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civil + structural ENGINEER

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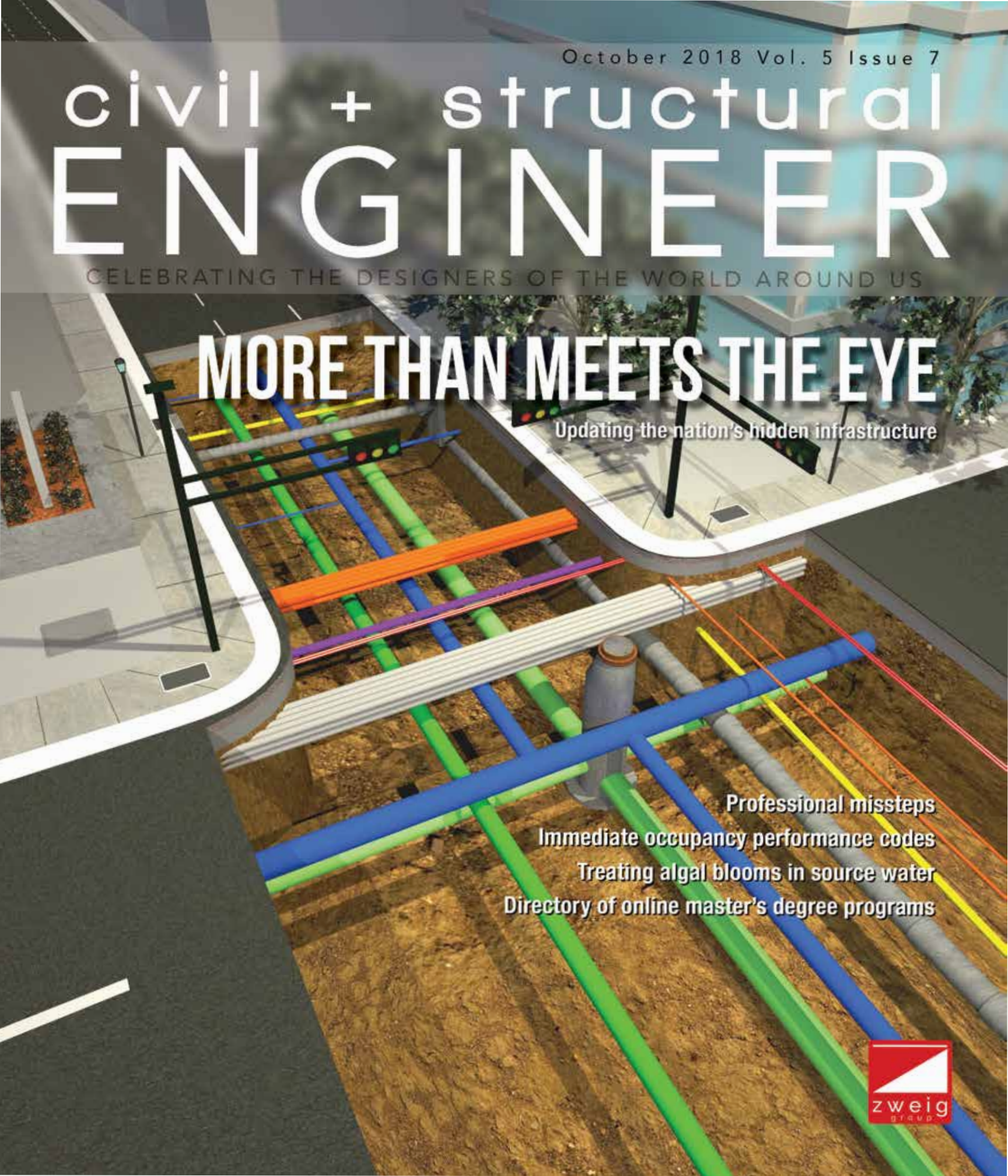

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Rendered view of typical subsurface utilities highlights the complexity of updating the nation's hidden infrastructure — story on page 51. *Image: Emerson Melin/Maser Consulting*

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Often ranked as the nation's most beautiful campus, the University of Virginia grounds were designed by Thomas Jefferson. Routing the new underground ductbank through the grounds proved challenging. *Photo: UVA*

UNIVERSITY OF VIRGINIA'S POWER PARTNERSHIP GOES UNDERGROUND

DEWBERRY ROUTES A DUCTBANK TO INCREASE RELIABILITY OF ELECTRICAL SERVICE TO CRITICAL FACILITIES WHILE MINIMIZING INSTALLATION IMPACTS.

