**Geotechnical Engineering Office, Civil Engineering and Development Department**
**The Government of the Hong Kong Special Administrative Region**

# GEO Technical Guidance Note No. 2 (TGN 2)
# Technical Recommendations Arising from Lessons Learnt from Landslides in 1997 and 1998



## 1. SCOPE

1.1 This Technical Guidance Note (TGN) outlines the recommended technical improvement measures to enhance the slope engineering practice in Hong Kong based on a review of landslides in 1997 and 1998 and the lessons learnt. Details of the background and findings of the review are given in Wong & Ho (1999).

1.2 Any feedback on this TGN should be directed to Chief Geotechnical Engineer/Landslip Preventive Measures 1 of the GEO.

## 2. TECHNICAL POLICY

2.1 The technical recommendations promulgated in this TGN were agreed by GEO Geotechnical Control Conference (GCC) on 17 August 2000.

## 3. RELATED DOCUMENTS

3.1 Wong, H.N. & Ho, K.K.S. (1999). *Review of 1997 and 1998 Landslides.* Landslide Study Report No. LSR 15/99, Geotechnical Engineering Office, Hong Kong, 49 p.

3.2 Wong, H.N., Pang, L.S., Wong, A.C.W., Pun, W.K. & Yu, Y.F. (1999). *Application of Prescriptive Measures to Slopes and Retaining Walls*. GEO Report No. 56 (Second Edition), Geotechnical Engineering Office, Hong Kong, 71 p.

## 4. TECHNICAL RECOMMENDATIONS

4.1 The following technical improvement measures are proposed:

4.1.1 The reliability of slope assessment and improvement works should be enhanced by attending to the following:

(i) As a basic requirement, a comprehensive aerial photograph interpretation (API) report should be prepared, with particular reference to establishing the history and nature of any past failures that may have affected the slope feature and the surrounding site setting. Special attention should be paid to any geomorphological evidence of large-scale relic instability. These landforms may be degraded to such an extent that they require care and expertise to be detected in an API. Such past slope failure or movement could have destabilised the terrain. The assessment of the API report on past slope performance must be duly taken into account in the design of ground investigation and slope improvement works, as well as in Stability

Assessments.

(ii) In assessing the design option to be adopted, the reliability and degree of robustness of the design scheme should be considered, taking into account sensitivity of the option to the uncertainties involved.[Note(1)] This assessment should be included as part of the design documentation.

(iii) The geological model assumed for design should be verified during construction and the verified information, including any amendments made to the design geological model during slope works, should be incorporated as part of the as-built records. The findings and details of verification of the design geological model (e.g. by whom, when, photographic records when the slope face is exposed, etc.), together with a schedule of key geotechnical design assumptions, should be included in the Maintenance Manual for future reference.

(iv) The designer should carry out a post-construction performance review during the Contract Maintenance Period to check that the design assumptions, particularly groundwater conditions, are compatible with observations on performance of the slope during the wet season.[Note(2)]

4.1.2 The risk of local slope failures should be minimised by incorporating improved detailing and protective measures, e.g. improved surface protection and drainage provisions, barriers, buffer zones, etc.[Note(3)]

## 5. ANNEXES

5.1 TGN2 A1- Explanatory Notes

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## EXPLANATORY NOTES

(1) High unsupported soil cuts are, for example, less robust than soil-nailed cuts of similar geometry and with similar ground conditions. This is because the reinforcing effect of soil nails will provide some redundancy by way of the safety margin against nail failure, and by causing the soil to behave as an integral mass which is capable of stress redistribution where there are local adverse ground conditions. Structural linkage between soil nail heads provided by wire mesh, beams/grillages or, if necessary, shotcrete, will further enhance the robustness of the soil nail scheme by contributing to the integral behaviour. The stability of an unsupported (or unreinforced) soil cut is comparatively more vulnerable to the effect of unforeseen adverse ground and groundwater conditions. For a slope in given ground conditions, the chance of an unsupported cut being affected by unforeseen adverse features would be greater with increasing slope heights because of the increased likelihood of encountering such features. Other examples of robust schemes include reinforced concrete retaining walls and reinforced fill slopes and retaining walls.

(2) Examples of areas to which attention should be paid during the post-construction performance review include signs of distress; significant blockage of, or washout of fines through, horizontal drains or weepholes; signs of seepage or wet patches; adequacy of surface water drainage provisions; changes in environmental factors (e.g. evidence of leakage from water-carrying services, ponding above slope crest, concentration of surface water flow, etc.); available monitoring records (such as piezometers and movement), etc.. In the case of fill slopes, GEO probe tests and/or in-situ density tests may be carried out to audit the adequacy of fill compaction, where considered appropriate.

(3) Examples of improved detailing and protective measures are given in Wong et al (1999). Further work in this area is being carried out by the Standards & Testing Division of the GEO and the findings will be promulgated in due course.

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