TRIBUNE

ASSOCIATION INTERNATIONALE DES TRAVAUX EN SOUTERRAIN
AITES

ITA
INTERNATIONAL TUNNELLING ASSOCIATION

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BUDAPEST: A NEW SUBWAY LINE FOR 600,000 NEW PASSENGERS.

Budapest has one of the oldest subway networks in Europe. 1.3 million passengers use the three existing lines daily – too much for the network of just 31.7 kilometers. Therefore, a fourth line is being built which connects the south western part of the city, Buda, with the north eastern Pest. The core element of line 4 will be a tunnel beneath the Danube River of which 5.35 kilometers are being excavated by machine. The crossing under the river is a premiere in Budapest, as the subway has only crossed the Danube above ground in the past.

The two identical Herrenknecht EPB machines S-354 and S-355 (∅ 6.05m) started tunnelling in May 2007. With small overburdens of sometimes only 6 meters they successfully cut through clay, fine sandy silt and marl. The S-354 achieved weekly top performances of almost 130 meters, its sister machine even proved its worth with performances of up to 160 meters. After completion of the construction work, line 4 will transport around 600,000 additional passengers a day.

BUDAPEST | HUNGARY

PROJECT DATA	CONTRACTOR
S-354, S-355 **2x EPB Shields** Diameter: 6,050mm Installed power: 1,200kW Tunnel lengths: 5,350m Geology: clay, fine sandy silt, marl	Strabag AG, Vinci Construction

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EDITORIAL

Welcome, dear Readers of the TRIBUNE and participants of the ITA-AITES World Tunnel Congress 2009, on behalf of the Hungarian Tunnelling Association and the professional colleagues who have participated in the organization of ourWTC 2009.

You can visit the Hungarian Republic, which is situated in Central as a part of the EU, with approximately 10 millions inhabitants. The whole area of Hungary is divided into 3 larger parts: • "Dunántúl" – West of the Danube; • "Duna-Tisza köze" – between the two largest rivers, the Danube and the Tisza; • "Tiszántúl" – to the East of Tisza. Lowland (about 68%), 30% is covered by hills between 200 and 400 meters and only 2% of the country rises above 400 meters.

As you see, most of Hungary is plains, which are not very interesting to the geologist or the speleologist. Young clastic sediments, deposited by lakes and rivers, are not karstified. Carbonate rocks with caves cover only 1.5% of the surface. The Northern part, along the border to Slovakia, belongs to the Carpathian Mountains. Here are the famous cave regions of Aggtelek and Lillafüred. Other karstic areas are at the Balaton, in the South and along the Western border to Austria. Against these facts, there are underground spaces in Hungary from the earlier centuries, as well.

There is an enormous difference in terms of time and technology between a hideaway provided by nature and the currently established underground spaces. The last 35 years brought about even more intensive development in tunneling and underground construction. Our Association tries to collect and distribute knowledge in appropriate form to those who need it for development and construction, just like ITA-AITES do.

Despite the fact that Hungary has only few mountains, we took a significant part in scientific research and training before reaching the current standard. This was mainly based on Prof. Jáky and Prof. Széchy, who also benefited from and further developed the experience gained by the former Hungarian engineers in mining and railway tunnel construction in the 19th century.

Underground construction may serve various purposes. Considering the old buildings in Budapest, Pécs, and Eger, the primary aim was protection and storage and still many of them are used for storage or certain industrial purposes (winery, brewery).

With the increasing population, transportation acquired an important role and it entailed tunnel construction as well. The first underground tram line on the European continent was built in Budapest in the late 19th century (1896) and it is still in operation (Metro 1 Line). Public utility tunnels were built under the Danube, the main sewer, of a large cross section suitable for passage of ships, was also built, and the alignment of Ördögárok creek in Buda was relocated into a tunnel (Ø 3-4 m).

A major breakthrough was achieved when after several initiatives had been taken, Budapest decided to construct a metro system to meet the expected transport demand of the developing city. This required major tunneling works under the narrow streets and densely built-up areas. After the initial difficulties local engineers shortly developed new structures. Local development has accelerated since the 1970s, construction of transport infrastructure systems commenced in Budapest on a national scale. Metro 2 Line was built and then Metro 1 Line was refurbished concurrently with the construction of Metro 3 Line. Continuous construction was planned in the transport system development program and the Metro 4 Line was scheduled for the early 1990s, which was delayed due to the political changes in 1989. According to the development program, the metro system, the basis of the Budapest mass transport system, would consist of five lines, including the extensions of the existing lines, and also connecting to the suburban and national railway lines. Metro 4 Line is under construction, and the financial conditions for the 5th line are being prepared. Extensions will be constructed in line with the development plan of the areas concerned, using the latest technology.

As for the road traffic in Budapest, a by-pass tunnel is planned due to the enormous number of vehicles, to reduce congestion on the Danube Bridge.

A proper road network has a significant role outside the city as well. Four tunnels are being built for the M6 Motorway and a tunnel of approximately 5 km will be built in the last section of the M0 Motorway Ring.

The development of the railway network induces construction of high-speed railway lines and integrated railway service for the neighboring settlements; this requires construction of tunnels in the near future.

Hopefully the informative nature of the Congress will also contribute to the prompt completion of new transport projects.

Kocsonya, Pál
President of the Hungarian Tunnelling Association
Chair of the Organizing Committee

Focus on Hungary

A. HISTORICAL TUNNELLING IN HUNGARY

In this brief writing, we are going to discuss tunnelling in the actual territory of Hungary considering the changes of the borders in time. We are going to use the contemporary term of the localities too, and give the present names as well

1. MINING TUNNELS

First, the mining of precious metals and ores was the reason for tunnelling activity in the country.

Mines in Hungarian territory gave more than three quarters of all the gold mined in Europe. (According to present day estimates, gold production in the second quarter of the 14th century was approximately 2000-2500 kgs per year). The mining continued the Roman activity in Transylvania (Erdély, now part of Romania) that produced long mining corridors, and an inclined transportation tunnel.

Following a long break, busy with wars, the Kingdom of Hungary restarted mining in 1746, partially by reopening old Roman and early Hungarian mines, opening new tunnels and partially by the development of gold washing. There were gold refining houses in free mining cities, where everyone had to bring their raw gold and silver for refinement and verification. In return, they were given new, royal money at a legally defined rate. .

One of the most developed mines was at Selmecbánya (Banská Stiavnica by German Schemnitz) in the present Slovakia. The international history of mining records that a highly elaborate system to dewater the deep mine with the 'hollow balls – chain'method was used here in the 15th century. For lifting water, three pumping units in series were used, each unit comprising 32 horses in groups of eight working four hour shifts with a twelve hour rest period that is 96 horses in all. Piston pumping installations activated by waterwheels were introduced in the 16th century, and steam engines for pumping were used in the first half of the 18th century. Black powder, as blasting agent was used here also first in 1627, and the worldwide first Academy of Mining was established also here in 1763.

2. NATURAL CAVES, HISTORICAL TUNNELS FOR LIFE AND DEFENCE.

Most of the fortresses, and castles with tunnels and underground corridors were built on hills or mountains, and because of the stormy history of Hungary, these played a key role in surviving the wars with foreign armies. Most of these corridors and tunnels got forgotten, or collapsed since then. Famous tourist attractions are the explored corridors and caverns as some of these in the Castle of Buda, and in the fortress of Eger.

The Castle Hill of Buda is a 1,5km long hill, overlooking the Danube, with the Royal Palace and the Old Town. This region has been on UNESCO'S World Heritage List since 1987.

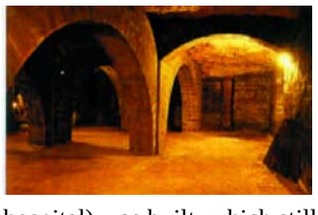
Nowadays the total length of underground spaces in the area of Budapest created for a purpose other than transportation or public utility facilities exceeds 140 km. These spaces are concentrated in three main areas: the historical city center under the Buda Castle Hill, the south-Buda areas (Budafok, Budatétény), and District 10 in Pest (Köbánya).

The limestone blanket in the Buda Castle Hill comprises freshwater limestone (travertine) that deposited from the springs in the Middle-Pleistocene period. The natural caves that were already used by men in the Middle Ages were formed at the interface of this travertine and the underlying limestone-clay marl layer.

A unique natural heritage is preserved under the historic buildings of the Buda Castle. These caves located at 8-12 m depth are natural lime-tufa caves that are scarce and hard to find anywhere in the world. The total area of the cave network amounts to some 18,000 m^2.

In the spring of 1935 a cave museum was opened under the Castle. With WWII drawing near, the utilization of the caves took a new direction. The cave network under the castle and the civic center region was transformed into an air raid shelter. The individual caves were connected and reinforced, then a lighting system and sewers were installed. Entrances from all residential buildings and offices were constructed to access the shelters.

This is when the underground hospital (so-called rock



hospital) was built, which still exists today. According to certain sources, 4,000 people sought shelter under the Castle at the end of the war during the siege that lasted several months.

This cave and cellar network preserves and demonstrates the geological composition and historical role of the Castle Hill, as well as the events of recent times.

3. BUDAFOK, TÉTÉNYAREA CAVES

The area currently forming District 22 of Budapest used to be the largest zone of the most concentrated residential caves in the Carpathian Basin and Europe, not created for religious purposes. The residential caves and the enormous cellar network were developed in relation to stone mining, then later viniculture established in this area.

The building stones were extracted from the 6-10 m thick Sarmatic limestone body by excavating enormous pits, "yards" of regular shape. This way caves of smaller size, suitable for living, and cellar networks of several thousand square meter area were formed. In one of these cellars with over 12

m height and 120 m length residential buildings were lined up.


Budafok

Wine cellars settled in the galleries and caves formed by stone mining, where the grapes grown locally and in the vicinity of Buda were processed and ripened. Hundreds of cellars were lying underneath the south Buda region, altogether 100 km long.

These galleries have been the centers of domestic wine and champagne production for more than 200 years now, there are bottling plants and laboratories operating underground, and it is not by mere chance that the only viniculture vocational institute of the country is located in Budafok.

4. KÖBÁNYA (Stone-quarry) CAVES

In Köbánya the formation of underground cave networks is also due to the mining of building stones, the name of this settlement also refers to this activity.

The depth of the caves varies relative to the surface. The average depth is 10-15 m but eventually the bottom of the cave may reach 30 m. The width of the caves also varies, the average value is 4-6 m but at certain locations vast caves of 10-12 m height and 8-10 m width formed in the rock equaling to the size of a church nave.

The caves in Köbánya soon acquired a new function and accommodated beer production and wine storage. The beer brewed in the Köbánya caves proved to be so successful that since then beer breweries have not been built in Budapest other than in Köbánya. Six breweries were established in a couple of decades above the former stone quarries.


Köbánya

Today out of the total 195,000 m^2 area of these caves only a section of 173,000 m^2 belongs to the brewery. Some of the caves are used for mushroom cultivation but most of them are left behind unused.

5. RAILWAY TUNNELS FROM THIS ERA STILL EXISTING IN HUNGARY

12 tunnels were built at the end of the 1800's and at the beginning of the 1900's.

In the majority of the tunnels repair and refurbishment works have been carried out.

5.1 The Small Gellért Hill Tunnel

It is our oldest tunnel, which provides access to the Southern Railway Station. Within the network this is the only electric railway tunnel with twin track. The design of the gates is shown in the photo.

The tunnel was built in 1860, with a length of 361 m, and it served the railway line Budapest - Vienna. Construction projects carried out on the surface with densely built-in environment tend to take place closer and closer to the tunnel alignment. The effects of surface defects, pipe ruptures are promptly reflected in the tunnel such as water ingress, which may lead to considerable problems due to the electric system.

Diagnostic tests (thermo-visual, georadar, video-endoscopic tests) carried out before the refurbishment works in the 1980s disclosed water ingress and other problems and the related locations. During the next refurbishment works these defects were repaired using recent up-to-date and efficient materials and methods.

5.2 Porvacsesznek Tunnel

The tunnel was built in limestone around 1884-1886 in the Györ – Veszprém railway line. The length of the single-track tunnel is 31 m and was refurbished in 1984. The only railway gallery in Hungary was built here connecting to the tunnel in 1962.

5.3 Piliscsaba Tunnel

The longest single-track tunnel in Hungary is 780 m long, it was built in 1895 in dolomite and clay on the Budapest – Esztergom railway line. The tunnel was reinforced in 1981, then a 210 m long dewatering drift was built beside it.

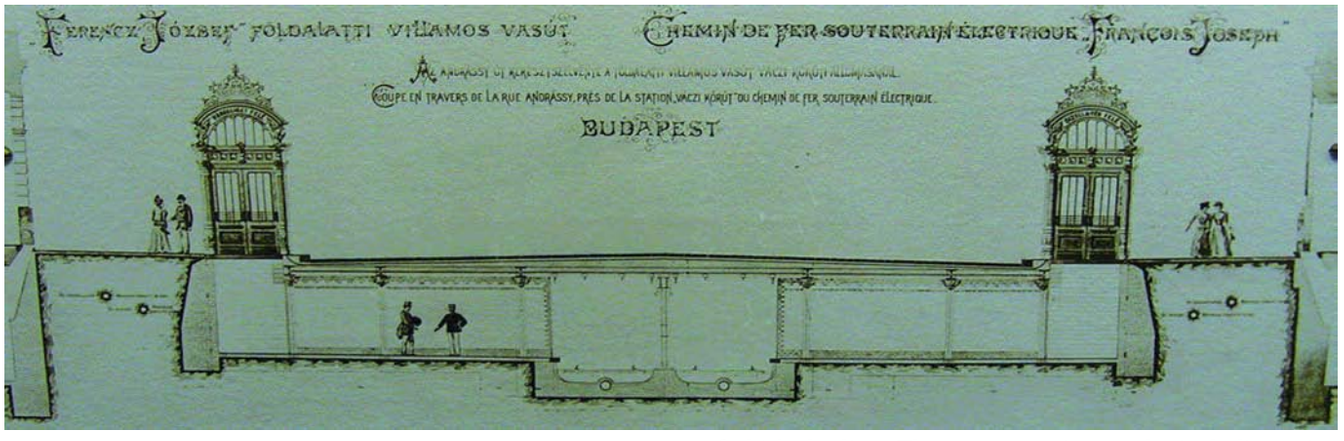
5.4 Abaliget Tunnels

The tunnel built in 1882 in the Abaliget region was abandoned after the refurbishment works in the 1970s. New tunnels were built in a new alignment.

These tunnels were constructed by mining method with blasting and excavation using pick hammer.

6. THE FIRST URBAN UNDERGROUND LINE ON THE CONTINENTAL EUROPE

When the city of Budapest made preparatory arrangements for the Millennial Exhibition at the end of the 19th century, the urban management body intended to provide appropriate mass transport means in the newly completed Sugár avenue. The application proposing a solution for passenger transportation underground was given preference. The underground line with the stations was built in 1894-1896.



The construction was carried out mainly by manual work by cut-and-cover, but an electric construction machinery line, considered rather up-to-date at the time, was also used.

The line was built at a shallow depth, due to groundwater problems, and the vehicles had to be designed to match the low clearance.

This vehicle of special design, comprising a curved longitudinal girder, is still exhibited in the Museum of Transportation.

The stations have elegant majolica tile covering prepared in the Zsolnay factory, with attention paid to the very details such as the design of corner joints and the displayed station names.

The Millennium Underground Railway became the most up-to-date electric-drive system of mass transportation at the end of the 19th century. This line was the first urban underground railway in continental Europe.

A complete reconstruction of the line was carried out up until 1973, the station lengths were extended to accommodate the three-car trains, and the line was also extended by some 1230 m to include two new stations.

After the completion of the Metro 2 Line, which started operation in 1972, Deák tér station became an interchange location.

The line, usually referred to as 'small underground', was named line M1.

The Metro 3 Line also connected to the Metro 1 Line at Deák tér station in 1976.

In the 1980s the examinations indicated the necessity to refurbish the line. The reconstruction works including reinforcement of the structures and the track, and the refurbishment of the signalling system were completed in 1995. The reinforcement of structures was carried out at the required locations, concerning the slab, the side walls and the intermediate columns.

A 20 cm in-situ reinforced concrete course was added to the slab. Columns were added to ensure smaller spacing in the intermediate row of columns, injection was applied on the side walls and other necessary locations to improve structural stability and waterproofing, then a waterproofing membrane was installed around the entire structure.

On the surface, of course, the affected public utilities and the entire road paving were reconstructed in 1996.

Technical Parameters of Metro 1–4 Lines					
	Line 1 Millenium	Line 2 E-W	Line 3 N-S	Line 4 Under construction	
				stage 1	planned total
Length of the line	4.4 km	10.3 km	17.39 km	7.3 km	15 km
Number of stations	11	11	21	10	17
Average distance between stations	420 m	1000.9 m	820 m	810 m	
Length of the trains	30.4 m	96 m	115.2 m	# 80 m	
Deepest station		38.4 m	28.2 m	38 m	
Shortest possible time between trains	110 sec	140 sec	150 sec	90 sec	

B. METRO LINE CONSTRUCTION

1. PARAMETERS OF THE BUDAPEST METRO LINES, STATION TYPES

Currently the metro line network in Budapest comprises three operating lines and one line under construction. The **Millennium Underground Railway** (Metro 1 Line – yellow line) opened in 1896 is 4.4 km long, with a shallow alignment and has 11 stations with platforms on both sides.

The **East-West metro line** (Metro 2 Line – red line) was built in two stages between 1950-1953 and 1963-1972, and was put into operation in 1970 and 1972 respectively. The refurbishment of the architectural and M&E installations in the stations was carried out between 2004-2007, each year during the summer school holidays, by closing certain sections of the line.

The **North-South metro line** (Metro 3 Line – blue line) was built between 1971-1990, it was put into operation in five stages.

The **DBR metro line** (Metro 4 Line – green line) is currently under construction, the first stage (Kelenföldi pu. – Keleti pu.) was commenced in 2006.

2 CONSTRUCTION METHOD OF STATIONS AND RELATED STRUCTURES

Various methods have been used so far for the construction of the deep stations. The first deep stations comprised three tunnels. The station includes three circular cast-iron segments of 8.5 m outside diameter. This arrangement was used for Keleti pu., Blaha L. tér and partly Deák tér stations.

Construction was carried out using manual shields. In

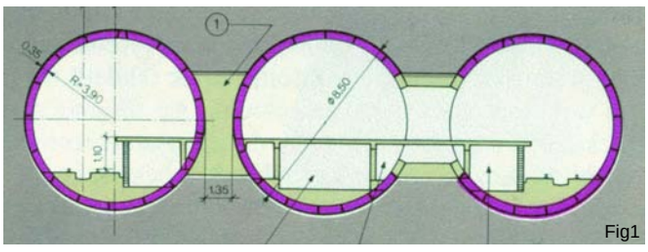


Fig1

order to decrease earth pressure, one drift in the invert and two others higher at the sides were driven in front of the shield using ribbed steel segments of 3.0 m diameter.

These drifts significantly decreased the earth pressure acting on the face.

Shields were left behind at the end of the stations.

At the openings between the tunnels special cast-iron elements were installed in the tunnel segments, forming a support arch above and below the openings.

At Deák tér station, the central tunnel was a concrete structure. Déli pu. station was built using concrete side walls and concrete block arch, in the cracked Buda marl (see Figure 2). Steel plate waterproofing was installed on the inside of the external lining, supported by an internal reinforced concrete lining. Moszkva tér station is also a concrete structure (see Figure 3), with arches of smaller curvature, flat side walls, and steel plate waterproofing.

