TRIBUNE

ASSOCIATION INTERNATIONALE DES TRAVAUX EN SOUTERRAIN
AITES

ITA
INTERNATIONAL TUNNELLING ASSOCIATION

ITA newsletter - la lettre de l'AITES

N° 31 - MAY 2007 - ISSN 1267-8422

Visualisation of the Lochkov tunnel portal

Visualisation des têtes du tunnel de Lochkov.

TRIBUNE

ITA newsletter
la lettre de l'AITES

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3,000 copies of this issue have been printed

Directeur de la publication :
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✆+41-216932310, ✍ +41-216934153
Édité par ACROTÈRE :
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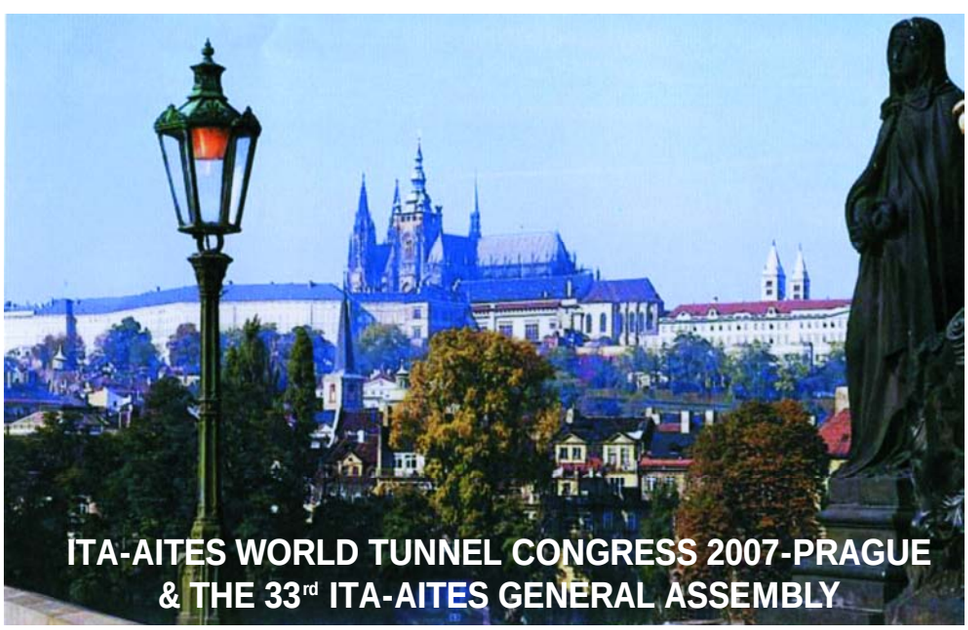
Imprimé par Imprimerie Techniprint
ZI Albasud - F-82000 MONTAUBAN
Crédits photos :Nations membres de l'AITES
Publicité : ACROTÈRE
Dépôt légal : Mai 2007



EDITORIAL

Dear readers of the Tribune and attendees of the ITA/AITES World Tunnel Congress 2007!

I am honoured to address you all in this official ITA/AITES magazine, TRIBUNE, not only on my behalf but also on behalf of the members of the Czech Tunnelling Committee (CTuC) and all those colleagues who have participated in the organisation of the WTC 2007.

My country, the Czech Republic, is not large either in terms of the population with slightly more than 10 million inhabitants, or the area. It is however special owing to its position early in the centre of Europe. Its neighbours are German speaking countries (Germany and Austria) in the west and south, and Poland and Slovakia in the east. This geographical position makes it predestined to become a kind of junction between the west and east of Europe. It also applies to the field of transit traffic, where the road and rail traffic along the north-south axis is to be added. The Czech Republic is now firmly a part of the European Union.

The Czech State was throughout history a central part of Europe, its history and culture; therefore all today's visitors may admire the wealth of historical landmarks and rich cultural life in our country. This applies most of all to Prague, the capital of the Czech Republic. It is a city boasting extremely rich history, whose historical centre has been a designated UNESCO World Heritage Site, but also a rapidly developing modern city, which is spread within the undulated terrain in the Vltava River valley, on ground which is characterised by complex and chequered geology.

We do not disguise the fact that the WTC 2007 motto „Underground Space – the 4th Dimension of Metropolises" was inspired by our problems associated with the development of Prague.

Underground engineering has its long history in the Czech Republic, which was influenced mainly by mining activities, but also by the morphology of the landscape. Detailed information on the underground engineering not only in the history but also at present has been gathered by a team of authors led by professor Jirí Barták from the Czech Technical University in a representative publication "Underground Construction in the Czech Republic". We published it on the occasion of the WTC 2007.

Czech underground engineering has experienced rapid development in recent years, both in terms of the number of completed structures and regarding the techniques which have been used. The main reason was the change in the political system in our country after 1989. Our state ceased to be a member of the eastern socialist block controlled by the Soviet Union, and fully fledged contacts with western European states and states in the whole world were gradually renewed, along with the restoration of democracy.

The tunnel excavation methods which had been utilised in the Czech Republic before 1990 consisted of non-mechanised shield driving and the Ring Method. Even TBMs had been used, primarily for driving water supply tunnels and, to a lesser extent, running tunnels of the Prague metro. The end of this period saw the success in the efforts to utilise the NATM on this project as a highly adaptable traditional tunnelling method. However, full mastering and expansion of this method was possible only in the new political conditions after 1990.

The NATM is today unequivocally the most prevalent tunnelling method in the Czech Republic. It is used not only in the construction of new sections of the Prague metro, but also for all of the other transport-related tunnels, no matter whether they are built on roads and motorways, or on railways (in this case with an exception of the mechanical pre-cutting method used at the Brezno tunnel construction). Deployment of TBMs on the planned construction of two single-track railway tunnels, at a length exceeding 20km, between Prague and Beroun will be a new challenge for Czech tunnellers.

To conclude, I would like to emphasise that we are aware of the benefit we can enjoy owing to the existence of the ITA/AITES and its activities. We will therefore be happy to be allowed to actively participate in ITA/AITES assignments.

Ivan Hrdina

Chairman of the Czech Tunnelling Committee ITA/AITES

Focus on Czech Republic

1. INTRODUCTION – THE HISTORY OF CZECH UNDERGROUND ENGINEERING

The Czech Republic is a relatively small intercontinental state with an area of 78 867km². It is located in central Europe and has a population of 10.2 million. This ranks the Czech Republic among countries with relatively high density of population. An independent Czech state had existed as long ago as Early Middle Ages, till incorporation of the Czech Kingdom into the Austro-Hungarian monarchy. The independence was restored in 1918, after World War I, by the foundation of the Czechoslovak Republic. The origination of the independent Czech Republic is dated to 1.1.1993, at which day the Czech and Slovak Federation was split into two separate states.

In terms of terrain morphology, our country can be categorised neither as mountainous nor flat; 67% of the area lies under the altitude of 500m a.s.l.

In terms of regional geology, the area of the Czech Republic can be divided into two basic units – the Bohemian Massif and the Carpathian System. The major part of the area is found in the Bohemian Massif (the age of about 900-700 million years). The Carpathian System (the age of about 140-45 million years) extends only to the eastern and south-eastern part of the republic.

Considering the variability of rock types and complicated tectonic pattern, it is possible to state that the geomorphological composition historically predetermined that the subsurface space would be exploited during the Recent Epoch of the Quaternary Period, in which human beings gradually increased their impact on the environment. The tradition of ore mining is long, lasting since the Middle Ages, and it is probably not by accident that the famous literal work 'De Re Metallica Libri XII' by Georgius Agricola originated in the first quarter of the 16th century in the context of extensive silver mining in the Bohemian town of Jáchymov.

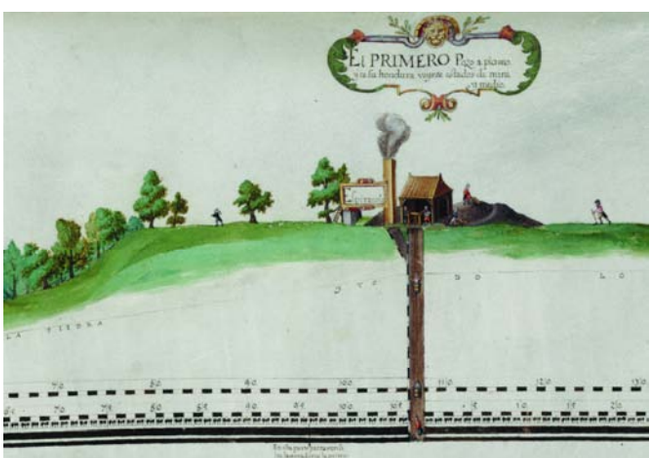


Fig.1/ Rudolph's Gallery (1593) – a section of the illustration

The subsurface workings which originated in the area of the Czech Republic and which were not associated with mining activities, were comparable with the world, however, rather in terms of the chequered purpose of utilisation than their size. The evidence of this statement is, for example, the water-management structure of the 1,102m-long Rudolph's Gallery, which carried water to ponds in Královská Obora (a royal deer park) in Prague. It was built on an initiative of Emperor Rudolph II of Hapsburg in 1582 – 1593. We should also mention the great number of extensive labyrinths of underground galleries in medieval towns, such as Jihlava, Tábor, Znojmo, Brno and Zatec. Extensive underground spaces, the so-called fortress underground, are also under medieval castles and in bastion fortified towns, such as Terezín and Josefov, which were built to prevent intrusion of Prussian armies in the 2nd half of the 18th century. The overall length of underground galleries in Terezín fortress reaches 30km. Another important utilisation of subsurface space for strategic purposes was the development of a complex system of border fortresses, using the Maginot's Line as its model, at the end of the 1930s. Mighty concrete artillery fortresses, which were set out at access roads leading from the border, were the basic element of the defence (against nazi Germany). The entire system of servicing and supplying all battle structures was underground, up to 35m deep, including sleeping quarters and equipment (power stations, air filtration stations), aid stations and magazines. Despite the technical perfection, this system never weighed in the battles of the World War II owing to the international political development of that time.

Of the linear historic underground structures, worth mentioning is the tunnel on the Schwarzenberg floating channel in the Sumava Mountains, which was driven during one winter season in 1821/1822, at a length of 429m (later reduced to 389m). The importance of this floating channel was in the fact that it crossed the main European divide and connected the catchment areas of the Danube and Vltava rivers.


Fig.2/ The tunnel on the Schwarzenberg floating channel

Focus on Czech Republic

The sewerage network in Prague is also a great historical underground construction. The oldest written reference to Prague sewerage is dates 1310. However the first more important work was carried out in 1818 – 1828. It consisted of 44km of sewers discharging to the river Vltava. The exceptional quality design for the sewerage under both the Old Town and Lesser Town was carried out and subsequently implemented at the end of the 19th century by an English engineer W.H. Lindley. The total length over 90km of sewers was built, together with the first sewage treatment plant in Prague-Bubenec; some of the sewers are still in service. The treatment plant was decommissioned in 1967 with respect to the insufficient capacity, but it is still one of gems in terms of Czech industrial architecture. At present, the entire Prague sewerage network length reaches notable 3 500km.

Fig3/ Frontier fortifications from the 1930s

2. TUNNELLING TECHNIQUES IN THE CZECH REPUBLIC

The majority of our older tunnels (which were, owing to the historical development, mostly built on railway lines) were constructed by traditional tunnelling methods based on a multiple-drift method, with timbering used for temporary support. Regarding the tunnel face excavation procedure, the tunnelling methods which used to be used comprised the Austrian, Belgium, German, English and Italian tunnelling methods; the former three methods were spread most of all. In the 1950s, the development of the original tunnel construction procedures started to be organised on a much broader basis, which integrated new scientific approaches, theoretical analyes of problems, development of mechanical equipment and introduction of controlled blasting. This development resulted in the introduction of the Ring Method, which utilises erector-installed segments for the tunnel lining. This method was spread widest at the construction of the Prague Metro. The Prague Metro construction even saw not only the utilisation of non-mechanised shields, but also successful deployment of mechanised, full-face shields (TBMs). Tunnel boring machines were also used at a significant extent for driving very important water-supply tunnels, sewers and cable tunnels. The New Austrian Tunnelling Method (the NATM, called also Spritzbetonbauweise or Sequential excavation method etc.) had not started to set up in the Czech Republic until the beginning of the 1990s, owing to the political system in the Czech Republic of that period. With a few minor exceptions, this method is currently dominating in the Czech Republic thanks to its versatility. The generally widest-spread tunnelling method by full-face tunnel boring machines (TBMs) is not currently used in the Czech Republic. The reasons are probably economical, but they are also associated with the long-term loss of contact with this technique and, most of all, with the limited potential of tunnelling contractors. The preference to the NATM is, however, probably well justified considering the Czech environment, which is characterised by relatively complicated conditions requiring varying configuration of the tunnel cross sections and short lengths of tunnels. Despite this fact, it seems today that the TBM technology will be again utilised in the Czech Republic in not so distant future, in the context of the construction of long railway tunnels or new sections of the Prague Metro.

Of the other tunnelling methods which were used here until recently or are being used in the present, let us mention the following ones:

- the Mechanical Pre-cutting Pre-vault Method, which was used in somewhat disputable way in the construction of the Brezno u Chomutova tunnel,
- the Tunnel Launching Method, which was used with great success in the construction of two tubes of the Prague Metro crossing the Vltava River ,
- the traditional cut-and-cover tunnelling method, which has been used relatively often in the parts of tunnels with very complicated layouts and cross sections (equipment centres, transition sections between mined tunnels and open-space routes, etc.),
- covered-over thin-walled tunnel structures, where the structures interact with the soil cover; this system is frequently used for so-called “ecoducts” and “ecotunnels” on new roads to allow ecological protection corridors to cross them.
- the cover-and-cut or top-down method (so-called Milan method), which is based on utilisation of structural retaining (diaphragm) walls to form permanent side-walls of the tunnel, and the final roof deck for bracing the walls; the top-down tunnel excavation is carried out under the protection provided by these structures. This method is very often used in cities for the minimised plan area of temporary works required and higher speed of the works; the so-called “Turtle Shell Method” is a modification of the cover-and-cut method - the tunnel vault structure is cast on moulded ground surface, and the top-down tunnel excavation is carried out below the vault.

Focus on Czech Republic

RAILWAY TUNNELS IN THE CZECH REPUBLIC

An unprecented upswing in railway traffic started in Europe and also in Bohemia approximately in the middle of the 19th century. This development laid the foundation of the modern tunnel construction. Thus the construction of tunnels on railway lines has today an over 160-year tradition.

The current railway network of the Czech Republic contains 154 operating tunnels at the total length of 38.5km; of this number, 17 tunnels were opened to traffic before 1850, 89 tunnels were opened between 1850 and 1900, and 36 in the years 1900-1945. The period after 1945 meant a check on tunnel construction. At the beginning, this period was characterised by rehabilitation of tunnels damaged during the war and, in the 1960s, by commencement of an extensive programme of reconstruction of railway tunnels connected with modification of the clearance profile of the tunnels and electrification of railway tracks. Only 15 new tunnels were built during the entire post-war period (till 2000). The boom in railway tunnel construction, which we are currently experiencing, began in the connection with upgrading of railway tracks to transit corridors, which are parts of the so-called "pan-European" railway corridors designed for utilisation by modern trains. The higher speed limit over track (160km/h) means more demanding requirements for the routes, primarily for the horizontal alignment, which must be straighter. As a result, new tunnels are necessary. There are 7 new tunnels at the total length of 2.7km on the corridor lines which were built after 2000; a large number of other tunnels is in the preparation phase. The extent of planned tunnel construction on railway lines significantly exceeds 50km, not only owing to one of the tunnels which is over 25km long. This length consists of tunnels for the Corridor III (the about 25km-long Beroun tunnels, 4.15km-long Ejpovice tunnels, and the 612m-long New Jablunkov tunnel) and Corridor III (13 tunnels at an aggregate length of 10.1km).

Two tunnels at the total length of 4.4km are at present being built and other tunnels are planned also for non-corridor lines. Let us briefly outline some interesting railway tunnels built in the past, being under construction and also planned for the future:

The original Trebovice tunnel on the Ceská Trebová – Olomouc railway line was the oldest of all tunnels in the Czech Republic, not only railway tunnels. This double-track tunnel was excavated in the years 1842-1845 using the German Tunnelling System. The excavation encountered serious problems while passing through the environment consisting of swelling and heavily squeezing clay. The 1.2 – 2.0m thick stone masonry lining was of the horseshoe shape with an invert. The 612.5m-long tunnel had to be closed in 1865 because of serious defects of the lining. It was reopened after an overall reconstruction in 1932, but only in a single-track configuration. The old Trebovice tunnel was abandoned forever in 2005. It was replaced, in the framework of the upgrading of railway corridors, by an open cut and a short, 95m long, cut-and-cover tunnel.

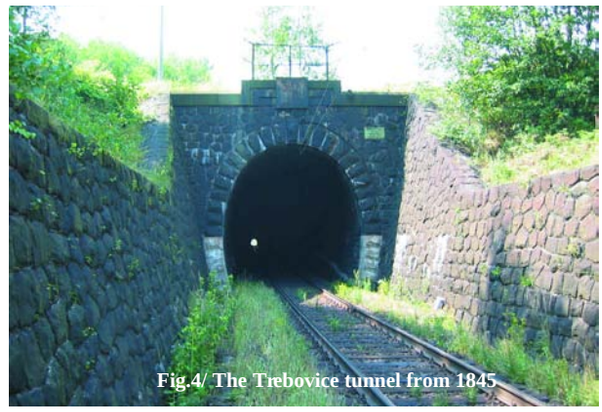


Fig.4/ The Trebovice tunnel from 1845

The Spicák tunnel in the Sumava Mountains continues, with its length of 1,747m, to be our longest railway tunnel. It was built in 1874 – 1877. The excavation of the double-track tunnel passed without major problems through an environment consisting of hard mica schist. The stone masonry tunnel lining is of a horseshoe shape.

The Vinohrady tunnels in Prague are probably the most extensive railway tunnel construction. It is a complex of four parallel tunnel tubes, which were built in phases to provide connection of the main Prague railway station in the western and southern directions. The Vinohrady I tunnel was built in 1869 – 1871, first as a single-track structure and subsequently rebuilt to become a double-track tunnel. The length of the tunnel, which was driven through Ordovician shale using a multiple-drift (Austrian) method, was 1,139m.

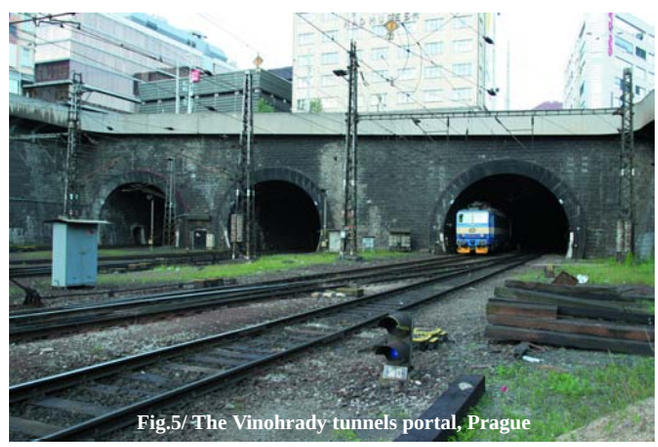


Fig.5/ The Vinohrady tunnels portal, Prague

The Vinohrady II tunnel was added in the years 1940 – 1944 to increase the capacity of the railway link. This double-track tunnel drive was 1,122.5m long. The stone masonry lining of both tunnels is horseshoe shaped, provided with an invert. A double-track germ of the Vinohrady III tunnel was excavated simultaneously with the construction of this tunnel. The

Focus on Czech Republic

Vinohrady III tunnel was, however, completed as late as 1983 – 1989; two single-track tubes were driven from the germ by the Ring Method, with precast concrete segmental lining. The bifurcation chamber allowing splitting of the germ into two single-track tunnels was the only part of the construction which was carried out using partly the Modified Side-Drift Method and partly in an open construction pit, with respect to the difficult geological conditions, low overburden with high-density development on the surface, and the fact that the area had been undermined during the construction of a metro line. The Vinohrady III tunnel consists of a 333m-long double-track section and 769m and 791m-long single-track tunnel tubes.

The Nové Sedlo tunnel in north-western Bohemia is 210.5m long. It is an interesting structure, which was built quite recently. The lining of this covered-over double-track tunnel consists of a system of thin-walled longitudinal precast reinforced concrete segments. The vault consisting of the segments was subsequently made fully continuous (the Bebo system). The tunnel was opened to traffic in 1980.

