ASHE scanner

Spring 2022

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Hernando de Soto Bridge deck at sunset during repair

See page 38

Columbus ASHE 2022

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Columbus, OH

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scanner
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MISSION
Provide a forum for members and partners of the highway industry to promote a safe, efficient and sustainable transportation system through education, innovation and fellowship.

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Tim Matthews, PE
ASHE National President 2021–2022

New Directions

My time as your ASHE President is ending. As I reflect on the last two years, I can honestly say it has been an honor and a privilege to serve this great organization. While a two-year term is not the norm, I am humbled that the membership had the confidence in me to serve during one of the hardest times in our history. The pandemic was incredibly challenging, yet we still managed to grow our organization during this time. It just shows how we can all come together when we need to and keep life moving forward.

In the first year of my term, not much happened. Like you, I spent all of my time on a virtual platform. Fortunately, I was in a position to continue my work and my life with minor impact overall. I would say that we were lucky.

In the second year, we had the vaccine! Even though the virus was still around and constantly changing, the vaccine gave us an opportunity to start gathering again. The National Board was able to meet on our regular schedule and in person. We spent time in Houston, TX, Norfolk, VA, Jacksonville, FL and recently in Cincinnati, OH. On behalf of the Board, I want to thank all the Sections that welcomed us to their Regions.

As President, I was also able to travel around the country to see many of you. In October, I had the honor to speak at the Ohio Transportation Engineering Conference in Columbus. In November, I spoke at the American Society of Engineers/American Society of Civil Engineers one-day conference in Phoenix, AZ. Thank you to James Barr for that invitation; it was great to enjoy warm weather in Phoenix too! I also joined the Tennessee Valley Section, along with Scott Jordan, for their holiday fundraiser for families.

On a final note, please watch for a new ASHE technology podcast series hosted by Melissa Boyles (Phoenix Sonoran Section) and Amanda Schumacher (East Penn Section). They plan to present a monthly podcast for our membership, sharing information about what is going on in our transportation community. Please plan to attend the ASHE National Conference in Columbus, OH, May 11 to 15. This will be our first in-person conference in two years, and it will be quite a celebration!

Please stay safe and actively involved in your Sections and Regions!

SPRING 2022

In This Issue

ASHE scanner

2– ASHE 2022 National Conference

3– New Directions: President's Message

6– Mountain Parkway Project Restores a Vital Route

11– As the Wheel Turns

12– Bobcat Crossing: Ohio University's New Pedestrian Passageway

16– The Dublin Link: Connection at Its Core

20-26– **ASHE 2022 National Conference**

27– Introducing Economies of Scale through Project Bundling

30– Complete Streets Approach Makes a Busy Roadway Safer

34– I-24 Bridge Replacements Use CM/GC Methods to Improve Safety, Timelines, Costs

38– Emergency Repairs on the Hernando de Soto Bridge

41– Beyond Deliverables: A New Take on 3D Design

6 Mountain Parkway Project Restores a Vital Route

25 Economies of Scale through Project Bundling

34 CM/GC Methods Improve Safety and More

41 Beyond Deliverables: A New Take on 3D Design

Bicentennial Park Bridge, Columbus, OH

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Mountain Parkway Project Restores a Vital Route

by Mike Killian, PE, Design Project Manager, Burgess & Niple, Inc., **ASHE Bluegrass Section**

When engineers with the Kentucky Transportation Cabinet (KTC) discovered the cause of a persistent dip in the pavement of the Bert T. Combs Mountain Parkway in July 2020, they realized they had a problem.

The solution required closure and complete rebuilding of a portion of the Mountain Parkway. Probably the most important road in eastern Kentucky, it links the mountain counties of the southeastern Kentucky River and Big Sandy valleys to Lexington. The road is the major connector between central Kentucky and points west, and the eastern Kentucky regional hubs of Pikeville and Hazard. It provides access to education, employment, health care and entertainment opportunities for a large swath of the state's population. In addition to local and commercial traffic, the route runs through a busy tourist area and provides access to recreational activities in this rugged, wooded area.

The affected portion of the Mountain Parkway lies in the vicinity of Natural Bridge and the Red River Gorge, an area marked by a number of sandstone arches. At the Powell-Wolfe county line, the Mountain Parkway begins a descent of Slade Hill. It runs along the hillside in this area underlaid with the same sandstone that has eroded over time, creating the tourist attractions for which the region is known. The road was opened to traffic in 1963 and has had little reconstruction in this region, except for an asphalt overlay project that replaced the original concrete driving surface.

Problems at mile point 35.8, near the Tunnel Ridge Road underpass, were first noticed May 26, 2020, when a dip in the left westbound lane was reported. It was so severe that there were anecdotal accounts of drivers going briefly airborne. "DIP" signs were installed to warn drivers of a possible hazard, and the lane was closed until the section could be strip patched with asphalt.

The patch was applied June 15, less than a month later, but the dip reappeared July 2, worse than before. The lane was again closed. Initial investigation showed no collapsed pipes, erosion or any other signs of what was causing the problem. On July 13, a crew from KTC discovered issues in the concrete subgrade via use

Placement of stones in one-foot lifts and geogrid between rock layers during construction on Mountain Parkway

of ground-penetrating radar. The next day, drilling operations discovered the existence of a narrow sinkhole or void beneath the roadway. By July 23, a hole had appeared in the strip patch and the asphalt that had been applied over the original concrete surface. Due to safety concerns both westbound lanes of the Mountain Parkway were closed, and westbound traffic was detoured via SR 15 between Exit 40 at Pine Ridge and Exit 33 at Slade. The eastbound (uphill) lanes remained unaffected and stayed open.

Subsequent geotechnical exploration and drilling/digging discovered a void in the sandstone fill that had been used to create the grade when the road was built in the 1960s. The base beneath the original concrete pavement slab had disappeared, and the concrete slab was serving as a bridge over the chasm. If that slab had collapsed under the weight of a passing vehicle, a 60-foot-deep gap would have been created in the roadway. As this was obviously unsafe, the road was closed. After examination of the original plans and data obtained by radar soundings and core drilling, repair plans were formulated to dig out the deteriorated fill material and replace it with rock and geotextile fabric.

(continued on page 8)

Mountain Parkway showing placement of rock embankment with geotextile fabric

Tunnel Ridge Road overpass looking eastward at Mountain Parkway corridor after project's completion

Mountain Parkway Project Restores a Vital Route

(continued from page 7)

Both carriageways were to be repaired, ensuring that problems did not develop in the eastbound lanes as well.

The project was advertised for bids in September 2020, and a $1.1 million construction contract was awarded to Walker Construction & Materials, LLC, that same month. The winning bid came in at around half of the estimate for repairs, which was $2 million. Completion of the repairs was a priority before the onset of winter weather, since the westbound detour along SR 15 has a narrow, crooked alignment with hairpin curves on Slade Hill.

The eastbound lanes were reconstructed first. They were closed to traffic October 2, 2020, and reopened two weeks later. The westbound lanes, which required more excavation and fill and were the ones originally impacted, reopened October 23. It was a week ahead of the original deadline specified in the contract. A year after the project's completion, the repairs appeared to be holding up well. There was only minor settling of the fill material, as expected, and there was no evidence to indicate the problem will reoccur.

A long-term closure of the Mountain Parkway would have been disastrous for a large area of eastern Kentucky. The work occurred during the busiest tourist season in the Red River Gorge, at the peak of fall foliage, so communication with the public was also critical. An aggressive construction schedule allowed the road to be reopened as early as possible with minimal additional traffic disruptions. Communication with the public all along the Mountain Parkway corridor and the impacted counties gave drivers ample notice of when both directions of travel would be shut down. The highway district kept drivers informed of the project's progress and issues during the closure via news releases, social media posts and interviews with members of the news media. Suggested additional alternate routes, other than the signed detours, were emphasized for commercial and long-distance traffic.

While the situation was inconvenient for more than three months, a far worse scenario could have occurred. The cooperation of all involved in providing the solution to this project in a timely manner helped ensure that the Bert T. Combs Mountain Parkway can continue to serve as a safer roadway for travelers in eastern Kentucky.

As The Wheel *Turns*

ASHE Members on the Move!

Sibley Receives ACEC Award

Valley Forge, PA—**Scott Sibley, PE,** **member of the ASHE Delaware Valley Section,** received the 2021 National American Council of Engineering Companies (ACEC) Community Service Award at their fall conference in Florida. The award is presented to individuals involved in service while demonstrating a sustained commitment to their communities. Sibley, a senior vice president at Gannett Fleming, is chief of operations for the firm's Transit and Rail Global Business Group, working from the Valley Forge, PA, office. **He has served as President and Board member for ASHE Delaware Valley Section and Director for ASHE Region 6** covering New Jersey, New York and the Delaware Valley. He serves as Vice Chair of the ACEC/PA SEPTA Committee and works with community organizations in Montgomery County, PA.

