

FUTURE OF GEOTECHNICAL ENGINEERING IN MALAYSIA

By

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Geotechnical engineering is a relatively new field in Malaysia. With the increase in number of infrastructure projects and mega-projects, there was a shortage of engineers earlier. Today, however, Malaysia has her fair share of experts in the field. JURUTERA speaks to several past Chairman of IEM-GETD (Geotechnical Engineering Technical Division) Ir. Dr. Ting Wen Hui, Ir. Dr. Ooi Teik Aun, Dato' Ir. Dr. Gue See Sew, Ir. Kenny Yee Kwong Sing and Ir. Yee Yew Weng to learn more about the prospects in geotechnical engineering.

Q. What are the changes you have noticed in the practice of geotechnical engineering here in the last 50 years? Are we on the right track?

Ir. Dr. Ting Wen Hui : There have been advances such as :

1. The widespread availability of jacked-in piles replacing small bored piles where non-vibration piles support is required.
2. Large diameter bored piles upto 3 m diameter have been installed for very large superstructure loads.
3. Mass ground mixing with stabilizers to improve poor ground has been introduced.

Q. What are the prospects for geotechnical specialists today? Have geotechnical specialist contractors made good progress in developing local construction technology for exporting? If not, what do you suggest the local specialist contractors do?

Ir. Kenny Yee Kwong Sing : Geotechnical engineering has definitely come of age in this country. Of the 40-plus construction companies listed in the Bursa Malaysia, 10% are involved in geotechnical works. A Google search shows 9 local institutions offering postgraduate courses (M. Sc. / Ph. D.) in geotechnical engineering. It is clear that geotechnical engineering is firmly founded on a path of continuing development. I believe the prospect for geotechnical specialists is good in this country and the region.

On the subject of geotechnical specialist contractors, I can only draw upon my experience as a specialist contractor in the field of ground improvement techniques. With the rapid expansion in

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housing and infrastructure developments, geotechnical engineers and contractors have to deal with less favourable sites such as coastal lowlands and swamps. A number of mega-size projects would be economically non-viable and / or technically non-feasible if they were constructed using conventional methods meant for good ground conditions. In this aspect, contractors have played a major role in the development of new construction methods and advanced construction plant and equipment. With the industry witnessing a strong growth during the 7th and 8th Malaysia Plan (1996 – 2005), it was necessary to adopt fast track implementation processes to meet demands. The design and build method was used. People used to say that contractors were taken out of the frying-pan into the fire for they have taken additional responsibility for design – the paradigm of design-and-built specialist contractors. Fortunately, they stood up to this baptism of fire.

With this rich experience gained, many local contractors have ventured overseas and made good progress. This success story is based on hard work and endurance.

Q. The interpretation of soil characterization is a joint effort between geotechnical engineers and engineering geologists. How can we integrate the responsibility of each individual when it comes to geotechnical design? Should there be a separate geological report and a geotechnical report, with each being responsible for their work?

Ir. Dr. Ooi Teik Aun : Geotechnical engineers are different from engineering geologists who study the formation of rock. When geologists talk about the age of soil formation, they talk in time frames of millions of years. They look at things quite differently from an engineer's perspective.

Geologists will determine whether a rock is full of faults or have crack lines. He may say it is a big fault and is active though the last movement was 100,000 years ago.

For an engineer, a structure has a life span of perhaps only 120 years. After that it will most likely be demolished. So he thinks : "If there is a fault I can stitch it, do rock bolting or some other thing. It's OK to build because I have already tested it and found the movement to be insignificant".

The geologist must carefully examine everything and present his findings to the engineer.

The engineer must take the geological report into consideration. But the geologist cannot say "you cannot build here because it's not safe". The engineer is the one who determines whether it is safe to build.

It is two separate reports because when you do a borehole, a geologist will dig a hole in the ground to do a physical survey and then make his report. The engineer takes this report and does a geotechnical report in relation to the structure that will be built.

However, clients in private projects want to save money (this doesn't happen with government projects), so they will tell the geologist to write the report, including the so-called engineering report.

Ir. Dr. Ting Wen Hui : There need not be conflict between geotechnical engineers and geologists. The former is employed to manage and consult conditions, geological features often have a role to play and a geologist's advice may be sought where required.

Dato' Ir. Dr. Gue See Sew : Geological input is needed by geotechnical engineers such as mapping of geological features for dams. Engineering geologists need to flag geotechnical engineers on areas that need further investigations for the properties of the sub-surface. Geological studies should be included in geotechnical reports for effective incorporation of the findings in the investigations and analyses.

Ir. Yee Yew Weng : I believe this to be more a political contention rather than a technical argument. An engineer needs to understand geology if, for instance, he is designing foundations in rock. If he is learned in geology, either from training or from experience, he can apply such knowledge to his design. If he does not have the necessary knowledge, he should consult a geologist. This is common sense, so I don't see why we need legislation.