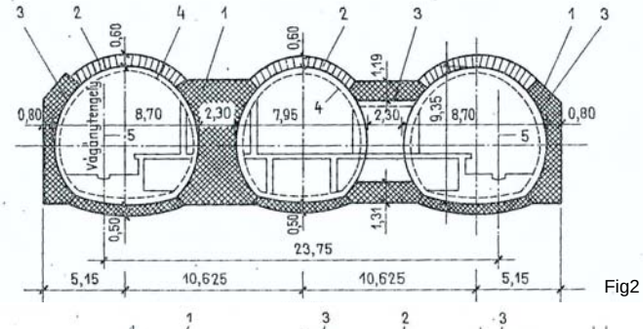


Fig2

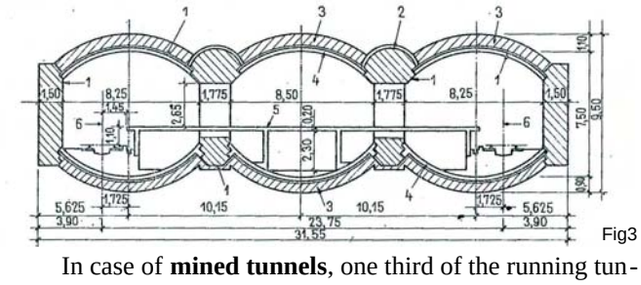


Fig3

In case of **mined tunnels**, one third of the running tunnels were constructed using mining method on the East-West metro line. Various types of mining method were used depending on the soil conditions.

The tunnel lining was in-situ concrete in most cases. On the North-South metro line, however, tunnels with reinforced concrete block lining were also built, moreover, cast-iron lining was also constructed in a short section by mining method.

Initially the tunnel was designed so that after completion of the primary lining, the internal waterproofing and the supporting reinforced structure could be installed. Later, however, at most locations the separate waterproofing membranes and the internal reinforced concrete lining were omitted. The required waterproofing was ensured by application of shotcrete mortar and several injections in the annular gap.

The structures of the **escalators** and the **ventilation shafts** were also built using the methods mentioned above or by in-situ casting of the elements on the surface followed by sinking them into place.

2.1 Astoria station structure

A brand new solution had to be used at this station. At this location no station had been previously anticipated and a decision on the design was made when the running tunnels had already been partly completed. Thus only a part of the station was built as a twin tunnel, while in the other part the completed structures had to be duplicated. The station arrangement was developed on the basis of the two twin tunnels, considering the passenger traffic, and mechanical and operational requirements.

The two previously completed running tunnels with 60 cm lining and 6.30 m diameter are located at the sides of the station. The foot and head beams are built 2.70 m from the tunnel axis, with the circular concrete column of 46 cm diameter in between.

In the middle tunnel of the concourse reinforced concrete pillars of 1.50 x 1.20 m were designed.

2.2 New type of station structure: built on both sides of the Danube

On the East-West metro line the construction of the stations on both sides of the Danube was commenced in the 1950s. On the basis of favorable experience gained during the construction of the previous station, and after further development thereof, a new type of five-tube station structure was built for these two stations. According to the analysis, this new structure resulted in significant cost and construction time savings relative to the three-tube station structures.

For the structural design of the five-tube station the following main factors were considered:

1. The size of the side tubes shall be identical to the size of the running tunnels so that these tubes can be built using the same shields.

2. The material and structure of the tunnels within the station should not differ from those in the running tunnels in the other sections.

3. The structural design should be in line with the operational, traffic etc. requirements.

The structures of Kossuth tér and Batthyányi tér deep stations were designed and built accordingly. Typical cross sections include the five-tube cross section (Fig. 4).

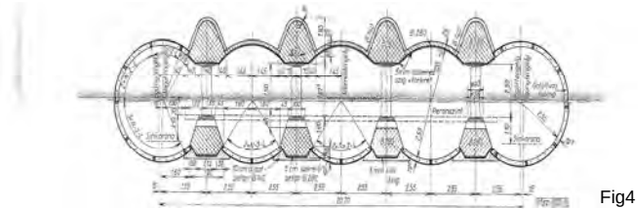


Fig4

As for the inner contour line, the five-tube cross section consists of five intersecting tubes of 5.10 m inner diameter, with longitudinal girders at the intersection points. The longitudinal girders consist of reinforced concrete beams at the top and bottom and the supporting columns.

Considering the requirement for complete waterproofing, the concrete structures of the stations were provided with waterproofing steel plates. The grooves of cast-iron elements were sealed with high-expanding cement.

All deep stations on the North-South metro line were built as five-tube structures, further developing the original design. One type of these stations comprised arches of 5.1 m diameter and columns, and the side tunnels were built using cast-iron segments and the shields used for the running tunnels. The other similar type comprised side tunnels of 6.3 m diameter and the corresponding arches of 3.15 m radius, to accommodate a tensioning shaft for four escalators.

At Kálvin tér the structure of 5.1 m diameter was built with six arches (see Figure 5). This way the twin tunnel structure with a shaft for four escalators could be implemented.

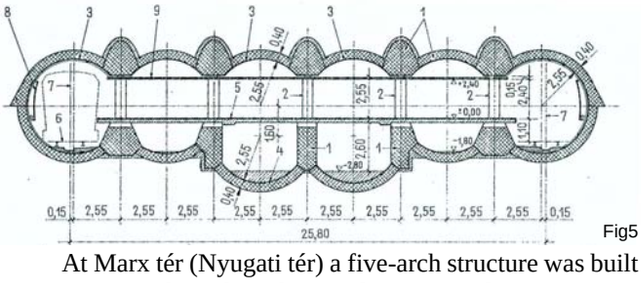


Fig5

At Marx tér (Nyugati tér) a five-arch structure was built (see Figure 6) where the side tunnels comprised cast-iron segments of 5.1 m diameter and between them three arches of 6.1 m span were built. This way a shaft for four escalators could be accommodated here as well without increasing the size of the running tunnels and the shields could pass through the location of the station unimpeded.

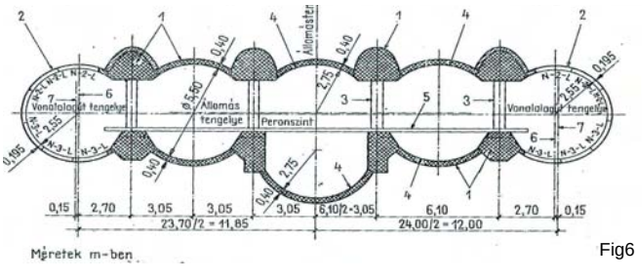


Fig6

3 TUNNELING SHIELDS USED FOR METRO LINE CONSTRUCTION IN BUDAPEST

3.1 East-West metro line

The first shield tunneling project commenced in 1952 under Rákóczi street. Concrete shield launch shafts had been built by mining method from an empty piece of land at the location of the running tunnels and the shield were then launched toward Keleti pu. station.

The shields were German-type mechanical shields with hemispheric cutters. Excavation was carried out using hemispheric cutters moved by hydraulic press. This method, however, did not work in the hard clay. The cutting edge could not initiate collapse of the soil, it distorted, warped and the rivets in the angle steel braces sheared off so that works had to be suspended shortly after. The hemispheric cutters were removed and manual excavation commenced.

On the East-West metro line the subsequent shield tunneling was usually carried out in a pressurized space (100-150 kPa). In the sand layers liable to liquefy that were sometimes encountered (Blaha Luija tér and vicinity), only application of higher pressure (180 kPa) could prevent the presence of water in the soil.

Beside the manual shields, mechanical shields of SCSN – 1 type manufactured in the Soviet Union were also used for one section of the metro line between Szent István tér – Moszkva tér stations, in order to improve performance. There the soil conditions were more favourable. The shield and the back up enabled the full mechanization of the excavation and loading activities. The average progress rate of the shields was 2.1 m per day but often up to 5 m per day was achieved. The lining comprised partly reinforced concrete blocks and partly cast-iron segments.

The conical cutter disc of the shield cut out the face without support, also liable to collapses, which did cause collapses at the fault locations. For example a large collapse took place under Sas street resulting in 45 mm settlement on the surface.

In the section under the Danube cast-iron segments with bolt connection were used to improve safety.

3.2 North-South metro line

The two mechanical shields were modified for the construction of this line, because due to the higher position of the alignment, the potential collapses caused by the excavation of the cutting head could even reach the sand-gravel layer with high water content. Therefore the rotor was removed and two excavating-loaders were installed under the upper working level after modification of the bracing.

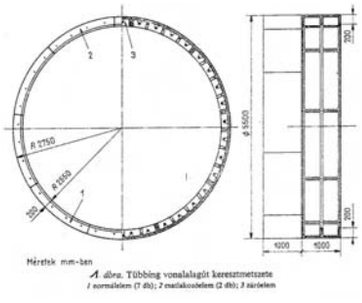
The top 30% of the cross section was excavated manually, the remaining 70% at the bottom by machinery. Loading was carried out by mechanical means for the entire cross section. The progress rate was 6-7 m per day. Rubber profiles were used to seal the tail. Laser-guided surveying was introduced to control the shields.

In the liquefied sand under Ferenc körút a major collapse occurred and it reached up to the pedestrian underpass above the work chamber. A2.5 m deep large cavity formed under the base slab of the underpass, which was filled with cement mortar injection.

In this section tunnelling could continue only with completely closed forepoling, later with the air pressure increased to 180 kPa.

3.3 Shields used for station tunnels

On the East-West metro line large-diameter shields were used for driving station tunnels as well. These were shields of 8.50 m diameter with open face, work benches, manual excavation, and steel shell left behind after driving.



3.4 Tunnelling shield used for the construction of the Metro 4 Line

The shields used for the construction of the Metro 4 Line are EPB shields with monoblock cutting disc and hydraulic drive. The shields can basically operate in several modes: open face with compressed air and closed face. On the Buda side the shields were driven in compressed air mode, except for certain critical locations where closed face mode was also used. The shields are 53 t each, the cut-

ting discs are of 6.1 m diameter. The maximum progress rate of the cutting disc driven by the eight hydraulic motors is 80 mm/min. It means excavation of more than 2 m^3 soil per minute.

4 TUNNEL LININGS APPLIED DURING CONSTRUCTION OF SHIELD-DRIVEN RUNNING TUNNELS IN BUDAPEST

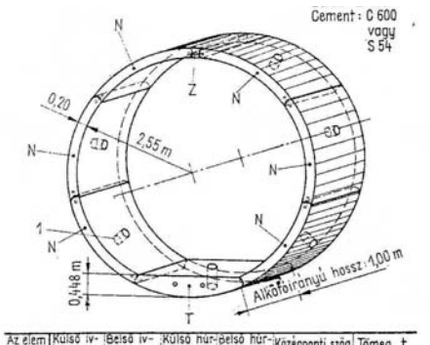
Three types of tunnel linings have been applied:
- ribbed cast-iron tunnel lining,
- tunnel lining, comprising articulated reinforced concrete blocks and asphalt waterproofing,
- tunnel lining, comprising watertight reinforced concrete segments with tied connection.

In case of cast-iron tunnel lining, a ring is made up of seven standard segments, two connecting segments and one keystone. The individual rings are connected by face bolts with equal circumferential spacing, which enables rotation and optional connection of the rings. In order to prevent corrosion, the extrados of the segments is covered in bitumen. Expanding cement is used for sealing the joints between the segments, and lead sealing is applied in those tunnel sections, where significant water ingress is encountered.

The sealing rings, required for bolted connections, were first made of asbestos and bitumen, that were later replaced by more economical PVC rings.

Later, **concrete segments** were used without bolted connections. Each ring consisted of an invert, six standard segments and a three-piece key segment. The static model of the structure is an articulated bar chain, which is unstable by itself, and stabilized only by the surrounding ground mass. The sidewalls of the moulds were rigid and fixed, in order to attain high levels of precision. During installation of the segment rings, quick-setting cementitious grout, mixed with muck and sodium silicate, was injected into the void.

This type of tunnel lining required backfill grouting to be carried out after the installation of each ring, and, during installation of the next ring, sufficient grout strength (0,3 kp/cm^2) was to be attained to support the articulation of the lining. Thus, it was possible to avoid deformation of the last installed and grouted ring, after the tailskin had slid out. The purpose of the asphalt layer on the tunnel lining was to seal the tunnel and smoothen the surfaces. This type of tunnel lining was used on the East-West and North-South metro lines in Budapest, as well as in Prague, Calcutta and a railway tunnel in Belgrade.



Az elem jele	Külső ív-hossz, mm	Belső ív-hossz, mm	Külső hur-hossz, mm	Belső hur-hossz, mm	Középponti szög	Tömeg, t
Z	141	130	151	130	3°00'00"	0,02
N	2443	2265	2363,5	2191,4	51°00'00"	1,92
T	2448	—	2367,7	2195,6	51°00'00"	2,07

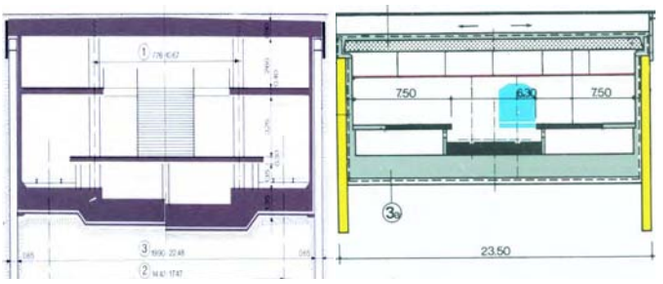
Reinforced concrete segmental lining with jointed connection is being used for Metro 4 Line. The tunnel lining is 30 cm thick. The adjacent surfaces are plane. The centreline of the tunnel, consisting of straight and curved sections, can be followed by rotating the tapered segment rings The composite action of the rings is enabled by the friction in the tunnel lining, resulting from the residual axial force, approximately 25% of the cylinders'thrust. A compressible rubber strip, running the length and width of the segments, provides watertight connection between the segments.

5 CUT- AND COVER STRUCTURES RUNNING TUNNELS, STATIONS

Cut-and-cover structures can be found along each metro line. In those parts of Budapest, where the metro runs in shallow tunnels under public roads, such as Kerepesi út, Üll_i út, or Váci út, the cut-and-cover method proved much more economical, in spite of the diversion of utilities, some of which were as old as 100 years.

Depending on the ground conditions, diaphragm walls were widely used besides conventional propping.

The cross sections shown below were constructed at a number of places along the line:



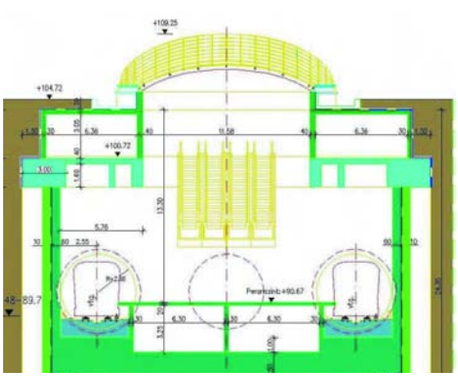
A section of the metro line under Váci út was constructed using Siemens propping to support the open trench, where the reinforced concrete frame structure was built. The structure itself was either a reinforced concrete open frame covered with precast beams, or a reinforced concrete closed frame.

Along other sections of the metro line, the construction of diaphragm walls was necessary, because of the ground conditions, the groundwater, or the proximity of buildings and other structures.

During the construction of Metro 2 and 3 Lines, the cut-and-cover method was used up to a depth of 12 m.

Although the stations along Metro 4 Line lie deeper, cut-and-cover and pile wall methods have been used, together with several rows of struts. Due to the proximity of buildings, inner pile walls had to be built in order to provide additional support to the trench, surrounded by diaphragm walls, becau-


se the maximum allowable settlement had been fixed, and for various reasons anchoring was not possible. At some stations, such as Gellért or Kálvin, the reinforced concrete struts are part of the permanent structure, therefore high-quality formwork was required, and the supporting structures had to be protected during later stages of construction.



The depth of the stations varies between 18 and 28 m.

Tétényi út station is the only one has an nature decklight.

During this Spring will be accepted the new traffic development plan for the Capitol City C its Suburbs, with the metro line 5

C. DEMAND FOR RAILWAY TUNNEL CONSTRUCTION ON THE HUNGARIAN RAIL NETWORK

1 GEOGRAPHICAL CHARACTERISTICS OF HUNGARY FROM THE POINT OF VIEW OF TUNNEL CONSTRUCTION

Although the Hungarian rail network is denser than the European average, the geographical characteristics of the country have required railway tunnels to be constructed in exceptional cases only. Due to special track alignment restraints, a tunnel had to be constructed in Balatonkenese, as well as in Budapest, near Déli railway station, where the lie of the land and the structure of the city necessitated a tunnel,.

2 NEW FACTORS INFLUENCING THE DEMAND FOR RAILWAY TUNNEL CONSTRUCTION

The situation has changed by now, and today the demand for tunnel construction is also influenced by other factors, such as environmental requirements, real estate development, as well as the significant changes in railway development parameters, that are required for enhanced- and high-speed railways.

These factors often have a combined effect.

Lately, due to **environmental reasons**, a railway tunnel has become necessary on the line connecting Hungary and Slovenia. The project, comprising a direct railway link between Hungary and Slovenia, was launched in the late 1990's, because at that time the newly independent Slovenia could only be reached by rail via Croatia

Enhanced- and high-speed railway lines require tunnels, even if the terrain is relatively mild. Compared to conventional railway lines, where the maximum speed is usually limited to 120 km/h, the planned enhanced-speed railway lines intended for speeds of 160 to 200 km/h require different track alignments. The same applies to the new high-speed railway lines, where the speed of the trains exceeds 250 km/h.

In Hungary the reconstruction of the railway lines forming part of the Pan-European Corridors, belonging to the TEN-T (Trans European Network – Transit) network, has started in accordance with the requirements of the European Union in order to enable enhanced speeds. During preparations for a high-speed rail network, the need for tunnel construction is influenced by a number of factors, such as the lie of the land, protection of the environment, settlement structures and real estate development.

The high-speed railway lines are included in the National Spatial Plans, their basic criteria are:

- Design speed: 300 km/h
- Two tracks in the second phase
- Passenger and freight transport
- Possibility to connect to the existing rail network at major junctions
- Minimum curve radius R=5000 m, with 120 mm superelevation and 0,65 m/sec^2 lateral acceleration
- Vertical curve radius: 16000 m

In the first phase of track alignment, the proposed lines were discussed. During the design, the first versions were along the Pan-European Corridors, which were clearly simplified during the discussions.

From the high-speed rail the impact study of the **Vienna – Budapest, Budapest – Debrecen – Záhony/Eperjeske and Cegléd – Szeged – Szabadka/Temesvár** lines has been prepared and approved as part of the National Spatial Plans. Furthermore, a decision has been taken about the connection

of Ferihegy International Airport to the high-speed rail network.

During preparation of the National Spatial Plans, the need for railway tunnels, as well as track alignment below ground level, has arisen in respect of the Vienna – Budapest high-speed railway line and in the area of Ferihegy.

In addition to those developments which are directly linked to railway infrastructure developments, the relocation of the railway lines below ground level or the construction of a new alignment with a railway tunnel have arisen lately, partly because of real estate **development** and **urban structure** reasons, or due to a related function.

3. DEMAND FOR AND POSSIBILITIES OF TUNNEL CONSTRUCTION IN THE HUNGARIAN RAIL NETWORK

3.1. Tunnel developments related to the reconstruction of the TEN-T network

In connection with these developments, the need for tunnel construction has arisen in a number of sections.

From the TEN-T projects, a preparatory study on increased speed in the Hungarian section of the V.C. Pan-European Corridor has been prepared, with track alignments for speeds of 120 and 160 km/h. In order to raise the speed, tunnel construction will be necessary in the railway line section running through the Mecsek mountain range. At Abaliget there are railway tunnels on the existing line. Between Godisa and Bükkösd, three new tunnels (340, 420 and 1270 m long) will be necessary in order to raise the speed limit to 160 km/h.

3.2. Tunnel construction for the high-speed network

The design parameters of the high-speed network require a much more restricted track alignment than conventional railway lines. First, the Budapest – Vienna/Bratislava link can be expected, which suits the Hungarian requirements as well. The **MAGISTRAL** project is the major forum of cooperation in respect of the Vienna – Budapest high-speed link. The target of this international initiative is the realisation of the **Paris – Strasbourg – Salzburg – Vienna – Budapest** high-speed rail link.

As part of the National Spatial Plans, the impact study of the Vienna – Budapest high-speed railway line has been prepared. The proposed alignment crosses the border at Hegyeshalom and Rajka, thus adjusted to the first phase of the MAGISTRAL project to Bratislava.

