



Editorial



Dear ITA friends,

Since the mid-2000s, there has been a major boom in the tunnelling and underground space market worldwide. Over the last ten years, the European and American markets have roughly doubled, but the most noticeable growth rates can be found in South America, the Middle East and Asia. Africa is also set to claim its stake in the market in forthcoming years, with several emerging countries showing an increasing interest in the industry. This growth is largely due to global urbanization and the need to find underground solutions to meet the needs of the world's rising population.

As the various articles in this issue show, there is consequently a growing demand for education and training in the tunnelling and underground space sector. University courses are increasingly sought after, with companies now headhunting engineers before they have even obtained their degree.

New training facilities are therefore popping up worldwide. Malaysia now has its Tunnelling Training Academy and in India there is talk of plans to set up a "Tunnel Technology Institute", to relieve the country

of its dependence on foreign expertise. Europe is also investing in innovative underground training facilities, with an ambitious project underway in Austria.

Through its actions, the ITA-CET Committee contributes to identifying current training requirements around the globe and providing education and training opportunities to student engineers and young professionals eager to make a career in the industry.

Since our last issue in May this year, another 6 training sessions have been held in South America, Asia and Europe, organized in collaboration with the ITACET Foundation. The Committee has continued to expand its list of potential lecturers, with three new additions: Senthil Nath, senior tunnel engineer at Geoconsult, Bjørn Nilsen, a professor at the Norwegian University of Science and Technology and Fermín Sánchez-Reyes, associate professor at the National University of Mexico.

The Committee is also pleased to welcome a new organization on-board: GT Ground Engineering from Romania, eager to help promote training in the field of tunnelling and underground space in this country.

Collaboration has been strengthened between the Committee and universities in Thailand and Chile, who have both shown interest in developing specialized Master's, similar to the ITA-endorsed Master's available in France, Italy, Spain and the UK. Members of the ITA-CET university network have also established collaborations with emerging countries. This university network is set to grow in the forthcoming months as further contacts are to be made with universities in Europe and elsewhere.

As you can see, the Committee has had another busy year and 2017 is set to be equally active. Many thanks to those who have been involved one way or another in our activities and season's greetings to you all!

Rober Galler ITA-CET Chairman

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FOR MORE INFORMATION

<http://www.ita-aites.org/en/wg-committees/committees/ita-cet>

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A rising demand for ITA training sessions

by Michel Deffayet (Vice Chairman)

Over the course of 2016, ITA Member Nations have shown increasing interest in ITA training sessions, proving that these short one or two-day courses are considered a valuable means of knowledge exchange for student engineers or young professionals.

In all, 19 requests for training sessions were received this year, a number which has constantly grown since the first sessions back in 2009. Whilst some sessions that were planned unfortunately had to be postponed for logistical reasons, a total of 13 sessions were effectively held over the year, in 10 different countries and on a variety of topics:

- Landslides and Tunnelling, Saudia Arabia, January 2016,
- Rockfall Protection Techniques, Saudia Arabia, January 2016,
- The Use of Excavated Materials, France, February 2016,
- Waterproofing, Chile, March 2016,
- Monitoring and Control in Tunnelling, WTC 2016, USA, April 2016
- Underground Space Use, WTC 2016, USA, April 2016,
- Mechanized Tunnelling in Soft Soil, Argentina, September 2016,
- Risk Management and Contractual Practices, Nepal, September 2016,
- Planning and Design in Conventional Tunnelling, Bhutan, October 2016
- Risk Management in Tunnelling, Malaysia, November 2016
- Health, Safety and Logistics in Tunnel Construction, Chile, November 2016
- Tunnelling in Soft Soil, Mexico, December 2016
- Mechanized Tunnelling, Challenging Case Histories, Italy, December 2016



Training session in Nepal, September 2016

A key factor for the success of these training sessions is the ability of the ITA-CET Committee to tailor the course content to meet Member Nations' specific requirements. Whilst a "portfolio" of ready-made programmes now exists for around twenty different topics, the organizing Member Nation is free to ask the Committee to adjust a



Image courtesy of Barun patra@freemove.com

programme, so as to cater for issues that are specific to that particular country. Requests are also considered for topics that are not covered to date in the portfolio.