Timpson Joins Dewberry

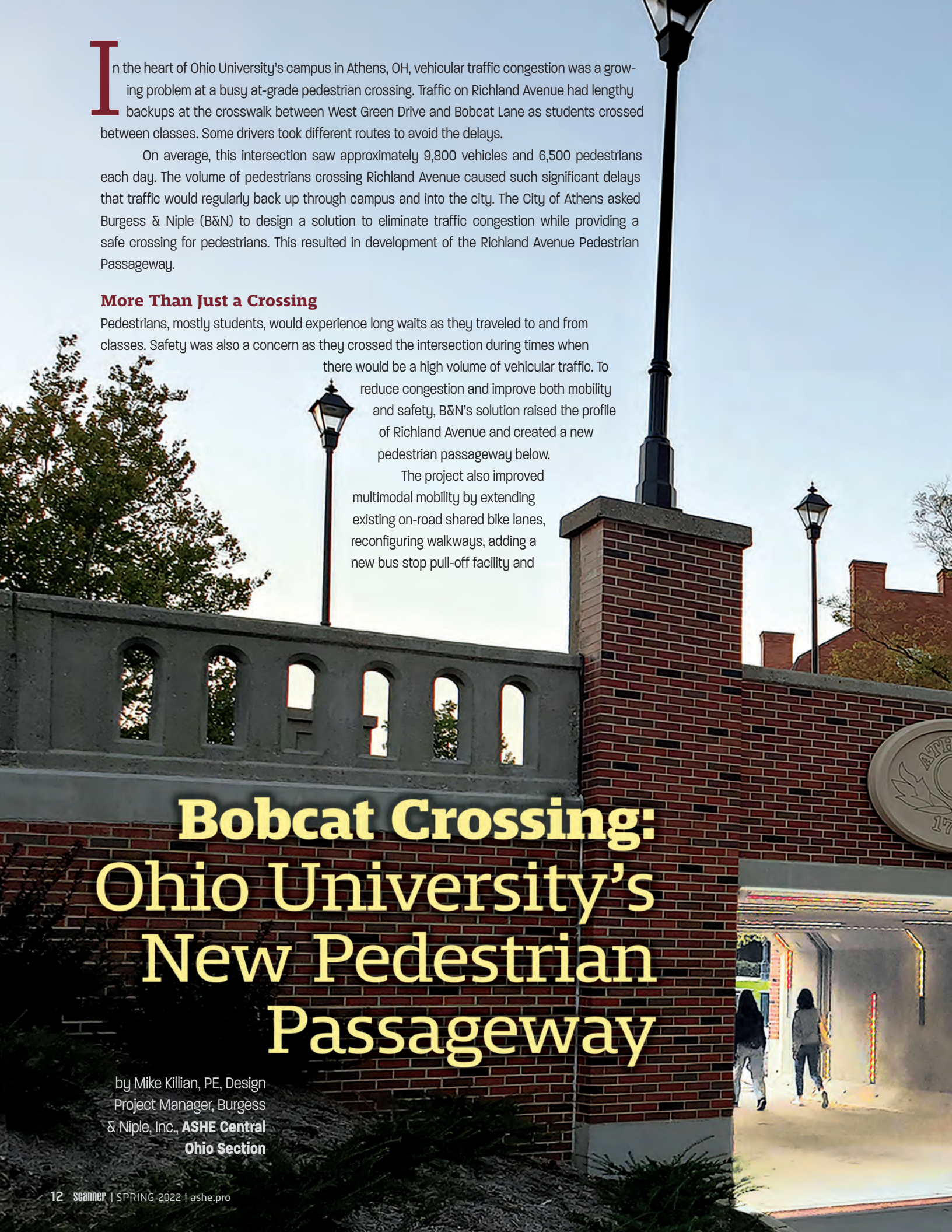
Atlanta, GA—**Ken Timpson, PE,** has joined Dewberry as a senior project manager on the firm's southwestern transportation team. **A member of the ASHE Georgia Section,** Timpson has more than 30 years of experience in roundabouts, multiuse paths, hydrology, hydraulics, pavement drainage and roadway design. He earned a Bachelor's degree in Civil Engineering from Georgia Institute of Technology.

Dewberry Promotion for Agnello

Bloomfield, NJ—**Peter Agnello, PE,** highway department manager in Dewberry's Bloomfield office, has been promoted to the position of associate vice president. He is a **member of the ASHE Central New Jersey Section.** Agnello earned a Bachelor's degree in Civil Engineering from Rutgers University. He also holds membership in the American Society of Civil Engineers.

Dewberry Promotes Gerstner

Fairfax, VA—**Patrick Gerstner, PE,** was promoted to associate vice president in Dewberry's Mechanicsburg, PA, office. A **member of the ASHE Harrisburg Section,** he has nearly three decades of experience and currently serves as department manager for the office's highway design group. Gerstner earned a Bachelor's degree in Civil Engineering from Virginia Tech. He is also a member the American Society of Civil Engineers.



Bobcat Crossing: Ohio University's New Pedestrian Passageway

by Mike Killian, PE, Design Project Manager, Burgess & Niple, Inc., **ASHE Central Ohio Section**

In the heart of Ohio University's campus in Athens, OH, vehicular traffic congestion was a growing problem at a busy at-grade pedestrian crossing. Traffic on Richland Avenue had lengthy backups at the crosswalk between West Green Drive and Bobcat Lane as students crossed between classes. Some drivers took different routes to avoid the delays.

On average, this intersection saw approximately 9,800 vehicles and 6,500 pedestrians each day. The volume of pedestrians crossing Richland Avenue caused such significant delays that traffic would regularly back up through campus and into the city. The City of Athens asked Burgess & Niple (B&N) to design a solution to eliminate traffic congestion while providing a safe crossing for pedestrians. This resulted in development of the Richland Avenue Pedestrian Passageway.

More Than Just a Crossing

Pedestrians, mostly students, would experience long waits as they traveled to and from classes. Safety was also a concern as they crossed the intersection during times when there would be a high volume of vehicular traffic. To reduce congestion and improve both mobility and safety, B&N's solution raised the profile of Richland Avenue and created a new pedestrian passageway below.

The project also improved multimodal mobility by extending existing on-road shared bike lanes, reconfiguring walkways, adding a new bus stop pull-off facility and

reconfiguring Bobcat Lane to allow for left-hand turns onto Richland Avenue. The improvements also included extending the existing barrier on the Oxbow Bridge to channel pedestrians through the passageway and minimize jaywalking.

Making the Grade

Raising the profile of Richland Avenue proved to be both a geometric and geotechnical design challenge. Numerous existing underground utilities were identified directly beneath or adjacent to Richland Avenue, including fiber optic, gas, electric, storm sewer, water and steam lines. Matching the grade of the proposed passageway with the grade of the existing crosswalk was important to avoid the cost of relocating primary fiber optic and steam line utilities that served the entire campus.

Additionally, soil borings taken prior to preliminary design identified an underlying weak layer of peat that would result in a significant embankment settlement and unacceptable damage to the underground utility lines. B&N's plans included two options for the contractor to choose from that would improve the soils before construction: rammed aggregate piers or Elastizell.

The Elastizell alternative, selected by the contractor, consisted of filling an over-excavated area beneath the roadway with a specifically designed lightweight concrete slurry. This slurry was engineered to compensate for the additional embankment weight so that, after construction, there was minimal additional settlement below.

Construction occurred mostly during summer break to avoid impacting the main academic calendar. However, shortly after the project started, the global COVID-19 pandemic began. By following State of Ohio guidelines, work on the passageway continued with minimal impact to students. *(continued on page 14)*

The east passageway approach reflected Georgian-style architecture of surrounding buildings.

Use of Elastizell helped avoid ground settlement and associated damage to utilities.

Bobcat Crossing: Ohio University's New Pedestrian Passageway

(continued from page 13)

Blending in and Matching Campus Architecture

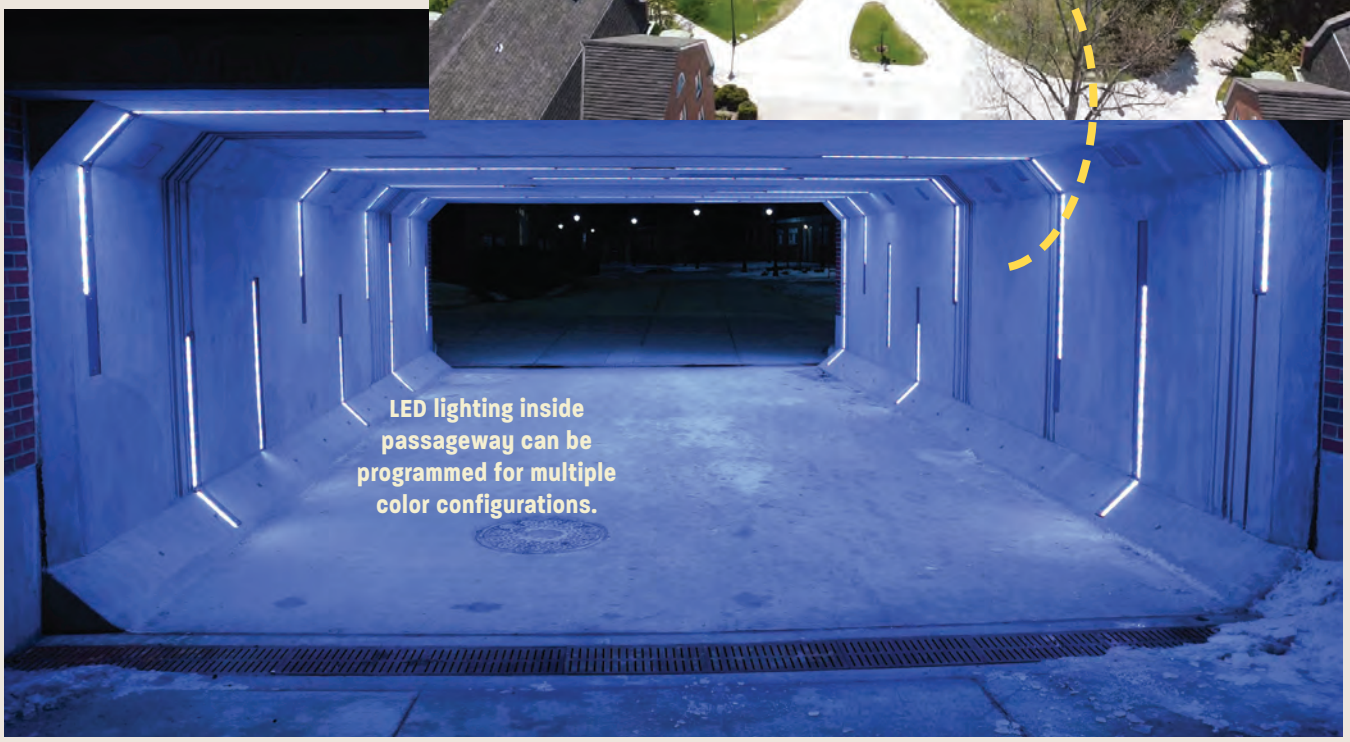
When designing the passageway, B&N's team took into consideration the Georgian Revival style of architecture throughout the campus. To ensure that new features reflected the architecture, the team studied and matched details of adjacent campus structures, from the shape of the building to the type and color of brick used. B&N included brick-lined passageway wingwalls and aesthetic crash-tested barriers on both sides of Richland Avenue that matched the style on the adjacent Oxbow Bridge. Other additions included Georgian-style vertical passageway pilasters and streetlamps that matched surrounding campus lighting.

