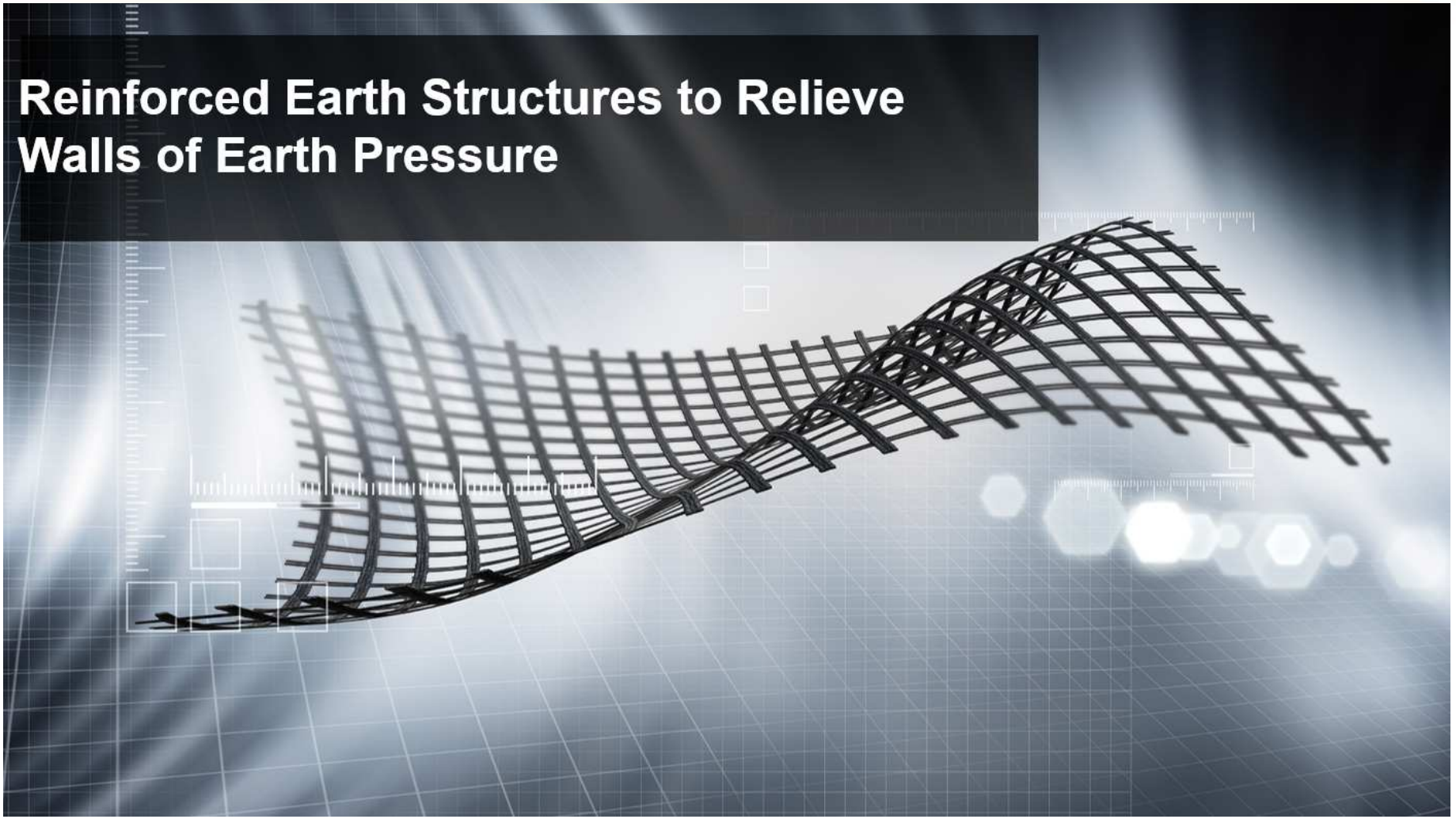
TC211-218 Workshop
MSE Walls and Reinforced Fills

Special Solutions with Goesynthetic MSE Walls

Dr.-Ing. O. Detert
HUESKER Synthetic GmbH

Reinforced Earth Structures to Relieve Walls of Earth Pressure



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Reinforced Earth Structures to Relieve Walls of Earth Pressure

