Geotextiles and Geomembranes 28 (2010) 72–84

Contents lists available at ScienceDirect

Geotextiles and Geomembranes

journal homepage: www.elsevier.com/locate/geotexmem

Comparison of bearing capacity of a strip footing on sand with geocell and with planar forms of geotextile reinforcement

S.N. Moghaddas Tafreshi [a,*], A.R. Dawson [b,1]

[a] Department of Civil Engineering, K.N. Toosi University of Technology, Valiasr St., Mirdamad Cr., Tehran, Iran
[b] Nottingham Transportation Engineering Centre, University of Nottingham, Nottingham, UK

ARTICLE INFO

Article history:
Received 7 March 2009
Received in revised form
4 July 2009
Accepted 18 September 2009
Available online 9 December 2009

Keywords:
Experimental model test
Bearing pressure
Strip footing
Reinforced sand
Reduction in footing settlement
Geocell

ABSTRACT

Comprehensive results from laboratory model tests on strip footings supported on the geocell and planar reinforced sand beds with the same characteristics of geotextile are presented. The various parameters studied in this testing program include the reinforcement width, the number of planar layers of geotextile and height of the geocell below the footing base. Contrary to other researches, the performance of the geocell and planar reinforcement is investigated at the range of low to medium settlement level, similar to those of interest in practice. The results show that the efficiency of reinforcement was decreased by increasing the number of the planar reinforcement layers, the height of the geocell reinforcement and the reinforcement width. For the same mass of geotextile material used in the tests at the settlement level of 4%, the maximum improvement in bearing capacity (IF) and percentage reduction in footing settlement (PRS) were obtained as 2.73 and 63% with the provision of geocell, respectively, while these values compare with 1.88 and 47% for the equivalent planar reinforcement. On the whole, the results indicate that, for the same quantity of geotextile material, the geocell reinforcement system behaves much stiffer and carries greater loading and settles less than does the equivalent planar reinforcement system. Therefore, a specified improvement in bearing pressure and footing settlement can be achieved using a lesser quantity of geocell material compared to planar geotextile.

1. Introduction

Geosynthetic materials have been widely used in geotechnical engineering applications for, e.g., longer-lasting road construction layers, stable embankments over soft soil and expedient access over soft ground. An additional, possible, use would be to improve the bearing capacity of footings, but, at present, this application is made difficult because of the limited knowledge on the load-settlement behaviour of footings on reinforced soils. To investigate such applications, researchers have undertaken many studies to investigate how best to arrange effective reinforcement. For example, Yoon et al. (2004), Ghosh et al. (2005), Patra et al. (2005, 2006) used model tests to study the influence of different types of reinforcement on the bearing capacity and settlement of the footing. They confirmed the beneficial effect of reinforcement on the enhancement of bearing capacity and reduction in settlement of footing. Hufenus et al. (2006) carried out full-scale field tests on a geosynthetic reinforced unpaved road to investigate the reinforcing effect on the bearing capacity and its performance on a soft subgrade. The various geosynthetics used for this reinforced unpaved road were found to have a relevant reinforcing effect only when used under a thin aggregated layer on a soft subgrade. El Sawwaf (2007) investigated the behaviour of strip footings on geogrid reinforced sand over a soft clay slope. Test results indicated that the inclusion of geogrid layers in the replaced sand not only significantly improves the footing performance but also leads to a great reduction in the depth of the reinforced sand layer that is required to achieve the allowable settlement. Moghaddas Tafreshi and Khalaj, (2008) performed an experimental study to investigate the beneficial effect of geogrid on the deformation of small diameter pipes and on the settlement of the soil surface when subjected to repeated loads that simulated vehicle loading. They reported that the percent of vertical diameter change and settlement of soil surface can be reduced significantly by using geogrid reinforcement.

Although planar geotextiles and geogrids have most often been studied, several investigations have also highlighted the beneficial use of geocell reinforcement in the construction of foundations and

* Corresponding author. Tel.: +98 21 8877 9473; fax: +98 21 8877 9476.
E-mail addresses: nas_moghaddas@kntu.ac.ir (S.N. Moghaddas Tafreshi), andrew.dawson@nottingham.ac.uk (A.R. Dawson).
[1] Tel.: +44 115 951 3902; fax: +44 115 951 3909.

0266-1144/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.geotexmem.2009.09.003