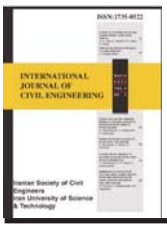

International Journal of Civil Engineering

Geotechnical Engineering

Strip footing behavior on reinforced sand with void subjected to repeated loading

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Received: January 2011, Accepted: August 2011

Abstract

This paper describes a series of laboratory model tests on strip footings supported on unreinforced and geogrid-reinforced sand with an inside void. The footing is subjected to a combination of static and cyclic loading. The influence of various parameters including the embedment depth of the void, the number of reinforcement layers, and the amplitude of cyclic load were studied. The results show that the footing settlement due to repeated loading increased when the void existed in the failure zone of the footing and decreased with increasing the void vertical distance from the footing bottom and with increasing the reinforcement layers beneath the footing. For a specified amplitude of repeated load, the footing settlement is comparable for reinforced sand, thicker soil layer over the void and much improved the settlement of unreinforced sand without void. In general, the results indicate that, the reinforced soil-footing system with sufficient geogride-reinforcement and void embedment depth behaves much stiffer and thus carries greater loading with lower settlement compared with unreinforced soil in the absent of void and can eliminate the adverse effect of the void on the footing behavior. The final footing settlement under repeated cyclic loading becomes about 4 times with respect to the footing settlement under static loading at the same magnitude of load applied.

Keywords: Repeated loads; Void; Geogrid reinforcement; Laboratory test; Strip footing; Footing settlement

1. Introduction

Underground voids located in the failure zone of the footing can cause serious engineering problem leading to instability of the foundation and severe damage to the superstructure. If the void is located below the footing at shallower depth, the consequence can be very costly and dangerous. They may occur as a result of settlement of poorly compacted trench backfill; natural caves, tunnels, pipes, water and gas networks and old conduits. Because of the population growth and increasing demand for extending the urban outspread to the areas that might have previously undergone mining operations, the mining cavities (voids and old conduits) are becoming a growing concern for geotechnical engineers dealing with foundation stability issues, especially above soft ground beds.

Many researchers have studied the performance of footing on unreinforced soil with void under static loads [1- 4]. Badie and Wang [2] performed a theoretical and experimental analysis on a model footing above clayey soil to investigate the stability of spread footings situated above a continuous void. The results of this study implied that there is a critical region under the footing and only when the void is located within that critical region, the bearing capacity of the footing varies considerably with the void location. When the stability and load-carrying characteristics of footing are affected by void, various alternatives such as filling the void with competent material; using piles to transmit the load to an acceptable soil or rocks at the bottom of the void; and relocation of the foundation so that it is placed away from the void may be considered. Among these, the footing relocation is relatively easy and costly justified. However, it is only practical if sufficient space is available. Other alternatives may be considerably expensive or impossible and infeasible for the existing conditions.

In recent decades, due to ease of construction and ability to improve load-carrying characteristics under static loads, geosynthetics reinforced soil has been widely of interest to geotechnical engineers in various applications [5-21].

Theoretical and experimental studies have been carried out on dynamic characteristics of shallow foundations supported on unreinforced soil to discover the role of load

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