Another factor that has led to the success of these sessions is the quality of the lecturers, chosen by the ITA-CET Committee. The Committee now has a list of over 120 lecturers from a wide variety of backgrounds who have expressed their interest in participating as speakers in ITA training sessions. Feedback from participants consistently shows that the experience and competency of ITA lecturers, who are internationally recognized as experts in their field, is highly appreciated.

Of course, none of these training sessions would be possible without the help of the ITACET Foundation, with whom the Committee collaborates on a daily basis. The Foundation takes care of the organizational aspects of training sessions and helps emerging countries to fund these sessions, which would otherwise not be possible.

Next year is set to be equally productive for both the ITA-CET Committee and the ITACET Foundation, with discussions already underway on future training sessions in Brazil, China, Chile, Dubai, Poland and Switzerland. In addition, the Committee will be working with the organizers of the WTC 2017 (Bergen, Norway), in order to prepare the programme of the two-day training session that has become a traditional part of the congress. This next WTC training session will deal with "Excavation and Support in Soft Ground Conditions".

If you are interested in taking part in our training sessions as an ITA lecturer, please don't hesitate to contact us at the address indicated on the cover of this issue.



The ITA-CET Committee General Secretary (left) with the ITA lecturers and several participants of the training session in Kuala Lumpur, November 2016



13
**ITA training
sessions in
2016**

4
continents

**Over 700
trainees**

76
lecturers

12
topics

When East meets West: Austria and India cooperate to train future engineers

By Robert Galler (Chairman)

A Memorandum of Understanding was recently signed between the MIT Pune, India and the Montanuniversität Leoben, Austria.

This MoU follows a year of preliminary works between the two universities. On the 4th and 5th of July, the Indian delegation was able to see the full extent of Austria's tunnel building knowledge for itself, over the course of a two-day visit.

In addition to several lectures at the Montanuniversität, the programme included a visit to the Fröschnitzgraben construction site of the Semmering Base Tunnel and the construction sites Ahrental and Wolf II of the Brenner Base Tunnel.

In the near future, India intends to considerably expand the infrastructure of this huge emerging country. An extraordinary number of underground constructions (including subways, road and railway tunnels as well as underground caverns and tunnels for hydroelectric power stations) are to be built. The construction of these numerous and varied underground structures requires appropriately skilled engineers, who are now able to benefit from training, thanks to the support of the Montanuniversität, Leoben, Austria.



Robert Galler, Montanuniversität, Austria, (pictured centre) with the Indian delegation from MIT Pune (July 2016)

The Committee says farewell to a valued member

by Kristen Drouard (Administrative Secretary)

It was with deep regret that the ITA-CET Committee's Steering Board said farewell to a highly valued member during its meeting in Lyon on 20th September.

As leader of Activity Group 2, which is focused on training and education for professionals, Volker Wetzig was involved in numerous actions aimed at identifying and meeting training requirements within the tunnelling industry.

Volker notably acted as the ITA-CET Committee's liaison member with the ITAtech

Committee, with whom he worked to develop the concept of Deminars (training sessions which are a mixture of a live demonstration and a seminar).

He was also involved in the ITA endorsement of the EFNARC Nozzleman Certification Scheme and pushed for the development of an ITA Training Pass which would provide mutual recognition of ITA-endorsed training courses within the tunnelling industry, based on a common standard.

Volker left his position at the Hagerbach underground test gallery in October and will unfortunately no longer be able to continue his

work for the ITA-CET Committee, whose members wish him all the best in his new activities.



