Australia's first Postgraduate Major in Tunnelling and Underground Engineering

Motivation for initiating the course

Australia's rapid infrastructure development has revealed a significant shortage of tunnelling professionals. To address this gap, the School of Civil and Environmental Engineering at the University of Technology Sydney (UTS) has launched a specialised degree in Tunnelling and Underground Engineering (TUE).

Dr. Haleh Rasekh, Major Coordinator and Advisor for TUE, explains, "Our aim is to equip students with the necessary skills and knowledge to meet industry demands in tunnelling and ensure the successful completion of complex underground projects."

A student in the program adds, "What I particularly like about the subject of underground structure and modelling is its blend of engineering and geology to solve complex problems. It involves advanced technologies and techniques for mapping and simulating subterranean environments, which are crucial for infrastructure development, resource extraction and environmental protection."

ATS involvement and its importance

The course materials are delivered by top industry and academic experts, many of whom are well-established engineers and active members of the ATS, including Helen Baxter-Crawford, Phil Clark, Todd Clarke, Alex Gomes, Sam Mirlatifi, David Och and David Oliveira.

This collaboration ensures that the curriculum remains current and industry-relevant. Prof. Daichao Sheng, Head of School of Civil and Environmental Engineering at UTS, emphasises, "Our partnership with professional bodies like ATS has been crucial. Their expertise and industry connections provide our students with unparalleled insights and opportunities, making our graduates highly competitive in the job market."

UTS's expertise in the topic

UTS is renowned for its innovative approach to education and strong industry ties. The university is consistently ranked among the top 100 globally for graduate employability and is Australia's number one young university. "UTS has a proven track record in engineering education," says Prof. Behzad Fatahi, Deputy Head of School. "Our expertise in civil and environmental engineering, combined with our focus on practical, hands-on learning, positions us perfectly to offer this pioneering program."

The TUE program at UTS benefits from the university's state-of-the-art facilities and resources. Students have access to advanced laboratories, cutting-edge software, and simulation tools that enhance their learning experience. This combination of academic excellence and practical training ensures that graduates are well-prepared to meet industry demands.

What the course involves

The TUE program is comprehensive, covering all aspects of the field. Students gain practical skills in modern site investigations, planning, design, construction, and management of tunnelling projects. The curriculum includes specialised topics like tunnel boring machines, trenchless technologies, and the safety and sustainability aspects of underground engineering. "We designed this program to be as practical as possible," says Dr. Haleh Rasekh.

"The industry experts who teach our courses ensure that we're learning the latest techniques and technologies used in the field." The program's flexible structure caters to diverse educational backgrounds and career aspirations, offering options such as a Graduate Certificate, Diploma, and multiple Master's degree pathways.

Opportunities for graduates

Graduates of the TUE program will find a wide array of career opportunities, including tunnel engineer, construction manager, project manager and consultant or specialist.

> "Passing on tunnel rehabilitation expertise and lessons learned to younger professionals is vital for keeping critical assets functional for future generations, efficiently designing future tunnels, extending their lifespan, and ensuring sustainable development."
> Sam Mirlatifi – Technical Director and Team Leader, Tunnels and Geotechnics in GHD and ATS Committee Member

For more information, contact:
Phone: 1300 ASK UTS (1300 275 887)
Website: futurestudents.uts.edu.au

> "TUE offers a comprehensive curriculum providing young engineers with a solid understanding of the key concepts, methods and principals involved in the modelling and design of underground structures. The collaboration between ATS and UTS has been instrumental in ensuring that the best industry practices and experiences are passed on to students."
> Alex Gomes – Chief Technical Principal Tunnels and Underground at SMEC and ATS Committee Member

Monash BEST has lift off

The Monash students innovating efficient TBM technologies for sustainable and resilient underground development

Monash BEST (Boring Excavating Student Team) was formed in 2023 by an enterprising group of young individuals that saw the need to push for innovation in the tunnelling industry. Qianbing Zhang, Associate Professor in Civil Engineering at Monash University is the team's Academic Supervisor and says the timing is perfect for the emergence of the group.

