

SUPPORTING THE INTERNATIONAL TUNNELLING INDUSTRY

by Dr Tom Iseley and Saleh Behbahani, TTC at LA Tech

As the global population increases and surface space becomes scarce in urban environments, underground space plays a vital role in developing sustainable municipalities. Therefore, conducting tunnelling research and managing our underground space will prove more cost effective in the long run and reliability is essential.

In an effort to maintain its leadership position with international tunnelling developments, Louisiana Tech University's (LA Tech) Trenchless Technology Center (TTC) has recently supported research projects in the following three significant areas:

- curved pipe jacking roof support structure
- utility tunnelling (utilidors)
- vertical tunnelling method.

During the past several years, TTC is pleased to have provided support to research associates and visiting scholars from Chinese institutes and universities with their tunnel related research.

While Peng Zhang was a PhD candidate in Geological Engineering – now a faculty member – at the China University of Geoscience, working under the supervision of Dr Baosong Ma, he served one year at TTC as a PhD research associate in 2016.

His research topic focused on the largest curved pipe jacking roof support structure to date, the Gongbei Tunnel, which was constructed in Zhuhai, China. This project consisted of 36 pipelines installed by a 1,620 mm diameter microtunnel boring machine.

This innovative design combined curved pipe jacking technology and ground freezing, whereby freezing soil between adjacent pipe strings, the frozen soil became the waterproof structure to support the tunnel excavation.

The average total length of this pipe roof tunnel is 255 m, including a transition curve of 88 m and a circular curve of 167 m in length.

GLOBAL RESEARCH

In 2017, TTC hosted a visiting scholar from China who was the Director of Construction Engineering Teaching and Research Section at Hubei Urban

Construction Vocational and Technological College. His research focused on utility tunnelling (UT), with China the first country to provide the leadership in establishing UT as a national priority to meet the challenges for congested underground urban conditions.

As a pioneer in this field, the Chinese approach can serve as a global model. Based on the International Tunnelling and Underground Space Association – Committee on Education and Training Foundation report, by the end of 2016 more than 2,000 km of utility tunnels had been built in 147 cities in China.

UT is classified into three categories based on functionality: trunk UT, branch (lateral) UT and cable UT.

Trunk UT is independent tunnelling with multiple chambers, which is used to accommodate the main pipelines in the cities, while branch UT is used to accommodate auxiliary pipelines in cities with single or double chambers tunnelling and cable UT generally is located under the sidewalk.

Recently Xiao Wang, a PhD candidate in the College of Civil Engineering and Architecture at the Zhejiang University in China, joined TTC as a research associate for one year to study vertical tunnelling (lifting) technology. The vertical tunnelling method, which was first invented in 1974, is often used to build hydraulic tunnels in China and has been used in more than 16 projects. Using the vertical tunnelling method allowed the standpipe to be lifted up from an existing horizontal tunnel and ultimately breakthrough at the ground surface.

Like the pipe jacking method, the jacking force during construction of the vertical lifting standpipe is an important factor that is

influenced by the stratigraphy, hydrogeological condition, pipe material, the height of the standpipe, and so on.

NEW PROJECTS

Back in February Dr Tom Iseley and Saleh Behbahani visited the DigIndy Tunnel System in Indianapolis on behalf of TTC tunnelling research team. Underground Engineering and Construction for Citizens Energy Group (CEG) Project Manager Nick Maynard accompanied them as tour guide for this project.

Mr Maynard received his bachelor degree from the Indiana University-Purdue University Indianapolis where Dr Iseley served as the Construction Engineering and Management Technology Program Director.

The DigIndy project is a US\$2 billion tunnel system project consisting of a 45 km network, which is 76.2 m beneath the city of Indianapolis with a diameter of 5.48 m.

This tunnel system will store more than 946 million L of combined sewage during and after wet weather, and then slowly release the sewage to the Southport Advanced Wastewater Treatment Plant. This project is scheduled to be completed by 2025.

In 2011, the city sold its water and wastewater assets to CEG, a public charitable trust.

Dr Iseley was also instrumental with the start-up of new company based in Indianapolis in Indiana, US, called International Infrastructure Solutions (IIS). The unique and powerful aspect of IIS is that one third of the company is owned by the World Trade Center Indianapolis (WTC-Indy), with the remaining equity owned by Dr Iseley and a long-time business associate and friend, Randy Marra.

