

Review on comparative study of standard proctor and modified proctor test

Waseem Nazir¹, Alok Sharma²

¹ PG Student, School of Civil Engineering, Lovely Professional University, Punjab

² Assistant Professor, School of Civil Engineering, Lovely Professional University, Punjab

ABSTRACT

The compaction attributes between standard Proctor and modified Proctor tests have been looked at. The outcomes show that most maximum dry unit weight esteems are tantamount for both the tests yet optimum moisture content qualities contrast marginally more. For both the tests: optimum moisture content was found to associate best with liquid limit, and the relationship for maximum dry unit weight with optimum moisture content was discovered to be nearly the equivalent. Since standard Proctor requires less time and 40% less compaction energy when contrasted with modified Proctor test, it tends to be considered as a reasonable option in contrast to the modified Proctor test.

Keywords: - standard proctor test, modified proctor test, optimum moisture content and unit weight.

Introduction

A land-based structure of any kind is as solid as its establishment. Therefore, soil is a basic component affecting the achievement of a development venture. Soil is either essential for the establishment or one of the crude materials utilized in the development cycle. Thusly, understanding the designing properties of soil it is significant to acquire quality and monetary lastingness. Soil compaction is the way toward amplifying the reasonableness of soil for a given development reason. There are numerous circumstances in designing practice when the soil is itself utilized as a development material. In the development of designing structures, for example, roadway, dikes or earth dams, e.g.; free fills are needed to be compacted to build the soil thickness and improve their quality attributes. Compaction is the most widely recognized and significant strategy for soil improvement. The densification of soil by the utilization of mechanical energy is known as compaction. In this cycle the soil grains get rearranged more closely, the volume of air voids gets reduced and the density of soil increases. It also leads to an increase in shear strength and helps to improve the stability and the bearing capacity of soil. It also reduces the compressibility and permeability of the soil. The level of compaction of a soil is estimated as far as dry unit weight. Since, all the PMGSY streets have been compacted according to the greatest dry thickness accomplished by standard Proctor test in light of the fact that the traffic was less and the heaps going ahead it were less. Presently, as we have entered the cutting-edge period the traffic on the streets has expanded which thusly has expanded the heaps going ahead the streets. These days the power of stacking going ahead streets has likewise expanded so we need appropriate compaction which can be accomplished simply subsequent to playing out the Modified Proctor test which is feverish. In this way, we'll be anticipating the consequences of Modified Proctor test dependent on the aftereffects of standard proctor test.

Background and Literature Review

2.1 Background

Soil compaction is a vital part of the construction process. It is used for support of structural entities such as building foundations, roadways, walkways, and earth retaining structures to name a few. For a given soil type certain properties may deem it more or less desirable to perform adequately for a particular circumstance. In general, the preselected soil should have adequate strength, be relatively incompressible so that future settlement is not significant, be stable against volume change as water content or other factors vary, be durable and safe against deterioration, and possess proper permeability.

When an area is to be filled or backfilled the soil is placed in layers called lifts. The ability of the first fill layers to be properly compacted will depend on the condition of the natural material being covered. If unsuitable material is left in place and backfilled, it may compress over a long period under the weight of the earth fill, causing settlement cracks in the fill or in any structure supported by the fill. In order to determine if the natural soil will support the first fill layers, an area can be proof rolled. Proof rolling consists of utilizing a piece heavy construction equipment (typically, heavy compaction equipment or hauling equipment) to roll across the fill site and watching for deflections to be revealed. These areas will be indicated by the development of rutting, pumping, or ground weaving.

To ensure adequate soil compaction is achieved, project specifications will indicate the required soil density or degree of compaction that must be achieved. These specifications are generally recommended by a geotechnical engineer in a geotechnical engineering report.

