



ITA-CET

Committee on
Education and
Training

Newsletter

Issue 6

May 2017

IN THIS ISSUE

10 years 2007 - 2017



Dear ITA friends,

Since the year 2000, the ITA has identified education and training as one of the most important challenges of the Association and officially established the ITA-CET Committee during the ITA General Assembly in Prague in 2007. The year 2017 therefore marks the tenth anniversary of our Committee which we are proud to say has gone from strength to strength.

In this issue of our newsletter we take a look back at the actions conducted over the last ten years and present the Committee's aims for the near future. One of these aims is to actively collaborate with the ITA Young Members Group, so as to better take into account the training requirements of young professionals and students. Our article on page 6 examines some initial avenues envisaged.

The beautiful city of Bergen, pictured in our cover photo, will host our next Committee meeting which will take place on Monday 12th June, during the 2017 World Tunnel Congress. All ITA-CET Committee members and members of the Committee's regional correspondent network are invited to attend.

Prior to the congress, on the 9th and 10th June, a two-day training course on "Excavation and Support in Soft Ground Conditions" will be held. This course has been jointly organized by the ITA-CET Committee, ITACET Foundation and the WTC (see article on page 5).

The Committee has continued to strengthen its relationship with its regional correspondents throughout the globe and particularly with member nations from South America and Asia, either through the preparation of training session content or through exchanges on existing or future Master's. Recent training sessions organized at the request of Member Nations in these regions show that risk management is considered an increasingly important issue by project stakeholders worldwide. Although still to be fully developed in the tunnelling profession, Building Information Modelling (BIM) is also likely to become a "hot topic" in the future, as our article on page 12 explains.

The ITA-CET Committee has also continued to develop its university network and is gradually gathering additional information on post-graduate academic courses in tunnelling on offer throughout the world. In this issue we take a look at the Master's in Tunnelling and Underground Works at the National Autonomous University of Mexico (UNAM) and the ITA-endorsed Master's at the University of Warwick, England (see articles on pages 9 and 10).

As you can see, the Committee remains active in promoting worldwide education and training in tunnelling. If you would like to actively participate in our actions, please contact us!

Rober Galler : ITA-CET Committee Chairman

Michel Deffayet : Vice Chairman

Ten years of educating tunnelling professionals around the world

A look at the Committee's achievements since its creation back in 2007 (page 2)

Bergen hosts the traditional WTC training course

"Excavation and Support in Soft Ground Conditions" is the focus this year (page 5)

Bringing in young blood

Developing collaboration with the ITA Young Members Group (page 6)

Risky business!

Risk management: an increasing concern for the tunnelling industry (page 7)

The ITA-CET and ITA-COSUF Steering Boards meet in Lyon

The two Committees discuss possible collaboration on training actions (page 8)

Rising to the challenge

Mexico's quest to train a new generation of tunnel engineers (page 9)

Focus on the ITA-endorsed Master's at Warwick University (UK)

A look at the contents of this course (page 10)

Helping Nepal go underground

ITA's contribution to training Nepalese engineers for major infrastructure projects (page 11)

ITA WG22: Building Information Modelling

The development of BIM in tunnelling sparks a need for training on this topic (page 12)

FOR MORE INFORMATION

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

ita-cet.secretariat@developpement-durable.gouv.fr



Ten years of educating tunnelling professionals around the world

by Michel Deffayet and Claude Berenguier
(ITA-CET Committee Vice Chairman and Secretary General)

In the early 2000's, the ITA identified education and training as one of the major challenges that the industry would have to face over the next decades, with the sharp rise in tunnelling projects calling for a marked increase in highly skilled manpower. The Association recognized the increasing importance of sharing knowledge amongst its members, particularly as new ITA Member Nations are often still inexperienced in underground works.

In order to meet this challenge, in 2007 the ITA approved the creation of an ITA Committee for Education and Training, with the aim of implementing a high-level education policy to help train young engineers. The Committee was officially established during the ITA General Assembly in Prague in May 2007 and was the second Committee to be created within the ITA. This year therefore marks the Committee's tenth anniversary and is an opportunity to look back on the Committee's achievements since its beginnings.

The work of the ITA-CET Committee stemmed from the activities previously carried out by ITA Working Group 18 on "Training". Indeed, during the first years of the Committee's existence, the two entities worked side by side. This WG was eventually integrated into the ITA-CET Committee in 2010.

