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Putting it Back Together
Battery Park Buildout
Q&A with Tom Hendrick, President & CEO of Wallace Engineering
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By Chad Clinehens, P.E.
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WHAT A DIFFERENCE A YEAR MAKES. In April 2018, I was president and CEO of Zweig Group. While the title hasn’t changed, plenty of other things have. The headliner is that I’m now the firm’s majority owner. And, in my expanded role as the head of a growing AEC management advisory firm, my list of obligations has predictably increased. I’ll save you the details, but as it pertains to Civil + Structural Engineer magazine, it means I’m now the publisher. That title – which comes with a multitude of high expectations – signifies an important development in my career, a development I’ve gladly embraced.

Instead of just contributing a column every month, as I did for about two years, I’m now involved in all facets of the magazine’s operations. But rather than micromanage, I’ve empowered a skilled media team to do what it takes to produce the industry’s finest AEC publication. This means ad sales, customer service, sponsored advertorials, graphic design, web design, and, of course, original editorial content. I also had to consider the nexus between readership and revenue – that all-important metric called circulation. As I mentioned in last month’s column, we decided to cancel our print publication in favor of an exclusively digital magazine format. The move concentrates our resources, allows for deeper focus, and saves a lot of trees.

Still, even if the market told us that the move to all-digital was the right thing to do, it was not an easy decision to make. We had to consider the reaction from advertisers. Personnel was realigned. The business model was reconfigured. And that’s publishing in a nutshell. It isn’t easy. The numbers are intimidating, the pitfalls are deep, and there’s a million things that can go wrong when you produce 50-plus pages of content every month – and then send it out to thousands of very intelligent people to consume. However, the challenges, and overcoming them, are what invigorate me and my team.

This is also where C+S Engineer dovetails into Zweig Group’s larger mission to Elevate the Industry. Our firm’s new focus demands that all of us Celebrate, Promote, Diversify, Change, and Educate. Together, we can use these five tenets to push awareness of the AEC industry, and the positive impact it has on the world, into the mainstream. When this happens, we’ll all reap bigger rewards, both personally and professionally. This magazine, as the premiere showcase for what’s happening in our field, will play an important role in achieving that aim.

But we also know that nothing happens overnight. And we don’t jam square pegs into round holes. The magazine will remain what it has been, a platform for what’s going on in management, technology, construction, surveying, sustainability, water resources, and training. Even in a time of great change, the magazine will not be allowed to drift from its mooring. When the opportunity comes to better serve the readership through delivery, the customer experience, or content, however, those opportunities will certainly be taken. In other words, C+S Engineer is going to elevate.

A magazine, like an AEC management consulting firm, is a living thing. It has its seasons. It is powered by people. The ability to change, and to serve a higher purpose, is innate. As a newly minted publisher, I now see the parallels in vivid color. Along with my media team, I am energized by the possibilities on the horizon. I want you, the reader, to share in my enthusiasm.

CHAD CLINEHENS, P.E., is Zweig Group’s president and CEO. Contact him at cclinehens@zweiggroup.com.
Facts about Stray Currents in MSE walls

Reinforced Earth® MSE walls have been used for direct support of electrified rail since the early 1970’s on five continents, and in the United States since 1977. The major metropolitan areas in the U.S. continue to use MSE walls with steel soil reinforcements to support electrified rail. On early projects, it was questioned whether stray currents from a rail system might negatively affect the corrosion rate of the soil reinforcements. A stray current in a rail system can be discharged into the ground when the railway is not completely insulated from the soil below. Three independent studies were conducted in the 1970’s and 1980’s by corrosion experts, and all concluded that the influence of stray currents is negligible in discrete steel soil reinforcements used in MSE walls.

The evidence points to four major factors. First, the discrete soil reinforcements are very short in comparison to the length of the rail tracks, and other common buried structures such as pipes and conduits. Second, the reinforcements in the soil are electrically discontinuous. Third, the MSE wall soil reinforcements are typically perpendicular to the direction of the rails and the system’s return current flow. Lastly, the MSE wall select backfill is specified to have a high resistivity, meaning current flow will seek a less resistive path such as the rails and in-situ soil.

Detailed information can be found in a 1999 technical paper in the Transportation Research Board’s journal, titled The Effects of Stray Currents on Performance of Metallic Reinforcements in Reinforced Earth Structures.

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April 6 - 9
Orlando, FL

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Canadian Prime Minister Justin Trudeau is in trouble. Ex-Justice Minister and Attorney General Jody Wilson-Raybould recently testified that Trudeau and his advisors pressured her to sidestep prosecution of SNC-Lavalin, the Quebec-based engineering and construction firm, on allegations of fraud and bribery.

What was the alleged transgression by SNC-Lavalin, one of the world’s true mega-firms? Paying bribes to former Libya strongman Muhammar Gaddafi’s family for lucrative contracts. According to various media reports, the bribery is alleged to have taken place between 2001 and 2011. If found guilty, according to The Guardian, SNC-Lavalin would be barred from bidding on federal projects for a decade. For a company with 3,400 employees in Quebec, that could be devastating.

Wilson-Raybould told justice officials that Trudeau and his team pressured her to support a “deferred prosecution agreement” with SNC-Lavalin, an agreement that would involve fines and enhanced compliance, but not criminal prosecution. When she did not go along with the plan, Wilson-Raybould told justice officials, she was demoted by Trudeau. The prime minister, of course, denies the allegations. But the cloud now hanging over Trudeau could come into play later this year, when he is up for re-election. Stay tuned.

Seriously, it won’t be good for your personal or professional life. Just take the case of an architect in upstate New York. Last year, the guy was handed an indefinite suspension and ordered to seek treatment until he was “fit to practice.” When the suspension ends, he’ll still be on probation for another two years, which takes this case into at least 2020. Why all the fuss? Because, the “Licensee admitted to the charge of having been convicted of two Driving While Intoxicated convictions.” Next time – or the next two times – you’ve had a few drinks, it might be wise to take an Uber.

There’s an interesting case brewing In United States District Court for the Southern District of New York. A photographer filed suit against an architecture firm because, he says, the firm used one of his photos – a photo that appeared copyrighted in the New York Times – in its marketing collateral without credit and without permission. The photographer is asking the court to give him any “profits, gains or advantages of any kind attributable to defendant’s infringement of plaintiff’s photograph,” or statutory damages of up to $150,000 “per copyrighted work infringed” pursuant to federal law. In a second claim for relief, the photographer is asking for as much as $25,000 for “each instance of false copyright management.” The firm denies the allegations and has asked the judge to toss the case. Regardless of how this case turns out, it’s got to be headache for all involved.

Earlier this year, a band of brash thieves came up through the sewer system and through the floor to burglarize a bank in Antwerp, Belgium. The break-in was near the city’s diamond district. According to news reports, when police arrived, the bank’s vault was still locked. When they finally got inside, they found a hole in the floor and empty deposit boxes. Investigators discovered at least two tunnels, one leading into the sewage pipe, and one leading out of the pipe and into the vault. The local newspaper, Het Laatste Nieuws, interviewed an Antwerp-based engineer, Els Liekens, who was quoted as saying, “I do not know how those burglars got out alive there. When it starts to rain, rainwater enters the sewers and can fill up very quickly, which can lead to drowning if you are there.”

According to The Wall Street Journal, it was the worst disaster of its kind in the last 50 years. At least 179 people were killed by the river of mine waste unleashed by the breach. Well over 100 are missing and presumed dead. In the wave or arrests following the disaster, Makota Namba, a senior engineering inspector, was taken into custody. Namba, and others, have since been released, but Namba remains a central figure in the case investigators are building as they discern what exactly happened – or didn’t happen – between the dam’s owner, Brazil mining giant Vale, and the German inspection firm TÜV SÜD. Another person who also looks to be an important figure is Andre Yassuda who, like Namba, worked as an engineer for TÜV SÜD at the time the dam broke. By the time this is all over, plenty of people will probably lose their jobs, and some might even go to jail, based on what the engineers know and what they have to say. Unfortunately, plenty of people have already been buried.

If you know of an interesting or off-kilter story taking place in the AEC industry, please contact C+S Engineer at rmassey@zweiggroup.com.
### ZWEIG GROUP 2019 EVENT SCHEDULE

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For more dates and location information: [www.zweiggroup.com/seminars/](http://www.zweiggroup.com/seminars/)
APRIL 2019

NASCC: THE STEEL CONFERENCE
APRIL 3-5 — ST. LOUIS
Educational and networking event for the structural steel industry, bringing together structural engineers, structural steel fabricators, erectors, detailers, and architects.
www.aisc.org/nascc

14TH NATIONAL LIGHT RAIL & STREETCAR CONFERENCE
APRIL 7-9 — JERSEY CITY, N.J.
Sessions showcase the positive results experienced in metropolitan areas that have embraced light rail and streetcar and explore new ways to plan, design, construct, maintain, and operate light rail and streetcar systems.
www.apta.com/mc/lightrail

DESIGN-BUILD FOR TRANSPORTATION & AVIATION
APRIL 8-10 — CINCINNATI
Only U.S. event targeted to the rapidly growing design-build transportation industry. Includes a newly added Aviation track.
www.dbtranspo.com

COMMERCIAL UAV EXPO EUROPE
APRIL 8-10 — AMSTERDAM
www.expouav.com/europe

DESIGN-BUILD FOR WATER/WASTEWATER
APRIL 10-12 — CINCINNATI
Targeted conference for owners and design-build practitioners in the water and wastewater sectors.
www.dbwater.com

CEO ROUNDTABLE RETREAT
APRIL 10-12 — SCOTTSDALE, ARIZ.
Presentations and one-on-one interaction with industry experts and ample networking time and candid conversation to gain new ideas, new tools, and new friends.
https://zweiggroup.myshopify.com/collections/seminars/products/ceo-roundtable?variant=34444441985

THE PRINCIPALS ACADEMY
APRIL 24-25 — DALLAS
Intensive course in all aspects of managing a professional service firm, including business planning, marketing/business development, accounting, financial management, project management, leadership, mergers and acquisitions, ownership transition planning, and recruitment and retention.