The soil type - that is, grain-size distributions, shape of the soil grains, specific gravity of soil solids, and amount and type of clay minerals, present - has a great influence on the maximum dry unit weight and optimum moisture content. It also has a great influence on how the materials should be compacted in given situations. Compaction is accomplished by use of heavy equipment. In sands and gravels, the equipment usually vibrates, to cause re-orientation of the soil particles into a denser configuration. In silts and clays, a sheep foot roller is frequently used, to create small zones of intense shearing, which drives air out of the soil.

Determination of adequate compaction is done by determining the in-situ density of the soil and comparing it to the maximum density determined by a laboratory test. The most commonly used laboratory test is called the Proctor compaction test and there are two different methods in obtaining the maximum density. They are the standard Proctor and modified Proctor tests; the modified Proctor is more commonly used. For small dams, the standard Proctor may still be the reference.

While soil under structures and pavements needs to be compacted, it is important after construction to recompact areas to be landscaped so that vegetation can grow.

2.2 Literature Review

In 1933, Ralph R. Proctor, an understudy at the University of California, Berkeley, set up a research facility methodology that effectively characterizes the down to earth greatest thickness of a soil example alongside the ideal dampness content expected to accomplish that thickness. That idea is referred to the present time as the dampness thickness relationship test, lab compaction qualities of soils, or just the standard Proctor test, and is point by point in ASTM D698 and AASHTO T 99 test strategies. Unit loads and dampness content field tests could now be communicated as a percent of the research center qualities for a similar soil, making it simpler for the architect to indicate what was required and to report the appropriateness of the work acted

in the field. Moreover, realizing the ideal dampness content gave clear direction for whether the soils being compacted should be made drier or wetter to make everybody's occupation simpler.

In the last piece of World War II and later into the 1950's, heavier unique burdens from bigger airplane and heavier, more regular truck traffic were setting more noteworthy interest on asphalts and soil subgrades. Once in a while the compacted soils had breezing through thickness assessments dependent on standard Proctor esteems yet were all the while avoiding a lot under burden to convey the expanded powers. In straightforward terms, densities were too low and ideal dampness were excessively high for these expanded loadings. Simultaneously, field compaction hardware was increasing and more proficient, making it conceivable to smaller soils to higher densities at lower dampness substance. The modified Proctor test was presented in 1958 as ASTM D1557 and AASHTO T 180 to deal with these equipment's at greater burdens.

Vincent Drnevich, P.E., etal,2007

In spite of the fact that it is realized that sway compaction tests are not suitable for granular soils, these tests keep on being broadly utilized. Extreme settlements as often as possible happen in granular soils where determined field compaction depends on Standard Proctor (ASTM D 698; AASHTO T 99) greatest dry unit loads. A lab test program assessed elective test techniques for granular soil compaction control and demonstrated that a Vibrating Hammer strategy (like British Standard BS 1377:1975, Test 14) has extraordinary guarantee for research facility densification of these soils. A single pinch Vibrating Hammer test on a broiler dry soil test can give the greatest dry unit weight and water content territory for compelling field densification of most granular soils. The most extreme dry unit weight acquired is equivalent to that from other current techniques, for example, the Vibrating Table test (ASTM D 4253) and the Modified Proctor test (ASTM D 1557), and is more noteworthy than that from the Standard Proctor test (ASTM D 698). The strategy is material to a more extensive scope of soils than ongoing vibratory table densification tests (up to 35 percent non-plastic fines and up to 15 percent plastic fines). The hardware is generally modest and is sufficiently compact to be taken into the field. The test is simpler and snappier to perform than different techniques referenced above and gives reproducible and steady outcomes. Huge estimated granular soils/totals make possible issues for compaction control techniques because of greater size particles. Greater size particles characterized here are those held on a 3/4-inch (19-mm) sifter. INDOT Specification 203.44 (b) 2 requiring adjustment of densities from research facility compaction tests on soils with larger than average particles aren't being utilized practically speaking. It isn't being followed fundamentally on the grounds that direction isn't given. Accordingly, the estimations of most extreme dry unit weight from standard compaction tests will be fundamentally lower than those remedied for curiously large particles. This finding might be the main motivation why granular loads up with curiously large particles are failing to meet expectations. The perfect running Vibrating Hammer Method of densification explicitly addresses the impact of oversize particles. In light of the outcomes from this exploration, a draft ASTM Standard for the Pulsating Hammer Method of Compaction has been composed, is well into the canvassing cycle, and ought to turn into an ASTM Standard Method of Test in late 2007 or mid-2008. It is remembered for Appendix A. This report additionally acquaints a straightforward alignment methodology with confirm that the vibrating hammer is providing adequate energy to the soil. The Pulsating Hammer Method of densification is an elective strategy for determining most extreme dry unit loads for granular soils. The technique additionally sets up a water content territory for field compaction. This examination extends the pertinent scope of granular soils to those containing greater size particles. An exploratory program, alongside audit of past compaction research, was done to decide the impact of oversize particles on compaction execution. Testing was acted in two sizes of compaction molds, 7-inch and 12-inch, in deciding this impact. A larger than usual revision technique was considered for water substance and dry thickness when playing out a test in a 7-inch form with scalping, for example expulsion of oversize particles. Aftereffects of an INDOT model usage venture used to decide the suitability of utilizing the Pulsating Hammer for field compaction are accounted for. Results show that the Pulsating Hammer strategy is adequate