From Budapest to Gyor, the high-speed railway line is planned to run in the same traffic zone as the existing motorway. Along this section, the crossing of motorway junctions and industrial estates has proved problematic, as a result of which the high-speed railway line can only be constructed in a tunnel below ground level.

Tunnels and viaducts are necessary because of the Vértes mountain range and the geographical characteristics at the junction near Budapest.

Track alignment below ground level is also required for the high-speed line through the Budapest conurbation.

3.3. Proposed tunnel constructions due to urban structure, real estate development and functions

Owing to urban and real estate development reasons, the relocation of line sections, especially stations, below ground level has been put forward in respect of various parts of the network.

Regarding the reconstruction of **Budapest-Nyugati** railway station, several possibilities have been studied in line with real estate development opportunities. The existing track level would be placed 10 m below the ground level, providing adequate structural thickness and clearance for trains, as well as soil overburden for green spaces.

Another similar development proposal is the relocation of **Pécs railway station below ground level** and running the adjacent railway lines in a tunnel.

The most significant railway tunnel construction project under study forms part of the **Budapest Suburban Project**. The railway tunnel would connect Budapest-Kelenföld and Budapest-Nyugati railway stations. The deep tunnel undercrossing the River Danube would have stations at Budapest-Déli railway station or Moszkva tér on the Buda side, as well as in the city centre and Budapest-Nyugati railway station on the Pest side. Due to the restraints imposed by the existing Metro 2 Line and the planned Metro 5 Line, surface connection on the Pest side can be in two directions. The deep tunnel towards Szob and Esztergom can reach the surface at Rákosrendez_ railway station, and the line towards Cegléd, before Zugló.

D. CONSTRUCTION OF UTILITY TUNNELS

In Hungary utility tunnels of different sizes, such as the water tunnel under the River Danube have been constructed long ago.

The constantly-improving utility construction technologies are applied in Hungary, as well. Throughout the country, pipe jacking has been used to construct ROCLA protective tunnels of 1400-3000 mm inner diameter for water, sewage and heating pipes, such as the Váci út main collector sewer next to the alignment of the

Focus on Hungary

metro under the pedestrian pavement and the road.

An important direction of development has been the jacking of pre-manufactured rectangular frame elements under a railway track structure for a water tunnel with inner dimensions of 6.1 x 2.85 m and a thickness of 0.3 m.

One of the most difficult phases of mine shaft sinking is the excavation through loose, water-bearing sedimentary rocks. Jacking has been applied during construction of a pump shaft near Feny_f_ with an inner diameter of 4.0 m to a depth of 36 m. As far as inclined shaft sinking is concerned, pipe jacking has been used to install 3 m diameter ROCLA elements near Tokod, Mogyorósbánya and Kányás.

The conventional pipe jacking technique has been applied during construction of the main collector sewer on the bank of the River Danube, as well as 5 other major cities.

In Veszprém the existing main sewers have been reconstructed in order to prevent the city from recurrent flooding with rainwater.

The launch shaft provided a working space for a tunnel section under the city. From here the tunnel was driven using the microtunnelling method.

During construction, different geological conditions were encountered: solid limestone, dolomite with calcite veins, clay and marl. DN 1600 ROCLA pipes were jacked after the shield on a length of 535.7 m. In total, 177 pipes were installed, including the elements of the 4 intermediate jacking stations. Up to now, this has been the greatest pipe jacking tunnel length in Hungary.

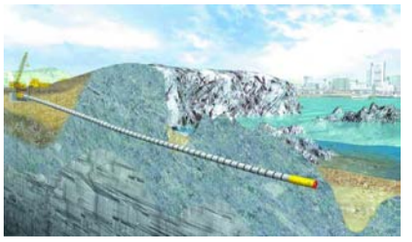
1. Szeged main collector sewer

In Szeged, nearly 10 km of the new main collector sewer with a diameter of NA100 – 180 cm has been constructed. Due to the large diameter (200 cm) and the relatively great depth (6 – 8 m), the entire tunnel section (3.6 km) in Szeged – Alsóváros was constructed using pipe jacking and an EPB (Earth Pressure Balance) shield.

2. Csepel Central Sewage Treatment Plant – river undercrossings

During this unique project, the River Danube has been a natural obstacle. A pair of reinforced concrete pipes with a diameter of NA1400 has been constructed on a length of 500 m under the riverbed of the Danube.

The launch and target shafts with a depth of 22-25 m and a diameter of 8-12 m were constructed on the banks of the river. In order to support the working space, interlocking pile walls of 1200 mm diameter and shotcrete were applied. A slurry shield, with an encasement adjusted to the pipe diameter, was used for pipe jacking.



The pipes of 3 m outer diameter for treated sewage were installed from the launch shaft on the bank of the River Danube on a length of 300 m towards the target shaft, protected by an artificial island in the river's channel. The bottom of the target shaft is 10 m below the riverbed.

Author's information:

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Member Nations Report 2008

AUSTRALIA

The mining industry in Australia is having a bumpy ride with the downturn in demand for raw materials however the civil side of the tunnelling business may actually be in for some wins. The need for our federal and state governments to stimulate their economies has lead to a number of major infrastructure projects being proposed and possibly even being brought forward.

Brisbane can look forward to another few years of tunnelling activity with the commencement of the Airport Link project with its 5.3km of tunnel and perhaps the Northern Link after that. Melbourne is talking Metro tunnels, north-south rail tunnels and east-west road tunnels. Current Sydney projects include the Sydney Desalination Project, the City West Cable Tunnel and the M5 East ventilation upgrade and there is also much talk about Metro and/or light rail tunnels. Over the Tasman Auckland is pushing ahead with plans for the Waterview Connection a 5km motorway tunnel and there is the proposed Britomart Rail Tunnel.

In the ATS we are continuing to promote Sydney as the venue for the World Tunnelling Congress in 2014 with the expectation that we will have plenty of potential business in Australasia to attract the northern hemisphere delegates. Perhaps the skill shortage will have been relieved a little by then as well; we are certainly attracting some good engineers from around the world as witnessed by the wide range of accents I hear on the phone calls from project sites. The tremendous success of our national conference held in Melbourne in 2008 gives us every confidence that we can host an excellent congress.

We are also working on improving the skills of our young engineers with another of our very popular tunnelling short courses scheduled for Sydney in late September 2009. Another way we are improving the skills of our members is through the technical sessions run by each of our state groups. These sessions are organized by our volunteers on the state committees and we should all be grateful for the comprehensive range of subjects and speakers they are able to attract for us. The Sydney Group held six technical sessions in 2008 and they were well attended with 50 to 80 attendees at each session. The Brisbane Group offer at least one technical session a month attracting audiences ranging between 60 and 140 reflecting the high level of activity in that city. Perth has had a quiet period due to the tunnelling activity in the state. It appears this may be changing as pre-Christmas a PTA tender was issued for the Perth Airport Rail Link Study. Melbourne is in a similar situation with a number of new rail and road projects on the table.

Membership continues to increase especially in the eastern states with many prepared to volunteer for our group committees. New faces are being welcomed each year maintaining the high level of energy and enthusiasm. Our efforts in Auckland to build up membership are not being rewarded, we get very large turn outs for the technical sessions but are yet to see this converted to members. We held our last executive committee meeting there and a technical paper on the Perth Metro presented by one of our executive members drew a large crowd. We also took the opportunity to make a site visit to the Hobson's Bay sewerage tunnel including a look at the boring machine.

2008 saw our David Sugden Award for a technical paper on tunnelling by a young engineer go to Jody Herley of Brisbane, who is looking forward to the trip to Budapest for the 2009 World Tunnel Congress. Jody's submission was top quality and she's a deserved winner, the girl's take out the prize again for the second year in a row!

We keep our members, engineering students and the interested public well informed through our web site www.ats.org.au. This is kept up to date and is a quality source of technical information on tunnels and tunnelling. We also offer genuine students free membership of the society which qualifies them to receive our Journal. This provides information on past, present and future projects and is an excellent tool for career planning, there are many opportunities in tunnelling, both in Australia and abroad.

AUSTRIA

The Austrian national committee of ITA participated the World Tunnel Congress in September 2008 in Agra/India with about 10 colleagues.

In 2008 again several conferences concerning tunneling were organized in Austria. The most important conferences were the AUSTRIAN TUNNEL DAY organized by the ITA Austria and the traditional "GEOMECHANICS COLLOQUIUM" organized by the Austrian Society for Geomechanics. About 1000 participants from 21 countries followed the interesting topics presented by national and international speakers, and as a highlight the AUSTRIAN TUNNEL DAY was opened by our ITA President Martin KNIGTHS. Both conferences took place in Salzburg in October 2008.

During the year 2008 in Austria a various number of tunneling projects – including extreme long ones – were started, were under construction or have reached the preliminary and tender design step.

• Starting with railway tunnels of ÖBB the Koralm tunnel has to be mentioned. The first big lot of this project – KAT 1 – was started on 15th of December 2008. The KORALM TUNNEL will close the missing railway link between Graz and Klagenfurt in the South of Austria. The tunnel system consits of two single tubes with an excavation diameter of about 10m and a length of more than 32,8 km each. The two tubes are linked with cross passages every 500m. While construction work for the investigation tunnels Leibenfeld and Mitterpichling has already been finished, tunnelling at the exploratory lot of Paierdorf will last till about 2009.

• There are some more future tunnelling projects of ÖBB belonging to the railway route of Koralm to be mentioned like Tunnel Peratschitzen, Tunnel Untersammelsdorf, Tunnel Kühnsdorf, Tunnel Lind, Tunnel Stein as well as Tunnel Srejach and further more Tunnel Laßnitzhöhe connecting the Koralm-route with the eastern part of Styria. Those tunnels are just under design.

Member Nations Report 2008

Another huge project named Semmering Base Tunnel is situated between Styria and Lower Austria. The project with a length of more than 20 km will consist of 2 single track tubes. At the moment an environmental impact study for the project is done.

• Looking at the railway route connecting Vienna with Salzburg some tunnels of ÖBB are under construction. Three of them are belonging to the socalled tunnel chain of Perschlingtal. All three, namely Reiserbergtunnel, Raingrubentunnel and Stierschweiffeld tunnel have quite low overburden and are situated between Vienna and St. Pölten.

• Further more several lots of the LAINZER TUNNEL, which will connect the western with the eastern and the southern routes of the Austrian railway network including cut and cover sections but also mined sections were under construction.

Coming closer to the capital of Austria, Vienna, the WIENER-WALDTUNNEL with a length of about 12 km and where the breakthrough of the project was celebrated in 2007, is still under construction.

• In the western part of Austria, at the UNTERINNTAL route in Tyrol, which is the northern access to the BRENNER BASE TUNNEL, the variety of chosen tunnel construction methods is very wide. BEG which is part of ÖBB, is responsible for realizing this project. The project UNTERINNTALBAHN which has a length of about 40 km consists of cut and cover sections and also mined tunnels. Following the very difficult alignment in this region in some parts of the route the use of compressed air had to be chosen. All at all there are 8 main lots.

• On February 6th 2009 at 19:21 hours, PORR Tunnelbau's experts steered one of today's largest tunnel boring machines of Europe, with a diameter of 13m towards the break-through point between Münster and Wiesing, accurate to the millimetre. The giant boring machine, which was especially developed for the Lower Inn Valley project, is about as high as a four-storey building and weighing 2,600 tonnes. Taking only 585 tunnelling days, a tunnel length of 5.8km was completed six months ahead of schedule.

• Going south from Innsbruck the BRENNER BASE TUNNELis under design. In the year of 2008 the environmental impact study was finalized and presented to the authorities in Austria and Italy. Some parts of the project are under preparation to start the construction – at least the exploratory tunnels. On the Italian side the first lot for exploration already started in 2007.

Regarding road tunnels of ASFINAG a lot of projects can be mentioned. One for example is Lainbergtunnel situated along A9 with a length of about 2000m which was finalized in 2008. Further more the 2nd tube of Katschbergtunnel with a length of 5400m and situated along A10 was finalized. After opening the 2nd tube, the first one was closed for repair work. The 2nd tube of Tauerntunnel with a length of 6400m which is also situated along A10 is still under construction.

• Looking at the Western Part of Austria 2nd tube of Roppener Tunnel along the route of A12 with a length of 5000m is under construction, repair work of the 1st tube will follow. Further more 2nd tube of Pfändertunnel with a the length of 6400m is under construction and repair work of the 1st tube of Pfändertunnel will start after opening the 2nd tube.

Tunnel Tradenberg with a length of about 2400m, 2nd tube of Ganzsteintunnel with a length of about 2100m, Tunnel Kirchdorf with a length of about 2700m and Tunnel Kaltenbach with a length of 1100m were/are under construction. Some of the 1st tubes of existing road tunnels are under repair work.

So all at all ASFINAG is building some 37.7km of new tunnels and has about 25,3 km of road tunnels under repair work.

Some of them like Tunnel Speltenbach and Tunnel Rudersdorf both belonging to S7 Fürstenfelder Schnellstrasse, 2nd tube of Bosrucktunnel belonging to A9, Freinbergtunnel and Tunnel Pöstlingberg belonging to A26 as well as some tunnels of S10 are all under design.

• But Austrian construction companies and tunnel consultants are not only working within Austria; for example in 2009 the tunnel construction company HINTEREGGER was working on an underground water supply project in Zürich with a length of about 6.8km, further more on the railway tunnel project Osterbergtunnel at the NBS Erfurt – Leipzig/Halle and the bypass tunnel of Schwäbisch Gmünd which is a road tunnel with a parallel safety tunnel.

• In 2008 also huge hydro power plants using lots of kilometers of underground facilities were under construction. Both LIMBERG and KOPS are situated in the western part of Austria.

In 2009 in Austria two conferences concerning tunnelling are mentioned. The one will be the "Geomechanics colloquium" (www.oegg.at) at the congress center in Salzburg in October, the other is the "Südbahntagung" (www.suedbahntagung09.at.tt) at the Mining University of Leoben in November.

Connecting to the work of the WG19 – Conventional Tunnelling – Austria is working on a paper called "NATM – the Austrian way of conventional tunneling" which shall be ready end of 2009.

In 2009 Austria's Mining University of Leoben, chair of Subsurface Engineering and the Technical University of Graz, chair of rock mechanics and tunneling are going to start a jointly organized post-graduate course in NATM engineering. Informations to the course can be seen on the homepage www.natm.at.

In 2008 ITA Austria celebrated its 10th year of constitution and wishes the ITA family all the best.

BELGIUM

ABTUS is a non profit association with open membership for individual and collective members (66 collective and 43 individual members).

Member Nations Report 2008

In 2008, ABTUS held its General Assembly 2008 on 19.03.2008 with conference on "Deep borings", participated in the General Assemly of ITA and the World Tunnel Congress in Agra, 20-25.09.2008, participated in the Congress of the French Tunnelling and Underground Space Association in Monaco, 06-08.10.2008 and organized a Studyday on 16.12.2008 "Geological borings"

SIGNIFICANT PROJECTS UNDER CONSTRUCTION:

• High speed train Brussels – Liège – Köln : installation of equipments in the tunnel under the hill of Soumagne (total : 1500 m)

• Rail-connexion of the airport of Brussels to the high speed railway network : 2 bored tunnels of 1100 m, cut-and-cover section of 1000 m

• Railway-tunnel "Schuman-Josaphat" for creating a second North-South link through Brussels and better connecting the European headquarters to the airport : built in-situ, 1250 m

SIGNIFICANT PROJECTS UNDER DESIGN :

• Railway-tunnel "Liefkenshoek" under the river Scheldt in Antwerp : bored tunnel (5570 m + cut-and-cover sections 500 m and 1075 m) or immersed tunnel (3450 m + cut-and-cover sections 2700 m and 1075 m)

• Closing of the motorway around Antwerp : tunnel under the river Scheldt : 1000 m, possibly included in a storm barreer

• Deep underground disposal of high level radioactive waste : gallery 250 m long, 220 m deep

• Road tunnel under the airport of Charleroi

• Section Charleroi-French border of the motorway E 420 : section of 13 km including 3 cut-and-cover tunnels (total 1700 m)

• Test cave for nuclear reactor : 70 x 47 x 43 m

OTHER POSSIBLE SIGNIFICANT PROJECT :

• Shortcut in the motorway around Brussels : bored tunnel (single tube with 2 traffic levels, cars and public transport busses, multimodal approach) : around 10.000 m length

BULGARIA

The private Bulgarian company Geotechmin OOD is part of the GEOTECHMIN group which is engaged, among others, in underground and tunnel construction. One of the most significant projects for 2008 is the construction of a connecting tunnel between Metrostation 9 and the existing tunnel under Dragan Tzankov Blvd in Sofia. Throughout the year GEOTECHMIN's representatives have taken part in a number of national and international forums in the fields of mining and tunnel construction.

Unfortunately, the situation remains unchanged when compared to the year 2007 with Bulgaria still lacking national working groups. There is no clearly structured national body (Tunneling Association) in Bulgaria at this time.

In 2008, after the approval of Geotechmin OOD, the Bulgarian company Hydromat Ltd. was accepted as an associated member of ITA-AITES. The company is engaged in the design, supply and installation of waterproofing and heat insulation materials. It is a leader in underground waterproofing. Hydromat Ltd. is the designer and contractor of the waterproofing works at one of Bulgaria's most important national projects – the Sofia Metropolitan.

Dragan Tzankov Connecting Tunnel, Sofia Metro Extension Project: Geotechmin OOD is the designer and contractor of the connecting tunnel between the existing tramway tunnel under Dragan Tzankov Blvd. and Metrostation 9 (MS9). The site is part of the project for the construction of the first diameter of Sofia Metropolitan. The section is 208 m long with 0.0375 longitudinal slope in the direction of MS9. The earth cover varies from 11 m at MS9 to approx. 7.60 m under Dragan Tzankov Blvd. The construction of the underground connection started on 8 May 2007, immediately after signing the agreement with the Japanese construction company Taisei Corporation, which is the main contractor for this section of Sofia Metropolitan. The works were completed on 27 July 2008.

Negarshtitza Hydrotechnical Tunnel – 1st stage: This hydrotechnical facility consists of a 680 m long tunnel with an inclination of 7-15% and a cross-section of 10.3 sq.m., and a 42 m long culvert with an effective cross-section of 5 sq.m. The facility is intended to free areas for "Negarshtitza" waste bank of "Ellatzite" open-pit mine. Modern shaft sinking machines have been used for the construction of the tunnel. It has been strengthened by means of various stabilizing structures – tube umbrella under the Symmetrix System, armored frames, metal arches and friction anchors. The hydrotechnical tunnel was completed in 10 months.

Drainage Gallery at "Ellatzite" Copper Mine: The future development of the mine has imposed the construction of a new drainage underground facility. The drainage gallery at Horizon 840 will be 1085 m long and with a cross-section of 12.4 sq.m. Modern shaft sinking machines are being used for its construction. Moreover, new underground facilities that will allow further research of the deposit are planned for construction

CANADA

The Tunnelling Association of Canada (TAC) (www.tunnelcanada.ca) held their 20th National Conference in Niagara Falls, Ontario in October 2008. The 3-day conference was well attended by over 150 delegates from the underground/tunnelling industry. The conference was also attended by Claude Bérenguier, ITA Secretary General. A site visit was organized to the Niagara Tunnel Project,

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where the world's largest open hard rock TBM is excavating the 14.4 m diameter, 10.4 km long water diversion tunnel.

The annual general meeting of TAC also took place during the TAC Conference in Niagara Falls and Mr. Rick Staples was confirmed a new TAC President, assuming the position previously held by Mr. Garry Stevenson.

Vancouver, Canada, will host the ITA World Tunnel Congress in 2010 and the 36th General Assembly (www.wtc2010.org) in May 2010. Organization for the congress is well underway by a designated committee together with the congress organizer, the National Research Council (NRC).

