

May 2022 Vol. 8 Issue 5

civil + structural ENGINEER

CELEBRATING THE DESIGNERS OF THE WORLD AROUND US



2022

Rising Stars
AEC Industry

2022 RISING STARS

LA METRO'S PURPLE LINE EXPANSION
DR. PHILLIPS CENTER FOR PERFORMING ARTS
PREFABRICATION AND ITS ROLE ON THE PATH TO NET-ZERO



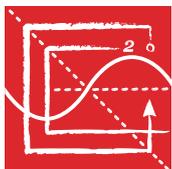


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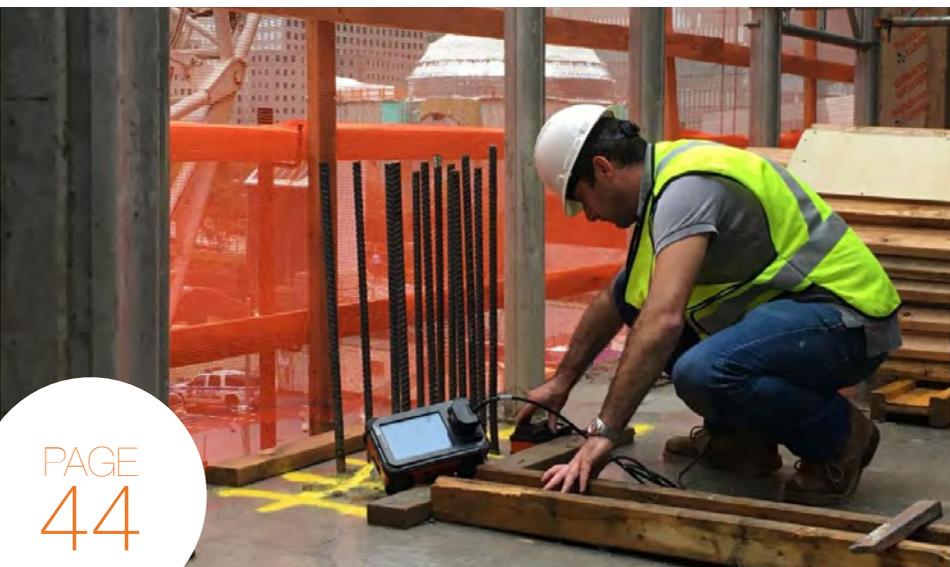
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BRICK BY BRICK: HOW TO INSPIRE THE NEXT RISING STAR

John Bray

“I avoid grandiose plans. I start with a small piece that I can do. I go to the root of the problem and then work around it. It's building brick by brick.” - Muhammad Yunus, Nobel Peace Prize Award Winner

It is no secret that the AEC industry has been experiencing a labor shortage for the last 15+ years. My work at Zweig Group as an Advisor to both Executive Search and Mergers & Acquisitions (M&A) clients has given me a unique perspective on how growing companies have tried to combat these forces through both organic and inorganic growth (also known as M&A).

The issue predominantly began following the financial crisis of 2008, where many Engineering companies were forced to lay off large portions of their employees due to the negative effects of the recession. This problem has been exacerbated in recent years by low numbers of graduating students that have entered the AEC industry.

How do we reverse this trend and inspire the current generation of students to become the next generation of impactful Engineers? There are a number of ways to get involved as you will see below but, to get to the root of the problem, it's building brick by brick.

Our mission at Zweig Group is to Elevate the AEC Industry. One of the five tenets of this mission is to Celebrate the incredible achievements of firms and individuals within our industry. While Chief Executives and rapidly growing firms deserve a lot of the praise; we believe it is equally important, if not more so, for Engineering firms to recognize and celebrate the achievements of their younger staff members as well.

Zweig Group's Rising Stars Award gives Engineering companies the opportunity to nominate their talented young staff members to receive recognition for the positive impact they are having on the Civil and Structural Engineering Community.

In honor of this year's Rising Stars Award Winners, here are a few ways that your firm can start (or continue) to take action and encourage young people to pursue a career in Civil or Structural Engineering. Who knows, they could even turn into a Zweig Group Rising Star at your firm one day.

1. Celebrate the achievements of young people in your company - how does your firm treat younger, less experienced employees? Are they an afterthought or a top priority? In what ways do you show them that they are a critical aspect of your future success? You should be nominating your young staff members for awards like Zweig Group's Rising Stars and others; share their accomplishments on LinkedIn and other social media; give admiration and personal shout-outs internally after a job well done. You need to be doing everything you can to show the next generation of engineers that young people in our industry are doing some really cool stuff, and that they could join the movement.

2. Encourage a culture of diversity and inclusion within your firm and the AEC industry. According to a survey of Generation Z students that was released by Monster in April 2022 - 33 percent of college graduates in 2021 and 2022 would not even apply for a job if they did not see a company's commitment to diversity in the job posting. Additionally, roughly a quarter of respondents said they would not apply for a position if they did not see diversity in leadership (26 percent), and women in leadership roles (24 percent). When college graduates are looking at your website, job posting, etc. – how would your company fare in these areas? Are you doing everything you can to foster an inclusive environment and promote diversity within all levels of your organization? These are absolutely things that the next generation of Engineers will be looking for in their future employers.

3. Highlight the positive impact that your firm's projects have on the environment - young people, STEAM students especially, care more about preserving our planet perhaps more than anything else. They want to play a role in creating positive environmental change on Earth. As Civil and Structural Engineers, your firms have a profound impact in shaping the sustainable society of the future. That is an incredibly exciting opportunity for anyone who is making a decision on their future career path. Are you committed to sustainability as a company? Is there more you can do to engrain that commitment into your culture? What are you doing to highlight and market the positive impact that your firm has on the environment?

4. Be active in your local student communities - I recently had the opportunity to be a presenting speaker at the Highland Park High School Science and Technology Festival in March 2022. I was surprised to see that none of the other 30 or so speakers at the event were from Civil or Structural Engineering companies, in spite of the fact that Dallas' feats of modern engineering are often lauded in media and publications. What is your firm doing to connect with young students who are trying to decide on a future career path?

5. Enhance your branding and marketing - When was the last time you spruced up your logo and marketing messages? What type of investments has your firm made in Marketing over the last 3-5 years? Young people don't want to work for a firm with a stale message and outdated look. It is important to take adequate time to develop and implement a thoughtful marketing strategy. Hire a branding consultant; study successful brands both within and outside of the AEC industry; constantly assess and improve your mission, vision, and values to ensure they are indicative of the culture you want to embrace; You need to make it a priority to create a company brand that is unique and captures the attention of the next generation.

THE FUTURE IS WRITTEN IN THE STARS

Luke Carothers

There has been no shortage of works throughout human history that try to define the relationship between humans and the stars in the night sky. Our earliest ancestors looked up at the stars and saw patterns that reflected their own lives, crafting stories to understand the worlds contained in the sky above them. As soon as we developed the technical capacity for doing so, we erected monuments that mirrored the positions of the sun, moon, and stars. At the same time Stonehenge was being built in England, between 3000 and 1520 BCE, ziggurats were serving a similar purpose across the world in Babylonia. Still further away, in modern day Mexico, the Maya people utilized a dome-shaped structure called El Caracol for the same purposes.

These early construction projects are exemplary of our ancient need to understand the sky above us. While there is no evidence to suggest that these ancient structures served any scientific purpose, they were able to reflect the sky above us in a way that our ancestors could better understand, bringing what once must have seemed so very far away just a little closer.

Later in history, advances in not only astrology but also engineering and construction allowed civilizations to further advance their study of the heavens. By the early 9th century CE, several early scientific tools had been developed to help accurately measure the positions of heavenly bodies. The Islamic world was at the forefront of these developments, with several notable observatories being erected in Damascus and Baghdad. Perhaps the most notable of these early Islamic observatories is the Ulugh Beg Observatory in Samarkand, Uzbekistan.

Although the exact date is unknown, construction on the Ulugh Beg Observatory began some time during the 1400s CE when Ulugh Beg, the city's ruler, invited a number of notable astronomers, mathematicians, and architects to help design and construct the structure. Built on a hill 21 meters above the ground, the observatory contains a cylindrical structure with a height of roughly 33 meters that contained a sextant. The weight and height of the sextant compromised the strength of the brick walls, so half of the sextant was constructed below ground, reducing the height of the building and strain on its walls. Using these architectural and astronomical advancements, Ulugh Beg was able to correct several mistakes made by the legendary astronomer Ptolemy.

Our quest to understand the heavens was further aided in the 17th century CE when Galileo developed the first optical telescope. Further developments led to the first observatories being built with telescopes, with their motion being entirely limited to movement along a single plane. By aligning this movement along the local meridian, astronomers could time the passing of stars based on the Earth's rotation, greatly improving the accuracy of position measurements.

Not satisfied, humanity again sought answers from the stars. By the 20th century, telescope technology afforded astronomers a much broader and clearer view of the night sky. In 1916, the Canadian government started work on the Dominion Astrophysical Observatory in British Columbia. When completed, the observatory housed a groundbreaking reflecting telescope nearly constructed on an asymmetrical mount, giving it access to most of the night sky with movement being provided by mechanical ball bearings. This groundbreaking telescope weighs nearly 42 tonnes and is 1.83-meters in length. To house this telescope, a cylindrical construction was topped by a domed roof with arched slat openings to allow access to the sky.

Since its completion, the Dominion Astrophysical Observatory has hosted many of the greatest achievements in our quest to understand the stars. For example, this structure allowed Canadian astronomer John Stanley Plaskett to demonstrate that the Milky Way is rotating, while also accurately measuring its size, mass, and rotational speed. Achievements such as these are significant steps in the evolution of our human quest for understanding.

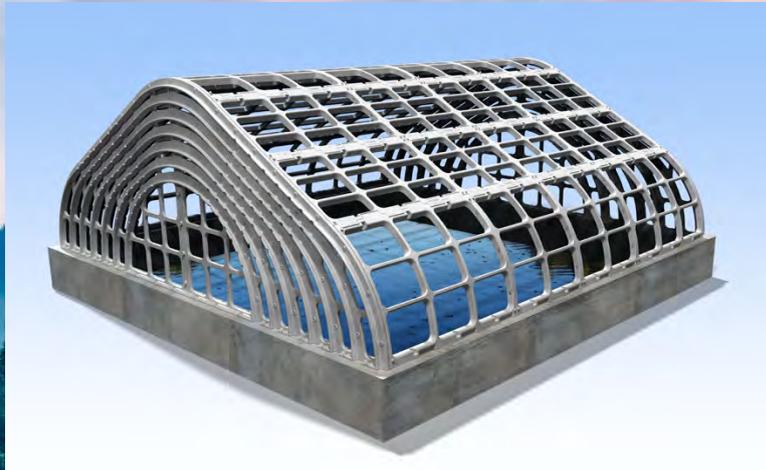
Our earliest ancestors looked at the heavens and studied them, coming to an understanding that the movement of heavenly bodies has a definite impact on our lives. These generations knew the heavens shared some patterns with the natural world, and they constructed structures—temples, sundials, stone markers—as well as stories to make sense of what patterns they found. As our understanding of engineering, architecture, and construction grew, we paired those pursuits with our need to understand the stars. Throughout history, from our earliest ancestors to now—in every part of the world—we seek to utilize our understanding of design and technology to know more about the worlds contained in the sky above us. Although we no longer color our exploration and knowledge of the stars with tales of gods and heroes, our fascination is still enraptured in the belief that the stars will tell us what is next for humanity. Our ancestors looked to the stars to answer their questions about the next harvest, war, or migration. In the same way, we now look at the stars to answer our questions about exploring and inhabiting new planets and finding other intelligences that share our yearning for the stars.

LUKE CAROTHERS is the Editor for Civil + Structural Engineer Media. If you want us to cover your project or want to feature your own article, he can be reached at lcarothers@zweiggroup.com.

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MAY 2022

2022 CFSEI EXPO

MAY 16-18 – DENVER, CO

The Cold-Formed Steel Engineers Institute (CFSEI) will host the 2022 CFSEI Expo on May 16-18, 2022 at The Curtis – a DoubleTree by Hilton Hotel in Denver, Colorado. After two years, the Expo returns to an in-person format that will include several educational sessions; announcements of the CFSEI Design Excellence and Creative Detail Award winners and the John P. Matsen Distinguished Service Award winner; and an exposition featuring state-of-the-art innovations, technologies and principles in cold-formed steel framing.

<https://www.buildusingsteel.org/2022/03/2022-cfsei-expo-to-be-held-may-16-18-in-denver/>

STRUCTURAL DESIGN TOPICS IN WOOD CONSTRUCTION

MAY 17-18 – BLACKSBURG, VA

The twelve topics selected was guided by good practice design including consideration for how structural design and applicable codes, material properties, and well-defined professional specifications can impact in-service outcomes. Participants will earn 15-hours of continuing education credit (1.5 CEUs) and a certificate at the completion of the course. The audience for this course is engineers involved in the design of wood construction projects, residential designers, metal-plate-connected (MPC) wood truss designers, engineered wood product (EWP) designers, general contractors, and building code officials, plan reviewers and inspectors.

<https://www.cpe.vt.edu/sdtwc/index.html>

SIMULATION WORLD 2022

MAY 18 – VIRTUAL

It's back! Join us at Simulation World to discover how simulation enables creators to explore limitless possibilities and take advantage of digital transformation opportunities. Simulation World 2022 is the first in a series of events planned for this year designed to inspire and educate executives, engineers, R&D, and manufacturing professionals about how engineering simulation strategies are helping innovators Take a Leap of Certainty to bring their world-changing ideas to life.

https://www.simulationworld.com/?promo=7013g000000HV6AAG&tr=true&utm_campaign=brand&utm_medium=media-referral&utm_source=cs-engineering&utm_content=digital_sim-world-2022_free_event-listing_event-virtual_register_na_en_global

JUNE 2022

THE PRINCIPALS ACADEMY

JUNE 12-14 – SCOTTSDALE, AZ

BAEC's mission is to empower Architecture, Engineering, and Construction financial leaders to be better equipped to guide their firms to greater value. The BAEC Summit will provide practical, focused information ideal for connection, communication, and collaboration between the AEC disciplines.

<https://baecsummit.com/>

THE PRINCIPALS ACADEMY

JUNE 16-17 – MIAMI, FL

The Principals Academy is Zweig Group's flagship training program encompassing all aspects of managing a professional AEC service firm. Elevate your ability to lead and grow your firm at this impactful two-day program designed to inspire and inform existing and emerging AEC firm leaders in key areas of firm management leadership, financial management, recruiting, marketing, business development, and project management. Learning and networking at this premiere event challenges traditional seminar formats and integrates participatory idea exchange led by Zweig Group's CEO Chad Clinehens, PE, and Zweig Group's Managing Principal, Jamie Claire Kiser. Zweig Group's leadership team draws from our 30+ year history working with AEC firms to teach the latest approaches to managing and operating successful firms – using our comprehensive data set of industry benchmarks and best practices. The Principals Academy is like a two-day mini-MBA for design and technical professionals and is the most impactful two days you can spend learning to build your career and your firm.

<https://zweiggroup.com/products/the-principals-academy-2023>

HxGN LIVE GLOBAL

JUNE 20-23 – LAS VEGAS, NV

HxGN LIVE Global 2022 promises to be our best conference yet with a hybrid in-person and virtual event taking place from 20-23 June 2022. The programme will be structured around audience-centric summit topics enabling you to discover and learn about innovative technologies and proven solutions driving our autonomous future forward in your professional field. This format will serve as a platform for inspiring thought-leadership discussions and a springboard for building customer communities around each summit topic. Whether you join us in Las Vegas or attend our virtual event from your home or office, you'll have exclusive access to all that HxGN LIVE Global has to offer.

<https://hxgnlive.com/global>

AEC EXECUTIVE ROUNDTABLE

JUNE 22-24 – DALLAS, TX

The 2022 AEC Executive Roundtable is a unique opportunity for AEC firm leaders to engage and interact with industry peers to discuss current issues facing firms today, explore industry trends and next practices, and confront the biggest challenges they face leading their firms. Through a combination of short informative presentations and panel discussions, along with multiple topic focused roundtables, this event will allow leaders to truly find the knowledge and insight they are looking for. Zweig Group's leadership team moderates the program, guiding group conversations, encouraging integration, and networking, and ensuring attendees gain valuable insight, new ideas and tools – and a new network of colleagues – to foster effective leadership at their respective firms. Come prepared to discuss your biggest challenges and successes during this highly interactive session. With you in control of the subject matter, roundtable discussions strike at the heart of what you need to effect change in your organization.