Q. What are the prospects for geotechnical specialists today? Have geotechnical specialist contractors made good progress in developing local construction technology for exporting? If not, what do you suggest the local specialist contractors do?

Ir. Dr. Ooi Teik Aun : Previously, this was because we never really studied it. We thought it would be expensive.

However, you must consider factors such as destruction to environment. For example, the construction of the MRT lines in Bangsar. They cut the slope and built structures close to residential houses and other structures.

There is a cost to the house owners. Property prices may drop and during construction, residents have to put up with the noise and perhaps workers who peep into their homes.

The structures could have been replaced by tunnels but of course it is better for the environment as everything is underground and looks neat.

We have never put emphasis on tunnelling. IEM actually formed a tunnelling division in 2000 and I was the founding Chairman of the Tunnelling and Underground Space Technical Division.

We have been trying to promote the use of underground space as a sustainable method of development as there are many advantages. Firstly, you don't need to cut down hills so there is no risk of landslides. During construction, the workers are underground, so there is little disturbance.

Elevated structures disturb lives. Even after construction if completed, the huge structures cause traffic congestion and there is always danger from the fast trains. Underground, it is safer. Even if the trains jump the track, they are confined in the tunnels. Underground rail track tunnels are uni-directional, so there will be no such as a collision.

Q. R & D important for advancing the knowledge and practice of geotechnical engineering. Currently this is carried out separately by universities, practitioners (i.e. consultancies) and government agencies. Should we encourage collaborations or should we leave it to the free-market force?

Dato' Ir. Dr. Gue See Sew : Improvements to practice require R & D culture. So practitioners need to collaborate with universities and research agencies. They should gather R & D topics and the areas of practice that need improvements, such as simplified and improved methods of testing to obtain soil properties for slope analyses.

Q. What are the foreseen improvements of roles by the consultants and contractors under the popular contractual setting presently favoured in Malaysia?

Ir. Yee Yew Weng : I have worked in consultancy for 13 years and in contracting, for 12 years. Contractual settings can be fairly diverse, depending on project and organizations. The consultant used to be responsible for all design aspects and if something goes wrong, the lawyers go after him. Nowadays, it is less clear, as the party with the deepest pocket normally cannot escape liability. Construction controls are far less stringent here than say, in Hong Kong

and in Singapore. The authorities allow a lot of self-regulation among professional bodies. This should not be abused, especially when it involves public safety.

Q. In view of the lack of knowledge and enthusiasm to pursue a career in geotechnical engineering in local universities, how can IEM Training Centre help?

Ir. Dr. Ooi Teik Aun : IEM Training Centre (IEMTC) will play a role together with two bodies – the Geotechnical Engineering Technical Division (GETD) and another society, the Malaysian Geotechnical Society (MGS). The two can identify what is needed in the geotechnical field and then tell IMTC that they would like to hold certain competency courses. Those who have completed these courses should be proficient geotechnical engineers.

IEMTC was set up to provide training by qualified trainers/ the Board of Engineers Malaysia (BEM) requires that engineers study and pass certain subject matters before they can be registered as professional engineers. These mandatory courses are conducted by IEMTC.

Are present geotechnical engineering practices sufficient to cover the risks arising from the design and construction aspects?

Ir. Dr. Ting Wen Hui : Broadly speaking, our Geotechnical Practice has reached maturity and should be able to deal with the relevant engineering risks.

Q. How is geotechnical risk management being recognized by the local insurance companies?

Ir. Dr. Ting Wen Hui : As far as is known, there is no specific insurance to cover geotechnical risks, only general construction risks.

Q. Should engineering contractor organizations be led by an Ir.?

Ir. Yee Yew Weng : As an engineer, I would like to say “yes” since an Ir. is a technically trained engineer who should be able to lead a company toward engineering innovation and excellence. However, not all engineers make good entrepreneurs. There needs to be teamwork and balance. If the Ir. is poor in entrepreneurial skills, he or she should leave the business side to others.

Q. What lies ahead for geotechnical consulting firms in Malaysia, in view of the increasing specialist geotechnical contractors with strong design capabilities?

Ir. Yee Yew Weng : The term “strong design capabilities” should be used judiciously. Anybody can do back-of-the-envelope calculations to estimate say, pile shaft friction using $f = 2 N$. This is not “design” but merely an exercise in estimation. Many can run on FE analysis these days, but this is not “design” either, just merely computing know-how.

An expert designer will have in this arsenal, a smorgasbord of scientific ingredients such geological survey, neighbouring soil information, test pile data, information on technology advances, research findings, literature data, analytical tools, etc. His mastery of engineering design will be exemplified by how he is able to create a leading edge design that is both practical and commercially astute. I do not believe that there are many contractors with such capabilities. The concern is, of course, whether geotechnical consulting firms are continuing to emphasize the need to develop such master designers in their organizations or if they will compromise to glorify back-of-the-envelope estimators.

