



Case Study – Mount Rushmore Rock Block Monitoring System

Keystone, South Dakota 2010



Mount Rushmore, Fiber Optic Strain Gage Install

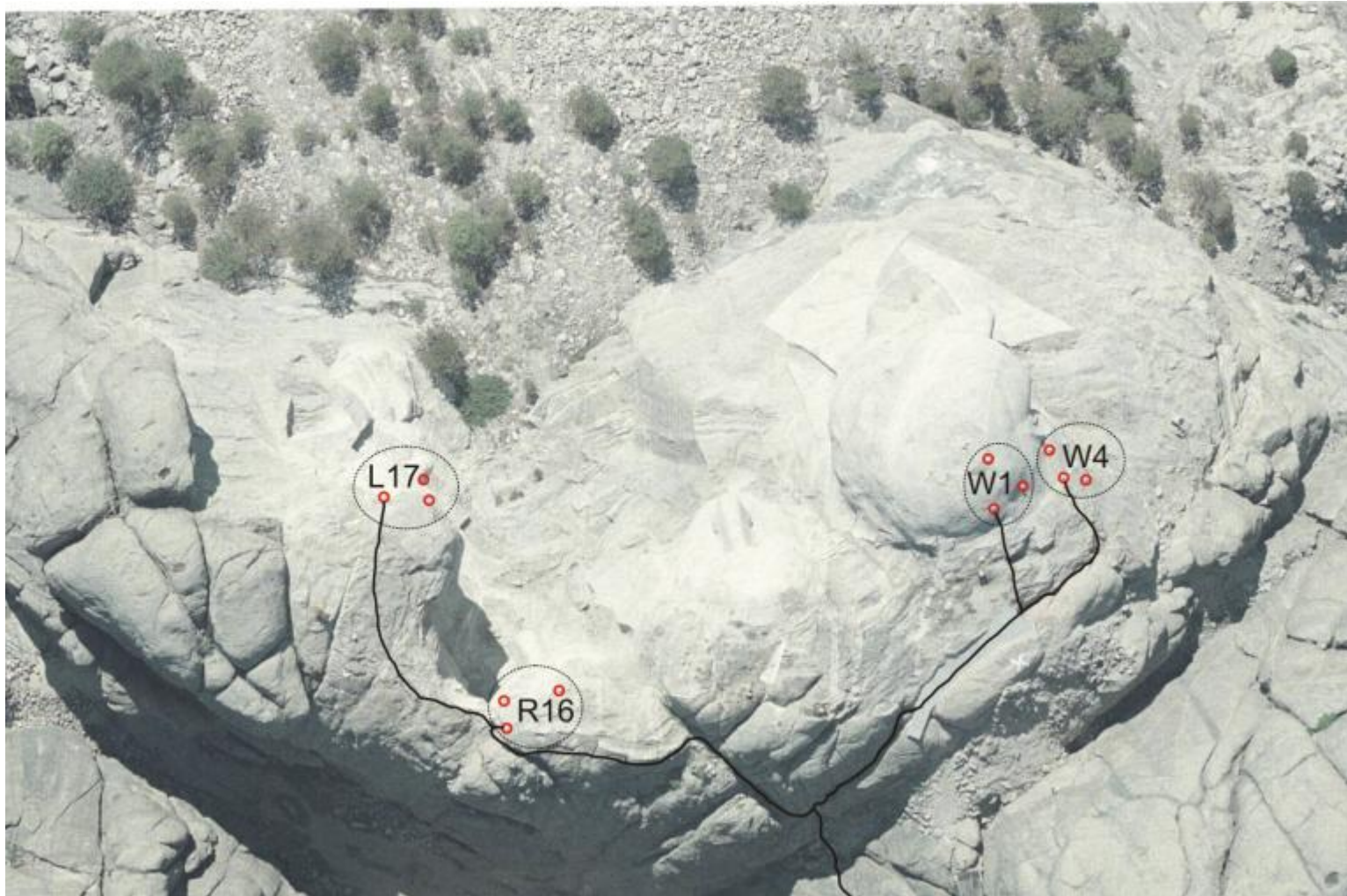


Aim	Replace existing, aging Rock Block Monitoring System (RBMS) with a crack monitoring system based on fiber Bragg gratings.
Location	Mount Rushmore National Memorial, South Dakota. Four locations on the monument, two on Washington, one on Roosevelt and Lincoln.
System Integrator	Respec Consulting and Services
End Customer	National Park Service, Mount Rushmore National Memorial
Date	September 8-10, 2010
Instrumentation	(1) sm125, Micron Optics Optical Sensing Interrogator
Sensors	<ul style="list-style-type: none">• 24 os3110 Optical Strain Gage, Spot Weld• 12 os4310 Non-metallic Temperature Sensor
Software	ENLIGHT Sensing Analysis Software
FBG Technology Benefit	Eliminated hundreds of pounds of copper wiring from the monument. Replaced lightning prone electrical based sensor system.