One of the main roles of the Committee is to prepare the contents of training events organized and promoted by the ITA at the request of a Member Nation. These events usually take the form of short one or two-day courses, although the Committee is open to requests for other types of events such as workshops or webinars.

The primary target audiences of these short courses are young engineers from developing countries and countries in transition. However, any ITA Member Nation can request the Committee's help to develop the content of training events.

After the organization of initial

training events in 2007 and 2008, it soon became clear that as an association, it would be difficult for the ITA to bear the financial risk of organizing such courses and for this reason, in 2009 the ITA General Assembly officially established the ITA-CET Foundation. This organization is financially autonomous from the ITA and relies on generous donations to help finance short courses in countries that would otherwise not be able to benefit from such events.

“To date, short courses have been organized by the Committee and Foundation in 24 different countries around the world.”

The two entities have quite distinct roles. The ITACET Foundation handles the organizational and financial aspects of these courses, whilst the Committee prepares the course programmes in relation with the host Member Nation and carefully chooses the lecturers, many of whom are renowned experts within the ITA.

The close collaboration with the ITACET Foundation is one of the main reasons for the success of these courses and the Committee is proud to have contributed to the training of over 6,000 students and young professionals over the last ten years. Requests for courses from ITA Member Nations are on the increase, particularly from countries in South America and Asia, where numerous major tunnelling projects are planned or underway. To date, short courses have been held in 24 different countries around the world.

Since its creation, the Committee has established draft course programmes on 20 different topics, from broad issues such as conventional tunnelling or mechanized tunnelling, to more specific issues such as numerical simulation. For each topic, the programme can be adjusted to meet specific requirements of the Member Nation. In this respect, the training events are tailor-made. The Committee is continuing to develop additional programmes as new issues and practices arise in the industry. Last year for example, a programme on "Sustainable Tunnelling" was created.

During the ITA-CET Committee meeting held in London in 2013, Robert Galler, representative of ITA-Austria and Professor in sub-surface

“The Committee is proud to have contributed to the training of over 6,000 students and young professionals”

engineering at the Montanuniversität, Leoben, was elected as the new Committee chairman. Michel Deffayet, from the Centre for Tunnel Studies, France, also joined the Committee in the same year. This change in chairmanship coincided with the creation of four Activity Groups:

- Activity Group 1 deals with training and education for Member Nations, and notably the preparation of short courses, as mentioned above,
- Activity group 2 aims to ensure that industry requirements in terms of training are met,
- Activity Group 3 is responsible for creating a university network and fostering communication between its members
- Activity group 4 is responsible for gradually developing e-learning as a form of training.



Michel Deffayet, current Vice Chairman and Robert Galler, Chairman since 2013

Since their creation, these Activity Groups have been highly active. In addition to organizing short courses for Member Nations, Activity Group 1 has established a network of regional correspondents who are interested in establishing a durable partnership with the ITA-CET Committee. The aim of this network is to communicate on existing training opportunities and further training requirements at a local level, in addition to developing training strategies and packages, through international co-operation when possible. This network currently comprises 20 correspondents based in Chile, Brazil, China, Thailand, Malaysia, Mexico, Vietnam, Argentina, Croatia, Myanmar, Bhutan and Nepal. These correspondents do not need to be official members of the ITA-CET Committee.

Activity Group 2 collaborates with industry representatives, notably through the ITAtech Committee, which has a representative within the ITA-CET Committee Steering Board. This collaboration has led to the development of Deminars (training sessions which are a mixture of a live demonstration and a seminar), which provide participants with a more hands-on approach than traditional academic courses. The work of this Activity Group has also led to the ITA endorsement of the EFNARC Nozzleman Certification Scheme. This scheme offers certification to experienced nozzlemen who can demonstrate their technical knowledge and practical skills. The scheme operates through national examiners and is progressing well with certified examiners and nozzlemen from across North America, South America, Europe, South Asia and Australasia.

Activity Group 3 has focused on developing a university network, comprising professors from universities that offer Master's or Doctorates in tunnelling or that wish to do so. Information on available courses has been gathered from these university members and published on the Committee's web pages. New information will be provided as and when received.

After analysing course content, methodology, teaching languages and lecturers, the Committee may endorse such courses on request. Five Masters have received official ITA endorsement to date:

- Specialized Master's in Tunnelling and Tunnel Boring Machines, Politecnico di Torino, Italy,
- MSc in Tunnelling and Underground Space, Warwick University, United Kingdom,
- Specialized Master's in Tunnelling and Underground Space, ENTPE/INSA, Lyon, France
- Master's in Tunnels and Underground Works, AETOS, Madrid, Spain,
- MAS in Tunnelling, EPFL, Lausanne, Switzerland (now closed).