Motivation

Earth pressure on walls or concrete structures can reach significantly high values

Reduction of earth pressure results more slender structures and therefore for cost savings

With GRE's the earth pressure can be reduced to zero by leaving a gap

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Reinforced Earth Structures to Relieve Walls of Earth Pressure

90° steep GRE‘s in as „wrap around“ wall

Reinforced Earth Structures to Relieve Walls of Earth Pressure

Executed projects

Reinforced Earth Structures to Relieve Walls of Earth Pressure

Parameter Study

Reinforced Earth Structures to Relieve Walls of Earth Pressure

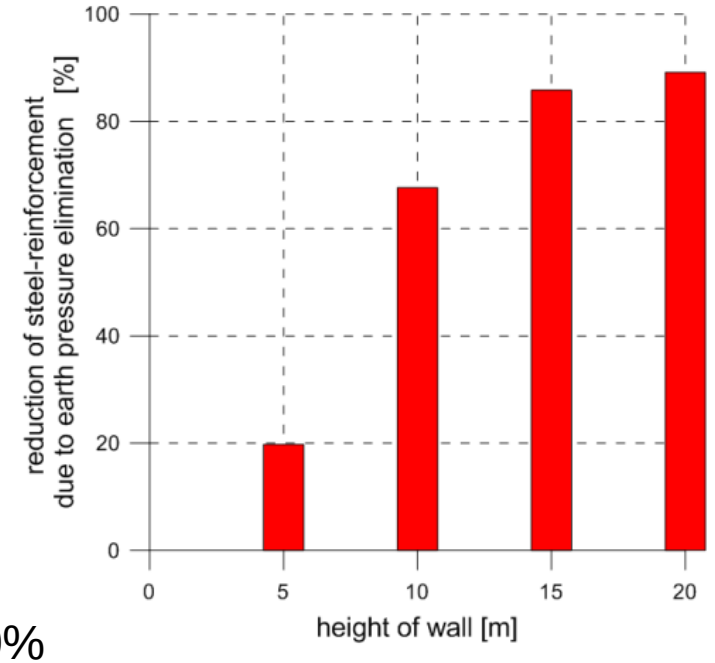
M. Raithel
Kempfert & Partner Geotechnik, Würzburg, Germany
O. Detert
HUESKER Synthetic GmbH, Gescher, Germany

10th ICG, Berlin, 2104

Study 1: Elimination
(total reduction)
of Earth Pressure

- Up to 5 m
  ⇒ savings about 20%
  (due to the necessary
  minimum reinforcement)

- Increasing height
  ⇒ effect rising significantly up to 90%



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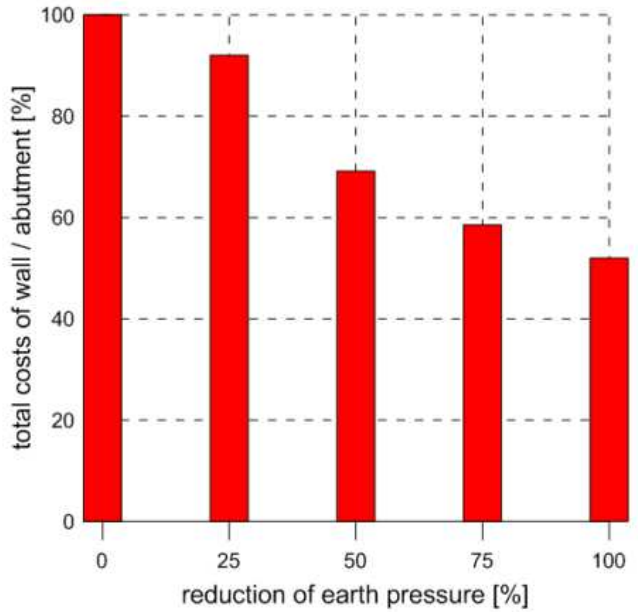
Study 2:
Percentage Reduction
of Earth Pressure

- Retaining wall
  Height: about 6 to 7 m
- Possible reduction
  of total costs up to 50%



