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THE NONLINEAR ELASTIC–PLASTIC ANALYSIS OF JOINTED ROCK MASS USING ELEMENT FREE GALERKIN METHOD

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In this paper, the application of meshfree (Element Free Galerkin) method in analyzing the nonlinear and elastic-plastic behavior of jointed rock mass is presented. The domain is represented by a set of arbitrary distributed nodes and the essential boundary conditions are enforced using penalty method. Few examples, showing the effectiveness of the method in predicting the elastic–plastic behavior of jointed rocks are presented and the results are compared well with finite difference method.

Keywords: Nonlinear analysis; elastic–plastic analysis; jointed rock mass; meshless; element free Galerkin.

1. Introduction

Crack propagations and large deformations in jointed rock mass are common phenomena. It is required to model these behaviors properly as they involve large geometrical changes. Many numerical methods have been proposed for jointed rock mass such as Finite Element Method, Finite Difference Method, Joint Element, Boundary Element Method, Discrete Element Method, Discontinuous Deformation Analysis, Rigid Finite Element Method, and several other methods. These methods are mesh-based and require remeshing the domain in each step of the evolution as geometry changes. Consequently, mesh generation in each step of the evolution leads to degradation of accuracy and complexity in the computer program and it is also a time-consuming task. Thus, the mesh-based methods are not efficient for problems involving large deformation and crack propagation that require the continuous remeshing of the domain. Although several strategies have been developed to maintain a reasonable mesh shape, such as the Arbitrary Lagrangian–Eulerian (ALE) method, extra computational effort and difficulties are also introduced [Noh (1964)]. Over the past three decades, many researchers have come to realize that so-called meshless methods can be developed that eliminate the meshes and their