

One-Day Seminar on Engineering Fill



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GEOTECHNICAL ENGINEERING TECHNICAL DIVISION

THE one-day seminar on Engineering Fill was held at the Tan Sri Prof. Chin Fung Kee Auditorium, Wisma IEM with a total attendance of 47 participants.

The seminar consisted of four lectures. The first lecture, entitled “Large Scale Compaction Works on Heterogeneous Fill”, was delivered by Ir. Kenny Yee. The ground improvement was related to the construction of the King Abdullah University of Science & Technology (KAUST) campus in Saudi Arabia.

The presentation dealt with the design and construction of the ground improvement works which, upon completion, should facilitate the use of shallow foundations in the treated ground for supporting low-rise buildings and infrastructure. Dynamic compaction (DC) and dynamic replacement (DR) methods were adopted to densify the sabkha soil and loose silty sand found at the site. The sabkha soil consists of 28% to 56% fines and typically has very low SPT-N values, i.e. not greater than 2.

The typical work procedure adopted in this project consisted of:

- 1) Identifying the general thickness of the sabkha soil using cone penetration tests (CPT);
- 2) Visually inspecting on-site the penetration of pounders to determine whether the DC or DR treatment method is to be used;
- 3) Carrying out pressuremeter tests (PMT) in the treated ground to assess the factor of safety (FOS) against

bearing capacity failure (minimum requirement: $FOS \geq 3.0$);

- 4) Carrying out stress analysis to verify that the future imposed stress in the subsoil does not exceed the yield stress (PY) of the subsoil;
- 5) Revising compaction spacing, grid pattern or compaction energy, if the requirement in Step (4) cannot be achieved;
- 6) Carrying out PMT to check for settlement compliance; and
- 7) Monitoring settlement during surcharging period.

The lessons learnt and recommendations include the need to:

- 1) Formulate a simple design concept that could be understood by the client, engineers and contractors;
- 2) Formulate a simple work procedure so that the right works are carried out during construction; and
- 3) Prepare simple checklists for acceptance criteria and QA/QC.

The second lecture, entitled “Settlement of Prepared Ground”, was delivered by Ir. Dr. Ting Wen Hui. In this context, “prepared ground” refers to ground that has been compacted to provide a specified settlement performance. The presentation highlighted that in past case histories, misconception on the engineering of fill had occurred for prepared ground. It was thought that a well-compacted fill may ‘support’ a building load, and it was not considered that the “collapse settlement” of a partly saturated fill could take place under self-weight, when the fill was subsequently saturated by the infiltration of surface and subsurface water.

Two case histories on problematic collapse settlements of prepared ground were described. Studies by Ir. Dr. Ting and others showed that the partly saturated soil becomes unstable on saturation and follows a path to reach the relevant stable state on full saturation. If the path followed falls on the right hand side (‘wet’ side) of the intersection point C (see Figure 1), the partly saturated soil on saturation collapses and results in collapse settlements (Point C denotes the intersection point between consolidation curve of partly saturated soil and consolidation curve of fully saturated soil).

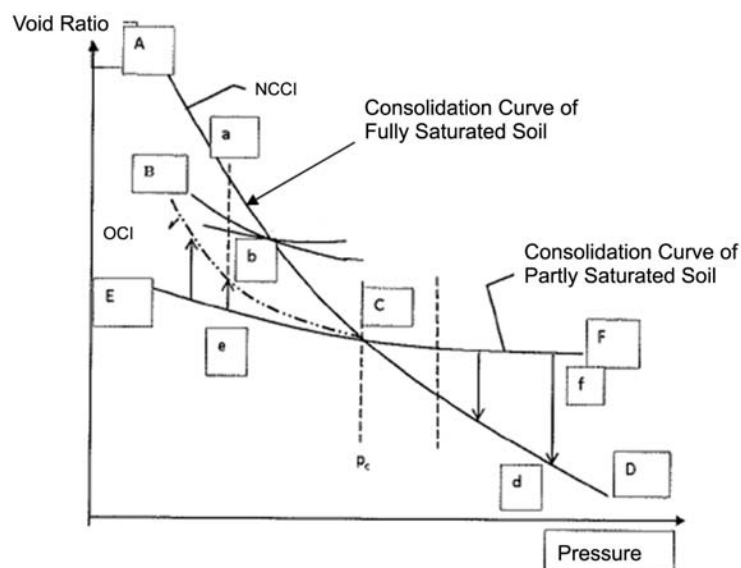


Figure 1: Consolidation curves of partly- and fully saturated soils (Ting, 1999)

The third lecture, entitled "Engineered and Unengineered Fill Slopes, and Case Studies", was delivered by Ir. Neoh Cheng Aik. The lecture discussed the design aspects of fill slopes, e.g. design criteria, stability, settlement, slope stabilisation, ground treatment, compaction, slope protection, drainage, etc. The lecture also illustrated common engineering problems encountered in various cases of fill slopes and suggested possible mitigation measures.

Several case histories of fill slopes that encountered failures or distress were used to demonstrate how the investigations and rectification works were carried out. It was highlighted that failures of unengineered fill slopes are neither accidents nor acts of God; they are mainly due to technical shortfalls as a result of oversight, ignorance or unawareness of the necessary mitigations against what could go wrong at site.

The last lecture, entitled "Reclamation and Rehabilitation of Land for Housing and Infrastructure Development", was delivered by Ir. Dr Ooi Teik Aun. The speaker recommended engineers to explore the innovation of using non-conventional methods when poor soil conditions may impair the integrity and serviceability of the structures. In such situations, the natural condition of poor soil needs to be altered to meet the project requirements where settlement limits are more stringent and poor ground strength needs to be significantly improved.

Commonly used ground improvement schemes, such as removal and recompaction, preloading, vacuum consolidation, stone columns, dynamic compaction, dynamic replacement, vertical drains, and use of geosynthetics, were described and various case histories were presented in this lecture. Due to increasing awareness of the impact of construction on the environment, sustainable construction techniques using green technology, such as ground improvement, were recommended. A carbon footprint auditing system was introduced for some of the commonly used ground improvement methods. Carbon dioxide (CO₂) emission audit analyses showed that ground improvement is a sustainable construction method that reduces CO₂ emission compared to conventional earthmoving and piling works.

Lastly, a token of appreciation was presented to each of the speakers. The seminar ended with great applause from the floor. ■

REFERENCE:

- [1] Ting, W.H. (1999) "A Survey of Embankment Construction Practice and Future Developments", Year 2000 Geotechnics, AIT, Bangkok.

CONDOLENCES

With deep regret, we wish to inform IEM members that Allahyarham Engr. Ibrahim Jaffar bin O.I. Humayun Khabeer (G 39146) and Allahyarham Dato' Ir. Mohammad Aidid bin Haji Zakaria had passed away on 24 May 2011 and 26 August 2011 respectively. On behalf of the IEM Council and management, we wish to convey our condolences to their families.

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