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Title: Improvement of Rib Support Design Utilizing Recent Advancements of the Coal Pillar Rib Rating (CPRR) System

Organization: Missouri University of Science & Technology

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Partnerships: Peabody Energy, Arch Coal Resources, NIOSH

Focus Area: Health and Safety Interventions – Ground Control

SYNOPSIS

Problem Statement: Despite numerous and concerted efforts to assess the stability of coal ribs, rib failure-related injuries and fatalities continue to occur in underground coal mines. A critical aspect of limiting coal rib failures is the design and validation of support systems. To date, a standard methodology for the design of coal rib supports which can accommodate the wide range of unique conditions found in coal mines in the United States has not been developed yet, forcing mine operators to rely on the trial-and-error process or to utilize industrial legacy practices.

Research Approach: Building upon recent success in the development and improvement of the Coal Pillar Rib Rating (CPRR), the research team at Missouri S&T, in collaboration with NIOSH researchers, will utilize a combined empirical-numerical approach to further develop the CPRR to a state which can be used for the analysis of supported coal ribs, and for the design of coal rib supports. Pairing with industry leaders in underground coal mining, supported coal rib monitoring in active mining conditions will provide the basis for the calibration and validation of hybrid distinct-finite difference element models, which have the ability to realistically model stress-driven coal rib failures as well as kinematic failures along explicitly modeled discontinuities such as face cleat systems. A suite of in-situ rock bolt pull-out tests is proposed for rock bolts installed in coal ribs located in active mining areas to better understand the coal rib-rock bolt interaction effect, as well as to validate numerical simulations of the support elements themselves. The validated numerical models will be used to conduct a parametric study to further develop the CPRR system into an intuitive and easy to use tool for mining engineers and coal mine operators to utilize for the assessment of coal rib stability and the design of coal rib supports based on their unique mining conditions.

Impact of Research: There are several key impacts from our proposed research:

1.) Proposal of new rib support methodology based on coal mining conditions such as coal type and mining depth,
2.) Inclusion of supported coal ribs into the modified CPRR calculation method,
3.) Validation of the CPRR method with field measurements from supported coal ribs in active mining areas.