National Conference on 'Advances in Engineering, Technology and Applied Sciences' - NCAETAS-2019
© 2019 IJSRSET | Volume 5 | Issue 6 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099

A Review: Experimental Study on Compacted Soil Using Ultrasonic Pulse Velocity Test

Radhika Kherde, Atharva Mahore, Aalhad Pannase, Tejunsh Bang, Saurabh Bante, Utkarsha Gajbhiye, Vidhita Gadre
Department of Civil Engineering, Dr. Babasaheb Ambedkar College of Engineering and Research, Nagpur, Maharashtra, India

ABSTRACT

Soil testing is very important to determine the load bearing capacity and strength of the soil. While soil testing we calculate the index properties such as water content, specific gravity, bulk density, dry density, consistency limit etc. And other geotechnical properties like compressive strength and shear strength. The specimens were prepared for the laboratory test by using proctor compaction method. The proctor mould of (100 mm dia.) and (125 mm length) is used. By using direct transmission method the wave velocity of each compacted specimen is measured. In this study the tests were conducted for investigating the use of Ultrasonic Pulse Velocity (UPV) over 16 samples of compacted clayey soil from Wanadongri region. Determining the index properties using the old methods and comparing it with the UPV results. Finally the calibration curve is plotted using the observations such as water content vs. velocity, dry density vs. velocity, bulk density vs. velocity, compressive strength vs. velocity. The curve shows that which of them is more efficient.

Keywords: Water Content, Bulk Density, Dry Density, Compressive Strength, Ultrasonic Pulse Velocity Test, Wave Velocity, Consistency Limit.

I. INTRODUCTION

Whether constructing a commercial building or residential building it all starts with the foundation. Since entire structure is hold by the foundation. Hence soil investigation is an important parameter which plays a crucial role that will allow planning of foundation work properly and accurately. So that soil testing is prime importance to determine index properties and engineering properties.

There are various methods adopted for soil testing. Some tests are performed in laboratory and some are in the field. These tests are simply divided into two parts destructive and non-destructive tests. For ex. In-situ density is determined by sand replacement method, core cutter method, rubber balloon method which is destructive tests. Non-destructive methods most commonly include nuclear density test, electrical resistivity and cone penetration tests. In this research non-destructive test is taken into account as it is easy, lightweight, less time consuming and give quick results.

Different soil types will require different type of foundation. Depending on the properties of soil what should be the type of foundation to be used and the depth of the same should be decided. For selection of materials, design, and quality control purposes compaction characteristics of soil are required. Compaction characteristics of soil are evaluated by analysing the relationship between water content and dry density of soil. To determine the variation of dry density and water content proctor compaction tests are generally adopted in the laboratory. However soil contains water and water sometimes causes troubles in

construction of foundation, this can be known by studying the soul conditions.

Ultrasonic testing can present a sophisticated and fast approach for determining characteristics of compacted clayey soils. The testing program consisted of measuring pulse wave velocity on compacted soil using the direct transmission method. Ultrasonic pulse velocity method is used to assess the quality of concrete, metals, asphalt, etc. In this test, by measuring the velocity of an ultrasonic pulse waves passing through a compacted soil sample the strength and quality of compacted sample is assessed. The waves pass through the sample and the time taken is recorded. High velocity rate indicates good quality and continuity of the material, while slow velocity rate may indicate sample with cracks or voids.

This non-destructive method can be used as an alternative to existing methods to analyse laboratory or field compacted soils as well as physical and engineering properties of soils by geotechnical researchers.

The brief review of various soils testing by different researchers is discussed below:

Nitesh Ashok Bhange (2018): In this study the conclusion drawn are the relation between velocity and water content are established as an identical relation to that of a typical compaction characteristic curve of proctor. The relation obtains between velocity and density for the sample tested. The empirical equation in this research for predicting density, water content, compressive strength are found to be encouraging.

T. Senthilmurugan (2005): In this work the conclusion were obtained irrespective of the soil type, compaction method and energy of compaction, the relation obtained between velocity and water content was established as an identical relation to that of a typical compaction characteristic curve of proctor. The peak velocity and maximum densities were within ± 1% water content for the tested samples of two types. It was observed that the pulse velocity increases with compaction energy and decreases with plasticity. The linear relation were obtained between density and velocity.

