



**ITA-CET**  
Committee on Education and Training

# Newsletter

Issue 11

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In this issue



Professors in tunnelling gather in Turin

Dear ITA friends,

Training remains one of the ITA's core goals and since its creation in 2007, our Committee has strived to assist Member Nations in educating and training tunnelling engineers around the world. This is primarily achieved by working hand-in-hand with individual countries to develop short courses that are tailor-made to tackle the specific issues faced within the scope of ongoing or planned underground projects.

The last couple of years have seen a steady drop in the number of requests for these short courses, which can be explained by political instability in certain regions and growing financial constraints for many. It is important, however, that Member Nations continue to pursue their training efforts in order to meet society's increasing need to go underground. Global awareness of the need to urgently tackle climate change will only heighten this need to "dig deep" over the coming years. In particular, Member Nations need to be ready for the modal shift which is already in motion in many countries, with an increasing number of metro, rail and hyperloop projects for the transport of both people and goods.

ITA-CET endeavours to develop training programmes that reflect the current trends and issues in tunnelling, working hand-in-hand with Member Nations and the ITACET Foundation to organise events around the globe. We encourage Member Nations to discuss their training requirements with us and to benefit from our highly knowledgeable lecturers, many of whom are prominent figures within the ITA community and world-renowned in their field.

In addition to developing short courses, the Committee also promotes education through its university network, comprising professors in tunnelling from around the world. In this issue we take a look at the first ITA-CET meeting of European tunnelling professors, held in Italy (see photo above) which was coupled with a conference enabling PhD students to present their research work.

Finally, as 2019 draws to a close, we would like to extend our season's greetings and wish you all health, happiness and success for 2020.

**Rober Galler: Committee Chair**

**Michel Deffayet: Vice chair**

## Another 300 trainees across the globe

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FOR MORE INFORMATION

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

[ita-cet.secretariat@developpement-durable.gouv.fr](mailto:ita-cet.secretariat@developpement-durable.gouv.fr)

# Another 300 trainees across the globe



Despite a reduction in the number of requests for training sessions in comparison to previous years, over 300 engineers have benefited from ITA-CET training events in 2019. These events, organised in collaboration with ITA Member Nations and the ITACET Foundation were held in 3 different continents, with Africa showing increasing interest in developing its training efforts.

The first sessions to take place this year were organised as pre-congress events within the scope of the WTC in Naples. The topics chosen by the WTC organisers were "Tunnelling 4.0" and "Communication and Stakeholder Engagement". As we reported in our previous issue, these events met with considerable success, attracting over 110 participants from 25 countries, who received a certificate of participation as seen in the photo above. The feedback was highly positive, with the session "Tunnelling 4.0" sparking particular interest from across the globe. The aim of this session was to highlight some of the most advanced aspects of digital technology applications in the design and construction of underground facilities. The programme, developed by the Committee, focused notably on Building Information Modelling (BIM) and automation in the design and construction of underground works.

The interest that this training session attracted led the Argentinian tunnelling association (AATES) to request a one-day session on this very same topic within the scope of its 9th Tunnelling and Underground Space Days. This is a good example of how an ITA-CET training session can be combined with a wider event, such as a national seminar or conference. Around 140 participants attended the session in Buenos Aires on 24th September, showing that there is an increasing awareness of the need for training on BIM in particular. Lecturers included top experts in the field, such as Jurij Karlovsek, the animateur of ITA WG22 on Information Modelling in Tunnelling.



Tunnelling 4.0, Naples May 2019



Tunnelling 4.0, Argentina, September, 2019



Argentina, September 2019

Over recent years, African countries have increasingly developed an interest in the activities of the ITA. Nigeria joined as a Member Nation in 2018 and Kenya in 2019. Both countries have realised the importance of developing training and education actions and have taken advantage of the services offered by both the ITA-CET Committee and ITACET Foundation. The Nigeria Tunnelling Association (NTA) has pinpointed education as one of the key pillars of its strategic plan. After an initial seminar on "Underground Space Use" requested in 2018, the NTAs asked ITA-CET to establish the programme for the first day of a two-day seminar entitled "Developing resilient cities of the future through the integration of tunnelling and underground space use", held on 16<sup>th</sup>-17<sup>th</sup> October 2019. This first day presented the main tunnelling methods along with project organisation and risk management issues. Key ITA members such as Jenny Yann (ITA president), Olivier Vion (Executive Director) and Arnold Dix (Executive Council member) were present at the event (see photo right).