The Veprek tunnel near Kralupy nad Vltavou (390m long) is counted among modern railway tunnels in the Czech Republic which have been built in the framework of the railway transit corridors. It was the first railway tunnel in the Czech Republic built using the New Austrian Tunnelling Method (2000-02). The excavation support consists of a shotcrete primary lining with mesh and a system of anchors and rock bolts, and of cast-in-situ reinforced concrete secondary lining. The waterproofing is of the umbrella (unclosed) type, with the membrane installed between the two linings.

Fig.6/ The Veprek tunnel

A complex of tunnels, which were recently opened to traffic on the Corridor I railway line, is also an example of the current tunnel construction. It comprises five tunnels, i.e. the Krasíkov tunnel (1 001 m), Tatenice tunnel (143 m), Malá Huba tunnel (324 m), Hnevkov I tunnel (180 m) and Hnevkov II tunnel (462 m). All of the tunnels are double-track structures, which were carried out using the NATM, with double-shell lining and the intermediate umbrella-type waterproofing system.

The Vítkov tunnels, which are parts of the New Connection project (a part of the Prague railway intersection development

Fig.7/ The Krasíkov tunnel interior

Fig.8/ The Hnevkov tunnel portal

scheme), must not be left unnoticed. Two double-track tunnels, 1,365m and 1,316m long, are being built in a central part of the city, in a section exposed to viewing by the public. The tunnels were excavated by the NATM; currently the final liners are being erected. When the tunnels are completed in 2008, they will replace the currently unsatisfactory existing

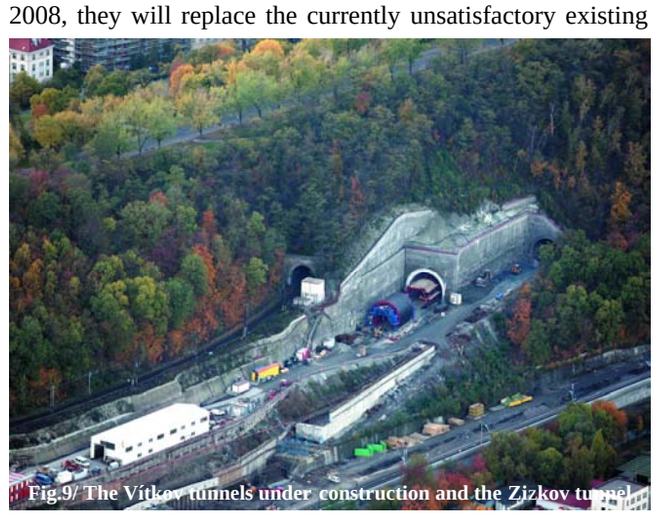


Fig.9/ The Vítkov tunnels under construction and the Zizkov tunnel

Zizkov tunnel, which links the main Prague railway station to the railway lines coming from the eastern half of the city
The first application of the Mechanical Pre-cutting Pre-vault Method in the Czech Republic took place at the excavation of the Brezno tunnel near the town of Chomutov. The 1,758m long single-track tunnel is currently in the completion stage, with the opening to traffic expected in April 2007. However, this method did not prove to be good for the tunnel excavation in the geological environment consisting of intensely disturbed claystone massif. After a collapse in 2004, which resulted in destruction of about 100m of the lining consisting of concrete pre-vaults, the remaining length of the tunnel was excavated using the NATM. Once it has been completed, this tunnel will become for some time the longest railway tunnel in the Czech Republic.
The Beroun tunnels in the Railway Corridor III between Prague and Beroun are probably the most interesting tunnel construction planned for implementation. The existing railway track runs along the meandering Berounka River valley and virtually cannot comply with the requirements for changes necessary for the track to allow the upgrading to the transit corridor. For that reason, the newly designed track section connects the above-mentioned towns by a mostly mined tunnel route, with a simple horizontal alignment. The Beroun tunnel tubes will be 25km long, running in parallel to each other. Full-face tunnel boring machines (TBMs) which will be utilised for the construction will be of a large profile (approximately 9.5m), which has never been used in the Czech Republic yet. Precast concrete segments will be used for the tunnel lining; only the portal sections will be excavated by the NATM. The geotechnical survey will call for great attention because the routes of both tunnel tubes pass through the Barrandiene geological region, where an occurrence of karst phenomena is expectable.

Fig.10/ The pre-vault tunnelling machine at the Brezno tunnel construction

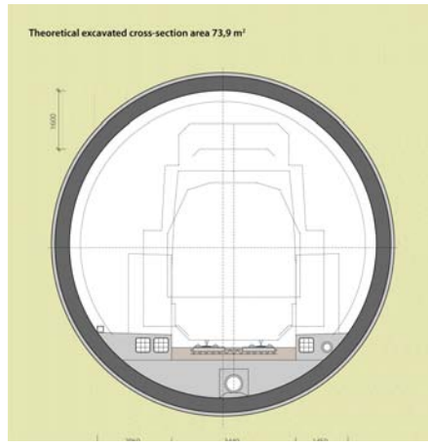


Fig.11/ A cross section through the Beroun tunnels being planned

VEHICULAR TUNNELS IN THE CZECH REPUBLIC

Compared to railway tunnels, vehicular tunnels are not indispensable in the morphology of the Czech landscape. This is why decisions to build a road tunnel were made considering the economical aspects, therefore only in exceptional cases, mostly in towns. Wider utilisation of vehicular tunnels has begun with the upswing in car ownership in the 1990s, which was followed by construction of new high-capacity roads (motorways, expressways, urban ring roads). Apart from provision of comfortable routes of the new roads, another significant reason for construction of vehicular tunnels is the growing respect for nature and the environment as the whole.
Till now, there are 18 operating vehicular tunnels in the Czech Republic; of that number, ten tunnels are in urban areas. Twelve tunnels have been commissioned since 1990, of that number six since 2000. The total length of all operating vehicular tunnels in the Czech republic is 9.6km, of that the length of tunnels on motorways and expressways amounts to 3.2km, tunnels on urban roads make up 6.0km, and on the other roads are 0.4km long in total. However, the number of vehicular tunnels is not final, even considering the number of tunnels under construction (seven tunnels at the total length of about 11.8km), and the prospect of its future growth is relatively very good. The extent of planned road tunnel constructions is similar to that planned for railways. The current plans contain a total of 45km of tunnels. New tunnels are being prepared primarily for the D3 and D8 motorways, the R49 expressway, and major urban roads in Prague and Brno. Together with all other vehicular tunnels, it makes up about 65 tunnels, mostly double-lane ones.
Some interesting vehicular tunnels are briefly described below:

Focus on Czech Republic

The first of all road tunnels in the Czech Republic was the Vysehrad tunnel in Prague. This 34m-long tunnel from the year 1904, which features architecturally designed portals, is traversed not only by vehicles, but also by a tramline and a pavement.

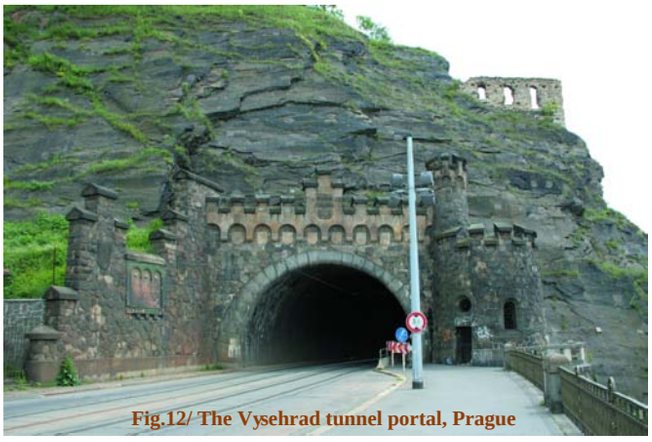


Fig.12/ The Vysehrad tunnel portal, Prague

The first important vehicular tunnel was the 426m-long Letná tunnel, which, again, is a tunnel built in Prague. It was built in 1943 – 1953 using the traditional multiple-drift system of the modified Austrian Tunnelling Method.

A curiosity of the Czech tunnelling history is undoubtedly the shortest tunnel which is known under the name Pekarova Brána (Pekar's Gate). This 4m-long tunnel was built in 1914 in the vicinity of the town of Turnov. At that time the builders of a local road encountered an obstacle, a sandstone rock. They decided to overcome it by carving a passage in the shape of a pointed Gothic gate through the rock.

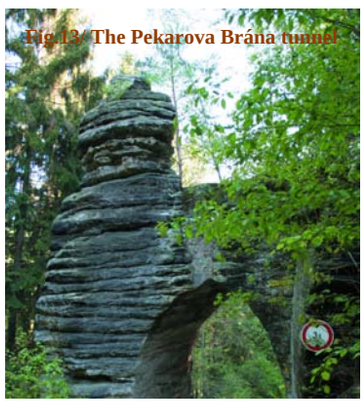


Fig.13/ The Pekarova Brána tunnel

The development of the car ownership from the end of the 1980s, and the necessity for solving traffic in towns which was associated with it, led to construction of several urban vehicular tunnels. In Prague, it was above all the 2,042m long Strahov tunnel, which was driven using an upgraded German system in 1984 – 1997, by means of a mechanised semi-shield and the Ring Method. The tunnel structure comprises a segmental upper vault, a pair of cast-in-situ abutments, which were built in abutment drifts excavated in advance of the tunnel excavation, and a segmental invert structure.

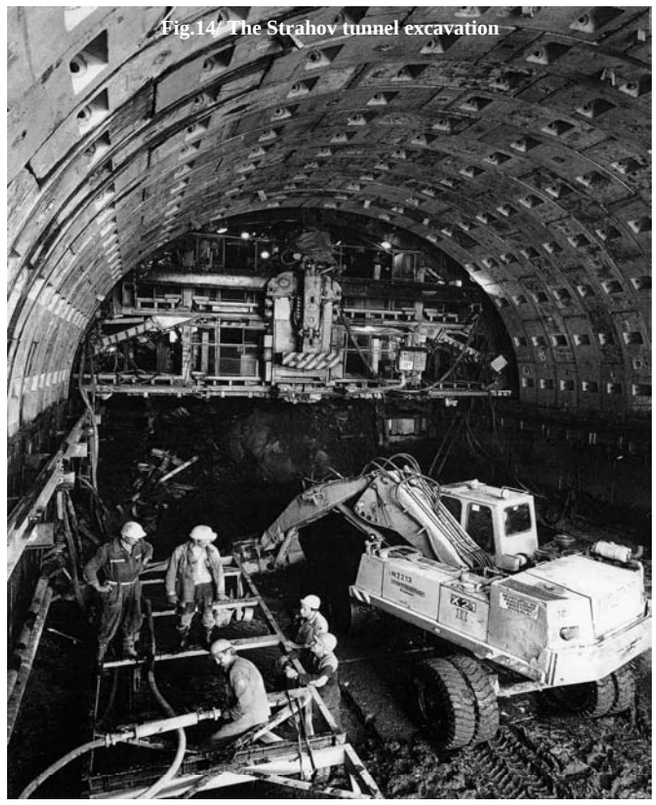


Fig.14/ The Strahov tunnel excavation

Another tunnel was the Mrázovka tunnel, which was inaugurated in 2004. This 1,300m-long tunnel with the cross section of 160m² (up to 340m² in bifurcation chambers) was built using the New Austrian Tunnelling Method. Its double-shell lining was provided with a closed intermediate waterproofing system. The excavation of this tunnel faced many technical problems, starting from a low overburden (locally a mere 11 metres), through poor geological conditions, low quality of existing buildings above the excavation, complexity of the tunnel cross sections (bifurcation chambers, underground intersections), up to a necessity for incorporation of a slab carrying the roadway, which had to act as a tie reinforcing the final lining of the tunnel. The importance of the construction of the Mrázovka tunnel certainly crosses the border of the

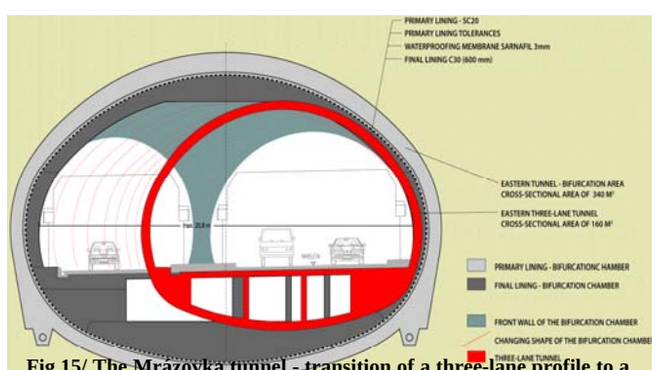


Fig.15/ The Mrázovka tunnel - transition of a three-lane profile to a largerprofile required forbifurcation

Czech Republic; it is a notable structure even within the European context. These were also the reasons why this construction was awarded the Construction of the Year 2005 in the Czech Republic.

The Pisárky tunnel in Brno is one of important tunnels built in other cities than Prague. This 500m long tunnel was constructed by the NATM in 1995 – 1997. The double-shell lining of the tunnel is horseshoe shaped, supported by longitudinal foundation strips, without an invert.

The Jihlava tunnel, which was built in 2004, is a typical representative of application of the so-called "turtle shell" tunnelling method, which is a variant of the cover-and-cut method. The lining of the 304m-long tunnel consists of structural diaphragm walls (which are built from a lowered surface level) and a cast-in-situ concrete upper vault resting on heads of the walls. The excavation of the tunnel interior was carried out under protection of these structures.

The first of all tunnels excavated in the Czech Republic by the NATM was the Hrebec tunnel on the I/35 road between the towns of Svitavy and Moravská Trebová. The lining of this tunnel is of the double-shell design with the umbrella (unclosed) type of intermediate waterproofing. The 355m-long three-lane tunnel was built in 1994 – 1997.

There are several representatives of modern motorway tunnel structures which have recently been completed in the Czech Republic. The 390m-long Valík tunnel is located on the D5 motorway near Plzen. The standard width configuration of the carriageways existing on the open surface route was maintained throughout the tunnel length with the aim of reducing the plan area of permanent works. Thus the intermediate rock pillar between the opposite-direction tunnel tubes was omitted. The rock pillar was replaced by a thinner structure of a concrete pillar, which was built in advance inside a central pilot gallery. The remaining spaces of both tunnel tubes were excavated subsequently using the NATM. The tunnel was inaugurated in 2006.

Four tunnels have been designed for the D8 motorway (Prague-Ústí and Labem-Dresden). Two tunnels (2,168m-long Panenská and 520m-long Libouchec) were commissioned in 2006, and two (270m-long Prackovice, 620m-long Radejcín) are in the preparation stage. Both completed tunnels are found in a schist crystalline complex at the northern border with Germany. Again, they were built using the NATM. The Panenská tunnel, with its length of 2,168m, has become the longest tunnel in the Czech Republic; the Libouchec tunnel is an example of appropriate utilisation the observation method, owing to which it was possible to change the original reinforced concrete final lining design to unreinforced concrete. The construction of the Prackovice and Radejcín tunnels is planned to start in 2008.


Fig.16/ The Libouchec tunnel interior

The construction of the 1,088m-long Klimkovice tunel is currently being finished on the D47 motorway near Ostrava. Again, the NATM is being used; the commissioning was planned for 2008, however, the trouble-less course of the works allows it to take place earlier, in 2007.

There are two mined tunnels on the Prague City Circe Road, the 1,662m-long Lochkov tunnel and 1,937m long Komorany tunnel, which are in the initial construction phase. Both tunnels have been designed to provide the passage of the expressway through hilly areas stretching along both banks of the river Vltava. In both cases, the NATM is used for the excavation. The commissioning is planned for 2009.


Fig.17/ Visualisation of the Lochkov tunnel portal

The probably most important tunnelling project will be implemented in Prague on the City Ring Road, namely the Blanka tunnel complex. It is a continuous tunnelled section at an overall length of 5.5km, which will consist of two mined tunnel sections (0.55km and 2.23km long) and cut-and-cover sections at an aggregate length of 2.72km. It is purely an urban tunnel, with two separate tubes for both traffic flows. In addition, the project contains two intermediate intersections with connections to the surface road network. The tunnel route runs through complex geological conditions (Ordovician layers and a Quaternary nappe) under extensively developed areas, touches the UNESCO-listed historical core of Prague, and passes under the Vltava River and a water-bearing terrace on its bank. The extent of this project,

including the impact on the urban environment (both during the course of the construction and after the commissioning) are absolutely exceptional, and the only construction to which they can be compared is the construction of the initial operating sections of Prague metro. The construction will be carried out using several tunnelling methods. The NATM principles will be applied to mined tunnels. Apart from the cut-and-cover method, the cover-and-cut technique (also called the Milan method – tunnel excavation under the protection of structural diaphragm walls and a roof deck) will be also used with respect to the needs for utter minimisation of the time and space required for the construction. The opening of the tunnel to traffic is planned for 2011. The tunnel which will originate will be the longest in the Czech Republic, more than twice as long as all existing tunnels.

There are other tunnels in the preparation stage on the parts of

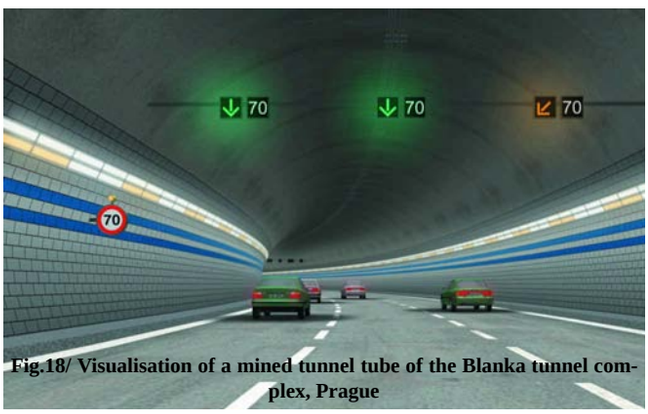


Fig.18/ Visualisation of a mined tunnel tube of the Blanka tunnel complex, Prague

the major roads in Prague which have not been completed yet (two ring roads, seven radial roads, two connecting roads) at a total length of 17km. All of those structures will be built gradually starting in 2008. The progress of the process of obtaining approvals for the constructions, which is often made very complicated by some environmental groups, will undoubtedly significantly affect the term of opening of the tunnels to traffic.

The trend which has started in Prague reflected itself to a lesser extent even to other towns in the Czech Republic. The Královo Pole (or Dobrovského) tunnel, which is currently under preparation in Brno on the Large City Ring Road, is an example. The 1,261m-long tunnel passes through very difficult geological environment consisting of Neogene clay, under a densely developed area. The commissioning is planned for 2011. Apart from the Královo Pole tunnel, another tunnel sections at a total length of 6.4km are planned for the Brno urban concentration.

As mentioned above, many tunnel structures, mostly rather short, are also planned for the network of motorways and expressways which is under preparation. The largest number is found on the D3 motorway, in the section running through a densely populated valley along the Sázava River south of Prague, which is also intensively utilised for recreational purposes. The objective of the planned tunnels is to provide suitable conditions for delineation of the route and to reduce the barrier effect of the motorway in the landscape. There will be six tunnels in the section starting at the motorway connection to the Prague City Circle Road and ending at the bridge over the Sázava. The aggregate length of about 2.5km of tunnels will consist of mined and cut-and-cover structures. The subsequent motorway section contains three 200m-long cut-and-cover tunnels. The constructions are expected to take place after 2010.

Long-term plans prepared by designers and investors contain lots of other tunnels, but the time of their implementation is mostly very distant, therefore their description could be misleading.