The business association between IIS and the WTC-Indy provides a unique pathway to transfer technical and management solutions to the global underground infrastructure industry through more than 320 WTC franchises.

It is exciting to see how underground infrastructure challenges can be accomplished today. It is not just the technology, but the people behind the technology that makes the industry so spectacular.

A NEW DAWN FOR INDUSTRY

Despite the progress being made, meeting the challenges of underground infrastructure will continue to become more difficult.

Who will be there to ensure projects are successful? Who will be there to ensure that existing underground utilities are accurately located and depicted on comprehensive mapping systems to prevent utility hits?

Who will be there to ensure that pipeline condition assessments are accurate and completed, to allow professionals to select the most cost-effective solutions to renew underground piping systems? The list goes on.

The answer is that unless the industry commits to education, training, certification, and so on, it will not be able to optimise our ability to meet the growing challenges of our underground infrastructure.

Dr Iseley will serve on the Science Committee for the No-Dig Poland 2020 Conference, where he will give a presentation titled 'Our most valuable assets when managing buried treasures'. As a plenary speaker, he also will be attending the International Conference on Infrastructure and Construction (ICIC-2019), to be held in Dubai, United Arab Emirates on 11–12 October 2019.

The aim of the ICIC-2019 is to promote quality research by bringing together world class researchers, international communities and industrial heads to discuss developments and innovations in infrastructure and construction.

Back in June, Mr Behbahani received the 2019 Rapid Excavation and Tunnelling Conference (RETC) Student Attendance Scholarship and attended the event in Chicago, Illinois. Furthermore, he received the RETC Student Attendance Scholarship and the Underground Construction Association of the Society for Mining, Metallurgy and Exploration Executive



Dr Iseley and Mr Behbahani visit the DigIndy Tunnel System.

Committee Scholarship in 2017 and 2018 respectively, where he represented LA Tech at networking events and technical sessions.

Dr Iseley and Mr Behbahani plan to attend the North American Tunnelling Conference in 2020, which will be held in Nashville, Tennessee.

CONTINUED EDUCATION

TTC was established more than 30 years ago to advance the science and practice of trenchless technology with a focus on what is required to have successful underground infrastructure projects.

One of the first steps was to understand the underground space involved in projects, including having the ability to locate and map underground utilities. As a result, more than three years ago, TTC partnered with the American Society of Civil Engineers (ASCE) Utility Engineering and Surveying Institute (UESI) to establish the Utility Investigation School (UIS).

After conducting many specialty schools, it is clear how important the field training is. We also have learned that without a properly designed facility, field training is often ineffective. When attendees cannot see or hear what is happening they often form clusters and talk about many things except the specialty school's subject matter.

TTC is fortunate to have a civil engineer as its president. Dr Les Guice was head of the Civil Engineering Department at LA Tech in 1988 when he hired Dr Iseley and together they established the TTC. We stand impressed with how technological solutions have advanced during the past 30 years and, for the most part, TTC has led the way in

advancing these solutions.

However, we realise that even with the best technical solutions, we will never be able to deal with the increasing challenges facing our underground infrastructure without a workforce thoroughly trained to execute these solutions, on projects conceived and designed by educated and trained professionals.

TTC is promoting a total solution approach. This includes continuing to expand developing the TTC Underground Infrastructure Campus (UIC). From the initial formation of TTC, we were fortunate to have a portion of the LA Tech campus dedicated to trenchless technology.

In 2009, this commitment to the UIC was further expanded when the trenchless industry commissioned the National Trenchless Technology Research Facility (NTTRF). We are proud to announce our commitment to the UIC's next facility being dedicated to field training.

The Barbera Education, Research and Training (BERT) facility will include a memorial structure to recognise the support from leaders of our industry. This facility will be available for research, development and training for the entire trenchless technology industry, including TTC Specialty Schools.

To date, three five-day Auger Boring Schools and four five-day UIS have been conducted with industry partners such as the ASCE UESI and the National Utility Contractors Association. In addition, BERT will be available to international equipment and material manufacturers and technology providers for research and development and technology validation. **1**