Volker Wetzig: leader of Activity Group 2

A new European training and research facility

by Robert Galler (Chairman)

Tunnel construction methods are just one of the numerous elements of safe and cost-efficient underground infrastructures. The safe operation of underground facilities is of utmost importance. With this in mind, the Austrian Ministry of Science, the Ministry for Transport, Innovation and Technology and the province of Styria approved the construction of a research, development, education and training centre for tunnelling: *ZaB – Zentrum am Berg* earlier this year. This facility, whose construction began in the summer of 2016, will facilitate research, training and education for the construction and operation of underground facilities as well as for deep drilling rigs for the oil industry. It will also serve as a training centre for emergency services and for maintenance and repair personnel.

Until now, it was seldom possible to conduct tests on underground construction methods, materials and safety equipment (from tunnel ventilation to extinguishing systems) under realistic conditions. Laboratory tests are limited and even tests in existing tunnels cannot represent actual catastrophe scenarios. Tests in existing tunnels are also laborious and expensive since the tunnel has to be closed for the test and traffic diverted. Additionally, the fire load in a tunnel test has to be limited or else the tunnel would be damaged.

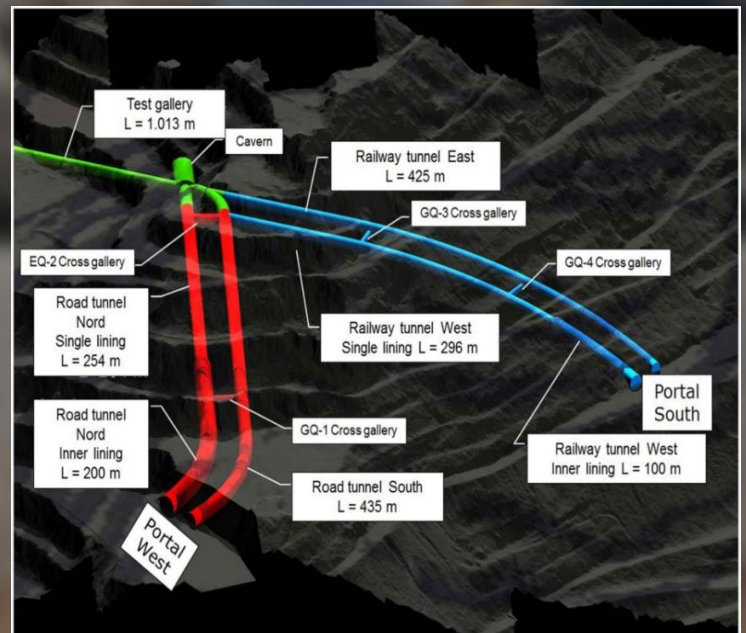
The *ZaB-Zentrum am Berg* in Austria will comprise an underground tunnel system solely for research and training purposes. Altogether five tunnels are planned in full operation – ideal conditions, not only for researchers but also for a wide range of emergency service organizations and industries.

At an altitude of about 1,000 m, two railway and two road tunnels are under construction, with a fifth tunnel to be used purely for test purposes. This will be a twin-bore system. The standard cross-section of the road tunnel sections is based on the Austrian Gleinalm Tunnel. In the rail tunnels, tracks will be laid in order to create a realistic scenario and also to simplify the delivery and removal of test objects.

Altogether, 3 km of tunnels will pass below the highest point of the Erzberg mountain, the Erzbergspitz, and there will also be sections with less overburden, to ensure that tunnel sections with various local conditions can be investigated. Students will be involved in the works from the start. Providing firsthand experience of what happens when a tunnel is built will offer the

ideal basis for understanding construction methods. Practical work at the *ZaB-Zentrum am Berg* is already fixed to be part of the course at the Montanuniversität in Leoben.

