Grant AFC719-15: A Practical, Mechanics-Based Approach to Pillar Design

Organization and Principal Investigator: West Virginia University (Ihsan Tulu)

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: The Mine Safety and Health Administration (MSHA) recommended pillar design programs; Analysis of Longwall Pillar Stability (ALPS) and Analysis of Retreat Mine Pillar Stability (ARMPS) treat the pillar as a passive structure that is designed to carry overburden dead-weight. This dead-weight is calculated by simple rules based on the geometry of the mining: like **"tributary area theory", "pressure arch theory" and "abutment angle theory."** The actual mechanics of the overburden, the effects of the pillar system on the overburden response are not included in these computations. The recent ARMPS-LAM program developed at WVU was an initial step towards incorporating mechanistic overburden behavior into the pillar design.

However, the overburden in this original version of the program was automatically calibrated to simulate the dead-weight load assumptions of ALPS and ARMPS. This project proposes to replace the dead-weight load calculations in ARMPS-LAM with an approach that will incorporate the specific geology and structural competence of the overburden and the in-situ horizontal stresses into the mechanical response of the overburden. Ultimately, this project proposes to transfer this new mechanistic overburden to ARMPS-LAM. By including this mechanistic overburden in ARMPS-LAM, the stiffness and failure state of the pillar system will naturally interact with the overburden response in the design rather than the pillars being treated as a passive structure. Therefore, we are proposing to incorporate overburden mechanics and overburden/pillar interactions into a simple practical the design method for mining pillars and panels. The exploratory research to be accomplished in this project in order to test the possibility of ultimately creating a practical mechanics based design tool will include:

1) Using a database of 12 case histories of calibrated finite-difference models from across the U.S. to determine the optimal ARMPS-LAM structural input given the specific geology, insitu horizontal stresses and overburden competence of the case histories.
2) Testing the accuracy and effectiveness of the developed ARMPS-LAM structural inputs using a laboratory prototype of a new geology-based laminated overburden model.

Specific Aims: The research objective is to develop a practical mechanics-based approach that can implement the relationship between overburden mechanics and pillar design.

- Specific Aim 1: Understanding how the critical parameters (overburden geology, structural competence of overburden and in-situ horizontal stresses) affect the overburden stiffness,stability and overburden/pillar interactions.

- Specific Aim 2: Develop a practical mechanics based approach to determine the optimal ARMPS-LAM structural input given the specific geology, in-situ horizontal stresses and overburden competence.