

UPDATE

MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 60

SUBSIDENCE ENGINEERING IN PENNSYLVANIAN KARST TERRAIN

At the request of a large retailer, MEA performed Phase I and Phase II subsidence engineering studies for a proposed construction site in Pennsylvania. This site was underlain with precipitant limestone which was solutioned over geologic time by the passage of acidic groundwater through the formation (ie. karst). Such bedrock conditions can lead to future land subsidence and associated damage.

The project commenced with conducting a Phase I investigation. The Phase 1 investigation entailed collecting,

studying, and evaluating the relevant available geological and geotechnical data in the vicinity of the site. A part of this phase of work included identifying the risks of subsidence and potential damage associated with alternative project site locations. The site which was chosen had sufficient subsidence

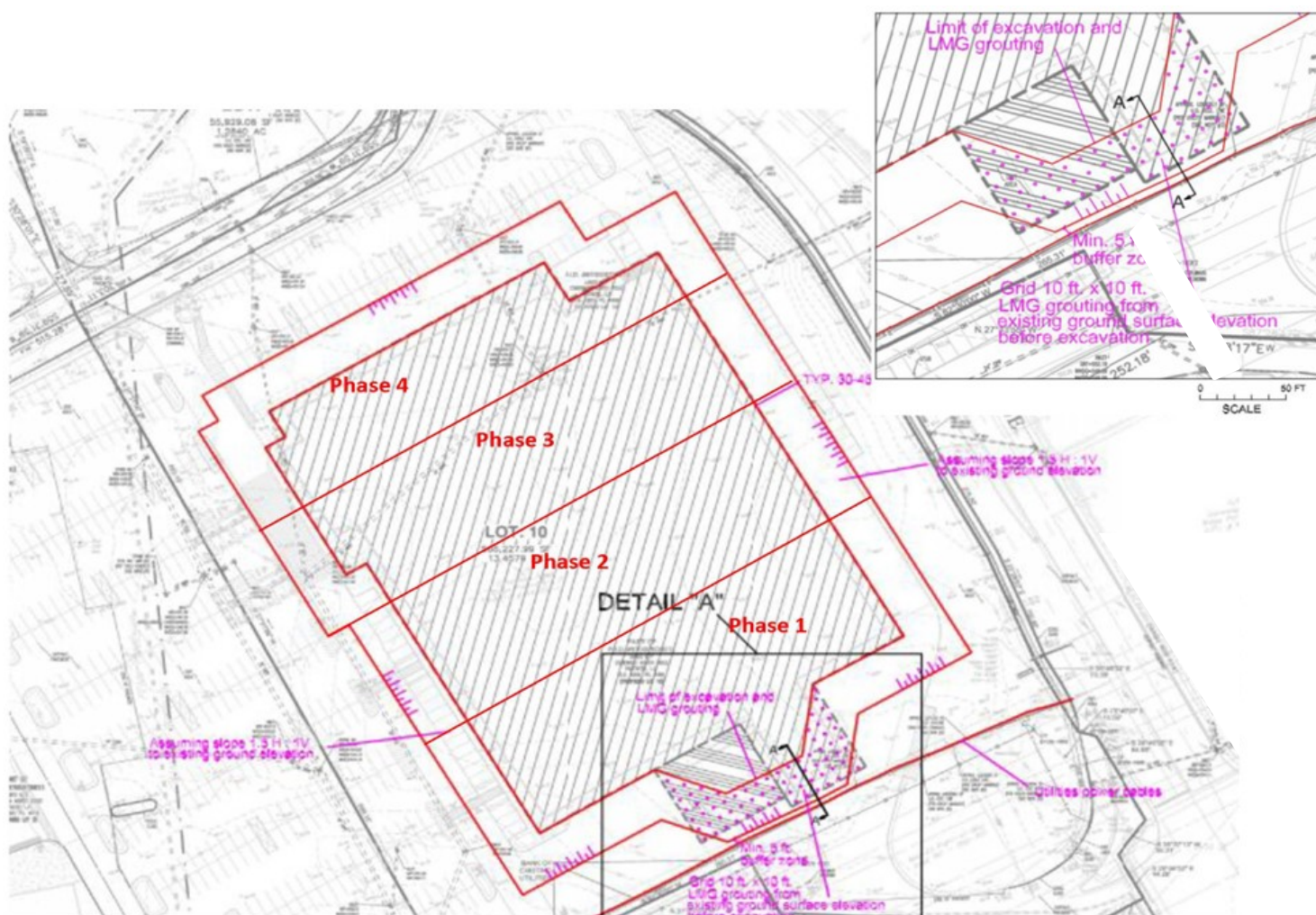


FIGURE 1—PHASED OVER-EXCAVATION PLAN FOR MITIGATING UNDERLYING SUBSIDENCE PRONE KARST FEATURES

risk and merited a Phase II study to be undertaken to better assess the site specific subsidence and damage risks, and any subsidence mitigation measures which could be taken at the site. From this investigation it was determined that there was a significant risk of subsidence with up to severe to very severe corresponding damage potential during the lifetime of this structure.