- A rock block is identified if one or more fractures combine to form a continuous trace
- Multiple Rock Blocks identified





Top view of monitoring locations



Installation of fiber cable runs for the four monitoring locations.



Securing the tie down clips to the rock with epoxy for securing the fiber cable runs.

Mount Rushmore, Fiber Optic Strain Gage Install

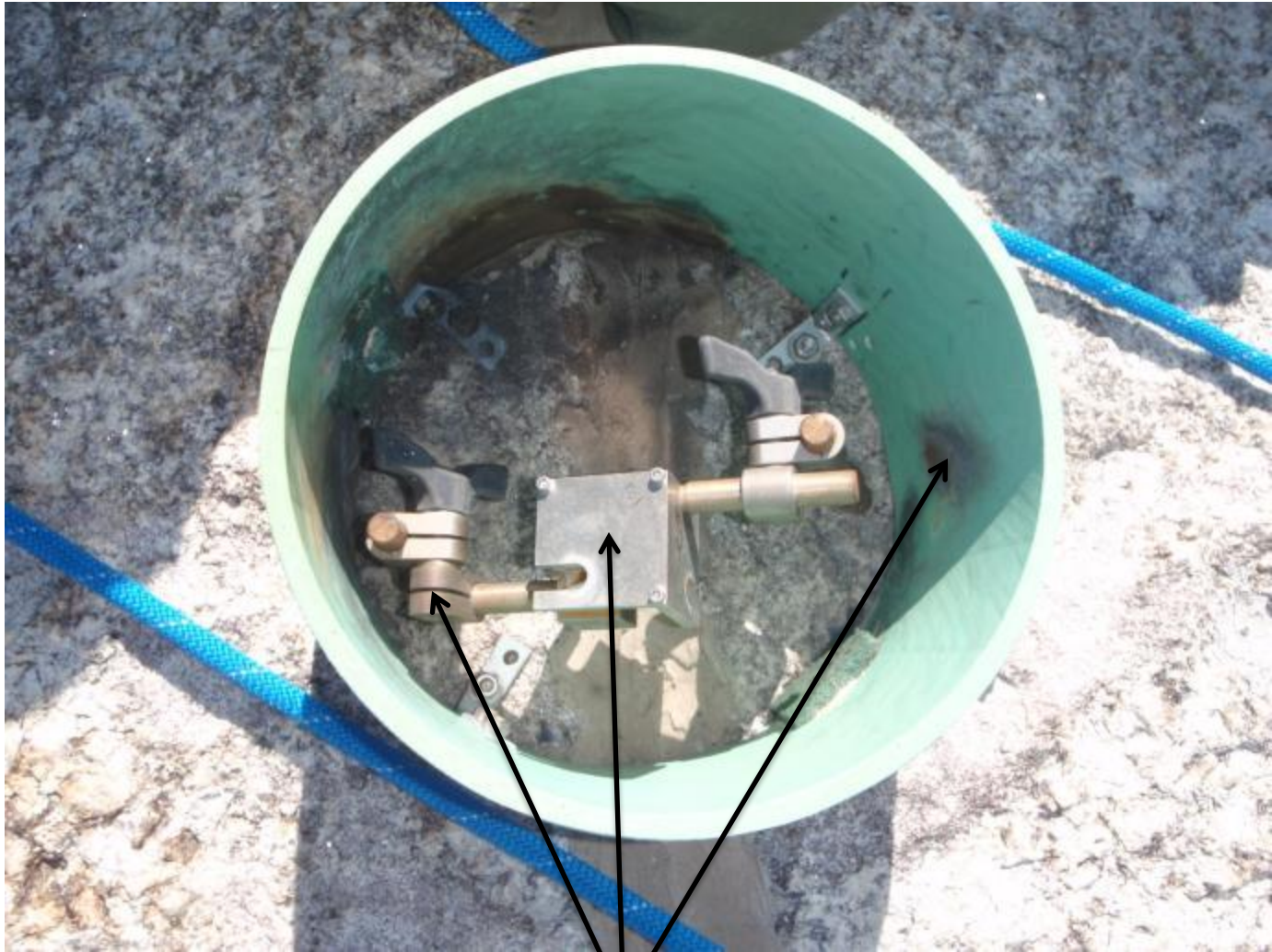


Previous monitoring system utilizing LVDT's

New monitoring system utilizing os3110 strain gages mounted on either side of the small cantilever beam. Temperature compensation is realized thru an active dummy gage configuration.