for use with particles and that greatest dry unit loads may happen at or close to immersion.

P.Talukdar & B.Sharma , 2014

Densification of soil at, maximum dry thickness is needed in many designing tasks. The water content dry density relationship of the soil acquired from Proctor's test frames the reason for particular and field compaction control. Lab assurance of maximum dry density (MDD) and optimum moisture content (OMC) by the Proctor test requires extensive time and exertion and these qualities are being utilized to choose for the maximum dry density (MDD) and optimum moisture content (OMC) of subgrade, in which generally static compaction technique is utilized. In this investigation, a research facility technique is contrived to decide the maximum dry density esteem (MDD) at optimum moisture content (OMC) esteem by utilizing static compaction. The investigation shows that the connection between water substance and dry thickness in static compaction is allegorical in nature. Complete three number of soils of fluctuating versatility qualities were tried.

Alex Austin with Standard test methods, 2007

A soil at a chose shaping water content is set in 3 coatings into a form of given measurements, with every single layer trampled by 25 or 56 blows of a 6.50-lbf (25.175-N) rammer released from a separation of 12.00 in. (304.8 mm), exposing the soil to an all-out compactive exertion of around 13100 ft-lbf/ft³ (599 kN-m/m³). The subsequent dry unit weight is resolved. The technique is rehashed for an adequate number of trim water substance to build up a connection between the dry unit weight and the embellishment water content for the soil. This information, when plotted, speaks to a wavy relationship known as the compaction bend. The estimations of ideal water substance and standard greatest dry unit weight are resolved from the compaction bend. These test strategies cover research center compaction techniques used to decide the connection between trim water substance and dry unit weight of soils (compaction bend) compacted in a 5 or 7-in. (102.6 or 155.4-mm) width form with a 6.17-lbf (23.9-N) rammer dropped from a tallness of 12.0 in. (305 mm) creating a compactive exertion of 13100 ft-lbf/ft³ (533 kN-m/m³).

NOTE 1—The hardware and strategies are comparative as those projected by R. R. Delegate with this one significant special case: his rammer blows were functional as "11 inch firm strokes" rather than free fall, creating variable compactive exertion relying upon the administrator, however most likely in the reach 16 000 to 26 000 ft-lbf/ft³ (699 to 1190 kN-m/m³). The standard exertion test (see 3.1.4) is now and then alluded to as the Proctor Test. Soils and soil-total combinations are to be viewed as regular happening fine-or coarse-grained soils, or composites or combinations of common soils, or combinations of normal and prepared soils or totals, for example, rock or squashed stone. From this point forward alluded to as one or the other soil or material. These test techniques spread over just to soils (materials) that have 30 % or less by mass of particles held on the ¾-in. (18.1-mm) sifter and have not been recently compacted in the research center; that is, don't reuse compacted soil. For connections between unit loads and embellishment water substance of soils with 30 % or less by mass of material held on the ¾-in. (19.0-mm) strainer to unit loads and embellishment water substance of the portion passing ¾-in. (19.0-mm) strainer, see Practice D4718.