STRUCTURES CONGRESS 2019
APRIL 24-27 — ORLANDO, FLA.
Learn the latest from the experts who develop SEI/ASCE standards and earn PDHs from 12 tracks of technical sessions — Buildings, Bridges, Natural Disasters, Professional Practice, Risk Management, Blast, Materials, Seismic, Forensics, and more.
www.structurescongress.org

AUVSI XPONENTIAL
APRIL 29-MAY 2 — CHICAGO
Join 8,500 technologists, regulators, and users across commercial and defense sectors for a comprehensive trade show for unmanned and autonomous systems.
www.xponential.org/xponential2019

AEC BUILDTECH
APRIL 30-MAY 2 — ROSEMONT, ILL.
Inaugural event intended for architects, engineers, and contractors to learn about new building technologies and processes and how to apply them. Offers continuing education credits.
www.aecbuildtech.com

MAY 2019

EXCELLENCE IN PROJECT MANAGEMENT
MAY 8 — KANSAS CITY, MO.
Financial Management for AEC Firms is a one-day seminar that was specifically developed to help design and technical professionals become more comfortable dealing with financial management and accounting. This course helps attendees become better stewards of the company’s resources and to better understand how to leverage resources and maximize profit.

WEF STORMWATER AND GREEN INFRASTRUCTURE SYMPOSIUM
MAY 8-10 — FORT LAUDERDALE, FLA.
Inaugural symposium crafted to deepen the technical knowledge of professionals involved with stormwater management and provide forums to discuss leading issues.

SWAN 2019 CONFERENCE
MAY 15-16 — MIAMI, FLA.
The annual flagship event of the Smart Water Networks Forum (SWAN), a global hub for the smart water and wastewater sectors, brings together global utilities, solution providers, researchers, consultants, and academics to further accelerate the smart water industry.
www.swan-2019.com
P3CONNECT  
MAY 15-16 — DENVER, CO  
National Conference for Public-Private Partnerships offers this event for public-sector officials and private-sector innovators focused on advancing public-private partnerships (P3s) nationwide.  
https://thep3connect.org

INTRODUCTION TO STRUCTURAL DESIGN OF WOOD BUILDINGS PER THE 2018 NDS  
MAY 21-22 — BLACKSBURG, VA  
Course is designed for individuals who never had the opportunity to learn wood design basics in a university-level course, but are involved in the design, construction, and inspection of wood buildings.  
www.cpe.vt.edu/sdwnds/index.html

GEO BUSINESS  
MAY 21-22 — LONDON  
www.geobusinessshow.com

SPAR 3D AND AEC NEXT TECHNOLOGY EXPO + CONFERENCE  
MAY 21-23 — ANAHEIM, CALIF.  
Co-located conferences feature 3D technologies from input to output, from 3D sensing to 3D processing to 3D visualization tools, plus the latest trends and best practices to help design, construct and manage AEC projects.  
www.spar3d.com/event  
www.aecnex.com

LEADERSHIP SKILLS FOR AEC PROFESSIONALS  
MAY 22-23 — SAN DIEGO, CALIF.  
Specifically developed to provide design and technical professionals with the skills to become more competent leaders, including strategies and techniques that will help them grow personally and professionally.  
https://zweiggroup.myshopify.com/collections/seminars/products/leadership-skills-for-aec-professionals?variant=12368768729123

JUNE 2019

SECOND INTERNATIONAL INTERACTIVE SYMPOSIUM ON ULTRA-HIGH PERFORMANCE CONCRETE  
JUNE 2-5 — ALBANY, N.Y.  
Innovation Awards and a platform to present recent Ultra-High Performance Concrete activities, research, and breakthroughs, as well as an opportunity to participate in hot topic panel discussions.  
www.uhpcsymposium.com

THE PRINCIPALS ACADEMY  
JUNE 5-6 — SEATTLE  
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Tom Hendrick is President and CEO of Wallace Engineering, a structural and civil consulting firm founded in 1981 in Tulsa, and has grown to include offices in Kansas City, Oklahoma City, Denver and Atlanta. The staff of twenty-seven principals and over 150 people represent personnel registered as Professional Engineers in all 50 states, Puerto Rico, District of Columbia, U.S. Virgin Islands, and British Columbia, Canada. The firm has engineered well over $100 billion in construction internationally since its founding.

A University of Oklahoma graduate, Hendrick has been designing structures since 1982 and has experience with a wide array of projects. His experience includes hundreds of retail, entertainment, and educational projects throughout the United States and formerly led Wallace Engineering’s international programs in Mexico, Puerto Rico, China and South America. Hendrick was named a principal in 1992 and was later named CEO in 2002 – at the request of his fellow partners. He held that position until 2017 when he was named President and CEO. Hendrick is the first new CEO named after the firm’s Founder and Chairman of the Board, Tom Wallace.

As CEO, Tom leads the implementation of new initiatives that not only focus on growth and profit, but also the organizational health of the firm. By stressing both the “smart” and “healthy” sides of a business, Hendrick is working to prepare and position Wallace Engineering for the challenges that inevitably lie ahead.

Civil + Structural Engineer: You have been at the same firm for 30 years, a remarkable achievement. You must have had other opportunities. Why and how were you able to stay in one place all that time?

Tom Hendrick: I thought that Wallace Engineering and its culture was something special from the day I started. There may have been other opportunities outside Wallace but I never pursued them. I did consider moving to one of our other offices at one time, but in the end I could not bring myself to leave Tulsa as it is a special place.

C+S: If you have run more than 46,000 miles in your lifetime, you must be fit. How has a healthy lifestyle affected your engineering career?

TH: Running has certainly helped me stay physically fit. However, I believe running has benefitted my mental well-being even more. I began running consistently when I was in college. I found that it calmed my mind and allowed me to think more clearly so I would go for a run in the morning on days when I had tests. To this day, when I have a presentation or need to make a big decision, an early morning run still calms me so I can accomplish what is needed.

C+S: After three decades at the firm, you were named president and CEO. While you probably had a long runway leading up to that moment, there still must have been a surprise or two. What were they, and how did you meet the challenge?

TH: My first surprise came in my first year as a Principal of the firm when I was asked to lead our international work (largely in Mexico and Puerto Rico), primarily because I had taken two years of Spanish in high school! Within two weeks of being asked to take this on, I was on my way to Mexico City for project meetings. I quickly enrolled in the local community college where I completed 18 college credit hours in Spanish. I also completed a Spanish immersion program in Cuernavaca, Mexico, which allowed me to oversee and lead the largely Spanish speaking staff that the firm hired.

My second surprise was in 2002 when my fellow principals asked me...
to be the managing principal of the firm after our former managing principal left to start his own firm. I had never taken a business class of any kind and truthfully did not know what was needed to manage and lead an engineering firm. I was able to overcome this by getting actively involved with ACEC, learning from leaders of other firms and by reading as many books as I could on managing and leading professional service firms.

C+S: The majority of your career has been spent in Tulsa. How does it feel to have played a role in renovating some of the historic downtown buildings?

TH: I take pride in all the projects Wallace Engineering works on! Our headquarters and the many buildings surrounding our building in the Tulsa Arts District are near the top of my list. It is gratifying to know Wallace Engineering has been a big part of transforming downtown Tulsa.

C+S: The annual party by Wallace Engineering looks like a good time! The event is well marketed and well attended. Having been to plenty of them, tell us what the party means to you and your staff?

TH: This annual party has taken on a life of its own. The party is always held the Thursday before Thanksgiving. For me, our staff, our clients and many other Tulsans, it signifies the start of the holiday season. The Tulsa World newspaper once proclaimed it as one of the five best holidays parties in the city.

C+S: Wallace markets itself as a firm that operates as a whole, even though the firm has five offices, three of them in major markets outside of Oklahoma. With that in mind, where do you stand on profit centers?

TH: We have always been and I believe always will be one profit center. Wallace Engineering doesn’t operate as a series of separate offices. Each office is part of the whole, One Wallace, allowing us to bring together the individual talents required – regardless of location – to produce projects that are seamless.

C+S: Wallace has 27 principals. How many years of experience – or large enough book of business – is enough to become a principal in your firm? Are you naming principals in their 20s or 30s?

TH: We have not defined a required number of years or minimum book of business to become a principal of the firm. Our criterion is a bit more subjective, but does require nomination from a current principal and a majority approval by all principals of the firm.

Two of firm’s current principals became principals in their 20s and a handful became principals in their 30s. Currently four of the 27 principals are in their 30s.

C+S: Describe the challenges you encountered in building your management team over the lifetime of your leadership. Have you ever terminated or demoted long-time leaders as the firm grew?
TH: As we have grown and added principals, one challenge we are facing is to reduce the number of decision makers. All of our principals want to be involved and we must make sure that each has their voice heard, yet 27 in the leadership group is unwieldy and we are working on solutions for that. We are very fortunate that we have never had to terminate or demote any long-term leaders.

C+S: How do you promote young and new leaders as the firm grows?

TH: We have always recognized and rewarded our engineers when they become licensed. We call everyone in the office together, recognize the achievement, and give him/her a gift along with a pay increase. Also, a leader in our firm can become an Associate, a position that offers them increased benefits and which allows them to participate in some of the management decision making of the firm. A couple of our young leaders were given opportunities to open and lead new offices and eventually became principals of the firm.

C+S: In one word or phrase, what do you describe as your number one job responsibility as CEO?

TH: My number one responsibility is keeping our employees happy.

C+S: What happens to the firm if you leave tomorrow?

TH: I have a very cohesive leadership team that I started last September. We meet weekly and touch base every work day. I have no doubt someone on my leadership team could take over temporarily, until such time a new CEO could be elected.

C+S: With technology reducing the time it takes to complete design work, how do you get the AEC industry to start pricing on value instead of hours?

TH: This is a real problem in our industry and one we need to overcome. I think it is by and large an educational issue. First, we need to educate ourselves as engineers that the services we provide are important to society. And we need to educate the general public on what we do as engineers. I think the general public views engineers positively and we need to parlay that belief into the understood value of our services.