Scientists from other fields have already expressed interest in using the tunnels. Researchers of the TU Graz, for example, intend to test existing and new ventilation concepts. The *ZaB-Zentrum am Berg* is ideal for the investigation of the propagation of gases and the necessary safety equipment. The effects of climate changes on tunnels, such as heavy rain or mudflows, can be instrumented and measured, which can also help the further development of rockfall protection systems. Geothermal energy could be used to keep tunnel portals free of ice in the winter. 50 companies have also already shown interest in research in the mountain, with project ideas ranging from civil engineering to information technology. There will also be a training centre in the ZAB where crisis situations like tunnel fires can be experienced under realistic conditions in order to be better prepared for a real incident.



ZaB-Zentrum am Berg, the construction of which started in July 2016

Malaysia: training tomorrow's manpower

by Claude Berenguer (Secretary General)



MMC-Gamuda's Tunnelling Training Academy Malaysia

Following the ITA training session on "Risk Management in Tunnelling" held in Kuala Lumpur on 13th -14th November 2016, the ITA-CET Committee's Secretary General was invited to visit [MMC-Gamuda's Tunnelling Training Academy](#). This training facility, which opened in Kota Kemuning in 2011, was initially set up to meet the need for highly skilled manpower for the Mass Rapid Transit (MRT) project in the Klang Valley.

Following the launch of the MRT project and realizing that Malaysia did not have a sizable pool of workers sufficiently trained in modern tunnelling and underground construction techniques, the company MMC-Gamuda took the initiative to upgrade the knowledge, skills and performance of local workers in the industry.

As well as training Malaysian workers, in early 2014 the Academy established a partnership with the Delhi Metro Rail Corporation (DMRC) in order to train engineers on skills and techniques required within major metro projects in the Indian capital. The Academy, which has the capacity to take in 200 trainees at any given time, therefore aims to play an important role in hands-on underground construction training in this area of the globe.

The visit to the Academy was kindly organized by Mr Ooi Lean Hock, Head of the Geotechnical Design Department at MMC-Gamuda and Mr Ooi Teik Aun from IEM (Institution of Engineers, Malaysia). The tour of the site provided an overview of the available equipment, which includes a TBM cutter head for tool change and maintenance training, an erector simulator for tunnel segment ring building, a shotcrete nozzleman training unit, a testing unit for annular gap filling (grouting), a testing unit for foam production and systems and devices for training in tunnel data acquisition and analysis.

There are three different training programmes offered at the Academy: "skills", "vocational" and "specialist" training, for trainees of varying academic backgrounds. The skills programme is for school leavers, while the vocational programme is for those with some experience in various engineering fields. The specialist or advanced training programme is designed for qualified engineers.



C. Berenguer, H. Wagner, O. Lean Hock and O. Teik Aun

So far, the Academy has trained several hundred "graduates" in fields such as data management, material testing, tunnel ring building, and shotcrete application. The dropout rate has been minimal.

It is hoped that over the next few years, the Academy will contribute towards progressively improving the tunnelling know-how of the Malaysian workforce, thereby reducing its dependence on international expertise.



The TBM cutter head used for tool change and maintenance practice

Focus on the Italian specialized Master's in Tunnelling and Tunnel Boring Machines

by Daniele Peila (Master's course director)



Students of the 10th edition of the Master's

The need for experts in tunnelling is rapidly increasing throughout the world. The specific qualifications required cannot be provided by traditional first and second level university degrees and call for a specially designed course. The Politecnico di Torino has therefore developed a Specialized Master's in Tunnels and Tunnel Boring Machines which has been endorsed by the ITA (International Tunnelling and Underground Space Association).

This university course merges theory-based lectures with lectures and presentations by renowned experts from construction companies, TBM manufacturers and design companies, in order to provide the multidisciplinary knowledge that is required to work in the tunnelling sector.

Applicants for this one-year, full time course must have at least a 5-year (10 semesters) university background and have a Master of Science (or equivalent) in one of the following fields or related subjects: civil engineering, environmental engineering, engineering geology or geology. Students are also required to have good knowledge of written and spoken English.

