

Research project TISROCK

# TBM Tunnelling in Squeezing Rock

The present issue is devoted to the research project TISROCK, which stays for: TBM Tunnelling in Squeezing Rock. The aim of this research was devoted to advance the mechanical excavation method using shield TBM with a segmental lining for squeezing rock. Squeezing is to be understood as to cope with high deformations >150 mm for an excavation diameter of 10 m and more. Attention was given to the fact that long tunnels with high overburden are at present in the design phase, for instance: Brenner Base Tunnel, Koralm Tunnel, Alpe Tunnel, Ceneri Base Tunnel and even more to come. In order to cover all aspects including theoretical studies of the rock mass behaviour, design and construction of deforming precast concrete segments, layout of the shield TBM and operational modelling, three Universities (TU Innsbruck, TU Graz, University of La Sapienza, Rom), two TBM contractors, one manufacturer of TBM and one of precast segments as well as three consultants have been involved. The work was split in five packages for each of them a project manager being nominated.

Financing this research project was found to be very difficult for following reasons: Although various ways to finance research by the EU exist, for this special set-up a solution could not be found. Restrictions of the CRAFT programme did not allow participating although members of three different countries and of different institutional bodies have been involved. The only possibility was to integrate this work in the EUREKA concept. But this provides only a platform EU wide, but is not financially subsidised.

In Austria it was possible to obtain a small financial support from the »Förderungsfond für die Gewerbliche Wirtschaft« (FFG) for work package 1 and 2 and from the Austrian Society of Geomechanics for work package 3. Even for the numerical modelling at the University La Sapienza subsidies could not be found.

However the enormous personal engagement of the members allowed achieving following remarkable results:

- Investigations have demonstrated that the behaviour of support elements of squeezing rock can be

optimized using back analyses with realistic modelling of faults and discontinuities. Also it was found that squeezing rock results in high deformations within the shield resulting in jams of conventional shield TBM. Additional measures such as rock bolting beside provision of sufficient over excavation may be a solution to avoid this phenomenon.

- Detailed studies have shown that high stresses in the lining will be built up which demand the installation of deforming linings. The so-called silo-effect at fault zones becomes decisive only at thicknesses of faults considerable less than 20 m.

- Ribbed shaped segments are possible to construct which provide a resistance to the rock mass at the outside formed ribs, whereas the rock mass can squeeze into the space in between. Prototypes have been constructed and tested.

- A concept of a shield TBM was developed, which consist of front shield, an inner and outer telescopic shield and a gripper shield, which can provide over excavation of nearly 400 mm. Beside the description of the concept technical specifications have been prepared. For obvious reason the realisation awaits innovative clients to take some risk in implementing the new concept.

- Finally a computer aided program for predicting advance rates of TBM have been developed. This program is already in use.

Max John und Eckart Schneider ■

## The research project TISROCK

