Engineering
UPDATE©
MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 36

MOISTURE SOFTENING EFFECTS ON MINE FLOORS

An underappreciated condition in the stability of room-and-pillar coal mines is the moisture softening effects on mine floors. An isometric view of a room-and-pillar coal mine is illustrated in Figure 1. Mine collapse from floor softening can occur while the mine is still active to long afterwards. It is the cause of a significant number of mine collapses where the softening condition is ripe to occur. This type of mine failure will result in surface subsidence which is commonly 500-1000 ft. across and over 1 ft. to about 3 ft. deep. These subsidence events are referred to as sags.

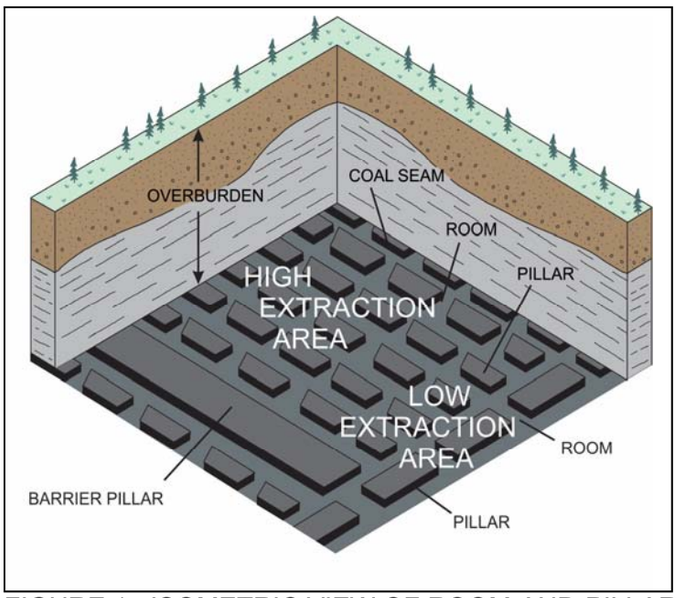

FIGURE 1 ISOMETRIC VIEW OF ROOM-AND-PILLAR MINES

The potential for a floor to soften is dependent on geologic conditions. Here, sufficient strata lay beneath the coal bed (or other mine ore), which are susceptible to deterioration when exposed to moisture. These floor rocks are commonly classified as claystone, mudstone, or clayey shale. An example of the effect exposure to water can have on these materials is shown in Figure 2. But, the degree of the effect that moisture will have on these rocks depends on the mineralogical content. It is, however, important to note that this geological condition is not prevalent under coal beds in many areas. Where there are more durable floor rocks present, floor failure is rarely a concern. In a mine, the area which is most exposed to moisture from groundwater inflows is in the entries (openings), where the water pools onto the floor. Being unrestrained in the mine

FIGURE 2 EXAMPLE OF EFFECT OF WATER EXPOSURE ON MUDSTONE

opening, these non-durable rocks can swell upwards and reach a fully softened state. The pooled groundwater not only soaks the floor materials in the opening, but also those under the adjacent pillar. Here, fine-grained rock beneath the pillar absorbs the pooled water, causing it to soften to some degree (i.e. a partial softened condition). See Figure 3. Note that these rocks can exert a swell pressure when exposed to moisture, which is related to a suction potential that can be greater than 500 psi. The suction potential and in turn the degree of softening depends on the rock composition, as well as the restraint applied by the pillar and an underlying resistant rock zone.

CONCLUSION

Where weak, non-durable strata are present in the mine floor, pillar floor bearing instability can be the critical mode of failure. These rocks can dramatically soften or reduce in strength when exposed to moisture. Consequently, this softening condition must be addressed if mine instability and subsequent surface subsidence is to be abated.

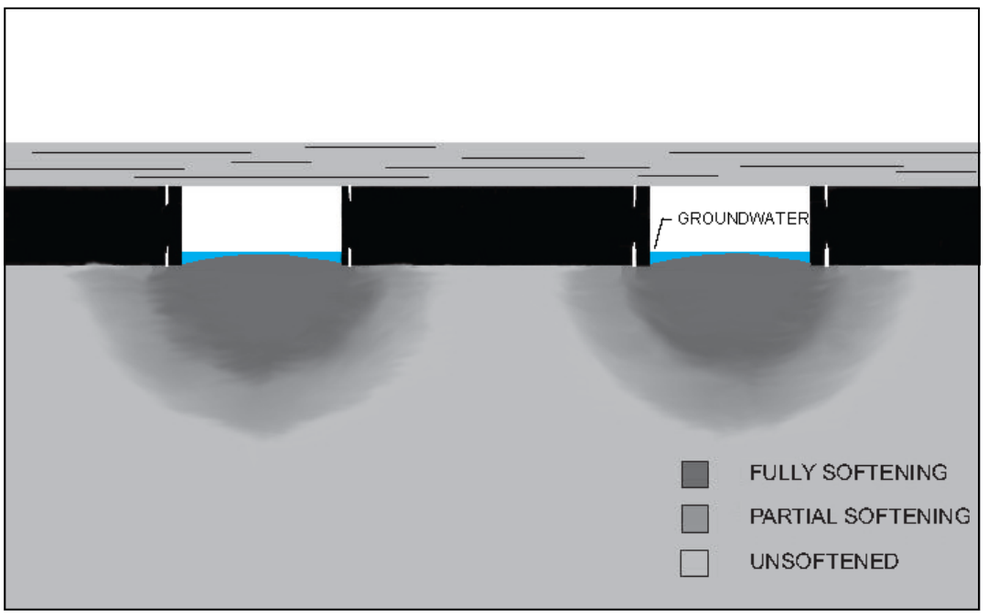

FIGURE 3 ILLUSTRATION OF SOFTENING IN FINE-GRAINED ROCKS FROM

Other Engineering UPDATES of Interest:

UPDATE 32: Developer Avoids Substantial Risk of Subsidence Damage

UPDATE 4: Improvement of Mine Support Saves Pipeline from Subsidence Event

UPDATE 14: Establishing Mine Subsidence Risk

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 25 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.

MARINO ENGINEERING ASSOCIATES, INC.
1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com