HK40
SLOPE SAFETY FOR ALL
斜坡安全．人人受惠

斜坡安全四十載
40th Anniversary of Hong Kong Slope Safety System

紀念特刊
Commemorative Brochure

CEDD
土木工程拓展署
Civil Engineering and Development Department

發展局局長賀辭
Message from the Secretary for Development

黃偉綸先生
Mr Michael W L Wong
發展局局長
Secretary for Development

二零一七年是香港特別行政區成立二十周年，欣逢也是土木工程拓展署轄下的土力工程處成立四十年，我藉此熱烈祝賀，並對該處自成立以來在香港斜坡安全上所作的卓越貢獻深表讚賞。

香港地少山多人多，城市基建急速發展，加上獨特的地質和多雨氣候等自然因素，斜坡安全問題是社會發展的一個長期隱憂。香港在土力工程處的專業團隊堅定不移的努力下，成功改善斜坡安全問題，令昔日的山泥傾瀉災難於近年不再復現，而既安全又美觀的斜坡則隨處可見。該處亦透過持續的公眾教育工作，成功把斜坡安全意識深深植根到市民大眾心中。這些佳績已為香港長遠的可持續發展奠下穩固的基礎。

在氣候變化的背景下，防範山泥傾瀉的工作必定會充滿挑戰。秉承四十年的良好聲譽和實事求是的精神，我深信土力工程處定能繼往開來，扮演領導角色，盡力控制山泥傾瀉災害，確保公眾安全。

The year 2017 marks the twentieth anniversary of the establishment of the Hong Kong Special Administrative Region. This year is also the fortieth anniversary of the setting up of the Geotechnical Engineering Office (GEO) of the Civil Engineering and Development Department. I am pleased to offer my warmest congratulations to the GEO, and to express my deep appreciation for its remarkable contribution to slope safety in Hong Kong.

Hong Kong is a densely populated and fast growing city with hilly terrain. Coupled with its unique geographical setting and rainy climate, landslide hazard is a long-term threat to the city's development. With the unswerving efforts of GEO's professional team, slope safety in Hong Kong has been improved considerably. Landslide disasters that repeatedly occurred in history have no longer taken place for years. Instead, safe and green slopes are now found around our neighbourhood. Also, the GEO has succeeded in instilling slope safety messages in the general public through continuous public education efforts. These achievements have laid a solid foundation for Hong Kong's long-term sustainable development.

Against a backdrop of climate change, guarding against landslides will always be challenging. With its reputation acquired over the past four decades and its pragmatic spirit in work, I am confident that the GEO will stride onwards and continue to play a leading role in combating landslide disasters to ensure public safety.

發展局常任秘書長（工務）賀辭
Message from the Permanent Secretary for Development (Works)

韓志強先生
Mr C K Hon
發展局常任秘書長（工務）
Permanent Secretary for Development (Works)

土力工程處在過去四十年跟市民一起共渡風雨，致力為香港處理山泥傾瀉的問題，成績有目共睹，我謹藉此機會致以衷心的謝意。

我在2011至2015年出任土木工程拓展署署長，因此曾親身見證著土力工程處對香港斜坡安全所作出的貢獻。事實上，經過四十年的努力，香港現時的山泥傾瀉風險已大幅降低，而土力工程處建立的斜坡安全系統更得到國際的認同和嘉許，成為其他國家的模楷。我對香港斜坡安全工作的成就感到欣慰，除了感謝同事們多年來的努力不懈，亦十分讚賞他們那份無懼天災威脅、誓保市民生命財產的使命感。

面對極端天氣、人口增加及斜坡老化等問題，土力工程處未來的斜坡安全工作仍然充滿挑戰。我堅信土力工程處的同事定會繼續悉力以赴，為市民服務。發展局亦將一如既往，繼續投放資源支持土力工程處應對山泥傾瀉的挑戰，為香港市民創造一個安全優質的生活環境。

In the past 40 years, the Geotechnical Engineering Office (GEO) has walked through rains and storms with Hong Kong people and dedicated their uttermost efforts in tackling landslide problem. I would like to extend my heartfelt gratitude to the GEO for their remarkable achievement in enhancing slope safety.

During my term of service as the Director of Civil Engineering and Development from 2011 to 2015, I had myself witnessed the invaluable contribution made by the GEO in Hong Kong's slope safety. Upon 40 years of endeavour by the GEO, the Hong Kong Slope Safety System has significantly reduced the risk of landslide in Hong Kong and won worldwide recognition and appreciation as the role model for other countries. I am not only grateful towards the achievements made by the Hong Kong Slope Safety System, but also thankful for the indomitable spirit as found among GEO colleagues in combating landslide risk. Their sense of mission in safeguarding the lives and properties of the public from the threat of landslide disasters has won my most sincere respect.

However, in the midst of extreme weather, population growth and slope deterioration, the path ahead of GEO's slope safety work remains challenging. I am confident that colleagues of the GEO will continue their endeavour in serving the public. As always, the Development Bureau will continue to allocate resources supporting GEO's slope safety work to create a safe and quality living environment for Hong Kong people.

土木工程拓展署署長獻辭
Message from the Director of Civil Engineering and Development

林世雄先生
Mr S H Lam
土木工程拓展署署長
Director of Civil Engineering and Development

香港山多雨水亦多，且每年都會經歷多次颱風的挑戰，加上在土地資源非常短缺的限制下，很多樓宇、馬路和設施都必須依山而建。因此，香港一直面對著嚴峻的山泥傾瀉威脅。六、七十年代多宗的山泥傾瀉災難催生了土力工程處，專責斜坡安全的工作。

土力工程處自1977年成立以來，肩負了處理本港的山泥傾瀉問題，成績有目共睹，深受市民讚賞。而在山泥傾瀉風險管理、斜坡工程標準制定、設計和監管等範疇的表現在國際岩土工程界內備受推崇。時至今日，本港的斜坡安全已達世界級水平。然而，山泥傾瀉的風險永遠存在。近年世界各地的天災因氣候變化而越趨頻繁，土力工程處重點加強公眾教育，提醒市民大眾居安思危，防災於未然。

展望未來，土力工程處將繼續努力，緊守崗位，做好專業工作，使斜坡安全更臻完善，以符合市民的期望和香港社會發展的需要。最後，我希望藉此機會向土力工程處全體同事的貢獻致以由衷的謝意。我亦在此感謝發展局一直以來對土力工程處的工作予以支持和信任。

The hilly topography and rainy weather of Hong Kong, together with the challenges from seasonal typhoons and limited land resources which made lots of our buildings, roads and facilities to be built adjacent to hillsides, expose Hong Kong under the threat of severe landslide risk. The tragic landslides in the 1960s and 70s led to the establishment of the Geotechnical Engineering Office (GEO) to look after slope safety.

Ever since its establishment in 1977, the GEO has devoted its effort to tackle landslide problems in Hong Kong. The significant achievements have gained wide recognition from the public. GEO's work in landslide risk management, setting of standards in slope engineering design and geotechnical control is often praised by geotechnical professionals worldwide. Slope safety in Hong Kong is nowadays commensurate with the highest international standard. However, the risk of landside will never vanish. In light of the increasing frequency of natural disasters around the world due to climate change, the GEO has enhanced public education, in particular, so as to raise the awareness and vigilance of the public towards landslide risk.

Looking ahead, the GEO will continue to dedicate its effort to perfecting the Slope Safety System and meeting the ever-rising expectation of the community and the development needs of Hong Kong. Finally, I would like to take this opportunity to express my heartfelt gratitude to all of the GEO colleagues for their contribution. I would also like to thank the Development Bureau for their continued support and confidence in the work of the GEO throughout these years.

序言
Foreword

潘偉強先生
Mr W K Pun
土力工程處處長
Head of the Geotechnical Engineering Office

二零一七年對土力工程處別具意義。因為今年是本處成立的四十周年，標誌著我們的斜坡安全工作已經踏入第四十個年頭。

土力工程處過去數十年不斷優化香港的斜坡安全系統，透過多元化的策略，成功把山泥傾瀉的風險控制在低水平。相比土力工程處成立初期，山泥傾瀉死亡人數已經大幅下降，這正好反映我們斜坡安全工作的成效。雖然香港的斜坡安全系統已頗具聲譽，但我們眼前還有很多挑戰，例如極端天氣、斜坡老化和城市發展，這些因素都會增加香港的山泥傾瀉風險。故此我們不能因而自滿，必須繼續精益求精，務求令香港免受山泥傾瀉的威脅，繼續成為一個安全宜居的城市。

身為土力工程處處長，我很榮幸能夠見證香港斜坡安全工作的發展和成就，並謹此感謝過往和現職的土力工程處全體人員。他們多年來努力不懈、上下一心、竭盡所長，為香港市民提供優質服務，保持斜坡安全的最高標準。

本紀念特刊載述土力工程處的發展、香港斜坡安全系統的背景和資料、近年標誌性的成就，以及對未來的展望。我謹向各位參與籌備這本紀念特刊的同事致謝。

潘偉強

The year 2017 carries a special meaning to the Geotechnical Engineering Office (GEO), as it is the fortieth anniversary of the setting up of the GEO and the Hong Kong Slope Safety System.

The Hong Kong Slope Safety System has been evolving over the past few decades and has successfully reduced the risk of landslides to a low level through multi-pronged strategies. Compared to the early days, the number of landslide fatalities has dropped significantly, reflecting the effectiveness of our slope safety work. Although the Hong Kong Slope Safety System is internationally renowned, there are many challenges ahead. Factors such as extreme weather, slope degradation and urban development encroaching onto hillsides may increase the landslide risk. There is no room for complacency and we will continue to strive for excellence so as to protect Hong Kong from the threat of landslides and keep the city safe and livable.

As the Head of the GEO, I feel privileged to witness the growth and achievements of the slope safety work in Hong Kong. I would like to express my gratitude to all the staff of the GEO, past and present, for their dedication over the years in providing quality service and maintaining the highest standards of slope safety.

This commemorative brochure gives an account of the development of the GEO, background and details of the Hong Kong Slope Safety System, iconic achievements in recent years and vision ahead. I would like to thank my colleagues involved in the preparation of this brochure.

土力工程處組織架構
Organisation of the Geotechnical Engineering Office

土力工程處處長
Head of the Geotechnical Engineering Office

何建生先生
Mr Ken K S Ho

土力工程處副處長（防止山泥傾瀉）
Deputy Head of the Geotechnical Engineering Office (Landslip Preventive Measures)

- 防止山泥傾瀉部1 Landslip Preventive Measures Division 1
- 防止山泥傾瀉部2 Landslip Preventive Measures Division 2
- 防止山泥傾瀉部3 Landslip Preventive Measures Division 3

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- 港島部 Island Division
- 斜坡安全部 Slope Safety Division

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- 九龍及新界東部 Mainland East Division
- 九龍及新界西部 Mainland West Division
- 礦務部 Mines Division

鍾偉強先生
Mr Philip W K Chung

土力工程處副處長（規劃及標準）
Deputy Head of the Geotechnical Engineering Office (Planning and Standards)

- 規劃部 Planning Division
- 標準及測試部 Standards and Testing Division

本處的使命
Our Mission

土力工程處透過實踐卓越的岩土工程作業標準、與社會和專業界別並肩合作，以及全體員工群策群力，致力在斜坡安全及工程發展方面達至最高標準，滿足香港的需求。

The Mission of the Geotechnical Engineering Office (GEO) is to meet Hong Kong's needs for the highest standards of slope safety and engineering development through excellence in geotechnical practice, partnership with the community and the profession, and dedicated teamwork of all staff.