<https://zweiggroup.com/products/aec-executive-roundtable-2022>

JULY 2022

ELEVATING DOER-SELLERS

JULY 14-15— HOUSTON, TX

Business Development for AEC Professionals equips professionals in architecture, engineering, planning, and environmental firms to grow the business while serving clients. Elevating Doer-Seller 2022 is hosted by three industry leaders: Chad Clinehens, PE, Dan Williams, PE, and Stephanie Warino, P.G., WV LRS, PMP. This interactive seminar presents business development techniques proven to drive value in your firm. Rooted in data and case studies, Elevating Doer-Sellers focuses on what works in today's AEC firm utilizing practical and proven techniques that resonate across your organizational chart.

<https://zweiggroup.com/products/elevating-doer-sellers-2022>

AUGUST 2022

LEADERSHIP SKILLS FOR AEC PROFESSIONALS

AUGUST 11-12 — NEW ORLEANS, LA

Practical leadership skills are vital to the health and success of every company in any industry. Effective leaders motivate their teams to achieve exceptional results, inspire others to be better than they thought possible, and create an environment where their team is focused and working towards a common vision. Zweig Group's team of management experts – who have extensive experience working with AEC firms providing solutions to the challenges facing AEC firms today – deliver practical solutions that technical professionals can put to work immediately to lead their firms to success.

<https://zweiggroup.com/products/leadership-skills-for-aec-professionals-2022>

SEPTEMBER 2022

COMMERCIAL UAV EXPO

SEPTEMBER 6-8 — LAS VEGAS, NV

Commercial UAV Expo Americas is the definitive event for professionals integrating or operating commercial UAS. With top-notch education, thousands of attendees, and more exhibitors than any other commercial drone event, it's the best opportunity of the year for anyone who needs to keep up with commercial UAS technology, trends, and developments.

<https://www.expouav.com/>

ELEVATEAEC CONFERENCE & AWARDS GALA

SEPTEMBER 14-16— LAS VEGAS, NV

The 2022 ElevateAEC Conference and Awards Gala registration is open for the annual in-person conference in Las Vegas, September 14-16. Celebrate the iconic black-tie awards gala 2022 winners of the Hot Firm list, Best Firms To Work For, Marketing Excellence, Rising Stars, Top New Ventures and the Jerry Allen Courage In Leadership Awards. Register now for the AEC industry's top IN-PERSON learning and networking event of the year.

<https://zweiggroup.com/pages/annual-in-person-elevate-leadership-summit>

SKETCHUP 3D BASECAMP 2022

SEPTEMBER 26-30— VANCOUVER, BC

Built for SketchUppers by SketchUppers, 3D Basecamp is where modelers of all levels come to learn and share their 3D skills. During 3D Basecamp, the best of the best share their tips, workflows and extensions. Whether you are just getting started or polishing your skills, the learning sessions at 3D Basecamp are jam-packed with knowledge that will enhance your workflow and get you modeling better in no time. Without a doubt, you'll walk away with something new. Sessions and training cover a variety of industries, topics and skill levels. We attract the best trainers and experts to be your SketchUp sherpas at 3D Basecamp. Discover what is possible when you are surrounded by people who inspire you.

<https://3dbasecamp.sketchup.com>

OCTOBER 2022

UAS SUMMIT & EXPO

OCTOBER 4-5 — GRAND FORKS, ND

Following a record-breaking UAS Summit & Expo in 2021, we are ready to build off last year's excitement in the Sili-Drone valley," said Dayna Bastian, program coordinator for UAS Magazine and the UAS Summit & Expo. "Drone usage is increasing rapidly, and we are looking to showcase presentations reflecting a variety of sectors including counter-drone, emergency management, agriculture, military operations, government and commercial usage and operations, research and development, and more.

www.TheUASsummit.com

NOVEMBER 2022

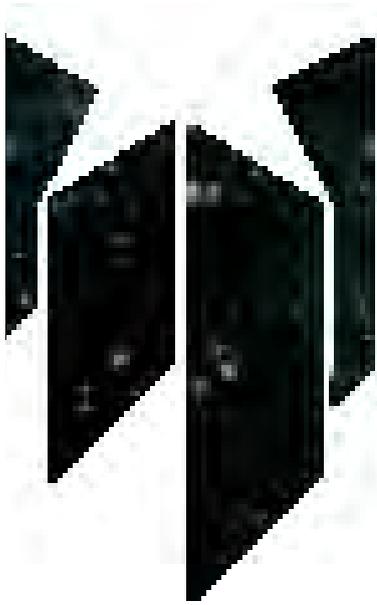
TRIMBLE DIMENSIONS+

NOVEMBER 7-9 — LAS VEGAS, NV

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<https://www.trimble.com/en/our-company/news-and-events/dimensions/overview>

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TO MAISIE JOHNSON AT MJOHNSON@ZWEIGGROUP.COM.



2022

Rising Stars AEC Industry

IT'S AWARDS SEASON—the time of the year we start honoring and celebrating some of the amazing accomplishments of people and firms in the AEC Industry. There is no better way to start than by recognizing those young professionals who have already made an impact through exceptional technical capability, leadership ability, effective teaching or research, or public service.

The 2022 Rising Stars in the AEC Industry have benefited the design profession, their employers, project owners, and society. Our winners this year hold a diverse skill set and technical capabilities and have done outstanding work in their communities. They are already leaders and mentors in their firms, bringing new ideas, practices, and impacts beyond their technical capabilities. They come from all over North America and beyond—from Guam to New York, from Houston to Chicago. This year we have everyone from Presidents and Principals of firms to EIT Civil Engineers. This shows that no matter where you are in a company, you can be a Rising Star in this industry.

I also want to take the time to acknowledge all of the people who nominated all of our winners and those who did not win this year. Recognition of a young professional's accomplishments, skill, leadership, etc. can go a long way in that young professional's career. The knowledge that there is someone out there who recognizes what they are doing and takes the time to nominate them for an award like this is very important. I would encourage everyone to try to think of that young professional in your firm that deserves this type of credit. Letting the next generation of leaders know that their work is getting noticed is not only good for their career but can be very helpful for the long term success of your firm.

Through our awards program, we also recognize revenue growth with our Hot Firm List. We recognize outstanding marketing through our Marketing Excellence Awards. We recognize those who are showing courageous leadership with our highest professional honor, The Jerry Allen Courage In Leadership Award. We honor those new firms who are already making an impact with our Top New Venture Award. And we honor those firms impacting their employee's live by creating great workplaces with our Best Firms To Work For award. We will be announcing and celebrating these winners over the next few months culminating with our awards celebrations at the 2022 Elevate AEC Conference in Las Vegas.

Zweig Group's Awards are at the center of one of the five tenets of our vision, Elevate the Industry; that tenant is "Celebrate." There is so much good that this industry brings to the built environment and to the lives of the people who work in it. We want to celebrate the firms, people, and accomplishments of the AEC Industry. These awards give the winning firms and people the recognition that they deserve in an industry that is often overlooked by society. The winners of our awards truly do help to elevate the industry as a whole. Celebrate your success, celebrate your accomplishments, celebrate your employees, and help Zweig Group Elevate the Industry.

KYLE AHERN is the Awards Manager at Zweig Group. He can be reached at kahern@zweiggroup.com.

RISING STARS IN **MULTIDISCIPLINARY ENGINEERING**



HILLARY ATON, PE

Water Resources Project Manager
Thomas & Hutton
Mt. Pleasant, SC

Hillary Aton started her career at Thomas & Hutton in 2015 as a Water Resources Designer and quickly advanced to a Project Engineer within two years and Project Manager by 2020. Aton oversees various civil and water-resources related projects, from initiation through design and construction, serving multiple clients, including many local government agencies. Aton's success is driven by a positive attitude and a sense of pride and responsibility, which has allowed her to grow and step into the role of master communicator, presenting project updates to stakeholders at neighborhood meetings, local government councils, HOAs, and private developers with ease.

Accomplishments/Projects: Drainage Improvement Studies - Forest Acres (City of Charleston), Phase 3 Drainage (City of Isle of Palms), Old Village (Town of Mount Pleasant), and Arbor Oaks (Town of Summerville), SCE&G Williams Station Spill Prevention (Berkeley County), Volvo Manufacturing Plant (Berkeley County)

Education: MS in Civil Engineering, Clemson University, BS in Civil and Environmental Engineering, The Citadel

Professional/Public Service: Berkeley County Habitat for Humanity, American Society of Civil Engineers, Member, Environmental Water Resources Institute, Member, American Public Works Association, Lowcountry Branch Secretary, National Association of Women in Construction, Palmetto Chapter, Founding Member



AARON LAUINGER

Market Director—Transportation and Water
Ulteig
Fargo, ND

Aaron Lauinger's 16-year history serving Midwest and Western clients covers multiple civil engineering disciplines. He has transformed Ulteig's transportation and water sectors, serving as market director since 2017. His strategic leadership resulted in new markets in Colorado and Texas, resulting in a 90 percent growth rate and service offering expansions through new traffic, environmental, and bridge teams. Aaron created the "Energy and Infrastructure" podcast and published thought leadership on electric vehicle impacts to the AEC industry. Aaron has a passion for teaching, mentorship, coaching, and advocating for diversity and women in engineering.

Accomplishments/Projects: Williston Basin International Airport (XWA), Project Executive

Education: BS in Civil Engineering, North Dakota State University

Professional/Public Service: American Council of Engineering Companies, North Dakota, CEO/Key Transportation Principal Committee, ACEC National, Energy and Water, Engineering Change Labs, Planning Committee, AWWA Member

RISING STARS IN MULTIDISCIPLINARY ENGINEERING



RIMA ABISAAD, PHD, EIT

Civil Engineer

EnTech Engineering, PC

New York, NY

Rima Abisaad began her career at EnTech Engineering by providing design devices for the firm's civil engineering team, but her passion for continuous learning and research soon distinguished her as a leader in the field. Abisaad is driven to transportation engineering because it combines the civil and traffic engineering disciplines, which allows her to focus her work on creating sustainable designs that keep people safe and get them where they need to be. Abisaad represents a rising generation of transportation engineering professionals that is ready to take on current and future challenges such as climate change and increased use of electric and smart technologies.

Accomplishments/Projects: Van Wyck Expressway Expansion, JFK Airport Terminal One, Civil3D Modeling, Project Lead

Education: PhD in Transportation Engineering, New Jersey Institute of Technology, BS in Civil Engineering, Lebanese American University, Beirut

Professional/Public Service: Transportation Club of NJIT, member, NJIT Intelligent Transportation Society, President, NJIT Institute of Transportation Engineers, President



**CONNER R. MAINES, PE,
NSSA AP**

Project Manager

JQ Engineering, LLP

Dallas, TX

Conner Maines has been able to rise rapidly in the Structural Engineering industry based on his demonstrated capacities for project design and management, leadership, and public service. An in-depth knowledge and grasp of technical issues has allowed Maines to participate in some of the more complex public sector projects undertaken by his firm. In just under three years with JQ Engineering, Maines has held management duties on many complex projects in both design and construction administration phases. Throughout his career, Maines has also been passionate about the positive impact our profession has on society, working with students at his hometown high school.

Accomplishments/Projects: Dallas/Fort Worth International Airport/Terminal D Expansion, Construction Administration Manager. Dallas/Fort Worth International Airport. Aircraft Rescue and Fire Fighting Facility, Project Manager and Structural Engineer of Record. Public Safety Building/Weatherford TX, Project Manager and Structural Engineer of Record

Education: BS in Civil Engineering, Texas A&M University, ME in Civil Engineering, Texas A&M University

Professional/Public Service: American Institute of Steel Construction (AISC), Committee on Manuals, Voting Member, Structural Engineers Association of Texas (SEAoT), Member, JQ Community Outreach, Co-Founder of the Waxahachie Dulin Memorial Scholarship

RISING STARS IN **MULTIDISCIPLINARY ENGINEERING**



JAMES BRISTOW, PE

Managing Partner
Universal Engineering Services
Las Vegas, NV

James Bristow is a professional engineer actively involved in improving his community socially, economically, and environmentally. An experienced leader who manages significant projects and teams, Bristow currently serves as a Managing Partner at Universal Engineering Services (UES). As a part of the fastest growing architecture, engineering and construction firm in North America, James Bristow has proven himself to be a critical leader. Additionally, he has demonstrated a passion for fostering rich opportunities for career path development among young engineering professionals by participating in multiple industry and professional boards.

Accomplishments/Projects: Las Vegas Convention Center, Phase II Expansion, UnCommons Development Project, Las Vegas, Project Neon Highway

Education: BA in Political Science, University of Nevada, Las Vegas, MS in Civil Engineering, University of Nevada, Las Vegas

Professional/Public Service: Green Our Planet, Board of Directors, American Concrete Institute (ACI), Examiner, Nevada Contractors Association, Voting Member, NAIOP, Government Affairs Committee



JOHN WINTERS, PLA

Group Leader/Project Manager
Thomas & Hutton
Mt. Pleasant, SC

John Winters joined Thomas & Hutton in 2015 and has 16 years of experience in recreational, golf course, resort, traditional neighborhood, mixed-used, commercial, retail and industrial planning and design. Winters has a penchant for not only understanding the tasks at hand, but also seeing them through to completion. He is notably adept at guiding his team through the client's needs and challenges to create a mutual understanding of the project's objective for the end-user. At the heart of Winters' work at Thomas & Hutton is a desire to create timeless spaces for people by balancing community, culture, and nature.

Accomplishments/Projects: Daniel Island Waterfront Park, Landscape Architecture Project Manager, Shem Creek Phase 3 Improvements, Landscape Architecture Project Manager, Battery Park Pedestrian Bridge, Landscape Architecture Project Manager

Education: BS in Landscape Architecture, Mississippi State University, European Institute of Golf Course Architecture

Professional/Public Service: Leadership Charleston, Charleston Metro Chamber of Commerce, Member

RISING STARS IN MULTIDISCIPLINARY ENGINEERING



SCOTT MCNALLY, PE

Site Development Department Manager

Croy
Marietta, GA

Scott McNally has repeatedly shown a capacity for leadership and responsibility, and was named head of Croy's Site Development department in 2021. In his first year in this role, McNally set records for both utilization and departmental profit. In this role, McNally leads a team of seven individuals who are both younger and older than him. McNally also demonstrates his leadership qualities through mentorship by diligently tracking key metrics, strategic planning and workload sharing, commitment to quality, and a positive team attitude.

Accomplishments/Projects: Greystone Power Headquarters Campus, Lead Design–layout, grading, and detention pond design, Kennesaw Depot Part, Project Engineer, Powder Springs Downtown Greenspace, Project Engineer

Education: BS in Civil Engineering, Georgia Southern University

Professional/Public Service: ACEC Georgia, Future Leaders Program, Cobb Chamber of Commerce, Next Generation Mentoring Program, Leadership Paulding, Participant



ANDRIA SCHMID, PE

Director of Civil Engineering

Ulteig
Greenwood Village, CO

Andria (Andi) Schmid was promoted to Director of Civil Engineering for Ulteig Engineers, Inc. in late 2020, overseeing eight engineering teams that comprised 110 employees. Since taking this position, Schmid has grown into one of the strongest leaders in the rapidly growing firm, consistently demonstrating her ability to build organizational cohesion, competence, and resilience. In this time, she has increased net service revenue 32 percent year over year, successfully hiring more than 20 new employees. Schmid also established and leads a women's Employee Support Group (ESG) to provide support to this critical, under-represented group of employees.

Accomplishments/Projects: CDOT Region 1 Fall River Road Project, Project Manager, I-70 EB Peak Period Shoulder Lane Project, CDOT Project Manager

Education: BS in Civil Engineering, Colorado School of Mines

Professional/Public Service: American Council of Engineering Companies (ACEC) Colorado, Member, Women's Transportation Seminar (WTS) Colorado, Member

RISING STARS IN MULTIDISCIPLINARY ENGINEERING



Senior Project Manager
The VERTEX Companies, Inc.
Freehold, NJ

Victoria “Tori” Spina has quickly risen through the career development stages at VERTEX, demonstrating the professional drive and work ethic that is consistent with the company’s highest level of project management practices. She currently manages multiple staff members in New Jersey and Maryland in a way that embodies VERTEX’s core value of caring for your team. Tori Spina consistently demonstrates a sense of urgency, is always willing to take on new challenges, and develops high quality deliverables.

