Effects of Fiber on Swell of Expansive Soils

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ABSTRACT

One-dimensional odometer swell tests were conducted to investigate the effects of geo-fiber on swelling characteristics of expansive soils from Saudi Arabia. Samples were prepared with varying fiber contents (0.25%, 0.50%, 0.75%, and 1.0%) by dry weight of the expansive soil. Replicate tests were performed to ascertain the variations in test results, if any. It was observed that there was practically no variation in the results of the replicate tests. In addition to the swell tests, unconfined compression tests were performed to study the effects of geo-fiber on unconfined compressive strength of the tested soil. Test results indicated that the addition of fiber reduced the free swell percentage and swelling pressure of the tested soil. As the fiber content increased, both the swell percentage and swelling pressure of the expansive soil decreased. The unconfined compressive strength was increased by increasing fiber content for soils compacted at the same dry density and water content.

KEYWORDS: Expansive soil; swelling pressure; stabilization; polypropylene fiber; unconfined compressive strength

INTRODUCTION

Expansive soils are soils which exhibit volume changes due to variations in moisture contents. Expansive soils spread out over a large area of the world. These soils exhibit large amounts of swell and shrinkage due to environmental and seasonal moisture changes. Thus, the related soil's movements seriously cause many structures built on them to damage. Damages to structures from the swell of foundation soils due to change in moisture conditions are common problems that occur frequently in many parts of the world including vast areas of the Kingdom of Saudi Arabia. Damages inflicted on superstructures by expansive soils each year are enormous. Although there has been no precise estimate, annually in Saudi Arabia, expansive soils are responsible for millions of dollars worth of damage to man-made structures (Ruwaih, 1987; Dhowian et al., 1990). The annual cost of damage is estimated at several billions of dollars worldwide (Nelson and Miller 1992). Damages can range from minor cracking of pavement or interior finishes in buildings, which is very common, to significant displacement of footings and superstructure elements. It is estimated that expansive soils cover an area of about 800,000 km² in the Kingdom (Ruwaih, 1987: Fig. 1). Expansive soils are encountered over a large area due to geological history, sedimentation, and climatic conditions (Slater, 1983).

Fig. 1. Map of the Kingdom of Saudi Arabia showing the distribution of the expansive formations (adapted from Ruwaih, 1987).

Several treatment methods to stabilize expansive soils and to reduce damage effects of expansive soils have been developed. These methods include replacement of expansive soils with non-expansive soils,