Compaction Parameters of Reinforced Clayey Sand

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***Abstract*—** Composite soils have been widely used in civil engineering applications, especially in slopes, embankment dam and landfills. This paper aims to investigate effect of fibre inclusion on compaction characteristic of composite soil (i.e. clayey sand composite). A series of laboratory tests carried out to evaluate fibre effect on optimum water content and maximum dry unit weight of composite soils. Clayey sand was selected as soil part of the composite and natural fibre was used as reinforcement. The fibre parameters differed from one test to another, as fibre length varied from 15 mm to 30 mm and fibre content were selected as 0.5% and 0.7%. For each test, compaction curved derived and the results were compared. The results proved that inclusion of fibre affected compaction behaviour of samples so that increasing in fibre content and length caused increasing in Optimum Moisture Content (OMC) and slightly decreased maximum dry unit weight.

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***Keywords*—**Direct shear, Reinforced, Fiber, Sand

I. Introduction

Fletcher and Humphries (1991) investigated influence of fibre inclusion on compaction of silty clay soil. Unlike the case of sandy gravel reported by Hoare (1977), the test results indicated that increasing the fibre content causes a modest decrease in the maximum dry unit weight. The optimum water content was found to increase by increasing fibre content. Other researchers (Nataraj and McManis, 1997; Al Wahab and El-Kedrah, 1995; Puppala et al., 2006; Miller and Rifai, 2004; Ozkul et al., 2007; Kumar Tabor, 2003) also reported similar results. In contrast, some researchers such as Ozkul et al, 2007 reported not significant changes on compaction parameter by fibre inclusion. Therefore, the problem of effect of fibre inclusion on compaction parameter needs to be investigated precisely. Authors believe that different research results are due to different material which each researcher has used. This paper aims to investigate influences that are induced by fibre inclusion on compaction characteristics of clayey sand.

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II. Material

Composite soils consist of two parts. The first part is soil part which can be dealt as normal soil. The second part is reinforcement part which can be made up of any material which helps soil to have better performance.

A. Soil Type

The soil type in this study was Western Australian sand. The properties of clay are presented in table 1. The sand distribution curve is presented in Fig 1. The soil part was reconstituted in lab by using sand with 20% of kaolin clay.

Table1. Clay properties

No.	Type	
1	Soil type	Clay
2	Liquid Limit	49
3	Plastic Limit	23
4	Pl. Index	26

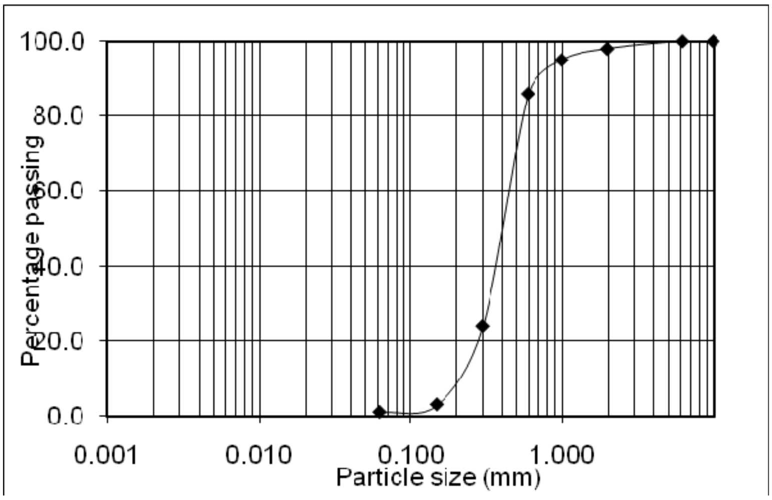

Fig. 1 Sand Particle Distribution

B. Fiber Type

The natural fiber has been used for this investigation. Figure2 shows the used fiber. The used fiber has good potential to absorb energy and good adhesion with soil particle.

Fig. 2 Natural fiber

III. TEST PROGRAM

A series of compaction tests have been conducted.

A. Compaction test

Soil compaction is a mean to increase the density of soil. In geotechnical projects, soil density is an important parameter. Any difficulty related to compaction may cause settlement of the soil and as a consequence unnecessary maintenance costs or structure failure. Therefore, all types of construction sites and construction projects take special care in mechanical compaction method.

