

The World Tunnel Congress 2017: 6 days of innovation sharing

Held in Bergen, Norway from 9th to 15th June by the International Tunnelling and Underground Space Association (ITA) and the Norwegian Tunnelling Society (NFF), the World Tunnel Congress and 43rd ITA General Assembly were a momentous occasion and an undoubted success for the global tunnelling industry. During the six days, over 1,500 delegates - experts, academics, civil and tunnel engineers - shared their experiences, methodologies and state-of-the-art technologies on different aspects of tunnelling and underground construction. Key issues faced by the industry were discussed in order to achieve a unified industry response to the surface challenges that affect urban populations.



A serene classical music introduction by the Holbergsuiten Grieg ensemble, and an opening speech given by His Royal Highness Crown Prince Haakon Magnus of Norway, were followed by the warm welcome given by ITA President Tarcisio Celestino. This paved the way for the start of the congress.

From this point flowed presentations, working groups, seminars and site visits. With 340 technical papers and 120 lectures, the World Tunnel Congress has once again consolidated its position as the world's premier tunnelling event.

➤ The International Tunnelling and Underground Space Association makes major announcements during the World Tunnel Congress 2017 :

• The ITA releases the new global market study of Tunnelling industry

During WTC 2017, the ITA released its latest market survey highlighting the economic trends in global tunnelling. If 2016 was an excellent year, then the future is definitely bright. With a total €86bn global output for tunnel and underground space construction in 2016, which represents a 23% increase over the figure for 2013, the industry's prospects for the coming years look to be very positive.

A few noteworthy factors have emerged, notably the rise of the Middle East as a strong market with its €10,2bn output in 2016 comparable to that of Europe (€9,7bn). Also on the rise is the Indian market that has doubled in three years. The European market however remains stable. China by itself represents about 50% of the world market.

The key future trend in tunnelling is undoubtedly the correlation between tunnels and sustainable development. Throughout the world, major underground projects are characterised by their sustainable credentials: for example, many cities are now building tunnels for the temporary storage of storm water (typically 5m-10m diameter and several kilometres long). Metro tunnels are

increasingly used to alleviate traffic and reduce air pollution in most cities in China, with similar huge developments on the horizon in India, in addition to recent projects in Qatar and Saudi Arabia.

The ITA analysis predicts a global output in tunnel construction of around €680bn, representing a pipeline of work of more than **eight years**. The total combined projects for India, South-East Asia and China match the total for Europe, and together they represent **75%** of the global tunnelling output.

- **The Tunnelling Association Nigeria joins the ITA:**

Nigeria was officially welcomed as the 74th member nation and represented by Mr. Abidemi Agwor, President of Tunnelling Association Nigeria.



Handshake – Mr. Abidemi Agwor, President of Tunnelling Association Nigeria & Prof. Tarcisio Celestino, President of ITA

Nigeria is the most populous black nation in the world and currently 7th most populous nation in the world, however Nigeria's population is expected to grow rapidly to become the 3rd most populous nation in the world behind China and then India which is expected to leap frog China to the first in the next 20 years. In 2015, 57,757,000 people in Nigeria lacked access to "improved" water. A 2006 study estimated that only 1% of Lagos households were connected to sewers.

The new membership of Nigeria into the ITA shows the strong determination of the Africa's most powerful economy, which represents \$520.1B¹ with a capacity to grow at rates greater than 5 percent yearly, as demonstrated in the 6.2% growth rate² before slowing down in 2015, to attain the goals fixed by the UN. For example, the African Urban Agenda (UN-Habitat programme) sets sustainable development targets for a 2063 horizon; and the sixth main target of the UN for sustainable development that states "By 2030, [to] achieve universal and equitable access to safe and affordable drinking water for all".

A lot of things have already been done in order to improve the situation: Lagos has four wastewater treatment plants which have been rehabilitated around 2010. From 2011, the state planned to build ten new "mega wastewater treatment plants" over a five-years period with the help of private investors. The National Integrated Infrastructure Master Plan launched in December 2013 proposed a yearly spend of \$30 billions over the next 5 years.

"Membership of the ITA will certainly boost the efforts that have previously been put into initiating the extensive promotion of using our underground space in Nigeria. We have set ourselves a 10-year strategic plan which we expect not just to achieve but surpass and being a member nation of the ITA is key to us meeting these goals. As an association with global relevance, part of our objectives is to promote the sustainable development Goals as set by the United Nations especially the goals that directly affect water and sewage, infrastructure and habitable environment, we are aware that these are also core global objectives of the ITA." **Mr. Abidemi Agwor, President of Tunnelling Association Nigeria**

¹ source: AFDB Nigerian Economic Outlook 2015

² source: AFDB Nigerian Economic Outlook 2015

- **From Norway to...Malaysia!**

On Wednesday 14th June, during the ITA General Assembly, the 74 member nations of the ITA elected the host nation for WTC 2020. After rigorous scrutiny of the three applicants, the winner was Malaysia with 30 votes, against 22 for Australia.

Co-organised with The Institution of Engineers, Malaysia (IEM), the 2020 World Tunnel Congress will have as its theme “*Innovation and Sustainable Underground Serving Global Connectivity*”.