HK40
SLOPE SAFETY FOR ALL
斜坡安全・人人受惠

二零一七年是土力工程處和香港斜坡安全系統成立四十周年，我們特別為此設計了一個紀念標誌。標誌貫徹了土木工程拓展署標誌的藍綠色調，當中「HK」字樣代表高樓大廈，而「40」字樣上的三根「泥釘」就象徵土力工程處為保護香港市民和城市發展免受山泥傾瀉威脅所作的努力。標誌的「綠葉」代表著土力工程處對美化斜坡和優化環境的重視，而「斜坡安全 • 人人受惠」則是我們一貫秉持的理念。

The year 2017 is the 40th Anniversary of the GEO as well as the Hong Kong Slope Safety System. An anniversary logo was designed to mark such a memorable occasion. The logo adopts the same colours of that of the Civil Engineering and Development Department (CEDD), with the letters "HK" signifying the tall buildings and the three "soil nails" on the number 40 representing GEO's efforts in safeguarding the city and the people of Hong Kong from landslide hazards. In addition, the "green leaves" symbolise GEO's emphasis on landscaping slopes and beautifying the environment. Last but not least, "Slope Safety for All" has always been our objective to achieve.

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風雨同渡　轉危為安
Facing Challenges • Building Resilience

1925年普慶坊山泥傾瀉 – 75人死亡
Po Hing Fong Landslide in 1925 – 75 fatalities

1966年北角山泥傾瀉 – 1人死亡
North Point Landslide in 1966 – 1 fatality

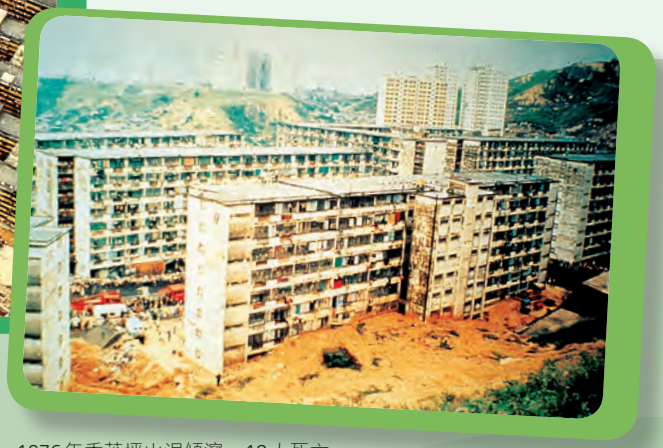
1966年山頂道山泥傾瀉 – 主要道路中斷
Peak Road Landslide in 1966 – Major road damaged

1972年寶珊道山泥傾瀉 – 67人死亡
Po Shan Road Landslide in 1972 – 67 fatalities

香港人口稠密，山多平地少，建築物與道路需依山而建，因而製造了很多陡峭的人造斜坡，加上季候性大雨，容易引發山泥傾瀉。七十年代的幾宗大型山泥傾瀉摧毀了不少家園，更令多人喪生。有見及此，政府於1977年成立專責部門處理斜坡問題，亦即是現在土木工程拓展署轄下的土力工程處。多年來，土力工程處一直與市民共渡風雨，透過建立斜坡安全系統逐步改善問題。

Hong Kong is densely populated and most of the land is hilly terrain. Many buildings and roads have to be built along hillsides, resulting in a large number of steep man-made slopes. Under the influence of seasonal rainstorms, Hong Kong is susceptible to landslides. Major landslide incidents in the 1970s claimed many lives and destroyed numerous homes. In light of this, the Hong Kong Government set up the Geotechnical Control Office in 1977 to tackle the slope safety problems. It was later re-named the Geotechnical Engineering Office (GEO), and is currently under the Civil Engineering and Development Department. Over the years, the GEO has been protecting the public through implementation of the Slope Safety System to gradually reduce landslide risk in Hong Kong.

1972年秀茂坪山泥傾瀉 – 71人死亡
Sau Mau Ping Landslide in 1972 – 71 fatalities



1976年秀茂坪山泥傾瀉 – 18人死亡
Sau Mau Ping Landslide in 1976 – 18 fatalities

1992年碧瑤灣山泥傾瀉 – 2人死亡
Baguio Villa Landslide in 1992 – 2 fatalities

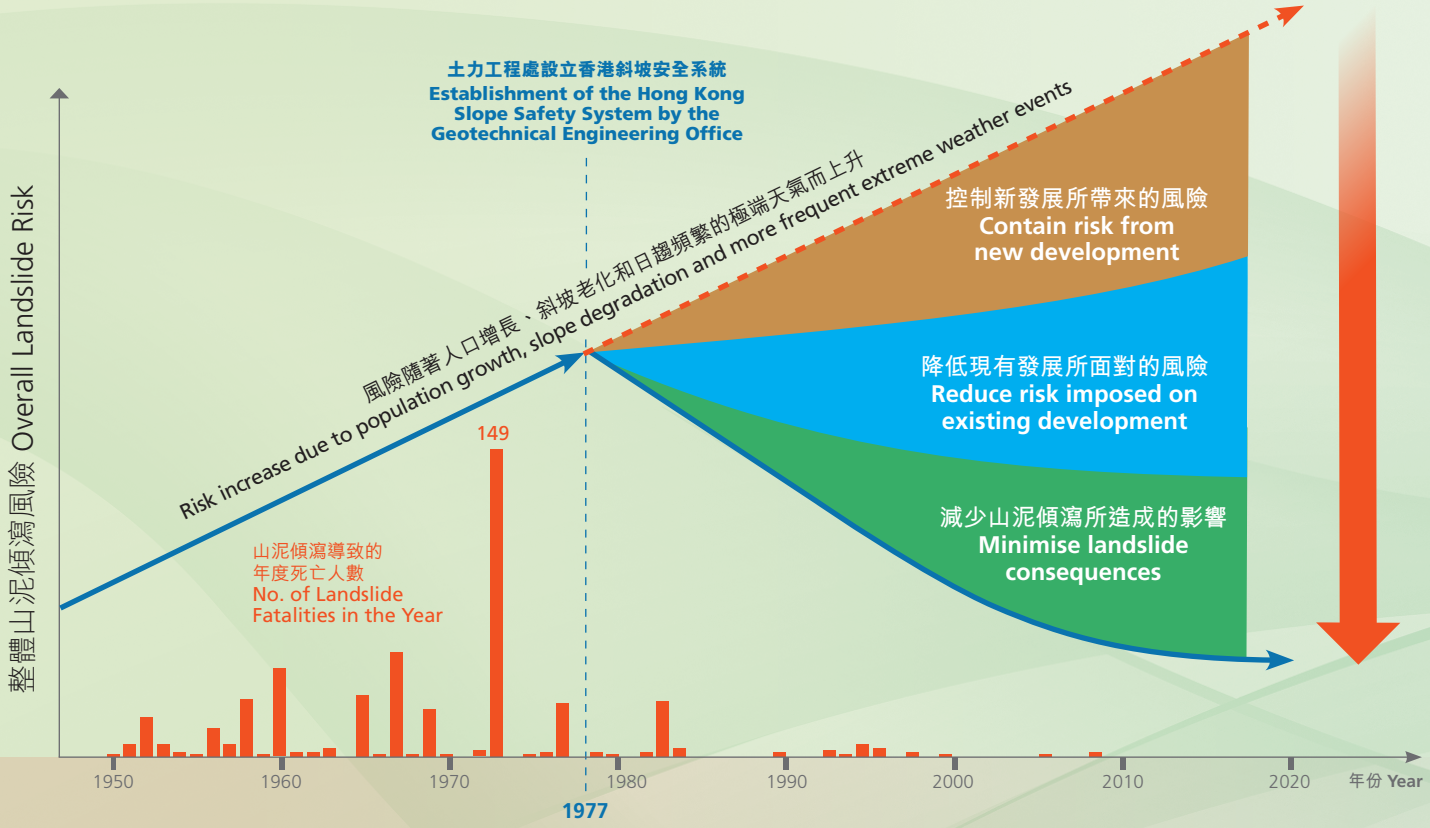
1994年觀龍樓山泥傾瀉 – 5人死亡
Kwun Lung Lau Landslide in 1994 – 5 fatalities

1995年深灣道山泥傾瀉 – 2人死亡
Shum Wan Road Landslide in 1995 – 2 fatalities

2008年舊咖啡灣山泥傾瀉 – 2人死亡
Cafeteria Old Beach Landslide in 2008 – 2 fatalities

香港斜坡安全系統
Hong Kong Slope Safety System

土力工程處自1977年成立以來，一直致力於改善香港的山泥傾瀉問題和提升岩土工程規管，並逐步設立一套全面的斜坡安全系統，從不同層面和範疇降低山泥傾瀉的潛在風險，成效顯著。香港現時的整體山泥傾瀉風險已較1977年的水平大幅下降超過七成半，而山泥傾瀉導致的傷亡亦已明顯減少。



審核發展圖則
Auditing development plans

清拆山區寮屋
Clearing hillside squatters

鞏固不合標準斜坡
Upgrading substandard slopes

Since its establishment in 1977, the GEO has strived to tackle landslide problem and regulate geotechnical engineering works. It also developed a comprehensive slope safety system to effectively monitor and minimise landslide risk through the implementation of multi-pronged strategies. The overall landslide risk in Hong Kong has been remarkably reduced to less than one-fourth of the risk level in 1977. Casualties due to landslides have also dwindled significantly in recent years.