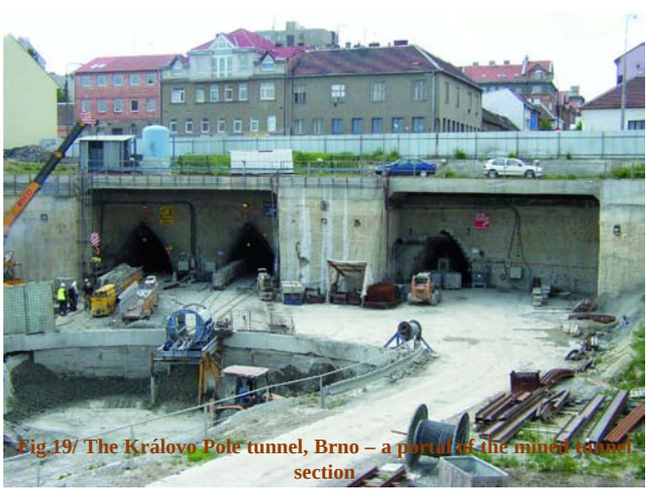


Fig.19/ The Královo Pole tunnel, Brno – a portal of the mined tunnel section

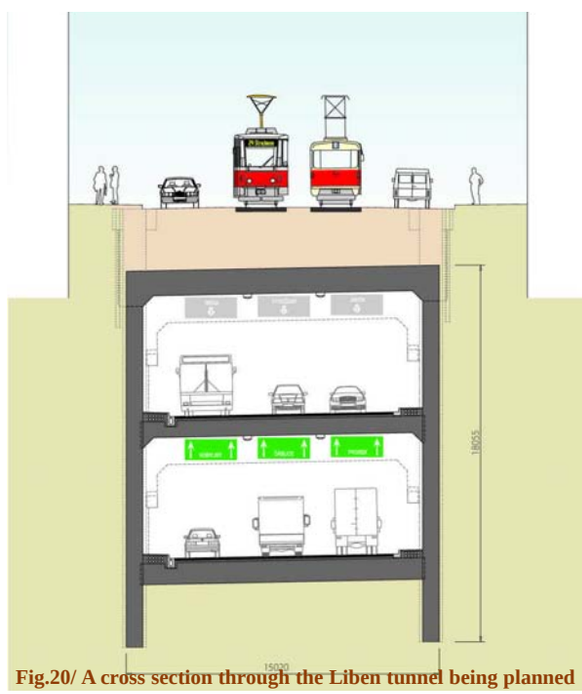


Fig.20/ A cross section through the Liben tunnel being planned

Focus on Czech Republic

PRAGUE METRO AND TUNNELS FOR URBAN MASS TRANSIT (UMT)

Prague Metro has undoubtedly become the largest underground project of all in the Czech Republic. The first realistic draft of a design for a subsurface railway was submitted as long ago as 1926. However, the real construction commenced in the 1960s, whilst the capital of the Czech Republic faced major traffic problems in the area of mass transit. It was the reason why the project of the underground railway, the metro, was undertaken. The construction has affected the life of the capital for decades and will affect it even in the future. Prague saw gradual origination of three metro lines, A, B and C, with transfer stations in the centre of the city. The gradual opening of the lines to traffic brought about a fundamental turn in the Prague mass transit system; each newly completed operating section significantly improved the situation in the mass transit.

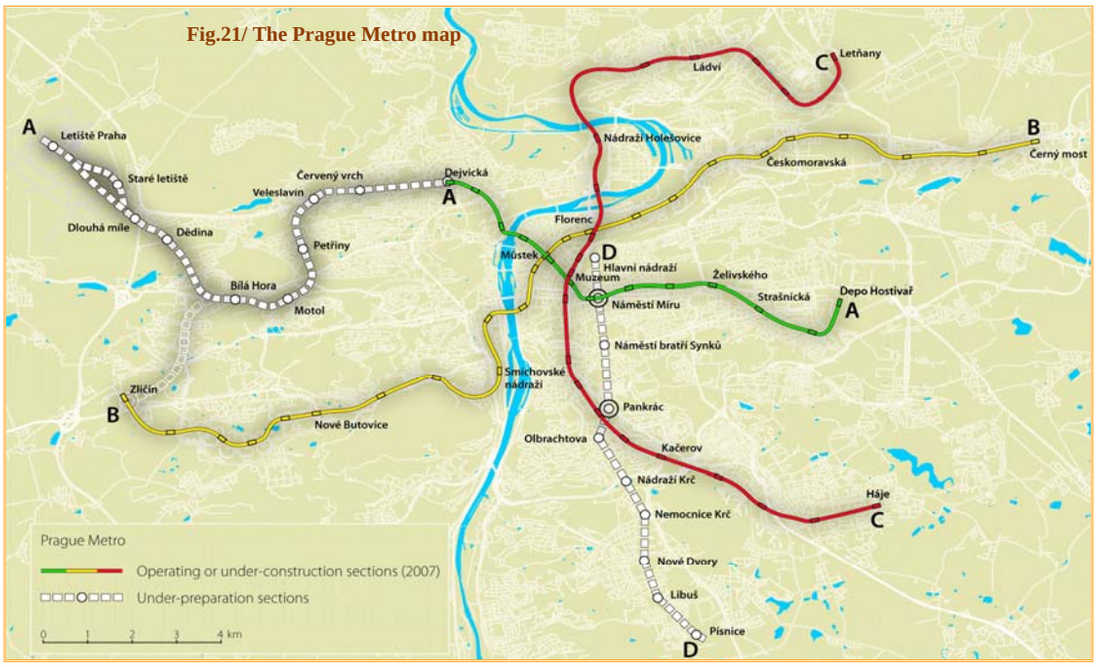


Fig.21/ The Prague Metro map


Fig.22/ A typical mined tunnel of the Prague metro with a segmental lining

The tunnelling techniques designed for the construction had to respect the variability of geological conditions in Prague, which are characterised by alternation of soft and hard Ordovician sediments. The major part of the tunnel drives was carried out by the Ring Method, with the lining from cast-iron or concrete segments, using shields, both non-mechanised and mechanised. The tunnelling procedures were continuously improved during the course of the decades lasting construction; first of all the procedure for construction of metro station tunnels underwent a principal optimisation process. The following types of three-vault stations, where two side tunnels are connected with the central (platform) tunnel through 3.0m-wide (later 3.75m-wide) passage openings, were utilised:

- the pylon type with cast-iron segmental lining and rock pillars between the openings
- the column type with cast-iron segmental lining and steel columns between the openings
- the pillar type with reinforced concrete segmental lining and concrete pillars (subsequently modified)

The second half of the 1990s saw the switching from the above-mentioned traditional methods to the NATM, which has become the only method of construction of mined tunnels since that time. The last in the series of mined metro stations, Kobylisy station (2002) was also built by this method. This station was the first single-vault station structure. Its cross-sectional area of 228m^2 was imposing. The excavation of the 148m-long station, which passed mostly through sandstone beds, was carried out using both horizontal division and a vertical division of the excavation face.

A unique procedure was developed and used in 2001-2002 for the construction of tunnels on the northern extension of Metro Line C passing under the Vltava River. The procedure consisted of casting of the entire length of the tunnel tube crossing the river in a casting basin, launching of the tube (floating) to

Focus on Czech Republic

Fig.23/ Vysocanská metro station – the three vault type with pillars

the final position, and sinking of the structure to a pre-dredged trench in the riverbed. This design was recognised with the FIB- Award Outstanding Structure and won the Engineering Academy of the Czech Republic Award in 2002.
A 4.6km-long operating section containing other three stations is currently under construction on the same metro line, in the north-eastern area of the city. Approximately a half of the tunnels are of the mined type, driven using the NATM. The remaining sections are built by the cut-and-cover method. The completion is planned for 2008; the overall volume of the muck and ground excavated in the cut-and-cover sections amounts to 1,138,000 m^3. The construction technique is significantly influenced by the fact that the route passes under a relatively low overburden and buildings existing on the surface, and crosses an area which has been affected by historical mining activities.
Today's Prague Metro has a length of 54.7km and 54 stations.


Fig.24/ Kobylisy metro station – the mined one-vault type

It comprises about 150km of mined tunnels and galleries. The routes of the lines A and B are considered to be completed in the long term.
The development of the Prague metro system which is planned for the near future covers primarily the Line A extension and the construction of a new line, Line D. Line A will be extended in a north-western direction, up to the Ruzyne Airport. The length of the entire section, containing eight stations, will reach 12.7km. Full-face TBMs are expected to be used for the drives in the 2010 – 2020 period. The new Line D will be added to help the busiest mass transit direction, i.e. from the southern residential areas of the city to the city centre. The main objective of this line is to reduce the number of bus lines at Kacerov station and to take part of the traffic load from Line C. The proposed Line D is 10.2km long, and has ten stations; of that number two stations will allow transfer of passengers. The line should be inaugurated by 2015.
Another planned underground construction for urban mass


Fig.25/ A metro tunnel tube in the inundated casting basin before launching

transit is the light railway transit system in Brno. The route of the so-called "north-southern tramway diameter" will contain 4.24km of double-track tunnels and nine subsurface stations in addition to the at-grade sections.

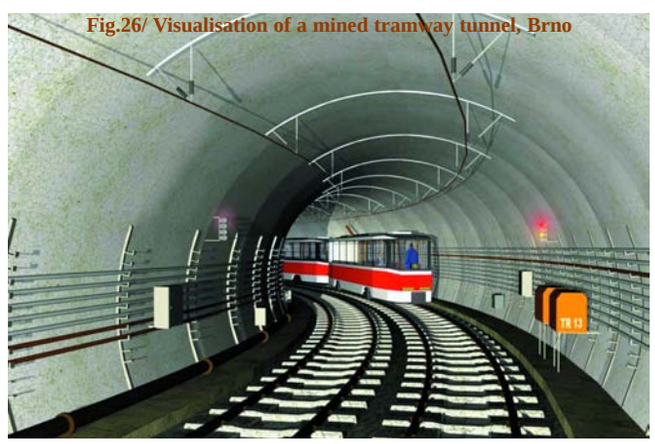


Fig.26/ Visualisation of a mined tramway tunnel, Brno

Construction of two about 0.5km-long mined double-track tunnels is planned for the new tramway line in Prague, from Podbaba to Suchdol
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OTHER IMPORTANT UNDERGROUND STRUCTURES IN THE CZECH REPUBLIC

Apart from transport-related purposes, underground structures are utilised in the Czech Republic also as special parts of other civil-engineering projects. The most widely spread is the utilisation in water resources and power generation projects and in urban infrastructure, mainly as routes for engineering networks.

Of the water resources and power generation projects, we must mention the construction of the underground hydropower plant of the Lipno I hydroelectric scheme on the Vltava River, in southern Bohemia, which was built in the 1950s. The cavern with the dimensions 22.1x65x38.6m and numerous galleries (about 3.5km) and shafts, including a 45° inclined tunnel, were excavated into a granite massif in the south-eastern part of the Sumava Mountains.

The pumped storage scheme Dlouhé Stráne is probably the most significant deed in the category of large-capacity underground construction in the Czech Republic. The excavation was carried out in a schist massif of the Hruby Jeseník Mountains, northern Moravia. The complex of underground structures of the scheme comprises 8.5km of mined galleries and shafts, several caverns and, above all, the largest cavern, i.e. the power cavern with dimensions of 87.1x50x25.5m. The total volume of the excavation reached about 300,000m^3. The project was finished in 1995, and it was elected by citizens One of Seven Wonders of the Czech Republic in 2005.

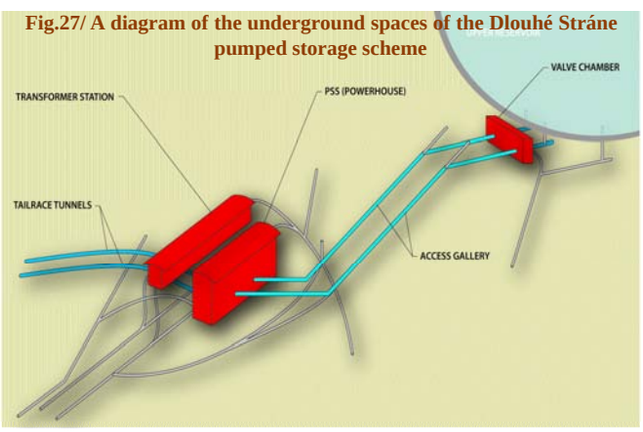


Fig.27/ A diagram of the underground spaces of the Dlouhé Stráne pumped storage scheme

Potable water supply tunnels also belong among important water-resources projects implemented in the not so distant past. We should mention the following ones:

- The potable water supply tunnel from the Zelivka WTP (1965-1972) – a 51.9km-long, cast-in-situ concrete-lined tunnel leading to the capital, Prague. Two rivers were crossed under by means of inverted siphons lined in steel armouring.
- The water supply tunnel Písecnice for the city of Chomutov (1970-1975) – a 9.25km-long tunnel, which was the first tunnel driven by a tunnel boring machine, a Ø 2,68 m TBM.
- The Brno regional water main, which was finished in the 1990s; it is a system of mined tunnels/galleries at an aggregate length of 75km.

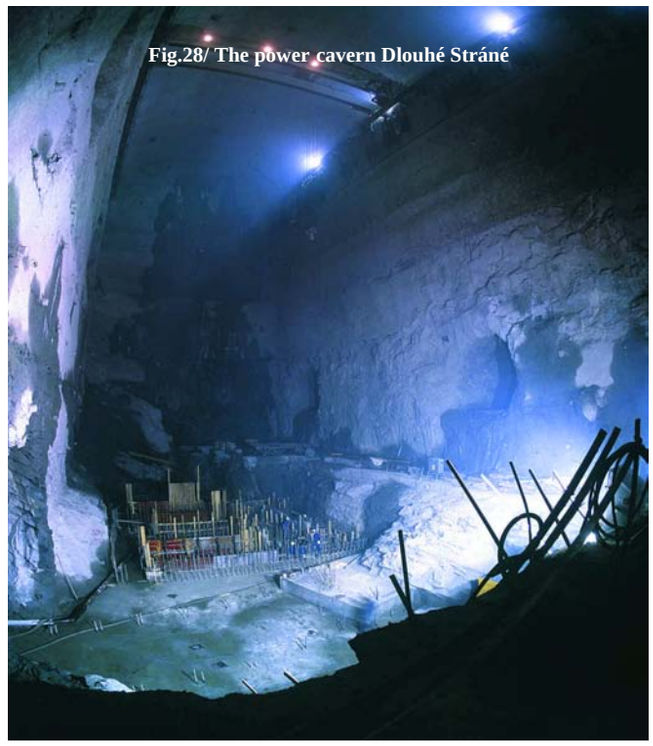


Fig.28/ The power cavern Dlouhé Stráné

The Háje underground gas storage facility near the town of Príbram, which was built in 1995 – 1998, is an extraordinary underground construction. The capacity of this deep-seated facility (up to 1 100m under the ground surface) is 72 million cubic metres at a pressure of 12.5MPa. The storage facility itself is a system of horseshoe-shape parallel galleries, which were mined in an environment formed by perfectly sound granite, without any excavation support. The system was sealed on both ends by two pairs of pressure-resisting plugs (steel fibre reinforced sprayed concrete structures) when the excavation had been completed. The total length of all galleries reaches 45km.

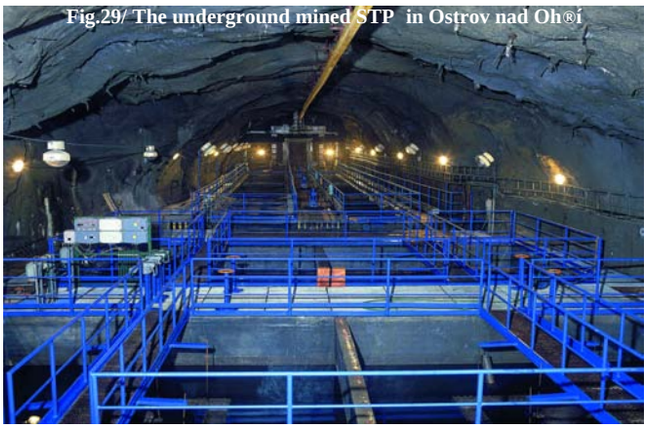
Setting of sewage treatment plants (STPs) underground is also an interesting way of utilisation of underground space. We should mention the STPs built in Pec pod Snezkou (1988) and Loket nad Ohrí (1997). Despite the fact that they are no large works (the capacities up to about 10 000 population served), the positive environmental effect of the STPs in the form of reduction of bad smell on the surroundings, no need for a sanitary protection zone and no interference with the landscape was a great benefit of this design.

Exploitation of the underground has been planned also for a new Prague STP, which is to be built and used when the lifetime of the existing, surface, the STP on Císarsky Ostrov island, which is currently being reconstructed, is over. The technological processes of the New Prague underground STP,

which should be set in a rock massif on the right bank of the Vltava near the northern border of the city, will take place in seven elongated caverns, each 566m long, 30m wide and 20m high. The total volume of the excavation, which will be carried out in sound Upper Proterozoic rock mass, is about 2,600,000m^3.

A very bold project, which is in the preparation stage, is the construction of a ship lock at the Slapy Dam, which has been designed in the form of a vertical shaft excavated in the location of a former diversion tunnel used during the dam

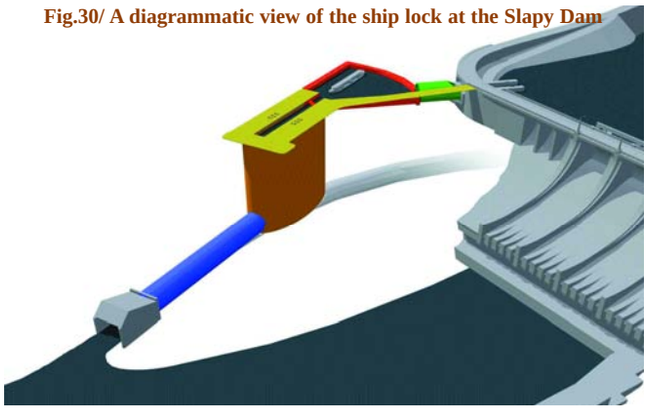
Fig.29/ The underground mined STP in Ostrov nad Oh®í



construction. The 60x25m elliptic ground-plan shaft is 60m deep, and will allow the passage of ships with displacement up to 300 tons.

Selection of a location suitable for an underground repository for spent nuclear fuel and radioactive waste from nuclear power plants is a separate problem, not only in the Czech Republic. With respect to the fact that there are relatively very

Fig.30/ A diagrammatic view of the ship lock at the Slapy Dam



extensive granite massifs in the Czech Republic, it is nearly certain that the repository will be set into a granite environment. The process of selection of the most suitable locality is currently underway. The preliminary survey and multi-stage selection resulted in six possible localities, which were selected as suitable for the deep-seated repository.

The Faculty of Civil Engineering of the Czech Technical University in Prague is currently preparing a project which will mean a significant promise for the future. They will build an underground training centre in a former exploration gallery, the Josef gallery. The about 9km-long gallery was driven with the aim of verifying golden reserves in the area along the central section of the Vltava River, in the locality of Mokrsko, about 50km from Prague. The survey was successfully conducted in the 1981 – 1991 period. However, the subsequent gold mining operations have never started because it would have had caused devastation of the valuable locality. The assignment of the training centre will be to support the university teaching and to carry out research in real underground conditions. This intention has been supported by the few similar university centres in the world which allow achieving of a high level of hands-on training of students in real conditions, promote the development of experimental activities and are helpful in the process of improving collaboration among university departments and companies.

CONCLUSION AND A CATCH-LINE

It is impossible to describe the large number of the other underground structures which were built in cities, towns and rural areas, as for example sewers, utility tunnels, energy tunnels, cable tunnels, heat distribution tunnels, pedestrian tunnels, underground parking garages, or civil defence structures. Let us leave the task of introducing other aspects of the Czech underground engineering to the World Tunnel Congress (WTC 2007) in Prague, with which this TRIBUNE content is closely associated. Some of the current Czech underground structures will certainly be topics of presentations which will be delivered by the designers and contractors. Significant projects of the near future will certainly not remain forgotten.

An extensive and detailed summary of underground structures will be also available in the publication “Underground Construction in the Czech Republic” which will be published on the occasion of the Congress and distributed to all attendees of the Congress. In the case of extra interest in receiving the publication, which is available both in Czech and English, you can directly address the publisher, SATRA, spol. s r.o., Sokolská 32, Praha 2 120 00, email: satra@satra.cz, tel. +420 296 337 111, or the secretariat of the Czech Tunnelling Committee (CTuC), Delnická 12, Praha 7 170 00, e-mail: ita-aites@metrostav.cz, tel. +420 266 793 479.

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The photographs by various authors used in this article were obtained from archives of SATRA a.s., Metrostav a.s. and Subterra a.s. companies and the archive of Mr. Pavel Scheufler.

WTC'07 Open Session
abstracts

NEW FINANCING TRENDS & CONSEQUENCES ON THE TUNNELLING CONTRACTS

CHANGE IN THE ECONOMICAL APPROACH - FROM THE INVESTOR'S AND TUNNEL-CONTRACTOR'S POINT OF VIEWS.

Martin Holfelder, Member of the Management, Civil -Tunnelling, Bilfinger Berger AG Arne Speer; Regional DirectorEast, BilfingerBerger BOTEurope GmbH

The Bilfinger Berger Multi Service Group will present a general overview of the co-operation between the two segments "Civil Engineering" and "Concessions". When making the decision for the participation in a PPPTunnel project as well as during the co-ordination meetings for EOI- and Tender phase the expectations of these two parties of Tunnelling and Concessions have to be determined: • Which contractual regulations and characteristics are acceptable for both BOT and Tunnel-construction? • Which areas must be defined as "no-go factors"? • How can the different risks be managed and/ or the possible chances within "Tunnel concession projects" be evaluated?
Following the decision about the re-financing principle of tolling-concept (traffic-risk with the Concessionaire) or Availability Fee-concept (traffic-risk with the Concessor) the following risks must be discussed and finally allocated: • Ground / Soil risk • Up-to-date Equipment risk at the end of the Concession period • Risk of Construction schedule delays / chance to reach early completion bonus • Interface between Construction Contractor, Operator, and Concessionaire • Definition and evaluation of the optimal life-cycle costs (larger investment – lower operation and maintenance costs versus lower investment – higher operation and maintenance costs) and the meaning for the state and the user • Technical and constructive alternative offers and their effects on the project (in-cluding risk-share)

Each and every party (Construction Contractor, Operator, Concession-aire and Concessor) shall take the risks, which it can influence and estimate best !

