



# SINGAPORE DEEP EXCAVATION AND TUNNELLING WORKS: UPDATES AND CASE STUDIES

Supported By



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BCA has worked together with the British Geological Survey (BGS) to establish a new stratigraphical framework which involved renaming of the geological units to replace DSTA (2009) used in the publication.

It is the time to have an in-depth understanding on the new geological units and its application in engineering works. At the same time, understanding the spatial distributions of soil and/or rock profiles is vital to underground geotechnical design.

3D geological models have become efficient and effective way of storing, processing, presenting, and analysing geological data, as well as vital research direction in geological fields, such as engineering geology.

A large TBM has been used in the Cross Island Line project of the LTA. Complex tunnelling works are likely to pose a higher risk to nearby buildings, especially if they are performed in difficult ground conditions. As part of the Risk Based Framework for Large Diameter TBM, some key measures are highlighted in this presentation that aim to mitigate such tunnelling risks during the upcoming large diameter tunnelling projects.

In addition to the above, prestigious speakers will present case studies on tunnelling, deep excavation, pipe jacking projects and share the geotechnical challenges encountered during the constructions as well as the appropriate mitigation measures.

**DATE: 18 OCTOBER 2022, TUESDAY**

**TIME: 9AM TO 5.30PM**

**FEES: \$192.60 (IES MEMBERS) / \$214 (CIJC MEMBERS) / \$267.50 (NON MEMBERS)**

*(Fees include 7% GST)*

**VENUE: ONE FARRER HOTEL**

**CPD: 6 STUS (STRUCTURAL) / 7 PDUS FOR PES & CENGs**

*(All Confirmed and Approved)*



## OUR SPEAKERS

## MODERATORS



**PROF. CHU JIAN**  
Chair of School and Environmental Engineering  
Director of Centre for Urban Solutions  
Nanyang Technological University (NTU)



**ER. KIEFER CHIAM**  
Director  
Geological & Geospatial Development Department  
Building Engineering Group  
Building & Construction Authority (BCA)



**MR MICHAEL GOAY**  
Senior Engineering Geologist  
Geological & Geospatial Development Department  
Building Engineering Group  
Building & Construction Authority (BCA)



**ER. CHOW WENG LEE**  
Technical Advisor  
Steering Engineers Pte Ltd



**DR AARON SHAM**  
Senior Engineer  
Enforcement & Structural Inspection Department  
Building Resilience Group  
Building & Construction Authority



**DR POH TEOW YAW**  
Director  
Geotechnical Engineering Department  
Building Engineering Group  
Building and Construction Authority (BCA)



**ER. CHAI KUIFHEN**  
Senior Engineer  
Geotechnical Engineering Department  
Building Engineering Group  
Building and Construction Authority (BCA)



**MR LEE LONGGUAN**  
Principal Engineer  
One Smart Engineering Pte Ltd



**DR JEYATHARAN**  
Deputy Director  
Geotechnical & Tunnels  
Land Transport Authority



**ER. TAN YEW CHAI**  
Director  
DP Engineers Pte Ltd

# About Speakers and Synopsis

## Speakers

## Synopsis

## About the Speakers

### 3D GEOLOGICAL MODELLING AND MANAGEMENT SYSTEM IN SINGAPORE AND ITS APPLICATIONS



**Prof Chu Jian**

*Chair of School of Civil and Environmental Engineering,  
Director of Centre for Urban Solutions Nanyang Technological University (NTU)*

Establishment of 3D geological model is an important step in overcoming the uncertainties in underground construction. In this presentation, the 3D geological modelling and management system established for Singapore will be introduced.

The methods and procedure adopted for the development of the 3D geological model are presented.

There will also be discussion of other technical challenges and related solutions, including the assessment of uncertainty of the geological model in 3D and updating it with new borehole data.

Case studies on the applications of the 3D Geological Model and associated benefits will be demonstrated.

Professor Chu Jian worked at Iowa State University in 2011-2014 as the James M. Hoover Chair in Geotechnical Engineering.

He is currently the Chair of ISSMGE Technical Committee TC217 on Land Reclamation and a Committee Member for ISSMGE TC211 on Ground Improvement and TC303 on Floods.

Prof Chu has delivered over 60 keynote and invited lectures at international conferences. He is an editor for a high impact journal Acta Geotechnica and associate editor for ASCE Journal of Materials in Civil Engineering.