- 管制新發展項目
  Control new developments
- 勸阻非法耕種及違例土地平整
  Discourage illegal cultivation and unauthorised site formation

- 鞏固及維修政府斜坡
  Upgrade and maintain government slopes
- 推動私人斜坡維修
  Promote private slope maintenance
- 緩減天然山坡山泥傾瀉災害
  Mitigate natural terrain landslide hazards

- 清拆山區寮屋
  Clear squatters from hilly terrain
- 發布山泥傾瀉警告
  Issue landslip warnings
- 教育公眾採取預防措施
  Educate public on precautionary measures
- 提供山泥傾瀉緊急服務
  Provide landslide emergency services

土力工程處緊急應變中心
GEO Emergency Control Centre

斜坡維修社區諮詢服務
Slope maintenance community advisory services

山泥傾瀉警告牌
Landslip warning signs

公眾教育活動
Public education activities

居安思危　未雨綢繆
Planning Ahead • Preparing for the Worst

2008年北大嶼山天然山坡山泥傾瀉
North Lantau Natural Terrain Landslides in 2008

2008年大澳天然山坡山泥傾瀉
Tai O Natural Terrain Landslides in 2008

香港人口不斷增加，城市發展愈來愈接近山邊，令山泥傾瀉所引致的風險與日俱增。加上氣候變化帶來的極端天氣及斜坡老化的影響，山泥傾瀉的潛在風險實在不容忽視。 居安思危，土力工程處於2010年推行「長遠防治山泥傾瀉計劃」，藉以更有系統地處理天然山坡和人造斜坡的山泥傾瀉風險。2008年6月大嶼山經歷了一場特大暴雨，並引發了多宗天然山坡山泥傾瀉，影響廣泛。事件正好說明處理山泥傾瀉災害必須未雨綢繆，因應環境變遷而作出適當部署。

Landslide risk is increasing with time due to the continual population growth of Hong Kong, which has resulted in encroachment of more urban development onto steep hillsides. The potential landslide risk brought about by slope degradation and extreme weather, which can be exacerbated by climate change, must not be overlooked. Planning ahead, the GEO launched the Landslip Prevention and Mitigation Programme (LPMitP) in 2010, managing the landslide risk of both natural terrain and man-made slopes in a more holistic manner. In June 2008, a record-breaking rainstorm triggered a large number of significant natural terrain landslides in Lantau, causing extensive impact to various facilities. This demonstrates the importance of getting prepared for extreme landslide events through taking suitable measures in response to a changing environment.

2008年北大嶼山公路天然山坡山泥傾瀉，導致通往香港國際機場的主要幹道被封閉約16小時
North Lantau Highway Natural Terrain Landslide in 2008, resulting in closure of major transport corridor to the Hong Kong International Airport for about 16 hours

2008年香港大學天然山坡山泥傾瀉，導致周亦卿樓部分樓層受損
University of Hong Kong Natural Terrain Landslide in 2008, resulting in damage to several floors of Chow Yei Ching Building

2008年羣山道天然山坡山泥傾瀉，導致通往大澳的道路被封閉14天
Keung Shan Road Natural Terrain Landslide in 2008, resulting in closure of access road to Tai O for 14 days

2008年裕東路天然山坡山泥傾瀉，導致西行線被封閉4天
Yu Tung Road Natural Terrain Landslide in 2008, resulting in closure of westbound traffic lanes for 4 days

天然山坡山泥傾瀉災害的緩減策略
Natural Terrain Landslide Hazard Mitigation Strategy

外國及本地的經驗說明在極端天氣影響下，天然山坡山泥傾瀉災害不容忽視。處理天然山坡山泥傾瀉災害一般會採用風險緩減措施，例如在山坡下興建混凝土泥石壩和柔性防護網，阻擋塌下的泥石湧入民居或道路而造成傷亡。由於不涉及大範圍的鞏固工程，風險緩減措施除了成本較低之外，還可以避免對環境做成不必要的影響。再加上合適的美化措施，天然山坡的外貌及狀況更可得以保留。

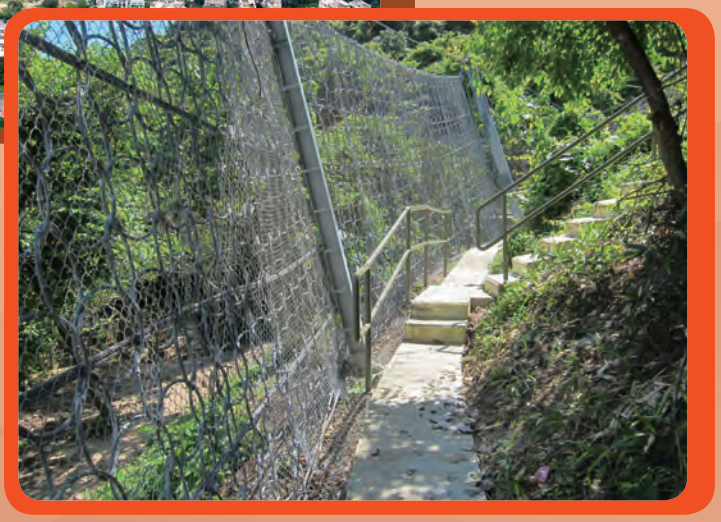
Both overseas and local experiences demonstrate that natural terrain landslide hazards must not be overlooked under the influence of extreme weather. Natural terrain landslide hazards are usually dealt with by risk mitigation measures, such as constructing concrete rigid barriers or steel flexible barriers at the hill toes to prevent debris from impacting on houses or roads and resulting in casualties. Apart from reducing the construction cost, the confined scope of risk mitigation works also helps avoid undue impact to the environment. The appearance and condition of the natural hillside can also be preserved by incorporating suitable landscaping and greening measures.

泥石壩
Rigid barrier

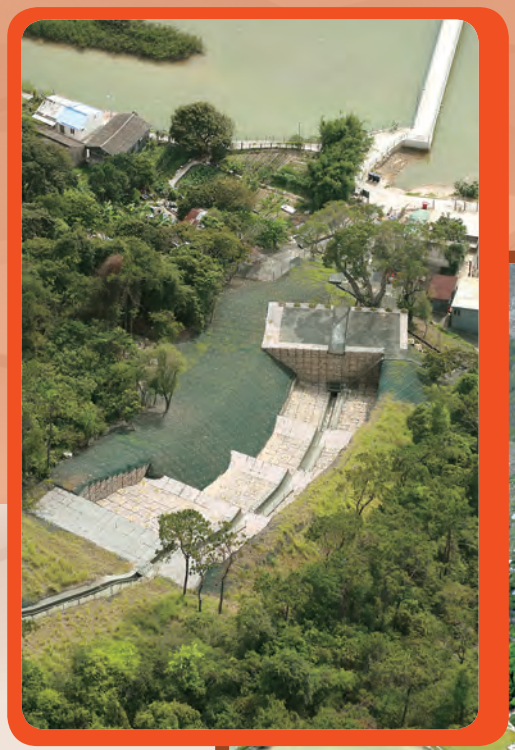
綠化措施
Greening measures

北大嶼山公路旁的天然山坡山泥傾瀉災害緩減措施（混凝土泥石壩）
Natural terrain landslide hazard mitigation measures along North Lantau Highway (concrete rigid barriers)

東涌壩尾的天然山坡山泥傾瀉災害緩減措施（柔性防護網）
Natural terrain landslide hazard mitigation measures in Pa Mei, Tung Chung (flexible barrier)



柔性防護網
Flexible barrier



石籠泥石壩
Gabion barrier

大澳南涌的天然山坡山泥傾瀉災害緩減措施（石籠泥石壩）
Natural terrain landslide hazard mitigation measures in Nam Chung, Tai O (gabion barrier)

寶雲道的天然山坡山泥傾瀉災害緩減措施（泥石壩及柔性防護網）
Natural terrain landslide hazard mitigation measures along Bowen Road (rigid and flexible barriers)

截至2017年，土力工程處已鞏固超過5,500個不合標準的政府人造斜坡；為超過180幅天然山坡完成風險緩減工程；並為超過5,700個私人人造斜坡進行安全篩選研究。

Up to 2017, the GEO has upgraded over 5,500 substandard government man-made slopes, implemented risk mitigation measures for more than 180 vulnerable natural hillside catchments and conducted safety screening studies for over 5,700 private man-made slopes.

立體打印模型
3D printing model

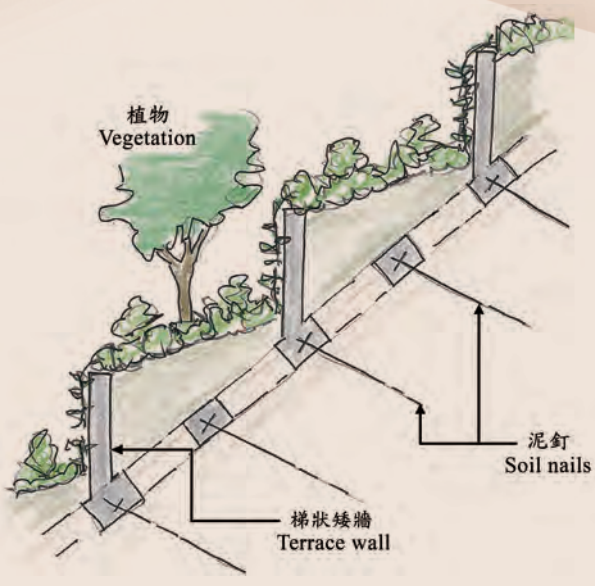
斜坡美化及生態優化
Landscaping and Ecological Enhancement

除了努力保障公眾安全，土力工程處亦同樣注重將斜坡工程與周邊環境融合，藉此為市民提供一個綠化、安全及生態上可持續發展的斜坡環境。土力工程處在重鋪人造斜坡植被或修葺天然山坡山泥傾瀉殘痕時，會盡可能加入本土植物，以優化生態環境及加強生物多樣性。土力工程處亦倡導利用土壤生物工程措施，以減緩天然山坡因山泥傾瀉或沖溝侵蝕而造成的不穩，作為傳統斜坡工程以外另一種低成本、可持續及環保的方案。

While the utmost objective is to safeguard the public from slope failures, the GEO has always given priority attention to blend in the engineering works with the surrounding environment by making them look as natural as possible and harmonising them with the built facilities. The aim is to cultivate a greener, safer and ecologically more sustainable slope environment for the community. The GEO uses native species for restoring vegetation covers on man-made slopes or repairing natural terrain landslide scars wherever practicable, with a view to achieving ecological enhancement and enriching biodiversity. The GEO also pioneered the use of soil bioengineering measures for minimising the deterioration of natural slopes due to landslides or erosion, offering a low cost, sustainable and environmentally friendly alternative to conventional slope works.