Furthermore the main key topics (beside others) for the tunnel builders are: • Contamination • Planning • Liquidated damages and • "fit for purpose"-necessities which have to be taken into consideration during the tendering and the construction phase. Therefore, the risks have to be recognized, defined and evaluated despite some predetermined judgment criteria concerning the minimization or rather exclu-sion of these risks.
The executing construction company of the tunnel building is familiar with the classic fields of the "early construction sphere" and therefore an accurate organization, know-how and proper management have to be set up.
The equity investor has to optimize the PPP-project – specifically regarding the wishes of the concessor – and will have to win the external lenders (banks) to sup-port the offer. Following the nomination of being preferred bidder, the whole consor-tium has to successfully reach Commercial and Financial Close of the Concession. This will only be achievable with a harmonically adjusted and fairly considered overall bid resulting out of the areas of construction works execution, operation and (heavy) maintenance for the concession period.

PPP FOR TUNNELLING - ENGINEERING SECTOR PERSPECTIVES.

Yann Leblais - Arcadis

In the PPP schemes, in its seeking for improving value for money, the public client asks for a global answer to its needs through a life-cycle cost which combines design, construction, operation, maintenance and financing. As a main consequence, the bidders are liable for a long period of time. It appears quite clearly that the design chain is deeply impacted, from upstream to downstream. As a specific consequence, the designer might deal with any failure in the operations during the whole life of the project. This scheme applies to any infrastructure project, including tunnels or not.

The first part of the lecture reminds the specificity of the tunnelling activity, mainly the ground, water and environmental conditions. In a second part, it presents what are the main market changes and trends for the engineering sector facing the PPP development: are there any new opportunities? The third part relates to the contents and conditions of the answer elaborated by the consortium. The accuracy of the answer the client gets would be based on the level of definition of the project he gives: is it such and how? The paper emphases on the competitive dialogue process and points out the differences with an answer to a conventional bidding. The fourth part is devoted to the three key issues on risk: identification, allocation and covering, especially within the bidder side. Is any risk borne by the party which is the best positioned to assess it and to bear the consequence of its materialisation, as said in PPPs general principles? The conclusion, based on some feedback, draws a perspective which is positive but cautious.

PUBLIC PRIVATE PARTNERSHIP PROJECTS - INSURANCE COVER AS PART OF THE GENERAL RISK MANAGEMENT STRATEGY.

Dipl. – Ing. Heiko P. Wannick, Munich Reinsurance Company

In recent years one can observe an increasing demand and interest for privately financed traffic infrastructure projects of which many involve substantial tunneling works. It is claimed that such projects are launched quicker, have shorter planning and construction times and do have lower overall lifecycle cost than projects run by public authorities. Furthermore, more risks are said to be assumed by the private partner.

Not all private traffic infrastructure projects have been a success story though. This paper analyzes the main risk factors attached to PPPor BOT projects with particular emphasis on projects involving tunnel construction and operation. These are mainly project development risks, design and construction risks, technology and performance risks, all kind of operational risks as well as financial and political risks.

The paper gives an overview to what extent risks can be currently transferred to the insurance markets and on possible new products

the industry is working on. It is stressing the particular risk exposure resulting from "Delay in Start Up" and "Business Interruption" insurances for tunnels under construction and in operation in view of the poor loss record experienced in recent years. Consequently, the paper underlines the importance of professional risk management practice and introduces endeavors made by the insurance industry to contribute to optimized risk management standards.

PPP FROM THE ECONOMIC POINT OF VIEW. Vincent Piron - VINCI Concessions.

It is worth noting that PPP are usually dealt from the legal point of view, and now from the financial point of view. But in fact the main aim of PPP's is to improve the economical efficiency of our countries, facing an increasing competition from what we called before the "developing countries", now the "dragons". And when the dragons reach the size of China, Indian, Russia and Brazil, it is really crucial that the old Europe increases it own efficiency, wherever it may be.

The PPP's contracting process improves the way Public Authorities are managing their purchase process in many ways. Firstly the long term view (whole life cycle) leads to sizable savings, mainly in terms of engineering and maintenance. Secondly the financing is an incentive for the private partner to deliver the project as soon as possible. And finally the socio-economical benefit of the project appears quicker than using a standard procurement procedure.

Obviously this is not a reason to place all contracts with a PPP procedure. Indeed there is an important drawback to that process: it creates some rigidity in the future public budget. Thus the balance between advantages and drawback must be clearly considered. This is the main reason why in France the "Conseil Constitutionnel" has drawn the attention of the lawmakers about the selection process: which contract can be done with PPPprocedures and which is better to be implemented under a traditional procurement.

PPP POTENTIAL IN THE CZECH INFRASTRUCTURAL TRANSPORTATION PROJECTS. Emanuel Síp, Deputy Minister, Ministry of Transport of the Czech Republic

One of the main priorities of EU Member countries is to secure preparation and realization of infrastructural transportation projects. It concerns both TEN-T projects and other projects on the central and local governments levels. With the increasing investment needs of the countries and municipalities we are facing the pressing issue how to secure financing of the projects and how to solve the discrepancy between the ever increasing investment needs of the public sector and the continuing growth of the public sector indebtedness.

The answer is to utilize the financial potential and technological, technical and management experience and skills of the private sector through application of PPP models. From the financial point of view, to draw the private sector financial sources into the transportation projects, for the benefit of both sides – public and private sectors. Considering and assessing various sources of financing, we can see an optimal combination – a multi-source-financing, which contains: • EU Structural and Cohesion funds (based on co-financing principle) + Public sector financial participation (central and local government levels) + Involvement of private sector financial sources (Public-Private Partnerships – PPP, concessions).

The principal benefits of such PPP schemes are: • public sector gains access to a range of private sector skills to provide a more efficient and cost-effective service; • private sector takes on a range of risks that under traditional public procurement would be borne by the public sector; while it gets a secure "job" for years, maybe decades • greater efficiency can be generated where a single party is responsible for design, construction, management and financing as a part of an integrated package.

Can we utilise the EU co-financing directly together with private financing (PPP) in the concrete infrastructural project? Generally it is not excluded, but there are more questions to be solved:

A "public" or "private" share of EU fund support for a PPP? (the latter discriminates the project vis-à-vis purely public investment)

Clear solution of Special Purpose Vehicle: • What accounting and tax regimes can be used? Public or private? (When repaying private investment, public bodies in fact pay private taxes enhanced by a complex interest rate…) • What treatment with unique infrastructure in case of bankruptcy? How to assess public aid in case of a PPP?

Stakeholders in PPP projects need to see EU legislation clarified to provide legal certainty, and a clearer insight into the real Value for Money for both partners.

What is the current situation in the Czech Republic? Can we apply the principles of PPP to our infrastructural transportation projects?

The answer is **"YES"**.

Czechia possesses a sufficient institutional and regulatory framework: • Ministry of Regional Development (Legislature) • Ministry of Finance (Regulator) • Office for Protection of Competition (Supervision of Tenders) • PPP Centrum (Methodology, preparation and support of PPP projects) • Association for PPP– one of the largest in Europe – on the private side (centre of PPPbest private practice).• Sectoral Ministries (incl. Ministry of Transport) • Regions & Municipalities

Legislation in force in the CR: • The Act No. 139/2006 Coll. on Concession Contracts and Concession Procedures (Concessions Act) • The Act No. 137/2006 Coll. on Public Contracts

The Czech Ministry of Transport prepared a solid pipeline of potential PPP transportation projects. The most advanced of them are:

D3 motorway section Tábor – Boßilec (Southern Bohemia). AIRCON Project

General Problems of PPP Concept in Transport: • Efficient protection of public interest, • Transparent and sustainable structure of PPP and clear balance of public payments/repayment, • Clear conditions of service quality, claims, sanctions for non-compliance etc, • Functional dispute prevention and resolution, conditions for contract update, for termination of partnership etc, • Demand and return conditions of a PPPproject must be always impartially and independently verified! • PPP for services (without private investment) are possible almost everywhere, only efficiency of solution matters!

Member Nations Report 2006

AUSTRALIA

Membership as at January 2007 is as follows: Members, 498; Student members, 119; Gold sponsors (4 nominees), 29; Silvers sponsors (2 nominees),23. This represents an increase of almost 20% over last year. The majority of this increase has come from Perth where our Perth Representative has put in enormous effort and from student membership as a result of concerted promotion by our Young Engineering Rep. Now that we have a committee established in Auckland we anticipate an increase there as well. The greatest proportion of the membership remains registered in Sydney reflecting the level of tunnelling activity there. The Society is financially sound with plans to publish another book/pamphlet from the material commissioned for the new NSW WorkCover code of practice for "Tunnels Under Construction". The Society's first publication, David Sugden's "A History of the Development of Performance Predictions for Hard Rock Tunnel Boring Machines" is now available. Details will be posted on our web site www.ats.org.au

The ATS worked closely with NSW WorkCover and other interested parties on the preparation of the new code of practice "Tunnels Under Construction" published by the NSW Government through WorkCover NSW. The code is available on line at www.workcover.nsw.gov.au

To attract more people into the tunnelling industry a DVD has been produced featuring a wide range of career options. The film was shot on Sydney underground locations and certainly presents tunnelling as a dynamic exciting industry to be part of. Interviews are conducted with a wide range of workers and those with the young engineers; both male and female are quite inspiring. Details will be posted on our web site www.ats.org.au

We plan to send out a copy of the DVD with the next issue of the Journal. A special thanks to our industry sponsors.

The David Sugden award for Young Engineers Writing was given to Andrew Coltrona for his paper on "Shear stiffness development and pore water pressure dissipation in cemented paste backfill". Andrew is a young engineer now working in Perth, Western Australia who for his prize will be attending WTC Prague under our sponsorship.

The Allen Neyland award presented on a triennial basis is to an Australian or New Zealander for outstanding achievement associated with Tunnelling and Underground Construction and will next be presented at the Melbourne 08 National Conference.

Our ATS Journal continues to go from strength to strength with the quality of the production ever improving. Our editor puts an enormous effort into it and this is reflected in the high quality of the offering. The October 2006 issue had 116 pages. It remains one of the greatest values for membership of our society.

The Sydney Group had an active year with a number of high quality technical presentations. They now start their meetings a little later and have moved to a new venue in Chatswood following a referendum of their members. It is hoped that this will make the technical presentations more accessible. The group is actively seeking ways to promote tunnelling as a career option at the universities and is also considering a history of tunnelling in Australia. Tunnelling activity is winding down a bit with the Epping Chatswood rail tunnel and the Lane Cove road tunnels in their final stages of fit out. A cable tunnel is due to start construction soon while a number of rail tunnels are in the planning stage.

The Melbourne Group also had an excellent programme of technical presentations over the year and is now busy planning the XIII Australian Tunnelling Conference to be held in Melbourne during May 2008. The East Link Tunnel continues to be the main activity with the Northern Sewer Project due to start this year.

The Brisbane Group has always had a tradition of holding more technical meetings than the other groups and 2006 was no exception with five technical sessions and two tunnel site visits. Two of the technical sessions were held in conjunction with the Australian Geomechanics Society (AGS). A highlight of the year was Queensland's Third Underground Space Workshop which was held in Brisbane in November with 55 delegates and some illustrious guest speakers. 2007 will be a busy year, tunnelling for the North South Bypass Tunnel as well as a number of other underground projects will get underway.

Perth Group has really found its feet in 2006 with a number of high quality speakers giving excellent presentations. The MetroRail City Project is drawing to an end of the construction phase.

In 2006 the Auckland Group concentrated on promoting itself to the local tunnelling community and this was rewarded in Jan 2007 with the formation of its foundation committee representing a broad spectrum of industry stakeholders. Tunnelling and underground construction looks set to take off with the imminent award of the construction contract for the Hobson Bay Wastewater Tunnel and a number of other projects in the planning stages.

The Australasian Tunnelling Society will be represented at the ITA-AITES 2007 World Tunnelling Conference in Prague and will continue to strengthen ties with the ITA in the interests of its members.

Member Nations Report 2006

AUSTRIA

The Austrian national committee of ITA has been represented at the World Tunnel Congress 2006 in Seoul with 5 attendees.

The most important conferences in 2006 concerning tunnelling were the traditional Austrian Tunnelday organized by the ITA Austria and the Geomechanics Colloquium organized by the Austrian Society for Geome-chanics. About 1000 participants from 21 countries followed the interesting topics presented by national and international speakers. Both conferences took place in Salzburg in October 2006.

During the year 2006 a various number of tunnelling projects were started or are still under construction. Starting with railway tunnels the biggest projects in Austria in 2006 were the following ones:

• Design work for the Koralmtunnel closing the missing link between Graz and Klagenfurt is fully under progress.

• Construction work for the exploratory tunnel Leibenfeld was finalized in 2006, construction work for the exploratory tunnel Mitterpichling will be finalized in Mai 2007, tunnelling at the lot of Paierdorf will last till 2009.

• Design work for the ca. 20 km long Semmringbasetunnel – the missing link for the high speed railway line between Vienna and Graz - was started with an environmental impact study.

• Lot LT31 of the Lainzer tunnel – a mined section - got under construction by ALPINE and HOCHTIEF. Lot LT33 was won by PORR / STRABAG / ZÜBLIN, supervision is done by GEOCONSULT / ILF. Tunnelling should be finalized in 2010.

• Along the high speed railway route connecting Vienna and St. Pölten the tunnel projects Perschlingtal and Wienerwald are under construction. The tender for Tunnel Perschlingtal was won by STRABAB - the length of the tunnel tube is about 5,5 km and is being build by the use of a TBM; the first tube will be ready in April 2007. The contractor of the Wienerwaldtunnel is a consortium consisting of PORR / BILFINGER / ZÜBLIN / HOCHTIEF / SWIETELSKY/ JÄGER; the design is done by IC-Consulenten and Basler + Hofmann. The length of the twin tubes is about 11.5 km, about 2 km of this length is tunneled by the New Austrian Tunnelling Method (NATM), the rest is done by TBMs. Tunnelling shall be finalized in 2009.

At the Unterinntal route, which is the northern access to the Brenner Base Tunnel, the variety of chosen tunnel construction methods is very wide. BEG, the responsible organization for realizing this project, which has a length of about 40 km chose cut and cover sections, but also mined tunnels. In some parts the use of compressed air, following the very difficult alignment in this region, had to be chosen. Lot H2-1 is already finalized, for the lot H2-2 the tender documents are prepared. PORR / BÖGLwon the contract for the lot H3-4; for H3-6 the contractual documents are under preparation. Lot H4 is under construction by ALPINE / GPS; tunnelling work in lot H5 is almost ready – innerlining work is still under progress. Lot H6 was finalized in 2006, in H7 tunnelling work, done by STRABAG, HOCHTIEF, ZÜBLIN, was started by the use of compressed air. The contract in lot H8 was won by the same consortium – STRABAG, HOCHTIEF, ZÜBLIN. This lot will be driven by a TBM which is already ordered by the above mentioned consortium.

• Tunnelling for connecting the Arlberg motorway tunnel with the very old Arlberg railway tunnel by so called safety cross passages was continued and should be finalized in 2007.

The next lines give a rough summary of the biggest road tunnel projects in Austria which are under construction:

• The breakthrough of the 2nd tube of the Katschbergtunnel was done, the inner lining will be finished in sum-mer 2007.

• Tunnelling at the 2nd tube of the Tauerntunnel, which was started in September 2005, is still under progress and should be finalized by PORR mid of 2008. Both tunnel projects are situated along the A10 Tauernautobahn - a well marked improvement of the traffic situation at the weekends at least during the summer months is expected by having both 2nd tunnel tubes at Katschberg and Tauern available.

• The missing link along the S35 between Graz and Bruck starting at Mixnitz is also under construction. GEOCONSULT which is the authorized representative of ASFINAG, doing the site supervision, shall be able to finalize the project till 2009.

• The missing link between Bruck and Vienna – the Ganzsteintunnel at S6 - which is situated besides Mürzzuschlag is also under construction.

• The major tunnel site along the A9 is the so called Lainbergtunnel – 2nd tube. At the moment the innerlining of the 2nd tube is under construction. By having finalized the new 2nd tube, the 1st tube will be closed for rais-ing up the safety standard. The tunnel project should be available for traffic end of 2008.

• The bypass tunnel for the city of Henndorf near Salzburg, a tunnel project which has a length of about 3 km was started in 2006 and will be finalized in 2008.

Construction for the 2nd tube of the Roppener tunnel was started; ÖSTU-STETTIN, HINTEREGGER, WAYSS&FREYTAG and IMPLENIA won the contract for this project; the design is done by Bernard-Ingenieure. The length of the whole project is about 5 km and shall be finalized in 2010.

Near Bregenz the 2nd tube of the Pfänder tunnel is going to be built. The project was started in 2006 and shall be finalized in 2012; the length of the whole project is about 6.7 km.

In 2007 the most important conferences in Austria concerning tunnelling will be the conference of “Interdisciplinary conflicts in the design of traffic tunnels” and the conference for “Computational methods in Geome-chanics” on 10th of October as well as the traditional “Geomechanics colloquium” on 11th and 12th of October 2007 in Salzburg.

Member Nations Report 2006

Connecting to the work of the WG19 – Conventional Tunnelling – Austria is working on a paper called “NATM – the Austrian way of conventional tunnelling” which shall be ready at the next ITA-meeting in Delhi in 2008.

BRAZIL

CBT is a committee of the Brazilian Society of Soil Mechanics and Geotechnical Engineering (ABMS). It is an open society based on membership. The board of directors is elected every two years. For the term 2005/2006, the board is composed by: Akira Koshima (President), Tarcisio Celestino (Vice President), Hugo Rocha (Secretary General), Ricardo Telles (Treasurer) and Claudio Murakami (Executive Secretary). The new board (2007/2008), elected in October 2006, encompasses: Tarcisio Celestino (President), Hugo Rocha (Vice President), Ricardo Telles (Secretary General), Flavio Kuwajima (Treasurer) and Francisco Ribeiro Neto (Executive Secretary).

The main event of the CBT during 2006 was the publication of the book "Tunnelling in Brazil" (328 pages), which reports 120 cases-histories of tunnels for energy (dams and pipelines), transport (motorways, railways and metros), public utilities (water supply, sewage and cables) and undercrossings. The work took four years and had a budget of 150,000 euros. The main objective of the book was to promote the use of the underground space towards the general public and decision makers in Brazil, as well the achievements of the Brazilian tunnelling community. The event for celebrating the publication of the book (23 June 2006) gathered 400 participants in Sao Paulo and in the following three months, a great impact in the midia (radio and TV interviews, magazines, newspapers etc.) was achieved. The book has been distributed to all ITA member nations and Executive Council members.

On the same day (23 June 2006), the new CBT website was inaugurated, with more modern format, tools and facilities in order to provide better services to CBT members.

One-day event (24 October 2006), on the occasion of the election of the new CBT board, focusing the theme "Modern Technologies of TBMs".

In 2006, CBTcontinued its task to promote mirror ITA WGs in Brazil. Seven Brazilian mirror groups have been quite active (WG-03, WG-05, WG-06, WG-12, WG-15, WG-18 and WG-19). The Brazilian mirror WG-05 has been working in the translation of the booklet Safe Tunnelling into Brazilian Portuguese, and WG-06 has been participating in the discussions of the new Brazilian standards on Fire Protection in Underground Structures. The Brazilian mirror WG-03 has been translating the ITIG code into Brazilian Portuguese. Also, the CBT has given full support for the activities of Tarcisio Celestino as animateur of the ITA WG-12 on Shotcrete.

The year of 2006 was very busy for underground works in Brazil, especially those related to mass transit systems in major cities. The Sao Paulo Metro continued the works of Line 2 Extension (more 5 km of tunnels completed in 2006) and Line 4 (13 km long fully underground to be completed in 2008). The Rio Metro continued to expand the system in Copacabana, towards one more station (1 km of tunnels). Besides subway tunnels, several hydroelectric power plants were resumed this year and are presently under construction, with hydraulic schemes predominantly underground. The Simplicio Hydroelectric Power Plant, just begun its works at the end of 2006, encompasses 12 km of tunnels. The San Francisco River diversion project, despite all environmental debates, was approved by governmental bodies and should start soon. It includes the partial diversion of the Sao Francisco River towards the Northeast of Brazil (40 m^3/s), aiming to guarantee the minimum amount of fresh water to people who lived in that region, as well to agriculture irrigation. This project includes hydraulic channels and tunnels, and the selected alternative encompasses a total length of 60 km of tunnels.

