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COAL MINE DESIGN WITH DIFFICULT FLOOR CONDITIONS

MEA was engaged to assess the mineability of a coal reserve with difficult mine floor conditions in central Illinois. It was deemed that this coal reserve could not be effectively mined because of the deep soft, unstable mine floor conditions. Moreover, over 150 subsided areas could be identified over an adjacent abandoned room-and-pillar coal workings. These subsidence events were likely the result of numerous floor failures after groundwater pooling on the mine floor. This mine was about 150 ft. deep where the coal reserve in question was roughly 490 ft. and consequently would have considerably greater pillar load that the floor would have to bear.

From a number of core borings done, the geologic and geotechnical conditions were identified across the coal reserve. The reserve's mine floor lithology is depicted in Figure 1.

To assess the ability of the mine floor to support the overburden loads it was important to identify the thickness or depth of the immediate, weak, and non-durable fine grained rocks. Across the reserve, the immediate non-durable weak mudstone floor ranged from non-existent to extending to depths of 20 ft. or more below the mine floor until a more resistant material is encountered. Depending upon the area within the reserve, this resistant material consisted either of limestone, sandstone, siltstone, or carbonaceous rocks of sufficient durability and thickness.

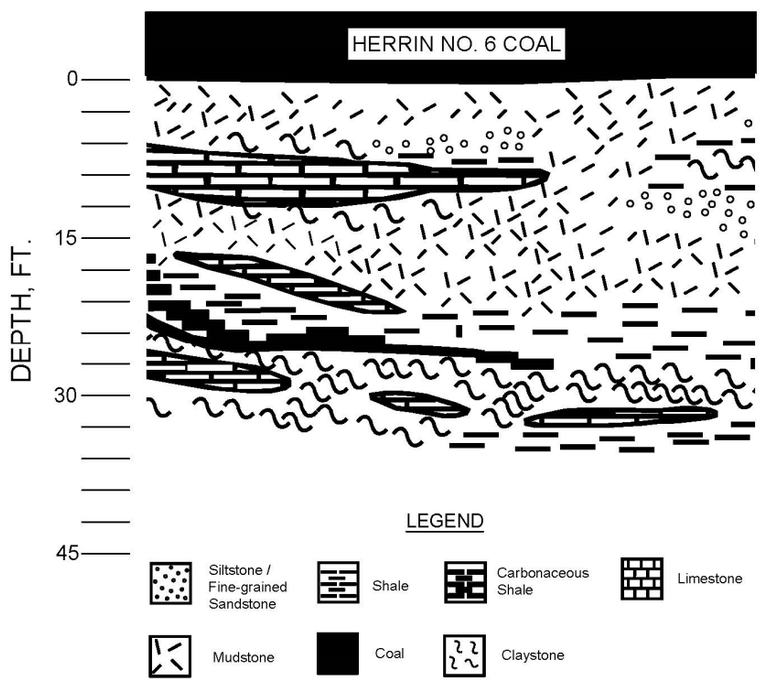

FIGURE 1 GENERALIZED FLOOR GEOLOGIC COLUMN ACROSS THE COAL RESERVE

To determine the coal pillar bearing stress that the non-durable mine floor could handle, it was important to determine what its engineering properties were through various degrees of softening when eventually exposed to flooding from groundwater seepage. This was quantified by performing one dimensional oedometer tests on the various fine grained immediate floor rocks across the reserve. From this testing, an assessment could be made of how much swell (or softening) occurred at different imposed vertical pressures. Test results of non-durable floor samples tested are provided in Figure 2. From this figure, it can be seen that vertical (pillar)

pressures of 320 psi to more than 510 psi must be present for no softening to occur when the sample was exposed to moisture.

The other important factor to assess is how fast does the softening occur with the reduction of applied vertical pressure. This would establish the engineering properties the when the fine grained floor located mainly under the pillar was in a partly softened state. Test data shows the limited softening occurs with vertical applied pressures to about 30 to 90 psi.