“Five Masters have received official ITA endorsement in addition to an on-line certificate in tunnelling”

In addition to these Masters, the ITA-CET Committee has also endorsed an on-line certificate in tunnelling, run by the University of Colorado, Bolder, USA, which includes a final face-to-face evaluation with the students. All these courses offer the chance to follow high-level innovative programmes, involving actors from different sectors of the industry.

Activity group 4 of the Committee has focused its efforts on examining how to develop training actions through e-learning, which will enable a broader public to be reached. The organization of video-conferences and webinars are examples of actions conducted or to be developed within the scope of this group.

Training requirements around the world are still clearly on the rise and one of the Committee's challenges in the near future will be to mobilize sufficient human resources to maintain its efforts. As with all the ITA's work, the success of the Committee's activities relies heavily on the drive and commitment of its members, whose active involvement is crucial. The identification of additional key members within the Committee is necessary and it is hoped that new collaborations within the ITA, with the Young Members Group for example, will provide fresh impetus and enable the Committee to further develop its actions. If you would like to become involved our activities, please contact us at the address provided on the cover page.



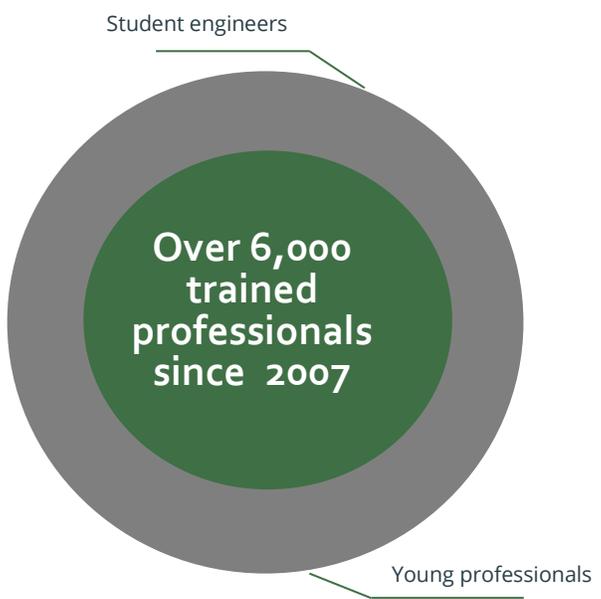
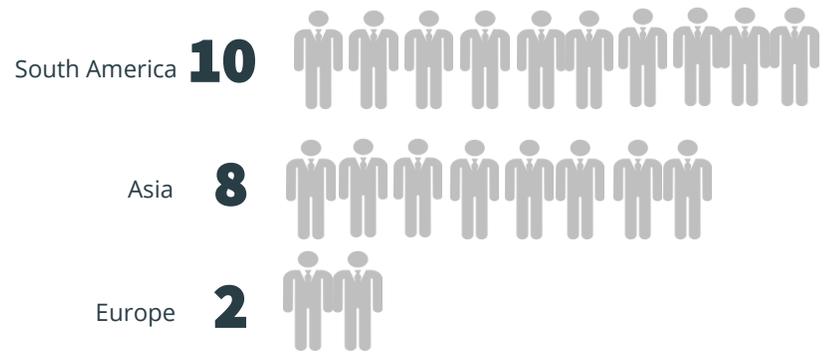
From the archives: the first ITA-CET Committee meeting, Turin, May 2008

ITA-CET Committee

FACT SHEET

KEY FIGURES

47 Committee members



- ### 4 Activity Groups
- Activity Group 1: Training and education for member nations
 - Activity Group 2: Training and education for professionals
 - Activity Group 3: University network
 - Activity Group 4: Development of e-learning and didactic materials

Bergen hosts the traditional WTC training course

By WTC 2017 Advisory Committee

Tunnelling in Norway is dominated by typical hard rock conditions with unlined tunnels primarily supported with sprayed concrete and rock bolts. However, projects sometimes encounter soft ground conditions in weak zones which can be tens of meters wide, requiring support methods as though the tunnel were fully excavated in soft ground.

The last few years has seen a sharp increase in soft ground tunnelling and many on-going tunnels worldwide are now excavated in such conditions. There is a global trend towards increasingly longer tunnels and underground projects are becoming ever more complex, often with a combination of hard rock and softer ground. This is both due to the requirements and expectations from society, breakthroughs in technology and the fact that the tunnel alignment decided on often has to overcome these geological constraints.

