Technology News

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Instrumented King Wire for Monitoring Cable Bolts

Objective

A cable bolt can be a strain-measuring device as well as a supporting device in underground mines. Placing instruments on a cable bolt allows certain characteristics of a rock mass, such as high strain and load, to be evaluated during mining and provides a means for mining engineers and mine inspectors to forecast a potential roof fall.

Background

Thousands of cable bolts are installed in U.S. mines each year. Studies performed by NIOSH researchers show that support loads can exceed the yield point of the steel, which can result in unstable ground conditions that pose direct safety hazards for underground workers. Rock falls can also create secondary hazards, such as caved escapeways and blocked ventilation passages. Development of methods and tools to assist in the evaluation and selection of rock supports could reduce the number of unplanned rock falls significantly.

Approach

Instrumented cable bolts developed at NIOSH's Spokane Research Laboratory were used along with existing ground control systems to monitor rock mass loads and movement. Axial and shear loads on the cables are determined as these loads are transferred to strain gages embedded in the king wire. In longwall, room-and-pillar, or underhand cut-and-fill mines, rock mass loads and movements can be detected down to microstrains of stress or millimeters of movement. By detecting such small amounts of ground movement and support load, early intervention to prevent a roof fall is possible, and miner safety and health are increased.

How it Works

Up to 10 strain gages are embedded in the king wire at whatever locations a mine ground control engineer may specify. The gages can either be set in pairs in the same plane to detect shear or set at 90° angles to detect loading in three dimensions. The cables are up to 5 meters long if they are to be grouted with resin or up to 15 meters if they will be grouted with cement. They are capable of holding an ultimate load of 214 kN and produce reliable readings to 178 kN, as shown in the calibration curve. The cables are fitted with an instrument plug for monitoring the gages and a special head for insertion into the rock. A data acquisition system, such as a Vishay strain indicator box, Campbell Scientific, or Omnidata system, is required to obtain the data for load and displacement calculations.

Patent Status

A patent has been applied for under the name "Instrumented King Wire for Monitoring Cable Bolts for Use with Resin Grout," application no. 60/076,138.

For More Information

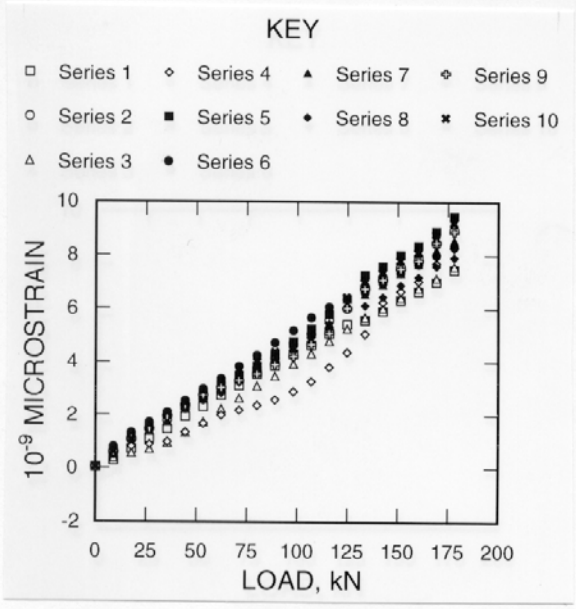
Additional information can be obtained by contacting Lewis Martin at (509) 354-8077, e-mail ljm8@cdc.gov, or Richard Curtin at (509) 354-8076, Spokane Research Laboratory, Spokane, WA, 99207.

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

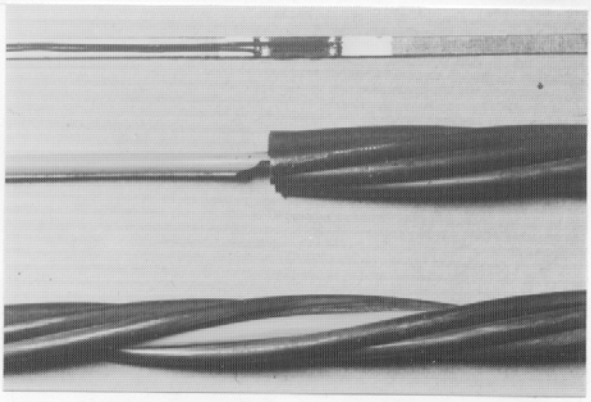
CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

To receive additional information about mining issues or other occupational safety and health problems, call **1-800-35-NIOSH (1-800-356-4674)**, or visit the NIOSH Home Page on the World Wide Web at http://www.cdc.gov/niosh

Mention of any company name or product does not constitute endorsement by the National Institute for Occupational Safety and Health.



Loads on instrumented cable bolts.



Top: King wire with gage; middle: king wire after molded epoxy and rewrapped with cable; bottom: epoxy-coated king wire during cable rewrapping.

Instrumentation plug and installation head.