BULGARIA

GEOTECHMIN LTD is the only official Bulgarian member of ITA. It is a prospering private company. It has in its employment 190 members of highly qualified specialists. GEOTECHMIN LTD issues journal “Mining Globe”.

In Republic of Bulgaria there aren’t structures of national groups such as the rest of the official members because of the limited volume of underground construction

GEOTECHMIN LTD, as main subcontractor of Taisei Corporation, performs design and construction works as subcontractor for construction of Sofia Metro with a metro-station and a tunnel section.

GEOTECHMIN LTD performs construction of a tunnel with length 550 m in neohomogenous material with protective umbrella method „ Symmetrix T”.

GEOTECHMIN LTD makes hydrotechnical tunnel for dewatering of mine Elazite, 2100 m long.

Other important projects in process of design and construction in Republic of Bulgaria:

- driving a tunnel of Ist Metrodiameter of Sofia subway by TBM,
- transport tunnel “Dupniza,

• tunnels at water-power system “Tzankov kamak”

In conclusion it can be stated that in 2006 there is growth in the underground construction in Bulgaria and there are new projects underway.

CANADA

An annual general meeting is held once per year with the executive committee meeting via conference call at least four other times throughout the year. Local chapter meetings are held in each region an average of 6 times per year. TAC also holds a national conference every second year with the next conference scheduled for the September 2008 in Ontario. Also, of note is that theRETC (Rapid Excavation and Tunnelling Conference – www.smenet.org) which is held every two years and attracts an average of over one thousand participants will be held in Toronto, Canada June 10-13, 2007.This will be the first time ever that the conference is being held outside of the United States. For additional information on TAC and current and upcoming activities please go to our website at www.tunnelcanada.ca. Tunnelling in Canada is undergoing a resurgence with numerous major projects entering the construction phase in 2006.

MAJOR TUNNELLING PROJECTS

Canada Line LRT, Vancouver, BC
• 14 km long alignment from airport to downtown - Bored Tunnel Sectionss will be 6.0m diameter
• Contractor : SNC Lavalin – SELI Joint Venture

Bathurst / Langstaff Sewer, York Region, ON
• 8.3 km of 3.3m diameter Bored Tunnel - Tunnels will be excavated by TBM
• Contractor: McNally AECON Joint Venture

Seymour Capilano Twin Tunnels, Vancouver, BC
• 2 No. tunnels at 7.1 km each 3.8M Diameter - To be excavated by TBM
• Contractor: Bilfinger Berger

19th Avenue Sewer, York Region, ON
• 4.2 km of 3.3m diameter Bored Tunnel - Tunnels will be excavated by TBM
• Contractor: McNally AECON Joint Venture

Sir Adam Beck Additional Diversion Project, Niagara Falls, ON
• 10 km of 14m diameter Bored Tunnel - Tunnels will be excavated by TBM
• Contractor: Strabag

Ashlu Hydropwer Project, Squamish, BC
• 4.2 km of 4m diameter Bored Tunnel - Tunnels will be excavated by TBM
• Contractor: Frontier Kemper

Galore Creek Mine Development, BC

Toronto Hydro Transmission Tunnel (Hydro One)

New Fresh Water Intake Tunnel (Halton Region)

South End Rock Tunnel (City of Greater Sudbury)

North East Sanitary Sewer (Edmonton)

South West Sanitary Sewer W12 (Edmonton)

District Heating Tunnels – ENWAVE, Toronto, ON

UPCOMING PROJECTS

Ninth Line/Sixteen Ave. Sewer Project, York Region, Ontario, Construction tender in 2006

St. John’s Harbour Interceptor Sewer, St. John’s Newfoundland

Hyde Creek Sewer, Coquitlam, BC

Port Mann Tunnel, Greater Vancouver, BC

Vancouver LRT, Evergreen Line, BC

2nd Narrows Tunnel, Greater Vancouver, BC

Kicking Horse Pass Tunnel, BC

SouthEast Collector Sewer, York Region, ON

Spadina Subway Extension, Toronto, ON

Ottawa LRT Tunnels, Ottawa, ON

All Five Regional Directors (British Columbia, Alberta, Prairies, Ontario and Quebec) have continued to notice an increase in the amount of work both ongoing and in the planning stages. The TAC/ACT is looking forward to continued growth in the tunnelling sector for several more years with large infrastructure projects in the major urban centers and continued development of Hydro Electric Power in British Columbia, Quebec and Newfoundland. This combined with the surging natural resources sectors and the push for further development of underground mines will ensure continued growth in the tunnelling industry in Canada.

CZECH REPUBLIC

The main field of the CTuC’s activity in 2006 was the intense preparation for the ITA AITES World Tunnel Congress 2007 (WTC 2007). All premises for the Congress negotiations have been booked. Technical excursions and social events are being prepared.

The following activities have been in full swing:

• The Organizing Committee (chaired by Mr. Georgij Romancov) held a plenary session in March, June, September and November. The meeting which was held on 25 September 2006 was attended by Mr. Claude Bérenguier, General Secretary of the ITA. In addition, selected members of the Organizing Committee held narrower operative meetings twice a month, with Mr. Ivan Hrdina, the chairman of the CtuC.

• The Scientific Council (chaired by Mr. Jiri Bartak) followed the main task to collect papers to be published in the proceedings of the WTC 2007, check them and hand over to A.A.Balkema Publishers for preparation for printing. Despite problems with the authors, 310 papers were handed over to A.A.Balkema Publishers for the printing of the proceedings. Further, the Scientific Council intensely worked on the preparation of the Open Session (responsible: Mr. Ermin Stehlik), Key-note Lectures (responsible: Mr. Radek Bucek) and the Trainig Course (responsible: Mr. Alexandr Butovic).

• Apart from that, co-operation with the Slovak Tunnelling Association on preparation of the WTC 2007 has commenced. The Congress web pages www.wtc2007.org, are fully functional. They contain all information necessary, including registration forms for the attendance at the Congress, for those interested in the exhibition and sponoring, for attendees of the Training Course and those interested in the excursions and post-congress tours.

Other events:

• Three sessions of the CTuC Council were held (Note: All members of CTuC Council are also members of the WTC 2007 Organization Committee).

• The seminar "New Trends in Tunnel Design" was held in Prague in January 2007, under the auspices of the CtuC. It was organised by D2 Consult Prague and IKP Consulting Engineers.

• The CTuC General Assembly was held in May 2006.

• The CtuC organised a one-day workshop "Fundamentals of Urban Tunnelling" in September 2006; this workshop will be continued by the Training Course which will be held before the WTC 2007 commencement. Its topic will be "Tunnelling in Urban Areas".

• Also under the auspices of the CtuC, a one-day discussion seminar was held in September; it dealt with safety waterproofing systems for underground structures.

• The CtuC started to publish technical publications in the "CtuC Documents" edition. The first volume "Safety at tunnel construction work" was adopted from the ITA and translated to the Czech language. The second volume "Guidelines for and principles of the NATM as the prevailing method of conventional tunnelling in the Czech Republic" was carried out by the CtuC Working Group for conventional tunnelling.

• The regular autumn CTuC Members´ Professional Session has been organised by PÖYRY ENVIRONMENT a. s. and AMBERG ENGINEERING a. s. in Brno. The main topic: construction and operation of utility tunnels in the historic centre of Brno and operating tunnels diagnostics methods.

• Four «TUNEL » editorial board meetings were held and 4 issues of the magazine were published.

The WG Shotcrete in Underground Construction aimed their efforts to the methodology of training and practical examination of nozzle operators. The field of safety and optimal operation of tunnels is dealt with by the CTuC "Committee on Safety in Tunnels", which collaborates closely with the Czech Road Association (a PIARC member).

WG Conventional Tunnelling continued working under the chair of Mr. Václav Soukup. The working group prepared the technical brochure "Guidelines for and principles of the NATM as the prevailing method of conventional tunnelling in the Czech Republic". It was issued to all CtuC members and major investors, the Czech Bureau of Mines and governmental agencies.

DENMARK

The Danish Society for Tunnels and Underground Works has arranged 6 member meetings during the year 2006 including technical site visits to the New Norwegian Opera House at the harbour front of Oslo and the Immersed Bjørvika Tunnel under construction crossing the Oslo Fjord. Further more a technical site visit to the TBM in action for the service tunnel for district heating in the city center of Copenhagen took place in November. Members of the society have participated in ITA General Assembly in Seoul, Korea and two Working Groups. A member has participated in the inauguration of COSUF in Lausanne at the end of May and activities within PIARC.

Phase 3 of the Copenhagen Metro with an extension to the Copenhagen Airport is progressing very well with all civil works structures completed in due time. Railway installations and testing procedures are ongoing and the line is foreseen to be inaugurated in October 2007.

The next phase (4) of the Copenhagen Metro contains a 15 km City Circle Ring with 17 underground stations. The project was decided already in 2005 and final political approval by the Danish Parliament is expected to be early 2007. The project requires an investment of 2 billion euros to be financed by the cities of Copenhagen and Frederiksberg, the State and users charges. The design work and geotechnical site investigations will start in 2007 with construction works to be initiated in 2009 - 2010. The project is estimated to be completed in year 2017.

A bored service tunnel as part of an updating of the Copenhagen power stations has been contracted to a joint

venture of MT Højgaard (DK) and Hochtief Construction AG (D) with mining starting in July 2006. The tunnel is performed as a segment lined tunnel in level – 35 m from a shaft next to Amager Power Station over one middle shaft in the inner town and is ending in a receiving shaft on the north side of Copenhagen City. The total length is 3.9 km and the mining is performed with a 5.1 m Herrenknecht TBM with an EPB shield. NATM tunnels are required at all shafts for starting, receiving and re-launching the TBM after being turned into a new direction in the middle shaft. The mining with TBM is planned to reach the receiving chamber by mid 2007 and the project is scheduled to be completed by the beginning of 2009. Consultants: COWI.

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 and proposals for financing were included in the proposal. The proposal got a favorable reception from the public as well as local politicians, because it was design to remove a very substantial part of the road traffic from the center of Copenhagen as well as providing access to previously unreachable development areas to the east of Copenhagen Harbour. The scheme has been developed further by the Copenhagen Municipality in 2006, and is now included wholly or partly in two alternative solutions. Planning work on access roads to the motorways in the north have been started under the project "Northern Harbour Link" which forms a part of the political agreement of the phase 4 of Copenhagen Metro necessitating further future decisions on the long term for the harbour tunnel.

A new Harbour Tunnel in the city of Aarhus is under planning and Environmental Impact Assessment studies (EIA) have been completed during 2006. The tunnel will be 2.1 km long connecting the harbour terminal with the motorway E45 passing through the city center of Denmark's second largest city. It will be a unidirectional cut-and-cover tunnel with two tubes and 2 lanes in each tube for carrying up to 40 % of HGVtraffic. The final planning will go out for public hearing and political approval by mid 2007. Construction works are estimated to be close to 200 million Euros starting in 2008 with an opening year for traffic in 2013. The project will be financed by the Danish Government and Aarhus Municipality. Consultants: Carl Bro Group.

The proposed 3 km new road link ("Northern Harbour Link") between the Nordhavn and Lyngbyvej located north of Copenhagen has during 2006 been developed further. Presently there are 3 alternatives being investigated containing cut-and-cover tunnels with a length from 0.5 to 2.5 km. The project is being developed by Copenhagen Municipality and in early 2007 the consultant will perform further alignment and EIA studies. The project is planned to be tendered out for construction works by mid 2009. It may be tendered as a PPP project to an estimated cost of 190 million Euros. The project is expected to take 5 years to complete.

EGYPT

ETS participated in the activities of ITA Annual Congress no.32 in , Seoul, Korea April 2006 and participated in the activities of numerous Working Groups .

ETS held an international symposium, in Sharm El-Sheikh, Egypt from 6-7 November 2006 under title "Utilization of Underground Space in Urban Areas ". Nine keynotes presentations have been presented by especial invited main international &local main speakers, beside a especial presetation titled " Underground Works in Aincient Egypt" and other 36 papers were presented and discussed. All 46 papers are embodied in the symposium proceedings. There were 7 delegates from France, 5 from Germany 4, from Switzerland and Korea, 2 from U.K., Italy, Norway, Russia and Iraq, 1 from USA, Canada, Brazil, Austria and Czech, and 130 from Egypt. ITA Executive Council joined the conference and held an EC meeting before the symposium on 4-5 November 2006.

ETS held 6 lectures & presentations on the following topics :

- Diversion of public utilities for Cairo metro line 3.
- Risk and Coordination matters in Tunnelling projects
- A fram work for project management.
- Urban tunnelling under existing structures in Seoul
- Tunnelling in USA
- Art work Handling in underground stations (Another dimension of thinking)

The total length of Greater Cairo Metro Line 3 is 30.5 Km of which nearly 28.5 Km is underground section. The route extends from Cairo Airport to Imbaba and Mohandeseen. The length of the branch to Mohandeseen is 3

Km, which shall be constructed as an underground section. The line crosses the River Nile twice. The planned capacity of the line when completed is 2.1 million passengers / day. The tender documents for stage I were completed & contractors were nominated. Concerning phase II of line 3 tender documents are under preparation. Stage I starts from Attaba to Abbasia section, stage II starts from Abbasia to Heliopolis. All these parts are underground. The total length of stage I is 4.3 km and that of stage II is 6.2 km. The design of stage I has taken into consideration the safe crossing at two major underground structures, namely the line 2 bored tunnel at Attaba and the waste-water spine tunnel north of Attaba. The stations will be constructed by the cut and cover method.

A new transportation study for Greater Cairo Area

The updated transportation study for Greater Cairo Area had been finished proposing 6 lines of metro till year2022. Three further metro lines are recommended in this study in addition to the already 3basic lines [lines 1 & 2 being finished , line 3 partially contracted.

FINLAND

During 2006, different events to contribution of rock engineering with drill-and-blast method took place in Finland

- Management and coordination of 5-years R&D program named "The competitiveness of Rock Engineering". The R&D program was sarted in 2002 and finsihed in 2006.
- Participation and cooperation in European Construction Technology Platform, ECTP in focus area Underground construction.

Finnish people are participating in four working groups: WG6, WG11, WG18, WG20

At the moment there are several large underground traffic tunnel projects under design or under construction in Finland. In the year 2006 excavation works has been started for a new, 2.5 km long city centre service tunnel for service traffic of different stores and shopping centres in the city centre of Helsinki. At same time the design of city centre traffic tunnel from west side to east side under Helsinki city centre is under planning and design. There are number of new underground car parking projects with 300 - 600 parking places each under under planning in different city centres of Finland.

There are several road tunnel projects under construction in Finland. For instance 7 twin-tube motorway road tunnels, total length 5,2 km, has been included in the last 50 km long part of the new motorway line of E18 between Helsinki and Turku. The contract agreement of the whole project has been made and it is based on life cycle model including construction works and 25 years financing and operation period, too. Construction works has been started during 2005 and the tunnel excavation works are just going on: www.tie-hallinto.fi.

In 2006 excavation works of a 1,5 km long road tunnel and a 13,5 km long railway tunnel for the land traffic connections of Vuosaari harbour in Helsinki has been carried out. The harbour project construction has been continued several years for a new, modern harbour in Helsinki with cargo traffic due to move there from the West and North harbours in 2008. From environmental reasons the land traffic connections will be built underground. Vehicular traffic will be placed in a tunnel to cross the Natura conservation area underground. Railway traffic will be placed in tunnels to bypass the many city and dwelling areas underground so minimizing the negative environmental effects of the harbour traffic: www.vuosaarensatama.fi/en/index.html

During 2006 the city of Espoo has made a big traffic solution based on metro traffic in Espoo. The first part of metro line from Helsinki to Espoo is just under planning and design.

The new ring line with airport link connect the Helsinki Vantaa airport to city centre of Helsinki by railway connections in future. This project includes 18 km railway line of which 8 km will be in tunnels (http://keharata.net) The investment decision about the project has not yet made.

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). At the moment about 1,5 km of total 4 km long access and research tunnel has been excavated.

Member Nations Report 2006

FRANCE

L'AFTES, Association Française des Tunnels et de l'Espace Souterrain, 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. L'Assemblée Générale Extraordinaire du 15 décembre a entériné le changement de nom de l'Association, qui à dater du 1er janvier 2006 devient "L'Association Française des Tunnels et de l'Espace Souterrain"

Vingt-deux groupes de travail actifs, dont le dernier groupe créé en 2006 est le GT 40 (Chaussées ferroviaires et routières en tunnels), représentent environ 320 membres.

Cinq recommandations ont été publiées dans TOS en 2006 (Traitement de terrains par injections, Traitement d'arrêts d'eau - Standardisation des diamètres < 6,5m - Lutte contre les nuisances - Formulation des bétons résistant au feu).
72 recommandations ont été publiées en français sur la revue Tunnels et Ouvrages Souterrains (T.O.S.) et seront progressivement mises sur le site de l'AFTES et téléchargeables gratuitement.
39 recommandations traduites en anglais dont 29 gratuitement sur le site de l'AFTES.

Les principaux travaux souterrains en 2006 : • Travaux de réaménagement et de mise aux normes de sécurité du tunnel Maurice Lemaire existant (Vosges - 6872m) • Travaux de réalisation d'une galerie de sécurité parallèle au tunnel Maurice Lemaire (6230m) • Travaux du tunnel routier bitube du Mont Sion (A41 – 3100m) • Travaux du second tube routier de Toulon (Var – 1000m) • Travaux de réhabilitation et de la mise en sécurité des ouvrages souterrains routiers de l'A8 • Travaux de sécurisation du tunnel ferroviaire TGVde Blaisy Bas (Côte d'Or – 4100m) • Travaux d'adaptation des ouvrages de la ligne TGVdes Carpates (11 tunnels) • Travaux du tunnel LGV des Chavannes (Rhin Rhône – 1970 m) • Travaux de la ligne de métro 1 - Marseille (2500m) • Travaux de prolongement de Méteor – Paris (Atelier 676m) • Achèvement de la construction du tunnel routier du Lioran (Cantal – 1500m) • Achèvement de la réhabilitation du tunnel routier bitube des Monts (Savoie – 2 x 900m) • Achèvement de la construction du tunnel routier bitube de Bois de Peu (Doubs – 2 x 520m)

• Étude de la mise en sécurité du tunnel actuel de Tende (Alpes Maritimes) • Étude du tunnel routier de Saint Béat (Haute Garonne – 1100m) • Étude d'un nouveau tunnel parallèle au tunnel de Tende (Alpes Maritimes – 3186m).

Le congrès international trisannuel se tiendra à MONACO, les 6,7 et 8 octobre 2008 avecx pour titre : « Le souterrain: espace d'avenir ». Thèmes du congrès : Le sous sol : espace de projets – Maîtrise des risques et des coûts – Innovations techniques en tunnel – Des tunnels perennes et sûrs.

GERMANY

DAUB - the German Tunnelling Committee is a registered non-profit restricted association with up to 30 members coming from owners, scientific institutions and consultants as well as from contractors. 18 DAUB members took part in the annual traditional D-A-CH-meeting 2006 involving Germany (D), Austria (A) and Switzerland (CH). The host was Austria. The meeting took place in Kitzbühel. It was attended also by 19 Austrian and 11 Swiss colleagues. The 1/2 day technical seminar dealt with "Mastering extremely difficult geotechnical Driving Conditions". The additional technical tour led to Vomp construction site on the Brenner access route in the Lower Inn valley not far from Innsbruck.

DAUB run 4 working groups during 2006:• Safety in tunnelling jointly with the Austrian and the Swiss National Tunnelling Committees • Asbestos in tunnelling • Non-reinforced inner shell lining • Financing of tunnels via PPP/BOT-projects.

These working groups are of temporary nature and will be closed as soon as they have finished their special task. 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).

The following major tunnelling projects were running in Germany during 2006: • **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.

Member Nations Report 2006

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	647	20	82
railway	488	30	235
road	205	42	138
Total	**1,340**	**92**	**455**

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.

HUNGARY

After asuccesful presentation on WTC GA 2006 in Seoul, delegates woteed for Hungary to be the host country for WTC 2009 in Budapest. The Chair of Organizing Committee is Mr Pal Kocsonya.

• International Conference on Tunnelling and Underground Construction was hold in Pécs, 2006. May 22-23., in South Hungary, with 230 participants, (ITA Past President was present, as well.)

• Geotechnika '06, (Geotechnics in Ráckeve/Hungary, 2006., annual), a regular two-days conference, was sponsored by HTA, as well.