CURRENTAND RECENTLY COMPLETED MAJOR TUNNELLING PROJECTS

Canada Line LRT, Vancouver, BC twin 2.2 km subway tunnels. TBM excavation completed and fit out ongoing. The entire new subway line to the airport will be operational in late 2009 in time for the 2010 Winter Olympics. Contractor – SELI-SNC Lavalin JV

Bathurst / Langstaff Sewer, York Region, ON– 3.3 m diameter, 8.3 km TBM excavated tunnels were completed August 19, 2008. Contractor - McNally AECON- JV

Seymour Capilano Twin Tunnels, Vancouver, BC – twin, 3.8 m diameter, 7 km drinking water tunnels have been re-tendered in late 2008 for award in early 2009 following project termination in early 2008. TBM excavation is approximately 50% complete

19th Avenue Sewer, York Region, ON 3.3 m diameter, 4.2 km TBM excavated tunnels were completed May 1, 2008. Contractor - McNally AECON- JV

Niagara Tunnel Project, Niagara Falls, ON 14.4 m diameter, 10.4 km TBM excavated tunnel is approximately 40% completed. Contractor – Strabag

Ashlu Hydropwer Project, Squamish, BC 4.4 km, 4.0 m diameter hard rock TBM tunnel completed excavation to the dead-end shaftbase in February 2009. Raisebore drilling of the 3.8 m diameter, 135 m deep drop shaft will commence in March 2009. Contractor – Frontier Kemper Constructors

Valley Ridge Feedermain Bow River Tunnel Crossing, Calgary, AB. 280 m long 1.6 m diameter TBM tunnel in weak sedimentary rock. Contractor – Dibco Underground, drop shaft excavation to commence in early March 2009

North East Sanitary Sewer (Edmonton) 2.5 diameter, 3.35 km excavation progress, Contractor – City of Edmonton Tunnelling Department.

South West Sanitary Sewer W12 (Edmonton) – 3.2 diameter, excavation commenced on March 3, 2009. Contractor – City of Edmonton Tunnelling Department.

FUTURE MAJOR TUNNELLING PROJECTS

Spadina Subway Extension, Toronto, ON – 8.6 km of twin tunnels and 6 stations – 2011

Yonge Subway Extension, Toronto, ON –6.8 km of twin tunnels and 6 substations - 2012

Kicking Horse Canyon Road Tunnel, BC – 3.0 km twin road tunnels – 2013.

Evergreen LRT Tunnels, Vancouver, BC – twin 2 km tunnels – 2010.

Port Mann Water Main Tunnel, Vancouver, BC – 1 km tunnel – 2009.

Southeast Collector Sewer Tunnel, York Region, ON – 16 km – 2009.

CHINA

In August 2008, we held the 7th Mainland China-Taiwan Science and Technology Seminar on Tunnels and Underground Works. The possibility and significance of Taiwan Strait Crossing Transportation Project was discussed in the seminar.

China was the third largest delegation at the World Tunnel Congress 2008 and the 34th General Assembly of ITAAITES. Chinese delegation has 72 members, among which 51 members registered and participated in the congress. Chinese delegation presented 16 articles and 3 posters. On behalf on China, President Guo Shanyun attended the 34th General Assembly of ITA-AITES. In the General Assembly, Professor Bai Yun of China was elected as one of the member of the executive committee of ITA-AITES. The term of Professor Bai Yun as the member of the executive committee of ITA-AITES is 3 years, which will be expired in 2011.

In November 2008, we held Symposium of the 13th Annual Conference of China Civil Engineering Society and the 15th Annual Conference of Tunnel and Underground Works Branch of China Civil Engineering Society. ITA Executive Committee meeting was held in Guangzhou, China at the same time. 33 research reports were discussed in the Symposium, including academician Wang Mengshu's "Principle and Key Aspects of Tunnel Design" and academician Zheng Yingren's "Analysis on Stability of Surrounding Rockmass of Rock Tunnels and Its Strength Parameters". 97 papers were selected from those submitted and were published in "Modern Tunneling Technology".

CURRENTAND RECENTLY COMPLETED MAJOR TUNNELLING PROJECTS

- Wuhan Yangtze River Crossing Tunnel
- Yellow River Crossing Tunnel on South-to-North Water Transfer Project
- New Dayaoshan Tunnel
- West Qinling Tunnel
- Chongmingdao Tunnel in Shanghai
- Beijing Rapid Transit Tunnel: Large Cross-section Urban Underground Railway Tunnel

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- Zhongtianshan Tunnel
- Zhengzhou Metro
- Guangzhou Metro
- Shenzhen Metro
- Shanghai Metro
- Beijing Metro
- Tianjin Metro

China has entered the rapid infrastructure-developing stage. 17 railway lines, each of which has more than 100km tunnels, will be built in 2009. The total legnth of the railway tunnels that will be under construction in China in 2009 will reach 3229km. For example, Lanzhou-Chongqing railway has 528km tunnels and Guiyang-Guangzhou railway has 463km tunnels.

CZECH REPUBLIC

In 2008 the CzTA ITA-AITES started preparation of the 11th international conference "Underground Construction Prague 2010". The Tunel magazine published by CzTA increased its content, quality and number of customers. CzTA organised 3 seminars, professional excursion to Leipzig, Hamburg and Denmark. The third book of CzTAdocuments focused on sprayed concrete was published in 2008.

WG for Shotcrete Use cooperates closely with WG12. The book Sprayed Concrete for Underground Structures was published by this WG. Actualization of Czech guidelines for sprayed concrete is currently ongoing.

Also working groups for conventional tunnelling, for design and calculations of underground structures and for waterproofing of tunnels continue in their activities

Two new double-track railway tunnels under Vítkov Hill, which are parts of the New Connection Project, are in operation since November 2008. The tunnels significantly contribute to the improvement of the capacity of railway tracks coming to the main station in Prague from the east.

- The work on the currently largest tunnel construction project in the Czech Republic, the Blanka complex of tunnels, continued in Prague. The project consists of a 6.4km long section of the City Circle Road, comprising twin-tube tunnels 5.5km long in total. The work started on the longest tunnel section, the Královská Obora section, which is 3.09km long ; 2.23km of this length is constructed by mining methods.
- The work is also underway on motorway tunnels on the Prague City Ring Road (an outer circle road), namely the Lochkov tunnel (1620m) and Komorany tunnel (1930m).
- The over 1200m long twin-tube tunnel are driven through the Brno Clay, which displays unfavourable geotechnical properties.

Of the projects to be implemented in the future, the greatest attention is attracted by the preparation of the construction of the Prague underground lines A extension and of the longest railway tunnel, from Prague to Beroun, which is to be nearly 25km long. The tunnels will be driven by TBMs.

DENMARK

The Danish Society for Tunnels and Underground Works has during the year 2008 arranged 6 member meetings including two technical site visits to see the TBM in action at the Hallandsås project in Sweden and to study the PPP project in southern Norway between Grimstad and Kristiansand, where more than 7 mio. cubic meter of rock are to be drilled and blast for the 8 road tunnels under construction with a total length of 12 km.

The 2nd October 2008 the Danish Society for Tunnels and Underground Works celebrated its 25 years anniversary with a one day seminar in Copenhagen. Almost 100 participants from all over Scandinavia including representatives from ITA EXCO made the seminar memorable and a major success.

Members of the society have participated in ITA General Assembly in Agra, India from 21 to 25 September 2008 including meetings in three ITA working groups. Members have also participated in activities within COSUF during 2008.

The **Cityringen** project has progressed well during 2008. The project consist of 15 km metro lines (30 km tunnels) with 17 underground stations, 5 emergency and ventilation shafts and a 1.5 km branch off tunnel to a new maintenance and service centre. The stations will be constructed by open cuts within a box structure of retaining walls of either secant piles or diaphragm walls, the platform will generally be 19 m below ground, with some stations only 15 m deep and one station 25 m deep. The tunnels will be constructed in limestone of 2/3 of the alignment, whereas in the northern part of the alignment the tunnels will have to be constructed in glacial water bearing deposits of sand, gravel and clay till. There are strict requirements for not lowering the ground water table during construction and closed face TBM´s of either earth pressure balance or slurry types will be required. For the station construction re-infiltration of ground water will be required for the control of the ground water table during construction, at some sites in combination with pre-grouting or freezing of the soil and rock mass.

The conceptual design and the Environmental Impact Study were approved in 2008 and tender documents are in preparation by the Client Metroselselskabet I/S and its consultants. During 2008 geotechnical and environmental site investigations have been ongoing with the completion of more than 200 geotechnical borings and the campaign continues in 2009.

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Prequalification of contractors was initiated in December 2008 by issuing an invitation to tender to build the metro. The civil works have been divided into two lots, a northern contract covering construction of 7.2 km twin tube tunnels and 8 underground stations and a southern contract covering construction of 7.9 km twin tube tunnels and 9 underground stations plus the 1.1 km branch off twin tube tunnels. The civil works contracts include E&M installations. A separate contract is issued for the transportation system containing signaling, track, and rolling stock for the full circle line. The short listed companies will be announced before the summer of 2009. Tender documents will be issued to the shortlisted contractors after the summer 2009 and it is intended to enter into contracts late 2010.

In September 2005 a proposal was published outlining a 12 km immersed road tunnel with 6 lanes linking the motorway system at the north with the motorway system at the south of Copenhagen. The alignment followed the Copenhagen Harbour Canal throughout and included an underwater parking facility. The cost was estimated to be close to 3 billion Euros. The proposal was very well received by the public and local politicians, because it was designed to remove a very substantial part of the road traffic from the center of Copenhagen as well as providing better access to development areas east of Copenhagen Harbour. The scheme has been developed further by the City of Copenhagen together with the consultant Rambøll in 2008, and is now included fully or partly in two alternative solutions. In December 2008 The Danish Government presented their plan for the Danish Transport Policy until 2020. The plan states that the government will initiate a strategy analysis for an Eastern Ring Road.

The proposed approximately 3 km new road link **("Northern Harbour Link")** between Nordhavn and Lyngbyvej located north of Copenhagen has during 2008 been developed further. Two alternatives, comprising cut-and-cover and bored tunnels with a length from 0.5 to 2.5 km have been investigated. The project is being developed by the City of Copenhagen and the consultant Rambøll. In January 2009 the Environmental Impact Assessment (EIA) report is expected to be approved by the City of Copenhagen. The project is planned to be tendered for construction works by 2010 and is expected to take 4 - 6 years to complete.

A new tunnel connecting the Motorway system and **Ring Road network around Aarhus** with Port of Aarhus – containing the largest container terminal in Denmark - is in the design phase. In October 2008 the City Authorities in Aarhus approved the design performed and presented during the Environmental Impact Assessment (EIA) process. The tunnel is a unidirectional cut-and-cover tunnel with two tubes each containing 2 lanes. The total length is 1.8 kilometres with no entrances/exits planned over the distance. On top of the tunnel Marselis Boulevard (a four lane street) will be excavated and reconstructed in a modern layout during the construction phase. In 2010 the construction works are planned to commence and expected completion is late 2015. Prequalification notice is expected to be launched in June 2009. The construction works will be tendered as “Design & Build” divided into two tender packages 1) a 2.0 km 4 lane road with 2 major and 4 minor bridge structures and 2) a 1.8 km cut-and-cover tunnel and reconstruction of Marselis Boulevard. The total budget for the project is approximately 200 million Euros. The Consultant is Ramboll.

The contractor PIHL is conducting a turnkey contract for construction of 3 fully automatic underground parking facilities with room for in total 840 cars for the client, Copenhagen Municipality. The 3 parking facilities are located at Nørrebro, Amagerbro and Islands Brygge.

The work commenced in March 2008 and is expected to be completed during the summer 2010. The contract includes all civil works and technical installations. The automatically parking facilities containing elevator systems to carry the cars to their correct positions and pick them up again will be supplied by the company Westfalia (D). The underground structures are constructed by reinforced concrete bottom slab and top deck The walls are made by either reinforced bored piles (length approx. 19 m / Ø1200mm) with a inner reinforced wall or sheet pile wall (HZ /AZ) without inner wall. Uplift anchors are installed and during construction the ground water is lowered by means of filter borings. The method of bored piles is used due to limit environmental impact from noise/vibration and geological reasons. In the depth of 10-12 m below ground level the Copenhagen limestone starts and the hardness varies from H1 to H5 (flint stone of layers 100 to 1000mm). In spite of construction sites located in dense populated areas and the actual geological conditions the contractor PIHL has been able to conduct the work without disturbances due to unacceptable noise or vibrations.

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EGYPT

ETS is an NG organization including 305 individual & 10 corporate members. ETS publishes a periodical newsletter every 6 months in Arabic, but abstracts of its monthly technical lectures & presentations (8 in year 2008) are included in English. ETS participated in the activities of ITA Annual Congress no.34 in Agra , India, Sep. 2008 and participated in the activities of numerous Working Groups of ITA. ETS participated in the congress of tunnelling held in Monaco, Oct. 2008.

The national W.Gs of ETS continued their co-operation & coordination with their respective W.Gs in ITA through correspondences by E-mail, fax, or ordinary mail.

The Greater Cairo Metro Line 3 is 30.5 km length of which nearly 28.5 km are underground together with 29 stations. The route extends from Cairo Airport to Imbaba. Additional branch to Mohandeseen of 3 km, is added which shall be also constructed in underground. The line crosses the River Nile twice. The planned capacity of the line when completed is 2.1 million passengers / day. The works on of the Cairo metro line 3 phase I, had already started in July 2007. This phase includes 4.5km in deep tunneling & 5 underground stations. Hoping to finish this phase by October 2011. Phase 2 will start in July 2009 parallel with phase 1& includes 6.5km. & 4 stations all underground. Hoping to finish this phase by October 2013.

• Line 4, phase I of Cairo Metro is under study hopefully to be tendered by January 2010 . This phase is of 12 km length and 11 stations. It crosses underneath the full width of the Nile river of about 600 m which is a big challenge .

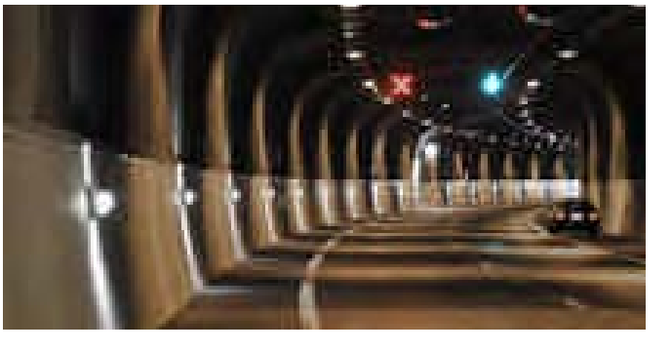
• The transportation study for Greater Cairo Area had been finished proposing 6 lines of metro till 2022. Three further metro lines are recommended in this study in addition to the already 3 basic lines [lines 1 & 2 being finished, line 3 is now under construction].

FINLAND

The main activity of the Finnish Tunnelling Association in 2008, was the proposal to serve as the host for ITA – AITES 2011 World Tunnel Congress. FTA was also in charge of secretary role for ITA Nordic Forum. In Finland, FTA participated in Rock Engineering seminars, and started distribution of Guides for planning and construction of Civil Defence shelters (216 pgs).

Members of FTA have increased activity in the working groups, participating in WG 3 Contractual Practices in Underground Construction, WG 6 Maintenance and Repair of Tunnels, WG 11 Immersed and floating tunnels, WG 12 Shotcrete Use, WG 19 Conventional Tunnelling, WG 20 Urban Problems, Underground Solutions. FTA is represented in the Steering Board of ITA – CUS, and also in ITA – COSUF.

• 2008, the construction of last 50 km part of motorway on E18 from Helsinki to Turku was finished, and now open for traffic. It included 7 twin-tube motorway road tunnels, total length 5,2 km. The contract is a Life Cycle Contract, including planning and construction and 25 years financing and operation period, too. Construction works started in 200 www.tiehallinto.fi.



• Rock works on a 2,5 km long Helsinki city centre service tunnel for supply to stores and shopping centres and for access to car parks are finalized.

•The new Ring Rail Line will connect the Helsinki Vantaa airport to city centre of Helsinki in 2014. This project includes 18 km railway line of which 8 km will be in tunnels (www.kehara-ta.net.) Design progress in 2008 enables construction start 2009.

• During 2008 the planning and design of the new metro line from Helsinki to Espoo has been started. The project includes 13,9 km of twin tunnels and 7 underground stations. Construction works will start in 2009.

• During 2004 the excavation works of Onkalo project, concerning the final disposal of used nuclear fuel in bedrock has been started in Olkiluoto, in western coast of Finland. This underground research and construction project will be continued about 100 years in future (http://www.posiva.fi/englanti). In the end of 2008 about 3 km of total 4 km long access and research tunnel had been excavated and investigated.

• The 120 km Päijänne raw water tunnel, which was completed in 1982 and supplies water to Helsinki / Espoo / Vantaa region was renovated in two stages 2001 and 2008. Renovation work is completed and shows competitive life cycle cost for the tunnel.

FRANCE

L'AFTES, Association Française des Tunnels et de l'Espace Souterrain, créée en 1972 sous le régime de la loi de 1901, a pour but de promouvoir le plus large usage possible du sous-sol au bénéfice de l'urbanisme et de l'aménagement du territoire et

de faire progresser la connaissance en matière de travaux souterrains dans les domaines scientifiques, techniques, juridiques, administratifs, économiques et sociaux en vue de réduire les coûts et les délais d'exécution et promouvoir ainsi le développement de tous les ouvrages et espaces souterrains.

Seize groupes de travail en activité représentant environ 250 membres.

• Compilation de 6 recommandations (en français) sur les revêtements en béton (calculs, conception, béton, mise en œuvre)

• 4 nouvelles recommandations ont été publiées dans TOS en 2008 : GT37 (résistance au feu tunnels routiers), GT28 (puits profonds – galeries inclinées), GT24 (reconnaissances à l'avancement), GT3 (tir séquentiel-mesures de vibrations).

• Sur le site, 23 recommandations en français et 32 recommandations en anglais téléchargeables gratuitement (Au total 82 recommandations en français et 40 en anglais).

QUELQUES OUVRAGES IMPORTANTS ACHEVES EN 2008

• Galerie de sécurité parallèle au tunnel Maurice Lemaire : L6230 m (Vosges)
• Tunnel routier du Mont Sion : L3100 m (A41 Genève)
• Descenderies du Lyon Turin : Saint Martin la porte L2050 m - Modane L4000m - La Praz L2500m (Savoie)
• Métro de Marseille : L2500 m (Bouche du Rhône)

QUELQUES OUVRAGES IMPORTANTS EN COURS DE TRAVAUX EN 2008

• Ville Toulon : Tube routier sud : L1000 m (Var)
• SNCF LGV : Tunnel des Chavannes en cours - L1970 m (Rhin Rhône)
• Métro Lyon : Démarrage des travaux de la ligne D - L1700m Oullins (Rhône)
• Métro Paris : Mise en service du prolongement de la ligne 13 - L1900 m (Ile de France)
• Métro Paris : Prolongement de la ligne 12 - L3800 m (Ile de France)
• Métro Paris : Prolongement de la ligne 4 - L1470 m (Ile de France)
• SIAAP : TIMA 2: Paris 12ème – L800 m – Ø 4,00 m (Ile de France)

QUELQUES OUVRAGES IMPORTANTS A LANCER EN 2009

• Tunnels routiers 2x2 de l'A89 : Violay L4000 m, Bussières L1000 m, Tarare L1000 m, Chalosset L700 m (Rhône / Loire)
• SIAAP - VL9 Charenton-Valenton (94) Lot 1 : Ø 2.50 m - L1400 m - Attribué et travaux 2009-2010 (Ile de France)
• SIAAP - VL9 Charenton-Valenton (94) Lot 2 : Ø 3,00 m - L3400 m - En attente attribution - Travaux 2009-2012 (Ile de France)
• SIAAP - VL9 Charenton-Valenton (94) Lot 3 : Ø 3,00 m - L1650 m -Consultation en cours–Travaux 2010-2012 (Ile de France)

QUELQUES ÉTUDES IMPORTANTES EN COURS

• Mise en sécurité du tunnel routier actuel (mono directionnel) de Tende : L3200 m (Alpes Maritimes)
• Nouveau tunnel routier mono directionnel parallèle au tunnel de Tende : L3000m m (Alpes Maritimes)
• Galerie routière parallèle au tunnel de la Croix Rousse de Lyon : L1800m et rénovation du tunnel : L1800m (Rhône)
• Liaison autoroutière Lyon-Saint Etienne : 4 tunnels 2x2 d'une longueur totale de 4000 m (Rhône / Loire)
• Galerie cycliste et de sécurité parallèle au tunnel du Siaix : L1500 m (Savoie)
• Galerie routière et de sécurité parallèle au tunnel du Fréjus : L12000 m (Savoie)

GERMANY

DAUB is a registered non-profit restricted association with up to individual 30 members; in details up to 10 from owners, up to 10 from scientific institutions and consultants, and up to 10 from contractors and machine producers. The members are personally elected for a period of 3 years. Re-election is possible as long as the member is not retired or has changed his field of duties, so that he is not any longer involved in tunnelling business. DAUB does not run its own official journal. Recommendations and official papers of DAUB are published on occasion by the international journal TUNNEL (ISSN 0722-6241). This journal contains bi-lingual articles in German and English and is issued 8 times a year with a number of 4500 copies per issue. All published papers are also available for download on the web site of DAUB.17 DAUB members took part in the annual traditional D-A-CH-meeting 2008 involving Germany (D), Austria (A) and Switzerland (CH). The host was Germany. The meeting took place in Weimar. It was attended also by 20 Austrian and 6 Swiss colleagues. The 2 day technical seminar dealt with most challenging actual tunnel projects, especially the underpassing of existing buildings by new tunnels as well as with the analysis of failures and accidents during tunnel construction. The additional technical tour led to the Finnetunnel which is part of the high-speed railway line between Erfurt and Leipzig/Halle in eastern Germany.

