Experimental Study Additional Brantas Sands Of Clay Density

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Abstrak. Land functions as a supporting medium for all living activities. The problem that is often encountered is the level of soil stability at each location is different, for this reason the following research is used to determine the parameters of stable soil density when soil structure composed of clay components added 10% of sand from the total weight of the specimen with different diameter variations using proctor testing. The density properties of clay soil after the addition of brantas sand with size variations passed the sieves number 8, 10, 16 and 20 amounting to 10% in perfect solid state the structure of the original soil specimens showed an $\gamma_d$ value of 9.61 gr/cm$^3$, in addition of sand 10% with a diameter passing through number 8 shows an $\gamma_d$ value of 10.44, at number 10 shows a value of $\gamma_d$ 11.77, at number 16 shows the value $\gamma_d$ 10.97 and in number 20 shows a value of $\gamma_d$ 11.55. The addition of sand to the expansionary structure with low stability can improve the level of stability of the soil structure. Moreover, the addition of sand with a no. 10 sieve diameter shows the value of dry volume density $\gamma_d$ of 11.77, the value shows the above average density parameter - average of several other test objects.

Keywords : Brantas Sands, Clay Density

1. Introduction

Soil is a mineral in the earth's crust which is very important in its function to support all facilities for living things, especially in its function as a medium for the construction of civil land construction is very often used. “In civil engineering, the security of a building is largely determined by the strength of its structure, both the upper structure and the lower structure (base structure). What is meant by the lower structure is the part of the building that is below the surface of the ground” [1]. “The function of the land itself is as a platform for the core of a building” [2]. The construction of the building's core is defined as the building foundation. “The foundation is the load bearing element of the column which then channels it to the hard soil layer” [3].

Thus the quality of the soil that will be used must meet the technical specifications. The consistency of the land, especially expansion (expansive) is fairly inadequate towards the carrying capacity of the building infrastructure that it supports. Soil has different mechanical properties, this is because the components of the soil structure are different, for that “the handling of one type of soil but located differently will also be different methods of improvement that will be carried out” [4], but in reality “Land the problematic ones such as shrinkage flower (expansive soil) are often found in Indonesia” [5]. “Expansive ponds have the potential for high shrinkage growth in the event of changes in water content”, [6].

In general, the structure of soil compilation can be divided into 4 core components that have different sizes and specifications, while the components are coarse grains (rocks), medium grains (sand), fine grains (clay) and finer are dust. Landforms that are mostly composed by coarse to medium tends to have a sufficient level of stability that perfectly meet the specifications to vandalism but the structure of the land that is predominantly composed by granules and dust stability tends to be poor in meeting the usability specifications. According to E. Bowles, it was explained that “the clay is
plastic at medium water content, in dry conditions the clay is very hard and is not easily peeled off only with the fingers” [2][7]. this causes soil structures composed of components made from fine grains (clay) to have a low level of stability and thus efforts are needed to stabilize the soil structure, “Soil stabilization can be carried out by mechanical means by compaction using mechanical energy to produce particle compression, or chemically by mixing native soil with certain added ingredients”, [6]. In preparing the following paper will do research on experimental Study addition of Brantas sands of Soil density, wherein the following study was used to determine soil density parameters stable when the soil structure composed of clay component was added 10% Brantas sands of the total weight of the specimen with a variation in the diameter sieve numbers 8, 10, 16 and 20 using a test proctor.

2. Literature Review

- Clay

Clay soil is component the compiler of the soil structure with the size of the size of the sieve gradation which is relatively small and its embodiment comes from rock weathering. The level of stability of clay soil to the amount of water content is very effective, whereas “The general condition of the water content in the soil changes - change from saturation” [8], resulting in the nature of clay being “Plastic when homogeneous with moderate amounts of water, but will harden in dry conditions” [2]. Thus it can be concluded that the level of consistency of clay is still fairly low. In the following study the structure of clay which is used as a media experiment to determine the optimum values of stability when added sand is the kind of expansive clay not contain humus. Soil is taken directly at a location of clay soil at a depth of 100-200 Cm from Kediri city, when the soil is dry, gradations of sieves are carried out and what will be used is a soil structure that escapes gradation number 40.

- Water

Water is a molecule of the chemical element H2O and is composed of 2 atomic covalent bonds. “This chemical is an important solvent, has the ability to dissolve other chemicals” [2] [7], so that the role of water in the following research is used as a soil dissolution medium when homogeneous with sand. “When water is added to compaction, this water will soften soil particles.

Soil particles slip from one another and move in a more tight position” [9]. The water that will be used as a solvent media in the test is taken directly from the clean water channel in the Kadiri University civil engineering laboratory.