The Scandinavian tunnelling industry is no stranger to such issues, with projects with extremely challenging geology coming up in the next years, including the world's deepest subsea tunnel and new urban infrastructure projects in mixed ground conditions.

Traditionally, there are two schools of tunnelling: hard rock tunnelling and tunnelling in soft rock/soil conditions. However, hard rock tunnelling does not necessarily involve good rock conditions. Certain sections can involve softer ground conditions which are the extreme opposite to that of hard rock. Consequently, tunnel engineers require knowledge of a variety of ground conditions that could occur

during tunnelling works, including excavation and support in soft ground conditions.

This year, the traditional two-day course organized prior to the WTC aims to bridge the gap between the schools of hard rock tunnelling (which prevails in Norway and Scandinavia and many places around the world) and soft ground tunnelling, by showing how experience from soft ground conditions can be applied to extreme hard rock tunnelling when required. This course will take place on Friday 9th and Saturday 10th June and has been co-organized by the ITA-CET Committee, ITACET Foundation and the Norwegian Tunnelling Society (NFF)

The course will kick off by defining what is meant by "soft ground" and will provide a brief history of soft ground tunnelling. The principles and specific aspects of both conventional and mechanized tunnelling will then be examined, including the choice of method for the project in question. The different types of TBMs and their use will be explained, followed by a presentation of several case studies from around the world, which will round off the first day of the course.

The second day will start by looking at future challenging projects in Norway involving soft ground conditions. The course will then move on to look at lessons learnt from soft ground tunnelling in an urban context. Recent technological developments will be presented by various industry representatives. Finally, a discussion with a panel of experts will enable participants to ask questions on the issues raised throughout the course.

The ITA-CET Committee has invited renowned speakers from universities and industry who are internationally recognized as top-level experts within the tunnelling industry. This training course is a unique chance to exchange with owners, suppliers and contractors from around the world and an opportunity to network with other young tunnellers.

To register for this course, please visit the WTC web site at <http://wtc2017.com/>



Bringing in young blood

by Robert Galler (ITA-CET Committee Chairman)
Sindre Log (Chairman of the ITA Young Members Group)



One of the ITA-CET Committee's aims over the forthcoming years is to strengthen its relationship with the other entities within the ITA and in particular with the Young Members Group. This group, which was officially founded at the ITA General Assembly 2014 in Brazil, provides a technical platform for young professionals to meet, exchange knowledge, and share experiences. At the group's creation, the then President of the ITA, Soren Eskesen, highlighted the importance of integrating the younger generation into the ITA's activities, stressing that "Young members will contribute new thoughts and ideas to our activities, helping to develop and secure the future of the ITA".

Eager to maintain the Committee's momentum by bringing in "young blood", the ITA-CET Steering Board invited Sindre Log, the new chairman of the ITA Young Member's Group, to attend its last meeting which took place in Lyon on 9th February 2017. This meeting was a chance to begin initial reflections on how the ITA-CET Committee and the ITA Young Members Group could collaborate.

Sindre Log: ITA Young Members Group Chairman



Sindre Log graduated from the Norwegian University of Natural Science and Technology (NTNU) in 2010, with a Master's in Civil and Environmental Engineering. He began his career in the cutter department at the Robbins Company, working on several projects throughout the world. He is currently General Manager of the Norwegian subsidiary of Robbins.

Sindre has been involved in the Norwegian Tunnelling society (NFF) for several years and in 2016 took over from Jurij Karlovsek as chairman of the ITA Young Members Group.

"Young members will contribute new thoughts and ideas to our activities, helping to develop and secure the future of the ITA".

Soren Eskesen, former ITA President

Among other things, the ITA Young Members Group and the ITA-CET Committee are seeking to cooperate in the close future on a series of webinars, aimed at providing training opportunities to a broad audience. In addition, the ITAYm is keen to assist the ITA-CET Committee in the organization of training courses, through its growing number of contacts in national Young Member groups throughout the world.

Training and professional development of young engineers are among the key activities of the ITAYm and their Member Nation groups and cooperation with the ITA-CET Committee will offer a valuable means of improving the quality of these activities even further.

Examples of collaboration for the next year are:

- the ITA-CET training course at the WTC in Bergen, which is endorsed with the ITAYm
- an envisaged webinar series to be launched in the forthcoming months
- ITA-CET contribution to ITAYm events, potentially including the ITAYm regional event in Hagerbach and the BTSym conference.

