Load transfer in bolt bending

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Abstract

Load transfer is a basic aspect of reinforcement system behaviour, which has to be understood deeply in order to get a proper stability in surface and underground excavations. In terms of load transfer concept some parameters were studied such as different bolt profile, which has great influnce in transferring load from bolt through the resin to rock, strength of material and confining pressure at shear joint interface which was applied as pretensioning in bolt. Also these parameters were evaluated by 3D numerical simulation. It was found that strength of material, bolt profile and pretensioning have significant influence on load transfer.

Key words: grouted bolt, bolt pretensioning, shear stress, fully bonded

1- Introduction

Significant research have, in the past, been undertaken to study the mechanical behaviour of bolted rock joints, Spang and Egger [9], Pellet and Boulon [7], Ferrero [5]. Bjurstrom [2] was the first to report on the systematic research work on fully grouted rock bolts. His shear tests were conducted on fully cement grout bonded rock bolts embedded in blocks of granite. According to Bjurstrom, inclining the bolt resulted in stiffening the shearing surface by increasing the shear strength at small displacement. Digth [4] carried out a series of laboratory tests, to evaluate the shear resistance of bolted joints using various materials and he found that the normal stress acting on the joint surface had no influence on the shear resistance, which is not consistence with other researchers. Also, joints with inclined bolts were stiffer than the perpendicular ones. Dight [4] proposed an expression to predict the maximum force mobilized in the bolt. He found that failure of the bolt was caused by the combination of axial and shear forces. Ferrero [5] proposed a shear strength model for reinforced rock joints based on numerical modeling and laboratory tests. The overall strength of the reinforced joint was considered to be the combination of both the dowel effect and the incremental axial force increase due to the bar deformation. Also, Ferrero proposed a modified analytical model for bolts installed perpendicular to the joint plane in stratified bedding plane.