Missouri University of Science and Technology

Alper Kirmaci- Ph.D. Thesis

Thesis Title and Abstract

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

Abstract: In underground coal mining operations, occurrences of rib failures resulting in injuries and fatalities persist, despite concerted efforts to assess the stability of coal ribs. The development and validation of support systems are imperative to mitigate coal rib failures. A pivotal component of this validation process involves comprehending the responses of bolts, as they significantly influence the effectiveness of coal rib support applications, which in turn play a critical role in managing the stability of subterranean coal mine excavations.

Conducting pull-out tests is essential for gaining a deeper understanding of these bolt responses. However, performing a series of in-situ pull-out tests encompassing various bolt specifications and diverse coal mining environments can be particularly challenging due to constraints associated with the mining setting and available equipment. To address this ongoing safety concern, the collaborative efforts of the National Institute for Occupational Safety and Health (NIOSH) and the MST Research Team have led to the development of the Coal Pillar Rib Rating (CPRR) system. This innovative approach is designed to assess the structural integrity of coal pillar ribs, with a specific focus on evaluating supported coal ribs and the formulation of effective coal rib support systems. This endeavor involves employing a synergistic empirical-numerical methodology to further enhance the CPRR system. Additionally, coal rib monitoring systems will provide essential infrastructure for the calibration and validation of hybrid discrete-finite difference element models.

In pursuit of a comprehensive understanding of the dynamic interactions between coal ribs and the adjacent rock, and to validate the numerical simulations of support elements, a series of in-situ pull-out tests for rock bolts, specifically those anchored in coal ribs within active mining areas, was carried out. Consequently, a systematic parametric study was conducted using the verified numerical models, aiming to advance the CPRR system's capabilities for assessing the stability of coal ribs and devising tailored coal rib support systems based on the unique conditions encountered in mining operations.