Asuri Sridharan and Puvvadi Venkata Sivapullaiah, 2005

The norm and changed Proctor densifying tests are conceived to set up dry unit weight-water content connections for a soil under controlled conditions, for example, compactive exertion, water content, and so forth This paper presents a scaled down compaction contraption principally for use in fine grained soils, which requires just around 1/tenth volume of soil required for the norm and adjusted Proctor test. Furthermore, the time and exertion associated with doing the compaction test is considerably less, Also, the compacted soil test, subsequent to managing, can be utilized for quality tests.

Finally, they came to on a resolution which are summarized in the accompanying focuses: -

1. A small scale compaction device has been intended to create Proctor and adjusted Proctor compaction bends for fine grained soils containing particles better than 2 mm. The created mechanical assembly comprises of shape of 3,81-cm inward measurement and stature of 10 cm with falling mallet of weight 2.0 kg will 34 blows/layer in 3 layers for Proctor compaction bend. For altered delegate bend, the sledge weight is 2,5 kg and number of blows per layer is 36, in three layers.
2. The energies per unit volume applied in the device for standard and adjusted Proctor densities are, separately, bigger than the energies per unit volume of the norm and changed Proctor tests. This is because of loss of energy during the effect between the mallet and the energy moving foot, higher sidewall contact and lesser impact of effect on the soil sick creation it denser, in the proposed contraption. Because of nonaccountability of careful estimation of coefficient of compensation, impact of effect and sidewall rubbing and different misfortunes, the quantity of blows needed with the proposed contraption was really gotten by looking at the compaction bends got from the proposed device and the norm and altered Proctor compaction bends rather than hypothetical computation.
3. In standard and changed Proctor tests, there will be swelling of soil when the test is directed on the wet side of ideal. Tn the proposed contraption, there is no possibility of protruding as the inner breadth of the shape and the energy moving foot are practically equivalent. Because of this failure in compaction, standard and changed Proctor tests give generally lower dry unit loads on the wet side of ideal when contrasted and the outcomes acquired with the new mechanical assembly, the distinction between the dry unit weight and ideal water content got from standard and proposed device is unimportant overall.
4. The proposed device is less complex and speedier, and the measure of exertion included is relatively substantially less, and furthermore spares a lot of soil.
5. Tests for quality tests can be acquired with, (least unsettling influence and lesser time).

MARIA J. SULEWSKA, DARIUSZ TYMOSIAK, 2010

Examination of compaction boundaries of the praiseworthy non-durable soil controlled by Proctor strategies and vibrating table tests. The motivation behind the work is to examine compaction boundaries of non-firm consistently reviewed soil – ideal dampness content (w_{opt}) and greatest dry thickness (ρ_{dmax}), got from Proctor tests and utilizing vibrating table. The examination was led on even-reviewed medium sand of consistency coefficient $CU = 3.10$ and coefficient of arch $CC = 0.99$. Compaction boundaries were inspected by utilizing Proctor tests – standard Proctor tests (I and II) and adjusted Proctor tests (III and IV) in consistence with PN-OT-05561:1988, and furthermore standard (A+A and A+B) and altered (B+A and B+B) as indicated by PN-EN 13286-2:2010, and by utilizing a vibrating table in consistence with PN-EN 13526-5:2006 at four example stacking endeavours. The dampness substance of the examples expanded by 1–2% in the scope of about 0% to about 10%. Based on the examination of information from soil concentrates with uniform grain size (ineffectively compactable soil), it very well may be presumed that the estimations of test outcomes ρ_{dmax} of medium sand with standard (or adjusted) Proctor tests as per PM-OT-03361:1977 and PJ-DS 14789-2:2010 are near one another. It tends to be inferred that on account of ρ_{dmax} , the vibrating table strategy (with the accepted test conditions) permits to accomplish results practically identical to those of Proctor (mean relative contrast 1.88%). Utilizing the pulsating table, the w_{opt} values were lower than those got by Proctor tests (mean relative contrast of 17.84%).