C+S: If the worker shortage continues, do you see wages increasing to encourage more talent to enter the AEC space, or will technology be used to counter the reduced workforce?

TH: I see both of these occurring. Wages are definitely starting to go up, but I don’t think we will be able to find all the personnel needed. We have to figure out ways to use technology to work smarter and more efficiently.

C+S: Engineers love being engineers, but what are you doing to instill a business culture in your firm?

TH: Wallace Engineering has always had a very open-book management style. We share how the firm is doing financially with all employees at least twice a year. Principals and associates receive financial information monthly. A current initiative we are working on is focused on the “healthy” side of the business – a business of minimal politics, minimal confusion, high morale, high productivity and low turnover.

C+S: Diversity and inclusion is lacking. What steps are you taking to address the issue?

TH: Diversity and inclusion certainly need improvement throughout our industry. We believe that for this to change all different kinds of people need to be introduced to engineering, architecture and construction at an early age. Wallace regularly supports and participates in: (1) school programs that introduce engineering principles to kids of all backgrounds; (2) women in engineering programs; and (3) reading programs to children at low-income schools.

C+S: A firm’s longevity is valuable. What are you doing to encourage your staff to stick around?

TH: We work very hard to create a great culture. We want our employees to have a career here, and we want that career to have meaning. We are spending more time talking about why we are in business (why we exist), what our core values are (how we behave) and how the different employee roles play into the success of the firm. I think if employees know the importance of their role and how they fit into the success of the company, we have a better chance of keeping them long-term. We have also recently improved our benefits to offer more health plan options, maternity and paternity benefits and time off for community involvement. I believe we have a good work-life balance that so many people desire.

RICHARD MASSEY is managing editor of Zweig Group publications. He can be reached at massey@zweiggroup.com.
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By Peter Wilk

The LiRo Group’s renowned Virtual Design, Construction and Operations (VDCO) team has opened its new studio and laboratory dedicated exclusively to the development and implementation of rapidly evolving Building Information Modeling (BIM) and related technologies that are used to simulate myriad aspects of the planning, tracking, design, construction, operations, and maintenance phases of roadway, transportation, railroad, infrastructure, and commercial development projects and existing facilities.

The revolutionary work of VDCO enables clients to walk through near-photorealistic simulations and make decisions based on comprehensive, “already-built” information – even before construction begins. The flexible, state-of-the-art, fully equipped laboratory space is housed within LiRo’s new 13,500-square foot offices in Battery Park City, on the 28th floor of One State Street Plaza. Team members use reality capture, mixed reality, virtual reality, game-engine visualizations, and automation tools regularly, as they research, test, develop, and innovate tools and applications for their clients’ benefit, integrating these technologies into client workflows.

VDCO’s new studio and laboratory space is offset from the rest of the open office areas for functional reasons. The team of 11 specialists frequently works with various cutting-edge scanning technologies to create the virtual worlds that are best experienced in a suitable space using special goggles. To this end, the laboratory was designed to allow team members to change their workstation configuration in near-infinite ways, to accommodate a vast number of virtual worlds within it. It is not unusual to see VDCO team members getting up and being extremely physically active, walking through virtual “doorways” and inspecting “ductwork.” The design called for the use of various acoustical dampeners to provide the sound privacy VDCO required, while the power and data supply is augmented in the studio, to allow for the inevitable future expansions in information capabilities.

“We are a laboratory in terms of what we do – we create new and indispensable tools for our clients,” said Cheryle Cranbourne, VDCO Manager. “And we are a laboratory in terms of how the environment was designed – it helps foster teamwork and taking initiative. We have our virtual reality equipment here, we have our scanners, we have our photogrammetry tools and drones, our 3D printer, our flat-screens and projector – our equipment looks different from everybody else’s equipment and we have our own space where we bring together the different team members from different disciplines and work side by side to develop these tools and provide these services for our clients. It’s a flexible space we can adapt to our needs and that changes over time, just like the work we do for our clients.”

From the largest transportation construction project underway in the country to large and small residential projects, LiRo’s experienced VDCO team members are experts at developing and integrating BIM-related technology and processes into their clients’ existing workflows. The team can build a 3D virtual model – which they call a “digital twin” or a “virtual twin” of the project – from 2D reference documents. In this virtual twin, the team members simulate the processes, data, and geometry of a building or infrastructure, essentially creating a “virtual” project prior to actual construction. Their expertise with various cutting-edge software tools enables them to analyze, visualize,
and communicate building information to the entire project team, empowering stakeholders to make better-informed decisions. This virtual version of the actual project can be used to simulate almost any aspect of the design, construction, and operations phases of a project. The team then links these to schedules (4D), and information-based cost estimation (5D).

The Virtual Design, Construction and Operations group began as an in-house services group supporting LiRo contracts, but the BIM work has been growing and taking on a life of its own ever since. These days, the VDCO team supports clients of its own. The group grew by reputation. Part of the success of the group is its diversity of expertise. While all the team members are dedicated to BIM and new technologies, the backgrounds range from architecture and engineering to construction management, high-end interior design, MEP engineering, and so on. Together, they are able to bring a precise mix of perspectives to benefit their clients, and at all stages, from planning through construction and operations.

VDCO’s recent and current transportation and infrastructure projects include the Metropolitan Transportation Authority’s (MTA) $10.2 billion East Side Access railroad tunnel in Manhattan and Queens, NY; the rehabilitation of the 25-span, four-lane vertical lift Gil Hodges Memorial Bridge over Jamaica Bay between Brooklyn and Queens, NY for the MTA Tunnels and Bridges (MTA B&T); MTA B&T’s agency-wide BIM implementation consulting; and the Triborough Bridge and Tunnel Authority’s $210 million rehabilitation of the Robert F. Kennedy Bronx Toll Plaza and Manhattan Plaza on Randall’s Island, NY.

Since 2012, VDCO has been BIM Manager for the nearly $10.2 billion transportation project known as East Side Access, on behalf of the Metropolitan Transportation Authority Capital Construction Division (MTACC). The project is bringing Long Island Rail Road service to eight new train platforms and a new eight-block-long, 350,000-square foot passenger concourse approximately 150 feet beneath Grand Central Terminal. The first expansion of the LIRR in over 100 years, East Side Access is to be completed in December of 2022. Work is taking place in multiple locations in Manhattan, Queens, and the Bronx, and includes the construction of new tunnels under Manhattan; the construction of five massive, 10-story-high ventilation buildings; the refurbishment of existing train tunnels under the East River; and major renovations to Harold Interlocking, an above-ground train yard and interlocking in Queens used 24/7, which is the busiest railway junction in the country.

The project is currently the largest transportation construction undertaking in the United States, and one of the largest and most complex projects ever embarked upon in New York City. VDCO has thus far modeled the project in its entirety, and is using the resulting BIM resources to create visualizations to coordinate and record laser scans for better as-built survey documentation, and to enhance construction tracking and logistics workflows as well as asset management processes. In addition, the VDCO team’s work has revolutionized the way the project’s stakeholders understand this massive undertaking, make decisions on its myriad interrelated components, and minimize risk, not to mention how VDCO’s efforts have greatly enhanced the level of collaboration among the numerous parties involved in East Side Access construction. The East Side Access visualization program’s 150-plus interconnected models spanning four-and-a-half miles is believed to be one of the largest – if not the largest – integrated project BIM in the world.
“LiRo recognized the value of BIM and other technologies in streamlining and accelerating project delivery early on, and began the VDCO team nine years ago, initially by using BIM to model certain projects and test it with scheduling and general coordination. Today, our firm’s technology services to both clients and other LiRo divisions are offered under the umbrella of LiRo Applied Technologies Division. In addition to VDCO, the group’s services include GIS, Surveys, and Information Technology,” said John McCaffrey, LiRo’s Chief Information Officer.

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Many things come to mind when people think of New Orleans – the beautiful architecture of the buildings, the vibrancy of the French Quarter and, of course, the landmark Superdome for great sporting events. What they probably don’t picture is a spectacular world-class airport welcoming them to the Big Easy, but that’s exactly what millions of air travelers will soon experience when they visit the Crescent City.

A visionary project of the City of New Orleans, the new terminal at Louis Armstrong New Orleans International Airport will showcase the vibrant spirit and distinct culture of the city. The Hunt-Gibbs-Boh-Metro Joint Venture team was the construction manager of this $1 billion game-changing project, which is one of the most visible symbols of infrastructure rebuilding in the Gulf South region post-Katrina.

Iconic design
The world-class design of the 972,000-square-foot replacement terminal was conceived by Pelli Clarke Pelli Architects and executed by the Crescent City Aviation Team, a joint venture of Leo A. Daly Company and Atkins North America, Inc.

The complex will feature three concourses with 35 passenger gates, seamless connections between concourses, nearly 80,000 square feet of retail space, parking garages and a surface parking lot, and an enormous concrete apron that ties into existing runways.

According to the design team, the terminal’s architectural form evokes the geography of the Delta region and the soft curves of the Mississippi River. The curved, T-shaped building forms a gentle arc on three sides, and a monumental roof rises toward the structure’s centerline where it crests over a large central skylight. Designed to allow long spans, the spherical-shaped roof is supported by massive concrete columns to reflect the region’s modern and upward trajectory.

Column construction challenges
To optimize the complex geometric design of the structure, the project team used specialized software to distribute the column grid, optimize the roof shape and right-size the building footprint. They also relied on innovative building materials throughout the project, including an advanced self-consolidating concrete (SCC) to produce the 350 massive support columns for the superstructure. The heights of the 40-inch and...
48-inch terminal columns ranged from 47 to 73 feet, and the heights of the 28-inch and 30-inch concourse columns ranged from 33 to 51 feet.

One of the biggest challenges in constructing the tall and complex columns was finding the ideal concrete mix that would perform on a variety of levels. The use of a conventional concrete was not an option for this application due to all the highly congested steel reinforcement, embeds and anchor bolts within the columns. In addition, project specifications required a high-quality class A exposed concrete finish, which would not be possible using a standard concrete mix.