- Sand

Sand is a mineral of outer earth crust formed from weathering of natural rocks and is still part of the composition of soil structure which has a medium grained size classification. In principle, “water is a natural granular material that has not been consolidated” [10], sand can be obtained by means of “disintegration (destruction) of natural rock (natural sand) or can be made by splitting (artificial sand)”, [11] [12]. The sand used is natural sand structure, natural sand itself is “Natural disintegration results from rocks or in the form of artificial sand produced by stone breaking tools” [6] [13].
The sand will be used is sand taken from the Kediri East Java Indonesia Brantas river as a medium for soil density stability which will be known to analyze the optimum proctor value when the soil is added 10% of brantas sand with a size passing through gradations number 8, 10, 16 and 20.

![Sands from Brantas River](image)

**Figure 2. Sands from Brantas River**

3. Research Method

Soil compactions testing is carried out to determine the parameters of soil density by converting a weight value to the volume value of the test object in the maximum solid state. “Compaction is an attempt to increase soil density by using mechanical energy to produce particle compression” [14]. Basically the proctor test is used as “increasing soil density by reducing the distance between particles so that air volume reduction occurs and there is no significant change in the volume of water” [15]. The steps to be taken in testing the proctor at Kadiri University Laboratory as follows:

- Calculate the value of the weight and volume of contents of the mold proctor using the caliper.
- Install the base and neck of the proctor mold and Put a little - by little test specimen into the proctor mold until it becomes 3 layers with each layer being pulverized as much as 25 x collisions.
- Remove the pads and neck mold and do grader's proctor the test specimen surface using the cutter.
- Recalculate the weight of the proctor mold when it is loaded with the test object.
- Remove the test specimen from the procto mold using a hydraulic jack and determine the water content using the oven.

![Soil compaction test equipments (Proctor Test), (b) Molding, (c) Oven in Kadiri University Laboratory](image)

**Figure 3. (a) Soil compaction test equipments (Proctor Test), (b) Molding, (c) Oven in Kadiri University Laboratory**
4. Results and discussion

From the results of the soil compaction test (proctor) at Kadiri University Laboratory are presented in the following tables and graphs:

**Table 1. Value Of Test Proctor Of Original Expansion Structure Test.**

| Test Objectives                  | 1   | 2   | 3   | 4   |
|----------------------------------|-----|-----|-----|-----|
| Weight Mold Proctor              | 4502| 4502| 4502| 4502|
| Weight Water (Ww) + Mold         | 6242| 6286| 6493| 6459|
| Weight Test (W)                  | 1740| 1784| 1991| 1957|
| Weight Solid (Ws)                | 1641| 1651| 1810| 1747|
| Weight Water (Ww) = W-Ws         | 99  | 133 | 181 | 210 |
| Water Content (Wc) = Ww / Ws * 100 (%) | 6.03| 8.06| 10.00| 12.02|
| Volume Mold (V) = π.r².t          | 188.28| 188.28| 188.28| 188.28|
| Weight Volume (γsat) = W / V     | 9.24| 9.48| 10.57| 10.39|
| Weight Solid Volume (γd) = Ws / V| 8.72| 8.77| 9.61 | 9.28 |

Proctor testing on the original soil structure specimen shows the optimum value of γd of 9.61 at a moisture content of 10%.

**Table 2. Test Of Proctor Mix Of Soil With Addition Of Sand No. 8 Feed 10%.**

| Test Objectives                  | 1   | 2   | 3   | 4   |
|----------------------------------|-----|-----|-----|-----|
| Weight Mold Proctor              | 4502| 4502| 4502| 4502|
| Weight Water (Ww) + Mold         | 6319| 6472| 6665| 6621|
| Weight Test (W)                  | 1817| 1970| 2163| 2119|
| Weight Solid (Ws)                | 1712| 1823| 1965| 1891|
| Weight Water (Ww) = W-Ws         | 105 | 147 | 198 | 228 |
| Water Content (Wc) = Ww / Ws * 100 (%) | 6.13| 8.06| 10.08| 12.06|
| Volume Mold (V) = π.r².t          | 188.28| 188.28| 188.28| 188.28|
| Weight Volume (γsat) = W / V     | 9.65| 10.46| 11.49| 11.25|
| Weight Solid Volume (γd) = Ws / V| 9.09| 9.68| 10.44| 10.04|

Proctor testing on soil structure specimens added with diameter sand escaping number 8 sieve shows the optimum value of γd of 10.44 at a moisture content of 10.08%.

