

**GEO Technical Guidance Note No. 40 (TGN 40)  
Guidelines on Temporary Drainage Provisions and Precautionary  
Measures against Severe Rainfall during Site Formation Works and  
Construction of Reinforced Fill Structures**

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1. **SCOPE**

- 1.1 This Technical Guidance Note (TGN) serves to remind practitioners of the need for adequate temporary drainage provisions and precautionary and mitigation measures against severe rainfall during site formation works and construction of reinforced fill structures, with particular reference to the observations and lessons learnt from the detailed investigation of two incidents which occurred at a construction site in Sau Mau Ping on 22 May 2013. It is intended to supplement the guidance given in Sections 8 and 9 of the Geotechnical Manual for Slopes (GCO, 1984) and Sections 7, 8 and 11 of Geoguide 6 (GEO, 2002). Besides, the Stormwater Drainage Manual (DSD, 2013), GEO Report No. 261 (Tang & Cheung, 2011) and TGN No. 39 (GEO, 2013) also provide useful guidance and information for surface drainage design.
- 1.2 Any feedback on this TGN should be directed to Chief Geotechnical Engineer/Landslip Preventive Measures Division 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 24 January 2014.

3. **RELATED DOCUMENTS**

- 3.1 Drainage Services Department (2013). *Stormwater Drainage Manual (with Eurocodes incorporated) – Planning, Design and Management (Fourth Edition)*. Drainage Services Department, Hong Kong, 172 p.
- 3.2 Fugro and Scott Wilson Joint Venture (2013a). *Report on the 22 May 2013 Distress at a Reinforced Earth Wall at a Construction Site above Shun On Road, Sau Mau Ping*. Fugro Scott Wilson Joint Venture, 86 p.
- 3.3 Fugro and Scott Wilson Joint Venture (2013b). *Report on the 22 May 2013 Landslide on a Fill Slope at a Construction Site above Lee On Road, Sau Mau Ping*. Fugro Scott Wilson Joint Venture, 48 p.
- 3.4 Geotechnical Control Office (1984). *Geotechnical Manual for Slopes (Second Edition)*. Geotechnical Control Office, Hong Kong, 295 p.

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- 3.5 Geotechnical Engineering Office (2002). *Guide to Reinforced Fill Structure and Slope Design (Geoguide 6)*. Geotechnical Engineering Office, Hong Kong, 236 p.
- 3.6 Geotechnical Engineering Office (2013). *GEO Technical Guidance Note No. 39 - Guidelines for Estimation of Surface Runoff from Natural Terrain Catchments for Drainage Design Purposes*. Geotechnical Engineering Office, Hong Kong, 4 p.
- 3.7 Tang, C.S.C. & Cheung, S.P.Y. (2011). *Frequency Analysis of Extreme Rainfall Values (GEO Report No. 261)*. Geotechnical Engineering Office, Civil Engineering and Development Department, Hong Kong, 209 p.

4. **BACKGROUND**

- 4.1 The intense rainstorm in the early morning of 22 May 2013 caused a major washout failure of a fill slope and distress at a reinforced fill structure involving landslide debris of 530 m<sup>3</sup> and 1,300 m<sup>3</sup> respectively. These features were located within the construction site of a major site formation project and were under construction at the time. Subsequent landslide investigation (FSWJV, 2013a & 2013b) revealed that the temporary drainage system at the time of the incidents was unable to cope with the surface runoff arising from the intense rainfall, leading to the area in the vicinity of the features impacted by large amounts of surface water and consequently resulting in the two incidents. It is also noted that the internal detailing of the distressed reinforced fill structure is vulnerable to piping in the event of significant water ingress into its drainage layers which were not sealed off during construction (FSWJV, 2013a).
- 4.2 The key lessons learnt from these two incidents are as follows:
- (a) Overwhelming of temporary drainage provisions during site formation works in severe rainfall events can lead to landslides and serious consequences. Due attention should be given to ensuring adequate temporary drainage provisions and precautionary and mitigation measures to discharge the surface water and subsurface water safely during construction.
  - (b) The integrity and stability of reinforced fill structures are vulnerable to excessive ingress of water and such structures require special attention in design and construction control.

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**5. TECHNICAL RECOMMENDATIONS**

**Site Formation Works**

- 5.1 A risk assessment should be carried out for projects involving site formation which may be vulnerable to severe rainfall events causing adverse landslide impacts on the public in case of uncontrolled overflow of surface water towards slopes, retaining walls and other features. This should include an assessment of the drainage-related hazards on slope safety when the site is affected by rainfall which exceeds the design event. If necessary, a risk management plan incorporating measures to manage the landslide risk, including any necessary precautionary and mitigation measures at different stages of construction, should be put in place to prevent adverse effects of overflow of surface water on slope safety when the capacity of the temporary drainage provisions is overwhelmed. The plan should contain, inter alia, the location of standby plant and equipment, the persons who will monitor the weather conditions and implement the measures when required (including outside working hours), and the emergency contact details of key personnel.
- 5.2 Temporary drainage plans should be updated in a timely manner to suit the site conditions during construction. Adequate drainage provisions shall be maintained on site at all times, including during the period when the temporary drainage works are being re-routed or re-constructed in accordance with any updated temporary drainage plans to suit various stages of construction.

**Reinforced Fill Structures**

- 5.3 The integrity and stability of a reinforced fill structure during construction are particularly vulnerable to excessive water ingress. Adequate temporary drainage provisions and precautionary and mitigation measures should be implemented to prevent excessive water ingress into the reinforced fill structure not allowed for in the design and thereby overwhelming its drainage capacity, causing distress or structure instability.
- 5.4 The adequacy of the subsurface drainage capacity of a reinforced fill structure should be assessed and regularly reviewed during construction, taking account of the changing site topography and temporary drainage provisions. The design and detailing of the subsurface drainage system of the reinforced fill structure should be robust enough against the build-up of water pressure from unintended ingress of water, which may cause hydraulic (piping) failure, internal or external instability, or distress.

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- 5.5        Upon completion of construction of a reinforced fill structure, its associated drainage layers are generally sealed off. However, under special circumstances, such as excavation works in the vicinity of a reinforced fill structure, the associated drainage layers may be exposed giving rise to the possibility of excessive ingress of surface water. The maintenance manual of the reinforced fill structure should draw the attention of the maintenance agent to the need for ensuring adequate temporary drainage provisions and implementation of necessary precautionary and mitigation measures, to keep the water away from the structure and guard against excessive ingress of water into the drainage layers under the circumstances.

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