Programmable lighting was a prominent feature inside the new passageway. Randomized Lumenpulse LED lighting strips were embedded into the concrete walls and connected to a control box outside, allowing the lights to be remotely programmed.

Goals Accomplished

The city reduced Richland Avenue traffic backups and provided a safe pedestrian crossing in the center of Ohio University's main campus. Using detailed design plans prepared by B&N, Rietschlin Construction, Inc., completed construction of the project between March and October 2020.

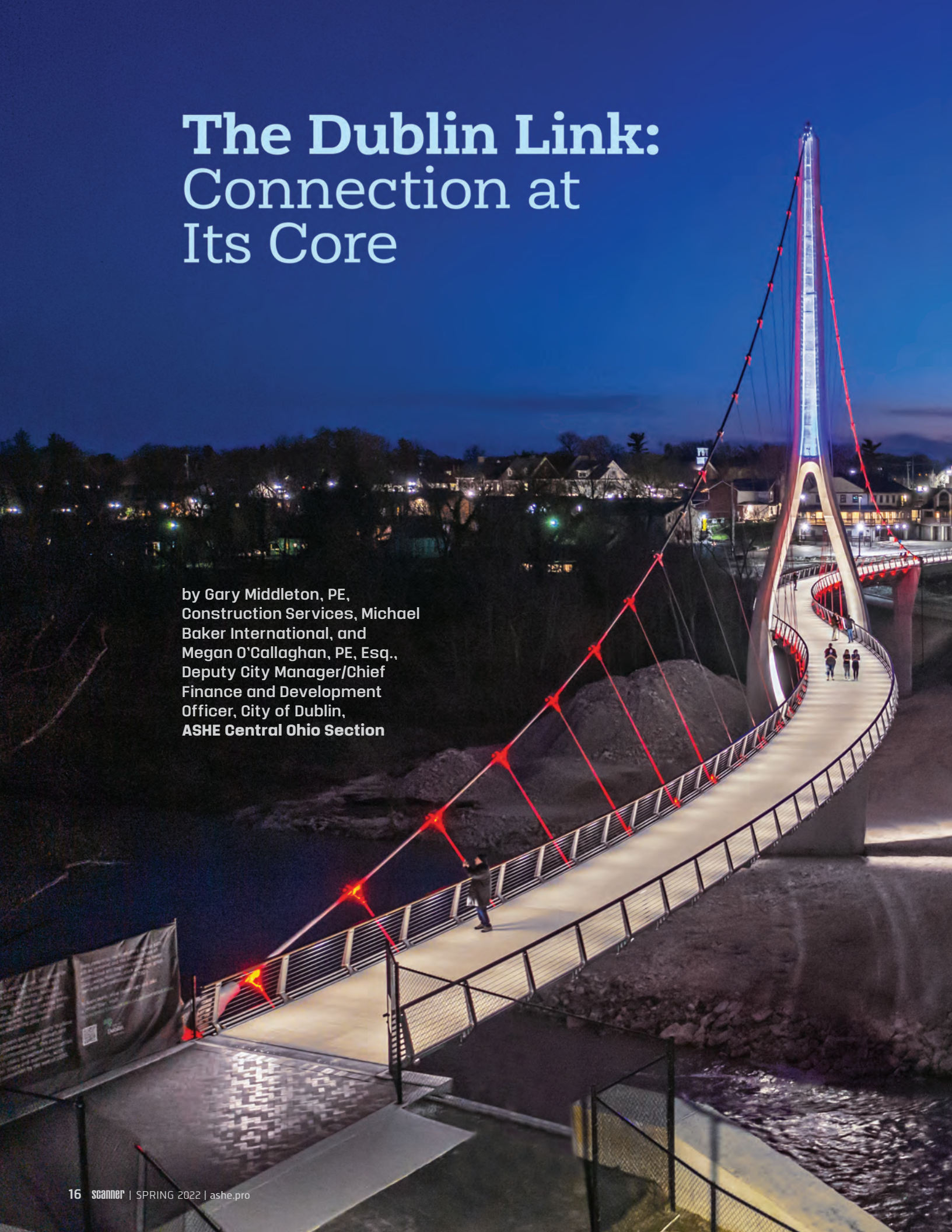
In November 2020, City of Athens Mayor Steve Patterson and Dr. M. Duane Nellis, then president of Ohio University, shared the following as part of a joint statement: "The project would not have been possible without the support of the Ohio Department of Transportation and the Transportation Alternatives Program funds of nearly $2 million. The City and Ohio University would also like to acknowledge the design of the project, completed by Burgess & Niple, and the contractor that devoted nine months to the project and brought the design to life, Rietschlin Construction, Inc."



LED lighting inside passageway can be programmed for multiple color configurations.

The Dublin Link: Connection at Its Core

by Gary Middleton, PE, Construction Services, Michael Baker International, and Megan O'Callaghan, PE, Esq., Deputy City Manager/Chief Finance and Development Officer, City of Dublin, **ASHE Central Ohio Section**



***SEE* this amazing pedestrian bridge while at ASHE National Conference.**

A 20-minute drive from the Conference hotel, at 6694 Riverside Drive, Dublin, OH, or directions available.

Dublin, a suburb of Columbus, OH, has a population of approximately 50,000. The winding Scioto River traverses the city, and for years, residents and local government had recognized the need to connect the area's retail, dining, commercial and residential destinations.

The Dublin Link, the longest single-pylon span in the world with a 1,760-foot-long "S" curve alignment, provided this connection for the city. The superstructure passes through a 176-foot-tall focal tower element that is a "needle-hole" concrete pylon. The steel box girder is an asymmetric "V," which changes shape as people cross the bridge, yet still maintains a 14-foot clear deck width from end to end. The bridge features one main suspension cable and with a single plane of hanger cables attaching along only the inside edge of the curved bridge deck.

Innovations and Challenges

Recognizing the unique nature of the bridge and many of its critical design features, the city adopted the Construction Manager/General Contractor method, a first in Ohio. Michael Baker International (Michael Baker) served as the construction manager (CM), the owner's representative, and provided inspection services. T.Y. Lin International was Engineer of Record, Endrestudio served as architect and Kokosing Construction was contractor for the project.

The CM team provided rebar congestion management; post-tensioning inspections, including rock anchors and tie downs; inspection of installation; and stressing of 120-millimeter diameter main suspension cable (galvanized, fully locked coil style from Italy). Also provided were inspection of installation and tuning of mass damper and viscous damper, electrical and aesthetic lighting inspections and Critical Path Method scheduling management.

Michael Baker coordinated with material

(continued on page 18)

Completed Dublin Link

The Dublin Link: Connection at Its Core

(continued from page 17)

suppliers, including those from Florida, Italy and Germany, which created challenges. For example, the cables were fabricated in Italy by one of only three companies in the world that produced the type of suspension cables designed for the unique "S" curve bridge. The cables were extensively tested in Braunschweig and Bochum, Germany, before being shipped to the project site. The main and hanger suspension cables were fabricated in Milan, Italy.

The design of the pylon shape was one of the most complex pieces. The pylon base had to be built parallel to the river flow to minimize water disturbance and scour. Detailed 3D Building Information Modeling prototypes were created of the pylon geometry. This included all rebar, embedded steel elements and electrical and lighting, which helped identify and resolve potential clashes between structural elements. The 3D modeling proved valuable for defining the complex twisting shape of the pylon in a way that facilitated construction. The contractor also developed a 3D model, which further incorporated the location of construction joints, forming methods and joint locations consistent with their preferred means and methods.

Pylons and pier

The S-shaped curve alignment, a challenge in itself, was designed to connect Rock Cress Parkway on the west bank with Bridge Park Avenue on the east, and these were roads that did not directly line up. A suspension bridge style was ultimately selected. However, the stays were attached to one edge of the superstructure to afford unobstructed views and walkways. In a conventional cable-stay system, pairs of stays support both sides of the bridge deck. With the support of only one edge of the deck, the resulting torsion in the deck was addressed by designing the S-shaped curve into the deck. In that way, the torsion was balanced by creating an arching effect in the plan direction.

The project also incorporated multiple innovative design elements. Intentional damping is a somewhat rare need for the design of bridges. Cable-supported bridges are light and flexible and are more susceptible to

vibrations than girder bridges. When damping is required, it is typically designed to mitigate vertical vibrations. Narrow bridges may also be susceptible to lateral vibrations requiring a different type of damper. To achieve the slender profile, the bridge included two pendulum-type tuned mass dampers, which minimized potential for lateral vibrations. The dampers were mounted under the bridge deck and completely hidden inside the closed steel box girder.

The "V" shape of the bridge girder had the potential for generating vortices in the wind, and the possibility of oscillations from vortex shedding was found during wind tunnel testing of the bridge. A wind guide vane, which disrupted potential for vortex shedding, was added to the bridge. Further testing in the wind tunnel showed significant improvement in the bridge stability for the wind environment.