寶雲道的天然山坡山泥傾瀉災害緩減措施(泥釘及梯狀矮牆美化工程)
Natural terrain landslide hazard mitigation measures along Bowen Road (soil nails and terrace wall landscaping works)

2005年寶雲道天然山坡山泥傾瀉
Bowen Road Natural Terrain Landslide in 2005



泥釘及梯狀矮牆
Soil nails and terrace wall

防災準備及應變策略
Disaster Preparedness and Emergency Response

為積極應對極端天氣所帶來的挑戰，土力工程處一如既往全力以赴，持續優化山泥傾瀉緊急服務和提升部門協作以及信息共享，針對嚴重山泥傾瀉的緊急應變作出準備。

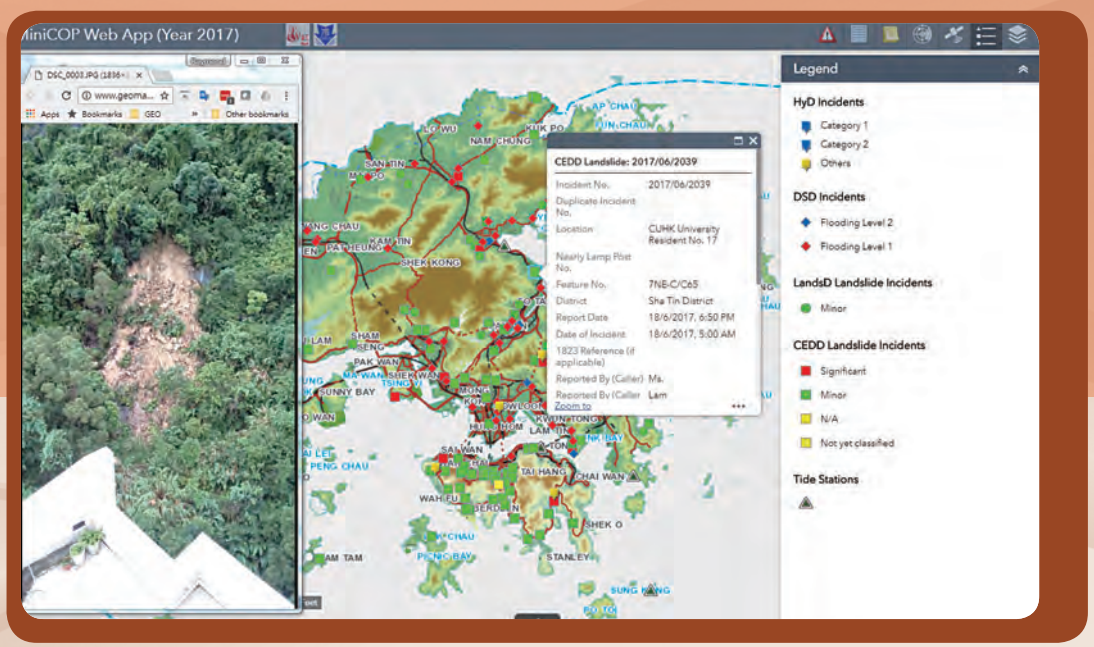
土力工程處設有全年二十四小時的緊急服務，可為各政府部門就處理山泥傾瀉事故及善後工作提供岩土工程方面的專業意見。

To face the challenge of extreme weather, the GEO endeavours to be as well prepared as possible for serious landslide incidents by continually enhancing the landslide emergency services, as well as collaboration and information sharing among different government departments.

The GEO maintains round the clock emergency services to provide specialist geotechnical advice to government departments in handling landslide incidents and removing landslide danger.

各部門必須通力合作才能迅速應對山泥傾瀉事故。因此，土力工程處積極建立溝通平台，強化部門間的協調能力，亦全力參與跨部門聯合應急演練。

Effective response to landslide incidents requires close collaboration among different government departments. The GEO actively establishes modern communication platforms to strengthen cross-department coordination and takes part in inter-departmental emergency drills.



極端降雨可能同時觸發多種天然災害，例如山泥傾瀉、水浸、塌樹和風暴潮。土力工程處正開發全新地理信息系統平台，供政府部門分享實時緊急資訊，例如山泥傾瀉、水浸、封路消息、臨時庇護中心資料、天氣數據等信息，讓各政府部門更緊貼掌握災情，以提升決策能力。

Extreme rainfalls may trigger different kinds of natural hazards concurrently such as landslides, flooding, tree collapses and storm surge. To enhance situation awareness among relevant departments, the GEO is developing a state-of-the-art Geographic Information System platform known as Common Operational Picture. This will allow better sharing of essential information among government departments at times of emergency including landslides, flooding, road closures, status of temporary shelters and weather condition so as to facilitate well-informed decision-making.

斜坡安全公眾教育
Public Education on Slope Safety

提高社區的抗災能力是應對山泥傾瀉災害不可或缺的一環。土力工程處透過教育和宣傳，不斷向市民灌輸防災意識。近年宣傳更與時並進，推陳出新，加入自我保護和鄰里互助元素，推廣方式亦趨多元化。

Building community resilience against natural disasters is crucial in landslide hazard management. Through continued effort in public education, the GEO aims to instil a disaster prevention mindset among the general public. Creative ideas are introduced in recent years to promote self-protection and neighbourhood support. Diversified means and channels of communication are also adopted in order to attract public attention.

一年一度的斜坡安全傳媒簡報會
Annual media briefing on slope safety

多元化的電視宣傳短片
Television announcements in the public interest with diversified themes

參觀寶珊排水隧道
Visit to Po Shan Drainage Tunnel

未來土力工程師日營
Day camp for geotechnical engineers of tomorrow

斜坡安全展覽
Slope safety exhibition

全港小學斜坡安全話劇比賽
Inter-primary school slope safety drama competition

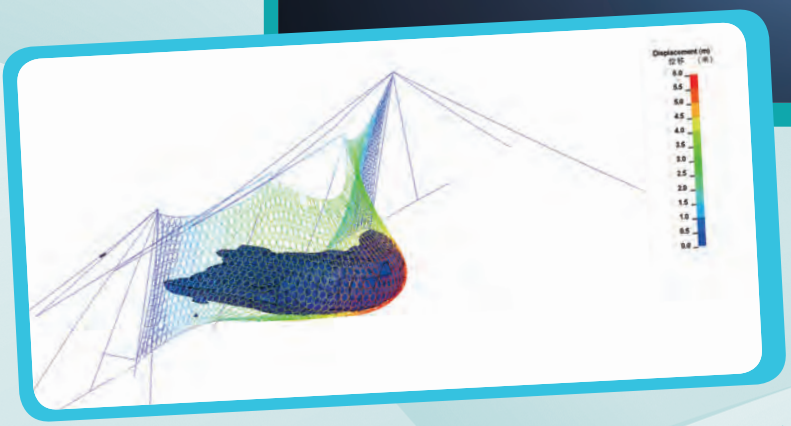
為中學生舉辦斜坡安全講座及考察活動
Conduct school talks and field trips on slope safety for secondary school students

為中學地理科老師舉辦斜坡研習及地質考察活動
Organise slope study and geology field trips for geography teachers from secondary schools

研發虛擬現實山泥傾瀉體驗
Develop virtual reality landslide experience

與其他機構（例如：紅十字會、童軍和香港賽馬會災難防護應變教研中心）合辦公眾展覽及教育活動
Organise wide range of joint public exhibition and education activities with other organisation (e.g. the Hong Kong Red Cross, Scout Association and Hong Kong Jockey Club Disaster Preparedness and Response Institute)

創新技術　與時並進
Advancing Technology • Engineering the Future



為求與時並進，土力工程處不斷透過自行研發以及與科研單位合作，引進創新工程技術和拓展應用新數碼及資訊科技，全方位提升管理山泥傾瀉風險的能力。位於半山區的寶珊地下水位調控系統，便是其中一個成功利用創新工程技術處理山泥傾瀉風險的例子。土力工程處亦已廣泛地運用三維泥石流動模擬技術和時域反射法於防治山泥傾瀉計劃工程，有效提高設計分析能力和品質監控。另外，山泥傾瀉偵測系統、地理資訊網路作業系統和遙感探測技術的應用則大幅加強了土力工程處在山泥傾瀉監測、緊急處理和事後調查工作上的效率和質量。

To holistically enhance the capability of landslide risk management, the GEO is keeping abreast of frontier development by pioneering innovative engineering techniques and leveraging new digital and information technology through in-house technical development and collaboration with research institutes. The Po Shan Groundwater Regulation System in the Mid-Levels showcases how innovative engineering techniques provides robust solution for mitigating landslide risk. In addition, the cutting-edge three-dimensional debris mobility modelling technique and time domain reflectometry have been widely adopted in LPMitP projects to achieve better design and construction quality control. The application of landslide detection system, Geographic Information Infrastructure and remote sensing technology has also significantly enhanced the efficiency and quality of GEO's work on landslide monitoring, emergency response and landslide investigation.

寶珊地下水位調控系統
Po Shan Groundwater Regulation System

寶珊排水隧道於 2013 年榮獲香港工程師學會頒發工程創意大獎
Po Shan Drainage Tunnel was bestowed the Innovation Award by the Hong Kong Institution of Engineers in 2013

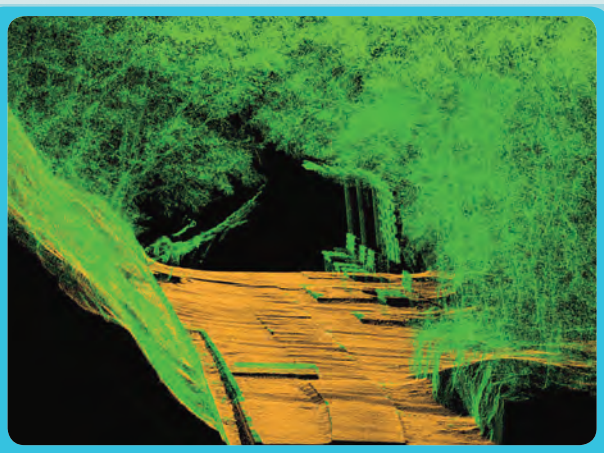
寶珊地段的山體受高地下水位及不利地質條件影響，容易引發大型崩塌。因範圍廣闊，傳統工程方案並不適合，土力工程處遂為寶珊地段設計出嶄新和具可持續性的地下水位調控系統。該系統由兩條排水隧道和172條可控式排水豎管組成，提供實時自動水壓監測，讓土力工程處人員在有需要時可透過排水調控地下水位，減低發生大型山泥傾瀉的風險，保障市民安全。該項目在香港工程師學會主辦的工程創意大獎2013中奪得建造組別第三名。

The Po Shan hillside is affected by high groundwater levels and adverse geological conditions, and hence is susceptible to large-scale landslides. The GEO designed a novel and sustainable groundwater regulation system to control the groundwater levels at the Po Shan hillside. The system comprises two drainage tunnels with a network of 172 sub-vertical drains, and is equipped with an automatic real-time groundwater pressure monitoring system to facilitate the GEO staff in regulating the groundwater levels so as to reduce the risk of major landslides and enhance public safety. The project was awarded the Second Runner-up in the construction category of Innovation Award for the Engineering Industry by the Hong Kong Institution of Engineers in 2013.

遙感探測技術
Remote Sensing Technology

土力工程處積極探索和利用遙感探測技術，例如激光掃描和攝影測量法，協助蒐集地型及地質資料，大大提高處方在地質研究和山泥傾瀉勘察工作方面的效率。

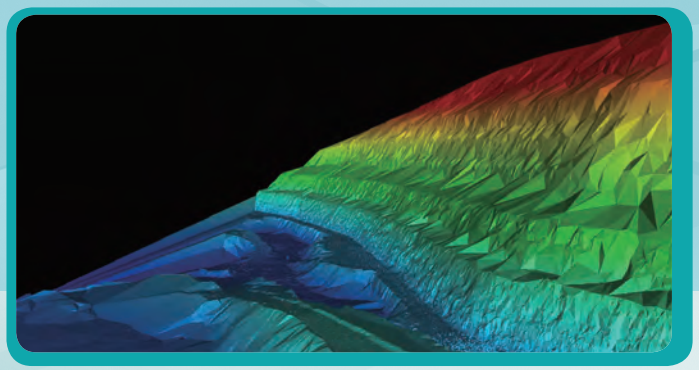
The GEO is at the forefront of applying state-of-the-art remote sensing technology, such as laser scanning and photogrammetry, for collecting topographic and geological data. This has greatly improved the efficiency and quality of geological survey and landslide investigation carried out by the GEO.