Education: BS in Earth and Environmental Science, Lehigh University, MS in Management and Organization, University of Colorado (Sp. 2024)

Professional/Public Service: Society of Environmental Insurance Professionals, Young Professionals, Development

VICTORIA SPINA



Senior Engineer
Arup
New York, NY

Adam Jaffe has worked on over 100 projects in his six year career with Arup. These projects have covered topics as diverse as the durability of precast tunnel segments, automated crash test simulation post-processing, embodied carbon and circular economy, the design of a refrigerator with no power source, and more. Because Jaffe has unique skills and sits in a small team, he has often worked as the project manager or technical lead on these projects. Jaffe is also the manager of Arup’s Material Skills Network in the Americas. In this role he supports learning, skill development, and knowledge-sharing in the materials discipline as well as working cross-regionally to adopt best practices and allocate funding for priority research topics.

Accomplishments/Projects: Million Cool Roofs Challenge, Project Manager and Technical Lead, Engineers Without Borders, Chill Challenge, Project Manager and Technical Lead

Education: BS in Materials Science and Engineering, Columbia University School of Engineering and Applied Science

Professional/Public Service: Institute of Materials, Minerals, and Mining, Member

ADAM JAFFE, MIMMM

RISING STARS IN STRUCTURAL ENGINEERING



**ERIN KUEHT, PE, LEED AP
BD+C**

Principal, Project Manager
Walter P Moore
Houston, TX

Erin Kueht joined the AEC industry in 2007 and has spent her entire career with Walter P Moore. Kueht manages a variety of complex structural projects, leveraging her expertise in structural engineering analysis, design, and management in a variety of market sectors. Kueht was named a Principal of Walter P Moore in 2017 and serves as the co-leader for the firm's Project Management Committee. She has demonstrated an outstanding ability to profitably manage her projects through a focus on alignment of scope and fee, along with strong risk management skills with a particular emphasis on managing risk through responsiveness and attention to quality.

Accomplishments/Projects: Churchill Downs, Project Manager, Houston Botanic Garden, Project Manager, Stephen F. Austin Basketball Practice Facility, Project Manager

Education: BS in Civil Engineering, Texas A&M University, MS in Civil Engineering, Texas A&M University

Professional/Public Service: Architecture Construction and Engineering(ACE) Mentoring Program, Founding Member, Executive Board, Passion Behind Design



ANGIE SOMMER, PE, SE

Associate Principal
ZFA Structural Engineers
San Francisco, CA

Angie Sommer started her career as a drafter for a structural engineering firm during her final year of college before graduating and working as an engineer on large, custom residential homes. Sommer joined ZFA Structural Engineers in 2011, advancing to the role of Senior Engineer six months later. By 2019, Sommer rose to Associate Principal and had joined the ZFA ownership group as a shareholder. Sommer has worked both internally and externally to further the causes of gender equity, diversity, and engagement in the structural engineering profession.

Accomplishments/Projects: SE3 Committee, Primary Author for 2016 SE3 Survey Report and 2016 SE3 Pay Report, 12+ Presentations Nationwide to Professional Organizations and Conferences

Education: BS in Architectural Engineering, California Polytechnic State University, San Luis Obispo

Professional/Public Service: Structural Engineers Association of Northern California (SEAONC), SE3 Committee, DEI Endowment Committee; National Council of Structural Engineers Associations (NCSEA), SE3 Committee, Racial Equity Task Group; Commercial Real Estate Women San Francisco (CREW SF), Communications Committee, Finance Committee, Chief Financial Officer

RISING STARS IN STRUCTURAL ENGINEERING



Senior Structural Engineer
BASE
Tamuning, Guam

Yuriy Mikhaylov joined BASE as a structural designer in 2010. Before this, Mikhaylov was a research assistant at the University of Hawaii studying the performance of multi-story reinforced concrete buildings in various seismic zones and under tsunami loads. His first major project was the Guam Regional Medical City (GRMC), which is a state-of-the-art hospital designed for extreme seismic and typhoon loadings to meet essential facility post-disaster requirements.

Accomplishments/Projects: Guam Regional Medical City, Lead Structural Designer, Tsubaki Tower, Lead Structural Designer, Aircraft Maintenance Hangars P-109 and P-601, Lead Structural Engineer, Special Inspector, Special Inspector of Record, Holds ICC Master of Special Inspection certification

Education: BS in Civil Engineering, University of Hawaii at Manoa, MS in Civil Engineering, University of Hawaii at Manoa

Professional/Public Service: Guam Symphony Society, First Violin

YURIY MIKHAYLOV, SE

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RISING STARS IN CIVIL ENGINEERING



JULIA SIMO, PE

Project Manager
Wallace Montgomery, LLP
Richmond, VA

Julia Simo has ten years of experience in structural engineering, project management, and program management. Prior to joining Wallace Montgomery, Julia worked for the Virginia Department of Transportation as a Structural Engineer in the Structure and Bridge Division and a Senior Construction Engineer in the Construction Division. Since joining Wallace Montgomery in June 2020, Julia has stepped into a leadership role on many transportation design projects. To deliver the designs for her current projects as efficiently as possible, Julia has managed the development of 3D models, which has improved efficiency, avoided delays during construction, and saved tens of thousands of dollars.

Accomplishments/Projects: Route 50/Route 606 Intersection Improvements, Project Manager, Albemarle Intersection Improvements Bundling Design-Build, Deputy Design Manager, Chatham Bridge, VDOT Lead Designer

Education: BS in Civil Engineering, Old Dominion University; MS in Structural Engineering, George Washington University; MBA (Data Analytics), University of Richmond

Professional/Public Service: Institute of Transportation Engineers, Washington DC Chapter, Presenter; American Society of Civil Engineers (ASCE), Reston Branch, Presenter; American Council of Engineering Companies (ACEC), Virginia Beach, Emerging Leaders Program; Women's Transportation Seminar, Central Virginia Chapter, Treasurer



**MATT MOFFITT, PE, CFM,
CPESC**

Associate Vice President
Baxter & Woodman, Inc.
Chicago, IL

During his time at Baxter & Woodman, Matt Moffitt has furthered the firm both internally and externally during his time at Baxter & Woodman. He was promoted to Water Resources Department Manager in 2013, growing the department from a staff of five to 45 through four new departments. Moffitt also fosters growth through mentorship; he has developed both department and project managers. He has secured five new clients, three of which have annual billings in excess of \$1 million. Moffitt is also a co-founder of BWNR, a Natural Resources Maintenance and Construction subsidiary company.

Accomplishments/Projects: Village of Wilmette Neighborhood Storage Project, Co-Program Manager, Village of Glenview Stormwater Management Program, Stormwater Engineer and Program Manager, City of Lake Forest Stormwater Engineer, Project Manager

Education: BA in Physics, Western Illinois University, BS in Civil and Environmental, Engineering, UIUC, Graduate Certificate in Water Resources Engineering, UIUC

Professional/Public Service: American Public Works Association, Suburban Branch, Chicago Metro Chapter, Vice President, American Society of Civil Engineer, Environmental and Water Resource Institute, Past-Chair

RISING STARS IN CIVIL ENGINEERING



President
Civil Tec Engineering & Surveying
Suffern, NY

Rachel Barese is a talented and competent civil engineer in the land development field. What makes Rachel unique is a combination of excellent engineering and business management skills. As President and a founding member of Civil Tec, Rachel has exhibited her leadership skills in guiding the growth of a thriving engineering business. Despite the challenges of the Covid-19 pandemic, Rachel has persisted in leading her company, continuing the business uninterrupted, and continuing its growth without detriment to the quality of work.

Education: BSCE in Civil Engineering, Bucknell University

Professional/Public Service: New York State Society of Professional Engineers, Rockland County Chapter, Young Engineer of the Year (2014-15), Vice President, Lower Hudson Valley Engineering Expo, Planning Committee, American Society of Civil Engineers, Member

RACHEL BARESE, PE

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RISEING STARS IN FULL SERVICE ENGINEERING



**BLAKE OLSON, AIA, NCARB,
NOMA**

Architectural Project Manager, Senior Associate
Galloway & Company, Inc.
Greenwood Village, CO

Blake Olson demonstrates a quiet yet decisive leadership style that has earned him the respect and appreciation of all who know him. His ability to effectively navigate challenging circumstances, evaluate multiple perspectives, and develop strategies for success has defined Olson as a leader for his team and company. Olson not only excels in management, leadership, and mentorship, but also in his commitment to being an instrument of change. Under his leadership, Olson has greatly elevated Galloway's strategic planning efforts around Diversity, Equity, and Inclusion by setting clear objectives, building a team to support these objectives, and shepherding actionable items until accomplished.

Accomplishments/Projects: Vasa Fitness National Rollout Program, Future Legends Sport Complex, Ko-Kwel Rehabilitation Center

Education: BS in Environmental Design, University of Colorado Boulder, MS in Architecture, University of Colorado Denver

Professional/Public Service: National Organization for Minority Architects (NOMA), Member, American Institute of Architects (AIA) Colorado Chapter, Member, AIA Colorado Justice Equity Diversity & Inclusion (JEDI) committee, Member



**SARA ANN LOGAN,
NACARB, AIA, NOMA, IIDA**

Vice President of Design and Engineering
Volumetric Building Companies
Philadelphia, PA

Sara Ann Logan has propelled a team from a few employees primarily working on single-family houses into a first in class integrated full service architecture, interiors, and production engineering multidisciplinary company with over forty talented designers, engineers, modelers, and project managers. As the VP of Design and Engineering, Logan has led her office to become the premier innovative design firm for modular construction while managing to keep focused on the company's original values. One of her most valuable skills is her ability to craft buildings from a form and function perspective while simultaneously understanding the implications from a manufacturing and construction perspective.

Accomplishments/Projects: 2021 Women Who Inspire, ArchNative, 2018 & 2019 Best Architecture Firm, Cambridge Scout Magazine

Education: BA in Architecture Arts, Rice University, B.Arch in Architecture, Rice University

Professional/Public Service: National Organization of Minority Architects (NOMA), Member, American Institute of Architects (AIA) Licensed in 13 states, Member, IIDA, Member

RISING STARS IN **FULL SERVICE ENGINEERING**



RYAN J. O'HEARN, PE

Structural Department Manager
R.E. Warner & Associates, Inc.
Westlake, OH

Ryan J. O'Hearn is the Structural Department Manager and a shareholder at R.E. Warner & Associates, Inc (REW). O'Hearn is responsible for managing and supervising all structural engineering work and personnel. He directly supervises a team of 15 professionals that provide full-service structural engineering services for a diverse array of projects across the industrial and government sectors. In recognition of his many contributions to REW, O'Hearn was nominated and elected to become a shareholder of the firm in 2016. O'Hearn has also been recognized as one of R.E. Warner's next generation leaders, and is currently enrolled in the 2022 Management Training initiative.

Accomplishments/Projects: Cargill Boat Loader Upgrade, Structural Engineer, Honda Auto Plant Weld Line Zone Innovation, Structural Engineer, Avery Dennison Performance Tapes New Coating Line and Plant Upgrades, Structural Engineer, New Aurora Road Pump Station, Cleveland Division of Water, Structural Engineer
Education: BS in Civil Engineering, Cleveland State University, MS in Structural Engineering, Cleveland State University

Professional/Public Service: American Society of Civil Engineers (ASCE), Cleveland Section, Chair of Communications/Website Committee, Past President

RISING STARS IN **ARCHITECTURE**



**MISELA GONZALES-
VANDEWALLE, AIA**

Senior Associate
O'Connell Robertson
San Antonio, TX

Misela Gonzales-Vandewalle is an Architect, Senior Associate, and rising leader at O'Connell Robertson where she leads talented teams of problem solvers to design buildings that enrich the lives of the people they serve. Gonzales-Vandewalle has supported the complex project development of numerous school and university buildings, creating environments that encourage innovation, foster security, and empower individuals. She approaches this work with empathy, caring personally about others, and promoting team strengths to cultivate a collaborative workplace and inspire design solutions that positively impact communities.

Accomplishments/Projects: Santikos Micronauts Center, Project Architect, San Antonio College Fletcher Administration Center, Project Architect, Ann Richards School for Young Women Leaders, Architectural Designer

Education: BS in Architecture, Texas Tech University, MS in Architecture, University of Texas at San Antonio

Professional/Public Service: Association for Learning Environments, South Texas Chapter, Board Member, North East Educational Foundation, Board Member, ElevateHer, 2022 Cohort Member, SAHCC Latina Leadership Institute Alumna

TEXAS SOLAR FARMS PROVIDING BRIGHT FUTURES FACE NEW TARIFF THREAT

By David Wallace, P.E.

WITH LOTS OF LAND AND SUN, the wide-open spaces of Texas are proving to be a great location for solar farms, paving the way for this top energy producing state to expand its foothold in the renewable energy sector. According to the Energy Information Administration, about one-third of the utility-scale solar capacity planned to come online in the United States in the next two years, about 30 gigawatts (GW), will be in Texas. California currently has the most installed utility-scale solar capacity of any state, but Texas has been catching up. In 2021, Texas added 6,060 mega-watts (MW) of solar power and has been tracking to add 10 GW of utility-scale solar capacity by the end of 2022, making it one of the fastest-growing and largest markets for solar power. This is until the U.S. Department of Commerce **initiated an investigation** for circumvention tariffs on solar products from Asian countries in late March. The decision came only four months after the agency rejected a similar petition that increased solar prices and threatened the livelihoods of tens of thousands of workers in the solar industry.

Improving economics and government tax incentives spurred investment in utility-scale solar facilities in Texas. This, combined with overall declining costs to produce solar power over the past decade, provided a boost in investments in new solar capacity in the state. In fact, the Solar Energy Industry Association (SEIA) ranked Texas as the top solar state in 2021, beating California. This momentum is now at risk due to the threat of tariffs and could ultimately result in the loss of 70,000 American jobs, including 11,000 manufacturing jobs nationally.

Job creation has been one of the most noteworthy and impactful benefits of the recent exponential growth of the solar industry in the U.S. McCarthy Building Companies' Renewable Energy and Storage group is involved with numerous utility-scale solar projects for private solar developers and utilities. The group is currently constructing or has completed nearly 70 utility-scale clean energy projects in states across the country including Arizona, California, Colorado,



Georgia, Illinois, Michigan, Nevada, Ohio, Virginia, Utah, and Texas. These solar projects have created new jobs for thousands of workers. In the last six months, McCarthy has constructed three utility-scale solar projects in northeast Texas, serving as the Engineer, Procure, Construction (EPC) contractor:

- A new 392-megawatt solar project in Sulphur Springs, Texas which is approximately 80 miles east of Dallas, is currently under construction, requiring approximately 400 workers to build. The solar farm will consist of 876,000 photovoltaic panels and 85 central inverters and will cover approximately 3,000 acres. Electricity produced on this farm will go straight into the electrical grid.
- Elm Branch: Situated 40 miles south of Dallas in Ennis, Texas is a solar farm comprised of more than 360,000 solar panels



nation of on-the-job training, mentorship, and technical instruction. The curriculum is designed to help veterans understand and develop the skills and knowledge essential to be successful on construction projects. Successful apprentices are eligible to be hired full time and continue to work with McCarthy on solar projects around the country.

“Solar has been providing excellent opportunities for underemployed or unemployed veterans and workers to embark on new rewarding careers,” said Scott Canada, Senior Vice President of McCarthy’s Renewable Energy & Storage group. “Veterans bring incredibly valuable skills that sync well with solar construction, including leading teams, working outdoors, and focus on completing the job. Through our accredited apprentice training program, we’re training them in the trades and providing a path for a long-term career in construction. We had great success with the program in Texas and are implementing it elsewhere around the country. Unfortunately, the new tariff threat is already impacting opportunities for Veterans and other Americans who are most in need of employment as the entire industry begins to stall as we await the decision.”

across approximately 1,350 acres of land, employing more than 150 workers during peak construction. The 163-megawatt farm is generating 272,000 megawatt hours of solar power annually – or enough energy to power 24,790 U.S. homes in a year, while reducing CO2 emissions by 156,000 metric tons.

- Briar Creek: Approximately 50 miles southeast of Dallas in Corsicana, Texas is a 153-megawatt large-scale solar project, which consists of 345,000 solar panels, sitting on 2,000 acres which created 150 jobs for its construction. The solar farm is generating enough clean and economic electricity to power 27,270 homes and a project of this size allows for the offset of 223,440 metric tons of CO2 annually.

During the construction process, there are 50 different operations occurring at any given time. Projects such as those mentioned above support more than 700 laborers and staff. McCarthy likes to hire locally and retain those who want to pursue a career in construction. To fill the construction workforce shortage gap, McCarthy implemented an accredited apprenticeship program for U.S. military veterans, which launched with solar construction projects in Texas, including 30 veteran apprentices on Elm Branch and nearly 40 veteran apprentices on Briar Creek.