Prof Chu is a recipient of R. M. Quigley Award (2004) from the Canadian Geotechnical Society and the Outstanding Geotechnical Engineer Award (2018) from the Geotechnical Society of Singapore among other honours. He is also actively involved in construction projects in Singapore and overseas as either a consultant or advisor. He was the past president of the Geotechnical Society of Singapore.

### RISK BASED FRAMEWORK FOR LARGE DIAMETER TBM



**Dr Poh Teoh Yaw**

*Director, Geotechnical Engineering Department Building Engineering Group, Building and Construction Authority (BCA)*

With rapid expansion of rail network and other underground infrastructure projects in our already densely built-up city, more tunnelling works will be carried out in close proximity to existing buildings.

With the advancement of tunnelling technology, large TBM has been successfully adopted in various projects overseas. Such complex tunnelling works are likely to impose higher risk to nearby buildings, especially for works in difficult ground conditions.

This presentation highlights some key measures covers under the Risk Based Framework for Large Diameter TBM aims to mitigate such tunnelling risk in the upcoming tunnelling projects that adopt large diameter TBM.

Dr Poh Teoh Yaw is a Director with Building and Construction Authority which oversees and administers the regulatory framework on building structure safety in Singapore. He is a geotechnical specialist with over 25 years of practical experience. He has authored over 50 publications in geotechnical design and construction including those published in international peer-review journals, conferences and local seminars.



**Er. Chai Kui Fhen**

*Senior Engineer, Geotechnical Engineering Department Building Engineering Group, Building and Construction Authority (BCA)*

Er. Ms Chai Kui Fhen, is presently a senior engineer in the Building and Construction Authority (BCA) of Singapore. She is a registered Professional Engineer in Singapore. She has more than 10 years of experience in the planning, design, and construction of underground infrastructure projects.

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### APPLICATIONS OF THE NEW GEOLOGY MAP OF SINGAPORE TO ENGINEERING WORKS



**Er. Kiefer Chiam**

*Director,  
Geological & Geospatial  
Development Department,  
Building Engineering Group  
Building and Construction  
Authority (BCA)*



**Mr Michael Goay**

*Senior Engineer  
Geologist at Geological &  
Geospatial Development  
Department  
Building and Construction  
Authority (BCA)*

A new geological map for Singapore at 1:50,000-scale was released by BCA in October 2021. The A0-size printed maps include bedrock, superficial deposits, combined bedrock and superficial deposits and engineering geology. The digital version of the also known as Interactive Singapore Geological Map (iSGM) was subsequently released in February 2022.

The new maps contain comprehensive descriptions of around 37 geological units and depicting extensive structural network comprising faults, thrusts, and folds. These units include a unique stratigraphic name which link to the Lithostratigraphic Framework of Singapore.

The presentation will provide an overview of the new stratigraphic framework based on the new findings gathered from field mapping works carried out both on land and offshore islands of Singapore, and detailed core logging of BCA's deep boreholes.

Er. Kiefer Chiam is the Director of Geological & Geospatial Development Department of BCA. He is registered Professional Engineer in both Civil and Geotechnical in Singapore.

His interest and experience span widely from site investigation work, foundation design, deep excavation to tunnelling and instrumentation works, and had published numerous geotechnical papers in technical conferences.

He leads his team at BCA in the review of stratigraphy and structural geology of Singapore and work closely with the British Geological Survey (BGS) to develop a new geological framework and 3D geological bedrock model for Singapore.

Mr. Michael Goay is a Senior Engineering Geologist at Geological & Geospatial Development Department of BCA. He is part of the team responsible for developing the new stratigraphic framework of Singapore together with the British Geological Survey (BGS). He has received guidance and training from BGS while working closely with them from 2013 until 2021. Prior to joining BCA, he has worked for many years on major geotechnical projects as a consultant and contractor relating to ground investigation and slope stabilisation works. He is a registered geologist with BOG (Malaysia). He has co-author in several geology papers and presented in overseas conferences.

### MITIGATING RISK OF IMPACT TO EXISTING STRUCTURES DUE TO URBAN PIPE JACKING



**Mr Lee Long Guang**

*Principal Engineer  
One Smart Engineering Pte  
Ltd*

Pipe jacking, also known as micro tunnelling, is a trenchless construction technique for installing underground infrastructure such as buried pipelines for sewerage, water supply, petrol-chemical, power and communications cables.