Leslie (1950): Leslie investigates the relation between water content and velocity in silty clay and stated that maximum velocity occurs at maximum density and optimum moisture content (OMC).

Desislava Z. Slavova (2010): In this study slightly higher wave velocities were observed for samples of higher dry unit weight. As the smaller compaction mould could be use for the compacted sample in place of the larger mould but the care and experience is needed to match the target values over a given compaction curve. Lower wave velocities are observed at higher moisture content. Hence the velocity shows the strongest correlation with variations in moisture content.

Ferreira and Camarini (2001): Ferreira and camarini investigated the feasibility of assessing the strength of stabilized soil through pulse velocity.

Nazli Yesiller (2000): The conclusions were made as ultrasonic testing can be use effectively for determining the compaction characteristics of soil in the laboratory as well as in the field. Through transmission these tests can be conducted in laboratory, where as surface transmission could be used over the field for determining velocity of compacted clayey soil. Hence this method can be use as an alternative for existing field method. However, field verification is required for completing the development of the method.

Hardin and Richart (1963): In their work on Ottawa sand reported certain concepts of wave propagation in dry, partially saturated and saturated sand.

Sheeran (1967): Among the investigators Sheeran made an extensive study on soils of three types in which velocities of p-waves were determined, compacted by kneading and impact methods. It was observed that maximum dry densities and peak velocities occurred within ± 0.5% water content for laboratory compacted soils.

Sologyan (1990): Reported a similar study taking into account the micro-structural properties of soils. The given information was relevant to agricultural operations. It was suggested that ultrasonic testing was used effectively to determine density, water content, and micro-structural properties of soils.

Wang et al (1991): The study by Wang et al brought out the effect of static compaction pressure on the variation of ultrasonic pulse velocity with water content.

Mclntire (1991): Stated that in a three-phase system such as compacted soil, transmission of waves occurs through all of the phases. Generally the velocities in solids are higher than velocities in liquids, which are higher than velocities in gases.

II. RESULTS AND DISCUSSION

The calibration curve will be plotted using the observations. By using the compaction curve the relationship between dry density and water content of soil is demonstrated. Comparing the observations and calculations of conventional testing methods with the ultrasonic pulse velocity by using graph. The curve will show that which of them is more efficient. Compaction properties of field soils are compared with the compaction properties of soils determined in the laboratory to verify the effectiveness of construction procedures.

Plotting of the following comparison graph:

Water content vs. Velocity

Dry density vs. Velocity

Bulk density vs. Velocity

Compressive strength vs. velocity

III. CONCLUSION

The basic objective of using ultrasonic pulse velocity test on compacted clayey soil is to discover improvements in existing practice and procedures that will enable planning and conducting soil tests with less time consuming, more effectively and quicker results can be obtain. Further as non-destructive test (UPV) is adopted, it provides excellent balance between quality control, safety and cost-effectiveness. Hence the study allows alternatives for existing field methods.

IV. REFERENCES

[1]. IS 2720 (part 5) 1985, plastic limit test and liquid limit test.

[2]. IS 2720 (part 2) 1973, plastic limit test.

[3]. IS 2720 (part 10) 1999, unconfined compressive strength.

[4]. IS 13311 (part 1) 1992 non-destructive testing (Ultrasonic pulse velocity).

[5]. Leslie, J.R. (1950) "Pulse Techniques Applied to Dynamic Testing", ASTM, 50, 1314-1323.

[6]. Hardin, B.O., Richart, F.E. (1963). "Elastic Waves Velocities in Granular Soils." J. Soils Mech. and Found Engg., ASCE, 89(1) 33-65.

[7]. Yesiller, N., Gokhanlnci and Carol Miller .J. (2000). "Ultrasonic testing for compacted Clayey Soils".Advances in Unsaturated Geotechnics 54-68.

[8]. Sheeran, D.E., Baker, W.H. and Krizek. R. J. (1997)."Experimental Study of Pulse Velocities in Compacted Soils". Highway record No.177, Highway Research Board,226-238.

[9]. Sologyan A.I., (1990). "Survey of Methods and Means for Determining Soil Density in the Fields". Soviet J. Non-destructive testing Plenum Publishing Corp. 25(7), 480-486.

[10]. "Soil mechanics and foundations" B.C Punmia.

[11]. en.m.wikipedia.org/wiki/Ultrasonic pulse velocity test.