Seminar on Excavation and Retaining Walls

By: Engr. Yee Yew Weng, MIEM., P.Eng.

The Geotechnical Engineer Technical Division of The Institution of Engineers Malaysia (IEM) and Hong Kong (HKIE) jointly organised a seminar on 'Excavation and Retaining Walls' on 24 March 2008 at the Tropicana Golf and Country Resort in Petaling Jaya. 'Excavation and Retaining Walls' are very important subjects in Geotechnical Engineering. The design and construction of excavations and walls, either for basement construction or development on slopes, require a thorough understanding of soil behaviour, design methodology and application of relevant technology. Failure and loss have often resulted where improper routes were selected by engineers either in design or construction, or both.

With that in mind, the Organising Committee invited speakers who are experienced practitioners and specialists in geotechnics from Hong Kong and Malaysia to present papers on these important topics. These speakers hail from various backgrounds such as government bodies, consultants and contractors, ensuring that the views shared during the seminar were well rounded. The topics covered were also diverse including a review of design codes and methods, innovative construction ideas, building on slopes, monitoring work, forensic study, ground treatment, etc.

The event attracted a large audience of more than 200 engineers. In addition, more than 10 Hong Kong engineers flew in to take part in the seminar. The event also afforded the opportunity for IEM and HKIE to exchange technical knowledge and experience between Malaysian and Hong Kong engineers. A total of eight papers were presented at the seminar, consisting of five papers by Malaysian engineers and three papers from Hong Kong.

Engr. Tan Yean Chin and Engr. Chow Chee Meng, Grad. IEM. (IEM), in their paper entitled 'Design of Retaining Wall and Support Systems for Deep Basement Construction', introduced their presentation by showing the audience photos of deep excavation failures from international projects as well as projects in Malaysia. They stressed that the selection of soil parameters is important for the design of deep excavation, and this should include all the necessary checks, e.g. global stability, basal heave, hydraulic gradient and axial stability.

They highlighted that for finite element analysis, the determination of boundaries, mesh, stage of construction, identifying interfaces, suitable soil model and appropriate soil parameters are important as the results of the analysis is very dependent on the input parameters. Two case histories of very deep excavations were used to emphasise their reasoning.

Dr Richard Pang (HKIE) gave a Hong Kong designer's perspective in his paper 'Introduction of the Limit State Partial Factor Method for Excavation and Lateral Support Works Design'. He started his presentation with an introduction to the Geotechnical Engineering Office (GEO) in Hong Kong and their publications. He mentioned that the development of the Limit State Design in Hong Kong was based on local experience and findings from failures of deep excavation. He stated that in Hong Kong, sheet piling work for deep excavation has the highest failure rate due to non-compliance, poor workmanship, inadequate penetration length, poor site control and poor supervision. He also emphasised that engineers should understand the importance of selection of parameters for analysis.

For finite element analysis, the design engineer should carry out sensitivity checks on the model by refining the mesh until no significant changes are found in the results. Dr Pang also mentioned that the involvement of design engineers should not be limited to the design stage only, that they should also be actively involved in the construction stage. He also mentioned that risk ownership

Figure 1: Some of the participants at the seminar

should be clearly defined to avoid any miscommunication in the project.

The third paper was presented by Dr Toh Cheng Teik (IEM) entitled 'Deep Excavation in Malaysia – The State of the Art'. He presented the types of excavation supports being used in Malaysia and gave a general view on the geological conditions in several development centres in Malaysia; Kuala Lumpur, Georgetown, Klang and the coastal areas, Melaka and Johor Bahru. He reiterated the fundamentals of soil mechanics and highlighted that engineers should understand well the tools that they employ in design.

Dr Toh added that commercial finite element programs may have intrinsic weaknesses and flaws, and this should be recognised and corrected by the user. He showed the audience many case histories of deep excavation using different types of excavation support systems including top-down methods and ground treatment. He felt that basement construction in Malaysia is generally of a high standard.

Engr. Dr Eric Li (HKIE) dealt with the important subject of 'Monitoring of Ground and Wall Deformation Associated with Deep Excavation in Recent and Old Reclamations in Hong Kong'. He explained that a good monitoring scheme should have a clear objective, the lines of communication identified, guideline on monitoring frequency and duration, alarm level, contingency plan, redundancy for damage and checking, protection and maintaining the monitoring locations. He showed the audience case histories of monitoring for three projects in Hong Kong.