Nigeria, October 2019

Kenya has also pursued its training efforts, requesting a two-day seminar entitled "Introduction to tunnelling – From design to construction", held on the 4<sup>th</sup> and 5<sup>th</sup> December. After a first session in 2018 dedicated to underground space use, this 2019 session aimed to take a deeper look at tunnelling projects. It notably aimed to present the main tunnelling methods, along with organisational and contractual aspects to be taken into account in an underground project. The session attracted around 80 participants, with lecturers including key ITA figures such as Lars Babendererde and Gerard Seingre.



Kenya, December 2019

Discussions for training sessions in 2020 are underway with several Member Nations. India, Chili, Colombia, Mexico and Thailand have all expressed interest and it is hoped that others will also follow suit. The WTC in Malaysia will of course include the traditional ITA-CET short course which will focus on "Innovations in Tunnelling – Geotechnical Engineering and Project Management". Member Nations interested in organizing a training event/seminar in collaboration with ITA-CET are invited to contact the secretariat:

[ita-cet.secretariat@developpement-durable.gouv.fr](mailto:ita-cet.secretariat@developpement-durable.gouv.fr)

# The ITA-CET Steering Board meets in Turin



advantages of making use of ITA-CET to help organise a training course or seminar: ITA endorsement of the event and use of the ITA logo to help promotion, not forgetting the quality of the lecturers, many of whom are prominent figures within the ITA community and world-renowned in their field.

The Steering Board then went on to discuss training for blue-collar workers and plans to develop a TBM driver certification scheme. The idea is to provide an ITA-endorsed training scheme combining theoretical classes and practical training given by experienced TBM experts (see our article overleaf for details).

Another topic on the agenda was the development of on-line learning

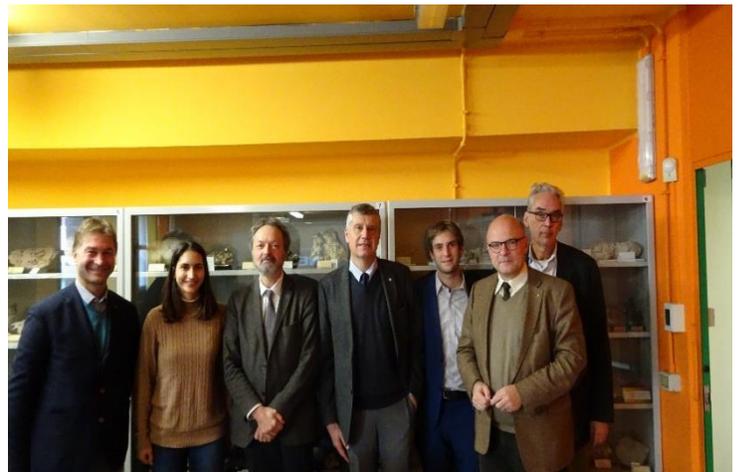
material and the production of short video lessons in collaboration with ITA Working Group animators. These video lessons will provide information on a variety of topics linked to the activities of the ITA Working Groups (for example mechanized tunnelling). The aim is to provide essential information to viewers and to encourage them to consult ITA WG publications for further information. These videos will be recorded at Politecnico di Torino (Italy) which has a communications department with the necessary filming facilities and skills.

The next Steering Board meeting will take place in Lyon on 4<sup>th</sup> March 2019.

The ITA-CET Steering Board met in Turin, Italy, on 5<sup>th</sup> December to exchange on work progress and future actions. The meeting kicked off with a look at the recent training sessions organised in collaboration with Argentina, Nigeria and Kenya, with the help of the ITACET Foundation. Discussions then naturally moved on to the Committee's relations with ITA Member Nations and how these relations can be strengthened. Despite efforts made during the WTC General Assembly in Naples to promote the joint activities of the ITA-CET Committee and ITACET Foundation, Member Nation requests for training assistance have undeniably dropped over the last year. There are several explanations for this:

- the unstable political context in some regions,
- the renewal of certain Member Nation representatives, with an insufficient awareness of ITA-CET activities amongst newcomers,
- growing financial constraints for many organisations, coupled with the feeling amongst some Member Nations that training events provided by the ITA should be cost-free,
- the increasing know-how of certain Member Nations who consider that they have now developed the necessary knowledge and skills for their projects.