By Devin Keeler, P.E.

SET IN THE ROLLING FOOTHILLS of the Blue Ridge Mountains, the University of Virginia (UVA) in Charlottesville offers one of the nation's most beautiful and storied campuses. The university was conceived by Thomas Jefferson as an idyllic "Academical Village," with a central, terraced lawn surrounded by pavilions, colonnades, and the iconic Rotunda. Chartered as a public institution in 1819, the university has been listed on the National Register of Historic Places for more than 50 years, and for more than 30 years as a UNESCO World Heritage Site.

The university's 1,700-acre grounds are also home to the UVA Health System, consisting of several teaching hospitals and world-class research programs. These include a Level 1 trauma center, a clinical cancer center, and a children's hospital. In addition, UVA's 54-acre Fontaine Research Park includes a rehabilitation hospital, a medical office building, and numerous research facilities and laboratories. The university also serves as a state emergency shelter, with requirements to maintain power and a potable water supply to the community during disaster events and other emergencies.

While UVA has maintained extensive back-up power systems, its hospitals, laboratories, and student operations have been challenged in recent years by numerous, short power interruptions — as many as 40 or 50 interruptions, or "blips," a year. Though not officially considered a power outage (defined as two or more minutes of no power), these disruptions required rapid response from maintenance teams at all hours to reset research lab and medical equipment, such as air handlers, MedVac pumps, freezers, and other critical items. The interruptions had the potential to impact the quality of patient care and research, as well as daily operations throughout the university.

