

CONTENTS:

**Sometimes Smaller
is Better**

pg 2

**Sophie Gets
a Makeover**

pg 3

**Launching a
Flagship at
Roanoke College**

pg 4

What is Karst and Why Should I Care? Part One of Three on the Karst Corridor

East Tennessee is in the middle of a Karst corridor that stretches from eastern Mississippi all the way to New England. When you're in our business, it's a great place to headquarter. But if we weren't so taken with the Tennessee valley, we'd have lots of other places to choose from. That's because Karst geology makes up about 25% of the world's land surface and roughly 25% of the US land form. (see map on page 5)

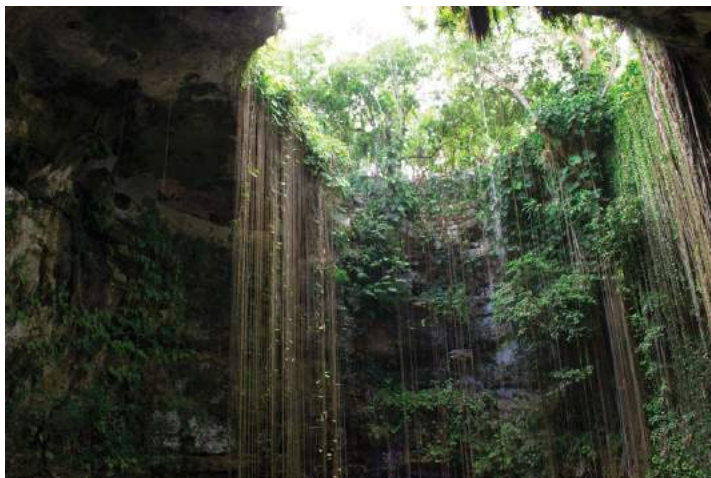
Characterized by a bedrock of dissolving carbonate rock (limestone, marble or dolomite) or evaporite rock (gypsum or halite), Karst topography is abundant in spectacular features and natural resources. Here you will find some of the most productive springs and water producing wells in the world. Here you will find beautiful rolling hillsides, caves, underground streams and lakes, and of course our bread and butter...sinkholes.

That's where it gets interesting for land owners, land developers, engineers and construction companies. How do you know if you're on terra firma or terra

not-so-firma? Are there voids? Is the bedrock pinnaced? Will a shallow foundation do the job? Having this information BEFORE construction begins has advantages over sorting out and correcting a problem afterwards. There are three important steps for getting answers to these questions. Note: Rembco doesn't actually perform these steps ourselves, but we're pretty good at finding the best people who do.

First, have a qualified engineer design a site analysis plan. A geotechnical engineer will be able to make an informed decision on what type of investigation is indicated and how many test points are needed. There are several types of subsurface investigations to choose among...from hand-augering shallow soil samples to deep soil borings. Rock coring, in-situ testing or geophysical methods (seismic refraction and electrical resistivity surveys) may also be considered.

(Continued on page 5)



Visit www.rembco.com for more information about geotechnical services. Or call Rembco today at (865) 671-2925.

Sometimes Smaller is Better

Rembco® Acquires a Man-Portable Drill

In our 32 years as a specialty grouting company, Rembco's "toolbox" has grown from only a couple of sinker drills (handheld rock drills) to a diverse collection of drilling assets that tops out with a 75,000-pound track mounted rig.

In our spring newsletter, we introduced Rembco's Casagrande C7, a new drill that added capacity and efficiency for micropiles, rock anchors and tie backs. Many of our client's needs, however, involve working inside or working with restricted access, weight limits or limited headroom – where a crawler drill just won't do.

Enter our latest acquisition, The TEI® Man-Portable!

The Man-Portable drill is an excellent intermediate asset. It fits right between our handheld drills that are sometimes under-powered, and our smaller track mounted drills that sometimes won't fit. This little wonder can be transported and positioned on the hole by crane, forklift, skid steer or even by hand. It offers the versatility of either a top mounted percussion drill, or a rotary down-hole drill. An onboard hydraulic clamp reduces manual labor and offers a more efficient and safer process when adding or removing drill rod or casing. When headroom is the issue, its mast height can be customized to less than 10 feet. Since it is powered by a remote hydraulic power plant, the power source (and accompanying noise) can be staged up to 100 feet from the drill. This allows more room for the operator in tight quarters and allows for a much quieter operation.

All in all, if you're adding an elevator shaft and need compaction piles or micropiles...if you have a building that needs compaction grouting, void filling or soil stabilization...or if you have a need for any geotechnical work with limited access, Rembco is ready to help. Make us your first call! 865-671-2925.



Sophie Gets a Makeover

The University of Tennessee Renovates Strong Hall

The University of Tennessee is renovating Sophronia Strong Hall. Known to some locals as Sophie, she opened as a female residence house in 1915. The new building will retain its location, its name, a portion of the original structure and – possibly – its resident ghost.

The Approach

As construction planning began, UT considered several approaches for stabilizing a deep excavation until the foundation and basement walls could be built and back-filled. One option for shoring the 26' deep cut was pile and lagging. It's not a great option, however, because a pile and lagging wall requires immense piles and tie-back anchors if it's greater than about 10' tall. That was too expensive. Another option, laying back the cut, would avoid a shoring system all together. On this site, however, an excavation with a 1:1 slope would require about 26' linear feet for the lay back. That would extend the construction site boundary into an adjoining parking lot on one side and into the adjoining streets on two other sides. So laying back the slope was not an option. The third option was a soil nail wall. A soil nail wall is less complicated and less expensive to build than a pile and lagging wall. And it requires much less space than a lay back because it can be built with a vertical or near vertical face. Soil nailing is generally the most economical option for a cut wall ...especially when it's a 26-footer!



