Project title: The Precise Determination of Rockbolt Performance Underground

Organization: Southem Illinois University Carbondale

Partnerships: Yieldpoint Inc, Kingston, Ontario, Canada

Investigator: A.J.S. (Sam) Spearing

Focus area: Safety

SYNOPSIS

Problem Statement and Justification: All previous *in situ* rock-bolt monitoring (mainly load versus displacement) solutions to date have been implemented via two methods. The first method incorporated opposing pairs of short base-length resistive strain gauges on opposing sides of a roof bolt. A more recent method incorporated long base-length displacement strain gauges spaced at regular intervals on opposing sides of a roof bolt in a similar fashion. Both of these methods have involved only two slots, along the rock bolt length, containing the strain gauges. It has been found that these designs have significant shortcomings as neither captures the entire strain profile along the bolt and both have inherent errors because only two slots are used. This project makes use of a novel monitoring technology that uses optical fibers in both two, and three slots in rock bolts, and represents the most innovative rock bolt monitoring technology to date. Preliminary tests have indicated that this is truly a ground-breaking technology.

Impact of the Research: The overlying focus of this project is to improve rock-related safety and potentially optimize the design of primary roof bolts in coal mines by measuring and understanding the loads in resin grouted rock bolts over time. This could potentially result in improved safety combined with increased productivity and possibly even reduced costs.

Objectives and Research Approach:

Objective 1 – Laboratory studies and instrumentation validation. This involves comparing the bolts with two slots using short gauges, long gauges and optical fibers under different loading conditions and at different orientations in the laboratory. Bolts with three slots and optical fibers will also be used. It has been found that the two-slot short gauge and long gauge designs have significant shortcomings as neither captures the entire strain profile along the bolt. By using only two slots, the load profile can easily misrepresent any reactive loads in the bolt depending on where the load is applied relative to the two slots. Considering that to obtain a strain tensor, three gauge rosettes are needed, and for the same reasons, three orientations of strain gauges along a bolt should also be needed (i.e. 3 slots).

Objective 2 – Installation of instrumented bolts in the field. The monitoring technology that offers the most thorough and reliable load monitoring along the bolt will be installed under various conditions underground. Coal mines have already offered underground sites.

Objective 3 – *ln-situ* monitoring and reporting.