Grant AFC719-49: Fundamental Investigation into Pillar Design and Global Stability by Integrating Pillar Load and Opening Convergence Response

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Focus Area: Health and Safety Interventions

Priority Area: Understanding the Role of Overburden Mechanics in Pillar Design and Global Ground Stability

Problem Statement and Research Approach: While, as an industry, we have an immense amount of knowledge and understanding of undergroundstress distributions, ground behaviors, and strengths, etc., our current methodologies utilized in the assessment of underground stability do not adequately represent site-specific conditions or known mechanistic behaviors of ground and support materials. Since the early 1970's, the mining industry has evaluated the structural stability of a given pillar by dividing an approximated pillar load by an approximated pillar strength. While this design methodology has served the industry well in the past, as modern mining operations continue to develop in more complex geological and geometric conditions coupled with market economics, industry professionals are in dire need of a modified stability assessment approach which considers both the stress condition and material displacements. Within the civil tunneling industry, the ground response approach has been successfully utilized in help design underground support measures that enhance the stability of an underground excavation. Through the incorporation of current industry knowledge and understanding of ground and support behaviors, the proposed project looks to investigate the development of a modernized ground response method (GRM) to further improve the analysis of local and global underground stability. Furthermore, it is expected that this work will provide a qualitative means by which to integrate the effect of irregularly shaped pillars and/or secondary-mining retreat line as well as the impact of ground support and load shedding behaviors.

Building upon the mining industry's current understanding of ground control, a GRM approach would provide the ability to evaluate the stability of the mining environment with respect to pillar, ground support, and rockmass behaviors. Thus, the proposed project will provide the mining industry with a more comprehensive means of evaluating the stability of the underground working environment with respect to industry understanding of ground behaviors and stress mechanisms. The results of this work will provide an all-encompassing pillar and ground stability analysis methodology which takes into consideration both the material stress condition and displacement as well as interactions between the seam and the surrounding overburden strata. Properly implementing the proposed analysis approach can provide insights into pillar and ground support optimizations while further increasing the health and safety of the underground working environment.

Specific Aims:
A ground response method (GRM) approach for the analysis of underground pillar and support stability will be developed by fulfilling the following objectives:
- Investigate pillar loading with respect to deformations.
- Investigate pillar strength with respect to deformations.
- Evaluate pillar stability with respect to deformations.
- Validate pillar-support methodology by comparing results to empirical databases (ALPS, ARMPS, etc.) as well as numerical analyses (LaModel, FLAC3D, etc.)