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ADVANCED ANALYSIS OF AERIAL SUBSIDENCE RISK

In order to make the best business decision, there is a need to assess the subsidence risk where larger development areas (such as, wind or solar farms, or commercial industrial parks) are undermined. This aerial evaluation should include both subsidence and damage potentials across the site over the life span of the project. This will determine the economic feasibility of the project for construction.

Therefore, the aerial risk analysis will help to accomplish the following goals:

1. The subsidence potential assessment, and

2. The associated damage potential assessment.

Subsidence risk maps help to assess the level of aerial vulnerability of the planned infrastructure and thus the optimal placement. The aerial subsidence risk maps should identify the important variables in assessing the exposure risk to the intended infrastructure. Based on our experience these commonly include:

- Number of expected future subsidence events during the life span
- Event likelihood by location across the site.
- Type and size of the subsidence event and,
- Severity of the subsidence event

In addition to the infrastructure itself, these variables depend on the subjacent mining and subsurface conditions and empirical relationships supported by a case history database. Consequently, the most appropriate subsidence prediction technology should rely on a site representative case history database of sufficient quantity. To provide these statistical predictions, MEA augments this analysis by utilizing its collected in-house case data. The results of these analyses are expressed in the form of maps which may quantify the expected event frequency, exposure, movement type and severity, and risk of subsidence across the project area depending upon the need of the project. One general example of an aerial subsidence risk map is shown in Figure 1.

FIGURE 1 EXAMPLE OF SUBSIDENCE RISK MAP ACROSS A LARGE PROJECT AREA

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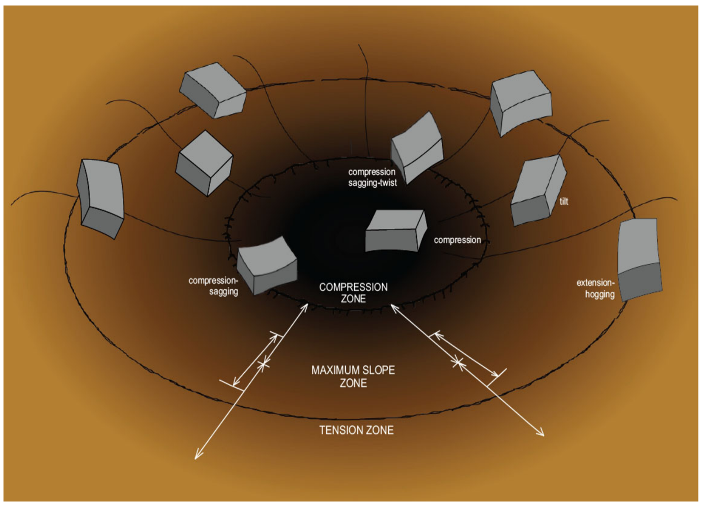
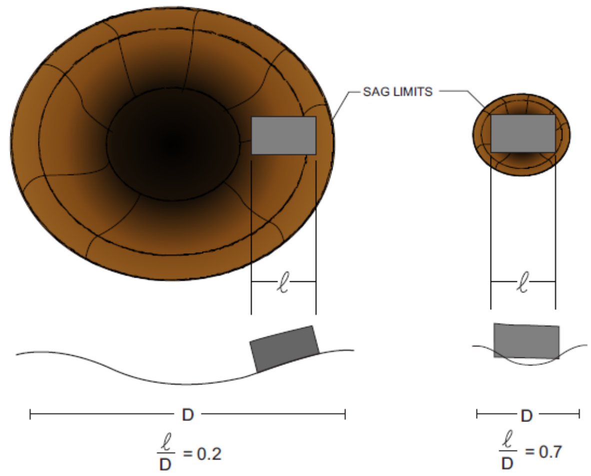
As or more important as the elements of subsidence exposure, is the assessment of damage potential over the life span of the project. In assessing the behavior of the project structures, it is important to understand the thresholds for the expected ground movement for the proposed infrastructure, and whether they could be exceeded given the subsidence potential across the site. The ground movements from a subsidence depression from mine collapse can present a complex range of induced deformations to the surface structure. Figure 2 shows illustrations of surface structures exposed to a sag subsidence (i.e., bowl-shape depression), which can encompass broader aerial surfaces.



A. SOME DEFORMED FLEXIBLE BLOCKS RESULTING FROM A SINGLE SAG EVENT



B. A GRAPHICAL COMPARISON OF A STRUCTURE TO SAG SIZE.

FIGURE 2 ILLUSTRATIONS OF SURFACE STRUCTURES EXPOSED TO A BOWL-SHAPED (SAG) DEPRESSION FROM A MINE COLLAPSE

Based on our experience, relevant tolerance limits include operational ability, repairability, hazard susceptibility as well as aesthetic, functional and structural limits. Combining the damage thresholds and the critical subsidence movements as well as event frequency of subsidence across the project site, and the resulting spectrum of damage intensity, the associated predicted structure damage may be aerially displayed and can be quantified over the lifespan of the project. Also, it has been MEA's experience that an important aspect of increasing the viability of the project is taking advantage of damage reducing measures.

SUMMARY

Advanced statistical analyses of projects with large areas (e.g., wind or solar farms) can be performed to provide the viability of a project site which is undermined and to minimize the damage potential by applying approximate damage mitigation measures. When properly done, the cost for such an analysis can easily be justified considering the cost of the vast-space infrastructure. In other words, the associated business decisions are only as good as the evaluation of the subsidence risk factors over the project life span.

Other MEA Publications that may be of Interest:

[Engineering Update #14: Establishing Mine Subsidence Risk]

[Engineering Update #30: Risk-Based Analysis Results in Efficient Mine Stabilization]

[Engineering Update #40: The Importance of Estimating Damage Potential]

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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