News about the Metro network: The reconstruction work of the 30-years-old 2. Metroline went on and the works in three stations were completed in 2006. These reconstruction works are going on in 2007, remaining 3 stations will be taken under work. Keleti Station got a 2nd exit (with escalators), as a necessity of the transfer connection for the Metro line No 4. In 2006 the construction of the Metro line No 4 was started with structural works of lunching shaft and four stations on Buda side.

The two shields will start their work in 2007 in April. It is the biggest tunnelling-work after the construction of Metro line No3. (2x7.5 km tunnel in first stage) All the tenders for the 10 station- structures of the first stage of Metroline No. 4 was completed in 2006. More information available on the website : www.metro4.hu

The construction of Underground Storage Facilities in Hungary for low- and intermediate level radioactive waste disposal went on with the construction of an access tunnel. Our association reviewed the work at the site following a professional day.


Lauching Schaft

ICELAND

The Icelandic Tunnelling Society which represents the ITA National Group Iceland is an indipendant 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 2006.

The year 2006 was very productive in terms of tunnel planning, design and construction. Work continued on the Kárahnjukar Hydro Project, where about 13 km are remaining of the total of 70 km of tunnels. Work started on the 11 km long Hélinsfjördur road tunnel. Other road and hydro tunnels are close to tender stage and construction expected to start late this year or next year. Numerous road tunnels are being planned and investigated.

IRAN

The major events of the IRTA in 2006 was the 7th Tunnelling Conference and 4th International Tunnelling Exhibition which were held in Sharif University of Technology, Tehran in 10-13 July 2006. The theme of the conference was "Underground Spaces, Science and Technology Development". Because of the importance of the tunnelling and underground space in Iran, the opening ceremony began with the message from The President of the Islamic Republic of Iran and official openning speech by the Minister of Energy. The President of ITA, Dr. H. Parker had honored the conference and IRTA by sending a very kind and encouraging message which was also presented in that ceremony. The conference had over 1100 participants. Many high ranking academic and officials from clients and industry in Iran and representative of international companies were among the participants. Over 220 full papers were submitted to the conference of which 75 selected papers were presented during conference. The conference had six keynote speakers from Canada, Germany, Switzerland and Iran.

A workshop on the subject of "Mechanized Tunnelling" was also held. The intresting aspect about the workshop was that it was presented by the official international represetative of the manufacturers of the TBM and mechanized tunnelling consultants. Over 150 persons participated in the workshop and obtained the Certificate of Attendance.
Over 30 academic, governmental and industial organizations were the sponsors of the conference.
The 4th International Tunnelling Exhibition was one of the largest and most attended exhibition of its kind in Iran. Over 70% of 67 booth and exhibition sites were used by international companies or their representives in Iran.
The other important aspect of tunnelling in Iran in 2006 (and years ahead) is the tremendous demand to use underground spaces for transportation, water conveyance and other civil and mining uses. Special attention was made to the tunnelling industry including education, research, design and construction.

There are 7 national working groups in IRTA. They include Education, Mechanized tunnelling, Long and deep tunnels, Urban tunnelling, Health and safety in underground space, Shotcrete, Conventional tunnelling. The activities of working groups include meetings, lectures, and sometimes brief publications. IRTAneeds a very close interacton between its WG's and ITA's and also with other member nations to exchange the information. We hope this happens in 2007. One of the main plan in 2007 is to hold short courses for the practitioners as a continuing education. The other inmportant plan for working groups is to publish guidelines and standards related to their subjects.

As a developing country, Iran needs to develop its infrastructures. Being in mountainous region, application of tunnels and underground spaces are a necessary for building infrastructures. Railroad, roads, highway, water and sewage conveying networks demand the use of underground spaces. The development of major cities also requires the use of more environmentally acccepted means of transportation such as subways. For these reasons in the short and long term plannings, the utilization of underground, both in urban and rural areas, became a priority. In development of national railroad network and natrionwide highway and road systems, over 150 km of tunnels are in design or construction stages. One of the major tunnelling projects is the Tehran-Shomal Highway which has over 50 km of twin tunnels in a very complex geological region of northern Iran. Two main long tunnels in this project, Taloon and Alborz tunnels (~12 km) are under construction. Major water conveying tunnels include tunnels of Ghomrood project (~ 50 km), Zahab tunnel (~ 50 km), Korhrang III tunnel (~22 km), Ghavoshan Tunnel (~21 km) and Siahbisheh Pumped Storage and Underground Hydropower Project.
In major cities, development of clean and efficient urban transportation has become a priority. In seven major cities, Tehran, Mashad, Tabriz, Esfahan, Shiraz, Ahwaz and Karaj, the urban underground light railway system is under design and construction. In Tehran two Lines 1 and 2 (~40 km) are in operation. Line 3 (27 km), Line 4 (22km) and extension of Lines 1 and 2 are in the construction stages, and Line 6 (24 km) and Line 7 (27 km) are in the design stages. In Shiraz, Esfahan and Tabriz the system has twin tunnels which are constructed by EPB-TBM. High attention is being paid to the high technology and mechanized tunnelling particularly in long, deep and urban tunnelling. The higher education and research are aimed to help in this development program.

IRTA, as the only national non-governomental organization on the subject of tunnelling, has a very major rule in this matter. A close contact and exchange with international organizations including ITA and its member nations, academic institutions and industrial establishments is one of the main priorities of IRTAfor the year 2007 and beyond.

ITALY

Società Italiana Gallerie is an open association (approximately 700 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).

At Seoul, during the ITA World Tunnel Congress, more than 12 Italian Representatives attended the various Working Groups Session. Two of them were chaired by Professors Daniele Peila and Claudio Oggeri. The report of the activity of the WGs was published by the SIG journal.

In the teaching field the 5th edition of the Post Graduate Master course of Politecnico of Torino was ended and 17 students attended to the course coming from Italy, UK, Greece, Turkey, Corea, Vietnam and Venezuela with more than 45 teachers coming from 15 different nations.

In the past year many important project were developed in Italy involving a lot of tunnelling works both conventional and mechanized.
- The works for the Porta Susa underground Railway station started;
- The Passante di Bologna (railway) Project excavation was finished with EPB machines;
- The design and build contract for the Passante di Palermo (railway) project has already been awarded;
- The metro line of Brescia is under Construction with an EPB machine.
- The new section of the Milan metro to reach the new "Fiera di Milano" with an EPB machine was finished;
- In Piedmont many road tunnels to improve the mobility for the olimpic games were constructed.

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KOREA

KTA has succesfuly held the event, ITA-AITES 2006 WORLD TUNNEL CONGRESS AND 32ND ITA GENERALASSEMBLY in Seoul from 22 to 27 April 2006. A total of 904 participants attended and 129 papers were presented. All the accepted papers, 203 papers, appeared in the special issue of TUST.

Six working groups are currently actively working in KTA. The active working groups include Standard & Specification, Shotcrete, Physical Survey, Mechanised Tunnel Construction, Urban Tunnelling, and IT in Tunnelling. In addition to regular meetings, working groups had seminars and workshops to exchange technical information. The important activities can be summarized as follow: The Urban Tunnelling woring group had a two-day traing course for urban tunnelling in September. The Standard & Sepcificatin working group is now revising the Tunnelling Design Guideline and Construction Sepecification for Ministry of Construction and Transportation. The ITin Tunelling working group is putting efforts in setting a guideline for numerical modelling of tunnels.

Bundang Subway Line Extension Project : Budang Subway Line consists of a river-bed tunnel which is being constructed using a shield TBM. Upon completion, the Bundang Subway Line is expected to release traffic congestions in this area.

Seoul Subway Line No. 9 Construction Project : In response to the demand for significant upgrade to existing infrastructures in Korea the subway system in Seoul (Seoul Metro) is being undergone a recent major expansion. One example is the construction of Line 9 which runs underground from Kimpo International Airport on the western part of Seoul towards the Gang-Nam busyness district, eastern part of Seoul. As the entire route is aligned in close proximity to Han River and under heavily populated areas, such as Yuido, Banpo, and Gang-nam business districts, the tunnelling conditions are rather difficult in terms of geotechnical aspects. The new Austrian tunnelling method (NATM) has mostly been adopted due primarily to its outstanding flexibility. In order to cope with difficult tunnelling conditions, multi-faced tunnelling methods are frequently adopted with other auxiliary method such as pipe roofing and circumferential pre-grouting. The construction is expected to be completed in 2008.

Second longest road tunnel completed – Misiruyoung Tunnel, the second longest road tunnel in Korea, was completed in May 1, which passes through Mishiruying Mountain. The 3.69 km long tunnel is expected to significantly reduce the travel time from Seoul to Cities in East coast.

THE NETHERLANDS

Member Nation representative is the Department of Tunnelling and Underground Works of the Royal Institution of Engineers in the Netherlands. On their behalf all activities are co-ordinated and carried out by COB – Netherlands Centre for Underground Construction.

COB is a public private partnership to further the development of knowledge in the field of underground space and further the use of underground space. The COB vision places the use of underground space central to spatial development in such a way that liveability is maintained and often increased at surface level. COB achieves her activities by activating her network of participants coming from all sectors of the construction industry and spatial development.

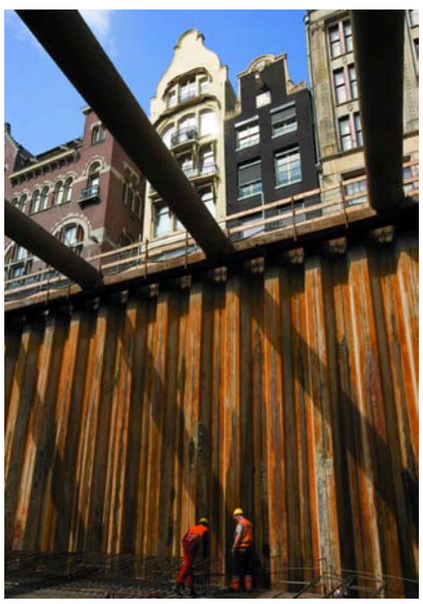
Besides the Department of Tunnelling and Underground Works, COB also supports the Schreuders Foundation –responsible for the annual underground space awards in the Netherlands-, the National Tunnel Safety Committee –a government appointed body for tunnel safety- and CARUS –the Centre Applied Research Underground Space, a university research group part of a partnership of three Universities of Applied Science in the Netherlands, and the chair of Underground Construction at Delft University.

RandstadRail's tunnel boring machine Pandora reached the Blijdorp district in May 2006, at a depth of 20 metres. The machine had made quite a trip by that time: it had already successfully passed the Noorderkanaal. In other words, it had covered almost half of its 2.800-metre journey. The RandstadRail project bureau and the client, the Maintenance & Operations Department of the sub-municipality of Rotterdam North, referred to this as a small milestone in the project.

Hubertus Tunnel – Tunnel rings placed at the Hubertus end. At the end of March 2006, two steel rings were placed in the excavated building pit at the Hubertusduin. These rings constitute the end point for the tunnel boring machine (TBM), the start being made from the start shaft at the Landscheidingsweg. The TBM was constructed in the start shaft after being transported to Schiedam from Germany in May 2006. A total of over 786 tons of components were shipped. Assembly of the tail section had started in the last week of April. Two colossal cranes were used to lift this part into the

start shaft. On around 20 May, the cutting wheel could be put in place, and the TBM was ready to go at the beginning of July.

North-South Line – Transport of tunnel sections and largest caisson sink. Gigantic tunnel sections of 140 metres are being constructed in the Sixhaven behind the Central Station of Amsterdam. Two of these sections were ready at the start of June. They were towed by four tugboats to a temporary 'parking place' in the western port area. Another achievement was celebrated in October 2006: the huge caisson – 60 metres long and 28 metres wide – opposite the Central Station was sunk to its final depth of 25 metres below NAP[mean sea level]. The caisson will serve as the start shaft for the tunnel boring machine. Two further caissons will follow.



CARUS – Renewing education and initiating research. The 'Centre Applied Research Underground Space' – or CARUS in short – will in 2007 enter its fifth year. Over the last year, CARUS has expanded from a research group at Zeeland University of Professional Education to an education provider and research group collaborating closely with the Netherland Centre for Underground Construction – COB. From 2007, CARUS will be an unique partnership of three universities of professional education, Zeeland University in Vlissingen, Utrecht University and Avans University in Tilburg and Breda. In the past years special consideration was given to developing curricula in the field of Tunnel Facility Management and Project Enabling. Tunnel Facility Management is the application of Asset Management in the field of Tunnel Maintenance & Operation. Project Enabling focuses on the need for a community based approach to make projects work. This approach holds especially true for Underground Space Development as this is often done within the confines of densely populated urban areas where community involvement is essential to the success of these projects.

COB – Netherlands Centre for Underground Construction. The COB finalised a study into safety aspect of underground facilities at the end of 2006. The publication will be presented at a special symposium at the beginning of 2007. Further research has been carried out in the field of cables and pipelines. These are causing underground congestion in urban areas and COB has called for the need to apply planning instruments to co-ordinate the use of the underground to prevent the situation becoming uncontrollable in future. The call has been taken up by the National Government and pilot projects on underground planning have been started in 2006.

NORWAY

The Norwegian Tunnelling Society with its 950 personal- and 60 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 rock excavation.

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 2006 focus has been put on safety and health with three ongoing projects. The Committee for conferences is responsible for arrangements, this year three. "Information" is promoting recruitment to the rock blasting 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 cources 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 conserning rock blasting.

Member Nations Report 2006

The year 2006 was an active year for the Norwegian tunnel builders.

The main ongoing projects are:

- Breidalen water transfer tunnel to the Øvre Otta HEP , 14 km, approx. 25 m²
- Sauda HEP, all together about 30 km of tunnels, shafts and underground power station
- Kjøsnesfjorden HEP, about 25 km of small section tunnels and shafts
- E10 Lofast road tunnel, about 6 km of tunnel excavated with drill and blast from one side
- Eiksund sub-sea road tunnel, approx. 6 km long and down to 284 m below sea level (world record)
- E16 Wøyen – Isi tunnel, 2 x 3,1 km for highway
- Halsenøy sub-sea road tunnel, length about 3 km
- Skrøo road tunnel, about 3 km long
- Finnfast sub-sea road tunnel, about 6 km long
- Narvik harbour, new underground iron ore ship loading facility
- Falconbridge rock cavern for staoring waste products, about 100 000m³
- Many smaller projects

During the year 2006 the underground activity in Norway was on the average level with an excavated volume from underground reaching about 3.5 mill m³. Towards end of the year the third PPP road project was started. The total volume of rock excavation on this project is more than 5 mill. m3 of which about 800,000 m³ will be from tunnels.
The outlook for 2007 is that there will be an increase in the rock excavation activity. For example will a new railway project between Oslo and Sandvika contribute to this increase.

POLAND

Polish Group of ITA is a member of ITA since 1978; includes 65 individual members and 5 group members.
PG of ITA publishes in 2 technical magazines: “Mine and Tunnel engineering” & “Geoengineering - Roads, Bridges and Tunnels”. We are preparing the X International Conference Underground Urban Infrastructure 2008 to be held in Wroclaw, 23-25.10.2008 in cooperation with the Polish Group of Trenchless Technology .

Due to rather small number of members the Polish Subcomittee has not created permanent Task Groups in the manner following AITES-ITA organisational structure. If necessary ad hoc work groups are formed in order to deal with a specific issue.

Underground activities in Poland. In Warsaw, currently the only town in Poland, design and construction of metro is now proceeding. An 18 km long part of the first metro line is now under operation. Its completion is scheduled for 2008. Total length of the first line will reach 23 km. In the current year a tender will be announced for the designing and building of the central part of the 2nd metro line in Warsaw with the length of 6.5 km, 7 stations an a tunnel under the river Vistula, which is 500 metre wide. Tenders for the remaining 3 parts of the 2nd metro line, whose planned length is 26 kilometres, will be announced in intervals of several months. It is planned that the first part of the 2nd line will be completed in the year 2012. Except for Warsaw, tender proceedings are now in progress for the construction of a road tunnel in Laliki, near the Polish - Czech border. The tunnel will be 0.6 km long.

PORTUGAL

The Portuguese Tunnelling Comission (CPT) was created in 2006, inside SPG - Portuguese Geotechnical Society, as the Portuguese Group of ITA. SPG has 982 members, 142 of them being members of ITA and CPT. In 2006, CPT organized an International Seminar on Tunnels and Underground Works with 191 participants (Lisbon, June 29-30) and hosted an ITA Executive Council Meeting in Lisbon (July 1-2).

The excavation of the Red Line of the Lisbon subway in the stretch Alameda – S. Sebastião went on, involving a 1400 m TBM tunnel, 9,8 mm diameter, a 800 m NATM Tunnel and two underground stations (Saldanha and S. Sebastião) with a total excavation of 180,000 m³ and five access and ventilation shafts with 240-750 m² cross sections. The design of the extension of the Red Line between the East Railway Station and the Airport was in progress too.

- Also in Lisbon, the old Rossio railway tunnel, 2.5 km long, built up in 1895, was closed to traffic for refurbishment works.

- Design studies were carried out too for the refurbishment the old masonry railway tunnels of Fátima (650 m), Albergaria (661 m) and Alhadas (519 m).

- Design studies for the high-speed railway lines Lisboa-Porto and Lisboa-Madrid, which will require a significant length of

twin tunnels in the approach of densely urban areas and the crossing of difficult geomorphologic regions, have also been in progress.

• The construction of the 8 km Odelouca-Funcho and of the 4 km Sabugal-Meimoa hydraulic tunnels, 3m in diameter, has been ongoing to. The last but not the least, relevant activity concerning the design and construction of road tunnels in Madeira Island was carried out. Two tunnels in the expressway Machico-Faial and one in Ribeira Brava were opened to the public in 2006. Under construction are, among others, four tunnels in the expressway Fajã da Ovelha – Ponta do Pargo, three tunnels in the expressway Ribeira de S. Jorge – Arco de S. Jorge, with a total length of 4,170 m, and two tunnels in Madalena do Mar, with a length of 1,910 m and 1,535 m respectively.

ROMANIA

In April 2006, General Assembly of ART elected Mr. Sorin Calinescu as the President of ART. A new special issue of "Constructii Subterane" Magazine. ART has a new web site: www.art.org.ro. The 5th National Conference of ART was held in Sinaia (october)

Working group "Research" approved « Guidelines for civil defense measures in Bucharest Metro » which were proposed to be promoted by Romanian Civil Defense Division from Ministry of Internal Affairs from the Government of Romania.

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.

• Continuing works 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).

• The Municipality of Bucharest will organise tenders in a PPPsystem conytract for 23 major underground parking facilities to be constructed in the central in order to ease traffic congestions in the city.

• Metrorex, the Bucharest metro operator, will put into operation a new section of 4.13 km with 4 new stations in the east part of the city, on 1st of December 2007 (EIB loan).

• EIB Board approved a loan for construction works of Metro Line 5 (Drumul Taberei – Pantelimon), first section with 9 km long and 13 stations, totaly in underground, between Drumul Taberei area and center of the city.

• The General Council of the Bucharest Municipality aproved the feasibility study for construction of a rapid link interconnection line from the international airports Otopeni and Baneasa with the metro network of Bucharest, in Victoriei Square area. The metro link will have 17 km long and 19 stations, totaly in underground. This investement will be carried out with a JBIC loan.

• Municipality of Bucharest began the construction works the for the modernization of "Eroii Revolutiei" plaza, including a new underground intermodal transfer and a pedestrian passage tunnel.

RUSSIA

Russian Tunnelling Association is a social organisation which joins more than 90 corporate members and more than 400 specialists, individual members. More than 90 papers were published in 7 issues of "Metro and Tunnels", RTA journal. The International Exhibition "Underground City 2006" was held in Moscow on the 25-27 of January. In its frames the International Scientific and Technical Conference "Technologies, machines, equipment, materials, norms provision and monitoring for tunnel construction and high-building underground parts construction" was held on the 26-27 of January with publication of the reports theses. The competition for the best utilization of progressive technologies, structures and materials during underground construction (Moscow, January).

Development of appraisals by experts on industrial safety and consideration of difficult technical problems of tunnel construction in Russia.

• The scientific and technical report on design and construction of transportation tunnels in Moscow (Serebrianiy Bor district) was expanded.

• Development of Recommendations on sprayed-concrete structures use with new materials and equipment.

• Development of the Enterprise Standard "Materials and solutions for tunnel face slurry pressure and cement grouting behind the tunnel lining while using shields with active tunnel face pressure balance".

• Development of the Enterprise Standard "Ground consolidation and creation of a screen against water-filtration using jet-grouting".

• Preparation and participation of the delegation of Russian Tunnelling Association in the World Tunnel Congress 2006 and the 32nd ITA General Assembly in Seoul.