DAUB run 5 working groups during 2008: • Safety in tunnelling, jointly prepared with the Austrian and the Swiss National Tunnelling Committees • Financing of tunnels via PPP/BOT-projects • Recommendations for the selection of appropriate TBMs • Recommendations for designing prefabricated tunnel lining segments • Geological investigations for tunnelling

These working groups are of temporary nature and will be closed as soon as they have finished their special tasks. Members of these working groups are mostly also members of DAUB, but specialists from outside are also involved in some cases.

The results of the working groups are published in technical journals, preferably in "Tunnel" (www.tunnel-online.info), but sometimes also in the German handbook of tunnelling (edited annually).

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The following major tunnelling projects were running in Germany during 2008: • **New ICE high speed lines** (250 to 300 km/h): between Karlsruhe and Basel; partly upgraded and partly replaced, integrating two major bored tunnel projects of 9 and 6 km respectively in length. Each tunnel consists of two parallel single tubes with about 10.5 m excavation diameter. Inauguration is planned for 2011 to improve the traffic connections between Northern and Southern Europe via Lötschberg and Gotthard base tunnels in Switzerland. • **DB project Stuttgart 21** putting the above ground main station underground by simultaneously turning it over 90 ° in plan view; this project involves besides the new underground main station nearly 40 km single/double track tunnels; intensive design work was started in 1997. First construction works started during 1998. After an intermediate slow down the project is planned to be reactivated in 2008. The entire project will be finished around 2015. • **Blessberg tunnel** (8.3 km as part of the Ebensfeld -Erfurt high speed line) and Finne Tunnel (6.9 km as part of the Erfurt-Leipzig/Halle new high speed line) are some major construction sites that started in 2007 • In 2007 a major program of **refurbishing and modernising** more than 150 years old railway tunnels along the river Nahe in Western Germany started using a special machinery to conduct the construction works under onging operation

General details on tunnelling in Germany can be seen in the table below according to the latest statistics conducted by STUVA.

Type of tunnel	in operation	under construction	planned
metro	660	24	50
railway	490	63	210
road	240	23	155
Total	**1,390**	**110**	**415**

Further information is given in the publication "Unterirdisches Bauen Deutschland 2005 - Underground Construction Germany 2005" including 75 projects of road, rail, metro tunnels, and caverns. In addition a description of the basic conditions concerning geology, clients and structure of the operators, awarding of contracts, financing, research and development in tunnelling, industrial safety and health care as well as statistics is given. The 500 page publication is available from STUVA at a price of 25 ¤ including mailing.

As an international tunnelling event the next biannual STUVA Conference in Germany will take place from 1 December until 3 December 2009 in Hamburg. This years motto is: **Tunnels – Key to Sustainable Mobility**

HUNGARY

Preparations for WTC 2009 in Budapest go continuously with the participation of organizing and scientific committee.

• II. and III. semester of a postgradual four-semester educational program for engineers in tunnelling.

• Visit and lectures of site works of St Gellért square station on the 4th metro line in Budapest on 18th of January 2008.

• Announcement of competition for diploma works in tunnelling

• The 13th Széchy Memorial Lecture Day in Budapest on 8th of February in 2008.

• Professional Scientific Day on 21 of February, Lectures about finite element modelling of tunnel lining, Budapest University of Technology and Economics

• The (annual) General Assembly of the Association was held on 17th of April.

• Studytour to construction site on Csepel Island to the Central Sewage water treatment plant on 28th of April.

• Professional Scientific Day in Eger on 6th of June, « City under the city » Visit of site works at reconstruction works of cellar system under the city

• Visit of site works of Rákóczi square station on the 4th metro line in Budapest and awarding a prize to the winner of the diploma work competition on 4th of September.

• Participation in ITA-WTC 2008 held in Agra (India) (19-25 September), where Hungary reported the progress of the WTC2009.

• Geotechnika 2008, (Geotechnics in Ráckeve/Hungary, 2008.october 28-30, annual), a regular three-day conference.

More information on underground works in Hungary are displayed in the article Focus on Hungary and on the Hungary page of the ITA website.

ICELAND

The Icelandic Tunnelling Society which represents the ITA National Group Iceland is an independant group of tunnelling professionals with corporate and ordinary members. Members were heavily involved in investigations, design and construction of major hydro and road tunnels in Iceland in the year 2008..

The year 2008 was productive in terms of tunnel planning, design and construction. Work was completed on the Kárahnjukar Hydro Project, a total of 70 km of tunnels. Work started on the 5,5 km long road tunnel between Ísafjördur and Bolungarvík **(Óshlío** tunnel) by Marti Contractors Switzerland and IAV Contractors Iceland . Work continued on the 11 km long **Hélinsfjördur road tunnel** by Metrostav from The Czech Republic and Háfell from Iceland. Other road and hydro tunnels are close to tender stage and construction expected to start within 1-3 years. Numerous road tunnels are being planned and investigated..

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ITALY

Società Italiana Gallerie is an open association (approximately 730 members), that promotes, coordinates and spreads the results of studies and researches in underground works. It publishes the "Gallerie e grandi opere sotterranee/Tunnels and large underground works" magazine (in Italian and English).

The working group activity in Italy, is mostly focused on the participation to the international working group for the occasion of the International world tunnel Congress.

RAILWAYTUNNELS :

Milan-Naples High Speed/Capacity railway line, **Bologna-Florence section**. The excavation and lining of the tunnels on the line (about 90 km in total) was completed at the end of 2005; the railway line will be in operation within 2009.

Milan-Naples High Speed/Capacity railway line, **Bolognafeed line.** The construction of the following in an urban context is at an advanced stage • 6.2 km of natural tunnel EPB shield 9.40 m in diameter; • 1.3 km of natural tunnel about 140 m^2 in section, through traditional excavation ;• Underground station of Bologna Centrale (platforms 12-17).

Brenner railway tunnel, boring of the pilot tunnel (about 50 km overall) is in progress. Also Mules adit excavation has started

Genoa-Ventimiglia railway line – Doubling of the track between Andora and San Lorenzo al Mare. The excavation of 11 natural tunnels for an overall 15 km approx is in progress, partly via TBM of 11.84 m in diameter, partly by traditional excavation (section of about 125 m^2)

METRO TUNNELS :

Naples, Line 1, Dante-Garibaldi extension, The work consists in the excavation via two EPB shields of 6.70 m in diameter of the twin-tube tunnel of about 6 km and 5 stations (Garibaldi, Università, Duomo, Toledo and Municipio). All The stations are created after freezing the ground. Excavation of line tunnels and of 4 stations is over. Excavation of Toledo station is in an advanced stage.

Naples, Line 6, The work concerns: a single tube tunnel of about 3,300 m to be created via an EPB shield of 8.30 m in diameter; 6 stations. Excavation works are in progress

Genoa metro (**De Ferrari-Brignole section**), The conventional excavation of the bored tunnel of about 1,500 m and 9 m excavation diameter is over. Brignole station excavation is in progress

Milan metro Line 3 – Maciachini-Comasina extension, Line tunnels excavation is over. Excavation works of the Affori Centro, Affori and Comasina stations are in an advanced stage.

Milan metro Line 5 – Garibaldi-Bicocca section, Excavation works of the line tunnel (6,250 m in length and 8.5 m dia.) and of 8 stations are in an advanced stage.

Rome metro Line B1 (Bologna - Piazza Conca d'Oro), The works for the construction of three stations (Annibaliano, Gondar and Conca d'Oro) and about 4 km of line twin tunnel (excavated via two EPB shields of 6.5 m in diameter, able to operate under face pressure of up to 4.5 bar) has started.

Rome metro Line C (S. Giovanni-Montecompatri/Pantano section), Excavation works of line tunnels (18.5 km in length and 6.75 m dia.by using 4 EPBS are in progress as well excavation works of the 12 underground stations.

Brescia metro, 14 km line tunnel (7 of which via an EPB shield of 8.10 m in diameter) and 17 stations, 8 of which underground). All the section to be bored via EPB shield is over.

ROAD TUNNELS :

Pedemontana Lombarda Motorway, Dalmine-Como, Gaggiolo pass connection, Final design of 6 km running tunnels,f 15 to 17 m dia., is over.

Modernisation of Motorway A1 Milan-Rome-Naples, Valico by-pass, Excavation of six twin tunnels (each tube about 180 m^2 cross-section), including the base one 8,700 m long, is in progress

Modernisation of Motorway A1 Milan-Rome-Naples – Widening to three lanes between Florence North and Florence South.Excavation of five twin tunnels (5,520x2 m total length) is in progress.

Trento North - Rocchetta road connection, Rupe tunnel, The Rupe tunnel of about 3700 m, excavated using conventional method, is completely bored..

Strada dei Marmi (Carrara ring road) Macina and M. Greco tunnel, Excavation works using conventional methods of Macina tunnel (1,000 m in length and 13.50 dia.) and M. Greco tunnel (2,400 m in length and 13.50 m dia.), are in progress.

Salerno-Reggio Calabria highway, Works on the large areas sub-contracted for the construction of about 25 km of tunnels are in advanced stage.

E90 motorway, SS 106 "Jonica" section, 11 tunnels, Excavation works of the twin tunnels (6,671 km in total length, 6.5 m dia.) are in progress..

Asti-Cuneo – Verduno and Alba tunnel, The detailed design of the tunnels (total length about 4.5 km) is in progress.

Quadrilatero (Umbria-Marche roadworks)10 tunnels, Final design is in progress..

A14 motorway, Widening of 5 existing tunnels from two to three lanes + the hard shoulder, Final design has started.

Frejus safety tunnel, The final design, which provides for the creation of a tube about 8 m in diameter and 12.87 km in length, is going through the approval stage.

New tunnel at Colle di Tenda, The project, which provides for the widening of the existing tube and the construction of a new 3,200 m long tube has been approved and financed by CIPE.

Grande Viabilità Triestina (Large-scale roadworks in Trieste), Excavation of Carso tunnel, 2830 m long and 130 m^2 in section, in the urban area is over..

Modernisation of Motorway A15 of Cisa, Three tunnels completed, excavation of the Calcinara tunnel of about 400 m is in progress..

OTHER WORKS :

Val Passiria hydroelectric powerplant, Tunnel 3.70 m in diameter, about 6 mm long, excavated via TBM, and other accessory works are over.

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KOREA

Korean Tunnelling Association (KTA) is a non-profit incorporated association based on membership (website: http://www.tunnel.or.kr). The board of directors is elected every two years. For the term 2008/2009, the board is composed by: President Dr. Gyu-Jin Bae, two auditors, four vice presidents, 11 executive directors, and 32 directors. The current membership of the KTA stands at 2,001 individual members and 44 corporate members. Nationally, the KTA publishes the Korean journal and magazine of "Tunnelling Technology" quarterly which report on all major tunnelling and underground activities in Korea, organizes conferences and seminars periodically, operates a number of specialized working groups to timely issues, and develops/revises the standards, specifications, guidelines for tunnelling in Korea. Internationally, the KTA interacts with the world leading institutes relevant to tunnelling technology, has technical site visits to prominent underground works, participates in ITA meeting and symposia, organizes international conferences and seminars, and introduces new overseas publications and guidelines to Korean tunnel engineers. Major events during 2008 include:

• The 3rd Training Course on Tunnelling Technology – Designing on Mechanized Tunnelling (110 participants)
• The 2008 General Assembly and Annual Conference (300 participants)
• The 1st Open Forum on Tunnelling Technology and Tunnel Picture Exhibition (250 participants)
• Attendance at the World Tunnelling Congress in Agra (55 delegates)
• The 9th International Symposium on Mechanized Tunnelling Technology (250 participants)
• 2008 Night for Tunnel Engineers (130 participants)

Nine working groups are currently active in KTA such as Standard & Specification, Shotcrete, Geotechnical Investigation, Mechanized Tunnelling, Urban Tunnelling, IT in Tunnelling, Blasting Excavation, Tunnel Disaster Prevention, and Environments in Tunnel Construction. WGs held meetings as well as small group seminars regularly and reported their activities to the KTA magazine routinely.

Key members in KTA have conducted tunnelling technology-related research projects, which were granted by the Korean Ministry of Land, Transport and Maritime Affairs (MLTM), such as Underground Space Construction Technology Research Centre (Prof. In-Mo Lee, 9.9 Million USD / 5 years), Rapid Excavation & Safe Tunnel (R.E.S.T) Research Center (Dr. Gyu-Jin Bae, 10.9 Million USD / 5 years), Rockfall & Landslide Prevention Research Center (Prof. Seung-Ho Lee, 11.5 Million USD / 5 years), Sub-sea Facility Shielding Technique Research Center (Dr. Hee-Soon Shin, 9.7 Million USD / 5 years) among others. These mega research projects cover various fields of tunnelling technology and will provide the state-of-the-art tunnelling technology for tunnel engineers in the future

The following major tunnelling projects were running in Korea during 2008:

• **Seongsoo-Cheongdam** Section of double track electric railway Boondang Line: It is a river-bed tunnel (800 m in length), crossing the Han River in Seoul and was constructed with a shield TBM in soft rock by Daewoo E & C.

• **Keumjung Tunnel**: Its construction has been almost completed. Its length is 20.3 km and thus is currently the longest tunnel in Korea. The tunnel has been constructed as part of the Kyungboo Express Railway 2nd Phase Construction Project for six years by TBM and NATM methods with consuming 600,000 persons and 170,000 pieces of heavy construction equipment. During its construction, the excavated muck is 2,800,000 m³ equivalent to 350,000 dump trucks and the amount of concrete used is 230,000 m³ equivalent to apartments for 5,000 residents.


Celebration for Open Keumjung Tunnel

• Five Sections of the **Kyungboo Express Railway** 2nd Phase Construction Project: The Kyungboo Express Railway is about 410 km long (including 42 tunnels) and is under construction as part of its 2nd phase. Construction orders were placed for five sections around Daejeon and Daegu cities (33.5 km long), which include 7 tunnels (19.5 km long).

• **Inje Tunnel**: Its length is 12 km so it is expected to be the longest road tunnel in Korea. Currently, it is on the design stage and will be constructed as part of the 71.7 km long Chooncheon-Yangyang expressway by 2014.

• **Boryoung Subsea Tunnel**: Although it is on the preliminary and tender design step, the Boryoung subsea tunnel has a length of 2.4 km connecting between Dacheon Port and Youngmok Port and will be the longest subsea tunnel in Korea. So, it is expected to facilitate tourism in those areas and decrease transportation/distribution cost very much.

THE NETHERLANDS

The Department of Tunnelling and Underground Works has over 750 members who meet four times a year. The meetings deal with both tunnelling and underground space projects, discussing new and ongoing projects and new developments in the field of tunnelling technology

In the Hague the **Hubertus Tunnel** project was successfully completed on schedule mid-2008. This project was the first TBM driven tunnel in urban surroundings. In Amsterdam work on the new **North-South Metro Line** continues. These include major works under the historic Amsterdam Central Railway station to accommodate an immersed tunnel element as part of the metro tunnel under the IJ river. TBM works under the historic old part of the city are now expected not to commence before 2010. This is due to serious delays that have arisen during excavation of the deep stations. Work will start early 2009 on the **Second Coen Tunnel**, an immersed tunnel under the North Sea Canal near Amsterdam in the A10 motorway. A new tunnel has been appro-

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ved under the canal from Terneuzen to Gent in the south-west part of the country near Sluiskil. Contractors are expected to propose both immersed tunnelling and TBM driven tunnel solutions. A call for tenders is expected mid 2009. The go-ahead was also given for a new tunnel project in the Hague. The Trekvliet bypass will provide a new access to the centre of the Hague via the Binkhorst Industrial Estate to the A13/A4 motorway intersection at Ypenburg. A 1.6 km bored tunnel is part of the proposed solution. In Delft work has started on the two km cut & cover tunnel carrying four railway tracks as part of the widening of the Rotterdam – the Hague railway line. The work includes a new underground station and car parks. The tunnel will replace the elevated railway which transverses the city of Delft. Proposal have been put forward by three groups for the A2 motorway project in Maastricht. Plans include a two km long tunnel for both motorway and urban traffic. The plans are partly financed by redevelopment of city areas adjacent to the project. In Rotterdam work is continuing on the Museum Park Underground Car Park. This facility includes an underground water storage basin. Plans have been announced for further underground works in the city of Arnhem. The plans have been made by the Spanish architect Manuel de Solé-Morales and are currently being reviewed by the City.

Hubertus tunnel, (picture Peter van Oosterhout)

NORWAY

The Norwegian Tunnelling Society with its 940 personal- and 64 company members has accomplished another active year with good progress in distributing the latest development in rock excavation techniques. Main events of the year was the annual Rock Blasting conference and various courses and seminars related to underground technology in general and rock excavation in particular.

There are five permanent committees covering Shot firers, Development, International Activities, Information & Public Relations and finally Conferences. Each of these appoints sub-committees (task forces) to cover specific projects. International Committee is responsible for ITA-matters, support the participation in ITA Working Groups and international conferences in general. The Development Committee initiates technological projects. During 2008 focus has been on health and safety as well as technology related to rock support in tunnels. The Committee for conferences is responsible for arrangements, this year three. "Information" is promoting recruitment to the rock blasting and tunnelling profession as well as strengthen the image of the profession in general. The objective is to distribute correct and positive information on construction activities at large. The shot firer committee is arranging short courses for personnel from smaller companies involved in rock blasting as well as an annual 3 day seminar covering the latest techniques and is giving an update on new rules and regulations concerning rock blasting.. .

Tunnels and caverns under construction

- New railway tunnel between Sandvika and Lysaker, 5.5 km double track tunnel
- Ringroad west, Bergen
- RV 64, The Atlantic ocean tunnel
- RV 17, Tverlandet – Godøystraumen, road tunnels
- Metro extention in Bergen, new tunnels and line
- . Kjøsnesfjorden HEP, about 25 km of small section tunnels and shafts
- Storage caverns for waste material, Odda
- Narvik harbour, new underground iron ore ship loading facility
- Røssvatn water transfer tunnel for hydropower
- PPP road project, Grimstad – Kristiansand, 6 twin road tunnels
- Vinterbro – Assurtjern, 4 km twin road tunnel
- RV 48 Helland – Havsgaardsdalen, road tunnel
- Finnfast sub-sea road tunnel, about 6 km long
- Eiksund sub-sea road tunnel, approx. 6 km long and down to 284 m below sea level (world record)
- Jøssingfjord underground hydroelectric power project
- Boulanjåkka water transfer tunnel
- Øksendalsoverføringen water transfer tunnel
- Sauda HEP
- Water transfer tunnel, Titania mine
- Underground parking facility in Fredrikstad
- Many smaller projects

During the year 2008 the underground activity in Norway was on the average level with an excavated volume from underground openings reaching about 4.1 mill. m^3. Excavation of road tunnels was by far the biggest sector with more than 2,2 mill. m^3 followed by storage caverns with a volume of 0,7 mill. m^3.
The outlook for 2009 is that there will be smaller increase in the rock excavation activity compared to 2008. Several railway and road tunnels are in the final planning stage and the Government is boosting their early start up.

