



## Landslide restoration project in Taoyuan, Taiwan



### Introduction:

Daxi Township in Taoyuan county is a hilly area beside Central Mountains, the geographic feature covers high mountain, deep water, and steep canyon. Most of the soil belongs to Ultisols and Alfisols. If heavy rain happens, the subgrade becomes easily eroded causing as a result of severe soil scour. Additionally, the human development and weather patterns transformation have exacerbated the situation of slope collapse. Consequently, failure has occurred due to the water erosion of slope bottom. This is a typical project of protecting the slope and preventing further collapse lead to endanger the back roads and houses, thereby causing a threat to people life and property loss.

### Design:

It was distinguished by two stage with up and down, and slope length were 10m and 15m, area were 108m<sup>2</sup> and 186m<sup>2</sup>, the offset distance was 1.5m. In order to protect the slope toe,

design institution buried 6m<sup>3</sup>, 24m<sup>3</sup>, 72m<sup>3</sup> ACEBag-g each at the top, offset, and toe; then, laid a steel pile with length 5m each 1m intervals(Figure 1). Moreover, a vegetative ACEFormer was used to prevent slope from being eroded. When finished filling, the single-layer area without irrigation was removed, seeds of plantation were sprayed within the open area, and lastly one tree was grown every 3m<sup>2</sup>.

The project spent the total area of 1.05 times the slope which is about 309m<sup>2</sup>, and it was expected to attain 20cm height after filling. ACEFormer was formed by interwoven double-layer of high tenacity woven geotextile of PET and PP. In order to meet the filling and anchor tension requirements, the tensile strength of fabric was set biaxial 50kN/m, the permeability rate was greater than 900L/min/m<sup>2</sup> to allow to filter out the excess water and AOS was 0.4mm for preventing leakage of filling material.

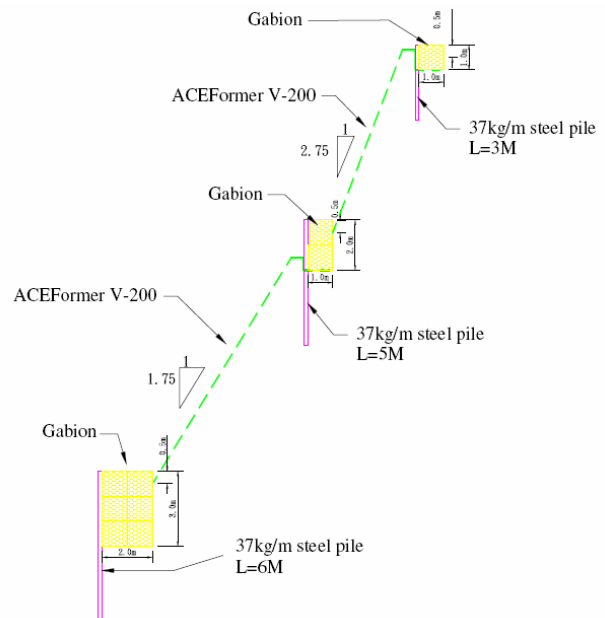


Figure 1. Design drawing



### Construction:

The collapsed surface must be excavated and divided in two stages. Next, the two stages should be leveled to smooth surface.

Laying direction of ACEFormer was from top to bottom, and right to left. ACEFormer was horizontally overlapped at a width of 50cm, and the right stage was overlaid above the left stage. Due to the slope inclination reached 70 degree, in order to avoid the ACEFormer from sliding down during filling process, steel rail stakes are anchored at top of each layer and steel bars are fixed on the surface of laid ACEFormer. Before filling, worker cut an opening about 20cm in the appropriate location at the top of ACEFormer, and inserted the filling irrigation pipe, then proceeded to start filling from right to left.



Figure 2. Before filling

The filler is 1 : 3 cement mortar, the amount of filling material is about  $0.1 \text{ m}^3/\text{m}^2$ . As a result of steep slope, if filling the ACEFormer completely in once, it will vary too much weight and size, so the thickness of the top and the toe will be different and uneven. For this reason, one-piece ACEFormer must be filled three times. After each time to fill, worker should wait for the cement mortar initial set and then continue filling. In this project, the construction was accomplished within a day.



Figure 3. During filling

### Performance:

The outcome of ACEFormer after finished filling, the convex-shaped part of the surface can reduce the water flow velocity and increase anti-erosion ability. Moreover, vegetative ACEFormer can also grow trees and vegetation to reach the effectiveness of soil and water conservation. In conclusion, ACEFormer is easy construct and provides high efficiency for project needs.



Figure 4. After construction