Understanding Ground Movements Around Excavations in Cities – talk by Prof. Guy Houlsby

GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

reported by Ir. Liew Shaw Shong

Ir. Liew Shaw Shong *is presently the advisor of GeoTechnical Engineering Technical Division (GETD). He obtained his Bachelor of Science Degree in Civil Engineering with First Class Honours from National Taiwan University at Taipei in 1991 and worked as a geotechnical engineer in Sino Geotechnology Inc. at Taipei for a year. In 1992, he continued his post-graduate study in University of New South Wales in Sydney, Australia and obtained his Master of Engineering Science in 1993. He is now the Senior Director of G&P Geotechnics Sdn. Bhd.*

Prof. Guy Houlsby from University of Oxford, UK, gave a technical lecture on Understanding Ground Movements Around Excavations In Cities at the Tan Sri Prof. Chin Fung Kee Auditorium on 3 December 2014. It was chaired by Ir. Liew Shaw Shong and attended by 48 participants.

Prof. Houlsby is the invited speaker for this year's 54th Rankine Lecture, one of the most prestigious events in the world of geotechnical engineering.

He started by introducing the massive network of rail link services across London, highlighting in particular the Cross Rail project, in which a full-sized train service will link the east and west of London's city centre. He then showed the MRT networks of Singapore, Korea, Malaysia and Vietnam. For the purpose of illustrating the impact of underground excavation with ground movements, he summarised the assessment procedures of ground settlement with the following steps, comparing the typical analytical approach and the more refined modelling approach as performed by his team.

Step 1: Assess the "green field" settlements, in which a common Gaussian type ground surface settlement profile relating the ground loss from the underground excavation of tunnelling construction.

Step 2: Apply the assessed ground surface settlement profile to the buildings within the influence zone to assess the internal stresses of the building walls under hogging or sagging structural deflection. However, he commented that the lack of soil-structure interaction in typical practice will not provide a reflective outcome of building damage. Simplified equivalent beam method to mimic the flexural stiffness of the walls with wall self-weight was also presented for comparison. But the powerful computing capability nowadays has overcome the need of such simplified equivalent beam methods.

Step 3: Assess the damage to buildings according to the established damage category

Ir. Yee Thien Seng presenting a memento and certificate of appreciation to Prof. Guy Houlsby

method (commonly in five categories, i.e. negligible, very slight, slight, moderate and severe). He showed the use of finite element analysis with a multiple yield surface plasticity (MYSP) model with the capability of modelling strain dependent shear modulus to assess induced strains in the building walls on shallow foundation in both coupled and uncoupled cases for a tunnelling in clay formation at Maddex Street under undrained conditions. With the building self-weight over the influence zone of tunnelling induced ground loss, more settlement was observed along the wall location. Similar analyses for Xingye Bank in Shanghai and Marina Bay in Singapore were also presented. One important discovery in modelling the embedded wall using a beam element without wall thickness, showed conservative outcomes in both moment and wall deflection because the effect of the counter-acting moment from the downward wall friction was inevitably ignored due to lack of level arm to this downward wall friction in the simplified wall geometry of zero wall thickness.

After the illustration of these case studies, he concluded the talk with the following salient points.

a) Analytical methods

- Case histories provide essential data for calibration and verification of modelling through back-analysis.
- Ability to predict ground behaviours with practical accuracy permit the designer to study and explore the design and construction options.
- 3D modelling of the problem is now possible and relatively efficient
- FEM has great potential in future geotechnical modelling; thus it's unlikely to lose favour by the geotechnical designer.

b) Essential features

- For soil models, the non-linearity at small strain, stiffness variation with depth and drainage effect can be incorporated for improvement of prediction accuracy.
- For structures, the structure stiffness and foundation details can be incorporated as well for a more representative soil-structure interaction analysis.

c) Results

- Masonry structures on sagging ground settlement profile – acts as stiff structure and suffers little damage

During the interactive discussion session, there were many interesting questions about the calibration of Tresca model and MYSP model, consolidation of fine soil resulting from groundwater drawdown in tunnelling construction, method of measuring shear modulus in small strain (using resonant column test), effect of post-grouting works in tunnelling and free surface condition in tunnel excavation, clarification of wall thickness modelling, and validity of interpreting of geological conditions in the alluvial formation with reference to the lower bound in the database of same formation in the region and the worth-noting high correlation factor of $G = 1000S_u$ in the clayey deposit for the case history at Shanghai.

IEM GETD chairman Ir. Yee Thien Seng then presented a memento and certificate of appreciation to Prof. Guy Houlsby.

The presentation slides will be posted on the IEM website when this report is published. Members can write to IEM GETD secretariat staff if they cannot locate the presentation slides in the website. ■

Note: This is continuation of the list of building fund donation list which was first published on page 36 in March Issue 2015.

Pengumuman yang ke-80

SENARAI PENDERMA KEPADA WISMA DANA BANGUNAN IEM

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