LANDSLIDE AND ROCKERY WALL MONITORING SYSTEM FOR RESIDENTIAL AREA

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18th Annual Technical Forum
Geohazards Impacting Transportation in Appalachia
August 7 to 9, 2018
Baltimore, MD
OVERVIEW

- Landslides
  - Nature of failures
- Rockery Walls
  - What is a rockery wall?
  - Why rockery wall can present a potential risk?
- Case Study
  - Nature of the hazards
  - Repair of the slope
  - Monitoring movement of wall
- What are the optimal monitoring solutions for the case study?
  - Monitoring the slope after the repair
  - Monitoring the rockery wall
  - Data Acquisition
- **Nature of failures:**
  - Soil saturation
  - Slope angle
  - Surcharge
  - Ground water
WHAT IS A ROCKERY WALL?

- Difficult design
  - Not standardized
- Construction relies on installers’ skill
- No reinforcement
- Can fail due to soil movement behind the wall
HAZARDS OF A ROCKERY WALL
CASE STUDY: RESIDENTIAL AREA IN NEVADA
NATURE OF THE HAZARDS – LANDSLIDE
NATURE OF THE HAZARDS – ROCKERY WALL
REPAIR OF THE SLOPE
SOLUTION - MONITORING

Monitoring the slope

Monitoring the boulders
SLOPE INSTRUMENT LAYOUT

IPI/Probe Inclinometer
VWP

Base Station (ADAS)
TIME-DOMAIN REFLECTOMETRY (TDR) : HOW IT WORKS

- Works like radar
- Reflectometer transmits short rise-time pulse
- Pulse is transmitted along the cable
  - Cable has a characteristic *velocity of propagation* (Vp).
  - Vp is known as a percentage of the speed of light.
- Pulse if reflected and the travel time determined
  - Length of the sensor cable can be calculated
TIME-DOMAIN REFLECTOMETRY

Electrical pulse sent down cable

Pulse reflected at crimps and breaks

Severity of and distance to reflection is determined

Coaxial cable grouted into borehole
MONITORING THE SLOPE AFTER REPAIR: TIME-DOMAIN REFLECTOMETRY
VIBRATING WIRE PIEZOMETER

- Monitors pore-water pressure in soil
- Water pressure changes the tension in the wire
MONITORING THE SLOPE AFTER REPAIR: VIBRATING WIRE PIEZOMETER
ROCKERY WALL INSTRUMENTATION LAYOUT

Base Station (ADAS)
MONITORING OF THE ROCKERY WALL: VIBRATING WIRE TILTMETER

- 8 Uniaxial tiltmeters on 3 different levels
- All connected to a vibrating wire analyzer
AUTOMATED DATA ACQUISITION SYSTEM

- Instruments connected to a datalogger
- Datalogger collects data
- Real-Time monitoring
  - Email alerts sent via modem
Station Monitoring

Shear Key

Rockery Wall

TDR A & B
TDR C & D
TDR E & F

Inclinometer
Piezometer

VITALS
Temperature (deg C)
34.0

Battery Voltage (Volt)
13.1

TILTMETERS

7/10/2018, 12:00:00 PM
7/10/2018, 12:00:00 AM
7/10/2018, 12:00:00 PM

WEB-PAGE INTERFACE
CONCLUSIONS

- Post-construction monitoring is essential
- Monitoring can determine if a problem actually exists
- Wide variety of instrumentation is available
- Automated instrumentation is cost-effective
  - Can be reused after stabilization is assured
  - Relatively inexpensive
  - Allows real-time data acquisition to spot trends