An Economic and Community Driver

The Dublin Link now connects the city's historic district downtown with the new Bridge Park development. This included restaurants and outdoor cafes, shops and boutiques, open-concept office spaces, upscale apartments and condominiums, parking garages, a new library and parks. With this increased access to both sides of the river, the area can continue to grow. The aesthetic of the bridge can even change to match public events and festivals thanks to dynamic programmable lighting.

The bridge also connects portions of park space, together known as Riverside Crossing Park. Envisioned as one of Dublin's most important civic and natural spaces, the 36-acre park will include a pavilion, upper and lower terraces, lawns, seating areas, waterfall features, a play space and bike racks. Additionally, the park's paths will connect with Dublin's trail system. The upper portion of the park was completed in late 2020, and the remainder is to be completed by late spring of this year.

The project began in February 2017. The final structure was completed and delivered on time, with the Dublin Link opening to the public in March 2020 at a final cost of $22 million.

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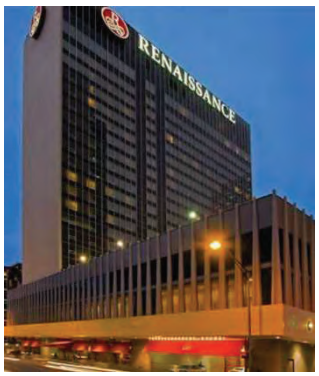

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Attendance and Activities Registration Form

Fill in highlighted boxes as appropriate – carry total over to Conference Registration Form.

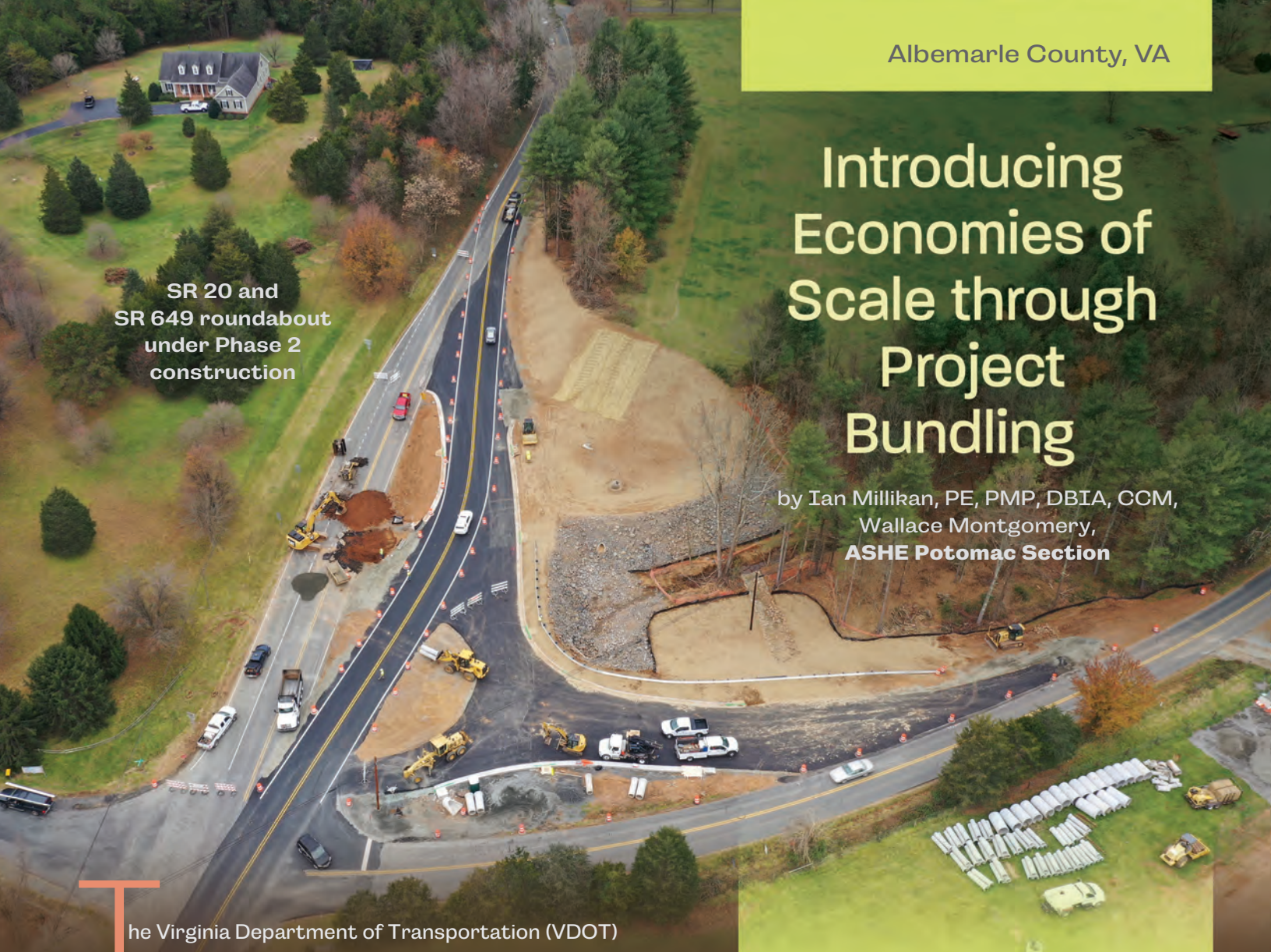
Time	Event/Activity	Cost	Number Attending	Total
Wednesday, May 11, 2022				
2:00pm – 7:00pm	Registration	Use Registration Form		
7:00pm – 12:00am	Hospitality Suite	n/c	–	–
Thursday, May 12, 2022				
7:00am – 7:00pm	Registration	Use Registration Form		
7:00am – 5:00pm	Golf Club of Dublin	Use Golf Form		
11:00am – 2:00pm	Guest Tour: German Village Guided Walking Tour	$25		$
12:00pm – 6:00pm	Hospitality Suite	n/c	–	–
6:00pm – 9:00pm	Welcome Reception/Ice Breaker with Exhibitors *(Hall opens for setup at 12:00pm)*	n/c	–	–
9:00pm – 12:00am	Hospitality Suite	n/c	–	–
Friday, May 13, 2022				
7:00am – 6:00pm	Registration	Use Registration Form		
7:00am – 8:30am	Breakfast	n/c	–	–
7:00am – 5:00pm	Exhibits Open	n/c	–	–
8:00am – 9:30am	Opening Session	n/c	–	–
9:00am – 11:00am	Guest Tour: Ohio Stadium	$15		$
9:30am – 10:00am	Break with Exhibitors	n/c	–	–
Technical Session 1				
9:30am – 11:30 am	Region/Section Officers Meeting	n/c	–	–
10:00am – 11:30am	1A – Community Connectivity	n/c	–	–
	1B – Highway Safety	n/c	–	–
	1C – Bridges	n/c	–	–
11:30am – 12:00pm	Break with Exhibitors	n/c	–	–
12:00pm – 1:30pm	Guest Tour: North Market	**$5**		$
12:00pm – 1:30pm	**Luncheon Honoring Past Presidents** **(*no other lunch provided by conference)**	**$20**		$
1:00pm – 4:00pm	Guest Tour: Columbus Zoo & Aquarium	**$25**		$
1:30pm – 2:00pm	Break with Exhibitors	n/c	–	–
2:00pm – 3:30pm	Past Presidents Meeting	n/c	–	–
Technical Session 2				
2:00pm – 3:30pm	2A – Technology	n/c	–	–
	2B – Community Connectivity	n/c	–	–
	2C – Large Urban Projects	n/c	–	–
2:00pm – 4:00pm	Guest Tour: High Bank Distillery	**$15**		$
3:30pm – 4:00pm	Break with Exhibitors	n/c	–	–
Technical Session 3				
4:00pm – 5:00pm	3A – Large Urban Projects	n/c	–	–
	3B – MORPC	n/c	–	–
	3C – Technology	n/c	–	–
5:00pm – 6:30pm	Hospitality Suite	n/c	–	–
6:30pm – 10:30pm	**Friday Night Event at the Columbus Zoo**	**$80**		$
10:30pm – 12:00am	Hospitality Suite	n/c	–	–

Time	Event/Activity	Cost	Number Attending	Total
Saturday, May 14, 2022				
7:00am – 6:00pm	Registration	Use Registration Form		
7:00am – 8:30am	Breakfast	n/c	–	–
Technical Session 4				
8:00am – 9:30am	4A – Highway	n/c	–	–
	4B - Stormwater	n/c	–	–
9:00am – 11:00am	Guest Tour: COSI – Center of Science & Industry	**$30**		$
9:00am – 11:00am	Guest Tour: Franklin Park Conservatory	**$25**		$
9:30am – 3:00pm	Technical Tour: Transportation Research Center	**$25**		$
9:30am – 10:00am	Break	n/c	–	–
Technical Session 5				
10:00am – 11:30am	5A – Highway Construction	n/c	–	–
	5B – Planning	n/c	–	–
11:30am – 12:00pm	Break	n/c	–	–
12:00pm – 1:00pm	Lunch	n/c	–	–
12:00pm – 3:00pm	Guest Tour: Easton Town Center	**$10**		$
1:00pm – 3:00pm	National Board Meeting *(National Board Members only)*	n/c	–	–
3:00pm – 6:00pm	Hospitality Suite	n/c	–	–
6:00pm – 7:00pm	President's Reception	n/c	–	–
7:00pm – 10:30pm	**Annual ASHE Banquet**	**$100**		$
10:30pm – 12:00am	Hospitality Suite	n/c	–	–
Sunday, May 15, 2022				
7:00am – 9:00am	Breakfast	n/c	–	–
9:00am – 10:30am	Conference Debrief Meeting	n/c	–	–
			Activities Subtotal	$

The iconic deer statue stands on the Rich Street Bridge gazing at the city of Columbus.