Although some factors cannot be changed, it was agreed that the Committee needs to work on establishing stronger relations with new Member Nation representatives. In particular, the Committee will urge Member Nations to consider organising an ITA-CET event within the scope of a wider event at a national level. This can notably help to lower organisational costs. Member Nations also need to be reminded of the



# TBM driver certification scheme



Example of a TBM simulator

The construction of tunnels and other underground structures requires highly skilled persons on all levels. When it comes to mechanized tunnelling, industry experts working in ITA WG14 and ITAttech have underlined the fact that one of the primary factors influencing the result of a TBM excavation is the know-how of the TBM driver (pilot).

In an era of increasing digitisation, the use of simulators for TBM driver training has been attracting growing interest over recent years, with various companies developing equipment that can recreate the geologies and operating conditions encountered out on the field. These simulators have the advantage of helping trainee drivers to acquire the correct reflexes for dealing with a wide variety of situations that they may come across in real-life excavation.

However, knowing how to operate a TBM is not the only skill that TBM drivers need to master in order to perform their tasks correctly. Knowledge of aspects such as hydrogeology, geotechnics and support technologies are vital if they are to know how to weigh up risks and

handle critical situations. Efficient communication between TBM drivers and construction stakeholders is also of prime importance and can only be guaranteed through a common language and understanding of the requirements and risks inherent to underground construction projects.

The ITA-CET Committee has therefore decided to develop a TBM driver certification scheme, following an initiative from ITA WG14 and the ITAttech Activity Group on Excavation (SubAG TBM Service Guideline). This scheme will adopt a holistic approach, by encompassing classroom teaching (including viewpoints from designers, contractors, owners and suppliers), e-learning, training on a simulator and supervised work experience. The aim is to provide an independent and standardized means of assessing TBM drivers, leading to recognised ITA certification that should ultimately improve the overall quality of TBM based works.

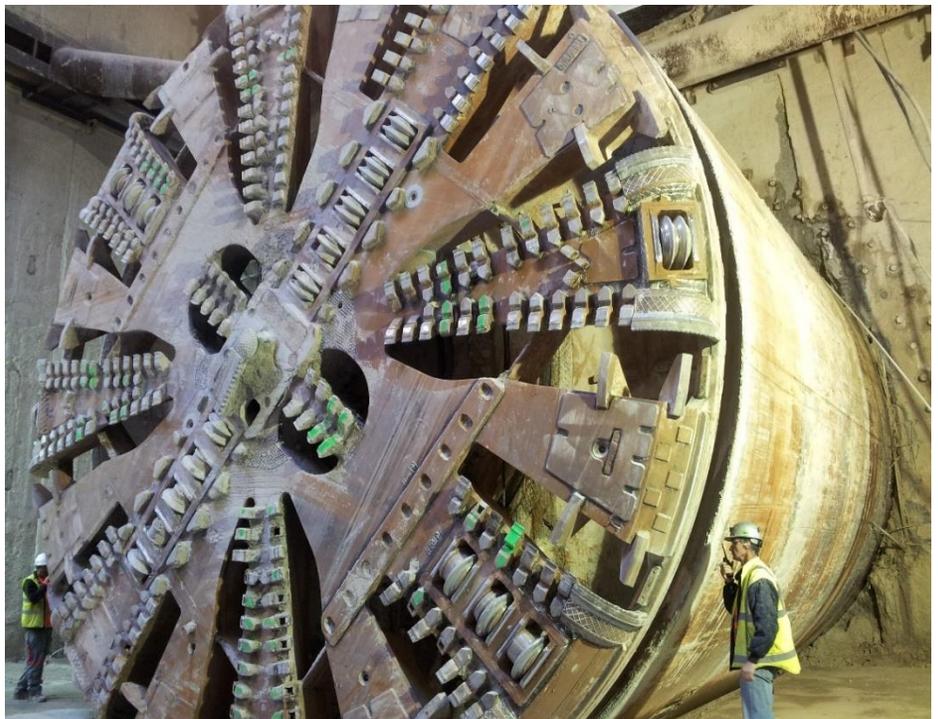
This certification scheme will be offered to future operators of TBMs as well as those already in the profession, who wish to deepen their knowledge of how to handle a TBM under various demanding circumstances. Only approved TBM simulators that respect pre-defined criteria will be used on the scheme and the trainers will be experienced TBM experts. The final training in a real TBM driver's seat will be gained under the supervision of experienced drivers.

To gain the final ITA TBM "driving license" for a specific TBM type (in the form of a registered certificate), the applicant will need to successfully complete different modules (theory-based elements with e-Learning and lectures, online exams, simulator training and assessment, oral assessment and proven working experience).