POLAND

Polish Group of ITA is a member of ITA since 1978; includes 65 individual members and 6 group members.
PG of ITA publishes in 3 technical magazines: “Mine and Tunnel engineering”, “Geoengineering - Roads, Bridges and Tunnels” & “Engineering and Construction”.

The conference “Underground Infrastructure of Urban Areas”, organized by the Wroclaw University of Technology and co – organized by the Polish Group of ITA was held in Wroclaw, Poland from 22nd to 24th October 2008. Many specialists from

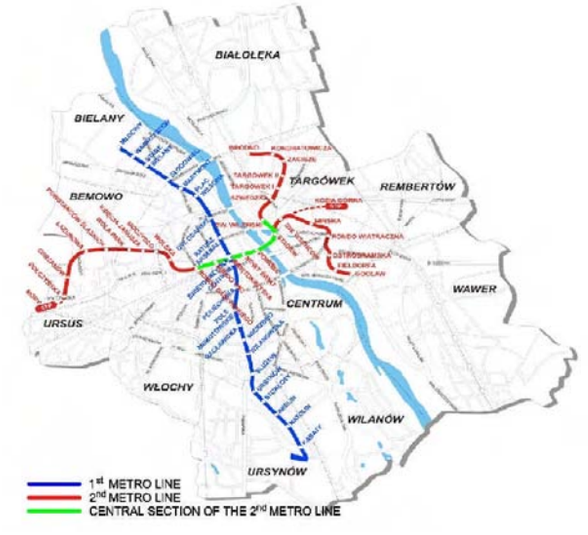
universities, scientific research centres, designing departements, underground construction companys, as well as Members of Executive Council of ITA took part in the Conference. 29 papers were presented and published by BALKEMA Taylor & Francis Group, London UK. The aim of conference was to create a forum in order to develop an exchange of experiences and provoke a discussion on the topics related to building of tunnels and underground infrastructure in the cities. The issues such as geotechnical tests and town planning were also disscused in this forum. The discussion was held on various problems related to underground infrastructure such as tunnels (traffic and railway tunnels, and underground), water and sewage ducts, garages, and subways is anticipated. The subject matter of conference was very crucial and up-to-date due to a current need for adjusting underground infrastructures to nowadays standards and requirements. The impact of these structures on the environment and the principles of sustainable development have to be considered nowadays.

The papers cover the following topics:

- New challenges in urban tunneling,
- Numerical modelling of the behaviour of a micro-tunneling,
- Rehabilitation of underground utilities,
- Design of the pipelines,
- Urban technical infrastructure and city management,
- Mapping the underworld to minimise street works.

The full list of papers is on website:
www.wbliw.pwr.wroc.pl/uiua2008

The 2nd line, running from east to west, will be 30.5 km long. The line will contain 28 stations (see the fig.) The line will be divided into 4 sections reflecting the assumed construction and commissioning schedule. First of all City Authorities are planning to build the central section with the length of 6.3 km which will consist of: 4.2 km of track tunnels, 7 stations with tunnels for train reversing with the total length of 2.1 km. At present a tender for the construction of that section in the Design and Build system is in progress. The subsoil of Warsaw is composed of Tertiary and Quaternary grounds. Tertiary formations are composed mainly of clays and silty clays. Quaternary soils are mainly sands with various grain size and loams, sandy loams and silty loams. Most of the metro route will run through layers of compacted soils. The Conceptual Design assumes maximum longitudinal track inclination in the tunnels of 40 ‰ and the following construction methods: for stations with insular platforms – cut and cover methods, the Milan method; whereas for track tunnels – the use of TBMs, without specifying their type. Prospective builders of the central section of 2nd metro line will have to face a number of organisational and technical problems. The new section of the metro line should be put into operation within 48 months from signing the construction contract. The form of the land and the existence of line 1 tunnels were the factors contributing to placing the 2nd line tunnels at a greater depth. Therefore at three stations the tracks will be situated at the depth from 21 to 24 m below street surface. Another significant difficulty will be the construction of the deepest station under the existing two-aisle road tunnel. Although the metro tunnels under the river Vistula which in that place has the width of 500 m and they will be built within a layer of compacted soils, some of their sections will be situated within very loose sandy ground filling the eroded river bottom. Another difficulty will be the passing of the TBMs under the existing buildings and within the steep slope running towards the river as stability of those structures must be guaranteed. Finally, station construction works may be hindered by the dense networks of underground utilities which will have to be rebuilt or relocated before the commencement of the metro construction process.



PORTUGAL

The Portuguese Tunnelling and Underground Space Commission is the member nation of ITA. CPT is a group of SPG-Sociedade Portuguesa de Geotecnia, the Portuguese Geotechnical Society, aiming at promoting research and development in the tunnel field and cooperation with foreign similar organisations. Therefore, CPT is the branch of the SPG devoted to cooperation with ITA. The Portuguese Tunnelling and Underground Space Comission (CPT) was created in 2006, as the Portuguese Group of ITA, inside SPG - Portuguese Geotechnical Society. SPG has 988 members, 145 of them being

members of ITA and CPT. In 2008, CPT organized the Seminar on Tunnels and Underground Works in Portugal (Lisbon, 29, 30 May, 21 presentations, 198 participants, 24 sponsrs, 12 exibitors).

Working Group on Portuguese Tunnels – data collection is in progress and a Seminar was organized (Lisbon, May 29 - 30,2008) - Working Groups, as mirror groups of those in ITA are under development (Conventional Tunnelling, Health and Safety of Underground Works, Urban Problems and Underground Solutions, Risk in Tunnelling)

MAJOR PROJECTS :

• The extension of the Porto Subway to Gondomar, including a 1 km tunnel is under tendering

• The extension of the Red Line of the Lisbon subway went on, involving over 2 Km long tunnels, and two major underground stations, Saldanha and S. Sebastião, with a total excavation of 180 000 m^3 and five access and ventilation shafts wich are also ending construction.

• The extension of the Red Line of the Lisbon Subway from Oriente Station to the Airport, with over 3.5 km long tunnels, has started construction.

• Design studies for the high-speed railway lines Lisboa-Porto and Lisboa-Madrid, requiring a significant length of tunnels in the approach of densely urban areas, have also been ongoing.

• Relevant activity concerning the construction of road tunnels in Madeira Island was carried on.

• The Marão Road Tunnel (2 galleries, 5,655 m each), after tendering, is now starting construction.

• Tunnels and underground structures for the reinforcement of the hydroelectric power schemes of Bemposta, Picote, Alqueva and Baixo Sabor are under construction or tendering

The 3rd CPT Seminar (Lisbon, 6 November, 2009) with 4 themes is under preparation:

1) Geomechanical characterization, modelling and design
2) Construction procedures and case histories
3) Maintenance and refurbishment of tunnels
4) Construction and operation safety

ROMANIA

A new special issue of "Constructii Subterane" Magazine has been published. The 6th National Conference of ART will be held between 1 and 3 october 2009, in Targu Jiu, Oltenia County.

Working group "Research" " is reviewing one national norm, according to European Norms: « Guidelines waterproofing, maintenance and operation of underground structures for Bucharest Metro » and beginning the draft form for « Seismic Norm for Tunnel Designing in Romania ».

MAJOR PROJECTS :

• Commissioning a new metro line, Sector 1 of Line 4 (EIB loan), 4.13-km in length, 4 stations, total underground, east part of Bucharest, on 19th of November, 2008.

• Continuing works to the hydropower development of the river Jiu on the sector Livezeni-Bumbesti includes 2 HPP located in the gorges area, connected by a headrace tunnel having a length of 20 km :

- first water supply tunnel, 3.8-m in diameter, 7-km in length, total excavation finished, concreted on 2.5-km long
- second water supply tunnel, 4-m in diameter, 12-km in length, 10.2-km length excavated, concreted on 0.5-km long.

•. Continuing works on Sector 2 of Line 4, to the urban rehabilitation works, in the 1 Mai – PLS Pod Constanta area (undercrossing of the Rosu-Nord and Arcuda aqueducts, by the metro line by special pipe jacking technology) and special works on new metro station, Bazilescu station, built on existing tunnels.

• The Municipality of Bucharest is running the procedure for tenders in a PPPsystem contract for new underground road passages in Bucharest:

- Interchange Modal Crossroad Razoare 2 (2.2 km in length)
- Sudului Square (South part of Bucharest, 1.5 km in length)
- Romana Square (City Center, 800 m in length)
- Aerogari Blvd. (near « Aurel Vlaicu » Baneasa Airport)

• The Municipality of Bucharest is running the tender for construction works for a new underground road passage (1 km in length), near Romanian Military Academy: Interchange Modal Crossroad Razoare 1.

• Works on Bistra – Poiana Marului Hydropower System, White River, first water supply tunnel with 2.8-km in length, 2.8-m in diameter.

• Works on Surduc-Siriu Hydropower System, Nehoiasu water supply tunnel, 18-km in length (14-km already done), 3.8-m in diameter, concreted on 13-km long.

SINGAPORE

Technical seminars were held monthly at the SMRT auditorium at North Bridge Road by speakers covering a wide range of topics related to tunnelling and underground construction. The technical seminars, generally conducted on the 3rd Thursday of each month, were free and open to TUCSS members and to the public. In total 107 seminars had been conducted by TUCSS up to the end of year 2008.

• TUCSS co-organised with LTA and ACES, the International Conference on Deep Excavations (ICDE) 2008 which was successfully held in November 2008. The theme of the conference was "Challenges and Risk Management of Underground Construction". The technical papers presented at the conference covered design, planning and execution process of deep excavations especially in heavily-urbanised areas and addressed challenges in subterranean development to meet the ever increasing demand for space.papers was also held.

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• TUCSS arranged a technical site visit for its members to view the Circle Line 4&5 Contract C855 Mined (NATM) Tunnels at Ayer Rajah Avenue on 28 June 2008. The 15 participants were able to observe the construction of the outer bound tunnel adopting top heading, bench and invert sequence in challenging Jurong Formation ground conditions. The attendees were given a comprehensive presentation and were treated to the hospitality of the representatives from WH-STEC-AMjv together with Amberg TTI.

• TUCSS Annual Dinner was held on 17 October 2008 at Rasa Sentosa Shangri La. The Dinner was attended by 199 TUCSS members, 50 non-TUCSS members, 43 invited guests and 30 TUCSS corporate members. The winners of the Hulme Prize 2008 were presented with their cash prizes during the dinner by Mr Rajan Krishnan. The recipients of the Geotechnical Awards 2008 from NUS and NTU were also presented with their cheques and certificates. TUCSS President Mr Ow Chun Nam acknowledged the generosity and contribution of the three annual dinner wine sponsors Arup Singapore Pte Ltd, Bachy Soletanche (S) Pte Ltd and Geoconsult Asia Singapore Pte Ltd.

• TUCSS Annual Lecture was held on 25 September 2008. The lecture was entitled "The Latest Technology in Mechanised Tunnelling – Soft Ground, Mixed Face, Hard Rock". The speaker was Dr Martin Herrenknecht, Chairman of the Board of Directors of Herrenknecht AG. The lecture gave participants insights into the following: 1) The latest technology in mechanized tunnelling for various ground conditions including soft, mixed face and hard rock 2) Cutting-edge tunnel boring machines for all ground conditions and with all diameters – ranging from 0.10 to 19 meters 3) Tailor-made machines for traffic and transport tunnels (Traffic Tunnelling, Ø > 4.2 meters) and supply and disposal tunnels (Utility Tunnelling Ø <_ 4.2 meters) and 4); State-of-the-art deep drilling rigs, to bore to a depth of 6,000 meters.

• A 2 day training Course on the Planning and Design of Tunnels was held at the Swissotel Merchant Court in March 2008. This was attended by 105 delegates and speakers.

• A 2 day training Course on the Construction of Tunnels was held at the Swissotel Merchant Court in October 2008. This was attended by 132 delegates and speakers.

• TUCSS Golf Tournament was held on 23 July 2008 at National Service Resort & Country Club. The event was attended by more than 180 non-TUCSS as well as TUCSS members. The sponsors for the Golf Tournament were: L&M Foundation, NatSteel, Technik-Soil (Asia), Chang Ding Engineering, CPG Consultants, Eng Lim Construction, Gammon Construction, GS Engineering, LYL Consultants, Maunsell Consultants, Pan-United Concrete, Penta-Ocean Construction, Sambo E & C, Sato Kogyo (S), Shimizu Corporation, Taisei Corporation, Tobishima Corporation, TY Lin International, WAK Technologies, Woh Hup – Shanghai Tunnel – Alpine, Yongnam Engineering, and Sembawang E & C.

• TUCSS signed a Memorandum of Understanding (MOU) with IES/ACES on 6th October for the Accreditation of Site Supervisory Staff (Tunnel). A copy of the agreement can be found on the following website: http://tucss.org.sg/.

SLOVAKIA

Slovak Tunneling Assotiation (STA) has extended total number with next specialized companies, in so far that are 45 members of all Slovakia. New committee STA has started since year 2008 and was extended with new members. The Committee has today 11 members, according to regulations of STAand two members of auditing commission.

Chairman elected	Ing. Róbert Turansky
Vice-chairman	Ing. Peter Witkovsky

Main aims which was chosen for next 4-year period are:

• Positive perception of Tunnels in an expert and amateur public. Positive perception of tunnels construction has been assuring through the media professional organization „ WEBSTER ".
On a chosen critical stages where are a missing tunnels in highways corridors were placed a bilboards with caution about absence of tunnels. The Web Site STA was extended and communications with a media was connected. We are preparing a essential communication with a top political persons of the Slovakian goverment. Positive campaign started in a TV and radio broadcasting. Result of those activity is a Goverment Decision about starting of Project D1 by PPP {Public -Private Partnership}.STA will continue in this positive campaign in year 2009 too.

• Guard and support study of the young generation in subtteraneous construction

Education, training and preparation of a students to Subtteraneous construction. The best Diploma Works are evaluated with corresponding prize Money. Participation of students on a Symposium is sponsored by Money fund. Students are visiting construction sites in Slovakia and abroad and we have aim to recruit them for this demanding profession. It concern to both Universities and secondary schools.

Others activities of STA

• STACommittee had met at 4 sessions a year 2008.
• Members of STA took participation on World Tunnel Congress in India actively.
• STACommittee had organized a Workshop about secondary ceiling in Bôrik Tunnel on Eastern Slovakia.
• An another workshop had a similar subject, but more concentrated to the shutthering and fire resistance of concrete in Tunnels.
• The Committee has been meeting media agency Webster with aim to rectify a positive campaign about Tunnels.
• Financial situation of STAmakes these activities possible, because STA members understand to positive target setting and they support action of STA Committee

SLOVENIA

Slovenian Association together with representatives from ITA - AITES has organized the International Workshop: TUNNELLING FOR HIGHSPEED RAILWAY PLANNING - AIS (Austria, Italia, Slovenia). in PORTOROZ on May 30, 2008. The Slovenian Association together with the University of Ljubljana has decided that 9th International Conference on Tunnel

Construction and Underground Structures, will be held in September 16-18, 2009 in Ljubljana, Slovenia. Members of Slovenian Association presented papers at various international meetings and conferences in Europe and overseas contries. Our members participate in WG 17 and WG 5.

The complex of Sentvid Tunnels which include two three lanes tunnels, two underground bifurcation caverns and two lanes tunnels, has been finished. The main rock structure in the area, where tunnels were built, belongs to Permian-carboniferous rock series with low bearing capacity. The main engineering challenge was the construction of two underground caverns (cross sections in the wider one measures more than 320 m^2) which were constructed succesfully

• The reconstruction of old tunnel Ljubno, 260 m long, with three lanes i.e. two traffic lanes and retreat lane, which is part of the road connection Karavanke – Obre jé, will start in year 2009. Technical solutions of the reconstruction were conditioned with specific properties of the hard soil named “sivica” which has swelling potential. The experience which was found during construction of new tunnel tube, is good base for economic and high quality civil works in existing old tunnel tube, constructed more than 40 years ago.

• Also two double-tube road tunnels Barnica (280 m) and Tabor (590 m) on the Razdrto – Vipava highway section is practically finished. The main rocks are flysh series with sandstone and marl layers which built bedrock matrix. The end of all civil and electromechanical works is planned at the middle of the year 2009.

• Tunnel CENKOVA, which was finished last year (2008) is a part of motorway section Lenart - Beltinci, i.e. subsection Sp. Senarska – Cogetinci in Slovenske Gorice area. Motorway run first through Cut&Cover section (230 m) than through tunnel and further on the opened alignment. The distance between tunnel tube axes is about 12 m and has specific requirement regarding to central reinforced concrete wall. The length of tunnel is 370 m. Basic characteristic of tunnel construction is that the ground space, where tunnel is built, mainly consists of soil layers with clayey sands, silts and clays with different consistencies.

• The similar twin road tunnel VODOLE, long about 225 m is under construction near Maribor contemporary. Ground conditions, from construction point of view, are better against CENKOVA tunnel.

• The twin tube Markovec Tunnel, approx. 2.2 km long on the motorway section between Koper and Izola near Adriatic coast will start with construction very soon, possible in next months, if contractor will be chosen. Rock structure of the tunnel consists of flysh rocks with sandstone and marl layers which are tectonically disturbed in some parts.

• Geological and geotechnical exploration works on the new second track railway alignment between DIVACA and KOPER didn’t start in year 2008. The same situation is in working activities on idea design of new alignment which include about 20 km railway tunnels.

• In future can expect some new projects on railways and road tunnels special on 3rd NEW DEVELOPMENTAXIS, and rehabilitation works on old tunnels either on rails and roads too

SPAIN

In April 2008 AETOS organized a technical Symposium about singularities in construction of the railways tunnels in the Northwest and South High Speed Lines

CONSTRUCTION WORKS

• Currently **Madrid Metro (MINTRA)** is carrying out the Madrid underground line 11 extension to Fortuna district (in Leganés) which involves an investment of approximately 200M¤ (financed by the ERDF under the Operational Program for the Community of Madrid 2007-2013, with a co financing rate of 40%). The project includes the construction of a station using the cut & cover method and about 3250 meters of tunnel bored with a tunnelling boring machine performed between June and November 2008, with an average output of 18.5 m per day..

• Of the more than 115 tunnels, managed by the **Railway Infrastructure Administrator (ADIF)**, were in various stages of construction during 2008, include:

- Urban tunnels : Barcelona (5,5 km), Girona (3,6 km), Montcada (3,7 km) and Madrid (6,9 km)
- La Cabrera Tunnel: (double tube) with 7,2Km in length. This tunnel belongs to the Spanish High Speed Line Madrid-Levante, with a record of 92,8 m excavated and 52 concrete rings placed in one day.
- Pajares Tunnel: (double tube), with 25 km in length. Is currently one of the most important tunnel of the network.
- Burato Tunnel: in the Spanish High Speed Line Orense-Santiago, with 4,1 km in length.

• The company that manages the investments of the **Department of Territorial Policy and Public Works of the Generalitat of Catalunya (GISA)**, in the year 2008 in terms of construction of urban underground railway works can be summarized in the following actions:

- Tunnel on Line 9 : Drilling of 8.9 km of tunnel (all of them with TBM 12 m and 9.40 m in diameter, and except 243 m. excavated in mine)
- Drilling of 670 m of the Metro Rail line 5 Barcelona.
- Drilling of 426 m. by the cut and cover method, in the extension of line 2 of the Metropolitan Railway of Barcelona

• Drilling of 139 m. by the cut and cover method in the workshops and 210 m. between screens in the queue of operations of Line 1 of the Metropolitan Railway of Barcelona

• Construction of the shaft and stations for the extension of the Ferrocarriles de la Generalitat de Catalunya in Terrassa. Currently has already started construction of the tunnel with one of the ways with TBM.