**Table 3. Test Of Proctor Mix Of Soil With Addition Of Sand No. 10 Feed 10%.**

| Test Objectives                  | 1   | 2   | 3   | 4   |
|----------------------------------|-----|-----|-----|-----|
| Weight Mold Proctor              | 4502| 4502| 4502| 4502|
| Weight Water (Ww) + Mold         | 6523| 6710| 6940| 6889|
| Weight Test (W)                  | 2021| 2208| 2438| 2387|
| Weight Solid (Ws)                | 1904| 2044| 2216| 2129|
| Weight Water (Ww) = W-Ws         | 117 | 164 | 222 | 258 |
| Water Content (Wc) = Ww / Ws * 100 (%) | 6.14| 8.02| 10.02| 12.12|
| Volume Mold (V) = π.r².t          | 188.28| 188.28| 188.28| 188.28|
| Weight Volume (γsat) = W / V     | 10.73| 11.73| 12.95| 12.68|
| Weight Solid Volume (γd) = Ws / V| 10.11| 10.86| 11.77| 11.31|

Proctor testing on soil structure test specimens added by sand with a diameter passing through number 10 sieve shows the optimum value of γd of 11.77 at a moisture content of 10.02%.
Table 4. Test Of Proctor Mix Of Soil With Addition Of Sand No. 16 Feed 10%.

| Test Objectives                          | 1     | 2     | 3     | 4     |
|-----------------------------------------|-------|-------|-------|-------|
| Weight Mold Proctor                     | 4502  | 4502  | 4502  | 4502  |
| Weight Water (Ww) + Mold                | 6342  | 6534  | 6775  | 6741  |
| Weight Test (W)                         | 1840  | 2032  | 2273  | 2239  |
| Weight Solid (Ws)                       | 1752  | 1881  | 2066  | 1999  |
| Weight Water (Ww) = W-Ws                | 88    | 151   | 207   | 240   |
| Water Content (Wc) = Ww / Ws * 100 (%)  | 5.02  | 8.03  | 10.02 | 12.01 |
| Volume Mold (V) = π.r².t                 | 188.28| 188.28| 188.28| 188.28|
| Weight Volume (γsat) = W / V             | 9.77  | 10.79 | 12.07 | 11.89 |
| Weight Solid Volume (γd) = Ws / V        | 9.31  | 9.99  | 10.97 | 10.62 |

Proctor testing on soil structure test specimens added with diameter sand passed number 16 sieve shows the optimum value of γd of 10.97 at a moisture content of 10.02%.

Table 5. Test Of Proctor Mix Of Soil With Addition Of Sand No. 16 Feed 10%.

| Test Objectives                          | 1     | 2     | 3     | 4     |
|-----------------------------------------|-------|-------|-------|-------|
| Weight Mold Proctor                     | 4502  | 4502  | 4502  | 4502  |
| Weight Water (Ww) + Mold                | 6452  | 6675  | 6895  | 6859  |
| Weight Test (W)                         | 1950  | 2173  | 2393  | 2357  |
| Weight Solid (Ws)                       | 1838  | 2012  | 2175  | 2104  |
| Weight Water (Ww) = W-Ws                | 112   | 161   | 218   | 253   |
| Water Content (Wc) = Ww / Ws * 100 (%)  | 6.09  | 8.00  | 10.02 | 12.02 |
| Volume Mold (V) = π.r².t                 | 188.28| 188.28| 188.28| 188.28|
| Weight Volume (γsat) = W / V             | 10.36 | 11.54 | 12.71 | 12.52 |
| Weight Solid Volume (γd) = Ws / V        | 9.76  | 10.69 | 11.55 | 11.17 |

Proctor testing on soil structure test specimens added with diameter sand escaping number 20 sieve shows the optimum value of sebesard of 11.55 at a moisture content of 10.02%.

Figure 4. The graph compares the proctor test on the test object at Kadiri University Laboratory.

On the chart shows the various results of the test proctor value test with a perfect solid results are at levels water approaches the amount of 10% calculated from total weight of test object.

5. Conclusion

On the results of compiling a paper entitled Experimental study of sand additives on clay soil density found at research results concluded that density of the clay after the addition sand with size variations passed sieve number 8, 10, 16 and 20 amounting to 10% in perfect solid state the structure of the original soil specimen shows an γd value of 9.61 gr/cm³, in addition of sand 10% with diameter passes sieve number 8 shows the value of 10.44, the addition of sand passing
the number 10 sieve shows an $\gamma_d$ value of 11.77, the addition of sand passing the number 16 sieve shows an $\gamma_d$ value of 10.97 and the addition of sand passes the sieve number 20 shows an $\gamma_d$ value of 11.55. There is a point for adding sand to the 10% sieve diameter of 10% in an expansive soil structure whose low stability can improve the level of stability of the soil structure. Moreover, the addition of sand with a diameter of number 10 shows a dry volume density value of $\gamma_d$ of 11.77, the value shows the density parameters above the average of several other test objects.

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