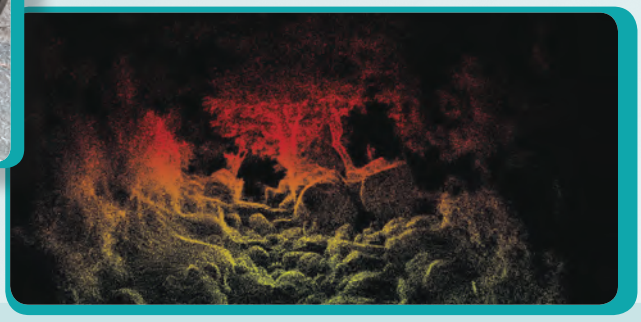
土力工程處在2011年進行了全港性空載激光掃描收集高分析度的地形信息。這項技術配合精密的數據處理，能將植被除去，得出地面高程點，繪製高解析度的地形圖（或稱「數碼地形模型」），清楚地展現天然山坡上的地貌特徵。

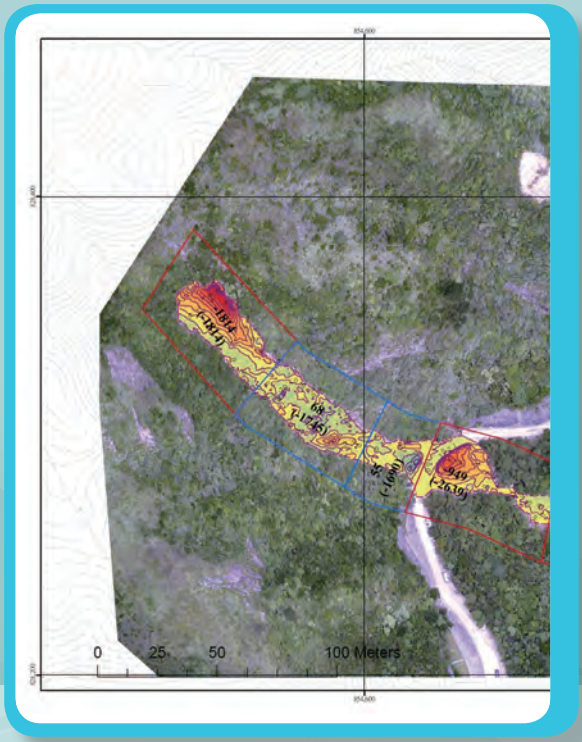
The GEO conducted a territory-wide airborne light detection and ranging (LiDAR) survey in 2011 to collect detailed topographic information. Airborne LiDAR technology is capable of obtaining high resolution bare earth profiles (or Digital Terrain Model, DTM) by eliminating the vegetation cover through sophisticated data processing, such that the geomorphology features on natural hillside can be shown clearly.

移動激光掃描和手提式激光掃描技術可輔助傳統測量方法，尤其在難以到達的位置。移動激光掃描可於狹窄的道路上，以一般行車速度收集路邊斜坡的空間數據，無需封路，因此不會阻塞交通。再者，細微和狹窄的激光束能穿透植物間的空隙收集植被下的地貌。便攜的手提式激光掃描系統則可應用於偏僻的山泥傾瀉位置、石澗等，並能夠快速地提供高解析度的地形資料供作地形製圖和斜坡勘察。



Mobile Laser Scanning (MLS) and Handheld Laser Scanning (HLS) technologies can supplement conventional surveying techniques especially in difficult site settings. The MLS can collect spatial data of roadside slopes on a narrow road at the speed of a moving vehicle without the need for road closure, thereby causing little disruption to traffic. Also, the small and narrow laser beams can penetrate through gaps between plants to collect ground profile data. The portable HLS system is capable of providing rapid, high resolution topographic information for landform mapping and slope investigation at remote landslide sites and bouldery streams.





透過比較全港性空載激光掃描數據所產生的原地形模型，和由數碼攝影測量法在山泥傾瀉後建立的數碼地形模型，便可以得出準確的山泥傾瀉體積。攝影測量法大大提高了土力工程處在山泥傾瀉勘察工作方面的效率，而無人駕駛飛行系統亦促進了在困難環境下的相片拍攝。此外，這技術也已應用在地質研究。無人駕駛飛行系統亦可於低飛環境獲取高質素的激光掃描數據。

Coupled with the pre-landslide topography generated from the territory-wide LiDAR data, accurate landslide volume can be obtained from DTM generated after the landslide by digital photogrammetry. Photogrammetry has greatly improved the efficiency of landslide investigation carried out by the GEO while the use of unmanned aerial system (UAS) can facilitate the acquisition of photographs at difficult terrains. This technique has also been applied to geological studies. Moverover, UAS can now be used to acquire high quality LiDAR data from low flying height.

合成孔徑雷達干涉技術可用於監測大面積範圍的地表移動。土力工程處曾就此技術進行研究，使用由人造衛星及地面儀器獲取的合成孔徑雷達圖像，以測試它是否適合監測香港的天然山坡。

Interferometric Synthetic Aperture Radar (InSAR) is a technique that can monitor ground movement of large areas. The GEO has conducted studies to investigate the applicability of InSAR on monitoring of natural terrain in Hong Kong using SAR images obtained from satellites and ground-based devices.

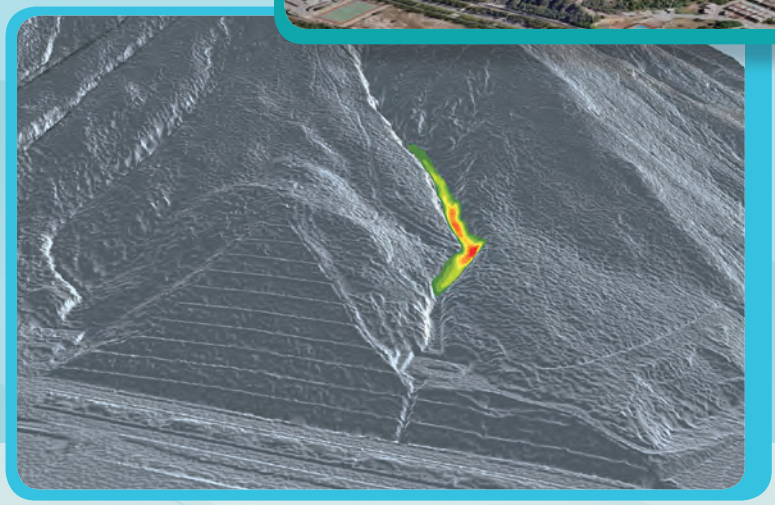
土力工程處一直探索將人工智能應用於香港斜坡安全管理的潛力。在一項與香港理工大學合作的試驗性研究中，深度學習被應用於識別在香港天然山坡上的外露岩石，當中運用了一個以超過一百二十萬個樣本圖像訓練的卷積神經網絡，分析數碼正射航空照片、多光譜衛星圖像和激光掃描數據。這研究取得了令人滿意的結果，而土力工程處亦正在探索如何更廣泛地應用此技術。

The GEO has been exploring the potential of applying artificial intelligence in slope safety management in Hong Kong. In collaboration with the Hong Kong Polytechnic University, a pilot study was carried out on the use of deep learning to identify rock exposed on the natural terrain in Hong Kong. A convolution neural network trained with over 1.2 million sample images was employed to interpret the ortho-rectified aerial photographs, coupled with analysis of multi-spectral satellite imagery and air-borne LiDAR data. Promising results have been achieved and wider applications are being explored.

三維泥石流動模擬技術
Three-dimensional Debris Mobility Modelling

土力工程處在研發和應用三維泥石流動模擬技術擔當領導角色，利用先進電腦模擬和運算技術，結合地理資訊系統，有效地分析泥石流動路徑和速度，使判斷和緩減天然山坡山泥傾瀉風險工作的結果更準確，效率更高。

The GEO has been playing a leading role in the development and application of three-dimensional debris mobility modelling (3D-DMM). Benefited from advanced modelling and computing technology, and coupled with Geographic Information System (GIS) in analysing debris flow path and velocity, the latest 3D-DMM can significantly enhance the accuracy and efficiency of studying and mitigating natural terrain landslide risk.



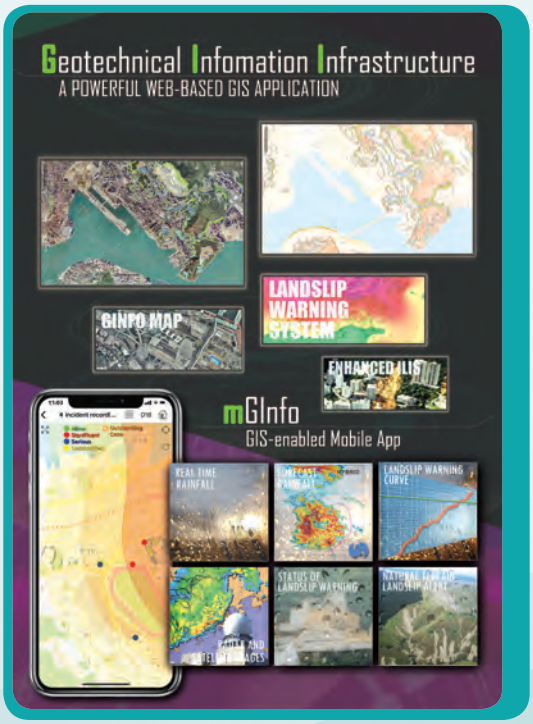
2008 年裕東路泥石流的三維泥石流動性模擬
3D debris mobility modelling of Yu Tung Road debris flow in 2008

時域反射法
Time Domain Reflectometry

土力工程處開創了「測檢泥釘工程的時域反射法」的研發，在不對泥釘造成任何破壞的情況下，檢測泥釘的長度和水泥的質量，確保施工水平符合標準。現時所有政府和私人工程均須利用此技術為泥釘作抽樣檢查。此項發明已於2016年取得知識產權署專利註冊處批出的短期專利。

The GEO pioneered the development of "Time Domain Reflectometry (TDR) method for quality control of soil nailing works". This is a non-destructive testing method to check the length and grout integrity of soil nails for quality control. Nowadays, soil nails in all government and private projects are required to be sample tested using TDR. The GEO was granted a short-term patent for the invention by the Patents Registry of the Intellectual Property Department in 2016.

