Geomechanics lab report

Environment, Nature

Aim

The main intention of this investigation was to determine the various stages of the Atterberg Limits. These included the liquid limit test (LL), plastic limit test (PL), plastic index test (PI), and linear shrinkage (LS) of a soil sample provided by the administration. This was then followed by a sieve analysis to determine the particle size distribution of another soil sample so that a suitable classification in both situations could be made in accordance with the Australian Standards AS1726 - 1993.

Procedure (Sample preperation)

On commencement of the experiment, each group was provided with two parts of 500grams of soil retrieved from the field and then oven-dried by the experiment supervisor. One part of the soil sample was coarse grain gravel for the particle size distribution chart and sieve analysis, whilst the remaining 500 grams of soil was of the fine-grained fraction. Preparation of Coarse-Grained Fraction During this procedure the mass of 500grams of soil was recorded and soaked in water for a duration of 24 hours. This was then followed by placing the soil sample into a 0. 75mm mesh sieve and the entire fine particle was washed away using running tap water and a small spray bottle until the water had started running clear. The sieved sample was then transferred in a tray which was again put into the oven at 100 degrees for 24 hours. Preparation of Fine-Grained Fraction The remainder of the 500 grams of the sample was then sieved through a 0. 425 mm mesh sieve and the contents collected. This procedure was done until approximately 150 to 200grams of the material was successfully passing sieve.

Procedure (Sieve Analysis)

This procedure involved the sieve analysis of the coarse fraction. This involved weighing the mass of the oven-dried coarse-grained fraction so that we are able to determine the particle size distribution. For this experiment, the mass of the coarse fraction used was 312. 10 grams. This was then followed by arranging the sieves from top to bottom in order from larger gapped mesh in the sieve to the smaller one (i. e. 37. 5mm to 0. 075mm) and then pouring the sample in the top sieve whilst shaking it for approximately 10 minutes. This provided mechanical energy to the soil allowing for it to pass all the sieve layers. The next procedure involved recording the soil mass that had accumulated on each sieve and the bottom pan. Furthermore, the percentage of original mass retained and cumulative passing % vs. particle size plot has been constructed as shown in Appendix A. As shown in the plot it can be noted that the results obtained were not accurate enough for the effective size values of D_10 and D_30 to be calculated. Yet the effective size D_60 was able to be found and was shown to be 1. mm as shown in the particle size vs percentage passing table in appendix A. Due to the fact that all effective size values have not been able to be attained from the graph, the uniformity coefficient C_u and the coefficient of curvature C_c were not able to be calculated. Yet if they could be then they would be calculated using these equations: Cu= D60D10 Cc= D102D10*D60 where CU= Coefficient of Curvature Cc= Coefficient of Curvature All values recorded have been further discussed in the Results section of this report.

Procedure (Atterberg Limits determination)

Liquid Limit (LL)

The liquid limit test west performed on the fine Sandy soil over the course of two sessions to determine the water content (percentage) at the point when the soil started to behave with liquid qualities. This test procedure involved gradually adding water to around well created in two-thirds of the soil sample on a glass plate. Then using two spatulas the sample was mixed until a smooth paste was formed. This was then followed by placing a small amount of the sample into the liquid limit device and leveling it horizontally using the spatula to create a smooth surface. Using the grooving tool the sample in the cup was divided in half. To determine the number of blows the handle of the mechanism was rotated at a speed of two blows per second and the number of blows recorded until the soil closed the groove to a length of 1 cm. It was expected that the number of blows is as close to 25+ or - 3 as possible. The group was successful in our fourth attempt where 28 blows were recorded. Once the sample was successful it was removed from the liquid limit cup and placed within a tin and the mass weighed. This was determined to calculate the moisture content percentage.

