

A Brief Report on “Green Technology for Sustainable Foundation Treatment of a High Embankment Constructed on Peaty Clay Soil”



by Ir. Kenny Yee

CONSULTING ENGINEERING SPECIAL INTEREST GROUP

THE Consulting Engineering Special Interest Group (CESIG) of IEM has organised a technical talk on “Green Technology for Sustainable Foundation of a High Embankment Constructed on Peaty Clay Soil” on 16 November 2010 at the Tan Sri Prof. Chin Fung Kee Auditorium, Wisma IEM. The speaker was Ir. Kenny Yee who is the Hon. Secretary-General of the Association of Geotechnical Societies in Southeast Asia (AGSSEA) and the Regional Director of Menard Geosystems Sdn Bhd. The talk was attended by 110 participants.

The 90-minute technical presentation consisted of three main sections. The first section dealt with the subject of “sustainability”. Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The duty and responsibility of a civil engineer, particularly a geotechnical engineer, is to improve foundation designs and construction processes that hold up (sustain) the structures that are to be built on it with less materials (to minimise wastage), less energy usage and generate less CO₂. Although it may not be able to achieve a zero-energy design, the move towards a low carbon economy of recycling and alternative low-carbon construction processes (using low-carbon technology) was the subject of the day.

The presentation introduced the concept of carbon footprint accounting procedure and CO₂ emission audit for construction projects. The presentation also included climate model simulation predictions, climate change vulnerability and data on global CO₂ emissions in 2009 in which China leads the world at 6,200 million tons of CO₂ followed by the United States at 5,800 million tons of CO₂. In Malaysia, CO₂ emission in 2007 was about 200 million tons (Figure 1). The first section of the presentation concluded with a study on the socio-economic impact in Malaysia as a result of climate change and outlined the steps taken by the Energy, Green Technology and Water Ministry to encourage and develop green technology.

The second section focused on ground improvement technology. The use of the conventional method of the removal and replacement of unsuitable material such as soft peaty clay soil with compacted suitable imported fill for embankment construction over shallow marginal ground or the use of deep piled foundation to support high embankment have been a common practice in the construction industry in Malaysia for many years.

Today, because of sustainability, engineers are being tasked with the requirement of selecting a suitable construction method that not only offers the most economical solution while satisfying all technical criteria, but one that also minimises its impact on the environment. In many cases, ground improvement has proven to be the solution. The presentation provided an overview of the various types of ground improvement methods available (see Figure 2).

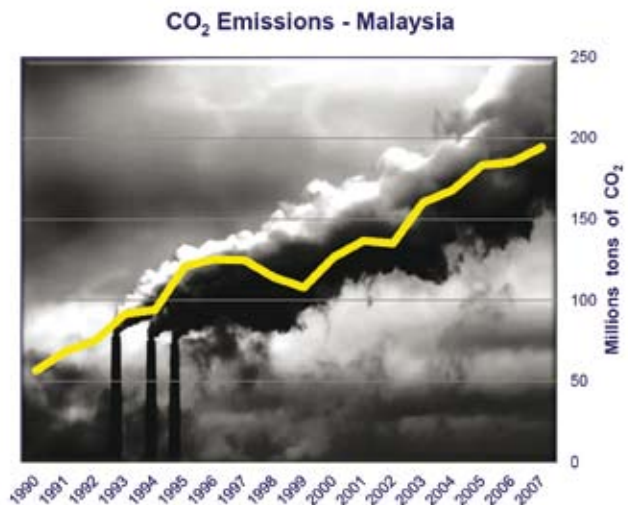


Figure 1: CO₂ emission in Malaysia

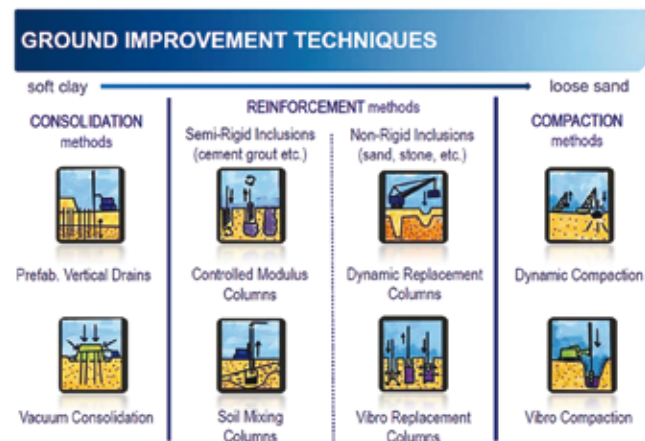


Figure 2: Various ground improvement methods

Ground improvement can be accomplished by modifying the soils characteristics with or without the addition of imported materials. It helps to save materials and resources. Hence, it is a sustainable construction method. It also minimises CO₂ emissions compared with conventional earthmoving or piling works. The presentation then covered in more detail the process of ground reinforcement using the Dynamic Replacement technique and the use of the Menard Pressuremeter Test as quality control for the treatment works. Dynamic Replacement is the process of constructing large diameter granular columns up to 2.5m by dynamic impact.

The third and last section highlighted the case study of using an alternative ground improvement solution with a combination of Dynamic Replacement with Vertical Drains to support a high embankment up to 16m on marginal ground with time constraint. Dynamic Replacement columns using sand and stone as backfilling materials up to 2.5m in diameter were used.

These columns provided the necessary ground reinforcement and accelerated the rate of consolidation similar to the Vertical Drains. The design concept and field implementation were presented together with settlement monitoring results. This alternative ground improvement solution, compared with the original method

of the removal and replacement method, has proven to be more sustainable. An assessment of the carbon footprint demonstrated a reduction in CO₂ emission.

The original method of removal and replacement would have emitted about 3,815 tons of CO₂, mainly from the fuel consumption of on-site plant and equipment and the transportation of unsuitable and suitable material to and from borrow pits and dumping sites. The solution of ground improvement saved the need for a huge quantity of earthmoving, while reusing existing unsuitable materials helped reduce fuel consumption. The result is a reduced overall carbon footprint by approximately 3,270 tons of CO₂ which represents an offset of CO₂ emission of about 700 people for a year.

The presentation concluded with the slogan, "Save Planet Earth... It's the only one we have. Achieving sustainability will enable the Earth to continue supporting human life as we know it."

The Q&A session that followed was most encouraging and lively. Many interesting issues were raised and it had indeed met the objective of the organiser to promote awareness on sustainability. The Chairman, Ir. Dr Ooi Teik Aun presented a memento to the speaker Ir. Kenny Yee and concluded the event with a word of thanks to everyone. ■

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Keynote Speakers



Datuk Loo Took Gee
Secretary General, Ministry of Energy,
Green Technology and Water,
Malaysia



Prof. John Loughhead
Fellow FCO, CEng,
Past President, IET



Dato Ir Azman Bin Mohd
Chief Operating Officer,
Terengganu National Berhad,
Malaysia



Ar Von Kok Leong
President,
Malaysia Green Building
Confederation, Malaysia



Ir Ahmad Fauzi bin Hasan
CEO,
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