Underground spaces in the service of a sustainable society

ITA-AITES
World Tunnel Congress and 37th General Assembly

May 21-26, 2011
Helsinki, Finland
The wonders of the modern world are to be found in its infrastructure.

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Invitation

The Finnish Tunnelling Association (FTA) is pleased to welcome you to Helsinki, Finland for the ITA-AITES 2011 World Tunnel Congress “Underground spaces in the service of a sustainable society” and the 37th ITA-AITES General Assembly, which will be held at Finlandia Hall Conference and Exhibition Centre from 21 to 26 May, 2011.

Over its 35 year history, the FTA has flourished through changing trends in society. During the first 20 years, the active work of its members and their background organisations slowly managed to transform underground spaces from ugly, unpleasant and environmentally disturbing places to accepted infrastructure components that are favoured even by environmentalists.

This was partly caused by the need to supply society with drinking water and to remove and treat wastewater as well as to ensure the availability of electricity, data networks and district heating in densely populated areas without disturbing the city structure. This could be managed only through building underground tunnels.

A boom in tunnelling is currently underway in Finland and it is expected to continue into the foreseeable future. A decision has just been taken to expand the metro system in our capital city and an underground airport transit link is under implementation.

Finland is as well investigating and planning an underground final storage facility for spent nuclear fuel – one of the first of its kind anywhere in the world.

We look forward to see you. Let’s meet in Helsinki!

Pekka Särkkä
Chairman SC WTC2011
President of the Finnish Tunnelling Association
Länsimetro - the westward extension of the Helsinki metro

Helsinki metro system will extend westwards to the city of Espoo. Länsimetro includes seven modern underground metro stations as well as bus connection arrangements and parking facilities at the stations. The basis for the new metro system is automated traffic, use of the latest technology and a high level of technical requirements. The Länsimetro project is making rapid progress. The project plan has been completed and construction design is under way. The construction of the work tunnels is scheduled to begin in autumn 2009. The metro system is planned to extend to Matinkylä suburb in southern Espoo earliest the end of 2013. The core of the underground tunnel system consists of two parallel tunnels with a length of 13.9 km. The entire metro line runs through a rock tunnel, which is economical and safe.

Key figures:

- New stations: 7
- Service tunnels: 9
- Vertical shafts: 15
- Construction time: minimum 40 months
- Excavated rock material: approx. 3 million loose m3
- Cost estimate: 714 million euros (price level in October 2007)
The Ring Rail Line offers a rail route to Helsinki-Vantaa airport

The Ring Rail Line is a 2-track passenger line for local traffic. The length of the new line is 18 km. The trains will run at 10-minute intervals during peak hours and in the daytime. Trains stop at all stations. The shortest transport time from Helsinki to the Helsinki-Vantaa airport via the Tikkurila station will be about 30 minutes.

The line runs in a tunnel under the Helsinki-Vantaa airport area. Both tracks have their own separate tunnel. The total length of the tunnel is 8 km including the Aviapolis and Airport terminal stations. The construction costs of the project are estimated at EUR 590 million. The cost estimate also includes the improvement of Highway 3 between Ring Road III and Keimola and a new travel centre in Tikkurila.

The Ring Rail Line project will have required detailed plans made and arrange tender competition for the construction contracts of the project. Construction started in spring 2009. Ring Rail Line will open for traffic on 2014 at the latest.
Public Swimming Baths at Itäkeskus

In this project the City Of Helsinki combined the construction of a population shelter and a multipurpose public baths. The building is a prime example of unprejudiced, creative design upholding the principles of sustainable development. The white painted ceiling of the subterranean cavernlike space makes the roof look like an outdoor pool under the sky, while the bright colours have an enlivening effect. The acoustic properties of the baths have been improved and the echo muffled by decorative elements like sails. The main construction material is rock with reinforced concrete. The floorspace of the building is 10,920 square meters, and the volume 61,250 cubic meters. The total area of the water surface is 1,281 square meters and the length of the swimming lanes 25/50 meters.
Geological disposal of spent nuclear fuel

Investigations focused on Olkiluoto In 2001, the Finnish Parliament ratified the decision in principle on selecting the Olkiluoto in the municipality of Eurajoki as the site for final disposal of spent nuclear fuel originating from four existing nuclear power reactors in Finland. After decision, Posiva Oy - the expert organisation responsible for the R&D and implementation of final disposal - focused further investigations on Olkiluoto and began preparations for the construction of the underground rock characterisation facility, ONKALO. ONKALO consists of one access tunnel and three shafts.