In addition to the above, the ITAYm is also ready to collaborate on initiatives in relation to university courses on tunnelling and underground works.

Risky business!

by Emmanuel Humbert
(ITA-CET Committee Technical Secretary)

Managing risks and uncertainties is part of daily life for engineers who design and build tunnels. More than any other type of civil engineering structure, tunnels have permanent interaction with the ground, the geotechnical behavior of which is always plagued by uncertainties. Knowledge of ground conditions can never be perfect and if these inherent uncertainties are not sufficiently taken into account, this can result in significant cost overrun and delay. Moreover, spectacular tunnel collapses that have hit the headlines in recent years have shown that large-scale accidents can occur during tunnelling works, with a risk not only to workers, but to third party persons and property, particularly in urban areas.

In order to mitigate such risks, various risk management tools and methods have been developed for tunnelling, which highlight the need to identify possible hazards and uncertainties from the initial stages of a project. During the early design stages it is still possible to adjust certain parameters to reduce risks, whereas in later stages, decisions such as tunnel alignment and the excavation method have often been fixed and there is much less room for maneuver.

In practice, the use of such methods and tools in tunnelling is relatively recent and has gradually developed over the last fifteen years or so, the ITA having paved the way by publishing risk management guidelines in 2004. Today, risk management is considered an integral part of tunnel design philosophy and an increasing concern for countries that are relatively new to tunnelling and embarking upon major underground works projects.

In order to share the ITA's knowledge in this domain, the ITA-CET Committee has developed a training course presenting current risk management thinking and practices. This short course, which can be conducted over one or two days aims to provide participants with an introduction to the risk management process throughout a project life cycle, from the planning, design, and construction of a tunnel or underground project, to its actual operation. The course, which can be adapted to meet specific requirements, is aimed at decision-makers, owners, geologists, consulting engineers, contractors and others with an interest in risk management activities.

The programme provides an introduction to the notion of risk policy, hazard identification and risk acceptance criteria, after which risk management tools are presented (risk registers, fault tree analyses, event tree analyses, decision tree analyses, qualitative and quantitative risk assessments). Risks from the owner, designer, contractor and insurer's perspectives are examined, whilst risks surrounding procurement and contractual issues are also dealt with.

ITA Member Nations are showing increasing interest in risk management issues and over the last year, requests for training in this field have been on the increase. The ITA-CET Committee and ITACET Foundation organized a course in Kathmandu, Nepal

in September 2016 and Kuala Lumpur, Malaysia, in November 2016, enabling over 250 engineers to be trained. Another course is planned in Chili in the near future.

With numerous major underground projects planned throughout the world in the next few years, training in risk management is likely to be in high demand. The ITA-CET Committee will continue to monitor technological developments that can participate to the reduction of risks, such as BIM (Building Information Modelling (see article on page 12) and endeavor to provide high-quality training, through the involvement of ITA experts.



Nepalese engineers at the ITA course on risk management, September 2016



ITA president Tarcisio Celestino lecturing at the course in Malaysia, November 2016

The ITA-CET and ITA COSUF Steering Boards meet in Lyon

by Kristen Drouard (ITA-CET Committee Administrative Secretary)

It was an opportunity not to be missed. Having both organized their respective Steering Board meetings in Lyon, France, the ITA-CET and ITA COSUF Committees decided to meet on 9th February 2017 to discuss how to better collaborate on knowledge sharing actions.

The meeting took place at the Centre for Tunnel Studies (CETU) and kicked off with each Committee presenting its respective activities. These presentations highlighted the fact that whilst both ITA-CET and ITA COSUF are engaged in knowledge sharing actions, they are significantly different, notably in terms of their scope and target audience.

The ITA-CET Committee and ITACET Foundation provide short training sessions for students and young engineers with little or no experience on the subject matter in question. These training events, organized at the request of an ITA Member Nation, cover a wide range of topics and are often held in developing countries or countries in transition.

ITA COSUF regularly organizes workshops focused on operational safety, aimed at professionals who are already experts in their field. These workshops are a mixture of presentations and round table discussions, with exchange between professionals being a main objective. This Committee may endorse certain conferences if they are not commercially-oriented and also produces technical reports.

to increase in the near future, with numerous underground projects in progress throughout the world. Developing countries do not always take operational requirements sufficiently into account when planning a project. As a result, there will be a demand to train asset owners and operators in the forthcoming years. Language could prove to be an issue however, as these actors do not always speak English. It may therefore be useful to "train trainers", who could then dispense training in their country in the operator's native language. It is clear that ITA COSUF could help the ITA-CET Committee and Foundation in the organization of training sessions for these actors by finding the right lecturers and helping to adapt the course programmes to specific requirements.