os3110 Weldable Strain Gage



Location previously abandoned due to lightning strikes.
Notice areas of charring or discoloration.

Mount Rushmore, Fiber Optic Strain Gage Install



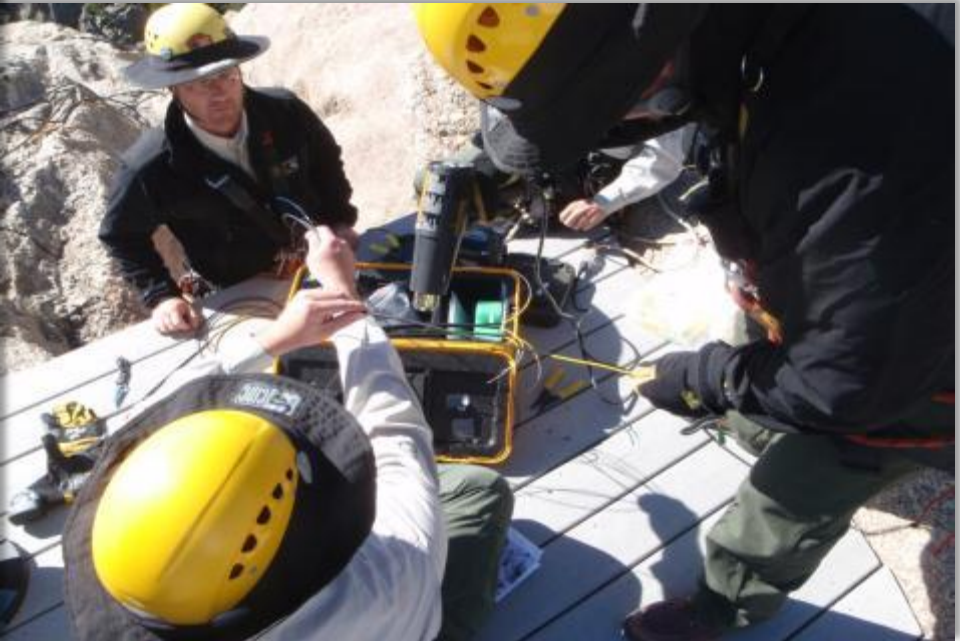
National Park Service Rope Access Team, roping off and performing installations. Counter clockwise from top left is Roosevelt, Lincoln and Washington below.



Mount Rushmore, Fiber Optic Strain Gage Install



Rope Access Team performing optical fiber splicing operations on top of Mount Rushmore. Cable splicing is a standard process for optical fiber based systems like this optical sensing application.





- ## Results

- Installation a success, fiber splicing performed on top of the monument. Gage orientation performed while roped off and hanging in place in front of monitoring stations.
- System design allows for damaged gages or cable to be replaced with minimal intervention.
- Absolute temperature measurements made at each location with os4310. Temperature compensation for strain measurements realized thru active dummy gage configuration on a cantilever beam.
- Fiber optic system's immunity to voltage gradients due to lightning or Electro Static Discharge allowed abandoned monitoring station reactivation.
- Hundreds of pounds of copper removed. Four, three millimeter fiber cable runs eliminated the need for copper cable harnesses. Aesthetics of the monument improved for the public.



Acknowledgements

National Park Service (end customer)

Duane Bubac, email: duane_bubac@nps.gov, Don Hart, email: Don_Hart@nps.gov, Allan Sage, email: allan_sage@nps.gov, Aileen Crawford, email: aileen_crawford@nps.gov

Respec

Tel: (605)394-6400, Rich Barry email: rich.barry@crazyhorse.org, Cody Vining email: cody.vining@respec.com, Vicki Franzen email: vicki.franzen@respec.com

Micron Optics, Inc

Tel: 404-325-0005, email: info@micronoptics.com, web: www.micronoptics.com