McCarthy partnered with ACS, a veteran-owned staffing organization to implement its accredited apprenticeship program. The program is free for veterans and each apprentice builds skill through the combi-

According to SEIA, as of 2020, more than 230,000 Americans work in solar at more than 10,000 companies in every U.S. state. In 2021, the solar industry generated more than \$33 billion of private investment in the American economy and by the end of 2021, there were more than 120,000 cumulative U.S. solar installations. According to the natural resources research and consultancy group, Wood Mackenzie, solar deployment will crater by 16 GWs annually if tariffs are imposed. That’s two-thirds of all the solar energy installed last year. And over the next four years, U.S. carbon emissions will increase by 61 million metric tons.

Hopefully the issue will be resolved quickly. If not, the impact of this new tariff will soon extend into the homes of many Americans. It’s already creating clouds of uncertainty in what was otherwise a very sunny future for solar energy in Texas.

Designing Resilient Port & Intermodal Yards with Geosynthetics

According to a recent [report](#), United States ports handled a record 50.5 million shipping containers in 2021—an increase in total container volume of 16 percent. Unprecedented demand for goods contributed to this staggering figure, and projections for 2022 do not indicate that demand will decrease anytime soon.

Ports and intermodal yards are a vital link in the nation's supply chain, and disruptions can cause an undesirable and costly ripple effect. Because ports are susceptible to a variety of interruptions, it is imperative to design resilient port infrastructure to support the increased container volume.

Ports and intermodal yards in coastal areas are more prone to pavement problems due to inherent soft, unsupportive soils and high water levels. Soft subgrade conditions combined with heavy traffic loads from trucks, reach stackers, and gantry cranes can accelerate the degradation of paved or unpaved surfaces and subbase materials. This results in differential settlement, ruts, potholes, and an overall reduction in pavement service life. Moreover, these issues require continual, costly maintenance, and can result in interruptions to facility operations. Repair efforts typically focus on grading, patching, or resurfacing, but the problem is not at the surface—it is a base stabilization problem.

Strengthening Base Materials Using GEOWEB® Geocells

Creating a resilient pavement structure capable of withstanding long-term, heavy-duty traffic demands starts with stabilizing the base materials. The [GEOWEB® Soil Stabilization System](#) was invented specifically for this purpose. Created through a collaboration between the U.S. Army Corps of Engineers (USACE) and Presto Products Co., GEOWEB® was designed to address the needs of the U.S. military to build sand access roads capable of supporting heavy vehicle loads over soft or unstable soils. The system's deep cellular network controls both the horizontal and vertical movement of unstable base soils. In load-support applications, when a static or dynamic load is applied to a geocell-reinforced layer, lateral earth pressures are mobilized and transferred across a three-dimensional network of interconnected cells. The layer essentially performs like a composite material, facilitating a phenomenon known as the mattress effect.

Reduce Construction Costs, Emissions with GEOWEB® Geocells

With geocells, it is not uncommon to see an overall reduction in the required thickness of the base layer in a load support application by 50 percent or more, along with an overall improvement in allowable bearing capacity. This applies to both unpaved and paved surfaces at port and intermodal yards, including container stacking yards, access roads, and chassis storage areas. This results in a reduction in upfront construction costs, and it provides long-term savings resulting from reduced maintenance and repair costs, along with fewer interruptions to facility operations.

Moreover, in many cases, geocells allow for the beneficial reuse of on-site materials, eliminating the need to purchase expensive aggregate or imported structural fill. Compared to planar geosynthetic products such as geogrids—which commonly rely on expensive, imported high-quality aggregate—geocells are highly versatile and can be filled with a variety of commonly available and economical infill options. Infill options include sand, crushed aggregate, recycled concrete, pulverized debris, recycled asphalt, or other locally sourced materials.

These advantages not only offer the potential for savings in terms of upfront construction costs and long-term operational costs,



but they also contribute to a significant reduction in carbon emissions due to less aggregate/fill processing, transportation, and handling.

Optimizing Pavement Structures Over Weak Subgrades Using GEOWEB® Geocells

When faced with weak subgrade conditions, the GEOWEB® Soil Stabilization System is ideal for project owners who may be interested in conducting a value engineering evaluation of project options. For example, the figure below provides a direct comparison of four structurally equivalent unpaved road designs over a subgrade with a CBR of 1 percent.



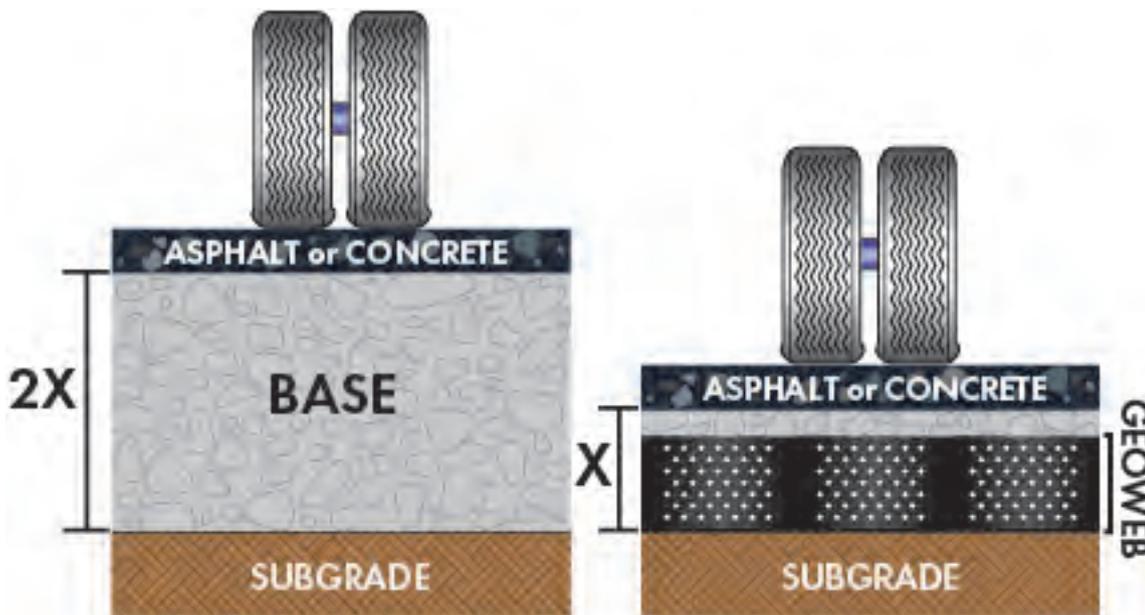
As shown in the above example, the unreinforced aggregate option would require *more than 36 inches of aggregate to achieve minimal stability*, and the planar geosynthetic option (geogrid + geotextile) would require more than 20 inches of aggregate. In contrast, GEOWEB® geocells reduce the total section thickness to only 12 inches; where suitable on-site material (OSM) is available, it is possible to limit imported aggregate to just the wearing course.

Value-Engineered Pavement Solutions for Better Performance

GEOWEB geocells can be added to port and intermodal projects to provide a value-engineered option to project owners for both paved and unpaved areas. This solution not only reduces upfront construction costs but also provides long-term savings and fewer interruptions to facility operations. For paved surfaces including asphalt, reinforced concrete, and roller-compacted concrete, the GEOWEB system decreases pressure on the subgrade to reduce differential and long-term settlement which will extend pavement life and reduce maintenance.

The selection of the GEOWEB pavement solution is influenced by loading, subgrade soils, traffic frequency, and infill type. The engineering team at Presto Geosystems works closely with engineers and project planners, offering **free**

project evaluation services and on-site installation support. Our recommendations will deliver a technically sound, cost-effective solution based on over four decades of accredited research and testing data. Please contact our knowledgeable staff and network of qualified distributors and representatives to discuss your project needs today.



CAN PREFABRICATION PLAY A ROLE ON THE PATH TO NET-ZERO?

By Jon Mohle

WITH INCREASING CONCERNS over climate change, public sector demand for more sustainable buildings and growing awareness of social responsibility, can prefabrication play a role in a more sustainable future?

When it comes to sustainability, an owner will typically address the main components of a project which include the structure, HVAC system, and building envelope, incrementally. In doing so, a project may end up with a cutting-edge HVAC system that reduces energy consumption but may not integrate well with other building components and, as a result, fail to meet overall sustainability goals. When focusing completely on only one piece of the puzzle, there is often little left in the budget to address a building's structural components or envelope in a similarly effective way.

However, the industry has come a long way and a growing number of projects are taking advantage of advances in prefabrication and holistically optimizing a building's core integrated systems to maximize energy efficiency and performance, as well as occupant wellness and comfort.

Sustainable Prefabrication in Action

With goals to be carbon neutral by 2030, California-based security provider, Fortinet, chose prefabrication to help meet sustainability goals for its new headquarters. The company, along with project stakeholders, worked closely with Clark Pacific to develop an early-stage prefabrication strategy that would holistically address the building's structural, mechanical, and façade systems for the best possible outcomes.

Clark Pacific manufactured and delivered the building's structural and integrated thermally active radiant flooring which will help reduce energy consumption and mechanical costs. As part of the building's overall solution, the system provides 100 percent fresh air to building occupants and activates the structure's mass as an energy storage solution.

The wall panels were also fabricated at Clark Pacific's Woodland facility and delivered to the jobsite, shortening the project schedule by four months compared to traditional construction. LEED-Gold certified,



Fortinet's headquarters uses 30 percent less energy than a standard building. Additionally, the building's radiant system will save 76,600 gallons of water per year.

However, Fortinet isn't alone in its efforts to create more environmentally friendly buildings. Across sectors, construction projects are taking advantage of prefabrication to lower their carbon footprint. The University of California San Francisco's new 595-unit student housing development, The Tidelands, leveraged prefabrication, becoming the institution's first residential development to earn LEED Gold certification. The building envelope using glass-fiber-reinforced concrete was manufactured off site by Clark Pacific. Architect Kieran Timberlake conducted a facade sun exposure analysis to determine the impact of solar heat gain and as a result, billows and horizontal and vertical sunshades were built directly into the panels on sun-facing elevations.



Working with Clark Pacific, the project was delivered six months ahead of schedule.

Energy Codes Drive Demand

Driving demand for high-performing building envelope systems are building energy codes, such as ASHRAE 90.1 and California's Title 24, that have significantly progressed to focus on reducing carbon emissions from the built environment. Prefabricated systems, such as composite precast panels, are not only energy efficient during the construction process, but also create buildings that are more sustainable throughout their entire lifecycle. This is done in part by incorporating barrier systems into premanufactured frames that include continuous insulation and caulked in punched windows which are proven to be more successful in resisting heat flow.

A recent Glumac study that compared 2 inches of a composite precast exterior envelope to baseline curtain wall and metal stud systems, found concrete precast panels performed better than all other envelope options and demonstrated a ~30 percent reduction in the amount of heating energy used. According to the same study, a precast composite envelope system can reduce HVAC energy use and cut costs compared to conventional envelope designs. With these advances in building materials, prefabricated buildings will hold temperatures better and decrease the need for heating and air conditioning use. This is also beneficial to avoid the inflated cost of energy during peak demand hours when the thermal mass within a structure can retain a desired interior temperature. With each additional building following this practice, the demand during peak hours is reallocated across the entire day and environmental strain is reduced. These systems routinely reduce energy costs by 10-20 percent. This marvel in energy efficiency is on the cutting edge of innovation in more environmentally responsible buildings.

Accelerating the Path to Zero

Industry conversations around embodied carbon have increased tenfold in recent years and for good reasons. Building materials represent nearly a third of the construction industry's embodied carbon. When it comes to materials, concrete isn't always viewed favorably. In fact, Portland Cement, the glue that holds concrete together, is alone responsible for 8 percent of the world's CO₂ emissions. At the same time, concrete is the most widely used man-made material

in the world. While concrete is often characterized as our biggest problem, it may be our biggest opportunity. Concrete is durable and long-lasting, and its thermal stability can lead to more energy-efficient buildings and facades.

Low carbon solutions for concrete exist today and some have been used successfully for over 40 years. These solutions make use of materials called Supplementary Cementitious Materials (SCMs), which are often post-industrial waste products such as flyash (a by-product of the coal industry) and slag (a by-product of the steel industry). These materials, which can replace a portion of the cement in concrete, are not burdened with high amounts of CO₂ and improve the concrete's performance. The only downside is that SCMs can slow down the curing process, causing the concrete to gain strength more slowly.

Historically, the construction industry has refined building design with only a single driving variable - cost. In efforts to simplify formwork, structurally inefficient systems emerged that save labor but use more material. Efforts to accelerate construction led to the development of mixes that can achieve high strengths in only a few days. These practices combined result in buildings that use more concrete and concrete mixes that use more cement.

Today, the industry must consider a second variable in building design, CO₂, and can't simply take a traditional design, toss in some SCMs and call it sustainable. In 2018, Clark Pacific evaluated dozens of potential designs for cost and carbon. Concrete volume was carved out by thinning slabs and adding ribs to achieve the same strength with less. Ribs were made wider to reduce the early strength requirements of the concrete and enable higher SCM mixes. Offsite fabrication allows for the use of a form heating system that accelerates early strength gain. This allows for the removal of up to 70 percent of the cement from mixes. The heating system removes roughly 20 times the carbon from the mix than it created while heating the forms. This aggressive approach removes roughly 25 percent of concrete from a building and the remaining concrete has half the carbon when compared to 2019 National Ready Mix Concrete Association Baseline mixes for similar strengths.

Whether building with concrete, steel, timber or precast, projects need to be addressed with both cost and carbon in mind. Advances in technology, materials, systems and processes captured in this article are encouraging first steps. As we look ahead, there's no doubt that future advances will take construction projects further down the path to Net-Zero.

JON MOHLE senior product manager at Clark Pacific.

A NEW HOME FOR THE PERFORMING ARTS IN ORLANDO

By Luke Carothers

THE DR. PHILLIPS CENTER FOR THE PERFORMING ARTS recently celebrated the grand opening of its second phase. Located in downtown Orlando, Florida, the \$200 million expansion is the culmination of a project that began when plans were announced in August 2008. The Dr. Phillips Center has been a two part project with the first phase of construction beginning when the project broke ground in the summer of 2011.

The project involved the construction of a two-level, multipurpose facility in the heart of Orlando. Phase I included the construction of a \$201 million, 250,000-square-foot cast-in-place concrete and structural steel framed building that includes a 2,700 seat Broadway-style theater as well as a 300 seat multi-purpose hall for smaller performances and a 300 seat banquet room. Phase I was completed in November 2014, and it marked the grand opening of the Dr. Phillips Center for the Performing Arts.

The \$200 million Phase II expansion broke ground in March of 2017. Phase II featured the construction of 127,680 square feet of new space including Steinmetz Hall and a 3,000-square-foot performance space called Judson's. On top of seating 1,700 and boasting world-class acoustic engineering, Steinmetz Hall is equipped with state-of-the-art machinery that allows for the reconfiguration of both seating and the stage. This high-tech machinery allows the space to transform and accommodate a wide range of performances.

The project's location in downtown Orlando, as well as the weight of the structure, placed a particular emphasis on the geotechnical aspects of the project. Universal Engineering Services (UES) spearheaded all geotechnical exploration, design, and testing services. As the lead geotechnical engineer for both phases of the project, UES played a major role in the construction of the nine-acre facility. Headquartered in Orlando, UES has demonstrated expertise through a high quality approach to geotechnical problem solving and value engineering on large, complex projects. UES also provided threshold inspection and test pile services for both phases of the project.

The biggest challenge to the design and construction process in Phase I was that the most important part of the work was done below ground, installing 700 grout displacement pilings to support and stabilize the building. Ken Derick, a Senior Vice President at UES, led the geotechnical side of the project. According to Derrick, the team overcame many of these challenges because they were able to add enough weight to "avoid structural tie-downs due to the buoyancy effect of the water table on the basement." Derick has been with UES for the past 30 years, working as a licensed professional engineer, building official, plan examiner, and standard commercial inspector. His expertise was key though the project's multiple iterations of foundation analysis and re-design.



During Phase I, one of the key steps in the design process was ensuring that the foundation settled uniformly. This was complicated by the weight of several walls, which had to be placed on piles. Derick notes that it is extremely important that the settlement of the piles and the shallow foundations match closely, or the differential movement could crack the foundation. The other challenge in this step of the design process was accounting for differences in the depth of the foundation, which varies throughout the project. Accurate planning was paramount at this stage because, as Derick points out, any crack in the foundation so far below the water table could result in significant flooding.