Introducing Economies of Scale through Project Bundling

by Ian Millikan, PE, PMP, DBIA, CCM,
Wallace Montgomery,
ASHE Potomac Section



SR 20 and SR 649 roundabout under Phase 2 construction

The Virginia Department of Transportation (VDOT) has benefited from bundling six intersection and interchange improvement projects into one design-build contract. The concept of project bundling was introduced by the Federal Highway Administration (FHWA) as part of its Every Day Counts, Round 5, Innovations campaign. According to the FHWA, bundling projects could save time and costs by streamlining project delivery requirements and leveraging design expertise. The program has shown success throughout the country on bridge reconstruction and rehabilitation contracts (most notably the Pennsylvania Department of Transportation's 558-bridge bundling P3 contract).

The VDOT contract was unique, however; it focused on geometric improvements to several intersections and interchanges within the same general location. All six projects were in Albemarle County, VA, near Charlottesville, home to the University of Virginia. These projects included:

-Converting the I-64 and US 250 (exit 124) diamond interchange into a diverging diamond interchange (DDI)

(continued on page 28)

SR 20 and SR 649 roundabout under Phase 1 construction

Introducing Economies of Scale through Project Bundling

(continued from page 27)

US 250 and SR 151 roundabout under construction

–Reconfiguring the I-64 and US 29 (exit 118) interchange to eliminate weave movements

–Widening the exit ramp at the US 29 northbound/Fontaine Avenue interchange

–Converting the US 250 and SR 151 intersection into a single lane roundabout

–Converting the SR 20, SR 649 and SR 1494 intersection into a single lane roundabout

–Realigning and extending Rio Mills Road to tie with Berkmar Drive

The efficiencies associated with bundling projects extend beyond design and construction into programming and financial planning. VDOT realized that it could secure and prioritize funding for all six projects by bundling them all under one design-build procurement. Most notably, the safety improvements associated with the I-64/Exit 118 interchange were a high priority that would not have been delivered as quickly if it were not included in the design-build bundle. The economies of scale also helped VDOT apply various funding sources and add projects with varying sizes to the bundle. Smaller projects have a greater potential to receive bids over the engineer's estimate if they are advertised by themselves. However, bundling them with other larger elements allowed VDOT to award all six projects without hesitation.

As lead designer, Wallace Montgomery (WM) dissected the scope of work for each of the improvements and developed an overall project schedule that would expedite completion of each individual project and the entire bundle. Although the six projects were bundled into one contract, each still required individual environmental permits and had specific right-of-way (ROW) impacts and utility relocation requirements. Designs for the projects with the least impacts (Exit 118 interchange and US 29/Fontaine Avenue interchange) were sequenced first so they could begin ROW acquisition and utility relocation activities as design on the more complex projects was still underway. This continued into the construction phase of the simpler projects so that design, ROW, utility relocation and construction activities across all six projects could progress simultaneously. This allowed the entire project team to work on the project at the same time.

Expediting Schedules by Minimizing Impacts

To meet the milestone schedules, WM teamed with Clark Nexsen (CN) and collaborated with Curtis Contracting, Inc., to reduce the likelihood of delays by focusing on high-risk activities. WM and CN divided the workload so the design phase of multiple projects could happen concurrently. Grading diagrams were optimized for each alignment, ROW acquisition was minimized and utility conflicts were avoided wherever practical. This approach allowed the team to expedite the project schedule because the overall duration of critical path activities could be reduced.

One example where this approach saved both time and money was the design of the DDI for I-64, exit 124. WM optimized the geometric layout of the DDI to allow traffic to flow more smoothly while avoiding major utilities, such as a 16-inch waterline that ran parallel to US 250. The revised geometry improved traffic safety and operations during construction and reduced permanent ROW and environmental impacts by eliminating impacts to the nearby Culpeper Creek. This design was refined while the improvements at Exit 118 and US 29/Fontaine Avenue were under construction.

The flexibility in design and construction offered by project bundling proved advantageous in other ways as well. When the design-builder realized that a disposal site for excess material from the DDI element could not be located, the

contractor was able to abandon the loop ramp at Exit 118 early and dispose of excess material at that location. This proved beneficial for the design-builder, VDOT and the traveling public. In another instance, the design-builder was able to use its pre-existing relationship with a utility company, which had relocated a utility on one of the earlier project elements, to expedite relocations on another element.

Collaboration Leading to Streamlined Deliverables

Early in the design process, WM held review meetings with VDOT to discuss their approach to each design segment. These meetings helped to resolve issues and build rapport between the designer, contractor and owner representatives. The team felt a sense of ownership as the design was refined, collaborating to expedite official submittals. Relationships built during design of the simpler projects were carried over to the more complex ones. Everyone already understood their roles and what they needed to do to keep the projects on schedule and under budget.

Specifically, on the SR 151/US 250 roundabout, these relationships helped expedite the design, review and approval of the hydrologic and hydraulic analysis and roadway plans to accelerate construction of the box culvert. WM proposed to reduce the length of the box culvert by shifting traffic onto a temporary alignment to minimize stream impacts and construction time. VDOT collaborated with the designers and reviewers to ensure the design and construction approach was agreed to by all.

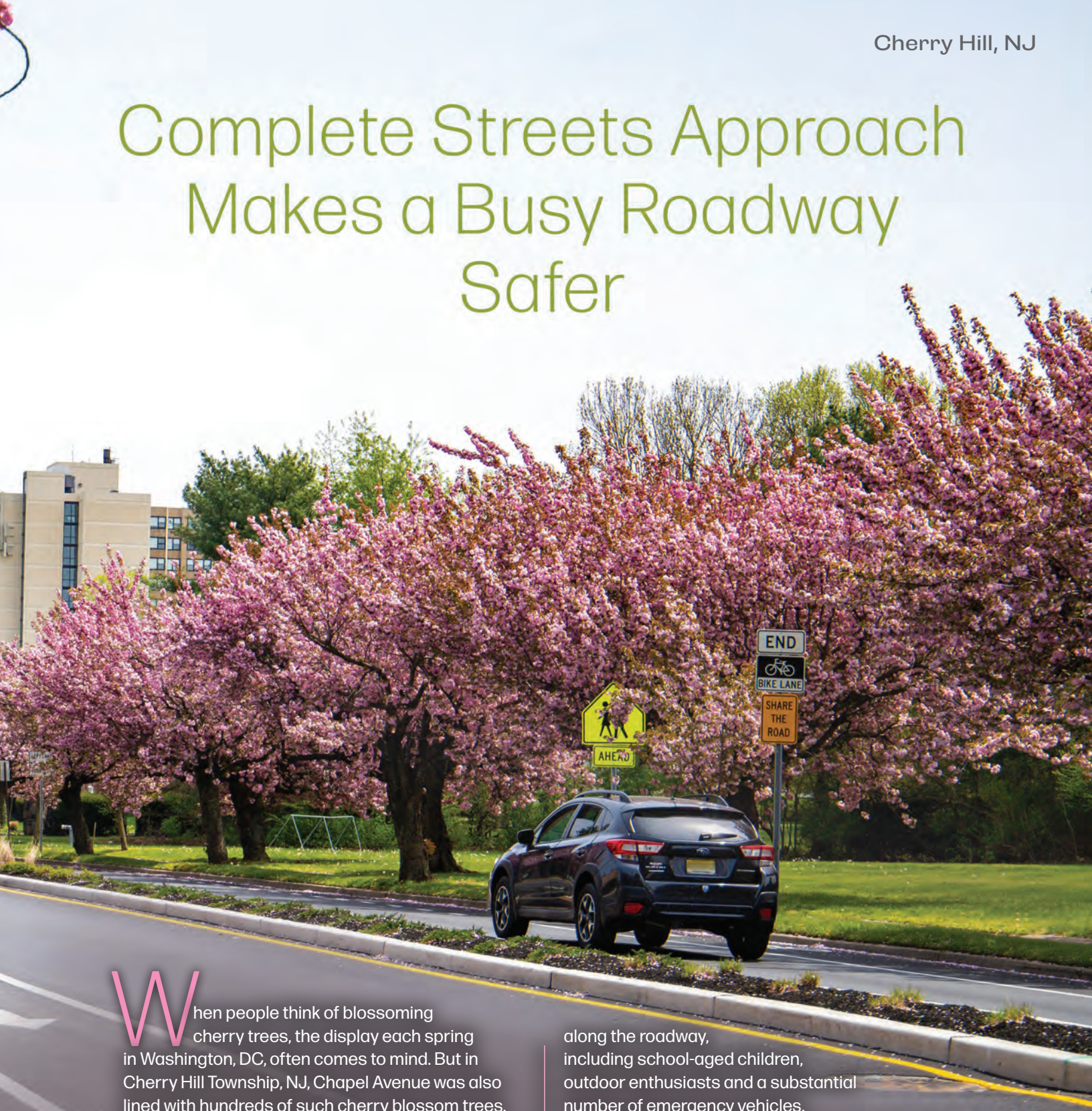
I-64 exit 124 interchange improvements (diverging diamond interchange) under construction

by Michael J. Drobny, PE, CME, Highway and Traffic Design, and Matthew Kearney, PE, French & Parrello Associates, **ASHE Southern New Jersey Section**

Chapel Avenue after construction

Chapel Avenue before construction

Complete Streets Approach Makes a Busy Roadway Safer



When people think of blossoming cherry trees, the display each spring in Washington, DC, often comes to mind. But in Cherry Hill Township, NJ, Chapel Avenue was also lined with hundreds of such cherry blossom trees. They were a point of pride for area residents and a symbol of their town's history. And, as with much of the country's aging infrastructure, the avenue needed improvements.

Chapel Avenue had many single-family houses but was also home to a variety of community facilities, including a regional high school, large elementary school, park, hospital and multiple houses of worship. The presence of these facilities led to a high number of pedestrians and bicyclists along the roadway, including school-aged children, outdoor enthusiasts and a substantial number of emergency vehicles.

