Slope Stabilization with High Tensile Wire Mesh

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Overview

- Introduction
- The TECCO® System
- Elements of the system
- Dimensioning concept
- Installation / Durability
- Sample Projects
Slope failure above foot wall
Slope failure above unsuccesfull barrier
Conventional solutions
Unsuccessful slope stabilization
Unsuccessful shotcrete facing

Unsuccessful, approx. 10 years old shotcrete facing, replaced by a green solution with wire mesh cover.
Unsuccessful Geogrid

Failure of soft Geogrid facing due to:

- Creeping effects
- Cutting of grid at sharp edges
- Overload
Replacement of old flexible solution

In case of high static stress:

Replacing the standard mesh or shotcrete by TECCO®
Combination of traditional rock/soil nailing with tensioned high performance wire mesh providing stability in the surface layer

Active slope stabilization and rockfall prevention

Alternative To Conventional Methods With Shotcrete, Geogrid, Retaining Structures

Solving problems when standard mesh is inappropriate
The TECCO® system can be applied at rock, weathered rock and loose soils.
Overview TECCO® Components

The Main Components:

- Rock or soil nail
- TECCO® mesh
- System spike plate
TECCO Components: Mesh

Characteristics of the TECCO® Mesh

- High-tensile steel wire (> 256 KSI)
- High tensile strength of the mesh (> 10.2 kips/ft)
- Safe force transmission mesh to nail
- Low weight
- Pretensioning of the system possible
- Simple handling
- Special corrosion protection
Characteristics of system spike plate

- Diamond shaped
- Specially developed for optimal load transfer
- Ridges for increased stiffness and easy rope connections
- Low weight
- Openings for vegetation
TECCO Components: Anchor

Characteristics of nails

- Standard steel bar anchors (e.g. GEWI, TITAN, Williams, etc.)
- Local products can be used
- Self drilling anchors for weak underground
What makes the TECCO® System unique?

- Special wire with extremely high tensile strength for large bearing loads and high resistance to tearing
- Dimensioning software program RUOLUM® based on common geotechnical design principles and the performance of the TECCO® system
Bearing Resistance Of The Tecco® Steel Wire Of Diameter 3.0 Mm To Tensile Stress:

\[ Z_w = 2,810 \text{ lbs} \]
- High-tensile steel wire mesh: tensile strength approx. 10.2 kips/ft
- Common steel wire mesh: tensile strength approx. 3 kips/ft
- Geogrid made of pet: tensile strength approx. 2.75 kips/ft
The performance data of the TECCO system has been checked and approved by the LGA.
The Dimensioning Concept

RUVOLUM
The Dimensioning Concept For Surface Protection Systems
The RUVOLUM Concept

The dimensioning concept comprises two investigations:

1. Investigation of superficial instabilities parallel to the slope
2. Investigation of local instabilities between single nails
Investigation of superficial instabilities parallel to the slope

\[ S \, [\text{kN}] = \frac{1}{\gamma_{\text{mod}}} \cdot \left\{ \gamma_{\text{mod}} \cdot G \cdot \sin \alpha - V \cdot \gamma_{\text{mod}} \cdot \cos (\Psi + \alpha) - c \cdot A - [G \cdot \cos \alpha + V \cdot \sin (\Psi + \alpha)] \cdot \tan \varphi \right\} \]

- G = dead weight of sliding body
- s = shear force
- v = pretensioning force
- c \cdot a = cohesion
- t, n = reaction forces
- \( \alpha \) = inclination of the slope
- \( \gamma_{\text{mod}} \) = model uncertainty factor
Investigation of local instabilities between the single nails

\[ X = \text{contact force} \]
\[ z = \text{force parallel to slope} \]
\[ p = \text{stabilizing force} \]
\[ g = \text{dead weight of sliding body} \]
\[ c \cdot a = \text{cohesion} \]
\[ t, n = \text{reaction forces} \]
\[ \alpha = \text{inclination of the slope} \]
\[ \gamma_{\text{mod}} = \text{model uncertainty factor} \]

\[
P \,[\text{kN}] = \frac{G_{\|} \cdot [\gamma_{\text{mod}} \cdot \sin \beta \cdot \cos \beta \cdot \tan \varphi] + (X-Z) \cdot [\gamma_{\text{mod}} \cdot \cos (\alpha-\beta) - \sin (\alpha-\beta) \cdot \tan \varphi] - c \cdot A_{\|}}{\gamma_{\text{mod}} \cdot \cos (\beta + \Psi) + \sin (\beta + \Psi) \cdot \tan \varphi}
\]

\[
X \,[\text{kN}] = \frac{1}{\gamma_{\text{mod}}} \cdot \{ G_{\|} \cdot (\gamma_{\text{mod}} \cdot \sin \alpha - \cos \alpha \cdot \tan \varphi) - c \cdot A_{\|} \} 
\]
The RUVOLUM® Design Concept

The RUVOLUM Concept has been checked and approved by:

Prof. Dr. Wichter of the University of Cottbus, Germany
The RUVOLUM® Design Concept
The Dimensioning Concept

- Definition of slope condition
- Selection of nail type, nail angle
- Determining max. possible nail pattern (distances a & b)
Additionally to the investigations of superficial instabilities:

Proof of the terrain’s resistance (deep sliding surfaces), using common methods to investigate the global stability (e.g. bishop)
Main Advantages

- Increased anchor grid, due to high performance mesh (less drilling works)
- Maintenance free after installation
- Low visibility
- Insensitive to small creepings, movements
- Greenable by hydroseeding / greening mats
- Fully designable
- Quick and easy installation
Installation - Anchoring

- No major earth movements necessary: minor preparation of slope

- Determine location of anchor points, taking into account required grid and low points in the slope

- Drilling anchor holes in difficult slopes possible by new drilling technology and drilling equipment.

- Installation and grouting of anchors (nails)
Installation - Panel Layout
Installation - Panel Connections
Installation – Panel Connection
Installation – Pre-tensioning
Installation – Border Connection
Corrosion Protection

After corrosion testing

GEOBRUGG SUPERCOATING®

Zinc coated

Homogenous surface

Al-Oxide layer

Coarse surface with cavities

Partially totally degraded and / or already with rust formation
Applications – Slope Stabilization
Applications – Slope Stabilization (cont’d)
Applications - Roadways
Applications - Roadways
Applications - Roadways
Applications - Roadways
Applications – Temporary Shoring
Applications – Temporary Shoring
Applications – Streambed Scour?
Applications – Existing Stone or MSE Walls
Questions ???