To ensure there would be no cracks in the foundation, Derick and his team performed various tests for a foundational support and settlement analysis. This included load tests on pilings where the team inserted strain gauges at various pile elevations, allowing the team to record movement and capacity at multiple zones of the pilings. Derick notes that this testing resulted in cutting the pilings down from 95 feet to 60 feet to "get the movement that would match up with the shallow foundations." This not only ensured uniform movement, but also saved the project owner over \$1 million. These piles prevented the foundation from settling unevenly, but they also posed challenges to the construction of the foundation itself. Because the piles protruded into the spread mat footings that make up the large



Steinmetz Hall construction phase 5. Photo: DPAC

mat foundation, the structural design team had to provide additional reinforcement to the foundation.

Throughout both phases of construction, the team had to contend with the constant presence of water trying to enter the site from both below and above. Michael Billings, Metals Project Manager, Certified Welding Inspector & Threshold Agent, led the threshold inspections work for UES on the project. Billings notes that one of the main aspects of the project during the construction phase involved dewatering efforts. To contend with the presence of water, the UES team recommended dewatering, which involved a series of pipes that worked around the clock to pump water out of the construction site. Billings also points out that, because the project is located in Florida, heavy rains caused problems for the project in the form of minor washouts and mild undermining in some slabs. To solve this problem, Derick proposed the use of flow fill materials and a host of other innovative solutions, with Billings and his team monitoring to ensure the correct product was used and that its placement would ensure the cavities were sufficiently filled.

While Phase I was built between 10-15 feet below the water table, Phase II was even deeper at about 30 feet below the water table.

Whereas in Phase I, the team was able to avoid the use of structural tie-downs, the depth of Phase II made deep foundations necessary to tie down the structure since its buoyancy would make it want to “float.” Derick notes that, at that depth, every column location had to be tied down with displacement piles underneath the Phase II building. To compound this challenge, the team had to install tangent piles between the two phases to prevent Phase I building from sliding into the deeper, Phase II hole beside it. The properly designed tangent pile allowed for the deep digging necessary for Phase II excavation to proceed without posing a risk to the existing Phase I structure.

Phase II also had to contend with other challenges stemming from the project’s depth. As the teams were digging out the foundation for the second phase, they encountered more and more clay soil that was holding water, making it difficult to pump that water out. Derick says that this resulted in several last minute changes such as removing soil and replacing it with rock to prevent settlement. Billings points out that it was critical when removing and replacing this soil that the fill was properly compacted to avoid any potential shift. Phase II also had to contend with a smaller job site, which made it harder to maneuver equipment such as cranes and lay out building materials. This smaller site meant that the cranes often had to be moved into the street, which resulted in UES designing crane matting and other safety measures.

During the second phase of construction, different aspects such as the moving components in Steinmetz Hall, complicated both the design and construction process. The hall’s stage area is constructed with metal tracks that are cast into the stage slab. The area’s “stage walls” move along these tracks to reposition to various configurations. Billings highlights the particular challenge of not only reinforcing the slab to support moving walls, but also doing so in a way that avoids the tracks themselves and maintains adequate spacing to allow for the proper consolidation of the concrete.

The conclusion of the second phase of construction was celebrated in January of 2022 with two weeks of events including performances by Jennifer Hudson, Leon Bridges, and a host of other notable performers. The opening of these new facilities represents a new space for world class art and entertainment for the city of Orlando, and the space’s fluidity attracts a wide variety of performers. Despite a near four year delay caused by Covid-19, the Dr. Phillips Center for the Performing Arts is a marvel of both technical engineering and construction and a beacon for a burgeoning artistic and performance community in the region.

LUKE CAROTHERS is the Editor for Civil + Structural Engineer Media. If you want us to cover your project or want to feature your own article, he can be reached at lcarothers@zweiggroup.com.

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NEW YORKERS READY TO WELCOME THE HOLY RAIL

LONG AWAITED, MUCH NEEDED AND EXTREMELY COSTLY, EAST SIDE ACCESS WILL YIELD FASTER, LESS STRESSFUL COMMUTES

By Katherine Bonamo and Thomas Renner

IN DECEMBER 2022, New York plans to unveil a major new hub for its public transit system. An entirely new concourse and terminal for the Long Island Rail Road (LIRR) will open directly beneath Grand Central Terminal in midtown Manhattan. For the first time, commuters from Long Island (and the borough of Queens) will be able to use the LIRR to travel directly to destinations on the East Side of Manhattan, the site of many workplaces.

Planned for decades, this massive investment in commuter rail marks the first major expansion to the busy LIRR in over 100 years. “As the first modern train terminal to be built in more than a half century, the East Side Access concourse will expand rail service, cut down on travel times into East Manhattan from Queens and reduce crowding,” New York Governor Kathy Hochul said. “This is yet another example of New York leading the way as we recover from the pandemic.”

For New York transit riders, a new flagship station for the LIRR is huge news all by itself. So is the expected 45 percent increase in the LIRR’s capacity. The LIRR will continue to use Penn Station on the West Side as well, allowing Long Islanders to choose the terminal closest to their work locations.

But the sheer scope of the East Side Access project is much greater than than most New Yorkers will ever realize. Overall, East Side Access is the largest infrastructure project in the 57-year history of the Metropolitan Transportation Authority (MTA). With a final price tag approaching \$12 billion, the effort has so far required nearly 15 years of intense work to complete. During a 2015 tour of the work in progress, **MTA Capital Construction President** Michael Horodniceanu called it “a project of ‘historical proportions.’”

Reshaping New York’s Infrastructure

Given the city’s complex geography, any new train routes from Queens to Midtown East would first need to find a way around—or under—the famed East River. To make East Side Access a reality, teams have carved out almost 13 miles of new tunnel, by methods including tunnel boring, cut-and-cover, jacked shield, micro-tunneling, drilling, and blasting. For the Queens side of the work alone, two 500-ton pressurized face “slurry” tunnel boring machines from German manufacturer Herrenknecht were custom built for the project. Over 2 million cubic yards of “muck” was excavated in total, including 1.5 million cubic yards that had to be hauled to the surface by conveyor belt, a process **Horodniceanu** described as “a nightmare.”

Important changes were also needed to integrate the new routes safely into New York’s intricate ecosystem of rail lines. Harold Interlocking in Queens was already the busiest railroad junction in the country, serving the LIRR, NJ Transit, and the New York & Atlantic Railway as well as Amtrak’s Northeast Corridor. East Side Access work at Harold involved not only tunneling work and reconfiguration of track, but installation of new signal, communication, and supervisory control systems. Crews installed 97 new track switches, five new steel railroad bridges, and 295 poles for Amtrak’s overhead wires.

Meanwhile, beneath the streets of Manhattan, workers built the vast new spaces of “Grand Central Terminal Caverns” to house both the public and working areas of new LIRR terminal. This major portion of the project included the construction of two completely new concrete caverns, with each an impressive 1,143 feet in length. Two existing caverns, previously used to store Metro-North trains, were fitted out for their new purpose with 830 precast beams, 844 precast panels, 694 precast walls, and 370 precast platforms.

To turn these caverns and tunnels into a rail terminal, workers needed 130,000 feet of track, 32 turnouts, 52 switches, and 35,000 cubic yards of track bed concrete. To supply power, the design included 800,000 feet of underground raceways, 7,000 light fixtures, seven power stations and two off-track facilities.

Safety with Style

The scale of these efforts notwithstanding, the brand-new LIRR concourse will remain the most highly visible result of East Side Access. Measuring 350,000 square feet in all, the new public space will include 25 retail storefronts, Wi-Fi and cell service, and digital signage with real-time train information. A notable feature will be the 17 high-rise escalators connecting commuters to the terminal’s mezzanine — at 182 feet each, these will be the longest in the New York City transit system. From the mezzanine, travelers can access upper and lower train levels with two new platforms and four new tracks each.

Planners also provided for amenities such as art exhibition space in the corridors leading from Grand Central’s entrance to the LIRR ticket booths. “Not only is it built functionally, but we want people to enjoy the experience. You see architectural flourishes throughout,” stated former New York Governor Andrew Cuomo on a tour of the facility last year.

At the same time, memories of both 9/11 and Superstorm Sandy remain vivid in the Tristate area. With recent history in mind, New Yorkers are clear on the need for prudent forethought when it comes to public spaces that will be used by large crowds. To plan responsibly for possible future emergencies, the new terminal features 53 fire-rated floor doors manufactured by BILCO.

Fire-rated floor doors are often found in public buildings, dormitories, office buildings, and exit stairwells. They are provided with a self-closing device and an intumescent fireproof coating on the underside. When a fire breaks out, the closing device is triggered by the heat and closes the door to compartmentalize the building and prevent the spread

of smoke and flames. By doing so, egress is protected and building occupants have additional time to evacuate safely. The fireproof coating on the underside of the door expands and seals the door opening to prevent the spread of fire to the next floor.

BILCO's fire-rated doors maintain the fire rating of a 2-hour floor ceiling assembly between building floors. The door hardware and sealants used in the product are specially selected for this purpose. BILCO's doors are UL-listed and meet NFPA 251, NFPA 288, ASTM E119 and BS476 Part 22 requirements. They also feature a pan cover designed to accept flooring materials for concealed access. The units chosen for East Side Access range in size from 30 inches x 30 inches to 42 x 60, one of the largest manufactured by the specialty access company.

Doors made by BILCO are frequently used in MTA construction projects. In this case, Fontana Metal Sales was the immediate source of the doors used for East Side Access. "It's a product that the MTA knows and it's easiest to purchase the known product," said Jason Benfield of the civil engineering team working on the project, Tutor Perini. "It's easier to get something approved when it's a product that is known to work in these applications."

Betting on the Future

When the LIRR was founded in 1834, the population of Long Island numbered around 37,000. Today it exceeds 2.8 million. As of 2017, about 1.4 million Long Island residents were employed in Manhattan,

with some commuting as long as two hours each way. For these long-suffering suburbanites, a quicker and more efficient way to commute is long overdue.

As the largest transportation infrastructure project currently underway in North America draws to a close, New York officials are optimistic about their vision of the economic future: a future based on drawing workers back to the heart of "The City." Planners hope for quality-of-life improvements throughout greater New York as well. "This smart, transit-oriented development will help spur economic growth, provide better connections to Metro-North Railroad and lead to reduced automobile traffic and improved air quality in the region," said MTA Acting Chair and CEO Janno Lieber.

In short, New York is backing the concept that a world-class transit system is essential for a world-class city. According to Horodniceanu, investment in public transport is "the only way you'll remain competitive on a world map, to be like London, Shanghai, or Paris." Long Islanders hoping to get to work in a timely manner can only welcome this view. Ninety thousand tons of steel and more than 1 million cubic yards of concrete later, the outcome of New York's bold bet on rail will soon become clear to all.

KATHERINE BONAMO AND THOMAS RENNER write about construction, engineering, architecture, and other trade industry topics for publications throughout the United States.

THE ROAD TO OPPORTUNITY: CLEVELAND'S OPPORTUNITY CORRIDOR, SECTION 3

AS THE LARGEST CITY on Lake Erie and one of the most populous urban areas in the country, the City of Cleveland, Ohio, was designed as a global city and today, more than 370,000 people call the city proper home, while the Cleveland-Akron-Canton Combined Statistical Area has a population of more than 3,600,000. A busy metropolis, Cleveland's economy relies on diversified sectors, including manufacturing, financial services, healthcare, biomedical and higher education, with notable destinations and businesses including the Cleveland Clinic, the Rock and Roll Hall of Fame, Cleveland Museum of Natural History, and the Cleveland Orchestra. However, not all areas of the city were being utilized to their full potential.

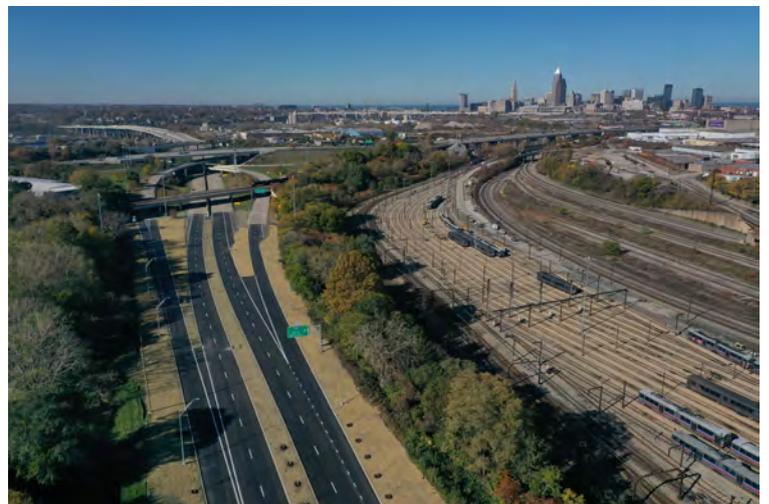


Photo: ODOT/Kokosing Construction

The area between the terminus of Interstate 490 and University Circle in Cleveland, traversing the Fairfax, Kinsman, and Central



Photo: ODOT/Kokosing Construction

neighborhoods, had become known as the “Forgotten Triangle” due to a lack of economic activity and investment. Encompassing nearly 1,000 acres on Cleveland’s southeast side, the Cleveland City Council Wards 5 and 6 neighborhoods had been a hub of heavy industry since the 1880s. However, population and investment in the area had declined and by the early 2000s, the neighborhood was experiencing abandonment and neglect.

The Ohio Department of Transportation (ODOT) and the City of Cleveland recognized the “Forgotten Triangle” as a remarkable opportunity for neighborhood regeneration. An Opportunity Corridor Steering Committee was formed with representatives from ODOT, the City of Cleveland, Cuyahoga County, Greater Cleveland Partnership (GCP), Area Community Development Corporations (CDC), Greater Cleveland Regional Transit Authority, Northeast Ohio Regional Sewer District (NEORS), Northeast Ohio Areawide Coordinating Agency (NOACA), residents, business owners, and other local stakeholders.

After completing the Opportunity Corridor Study, three primary needs for the area were identified:

- Improving system linkage among the roads, neighborhoods, and businesses in the area
- Improving mobility between the Interstate system and University Circle
- Supporting planned economic development

In late 2021, the long-awaited Opportunity Corridor, a new three-mile roadway that runs from East 55th Street at Interstate 490 to East 105th Street, reached substantial completion. The 35-mph boulevard includes a median, crosswalks, pedestrian and traffic signals, a multi-use path, tree lawns and vehicular, pedestrian and rail bridges. The thoroughfare not only brings enhanced transportation, mobility, and connectivity benefits to this area of Cleveland, but it is also spurring new economic development, new jobs and a new identity for the community. Additionally, it enhances access to Cleveland’s cultural hub, healthcare, and educational facilities.

The Opportunity Corridor project was split into three sections. Design-Build was selected as the project delivery method for Section 3, with Michael Baker International serving as the lead designer and Kokosing

Construction as lead contractor. This section, a new five-lane boulevard facility, features:

- Two miles of new roadway on new alignment
- Seven signalized intersections
- Seven bridges of various types
- Four groups of retaining walls
- Three Best Management Practices (BMPs) for stormwater treatment
- New sanitary, storm and combined sewers
- Electric, storm, and sanitary stubs installed for future development

Accounting for Existing Railroad and Transit Infrastructure

Because of the location of the “Forgotten Triangle,” work required significant coordination with, and adjustments to, cargo railroads and commuter transit infrastructure.

When it comes to excavations for major projects, particularly in densely developed urban areas, there are alternatives to the conventional bottom-up building approach. As was the case with Opportunity Corridor, Section 3, the team employed top-down construction versus the bottom-up method. Michael Baker recommended this method because of its many benefits, including:

- The ability to construct substructure elements such as abutments and piers from existing grade elevation downwards without prior excavation or the need for extensive amounts of temporary shoring.
- The ability to construct retaining walls from existing grade elevation downwards without prior excavation or the need for extensive amounts of temporary shoring.
- Allowing construction of bridges at the ground level, reducing the equipment necessary for erecting and detailing bridge superstructures.
- Better overall construction schedule flexibility with disposition of excavated materials.

