**Effect of L/D Ratio of UCC Specimen on Shear Strength of Clay Soil**

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**Abstract**

The role of Geotechnical engineering application in land reclamation, construction of highway, railway and canal embankments require a very large quantity of soil of desirable properties. It is often difficult to obtain good quality soil for the above applications from the nearby quarries. In such a situation, the locally available problematic soils (having low shear strength high compressibility and swelling nature) after stabilizing the same with the addition of admixtures such as use of sand, lime, cement etc. for the improvement of problematic soils is costly because of their high demand in other civil engineering applications. To overcome the difficulties experienced with problematic soils in geotechnical applications on one side and safe disposal of solid wastes on the other side, an attempt is made in this study to explore the possibilities of utilizing to improve the engineering behaviour of problematic soils. In this study an attempt is made to know the index properties, compaction and unconfined compressive strength, may be used to improve the strength properties in four different types of problematic soil which have high swelling and high compressible nature. It can be concluded the as the L/D ratio decreases the unconfined compressive strength increases.

**Keywords:**

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**1. Introduction**

The factors influencing the index and engineering behaviour of Fine-grained soil are type and amount of clay, pore fluid characteristics (ion concentration, valence, dielectric constraint) soil structure etc. Influences of these factors on the engineering behaviour of soil are discussed below. The Uniaxial Compressive Strength (UCS) of rock material is one of the basic geomechanical parameters used to characterize the rock and to determine the rock mass classification. A number of factors influence the result obtained, e.g. the type of pore fluid, loading rate, environmental conditions, specimen size and shape, while the scatter around the mean will affect the UCS value (coates 1965; Hock and Brown 1980; Hudson and Harrison 1997; Lockner 1995) Generally, a decrease in the strength of rocks is experienced with increasing pore pressure, decreasing loading rate and increasing temperature (Lockner, 1995). Bieniawski (1968) undertook tests on cubic coal samples and showed that the UCS of coal decreased with increasing specimen size but after a sample dimension of 1 m the UCS was nearly constant. However, Hodgson and Cook (1970) and Obert et al. (1946) reported no change in rock strength with specimen size while significant strength reductions with increasing specimen size have been reported by Mogi (1972), protodyakonov and Koifman (1963), and Hoskins and Horino (1969) (after Hoek and Brown 1980). Hoek Brown (1980) reviewed data from the literature including UCS measurements on core and cubic rock specimens having dimensions between 10 and 200mm. According to these data (on two sedimentary and fine crystalline rocks), UCS decrease with increasing specimen diameter. They suggested an equation to convert the strength

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value of a different diameter specimen to that of a 50mm specimen (at the time the commonly used laboratory test sample size).

The unconfined compressive test is used to measure the shearing resistance of cohesive soils which may be undisturbed or remoulded specimen an axial load is applied using either strain control or stress control condition. The unconfined compressive strength defined as the minimum unit stress obtained within the strain. To study the index properties like liquid limit, plastic limit, shrinkage limit and specific gravity compaction characteristics and unconfined compressive strengthof the problematic soils.

2. Materials

The various testing procedure adopted to study on the index, compaction, and unconfined compressive strength characteristics of four types of soils with increasing and decrease various diameter and length of PVC pipe moulds. As the soil were selected such that they are problematic in nature, i.e. high swelling, high compressible and having low shear strength.

2.1 Soils used

Three natural soils are collected in and around the city of Chennai. The soil 1 is collected from Velachery, soil 2 is collected form Koyambedu and soil 3 is collected from Urappakkam. And soil 4 is collected from Tambaram. All the soils were collected from a depth of more than 2m below the existing ground level. Care is taken to collect the soil without any organic matter. All the waste particles are also removed while collecting.

Table 1. Describe the properties of the soil which is obtained from the different places

| Description           | Soil 1 | Soil 2 | Soil 3 | Soil 4 |
|-----------------------|--------|--------|--------|--------|
| Liquid limit (%)      | 28.06  | 35.5   | 43.33  | 63     |
| Plastic limit (%)     | 17.76  | 20.95  | 25.07  | 33.75  |
| Plasticity Index (%)  | 10.3   | 14.55  | 18.26  | 29.25  |
| Shrinkage limit (%)   | 10.56  | 17.96  | 22.59  | 25.43  |
| Specific gravity (%)  | 2.17   | 2.57   | 2.63   | 2.92   |
| IS classification     | CL     | CL     | CL     | CH     |

3. Methods

The details of basic test, compaction test and unconfined compressive strength tests, conducted on the different combination of four soils with increase and decrease different five ratio are 1.5, 1.75, 2, 2.25, 2.5 are furnished in. The Table 2 also gives the total number of tests conducted for different proportions of soil.

Figure 1 represents the different types of mould which is made of PVC and with different size variation Figure 2 represents the soil specimen which is made using the mould of different size for testing.

