case history

A 35 m high reinforced slope in Taichung City, Taiwan

Location:	Chung-Hsin Village (Taichung City)
Owner:	A private investment group
Designer:	Plato Engineering, Nelson Chou
Contractor:	Johnson Contraction Co., Ltd.
Product:	TENAX **TT 601 SAMP** mono-oriented geogrids

The Problem

In the central part of Taiwan, a housing real estate scheme required to extend its construction on top of a mountainous area.
The property owner planned to maximize the usable land space to fit in luxury villas and townhouses. In order to create more space for new housing, the engineers had to consider building a 35 m high wall, about 60° steep, with 250,000 m^3 of excavated backfill soils on a V-shaped valley. The fill soil was excavated from a nearby hill.
Considered design inputs were the environmental impact, the aesthetics, the maximization of usable space and the full utilization of available on-site weathered shale for backfill soil.

The Solution

Several design and construction options were considered and a cost effective decision resulted in the construction of a 35 m high geogrid reinforced slope.
The 35 m high wall consists of a stepped slope with 5 m high partial slopes at 2:1 (V:H) and 2.5 m wide berms. The main design considerations included seismic factors, existing backfill, adequate sub-surface and backfill drainage, vegetation of slope face and increase of development space.
TENAX **TT 601 SAMP** HDPE mono-oriented geogrids were selected for the reinforcement of the weathered shale fill. The site is in a sub-tropical rain forest area, where torrential rainstorms are frequent; therefore the contractor had to complete the installation within a three months time scale.


1


2


3


4

Photo 1: Overall project view during construction.
Photo 2: Complete project before vegetation.
Photo 3: Reinforced slope two months after construction.
Photo 4: Fully vegetated reinforced slope after five months.

013100747

TENAX®
Man, Technology, Environment.

The installation system was constructed from timber formwork fixed in place with wire ropes to achieve the required slope angle and to support the face during compaction.
The geogrids were fixed in place using U-shaped steel staples in the reinforced soil block and also on face supported by the formwork. Vegetation of the face was achieved by utilizing a pre-seeded straw mat placed inside the face wrapping length of the geogrid.
To avoid desiccation due to summer draught at the steep face, a irrigation system was designed, consisting of flexible plastic pipes (ø 1/2") and water sprinklers, uniformly distributed on the wall face. The seepage of the torrential rain water on the face of the slope was considered critical for the local stability of the face: hence the seepage flow was collected by horizontal strips of geocomposite edge drains, 5.0 m long and 200 mm wide, placed at a horizontal interval of 1.5 m and a vertical spacing of 1.5 m.

Conclusions

The successful completion of the 35 m high geogrid reinforced soil wall achieved the following objectives:

- low cost, fast construction and easiness to shape the slopes;
- fast and excellent vegetation of the face;
- excellent stability: after five years of monitoring, only minimal base and face movements were recorded;
- positive drainage: low pore pressure was noted in the reinforced block while the culvert discharges a continuous high flow.

Hence this project shows that good geosynthetics engineering can provide a solution even to extremely difficult geotechnical problems.

The TENAX Laboratory has been created in 1980 and has been continuously improved with the purpose of assuring unequalled technical development of the products and accurate Quality Control.
The TENAX Laboratory can perform mechanical, hydraulic and durability tests, according to the most important international standards like ISO, CEN, ASTM, DIN, BSI, UNI.

TENAX TT SAMP geogrids are manufactured by extruding and mono-directional drawing of high-density polyethylene (HDPE).
TENAX TT SAMP geogrids, being chemically inert and having a high tensile strength and modulus are specifically produced for the reinforcement of soil.
Soil and aggregate interlock within the geogrid openings, which confine the soil and limit its relative displacements and increase the soil's shear stress resistance. Soil compaction produces an interlock between the soil and both faces of the geogrid layer, thus it's necessary to reach a higher level of tension in order to overcome such an interlock and generate movement.
The composite soil/geogrid structure therefore, acts as if it has an intrinsic tensile strength. The insertion of the geogrid thus produces a type of cohesion within materials that would be otherwise non-cohesive. The soil/geogrid structure integrates the fill soil high compressive strength with the geogrid's tensile strength, thus creating a material having greater rigidity and stability than the aggregate alone. The geogrids capacity to absorb stresses and redistribute them in the reinforced mass further increases the structure's resistance to static and dynamic loads.
TENAX TT SAMP geogrids therefore constitute an innovative and advantageous solution from a technical and economic point of view for all applications requiring improvement in the characteristics of the granular, cohesive, unconsolidated, or aggregate materials.

The reinforcing element provided by the **TENAX RIVEL** System is composed of a **TENAX TT SAMP** series monoriented HDPE geogrid and, on the face, by a non structural guiding and supporting formwork, produced by bending to the slope angle a sheet of welded wire mesh (150 x 150 mm mesh or also 200x200 mm, Ø 8 mm). The formwork is supplied with hooked tie rods that guarantee the geometric stability of the formwork itself during the soil compaction phase. The use of the formwork provides a rapid rate of installation and more accurate project construction and finished face.
A vegetative biomat is placed on the inner face to protect the face against the erosion and create an adequate surface for the eventual hydro-seeding or sowing of suitable grasses.

TENAX TT 601 SAMP
mono-oriented geogrids

DIMENSIONAL CHARACTERISTICS:

Mass per Unit Area:	920.0 g/m²
Roll width:	1.00 m
Roll length:	30.0 m

TECHNICAL CHARACTERISTICS:
Test Method ISO 10319

Peak tensile strength:	
Longitudinal:	100.0 kN/m
Yield point elongation:	
Longitudinal:	13.0%

Certificate n°Q2568

The TENAX Quality System is certified in accordance with the ISO UNI EN 9002 Standard.

TENAX International B.V. • Geosynthetics Division
Via Ferruccio Pelli, 14 • CH-6900 Lugano SWITZERLAND
Tel. +41 +91.9242485 • Fax +41 +91.9242489
http://www.tenax.net • e-mail: geo@tenax.ch

Man, Technology, Environment.