Engineering
UPDATE©

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RISK BASED ANALYSIS RESULTS IN EFFICIENT MINE STABILIZATION

The initial concern at the project site was focused on potentially hazardous conditions on a 400 ft. high rock cut which was adjacent to and behind a commercial building located in West Virginia (see Figure 1). The bottom of this rock cut, which was the result of the land development, exposed a coal seam that had been mined over 70 years ago. This old coal mine structure, which was supporting this very high rock face, was deteriorating as it was being exposed to the elements.

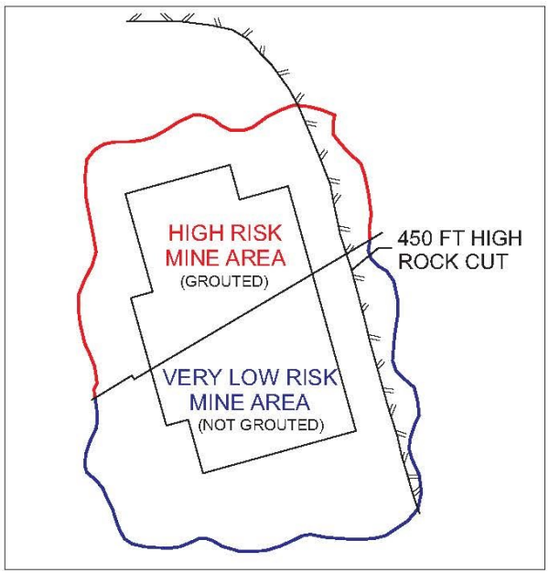

FIGURE 1: SITE LAYOUT WITH ASSESSED MINE COLLAPSE RISK AREAS. STABILIZED ONLY HIGH RISK AREA IN LIEU OF ENTIRE MINE UNDER BUILDING

These climatic effects could be seen in the mine roof as it collapsed over time (see Figure 2). To mitigate these deteriorating mine conditions, the open and exposed voids were filled with grout, lift by lift. Where mine openings contained significant collapsed roof materials, the rubble was consolidated by pressure grouting with up to 75 ft. long injection holes drilled into these areas (see Figure 3).

In addition to the existing rock cut concerns, MEA discovered during its investigations that evidence existed that subsidence had already occurred at the existing commercial building. According to a survey done around the building, about 4 in. of subsidence had occurred, resulting in localized ponding on its flat roof. Under further investigation, it was found that the building rested on another abandoned coal mine which operated from the 1940s to the late 1960s. Based on information collected from drilling into these old coal workings, the mine was found to be open, dry and about 160 ft. deep.

Based on rock testing and MEA's stability calculations, it was found that the coal mine had limited stability under the northern half of the building which meant there was a high risk of subsidence in the future. However, an acceptable amount of risk existed over the southern portion of the underlying old works (see Figure 1). Therefore, the noted settlement of the building was consistent with the risk analysis performed across the building.

FIGURE 2: MINE OPENINGS IN 400 FT. HIGH ROCK CUT. MINE ROOF CAVED UPWARD OVER TIME.

Given the assessed range of risk under the building, the owner chose to only grout stabilize the northern half and saved about $3 million. This was in lieu of stabilizing the entire mine beneath the structure, which would be conventionally done.

FIGURE 3: GROUT INJECTION WITH PRESSURE INTO THE MINE OPENING FILLED WITH CAVE MATERIAL ALONG THE ROCK CUT.

SUMMARY

Two separate levels of old coal workings were stabilized because of the potential hazards to an existing commercial building if either mine were to fail. Based on the engineering risk analyses performed, about half of the coal mine beneath the store was not remediated as the risk of failure was assessed to be very low. With confidence in the risk assessment, a savings of about $3 million was realized when compared to the conventional approach of stabilizing the entire mine. Reliable and proper risk based analysis, however, requires an adequately trained and experienced engineer with a successful track record.

Other Engineering UPDATES of Interest:

UPDATE 1: Successful Deep Mine Backfilling to Mitigate Mine Subsidence

UPDATE 6: Subsidence Mitigation by Combining Foundation Treatment with Deep Mine Grouting

UPDATE 21: Mine Subsidence Damage During Construction of Medical Center and Remedial Measures Taken

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 MEA 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