# *OHN10102790139*
# *Determination of the shallow footings settlement resting on a Geocell reinforced soil: Analytical solution*

***Nasser Valinezhad[1], Mahmoud Ghazavi[2]***
***1- PhD candidate in Geotechnical Engineering, K. N. Toosi University of Technology***
***2- Associate professor of Civil Engineering, K. N. Toosi University of Technology***
*ns.valinezhad@gmail.com*

***Abstract***
*Geocell can be used as a reinforcement to increase bearing capacity of a soil foundation and reduce its settlements due to its cellular structure. A generalized analytical model is presented for determination of footing settlement on a subgrade soil idealized as a linear elastic layer. The geocell layer could be considered as a beam. A forth order ordinary differential equation (ODE) is derived and solved according to appropriate boundary conditions using Laplace transform. The results have a well coincidence with available data published in the literature. Parametric studies have then been performed to demonstrate the effect of contributing parameters such as modulus of subgrade reaction, geocell layer width and height and geocell mattress shear modulus on footing response.*
***Keywords: Geocell reinforcement, Laplace transform, Analytical solution, Closed form formulation***

## *1. INTRODUCTION*

*The term geocell is a generic term describing a class of geosynthetic products manufactured from thin strips of high density polyethylene HDPE material which are interconnected to form a three-dimensional honeycombed structure. It can be filled with compacted soil. The effect of cellular confinement on the infill soil is to increase the stiffness and strength of the confined soil. Also the footing pressure is redistributed by geocell mattress over a wider area. Thus the composite geocell-soil layer in several applications has been demonstrated to act as a stiffened mat that provides greater load bearing capacity and stiffness than the same granular base constructed without cellular confinement [1].*

*Most of the research work on geocell reinforced foundations, [2, 3, 4], deals with the bearing capacity of geocell reinforcement. However, in the design of foundations, settlement should also be controlled. Therefore, a simple general method which considers these two simultaneously is required.*

*The exhaustiveness of a given model in simulation depends on the nature of simplifying assumptions it makes. Hereupon, despite the availability of a variety of finite element based software for modeling shallow footings, there is still interest among users in analytical subgrade models, particularly to analyze beams on elastic foundations [5-12].*

*Analytical subgrade models are commonly developed following two approaches: continuum and mechanical. This paper presents a new approach of mechanical modeling by addressing a state-of-the-art solution for governing differential equation by the use of Laplace transform. The model uses an improvement to the Winkler foundation model which is made by Pasternak [13]. Here the geocell reinforced soil layer is assumed as a beam subjected to the footing pressure. According to experimental studies on geocell reinforced sand, pressure–settlement responses corresponding to reinforced beds were found to be much stiffer in comparison with unreinforced case and indicate a linear pattern at low displacements [4, 14]. Thus, it is rational to assume linear behavior for the sand within the geocell pocket [15]. In this paper linear variation of load-settlement pattern is only presented.*

## *2. ANALYSIS PROCEDURE*

*Pasternak foundation allows the traverse connection in the supporting subgrade or sub-base layer of a beam to be considered in addition to the modulus of subgrade reaction. This model has a very clear physical meaning and can be applied conveniently. According to Pasternak [13], the expression relating the pressure and corresponding deflection of the foundation surface is as follows:*