"The Australian tunnelling industry presents many opportunities for young engineers to dedicate their passion and knowledge to underground development. Monash BEST with its pioneering focus on tunnelling technologies offers university students an entry into this growing sector, with the hopes of bringing new talents and innovations to future underground construction projects."

"One of the team's key missions is to create the winning tunnel boring machine (TBM) for the 'Not-A-Boring" competition, hosted by Elon Musk's 'The Boring Company,'" explains Hung Anh Dau, a final year engineering student and Monash BEST's Chief Executive Officer, although it's certainly not the only thing they are focused on.

"In the long run, we aim to gather all of our knowledge and findings from developing the competition's fastest TBM, and give it to the tunnelling industry via faster, safer and more efficient tunnelling technologies," he says.

The student team has got off to a flying start, with over 60 members spread across three subteams which include people from disciplines including engineering, science, commerce and the arts. The subteams include:

1. Automation
The Automation Subteam focuses on the development of TBM cutterheads and excavation assemblies. The division also focuses on testing cutterhead prototypes created using additive manufacturing, as well as conducting Finite Element Analysis on cutterhead components.

2. Propulsion
The Propulsion Subteam focuses on developing a system that can provide the necessary forward thrust for the TBM to facilitate the excavation process both safely and efficiently. The Subteam is currently working towards the innovation of an electric model that could offer increased range of motion while maintaining sufficient force outputs.

3. Structure
The Structure Subteam is divided into two divisions:
a. The Design Division focuses their efforts towards the creation of 3D models of traditional TBM components using CAD software as well as Rhino 3D for visualisation purposes.
b. The Geotechnical Division's goal is to improve the functionality of a program developed by Jordan Engel, a current fourth year student at Monash University, for his Final Year Project under Qianbing's supervision, which allows for the automated selection of a TBM based on ground conditions present. This is currently limited to the selection of either an Earth Pressure Balance or Mixshield TBM from soft and heterogeneous soils respectively, however Jordan, as Geotechnical Division Lead of Monash BEST, aims to develop the program further.

Since establishment, Monash BEST have placed an emphasis on research which has led them to build a solid foundation on the theoretical and mechanical aspects of tunnelling. In 2024, they consolidated

> "In partnering with us, companies will enjoy exposure and awareness amongst our pool of talented individuals, as well as accessing our R&D. We welcome support in every stage of our development process, whether it be CAD or computational analysis, to fabrication and manufacturing."
> Hung Anh Dau, Monash BEST's Chief Executive Officer

their knowledge and created a prototype TBM they named 'miniGaia.' In the future, they hope to use advanced guidance systems to make the machine semi-autonomous.

The team has been so organised and professional in its approach it has received support and endorsement from a variety of places. Monash University provided the initial funding, advice, administrative help, office space, software and assistance from notable professors and alumni.

The team also connected into the ATS Young Members (ATSym) Committee with whom they collaborated on the well-received ATSym x Monash BEST Tunnelling Industry Night in early 2024. They are also receiving the support of top industry advisors, including ATS member and ITA-AITES President, Professor Arnold Dix; ATS President, Richard Buckingham; and Dr Jay Lee, ATS Events Coordinator in Victoria. Other support has come from Dr Ross Digby, Holmesglen Institute Victorian Tunnelling Centre.

With great momentum, the group is currently working hard to build an outstanding TBM for the Not-A-Boring competition; develop the framework for an ITA-AITES endorsed international virtual TBM competition for university students; and develop a range of educational models and tools to promote STEM education to younger students. Lastly, they aim to build their industry connections and support network, with the goal of increasing their financial standing and technical knowledge base.

"It is incredible seeing what my fellow engineering students are able to achieve within a short timeframe, and I am massively grateful to be working with such a talented group of people," says Hung Anh Dau.

More information
If you'd like more information about this student-led team or are interested in supporting them via sponsorship, check out the first edition of the BEST Magazine via the QR code: