Investigation on Experimental Analysis of the Effect of Geocell on the Load-Settlement Behavior of Dredged Sand in Shahid Rajaee Port

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Received: 26 July 2017 Accepted: 25 Sep. 2017

Extended Abstract

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Introduction

In some ports, the dredging and accumulation of a large amount of sedimentary material turned to a serious challenge, because of their sequent environmental and economic effects. These problems clarify the necessity of reusing dredged materials. Often, owing to their poor mechanical properties, they are not applied directly in technically engineering uses, so they require to be improved. Geocell application is one of the methods used for the improvement of soil behavior, which confines the sand mass through itself in the three-dimensional structure. These methods ease the speed of applying emerged it into a perfect option for stabilizing of the granular soil.

In Shahid Rajaee port, by the dredging process for developing new phases, a large amount of calcareous sand is being accumulated near the Persian Gulf coastline. Therefore, in order to provide a solution to reuse these materials, this study attempts to investigate the beneficial influence of reinforcing sand by geocell on its load-beneficial behavior experimented by the plat loading test. For this purpose, a large scale model including circular foundation on reinforced and unreinforced sand has been employed under cyclic loading process.

Material and Methods

Soils

Two types of soils were used in this study. The first type was the sand derived from the dredging process of Shahid Rajaee port which has been used in different layers of the models. The second type of soil was well-graded gravel which has been used only in the cover layer.

Geocell

The geocell in this study were made of heat-bonded non-woven polypropylene geotextiles. Single cells were 110 mm long, 100 mm wide and 100 mm height.

Plate load test

In order to determine the bearing capacity of backfills, repeating plate load test was used with 150 mm diameter. Loading process included four stress levels (250, 500, 750 and 1000 kPa) consisting of 10 cycles each.

Test backfills

Four backfills was made by manually compacting the dredged sand, with tamper up to 350 mm in reinforced cases and 450 mm in unreinforced cases. Then geocells placed and dredged sand filled with accuracy in cells. Finally, a 50 mm thick sand or gravel cover layer, was placed. All lifts were compacted to 70% of relative density with 4% moisture content.

Results and Discussion

PLT results are summarized in Table 1. According to the results, only geocell reinforcement backfills can carry standard truck wheel load (550 kPa). Geocell can increase the ultimate strength of backfills with a sand cover layer by 70% (from 416 kPa to 725 kPa) while in backfill with a gravel cover layer showed 80% increase (from 520 kPa to 960 kPa) in ultimate strength. The gravel cover layer in unreinforced backfills increases the ultimate strength by 25 percent (from 416 kPa to 520 kPa).

Table 1. Results of PLT and performance ratings

Backfill name	UR-S	GR-S	UR-W	GR-W
Maximum stress (kPa)	416	725	520	960
Settlement at failure (mm)	4.6	9.0	15.5	14.9
Plastic settlement (mm)	3.5	7.0	12.5	12.0
Number of load cycles	10	20	20	30
Bearing capacity ratio (BCR)	1	1.74	1.25	2.32
Performance rating	4	2	3	1

Base on Table 1, bearing capacity ratio (BCR) has been increased up to 2.3 and has best when geocell reinforcement and gravel cover layer were used together. Geocell utilization as reinforcement for sand backfills, improves the stress-settlement behavior. Dredged sand can be used as backfill material for yards and access roads when reinforced with geocell and covered with a layer of well-graded gravel.

Key words: Geocell, Plate loading test, dredged sand, load-settlement behavior

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