The new Norfolk Southern mainline bridge over the Opportunity Corridor required this phased, top-down design approach and a shoofly relocation to maintain the Norfolk Southern tracks. Section 1 involved the relocation of Norfolk Southern to the east, while a portion of the new bridge was constructed. Section 2 involved the relocation of Norfolk Southern onto the newly constructed portion of the bridge

Design-Build Design Project Manager

Lawrence P. Ciborek, P.E., Project Manager –

Bridge at Michael Baker International

Design-Build Lead Roadway Engineer Sean

Milroy, P.E., PMP, DBIA, Project Manager –

Transportation at Michael Baker International

Design-Built Lead Structures Engineer Chris

Cummings, P.E., DBIA, Department Manager –

Bridge at Michael Baker International

Owners Representative Julie A. Meyer, P.E.,

Opportunity Corridor Project Manager at Ohio

Department of Transportation

Design-Build Project Manager Kerry Hart, DBIA,

Senior Area Manager at Kokosing Construction

while the remainder of the bridge was constructed. The final phase shifted Norfolk Southern to its final location in the center of the bridge. Drilled shafts were used for pier and abutment foundations in conjunction with top-down construction. Due to the relatively long spans and substructure deflection limits, drilled shafts included heavy reinforcement and embedded steel shapes. A concrete facing was installed on the drilled shafts after the embankment below the bridge was excavated to allow for the new roadway beneath.

The E. 55th Street structure was also constructed via top-down methods to maintain traffic along E. 55th Street. This single span, 108' long, bridge included semi-integral abutments founded on 24" closed-end pipe piles. Similar to the Norfolk Southern crossing, a concrete facing was installed on new piling post excavation. The piling was oriented as a frame to withstand the large overturning moments due to the depth of excavation. Limited right-of-way and poor soil conditions at this location limited more traditional methods such as tied back foundations or drilled shafts.

The project also required crossing the Greater Cleveland Regional Transit Authority (GCRTA) Blue Green line and the needed structures were curved with a 57-degree skew. The tracks below were along a curved alignment, which combined with existing utility conflicts, severely limited substructure placement, necessitating a refined superstructure analysis to finalize designs.

Addressing Drainage and the Stormwater

Another major aspect of the Opportunity Corridor, Section 3 project addressed drainage and stormwater within the project area. Michael Baker's drainage design services included hydrologic and hydraulic modeling of the storm sewer system using advanced modeling software. The firm used the citywide model to evaluate proposed stormwater alternatives for the new roadway and impacts on the existing sewer system. The model was also used to size the proposed drainage and diversion structures.

The Opportunity Corridor, Section 3 project is located within a combined sewer service area, with outfalls to two different treatment plants (Easterly and Southerly). The project could not add peak flows within the combined sewer system but was able to utilize the various branches of the Kingsbury Run Culvert Stormwater Outlet (SWO) to remove large portions of the drainage area. And that all new storm outfall locations received stormwater Best Management Practices (BMP) in accor-



Photo: ODOT/Kokaosing Construction

dance with ODOT L&D Volume 2 requirements and outlet into SWO outfalls in accordance with NEORSR requirements on the Kingsbury Run system where feasible.

Realizing the Opportunities

The Opportunity Corridor provides connections to rail, transit, commercial transportation, an industrial park, and residential neighborhoods. During five years of design and construction, developers recognized the opportunity and invested approximately \$1 billion in projects within a quarter mile of the corridor. Opportunities for additional developments, such as the Northeast Ohio Food Hub, exist along the corridor. The project is aligned with the city's effort to restore jobs and new housing opportunities along the boulevard. It also provided multi-modal connections between neighborhoods and public transportation facilities that were previously separated by numerous natural and man-made barriers. The approach to bring an all-encompassing improvement to the "Forgotten Triangle" addressed the area's needs for multiple transportation options and neighborhood expansion. Additional improvements make the area a true destination, including safer pedestrian spaces, two pedestrian bridges, and a future connection to the Cuyahoga Greenways Network, which connects hundreds of miles of existing and expanding bike routes.

Forgotten no longer, the Opportunity Corridor is an important transportation investment towards revitalizing Cleveland's Fairfax, Kinsman and Central neighborhoods, opening up new opportunities and building a vibrant environment for residents and visitors alike.

L.A. METRO'S PURPLE LINE EXTENSION PROJECT WILL RESHAPE DAILY COMMUTE FOR LOS ANGELES

WHEN THE WORLD'S TOP ATHLETES descend upon Los Angeles for the 2028 Summer Olympic Games, a new underground rail line will provide a critical means of transportation to many of the venues for athletes and spectators alike.

The \$9.5 billion Metro Purple Line Extension Project is a nine-mile heavy rail line that will operate as an extension of Los Angeles Metro's Purple Line from its current terminus at Wilshire/Western Station to a new western terminus in West Los Angeles near the Veterans Administration (VA) West Los Angeles Medical Center in Westwood. The full project, which is divided into three sections, is on target for completion before Los Angeles hosts the 2028 Olympic Games.

The subway extension will connect the D Line (Purple) to several major destinations, with stops near the La Brea Tar Pits and the Los Angeles County Museum of Art, Beverly Hills and the campus of UCLA (where the Olympic Village will be located when Los Angeles hosts the 2028 Summer Olympic Games.)

"The nine-mile extension will provide an easy, reliable means of transportation to the Westside of Los Angeles, the second-largest job and population center in the entire region," said Ashok Kothari, WSP USA project director. "This project will improve mobility and reliability, transit service, and access to major activity and employment centers. During the Olympics, it will provide a critical means of transportation for athletes and international spectators."

WSP has been providing environmental and engineering services to the Los Angeles County Metropolitan Transportation Authority (Metro) since early planning studies began in 2007. The firm's responsibilities have included the preparation of the alternatives analysis, environmental impact and funding reports, preliminary engineering, request for proposal (RFP) documents and design support during construction services including systems testing and commissioning.

"Activity centers in the study area are served by the city's infamously congested roadway network, which is forecasted to deteriorate further with increases in population and employment," Kothari said.

The final environmental impact statement and environmental impact report (EIS/EIR), which was prepared by WSP, determined that when the project is completed, travel time from the existing end of the Purple Line, Wilshire/Western Station, to the new Westwood/VA Station will drop from an average of 46 minutes by car to just 15 minutes by subway.



Section 1

Groundbreaking was held in November 2014 for Section 1, a twin-bored, four-mile tunnel extending from the existing Wilshire/Western Station and includes underground stations at Wilshire/La Brea, Wilshire/Fairfax and Wilshire/La Cienega.

With design work complete and construction having reached the 75 percent mark, Section 1 is on track for opening in 2024.

To celebrate the 50 percent completion milestone for Section 1, a "Halfway Completion Ceremony" was held on June 2, 2019 at the La Brea Tar Pits area, attended by local officials, members of the design and construction team, and the local community.

It was an appropriate location for the event, as the unique area posed some of the biggest geologic challenges for the extension project.

Section 1 Challenges - Construction in the La Brea Tar Pits Area

Challenges associated with the La Brea tar pit area included the need for careful, accurate assessment of the "tar sand" properties for tunnel and station design, determination of the most appropriate construction methods in the gassy ground and awareness of the potential for encountering Ice Age-era fossils, similar to those displayed at the La Brea Tar Pits and Museum in the Wilshire/Fairfax Station area.

To investigate this area prior to construction, in addition to geotechnical borings, WSP designed an exploratory shaft to provide information to designers and contractors on soil properties, construction methods in these conditions, gas monitoring data and construction methods to preserve large fossils should they be encountered. Contractors visited the shaft excavation during the Section 1 early procurement phase.

Sections 2 and 3

To stay on target for a fully operational subway extension in 2027, work on the second and third sections of the project is already well under way. A groundbreaking ceremony for Section 2 was held in February 2018.



This 2.6-mile Section 2 extension includes additional stations at Wilshire/Rodeo and Century City Constellation. Construction is 49 percent completed, and revenue service on Section 2 is expected in 2025.

In May 2021, a groundbreaking ceremony was held for Section 3 of the project. Construction is currently 34 percent complete and consists of another 2.6-mile stretch of twin-bored tunnel that will include stations at Westwood/UCLA and a new terminus station at Westwood/VA Hospital in West Los Angeles. Section 3 is scheduled for completion in 2027.

“The presence of an active fault line on both Sections 2 and 3 alignments required our team to locate fault zones and design the tunnels to remain safe, should a fault rupture occur,” Kothari said. “WSP provided the preliminary geotechnical investigations and crossing designs and worked alongside the design builder during final investigation and design of fault crossings.”

The contractor’s final design program included large-scale laboratory testing to confirm the findings of the design assumptions.

The project team faced a few other hurdles at Sections 2 and 3.

Section 2 Challenge

During the planning stages of this project, there were two possible locations for the entrance to the Century City Constellation Station, both on corners of the busy intersection of Constellation Boulevard and Avenue of the Stars. Ultimately, Metro determined the best option would be an entrance on the northeast corner of the intersection, on an undeveloped property owned by JMB Realty (JMB).

In working with JMB to secure the easement, Metro became aware that the property owner had plans to develop the vacant land into a development with high-rise towers. Metro saw this as an opportunity to work with JMB in a mutually beneficial joint development agreement.

The elements of the Metro entrance that need to be placed on the private property are the entrance plaza at the surface and the underground portions of the entrance, which connect patrons to the actual subway station, and additionally some ventilation gratings and a set of emergency exit stairs.

Through Metro’s preliminary engineering phase, engineers from both Metro and JMB worked together to ensure that conceptually, the projects could work together, and changes could be made to each party’s designs so the two projects would complement one another.

During the coordination process, several challenges were addressed, including:

- the integration of changes from one project into the other;
- finding a suitable area available for construction staging, since both projects were planned to progress simultaneously;
- planning for two mega structures to be built independently of each other, since at the design stage it was not clear which project would start and complete construction first; and
- ensuring through real estate easements that all parties would have the access needed to different areas of the property both in the temporary condition (during construction) and in the permanent condition.

These challenges were overcome in part by regular meetings, good coordination, and sharing electronic files, including 3D BIM models regularly. Additionally, in this joint development process both parties collaborated closely so that the designers of the high-rise understood the needs of an underground heavy rail subway system and vice-versa.

“Without that understanding, it would have been much more challenging to undertake,” Kothari said.

Section 3 Challenge

For Section 3, the most critical element for constructing the project was identifying the launch site for the Tunnel Boring Machine. The site originally identified as the best location for the staging area was on U.S. Army Reserve property at 1250 Federal Avenue but was later moved to the VA campus. This change required extensive collaboration with representatives of the VA to make it possible.

“The site selected was located in a historic district, protected by the National Historic Preservation Act, thereby requiring collaboration with the Federal Transit Administration and VA’s historic preservation staff,” Kothari said. “VA approval of the environmental documentation prepared for the new construction site was also required, thereby requiring coordination with VA on drafts of the documentation.”

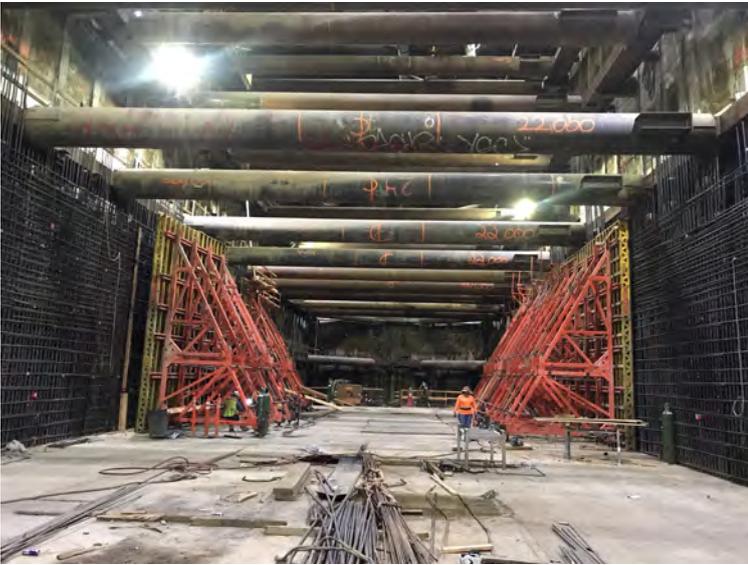
Negotiations proved successful, and all agreements with the VA were completed, allowing for a timely start to construction.

Technical Innovations

The emergency ventilation design implemented many innovative solutions to deal with Metro requirements to control smoke and heat that could potentially be generated by a serious rail car fire that generates a fire heat release rate of 86,528,000 BTU/hour.

“The need to control the smoke and heat generated by such a large fire required innovative solutions,” Kothari said.

To meet this stringent criteria, the station design incorporated high ceilings in the platform areas that act as a reservoir to contain smoke dur-



Section 2 - Wilshire/Rodeo Station

ing the early stages of a fire. Downstand enclosures around the vertical circulation (stairway and escalator) openings are designed to prevent smoke from rising into the concourse, allowing those areas to remain free of smoke and allow patrons to move to a point of safety.

A large over-platform exhaust (OPE) duct/plenum will be placed over the platform with chimneys alongside the concourse. This design was verified using computational fluid dynamics (CFD) to analyze the convey smoke from an under-concourse train fire into the OPE.

To address Metro's concerns for protecting patrons during a fire in the crossover, during the final stages of design an internal exhaust plenum connecting the tunnel end of the crossover to the emergency ventilation fan plenum was added.

"This will allow for smoke extraction at either end of the crossover, permitting evacuation in either direction after identification of the location of the railcar fire," Kothari said.

Other technology incorporated during the Advance Preliminary Engineering phase was the use of platform heat detectors to quickly activate the emergency ventilation system and the use of Revit 3D design software to model the station, which in turn was used to prepare the CFD model.

"Many of these innovative ideas came as a need to solve unique problems created by the large fire and were initiated by WSP's ventilation expert William Kennedy, who passed away in 2012," Kothari said. "It was designed in conjunction with the Purple Line Extension design team, with assistance from WSP's modeling team based in New York City."

Environmental Considerations

Aware of the need to minimize any negative environmental impact, the design and construction team have taken measures whenever possible to create opportunities for improvements to the communities located along the new extension.



Section 3 - Westwood/ VA Hospital Station Tunneling Site

The maintenance of way (MOW) building constructed as part of the project is located on a brownfield site that was successfully remediated by removing underground storage tanks and contaminated soil. Additionally, the project team actively treated an underground hydrocarbon plume left by the former industrial facility.

"We engaged a third-party commissioning agent to oversee the integration of the various mechanical, electrical and plumbing systems to maximize the efficiency and performance of the MOW building management system," Kothari said. "The building features a 353-kilowatt photovoltaic system over rooftop parking, which was a major contributor to achieving a LEED Gold certification from the U.S. Green Building Council."

The project team also incorporated a value engineering proposal (VEP) proposed by the Section 2 Design/Build Contractor, Tutor Perini/O&G JV into the tunnel segments, which allowed the use of a specially reinforced concrete segmental lining in lieu of a steel segmental lining through an area of seismic faults.

The special concrete lining consists of hoop reinforcement with continuous bars, dense rebar mats, additional steel fibers and the installation of interior bands to mitigate soil and water ingress in the event of a seismic event. The VEP was a collaborative effort between Metro, WSP and the contractor.

Communication Tools

The use of building information modeling (BIM) has added value to the project through near-real-time collaboration amongst all the many disciplines of the design teams and with the client which accelerated the design development process.

"Modular stations were envisioned to improve system-wide uniformity, and BIM facilitated the highly-coordinated development of these modules which were then strategically combined based on site-specific constraints," Kothari said. "BIM was used to model existing conditions, such as building foundations and utilities, which led to a much more advanced preliminary design since conflicts with the proposed design were identified and resolved early."

BIM also helped the design team achieve Metro's goal of constructing columnless platforms for all stations along the Purple Line Extension.

"BIM has been an invaluable communication tool used to interface with the client, stakeholders, adjacent property owners, third-party agencies, and the community," Kothari said.

Metro will finish the project with a complex record model and a loaded parametric database, which can be used for decades to come in the operation and maintenance of its facilities.

Communication has been a critical asset for the project, not just between team members, but to keep the community apprised of the progress as well.

The WSP project team co-located with client staff in an integrated project office (IPO) to facilitate its ability to respond to the client and project's needs and simplify communication.

"It was very important to the client to have all the project staff in one location as soon as possible and the IPO has enabled us to respond to client requests quickly," Kothari said. "Our team is available immediately to meet with the client to resolve any issues that arise or respond to any special requests." Sameh Ghaly, LA Metro senior executive manager for project management, praised the ongoing collaboration the agency has had with Kothari since the advent of his preliminary engineering work on the project in 2010.

"Ashok is one of the most accomplished global mega-project managers in the transportation industry, and under his leadership, the team has provided critical engineering and environmental support to LA Metro, including environmental impact and funding reports, preliminary and advanced engineering, preparation of RFP documents and design support during construction."

The WSP project team provides technical support for community outreach meetings and presentations and third party coordination meetings and presentations.

"Public support for the Metro Purple Line Extension Project remains high," he said. "Metro has a robust Construction Relations unit that disseminates up-to-date information about project progress and responds to community concerns during construction."