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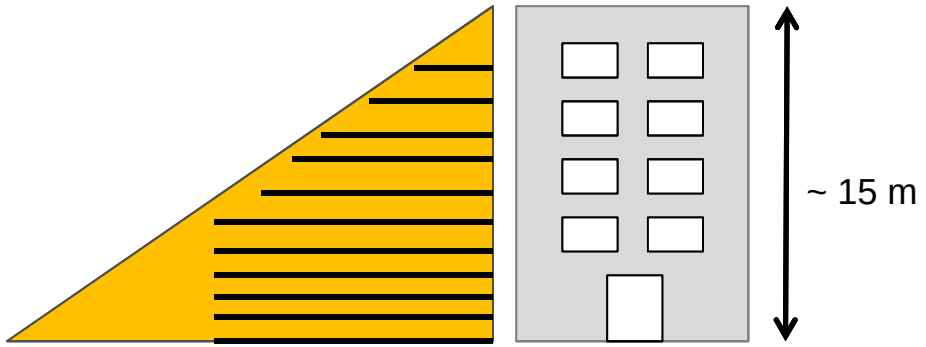
Case Study 1

Earth pressure relief for explosion protection wall

Case Study 1

Earth pressure relief for explosion protection wall

Oil storage

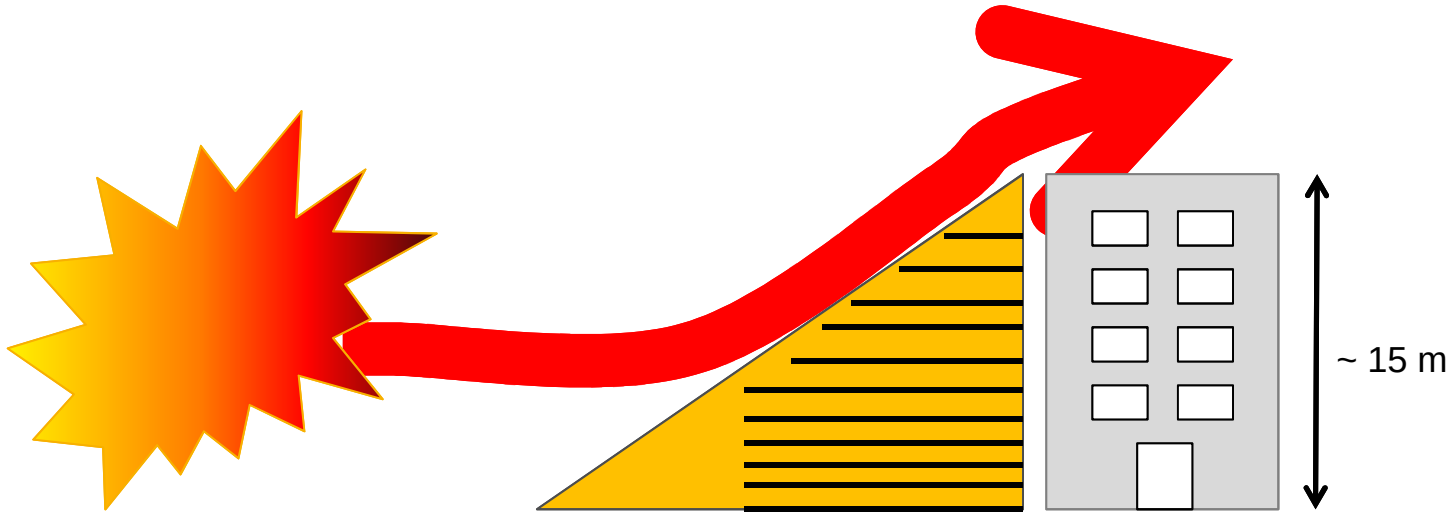


Protection wall

Office building

Case Study 1

Earth pressure relief for explosion protection wall



Reinforced Earth Structures to Relieve Walls of Earth Pressure

Case Study 1

Earth pressure relief for explosion protection wall

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Reinforced Earth Structures to Relieve Walls of Earth Pressure

Case Study 2

Bridge with slender side walls

Concrete side walls are not designed for earth pressure

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Reinforced Earth Structures to Relieve Walls of Earth Pressure