The paper on 'Case Studies of Support of Open Excavations and Distressed Retaining Walls in Malaysia' was presented by Engr. Liew Shaw Shong (IEM). He illustrated basic geotechnical design and good practice using three case histories of retaining wall support systems, namely, jack-in pipe anchors, soil nailing and piled retaining wall. Soil nailing was use for a five-and-a-half storey car park which requires 7m to 14.5m deep excavation. He showed that raked piles or stone columns were used to support high retaining walls subjected to lateral load successfully.

The presentation on 'An Account of Deep Excavations using Steelworks in Hong Kong' was made by Engr. James Sze (HKIE). Sze explained the advantages of using the steel wall system as they are faster to install, has uniform properties, are easy to dismantle and can be reused. He illustrated his talk using two case histories, firstly, for a rail diversion construction and, secondly, deep excavation for a local university, which used sheet pile system and pipe pile system respectively. He mentioned that monitoring has shown that pre-drilling works for the sheet pile can cause settlement, and bracing may have to be used to reduce soil movement. Finally, he stressed that it is necessary to monitor the movement of adjacent structures during installation works.

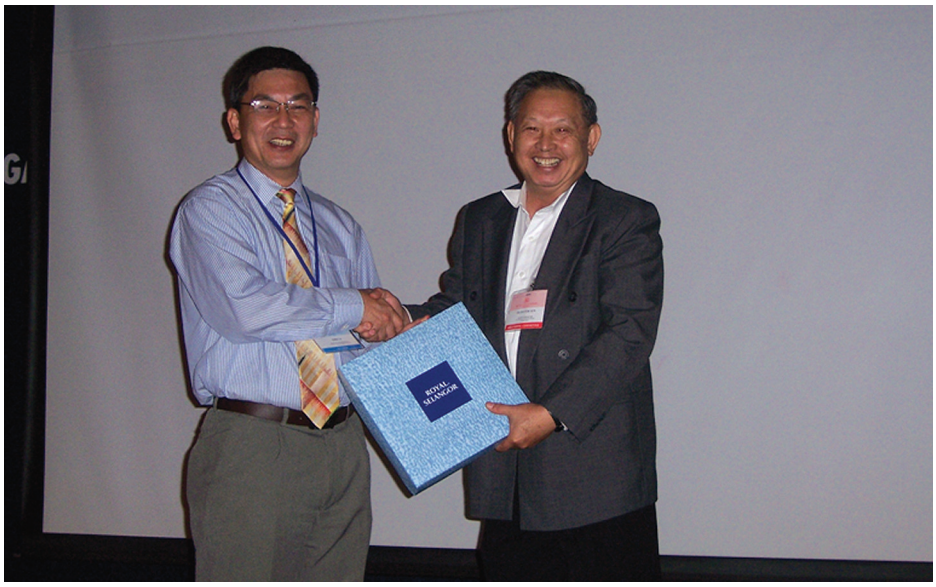

Figure 2: Engr. Dr Ooi Teik Aun presenting a momento on behalf of IEM to HKIE Geotechnical Engineering Technical Division Chairman Engr. Dr Eric Li

The Organising Chairman, Engr. Yee Yew Weng (IEM) gave a presentation dealing with ground improvement entitled, 'Case Studies – Deep Soil Mixing in Excavations'. He began by introducing deep soil mixing technique and the equipment required. He showed pictures of the technology being applied for deep excavation works overseas, mainly in Europe and Japan, and more recently in Malaysia.

Yee explained the advantages of using deep mixing method include a strut-free and steel-free excavation for up to 10m deep. He presented two case histories which were carried out successfully in soft coastal marine clay in Malacca and in ex-mining soil in Kuala Lumpur. He explained that, for both projects, the cement mixed walls were designed using the gravity wall concept as an alternative to conventional steel or concrete retaining walls.

The final presentation for the day was made by Engr. Oh Chin Wah (IEM) on 'Retaining Walls in Genting Highlands'. The presentation highlighted the challenges of construction on hilly terrain, and impressive walls up to 30m high have been constructed. In most cases, hand-dug caisson was used as the vertical retaining member (requiring minimal construction equipment on steep terrain) and deep ground anchors were utilised as tie-backs. Oh also explained the sequence of construction employed from 11 case histories.

The seminar was concluded at 5.30 p.m. with tokens of appreciation given out by Engr. Dr Ooi Teik Aun to the presenters. The Organising Committee also presented mementos to delegates from HKIE. Yee also thanked participants and co-organisers from HKIE who took the effort to travel to Kuala Lumpur. He expressed great appreciation for their consistent and vigorous support of IEM's activities.

HKIE presented IEM with a few volumes of 'Thirty Years of Slope Safety Practice in Hong Kong', a compilation of 45 high quality papers which record the development of slope design and management in Hong Kong. The books are available at the IEM library. ■