Forum on 'Is it Safe to Build on Slopes?'

By: Engr. Chua Chai Guan, MIEM, P.Eng. and Suvarna Ooi

INTRODUCTION

Following the decision of the Selangor State Government to ban development on Class III slopes, the issue of development on slopes has come under scrutiny among engineers and the public alike. Reference is made to the article entitled 'Debate on the pros and cons of hillside projects' published on 10 June 2008 in a local English daily. To chart a way forward, a Forum entitled 'Is it Safe to Build on Slopes?' was held on July 31, 2008 at Bangunan Ingenieur, Petaling Jaya at 5.30 p.m. Organised by the Geotechnical Engineering Technical Division (GETD), the forum also addressed several issues brought up by the 150 participants who attended the forum.

The panellists for the forum were Engr. Dr Gue See Sew, Past President of IEM; Ir. Yap Kok Ming, Immediate Past President of the Association of Consulting Engineers Malaysia (ACEM); Engr. Yee Thien Seng, a Committee Member of the GETD; and Ir. Dr Che Hassandi bin Abdullah, Head of Research and Development Unit of the Slope Engineering Branch of the Public Works Department (Cawangan Cerun) who represented Y. Bhg. Dato' Ir. Dr Ashaari bin Mohd; Senior Director of the Slope Engineering Branch.

Engr. Yee Yew Weng, Chairman of the GETD, welcomed those who attended the forum and read out the forum guidelines. He mentioned that IEM had written a position paper entitled 'Mitigating the Risk of Landslide on Hill-Site Development' in 2000 which was subsequently submitted to the Minister of Science, Technology and Environment in 2002. Among the recommendations of the position paper are:

(i) the slopes for hill-site development shall be classified into Class 1 to Class 3 according to the level of risk. Class 3 (>27 degree) being the highest level of risk.

(ii) For Class 1 development, existing legislation procedures can be applied. For Class 2 development, a Geotechnical Report by a Qualified Professional Engineer is mandatory. For Class 3 development, the developer shall also engage an Accredited Checker.

(iii) The Board of Engineers Malaysia shall carry out the registration of Accredited Checker to ensure only suitably competent and qualified engineers are engaged.

(iv) A new federal department to be called 'Hill-Site Engineering Agency' shall be formed under the Ministry of Housing and Local Government to assist local governments in respect to hill-site development.

Engr. Y.W. Yee remarked, **'It has been eight years since IEM drafted this paper. How effective has the paper been and do we need to revisit the position paper?'**

Next, Engr. Dr Chan Sin Fatt, a former Chairman of the GETD and moderator of the forum, addressed the floor. He said, 'Of all the branches in geotechnical engineering, slope engineering is one of the most complex fields and carries the highest amount of risk simply because of the level of uncertainty involved.' He encouraged comments from the floor, including differing views.

VIEWS FROM THE PANELLISTS

a) Engr. Dr Gue See Sew

The first panelist, Engr. Dr Gue, started off by referring to the Highland Towers disaster which he claimed collapsed due to design errors. He guided and explained from his six charts the causes that contributed to landslides. He referred to the IEM position paper entitled 'Mitigating the Risk of Landslide on Hill-Site Development' in which he said states that the main causes of landslides were:

- Design – inadequate ground investigation, lack of understanding of structural analysis and design.
- Construction – lack of quality assurance and quality control by contractors.
- Site Supervision – lack of proper site supervision by consulting engineers.
- Communication – lack of communication amongst various parties involved in construction particularly the site people and the design team.

Dr Gue explained that the findings were based on the limited investigation report made available to the committee at the time. He also referred to a paper he co-authored entitled 'Landslide: Case Histories, Lessons Learned and Mitigation Measures' which was presented in 2006. **Based on his personal experience, most slope failures in Malaysia are due to design errors.**

To help prevent future landslide disasters, Dr Gue made several suggestions. He said, 'Firstly, lecture modules should be developed for undergraduates to strengthen their fundamentals. Often, the lecturers reproduce the same lecture notes for the students, thus there is no improvement. Furthermore, I also hope that IEM and ACEM can pool resources to help lecturers or practitioners produce training modules for graduates.'

Finally, he advocated for proper engineering methods such as the planning of site investigation (SI), field supervision and inspection of laboratory works; the proper interpretation and selection of parameters, and the determination of the water profile especially with long term monitoring;

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analyses, design and specification; the supervision of construction by consulting engineers; and the implementation of a maintenance schedule.

b) Ir. Yap Kok Ming

The next speaker was Ir. Yap who made a comparison of slope development in other countries, namely, Hong Kong. He said, 'According to data provided by the Hong Kong Geotechnical Engineering Office, there are 54,000 registered slopes in Hong Kong. The recorded annual rainfall is 2,300mm, which is about the same in Malaysia. Even in Hong Kong, many landslides occur every year with an average of 300 to 400 landslides.'