According to Mike Lopez, project superintendent at Gibbs Construction, the project team needed an innovative concrete solution that would flow easily through and firmly self-consolidate around all the highly congested embedded reinforcement within the columns, as well as achieve a 28-day compressive strength of 7,000 psi. The concrete also needed to produce a smooth high-end surface aesthetic that the owner was expecting with every pour.

Selecting the right mix

To meet the stringent performance criteria for this high-vertical application, the project team selected an advanced self-consolidating concrete (SCC), called Agileflow™ (formerly Agilia®). This highly fluid concrete places more quickly than standard concrete, flows easily through highly congested reinforcement and provides superior non-segregation properties for greater structural integrity. Other advantages of the SCC technology include increased strength, higher-quality finished surfaces and reduced production times and labor costs.

“We used this very workable SCC mix provided by Lafarge on another project that had very large transfer beams containing highly congested steel rebar and post-tensioned cables,” said Lopez. “Based on the product’s performance in that extremely challenging application, we were confident that it was the ideal solution for constructing the structural support columns at the airport.”

Based on all the logistics challenges and other delays that come with working on a 100-acre airport construction site, the ability of the product to maintain its workability for up to two hours was another benefit valued by the project team. With most standard SCC mixes, the spread starts to decline tremendously at 1 hour and could cause stability problems.

Custom solution

Following a common defined procedure, Agileflow mixes are custom-designed based on the targeted performance properties for each site-specific application. The key to successful performance requires special care in the selection and proper proportioning of materials in the mix to avoid segregation while providing optimal workability properties.

Primary considerations in developing the optimal concrete for the airport columns were flowability, viscosity, compressive strength, durability, and maximum temperature gain control. Key performance parameters included compressive strength of 7,000 psi at 28 days, maximum temperature of 95 degrees F, and spread of 28 to 31 inches. “We design our Agileflow advanced SCC mixes to flow at higher capacities and to avoid separation in applications with high drop heights,”
said BJ Eckholdt, quality control manager at Lafarge, a member of LafargeHolcim. “With the concrete developed for the airport columns, we could easily take the spread to 31 inches, whereas most standard SCC mixes would fall apart at that mark.” To achieve specified performance goals, the SCC mix for the columns contained a high percentage of cementitious material to control heat gain.

As a final step, a demonstration trial was run in a job-site column form to fine-tune the mix and ensure stakeholder expectations were met with flow through and consolidation around the heavily congested reinforcement, strength attainment, and surface finish quality.

**Work gets underway**

Construction on the airport project kicked off in January 2016. Six months later, crews were placing pile caps on more than 4,000 pre-stressed, precast concrete piles that were driven 100 feet into sand strata to support the weight of the superstructure. The building’s concrete columns were each supported by four to twelve of these 14-inch-square piles.

All of the structural columns were constructed in 20-foot lifts. Work on the exterior perimeter columns started with soil excavation for column placement and then pouring a concrete footing over the pile caps. A rebar cage assembled horizontally was then lifted by a crane, placed vertically onto the footing and attached to the footing’s metal starter bars. After cleaning the formwork and applying a release agent to prevent the bonding of concrete to it, crews bolted the two-piece steel formwork around the rebar cage and poured the concrete into the form.

The superstructure was designed with a moment-frame system – a hybrid of steel beams connected to embeds on the concrete columns – to keep the internal spaces of the building as open as possible. Concrete for the internal columns was poured up to the second-floor of the structure and then steel erectors assembled the structural steel. After the deck was put in place, concrete was poured for the second-floor slab and crews worked off the slab to extend the columns up to the third floor. This same work process was followed to extend the columns up to the roof line.

Working the terminal and concourses at the same time, the project team required seven cranes on the job site for all the concrete column construction activity. Following a tight production schedule, crews were pouring concrete in 20-foot lifts on four or five columns a day, removing formwork after 12 to 24 hours and starting the next 20-foot lift the next day. Prior to every pour, an independent quality-control laboratory tested the SCC mix to ensure the temperature was below its maximum specified value and that the spread was within the desired range for placement. Six to eight test cylinders were also taken to determine 7-day and 28-day strength breaks. The columns were hitting their seven-day strengths in three to four days.

**A new world-class aerial landmark**

When the new modern terminal opens in May, it will not only be an example of outstanding design and stellar engineering, but also a tribute to all the construction trades in making the architectural vision a reality.

Construction of the 350 structural columns took about 12 months and required more than 6,500 cubic yards of the Agileflow concrete to complete. The specified compressive strength on this project was 7,000 psi at 28 days; however, the SCC mix consistently achieved strengths surpassing 11,000 psi.

“We are all very proud to have played a role in the successful completion of this magnificent new aerial landmark and the lasting impression it will leave for millions of visitors to the city of New Orleans,” said Lopez. “The superb self-consolidating properties of the advanced SCC product was a great solution to our column production challenges, and the surface finish allowed for the final field finish with minimal rubbing and patching—a huge benefit in terms of time and labor cost savings.”

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All the concrete structural columns for the terminal were constructed in 20-foot lifts. *Photo: New Orleans International Airport*
WoodWorks “Ask an Expert”
This Month: Two Q&As on Mass Timber Building Design

In addition to offering education and free project support, WoodWorks – Wood Products Council publishes a monthly “Ask an Expert” Q&A addressing technical questions related to the design and construction of commercial and multifamily wood buildings. The current Q&A can always be found on the home page at woodworks.org, and you can browse or search 40+ Q&As in the archive at www.woodworks.org/ask-an-expert/.

Here are two Q&A examples related to one of the most topical aspects of wood building design: mass timber.

Q: How do you demonstrate the fire resistance of exposed wood members using char methods in lieu of gypsum?

A: IBC Sections 703.2 and 703.3 offer multiple ways to demonstrate fire-resistance ratings of structural members and assemblies. One method noted in Section 703.3 is to calculate the rating in accordance with IBC Section 722.

For exposed wood members and decking, IBC Section 722.1 references Chapter 16 of the American Wood Council’s National Design Specification® (NDS®) for Wood Construction. This chapter gives a nominal char rate of 1.5 inches of wood thickness per hour of fire resistance. Using the calculations and information in this chapter, a fire rating of up to 2 hours can be calculated.

The 2015 NDS allows calculated fire resistance of a number of wood products, including solid sawn lumber (this includes nail-laminated timber), glued-laminated timber (glulam), laminated veneer lumber (LVL), parallel strand lumber (PSL), laminated strand lumber (LSL), and cross-laminated timber (CLT). For structural members using this method of exposed fire-resistance calculations, the effective char rate, which is slightly higher than the nominal char rate and includes a heat-affected zone, is used. For nonstructural members such as blocking, the nominal char rate is used. NDS Chapter 16 includes additional design considerations for certain structural members such as glulam beams, timber decking, and CLT. It also presents adjustment factors applied to the allowable
design properties of exposed structural members rated for fire resistance.

The American Wood Council’s Technical Report 10 (TR 10) provides background information for the established methods in the NDS, which can help both the designer and the authority having jurisdiction in applying and evaluating this method. TR 10 also includes design examples for exposed structural wood members using the provisions of NDS Chapter 16.

Q: When designing cross-laminated timber (CLT) panels for gravity-load applications such as floor or roof panels, should I use the CLT layups defined in the ANSI/PRG 320 standard as the basis of design?

A: Cross-laminated timber is an engineered wood component manufactured from dimension lumber or structural composite lumber to create large, flat panels of solid wood. It is a member of a new class of massive (or “mass”) timber products—i.e., large-dimension engineered structural wood components that complement the dimension sawn lumber, solid sawn timbers, and structural composite lumber products frequently used in building framing. Other forms of mass timber construction include nail-laminated timber (NLT), dowel-laminated timber (DLT), glued-laminated timber (GLT) panels, and solid panels of structural composite lumber materials. The size and strength of mass timber structural components make them an alternative to concrete, steel, and masonry components for many building applications.

In North America, the availability and acceptance of CLT are relatively new; however, adoption is happening quickly considering the speed at which material design standards and building code modifications typically occur. The ANSI-approved product standard, ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber, provides a basis for standardization of CLT quality, manufacturing, and structural properties for structural building applications in North America. Starting with the 2015 International Building Code (IBC), CLT is identified as a structural material, defined in IBC Chapter 23 with reference to the PRG 320 standard. CLT framing is allowed within Construction Types III, IV, and V, and for roof members in Types I and II roof assemblies requiring a 1-hour fire-resistance rating or less.

PRG 320 defines how the structural properties of the CLT panels are to be determined through a qualification process. The PRG 320 standard also defines, as examples, seven stress grades of CLT panels based on commonly available visually graded and machine-rated lumber species groups and grades. CLT grades E1 through E4 use machine stress-rated lumber for layers parallel to the major axis. CLT grades V1 through V3 use visually graded lumber for layers parallel to the major axis. The predefined structural capacities of the CLT example grades are found in the PRG 320 standard and can be useful as a reference; however, not all of the example grades and layups in the standard are being manufactured at this time. Manufacturers also have additional CLT grades and layups with structural properties certified through the PRG 320 qualification process—i.e., there are many more layups available than just those suggested. Because of this, consideration of the CLT products being manufactured is recommended in order to see what specific grades and layups are available.

If you need help finding CLT manufacturers to consider, most of the manufacturers in North America are WoodWorks National Partners and listed here. Or, feel free to ask for assistance by contacting your local WoodWorks regional director (map here) or the WoodWorks help desk at help@woodworks.org.

To read more about CLT floor and roof panel design, check out this article.

About WoodWorks
WoodWorks–Wood Products Council provides free technical support as well as education and resources related to the code-compliant design of commercial and multifamily wood buildings. A nonprofit organization staffed with architects, structural engineers, and construction experts, WoodWorks has the expertise to assist with all aspects of wood building design, including (but not limited to): allowable heights and areas/construction types, structural detailing of wood and hybrid systems, fire resistance and acoustical-rated assemblies, efficient and code-compliant lateral system design, alternate means of code compliance, and energy-efficient detailing.