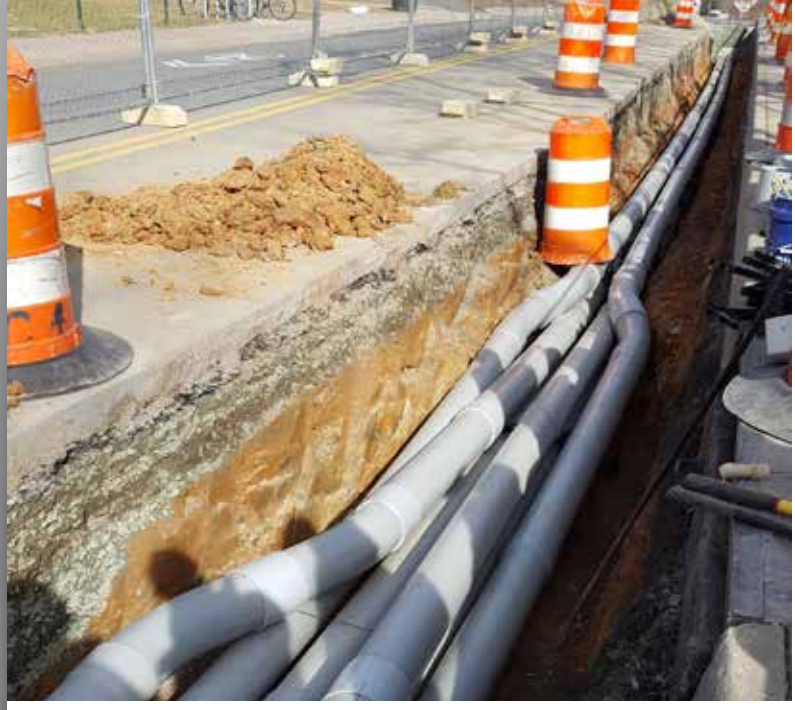
A powerful partnership

To address the fluctuations in reliability, UVA administrators partnered with Dominion Energy in 2014 to evaluate options to enhance service. The university owns and maintains a 15kv underground distribution service to its academic, research, and medical center buildings. Campus administrators and Dominion Energy representatives recognized, however, that most of the problems originated along the 35kv overhead lines upstream of the university substations — impacts such as fallen tree limbs, ice storms, lightning strikes, and animal activity. As a result, the partnership determined that the most resilient solution would be to transfer three miles of 35kv overhead electric service to an underground ductbank between three substations, two of which existed on campus. UVA agreed to fund the routing, design, and construction of the underground ductbank, while Dominion Energy funded the purchase and installation of the electrical cable.

Routing: A detailed analysis

Routing the ductbank through the historic grounds would prove to be the most challenging aspect of the project. UVA turned to Dewberry's civil engineers, who had completed numerous projects on the grounds in prior years, to assess the routing. The team developed a complicated matrix with more than 110 unique considerations across four categories: transportation, environmental impacts, cultural resources, and land use impacts. Each factor was ranked and weighted to compute a score for the various routes.

In all, Dewberry's team analyzed 37 routes and considered factors such as wetlands and stream crossings, historic lawns, utilities, walkways, bike paths, bus lanes, large steam tunnels, traffic impacts during construction, and future building sites. The two existing substations were located on opposite sides of a major railroad, further complicating the route analysis.



With most of the ductbank route set along active roadways, maintenance of traffic and pedestrian detours were critical to minimize impact on motorists. *Photo: Dewberry*

"This was a very invasive project," said Don Sundgren, associate vice president and chief facilities officer for the university. "The evaluation matrix helped us study the different routings and select the best one."

Minimizing impact

The detailed analysis enabled the university to identify a shortlist of potential routes and finalize the optimum alternative — one that runs largely on UVA property and primarily along streets. The university's focus on minimizing impacts continued through the survey process, during which Dewberry directed the use of a truck-mounted laser scanner for surveying along the roadways. This significantly reduced the impact on traffic compared with a conventional survey approach. The scanner expedited data acquisition and obtained high-quality information while requiring no roads to be closed or impacted during the process.

The final design included a detailed horizontal and vertical alignment for the entire three-mile route length and 33 large underground vaults spaced approximately every 500 feet. With most of the route set along active roadways, maintenance of traffic and pedestrian detours continued to be critical to minimize the impact on motorists. Creative interventions included design of a jack-and-bore installation under one of the busiest corridors, Fontaine Avenue, enabling the road to remain open. This busy thoroughfare runs adjacent to the UVA Research Park, a city fire station, and the preferred route for ambulances heading to the hospital. Despite hitting a lot of rock during the process, the trenchless technology enabled the ductbank to be installed in this location without closing the street.

Reliable service

The new underground ductbank is expected to reduce the number of power interruptions by more than 90 percent. Based on this metric, the university is expecting three to four outages per year. Through the first six months of operation, there have been zero outages. This includes continuous service during severe snow and wind storms that produced outages elsewhere across Charlottesville and the region.

With construction recently completed, both the university and the Charlottesville community are seeing positive results. UVA received a dedicated circuit from Dominion, and the institution now has additional capacity to expand. The city of Charlottesville also netted additional capacity as a result. Most importantly, UVA now has nearly continuous service, with almost no interruptions.

"We wanted as close to 100 percent reliability as we could get," Don Sundgren said. "The way to do that was through the underground ductbank so it's not subject to all the interruptions that occur. It's very important to support our university's research and of course our patient care at the medical center. That was our primary objective and we achieved that with the ductbank."

"Through some very creative and productive conversations, we arrived at a joint perspective on improving service to and from our substations to the campus and putting most if not all of the infrastructure associated with these circuits underground," said Kevin Curtis, vice president of technical solutions at Dominion Energy. "Placing the infrastructure underground in a ductbank makes it even more protected from dig-ins and more resilient in general. It's a first-class service."

A jack-and-bore process allowed for ductbank installation along a busy street without closing the street to traffic. *Photo: Dewberry*

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