Radial Point Interpolation (RPIM) meshless method for analysis of soil nail walls

Noroozi.Behnam[1], Oliaei.Mohammad[2]

1- MSc student of geotechnical engineering- Tarbiat Modares University
2- Assistant professor of geotechnical engineering - Tarbiat Modares University
b.norozi@modares.ac.ir
M.Olyaei@modares.ac.ir
b.norozi@modares.ac.ir

Abstract

Soil nailing has been widely used as a reinforcing technique to retain excavations and stabilize slopes. The behavior of reinforced soil walls can be understood by studying the state of stress within the reinforced zone. Analysis and design of soil nail walls are usually done by using equilibrium methods. Several parameters influence the behavior of these structures. So that proper assessment of the interaction between the nails and the surrounding soil is very important for the safety and economical design of the composite reinforced soil structure which is not considered properly in typical design process.

The purpose of this study is to investigate soil-nail interface in finite element method with meshless method. In this article, RPIM meshless method is proposed for simulation of soil nail walls. Difficulties of methods related to mesh are solved by using this method, especially modeling of thin media, i.e. nail. A code has been developed based on this method and some examples are solved for analyzing the code.

Keywords: Soil nail walls, soil and nail interaction, Radial basis, point interpolation

1. INTRODUCTION

Soil nailing is a practical and proven technique used in constructing excavations and stabilizing slopes by reinforcing the ground in situ with relatively small, fully bonded inclusions, usually steel bars. These are introduced into the soil mass, the face of which has been locally stabilized by sprayed concrete and act to produce a zone of reinforced ground. Several parts of soil nailing is shown in Fig.1. Numerical simulations have been performed using different techniques by several researchers as the following: Finite Element Method (Zhou, Y., et al[1], Olia, A. and J. Liu[2], Singh et al[3]), Discrete element method (Kim et al[4]),Finite difference method (Babu et al[5]). However these methods have some deficiencies, such as the discontinuity of stresses on element boundaries, low accuracy at large deformation analysis or the weakness of these methods in the two dimensional modeling of thin media, i.e. nail. Therefore the authors have been encouraged to apply a new family of numerical methods, independent from mesh, for the analysis of soil nail walls. These new families of numerical methods are globally called mesh-free or meshless methods. Various meshless methods that have been proposed and achieved remarkable progress in recent years are listed in table 1.
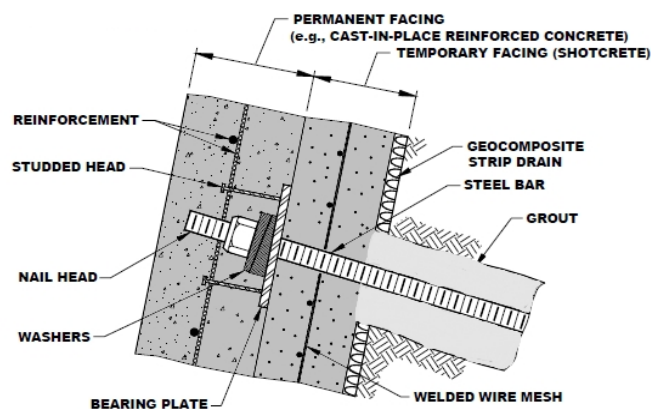

Fig.1.Parts of soil nailing[6]