



1 – Day Short Course on Finite Element Modelling in Tunnels and Tunnelling

by Ir. Frankie Cheah

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Overview

As mentioned by the Chairman of the Tunnelling and Underground Space Technical Division (TUSTD) of IEM, Ir. Khoo Chee Min in the Preface of the lecture note, that undeniably, tremendous growth and remarkable breakthroughs have been achieved in the tunnelling industry in Malaysia over the past two decades. He went on to add that the demand for tunnel constructions in urban areas has evolved complex calculations and analyses in order to satisfy the correct simulation for this type of underground construction. The 1-day short course on Finite Element Modelling in Tunnels and Tunnelling was for the first time organised in Malaysia on 29 January 2019 at Wisma IEM, Petaling Jaya. (Figure1).



Figure 1: Participants for the 1-Day Short Course with course note

The 2 speakers for this course were Dr William Cheang (Figure 2) from Bentley, Singapore and Dr Lee Siew Wei (Figure3) from Golder Associate, Hong Kong.



Figure 2: Dr William Cheang



Figure 3: Dr Lee Siew Wei

The short course was attended by more than 50 participants from both contractors and consultants related to the tunnelling industry from all over Malaysia. The short course was sponsored by 3 local contractors, namely, Bauer (M), Jack-In-Pile (M) and Advanced Geotechnics Sdn Bhd. Their invaluable sponsorships had in fact, helped to maintain a low course fee for the participants.

Short Course Outline

The one-day short course was opened by the IEM, TUSTD founder chairman, Ir. Dr Ooi Teik Aun who gave an opening address at 9 am and followed by 3 lectures in succession before the lunch break and 3 more lectures again in succession, after the lunch break. The short course ended at 6pm after the presentation of certificates by IEM, TUSTD Chairman, Ir. Khoo Chee Min together with Ir. Dr. Ooi Teik Aun to both the speakers and sponsors for the course.

Lecture 1 - Introduction to Geotechnical Finite Element Modelling of Tunnels

Dr William presented an overview of the geotechnical finite element model and had covered the importance of geometry, drainage and groundwater condition, calculation type and constitutive soil models, which respectively, plays important role in impacting the output for the finite element analysis.

Lectures 2 & 3- Modelling of Tunnels in 2D using PLAXIS- Methods, Features and Options and Applications and Case Histories

Both speakers presented the modelling of tunnel in 2D FEM analysis with case study of a project in Hong Kong. The most important message delivered by the lecturer was that a good prediction of Greenfield surface settlement curve in 2D, will require a good experience from the modeller together with a good understanding of the advanced constitutive soil model and a refined method of modelling of tunnel excavation.

Lectures 4 & 5 - Modelling of Tunnels and Tunnelling in 3D-PLAXIS Methods, Features and Options and Application and Case Histories

These covered the modelling of tunnel in 3D FEM analysis with case study of a project in Hong Kong. The lecturers compared both 2D and 3D modelling methods in term of ground/building settlement with pile movement/stresses. In 2D analysis, plane-strain tunnel excavation in plane behaviour while the effect of soil arching along the TBM is not simulated in accordance with 3D condition. In the pile movement where in 2D analysis, the behaviour is not unrealistic as it provide a larger surface area for mobilising the shaft friction. For 3D analysis, with the modelling of individual real geometry of the piles, the behaviour of the mobilised shaft friction could be covered accordingly.

Lecture 6 - Concrete Model for Tunnelling

Dr Lee covered the usage of Concrete Model that was able to simulate the softening effect in both compression and tension in soil block as compare with Mohr Coulomb that simulates perfectly plastic behaviour. The application of the concrete model was successfully adopted in a NATM tunnel project in Slovakia. The tensile stress measured with the application of this soil model was captured by Schaedlich et al. (2014) as shown in Figure 4.

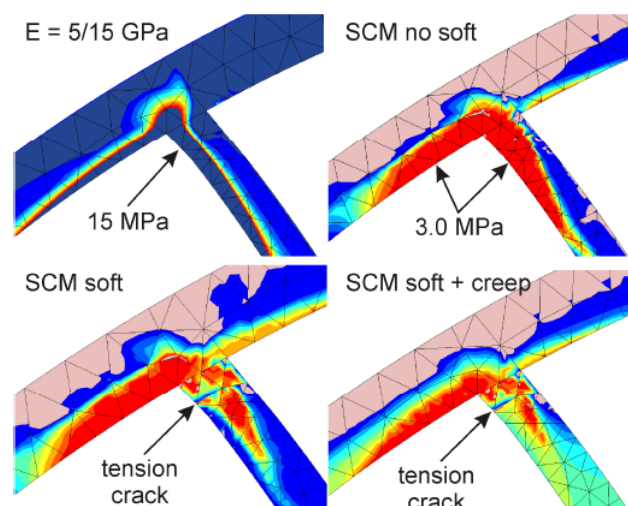


Figure 4: Tensile stress behaviour in the drift wall

Short Course Closing

The 6 lectures of the one-day short course in FEM in Tunnels and Tunnelling ended with a Q & A session and followed by the presentation of certificates to both the speakers and sponsors. With regard to this short course, the TUSTD team would like to encourage all the participants to provide feedbacks via the QR code image shown in the lecture note.



Figure 5: Group photo of the organising team with the speakers

From left – Ir. Frankie Cheah, Ir. Dr. Ooi Teik Aun, Dr. Lee SW, Dr William Cheang, Ir. Khoo Chee Min



Figure 6: Certificate Presentation to Bauer (M)



Figure 7: Certificate Presentation to the Advanced Geotechnics