

LESSONS LEARNED:

CONSTRUCTION ENGINEERING SERVICES

OBSERVATIONS AND LESSONS FROM THE SCHOOL OF EXPERIENCE

KARST ENVIRONMENTS

Karst is a term used to describe an area where limestone bedrock has eroded in an irregular manner. This irregular erosion is caused by the dissolution of the limestone which occurs as water is transported through the rock. As a result, these areas are often characterized by extremely variable rock surfaces, rock pinnacles, solution channels, sinkholes, and caves that may not be able to adequately support the proposed site improvements and buildings.

Developing and building in Karst environments provides many challenges and risks not encountered in other geologic environments. The unpredictability of the subsurface conditions frequently makes planning and construction in a Karst environment very challenging.

There are several things that can be done to reduce the risks associated with development in Karst environments. A preliminary site evaluation, which may include a detailed geologic review, site reconnaissance, fracture trace analysis, and traditional subsurface explorations, can help identify areas within a site that may have existing solution features and areas that are at a higher risk of developing solution features. Conducting a preliminary evaluation very early in the design process can facilitate a site design that avoids building over high risk areas and the associated higher construction costs.

Once a site design has been decided upon, additional exploration programs, including geophysical explorations and more specific subsurface explorations need to be conducted to provide detailed information regarding the presence of solution features and the rock elevations within the proposed construction areas. Solution features can be mitigated by using a deep foundation system, a pressure grouting program, or a simple plug repair of solution features. Unlike most other building environments, it is often necessary to do physical exploration at each foundation element location either prior to, or during, construction. Soil borings, rock coring, and air-track drilling are methods commonly used for physical exploration. However, even the most extensive exploration program cannot fully eliminate surprises from occurring during construction in Karst environments.

Unlike most other building environments, the subsurface conditions can change after the geotechnical exploration has been completed. Variations in the groundwater levels and construction activities such as blasting activities may contribute to the formation of collapse features at a site. For instance, sinkholes can form where water is allowed to enter the subsurface at one location. Infiltrating water can lead to solutioning and sinkhole formation well downstream of the point of entry due to the connected nature of limestone bedding and fracturing. Therefore, control of surface water and stormwater at the site is important. As such, it is important to design and implement construction controls to avoid excessive infiltration of water.

Given the challenging environment that is associated with building in Karst environments, it is important to keep the geotechnical engineer involved during construction to address conditions that are often encountered during construction. Should a sinkhole develop or be found during construction, the geotechnical engineer can recommend an appropriate repair to the feature and reduce the potential for future problems.

While Karst environments present unique challenges to a construction project, careful evaluation of a site's conditions, proper site and foundation design, and prudent construction operations can reduce the impact of Karst environments on development costs and site and building performance.

We trust that this "Lessons Learned" is helpful to you in planning a project located in Karst areas.

Respectfully,