Posiva started to construct ONKALO in 2004. Research has been conducted there since the beginning of its construction. The final disposal level (-420 m) will be reached in the beginning of 2010.

ONKALO will help to obtain exact information about the bedrock on the site of final disposal for the purpose of planning the final disposal repository and assessing its safety. This information is also needed for the application for the construction licence that will be submitted in 2012.

ONKALO provides also an opportunity to develop excavation techniques and final disposal techniques in realistic conditions. Later, the ONKALO facilities can be put into use when building and using the repository.
A city growing inside bedrock

As the city’s structure becomes more dense, more and more facilities suited for different purposes are being built underground, if possible. There is also a growing need to connect the premises to each other to form coherent and interrelated complexes.

Since the 1960s more than 400 of those already have been built underground in Helsinki. More than 200 reservations exist for long-term underground projects. Demand for underground facilities has grown considerably and, at the same time, the need to control construction has increased substantially.

The Underground Master Plan of Helsinki, having a legal status, reserves designated spaces for public utilities and important private utilities in various underground areas of bedrock over the long term. The Master Plan also provides the framework for managing and controlling the city’s underground construction work, and allows suitable locations to be allocated for underground facilities.

ILLUSTRATIONS
Extract from the Underground Master Plan of Helsinki at a scale of 1:10,000
**Underground Service Traffic Tunnel in the Helsinki city center**

The Underground Service Traffic Tunnel (KEHU) will be an important new route for service transport at the Helsinki city center. Lorries, delivery vans will transport goods to various department stores and shops with the objective to decrease the heavy traffic at the ground surface. The west part of the tunnel can also be used as a driveway to the underground parking facilities.

KEHU tunnel consists of two different portals, one from the west for all cars and one from the east for service transport only. The total length of the tunnels is 2 km. The tunnel cross section is about 110 m².

The construction works started in autumn 2005. The tunnel will be opened in two stages, the west part will be opened for public in May 2009, and the east part in the end of year 2009. The construction costs are estimated to be about EUR 90 million.

The west part of the tunnel can also be used as a driveway to several underground parking facilities. There will be three new facilities housing some 1500 car places underground (yellow) in addition to four already existing facilities (colorless) with some 2000 car places.
The Päijänne Tunnel - the raw water system of the Helsinki area

The Päijänne Tunnel brings raw water from Lake Päijänne to the Helsinki area waterworks, which supply more than 1,000,000 inhabitants. The tunnel is 120 km long. It’s cross section is mainly 16 sq. m and average depth is 40 – 90 m below ground level. In the tunnel there is a water power plant, which regulates the discharge to the tunnel and generates electricity. The discharge capacity at free fall is about 10 cu.m/s. The water intake is nowadays in meantime 3.2 cu.m/s and annually about 100 mill. cu.m.

The tunnel has been excavated from the bedrock, which belongs to the precambrian migmatite (granites and gneisses) zone of southern Finland. The excavation of the 24 access tunnels and the main tunnel started at the north end in November 1973 and ended in spring 1982. During the excavation there has not used enough reinforcement works and later there was some problems with obstacles. Repairing works of the reinforcement in the northern part of the tunnel took place in 2001 and also in the southern part in 2008. Nowadays there are about 50,000 bolts and about 40 percent of the walls of the tunnel are shotcreted, which doubles the original reinforcements. Grouting has not been extensively used because leakage will not matter when the tunnel is in use.
Service and Utility Tunnels

Helsinki, the capital of Finland, has a maintenance tunnel network of more than 200 km, of which 45 km are different utility tunnels used by a number of operators. They have been built since 1977, and house transmission lines and piping for district heating and cooling, electricity and water supply systems, as well as a large number of different cable connections. City Geotechnical Division has been the main actor in the preliminary and implementation design required for the rock construction of these utility tunnels inclusive different auxiliary underground spaces, like machine halls, vertical shafts and the necessary access tunnels.
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