Evaluation of passive lateral earth pressure on retaining walls by the Zero Extension Lines method

Amin Keshavarz[1], Zahra Pooresmaeil[2]

1- Assistant professor, School of Engineering, Persian Gulf University, Bushehr, Iran
2- Graduate Student, School of Engineering, Persian Gulf University, Bushehr, Iran

keshavarz@pgu.ac.ir
zpooresmaeil@pgu.ac.ir

Abstract

Stability of retaining walls is a concern for geotechnical engineers. In this paper, the Zero Extension Lines (ZEL) method has been used to assess the stability of retaining walls in passive case. The backfill soil is considered a non-cohesive soil. The equilibrium equations along the zero extension lines have been solved by the finite difference method. A computer code is prepared to calculate the ZEL net and the distribution of the passive lateral earth pressure behind the retaining wall. For associative soil where the friction and dilation angles are equal, the results are the same as the stress characteristics method. The effects of dilation angle on the passive earth pressure coefficient and failure zone have been evaluated.

Keywords: Zero Extension Lines, Passive lateral earth pressure, Retaining Walls

1.   Introduction

Retaining walls are structures used to prevent soil or other granular materials from lateral sliding. Stability of these structures is an important issue in geotechnical engineering. In order to study the stability of the retaining walls, different methods are provided to evaluate lateral earth pressure in passive case. Rankin and Coulomb are the common methods to evaluate the lateral earth pressure.

Zero Extension Lines (ZEL) method is a good method for the stability analysis of retaining walls. This method was first used by Roscoe to solve static and dynamic problems of retaining walls [1]. In 1971, James and Bransby used ZEL method to predict the strain patterns behind retaining walls [2]. ZEL method has been used to study the stability of several types of geotechnical structures, such as the stability of slopes [3, 4], the bearing capacity of footings and evaluation of static and dynamic lateral earth pressure [5, 6]. Furthermore, this method has been used to predict the behavior of dense frictional soils [7] and load-displacement behavior of foundations [8]. Veiskarami et al. has been used this method to predict the bearing capacity of foundations considering the stress level effect [9, 10].

This method analyzes geotechnical problems in the strain field. The soil can be assumed as associative or non-associative. ZEL method is similar to stress characteristics or slip lines method. In the stress characteristics method, the soil is assumed as associated soil, i.e. the friction angle of the soil is equal to its dilation angle. ZEL method has the capability of considering the soil as non-associative soil.

In this paper, ZEL method has been used to evaluate the lateral earth pressure behind retaining walls in passive case. After solving the problem, the ZEL net has been calculated and the distribution of lateral earth pressure behind retaining walls can be obtained.

2.   Theory

2.1   The equilibrium equations