For assistance with a project, visit www.woodworks.org/project-assistance or email help@woodworks.org.

For a calendar of education events across the country, click here. Follow WoodWorks on Twitter (@WoodWorksUS), LinkedIn (@WoodWorks), or Instagram (@WoodWorksUSA) to be alerted when a new “Ask an Expert” is released.
Anyone familiar with Chantal Arguin would likely tell you: She doesn’t care for the word “No.” “When someone says ‘No’ to me, and they don’t have a good reason, I will listen to them, but I will do what I wanted to do anyway,” says Arguin, a professional surveyor/entrepreneur. “That word is a good motivator for me. Always pushing for more is in my DNA.”

That drive is what propelled her to become a licensed land surveyor in 1991, a sector that was only four percent female in Quebec and has only risen to about 13 percent today. That same drive pushed her to become the first woman and the youngest president of the Quebec Order of Land Surveyors, the province’s association for professional surveyors, in 2000 – she was unanimously elected, quieting male critics who were unsure a woman could lead the organization.

It was also that same drive that led her to start and lead not one but two companies – geomatics company Trifide Group in 2002 and, at the request of Trifide customers, Arguin and Associates, a land surveying company in 2010.

Since opening her businesses, her aversion to the word “No,” her proven geomatics expertise and her love of technology have been the driving force behind her can-do attitude, her growth mindset, her commitment to trusting her instincts, and her success. It has been a winning formula, and a particularly necessary one in an increasingly competitive market where smartphones and consumer-grade drones are threatening professional surveyors and geomatics professionals’ livelihoods.

The differentiating factor
When Arguin launched Trifide Group, its core business was providing 3D city-scale photo products and photogrammetry services. That was quickly eroded by the arrival of Google Earth and other similar free or low-cost sources of satellite imagery with sufficient resolution for large-scale mapping and planning. Undeterred, Arguin adopted new technologies to shift to 3D mobile mapping and specialized photogrammetry services. She systematically and strategically acquired new tools at every turn to advance and expand her offerings to include laser scanning, thematic mapping, marine mapping, bathymetric surveys, GIS consulting, and land and construction surveys. And when the volume of requests for land surveying became too high, that part of the business was spun into Arguin and Associates.

Between the two companies, Arguin’s mix of technologies includes 3D mobile mapping, laser scanners, GNSS receivers, total stations, unmanned aerial systems, and a host of processing and extraction software specified by clients.

“When everybody goes right, I want to go left,” says Arguin. “That’s why I’m always trying new technology and combining different tech-
nologies to be more successful and more competitive. We have to be the first ones to try new technology to understand how we can make money with it. I believe if you aren’t in front, you won’t win.”

In addition to building a technology advantage, she leverages her expertise in surveying to ensure all her deliverables are georeferenced and certified — a needed competitive edge to combat the trend of “lay people” selling products and services once offered only by geospatial professionals.

“With consumer-priced drones and iPhones, we now have to compete with people who claim they can lay out property corners or provide aerial surveys,” says Arguin. “And with Google Earth and Google Street View, you can get satellite imagery for free. But many clients require georeferenced information and the certification that the geo-positioning is accurate. Google can’t provide that and neither can a person with an off-the-shelf drone or smartphone. So my competitive advantage is that I’m a qualified, professional land surveyor, and my staff are geospatial professionals, so every time we deliver data it is certified data.”

Providing certified data to differentiate herself in the market notwithstanding, it is her penchant for saying “Yes” to complex projects and difficult situations that has also set her apart. One of the most recent examples of this was a mobile mapping survey in Quebec’s remote Basse-Côte-Nord (BCN) territory, a stunning 250-mile stretch of wild coast, home to some of the oldest fishing villages in Canada. Known in English as the Lower North Shore, the northeast region is home to 14 formerly self-sufficient communities of French, Innu First Nation, Acadian and English speakers who dot this rocky, weather-beaten expanse where the Atlantic, the boreal forest and the tundra converge.

The task was to acquire 3D mobile mapping images of the roads in eight villages and five provincial airports within the BCN. The catch was none of the eight villages are connected by roads and the only way in or out is by air or boat.

“Access alone to these places is enough of a challenge but some of the roads are nearly impassable,” says Arguin. “Since we would have to travel between the places by plane or boat, we’d need to rent a vehicle each time, so the imaging set up would be different for every vehicle. Traditional, fixed mobile mapping systems wouldn’t work.”

Arguin met the challenge the way she’s always done: she adapted and found technology that would work. In 2016 she purchased the Trimble MX7 mobile imaging system specifically for the BCN project. The MX7 would provide the flexibility, ruggedness, and most importantly, the portability the team would need to tackle the assignment.

Into the wild
The aim of the BCN project was to collect georeferenced, 3D images of the selected villages and airports to enable government authorities to inspect the quality of roads, runways and taxiways from their desktops. Such detail would allow them to identify areas of damaged roads or runways and then prioritize and plan for badly needed maintenance and repair work. The chosen villages included La Romaine in the west, Chevrier, Tete a la Baleine, La Tabatière and the easternmost town of Blanc Sablon. The roads and airport of Anticosti Island, south of the BCN, also needed to be captured. In total, the two-person Trifide team had to cover 263 miles of roads and 12 miles of airport runways and taxiways. With the survey done, work could begin. In January, tree clearing started on the five-mile section between Kegaska and La Romaine, according to the Ministère des Transports.

“The compact size of the MX7 would make it easy for us to transport the unit by air or boat and install it on local vehicles,” says Arguin. “And its ease of use and comprehensive imaging would allow us to handle the whole project with only two people.”

On top of the logistical travel complexities of the project, Trifide was required to work around the tight schedules of each airport’s traffic — no runways or taxiways would be shutdown to conduct the work.

On a cool morning in mid-October in 2016, Hélène Gagné and Ginette Allen, Trifide team leaders, flew to the 3,059 square mile Anticosti Island, the largest — and unexpectedly challenging — sites of the BCN project. They hit their first snag before even leaving the Port-Menier Airport. Their only rental car option was a pick up truck, meaning there was no roof rack to install the MX7. So, the industrious crew built a customized wooden rack and installed it in the truck bed to provide a stable platform for the MX7. Having resolved that, they moved to the next challenge: how best to contend with 188 miles of unpaved roads — some nearly impassable — that they needed to cover.

Choosing the most optimal route, they first set a control point and collected two hours of data with a Trimble R10 GNSS receiver. With control established, they mounted the MX7 and began driving the island’s main road at speeds of 25 mph — or less, given the terrain — as the MX7 captured a 3D image every 15 feet. To ensure they could accurately georeference the images, they set up the R10 at 25-mile intervals.

“The MX7 is equipped with a GPS receiver and an inertial measurement unit,” says Arguin. “By combining that data with the data from
the GNSS base station, we could obtain a precision of about 0.7 feet in our environment conditions.”

In three days, Gagné and Allen had imaged the island’s road network and its airport’s runway and taxiway – and became friendly with a good number of curious white-tailed deer.

From there they flew back to BCN to the village of La Romaine, an Innu First Nations reserve, to capture its eight miles of roads and its 0.6-mile runway. They then either used planes or ferries to reach the rest of the villages. In each place, the team’s ritual was the same. They established control with the R10, mounted the MX7 on their vehicle, plotted their acquisition route and drove carefully, deftly avoiding the large potholes, sizable cracks, and boulders that riddle many of the roads. In total, Gagné and Allen collected 180,000 3D images in 11 days.

"With the rough state of the majority of the roads and the tight logistical timelines we had, we needed a rugged, reliable and lightweight system,” says Arguin. “We could attach the MX7 in minutes and with a 360-degree, high-resolution camera, we could capture all directions in one pass.”

After each day in the field, the Trifide team downloaded the images using Trimble’s mobile image processing software and checked the imagery for clarity and precision. They then used the Applanix POSPac™ MMS software workflow to directly georeference all 180,000 images. With this process, they created individual image sets for each village and airport that met the GIS positional accuracy requirements and delivered them to Trifide’s customer.

"With this technology we were able to produce highly detailed, 3D inventories of each village’s road and airport infrastructure in a little over a week,” says Arguin. “Given the remoteness of the area, having such precise visualizations gives authorities the ability to inspect any segment of any road, from their own distant office, and create targeted repair and maintenance programs. It’s an efficient and effective development and management tool.”

New technology, old roots

Given the success of their debut project with the MX7, Arguin has since racked up thousands of kilometers with it.

They’ve taken it to a number of small airports to image runways and taxiways for pavement analysis. They’ve used it for the shoreline inspection of a lake in the Quebec city of Choeingu to provide local authorities with a baseline inventory of the riparian vegetation around the water. Such a foundation enables them to image the vegetation coverage over time and assess if there have been any violations of riparian vegetation regulations.

And they used the technology for the Port of Montreal. With the MX7 mounted on a boat, they surveyed 16 miles of ship channel. The images enable the Port to inspect the channel walls and bollards to check for wear or damage.

In addition, Arguin has been using her persistence and persuasive powers to expand her 3D mobile mapping business to the city level. In a way, she’s been trying to return to her founding roots of providing 3D city-scale images.

“Typically, cities contract surveying companies to create signage inventories or other asset inventories – work we can absolutely do with our GNSS surveying technology,” says Arguin. “They are expensive projects for the city because they take a lot of time and personnel to complete the work. With my mobile mapping system, I can beat the traditional survey method by about 70 percent. That’s speed and value for money.”

She may be making some progress. She recently presented the benefits of mobile mapping to a municipality – the same city she’s been talking to about the technology since 2010 – after they finally expressed interest in adopting it.

But for Arguin, the long game is what motivates her. And she’s been skillfully playing it ever since she was snubbed by male surveyors early in her career. She still hears critical comments, but she tends to bat them away like annoying flies. Instead, Arguin remains laser focused on her mission – to prove by doing, to learn, to push herself and her technology, to leverage her land surveying and geomatics expertise to provide certified data, and, above all else, to ignore the negative noise.