WSP technical staff have assisted Metro with presentations at community meetings where they have been able to answer the community's questions related to air quality, noise, subsurface conditions and tunneling.

"Because WSP also prepared the project's environmental documents and technical requirements, we could explain the construction contract requirements, the criteria for their development, and how Metro would be monitoring construction to protect the community," Kothari said.

Progress During Pandemic

Despite the challenges posed in 2020-21 by the COVID-19 pandemic, Kothari said that construction progress on the Metro Purple Line Extension Project has not been negatively impacted. During the "Safer at Home" order in Los Angeles County, services provided by Metro were classified as essential services and construction work was exempted from the order.

"The initial challenge was to put a program in place to rigorously monitor safety procedures at the office and in the field and ensure that anyone who tested positive self-quarantined immediately and reported their condition to their supervisor so that offices were closed and that spaces could be sanitized," Kothari said. "Additionally, project team members were allowed to telecommute, if feasible, based on their responsibilities. Due to this program, few illnesses were reported at the work sites."

A benefit from the countywide order was the reduction in traffic around the work sites. For example, on Section 2 at the location of the Wilshire/Rodeo Station, the City of Beverly Hills approved a full closure of Wilshire Boulevard for three and a half blocks for over two months to expedite piling and decking activities.

"The project was able to complete the decking with significantly fewer impacts to local business and shave months off the schedule because this activity was originally scheduled to occur over weekends between August 2020 through January 2021," Kothari said.

Mentoring/Protégé Program

WSP established a mentoring/protégé program on Section 3 of the project with Metro's support in June 2016, designed to benefit the sub consultant firms working with us on the project. The goals of the program were to:

- Assist small businesses, with consideration given to minority-, woman-, disabled veteran-owned and other historically underutilized businesses (HUBs), to increase capacity and access to opportunities to grow their business;
- Create strategic relationships with key smaller firms and establish a go-to relationship between WSP and protégé firms;
- Use WSP's global resources for knowledge-sharing with subconsultants; and
- Foster the establishment of long-term business relationships between protégé firms and WSP.

Kothari is grateful for the opportunity to participate in the creation of a major transportation project that will transform mobility options and quality of life for Los Angeles' commuters.

"The depth of resources and expertise WSP provides has been a significant benefit to our client on the project, and I have been honored to lead a talented and dedicated team of professionals along the way," Kothari said. "You feel an extra sense of pride when you play a role designing something so critical to the people who live in your own hometown."

AMC BRIDGE ADVANCES REAL-TIME GENERATIVE DESIGN TECHNOLOGY: DESKTOP METAL'S LIVE PARTS CASE STUDY

THE MORE OPPORTUNITIES metal additive manufacturing opens up to improve manufacturing capability, the more challenges industry professionals face on their way to reach material and cost efficiency, design flexibility, and better performance of their solutions.

Looking to overcome the limitations of existing additive manufacturing (AM) technology and unlock AM's full potential, Desktop Metal, an award-winning metal 3D printer manufacturer, turned to AMC Bridge to advance the Live Parts™ solution for real-time shaping of metal parts.

Client

Desktop Metal (NYSE: DM), based in Burlington, Massachusetts, is pioneering a new generation of additive manufacturing technologies focused on producing end-use parts. The company designs and markets 3D printing solutions for all scales of production—from complex prototypes and on-demand tooling to the rapid manufacture of thousands of parts.

Founded in 2015 by leaders in advanced manufacturing, metallurgy, and robotics, Desktop Metal addresses unmet challenges of speed, cost, and quality to make metal 3D printing an essential tool for engineers and manufacturers worldwide.

Challenges

Advancing at a rapid pace, metal 3D printing has already overcome the geometric limitations of conventional manufacturing processes, creating new freedom for part shapes design. Nowadays, metal additive manufacturing technologies allow generating highly complex, lightweight, and stable structures that have never been possible with traditional manufacturing techniques, such as machining and casting. However, a lot of manufacturers and engineers are still challenged by the appropriate ways of using these technological advancements.

To demonstrate advantages of the latest innovations that enable creating light and strong designs similar to shapes found in nature, Desktop Metal had an idea of upgrading Live Parts, their existing technology, applying a growth-based approach, where parts grow similar to plants in the real world, that is, they become stronger in areas of high stress and strain. The growth algorithm was also aimed at improving the generative process by automatic handling of both design and manufacturing constraints. Besides, the client wanted to seamlessly integrate Live Parts into the CAD system environment.

With a proven track record of successful CAD interoperability developments, AMC Bridge was an ideal candidate for the project.

Solution

To fulfill the client's needs, the AMC Bridge development team extended the functionality of the existing Live Parts technology and integrated it into SOLIDWORKS 3D CAD package.

Live Parts is a generative design tool that applies morphogenetic principles and advanced simulation to auto-generate part designs and generates new parts based on initial constraints specified by the user—restraints, loads, and so on. The tool produces geometry for lighter-weight, strong metal parts that can be efficiently printed.

The Live Parts functionality enables users to:

- Generate real-time parts from scratch using only initial constraints.
- Easily set constraints and loading conditions.
- Create optimized, manufacturing-ready models in a matter of minutes, mainly because of GPU-reduced design time.
- Control the modeling process.
- Directly export design changes to SOLIDWORKS and other CAD software for refinement, finite element analysis, and modeling.
- Easily adjust parameters in real time throughout the 'growth' process:
 - Select material properties and create a particular material.
 - Set up force magnitude and direction.
 - Set up gravity direction.
 - Tune up the safety factor, which affects the part's thickness and robustness.
 - Ensure integration between CAD software and Live Parts to receive fast optimization.
 - Export files in the format needed for the manufacturing method selected by end users.
 - Generate highly optimized parts that can stand up to strenuous conditions.

Aimed to ensure quick generation of optimized, manufacturing-ready models in a couple of minutes, Live Parts runs in the cloud on NVIDIA CUDA GPU-accelerated virtual machines.

Process

To achieve maximum efficiency during the development process, the AMC Bridge team of experienced professionals divided the scope of work into the following milestones:

- General functionality extension, development of the UI, core algorithms, and algorithms for growth control.
- Performance improvement using NVIDIA CUDA GPU:
 - Face strain computations for voxels.
 - Triangles snapping to initial mesh geometry.
- Full implementation of the SOLIDWORKS extension that allows creating input models for Live Parts.
- Development of the application update mechanism.
- Development of the web application to control Live Parts deployment on the Paperspace® cloud.

- Implementation of user subscriptions to different billing plans.
- Maintenance and further enhancements of the application.

The team worked in close collaboration with Desktop Metal to advance the technology and overcome the following key challenges:

- Adapting Live Parts to SOLIDWORKS entities and environment.
- Improving face strain calculation using NVIDIA CUDA to ensure better performance.
- Various user experience improvements.
- Changing mesh generalization.
- Integrating the finite element library for accurate model adjustment during the simulation process.
- Adding the versioning mechanism for input data to avoid conflicts between the new functionality and the previous data formats.
- Integrating the licensing library to make a standalone application.

Focused on progress at every project milestone, the team regularly provided deliverables of the developed functionality during weekly reports and meetings.

Upon completion of functional and regression testing, the ready-to-use technology was delivered to Desktop Metal.

Results

Due to the collaborative effort made by both teams during an iterative development, Live Parts was extended to a complex SaaS/PaaS solution. The resulting application is an industry-leading simulation software extension that fully meets users' needs and requirements. It is used by innovative companies in various industries, from medicine, manufacturing, tooling, automotive, consumer electronics to oil and gas.

According to Design World®, a leading publication in the design engineering space, Live Parts was highly appreciated by the judging panel of LEAP Awards 2019 and became a gold winner in the Software nomination.

The efforts of the AMC Bridge development team were recognized by the client. In his feedback on working with the team, Andy Roberts, Technical Fellow at Desktop Metal, emphasized:

'Continue to have a great experience working with the team. Highly communicative and appreciate the partnership.'

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SMOOTH FINISHES: PAVING, 3D AND THE ROAD TO AUTONOMY

By Vicki Speed

EQUIPMENT AND ASSOCIATED HARDWARE and software that streamlines and simplifies paving operations has advanced by leaps and bounds in recent years, so much so that the capabilities have changed the way contractors operate and how owners specify jobs.

In most cases, the differentiator has been the adoption of 3D paving control solutions that not only drive productivity, but deliver assured vertical and horizontal accuracies to within millimeters. Whereas 3D solutions were once used primarily for high performance surfaces, such as racetracks and airport runways, contractors have since recognized the ROI in the way of productivity and quality across all projects. With an accurate 3D design model and precise control, the paving contractor can complete the project faster, with a better material yield and minimal material waste, while producing a higher quality, longer lasting result.

These solutions work particularly well where there is variable depth and slope—and state transportation owners and the Federal Highway Administration have taken notice. As a result, some state departments of transportation are rewriting specifications to require lower International Roughness Index (IRI) percentages, while others are incentivizing smoothness with bonuses for IRI percentage improvements.

Perhaps even more exciting to some is that 3D paving technology has become a proving ground for more automated and autonomous operations in construction.

Performance Focused

From a hardware perspective, a 3D paving control system incorporates machine specific sensors and other components, as well as specialized software algorithms to place material to a target 3D design elevation. These solutions utilize highly accurate instruments, such as total stations, and other guidance methodologies such as GNSS. With an x, y, and z (elevation) position, the software guides the machine to grade and slope according to the model. Put simply, it's a sensor that sends 3D commands to the machine controller, which in turn controls the hydraulics of a machine to a defined 3D design elevation.

The software algorithms are a bit more complex. A 3D machine control system utilizes a 3D design to place material to a target elevation, often in multiple lifts, or layers, until the final design elevation is reached. Machine control systems, like Trimble Roadworks Paving Control Platform for Asphalt Pavers, sends 3D design information to the machine's underlying controller to control the elevation and/or slope of the screed to achieve design elevation. Other machine control systems, like Trimble PCS900 Paving Control System for Concrete Pavers, are able to both control the pan of the machine to a certain elevation and steer the machine to a steering line, or main alignment within the design. The result is a more accurate and consistent surface with better



rideability results that can meet today's smoothness specifications and increase the contractor's smoothness bonus.

For reference, Trimble total station based paving systems are accurate to +/- 3mm horizontally and +/-1mm vertically when at a distance of up to 100 m from a Trimble SPS930 Universal Total Station. PCS900 concrete paving systems are able to achieve this accuracy both by steering the machine according to a mainline alignment in a 3D design as well as vertical placement of concrete material by the paver pan. That consistent accuracy is a big reason for adoption by contractors all over the world.

Milling and paving contractor KUTTER GmbH & Co. KG Construction Company, headquartered in Memmingen, Germany, relied on its 3D paving workflows to support the Karl-Marx-Allee Boulevard modernization project. The project required the removal of the roadway's concrete layer to a specified level. According to the site manager, the high points along the road were on average about 10 meters apart, so the milling depth changed continuously. In order to ensure the drainage of rainwater, engineers specified a swinging gutter profile over a length of approximately 800 meters and a width of 5.75 meters. Further, the engineering plans required the slope to vary between 2.5 percent and 3.0 percent at intervals of 3-5 meters. On the remaining 9.25-meter width of the roadway, the profile had to have a transverse gradient of 2.5 percent from the center to the edge of the roadway. This geometry resulted in a constantly changing milling depth between 0 and 12 centimeters.

The project team used a compact milling machine with a milling width of one meter equipped with the Trimble PCS900 Paving Control System for Milling Machines. With the 3D technology on the milling machine, crews were able to produce the profile exactly as planned. The deviations from the terrain model were at most 3 mm from the target value. The high accuracy of the milled surface made the placement of a constant thickness asphalt quick and easy without the need for time-consuming leveling or compensation layers.

A similar solution has been developed for asphalt paving. For instance, last year Trimble introduced its Trimble Roadworks 3D Paving Control Platform for Asphalt Pavers. The technology lets operators accurately

The 3D Advantage Helps Hawaiian Contractor Meet Spec, Reduce Waste

Jas. W. Glover, Ltd. (Glover), a locally owned and operated Hawaiian general contracting company specializing in concrete and asphalt paving, found similar advantages when tasked with the re-construction of Runway 8R-26L, also known as the Reef Runway at the Honolulu International Airport on the island of Oahu.

The FAA and the Hawai'i Department of Transportation (HDOT) required that each section of the runway take no longer than 15 days to complete, with stiff penalties written into the contract for missing deadlines. To increase milling and paving production at the Reef Runway, Glover added a 3D paving control system on an additional Roadtec RX-900 mill and Cat AP1055D paver. The system included four more total stations and two rovers for topos, layout and checking grade. The firm ran two 12.5' wide 3D mills and two 25' wide 3D pavers to keep up with production. The ability to control the milling elevation, and placing material to elevation with the pavers while maintaining slope and smoothness without stringline or wires was key to the project success. Each machine was controlled by a total station, and Glover crews used additional total stations to leapfrog every 1,000 feet without having to stop the machine.

The company built the 3D models in Trimble Business Center software. The 3D design is then transferred to the machine and displayed to the operator to show areas that are on, above, or below ideal grade comparing the actual drum position and slope with the digital design. The system automatically guides the milling drum to cut the ideal depth and slope without stringlines or manual adjustments. Not only did the paving control system on the milling machines provide a smoother base for paving, that smarter milling means they have to remove less waste material and mill off the minimum depth only.

According to the company executives it would have been nearly impossible to mill everything to the new profile without using 3D technology because of the existing variable slopes of the runway. They say the technology saved crews huge amounts of time and manpower in terms of layout, topos and establishing where the grades should be.

The owner was also pleased with the smoothness of the runway surface, noting that there were zero grinds on the finished product and elevation was within specification. In fact, Glover met the half-inch grade tolerance, quarter inch up or down for the entire length of the runway.

With 3D milling and paving machine control from Trimble, the company was able to lay 5,000 tons of asphalt to grade and slope per night, in a 12-hour shift compared to 2,000 or 2,500 tons per shift, on other jobs.

control the screed to pave with variable depth and slope based on a 3D design. It can take out high and low areas on the first layer as the screed follows the design for slope and thickness. The system automatically lays the right amount of asphalt for improved accuracy and increased productivity.

By avoiding excess asphalt placement, the system increases road smoothness, which can also lead to potential bonus pay on projects that offer such incentives. It also means not having to spend time setting out and taking up stringline.

Facilitating Adoption

While 2D paving solutions are well adopted in the industry, 3D can be a difficult investment decision for contractors, despite the proven ROI. It's one reason why technology developers are introducing subscription-based models to help contractors transition.

Subscription-based services such as Trimble Platform as a Service (TPaaS), available in North America, give contractors the ability to purchase certain hardware and software solutions for a set monthly price and get full technology assurance, including hardware upgrades, throughout the agreement. A subscription investment also turns a capital expenditure into an operating expense, which could also help contractors benefit from federal infrastructure spending.

Influencing Autonomy

Moving forward, OEMs continue to advance machines with more technology, including the addition of integrated temperature sensors, compaction sensors, safety sensors and even GNSS positioning. At the same time, operator assist functionality such as 3D machine control steering and other advancements in machine automation are a focus area for machine control providers and OEMs. These organizations are building new lines of machines that will be capable of more autonomous features, either by adding aftermarket technology designed for that purpose, or delivering "technology ready" applications.

However, autonomous construction – and specifically removing an operator or overriding the operator – is a hot and emerging technology direction but is likely many years out.

For now, the advantages derived by automatic and semi-autonomous operations are clear, helping contractors greatly improve productivity, manage labor shortages, more efficiently use materials and deliver higher quality products.

UNDERSTANDING THE OPPORTUNITIES FOR AI-CAMERAS AND LIDAR FOR SMART ROAD INFRASTRUCTURE

By Dr. Georges Aoude

AS THE CONSUMER ELECTRONICS SHOW (CES) in January sparked a new wave of autonomous vehicles (AVs) coming to the automotive market in the next few years, much focus as of late has been on the technology of these vehicles themselves. However, the technology embedded in road infrastructure is also beginning to see more conversation between service providers and municipalities.

With advancements in artificial intelligence (AI) and 5G network connectivity, smart-road infrastructure technology offers the promise of being added to many different roads, bridges, and other transit systems across the U.S. in hopes of improving real-time traffic analytics and tackling the most challenging road safety and traffic management problems. One technology at the center of this discussion is the present-day use of AI-enhanced cameras and tomorrow's promise of LiDAR technology.

Artificial Intelligence Will Enhance Camera Sensing Performance

Today there are hundreds of thousands of traffic cameras deployed in the U.S. alone, and even millions more when CCTV cameras are considered. They are mainly used for road monitoring and basic traffic management applications (e.g., loop emulation). However, bringing the latest advancements of AI to these assets can immediately improve basic application performance and unlock more advanced software applications and use-cases.