Ir. Yap pointed out some of the common causes of landslides in Hong Kong. Among the natural factors are heavy rainfall which can lead to damage to slope surface protection, erosion of soil, infiltration of water into soil or rock and rise in the groundwater table; and adverse geological features such as exposed boulders and weak weathered seams.

He also shared human factors that can contribute to slope failures such as inadequate design or construction which includes slope designs that are not up to safety standards, temporary works that are not properly designed and slope works that are not properly constructed; leakage from buried water pipes or sewers; and lack of regular slope maintenance that could lead to deterioration and failure.

Referring to the current situation in Malaysia, Ir. Yap said, 'We need to be honest with ourselves as to what the true situation is in terms of the design and management of slopes in Malaysia'. He added, 'We can have development on slope, but we have to consider the following issues such as proper design and construction; tight checking and approval system by authorities during design, construction and post-construction; check existing drainage system and propose adequate drainage system; and proper regular maintenance.'

In concluding his presentation, Ir. Yap said, 'Currently in Hong Kong, most slope failures are not due to design failures because the approval and checking system is very stringent. Although Malaysia also has its own checking system, it has to ensure that it is strictly enforced. **In Hong Kong, checks are conducted during the design, construction and even during the post construction stage. Maybe this is something we can consider.'**

c) Engr. Yee Thien Seng

Engr. T.S. Yee felt that the collective global geotechnical engineering fraternity possesses the necessary knowhow to make quantitative assessments into the state of stability in a slope that should sufficiently err on the side of caution. He said, 'It has been established since 1970 that 'fully softened' soil strengths operate in slope stability problems and neither cohesion nor dilatational strengths contribute towards resistance to failure in a slope. The knowledge of the fact that soil suctions in the ground get very rapidly and almost totally eliminated upon exposure to rainfall and the ability to record the highest phreatic surface in the field also help to this end.'

Engr. T.S. Yee added, 'All these, together with stability analysis tools available to the industry, should permit slope engineers to work satisfactorily with a far lower Factor of Safety (FoS) than those enjoyed by other branches of civil engineering. The adverse groundwater regime is the highest phreatic surface in the slope body which will determine its most critical state of stability. The water level in the ground at the instance of measurement will most probably not be the highest or most adverse. We need to use a system capable of recording the highest groundwater table in the slope.'

When he brought up the issue on instruments for landslide warnings, Engr. T.S. Yee said, 'The deformations required to reach failure are very small and the loss of soil suctions is almost instantaneous when subjected to rain infiltration. So when a slope failure occurs, it takes place very abruptly, and there is practically no reaction time for crucial instrument measurements to be of use.'

He added that after the Highland Towers disaster, the Accredited Checkers Register was setup, and is currently maintained by the Board of Engineers, Malaysia. Engr. T.S. Yee said, 'These checkers are supposedly the cream of practising slope engineers in the country. Yet, for the record, there are slopes designed by engineers who are also Accredited Checkers which have collapsed. There are also slope engineering designs checked by individuals who are Accredited Checkers that too suffered failure. Apparently, the accredited design checking process is not serving its intended objectives.'

He gave an account where an advertorial from an Accredited Checker, published in the June 2007 issue of JURUTERA, was labelled as a 'misleading message' by a fellow Accredited Checker in a letter to the editor which was published in the July 2008 of JURUTERA. **Such events go to show that the present register of Accredited Checkers is not exclusively populated with individuals possessing the requisite capabilities in slope engineering and that the Accredited Checker system is not necessarily working for the good of society.**

Engr. T.S. Yee said, 'As a way forward, we could agree to ban all construction on slopes, or implement a severe penalty on the responsible individuals involved like the endorsing engineer and the checking engineer when the constructed works under their purview collapse, leading to the loss of lives and/or properties as practised in a neighbouring country.' He had earlier also pointed out that Mechanism No. 5 offered in the Majlis Perbandaran Ampang Jaya Report by the Highland Towers Inquiry Committee as the one being instrumental for the actual collapse of Block 1 does not stand up to scrutiny by soil mechanics.

d) Ir. Dr Che Hassandi bin Abdullah

The last panellist to speak was Ir. Dr Che Hassandi, who gave a short presentation on the guidelines being used by the government and the local councils. He said, **'The issue we need to address now is why the authorities need to have these guidelines. I believe the main reason is because, at the local council level, they do not have the capacity to monitor slope development.** Take, for example, the Ampang Municipal Council (MPAJ) who has only one engineer to look after the whole area.'