Q. Despite significant growth over the years, why have local consulting firms not grown in size like those in Australia, UK, etc.?

Dato' Ir. Dr. Gue See Sew : Top consulting firms in Malaysia have actually shrunk in terms of size i.e. the number of employees. The largest consulting firm had 600 employees in the 1980s. Today, our largest consulting firm has only 500 employees. The Netherlands, with a population of 17 million (less than 60% of our population), has consultancy firms with over 20,000 employees.

There are two main reasons.

Our engineering consultancy firms face challenges in sustainability. They lack sustainable attributes. Many of them don't last beyond the founders.

Then there is lack of facilitation from the government and stakeholders. Very often, there is a mismatch in the appointment of engineering consultancy firms for large projects.

Q. What do you think is the key challenge in exporting geotechnical specialist skills to other countries?

Dato' Ir. Dr. Gue See Sew : We have the capability but we lack capacity. Malaysia has lost many geotechnical engineers to other countries, particularly Singapore and Australia. If we don't have the capacity, how can we export our services?

Ir. Kenny Yee Kwong Sing : Every country has a different story. I first ventured overseas 18 years ago and worked in 9 countries. It is not always smooth sailing. While the business dynamics keep changing, the fundamentals have not. To do well is to reflect on the lessons of past deals to improve the chances of success. Some of those lessons are critical, such as choosing partners that can make tangible business contributions, forms of business organization, safeguarding intellectual property, ensuring operational control, and managing talent. An in-depth understanding of the taxation system, legal system and dispute resolution, labour laws and immigration policy (for visas and work permits), importing and exporting regulations for plant and equipment, exchange control on importing and exporting investment funds, foreign investment incentives and restrictions are equally important. Political and social stability and an understanding of the cultural mandates of each country must not to be forgotten before you put your money on the table. Also, an in-depth knowledge of design codes used, codes of practice and local by-laws and regulations is a key requirement to technical management.

Last but not least, we need to "sell". We need to identify specific products or expertise that we can sell profitably. Developed markets are usually matured markets. Potential good markets are new markets with unknown risks. It's all about controlling risks. This is best described by an old saying : "Two roads diverged in a wood, and I took the one less travelled by, and that has made all the difference".

Q. How can we further develop the relationship with geotechnical engineers in the neighbouring countries?

Ir. Dr. Ooi Teik Aun : The Southeast Asian Geotechnical Society (SEAGS) was formed in 1967 with its secretariat in AIT Bangkok, Hong Kong, Singapore, Kuala Lumpur and Taipei. In December 2007 the Association of Geotechnical Societies in Southeast Asia (AGSSEA) was formed after Hong Kong, Singapore and Thailand left SEG Southeast Asian Geotechnical Conference was held in Taipei in 2010 and it was decided that the next conference (18 SEAGC-1 AGSSEAC) was to be held in Singapore.

These conferences help to coordinate the exchange of geotechnical engineering information and advances once in three years. The 19 SEAGC-2 AGSSEAC will be held in Kuala Lumpur in 2016. This is how the geotechnical communities kept close together.

IEM is the Engineering Secretariat for ASEAN Engineers Register and APEC Engineers Register. The Board of Engineers Malaysia (BEM) also regulates the registration of ASEAN Chartered Professional Engineer (ACPE). All these help to create mobility for engineers in the ASEAN region.

Different countries have different levels of geotechnical development. For example Hong Kong and Singapore are very advanced and they have well developed metro transportation systems. Its Mass Rapid Transit (MRT) is recognized as the benchmark for the level of geotechnical development because these systems have very deep tunnels and big spaces underground. There is no room for failure and very strict control is exercised during construction. In Singapore, one can virtually go anywhere by MRT. Singaporeans have been taken underground work to the next level and developed rock caverns to store ammunitions.

We are learning from Singapore. Malaysia brought a lot of experienced people who were involved in MRT work in Singapore to work on the MRT.

Cambodia now is very much like Malaysia of 40 years ago. For example, when it comes to piling, the people lack equipment. They don't even have cranes for heavy lifting. So the technology they need is different.

In Malaysia, we want to move away from the old methods of doing things. We want to introduce mechanized methods. We do off-site casting and then we transport the precast elements to site at night. We go underground so that work would not interfere with surface activities and the public won't see the tunnelling work.

Malaysia is ahead of Cambodia, so we are obliged to help the Cambodians so they won't have to make the same mistakes.

Hong Kong suffered a lot from landslides in the 1970s, so they also set very high standards of geotechnical practice. Its GEO (Geotechnical Engineering Office) is acknowledged as the worlds best.