“If I had let naysayers influence my career, I might not have pursued surveying,” says Arguin. “Thank goodness I didn’t listen because being a licensed surveyor is my most valued possession. It’s what allows me to do what I do and be successful. I would never give that up.”
AEROmetrex Creates 3D Reality Model to Reduce Sydney Congestion
Bentley's Reality Modeling Solution Processed 60,000 Images in 26 Days for Sydney’s Parramatta Light Rail

Designing a New Rail Line Connecting the Greater Parramatta Area
In November 2016, Australia’s Department of Transport New South Wales (NSW) commissioned AEROmetrex, a world leader in reality modeling, to design the Parramatta Light Rail. The Parramatta Light Rail project was designed to facilitate the shift of Sydney’s population center to the west.

Like many large cities, Sydney, Australia is experiencing rapid growth and unsustainable property prices. The city cannot expand to the east, north, or south due to physical barriers, so it is moving west toward the Greater Parramatta area. By 2036, it is estimated that more than half of Sydney’s population will be centered in this area. There are already developments in place for new residential and commercial locations, a new health precinct, and better access to the Sydney Olympic Park facilities. The challenge, however, is that existing public transportation and rail networks are inadequate to handle these developments. The Parramatta Light Rail project will help ease some of Sydney’s most congested traffic routes and reduce commuting times.

AEROmetrex was retained to create a 3D reality model of the proposed rail network route. This model would be used for preliminary route selection and, later, for community consultation and as a surveying data source. The reality mesh would cover an area of 19.6 square kilometers, or about 7.55 square miles. AEROmetrex needed to create a 3D model that would be used for all aspects of planning, route selection, estimating, and consultation. The project team wanted a model that would help unify data for all disciplines involved in the project, as well as to create a federated dataset to use as the 3D framework for the project.

Creating a 3D Model from Photographs
The Parramatta Light Rail project was the largest high-resolution ContextCapture project undertaken by AEROmetrex. To create the 3D model, the project team photographed nearly 60,000 images of the corridor from a low-altitude oblique perspective using a helicopter over a period of six weeks. By using a helicopter to take photographs of the area, it was safer for the surveyors because they did not have to be on the ground on a busy road or rail corridor. It also helped reduce traffic congestion; any ground-based methods would have added to Parramatta Road’s congestion, requiring specialist traffic management companies to manage any stationary surveying.

The reality mesh was then scaled to GPS-surveyed ground control using Bentley’s ContextCapture to provide a final overall accuracy. It took about 10 weeks to create and deliver the 3D model to the client. The project team edited and retextured the 3D models, providing high data integrity on features that were of special interest to AEROmetrex’s client. The team also created a “true ortho” of the area, a scale-corrected 2D image where all the features, including the one above the terrain surface, were represented in their true position. This feature ensured that no details were obscured by buildings or trees.

Providing a Single Source of Truth
AEROmetrex’s 3D model improved collaboration between stakeholders by adding interpretability and context to all forms of other data. It created a single source of truth and provided easy incorporation of design models and underground services. The model can be displayed and used with all Bentley applications. The project has delivered a holistic, interdisciplinary, and federated dataset, creating a solitary location where users can trust that the information is accurate. The design models could also be readily integrated into the reality mesh and even textured in the final presentation. They can then be used to access various parts of the project, such as security and visibility, before beginning the physical construction. Finally, the ability to integrate and display underground services data into a 3D reality model is a profound benefit, improving collaboration between rail construction contractors and utility and service companies.

Improving Community Connectivity
Once constructed, the project will have significant positive impacts on the local community. Currently, the 3D reality model removes uncertainty and fear of the unknown by allowing the community to view the model from any angle or perspective. This capability helps people see how the project will impact the local community and the benefits. The project will ultimately lead to fast and safe public transport and connect western Sydney communities that were currently only available by car. It will also decentralize jobs and growth to the west, reduce pressure on growth in other parts of the city, and provide an essential link between Sydney and Parramatta.

By using Bentley applications to help design the rail, the project team reduced its environmental impact on the surrounding area. ContextCapture allowed the data to be captured quickly in a helicopter, minimizing the number of vehicles needed to survey the area. Also, the inclusion of accurately depicted features in the reality mesh will enable better management of environmental impact on those features, which may not have been modeled in traditional surveying approaches. It is much more cost-effective to assess impacts and to test scenarios in the virtual world than in the physical world. Virtual modeling has zero environmental influence apart from the electricity used to run computers.

Saving Time with 3D Modeling
The final data products were delivered to the client in April 2017. Implementing Bentley applications realized significant time savings for the Parramatta Light Rail plan. The project team processed the thousands of images in 26 days. Using Bentley applications allowed the team to edit the model in 45 days, meeting the project deadline.

Moving forward, team members will test various options for the rail line in the virtual space, including routing, obstruction removal, property assessment of property acquisitions, and widening of corridors. The successful execution of the final Parramatta Light Rail plan connected the western Sydney communities with the rest of the city. Since this project has been implemented, AEROmetrex has continued to enhance their project solutions by using Bentley’s sophisticated reality modeling applications.
To address congestion in densely populated cities, transportation engineers and city planners are increasingly turning to tunnels. Take the Rotterdamsebaan tunnel currently under construction beneath The Hague (Den Haag) in the Netherlands. This complex project exemplifies a new era in urban tunnel construction. It is efficiently built, environmentally friendly, and designed to mitigate any impact on urban centers.

The Hague is the third largest city in the Netherlands. Within its boundaries are some of Europe’s densest populated metropolitan areas. It is home to federal agencies, royal residences, a busy harbor, and international bodies that include the International Court of Justice, the International Criminal Court, and major United Nations facilities. With so many stakeholders, independent monitoring of the Rotterdamsebaan tunnel’s impact was imperative.

The Hague city council contracted Fugro to oversee the monitoring process. Fugro is an international leader in providing geospatial measurements and asset integrity data for large infrastructure construction, energy, and natural resource management. Fugro would monitor the impact of the project on infrastructure along the tunneling corridor and would be responsible for surface deflection monitoring. In addition to Fugro, BAM Infra is collaborating on the project. BAM is a well-respected infrastructure and tunneling construction firm and is the main contractor for the Rotterdamsebaan project.

While modern Tunnel Boring Machines are designed to minimize ground movements caused by the tunneling process, there will always be some ground reaction. The Rotterdamsebaan TBM, boring two parallel 11m diameter tunnels successively, is operating at the relatively shallow depth of 20 to 30 meters below the surface. Despite this shallow traverse, the maximum allowed settlements, detectable at the surface, is only 12 millimeters. That the tunnels are constructed to meet such tight tolerances is a testament to meticulous design, advanced TBM technology, and skilled contractors. Such tight tolerances also put a premium on the instrumentation and skill of the monitoring teams.

Fugro applies best practices when monitoring such projects. These practices include utilizing multiple robotic total stations arranged in networks in and around features to be monitored.

These total stations are remotely controlled by monitoring software in cycles taking pre-programmed measurements with millimeter precision. Long- and short-term trends are easily identified based on these measurements, producing real-time results as the TBM passes under each segment of the tunnel corridor.

For its monitoring work, Fugro uses high-precision total stations like the 0.5-second Trimble S9, which project manager and geodetic engineer for the project, Richard Bun, describes as an “A-class instrument.” On a project of this magnitude, 40 or more total stations may be in use at any given time.

Fugro developed its own monitoring software, GeoRiskPortal®, which has been successfully used on a variety of projects worldwide. GeoRiskPortal® connects to many types of monitoring instruments, including strain gauges and extensometers. Until this project, however, Fugro had previously connected GeoRiskPortal® to just one brand of total station and wished to begin using Trimble total stations for automated monitoring as well.

“Our goal was to connect with more than one brand of total station,” Bun said. “We have 50 surveyors in the Netherlands and they use two brands of instruments, including Trimble.”

Since Fugro incurs a significant development cost to integrate instruments with GeoRiskPortal®, the company contacted several manufacturers to work with them on the project. With the measurement performance of the S9, the support of the Trimble engineers and the ability to efficiently integrate it into the GeoRiskPortal® system, Trimble could provide a compelling solution.

**Accurate integration**

In order to integrate the total stations with software such as GeoRiskPortal®, an instrument needs to accept commands from the software and provide feedback and measurements (including metadata) without connectivity lapses or significant latency. To meet these requirements, Fugro used the Trimble Precision SDK (TPSDK), a software development kit that supports multiple Trimble instruments, including the S Series total stations. The SDK enables software control of the instruments, allowing developers to pair these high-precision tools with their own custom software and instrumentation. The Trimble Precision SDK
enabled Fugro to efficiently integrate the Trimble total station with its GeoRiskPortal® software.

Developers can access the TPSDK and many other Trimble SDKs online. In addition, there is a community of developers using Trimble SDKs on the collaborative cloud portal/platform, GitHub.

Bun’s team set up four networks of monitoring instrumentation for the harbor, the tunnel exit area, and two residential districts. The exit area at the end of the tunnel in the center of The Hague was of particular concern as the TBM comes to the surface. “We need to monitor the buildings immediately adjacent to the tunnel, certain additional buildings in the surrounding areas, and the ground surface,” Bun said.

Bun explained that a control network of fixed reference marks is placed away from any movement caused by the tunneling. The total stations are situated throughout the corridor to have clear views of all building and surface features monitored for deflection. A concern in using total stations in developed or residential areas is noise. Typically, each total station is mounted on a small platform bolted to the sides of buildings or poles, under bridges or positioned where they can capture a panoramic view from above the site. Sometimes the mounts are close to the windows of businesses or residences and the noise generated by the frequent rotations of the total stations may be irritating to the occupant. This isn’t a problem with the Trimble S9, though, as it utilizes a magnetic drive to provide silent operation.

To connect the total stations into the reference networks, Bun placed target prisms on buildings and chimneys that can be seen by at least two total stations. “We form networks that can be constantly measured and checked with the least squares adjustments,” he said.