Ir. Dr Che Hassandi added, 'Besides slope development, the engineer is also responsible for the design, development and construction of buildings. This is the reason why engineers prefer to have these guidelines. In fact, they may prefer not to have any development on slopes. At the end of the day, when a disaster occurs, these engineers are the ones who will receive the flak for not doing their job properly. The pressure on the government is worse with the establishment of a one-stop centre which requires a development to be approved within two weeks.'

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FEEDBACK FROM THE FLOOR

When the last speaker finished his presentation, the Chairman opened the floor for discussion.

a) Engr. Dr Ooi Teik Aun, a committee member of the GETD, was the first to speak up. He said, 'I would like to bring you all back to the scene of the Highland Towers collapse as referred to by Dr Gue and Engr T.S. Yee. The Highland Towers was built in 1976, and 18 years later on 11 December 1993, Block 1 collapsed after 10 days of continuous rainfall. In addition, Blocks 2 and 3 was considered and declared unsafe or unfit for occupation by MPAJ. '

He continued, 'I must point out that the Ampang Jaya report was not accepted in total by the High Court, only the factual material recordings were accepted. In other words, the facts and data, were accepted. Engr. T.S. Yee may be happy to know that only rotational slides of 1-4 were accepted by the High Court.'

Engr. Dr Ooi elaborated that the landslide that brought down Block 1 of the Highland Towers was found by the High Court to have been the retrogressive rotational slides originating from the high retaining wall behind the second of the three tier car-park behind Block 1. All drainage experts who testified in the case agreed the flow regime of the east stream originating from the ground of a neighbouring development on the higher slope into the pipe culvert running across the hill is highly undesirable and dangerous. This water emanated from the poor and non maintained drainage as well as the leaking pipe culvert carrying water from the diverted east stream. Water from the east stream thus overflowed the slope. **Hence, the major cause of failure is due to lack of maintenance of the drainage of the site and not design error.**

Engr. Dr Ooi also pointed out the impact of the court's ruling on the building industry, which included among others:

- That Building Professionals are duty bound to design for the environment of the site as well as the site itself in assessing risks to safety particularly in hillslope development.
- Building professionals cannot hide behind a limited scope of engagement.
- Building professionals are required to ensure that those engaged to design and supervise are competent and carry out their work in workman-like manner.
- If building professionals claim to have expertise in a particular area in which they are unqualified, their conduct will be measured against ordinary competent qualified practitioners of such expertise.
- Building professionals must ensure that the law is followed by reporting to the authorities, if necessary, if the client breaks the law even at the risk of being discharged by the client.

Engr. Dr Ooi said, 'After the Highland Towers tragedy, the local council became more cautious because of pressure groups who came up with a very complicated system of checking. Although slope development on Class I and II slopes go through the normal process, Class III and IV requires many layers of geotechnical reports. The project is then scrutinised by many organisations including Kumpulan Ikram Sdn Bhd (Ikram) and other relevant authorities before a very powerful committee makes its final decision. We have a very strict system at the moment. There is no reason for slope failure due to design under such a system.'

b) The next person to speak up was Engr. Shaik Abdul Wahed bin Dato' Hj. Rahim, Director of Jurutera Perunding GEA (M) Sdn Bhd. He said, 'We should get back to basics. Before designing a slope, we should get our information right, and that means SI. However, almost all the public sector SI is being carried out by an entity over which engineers have no control.' Engr. Shaik continued, 'Next, we come to the issue of supervision of the construction itself. As far as the design is concerned, most of our slopes are designed in isolation. We only consider the properties (premises/assets) we are working with, but ignore the overall picture, i.e. how they affect each other.'

c) At this point, Engr. Liew Shaw Shong, Secretary/Treasurer of the GETD, said, 'Very often, the design engineer encounters a dilemma when designing a project either at the foothill, in the middle or at the top of the hill. If the designer takes the hill into consideration in his analysis, he will find that very often, he will not have enough FoS. The question is, to what extent should the design engineer consider the issue of stability of the slope? On the other hand, I share the same belief that a guideline is important as there is currently no guideline that can be used as a reference by geotechnical engineers for checking purposes. What guideline is the checker checking against?'

d) In reply, Ir. Dr Che Hassandi said that although a guideline for slope development was a good idea, he is concerned that it will be made legally binding. Instead, he believes there is a need for self policing. He said, 'Being an engineer, I understand that having a guideline can lead to proper SI as well as proper design and construction. However, even if a single link in this chain is broken, either at the design or construction stage, it will tarnish the reputation of the engineer. At the same time, the authorities may also come out with guidelines that are almost impossible to follow. As a professional, we should look into self policing, which requires a lot of discipline.'

