Spotlight: Colorado School of Mines Demonstrates that Squat Coal Pillars can Fail Violently Resulting in Coal Bumps

Alpha Foundation Grant AFC113-10: Numerical Modeling Methodologies for Assessing Burst Potential in Coal Mines

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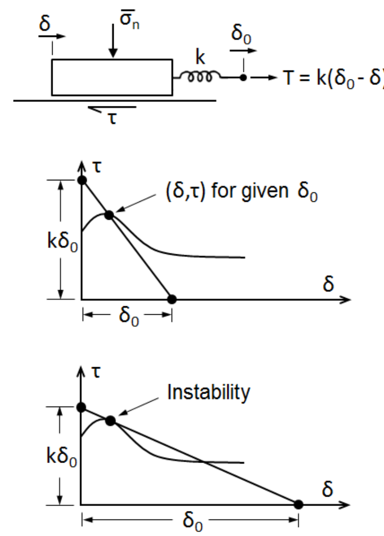
Historically, coal bumps have been the most catastrophic form of ground control failure. While their occurrence is infrequent, the energy produced during these events is often fatal for anyone in the immediate vicinity. Furthermore, the prediction of their occurrence at the local or regional scale within a particular mine has been very challenging and remains unsolved. One of the reasons for the difficulty in making predictions of when coal bumps will occur is that pillars that seeming have very stable designs are the very ones that fail violently.

Colorado School of Mines in a project funded by the Alpha Foundation has demonstrated that pillars with high width-to-height ratio, which typically will maintain highly, confined inner cores through their squat geometries, can fail in a highly unstable and dynamic manner. The study has shown that shear failure along the pillar and roof interface facilitates excessive energy releases that can cause sudden dynamic failure within the coal pillar when strain-softening (quasi-brittle) coal material properties are considered.



The approach used in the study was to model the coal rock interface numerically with a continuously-yielding contact condition at the rock-coal interface. The models showed that sudden slip along interface leads to rapid de-confinement causing unstable shear and weakened regions along the interface that lead to greater volumes of affected coal and larger magnitude of compressive failures.

Back-analysis studies of the Crandall Canyon coal mine collapse provided an opportunity to assess the effects of various material and coal/rock interface properties on unstable failure, which helped to validate the approach. While an appropriate calibration of material properties will continue to be difficult when using this approach and additional research is still needed to improve the constitutive modeling of quasi-brittle rock failure under dynamic loading conditions; this methodology provides a means to explain a mechanism that causes coal bumps and provides an opportunity to quantify parameters that may lead to improved assessments of rock burst events within the bounds of available in situ rock property data.