Tunnels & Underground Construction on 24 November 2012

By Michelle Kwan

On 24 November 2012 the Association of Geotechnical & Geo-environmental Specialists (Hong Kong) organized a seminar on Tunnels & Underground Construction. It covered a wide range of aspects from tunnel planning and design methodologies to construction challenges and risk management.

I learned that geology and prior development affected the construction method of deep tunnels i.e. blast or non-blast method, and types of machine. Legislation restricted the working pressure of a person. In HK the limit was 50psi. This pressure limit value was introduced in 1970 and some countries had already reviewed and increased the pressure limit. It might be beneficial to the industry if the authority could review it as well.

Ground water inflow could be controlled by pre-excavation grouting at the more fractured part, pre-excavation ground freezing at the most weathered part and post-excavation barrier construction in open mode with external bags for low flow (less than 80 l/s) while under pressurized conditions according to a specific sequence of backfilling for high flow. Ground freezing was more expensive than pre-grouting but saved time. Significant groundwater inflow was possible in the construction of a deep tunnel, which pre-excavation grouting would be a principal activity to control the water inflow. As such, it might be beneficial to a contract if the cost of pre-excavation grouting was shared by the project owner. Imposing multiple groundwater inflow limits according to the local conditions avoided possible under and over grouting caused by imposing single inflow limit. Water inflow test could be carried out through probe holes to determine the need and effectiveness of pre-excavation grouting.

For tunnel design, it might be worthwhile to consider and allow tunnel temporary supports as reinforced ground for the tunnel permanent supports, also to consider and allow some reduction in the rock boundary stresses as geotextile drainage layer surrounding the tunnel allowed ground movement/relaxation. The Modified Barton Q Support Chart by Papworth provided energy absorption information of fibre reinforced shotcrete.

Excavation in blocky ground damaged the cutter head, belt conveyors and slurry circuit. Also, the process consumed much energy. Wear and tear of the cutter head could be reduced by rearranging the position and number of cutters which was a trial and error process on the site. Damages on belt conveyors system could be reduced by calibrating the cutter head opening and installing a block separating unit outside.
Spoil disposal through pipes instead of by trucks could mitigate the increased traffic load on the busy public road. Also, “Rotary All Round Casing Method” was used to remove the clashing piles. Roadheader was one of the options for excavation. It cut and might taper the cross section, minimize ground over break.

I not only gained the experience in tunnel design and construction shared by the presenters, but also built network with people working in the industry. I raised questions about polypropylene to the presenter, then after the end of the seminar, I was approached by a supplier who gave me more information on it.