岩土資訊系統
Geotechnical Information Infrastructure



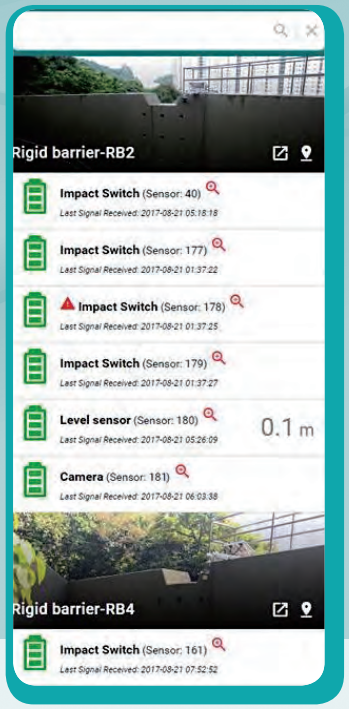
土力工程處利用地理資訊網路作業系統，自行研發岩土資訊系統，為岩土工程人員提供全面的岩土和斜坡資料，包括航空照片、地形資料及地質記錄等，並可透過互聯網及手機檢視，簡單快捷，因此成為從事斜坡設計、建設、管理及維修人員不可或缺的工具。該系統也可即場為視察山泥傾瀉的土力工程師提供岩土資訊，有效提升部門處理山泥傾瀉事故的能力和效率。

岩土資訊系統內的一些數據集（如光學雷達、天然山坡山泥傾瀉資料增定目錄等）均具備大數據的特質。土力工程處將結合物聯網裝置（如遙距感應器）所收集的實時現場數據，加強處方在面對極端天氣事故時的緊急應變能力。

The GEO has developed a web-based information system known as Geotechnical Information Infrastructure (GInfo) for data management. GInfo facilitates geotechnical engineering practitioners to access a comprehensive database of geotechnical and slope information, including aerial photographs, terrain and geological data, etc, via the internet and mobile devices. GInfo has been an indispensable tool for practitioners responsible for design, construction, management and maintenance of slopes. It also greatly enhances the capacity and efficiency of the GEO in handling landslide incidents by providing instant geotechnical information to geotechnical engineers inspecting landslide incidents.

Some data sets in GInfo (such as LiDAR, Enhanced Natural Terrain Landslide Inventory) possess the characteristics of Big Data. Together with real-time field data collected by Internet of Things devices (such as remote sensors), the GEO will further enhance its emergency response for extreme weather events.

山泥傾瀉偵察系統（智能泥石壩）
Landslide Detection System (Smart Barrier)



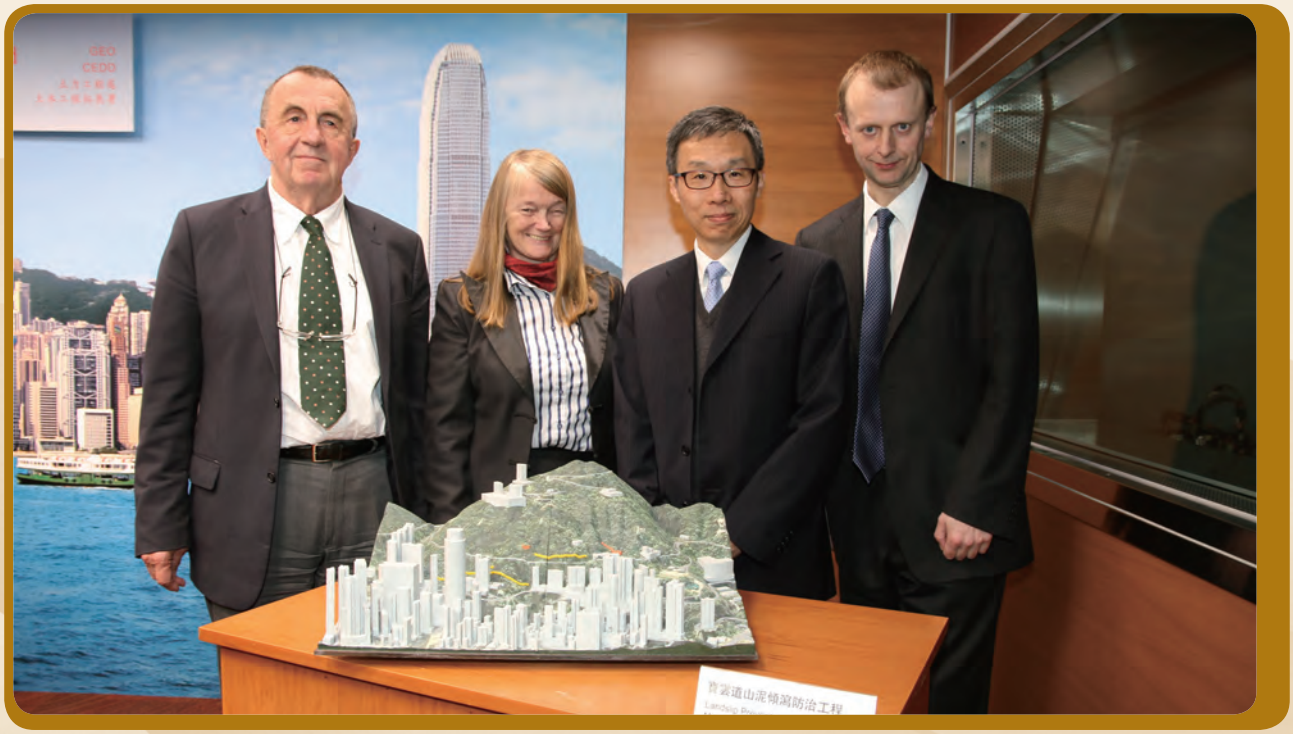
流動應用程式
Mobile application

土力工程處於深井新村的泥石壩試行安裝與香港中文大學合作研發的山泥傾瀉偵察系統，透過流動應用程式遙距監控壓力及高度感應器，全天候監察泥石壩狀況，並因應結果作出即時通報，令部門可更快速地應對緊急的山泥傾瀉事故。

The GEO has installed a prototype of the novel landslide detection system, which has been developed in collaboration with the Chinese University of Hong Kong, on a rigid barrier in Sham Tseng San Tsuen for pilot testing. The system can continuously monitor the condition of the barrier using custom-designed impact switches and level sensor, and provide alerts to the GEO via mobile application in the event of a landslide, thereby enhancing the efficiency of emergency response by the GEO.

深井新村泥石壩的山泥傾瀉偵察系統
Landslide detection system installed on a rigid barrier in Sham Tseng San Tsuen

專業成就　蜚聲國際
Embracing Professionalism • Achieving Organisational Excellence



土力工程處於過去四十年在斜坡安全工作的努力深受社會各界及國際專業組織認同，由國際知名的岩土工程專家擔任成員的斜坡安全技術檢討委員會表示：

> 「土力工程處在斜坡安全範疇上的專業水平於國際上是獨一無二的。委員會樂見土力工程處持續領導國際在斜坡安全上的實踐，並繼續成為其他國家的仿效對象。」

土力工程處的斜坡安全工作在岩土工程界享負盛名，常有世界各地機構代表團探訪，進行知識經驗交流。土力工程處人員一直以誠懇認真的專業態度，竭誠為市民服務，並且不時以創新思維帶來突破性的技術發展，成績超卓。

The slope safety work of the GEO in the past four decades has earned recognition from various sectors and international professional bodies. The Slope Safety Technical Review Board (SSTRB), comprising internationally renowned geotechnical experts, expressed its commendation on the GEO:

> "The level of expertise on slope safety at GEO is unique on an international scale. SSTRB finds that GEO continues to lead international practice on slope safety and is a model that other countries aspire to follow".

The slope safety work of the GEO is well recognised among the global geotechnical community and delegates from many overseas organisations have visited the GEO for experience sharing. Staff of the GEO are dedicated to serving the community with their geotechnical expertise and professionalism. Their innovative ideas and novel use of advanced technology have also given rise to remarkable breakthroughs.

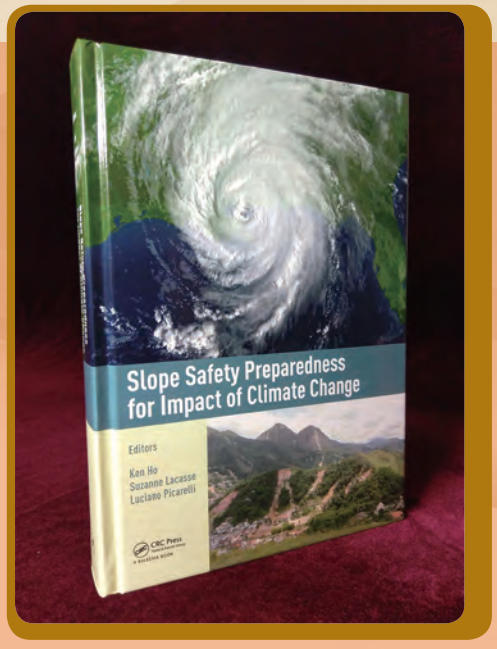
跨地域合作
International Collaboration

土力工程處在防範山泥傾瀉工作上，與海外政府機關和國際著名岩土機構及學者緊密合作，推動技術發展。

The GEO joins hands with overseas government bodies, international renowned geotechnical organisations and experts in advancing the geotechnology on landslide prevention work.

與首爾於2013年簽訂防治山泥傾瀉災害合作諒解備忘錄
The signing of a Memorandum of Understanding on mitigation of landslide hazards with Seoul in 2013

與中國科學院成都山地災害與環境研究所於2017年簽訂技術交流合作意向協議書
The signing of co-operation agreement with the Institute of Mountain Hazards and Environment of the Chinese Academy of Sciences, Chengdu in 2017



土力工程處與著名岩土工程師合力編撰《應對氣候改變的斜坡安全工作》一書
The GEO jointly published the book titled "Slope Safety Preparedness for Impact of Climate Change" with internationally renowned geotechnical experts

CITY: **HONG KONG**

Landslide Protection with Low-Impact Design

→ Hong Kong is protecting residents from deadly, rain-induced landslides by strategically installing barriers and drainage tunnels.

↓50K

PROJECTED LANDSLIDES COULD BE AVOIDED THROUGH LOW-IMPACT DESIGN.

The topography across Hong Kong's land area is dramatic: more than 60% of the land is steeper than 15 degrees and 30% is steeper than 30 degrees. Very high rainfall on this hilly natural and man-made terrain has resulted in frequent and disastrous landslides across the densely developed city. Quantitative risk assessments had predicted up to 2,500 landslides per year and identified high-risk zones. To mitigate these risks, the city is implementing low-impact and effective landslide protection solutions.

Using remote sensing tools and GIS-based landslide modeling, the city has designed and strategically placed both flexible and rigid barriers to resist the impacts of landslides. This approach was chosen in favor of slope stabilization, which is not only costly but also requires extensive earthworks and tree felling. In addition, drainage tunnels and smart monitoring technology enable better control of groundwater in the city's slopes – one of the primary drivers of landslides.

THE CHALLENGE

Hong Kong is a mountainous city with dense urban development built on steep man-made and natural terrain. Many of the man-made slopes were constructed 50 years ago without proper engineering, and with the city's high rainfall, landslides are common and cause extensive socio-economic damage and fatalities.

CO-BENEFITS

Economic

The project lowered the landslide risk to "as low as reasonably practicable," reducing direct and indirect economic losses associated with landslides. The project also created 550 jobs during construction.

Environmental

Any trees felled and undergrowth cleared during the engineering works is compensated by planting additional trees and shrubs.