Underground activities in Russia: • Driving of right transportation tunnel of 14.2 diam. and the service tunnel of 6.2 diam. in Serebrianiy Bor (Moscow) was completed. Now the necessary works inside the tunnels are performed. • Metro lines construction was continued in Moscow, Saint-Petersburg, Nizhny Novgorod, Ekaterinburg, Cheliabinsk, Krasnoiarsk, Kazan, Novosibirsk,Omsk. • In Ufa the

construction of the urban road tunnel was continued using NATM. • Road tunnels construction was completed round Sochi on the Black Sea coast. • The Technical and Economic Substantiation for Orlovskiy road tunnel under river Neva in Saint-Petersburg was completed. • 2006 was a year of anniversaries:Moscow Metrostroy was 75; Moscow Metropoliten was 70; Institute "Metrogiprotrans" was 75; Institute "Lenmetrogiprotrans" was 60; "Soyuzgidrospetsstroy " was 55; "Gidrospetsproekt" was 50.

In connection with underground construction Russian Tunnelling Association has working contacts on up-to-date technologies and machines with such foreign firms as VINCI Construction Grands Projets (France), Herrenknecht AG and Heymann Untertage Technik (Germany), Lovat Tunnel Equipment Ink. (Canada), Beton-und Monierbau (Austria), WIRTH Maschinen-und Bohrgerate-Fabrik (Germany).

SINGAPORE

Nine 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 the public.

• TUCSS has donated S$ 15,000 each to National University of Singapore and Nanyang Technological University for the TUCSS Geotechnical Engineering Award. A cash award of S$1,500 will be awarded to the best final year student from each university.

• A half-day seminar on practical tunnel design and construction organized by Amberg Engineering Pte Ltd was held on 26 June 2006. The presenter, Mr Mchael Rehbock-Sander highlighted three major projects showing the variety of tunnel design and construction in different conditions, i.e. Soil and rock conditions, high and shallow overburden, as well as presence of groundwater. The seminar was attended by 48 participants.

• An extraordinary General meeting was held on 26 june 2006 at SMRT Auditorium with 22 attendees. The following Honorary members have been elected during the meeting:Mr Low Tien Sio, Mr Rajan Krishnan, Assoc. Prof. Zhao Jian

• TUCSS successfully organized the International Conference on Deep Excavations 2006 from 28 to 30 June 2006, held at Singapore Expo. There were altogether about 250 delegates from 15 countries attending the conference. This conference is jointly organized by Association of Consulting Engineers, Singapore, the Land transport Authority and TUCSS. 21 PDUs were approved for this conference.

• TYLin International Pte Ltd organized a presentation on design and Construction of special bridges by Dr Tang Man-Chung, chairman of TYLin International Pte Ltd on 30 october 2006 at Land transport Authority 's club house. TYLin International had offered 30 complimentary seats to TUCSS members for this seminar.

• Mott MacDonald (S) Pte Ltd organized a presentation on geotechnical baseline reports: past practices, lessons learned and future applications by Mr Randall J. Essex, Executive Vice President & director of tunnels of Mott MacDonald, USA, on 2 November 2006 at land transport Authority 's club house. MottMacDonald had offered 30 complimentary seats to TUCSS members for this seminar.

• TUCSS has also successfully organized the biennial Asian Rock Mechanics Symposium 4 (ARMS4) from 8 to 10 November 2006 at Meritus Mandarin Hotel. This conference is jointly organized by the ISRM and TUCSS.

• TUCSS annual lecture 2006 was held on 5 September 2006 at Auditorium of KK Women's and Children's hospital. The title of the lecture was tunnelling and geotechnics – new horizons by Prof Robert Mair of Cambridge university, UK. A total of 205 participants attended the lecture.

SLOVENIA

Slovenian Association, together with DARS, d.d. (SLOVENIAN MOTORWAY COMPANY) organized a workshop on SAFETY IN ROAD TUNNELS. The workshop was held in Ljubljana, Slovenia on March 16, 2006.• Together with University of Ljubljana, our association organized the 8th International Symposium on Tunnel Construction and Underground Structures, which was held in November 15-17, 2006 in Ljubljana, Slovenia. • Members of Slovenian Association presented papers at various international meetings and conferences in Europe and overseas countries.

Our members participate in WG 17 and WG 5.

A twin tube with two and three lances in the Sentvid Tunnel, located close to Ljubljana motorway ring, is under construction. Rock structure belongs to Perm-carboniferous rock series and have low bearing capacity. Very bad rock conditions do not alow higher progress in excavation works. The main engineering challenge is the construction of two underground caverns (cross sections in the wider one measures more than 320m^2). The caverns will allow the connection with three separate entrance and exit tunnels.

• The design of a twin tube of the Markovec Tunnel on the motorway section between Koper and Izola near Adriatic coast has been finished. Rock structure of the tunnel consists of flysh rocks with sandstone and marl layers which are tectonically disturbed in some parts.

• A similar rock structure have also two double-tube road tunnels Barnica and Tabor on the Razdrto – Vipava highway section. This is the last part of the highway betveen Ljubljana in Nova Gorica which has not been finished yet.

• There are some short, single and twin tube road tunnels on the motorways and state roads in different areas in Slovenia which are currently under design and construction phase.

• In future we can expect some new projects on railways and road tunnels, and rehabilitation works on old tunnels either on rails and roads. .

Excavation of the Sentvid Tunnel

SWEDEN

BK Swedish Rock Construction Committee is a non-profit organization consisting of 82 corporate members within the civil engineering sector (incl mines, manufacturers, R&D asister organizations). BK´s Executive group (7 members of the Board) and the Board (19 members) meet three times per year respectively. BK´s major task is to arrange the annual meeting (abt 500 people) to which students and doctorands are invited at a subsidized participation fee.

BK does not have national working groups corresponding to those of ITA. However, through the national group, Sweden currently has representation in the following WGs of ITA: 2, 5,.6, 11, 12, 14, 15, 17, 18, 19 and 20. We also have an ad hoc representation in the Committee on Safety of Tunnels in Operation (through the representive of the Swedish member of PIARC). The participation at ITAs annual meetings is normally good. A follow-up meeting of these is arranged by BK every year to inform about the activites of the WGs and invite other viewpoints on the ITA activities.

The Stocholm region is constantly growing and new infrastructural solutions are in demand. (1) The Northern Link, part of the Ring Road around Stockhlm, is 5 km of which most in twin tunnels, the longest 3 km. Access tunnels are now under construction. (2) the Outer-by-pass road, will be a 21 km long six-lane highway of which 16 km will be in tunnels.Estimated cost is SEK 25 billion (2006). Alternative routes are being discussed. (3) The Citybanan project is scheduled to be a 6 km 2-track commuter train tunnel under the centre of Stockholm city, mainly in rock tunnels with 2 new stations 30-40 m underground. This project has, however currently been postponed due to political reasons.

• The Citytunnel railway in Malmö (southwest Sweden) is a complex project well underway, totalling 17 km of which 6 km are in 2 parallel bored tunnels and underground stations. The tunnel tubes will be connected by 13 cross-tunnels for safety and evacuation purposes in case of accidents. Estimated construction time: 2005-2011.

• An environmental project was started in 2004/05 to improve the waters of the Årstavik Bay (Stocholm suburb). Two rock caverns, totalling 30 000 cubic meters will be built, where the stormwater from Årsta will be purified in basins before transportation into the Årsta Bay.

• For more information about subsurface activities in Sweden, kindly refer to the English version of our website www.bergsprangningskommitten.se and click on “Tunnelling in Sweden”. Our site can also be reached from the site of ITA under Member Nations. There you will find links also to the projects mentioned above.

Member Nations Report 2006

SWITZERLAND

The Swiss Tunnelling Society has succesfully held the Swiss Tunnel Congress in June 2006 in Lucerne.This event will be up-graded in the coming years to be an outstanding show case for the competence of the Swiss Tunnelling Industry. Additionally regular contacts with neighbouring countries and the ITA were kept .

The Swiss Tunnel Society has no standing scheme of working groups. Such groups are formed on demand. In the last year, a national WG has worked on standards. The Swiss Tunnel Society published a new set of standards on tunnelling representing the latest state of the art in Switzerland, which also was applied for the design and the constructions of the two base tunnels through the Alps (Lötschberg and Gotthard Basetunnel). These standards are available in German, French and English.

Lötschberg Base Tunnel : The new 35 km long Lötschberg Tunnel will be going under operation in May 2007 as the first of the two new Alp-crossing Railway Links. Currently all the mechanical and electrical equipment is installed and first test runs with highspeed trains going up to 260 km/h are carried out. After commissioning the travel time between Switzerland and Italy will drop considerably. The construction of the Lötschberg Base Tunnel was very succesfull and both financially and time wise in schedule. Further details see www.blsalptransit.ch

Gotthard Base Tunnel : The Gotthard Base Tunnel is the world longest tunnel. Construction started in 1995 with intermediate attacks , in 2002 with the main drives and the tunnel will see the last breakthrough in 2011. Heading is progressing well and more than 50% of the tunnel are excaveted. The tunnel will go under operation in 2016. Further details see www.alptransit.ch or www.basistunnel.ch.

Ceneri Base Tunnel : The Ceneri Base Tunnel is – together with the Gotthard Base Tunnel - part of the new Alp-crossing Railway Link. The first lots for the excavation of access galleries have been tendered out in 2006.

Other tunnel projects in Switzerland: the list of tunnels under design or construction sees many more projects. To mention just a few of them:

DESIGN STAGE:
N4, Läntigen und Morschacher
N8 Brünig und Kaiserstuhl

UNDER CONSTRUCTION:
N1c, Aescher, Eggrain, Hafnerberg
N2, Nordtangente Basel, Schlund, Spier, Kirchenwald
N4, Flüeler, Uetliberg
N8, Aecherli, Giswil, Umfahrung Lungern
N16, Pré Boivin, Moutier, Raimeux, Roche St-Jean, Banné, La Beuchille, Perche

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 2006:1) 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 :	93	36.842 m.
Under construction	63	75.547 m.
In the design phase :	46	49.043 m.
Total :	208 :	161.431 m.

There are 5 railway tunnels 24.365 m. are under construction
The total length of the rail systems in Istanbul is 110,5 km.
8,2 km. Metro (Underground)
17,5 km. LRTS
11,2 km. Tram-Car
72,0 km. Urban Commuter system
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.
(8,6 km. excavated 1,8 km. immersed, 2,3 km. cut and cover)
Number of stations : 37

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

Member Nations Report 2006

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. In addition it continues to produce technical guidance on tunnelling-related topics.

During 2006, BTS working groups have : •published guidance on best practice in reducing exposure to hand-arm vibration, • drafted interim guidance of reducing exposure to nitrogen monoxide. The Compressed Air Working Group has met twice to consider issues affecting work in compressed air

Construction began on the 17km of tunnels and a powerhouse cavern for the Glendoe Hydro scheme - the first major hard rock tunnelling project in the UK for a number of years.

• Tunnelling was underway below the Thames for the extension of the Docklands Light Railway Extension to Woolwich.

• A series of cable tunnels were under construction as part of site preparation for the 2012 Olympics.

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

• Work continued on access tunnels associated with the Kings Cross/St Pancras Station development for the Channel Tunnel Rail Link which is expected to open in October 2007.

• Major tunnel refurbishment works were underway on the Blackwall Tunnel and on tunnels on the M25 motorway.

• Design work is well advanced on the A3 Hindhead tunnel and Edinburgh Airport Rail Link tunnel.

UNITED STATES OF AMERICA

UCA continued to conduct conferences to share knowledge about underground construction.

• Regional conferences were held in both New York City and Cleveland Ohio.
• Our biannual North American Tunnelling Conference (NAT) was held in Chicago, IL
• Attendance continues to be high for these events and all have received positive feedback.

Better Contracting Practices update, has met at NAT 2006 to review status.
• It is expected that this will be published in early 2008.
• All members of UCAhave access to the US Tunnel Demand Forecast a subgroup of members compiles this information for distribution.

• The NAT Conference Committee has started its program organizing for 2008.
• The program will be held in San Francisco, California June 7th - 12th.

The NY Region remains a hotbed of current and planned underground projects with up to $80 Billion (US) projected in the next 10 to 15 years. Currently underway, South Ferry Station, East Side Access Tunnels, Water Tunnel #3 Stage 2 Manhattan Tunnel, Fulton Street Transportation Center- Day Street Project, Water Treatment Foundations & Connecting Tunnels in the Bronx. NY bidding soon, 2nd Avenue Subway 96th to 63rd Street, #7 Subway Extension Tunnels and two Stations, East Side Access Station Caverns. Planned Access to the Regions Core – twin tunnels from NJ to NY & a new station cavern under 34th St., Cross Harbor Freight Tunnel – tunnels from NJ to NY to divert truck traffic from bridges, Tapanzee Bridge Replacement with miles of approach tunnels in Rockland and Westchester Counties, Further extensions to City Tunnel #3 from NYC to reservoirs in Westchester County.

• On the West Coast of the USA the Beacon Hill Tunnel & underground Station in Seattle is well underway while the Brightwater Conveyance System has bid and started their major sewer system expansion.

• In Los Angeles the Eastside Light Rail Project is well underway.

• In San Diego the San Vicente Pipeline tunnel is underway as well as the Lake Hodges tunnel project.

• In the middle of the country the TARP system in Chicago continues with the Little Calumet Leg, the CUP McKook Reservoir and the MWRD McCook Haul Tunnel projects.

• In Milwaukee the Elm Road Generating Plant Cooling Water Intake Project well underway.

• There are numerous other projects currently underway,

• The reader can find more information from publications like TBM Magazine, T&T or the UCA of SME Tunnel Demand Forcast which will resume publication in 2007.

Member Nations Report 2006

INDIA

DELHI METRO PROJECT – PHASE-II

Phase-1 of Delhi Metro Project comprising of 65 route kms and 59 stations put to operation successfully ahead of time schedule, the work of phase-2 has been taken up in rigorous manner. The phase-2 comprises of approximately 125 route kms. and 79 stations tentatively, & is to be completed before the commonwealth games scheduled to be held in Delhi in October, 2010. Out of this 125 route kms, approx. 25 kms of route has been proposed to be underground & is to be carried out by Tunnel Boring Machines (TBMs), NATM, cut & cover etc

The proposed corridors having underground stretches in phase-II are as below:

S.No.	Line	Length	underground
1	Vishwa Vidyalaya – Jahangirpuri	6.90	1 km
2	Central Sectt – Sushant Lok	26.80	12 km
3	New Delhi – Airport	19.5	6 km
4	Central Sectt – Badarpur	20.16	6 km

The physical work in first two corridors has already commenced & in other two corridors the physical activities shall be starting by Sept, 2007. It is also to mention that out of 25 km of underground work, approximately 13 km is envisaged to be carried out by shield TBM.
It is envisaged that during peak construction activities, approx. 10 nos. of such machines shall be working in different stretches and different ground strata over next 3 years in Delhi. In other words it can be said that Delhi is going to be next hub for tunneling activities in the coming years and shall be witnessing lot of good engineering skills.

JAMMU-UDHAMPUR-SRINAGAR-BARAMULLA RAIL LINK PROJECT

Indian Railways had taken up the arduous task of linking the Kashmir Valley with Jammu by a rail network of 343 km. The work on first phase (56 Kms) between Jammu to Udhampur was completed in 2005 and services are operational on this route. The link 25 Km between Udhampur to Katra Vaishnodevi is under construction and may be completed by 2007. The work on 119 km track from Qazigund to Baramulla is nearing completion. The 138 km stretch between Katra to Qazigund was commenced in 2003. However this stretch is most difficult and un-parallel to any rail linking project built in India so far. It involves 104 kms of tunneling wherein one tunnel is about 10.9 km long under the rock cover of 2000 mts below the Pirpanjal range of Himalayas.

This task of herculean task of 138 km has been entrusted to two public sector companies; from Katra to Laole between Km 30 to Km 120 to Konkan Railway Corporation Ltd. and from Laole to Qazigund between Km 120 to 168 to IRCON International.
In Konkan Railway section, to execute entire 90km track length, construction of 225 km access road is necessary which have become bottleneck to complete this project on time.

NO. OF TUNNELS	40 (71.50 kms)
NO. OF MAJOR BRIDGES	50
NO .OF MINOR BRIDGES	24
SPECIAL BRIDGE	Chenab Bridge with a height of 359 m (Bed Level to Formation Level) & with an approx. cost of Rs. 512 Crores.
LONGEST TUNNEL	Tunnel No. 19/29 (6574 m near Basindhadhar)
TOPOGRAPHY OF TUNNELS	Tunnels are located in geologically disturbed zones in dolomite & muree forma tions and crossing four major thrusts.
VENTILATION IN TUNNELS	Long Tunnels (More than 2 KMs) shall have forced Ventilation.
M ORE ABOUT TUNNELS	All tunnels are lined.
DISASTER MANAGE MENT	All tunnels (More than 3 KMs) shall have 3 mtr wide road along the track to cater for disaster management.
WORK IN PROGRESS	10 Tunnels, others are awaiting access roads.

Roads are to be built first and railway tunnels to be latter. The other details are as under:-

NO. OF TUNNELS	23 (32.982 Km)
NO. OF MAJOR BRIDGES	28
NO .OF MINOR BRIDGES	10
LONGEST TUNNEL (10.9 KMs)	Tunnel No. 80 (Pirpanjal)
WORK IN PROGRESS	9
TUNNELS COMPLETED	4

In IRCON Section, to execute 48 kms of track 35.9 kms of access road have been constructed. The other details are as under:-

In IRCON section 48 KM w. in 9 tunnel complete 4 nos. ; T80 – 10.9; 1.64 Km; Nos. station 3; Max height of bank: 22.3; Rob-3; 2500 Crores; 35.9 KMs length

THE PIR PANJALRAILWAY TUNNEL is detailled in the ita web site.

Member Nations Report 2006

SAUDI ARABIA

Even though MOTis one of the newest members in ITA, it has been very active one. MOT has participated in several conferences and activities held by the ITA. In addition, MOT organized a workshop in November 2006 entitled " Safety in Tunnels and Underground Structures" (see herafter)

Several projects are under study and construction throughout the Kingdom. Two major projects will be briefly discussed herein.

1) The East-West Railroad:

This railroad connects the cities of Jubail, Dammam, Riyadh and Jeddah. 14 tunnels totalling 20 km. in length are being executed in this project. In addition to the construction of tunnels, this project includes the construction of : road over and under bridges, retailing walls, protection and diversion works for utilities, level crossing etc. The general functional requirements of the tunnels include: Even though the track is to be constructed as a double line, the design of the tunnel assumes twin single track tunnels which will carry double-stack container wagons. On single track sections, a single track will be provided. Walkways have been provided to allow an emergency egress of railway personnel and passengers. Tunnel alignments have been designed to allow gravity drainage. In average the external and internal areas of the tunnels are 90.026 m^2 and 67.661m^2 respectively. In terms of excavation, drill-and-blast excavation in rock is required for most tunnels and support is provided by rock bolts and an in-situ lining.

2) Deleh Descent Road:

This project is located in Ad darb road in Abha province.

This road suffered extensive structural damage as a consequence of two impressive floods triggered on 1982. one tunnel flooded as a result of these events. Therefore, two new tunnels (309 & 200 m long) were suggested to overcome this problem. The construction of the tunnels included the following tasks: a- Excavation: Top heading and bench. b- Rock bolts : systematic bolts 4- 5 m. long spaced 1-1.5 mm. c Shotcrete : 150~ 200mm. in crown, 150mm. in sides, and 50 mm. on face. d Steel sets : Light to medium ribs, spaced 1.5 m. In general, the tunnel consist of the tunnel (under the mountain), the artificial gallery and the protection walls. The new Austrian Tunnelling method is followed for drilling and excavation.

The Ministry of transport (MOT) has executed a modern network of roads totalling (53000) km. at the end of 2005. The total numbers of mountain tunnels in Saudi Arabia is now 105 tunnels totalling in length 33 km. In addition more tunnels are being executed in several projects including 14 tunnels totalling 20 km. in length in east-west Railroad project between Riyadh and Jeddah. Furthermore, 887 underpasses have been completed in Saudi Arabia.

SLOVAKIA

The activity of the association focused on several basic points:

1.Co-operation and co-financing of the WTC 2007 in Prague together with the Czech Tunnelling Committee.

2.Support of education of the young generation in building industry with orientation to underground technologies of tunnelling.

3.Active participation in the ITA/AITES groups.

4.Organisation of the conference with international participation under the name “Podzemné stavebníctvo” (“Underground Building”).

Point 1:

The STA cooperates with the Czech Tunnelling Committee in all activities in the WTC 2007 committee, i.e.:

a)Financing; b)Scientific board; c)Advertising activity; d)Post-congress activities. The objective of this activity is creation of conditions for successful course of the congress.

Point 2:

The STA is a relatively strong organisation from the financial point of view, which closely co-operates with technical universities and a)Has established rewards for excellent students and postgraduates. b)Actively cooperated in supporting education of students, also in the form of involvement in work groups. c)Included and financed participation of excellent students in WTC 2007. d)Prepares financing of students in training centres. e)The students took part in Workshop 2006 in Prague.