AI and Machine Learning deliver superior sensing performance over traditional computer vision techniques found in legacy cameras. They enable more robust, flexible, and accurate detection, tracking and classification of all road users with algorithms that can automatically adapt to various lighting and weather conditions. In addition, they allow for predictive capabilities to better model road user movements and behaviors, and improve road safety. Agencies can immediately benefit from AI-enhanced cameras with applications such as road conflict detection and analysis, pedestrian crossing prediction, and infrastructure sensing for AV deployments.

LiDAR Technology Cannot Fully Replace Cameras

LiDAR can provide complementary and sometimes overlapping value with cameras. However there are still several safety critical edge cases where LiDAR's technology does not perform well (e.g., heavy rain and snow, granular classification), and where cameras have been proven to handle better. Moreover, today's LiDAR technology remains expensive to deploy at scale due to its high unit price and limited field of view. As an example, it would take multiple LiDARs at a hefty investment to be

deployed in a single intersection, where just one 360-degree AI-camera can be a more cost-effective solution.

For many budget-focused communities, AI-cameras remain the proven technology of choice today. Over time, as the cost of LiDAR technology moderates, communities should evaluate augmenting their infrastructure with such sensors.

Eventually, Sensor Fusion Will Drive Strong Results

When the cost of LiDAR technology eventually sees an anticipated reduction, it will be viewed as a strong and viable addition to the AI-enhanced cameras that are being installed today. Similar to autonomous vehicles, sensor fusion would be the go-to approach for smart infrastructure solutions and would maximize the benefits of both technologies. See table below.

Relative Performance Comparison of Camera vs. Lidar Today

Feature	Legacy Camera	AI-powered Camera ¹	Lidar	AI-powered Camera and Lidar Fusion
Challenging lighting (low light, glare)	Low	Medium	High	High
Adverse weather conditions (snow, rain, fog)	Low	High	Medium	High
Localization	Low	Medium	High	High
Classification	Low	High	Medium	High
Affordability	High	Medium	Low ²	Low ²

1. Assumes presence of with IR or good low-light sensor
2. Expected to improve with time

The use of a cost-effective and performing AI-powered camera today, combined with the great potential of LiDAR in the coming years could help communities and municipalities achieve a win-win scenario today and tomorrow.

At the end of the day, the goal is clear in improving overall traffic flow and diminishing vehicle crashes and fatalities, but the technology and implementation strategy has to be right in doing so. The technology monitoring our roads needs to change too, thus calling for the consideration of AI-powered cameras today with the promise of LiDAR tomorrow.

DR. GEORGES AOUDE is the co-founder of Derq, an MIT spinoff powering the future of connected and autonomous roads, making cities smarter and safer for all road users, and enabling the deployment of autonomous vehicles at scale. Derq provides cities and fleets with an award-winning and patented smart infrastructure Platform powered by AI that helps them tackle the most challenging road safety and traffic management problems.

USING GROUND PENETRATING RADAR TO INCREASE CONSTRUCTION EFFICIENCY

ON-SITE EQUIPMENT CAN KEEP WORKFLOW GOING SMOOTHLY

By Brett Caldwell

AS THE SAYING GOES, “Time is money,” and general contractors, superintendents, and project managers know that the cliché means focusing on keeping workflow going as smoothly as possible. Like a conductor of a symphony, GCs make sure each trade “chimes in” when needed – not before and not after. Especially in the construction world, the GC’s role is to keep the “instruments” (mechanical, electrical, and plumbing contractors, concrete, framers, fire and sprinkler, drywallers, and steel contractors) working together in harmony. Giving construction crews ground penetrating radar (GPR) systems helps enhance the safety and efficiency of the jobsite.

Many factors can reduce construction efficiency

Construction efficiency can be affected by a variety of factors. There can be breakdowns in timing due to shipment delays. Did a plumbing sleeve get knocked out of place during the pour? Did steel pieces needed to weld framing together get covered by concrete? Is there a change order that requires a conduit or pipe run to be moved 10 inches – on all 30 floors? While these issues are being sorted out, there is often a domino effect with multiple contractors – even one or two minor issues can result in a cascading delay for the tradespeople on site.

Data sharing on the construction site

While construction cultures do tend to vary by region, it is not uncommon to see superintendents, assistants, project managers, and engineers walking around with ToughPad tablets connected wirelessly, giving them real time access to individual plans, schedules, and drawings. Imagine standing on the 30th floor of a high rise and being able to pull as-builts on a screen rather than having to walk all the way to a construction office that may or may not even be within the building.

Different manufacturers are bringing in tools to digitize space and drawings. For example, if the fire sprinkler pipes are mistakenly placed in the same location as plumbing lines, those with tablets could shoot the conflict to CAD engineers and get it resolved much more easily. Being able to upload the GPR data to the company’s server and share it with engineers who have to make a decision on whether it is clear so they can drill is a real time and money saver. Without this information, they would have to go to the office, print out the data and drive it somewhere – adding steps and time and costing more money.

On the horizon is an increase in cloud-based sharing of information along all levels of the construction process, from data collection to



the decision makers (engineers, project managers) and back down to the trades doing the work (electricians, plumbers, mechanicals). This even extends to GIS-based data making its way to excavators clearing ground for the beginning of a project.

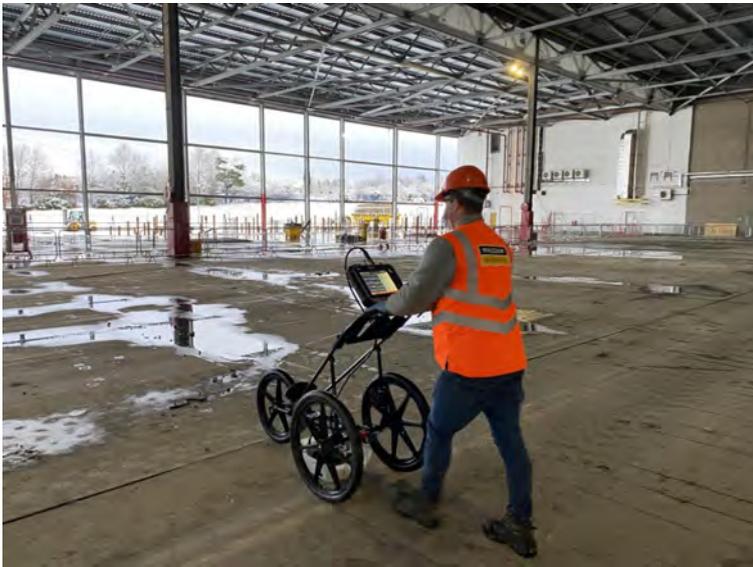
GPR tools can improve safety

GPR is almost always needed when something unexpected occurs. It is rarely something planned out in the construction cycle. So how can contractors keep unplanned events from adversely affecting the construction schedule? One way is to give GCs access to GPR equipment on each jobsite. Many trades and GCs are bringing in units to keep on hand, so a simple problem can be fixed quickly.

Newer equipment features user friendly interfaces, easy enough that someone who does not “do GPR for a living” can take the tool out and use it for clearing an area, double checking to see if possibly a sleeve has been forgotten – or to make sure concrete drillers are not going to hit anything. This can be done relatively easily, with manufacturer’s training and a bit of experience. (It should be noted that GPR service providers will always have a place; some areas are just so complicated that having years of experience with thousands of scans under their belt is necessary.)

Take a recent example of a tower crane being used for support during construction of a high rise building in Austin, Texas. The crane anchors affixed to different floors started breaking, presenting a significant safety issue as there was a public street below and the new construction was surrounded by occupied buildings. The job came to a screeching halt when it was discovered; GPR was used to verify damage and indicate areas for new anchors, and the job could quickly start up again without further delay.

Another example was a utility company that was conducting horizontal boring for installation of a fiber optic cable. A horizontal boring company used 811 to mark out utilities based on use of as-builts. Un-



can™ Mini XT and LT, rugged all-in-one concrete scanning systems designed for contractors who need to locate rebar, conduits, post-tension cables, and voids.

Another option is the GSSI UtilityScan® GPR system, with a simple user interface that makes it easy to locate and mark the depth of underground utilities in real-time in the field. The on-screen 3D data collection mode allows users to easily define the time slice depth and thickness in the field with the 3D data on the screen. The optional LineTrac® power detection module enables contractors to identify and trace the precise location of underground electric and RF-induced utilities.

Future of GPR tools focuses on improving data flow

Construction personnel can save time and money now by maintaining simple GPR tools on-site. All eyes are looking towards how quickly one can eliminate or reduce the dead time between collection of data and sharing it – so we can get the trades back to their work.

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fortunately, an unmarked water line was cut while laying the fiber optic cable. The contractor had two out of town crews standing by (on per diem), waiting for the water line to be located for the entire apartment complex. This is a case where on-site GPR could have verified the utility markings simply and quickly before the issue arose.

I have personally experienced multiple instances of change orders occurring that moved locations of various piping or conduits, resulting in delays for multiple trades. Any time something unexpected was found during a saw cut – say a conduit was struck – you have not only the saw crew on hold, billing your company stand-by time, but also the trades waiting on the work. Could there be anything worse than hourly employees standing around due to these issues?

The best scenario would be if the GC could use on-site GPR equipment to do basic clearing immediately and get back to work. Instead, the contractor often has to call in a service provider and schedule the work. Then the provider has to scan all the possibly affected areas before getting back to work.

This method of locating is very frequently an issue in remodeling jobs. GPR may be built into the planning process, but usually a crew will start saw cutting – and when they hit a conduit that crew goes on standby, charging standby rates until GPR can be brought in to verify where it is safe to cut. I saw this happen once at an old strip mall where they were moving the bathroom and needed to sawcut trenches to run plumbing.

Clearly, keeping GPR equipment on site would be a benefit to ensure the tight construction schedules are kept. Examples include GSSI's StructureS-

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New Prism Pole System Provides Significant Time Savings

An innovative prism pole system with tilt compensation, automatic pole height readings and unique target identification takes total station surveying to the next level.

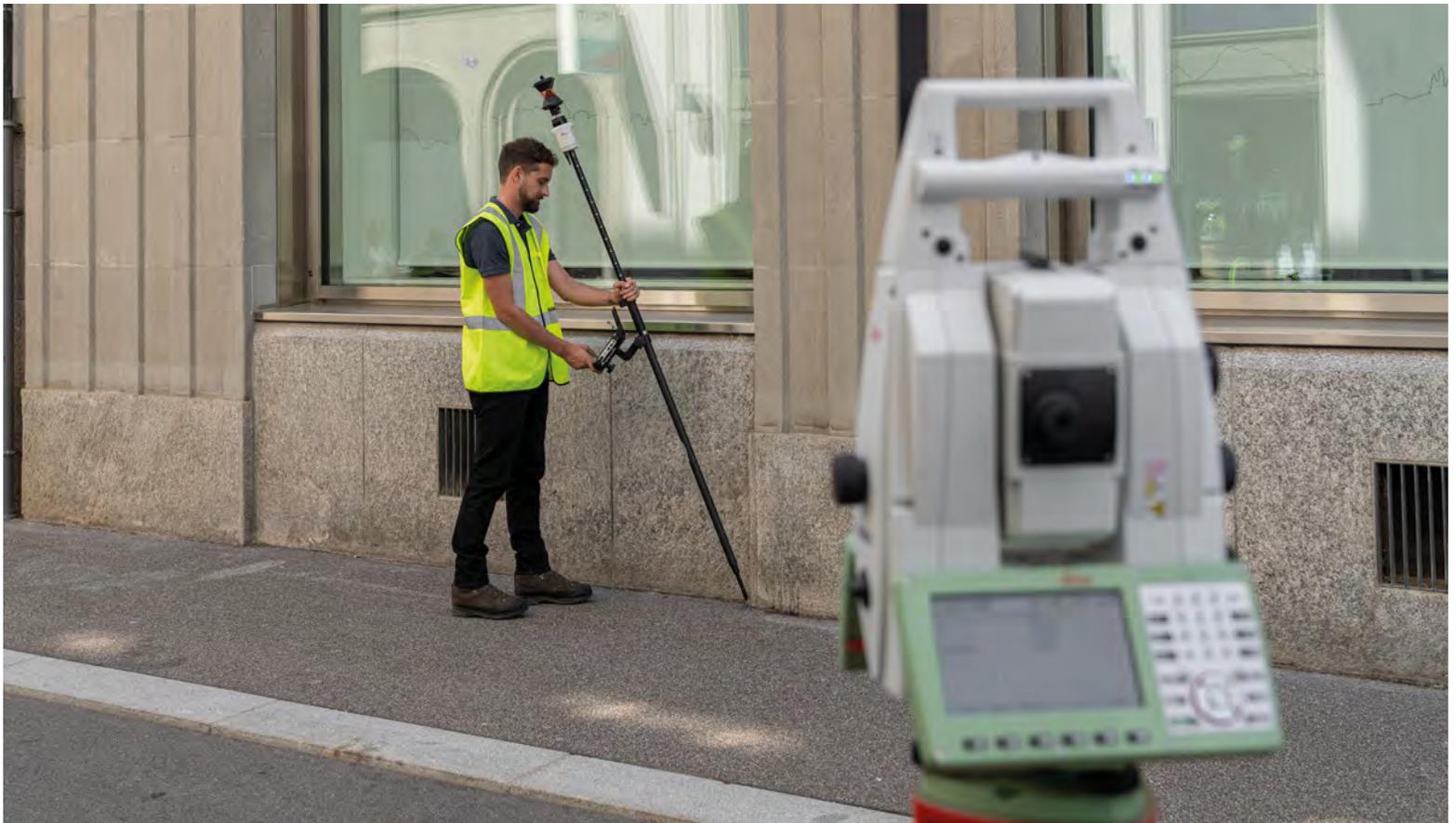
How much time would you save on every surveying project if you didn't have to stop to level your prism pole or measure the pole height after an adjustment?

These are just a couple of the advantages of the new **Leica AP20 AutoPole** from Leica Geosystems, part of Hexagon. The groundbreaking technology combines an intelligent sensor module with a new reflector pole and operates with Leica Geosystems' existing automated total stations to make surveying workflows fast and autonomous.

Tilt Compensation Increases Productivity

When Leica Geosystems in 2017 introduced the first calibration-free tilt-compensating GNSS solution, the Leica GS18 T, it was a true game-changer. The ability to measure without leveling the pole provided productivity gains of 20 percent or more. Now those same productivity gains can be realized in total station surveys with the new Leica AP20 AutoPole.

The system's tilt compensation capability decreases measurement time and increases flexibility and safety onsite by allowing you to easily measure points in inaccessible or hazardous locations. Rather than keeping an eye on the level bubble, you can focus on where you're walking. A quick glance at your field software provides real-time information on the current pole tip accuracy. You can also flip the pole upside down to take inverted measurements.



“Because you don’t have to level up the pole, you can just keep moving,” says Burke Asay, US/Canada product marketing manager for Leica Geosystems. “It makes you very efficient in the field.”

Automatic Pole Height Measurement Eliminates Errors

If you’ve ever been on a survey and forgotten to enter a change in your prism pole height on your controller, you’re not alone; it happens to everyone. With the AP20 AutoPole, this problem is easily eliminated.

Using a Bluetooth connection, the AP20 software automatically detects the pole height as soon as the upper tube of the pole is snap-locked into predefined lock positions, which are spaced at standard 5-cm intervals. The achieved accuracy in height is +/-1.0mm. Since you no longer have to read and type height changes in the field, you save time in post-processing corrections and avoid returning to the field to remeasure.

Automatic Target Identification Prevents Work Interruptions

On a busy construction site with multiple sensors and targets, finding and staying locked on to the correct target can be a challenge. The AP20 AutoPole overcomes this issue with the TargetID function, which uniquely identifies the correct target and ensures that your instrument will always lock to it.

Technology Extends Your Surveying Potential

Finding and keeping top talent, solving complex project challenges with confidence, creating accurate, meaningful deliverables quickly with no compromises—these are just some of the requirements to be successful in today’s fast-paced surveying and engineering professions. Technology provides an advantage. With innovations like the AP20 that increase your efficiency and confidence, you can complete more work in less time and continue to grow your business.

For more stories on how technology improves surveying efficiency and quality, visit <https://pure-surveying.com/insights>.

To learn more about solutions to maximize your surveying potential, [get in touch with a surveying and engineering expert at Leica Geosystems](#).



The AP20 AutoPole maximizes safety, flexibility and efficiency in total station surveys. [Watch the video and learn more here.](#)

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