With this self-monitoring reference network in place, the total stations can continuously take measurements while compensating for any movement.

“For soft ground or fields we put an iron pipe in the ground that sticks up about one meter and has a prism on top,” Bun said. “For hard surfaces like asphalt roads or concrete sidewalks, we can use the reflectorless mode of the total station. On buildings we do two tiers of prisms, the first at about 3 meters and the second at about 5 meters.”

Based on these measurements, the GeoRiskPortal® software can model any vertical, horizontal, or lateral movements of the surface or structures in real-time. When working in harmony, the robotic total stations are like “silent sentinels” keeping a watchful eye on any property and infrastructure above the tunneling, Bun said.

At the time of this writing, the TBM was nearly done with the first of the two parallel 1,640-meter tunnels and preparing to begin the second parallel tunnel. Bun said that there was an initial investment to modify Fugro’s software to accommodate the Trimble S9, but the benefit of being able to use a better selection of instruments, especially on a project of this size, far outweighed the costs. Fugro has already expanded its capabilities on other monitoring projects and looks forward to continuing this momentum moving forward.

Editor’s note: Drilling of what’s known as the Victory Boogie Woogie tunnel was finished earlier this year. Construction is still ongoing. The Rotterdamsebann is scheduled to open next year.

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Soil reinforcement made from steel or various polymeric materials are conventionally used in many construction projects around the country, but when it comes to areas with more extreme soil chemistries, the job requires something more built-to-last. Manufactured with high tensile strength and chemically engineered to withstand pH extremes, Tensar’s Uniaxial Geogrids made of high-density polyethylene (HDPE) are perfect for projects in cold-weather climates, coastal areas with exposure to salt water environments, and light rail transit systems that introduce stray current into the underlying soils. Build your next big project with Tensar’s UX Geogrids.

Since San Diego built its Tijuana Trolley light rail transit system in the 1980s, many American cities have looked to light rail systems as affordable alternatives to under subway systems. Portland, Buffalo, Sacramento, and San Jose followed suit after San Diego in the 80s, and Houston recently installed its own light rail system in the 2000s.

These systems usually see relatively high commute share, but it doesn’t take much service level disruption to scare passengers away. And with many systems around the country now into their third decade of service, maintenance of the infrastructure supporting these transit lines will become more common, leading to more construction delays.

This is where Tensar’s Uniaxial (UX) Geogrids can save a city’s return on investment. Unlike other soil reinforcement made of steel, or polyester (PET), Tensar’s UX Geogrids are made of HDPE, a “hot-soil”-resistant polymer that boasts high tensile strength and longevity in the most extreme conditions – the same polymer is used to line landfills. HDPE lends a much longer design life to big projects, especially in coastal cities like San Diego and Boston where a combination of stray current from light rail and higher pH soils from tidal areas quickly attack steel and other polymeric reinforcement.

Given that HDPE is inert to aggressive soil environments on both ends of the pH scale, this material is right at home among the elements, performing well in both wet and dry environments. A technical brief on the durability of geosynthetics by the U.S. Federal Highway Administration (FHWA-RD-01-050) found that in a test performed on HDPE, “…no oxidative degradation leading to strength loss was measured or could be inferred.” This durability allows for a wide variety of backfill options, even if those include hot soils. Whether you’re working on America’s next light rail system, a retaining wall near the coast, or a highway built for harsh winter conditions, you need construction materials that stand the tests of time and mother nature. Other soil reinforcement might get the job done at first, but they simply can’t handle the pressure over time. Go with the durable materials that are time-tested in aggressive environments and use Tensar’s Uniaxial Geogrids for your next big construction project.

About Tensar International
Headquartered in Atlanta, Tensar International is a full-service provider of specialty products and engineering services that offer innovative and cost-effective alternatives to traditional construction methods. Tensar solutions are based on advanced soil stabilization and reinforcement technologies and incorporate unique, engineered applications for commercial, industrial, municipal, residential and transportation infrastructure site development. The company specializes in solutions for common site development challenges, including grade changes requiring retaining walls and poor soil conditions affecting the cost of roadways, parking lots and building structures. Patented, polymeric Tensar® Geogrids and Tensar’s Geopier® foundation reinforcement piers are the primary components of the company’s systems, offering reliable strength and durability. Contracted services include site evaluation, conceptual engineering, design, value engineering and installation advice. For more information, visit tensarcorp.com.
ARE WE FOCUSED ON THE RIGHT THINGS?

By Indranil Seth

SO LONG AS WE ARE PASSIVE SPECTATORS to the ever growing concern over the protection of the environment, and hence the call for sustainable growth planet wide, we are destined to find ourselves increasingly engulfed by the problem at hand. Instead of losing focus, we can do a reality check and ask ourselves: “Are we focused on the right things?” The issue is metaphysical and rational, and when you dive into it, one finds an endless list of questions.

Are the signs of climate change enough to compel you to jump on the sustainability bandwagon? Do we need, or even have, quick fixes for the issues we face? Are we justified in our current approach toward the problem? Are we doing enough to arrest the damage and jump-start our development curve back on a sustainable trajectory? Is it true that past generations were blind to this ticking time bomb? Who is really to be blamed for today’s carbon footprint mess?

As the developing world surges ahead with economic development in the 21st century, we all agree that there is going to be significant growth in energy demands. Are we ready to fully embrace our environmental and sustainability commitments in this growing new world order? We cannot afford to have some nations achieve significant economic growth at the cost of the environment while other, not-so-fortunate nations seek to emulate them. Unless emerging energy requirements are met sensibly and fairly, environmental degradation will continue to happen. We could fail to save the planet even as the effort to do just that gains momentum.

As some companies vie against one another to increase the green of their profits, and in the process increase the black of their carbon footprint, we are witnessing a haste to save the planet’s resources. We must understand that alongside the commitments made by the multinational corporations to sustainably develop the planet, every individual and every nation – rich or poor, large or small – has an equal stake in the outcome. As time is an unavoidable factor in mankind’s race to overturn the odds against environmental responsibility, it is imperative that all nations – and every human being on the face of this planet – are invaluable pieces to the same puzzle.

Environmental responsibility and sustainability differ from economic growth and military power. The latter two can be, and historically have been, unequally distributed across the world. But we cannot afford the same luxury as it relates to the environment. Lately, the effects of climate change throughout the world have made us wonder if we are equally responsible for the environmental degradation brought about by the development and industrialization of some parts of the world in the past few centuries, particularly the 20th. If we look back at history we see the Industrial Revolution dawn and flourish, and the see-saw balance between development and environmental obligations unfold thereafter.

Did we not know back then about the environmental consequences of modernization and the need for sustainable growth as we do now? It seems that somewhere down the road we unknowingly crossed the line. An interesting fact is that sustainable growth is not a new invention. Rather, it has been with mankind since time immemorial. Various ancient civilizations around the world have managed to grow sustainably without harming the delicate balance of the planet. In fact, it may be argued that these civilizations were more educated about the harms of environmental degradation and the fruits of sustainable growth than we were.

So, why now the hue and cry over environmental consciousness and the need for sustainable growth? Also, have we again become eager to start a new kind of revolution, only this time wearing the environmental protection and sustainability mask? And do human relationships play an active role in attaining sustainable growth in societies? Absolutely! Economic development and the environmental piece are unsolvable without the human condition playing a key role.

The world today needs to meet the sustainable growth challenges by tackling not only the present environmental problems, but also societal, cultural, and economic issues. When any type of development occurs, an irreversible aberration of the natural balance takes place, but sustainable development minimizes such disturbances, at least to a certain extent. Therefore, the solution cannot be a piecemeal approach. We must have a deep understanding of the human race’s existence on this planet, and identify the lines that should not be crossed.

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When slopes are remediated, several criteria are considered in the design to ensure the surface will remain stable in its environment. Slope angle, slope length and slope vertical height, as well as infill type and weight, native soil type and hydraulic conditions must all be factored into the design solution. Most vegetated slopes 2H:1V or milder may only require a 2D planar erosion control blanket (ECB) to protect the surface pre-establishment of vegetation. Turf reinforcement mats (TRMs) are a stronger surface treatment, but offer limited depth and ability to confine fill.

**3D Deep Surface Protection of Slopes**
Steep slopes susceptible to sliding and erosion issues from erosive soils and concentrated runoff may require deeper surface protection. This is where GEOWEB® geocells are most effective. The system's cellular network of 3D deep cells controls slope-surface stability and erosion issues on steep slopes, shorelines and channels. Stabilization of the slope surface materials allows embankments to be designed steeper (1H:1V and higher) with less horizontal footprint and use of land space. Through confinement, the infill is resistant to movement and migration from gravitational forces, soil saturation, sheet flow runoff, and water flow. A stable growth environment is created for vegetation whereby it isolates each cell to create an eco-zone protected from erosive forces. Aggregate and concrete fill are options for permeability and hard-armoring of the surface.

**High-Performance Stormwater Channels**
Channels with continuous low-flows and moderate-high flow intermittent channels also benefit from GEOWEB® 3D confinement. The 3D network creates check-dams that protect the soil layer from hydrological erosive forces and resulting erosion that impacts unconfined soils.

With a TRM overlayment, vegetation may be used instead of expensive rip rap, improving the resistance to withstand up to 30 ft/s (9 m/s). This significant improvement essentially doubles performance resistance to shear stress and velocities for TRMs and ECBs. Higher flow channels are designed with GEOWEB® system and aggregate or concrete infill. Applications that benefit from this system include roadside ditches, stormwater channels, shoreline embankments, dams, spillways and pond overflow systems.

The GEOWEB® system is the industry’s most robust geosynthetic – offering diversity in solving complex, challenging problems for slopes and channels while providing sustainability and environmental low impact design solutions.