B. Main Equipments

- Proctor mould with a detachable collar assembly and base plate.
- Manual rammer weighing 2.5 kg and equipped with height of drop to a free fall of 30 cm (for standard method)
- Sample Extruder.
- A sensitive balance.
- Straight edge.
- Moisture cans.
- Drying Oven

IV. TEST METHODOLOGY AND PROCEDURE

1. 1. About 4.5 kg of air-dried soil was put in the mixing pan so that it could pass No. 4 sieve.

2. The moisture content was increased by about 5%.

3. The weight of empty mould without the base plate and the collar was recorded as W1 (gr).

4. The collar and base plate was fixed and the first soil part was compacted with 25 blows in proctor mould

5. Some scratches were put with a spatula forming a grid to ensure uniformity in distribution of compaction energy to the subsequent layer. The second and third layer was placed and 25 blows were applied 25 blows.

6. The final layer was placed so that the compacted soil is just above the rim of the compaction mould when the collar is still attached.

7. The collar carefully was detached without disturbing the compacted soil inside the mould and edge was used to trim the excess soil leveling to the mould.

8. The weight of the mould with the moist soil W2, (gr) was determined.

9. Sample was extruded the sample and evaluated for water content in some cans

10. The rest of the compacted soil was broken with hand to pass US Sieve No.4. and moisture content was increased by 2%.

11. Steps 1 to 10 repeated again for different moisture contents.

12. The dry density plotted versus moisture contents.

V. RESULTS AND DISCUSSIONS

The results of laboratory investigation are presented in this section. As the tests were designed systematically the effect of each fibre parameter can be observed in this study. The first engineering graph is related to effect of fibre dosage on compaction curve of composite soil. Respectively, second part is focused on effect of fibre length (aspect ratio) on soil composite compaction characteristics.

The results from laboratory compaction test was interpreted and figure 3 shows the effect of fibre content on maximum dry density and optimum moisture content while the fibre length kept constant at 15mm. Respectively, figure 4 indicates effect of fibre length on maximum dry density and optimum moisture content while the fibre content is constant at 0.5%.

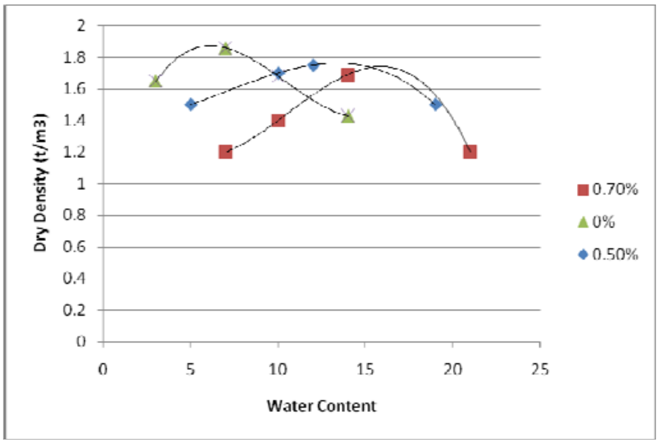

Fig. 3 Effect of fibre content on compaction curve (fibre length 15mm)

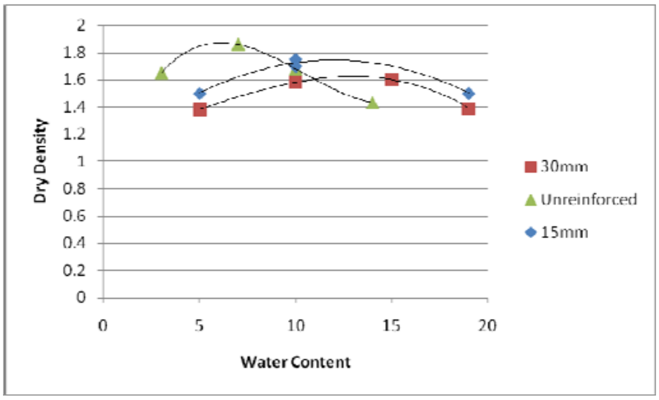

Fig. 4 Effect of fibre length on compaction curve (fibre content 0.5%)

VI. Conclusion

Compaction tests were conducted on composite clayey sand. This investigation proved that:

- Maximum dry density showed slight decrease due to induction of fibre
- Optimum Moisture Content (OMC) increased with increasing in fibre content
- Increasing in compaction effort causes increasing maximum dry density, this fact was observed for composite soil as well.
- Natural fibre showed to be good material to be used in practical projects

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