• Construction of the shaft and stations for the extension of the Ferrocarriles de la Generalitat de Catalunya in Sabadell.

• Adapting to PMR,s at 8 stations of the Metro Rail network in Barcelona and the Ferrocarriles of the Generalitat de Catalunya.

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SWEDEN

BK Swedish Rock Construction Committé, is a nonprofit national organization with 84 corporate members from public and private construction managers, constructors, equipent suppliers, mining companies, consulting firms, institutions and research foundations. BK is also the national group of ITA in Sweden. BK's board meets three times per year. BK's Annual Meeting in March normally gathers more than 500 delegates

Representatives of BK's member companies are currently represented in ITA Working Groups no 2, 5, 12, 15, 17, 18 and 20. When called for, special groups are assigned to organize seminars, on specific subjects like quality, assurance, risk sharing, underground constructions, partnering and different kind of contracts etc. Information about ITA's activities and the Swedish representation in ITA is distributed an annual meetings and other events in Sweden. And also coordinated with R&D activities at SveBeFo Swedish Rock Engineering Research

Major tunneling projects in Sweden currently under construction or being planned. Besides these major projects several tunnels and other underground facilities are under construction like garages, a cold water storage, sewage tunnels and cable tunnels to mention a few.

The City Tunnel in Malmö. The tunnel section of the City Tunnel project is 6 kilometers and construction works are finished 2008. Four and a half kilometers has been bored through sedimentary rocks with two shielded TBM's. The bored tunnel comprises two parallel tunnel tubes with an internal diameter of 7.9 metres. A total of 13 cross tunnels connect the two tunnel tubes at approximately every 350 metres.

The Bothnia Line is the biggest modern railway project in Sweden. It is a single-track railway running from north of Sundsvall to Umeå, in total 190 km long, with 140 bridges and 25 km of tunnels, most of them finished 2008.

E20 European Highway, Norra länken. Norra Länken now under construction, most of it in tunnels, will together with the existing Södra Länken and Essingeleden form a centrally located, continuous traffic route system, only the eastern part missing to complete a ring road. Besides a length of 4 km in twin tunnels a number of access and service tunnels etc are included in the project. Norra länken is also of national interest through its connection to Sweden's most important seaports for cargo and passenger traffic to the Baltic States, Finland and Russia.

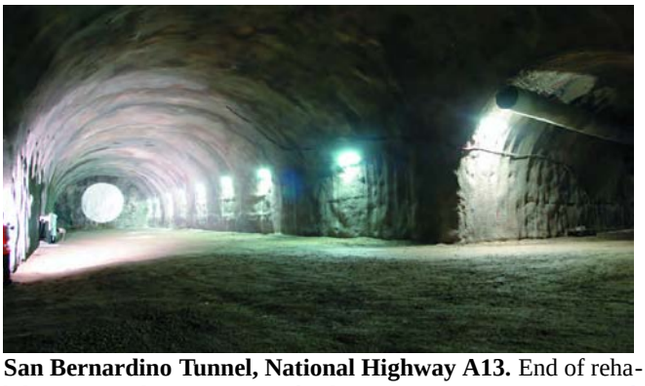
The City Line in Stockholm. The City Line is a double-track railway with two new stations to be built in a six km long tunnel between the commuter stations Stockholm South and Tomteboda north of the City. The City Line will solve the capacity problem for rail traffic through central Stockholm. The City Line will be used for commuter trains while other services will run on the existing surface tracks through Stockholm.

Road tunnel passage west of Stockholm, "Förbifart Stockholm". Planning of this 21 km long project including 16 km of twin tunnels is currently going on and construction is planned to start 2012 and be finished within eight years.

SWITZERLAND

The STS had an extremely active and successful 2008. A lot of new activities perceived in 2008, next to the traditional events such as the Swiss Tunnel Congress or the STS excursions. Examples are the activities together with the Fachverein Infra; the brochure und DVD 'Jobs mit Tiefgang'or the technical seminar 'Hohe Garantieleistungen für Grossprojekte' (High Warranties for Large Projects). Please refer to the corresponding page on our website www.swisstunnel.ch

Status of Work on the Gotthard and Ceneri Basetunnels. As of January 1, 2009, of the total of 153.3 km of tunnels, galleries and passages of the Gotthard Base Tunnel, 124 km, or 80.8 %, had been excavated. The total amount driven in December 2008 was 964 m.
Work on the Ceneri Base Tunnel is proceeding at full speed. On the north portal at Camorino/Vigana, as well as on the south portal at Lugano/Vezia, preparation work is in progress. At Sigirino, following breakthrough of the window adit, final work in the logistics cavern is in progress.



San Bernardino Tunnel, National Highway A13. End of rehabilitation work 21.09.2007, final pavement in 2008 www.tiefbauamt.gr.ch

Bypass Saas, Prättigauer road A28. Breakthrough 25.06.2008 - Inauguration 2011 www.tiefbauamt.gr.ch

Bypass Biel, A5. Start construction site on 03.12.2007 Eastern Branch, Earth Pressure Balances Shield will start in 2009 www.a5-biel-bienne.ch/

Member Nations Report 2008

Cross-City Link Zurich, Weinberg Tunnel. The Weinberg Tunnel, the under crossing of the southern part of the main station Zurich, with mining cut-and cover method and the crossing of the Sihl for the station Löwenstrasse are the core construction sites of the Cross-City Link in Zurich and under construction now. Opening will be in 2013.
http://infra.sbb.ch/bauarbeiten/weinbergtunnel.htm

West Bypass Zurich N4/N20. Opening West Bypass Zurich N4/N20 4 . Mai 2009 Uetlibergtunnel (4'410m) Aeschertunnel (2'160m) Hafnerbergtunnel (1'385m) www.uetlibergtunnel.ch

A16 Transjurane. Still under construction Moutier tunnel, Neu-Bois tunnel and Bure tunnel www.a16.ch

TURKEY

The name of the Organization is TURKISH ROAD ASSOCIATION (TRA). There are seven National Working Groups in the Association. TRA is an independent and open Association. The members are combined of individuals, organizations and companies of public and private sector. TRA published several books and some national conferences are at planning phase.

The working groups and important events of the year 2008:1) Planning Working Group, 2) Road Construction Working Group, 3) Bridges and Tunnels Working Group, 4) Maintenance Working Group, 5) Trafic Safety Working Group, 6) Highway and the Environment Working Group, 7) Intelligent Transport Systems Working Group. The working groups organized various meetings, national conferences, exhibitions and published some books, reports and booklets.

Significant projects of underground constructions: The total number and length of tunnels on the state highways and on the motorways:

	Number	Length
In operation:	150	90.227 m.
Under construction:	52	52.577 m.
In the design phase:	59	90.124 m.
Total:	229 :	232.928 m.

There are 5 railway tunnels 24.365 m. under construction

Nowadays, the Marmaray, is a very important project in Istanbul. This project will connect two sides of Bosphorous. Important figures of this project:

Total length : 76,3 km.
Surface Metro : 63,0 km.
Total length of the tunnels : 13,3 km.
(9,8 km. excavated 1,8 km. immersed, 2,3 km. cut and cover)
Number of stations : 37 (4 underground)

Concerning metros, the following projects are under construction:

• Istanbul : Line TAKSIM-SISHANE-YENIKAPI (5.2 km) and AKSARAY-YENIKAPI (0.7 km)
• Bursa : New line 5 km and 6 stations
• Izmir : ÜÇYOL-ÜÇ KUYULAR (5.5 km and 4 Stations
• Ankara : BATIKENT - SINCAN and KIZILAY - KEÇIÖREN and will be connected to KIZILAY - ÇAYYOLU, KIZILAY - BATIKENT line.

Some of the turbine houses of the Hydroelectrical Power plants are under the ground. There are many tunnels in different sizes for irrigation.

Various tunnel projects (design and construction) have been carried out under responsibility of different authorities in 2008. Information about those projects is summarized as follows.

General Directorate of Highways

With completion of tunnel constructions, number of tunnels in operation increased to 150 with an approximate length of 90 km. 52 tunnels (52.5 km) are under construction, design of 59 tunnels (80 km) are going on.

General Directorate of Railways, Harbors and Airport Construction

Bosphorous Rail Tube Tunnel crossing, which has significance for Turkey's connection to the European Network, proceeds in 2008. Archeological excavations, NATM tunneling works and TBM excavations are being performed. Dredging works and ground treatment of the strait had finished. Manufacturing of eleven tube elements had been realized and immersed in trench.

Bidding of Bosphorous Highway Tube Tunnel crossing was held in 2008 according to Build-Operate-Transfer method. Tunnel with a length of 5.5 km will serve to automobile. Construction will be carried out with TBM, and according to NATM principles. There are also cut and cover parts

Municipalities

Beside tunnels in operation, design and construction of metro and highway tunnels have been performed in different cities. In capital city, Ankara, construction of tunnels in 3 metro lines proceeded. In Istanbul, construction of 2 metro lines have been performed with EPB and DS TBM and NATM techniques

General Directorate of Hydraulic Works

Some of the turbine houses of the Hydroelectrical Power plants are under the ground. There are many tunnels in different sizes for irrigation.

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UNITED KINGDOM

The British Tunnelling Society continues to be active in providing its extensive membership with a range of professional, technical and social activities throughout the year. Monthly meetings are held at the Institution of Civil Engineers in Westminster and are open to non-members. Tunnelling engineers on visits to London are particularly welcome. In addition the BTS continues to produce technical guidance on a range of tunnelling-related topics.

During 2008, BTS working groups - published guidance on reducing exposure to nitrogen monoxide. - are drafting guidance on best practice for monitoring of underground construction. - are capturing knowledge on timber support techniques.
• The Compressed Air Working Group has met to consider issues affecting work in compressed air including real time Doppler monitoring of the workforce, high pressure exposures and to review existing national guidance on the topic. • BTS continues to assist with an employers' training forum to deliver National Vocational Qualifications in tunnelling at operative level. • BTS has continued to interact with MPs through its Parliamentary Lobby Group. • BTS interfaces with other UK professional groups interested in geotechnical matters through membership of the Ground Forum. • BTS supports the ICE's Panel for Historic Engineering Works – Tunnels sub-panel.• BTS contributes to the work of various British and CEN standards relating to tunnelling and tunnel machinery .• BTS ran two successful training courses in 2008, one on tunnel design and construction and the other on health and safety in tunnelling. • A "Young Members" group has been formed within the BTS to encourage greater particiaption in the Society's activities and in tunnelling generally by graduates and young engineers.

Tunnelling has been completed on the **Glendoe Hydro** scheme and impounding is well advanced.

• Various tunnels were being designed or constructed for water, sewerage and cable utility services including extensions to Thames Water's London Water Ring Main, a number of cable tunnels for the national electricity grid and the national gas grid.

• Major tunnel refurbishment works were completed on Hatfield Tunnel and commenced on Bell Common tunnel both on the M25 motorway.

• Work continued on the A3 Hindhead tunnel.

• A major interceptor sewer tunnel was under construction in Belfast to collect sewage currently being discharged into Belfast Lough. This investment is a direct outcome of the "peace dividend" arising from the end of IRAterrorist activity there.

• Tenders were invited for the first phase of Tideway – a major sewage storage and transfer tunnel system in London to reduce storm discharge into the Thames .

A3 Hindhead Tunnel – Northern Portals (photograph courtesy of Balfour Beatty and Highways Agency)

• The CrossRail project has been given government approval and the relevant legislation has received the Royal Assent.

UNITED STATES OF AMERICA

The Underground Construction Association Division membership for 2008 is 652, a steady growth evident in the last year. As of December 2008, UCA had 55 students. The Membership committee is targeting corporate and sustaining members in a recent drive. The new Student Outreach Committee will focus recruiting student members. **Education and Training**, a newly established standing committee of UCA has received a positive response by the membership. A call for additional members in the December 2008 T&UC magazine has resulted in additional interest. The next steps will be developed during 2009. The **student outreach committee** is a standing committee comprised of Executive Committee members as well as members from the general membership. Brenda Bohlke is temporary chair; other members included Paul Scagnelli, Jeff Petersen, Marc Kritzer, Bob Palermo, Greg Raines, Lonnie Jacobs, Jamal Rostami. The first task is to develop a general power point with the Benefits of Going Underground Committee. It will be used when members visit universities to discuss career opportunities in the underground industry. Arup, Kiewit, Frontier Kemper, and other members are actively reaching out to various universities. The second task is to establish a protocol and guidelines for student scholarships including the student paper awards, instituted during the 2008 North American Tunneling Conference. Draft guidelines are under development and consideration for the January 2009 executive committee meeting. The **benefits of underground construction committee** has grown with additional members and has been actively developing an excellent power point presentation outlining the Benefits of Going Underground, highlighting the many types of facilities and functional use of the underground space, technological achievements. This presentation is available for all members to use and is posted on the UCA website. **New Technical Program Committees** approved by the Executive Committee: (1) Tunnel Rehabilitation: a burgeoning market for the tunnel business. Chair Henry Russell (2) Concrete Specifications for Underground Construction: Chair –Bob Goodfellow and George Yoggy. (3) Design Build Construction Contracting Practices: Proposal received summer 2008 for consideration (4) Education and Training Committee – Newly formed and proposal submitted for consideration summer 2008 by the Exe. Committee. (5) Student Outreach – see above.

North American Tunnelling and Underground Construction Projects:

• Quarterly, UCAupdates the tunnel demand forecast that identifies the most significant upcoming tunnel projects, the owner, description, function, value and prospective bid dates.

• Tunneling hotbeds continue to be in the urban areas with major projects planned and underway in the areas of transportation, as

Member Nations Report 2008

wells as water and wastewater in New York City, New Jersey, Seattle, San Francisco, Washington, D.C. Los Angeles, Portland, Oregon, Pittsburgh. Sewer and water conveyance systems across the US are estimated at over $150 Billion in the next 10 years. Transportation projects, in particular urban and regional transit are noteworthy with tens of billions of dollars in New York alone with the East Side Access Project, the Second Avenue Subway, Seventh Avenue Extension, and WTC.

• Prospects for The Hudson Express with the EIS will provide future work, along with the New York Department of Environmental Protection's Facility plan for the Third Catskill Delaware Aqueduct. Seattle has a long slate of significant projects underway the past year, including Brightwater CSO project. Seattle Sound transit tunnels at Beacon Hill and the voter's approval of over $17Billion for future transit expansion. The Alaska Way Viaduct tunnel option is still alive and promoted by a new evaluation of a large bore alternative away from the waterfront.

• San Francisco has an active tunneling program as part of their regional transportations: Devils Slide tunnel will eliminate the costly and disruptive landslide hazards along Rt. 1 south of the city. This construction will continue into 2009. The SF Muni extension under Third Street is awaiting final approval. CalTrans has very aggressive plans to construct a large TransBay Terminal underground and house commuter rail, BART, and, ultimately, the high speed rail, as well as regional buses. Tunnel access for rail is part of this planning process. .(more on the web site).

VIETNAM

In co-operation with ITA Executive Council Members, ITST held a workshop on "Tunnel construction in soft soil condition" on February 2008. This event attracted many members from state management officials, scientists working in various institutes, Universities, scientific Associations, and many researchers working in and out ITST.

• In 2008, ITST carryed out some mainworks in fields of transport engineering design, design evaluation (Kimlien Intersertion upgrade and rehibilitaion Project, Longvan subway in Bacninh Pro.,…), supervision works (Vinhtuy Bridge, Pauon Bridge, Hamluong bridge…), field and indoor quality test and check, applying research works in new technology, new material, new structures,…

• In 2008, co-operation with national and international consultant firms (TediSouth, JARTS, NipponKoe, Systra, Ingerosec …) for preparing technical proposal in some big projects (Hanoi metro Projects, Hochiminh metro Projects, Hanoi-Hochiminh railway upgrade and high speed railway,…

In the year of 2008, IBTE-ITST run some training courses on geo technical software such as Plaxis, Midas/GTS and designing of underground structure. Besides, IBTE-ITST held a seminar on Management and Maintenance of Highway and Railway Tunnels. Carry out evaluation work of construction design of Subway in Kimlien Intersection upgrade and rehabilitation Project, Hanoi Vietnam. Carry out evaluation work of technical design of Longvan tunnel (across highway N01A) in

Bacninh province. Co-operation with Hanoi Transportation University in tunnel and metro engineer training. Carrying out research works in tunnel and metro field (in tunnel management and maintenance, underground space applying for transportation and are field, ect). Send senior engineer abroad (Japan) for tunnel and metro study With other counterparts (in and out of Vietnam) preparing technical proposal for metro projects in Hanoi city and in Hochiminh city (in progress

During 2008 there are many on-progress and in-study projects in Vietnam:

• Kimlien intersection upgrade and rehabilitation project in Hanoi
• Thuthiem immersed tunnel project in Hochiminh city
• Car pass tunnel linked between two central based provinces of Khanhhoa and PhuYen
• Four metro projects in Hanoi (in progress)
• Six metro projects in Hochiminh city (in progress)
• Some projects on rehabilitation and renovation of railway tunnels

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BILFINGER BERGER

Bilfinger Berger is a leading internationally active construction and services company. As a Multi Service Group, Bilfinger Berger delivers comprehensive solutions both in German and international markets. Bilfinger Berger Civil is among the leading players worldwide for major infrastructure projects. With highly specialized units for bridge construction, tunnelling, foundation engineering, road construction, plant and infrastructure services, we are always a step ahead and can develop optimal solutions for our clients at any time. The main tunnel and underground construction activites in 2008 were carried out on the following projects:

- City Tunnel Malmö (Sweden)
- Combined Sewer Overflow Tunnel Portland (USA)
- Exploratory Tunnel Saint Martin la Porte (France)
- Gotthard Base Tunnel, Lot Sedrun (Switzerland)
- Light Rail Cologne (Germany)
- Motorway E18 Grimstad-Kristiansand (Norway)
- Clem Jones Tunnel (Brisbane, Australia)
- Wienerwaldtunnel (Vienna, Austria)
- Wehrhahn-Line Duesseldorf Lot 1 (Germany)
- SBB Transit-Line Section 3 Weinbergtunnel (Switzerland)
- One of many tunnelling highlights last year was the breakthrough of TBM "Florence" (one of two 12.4 m double shield TBMs in Brisbane) at Kangaroo Point in early December 2008.

Clem Jones Tunnel: Breakthrough of TBM "Florence"

After assembly of the 11.3 m large TBM in October 2008, the excavation of the 4,400 m long Weinbergtunnel in Zurich is well underway.

- With respectable TBM performance rates of the 7.74 m slurry TBM in Portland, 43% of the approx. 8,800 m long Combined Sewer Overflow Tunnel in Portland was completed. Concreting performances of over 250m/week or 2,000 m/month made it possible that approx. 70% of the 21.5 km of inner lining at the Wienerwaldtunnel could be completed at the end of 2008.
- The works for the City Tunnel Malmö are ahead of schedule with a degree of project completion of around 95%. One of two tracks has already been handed over to the client.

HOCHTIEF

With decades of experience in international heavy civil engineering structures, the Civil Europe Division of HOCHTIEF Construction is concentrating its know-how in the field of complex infrastructure projects on the growth market Europe. Our clients profit from the highest technical competence in all types and all conventional and fully mechanised methods of tunnelling as well as from our local presence, for instance in Eastern Europe. Some recent tunnelling projects:

- in the Czech Republic we build together with partners a section of the Prague Ringroad 514, including a 1.100m long drill & blast tunnel.

- in Glendoe, Scotland, we are completing a 100MW hydroelectric power plant comprising design and turnkey construction of an underground powerhouse, 8km hard rock TBM tunnel, 8km aqueduct tunnel and 4km pipeline tunnel, drill & blast each.
- in Austria, HOCHTIEF is involved in two tunnel joint ventures:

- the Lainzer Tunnel, 3km twin track conventional rail tunnel

- the Jenbach Tunnel as part of the Brenner Traffic Feeder Line, a 4km twin track rail tunnel, driven with a 13m diameter slurry shield

- In Stockholm, Sweden, HOCHTIEF is building lot 35 and 51 of Norra Länken in JV: 2 tubes (1,200m each; D&B) of a road tunnel, undercrossing the inner city of Stockholm, including 2 ramp and a concrete tunnel (C&C).