As a trenchless technology, pipe jacking has become a popular alternative to conventional open trenching or excavation for such underground installations, as it can minimise disturbance to the ground surface as well as disruption to road traffic.

The speaker will introduce the various types of temporary ERSS jacking and receiving shaft for pipe jacking projects.

In this session, some case studies will illustrate some past successful projects and the challenges faced and mitigation measures implemented to minimise risks to adjacent structures and utilities.

Mr Lee Long Guang is Principal Engineer at ONE SMART Engineering Pte Ltd and is currently pursuing a Doctorate of Engineering (EngD) at the National University of Singapore (NUS). Mr Lee graduated with Master of Science (Geotechnical Engineering) from NUS and he is one of the BCA-Industry iBuildSG Scholarship Recipients.

Mr Lee's area of research mainly focus on numerical modelling of Pipe Jacking and has more than six years of working experiences as Design Engineer, Project Supervision and Project Management.

He has involved in two major Infrastructures project which includes Drainage Works, Underground Pipeline and PUB triple water pipeline project at Ang Mo Kio and DSTA which consists of twin 1.8m diameter Potable Water pipe and 2.2m diameter Raw Water pipe using Mini Slurry TBM for Pipe Jacking.

He has published technical papers on geotechnical engineering and presented technical papers at international conferences.



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### **CASE STUDIES ON PERFORMANCES AND FAILURES OF ERSS IN SINGAPORE GROUND FORMATIONS**



**Er. Chow Weng Lee**  
*Technical Advisor*  
*Steerling Engineers Pte Ltd*

The island city state of Singapore is relatively small, but there are many different types of ground formations there.

In order to maximise land use, underground space is being utilised intensively. Due to these factors, excavation and construction work can face challenges in different ground conditions that need to be addressed to mitigate risks and ensure the safety of the workers.

Case studies and lessons learnt of failures and incidents from past underground excavation works in various ground conditions will be presented.

Er. Chow Weng Lee has more than 20 years' experience in the geotechnical engineering field.

He has been involved in numerous design and construction of major civil and infrastructure projects for underground MRT stations and tunnels, reclamation works and tunnelling works in Singapore, Malaysia and India both in private and public sector projects.

Er. Chow is currently involved in few interesting infrastructure and development projects such as the North South Corridor, Jurong Regional Line, Founders Memorial and New Science Centre.

### **LESSONS LEARNT FROM DEEP EXCAVATION AND TUNNELLING WORKS IN SINGAPORE**



**Dr Jeya Kumarasamy**  
*Deputy Director*  
*Geotechnical & Tunnels*  
*Land Transport Authority*  
*(LTA)*

Construction of major underground infrastructures such as metro stations and tunnels, road tunnels, underpasses, underground basements requires various excavation and tunnelling methods.

The majority of these major infrastructure developments are developed in highly populated urban areas, which makes it inevitable that they will be built near/under existing structures.

In addition, construction of these underground structures faces lots of challenges due to unfavorable ground conditions, site constraints, limited construction timeline, etc.

This presentation will highlight some of lessons learnt from deep excavation and tunnelling works for major infrastructure developments in Singapore.

Dr Jeyatharan Kumarasamy graduated from University of Peradeniya, Sri Lanka with B.Sc. (Eng.) First Class Honours in 1985 and obtained Ph.D. in Soil Mechanics from Cambridge University, UK in 1992. He is a registered Professional Engineer (Civil) in Singapore.

Jeyatharan is currently a Deputy Director (Geotechnical & Tunnels) with Land Transport Authority (LTA), Singapore. Prior to that, he worked in few consulting companies such as Parsons Brinkerhoff and Arup Singapore Pte Ltd on various major infrastructure projects for about 10 years.

Dr Jeya has over 25 years of practical experience in planning, design and construction of major infrastructure projects. He also has several years of experience in soil investigations, geotechnical instrumentation and monitoring, and preparation of Geotechnical Baseline Interpretative Reports (GIBR).

He is currently the President of the Tunnelling and Underground Construction Society, Singapore (TUCSS) and a member of the executive committee of the International Tunnelling and Underground Space Association (ITA).