Engineering
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SMART COAL EXTRACTION WITH VARYING SOFT FLOOR CONDITIONS

Conventional methodology that is used in mining of coal determines an overall extraction ratio for the mining of a coal reserve. The use of a uniform production extraction ratio creates inefficient removal of coal. Inevitably, because of variations in mine depth and mine geology, some areas of the mine will be over-designed, and some may be under-designed, which may result in failure leading to surface subsidence.

When coal seam conditions remain relatively consistent throughout the coal reserve, mine stability and thus the variability in allowable extraction depend upon the soft floor conditions. Based on our experience, there can be significant variation in floor conditions across a reserve resulting in concern because such failures are not expected to express themselves on the ground surface when the room-and-pillar mine is greater than about 165 ft. deep.

In assessing the floor bearing capacity, the softening of the most immediate fine-grained rocks is considered because there will ultimately be groundwater pooling on the floor. The softening effect of the floor does not lend itself to conventional bearing capacity formulae, however. These formulae assume that the weak floor layer(s) are homogenous. With the soaking and softening of the fine-grained floor from pooling of groundwater, the stiffness and strength of the floor will vary considerably from the room to under the pillar. Consequently, a fully softened condition will be

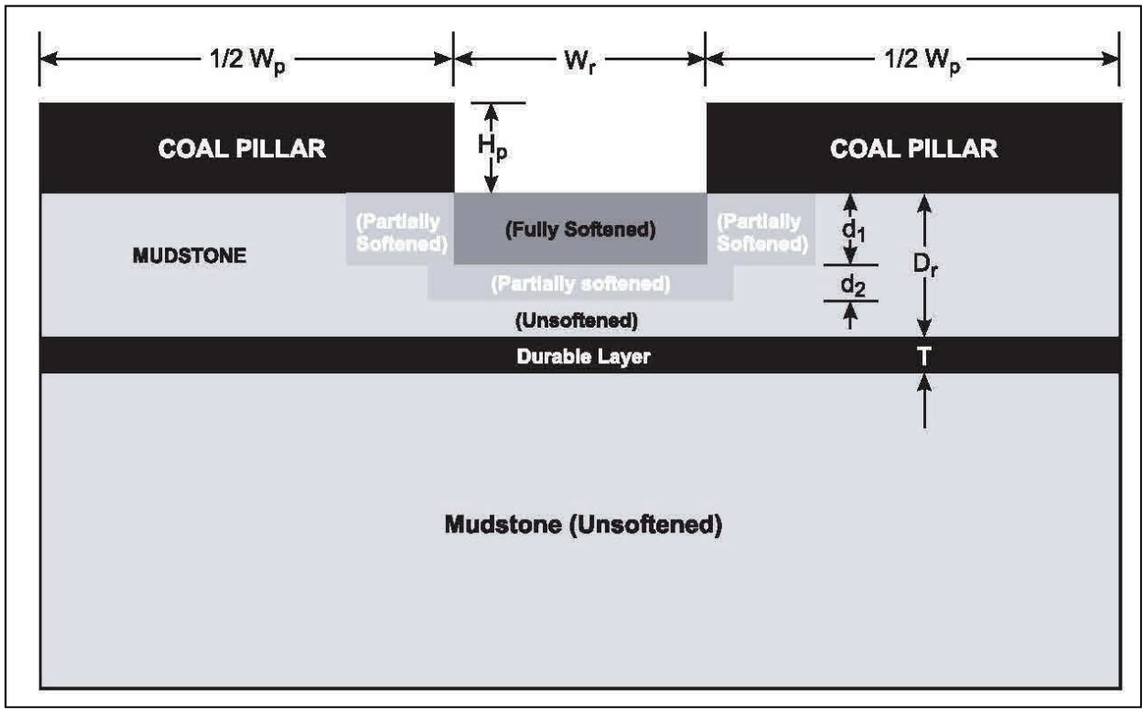

FIGURE 1: CROSS-SECTION OF SOFTENING OF THE MINE FLOOR AFTER POOLING OF GROUNDWATER USED IN MODELING

present in the room, a partially softened condition around the periphery of the pillar, and an unsoftened condition under the core of the pillar if the pillar is sufficiently wide. An illustration of these states of softening is depicted in Figure 1.

Rock mechanics testing and numerical analysis for the various floor conditions present across the coal reserve are performed to determine the softened floor bearing capacity. By considering the weak floor conditions across the reserve, the allowable extraction ratio is then determined.

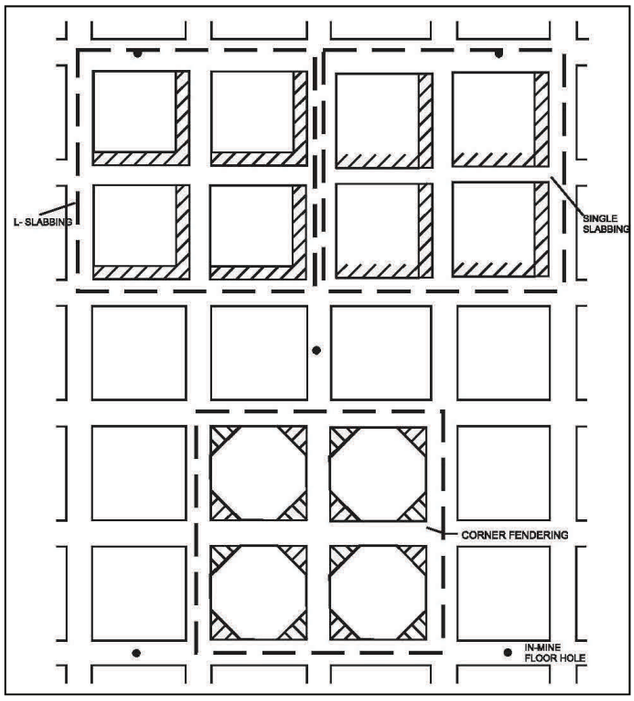

FIGURE 2: AN ILLUSTRATION OF SECOND MINING TO ACCOMMODATE VARYING SOFT FLOOR CONDITIONS

During one MEA project, the softened floor conditions across the coal reserve resulted in allowable extraction ratios that ranged up to 1.6 of the minimum value. In other words, the mine could not be efficiently designed using only one production extraction rate. Therefore, because of the variable floor support conditions, mining at the minimum extraction ratio with secondary mining, executed after data is gathered by in-mine coring of the localized floor, was recommended. The extent of second mining is then determined by the localized floor conditions and mine depth. An illustration of the proposed secondary mining is provided in Figure 2.

Other Engineering UPDATES of Interest:

UPDATE 33: Investigation of Excessive Fill Shrinkage from Embankment Construction

UPDATE 16: Assessment of Critical Face Travel Beneath Surface Structures

UPDATE 14: Establishing Mine Subsidence Risk

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 24 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and principal engineer of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact Dr. Marino at the address listed below.