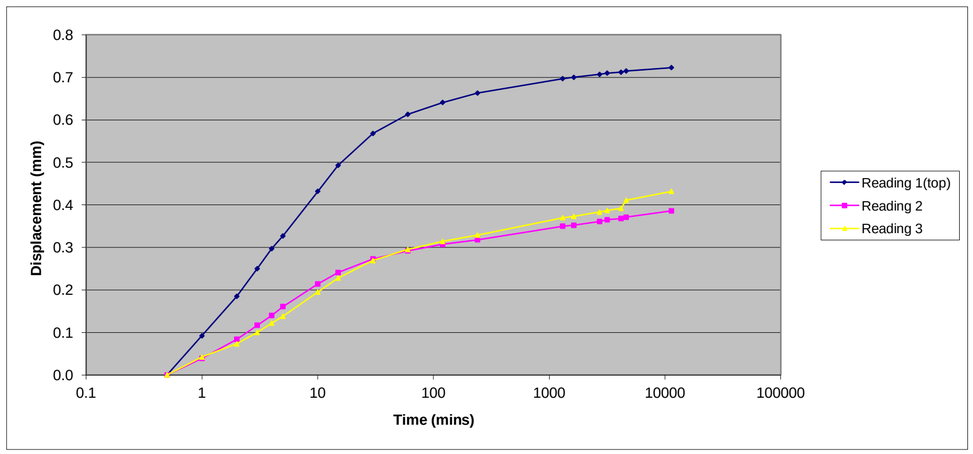
Sample I.D: Hollingson

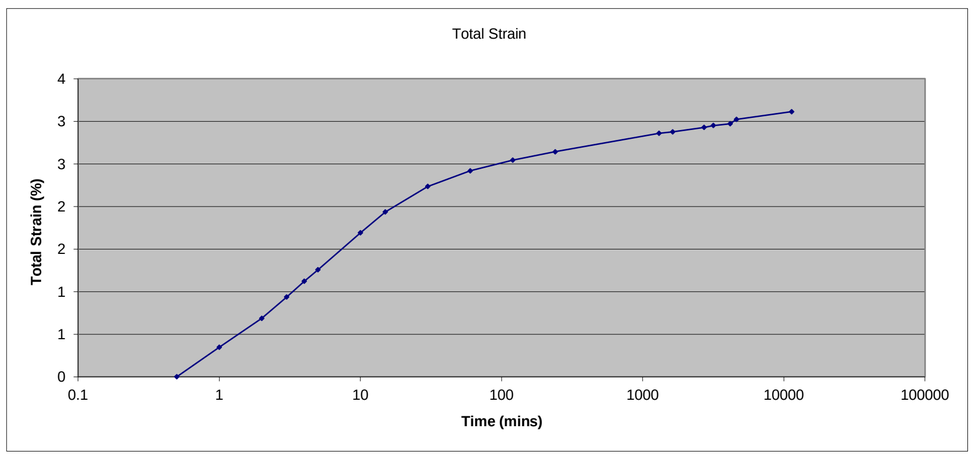
Before test measurements:			Height/Width/Length (mm)	mm^3
Orig. sample weight:	232.69	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X45	M.C Tin2 ID:	23
M.C Tin1 Mass:	12.7	M.C Tin2 Mass:	12.63
M.C Tin1 + Wet sample:	92.00	M.C Tin2 + Wet sample:	85.98
M.C Tin1 + Dry sample:	75.44	M.C Tin2 + Dry sample:	70.53
M.C	26.39	M.C	26.68
Average	26.54		