Health

Reduced landslide risk has improved public safety and created a more livable environment for Hong Kong citizens.

Hong Kong has pledged to inspect or upgrade 200 man-made slopes to prevent landslides.

CITIES100 71

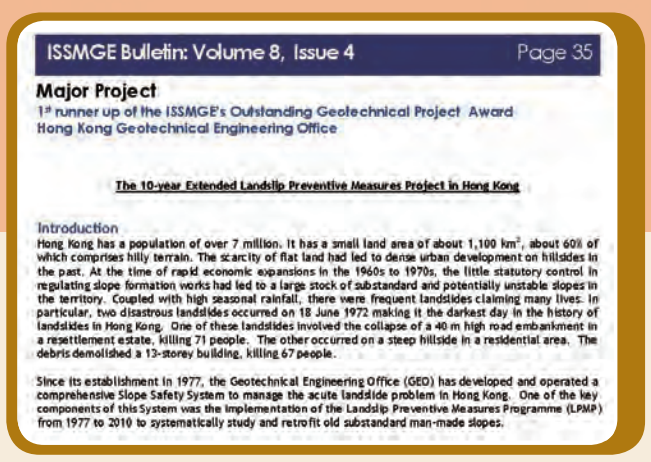
長遠防治山泥傾瀉計劃獲C40城市氣候領導聯盟選為2017年全球100個應對氣候變化的良好措施，並得到【Cities100】刊物撰文表揚
The LPMitP was recognised by the C40 Cities Climate Leadership Group as among the 100 global best practices in addressing climate change in 2017 and the project profile was published in "Cities100"

土力工程處與香港科技大學
共同發表的期刊文章獲得
英國土木工程師學會的Telford
Premium 2017 獎
The paper titled "Coarse granular flow interaction with silt structures" jointly published by the GEO and the Hong Kong University of Science and Technology was awarded the Telford Premium 2017 by the Institution of Civil Engineers

長遠防治山泥傾瀉計劃獲得C40城市氣候領導聯盟的肯定，
入圍2017年C40城市獎「城市的未來」最後5強
The LPMitP won recognition by the C40 CITIES as one of 5 finalists for 2017 C40 CITIES Award under the category of Cities4Tomorrow

寶珊排水隧道工程獲得香港工程師
學會及New Civil Engineer的肯定
Po Shan Drainage Tunnel project won recognition from the Hong Kong Institution of Engineers and the New Civil Engineer

土力工程處在2014年獲頒「地理資訊系統特殊成就獎」
"Special Achievement in GIS" awarded to the GEO in 2014


ISSMGE Bulletin: Volume 8, Issue 4 Page 35

Major Project

1st runner up of the ISSMGE's Outstanding Geotechnical Project Award
Hong Kong Geotechnical Engineering Office

The 10-year Extended Landslip Preventive Measures Project in Hong Kong

Introduction

Hong Kong has a population of over 7 million. It has a small land area of about 1,100 km², about 60% of which comprises hilly terrain. The scarcity of flat land had led to dense urban development on hillsides in the past. At the time of rapid economic expansions in the 1960s to 1970s, the little statutory control in regulating slope formation works had led to a large stock of substandard and potentially unstable slopes in the territory. Coupled with high seasonal rainfall, there were frequent landslides claiming many lives. In particular, two disastrous landslides occurred on 18 June 1972 making it the darkest day in the history of landslides in Hong Kong. One of these landslides involved the collapse of a 40 m high road embankment in a resettlement estate, killing 71 people. The other occurred on a steep hillside in a residential area. The debris demolished a 13-storey building, killing 67 people.

Since its establishment in 1977, the Geotechnical Engineering Office (GEO) has developed and operated a comprehensive Slope Safety System to manage the acute landslide problem in Hong Kong. One of the key components of this System was the implementation of the Landslip Preventive Measures Programme (LPMP) from 1977 to 2010 to systematically study and retrofit old substandard man-made slopes.

長遠防治山泥傾瀉計劃獲得2014年國際土力學
與岩土工程學會傑出岩土工程項目獎亞軍
The LPMitP won the First Runner up of the International Society for Soil Mechanics and Geotechnical Engineering's Outstanding Geotechnical Project Award 2014

來訪團體
Worldwide visitors

挪威 Norway

英國 United Kingdom

德國 Germany

瑞士 Switzerland

意大利 Italy

國際土力學與岩土工程學會 The International Society for Soil Mechanics and Geotechnical Engineering


北京 Beijing
四川 Sichuan
南韓 South Korea
日本 Japan
廣東 Guangdong
香港
Hong Kong
台灣 Taiwan
孟加拉 Bangladesh
汶萊 Brunei
馬來西亞 Malaysia
印尼 Indonesia

承先啟後　繼往開來
Inheriting the Past • Inspiring the Future

土力工程處和香港工程師學會於2017年12月11日合辦斜坡安全高峰會，把慶祝土力工程處成立四十周年紀念活動推向高峰。超過260位從事斜坡工程及山泥傾瀉風險管理方面的專家和持份者在高峰會探討香港斜坡安全問題面對的挑戰和機遇。高峰會分開四個專題討論環節，以探索山泥傾瀉風險管理的新方向，包括（一）全方位山泥傾瀉風險管理、（二）創新與科技發展、（三）氣候變化與災難應變及（四）與民共抗山泥傾瀉風險。

More than 260 leading experts and stakeholders in the field of slope engineering and landslide risk management discussed challenges and opportunities in respect of slope safety issues in Hong Kong at the Slope Safety Summit on 11 December 2017. The event was jointly organised by the GEO and the Hong Kong Institution of Engineers to mark the finale of a series of celebration events for commemorating the establishment of the GEO 40 years ago. The Slope Safety Summit focused on four different themes, namely (i) holistic landslide risk management, (ii) innovations and technological advances, (iii) climate change and crisis preparedness, and (iv) facilitating the public to contribute to combating landslide risk. The Summit provided an excellent platform to explore the future direction in managing landslide risk.

行政長官、發展局局長及其他主禮嘉賓主持開幕儀式
The Chief Executive, Secretary for Development and other guests of honour at the opening ceremony

發展局常任秘書長（工務）
韓志強先生
Mr C K Hon,
Permanent Secretary for Development (Works)

土木工程拓展署署長林世雄先生
Mr S H Lam, Director of
Civil Engineering and Development

土力工程處處長潘偉強先生
Mr W K Pun, Head of the Geotechnical Engineering Office

斜坡安全高峰會籌委會榮譽主席何建生教授
Prof Ken K S Ho, Honorary Chairman of the Organising Committee of the Slope Safety Summit 2017

穆根士頓教授及布蘭特教授，聯同現任及歷任土力工程處處長，回顧斜坡安全系統的建立與發展，並帶領與會者探討山泥傾瀉風險管理的未來方向與策略。

Prof Norbert Morgenstern and Prof John Burland, together with the current and former Heads of the GEO, gave an overview of the key issues that have profound influence in shaping today's slope safety system, and explored the future direction of landslide risk management strategy.

穆根士頓教授 Prof Norbert Morgenstern
白能達博士 Dr Edward Brand
陳健碩先生 Mr Raymond Chan
汪學寧先生 Mr H N Wong
布蘭特教授 Prof John Burland
麥隆禮教授 Prof Andrew Malone
陳潤祥先生 Mr Y C Chan
潘偉強先生 Mr W K Pun

蘭卡斯博士及栢尼教授分別與各學者、政府官員及業界代表探討香港因應極端天氣而面對的山泥傾瀉風險，並發掘應對的創新思維和科技。

Dr Suzanne Lacasse and Prof Dave Petley separately led the expert panel discussion with scholars, Government officials and representatives of the industry, reviewed the key challenges that Hong Kong is facing due to climate change and its effect on landslide risks, and explored the use of innovation and advanced technology to meet the challenges ahead.

蘭卡斯博士 Dr Suzanne Lacasse
殷得高教授 Prof John Endicott
吳宏偉教授 Prof Charles Ng
殷建華教授 Prof J H Yin
李焯芬教授 Prof C F Lee
關順行博士 Dr Julian Kwan

栢尼教授 Prof Dave Petley
謝展寰先生 Mr C W Tse
李細明先生 Mr S M Lee
李國棟醫生 Dr Donald Li
麥成章先生 Mr Vincent Mak
孫向榮博士 Dr H W Sun

立法會議員盧偉國和葉劉淑儀以及其他專家探究如何喚起大眾關注和參與防治山泥傾瀉，並討論優化防範與應對災害的公眾教育和傳訊策略方針。

Dr the Hon Lo Wai Kwok, the Hon Mrs Regina Ip and other expert panellists discussed on public education and communication strategy to enhance public awareness and participation in combating landslide hazards, focusing particularly on crisis preparedness and responses.

盧偉國議員博士 Dr the Hon W K Lo
黃澤恩博士 Dr Greg Wong
黃志明先生 Mr C M Wong
楊文佳先生 Mr Gary Yeung
葉劉淑儀議員 The Hon Mrs Regina Ip
楊暉女士 Ms Jenny Yeung

行政長官林鄭月娥女士在斜坡安全高峰會開幕典禮致辭全文
Opening Address by the Chief Executive Mrs Carrie Lam at the Slope Safety Summit 2017

Colleagues, distinguished speakers, ladies and gentlemen,

Good morning. The year 2017 is a memorable year for us as we are celebrating the 20th anniversary of the establishment of the Hong Kong Special Administrative Region. As festivities and celebration events are coming to a close, I am pleased to join you at this Slope Safety Summit today which marks the 40th anniversary of the Hong Kong slope safety system, notably with the setting up of the Geotechnical Engineering Office (GEO) 40 years ago. I wish to commend the Civil Engineering and Development Department for its initiative in hosting this summit together with the Hong Kong Institution of Engineers for us to reflect on our past successes and to prepare for the future. I wish in particular to welcome many distinguished experts who have contributed so much to our slope safety system over the years, including Professor Norbert Morgenstern, Professor John Burland, Dr Suzanne Lacasse and Professor Dave Petley. Each one of them has played critical roles in our GEO – both in terms of its establishment and its continuing evolution.

Their geotechnical expertise and experience, their extraordinary commitment to slope safety, helped build the global city that Hong Kong has surely become over the past few decades. To be sure, it has been a long uphill – or should I say, downhill – struggle. Let's turn the clock back to some 50 years ago. Hong Kong's population soared from some 3 million in 1960 to more than 5 million in 1979. That population surge placed tremendous pressures on Hong Kong, particularly on our social welfare and housing systems. A number of tragic landslides, culminating in the Sau Mau Ping disaster of 1976, led to the establishment of an Independent Review Panel on Fill Slopes.

Professor Morgenstern was a member of that trailblazing Review Panel. In a foreword to the Review Panel Report's later republication, he paints a poignant picture of that heart-rending time. Allow me to quote him here: "It is hard to recapture the sense of urgency that surrounded the preparation of this Report. At the time of the Sau Mau Ping disaster in 1976, Hong Kong was in the midst of an enormous public housing undertaking. The Sau Mau Ping landslide raised questions regarding public safety associated with this housing programme, and I still vividly remember Sir Murray MacLehose, then Governor of Hong Kong, asking, 'Do I have to evacuate several thousand people each time it rains?'"