The street had another challenge as well: a high rate of speeding vehicles. While the posted speed limit was 25 mph, further investigation confirmed that actual speeds regularly exceeded this limit, mainly due to the avenue's wide lane widths.

In late 2017, French and Parrello Associates (FPA,) was retained by Camden County to provide preliminary and final designs for roadway improvements to the nearly two miles of Chapel Avenue (CR 626). *(continued on page 32)*

Complete Streets Approach Makes a Busy Roadway Safer

(continued from page 31)

Chapel Avenue's typical flush cobblestone median with cherry blossom trees in bloom

Chapel Avenue's finished landscape island

FPA was responsible for:

- Developing design alternatives
- Leading a community outreach effort to secure project support
- Preparing contract documents to improve driver and pedestrian safety and bicycle compatibility
- Installing decorative landscaping to improve the overall condition of the roadway

FPA developed three design alternatives for consideration by the county, township and other stakeholders. The firm also hosted a series of stakeholder meetings and a public information center, addressed concerns and refined the design until an alternative was selected. The design followed a complete streets approach, focusing on reducing travel speeds, improving pedestrian accommodations, adding and improving bicycle facilities and incorporating key streetscape elements, including the township's cherry blossom trees.

FPA's design provided:

- A 12-foot-wide travel lane in each direction
- A five-foot-wide bicycle lane in each direction
- An eight-foot-wide parking lane on the westbound side
- A variable-width, flush stone median throughout the roadway, of critical importance so that residents could make left turns into their driveways
- Raised landscaped islands at several locations, including in front of the hospital, allowing for plantings that complemented the existing cherry blossom trees
- A traffic signal upgrade to improve pedestrian accessibility
- A traffic signal replacement to improve pedestrian accessibility and traffic operations
- Replacement of damaged segments of sidewalk
- Installation of curb ramps compliant with Americans with Disabilities Act regulations

During the next three years, FPA delivered this nearly $4 million project on schedule with minimal disruptions. With completion of the project in spring 2021, Chapel Avenue was safer for all.

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I-24 Bridge Replacements Use CM/GC Methods

by Kevin McAlister, PE, Barge Design Solutions, Inc., **ASHE Middle Tennessee Section**

Originally built in 1965, the I-24 bridge over South Germantown Road and the Belvoir Avenue bridge over I-24 in Chattanooga, TN, showed visible structural deterioration in 2017. Traffic volume had more than doubled along South Germantown Road over the last 40 years, with Tennessee Department of Transportation (TDOT) data revealing 107,724 vehicles travelling the roadway per day in 2018. Numbers were projected to increase four percent each year, adding additional wear on bridges already in need of increased capacity.

Travelers in the community counted on the bridges and roadways for freight transportation, accessibility and mobility, which set new requirements in place for design and construction of two bridge replacements. TDOT aimed to replace the bridges while maintaining the vertical profile of I-24, improving vertical clearance and minimizing impacts to traffic. These goals were set to minimize construction expenses, maintain a shortened timeline and create safe transportation routes.

Alternate Delivery Method Brought Collaboration

Working closely with TDOT, Barge Design Solutions, Inc. (Barge), created a plan to encourage a more collaborative approach for design and construction, shortening project timelines

Completed I-24 bridge over South Germantown Road

to Improve Safety, Timelines, Costs

while maintaining safety and controlling costs. They added the Construction Manager/General Contractor (CM/GC) alternative delivery method to the design, a process that required leadership and experience.

"The CM/GC method provides a strong platform for connectivity and collaboration within the entire design team," said Kevin McAlister, PE, Barge's Director of Bridge Engineering. "Having the owner, the design team and the contractor at the table during the design process puts us all on the same page, providing greater control of the overall design."

The CM/GC process allowed the construction manager to actively participate in the bridge design processes from the start, paving the way for reduced risk, accurate cost estimates, constructability assessments and scheduling, as well as for safer construction zones and bridges. Bell and Associates Construction of Brentwood, TN, was the construction manager for the bridge builds, working alongside Barge to offer input.

Over five months, Barge conducted design team meetings with TDOT and Bell to evaluate the current design, review traffic control scenarios and plan for efficient execution of the construction. The meetings centered around I-24 traffic control, bridge design details and bridge and retaining wall construction. Other discussions included geotechnical investigations, noise abatement, environmental concerns and hazardous material disposal. This process gained direct feedback for items such as constructability, beam erection planning, crane placement, staging, material transportation and demolition procedures.

(continued on page 36)

(continued from page 35)

Project by the Numbers

- 100,000 vehicles a day
- Four percent traffic growth each year
- $32.9 million construction cost
- Nine days of lane shifts, reductions and closures instead of 510
- Three separate weekend closure periods with 58 hours for bridge superstructure replacement
- $6 million saved in lane closure costs

Accelerated Bridge Construction (ABC) Added Safety, Saved Time

The design team applied ABC techniques to the South Germantown bridge design to limit traffic disruptions and increase safety through accelerated scheduling and multitasking. This allowed for several tasks to occur simultaneously, rather than sequentially, with no overlap. For instance, while construction teams worked on-site on various aspects of the bridge build, concrete beams and prefabricated panels were built off-site and delivered, ready for installation.

The project team established a Traffic Control Plan to alleviate safety risks, reduce driver distractions in the work zone and keep public inconveniences at a minimum. During the three planned weekend closure periods, continuous traffic flow through the work zone remained consistent.

During one meeting with TDOT, Barge discussed Bell's request to build an abutment under the South Germantown bridge deck instead of behind it. Through open discussions within the CM/GC process, this agreed-upon plan eliminated traffic disruption with no required lane closures for travelers, while making the construction site safer for the workers. Jonathan Haycraft, PE, Barge Vice President and Director of Transportation Services, commented about the CM/GC design process: "At the end of the day, everything we do is for the public. By using design to maximize safety, we serve the travelers and the bridge construction workers within our communities, making safety on our roads a top priority."

The team also discussed the soil profile surrounding the South Germantown Road bridge site, conducted by K.S. Ware and Associates, of Nashville. The subsurface presented clayey soils, small boulders and complete voids in the soil, adding further complexity of the deep foundation design. In response, the team planned for 172 micropiles to be drilled more than 160 feet deep into the foundation to resist compressive, uplift/tension and lateral loads. The micropiles allowed the contractor to work in tight spaces with low overhead clearance, using simple methods that minimized disturbance to adjacent structures, soils and the

environment. Construction occurred under the existing bridge system without disturbing traffic flow, reducing the timeline, risk factors and user cost.

Project Completion

ABC techniques were of significant value for replacing the I-24 bridge over Germantown Road. Traditional daily lane shifts, reductions and closures were reduced from 510 days to nine days of total closure time, replacing the bridge superstructure in three separate weekend closure periods of 58 hours for less risk and cost. At an estimated user cost of $6,000 per lane per day and at least two lanes closed during each phase of construction, the team estimated a user cost savings of more than $6 million from road user costs alone. This also benefited the environment by reducing carbon dioxide emissions produced from thousands of idling vehicles sitting in construction zone traffic each day.

The CM/GC method used in the bridge replacements, applied only the third time in Tennessee, enhanced collaboration for both bridges, making the process more efficient. For this project, Barge received a Structural System Honor Award and a People's Choice Award at the 2021 American Council of Engineering Companies of Tennessee Engineering Excellence Awards presentation.

As America's infrastructure and interstate systems continue to age, incorporating CM/GC and ABC as standards of practice to reconstruct roads and bridges could minimize economic, social and environmental impacts for years to come.

Emergency Repairs on the Hernando de Soto Bridge

Initial find of tie girder fracture

The Hernando de Soto Bridge is a steel-tied arch structure carrying I-40 across the Mississippi River between West Memphis, AR, and Memphis, TN. As one of only two crossings over the Mississippi River in the Memphis area, the bridge was a vital transportation, commerce and national defense link. Both the Arkansas Department of Transportation (ARDOT) and Tennessee Department of Transportation (TDOT) shared responsibility for the bridge. ARDOT oversaw inspections, and TDOT made repairs.

On May 11, 2021, inspectors from Michael Baker International (Michael Baker), the firm that provided inspection services for portions of the bridge above deck, noticed a fracture in the tie girder of the bridge below deck, located within ARDOT's scope of inspection. The inspectors immediately contacted local authorities to close all traffic across and under the bridge.

Hands-on inspection of tie girder fracture

Initial Assessment

Since the extent of damage was unknown, the Michael Baker team used unmanned aerial systems (UAS), or drones, to scan the fracture as well as the rest of the structure. The initial UAS video confirmed that the fracture included the complete loss of one of the two web plates, one of the two flanges and partial fracture of the second flange. More than 50 percent of the member cross section was lost in the fracture.

The team saw no additional damage outside of the fracture, and TDOT chose Michael Baker as the lead designer for all project phases. Plans for repair moved into design and construction. Once the structure was deemed stable, the U.S. Coast Guard reopened the river for navigation. Vehicular traffic across the bridge remained halted for the duration of the repairs.

Local and National Implications

The impact from the bridge's shutdown was felt almost immediately. With the movement of goods and people halted along this major corridor, the approximately 60,000 vehicles that used the route daily had to be rerouted, causing lengthy delays and increasing traffic along other routes. The Arkansas Trucking Association estimated that the extended travel time cost the trucking industry more than $2.4 million each day the bridge was closed.

The emergency closure gained attention across the country from the public, media outlets and politicians. Tennessee Governor Bill Lee, Arkansas Governor Asa Hutchinson and U.S. Secretary of Transportation Pete Buttigieg all visited the bridge in the days following the closure.