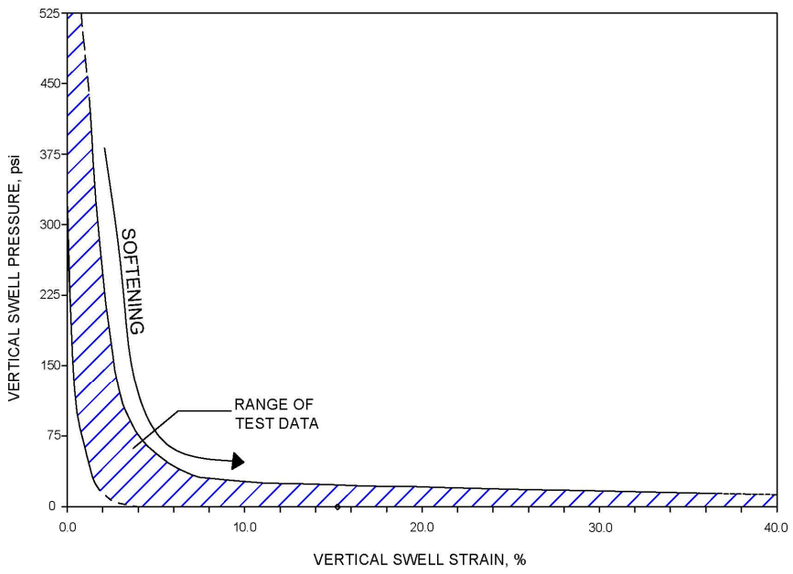

FIGURE 2 RANGE OF SWELL PRESSURE VERSUS SWELL (OR SOFTING) PLOTS ON NON-DURABLE MINE FLOOR SAMPLES WHEN EXPOSED TO WATER

To analyze the bearing capacity of the mine floor considering the ultimate states of floor softening under the pillar and in the mine entry, numerical modeling was necessary. Figure 3 depicts the modeled floor softing conditions. The ultimate floor bearing capacity could then be determined.

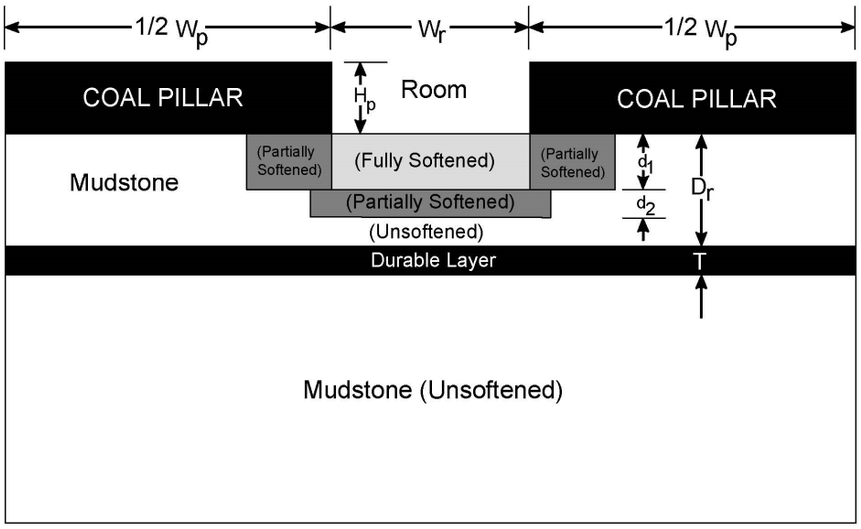

FIGURE 3 FLOOR SOFTENING MODEL USED TO ASSESS MINE FLOOR BEARING CAPACITY

RESULTS

From the extensive identification, classification, and material testing of the mine floor conditions across the coal reserve, a much greater understanding of the extremely weak floor could be determined. As a result, the ultimate mine floor support variables could be identified resulting in a more viable coal mining scenario where the reserve was considered effectively unmineable due to difficult floor conditions to one which had economic value.

Other MEA Publications that may be of Interest:

Engineering Update #14: Establishing Mine Subsidence Risk

Engineering Update #22: Smart Coal Extraction with Varying Floor Conditions

Engineering Update #36: Moisture Softening Effects of Mine Floors

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 28 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 founder 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 MEA at the address listed below.

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