Case Study 2

Construction of oversteep 110° geogrid reinforced soil wall

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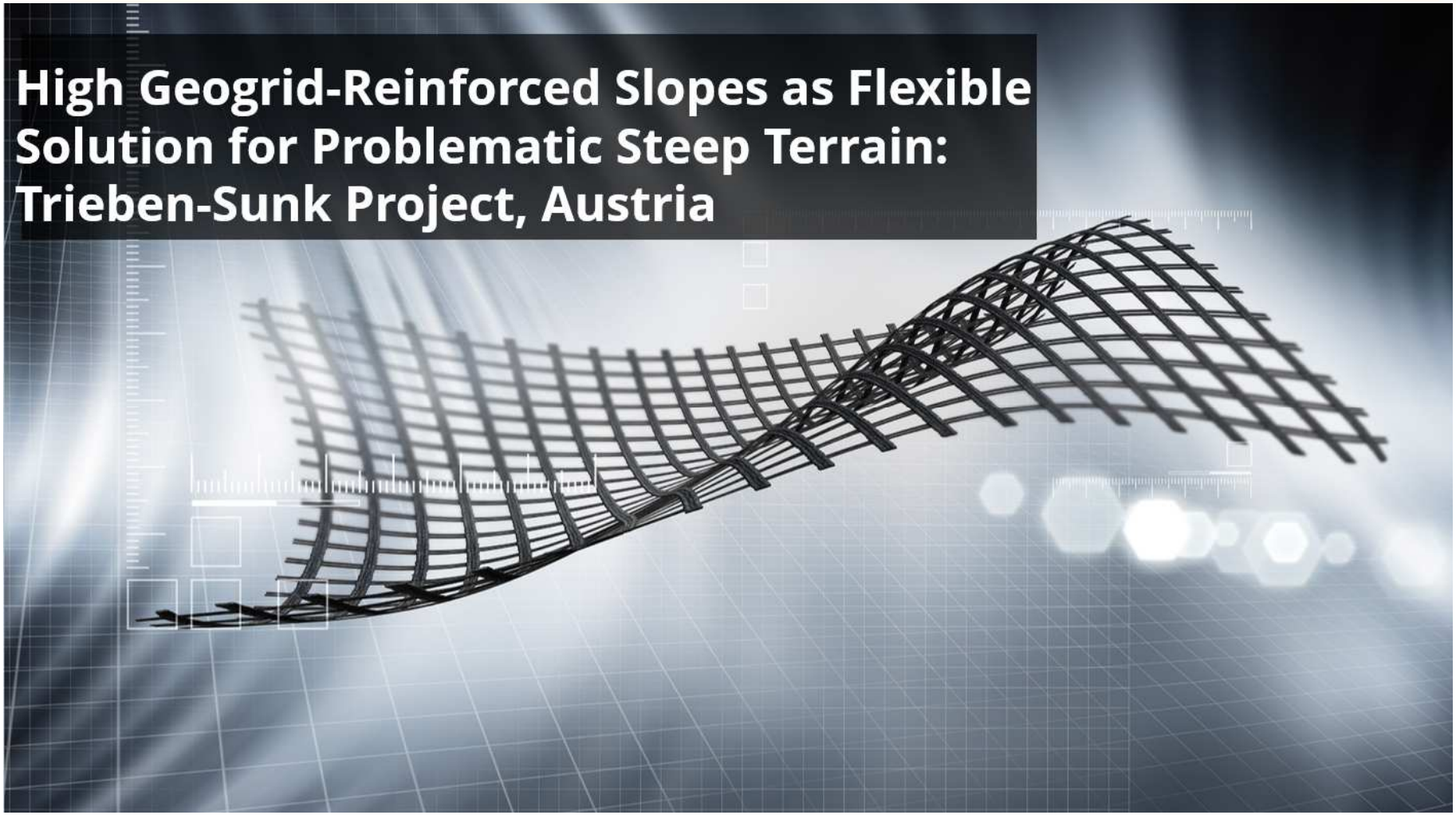
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria



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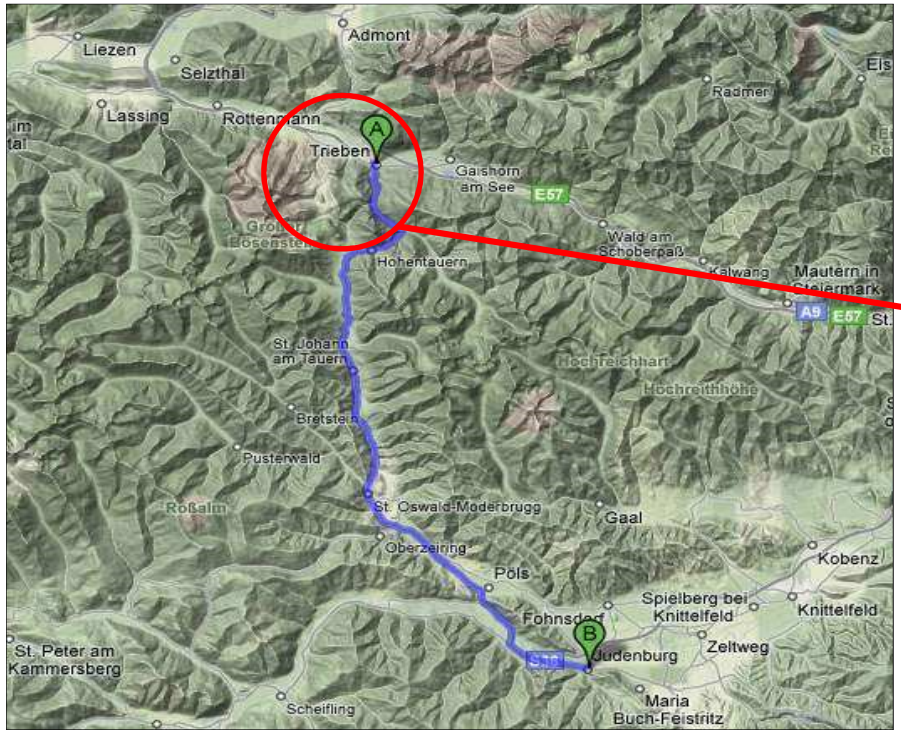
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- B114: Important connection between Trieben and Judenburg in Austria



Focus on this section close to Trieben

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- Permanent slope movement
  - Damage on retaining structures
  - Rupture of anchors to back-anchor bridges
  - Complex and cost-intensive maintenance works
  - 2 m asphalt layer due to compensation of settlements

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- Up to 20% road inclination → dangerous, especially in the winter time
- 1991 bad bus accident with several dead people

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- Acute danger of large-scale landslide
  - GPS monitoring of the road → Blocking possible at anytime
- Due to the situation at that time different options have been investigated
  - Continuation of maintenance works on existing road
  - Construction of new road
    - tunnel
    - supported on embankments on the other side of the valley

High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- Problematic area
  - Steep terrain
  - Avalanches and landslides
  - Creep-prone slopes
- Estimated Traffic (2008)
  - 2000 vehicles/24h
  - 9% heavy-goods vehicles

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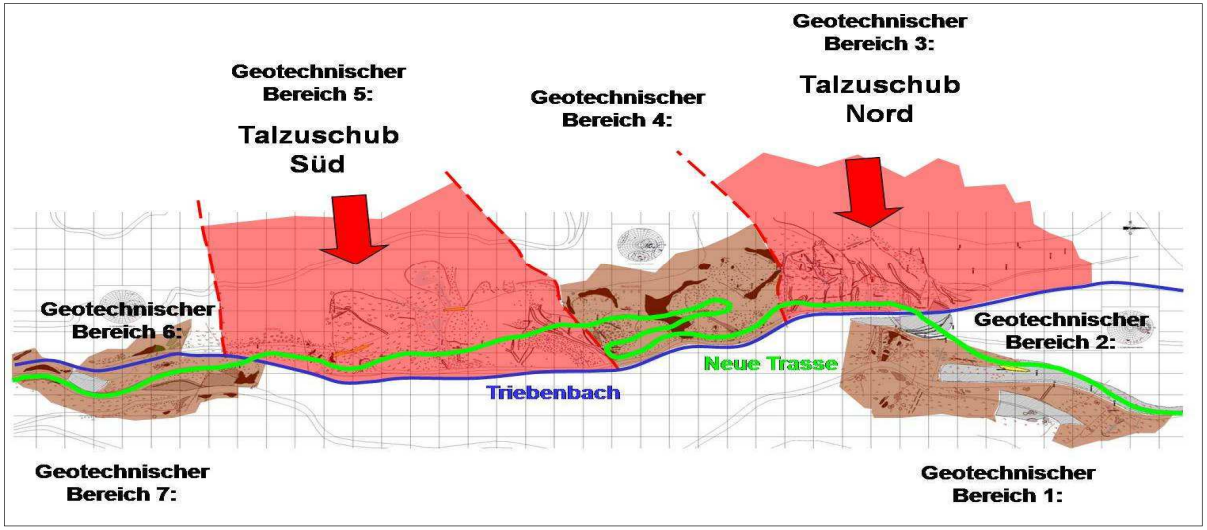
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