Teamwork and Collaboration

The team knew that collaboration and efficiency in design and schedules would be important for repairing the fracture and reopening the bridge as quickly as possible. Michael Baker called on more than 60 engineers from 20 of the firm's offices around the country to contribute to the project in design and review/oversight roles. This ensured that timely decisions were made at all phases of the work and that multiple phases could be advanced in parallel to minimize the overall schedule. *(continued on page 40)*

by Aaron Stover, PE, SE, Michael Baker International; Ted Kniazewycz, PE, Tennessee Department of Transportation; Rick Ellis, PE, Arkansas Department of Transportation, **ASHE Middle Tennessee Section**

Emergency Repairs on the Hernando de Soto Bridge

(continued from page 39)

Plates installed in Phase 3 to address more defects found in the tie during the inspection

TDOT selected the Construction Manager/General Contractor project delivery method, allowing owners, engineers and contractor to collaborate on repairs. Within a week of the fracture's discovery, Kiewit Infrastructure South Company (Kiewit) came on board as General Contractor.

Three-Phased Approach to Design and Repair

Under TDOT, a three-phase repair plan was executed in collaboration with Michael Baker and Kiewit. Design and construction overlapped between the phases to expedite the repair process. The plan included:

External post-tensioning in Phase 2 allowed for removal of temporary plates from Phase 1 and installation of new strengthening plates.

Phase 1: Stabilization

With a concern that the bridge was compromised, the Michael Baker team approached the initial repairs with a "do no harm" mindset and first established safe working loads for construction crews and equipment staged on the bridge. The temporary repair involved putting a stabilization splice into place to temporarily restore the capacity of the fractured section of the tie, and Stupp Bridge Company began fabricating roughly 30,000 pounds of structural steel plates. Kiewit assembled a suspended platform to install the splice, which provided additional redundancy to the member without applying any corrective twist or loading to the damaged tie. This allowed teams to work toward a long-term repair in Phase 2.

Phase 2: Member Repair

To identify the best permanent repair for the bridge, Michael Baker engineers evaluated several options. The solution consisted of using external post-tensioning to reduce tension in the existing tie. This lessened its level of stress and possibility for further damage.

Eight high-strength steel post-tensioning tendons, each three inches in diameter and supplied by DYWIDAG, were connected to steel weldments (fabricated by G&G Steel) at either end of the fractured tie. To deliver the force to partially de-tension the tie, the team used high-pressure rams. Throughout this work, the team performed extensive real-time monitoring of the post-tensioning operations. With the tie partially unloaded, the temporary Phase 1 stabilization plates were removed, and new strengthening plates were installed with nearly the capacity of a completely intact tie by themselves. The new plates were fabricated by W&W AFCO Steel, and in combination with the existing steel, they provided a redundant load path. Phase 2 was completed with installation of the strengthening plates and removal of the post tensioning.

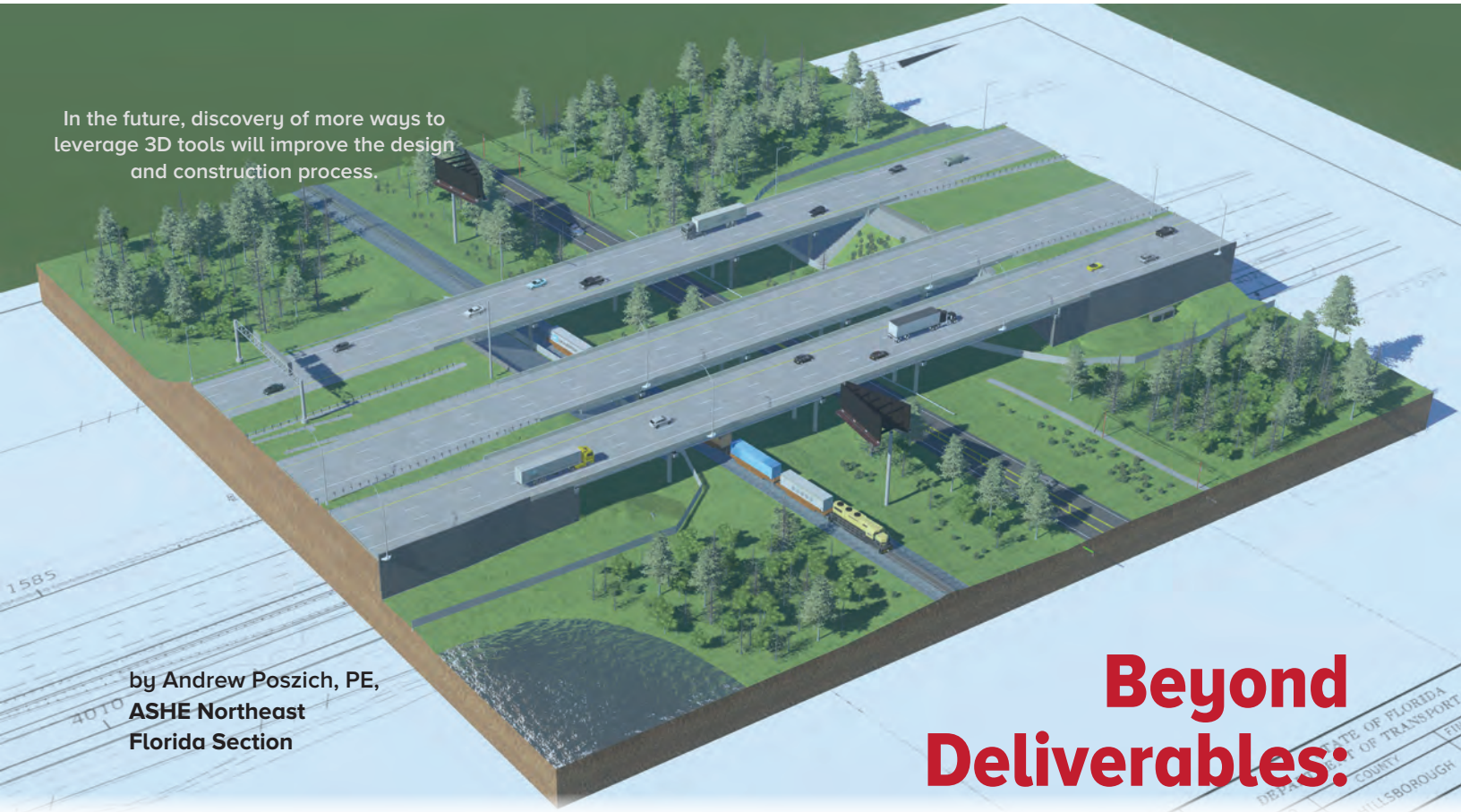
Phase 3: Overall Tie Girder Repair

Phase 3 addressed additional defects noted in the tie during inspection. Nondestructive testing was performed of welds along the structure. Smaller indications were either cored or ground out, and larger indications were plated over to provide a redundant solution.

Stabilization of the tie girder in Phase 1 with temporary steel plates

Reopening the Bridge

For several weeks, activities progressed 24 hours a day, supported by extended shifts. The eastbound and westbound lanes of I-40 over the bridge were initially scheduled to open on August 2 and August 6, 2021, respectively. The eastbound lanes opened ahead of schedule on July 31, and the westbound lanes opened August 2. Eighty-three days after discovery of the fracture, traffic started flowing across the Hernando de Soto Bridge again.



In the future, discovery of more ways to leverage 3D tools will improve the design and construction process.

Beyond Deliverables: A New Take on 3D Design

by Andrew Poszich, PE,
ASHE Northeast Florida Section

Transportation project requirements constantly evolve as technology enables people to see designs in greater detail than ever before. Though many see these requirements as the driving force behind change, there are benefits to going beyond the minimum. Whether adding modeled conflict envelopes for mechanically stabilized earth straps and unsuitable soil for design, or including utility trenches for constructability and phasing, there is much to consider for a next project.

Traditional Deliverable

The catalyst for 3D deliverables has been the efficiency of Automated Machine Guidance or machine-controlled field equipment. Florida Department of Transportation (FDOT) requirements have been established to provide the level of detail necessary to execute earthwork grading and final surface analysis. This, in combination with existing grade and alignment files, provides the contractor with a reference for understanding the project. However, today's contractual requirements still revolve around a set of 2D plans.

Full 3D models are often submitted alongside these LandXML files, but there is a missed opportunity when they are not used to their full potential. Much of the issue is file incompatibility between the software used by the designers and the software and equipment used by the contractor. However, this will change as FDOT pushes the industry more toward NexGen plans, which keep the 3D model at the center of the design process.

While progressing into the next generation of project delivery requirements, it is possible to begin examining new ways to leverage 3D tools today to improve the design and construction process.

Beyond Design

The past several years saw a shift from 3D modeling being an afterthought to becoming a critical component in any design workflow. The industry is seeing a push for such 3D components as drainage, structures, geotechnical and utilities and building information modeling to become more mainstream. It is critical to look beyond standard requirements and begin to identify tools to optimize the design process.

Water Table

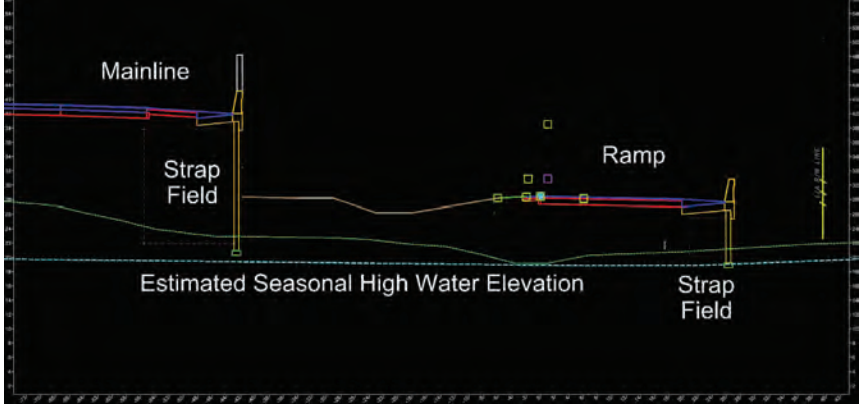
While some regions must design around underground rock layers, Florida's challenge is often the water table. While it doesn't fully replace engineering judgment, a clear visual estimation

(continued on page 42)

Beyond Deliverables: A New Take on 3D Design

(continued from page 41)

for the water table in all profile and cross-section views would make the process more efficient.