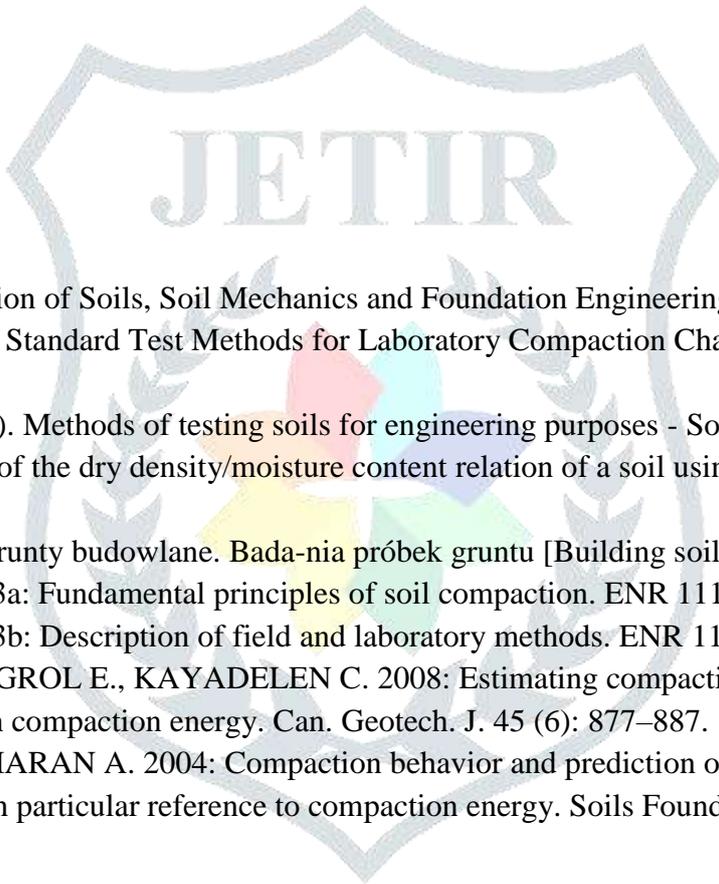
3. Conclusion

Based on the examination of information from the investigations on medium sand with uniform grain size, it tends to be closed that:

1. Consequences of investigations of the estimations of compaction boundaries (wopt and ρ_{dmax}) researched utilizing the Proctor tests as indicated by PN-B-04481:1988 and PH-EG 14589-2:2011 + PL-JH 13286-2:2010/LK:2014 are comparable.
2. Consequences of trial of ρ_{dmax} values prevent mined with the utilization of a vibrating table (with a unit test surface heap of 9.38 kPa and a compaction season of 10 min) are equivalent to the Proc-peak test results, and wopt is a lot of below a normal of about 19%.
3. Applied strategy for testing the compaction boundaries utilizing a vibrating table is helpful for testing the compaction boundaries (wopt and ρ_{dmax}) of medium sand with uniform grain size distribution.

As per all the reviews mentioned in this paper, I came to a conclusion that all have done a great job on soil using different techniques. Most of them have used standard proctor and modified proctor apparatus for compaction. So, after a broad study I will be predicting the equation between SPT and MPT which will predict the results of SPT by directly doing the MPT and hence will be time saving for upcoming projects.

4. References

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