- New road to be built
- Construction on opposite hillside (slopes are also prone to creep)
- Reduction of inclination by serpentines
- Direct crossing of creep prone areas
- Traffic can run during construction on old road



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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Cut areas

- Rock areas
  - Shotcrete plus anchors in a „2 m x 2 m“ pattern
- Loss rock areas
  - Temporary securement by shotcrete
  - Permanent back-anchored by up to 28 m long anchors for working loads of 400 kN

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Geogrid reinforced embankments in fill areas

- Due to previous experience a flexible solution was preferred
  - Geotextile reinforced embankments
  - Able to compensate deformation to a certain extent without damage
- Highest Embankments at that time in Austria with this technology (max. 28 m)

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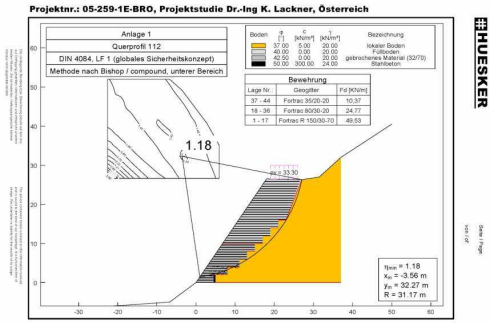
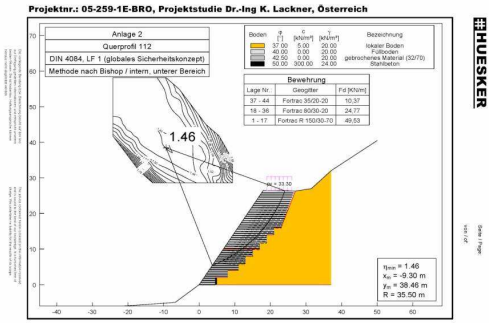
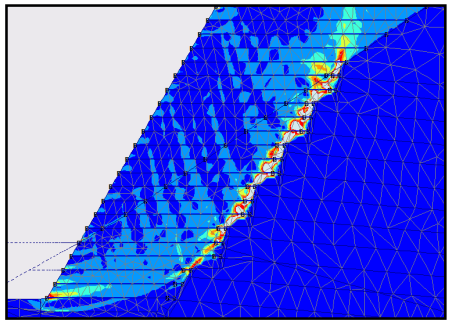
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Comprehensive and complex Design

- Calculation with Bishop/Janbu (GGU-Stability)
- Numerical analysis (Plaxis V8)
- Analysis of three scenarios
  - Current stability
  - Construction stages (cut and temporary safeguard)
  - Final stage