By leaning from each other together we help to uplift the standard of geotechnical engineering practice in the ASEAN region and transform it into a region of opportunities and growth.

Q. What is the most valuable lesson you have learned, based on your past experiences?

Ir. Dr. Ooi Teik Aun : As a young engineer, I started in Public Works.

First, it was to carry out investigations of ground or site either a new building or an existing building which was having problems.

If it was a new site, my job was to determine the parameters for design.

On the other hand, when a project had failed, I would investigate the cause of failure and provide remedial rehabilitation work design.

The lesson was very simple. In most failed projects, there was not enough risk assessment. For example, if I want to do something, I must ask myself what can happen to the structure once it is completed.

Look at Highland Towers. I was on the committee investigating the collapse. Had the designer ever given thought to the possibility of a landslide?

No. He did not take care of the water flow. He allowed water to flow from one end of the building to the other end, so there were lots of chances for the water to leak into the soil. That was exactly what happened.

Before we proceed, we must think of what may go wrong. If something does go wrong, what will be our measure to mitigate the issue?

If it happens, the building must not collapse. It can crack but not collapse.

Dato' Ir. Dr. Gue See Sew : We must continue to improve the practice by finding better solutions to engineering problems in terms of lower construction costs, shorter time and lower long-term maintenance costs.

In addition, I would like to add that subsurface is not man-made and is often varied across a small site. Limestone formation, for example, can have significant variations within a distance of a few metres. This makes the geotechnical engineering profession very interesting and challenging.

Every project resting on the ground requires geotechnical input and projects are getting larger. The MRT project is an example of a mega project that requires intensive geotechnical input to ensure safety and cost effectiveness.

Ir. Dr. Ting Wen Hui : Thirst for knowledge and humility are good qualities required for learning in any study.

Ir. Yee Yew Weng : When I was a young consulting engineer, most of my world was black and white. The white represents the idealistic way of devising a design in strict adherence to codes, drawing up tough specifications and then ensuring that construction controls on site lock down each deviant practice.

The black represents every individual and mind-set that runs contrary to the white world. Closing my mind to ideas and thoughts of others and judging their actions based in my own subjective perception, were the biggest stumbling blocks in my career growth. Each time I was able to break out of such mental blocks, I was transported to another perspective, as the perceived black-white boundary became less important. The opinion of others should never be stifled but instead, should be allowed to be articulated, weighed and considered.

Q. How can we provide conducive career development for young geotechnical engineers?

Ir. Dr. Ooi Teik Aun : There is no such thing as creating a conducive environment. You must start from the bottom. You have to work on the ground to understand the issues.

Learn from a good senior engineer. If you want to someday design a 100-storey building, join a firm with an expert in the design and construction of a 100-storey building.

You must find the right place to work and you must look for the right mentor for the area of expertise you wish to specialize in.

Q. Any advice for young people who want to succeed in this field?

Ir. Dr. Ooi Teik Aun : There is plenty of potential in geotechnical engineering because with development, there will be more and more challenging projects ahead.

Buildings are getting taller, foundations more sophisticated and basements deeper. Today, we talk about basement 6-7 levels deep and this is very challenging. When you build a basement, you worry about movement. You also worry about the movement affecting a nearby building.

You have to learn instrumentation and a new system known as BIM (building information modeling) which allows everybody, from architect and engineer to quantity surveyor and landscape designer, to use the same software. They don't have to redraw from scratch. Everything is there. You just have to add your own design. You can even run a program to see the interaction between one another and if there is any conflict, for example if a pipe is installed, will it hit a beam? This is the kind of sophistication available today.

Young engineers have to spend more time reading and learning. Write as well and submit papers to journals, seminars and conferences. It's through writing that you will start thinking. When you write, you ask yourself all sorts of questions.

Ir. Kenny Yee Kwong Sing : Get a good mentor and remember the old saying : "Tell me and I forget, teach me and I may remember, involve me and I learn".

For those who aspire to be the big BOSS, this one is for you : The person who knows how will always have a job, and the person who knows why will always be the boss.

Dato' Ir., Dr. Gue See Sew : Geotechnical engineering is a very challenging profession. You will never get bored. Often, your value-adding to projects is appreciated. As challenges become increasingly more complex, the amount of engineering input becomes more significant. Projects are now getting larger and moving towards soft grounds and hilly terrains.

Ir. Yee Yew Weng : Engineering is a profession that requires detailed application. There is no short cut as technical knowledge is best learnt through experience. One has to practice many items, fail many times but keep getting up and taking a go at it again. These days, the young can work anywhere and do anything (well, almost) that he pleases. However, he needs to put passion into the task and become really skilful.

Ir. Dr. Ting Wen Hui : Besides the thirst for knowledge and humility, an inquisitive mind is needed.

(Courtesy Jurutera January 2015)