Because of the assessed subsidence risk, one recommendation was to perform full depth low mobility grouting with closely spaced injection holes across the entire building pad footprint. Alternatively, MEA offered another more unique mitigation plan which would result in about half the costs to this intense grouting effort. Given the site specific conditions, MEA designed a plan which involved multiple mitigation methods. This mitigation scheme included over-excavation across the majority of the building pad area to approximately 20 feet deep. This allowed the most prominent solution and chimney subsidence features to be exposed and targeted for the appropriate mitigation treatment.

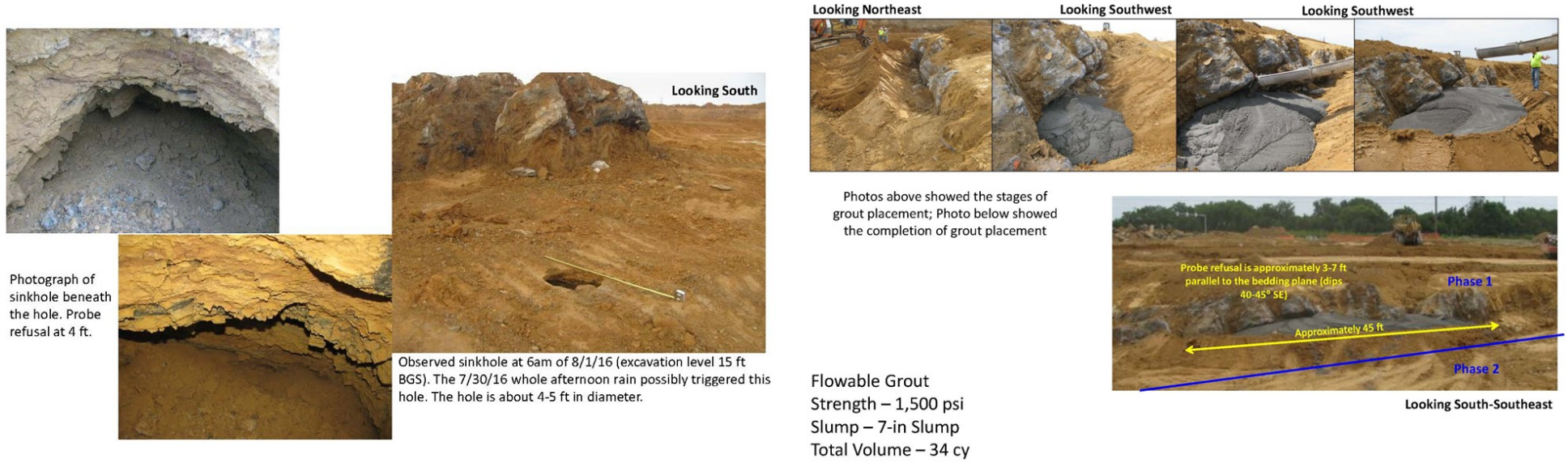


FIGURE 2 EXPOSURE AND TREATMENT OF SUBSIDENCE PRONE KARST FEATURES FOUND BY UNDERCUTTING THE BUILDING PAD

This work was done in phases across the site. This phased work is shown in Figure 1.

During the overexcavation operation, voids in limestone bedrock, chimney subsidence, and softened wet areas from subjacent downward piping of fines were exposed. These exposed subsidence related features were successfully treated by various means. Based upon onsite inspection by MEA, the appropriate treatment measure was identified, designed, and monitored on site by MEA. These measures are depicted in Figures 2 and 3. These measures included void fill grouting, dental concrete placement, and upstage low mobility grouting.