Table 2. Refers the tests performed on the four types of soil collected

| Soils   | Basic Tests | Compaction Test | UCC Test L/D Ratios of mould | Dia. of mould |
|---------|-------------|-----------------|-----------------------------|--------------|
|         |             |                 | 1.5 | 1.75 | 2.0 | 2.25 | 2.5 |     |
| Soil 1  | LL, PL, SL, SG | MDD, OMC         | Cu  | Cu   | Cu  | Cu   | Cu  | 2.7 |
| Soil 2  | LL, PL, SL, SG | MDD, OMC         | Cu  | Cu   | Cu  | Cu   | Cu  | 3.4 |
| Soil 3  | LL, PL, SL, SG | MDD, OMC         | Cu  | Cu   | Cu  | Cu   | Cu  | 4.4 |
| Soil 4  | LL, PL, SL, SG | MDD, OMC         | Cu  | Cu   | Cu  | Cu   | Cu  | 2.7 |
|         |             |                 | Cu  | Cu   | Cu  | Cu   | Cu  | 3.4 |
| Total Number of tests | LL=4, PL=4, SL=4, SG=4 | Compaction test = 4 | UCC=60 |
4. **Result and Discussion**

4.1 **Comparison of L/D Ratio and Unconfined Compressive Strength**

The effect of unconfined compression strength on different lengths and diameter of 2.7 cm with five different ratios of 1.5, 1.75, 2.0, 2.25 and 2.5 on four different soil samples which is collected from different places. The values of the compressive test of the soil sample are denoted in the Table 3.

The effect of unconfined compression strength on different lengths and diameter of 3.4 cm with five different ratios of 1.5, 1.75, 2.0, 2.25 and 2.5 on four different soil samples which is collected from different places. The values of the compressive test of the soil sample are denoted in the Table 4.

Thus the Figure 3 shows the difference in length by diameter (2.7 cm) ratio and unconfined compressive strength for all the four soil samples collected. The graph shows an increment of 20% in compressive strength when comparing with the soil 1. When comparing with the soil 2 with soil 3 there is a decrease in 30-40% of compressive strength. The compressive strength of the soil 4 shows an increase as the length by diameter increases when compare with the soil 1, soil 2, soil 3.

| Table 3. Represents L/D ratio for 2.7 cm diameter to the four samples on UCC |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Diameter (cm) | L/D | Soil 1 kN/sqm | Soil 2 kN/sqm | Soil 3 kN/sqm | Soil 4 kN/sqm |
| 2.7 | 1.5 | 12.753 | 13.734 | 14.715 | 16.677 |
| 2.7 | 1.75 | 30.411 | 4.905 | 8.829 | 29.43 |
| 2.7 | 2 | 5.886 | 18.639 | 5.886 | 22.563 |
| 2.7 | 2.25 | 11.772 | 10.791 | 4.886 | 13.734 |
| 2.7 | 2.5 | 17.658 | 17.658 | 7.848 | 26.487 |

| Table 4. Tabulates the L/D ratio for 3.4 cm diameter to the four samples on the UCC |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Diameter (cm) | L/D | Soil 1 kN/sqm | Soil 2 kN/sqm | Soil 3 kN/sqm | Soil 4 kN/sqm |
| 3.4 | 1.5 | 3.924 | 4.905 | 6.867 | 11.772 |
| 3.4 | 1.75 | 7.848 | 2.943 | 4.905 | 16.677 |
| 3.4 | 2 | 6.867 | 12.753 | 4.905 | 25.506 |
| 3.4 | 2.25 | 2.943 | 12.753 | 3.924 | 20.601 |
| 3.4 | 2.5 | 4.905 | 3.924 | 3.924 | 18.639 |

| Table 5. Tabulates the L/D ratio for 4.4 cm diameter to the four samples on the UCC |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Diameter (cm) | L/D | Soil 1 kN/sqm | Soil 2 kN/sqm | Soil 3 kN/sqm | Soil 4 kN/sqm |
| 4.4 | 1.5 | 2.943 | 8.829 | 4.905 | 4.905 |
| 4.4 | 1.75 | 2.943 | 9.81 | 2.943 | 4.905 |
| 4.4 | 2 | 0.981 | 17.658 | 1.962 | 2.943 |
| 4.4 | 2.25 | 5.886 | 9.81 | 6.867 | 1.962 |
| 4.4 | 2.5 | 1.962 | 10.791 | 3.924 | 1.962 |
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The Figure 4 shows the difference in length by diameter (3.4) ratio and unconfined compressive strength for all the four soil samples collected. The graph shows an increment of 40% in compressive strength when comparing with the soil 4 with the other soils. When comparing with the soil 2 with soil 3 there is a decrease in 10% of compressive strength. The compressive strength of the soil 1 shows decrement as the length by diameter increases when compare with the soil 4, soil 2, soil 3.

Figure 5 shows the difference in length by diameter (3.4) ratio and unconfined compressive strength for all the four soil samples collected. The graph shows an increment of 40% in compressive strength when comparing with the soil 4 with the other soils. When comparing with the soil 2 with soil 3 there is a decrease in 10% of compressive strength. The compressive strength of the soil 1 shows decrement as the length by diameter increases when compare with the soil 4, soil 2, soil 3.

5. Conclusion

From this study it can be concluded that the different L/D ratios for the unconfined compression test conducted on four different soils with varying lengths and diameters. The three soils 1, 2 and 4 shows maximum strength at 2(L/D ratio) and the other soil 3 shows maximum strength at 1.5(L/D ratio). In the diameter of 2.7 cm for soil 1, 2, 3 and 4 the maximum strength occurring at the L/D ratios is 1.75, 2, 1.5 and 1.75 respectively. In the diameter of 3.4 cm for soil 1, 2, 3 and 4 the maximum strength occurring at the L/D ratio is 1.75, 2, 1.5 and 2 respectively. In the diameter of 4.4 cm for soil 1, 2, 3 and 4 the maximum strength occurring at the L/D ratio is 2.25, 2, 2.25 and 1.75 respectively. By increasing or decreasing of length and diameter of specimen shows decrease in the strength. It is hence concluded that 2(L/D ratio) is effective in finding the unconfined compression test for these soils.

6. References

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