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Editorial – Deep Tunnels: Issues in Rock Engineering

This Special Volume of the Rock Mechanics and Rock Engineering Journal contains a series of contributions on ''Deep Tunnels'' and some of the major issues in Rock Engineering today. This is to recognise that we are presently living a new ''Renaissance'' in tunnelling. New infrastructures need be constructed, mainly for rail transportation. Roads and highways are being upgraded due to the increase in traffic demands and for a safer and more comfortable mobility in each country and among different countries. It is true in Europe, where a major interest is in the new crossing of the Alps in the form of Base Tunnels for rail transportation which in cases may reach lengths of more than 50 km in a variety of ground conditions, at great depths. Of similar importance is tunnelling all over the World, also in the more general framework of the utility systems.

With the intent to place special emphasis on fundamentals through applications, this volume covers first the convergence-confinement analysis of deep tunnels and the determination of improved Longitudinal Displacement Profiles (LDP) as discussed by Vlachopoulos and Diederichs in paper 1. It is shown that failure to use the appropriate LDP may result in significant errors in the definition of installation distance (from the face) for tunnel support systems. Then, the attention of papers 2 and 3 turns to the analytical and numerical study of rockbolt support. Bobet (paper 2) presents a two dimensional model for elastic anisotropic rock with regularly spaced rock bolts installed around the cavity. Carranza-Torres (paper 3) addresses the mechanics of rockbolt reinforcement in terms of increased stress confinement and decreased tunnel convergences as compared with the corresponding stresses and displacements obtained for non-reinforced tunnels.

Recent developments in numerical and physical modelling of tunnels are described in paper 4 by Wang et al. who show the use of the Realistic Failure Process Analysis (RFPA) code, originally implemented for the simulation of progressive failure, when studying the extent of the Excavation Damaged/Disturbed Zone (EDZ) around underground openings. This study incorporates the effects of heterogeneity and anisotropy into both numerical and physical models. Then, the interest turns to the ''squeezing'' behaviour of tunnels, i.e. the phenomenon of large time dependent deformations that may develop when tunnelling through weak rocks. Debernardi and Barla, in paper 5, describe a novel viscoplastic constitutive model which is shown to fit very satisfactorily the results of laboratory creep tests on clay shales and relaxation tests on coal, as recently performed for design analysis of tunnels in squeezing conditions.

In keeping again with the analysis of the squeezing behaviour in tunnelling, Cantieni and Anagnostou in paper 6 show that when such squeezing conditions are very severe, plane strain assumptions involved in two dimensional analysis may lead to ground pressure and deformation values that are considerably lower than those produced by stress analyses that take into account the spatial effect in the vicinity of the tunnel face. Similar conclusions are derived by Sterpi and Gioda in paper 7, by using a viscoplastic constitutive law which includes the effects of tertiary creep. It is shown through axisymmetric and plane strain analyses of full face excavation that this latter computational scheme does not provide adequate results with respect to the prediction of tunnel convergences close to the heading.

Finally, three case studies of tunnels in different rock mass conditions are presented. In paper 8, Rojat et al. describe the brittle rock failure phenomena that have been observed at the tunnel face and at the walls in the Steg Lateral Adit of the Lötschberg Base Tunnel. In paper 9, Bonini et al. report the experiences gained when analysing the time dependent response of the heavily squeezing and/or swelling clay shales during full face excavation of the large size Raticosa tunnel along the Italian High Speed railway line between Bologna and Firenze. In paper 10, Hoek and Guevara Briceño describe some of the rock engineering issues that were faced during the construction of the Yacambú-Quibor tunnel in Venezuela through silicified and graphitic phyllites where extreme squeezing problems were encountered.

Giovanni Barla, Editor