The mixture in the liquid limit range was placed in a 0. 25-meter length mold with an internal diameter of 0. 025 meters and left on top of the oven so that the linear shrinkage could be determined. All values obtained are discussed in the results. Plastic Limit (PL) To determine the plastic limit (as a percentage), after which the soil could no longer be deformed; water was added to the remaining one-third of the dry soil on a separate glass plate and molded by hand. Small amounts of the soil were rolled on the flat glass plate until they formed into a diameter of 3 mm and then started to break apart. According to AS12989, it was proved that the soil had reached its plastic limit. This soil was then placed in a tin and similarly to the liquid limit, all mass values of the tin and sample were recorded. These were left to dry in the oven. All results obtained the following day have been discussed in the results section. Linear Shrinkage (%) As instructed, results for the linear shrinkage were collected after the duration of 24 hours from the laboratory and the linear shrinkage (in percentage) was calculated using the formula: LS= LsL*100 where Ls= Recorded Shrinkage L= Initial Length of Sample

In addition to the linear shrinkage, all dry mass results were also collected from the previous day and recorded as shown in the results section of this report. Plastic Index Conduction of the plastic limit and linear shrinkage test led to the calculation of the moisture content in percentage and this further allowed us to calculate the plastic index using the formula. Ip= Wl- Wp where Wl= Liquid Limit Wp= Plastic Limit * Classification of Soil After the soil tests have been completed as listed above and results obtained, the soil sample was classified according to the Australian Standards AS1726 – 1993. The results obtained above show that after conducting four tests in the lab the number of blows was varied quite a lot. The reason behind this was that at the start a greater amount of liquid than required was placed in the soil making it two wets. Then as extra dry soil was added to the sample the number of blows gradually increased allowing for a result acceptable within the 25 + - 3 limit was met in test 4 Hence the soil sample’s LL can be taken as 68. 64%.

The above table represents the values calculated and determined results for the plastic limit of the soil in this experiment. This was done by weighing the mass of the soil and tin after it had been rolled into a 3mm diameter rod until it crumbled and then oven-dried. Atterberg Limits Determination (Plastic Index) Looking at the graph attached in appendix B (Number of Blows vs. Moisture Content), the value for the Plastic Limit was unable to be as accurately determined as we would have hoped but using the plastic Index equation below it was found to be 44. %.

Plastic Index %= Liquid Limit-Plastic

Limit= ___________% Plastic Index %= 68. 64-24. 24= 44. 4%

Linear Shrinkage Determination| Mould No. Linear Shrinkage Determination After removing the mold containing the soil sample after 24 hours from the top of the oven, the linear shrinkage of the soil was measured using a ruler.

The same has not crumbled at the touch and has not shown any curling effects. The Overall linear shrinkage is calculated to be 12. 60%. LS= LsL*100 LS= 32254*100= 12. 60% Discussion The classification of the Coarse and Fine-Grained soil was made according to the Australian Standards as1726 – 1993. All justification of the results and classifications of the Sieve Analysis and Atterberg Limits have been made through the combination of the identification and classification tables in the appendix. Coarse-Grained Soil As per the Particle size plot in the appendix, the sample is shown to have only coarse grain materials. Consisting of 22% Gravel (7% Medium Grain and 15% Fine Grain) and 38% Sand (22% Coarse Grain, 13% Medium Grain and 3% Fine Grain), indicates that the soil is widely distributed and hence making it a Gravelly SAND. Fine-Grained Soil Using the Atterberg Limits to find the Plastic Limit and Liquid Limit percentages, these were applied to the Plasticity vs. Liquid Limit Chart (AS1726-1993) to determine the classification of the soil sample.

As the intersection point is below the " A" line with a high liquid limit of 68. 64%, the reaction to shaking was low to none and the toughness is low, the classification of the soil sample is most likely to be MS-SILT Highly Plastic. Also according to the Australian Standards, the color of our soil was Brown mottled red-brown. Since the fine-grained soil was cohesionless and free running we can classify the soil as dry. In accordance with the Plasticity vs. Liquid Limit chart, the soil is of High Plasticity as the liquid limit was of a value greater than 50%. In addition to the above, the particle size distribution curve is also widely spread so the soil is classified as " Well Graded". Conclusion In this experiment we used the Sieve analysis and Atterberg Limits tests to investigate the properties of the soil as mentioned in the Australian Standards AS1726 -1993. In addition, sample tests were conducted including the liquid limit test (LL), plastic limit test (PL), plastic index test (PI), and linear shrinkage (LS) of the soil sample provided by the administration. All results obtained have been justified and the classifications of the soil made in accordance with the Australian Standards 1726 – 1993.

Reference

- Evans R, 2010, HES2155 Geomechanics, Swinburne University ofTechnology, Melbourne VIC.

- Appendices Appendix A (Particle Size vs. Percentage Passing Plot) Appendix B (Plot of Number of Blows Vs. Moisture Content) Appendix C (Soil Classification Tables).