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Size effect of foundation on modulus of sub grade reaction in clayey soil

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Abstract

In the practical design procedure, use of Terzaghi equation to determine the modulus of sub grade reaction for exact foundation is common, but there are some uncertainties in utilizing such equation. In this paper the effect of size of foundation on clayey sub grade with use of finite element software (Plaxis 3D) is proposed to investigate the validation of Terzaghis formulation on determination of sub grade reaction modulus. Also the comparison between Vesics proposed equation, Terzaghis one and obtained results are presented.

Keywords: Winkler model, Modulus of subgrade reaction, Terzaghis equation, Foundation, Plate load test

1. Introduction

Soil medium has very complex and erratic mechanical behavior, because of the nonlinear, stress-dependant, anisotropic and heterogeneous nature of it. Hence, instead of modeling the subsoil in its three-dimensional nature, subgrade is replaced by a much simpler system called a subgrade model that dates back to the nineteenth century. The search in this context leads to two basic approaches which are Winkler approach and the elastic continuum model are of widespread use, both in theory and engineering practice.

Winkler [10] was assumed the soil medium as a system of identical but mutually independent, closely spaced, discrete and linearly elastic springs and ratio between contact pressure, P, at any given point and settlement, y, produced by load application at that point, is given by the coefficient of subgrade reaction, ks :

$$K_s = \frac{P}{y} \qquad (1)$$

In fact, in this model subsoil is replaced by fictitious springs whose stiffness equal to ks. However, the simplifying assumptions which this approach is based on cause some approximations. One of the basic limitations of it lies in the fact that this model cannot transmit the shear stresses which are derived from the lack of spring coupling. Also, linear stress-strain behavior is assumed. The coefficient of subgrade reaction, ks, identifies the characteristics of foundation supporting and has a dimension of force per length cubed.

Many researches like Biot [2], Terzaghi [8], Vesic [9] and Vallabhan et al[1].... have investigated about the effective factors and determination approaches of ks. Geometry and dimensions of the foundation and soil layering are assigned to be the most important effective parameters on ks. In generally, the value of subgrade modulus can be obtained in the following alternative approaches:
1- Plate load test, 2- Consolidation test, 3- Triaxial test, 4- CBR test

Many researchers have worked to develop a technique to evaluate the modulus of subgrade reaction, Ks. Terzaghi [8] made some recommendations where he suggested values of K for 1*1 ft rigid slab placed on a soil medium; however, the implementation or procedure to compute a value of K for use in a larger slab was not specific. Biot [2] solved the problem for an infinite beam with a concentrated load resting on a 3D elastic soil continuum. He found a correlation of the continuum elastic theory and Winkler model where the maximum moments in the beam are equated. Vesic [9] tried o develop a value for K, except, instead of matching bending