Compaction of soil materials using kaolinite soil with concrete waste mix

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Abstract. Constructions of buildings above ground level Clay is one of the most common problems in construction in many parts of the world. Soil is a basic element of construction work, both roads, and buildings. Unstable soil can cause damage that occurs on the road, such as a bumpy road surface. This land problem is not limited to surface movement, but it covers the whole, such as depreciation and soil development. Compaction is done to reduce the volume of soil grains. Soil compaction aims to increase the weight of dry volume, reduce soil subsidence, reduce soil plasticity, reduce volume changes as a result of changes in water content. This research, a standard proctor test, was carried out by adding concrete waste to the clay. Addition [1] of concrete waste with variations of 5%, 10%, 20%, obtained dry weight (1.58), (1.65), (1.61). The research showed that the addition of 10% of concrete waste obtained an optimum dry weight of 1.65 with a moisture content of 10%.

1. Introduction

Construction of buildings above ground level Clay is one of the most common problems in construction in many parts of the world [1]. Expansive soils are very problematic because of their inherent characteristics to undergo volumetric changes according to humidity. They increase in volume when they absorb water and shrink when water evaporates [2]. This makes the ground surface bumpy, primarily when the ground surface is used as a heavy vehicle crossing road, and building foundations [3]. The design, construction of roads, and other geostructures often require the incorporation of other materials with low-quality soil and high humidity susceptibility to construction [4]. Chemical stabilization for expansive soils has proven to be quite successful in controlling changes in soil volume due to the nature of soil depreciation and expansion, one of which is the use of cement [2]. Soil is defined as a material consisting of granules of solid minerals that are chemically bound to each other [5]. Soil is a basic element of construction work, both roads, and buildings. Unstable soil problems may cause damages that occur on the road, such as the undulating surface of the road, this soil problem is not limited to subsidence but covers the whole, such as depreciation and soil development [6]. There are several types of soil, clay is a problem in construction work, because of the low level of stability. Soil is the layer that receives the burden from the pavement layer above it and is also the last part that receives the load distribution from the surface layer [7]. Because the need for construction materials can be analyzed in two aspects, such as construction materials or soil layers for structures [8]. Soil compaction is a mechanical effort to close soil grains. Compaction is carried out to reduce soil volume, reduce pore
volume but not reduce soil grain volume [9]. Compaction is a soil improvement solution to support the building above it, in the sense that the land will be used as pile material [10]. Soil compaction aims to: Enhancing soil shear strength, Reducing compressibility [11], Reducing soil plasticity [12,13], Reducing volume changes as a result of changes in water content and others [14]. This is done to produce good compaction soil material. The level of soil density is measured from the weight value of the dry volume ($\gamma_d$) [10].

2. Research methods
The research using experimental methods and previous research theory studies. Experimental research is carried out at Civil Engineering Laboratory of Kadiri University.

2.1. Clay soil
Clay soils are mineral particles formed by weathering the earth's crust. The earth's crust is composed of weathering, which has the elements of silicon, oxygen, and aluminum. The main factor used to control the size, shape, physical properties, chemical properties, and soil particles are mineralogy. Minerals contained in the soil will affect the physical and mechanical properties of the clay soil [16]. The mineralogy composition of clay is different from other soils. Almost all clay minerals are crystalline minerals in the form of clay sheets, which can develop cohesion and plasticity [17]. In this study, we used a soil structure that passed the sieve gradation number 40 by sampling at RT10 RW 02, Sigit Hamlet, Kedung Sigit Village, Karangan District, Trenggalek Regency. This aims to get rid of the soil that contains humus and plant roots. Soil samples that are taken already represent the soil at the sampling location.

2.2. Water
Concrete Water is a natural material needed for human life [18]. According to Susana [19], Water is the most abundant chemical compound in nature. Water is a chemical compound that is colorless, odorless, and tasteless. Water has universal solvent properties where chemical elements and compounds can be dissolved. Therefore, water is one of the important ingredients in this study, as a solvent for the soil reaction to achieve a homogeneous state.

2.3. Concrete
Concrete is a mixture of cement, aggregate, water with and without added material, forming a solid mass [20]. Concrete is used as a building structure, foundation, pavement, bridge, and so on. In this study, to find solutions to soil problems, the soil will be repaired with concrete waste grains, because clay can bind coarse grains with cohesive properties. Concrete waste has a rough grain shape and hard enough so that it can increase the carrying capacity of the soil [21].

2.4. Compaction test
Compaction is a process in which soil particles are rearranged and packed into solid shapes with the help of mechanical equipment and aims to reduce soil porosity to increase the dry weight of the soil. The technical properties of clay soils after compaction will greatly depend on the method or effort of compaction, soil type, and moisture content [22]. A compaction test using this proctor is used to determine the value of the optimum moisture content and maximum dry soil volume weight [23]. Compaction is carried out at different groundwater levels related to the soil consistency limit to get maximum results [24,25]. So by conducting compaction tests using a proctor can find out the addition of concrete and what percentage water content to achieve optimal levels. The method used in this test proctor uses AASHTO T99 / SNI-R-03-1742-1989 regulations. Research using the proctor test method. Soil samples have been used for the measurement of the density of the Standart Proctor Test from
Trenggalek. Samples Obtained from Advanced Below 500 mm, subsurface samples contain clay elements [26].

The first phase of research is studying the literature, then continue to provide tools and materials for research. The material in the form of soil taken from Trenggalek, and concrete waste obtained from the Laboratory. The soil used escapes filter No.40, with the soil in dry air conditions. The concrete waste used previously was crushed and then filtered with a No.40 before being used as a stabilizer for specific gravity tests. The second step is to test the physical properties of the original soil and mixed soil concrete waste with a mixture percentage of 5%, 10%, and 20%. Next, test using the Proctor standard test. The third stage is the stage of data analysis and discussion about the tests that have been carried out. After analysis and discussion, conclusions can be drawn from the results of the study.

3. Results and analysis

3.1. Test results of proctor standard test

Data is collected when testing standard proctor. The value of the proctor test uses the proctor test table to determine the amount of dry weight; the optimal value of dry weight can be seen from the figure. Variations in the addition of concrete are 5%, 10%, and 20%. The figure of the test results can be seen below:

![Proctor testing comparison chart](image)

The figure shows the various results of the test value of the proctor test with the optimum results being the addition of concrete waste with an amount of 10% calculated from the total weight of the test specimens. Tests show that when adding 5% concrete waste, the dry weight value is 1.58 gr/cm³, 10% concrete waste is added, the dry weight value is 1.65 gr/cm³, and the addition of 20% concrete waste is 1.61 gr/cm³. The research showed that the addition of 10% of concrete waste obtained an optimum dry weight of 1.65 gr/cm³ with a moisture content of 10%.

4. Conclusion

In this study, the effect of vibration strength on compressive strength was carried out on concrete quality fc 21.7 MPa. Vibration using a vibrating table with acceleration 180 m/s², velocity 160 m/s, and displacement of 1000 mm, with a duration of 1 minute, 2 minutes and 3 minutes can increase the compressive strength of concrete. Concrete compressive strength increases with increasing duration of shaking with the highest compressive strength achieved by concrete shaking for 3 minutes. Increasing
the duration of shaking time, in addition to affecting the compressive strength also affects the water level that rises to the surface. The highest moisture content is achieved by concrete with vibration for 3 minutes. It can be concluded that the addition of the duration of shaking produces a significant increase, both an increase in the value of water content and compressive strength.

Acknowledgment
The researcher wants to support Kadiri University, especially the Engineering Faculty, for giving a chance for doing the research and composing the report.

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