The college apparently came to the same conclusion, so they called Rembco to provide the design and drawings for a temporary soil nail wall. When our proposal was approved, we began construction and testing of a 26' soil nail wall. This isn't our first experience with similar construction at the University. In fact, Rembco first provided a similar shoring system for UT more than 30 years ago. Here's how we do it.

The Soil Nail Wall Demystified

Starting at grade level, the site is excavated 4' to 6'. Next, we start at one end of the vertical cut face and drill a near horizontal hole to a prescribed depth in the face of the cut. As the drill rod is withdrawn, the hole is pumped full of slurry grout. Then, a threaded steel bar with centralizers is inserted into the grout filled hole. While the cemented bar is left to set up, it's time for the next hole. The drill rig is moved a pre-determined distance along the face of the cut and the process is repeated. We do this along the entire length of the wall – constructing a horizontal line of equally spaced soil nails. After installing the last nail at this elevation or “lift”, reinforcing wire is pinned all along the vertical face. The wire covered face is then sprayed with a 4” blanket of shotcrete. The threaded bar tips protrude through the shotcrete allowing metal plates to be installed and tightened until they are snug against the shotcrete facing.



That's a soil nail wall!

For a taller wall, we build onto the bottom of the section we just built. The section is begun by excavating another 4' to 6' from the jobsite. Then the drilling, grouting and shotcreting process begins again. With this approach, an entire vertical or near vertical wall is built from the top down, in 4' to 6'-lifts, until the lowest level of the excavation is reached. (See attached photographs from the Strong Hall project.)

The Results

As with many of our projects, Rembco's portion of Sophie's face-lift was done in a limited space and with lots of other construction activity. But we finished on time and under budget.



Launching a Flagship at Roanoke College

Leaders at Roanoke College in Salem, Virginia, have a simple but ambitious vision for their school: to educate mind, body and soul. Recently, that vision became sharply focused with their commitment to build a new campus flagship facility, the Cregger Center. But just as a stiff keel is crucial to any flagship, a solid foundation is crucial to any flagship facility.

The Cregger Center provided us not only with technical challenges but also with an unusual opportunity.

The Challenges

With design in hand for a facility using a traditional shallow foundation, the College Board must have been disappointed when subsurface investigation found the soil to be so poor that a shallow foundation was inadequate. They were faced with a dilemma – either redesign the building for a deep foundation system, or find a way to make a shallow foundation work. After further consideration, they settled on the latter of the two. Then they called Rembco. (Good move!)

A shallow foundation is dependent on adequate and uniform bearing of the underlying soils. It is not designed to withstand point loading that is inherent to deep foundation piles. Making a shallow foundation work in this poor soil condition would require a unique ground modification system. This system would have to provide sufficient bearing capacity and lateral strength without imposing point load on the footing.

Rembco proposed a hybrid system designed to achieve both. As is commonly done, compaction piles were to be constructed extending from competent rock up to the desired elevation. The hybrid twist is that the piles were not to be anchored to the footing, but would instead terminate 18 inches below each section of the stepped footing. A trench would be excavated from grade level down to the pile caps and then would be filled with two feet of compacted stone. The building's shallow foundation system would rest on this stone filled trench – taking advantage of an improved subgrade and structural elements without experiencing point load from the piles.

A concern on this job that is not usually associated with compaction piles was that ground heave could compromise the bearing capacity of the soil near the shallow footing, so surface conditions had to be monitored closely during compaction grouting. If any lifting was noted, the volume of grout injected in each subsequent lift was reduced. If the injection volume had to be decreased below a minimum threshold (affecting the column's diameter), supplemental piles were installed to ensure adequate performance.

The Opportunity

And, finally, an unusual opportunity arose when our client required that two piles be excavated and inspected. Although testing the load capacity of our piles is common, we very seldom dig-out a pile to look at it. We were very pleased to see that the theoretically uniform piles were indeed cylindrical.

Foundation contractors are usually one of the first-in and one of the first-out at any construction project, and that was the case for us in Salem. Although we are looking forward to seeing the finished facility, we'll have to wait awhile for its completion. Until then, our client and the Roanoke community can rest assured that their campus flagship will set sail with a stiff keel.

No cookie cutter solutions here. When you have a geotechnical problem, no matter the size, it pays to make Rembco your first call. Mike Bivens, our Chief Engineer, can be reached at (865)363-4708.



What is Karst and Why Should I Care?

(Continued from page 1)

Second, perform the investigation and get expert assessment. The analysis will reveal, among other things, whether or not underground voids exist on the site, and if so, where. You may even discover an active sinkhole.

And finally, determine your risk. Your engineer will be able to answer questions about your risk and how it can be reduced or remediated. Will a shallow foundation will be adequate? If not, is soil improvement the best solution? Or is a deep foundation system required?

With this information in hand, you will be prepared to make a better decision regarding placement of facilities and infrastructure, development planning, and even land purchases. It also provides the basis for estimating the scope of work, pricing methodology and ultimately – costs.

So now that you understand how having a good site plan works to your advantage, how do you go about getting one? Well, one good approach is to call a geotechnical contractor with a design/build team. One who's familiar with these questions, who knows how to find answers, and who can deliver the solution...like Rembco.

If you found this article informative, watch for your Spring edition of The Stabilizing Force. In part two of our Karst series, we will take a close look at site investigations and how they dictate the best approach to solve your geotechnical issues. Why do you need one? What are the different methods? What are the intended purposes, advantages and disadvantages of each? Which one is right for me?

Til then... remember that Rembco's design/build approach allows us to use all the resources at our disposal to design a solution that will solve your problem while saving you the costs of unnecessary labor, time and materials. We'd like to be your first call. You can reach James Grubbs, our Lead Estimator and Project Manager, at 865-671-2925.