A clear visual estimation for water table and strap fields in profile and cross-section views can make the design process more efficient.

Strap Fields

Much of the justification for additional 3D modeling efforts stems from clash detection, or the ability to automatically identify overlapping design elements. Strap fields are a prime example. This can also be used as a conflict region modeled behind various wall types, which indicate an area for other components to avoid.

Vertical Clearance

In a similar spirit to wall strap field regions, the same could be applied to roadway vertical clearances. By proving a physical representation of this vertical limit in the 3D model, a designer working on overhead components (from bridges to utilities) will have immediate indication of any clearance issues. Furthermore, automated clash detection tools can be used to check clearance along the entire corridor.

Project Completeness

The concept that the model is only as powerful as its weakest component is an impactful ideology. This suggests that missing components can create a greater expense to the project than the actual effort it would take to bring these elements into the 3D design. Imagine a comprehensive clash analysis without including bridge foundations and underground utilities or setting guide sign foundations without visualizing off-site grading. For those who have invested time into mastering 3D capabilities, these are crucial processes for any future project.

Visualization

Once a team agrees on developing a complete 3D model, they can further leverage the model as a communication tool. With all components represented, engineered visualization can be introduced, bringing greater context into meetings, more easily measuring performance and expediting decision-making.

Beyond Construction

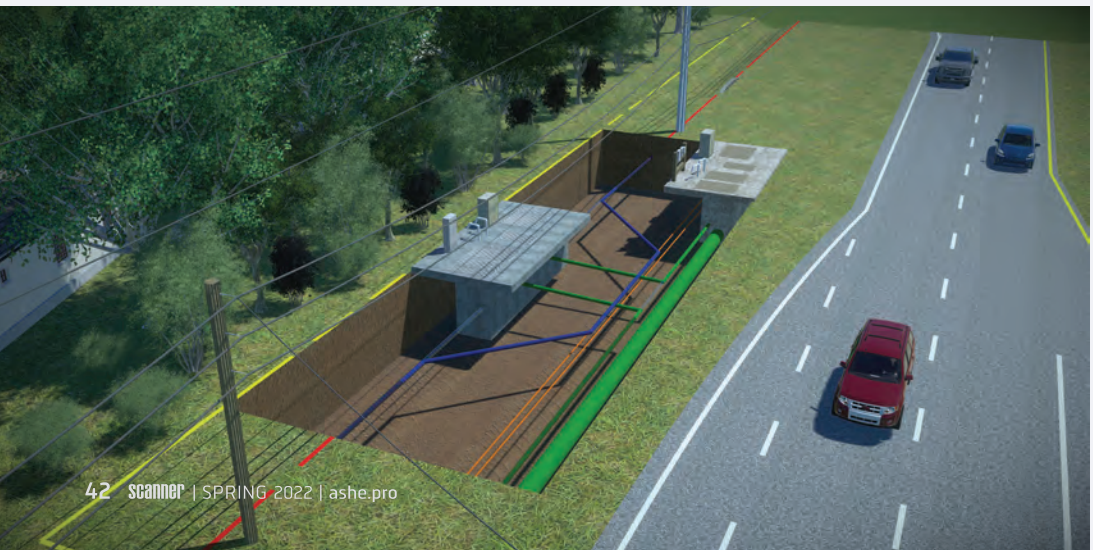
While LandXML final grade and earthwork surfaces are today's standard delivery, the future will incorporate even more elements into the design model to expand its use and potential. FDOT's NexGen plans bring much of this to the forefront, but the following can be incorporated into today's ongoing projects:

More Layers

While a proposed final surface is ideal for review and coordination, it typically is not the most practical for automated machine control. To properly run the equipment, break line surfaces need to be extracted for each pavement layer. This is especially useful on projects with complex pavement designs where depths are varying. When considering ultimate file delivery and project splits, it is important to remember that what is best for the designer is not always what is best for those in the field.

Subsoil Excavation

The excavation of unsuitable materials can lead to major constructability concerns. It is true that some level of on-site exploration will always be needed, but a modeled 3D volume will give teams a better understanding of

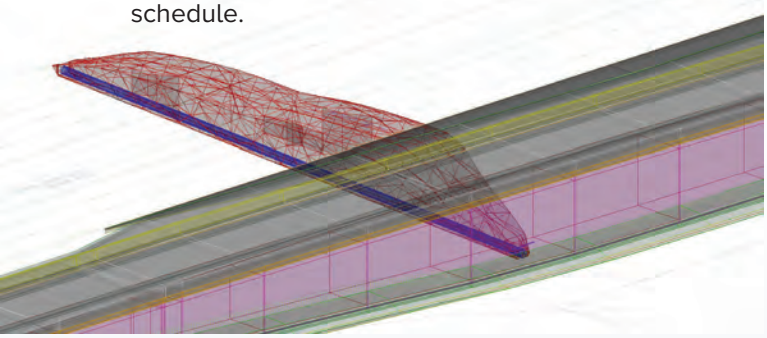


Designers working 3D components will have immediate indication of any overhead clearance issues.

what needs to be taken out underground as well as the impacts of excavation. Traditional cross-section representation can be misleading, with critical areas potentially being missed altogether. Because temporary shoring may not always be feasible, identifying this type of issue as early as possible will allow for an optimal solution to be developed.

Utilities Trenches and Foundations

Another challenge contractors often face is the order in which underground features are constructed. It is not always obvious which utility should be constructed first, or whether a foundation can be installed without impacting neighboring components. Having a separate deliverable dedicated to trenching and excavation limits can save time in establishing the project schedule.



A separate deliverable dedicated to trenching and excavation limits can save time.

4D/5D Modeling

While not yet in widespread use, the process of integrating both schedule and cost into a 3D model is being used more regularly on major construction projects throughout the world. While this may still be in the future for most, deliverables can still be established with these dimensions in mind to provide a more seamless transition from design to construction.

Keeping an Eye on the Future

In regard to technology, it is imperative to not just keep pace, but to also look ahead. Industry professionals are charged with making the most out of investments in infrastructure. These novel approaches to 3D design promise to streamline workflows, improve communication and help the industry deliver much-needed safety and mobility projects more efficiently.

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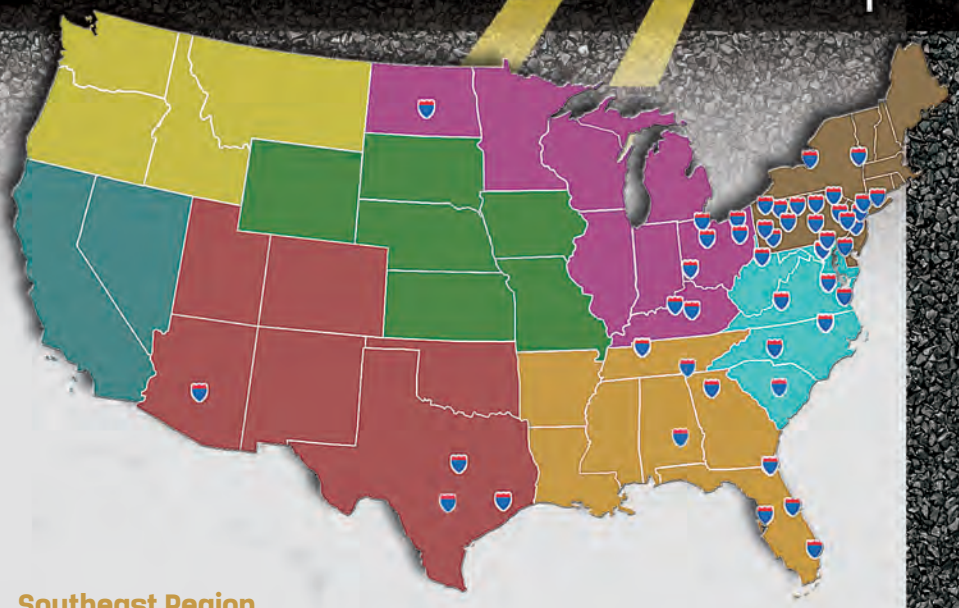

Regions *and* Sections

Northeast Region

SECTIONS

Albany	84
Altoona	196
Central New York	50
Clearfield	174
Delaware Valley	344
East Penn	112
First State	198
Franklin	123
Harrisburg	369
Long Island	47
Mid-Allegheny	126
New York Metro	134
North Central New Jersey	136
North East Penn	134
Pittsburgh	523
Southern New Jersey	170
Southwest Penn	271
Williamsport	76
Subtotal	**3,267**

Mid-Atlantic Region

SECTIONS

Blue Ridge	64
Carolina Piedmont	68
Carolina Triangle	216
Chesapeake	281
Greater Hampton Roads	83
North Central West Virginia	51
Old Dominion	87
Potomac	150
South Carolina	101
Subtotal	**1,101**

Southeast Region

SECTIONS

Alabama (New!)	55
Central Florida	85
Georgia	443
Middle Tennessee	294
Northeast Florida	181
South Florida	11
Tampa Bay	46
Tennessee Valley	106
Subtotal	**1,221**

Great Lakes Region

SECTIONS

Bluegrass	95
Central Dacotah	96
Central Ohio	194
Cuyahoga Valley	106
Derby City	85
Lake Erie	209
Northwest Ohio	48
Triko Valley	158
Subtotal	**991**

Southwest Region

SECTIONS

Central Texas	71
Dallas-Fort Worth	35
Houston	101
Phoenix Sonoran	135
Subtotal	**342**

National Total	**6,922**
Professional Status	56%
Government	12%
Consultant	75%
Contractor	5%
Other	8%

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