Joint knowledge sharing actions could take the form of training sessions / webinars organized by ITA-CET that would present the results of ITA COSUF technical reports. The Committee chairs will attempt to meet in Bergen during the WTC to further discuss possible avenues for collaboration. To facilitate this cooperation between the two Committees, a representative of ITA COSUF is invited to attend future meetings of the ITA-CET Committee Steering Board.



Members of the ITA-CET Committee Steering Board at work, prior to the joint meeting

This meeting was not the first time that the two Committees joined force to work on training actions. Indeed, collaboration goes back to 2009, when they both worked together to develop a training session programme on the "Management of (User) Safety in Underground Facilities". Several training sessions dealing with operational safety issues have since taken place, notably in China.

Discussions amongst the members of both Committees highlighted that there is a clear demand for training on operational safety which is likely



Robert Galler explains the training activities of the ITA-CET Committee



ITA COSUF Steering Board members discuss possible joint training actions

Rising to the challenge

Mexico's quest to train a new generation of tunnellers

By Roberto Gonzalez Izquierdo (President of AMITOS)



The need for high-performance infrastructure, coupled with the constant growth of cities, the mobility needs of large populations and the limited surface space available, has naturally led to an increase in the construction of tunnels and underground works.

Within this context, the National Autonomous University of Mexico (UNAM), the Alliance for Training and Research in Infrastructure for Development in Mexico (FiiDEM Alliance) and the Mexican Association for Tunnel Engineering and Underground Works

(AMITOS) have collaborated in order to develop a Master's degree in civil engineering, with a specific focus on tunnelling and underground works. This Master's is currently in its 4th year and so far, six students have successfully graduated. The next edition will begin in August 2017.

It is hoped that the innovative content of this course will attract students and help train a new generation of tunnel engineers for which there will be a strong demand over the next few years, due to the large number of underground infrastructure projects that are planned in Mexico.

The programme was developed after an analysis of several international Master's endorsed by the ITA, by incorporating the strengths of each of them and taking care to balance theoretical, technological and practical aspects. The course comprises 13 modules covering topics such as geology, rock and soil mechanics, numerical methods in underground works, excavation procedures, support systems, laboratory and field testing and shotcrete.

Lecturers comprise experts from the academic world and industry, including ITA experts. The course is taught primarily in

Spanish, with some lectures from invited experts given in English. The duration is four semesters, during which students have a hands-on opportunity to be involved in a project and benefit from internship in a company.



Photos courtesy of AMITOS

Additional information available at:

<http://www.ingenieria.unam.mx/~posgradoingcivil/index.html>

Eugenio Enríquez Castillo
eugenio.enriquez@alianzafiidem.org

Susana García Coto
amitos@amitos.org



Focus on the United Kingdom specialised Master’s in Tunnelling and Underground Space

by Alan Bloodworth (Course director at Warwick University)

The Master’s course (MSc) in Tunnelling and Underground Space was developed at the University of Warwick in direct response to the needs of the tunnelling industry, as expressed through the British Tunnelling Society (BTS). It has been in operation since 2011, providing about 75 graduates with specialised knowledge in tunnelling during a period of great demand in the UK for engineers on projects such as CrossRail and the London Underground station upgrade programme, as well as in many other countries around the world.

The course duration is one calendar year full-time or two years when studied part-time, and in common with most UK Master’s courses is 90 ECTS. It comprises eight taught modules listed in Table 1, which cover theoretical and practical aspects of tunnel design and construction together with Health, Safety and Environmental Considerations and Construction Management specifically for the context of tunnelling. About 50% of the course is delivered by external lecturers from design consultants, contractors, suppliers and manufacturers, who bring their expertise and real case studies to enrich the course content. The BTS maintains a strong interest in the development of the course, with a Steering Board of BTS members and Warwick academic staff meeting twice a year, and an industry champion for each module.