Point 3:

The STA is inscribed (and registered) in four work groups: Mechanical tunnelling ; Contractual practices in underground building; Long tunnels in big depths

Point 4:

The STA co-organised the conference “Podzemné tavebníctvo” (“Underground Building”) from 1st to 3rd October 2006. It is traditionally the main organiser of the conference Skanska - Banské stavby Prievidza. The conference was held with the token of great interest of both international and domestic participants.

From other activities of the STA: a) the cooperation with the Ministry of Transport in the area of consulting services; b) Cooperation with the Slovak Mining Society; c) Co-organisation of lectures on fire safety, traditionally conducted by prof. Alfréd Haack (in July 2006); d) The course of distance education on the topics of “the Conventional Methods of Tunnel Excavation“ under the auspices of the Slovak Technical University in Bratislava continues on a regular basis. The STA took active part in the congress WTC 2006 in Seoul.

In conclusion it may be stated only that the activity of the association is every year on a higher level and I suppose such trend also for the next year 2007.

ITA "Prime Sponsors" Report 2006

BASF

July 2006 – BASF agrees to buy Degussa`s construction chemicals business……..

The recent change of ownership brings new opportunities in the world of underground Construction …

- By combining its own chemical expertise with Degussa`s know how in construction chemicals applications, BASF will provide its customers with innovation at the highest level and help them to be more successful in the competitive construction sector….

This clear message from the Board of BASF sets the scene for 2007 and provides additional drive and support for our growing underground division which enjoyed a record year in 2006.

Growth has come from our focus on new technologies, including an expanded range of injection products for tunnelling and mining, TBM foams, polymers and sealants and a unique sprayable membrane for waterproofing.

Together, these products, our application equipment and professional site support have added value to the one stop shop solution, favoured by our customers.

Our aim is to offer comprehensive, fast, cost effective and safe solutions, which reduce construction risk.

MEYCO® equipment has also featured strongly in 2006 with a range of innovative products designed to accurately apply sprayed solutions to tight tolerances in demanding environments. The patented Logica technology combines a surface scanning laser with a PLC controlled robotic arm designed for use in both tunnels and mines. Significant reduction in rebound of sprayed material is readily achievable and thickness can be controlled accordingly.

MEYCO®`s equipment range is available globally through our regional organisation..

Passive Fire Protection:

The topic of reducing risk equally applies to protecting tunnels from the devastating effects of fire. In recognition of this, a high profile seminar on Fire Protection Engineering was held together with ITA, BTS and The Concrete Centre in October at the Insitution of Civil Engineers in London attracting 170 delegates.

MEYCO® Fix Fireshield 1350, a new development from UGC is a passive protective shield capable of ensuring that structural concrete lining does not spall or lose mechanical strength when heated to extreme temperatures.

Simply installing this passive protective barrier to the lining ensures that should a major fire occur, interface temperatures will be maintained to below 300ºC.

This durable solution is practically maintenance free. Repair and reinstatement of the Fireshield is a fast and low cost operation.

2006 saw BASF gain additional project references in Holland, Sweden, France and Denmark.

2007 offers even more to our customers!

UGC under the new management of BASF looks forward to 2007 with a renewed vitality and clear focus on further developing its tunnelling and mining business. Our top priority is to ensure total satisfaction for our customers, who in 2006 challenged us to apply our engineering know how, develop unique products, meet strict environmental application requirements and achieve strict logistic targets.

If you would like to learn more about BASF UGC or apply to become one of our TEAM UGC Application specialists, please take a minute or two to visit our web – www.ugc.basf.com

We look forward to meeting you!

ITA "Prime Sponsors" Report 2006

BILFINGER BERGER

As one of the leading international tunnelling specialists, we are able to handle complex projects with a high degree of professionalism.

The three major projects that we began in 2006 are as follows:

• North South Bypass Tunnel (NSBT), Brisbane (Australia):

We are currently involved in the planning, design and execution of the NSBT roadway tunnel underneath downtown Brisbane. The total project is 6.8 kilometers long and is made up of two 4.7 kilometer long double-lane tunnels. Two 12.5 meter diameter hard rock TBMs and 6 roadheaders will be used for the drive. The total cost of the project is around 1.2 billion ¤uros. After its completion, the NSBT will be Australia's longest and most technically advanced tunnel.

City Railway Cologne

• Autobahn E18, Grimstad (Norway):

This is an autobahn operational project in Norway. The 38 kilometer long section of the E18 Autobahn between Oslo and Kristiansand is one of Norway's main traffic arteries. Seven double-lane tunnels with a total length of 11.32 kilometers have been planned. The project is valued at 475 million ¤uros.

• Combined Sewer Overflow Tunnel (CSO), Portland (USA):

Work is also being done in the United States on the 9.26 kilometer long East Side CSO Tunnel, a combined flood and waste water canal that, after its completion, will serve as a sewage channel for the 14 existing canals. The tunnel is being driven with a 7.7 meter diameter hydroshield machine. Seven slurry wall shafts, up to 40 meters deep, will be constructed along the alignment. After it is finished, the CSO Tunnel will be able to better protect the City of Portland from flooding disasters.

City Railway Malmö

Bilfinger Berger has thus been able to extend its market position in international tunnelling during the year 2006.

Further Projects of the Bilfinger Berger AG, Tunnelling Branch:

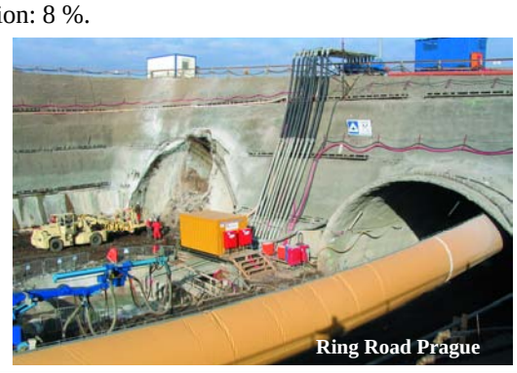
- City Tunnel, Malmö (Sweden)
- Kirchenwald Tunnel, Hergisweil (Switzerland)
- Seymour-Capilano, Vancouver (Canada)
- Roadway Tunnel Dortmund-Berghofen (Germany)
- Exploratory Tunnel Saint Martin la Porte (France)
- Exploratory Tunnel Modane (France)
- Tunnel Brixlegg (Austria)
- Wienerwald Tunnel (Austria)
- Gotthard-Base Tunnel, Lot Sedrun (Switzerland)
- City Railway Cologne (Germany)

Seymour-Capilano, Vancouver

HOCHTIEF

With decades of experience in international structural engineering, 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 mechanized methods of tunneling as well as our local presence, for instance in Eastern Europe. Some recent tunneling projects:

• In the Czech Republic we build together with partners a section of the Prague Ring Road 514. 1,100 meters long blast tunnel. Contract awarded in mid-2006. Actual grade of completion: 8 %.



Ring Road Prague

ITA "Prime Sponsors" Report 2006

• In Glendoe, Scotland, we are realizing a 100-megawatt hydroelectric power station. Design and turnkey construction of an underground powerhouse. Eight- kilometer hard rock TBM tunnel. Eight-kilometer aqueduct tunnel and four-kilometer pipeline tunnel, drill & blast each. Contract awarded in early 2006. Actual grade of completion: 20 %.

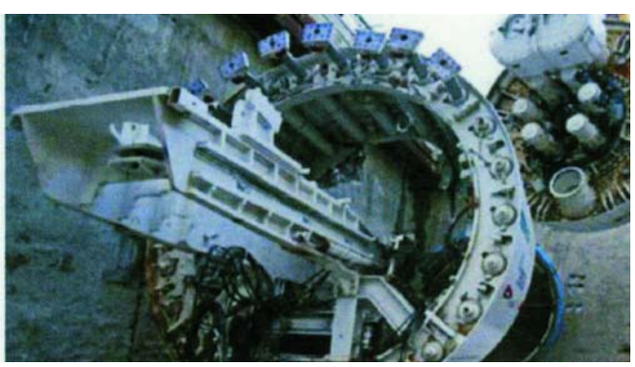
• In Austria, HOCHTIEF is leader of two joint ventures building two tunnel sections: Both contracts awarded in mid-2006. The Lainzer Tunnel involves a three-kilometer twin-track conventional rail tunnel through Vienna. The railroad twin-track Jenbach Tunnel is part of the Brenner feeder traffic branch line: four kilometers in length, shielded TBM with a diameter of 13 meters and segmental lining. Both Austrian projects in start-up phase.

In Copenhagen we are carrying out with partners a district heating tunnel to expand the Copenhagen Energy's supply network: Tunnel with total length of four kilometers, dug by an EPB tunneling machine. Contract awarded in spring 2005. Actual grade of completion: 55 %.

District Heating Tunnel, Copenhagen

LOVAT

Since 1972, 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.
Founded and operated by the LOVAT family, the company's extensive experience, advanced technology and continued development provide solutions for any tunnelling challenge on any project..



LOVAT's success is built on the foundation of innovation, efficient design management, manufacturing excellence, and the guarantee of quality service. The company name is synonymous with outstanding achievements and contributions in the tunnelling industry.
LOVAT adds value to a project by understanding and applying the most cost-effective solutions in response to a tunnel challenge. It means being current with the market and knowing what equipment can deliver the highest quality at the best price in the fastest time. The LOVAT Team, strives to

apply innovative design and manufacturing techniques to get the job done in the most cost effective and efficient manner possible without compromising schedule, quality or safety.
LOVAT manufactures a complete range of tunnelling equipment including:
• Single and Double Shield Rock TBMs
• Earth Pressure Balance TBMs
• Slurry TBMs
• Pipe Jacking TBMs / Systems
• All ranging in size from 2 to 14 m in diameter.
In addition to traditional manufacturing LOVAT also provides additional services to our customers including:
• TBM refurbishment both in our plant and on site;
• Assistance in marketing of TBMs to new buyers;
• After market assistance in the ongoing operation and servicing of the equipment long after the initial contract has been satisfied;
• Sourcing of existing equipment to meet project requirements.
As part of an ongoing strategy of improving customer service and expanding our product line LOVAT announced a Joint Venture with Kawasaki Heavy Industries of Japan for the joint manufacture of Slurry TBMs and large diameter TBMs (greater than 10m) primarily for the North American and European Markets.

2006 at A Glance

• The City of Edmonton purchased its 5th LOVAT TBM adding to its already busy fleet.
• McNally / AECON Joint Venture purchased three TBMs for

the Bathurst Langstaff and 19th Avenue Sewers in York Region, north of Toronto, Canada

• Gulermak Dogus Joint Venture purchases machines 2 and 3 (machine 1 is already on site mining) for work on the expansion of the Istanbul Metro.

• Work continues in the UK with the purchase of another LOVAT TBM by Morgan Est for the Croyden Cable Tunnel. The TBM is a 3.7m diameter mixed face EPB.

• Ongoing work includes record performance by J Murphy & Sons on the Lea Valley Cable Tunnel with production reaching more than 600m of completed tunnel in 5 days across the four machines.

• Kenny / Shea / Traylor Joint Venture purchases a 6m LOVAT EPB TBM for the first phase of the Brightwater Conveyance System, East Contract, USA

• Engeocom of Moscow purchased a refurbished LOVAT ME254SE for continuing work on the Moscow Metro.

• Gamma / Nurol / Taisei Joint Venture purchases an 8m diameter mixed face EPB TBM for European section of the Bosporus crossing in Istanbul, Turkey

• Largest LOVAT TBM to date is being manufactured to mine escalator access tunnels for the Moscow Metro. The 11m EPB TBM will operate on a 30º slope and will utilize a muck pump for material removal while excavating the tunnels.

MAPEI

MAPEI UNDERGROUND TECHNOLOGYTEAM

The launch of the "underground Technology Team" in 1999 was Mapei's clear and decisive response to the construction market's growing demand for a product range and customer service dedicated to underground spaces. The construction industry today is more oriented towards the exploitation of underground spaces, because of the lack of available surface areas. Moreover this choice is also influenced by the considerable design freedom allowed by underground infrastructure, which can be independent of the topographic limitations necessarily imposed by surface constructions.

Underground works have a unique nature due to the complexity linked to their design phase, but above all to the severity of the work environment. For the construction phase, therefore, it is necessary to employ specialized, reliable technical personnel, able, thanks to their expertise, to afford the most unexpected situations and assure a correct and immediate progress of work.

Large underground works require the use of particular technologies and dedicated product systems, such as those specifically studied, produced and marketed by Mapei. Through the dedicated "Underground Technology Team", Mapei has the goal of fully meeting every technical requirement of its customer within the field of underground constructions.

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. Last year was particularly notable for Robbins, from signing the largest TBM order in history to manufacturing the largest hard rock TBM to breaking world records on challenging projects.

Robbins manufactured the world's largest hard rock TBM, 14.4 m in diameter, in 2006 for the Niagara Tunnel Project in Queenston, Ontario, Canada. The TBM is impressive not only for its sheer size, but also for its initial onsite assembly (without pre-assembly in the Robbins manufacturing facility). Less than 12 months passed from the time that the machine was ordered until its launch (about 4 to 5 months less than a pre-assembly in-shop). The TBM began boring in September 2006 on a 10.4 km long hydroelectric tunnel underneath Niagara Falls.

Robbins' latest innovation, 20-inch cutters, are currently

District Heating Tunnel, Copenhagen

being utilized on the Niagara project. The first back-loading 19 inch cutters were successfully utilized on three Robbins TBMs for the Karahnjukar, Iceland Hydroelectric Project, which finished in December 2006. One machine tied a world

record for boring 92 m in 24 hours.

In May 2006 Robbins signed the largest TBM order in history with contractor Jaiprakash Associates, which includes two 10 m diameter Double Shield machines, back-up systems, cutters, conveyors, related equipment, and personnel for a 43.5 km long water tunnel.

Robbins is already on its way to another successful year in 2007, with major contracts already signed for projects around the world.

To find out the latest news about our recent projects and breakthroughs, visit www.TheRobbinsCompany.com.

SIKA

In the globally operating speciality-chemicals group Sika AG, with its headquarters in Switzerland, business in the field of underground construction is concentrated in the hands of Sika Tunneling & Mining.

Here new developments in the three core competence fields Construction Chemicals, Equipment Solutions and Waterproofing Systems are pushed and offered to the market. By bringing together our experiences from Sika Tunneling & Mining in cooperation with the worldwide Sika companies, several big international projects have been aquired in 2006. The Swiss Quality standard of Sikaplan waterproofing membranes opened new markets for big tunnel projects in Canada as well as in Europe. The diesel-powered Sika-PM622 PCD

is a new launched concrete spraying system which has been developed together with our alliance partner, the concrete pump experts Putzmeister. The Sika-PM622 PCD has been developed for applications where the previous spraying boom reach of 16 meters is insufficient. There is only one diesel engine both for driving and spraying. Thus the concrete spraying system is autonomous, i.e. independent of external energy supply and can, because of this flexibility, be directly and quickly operationed everywhere. The optionally available closed, air-conditioned driver's cab is particularly suitable for work in tropical and dusty environments.

In the field of shotcrete and concrete admixtures Sika has successfully strengthened its leading position with the latest Sika ViscoCrete generation, suitable also in precast element production

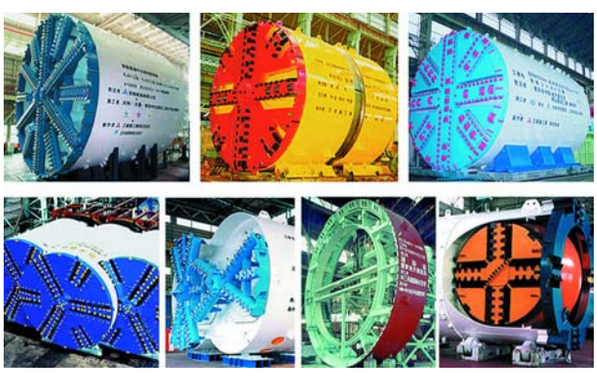
The revision of Sika's Strategy 2010 has also led to modifications at the Group Management level. In keeping with the aim to devote more attention to growth markets, the Mid-East, India and East Africa are to be consolidated into a new corporate region. The Construction Division, accounting for 75% of Group sales, is to be organized into three business units each concentrating on a defined grouping of customers:contractors, distributors and concrete manufacturers in which Sika Tunneling & Mining is integrated as from January 2007.

ITA "Prime Sponsors" Report 2006

STAJ

The Shield Tunneling Association of Japan, STA, was established in 1999, and its membership consists of 97 companies including leading general contractors, TBM and lining segment manufacturers. Fourteen proven and reliable shield tunneling methods have been registered with the association to date, and the association is helping to apply these shield tunneling methods to various projects and promoting widespread use of those methods.

The main activity of the STA is to introduce those technologies to engineers through domestic exhibitions and meetings (e.g. Sewer Tunnel Exhibition, and Japan Society of Civil Engineering, etc.). Moreover, with the aim of improving technical skills for the STA members, visits to shield construction sites are held occasionally. As we STA also consider that our shield technologies should be spread out to the world widely, we are performing several activities in overseas, such as dispatch of the lecturers to the training session of ITA and presentation at several technical meetings.



The STA hopes you to contact us and feel state-of-the-art shield technology of Japan. The STA registers fourteen reliable shield technologies as follows, which are divided into five categories such as: • Tunneling technology,• Multiface, • Non-circular, • Special technique and • Lining technology.

1.Tunneling technologies
DK Shield Method - Rheological Foam Shield Tunneling Method - Chemical Plug Shield Method

2.Multiface
Horizontal and Vertical Variation Shield Method - Multi-circular Face Shield Method - DOT Tunneling Method

3.Non-circular
DPLEX Shield Method - Wagging Cutter Shield Method - JIYU-DANMEN Shield Method

4.Special technique
Enlargement Shield Tunneling Method - Rotating Shield Method - Mechanical Shield Docking Method

5.Lining technologies
P&PC Segment Lining Method - Extruded Concrete Lining Method

ITA"Prime Sponsors" & "Supporters" reports have been forwarded by the companies. They have been written under the responsability of their authors.

ITA "Supporters" Report 2006

BABENDERERDE INGENIEURE

German company Babendererde Ingenieure together with its US based sister company Babendererde Engineers are serving tunnel and underground projects worldwide. The dedication towards quality and to deliver successful projects allowed again growth of the company.

www.bab-ing.com

In 2006 the services included Design for highway tunnels, Specifications for metro tunnels, Construction Management services for railway projects, as well as Inspections and Trouble Shooting for TBMs in difficult situations. As well BI has concluded special projects for private clients to recover anchors under compressed air or legal services. BE/BI have extensive experience in working in different contract environment as DBB, D&B or PPP.

The electronic program TPC is introduced to the market. It is a highly flexible tool to manage all technical data of tunnel projects and have them visualised for control and reporting purposes.

CEGELEC

Equipment and SCADA restoration of the "Tunnel de l'Epine" (2006)

• The client

AREA, Rhone-Alps motorway company (France), subsidiary of APRR created in 1971, controls 384 km of motorways in the Rhone-Alps area until 2032.

• The project

The equipment and SCADA restoration of the 2 tubes of the "tunnel de l'Epine".

This restoration is part of an upgrade of the security equipments in all road tunnels in France.

• Cegelec services (2005-2006)

Thanks to its experience with other road work, Cegelec "Agence Infra-structures & Process (IPE Departement)" has dealt with:

• Complete restoration of the HT loop
• LT distribution in the whole tunnel
• The lighting restoration
• The complete restoration of the command control system
• Specific road management strategies
• The realization of an Ethernet network using optical fibre
• Supply, installation and connection of cameras for the Automatic Incident Detection
• Road signs installation
• Installation of radio diffusion system in tunnel

The start-up was carried out under exploitation, without cut of traffic, preserving the security management of the tunnel.

The tubes have been renovated independently.

VSH HAGERBACH TEST GALLERY

VSH Hagerbach Test Gallery offers specialist trainings for fire fighters for tunnels from all over the world. The participants have been introduced into the problems of an incident in a tunnel situation by different scenarios with artificial smoke. Small attacks on real fire have been exercised in order to train the fire fighters with handling of the accumulation of heat and smoke in a tunnel. At the end of the course all separate trained elements have been comprised in the simulation of real tunnel accidents with real fires in the 200 m long fire gallery.

The past trainings have shown that they are really necessary: even most professionally trained fire fighters behave in an other way in a tunnel than under open field conditions. Sometimes slight mistakes occur which could be fatal for the persons that are injured.

During the training it has also become evident that there are intensive relations between the construction of a tunnel, with elements like cross-cuts, water supply, communications-systems, and the requirements of fire fighters.