- The European X-ray laser facility XFEL construction will be started near Hamburg/ Germany. Lead by HOCHTIEF Construction, a JVwill execute a system of tunnels of more than 5,8km of length for the Client DESY center of research.
- in Germany HOCHTIEF is leading the joint ventures building:

- the NST (New Schluechtern Tunnel), a 10,24m TBM (open or EPB mode) is carrying out a 3.950m long rail tunnel

- the metro line U4 Hafen City in Hamburg. The project includes 2x 2.800m of tunnel by a slurry shield.

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IMPLENIA

Gotthard Base Tunnel, lot Sedrun:

- conventional drill & blast southwards of total 1'495 m single lane tunnels, of which 225 m in deep rock formations and highly tectonized zone
- waterproofing on 2'800 m in the two single lane tunnels towards north
- 4'520 m base mat concrete, 970 m kicker and approximately 1'660 m inner concrete lining
- Inner concrete lining completed for the Emergency Stations South & North; concrete lining for the four bifurcations (cross over) in progress
- Concrete production to date: app. 33'000 m^3 sprayed concrete and app. 80'000 cast in situ concrete (total volume 113'000 m^3)

Gotthard Base Tunnel, lots Bodio (554) and Faido (452):

- Lot 554 (Bodio): TBM excavation and concrete linings in both single lane tubes completed, length twice 14'800 m
- Lot 452 (Faido): excavation and support completed in Multifunction Facility including both emergency stations, both cross over, overpass and ventilation shafts (length overall 2'500 m, total excavation volume 680'000 m^3)
- Lot 452 (Faido), 10th march 2009: TBM excavation eastern tube 5'200 m and western tube 4'400 m (current rock overburdens exceeding 2,000 m)
- Lot 452 (Faido): successful crossing of the Piora Syncline (sugar grain dolomite)

Durchmesselinie Weinbergtunnel (Transit tunnel under the Zurich main station)

- Excavation with Gripper TBM (dia. 4.75 m) of safety and rescue tunnel, 1'050 m
- Excavation of access shaft Brunnenhof, 150 m deep and breakthrough with neighbouring lot Oerlikon
- Installation of main TBM (dia. 12.3 m) and excavation of the first 200 m of the 4'300 m long double track railway tunnel.
- Installation of complete backup of the TBM and ready to continue excavation

Pumped Storage Scheme Nant de Drance, Valais, Switzerland:

- Successful Contract award of the civil works including all underground works, caverns, waterways, intake structures and the concrete aggregates production. Total value of the contract 530 mio. CHF
- Preparatory works for access tunnel and site installations in progress

Other main tunnel projects:

- Bypass tunnel of Lungern, Canton Obwalden
- N16 Jura Highway tunnel Sous le Mont, Canton Berne
- Bypass tunnel of Bulle, Canton of Fribourg
- N16 Jura Highway tunnels Neu Bois, Canton Jura

LOVAT

For over 35 years, LOVAT has specialized in the custom design and manufacture of Tunnel Boring Machines (TBMs) utilized in the construction of metro, railway, road, sewer, water main, penstock, mine access and telecommunications tunnels. LOVAT's extensive experience, advanced technology and commitment to continuous development has provided solutions on over 700 tunneling projects worldwide.

LOVAT offers a complete selection of highly versatile TBMs, ranging from 2 to 14 meters in diameter, and related products customized to suit project requirements:

- Single and Double Shield Rock TBMs
- Earth Pressure Balance TBMs
- Slurry TBMs
- Semi-pressurized and Non-pressurized Soft Ground TBMs
- Pipe Jacking TBMs / Systems
- Rolling stock
- Full complement of accessories and fully integrated auxiliary equipment designed to maximize TBM productivity

In addition to traditional manufacturing LOVAT also provides additional services to our customers including:

LOVAT 250th TBM

- TBM refurbishment, available at LOVATs facilities or on site
- 'Turnkey' project solutions, including customized tunneling and segment systems design
- Buyer training for TBM operation and maintenance
- On site assistance for TBM Operation, TBM Assembly/Disassembly, Hydraulic & Electrical/PLC Servicing and general TBM Troubleshooting
- Spare parts support including stocking of critical items and 24 hour worldwide shipping

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2008 at A Glance

• Canada Line, Vancouver – twin 2.2 km subway tunnels. TBM excavation completed and fit out ongoing. The entire new subway line to the airport will be operational in late 2009 in time for the 2010 Winter Olympics. Contractor – SELI-SNC Lavalin JV.

• Bathhurst/Langstaff Sewer Tunnels, Toronto, ON – 3.3 m diameter, 8.3 km TBM excavated tunnels were completed August 19, 2008. Contractor - McNally AECON- JV.

• 19th Avenue Sewer Tunnel, Toronto, ON – 3.3 m diameter, 4.2 km TBM excavated tunnels were completed May 1, 2008. Contractor - McNally AECON- JV.

• Singapore Cable Tunnel, Singapore – 6.1 diameter, 2.63 km excavated tunnel was completed on February 21, 2008 – Contractor – Downer Engineering Ltd.

• NI Water Belfast Sewer Stormwater Management, Ireland – 4.7 diameter, 1.29 km excavated tunnel was completed in May 2008 – Contractor – Morgan-Farrans JV.

• Metro de Sevilla, Spain – 6.1 diameter, 4.67 km excavated tunnel was completed on April 21, 2008 – Contractor – UTE Metro de Sevilla (Dragados, Sacyr, Cavosa JV).

• King County Brightwater Conveyance System, East Contract, USA – 5.8 diameter, 4.23 excavated tunnel was competed in December 2008.

• Moscow Metro System, Russia – 11 diameter - The first drive in tunnelling history where a large diameter EPB TBM has excavated a metro escalator tunnel on a 30° decline. The first of several planned 120 metre long escalator access tunnels was completed on December 19, 2008 - Contractor - Mosmetrostroy.

• Northeast Sanitary Sewer Tunnel, Edmonton, AB – 2.5 diameter, 3.35 km excavation progress, Contractor – City of Edmonton Tunnelling Department.

• Southwest Sanitary Sewer Tunnel, Edmonton, AB – 3.2 diameter, excavation commenced on March 3, 2009. Contractor – City of Edmonton Tunnelling Department.

• Chengdu Metro Tunnel Project, China – 6.3 diameter, TBM is scheduled for delivery for early 2009. – Contractor – CRTG (China Railway Tunnel Group)

• Melbourne Main Sewer Replacement, Melbourne, Australia – 2.9 diameter, TBM is scheduled for early 2009 – Contractor – John Holland Tunnelling

• Krolsky Water Drainage Tunnel, Russia – 4.2 diameter TBM is equipped with LOVAT 17" disc cutters and powered by a Variable Frequency Main Drive, with Cuttinghead spead ranging from 4.7 to 9.1 rmp. The Single Shield Hard Rock TBM will bore 2.25 km tunnel – Contractor – OAO Bamtonnelstroy.

• Jay Dee/Coluccio/Taisei J.V. - Brightwater Conveyance System, West Contract - 4.7 diameter is currently excavating a 6,400 metre long tunnel and is equipped with an intergral airlock. The lock will be constructed to ASME and local WOSHA standards and will comprise two parallel inline airlocks (operational independent of each other to facilitate maintenance in high pressure conditions.

MAPEI

MAPEI is located in Milan, Italy, with subsidiaries worldwide including more than 50 production facilities in 24 different countries.
MAPEI is a market leader in the development and application of chemical products used within the Construction Industry.
The "Underground Technology Team" (UTT) is the division of the MAPEI Group fully dedicated to Underground activity. Underground construction has a unique character, due primarily to the complexity and severity of conditions within this work environment. It is therefore necessary to apply an extremely high level of specialization and completely dedicated product systems, such as those developed and produced by MAPEI. The range is wide and complete and includes products for usage in the following areas:

new Metro Line in Budapest, Hungary (Client BAMCO)

• Admixtures for concrete and sprayed concrete.
• Mechanised tunnelling by TBM.
• Injection and consolidation with chemical resins or cement-free binders.
• Waterproofing by means of synthetic membranes, chemical resins or cementitious products.
• Tunnel reparations using premixed mortars.
• Tunnel coating with paints, osmo-

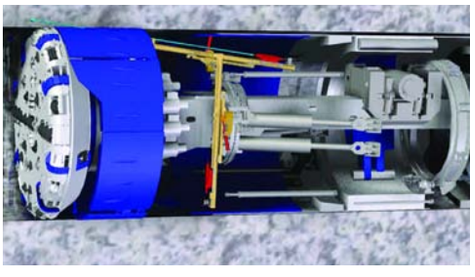
Hoellbergtunnel tunnel, Germany (Client BARESEL)

tic grouts or ceramic coating (adhesives and tile joints), etc.
During the year 2008 the activities of the MAPEI-UTT continued to increase and developed in those countries where UTT is already well established in addition to new markets.
UTT confirmed its position as market leader in supplying alkali-free accelerators (MAPEQUICK range) for sprayed concrete in various European countries. Many and important projects of ground consolidation and waterproofing were carried as well, by injecting cement-free hydraulic binders (MAPEJETSYSTEM). In addition, the UTT enlarged its market position in the mechanized tunnelling by entering as a primary supplier into TBM projects with its foaming agents (POLYFOAMER FP, STABILFOAM range), admixtures for the backfill grouting (MAPEQUICK CBS SYSTEM), greases (MAPEBLOX range), etc.
In the year 2009 MAPEI will also enter in the worldwide market with high-quality synthetic membranes for waterproofing every kind of underground working.

ROBBINS

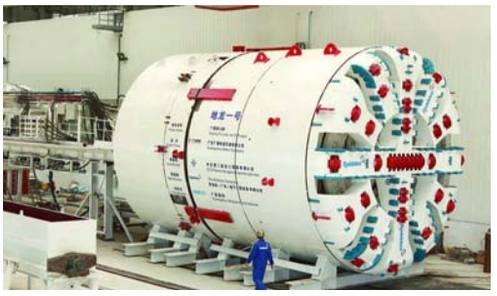
With more than 50 years of innovation and experience, The Robbins Company is the world's foremost developer and manufacturer of advanced, underground construction machinery. In the past year, Robbins has developed a new TBM concept for high-cover tunnels, proven its onsite assembly method, and further expanded its presence in the soft ground market.

Ideal for a wide range of adverse conditions, the All Conditions Tunneler (ACT) machine is a novel TBM concept designed to detect and stabilize geologic instabilities far in advance of the face. The ACT TBM improves on existing open and shielded TBM types by using a retractable shield depending on the ground conditions. In competent rock, the Robbins ACT can bore in open mode with full ground support capabilities. In unstable ground, the shield can be operated in closed mode while 360 degree collaring holes retain the machine's probe drilling and ground conditioning abilities.



All TBM types, including the ACT, can be assembled using Robbins' proven process, Onsite First Time Assembly (OFTA). OFTA allows TBM components to be assembled onsite rather than in a manufacturing facility—a method that saves the contractor time and costs due to decreased shipping and man hours. The OFTAmethod has been successfully employed on TBMs around the world, including two 10.0 m diameter Double Shield TBMs for water projects in India, and a 10.2 m diameter EPB TBM for the Mexico City Metro.

Beginning in 2008, Robbins has increased its presence in the soft ground market through a worldwide launch of EPB TBMs. Most recently, a Robbins 6.5 m diameter EPB excavating a section of India's New Delhi Metro achieved the highest record on the project—202 m in one week, which was faster than any of the 12 machines from other manufacturers working on the metro. Other Robbins EPB projects include four machines in Mexico City for the metro and Emisor Oriente projects, three machines for Chinese metro projects in Guangzhou and Chengdu, and a 6.3 m machine for Azerbaijan's first ever TBM-driven tunnel.



Robbins continues to excel in 2009, with major contracts signed around the world. For more information on recent projects and groundbreaking R&D, visit the Robbins booth G7-8 or visit www.TheRobbinsCompany.com.

SIKA

Sika AG, located in Baar, Switzerland, is a globally active company supplying the specialty chemicals markets.

Sika's product lines feature high-quality concrete admixtures, specialty mortars, sealants and adhesives, damping and reinforcing materials, structural strengthening systems, industrial flooring and membranes. Subsidiaries in more than 70 countries worldwide and approximately 12,900 employees link customers directly to Sika and guarantee the success of all of its business relationships. With this business structure Sika generates annual sales of CHF 4.6 billion.

Brenner Base Tunnel

The year 2008 will go down in history as the year in which global market conditions changed more quickly than ever before in the history of economics. In the current business year Sika will proceed with this situation-appropriate reaction to country specific changes. Overall Sika achieved growth of 7.3 % in local currencies in the year under review, resulting from organic growth of 5.9 % an.

Sika is known as a reliable partner in the tunneling business for safeguarding of excavation (Sigunit, Aliva, Sika-PM), waterproofing (Sika Plan), arch construction (Sika ViscoCrete) and for concrete protection (Sika Guard). The individual solutions provider Sika, is known towards extraordinary requirements in the infrastructure domain e.g. with the Sika ViscoCrete Toolbox. Sika made its admixture Sika ViscoCrete, which stems from the range of high-value concrete admixtures, marketable for mid-

range quality applications and thereby extended its market penetration. This development is of substantial significance above all in the growth markets, since up-and-coming local competitor's market share can thereby be contested and conventional admixture technologies supplanted. Visit our website at www.sika.com.

STAJ

Major Success using Innovative "Harmonica Tunneling Construction Method."

Harajyuku-Intersection in Kanagawa Prefecture is infamous for its reputation as one of the most traffic congested intersections in Japan. Ministry of Land, Infrastructure, Transport and Tourism planned to construct an underpass tunnel on National Route No.1 to reduce the congestion by using this Non Disturbance Tunneling Method, also known as the "Harmonica Tunnel Method", which was proposed during the tender. It has been named so because of its cross section resembling the musical instrument.

A 420m long underpass structure was constructed along 320m of horizontal curve radius and 1,000m vertical curve radius alignment. The tunnel cross section consists of 186m length of Box-culvert and 234m length of U-shaped tunnel approach. 73m of the 186m Box-culvert section was constructed by this method.

Harmonica Tunneling Method enables construction of one very large tunnel using small rectangular EPB shield tunnel machines repetitively. It is applicable for very small overburden depths without disturbing existing surface traffic in urban areas. Major benefits of this method are minimized surface settlement, design flexibility of tunnel cross section, and smaller plant area at construction site.

The expressway in two upper and lower layers and utility tunnels are high-speed constructed in the dug large section tunnel.(MMST construction method)

In Metropolitan Expressway Kawasaki route, between the skies (WxH 22mx17m) was completed in narrow urban areas by the MMST (multi-micro shield tunnel) construction method. A complex, linear expressway (upper and lower arrangement parallel configuration) and the utility tunnels (electricity, telephone, gas, waterworks, and industrial water) are constructed in this tunnel now.

There are two features of an internal structure. The first is an elevated structure composed of steel-made Column-beam and a half precast floor version in the tunnel pit. The second is precasting BOX structure to do the utility tunnels divided in detail. The bottom of an elevated structure without timbering serves as a work passage and a construction place of another construction. As a result, two or more construction at the same time becomes possible in the tunnel. Moreover, a great labor saving of the field operation is attempted by making the structure precast. The internal construction worker's high-speed construction is done by this two for completion in 2011

Construction of an underground reservoir tunnel as an urban-type flood-control measure by means of the P&PC segment construction method with HD tunnel lining

The Minami Ward of Saitama City is faced with the difficulty of discharging surface water in a timely manner through the existing combined sewage system due to a quick increase in the volume of rain water collected from the ever-expanding urban areas and frequently occurring torrential rains. In order to minimize flood disasters, this construction work is intended to provide an underground stormwater storage tunnel with a holding capacity of 40,000 m^3; the segment's inner diameter is 4.75 m and the total length is 2,260 m, which is constructed by means of the mud pressure shield method. For the purpose of preventing any harmful corrosion of the inner surfaces of the segments due to hydrogen sulfide gas and to enhance the smooth inner surface, a resin called "HD tunnel lining" (High Durability tunnel lining) is applied to the pipe. The P&PC (Pre-stressed and Precast Concrete) segment method is applied to the assembly of the segments used for the general portion of the tunnel, where the assembled segments are connected and fastened to each other through circumferential pre-stress. More precisely, a circumferential duct is built in each concrete-made segment, and, when the segments have been assembled into one ring, PC steel wires are introduced from an opening provided at the inside surface and inserted through the circumferential duct; these wires are then tensed and fixed, and thus the tunnel ring is pre-stressed.

ITA "Supporters" Report 2008

COWI

COWI has more than 50 years of experience of providing cost-effective tunnel designs for clients all over the world.

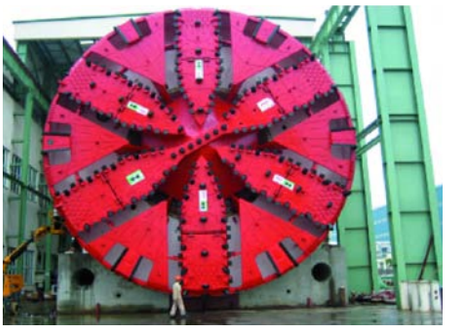
COWI teams consist of geotechnical engineers, hydrologists, tunnel engineers and tunnel ventilation specialists and provide services in all phases of tunnel projects - from feasibility studies over design, construction and commissioning to operation and rehabilitation.

During 2008 COWI continued to experience growth in the immersed and bored tunnel businesses.

The design of the Cityring metro in Copenhagen is presently our largest project and includes 16 kilometres of bored tunnel and 17 underground stations. Our bored district heating tunnel project in Copenhagen will open in time and on budget in 2009.

In China we have been providing consulting services to the contractor for the Nanjing Yangtze River bored tunnel which consists of two 3 kilometre long tunnels with external diameters of 14.9 metres. In Korea we continue to be in-volved in the Busan immersed tunnel with regard to the technical follow-up of the construction of one of the longest and most complicated immersed tunnels. In 2008 we entered an agreement with a contractors' consortium to prepare the detailed design of the Söderström immersed railway tunnel in Stockholm.

Furthermore, in 2008 we signed a contract for a new fixed link across the Ma-racaibo Lake in Venezuela which includes a 4 kilometre long combined road and railway immersed tunnel. Lately, we have entered an agreement regarding work on the fixed link Hong Kong-Zhuhai-Macao which involves a long immersed tunnel.



We have continued our projects regarding a new immersed tunnel in Seattle, USA as well as the immersed tunnels under construction in Ireland and Norway At the end of 2008 we were awarded the job of reviewing the feasibility studies for a record bored tunnel under the Gibraltar Strait.

Join the Underground Space Dialogue

ITACUS is a committee of the International Tunnelling and Underground Space Association (ITA). Participation is open to all professionals who represent an organisation or institution and who are motivated to contribute to the aims of the committee. Why not express your interest in taking part in ITACUS by completing this form?

ITACUS membership

The ITA invites all parties world-wide to become a member and to cooperate within the ITA Committee on Underground Space (ITACUS). Committee members can only be corporate members. Official membership in ITACUS is subject to confirmation by the ITA General Assembly, however it is not necessary for ITACUS members to be members of the ITA or vice versa.

The organisation submitting this form hereby expresses an interest to join ITACUS and its activities. It is noted that a formal request for membership will be submitted to the next ITA General Assembly. At this time there is no membership fee for ITACUS

Registration of Interest	
Organisation	
Type of organisation	☐ Public or Educational ☐ Non-public
Member name	
Postal address	
Phone	
Fax	
E-mail	
Date	Signature

About ITACUS

ITACUS sees it as its mission to advance the awareness and thinking on the use of underground space through the creation of a worldwide dialogue. The committee will fulfil its mission in a pro-active manner, furthering the cause of underground space use within the context of societal needs, environmental concerns, sustainable development and climate change

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