Presto offers free project evaluations and site support.
PUTTING IT BACK TOGETHER

PUNTA GORDA, FLORIDA EXPECTS TO COMPLETE SEAWALL REHAB BY JULY

By Richard Massey

About 80 percent of the Punta Gorda seawall system damaged in 2017 by Hurricane Irma has been replaced. Officials there expect the project to be complete by July. Punta Gorda is using ChromX9100 steel rebar, the most corrosion-resistant product offered by MMFX. So far, the city’s contractors have made quick work of repairing about 11 miles of seawall, most of it older construction from the 1960s and ‘70s. Irma made its final landfall south of Punta Gorda as a Category 3 and raced up the west coast of the state, leaving catastrophic damage in its wake.

In Punta Gorda, the post-hurricane analysis found aging seawalls nearing the end of their lifecycle, saturated ground behind the seawall, a negative tide, meaning Irma sucked water from Charlotte Harbor, and numerous instances of waterline cracking, rusted and missing tiebacks, unreinforced outfalls, and inadequate berms. Much of Punta Gorda is built around a 55-mile system of canals, hence the need for 110 miles of seawall.

Since no single contractor had the bonding capacity for the $30-million project, the city hired three separate contractors, all of which are using the same standardized materials throughout.
“We are very pleased with the progress of the three contractors,” said Mark Gering, P.E., Punta Gorda city engineer. “The only problem we’ve encountered is that the three contractors have slightly different means and methods. We are constantly hearing from residents that the contractor who did their friend’s seawall across town did it differently. Eight weeks of seawall work in their backyard is undoubtedly annoying but the majority of our residents are thankful that the work is getting done and they didn’t have to deal with contracting, inspections, etc.”

By the numbers:

ANNUAL PROJECT
• 1,320 panels annually
• 10 panels per day maximum pour capacity
• 1.5 miles seawall replaced annually

IRMA PROJECT
• 10,000 panels needed
• 55 panels per day maximum pour capacity
• 11 miles seawall to be replaced in 18 months
• 8 contracts / 3 contractors for entire city
• $30M budget
• staff of 14

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Q&A: EVOLUTION OF TRAINING AND TECHNOLOGY

DAVID BUTTS, BIM SPECIALIST WITH GANNETT FLEMING, OFFERS HIS PERSPECTIVE ON EFFECTIVE SOFTWARE TRAINING, STANDARDS, WORKFLOWS, AND TRENDING TECHNOLOGIES.
By Bob Drake

WITH THE RAPID EVOLUTION OF DESIGN AND ANALYSIS SOFTWARE for civil and structural engineering, firms can struggle to keep staff trained and productive with the latest tools. Last November during Autodesk University in Las Vegas, David Butts, BIM specialist with Gannett Fleming, took a break from teaching classes to offer his perspective on effective software training, standards, workflows, and trending technologies.

Following is an abridged version of the interview; read the entire Q&A online at www.tinyurl.com/apr19-training.

C+S: What is Gannett Fleming’s approach toward training to keep staff current with design, analysis, and collaboration technologies?

Butts: We actually changed how the company was approaching things. We have a learning management system in place, but it is basically part of the career development program. We would harvest videos, get handouts, and we would have little vignettes that people would have to train. But software technology is a little bit different, especially when you talk about design tools. I used to do classes on a regular basis. I would go and teach a class and sit down in front of a group of 15 or 20 people and we would go through the features and benefits. That's how we would train people. This is a tool. Push that button; you get that result. The problem we ran into is that when people walk out of that classroom, if they're not using the tools immediately, they lose that. They don't retain what they learned.

What we've been doing is following up, mentoring. The majority of the training I do is one-on-one. I do a ton of training on individual cases and instances of just a problem that somebody’s having. Using online tools — Skype, Webex, whatever I can to see somebody’s desktop — I walk them through a problem. It's really interesting that the formal training that we did for years really hasn't been the most effective thing. Yeah, it’s great for introducing somebody, but it’s not a great tool to really train somebody. It’s throwing somebody to the wolves, getting them in there on the software, standing over their shoulder, helping them, being there to nurture them and support them, and make sure that they can use the tools effectively so that we don’t lose money on jobs.

We hear a lot of things about the different learners, the different skill levels of learners. We have a traditionalist — somebody who’s a bit older than me who’s good training by step-by-step directions. You get a baby boomer like me that likes to talk a lot, tell stories; we relate to third-party stories. You get to Generation X and Generation Y users, they really learn from doing things. They want short directions, short videos, and things like that because they already have the computer skills they need — the stuff we didn’t have growing up, they have that core skill already. As we get into Millennials, there’s an expectation that we’re going to conform to what they know. So it's fascinating to watch that training evolve and see how things have changed.

What we do now is look at all the characteristics of a person — including learning style. What is this person good at? What are their skills? We test them when they come on board to really figure out what they know. It’s not a test to determine whether or not we’re going to hire
them. The test is to understand whether or not we can train this person. Where is their skillset and do they have the capability to retain what we’re teaching them? We’ve starting doing a lot more front-end testing and evaluation of the user’s skills.

Now what we’re doing is trying to build a track for them, saying, “You need to focus on this task. You need to get really good at this one thing.” We try not to give them too much because if you tell somebody, “I want you to make a Revit family from start to finish,” and we just hand it off to them, it can take them six months to figure that out. If I’m trying to put “containers” together for the training, I want to make sure that those containers are measurable, and we can see somebody having success with the tools.

Training as we’ve done it for years has really evolved. We’ve also gotten away from book-type training. Most of what we do is based on training videos — real short segments. We also do a lot of training by discussion and by group. Another thing we’re working on is that within our communities, we’re trying to get coworkers to do training — a peer-pressure-type training. They can go back to that person and say, “I did it this way. Let me show you how I did it.” That’s actually having a big impact.

That’s the big thing that we do for training right now: We look at the person as an asset, how do we improve the asset, and how do we make them successful.

C+S: Do you as a company have standards and workflows relative to BIM to adhere to?

Butts: We do have standards and we do have workflows. Because we have a lot of offices, the problem is sometimes those offices become silos and they develop their own workflows and standards. We’ve been working really hard to wipe that away. It’s not that we don’t want people doing work that’s specific to their region or specific to their local needs, but we have to have a core underneath of standards that is the baseline that is the Gannett Fleming standard. We have to maintain that quality and make sure people recognize our documents regardless of what software it is. We should be able to put out a product that they can’t tell what we used to develop it.

Over the last year and a half, we have spent a good chunk of time just going through things like standard symbol content. What’s a receptacle supposed to look like? What does a door look like? Do we have that part that’s available for everybody to use so if I come from Los Angeles or New York or Woodbury or Marlton or Camp Hill and go to any of other those offices, I can’t tell where it came from.

Now we have that core standard in place. We’re looking above that standard. What is it we need to do when we start dealing with specific industries like water, wastewater, and transit? What are the requirements for those types of projects that we need to have content that’s specific for them? To that end, we’re developing our BIM specialists program within the company where we’re elevating people that have shown exceptional talent. They understand what a good set of construction documents and a good construction deliverable is. They’ve been helping us put these things together and make sure that what we have is a good quality output. It’s something that represents the part accurately in the field.

C+S: In your work with Gannett Fleming and at Autodesk University and other training events, what do you see as the greatest training needs within the AEC industry?

Butts: My personal experience was, when I was in a four-year college, I was taking a lot of classes that really didn’t relate to the practical application of what I wanted to do. There was too much spread out and too much elective-type training that really wasn’t focused on what I needed to really understand about my job. As we look at how people get trained and how we improve that, the first thing we have to do is go back to the college level and work with the colleges. If I have somebody who’s learning mechanical engineering, it’s not necessarily that they don’t need to learn Inventor or Solid Works or whatever program they’re using, but we need them to learn programs like Revit. How do I do HVAC design? How do I do piping design? We need to be able to identify the track that engineer is taking and make sure we’re teaching them on the latest tools possible.

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Zweig Group recently released its 2019 Valuation Survey of AEC Firms, a staple of industry-leading firms for over 25 years. When it comes to estimating the value of a business enterprise, it is important to understand exactly what is being valued and for what purpose. Without an established market in which a firm’s shares are actively traded, an appraiser can only estimate the market value through the application of pertinent measures and indicators of Value from relevant data. Therefore, this survey and its corresponding publication are so valuable to the AEC industry. This compilation of data is intended to provide some benchmarks and metrics that allow firms to see how their own Value ratios stack up against industry norms.

Zweig Group calculates six different Value ratios that determine Zweig Group’s Z-Value formulas. These formulas determine the four Z-Values (Z1, Z2, Z3, & Z4) that are based on different criteria within the data set. For example, while the Z1-value is based on all valuations, the Z3-value is calculated by filtering the sample down to only the firms that had a valuation performed for an internal ownership transition. These statistically-derived Z-values may facilitate comparisons between different firms and between multiple valuations of the same firm. Raw Z-values can be adjusted upward or downward considering the effects of these variables as indicated by the survey results. Variables include but are not limited to purpose of valuation, type of firm, age of firm, and size of firm.

In general, valuations conducted for external purposes, such as a possible merger or sale, tend to yield higher Value ratios than those conducted for internal use (buy/sell agreements between stockholders, internal ownership transfer, etc.). Valuations performed in connection with a potential or actual sale or merger resulted in higher median values for all six Value ratios.

Similarly, median Value ratios determined by independent business appraisers were generally higher than the field (inside or outside accountants, firm principals, management consultants, etc.). Only the Value per net service revenue ratio for this category at 0.52 failed to exceed the overall median of 0.53. Formal appraisals are the most accurate method of valuing a firm, which is good news for firms considering the historical survey results.

Younger firms, founded after the year 2000, were valued higher from a Value to net service revenue perspective. This is likely because these firms were growing at a high rate and were also projected to continue to grow revenue, EBITDA, profit and backlog faster than more mature firms over the next few years. Historically, we have found that larger firms were typically valued higher from a Value to EBITDA ratio standpoint than smaller firms. This indicates that as firm size grows, so does the relative value of the underlying assets or equity of the firm. Conversely, from an Equity value to book value perspective, larger firms had a lower multiple, likely because larger firms were carrying more underlying assets and owner equity than smaller firms.

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