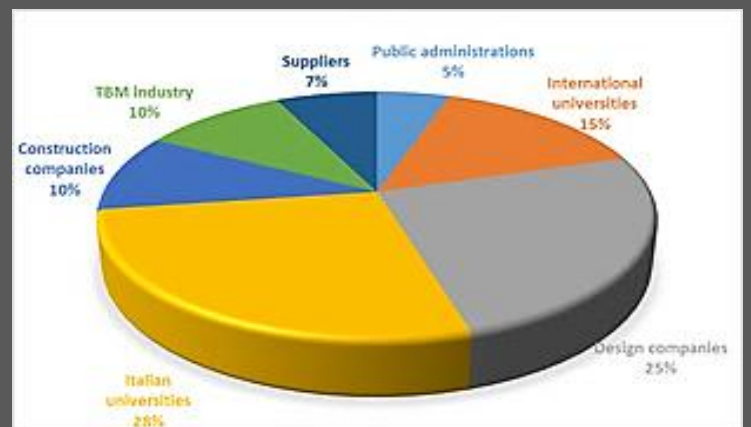
The course starts in January each year, with lectures given up until July. Site visits are regularly organized throughout the year, which enable students to see theoretical aspects put into practice in real-life projects. This year for example, the students visited the French side of the Frejus Exploratory Tunnel and had the chance to tour round the segmental lining factory and the underground cavern for the assembly of an NFM single shield rock TBM. They also visited the Herrenknecht factory in Schwanau, Germany, where EPBs, mixed shield TBMs and rock TBMs are being built for future projects. As student Rodrigo Winderholler explains: "Seeing the separate TBM components and studying them in detail is fundamental to understanding their working principles and functioning".

In July, students then start an internship (250 h) until November, which takes place on a tunnel construction site or in a design company. The Master's course director assigns the job site based on an interview with the students. On the basis of their internship work, students then prepare a written report that is discussed in the final exam.

The subjects covered in the Master's are grouped into nine modules. The corresponding teaching hours and ECTS can be seen in the table below.

SUBJECT	ECTS	LECTURES HOURS
Tunnel design and construction method	8	80
Rock Mass Characterization. Geo investigations and risk assessment	6	60
Tunnel supports	5	50
Numerical design	3	30
General aspects of mechanized tunnelling and Hard Rock TBMs	8	80
Soil mechanics tunnelling	6	60
Plants and microtunnelling	3	30
Contractual and legislative aspects, work sites management, quality	4	40
Safety and environmental issues of work sites	3	30
Final report	4	100
Internship	10	250
TOTAL	60	810

The pie chart below shows the background of course lecturers.



In addition to the final exam, three other written exams are taken during the course of the Master's:

- Exam 1, after modules 1 to 4,
- Exam 2, after modules 5 to 7
- Exam 3, after modules 8 and 9.



Students at work in the soil mechanics laboratory

The students who follow the Master's course are of interest to design firms, construction companies and tool suppliers, as well as TBM manufacturers. Public administrations and tunnel owners can also benefit from the skills acquired during the course.

“A programme that gives students access to some of the best engineering minds in the field of underground construction.....”

As past student Luis Piek explains: "The Master's in Tunnelling and Tunnel Boring Machines at the Politecnico di Torino was an excellent opportunity for me. It provided a well-balanced mix of academic professors, engineering consultants, and tunnel contractors in an intimate environment that was unique in the world. Professor Peila and Pelizza have built a programme that gives students access to some of the best engineering minds in the field of underground construction. Since graduation, I have utilized the programme to continue my tunnelling career. I would recommend this Master's course to other engineering students who want to become professional engineers, contractors, or owner representatives in the field of tunnels and tunnel boring machines".