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e) Still on the issue of guidelines, Dr Gue pointed out that there are two types of guidelines to consider, namely, design guidelines and policy guidelines. He said, 'When it comes to policy guidelines, IEM, Ikram and Minerals And Geoscience Department, Malaysia (JMG) each has its own set of guidelines. So what do we do now? Which one should we follow? In practice, if you submit your report to JMG, you follow JMG's guidelines. My suggestion is to harmonise all these policy guidelines. Get representatives from JMG, Ikram and IEM to discuss and determine how we can move forward.'

f) Eriko Motoyama, a consultant to the Program For Public Awareness and Education, JKR, said, 'While creating public awareness on slopes, I talked to several resident associations, and from the feedback that we got, the public queries the need for them to get involved in slope maintenance, or any kind of community based initiative, because they feel that they are not seeing much action taken by the local authorities.'

She added, 'On the other hand, when we talk to the local authorities, they have mentioned a desire for a standard set of guidelines. However, with so many guidelines around, we are unsure as to which one to lead them to. With each organisation having their own set of guidelines, I have to agree with Dr Gue that it is a good time to consolidate all of it. I really feel there should be one consolidated version that everyone can refer to so that we can be on the same page.'

g) In response, Engr. T.S. Yee said, 'I can only agree with Motoyama that society has lost its faith in us, the engineers. We can only blame ourselves for not doing a good enough job. Maybe it is time that we collect ourselves and try to regain back control as well as regain the faith of society.'

h) When Dr Ooi suggested that the Slope Engineering Branch of the Public Works Department, Malaysia, would be the best organisation to consolidate the guidelines, Ir. Dr Che Hassandi responded , 'Although we would like to do that, we need to realise this effort takes time. Since it was established in 2004, the organisation has been kept busy doing slope inventory on JKR roads all over Malaysia, including Sabah and Sarawak. The other difficulty is, the organisation is not given blanket authority to go into areas under the local councils. We need the help of the town councils who, in turn, need to get approvals from the individual landowners.'

i) Engr. Lee Heng Keng, Deputy Director-General of the Department of Environment (DOE), who was involved in the guideline for highland development, said in his personal capacity, 'I believe slope development was banned because there have been too many failures in the past. One failure is bad enough, but with so many disasters occurring, the authorities are looking for a quick solution. If the failure of a slope development can be easily determined, what is the penalty against the perpetrators?'

He added, '**Besides looking at how to discipline the people involved, the institution should also try to instil a sense of professionalism among the practitioners.** Also, allow me to point out that the original guideline was meant for highland development and not for slope development. Perhaps this is a good time to develop a set of guidelines specifically for slope development.'

j) Reiterating the message, Engr. Shaik said, 'We are not as good an engineer as we should be. We are using information blindly and we do not supervise our designs. Indeed, how many times have we done work where the client insisted on using his own engineer to supervise our design? The other issue is the lack of maintenance.'

k) Engr. Allen Cheong, Executive Director of Cara Ikram Sdn Bhd, came to the defence of local engineers. He said, 'I do not agree that Malaysia engineers are no good. In fact, I believe there are many good engineers here. The question is how we can constantly improve ourselves.'

l) Engr. Mokhtar Sheikh bin Mohamed, the Principal of Perunding Seri Alam, was the next one to speak up. He said, 'I believe that engineers should be involved in the design, construction, supervision and maintenance stages of a project. This is part of their responsibilities and they are accountable for it, even to the extent of future development.'

He continued, 'However, the reality is, engineers are only required at the design stage in most cases. They are not allowed to follow-up, and often, the supervision is done by the client's personnel. The irony is, the former is still responsible for the project even though they are not supervising it. **I believe that engineers should be in control and be given the chance to follow a project right through, from the very beginning to the very end, including maintenance.**'

Engr. Mokhtar concluded, 'Personally, I have been involved in various stages of a project including the supervision of construction, maintenance, and even the retrofitting of slopes. I have found that at certain stages, the quality of work is not up to standard, resulting in the need to strengthen such slopes. '

m) Concurring with Engr. Mokhtar's views, Dr Chan said, 'The geotechnical engineer who created the design should follow up by supervising for the simple reason that most geotechnical designs are only tentative up to the construction stage. Usually at the design stage, there is not enough information to work on, and the missing information is only uncovered during construction. I think engineers must make a case that, in general, the supervision of geotechnical work must be conducted by the people who created the original design as only they will know to what extent the design is tentative and what needs to be completed.'

n) The final comment came from Tan Boon Kong, who said, 'I would just like to point out that the JMG guidelines for Class I to Class IV slopes was developed by one of my colleagues who is a geologist. However, when the proposal was submitted to the authorities, the classification for Class IV slopes was changed. In the latest development, the authorities have even banned development on Class III slopes. Perhaps it is time for engineers to refer to the original proposal, and to determine the justification for not allowing development on Class III and Class IV slopes.'

APPRECIATION

Engr. Y.W. Yee brought the forum to a close at 7.30 p.m. He thanked all the participants who attended the forum and, on behalf of IEM, gave out mementos to the panellists. ■