Dr. Ooi Teik Aun, Chairman of the Tunnelling and Underground Technical Division of the Institution of Engineers, Malaysia

Tunnelling Market in Malaysia:

Malaysia is experiencing steady growth in urban areas and therefore requires improved infrastructure in transportation and energy. Recently, the country launched successful urban underground projects such as: the SMART project to provide a storm water storage reservoir and a 9,7km, 11,8m diameter bypass tunnel; Pahang-Selangor Raw Water Transfer Tunnel, which can deliver 1,89 billion litres per day, and the Mass Rapid Transit, a rail-based public transport network.

➤ **A worldwide event dedicated to innovation & high-skilled expertise :**

The line-up for WTC2017 included:

➤ **Muir Wood Lecture**

Now a much anticipated event at WTC, this year's Muir Wood lecture was given by Professor Hakan Stille of The Royal Institute of Technology, Stockholm. The theme was '*Geological Uncertainties in Tunnelling - Risk Assessment and Quality Assurance*' and Prof Stille noted that compared to other civil engineering projects, the greater uncertainties in rock tunnelling may require adapting various standards to suit underground projects. The tunnelling industry needs an appropriate project model based on tollgates and milestones that is applicable to rock engineering based on the epistemic nature of geological uncertainties and which can be minimised by updated observation and investigation.

Prof Stille said that interpreting warning signs can prevent events such as tunnel collapse and high levels of water ingress, and if the project manager has overall responsibility the work can respond to the encountered complexity.

He reminded the audience that rock is unlike concrete and steel, so normal calculations alone are insufficient for design verification. In most cases therefore, the observational approach in tunnelling is mandatory and can be seen as part of risk assessment and quality control.

A common approach is to adopt prescriptive measures such as rock classification systems although their limitations must be understood in order to achieve adequate risk assessments. 'Doing things right' and 'doing the right things' form part of a dual quality system as defined in Euro Code 7 (EC7) that must be adapted to rock engineering problems.

The "Open Session":

Tuesday's Open Session had as its theme '*Rethinking major infrastructure projects: a new look at underground solutions and public acceptance.*' A total of seven eminent speakers enthralled the audience with a variety of tunnel projects and themes that explored not just the technical and financial aspects, but also questions around the importance of gaining public acceptance. But how do we achieve that?

Communicating to the public the benefits of tunnelling projects, including works mitigation and schedules, and environmental considerations, was considered critical in getting public support and understanding for these schemes. In many of the projects discussed, such as enlarging the underground station adjacent to Norway's National Theatre in Oslo, and New York's Second Avenue Subway it became apparent that neighbours and residents desire minimal disturbance (noise, vibrations, dust etc) and limited project visibility, as well as early promotion of the contractor's environmental programme and mitigation measures.

Where possible, from the earliest possible stages, we should clearly identify and communicate the benefits that these projects will bring to the localities concerned. This is particularly true if there are to be spin-offs in terms of economic growth, wealth creation and jobs. Local community support is therefore essential and it is important to:

- Liaise with neighbours, stakeholders, politicians and media to highlight the construction works schedule and identify challenges and mitigation measures; communicate with them at all stages of the project to keep them involved;
- Each project is different and therefore technical solutions must be adapted to suit the local environment and
- Respecting the general public is key to gaining acceptance for the project, especially when the work site is in a sensitive area and the project has high media scrutiny.

The open sessions generated interesting questions including how to define an environmental programme during the construction phase; what kind of mitigations were put in place to minimise disturbance and environmental impact (can these be reused as tools on other projects?). And did project design teams include specific sub-teams to take care of liaison and community relations?

Combined technical sessions

It wouldn't be a WTC without the participation of the ITA's expert committees which were fully active in Bergen.

The ITA Committee on Technologies (ITAtech) looked at 'Innovation in Drill and Blast, and Rock Support'. Papers included the use of conveyor belts for mucking on the Solbakk project (the world's longest and deepest subsea road tunnel); investigating blast damage; insitu pressure

measurements during pre-excitation grouting in rock tunnels, and the design philosophy for permanent sprayed concrete linings.

ITACUS (Committee on Underground Space) examined the 'Use of the Underground', and in particular new ideas and uses for underground space. This went beyond simply utility tunnels and examined new commercial uses, underground concourses and how cities can utilise underground space for sustainable development. How can we as an industry influence the development of new underground uses?

The ITA-COSUF (Committee on Operational Safety and Underground Facilities) had the theme of 'New Security Challenges for Design and Operation'. Terrorism has unfortunately become a fact of life. How should it be managed in tunnel systems? How will decision making be influenced in times of disaster and terror? And how can we protect tunnel control centres from threats to their cyber security?

Working Group 22: dedicated to digital applications and BIM

The creation of the Working Group 22 was agreed by the ITA General Assembly, around "Information Modelling in Tunnelling". This group gathers Australia, Austria, Brazil, Germany, Italy, Norway, Slovenia, Singapore, Sweden, Switzerland and United Kingdom. Its animator is Dr. Jurij Karlovsek and Vice -animateur is Mr. Paolo Cucino.

This working group aims to study "Building Information Modeling" software's application for the underground construction. Identifying the differences between civil engineering and underground constructions and ensure that BIM respects these differences is one of the main goal of this group. It also focuses on the development of common procedures based on experiences and lessons learned including other engineering fields.

About the International Tunnelling and Underground Space Association:

The International Tunnelling and Underground Space Association (ITA) is a non-profit and non-governmental international organization, which promotes the use of underground space for a solution to sustainable development. Founded in 1974 and operating out of Lausanne, Switzerland, ITA currently associates 74 Member Nations, 300 affiliated members, 17 Prime Sponsors and 60 supporters, as well as individual members.

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