Geotechnical Risks and Management Systems: An FHWA Perspective

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Competing Demands…
Geotechnical Management

- Slope Management Systems
- Geohazard Management Systems
- Retaining Wall Inventories and Management
- Management of Geotechnical Systems & Appurtenances
  - Mechanically stabilized systems - Rock-bolts/anchors, dowels/soil-nails
  - Drainage systems
  - Rock-fall mitigation systems
  - Ground improvements
- Geotechnical Data Management Systems
Natural and Man-made Conditions affecting Slopes and Infrastructure
## Hazard vs. Risk (Threat)

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Risks</th>
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<tbody>
<tr>
<td>Earthquake</td>
<td>Earthquake occurs…</td>
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<tr>
<td>Hurricane</td>
<td>a) resulting in fatalities.</td>
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<tr>
<td>Abandoned Underground Mines</td>
<td>b) resulting in major injuries.</td>
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<tr>
<td>Karst Geology</td>
<td>c) Resulting in disruption of lives.</td>
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<tr>
<td>Landslides</td>
<td>d) damage to property…</td>
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<tr>
<td>Rockfall…</td>
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Risk Management

- Limit Surprises
- Minimize Management by Crisis
  - Operate Proactively instead of Reactively
- Reduce Long-term Costs
- Increase Likelihood of Success
  - “Do It Right” the First Time
- Prevent or Minimize Bad Things from Happening
- Optimize Designed Solutions

Minimize Threats  Maximize Opportunities
## Slope Failure Impacts and Management

### Threats
- Closure
- Impedance to Mobility
- Economic Impact to Region & Users
- Cost of Repair/Remediation
- Injury and damages
- Loss of Life

### Obstacles
- Resources (time, money, people)
- Convincing Decision Makers
- Proactive Funding Mechanism
- Mitigating Off-ROW threats before failure
Slope Management Systems

Motivation - ECONOMICS

- Problem of frequency and severity
- Costs often poorly tracked, but known to be great
- Seldom have funding to address all problems
- No “one size fits all” strategy available
Slope Management Systems

Limitations

• Do not “solve problem” – rather provides information needed to address problem most effectively
• Do not establish optimum strategy – rather enables implementation of selected strategy
• Are not self-sustaining – require maintenance and upgrades (funding and manpower!)
## Slope Characteristics

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<td>Ground-water</td>
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## Highway/Traffic Characteristics

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# Slide Characteristics

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## Consequences

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Other Features…

- Incorporate into GIS and integrated data layers (site info, photos, topographic, geologic maps, Google Earth Pro, etc.)
- Integrated Geologic Structure and Geotechnical Data
- Profiling Data
- Distinguish between modes of failure
- Condition assessments/performance monitoring of slopes and appurtenances (i.e. condition of rock-bolts/dowels, drains, mesh, fences, etc.)
- Effectiveness of Ditch (Catchment)
- Mitigation Cost
Example:

NH DOT Rock-cut Management System
Costs and Economic Strategies

Costs depend on...

- Size and severity of problem condition
- Maintenance/repair technique(s) used
- Site location
- Availability of equipment and materials
- Whether contracted or “in-house”
- Degree of improvement achieved

Economic Strategies

- Minimize costs
  - Immediate costs
  - Life-cycle costs
- Minimize risk
- Minimize “total cost”
- Maximize “value”
Take-Aways

Realistic Scope - Functional & Maintainable System

Support of Upper Management and Necessary Designated Resources
  • Clearly convey risks and benefits
  • Value-Added & Representation of Geotechnical Engineering

FHWA Initiatives
  • Guidance framework for slope/geotechnical management systems
  • Integration of Asset Management
    • Life-cycle considerations of geotechnical features and systems
    • Integration of Geotechnical Data Management
  • Distinction between “Hazard” and “Risk”
    • Groundwork for Standard of Practice
Questions?