Date	Course title	ECTS
October	Geological Investigation and Ground Characterisation	7.5
November	Underground Construction Methods	15
December	Communication and Leadership	7.5
February	Rock Mechanics	7.5
February	Health, Safety and Environmental Considerations	7.5
March	Tunnel Design	7.5
March	Finite Element Methods for Tunnelling	7.5
April	Construction Management	7.5
June-September	Group Design Project	22.5

Table 1 : Modules on the MSc Tunnelling and Underground Space

All modules are designed specifically for the course, to maintain its coherence and the cohort identity. Module contact time is concentrated in one-week intensive blocks, which enables part-time students who may be working for employers some distance from Warwick to arrange time away from work to attend. Most modules are also offered as standalone professional development courses. The result is a very diverse mix of students, some experienced in the industry and others less so, leading to a high degree of interaction in the classes (Fig. 1) with students sharing their different perspectives. We are seeing increasing international participation in the course, with students from Indonesia, India, Peru, China, South Africa, Nepal and Romania this year.

Site visits have been organised to CrossRail and National Grid cable tunnel sites and to TUCA (Tunnelling and Underground Space Academy, (Fig. 2) in the past year. Students are also encouraged to attend BTS and BTS Young Member events in London and more locally. Former student Shingai Mutukwa says: “The course has been both challenging and rewarding. The technical modules are delivered in collaboration with industry experts. This opportunity to learn from leaders in industry is

invaluable. I have learnt a vast amount and my employer is already reaping the benefits of their investment. The skills I have developed have given confidence to explore new options within the industry. Additionally, the networks I have built will help as I progress through my career.”



Figure 1 : 2016 class on the Tunnel Design Module

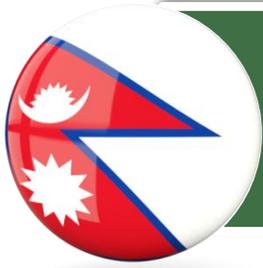
For full-time students, the project component of the course is a Group Design Project during the summer from June to September. In groups of four or five, students tackle a design task which is normally a real project either in its planning or outline design stages. Last year’s cohort proposed solutions for a tunnel by-passing the 5000-year old World Heritage Site of Stonehenge in Wiltshire, UK; a project currently being promoted by Highways England. In previous years, students have designed tunnels at Silvertown under the River Thames, and the Edinburgh Airport Rail Link.

Part-time students undertake an individual project during their second year on a topic normally related to their employment. Recent examples include projects on the reuse of historic underground space, settlement effects due to twin tunnels and the cost-benefit analysis of rail tunnel enlargement.

If you would like to obtain more information about the course, please visit the official website at www.warwick.ac.uk/tunnelling.



Figure 2 : Student visit to TUCA, London



Helping Nepal go underground



How the ITA is contributing to training engineers for major underground infrastructure projects in Nepal

by Subas Sunuwar (Nepal Tunnelling Association)

Nepal boasts the highest mountains in the world and has three major mountain ranges with deep valleys. Development of infrastructure projects in this complex geological terrain requires excavation of long and deep tunnels.

The history of tunnelling in Nepal goes back almost 2000 years when caves were excavated by the inhabitants of Mustang, in the central-northern districts of Nepal. This is the first recorded case of construction of underground structures in Nepal. To date, only 200 kilometres of tunnels have been excavated for hydro, irrigation, mining, water supply, sewerage and transport purposes. However, a number of tunnels, totaling approximately 200 kilometers, are currently being excavated or are at the advanced planning stage for hydro, irrigation and road and rail transport purposes. A 4.6-km long road tunnel from Kathmandu to an adjacent valley is at the detailed design stage, and a 26-km long tunnel for drinking water supply to Kathmandu Valley is 85% complete. Similarly, platform preparation is under way for a Robbins' double shield 4.2m diameter TBM, which will excavate a 12-km long irrigation and hydro power tunnel (Bheri-Babai Diversion Multipurpose Project)

site investigation methods, contractual practices, risk management and state-of-the-art-technology.

The Nepal Tunnelling Association (NTA) was formed in September 2011 to promote the usage, research and knowledge dissemination of underground space (tunnels, caverns and shafts) for safe, sustainable and eco-friendly infrastructure development in Nepal using state-of-the-art and indigenous technologies. NTA represents Nepal within the International Tunnelling and Underground Space Association (ITA), conforms to the aims and objectives of the ITA and aims to establish relations with similar organizations worldwide.