The answer was no, because that report prompted the birth, in 1977, of the Geotechnical Engineering Office – or the Geotechnical Control Office as it was initially called.

For more than a decade, Professor Morgenstern also led the Slope Safety Technical Review Board. The Board was established in 1995 in the wake of the Kwun Lung Lau landslide of 1994 to advise Government on technical aspects of slope safety. In doing so, he helped bring to life the celebrated slope safety system we recognise with pride today.

As for Dr Suzanne Lacasse and Professor Dave Petley, they are current members of the Technical Review Board, offering Hong Kong expert advice and valued international insight. I know that first-hand. As Secretary for Development from 2007 to 2012, I met with Suzanne every year, getting her invaluable advice on slope safety management.

Indeed, as Secretary for Development, I supported the launching, in 2010, of the long-term Landslip Prevention and Mitigation Programme by the GEO. The Programme systematically tackles landslide risks linked to both man-made slopes and natural hillsides – both of which we have in perilous abundance. I still vividly remember that in the first couple of months of my taking up the position of the Secretary for Development, the then head of the GEO, Raymond Chan, came to see me presenting graphs after graphs to illustrate that while Hong Kong has done a lot in stabilising our man-made slopes, we must not lose sight of natural slopes, which are everywhere with our topography. Without asking any further questions, I gave policy support and secured the new resources for this programme which was rolled out in remarkable expediency. It is gratifying to note that this is an area where there is no room for complacency; the Government is still spending HK$1 billion every year on slope upgrading and mitigation works under the programme.

This morning, in my new capacity as Chief Executive of the Hong Kong Special Administrative Region, I'm here to applaud the extraordinary work you've all done over the years, and to reaffirm Government's commitment to maintaining the highest standards of slope safety in Hong Kong to protect people's life and property.

There is much to applaud. Evolving in response to experience, continual improvement initiatives and technological advancement, we now have in place one of the best slope engineering and landslide risk-management systems in the world. Indeed, the risk of landslides from Hong Kong's man-made slopes today is down some 75 per cent from the 1977 level.

But landslide risks will never drop to zero given that the majority of Hong Kong's land area is hilly terrain. Today, we must also contend with the acute challenges of population growth, slope degradation and, most notably, climate change. Climate change is already affecting us. And there is the very real likelihood that climate change will result in more frequent, more extreme rainfall, triggering deadly landslides from our mountainous landscape.

Typhoon Hato, in August, highlights the impact of extreme weather. Hato, Hong Kong's first No. 10 typhoon signal since 2012, injured at least 129 people here. It felled some 5,300 trees and resulted in flooding and coastal-area damage. It was indeed a powerful reminder that we must be prepared to deal with extreme weather; that we must maintain the highest landslide vigilance.

The Government has in place a Contingency Plan for Natural Disasters, created to ensure that we respond to emergency situations quickly and effectively across the whole of Hong Kong. In this, the GEO plays a vital part. It maintains a 24-hour, year-round landslide emergency service, advising government departments on action to be taken in case of landslide danger. I understand that, in recent years, they have been using sensors to detect landslides by monitoring changes in conditions of landslide-resisting barriers. This is a good example of how we embrace technology to achieve greater efficiencies in city operations, which is a key part in our ongoing quest to transform Hong Kong into a smart city.

The GEO has also stepped up public awareness measures, producing a variety of publicity messages and educational activities promoting slope safety. This public awareness programme reaches into every sector of our community including schools. The exhibition outside this hall, organised under a "public education on slope safety" theme, makes a clear and compelling statement of our community-wide resolve.

Ladies and gentlemen, today is a special occasion as we have here all the ex-leaders of the Geotechnical Engineering Office. You and your colleagues worked tirelessly in enhancing slope safety in Hong Kong. May I, at this point, invite all our heads, past and current, to rise for us to give them a big round of applause. You have been so successful that some of our younger generations who were born after the tragic landslides in the 1970s may now have taken slope safety for granted. But I will not. I know it is your vision and hard work which protect Hong Kong from landslides. You are truly the unsung heroes of Hong Kong. On behalf of the Hong Kong Special Administrative Region, I express my gratitude to you all.

Before I close, I must say how pleased I am to see guests here from all over the world, including the Mainland, Thailand, Malaysia and other Southeast Asian countries. Such information exchange echoes the central role of connectivity in the Belt and Road Initiative. Hong Kong is most willing to share the wealth of knowledge and expertise that we have accumulated in combating landslides and in slope-safety management over the past decades with countries along the Belt and Road. Indeed, slope safety is a prerequisite to the infrastructure development that will drive the Belt and Road's future.

My thanks, and gratitude, to the Geotechnical Engineering Office of our Civil Engineering and Development Department, along with the Hong Kong Institution of Engineers, for organising this most welcome event, this local and global gathering which brings together past and present, united in a future built on a smart, sustainable and safe Hong Kong.

I wish you all a memorable Summit and a new year blessed with health, happiness and continuing success.

Thank you very much.

勉勵之言
Words of Encouragement

I am delighted to have been able to participate in this celebration of the success of GEO and to wish it well in its future.

Norbert Morgenstern

穆根士頓教授
Prof Norbert Morgenstern

It has been a great privilege to have taught so many of the engineers working at GEO and to have witnessed their professional contributions to developing the impressive infrastructure and constructions in Hong Kong.

John Burland

布蘭特教授
Prof John Burland

Dear GEO,

Congratulations on your 40th anniversary!

You have demonstrated that you are a world class organisation, the best in the world on slope safety.

My best wishes for the next 40 years!

Suzanne Lacasse
2017-12-11
Slope Safety Summit

蘭卡斯博士
Dr Suzanne Lacasse

There is little doubt that GEO has designed and implemented the most successful Slope Management programme in history. You have set the bar; the rest lag far behind. I have found working with GEO to be endlessly enjoyable and interesting. Congratulations on your first 40 years.

D. N. Petley

栢尼教授
Prof Dave Petley

My time in the GCO was very happy and, I believe, very successfull. I am delighted to be at this Seminar with so many old colleages. Please invite me again for the 50th celebration.

Ted Brand.

白能達博士
Dr Edward Brand

It is a very good achievement to have kept the mission on track for 40 years.
But more difficult yet, will be quite a challenge to keep this great machine flying for the next 20 years.
You have my greatest good wishes for your continuing endeavours for the good of the people of Hong Kong.

Andrew

麥隆禮教授
Prof Andrew Malone

GEO is indeed one of the most reputable geotechnical Organisation world-wide. The vision, mission and values of the Office have been very well achieved. A job well done! Keep it up.

Ursula
11.12.2017.

陳健碩先生
Mr Raymond Chan

Happy 40th Anniversary. GEO
Learn from the past, focus on the future

YC Chan

陳潤祥先生
Mr Y C Chan

It's my great privilege and honor to have taken part in the endeavor for slope safety and geotechnical excellence in the past 40 years. My best wishes for every success in taking the lead and meeting the challenges ahead.

H. N. Wong
Dec 2017

汪學寧先生
Mr H N Wong

土力工程處歷史回顧
The History of the GEO

工務局轄下土力工程處成立
Establishment of the GCO under the Public Works Dept.
(13-7-1977)

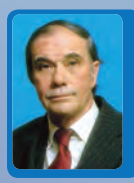
成為工程拓展署轄下部門
Under the Engineering Development Dept.
(4-1982)

成為土木工程署轄下部門
Under the Civil Engineering Services Dept.
(6-1986)

土力工程處英文名稱易名
GCO retitled as GEO
(9-1991)

1970 1980 1990

處長
Office Head



柯樂勤
G.B.O'Rorke
1977

羅德賢
S.Rodin
1978

白能達
E.W.Brand
1979-1989

麥隆禮
A.W.Malone
1989-1998

高級管理人員
Senior Management Team

1980

1984

成為土木工程拓展署轄下部門
Under the Civil Engineering and Development Dept.
(7-2004)

(1997)

(2007)

(2017)

2000

2010

2020

陳健碩
R.K.S.Chan
1998-2011

陳潤祥
Y.C.Chan
2011-2013

汪學寧
H.N.Wong
2013-2016

潘偉強
W.K.Pun
2017-

1997

2013

2007

2016

斜坡安全技術檢討委員會
Slope Safety Technical Review Board

斜坡安全技術檢討委員會首於一九九五年成立，負責檢討政府斜坡的安全管理工作，並就斜坡安全系統的技術問題向政府提供意見。斜坡安全技術檢討委員會參照國際作業標準，定期審視土力工程處的工作及協助土力工程處提升技術水平。多年來，委員會為土力工程處提供寶貴意見，並充分肯定香港政府應對山泥傾瀉風險的政策與資源投放。委員會認同土力工程處及本港的岩土工程界，對山泥傾瀉發生過程的了解、岩土工程的質量及成本效益，以及減低山泥傾瀉風險等方面，作出了重大的貢獻。

第一屆 First Board (1995-1998)
穆根士頓教授 Prof Norbert Morgenstern
菲奧教授 Prof Robin Fell
黎佐賢爵士 Sir John Knill

第二屆 Second Board (1998-2001)
穆根士頓教授 Prof Norbert Morgenstern
蘭卡斯博士 Dr Suzanne Lacasse
李焯芬教授 Prof C F Lee

第三屆 Third Board (2002-2005)
穆根士頓教授 Prof Norbert Morgenstern
保頓教授 Prof Malcolm Bolton
王思敬教授 Prof Wang Sijing

第四屆 Fourth Board (2006-2009)
蘭卡斯博士 Dr Suzanne Lacasse
王思敬教授 Prof Wang Sijing
亨格教授 Prof Oldrich Hungr

第五屆 Fifth Board (2010-2013)
蘭卡斯博士 Dr Suzanne Lacasse
列圖博士 Dr Peter Lyttle
鄧漢忠教授 Prof Wilson Tang (2010-2012)
栢尼教授 Prof Dave Petley (2012-2013)

The Slope Safety Technical Review Board (SSTRB) was first established in 1995 to review the Government's work in slope safety management and advise on technical aspects of the slope safety system. The SSTRB regularly benchmarks the work of the GEO against international best practice and assists the GEO in enhancing technical quality. Over the years, the Board has provided valuable advice to the GEO and endorsed the Government's policy and resources allocated for landslide risk management. The Board was satisfied that the GEO and the local geotechnical community had made leading contributions to the understanding of slope failure mechanisms, to the quality and cost effectiveness of geotechnical construction, and to the reduction of landslide risk.

第六屆 Sixth Board (2014-2017)
蘭卡斯博士 Dr Suzanne Lacasse
亨格教授 Prof Oldrich Hungr (2014-2016)
栢尼教授 Prof Dave Petley

Commemorative Brochure
紀念特刊

Slope Safety Summit Video Archive
斜坡安全高峰會足本重溫

GEO Facebook
土力工程處臉書

二零一七年十二月　December 2017