After test Measurements:				
M.C. tin I.D:	castor		M.C. Tin Mass:	12.97
Dish + Satu. sample:	254.88		Initial M.C.	24.72
Dish + Dried sample:	199.54		Final M.C:	29.66
Particle Density:	2.68	$Mg \cdot m^{-3}$		
Dry Density:	1.49	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	0.80			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1(top)	Reading 2	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.000	0.000	Flood	0.000	0.000	0.000	125000	0.000
1	0.092	0.039	0.042		0.184	0.078	0.084	125433	0.346
2	0.185	0.084	0.073		0.370	0.168	0.146	125857	0.685
3	0.250	0.117	0.100		0.500	0.234	0.200	126171	0.937
4	0.297	0.140	0.122		0.594	0.280	0.244	126402	1.122
5	0.327	0.161	0.138		0.654	0.322	0.276	126571	1.257
10	0.432	0.214	0.195		0.864	0.428	0.390	127113	1.691
15	0.493	0.241	0.228		0.986	0.482	0.456	127419	1.935
30	0.568	0.273	0.269		1.136	0.546	0.538	127794	2.235
60	0.613	0.292	0.295		1.226	0.584	0.590	128022	2.418
120	0.641	0.307	0.314		1.282	0.614	0.628	128180	2.544
240	0.663	0.318	0.329		1.326	0.636	0.658	128302	2.641
1305	0.697	0.350	0.370		1.394	0.700	0.740	128574	2.859
1630	0.700	0.352	0.373		1.400	0.704	0.746	128595	2.876
2721	0.707	0.361	0.383		1.414	0.722	0.766	128661	2.929
3165	0.710	0.365	0.387		1.420	0.730	0.774	128689	2.951
4167	0.712	0.368	0.392		1.424	0.736	0.784	128714	2.971
4619	0.715	0.371	0.411		1.430	0.742	0.822	128778	3.023
11355	0.723	0.386	0.432	end test	1.446	0.772	0.864	128891	3.112





3D Swell test

Sample I.D: Knowl Hill

			Height/Width/Length (mm)	mm^3
Before test measurements:				
Orig. sample weight:	237.54	Sample Dimensions:	50	125000

Moisture Content of original sample			
M.C Tin1 ID:	X14	M.C Tin2 ID:	X46
M.C Tin1 Mass:	12.78	M.C Tin2 Mass:	12.63
M.C Tin1 + Wet sample:	125.88	M.C Tin2 + Wet sample:	101.44
M.C Tin1 + Dry sample:	100.37	M.C Tin2 + Dry sample:	81.34
M.C	29.12	M.C	29.25
Average	29.19		

After test Measurements:				
M.C. tin I.D:	X2		M.C. Tin Mass:	12.79
Dish + Satu. sample:	264.45		Initial M.C.	29.69
Dish + Dried sample:	195.95		Final M.C:	37.40
Particle Density:	2.74	$Mg \cdot m^{-3}$		
Dry Density:	1.47	$Mg \cdot m^{-3}$		
Voids Ratio (e_0):	0.87			

Test readings					Strain 1	Strain 2	Strain 3	New volume (mm^3)	Total Strain
Time	Reading 1	Reading 2 (top)	Reading 3	Comments					
0	0.000	0.000	0.000		0.000	0.000	0.000	125000	0.000
0.5	0.000	0.000	0.000	Flood	0.000	0.000	0.000	125000	0.000
1	0.011	0.017	0.000		0.022	0.034	0.000	125070	0.056
2	0.025	0.064	0.000		0.050	0.128	0.000	125223	0.178
3	0.031	0.095	0.008		0.062	0.190	0.016	125335	0.268
4	0.040	0.131	0.018		0.080	0.262	0.036	125473	0.378
5	0.042	0.150	0.024		0.084	0.300	0.048	125541	0.432
10	0.075	0.287	0.073		0.150	0.574	0.146	126090	0.872
15	0.107	0.372	0.117		0.214	0.744	0.234	126495	1.196
30	0.185	0.547	0.204		0.370	1.094	0.408	127353	1.882
58	0.273	0.740	0.304		0.546	1.480	0.608	128318	2.654
120	0.381	0.926	0.426		0.762	1.852	0.852	129378	3.503
243	0.488	1.173	0.546		0.976	2.346	1.092	130592	4.473
420	0.562	1.317	0.633		1.124	2.634	1.266	131377	5.102
1425	0.695	1.547	0.795		1.390	3.094	1.590	132736	6.189
2824	0.730	1.610	0.840		1.460	3.220	1.680	133108	6.486
4259	0.743	1.636	0.858		1.486	3.272	1.716	133256	6.605
5694	0.752	1.653	0.868		1.504	3.306	1.736	133350	6.680
6169	0.756	1.659	0.873		1.512	3.318	1.746	133389	6.711
10014	0.769	1.683	0.890		1.538	3.366	1.780	133530	6.824
15590	0.786	1.711	0.907		1.572	3.422	1.814	133692	6.953
16823	0.788	1.715	0.909		1.576	3.430	1.818	133713	6.970
17269	0.789	1.716	0.910		1.578	3.432	1.820	133720	6.976