International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 30, Issue 02, Quarter 02 (April to June 2018)
ISSN (Online): 2347-601X
www.ijemhs.com

Study of Consolidation Characteristics of Fiber Reinforced Cohesive Soil

Nilambari Panda
Aryan Institute of Engineering & Technology, Bhubaneswar

ABSTRACT

Clay soils and their connected strange conduct like exorbitant shrinkage, expanding, solidification settlement and breaking on drying has been the subject of numerous examinations. Lately, an expanding need is being felt for different sorts of developments in minimal, low or recovered grounds and seaside regions which are not reasonable regularly for development purposes. Clays, notable for its high compressibility and helpless shear strength, represent various issues to manufacturers. Past investigations for the most part assessed the impacts of added substances like lime, concrete and sand on these attributes of clays. Starting outcomes demonstrated that the dirt qualities were improved. Be that as it may, allegedly by and large, these added substances brought about a diminishing in pliancy and expansion in water driven conductivity. Therefore, there has been a developing interest in soil/fiber support. The current examination has zeroed in on the effect of short arbitrary fiber incorporation on combination settlement in compacted clays. To inspect the potential enhancements in the combination attributes, nearby clayey soil was built up with irregular circulation of polypropylene (engineered) and coir (regular) filaments as rate (0-1% at an augmentation of 0.2%) of dry load of soil with 10, 15 and 20 mm lengths. Results demonstrated that the pressure record and coefficient of volume change decline with consideration of polypropylene/coir strands in the dirt up to certain fiber content and increment from there on. The coefficient of union increments with expansion in fiber content and fiber length in the scope of strands considered in the examination. Hence, the time needed to accomplish essential combination diminishes for fiber-built up soil for a given level of solidification and a given waste way.

KEYWORDS: Aspect ratio, polypropylene fibers, coir fibers, consolidation test, void ratio, compression index

INTRODUCTION

Reinforced soil is one of the techniques of ground improvement, the concept of which was first given by Vidal of France in 1966. Since then significant advances have been made in the design and construction of geotechnical structures such as retaining walls, foundations, embankments, pavements, etc. The function of the reinforcements in the soil matrix is to increase the strength (shearing resistance) and reduce the deformation. The primary advantages of randomly distributed fibers are the absence of potential planes of weakness that can develop parallel to oriented reinforcement (Maher and Gray 1990).

Many investigators have worked on reinforced soil using synthetic as well as natural fibers. Notable among them are Ranjan *et al.* (1994), Charan *et al*. (1995), Gregory (1999), Kumar et al. (1999), Prabhakar and Sridhar (2002), Zornberg (2002), Consoli *et al*. (2003), Cyrus and Babu (2005), Sivakumar and Vasudevan (2005), Kumar *et al*. (2005), Nagrale *et al*. (2005), Marandi *et al*. (2008), Jadhao and Nagarnaik (2008), Ramesh *et al*. (2010) and Pradhan *et al*. (2012). Both clayey and sandy soils have been used including fly ash.

As more and more land becomes subjected to urban and/or industrial development, sites with good foundation soil, suitable for building activities are difficult to find. In recent years, an increasing need is being felt for various types of construction in marginal, low or reclaimed lands and coastal areas which are not suitable normally for construction purposes. The high compressibility and poor shear strength of cohesive soil poses numerous problems to civil engineers while constructing buildings and embankments on such deposits.

Cyrus and Babu (2005) studied the compressibility behaviour of Cochin marine clays (CH) with inclusion of randomly distributed coir fibers of 10 mm long. The fiber contents were 0.5, 0.8, 1 and 2 percent by dry weight of soil. Specimens were tested at pressures of 6.25, 12.5, 25, 50, 100, 200, 400, & 800 kPa. They reported that the compressibility of clay reinforced with coir is appreciably less than the untreated clays. Compression index values decreased with increase in coir fiber content up to 0.8% and then a reverse in trend was seen at higher percentages. They also reported that the variation of coefficient of consolidation of Cochin marine clay with coir showed that the rate of settlement had an increasing trend till coir fiber content up to 0.8%.

Abdi *et al*. (2008) studied the consolidation settlement and swelling characteristics of clays with inclusion of 5, 10, and 15 mm polypropylene fibers at fiber content of 1, 2, 4 and 8% by weight of dry soil. They concluded that addition of randomly distributed polypropylene fibers resulted in substantially reducing the consolidation settlement of the clay soil. Length of fibers had an insignificant effect on this soil characteristic, whereas fiber contents proved more influential and effective. Inclusion of polypropylene fibers to the clay soil resulted in reducing the amount of swelling after unloading. The effect was proportional to the fiber content. But at constant fiber contents, the amount of swelling was not significantly affected by increasing fiber length.

Viswanadham *et al.* (2009) studied the swelling behavior of a geofiber-reinforced expansive soil (CH) with random inclusion of polypropylene fiber of width of 2 mm and thickness of about 0.021 mm. The fiber content was varied as 0.25% and 0.50% by dry weight of expansive soil and the aspect ratio l/b of the fibers was varied as 15, 30 and 45. The specimens (soil–fiber blends) were statically compacted at OMC and MDD in the oedometer of 75 mm diameter and 25 mm high in five layers, each of thickness 5 mm, to ensure uniform dry density. They conducted the swell-consolidation tests on oedometer specimens and reported reduction in heave in the reinforced specimens. Heave was reduced more at lower aspect ratios than at higher aspect ratios. Swelling decreased with increasing fiber content for all aspect ratios. Swelling pressure also decreased in the case of fiber-reinforced samples. While the swelling pressure was 105 kPa for unreinforced sample, it was equal to 90 kPa, 85 kPa and 98 kPa, respectively, for fiber-reinforced samples at l/b = 15, 30 and 45.

Kar and Pradhan (2011) studied the strength and compressibility characteristics of local cohesive soil (CL) with random inclusion of both polypropylene and coir fibers and observed that compression index as well as the coefficient of volume change decreased with increase in the fiber content. The coefficient of consolidation increased with increase in fiber content.

In the background of the above studies made by different investigators, this paper attempts to present results of consolidation characteristics carried out in local cohesive soil (CL) with random inclusion of polypropylene (synthetic) as well as coir (natural) fibers.

CONCLUSIONS

Based on the results and discussions the following conclusions are drawn.

The compression index (C_c) decreases with inclusion of polypropylene/coir fibers in the soil up to certain fiber content and increases thereafter. Thus, minimum C_c value is observed at fiber contents of 0.6% and 0.8% for soil reinforced with polypropylene and coir fibers respectively. The coefficient of volume change (m_v) also decreases with increase in fiber content up to 0.4% for polypropylene fibers and 0.6% for coir fibers and increases thereafter.

The coefficient of consolidation (Cv) increases with increase in fiber content and fiber length in the range of fibers considered in the investigation. But, the rate of increment is more for polypropylene fibers. Thus, the time required to achieve primary consolidation decreases for fiber-reinforced soil for a given degree of consolidation and a given drainage path.

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