REMARKS

Experience and knowledge in subsidence engineering can play a huge role in how such a site is approached to adequately reduce the damage potential, especially as it relates to karst terrain. This project presented some site specific challenges with the mitigation of this geohazard. Given the project conditions, a unique site specific solution was developed which was successful and much more cost effective than the conventional approach typically employed in this scenario.

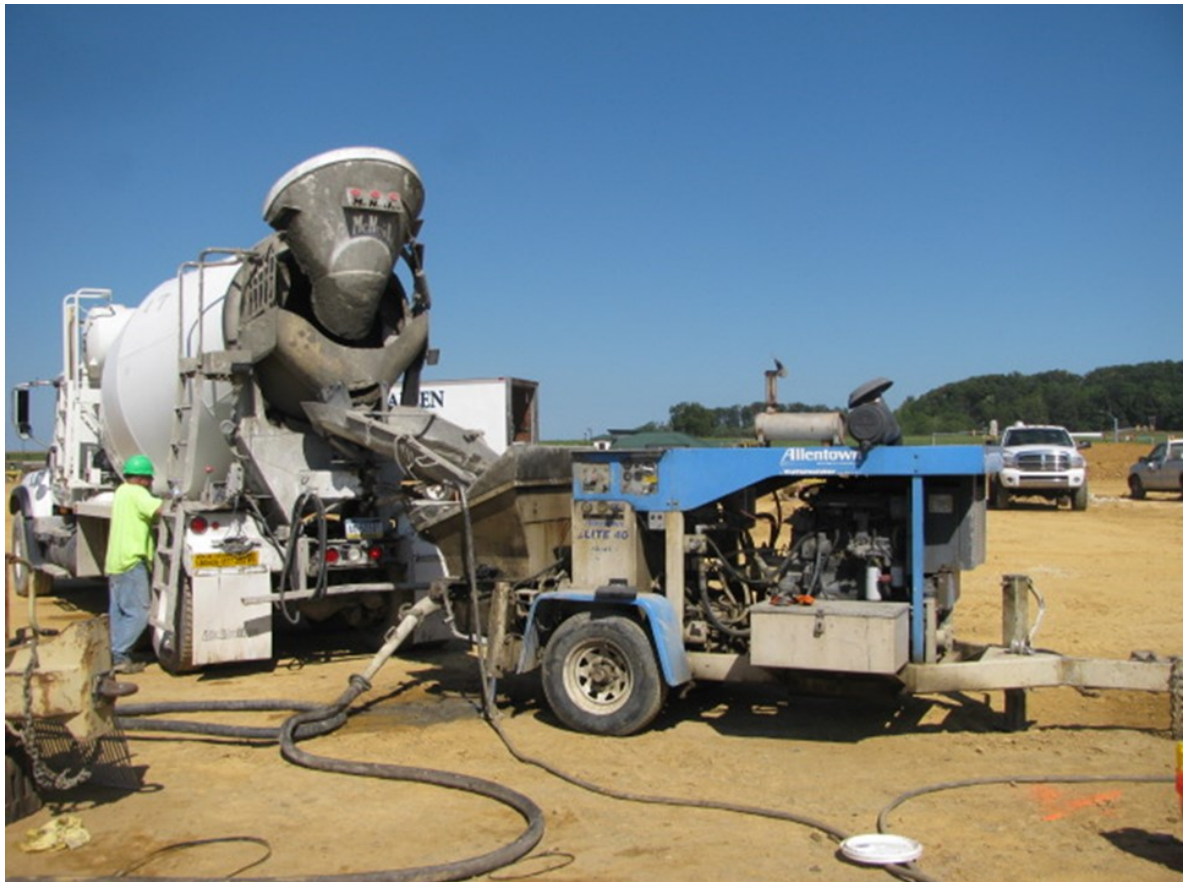


FIGURE 3 SELECT UPSTAGED COMPACTION GROUTING OF KARST AFFECTED AREAS

Other MEA Publications that may be of Interest:

What is Karst Subsidence?

<https://meacorporation.com/what-is-karst-subsidence/>

Engineering UPDATE #34—Risk Investigation on Sinkhole/Subsidence Prone Lands

<https://meacorporation.com/wp-content/uploads/Update34web.pdf>

Engineering UPDATE #58—Subsidence Engineering in Floridian Karst Terrain

<http://meacorporation.com/wp-content/uploads/Update-58.pdf>

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 30 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. 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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MEA
MARINO ENGINEERING ASSOCIATES, INC.

1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
<http://www.meacorporation.com>