Geomechanics and Engineering, *Vol. 8, No. 6 (2015) 845-857*
DOI: http://dx.doi.org/10.12989/gae.2015.8.6.845

3D analytical method for mat foundations considering coupled soil springs

Jaehwan Lee, Sangseom Jeong * and Joon Kyu Lee

Department of Civil and Environmental Engineering, Yonsei University, 50 Yonsei-ro, Seodaemun-gu, Seoul 120-749, Republic of Korea

(*Received June 24, 2014, Revised January 07, 2015, Accepted February 27, 2015*)

Abstract. The 3D numerical analysis is carried out to investigate the settlement behavior of flexible mat foundations subjected to vertical loads. Special attention is given to the improved analytical method (YS-MAT) that reflects the mat flexibility and soil spring coupling effect. The soil model captures the stiffness of the soil springs as well as the shear interaction between the soil springs. The proposed method has been validated by comparing the results with other numerical approaches and field measurements on mat foundation. Through comparative studies, the proposed analytical method was in relatively good agreement with them and capable of predicting the behavior of the mat foundations.

Keywords: soil-structure interaction; mat foundation; soil spring; coupling effect; settlement

1. Introduction

Mat foundations are usually used as a load distributing element supported by piles or directly placed on soils or rocks having sufficient load-carrying capacity. The mat foundations are cost-effective, with savings up to 20% of the total cost, compared to deep foundations (Briaud 1993).

The structure part of mat foundation can be modelled as a flexible or a rigid plate. The conventional rigid method has been used for practical design of mat foundation. This method assumes a mat to be a rigid body, which does not consider the mat flexibility and the thickness would have to be greater. Also, even very thick ones deflect when loaded by the superstructure loads (Bowles 1997). Alternatively, mat foundation can be designed as the flexible plate. The flexible theory of plates can be categorized as the thin and thick plate theory. In practice, there are two main approaches to model the soil beneath the shallow foundation. These models are known as the Winkler model and the continuum model which makes use of the FE analysis (Dutta and Rana 2002, Colasanti and Horvath 2010).

The continuum model is computationally difficult to exercise and requires extensive training because of the three-dimensional and nonlinear nature of the problem. Also the time consuming, both in modelling and computation, can be exhausting. However, the Winkler model is relatively easy and simple to exercise. For the design and analysis of the flexible mat foundation, the

*Corresponding author, Professor, E-mail: soj9081@yonsei.ac.kr

http://www.techno-press.org/?journal=gae&subpage=7 ISSN: 2005-307X (Print), 2092-6219 (Online)