

## **Failed implementation and criticism of the NATM**

*from* [www2.ce.metu.edu.tr](http://www2.ce.metu.edu.tr) (Middle East University, Turkey)

A number of NATM tunnels have collapsed, leading to debates on the method. A well-known NATM tunnel collapse is the Heathrow Express Tunnel in October 1994, causing extensive media coverage. There were allegations that the method was unsuitable for tunnelling in the London Clay; allegations that was deemed groundless by NATM proponents, referring to the success of the method in many other clay conditions all over the world. The collapse of the Heathrow Express tunnel in 1994 caused a symposium by the Health and Safety Executive (HSE) in the UK. The HSE was at that time aware of totally 116 NATM related collapses.

Two collapses in Germany, the Munich Metro and Kriebitz Tunnels received similar media attention, and in Turkey the Bolu tunnel experienced massive problems.

When analysing the background of these collapses, the most important fact is that the large majority of NATM tunnel collapses have occurred during construction. Moreover, the principle collapse in NATM is the face failure, i.e. collapses have occurred only at the face where the lining is still weak and cantilevered. Completed, correctly constructed NATM linings have almost never failed.

In literature, and in the NATM debate in the tunnelling society, one particular item is addressed as very important: skill and experience of the site-engineering team. This view is defended by the fact, that the majority of incidents have been associated with night shifts. For instance, the 1994 Heathrow Express Tunnel collapse took place at 01:00 h.

A contractor, however, need not be an expert in NATM tunnelling provided the correct business relations are established to obtain expertise elsewhere. The design of NATM tunnels relies heavily on the available data of the soil conditions. During the discussions it has been claimed, that the designers of NATM tunnels have often had insufficient data to work with, and in fact most NATM collapses are connected with 'unexpected ground conditions'.

NATM is a safe method if properly applied. Proper application requires:

- Theory and calculations
- Experience of engineers
- Good labour skills
- Excellent monitoring/instrumentation.