The idea is to enable interested training entities around the world to deliver the courses, provided that they respect the rules of the certification scheme. Quality audits will be conducted by an independent, external entity.

Pedagogical aspects will be the responsibility of the ITA-CET Committee (AG2), while administrative aspects will be dealt with by the ITACET Foundation.

A first one-week pilot course is envisaged for mid 2020 at the Hagerbach Test Gallery in Switzerland. It will be conducted by experienced TBM experts and can be tailored for specific TBM types. The detailed syllabus of the ITA TBM Driver Certification Scheme will be published after final approval by the ITA-CET Committee Steering Board and implemented in collaboration with ITACET Foundation.



# Bringing together tunnelling academia

Fostering relations between tunnelling academia is the prime goal of the ITA-CET university network, which was set up in 2009 as an exchange platform for universities offering Master's degrees in tunnelling and underground space. This network currently comprises 28 higher education establishments from 20 different countries around the world.

Whilst membership continues to rise every year, ensuring that members do effectively "network" has proven quite complex. The global scale of the network means that it is difficult to physically bring all its members together on a regular basis. An ITA-CET University Network Group was set up on LinkedIn at the end of 2017 in order to facilitate exchanges amongst members, but has not met with the success that was hoped for.

Meetings organized at a regional level would appear more practical to implement and the Committee Steering Board therefore took the decision to organize a first regional event in Europe on 5<sup>th</sup>-6<sup>th</sup> December 2019. The aim of this two-day event was to bring together European tunnelling academia and facilitate exchanges on current research work, tunnelling courses on offer and exchange possibilities for both professors and students. It was hosted by the Politecnico di Torino in partnership with the Italian Tunnelling Society (SIG).

The first day consisted of a meeting of professors in tunnelling and underground space representing the following universities and higher education establishments: ETH Zurich (Switzerland), Ruhr-Universität Bochum (Germany), University Sapienza of Rome (Italy), University of Bologna (Italy), Politecnico di Torino (Italy), University of Molise (Italy), Politecnico di Milano (Italy), Montanuniversität Leoben (Austria), University of Leeds (United Kingdom), ENTPE (France), Norwegian University of Science and Technology. Surprisingly very few participants knew each other and in this sense the meeting was a success even before it began, as it enabled them to at last meet their peers from elsewhere in Europe!





Disk cutter tests at Montanuniversität Leoben

numerous research areas such as the expansion of EPB applications with foam conditioned soils (foam injection unit seen below) or Life Cycle Costing models (LCC models) for underground infrastructure. It notably hosts the Collaborative Research Center "Interaction Modeling in Mechanized Tunneling" (SFB 837), set up by the German Research Foundation. As explained by Prof. Markus Thewes, this centre has four main fields of research: subsoil and tunnel boring machines, process modelling, lining systems and support, information management and risk modelling. Examples of research projects within these fields include "slurry infiltration and soil conditioning in hydro and EPB shield TBMs", "computational simulation models for tunnel planning and real-time steering of construction processes", "multi-level design of flexible tunnel lining systems for large ground deformations" and "tools enabling transparent and participative planning in urban tunnelling".

The Sapienza University of Rome (Italy) has been examining soil conditioning processes for EPB-TBM tunnelling and the numerical modelling of mechanized excavation (stresses in the lining, soil-shield-lining interaction). Prof. Salvatore Miliziano explained how the professors, researchers, engineers and technicians at this university have also founded GEEG (Geotechnical and Environmental Engineering Group), a startup aimed at sharing the knowledge acquired through research in the field of chemical treatment of soils with contractors and engineering and chemical companies. An example of research conducted within the scope of this startup is the study of "the abrasion of the TBM cutter heads based on the experimental evaluation of the properties of soils and excavation tools".

Research fields at ETH Zurich (Switzerland) deal with classic rock pressure theories (squeezing rocks, swelling rocks), stability and deformation issues of TBMs in rock or soft ground, and geotechnical auxiliary measures. Prof. Georgios Anagnostou gave an overview of some specific topics, which include "shield jamming in creeping/consolidating ground", "tunnel face stability in deep tunnels through squeezing ground", "swelling control in tunnelling by rock heating" or "the geomechanics of opalinus clay".

