A CONTACT BAND ELEMENT AND ITS APPLICATION TO INTERFACES AND JOINTS SUBJECT TO LARGE SHEAR DEFORMATIONS

X. Wang[1*] and L. B. Wang[2]

1. Assistant Professor, Dept. of Civil and Environmental Engineering, Louisiana Tech University, Ruston, LA 71272 (corresponding author), E-mail: xwang@latech.edu
2. Associate Professor, Dept. of Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

Abstract

It is presently a concern and challenge to numerically model shear band localization. Many numerical methods have been developed to take into account the strain and displacement discontinuities across a shear band. In this paper, a contact band element method is proposed to model the shear band with a finite thickness under large shear deformation [3]. The shear band elements, alternatively called contact band elements, are continuously updated based on the currently configurations to prevent the large distortion of conventional finite elements and maintain realistic shear band configuration. The contact band element method, with a technique for the special shear band element, consists of the schemes to keep the shear band elements in good shapes, handle the band overlapping, kinking and separation problems [2].

As an application, the contact band element is utilized to model an interface or joint subject to large shear deformation in this paper [1]. In the proposed algorithm, continuous interface elements with a finite thickness are reconstructed at every load step based on current interface configuration, by employing the concept of contact band element. Special strain expressions for the continuous interface elements are derived with regard to the characteristics of shear strain concentration along the interface. The elastic cross-anisotropic model with the special Mohr–Coulomb criterion is applied for the continuous interface elements in view of the anisotropy of interface materials. Simulation of a pullout test has shown that large pullout displacement and realistic structure configuration might be effectively modeled and smooth distributions of mobilized shear stresses along the interface and axial forces in the reinforcement can be obtained without any fluctuation for different interface element thicknesses. However, the stress and axial force distributions along the interfaces and the reinforcement, especially near left end of the reinforcement, vary with the interface thickness. It strongly implies that the continuous interface element with an appropriate thickness should be a good choice for a rock interface or joint with fillings in.

References

[1] X. Wang and L. B. Wang, “Continuous interface elements subject to large shear deformations”, the International Journal of Geomechanics, ASCE, 6(2), 2006 (in press).

[2] X. Wang, D. Chan and N. Morgenstern, “Kinematic modeling of shear band localization using discrete finite elements”, International Journal for Numerical and Analytical Methods in Geomechanics, 27(4), 289-324, 2003.

[3] X. Wang, D. Chan and N. Morgenstern, “Numerical modeling of shear bands by element bands”, International Journal for Numerical Methods in Engineering, 54, 1131-1159, 2002.

Key Words: Shear band localization, Contact band element, Special strain description, Pullout test