In recent years, NTA, and the ITA have worked together to train and improve the knowledge of engineers, geologists and tunnelling professionals from Nepal and neighbouring Himalayan countries, through ITA training courses developed and organized by the ITA-CET Committee and ITACET Foundation. Internationally renowned experts chosen by the ITA-CET Committee have efficiently conducted four courses in Nepal to date:

- Sprayed Concrete in Tunnelling under Himalayan Conditions (December 2011);
- Tunnel Design, Construction and Risk Management (December 2012);
- Site Investigation, Design and Construction of Hydro and Transport Tunnels (December 2013);
- Risk Management and Contractual Practices (September, 2016).

More than 200 professionals participated in each of these training sessions. Feedback from the participants has been very positive, and every year there have been requests for more such courses, encouraging continued collaboration.



ITA training courses in Kathmandu pictured above and right

Constructing tunnels and caverns in the tectonically active Nepal Himalayas is complex and full of uncertainties. Experience has shown that excavating tunnels and caverns in the Himalayas requires a good understanding of geology, careful tunnel design, appropriate risk management, the selection of suitable construction methods and technologies, and sound contractual management. Therefore, engineers, geologists and other personnel involved in underground excavations in the Himalayas need to be updated on design practices,



New ITA Working Group 22

Information Modelling in Tunnelling

By Jurij Karlovsek

ITA-CET Committee Member and Animateur ITA Working Group 22

Building Information Modelling (BIM) involves creating information models or data sets formed of graphical and non-graphical information in a shared digital data environment. More than just a 3D animated digital representation of the physical and functional characteristics of a building or infrastructure, BIM can include additional valuable information on project schedule (4D BIM), costs (5D BIM), sustainability issues (6D BIM) and relevant data for facilities management purposes (7D BIM).

BIM facilitates the exchange and interoperability of information in digital format between project stakeholders and serves as a shared knowledge resource, providing information on an asset throughout its lifecycle. BIM can support decision making from the planning stage, through to design and construction, operation, maintenance and refurbishment. It can enable a project to be conducted more efficiently and effectively, as the information model can be handed from the design team to the main contractor and subcontractors and then on to the owner/operator; with each profession adding specific data to the shared model.

The increasing use of BIM in major projects worldwide and the mandatory use of BIM in public-funded projects in certain countries indicates that model-based civil engineering is here to stay. However, whilst information modelling systems can help deliver quality engineering to owners and contractors, the process requires specific skills, tools and robust procedures. If the tunnelling community is to make the most of what BIM can offer, it is of paramount importance to share experiences and to implement standards and guidelines which are driven by the industry itself. While BIM approaches have been fairly detailed for the vertical building industry, the horizontal construction industry, (including the tunnelling industry) has so far passively endured this evolution, taking no active part in influencing the regulation process.

ITA recognizes the importance of developing BIM in tunnelling, which will help reduce direct costs, improve efficiency and reduce risks. There is a growing interest in specialist conferences explaining the application of information modelling within the tunnelling industry and in 2016, the ITA organised a "BIM in Tunnelling" workshop in San Francisco during the WTC that drew in 112 participants from 23 different countries: Argentina, Australia, Austria, Brazil, Belarus, China, Finland, France, Greece, Germany, Italy, Korea, Thailand, Malaysia, the Netherlands, Poland, Qatar, Saudi Arabia, Slovenia, Sweden, Switzerland, UK and USA.

The proposal for an ITA Working Group 22, "Information Modelling in Tunnelling" was put forward in May 2016 and interest from Member Nations has been considerable. Once formally established, WG22 will work with local governments, institutes, academia and construction professionals from all disciplines to provide research, knowledge, processes and tools to enable the industry to reap the benefits of BIM in tunnelling. The Working Group's main objectives are to:

- Develop common procedures based on experiences and lessons learned, including from other engineering fields,
- Identify where tunnelling differs fundamentally from civil surface construction and ensure that BIM standards and processes reflect these major differences,
- Develop online documents and procedures for consultants, contractors, owners and operators, describing the value, data sources, best practices and benefits for a project using BIM software for tunnels,
- Establish workshops to help define, consult and promote the adoption of the above-mentioned documents and procedures,
- Provide contact points for each part of the BIM process and list suppliers developing BIM software, to ensure a flexible and harmonized approach to the service market.

It is clear that to achieve these objectives, support will be required from within the ITA, through its Committees and the other Working Groups. The need for training in BIM will increase sharply over the next few years, as a growing number of ITA Member Nations recognize the benefits that it can provide in major underground infrastructure projects. The ITA-CET Committee and ITACET Foundation will closely monitor the developments of Working Group 22 and are ready to play an active role in disseminating training and education material on this topic in the near future.

