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Investigation of Strength Parameters of PVA Fiber-Reinforced Fly Ash-Soil Mixtures in Large-Scale Direct Shear Apparatus

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Abstract

Soil reinforcement is an old and still efficient technique in improving soil strength and stiffness properties. Current paper aims at quantifying the effects of different inclusions on mechanical behavior of fiber-reinforced cemented soil. An experimental program was conducted to study simultaneous effects of randomly oriented fiber inclusions and cement stabilization on the geotechnical characteristics of fly ash-soil mixtures. Chamkhaleh sand, polyvinyl alcohol (PVA) fiber, cement and fly ash with some water were mixed and compacted into large scale direct shear apparatus with three equal layers. PVA fibers were randomly distributed in three compacted layers at predetermined weight contents. Direct shear tests were carried out on fly ash-soil specimens prepared with different cement, fly ash and polyvinyl alcohol contents, and 7 different curing periods. Results show that cement increases the strength of the raw fly ash-soil specimens. The fiber inclusion further increases the strength of the cemented and uncemented soil specimens and transforms their brittle behavior to ductile behavior. The fiber reinforcement and distribution throughout the entire specimen results in a significant increase in the strength of fly ash -soil- cement mixtures.

Keywords: Chamkhaleh Sand; Polyvinyl Alcohol (PVA) Fiber; Cement; Fly Ash; Large Scale Direct Shear Apparatus.

1. Introduction

Construction of buildings and other civil engineering structures on weak or soft soils can be highly risky because such types of soils are susceptible to differential settlements due to their poor shear strength and high compressibility. Improvement of certain desired properties like bearing capacity, shear strength and permeability characteristics of soils can be undertaken by a variety of ground improvement techniques such as densification, reinforcement and stabilization.

Recently, engineers are showing more interest in using various types of materials in civil engineering applications to achieve better performance, diminish project costs, facilitate and expedite the program and more than these, to have more environmentally-friendly and strengthened construction scheme. Soils can be reinforced either by inclusion of bars, sheets and strips within a soil mass known as systematically reinforced soils or randomly addition of discrete fibers into a soil fill. Use of natural fibers can be attributed to ancient times. However, nowadays, use of randomly distributed fiber reinforcement techniques has been particularly paid attention to.

Randomly distributed fiber reinforced soils have shown to be superior to those systematically reinforced ones. Apart from being economic and causing significant growth in bearing capacity, soil mechanical properties, tensile and shear

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