INNOVATIVE LANDSLIDE REPAIR

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Nathan Beard, P.E.
INTRODUCTION

- Who is GSI?
  - Design/Build/Warranty Contractor
  - Specialize in emergency geohazards
    - Landslide, rockfall, shoring, bridges, gas pipelines...
  - Average over 5 geohazard mitigations per week

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• Project Limitations
  
  o Limited access…constructability
    - Actively moving slope, saturated, active traffic, no benching…
  
  o Property limits or easements available
  
  o Environmental concerns
    - Stream, vegetation, permits, disturbance area…
  
  o Cost and project duration (more with less)
    - Maximizing material system effectiveness – orientation (Lateral and axial loading, bending, tension vs. compression)
    - Time is Money
Case Study

SR 247 – Nelson County, KY

• ~250-ft long Emergency slide closed KY 247
• Movement of slide was first observed by GSI in 2008
• Adjacent to creek - Creek turns nearly 180 degrees at failure
Landslide toeing out in creek; very soft fat clay.

Secondary failures above main landslide
Small Diameter Micropile
• What is a micropile?
  o General definition from multiple industry documents (AASHTO, IBC, FHWA, DFI)
    - Steel pipe casing or steel core reinforcement
    - Drilled and grouted
    - Diameter of 12 inches or less

• What is a small diameter micropile?
  o Diameter of 6 inches or less

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• Specifications and guidelines for micropiles
  
  o Primarily used for structural supports
    - Foundations, underpinning, seismic retrofits
  
  o No consensus regarding proper design approach for micropile systems for slope stabilization
    - FHWA/NHI Micropile Design and Construction Reference Manual removed chapter 6
      “Design of Micropiles for soil slope stabilization”
• Stability analysis

Sliding Surface

Reinforcing Member

\[ R \]

\[ R_{axial} \]

\[ R_{lat} \]
Analysis of Soil-Structure Interaction Problems Using LPile 2012

Presented by
Bill Isenhower

J. Erik Loehr
University of Missouri
Short Course for Soil Nail Launcher, Inc.
Grand Junction, CO
June 11, 2012

John Curran & Team
rocscience
software tools for rock and soil

ENSOFT, INC.

GeoStabilization International
ENGINEER TEAM
• Example Micropile System
Magnitude of contributions depends on:
  • Orientation of reinforcement compared to soil movement
  • Type of reinforcement
  • Depth of sliding
  • Frictional resistance of soil

FS = 1.07
• Search for critical sliding surface

This is a huge challenge
• Critical failure location moves with addition of reinforcement
• Resisting forces vary with location
• Must perform rigorous search

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DESIGN – EXAMPLE PROBLEM

- L-Pile p-y analysis
• Axial resistance from t-z analysis
  • Using an excel spreadsheet based on Hooke’s law

1. Apply displacement in soil above sliding surface
2. Determine response from t-z analysis
3. Mobilized resistance is axial force in member at depth of sliding
4. Repeat steps 1-3 until limit state is reached
Case Study

SR 35 – Fort Payne, AL

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Case Study
I-77 in Carroll Cnty, VA
Area = 3001.0804, Length = 217.5432
Enter an option

- Distance
- Radius
- Angle
- Area
Note: The Wall will be Constructed in 4-5' Lifts.

17.5'

4', Typ.

12" Nominal Reinforced Shotcrete

15" +/- 5", Typ.

Self-Drilling SuperNail®, Typ.

Horizontal Drain, Typ.
- Up to 40'-6" in Length, 10-ft-o.c.

Note: Horizontal Drain Locations
VH may vary based on nearby limitations.
Thank You

geohazard mitigation experts

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