Prof. Daniela Boldini (currently at the Sapienza University of Rome) presented the research work conducted in her previous position at the University of Bologna (Italy). Topics focused on shallow tunnels include "the numerical modelling of tunnel-induced displacements and damage on masonry", whilst activities connected with deep tunnels concern the "numerical modelling of blast-induced structural damage" and an "analysis of acoustic emissions from flat-jack tests for rock burst predication".

In the UK, research projects at the University of Leeds include "tunnel cost estimation and time overruns in mega projects", "high-speed railway-induced vibrations around tunnels" and "underground space and urban sustainability" as Prof. Chrysothemis Paraskevopoulou explained.

Robert Galler, Montanuniversität Leoben (Austria), presented the ZaB (Zentrum am Berg), a large-scale underground research, development, training and education centre, which has life-size road and rail tunnels as well as a test tunnel, enabling research and development actions as well as the training of emergency services under realistic 1:1 scale underground conditions. The university has notably been conducting research on disc cutter force management (see photo above), the behavior of geomaterials and the behavior of concrete and shotcrete, with the development of new laboratory tests (direct tensile tests, torsion tests and tests for the predication of penetration).

The tunnelling and underground space laboratory of the Politecnico di Torino is headed by Professor Daniele Peila and is specialized in the study of machines and procedures for mechanized full-face excavation, including soil and rock mass supports and reinforcements. It notably develops innovative test devices and prototypes designed to assess soil conditioning and wear.

The ENTPE (Prof. Denis Branque), the Politecnico di Milano (Prof. Claudio di Prisco) and the University of Molise (Prof. Carlo Callari) also briefly present their Master courses and various research projects. Lastly, Prof. Bjørn Nilsen from the Norwegian University of Science and Technology (who was unable to be physically present) provided information on ongoing research activities in tunnelling in Norway. We will endeavor to present the work of these universities in a further issue.

After a round table of introductions, the professors were invited to present the research topics currently conducted in their respective establishments and the degree courses that they offer. Some establishments offer Master degrees specifically focused on tunnelling and underground space use whilst others offer courses on wider fields which include modules on tunnelling. Three of the establishments present (Politecnico di Torino, Politecnico di Milano and ENTPE) offer Master degrees that are endorsed by the ITA.

The scope of the research activities presented was truly impressive and it would be impossible to give an exhaustive list in this article, which therefore provides only a few examples.

The Institute for Tunnelling and Construction Management at Ruhr-Universität Bochum (RUB) in Germany is involved in



Foam injection unit at RUB

Of course, no trip to Italy is complete without experiencing the local cuisine and wine! Our Italian hosts kindly organized an informal evening dinner for the professors which enabled further networking. An evening event was also organized for the students attending the PhD conference the next day.



The aim of the second day was to enable PhD students from various European universities to network and present their research work. The event was chaired by Robert Galler (ITA-CET chairman and full professor at Montanuniversität Leoben, Austria), Daniele Peila (full professor at Politecnico di Torino and a member of the ITA-CET Steering Board) and Eugenio Brusa (full professor and chairman of the PhD School at Politecnico di Torino).

The following topics were presented, followed by questions to the students:

- *Numerical investigation of tunnel face stability*, Dimitris Georgiou, National Technical University of Athens, Greece
- *Deep tunnel face stability*, Thomas Pferdekaemper, ETH Zurich, Switzerland
- *Monitoring of cut and cover tunnels*, Flaviu Ioan Nica, Technical University of Civil Engineering Bucharest, Romania
- *Process simulation and interactive alignment planning for TBM tunnelling*, Annika Jodehl, Ruhr-Universität Bochum, Germany
- *The design of the soil conditioning process for EPB-TBM tunnelling*, Diego Sebastiani, University Sapienza of Rome, Italy
- *Two-component backfilling: a laboratory test campaign*, Carmine Todaro, Politecnico di Torino, Italy
- *Automized face monitoring in TBM tunnelling*, Robert Wenighofer, Montanuniversität Leoben, Austria
- *Modelling high-speed railway-induced vibrations around tunnels (ground support)*, Harry Holmes, University of Leeds, UK
- *Impact of tunnel excavation with TBM on piled foundations*, Agathe Michalski, ENTPE, France
- *Optimization of test methods and design of transition zones in unlined pressure tunnels*, Henki Ødegaard, Norwegian University of Science and Technology, Norway.



This two-day ITA-CET event proved a great success and the decision was taken to repeat it next year. It is also hoped that a similar event could be organized in another region of the globe in the future. Any ITA Member Nations that are willing to host an event of this type are invited to make themselves known to the ITA-CET secretariat

