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Static Response of Reinforced Soil Retaining Walls with Modular Block Facing

Morteza Sabet[1], Amir M. Halabian [2], Kazem Barkhordari [3]

1 Graduate Student, Department of Civil Engineering, Yazd University
2 Assistant Professor, Department of Civil Engineering, Isfahan University of Technology
3 Assistant Professor, Department of Civil Engineering, Yazd University

Morteza.sabet@gmail.com
Mahdi@iut.ac.ir
Kbarkhordari@yazduni.ac.ir

Abstract

Effect of backfill compaction, reinforcement connection type, geogrid-soil interface properties, and facing inclination on static response of Geosynthetic Reinforced Soil Walls (GRSW), was investigated using finite difference method. The numerical simulation of wall was included sequential construction of the wall. Backfill soil was modeled with Elastic-plastic Mohr–Coulomb model and modular block was modeled with elastic model. Results include the facing displacement, maximum load reinforcement and lateral earth pressure. Numerical results show the magnitude of lateral displacement decrease with increasing facing inclination and compaction load, the maximum reinforcement load increased significantly with an increase in compaction load. It was found that finite difference procedure was able to simulate the static response of GRS wall very well.

Keywords: Reinforced soil walls, Numerical models, Reinforcement, FLAC 3D

1. INTRODUCTION

GRS structures are cost effective alternatives for the most applications where the reinforced concrete or gravity type walls have traditionally been used to retain soil. The performance, economics and expediency of construction of these reinforced walls made them popular. In the USA they have been demonstrated to be 50 percent of the cost of traditional concrete gravity structures [1]. So the reinforced soil walls have been the subject of some researches, and many researchers have examined the effect of different parameters on the design of reinforced walls. Current practice consists of determining the geometric and reinforcement requirements to prevent internal and external failure using limit equilibrium methods of analysis. Many conducted researches have shown that the current limit equilibrium-based analysis methods over-estimate reinforcement forces under operational conditions [2]. In the limit equilibrium methods reinforcement load is calculated from classic active earth pressure theories such as Rankine or Coulomb earth pressure theory [3]. The Federal Highway Administration provides design guidelines for a variety of mechanically stabilized earth (MSE) walls. It introduces the same computational scheme for all wall systems, including metallic and polymeric reinforcement, using empirical parameters to adjust for the specific properties of each system. It means that the geogrid-soil interface properties, reinforcement connection type, reinforcement stiffness and other factors have not been considered. Researches have shown using reinforcement with high stiffness layer will attract more load. Therefore, the possibility of exceeding the tensile strength for stiffer reinforcement layers should be examined.

In the field of retaining walls, previous studies focused on effect of wall and reinforcement geometry, mechanical properties of reinforcement and backfill soil. Effect of parameters such as backfill compaction, reinforcement connection type, geogrid-soil interface properties have often been ignored [4]. The objectives of this study were, at first, to verify numerical simulation conducted by other researchers, Then it was persuaded to identify static behavior of these walls and to investigating the effect of missing parameters on static response.

2. CALIBRATION

The finite difference model developed in this study was verified with the results of the model that employed by Huang et al. [5]. Huang et al. through a numerical study examined the effect of different constitutive soil models. The model geometry dimensions were shown in Fig 1. Properties of material and reinforcement were described in Table 1.