This Specialized Master's has now reached its 10th edition, which comprised 15 students. Claude Berenguier, Secretary General of the ITA-CET Committee sat on the panel of examiners who listened to the students defend the following theses on the 6th December:

- "Mechanized and conventional tunnelling: Pros and cons. The case of the Catania metro Project" (A. ALKHARASHI).
- "Two-component backfill grout system in the Follo Line project case study" (A.M. ALVAREZ ORTIZ).
- "Implementation methodology for the investigation and location of karstic voids and their tackling in an urban environment" (I. ANAGNOSTOPOULOS).
- "Common problems and resolutions in tunnelling and underground projects. The Forrestfield airport link case study in Australia" (A. ANDERS).
- "TBM Performance: AI -hayer wastewater conveyor" (A.N. BUD)
- "Drill and blast excavation of main tunnels and raise boring of a shaft in a talc mine" (D. CORAGLIOTTO).

- "Structural aspects regarding TBM assembly and annexed equipment" (C.F. FAVERIO).
- "Tube-à-manchette (TAM) grouting: Turin Metro line 1, 3rd section Lingotto-Bengasi (L.GUERINO).
- "Analysis of drill-blast cycle times for the USBRL tunnel in the Himalayan mountains" (N. KUMAR).
- "Geognostic Maddalena Tunnel: TBM performance analysis in hard rock" (L. GUERINO).
- "Geotechnical considerations in tunnel design for the renewal of a hydroelectric power plant" (G.H. RACIOPPI).
- "Risk management analysis for soft ground TBM type selection" (C.F. FAVERIO).
- "TBM performance analysis in the Xe-Pian Xe-namnoy project"(S. SON).
- The assembly of two Herrenknecht EPB TBMs on the Novi Ligure job site for the Terzo Valico project" (G. STEFANO).
- "Building information modeling applied to underground structure design" (R. WINDERHOLLER).

If you would like to obtain more information on the course, please visit the [official web site](#).

A [blog dedicated to the 2015-2016 edition](#) is also available and provides an insight into the course from a student's point of view.



Above: student Rodrigo Winderholler with the course director.

Below: the students of the 2015-2016 edition proudly show off their degrees.





Thailand plans to develop a post-graduate Master's in Tunnelling

By Claude Berenguer (Secretary General)



From left to right: Messrs. Auttakit, Siripong, Nintakath, Berenguer, Komsan, Noppadol, Wagner, Aye and Chadin

One of the ITA-CET Committee's missions is to contribute to the development of Master's courses in tunnelling throughout the world. The Committee was recently requested to help in the creation of a post-graduate Master's in Tunnelling in Bangkok, Thailand.

The Committee willingly agreed to take on this task and nominated Harald Wagner (based in Thailand) and Claude Berenguer to initiate corresponding actions.

A first meeting was organized at KMITL (King Monkut's Institute of Technology Ladkrabang) on 17th November 2016. Amongst those present were the ITA-CET Committee representatives, the main potential actors from KMITL and TUTG (Thai Underground and Tunnel Group and an ITA Member Nation Representative), in addition to

Dr. Noppadol from the AIT (Asian Institute of Technology). The main conclusion of the meeting was the formal decision to create the "Professional Master's Degree Programme in Tunnelling and Underground Facilities". The programme would run over 4 semesters: 2 semesters on academic aspects, 1 semester on an internship (on-the-job training) and 1 semester on the preparation of a thesis.

It is hoped that the course will start to run in August 2017. A draft curriculum will be prepared before the end of 2016, in order to start marketing and attract potential ASEAN students and sponsoring companies in early 2017.

These decisions were approved by KMITL President Dr. Suchatvee Suansawat, as well as by TUTG President, Dr. Sramoon Aphichat.



Pictured centre: Dr Suchatvee, President KMITL, 4th from right: Sramoon Aphichat, President TUTG

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Noppadol Phien-wej (AIT)

KMITL representatives:

Nunthawath Jarasrungleungdej & Harald Wagner

TUTG representative:

Auttakit Asanprakit

Secretary of the Committee:

Siripong Nakthong

Tunnelling industry and consulting representatives:

ZawZaw Aye & Siripong Nakthong

ITA-CET Committee representatives:

Harald Waqner & Claude Berenquier