



One Day S Short Course on Practical Application of FEM in Geotechnical Engineering

by Dr Ng Soon Min

Dr Ng Soon Min is currently a committee member in Geotechnical Engineering Technical Division (GETD).

The One Day Short Course on Practical Application of Finite Element Modelling (FEM) in Geotechnical Engineering was organised by the Geotechnical Engineering Technical Division (GETD) on 14th June 2019 at Hilton Petaling Jaya, Selangor. The short course was delivered by Prof. (Engr. Dr.) Harry Tan Siew Ann from the National University of Singapore (NUS) and was attended by 80 participants.

This short course was tailored into 4 sessions for geotechnical practitioners using FEM in geotechnical engineering and covered the following areas:

- Selection of appropriate soil models
- Common mistakes and pitfalls in FEM
- Practical methods of parameter calibration
- Pressuremeter tests to validate soil parameters
- Advanced non-linear model of very soft clay behaviour
- Lesson learned on deep excavation, mixed raft foundation and soil nailed slopes.

Prof. Harry Tan began the first session by introducing the general rock and soil behaviour which will enable us to judge the results when using soil model in FEM. 8 different constitutive (material) models were discussed in detail and the limitations for each soil models were explained. Two advanced constitutive models named the Creep-SCLAY1S and t_{ij} concept were highlighted due to their ability to simulate anisotropic and rate dependent behaviour of soil. Besides, the mathematical formulation for these models also includes the possibility to model bonding and destructuration. Prof Harry concluded the first session with the discussion on common pitfalls in FEM such as initial stress conditions, soil drainage conditions, FEM boundaries and mesh quality.



Prof. Harry Tan delivering the course

After the morning tea break, Prof Harry continued with session 2 discussing parameter calibration for oedometer tests, triaxial tests, small strain stiffness and cone penetrometer with pore pressure measurement (CPTu). He then proceeded with the performance of FEM to capture the behaviour of actual pressuremeter tests. The results from his study showed a satisfactory performance and he commented that calibration of advanced constitutive models by pressuremeter tests is also possible if supplemented by other tests.

Prof Harry commenced Session 3 after the lunch break with practical case studies of FEM in geotechnical engineering. The first case study used 3D FEM analysis to explore the underlying reason of the excessive movement of a Grout Mix Piling (GMP) retaining wall. He highlighted on the importance of using the advanced Hardening Soil (HS) model that is able to produce realistic results. The speaker then proceeded with second case study that utilised 2D and 3D FEM analyses to investigate the performance of an anchored Contiguous Bored Pile (CBP) wall in Kuala Lumpur. In comparison, it was found that the 2D FEM over-predicts the actual movement whereas the 3D analyses provides better approximation to the on-site data.

The fourth session of the course was on examining the settlement trends for a mixed foundation system consisting raft foundation with settlement reducing rigid inclusions and bored piles. Settlement profiles and trends from monitoring records were compared with 3D FEM analysis output. The insights obtained from this study to produce an improved settlement trend prediction are the inclusion of building structural stiffness model and having better construction sequence information. The final case study discussed on the application of FEM to study soil nail behaviour. It is highlighted that the soil-nail interaction is a 3D and complex problem hence it must be correctly addressed. Prof Harry recommended the appropriate selection of structural element such as 2D embedded pile row element to model soil nail group in plain-strain condition.

At the end of the course, Prof Harry concluded that FEM is a valuable approach to produce an optimised design for a complex problem and he took on numerous questions from the participants during the Q and A session. The course ended with rounds of applause from the audience and a memento of appreciation was presented by the GETD Chairman, Ir Lee Peir Tein to Prof Harry Tan.



Memento of appreciation to Prof. Harry Tan by Ir. Lee Peir Tein