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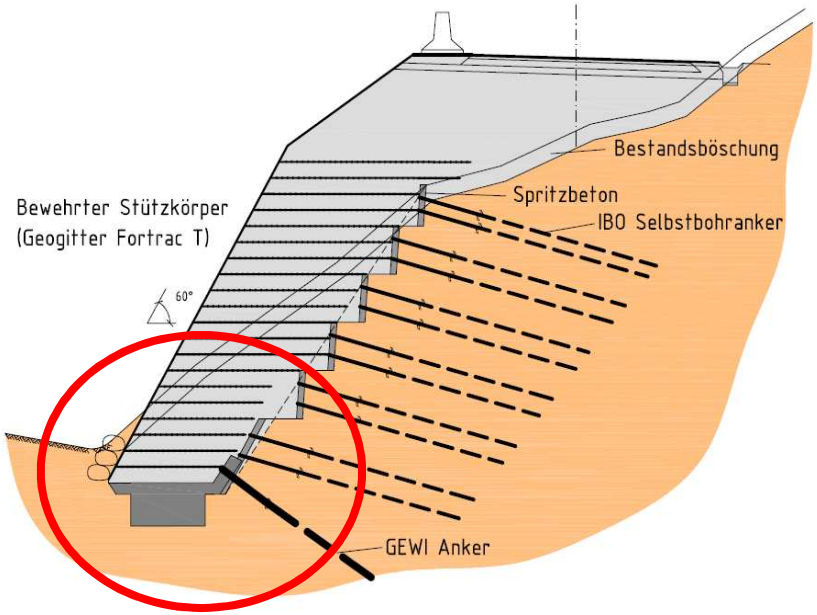
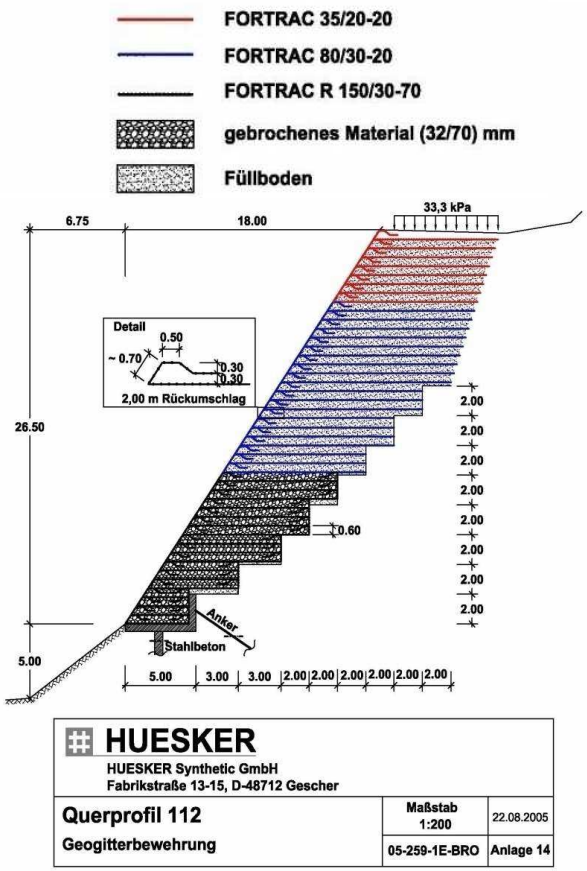
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Comprehensive and complex Design

- Stable base construction to secure global stability





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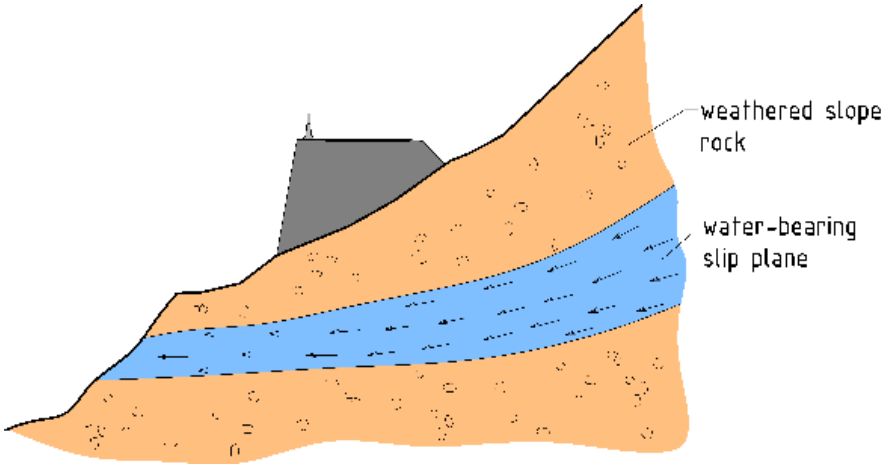
High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Comprehensive and complex Design

- Drainage of water-bearing potential slip plane



High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

Preparation of stable base by means of back anchored concrete blocks

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

Preparation of reinforcement at central place. Easy and space-saving transportation of folded reinforcements.

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

Placement of lost formwork, reinforcement and erosion protection in the front.

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

Use of local material for wall construction.

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

19th International Conference on Soil Mechanics and Geotechnical Engineering
17 (Sunday) – 22 (Friday) September 2017
COEX Convention Centre, Seoul, Korea

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High Geogrid-Reinforced Slopes as Flexible Solution for Problematic Steep Terrain: Trieben-Sunk Project, Austria

Construction sequence

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Questions

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