

TERRANOTES

A Ground Improvement Update from TerraSystems

DYNAMIC COMPACTION FOR SINKHOLE CORRECTION

A major geotechnical dilemma with development of a site in karst topography is judging whether the site is susceptible to sinkhole development. For those sites with known sinkholes or with conditions conducive to sinkholes, do you correct the existing sinkholes or subsurface cavities and build? ... or do you found the structure on deep foundations?

Most sinkholes develop by raveling of the overburden soils into fissures or cavities in the carbonate rock, causing voids or "domes" to form within the subsurface. This process is graphically illustrated in Fig. 1.

Several techniques are available to locate these domes, including indirect geophysical techniques such as ground probing radar, gravity surveys, etc.; and direct techniques such as borings or probings. The cost of geophysical techniques for most small to medium-sized projects prohibits their use; and the geotechnical engineer is forced to rely on limited borings, surface observations, and his knowledge of the general area.

The resulting risk and uncertainties as to whether soil domes and soft clay-filled cavities are present have caused many projects to be founded on deep foundations for conditions that would otherwise warrant shallow foundations. In addition, there are many recorded case histories where the subsurface cavities were undetected during the exploration but caused failures during or after construction.

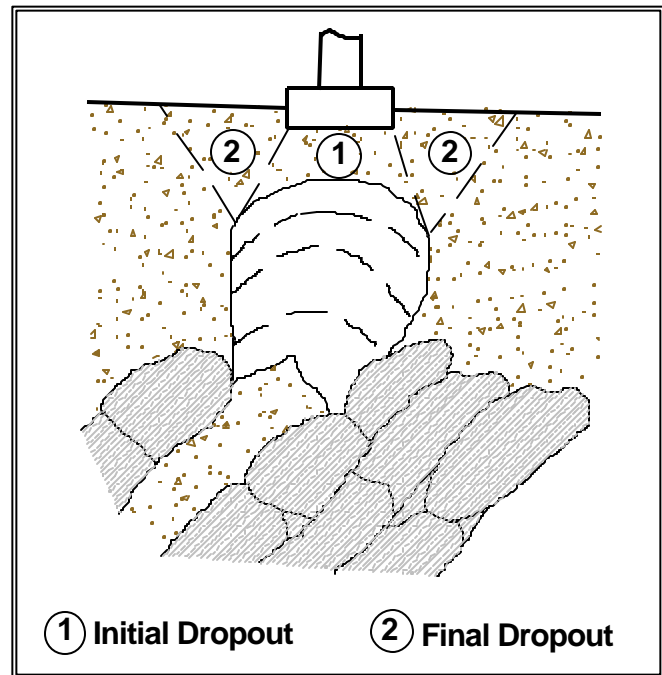


Fig. 1 Typical Sinkhole Development

Various techniques have been used to improve sites in sinkhole susceptible areas and reduce the probability of sinkhole development. These techniques have included preloading, various types of grouting, excavation of the overburden soils and sealing the fissures in the rock with grout, as well as dynamic compaction. In addition to improving the subsurface conditions by collapsing the soil domes, dynamic compaction serves as an exploration tool in locating the subsurface cavities. In essence, heavy weight dropping on a close grid pattern is used over the proposed building site to locate and collapse

existing soil domes. The dynamic compaction technique allows the use of shallow foundations and can provide an owner tremendous savings. This process is illustrated in Figure 2.

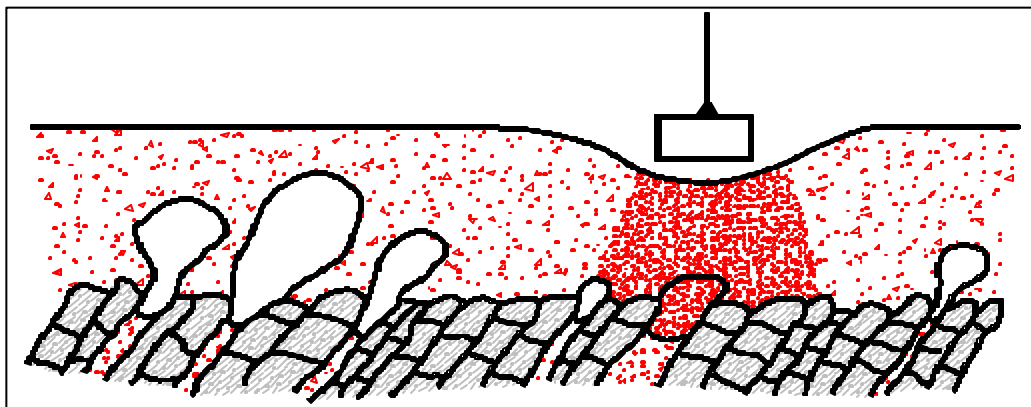


Fig. 2 – Dynamic compaction used to collapse subsurface voids



Fig. 3 – Valley Forge building site

Repeated high energy impacts using weights of 8 to 20 tons dropped from heights of up to 70 feet are used to first locate the domes. Once a dome is located, additional high-energy impacts are used to collapse the dome. Granular material is used to backfill the craters, and the area is repounded until an acceptable response is achieved. Dynamic compaction has been successfully used for sinkhole correction in a number of states, including Florida, North Carolina, Virginia, Missouri, Pennsylvania, and Tennessee. Several building sites have been treated by dynamic compaction in the Valley Forge area of Pennsylvania. On one of the sites, on which a three-story building was to be constructed, cumulative crater depths of up to 14 feet were achieved in areas of known solution activity. For this particular site, a predetermined grid pattern was used at the column locations to achieve maximum densification beneath the foundations. Figure 3 shows the first phase of crater development at footing locations on this project. Pre-existing domes in the overburden soils that were filled with air or soft clay were eliminated by dynamic compaction.

Another site improved by dynamic compaction was in Knoxville, Tennessee. The site had been graded several years before and had been left unattended, resulting in subsurface erosion and sinkhole development. Several of the observed sinkholes were large enough to hold a pick-up truck. Dynamic compaction was used to locate and collapse as yet undeveloped sinkholes, as well as to correct the existing sinkholes. In addition, several of the sinkholes within the building area required special attention. These were plugged with concrete and then backfilled with alternating layers of compacted fill and geotextile. Following completion of site improvement, the site was developed with a large Wal*Mart.



Fig. 4 – Placing grout to seal off the throat of a sinkhole exposed by dynamic compaction

We would welcome an opportunity to discuss the potential use of dynamic compaction on one of your projects. We also offer ground improvement services in wick drains, vibrocompaction, stone columns and TerraPiers™ . If you would like information on any of these other services, or would like additional information on dynamic compaction, please contact us at 540-882-4130 or email us at jjones@terrasystems-inc.com. We welcome the opportunity to hear from you.



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